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Body weights and wing moult of the Bronze Mannikin *Lonchura cucullata* and Blue-billed Mannikin *L. bicolor* in Sierra Leone

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Summary

The weight and stage of wing moult of 552 Bronze Mannikins and 660 Blue-billed Mannikins were recorded in western Sierra Leone over a 19-month period. Body weights declined during the dry season to minima about March-June and were greatest at the end of the wet season and early dry season. Annual variation in body weight was about 12-13% in both species. Males were slightly heavier than females for most of the year but females became significantly heavier than males for three months towards the end of the rains. Moult was protracted in both species. Adults moulting remiges could be found in all months of the year. The primary moult of juveniles may be incomplete. The peak moulting season (when all trapped birds were moulting) occurred during the dry season (January-May). It is suggested that the low daily metabolic demands of the slow moult enable it to occur then – a period of decreasing food availability – after breeding has taken place during peak food availability in the wet season.

Résumé

Le poids et l'état de la mue de 552 Capucins nonnettes *Lonchura cucullata* et de 660 Capucins à bec bleu *L. bicolor* ont été notés en Sierra Leone occidentale sur une période de 19 mois. Le poids corporel baissait pendant la saison sèche jusqu'à son minimum entre mars et juin et était le plus élévé à la fin de la saison humide et au début de la saison sèche. Chez les deux espèces le poids corporel variait au cours de l'année d'environ 12-13%. Les mâles étaient légèrement plus lourds que les femelles presque toute l'année mais les femelles étaient considérablement plus lourdes que les mâles pendant trois mois vers la fin des pluies. La mue était prolongée chez les

deux espèces. On trouvait des adultes avec des rémiges en mue à tous les mois de l'année. La mue des primaires des juvéniles peut être incomplète. Le pic de la mue (quand tous les oiseaux capturés sont en mue) avait lieu pendant la saison sèche (janvier-mai). Cela suggère que, du fait du faible coût métabolique journalier de cette longue mue, elle puisse avoir lieu en saison sèche – quand la nourriture disponible diminue – après la reproduction qui s'est déroulée durant le maximum de nourriture disponible en saison des pluies.

Introduction

Woodall (1975) carried out a comprehensive field study of the life history of the Bronze Mannikin *Lonchura cucullata* in Zimbabwe. Eyckerman & Cuvelier (1982) presented notes on the pattern of moult of this species in Cameroon, and Thompson (1989) investigated its diet and breeding seasonality in Sierra Leone. Akinpelu (1994a, b) presented data on breeding season, moult and weight cycles of Bronze Mannikin and Blue-billed Mannikin *L. bicolor* in Nigeria.

These two species regularly cause damage to cereal crops (Bashir 1983, Manser 1984, F.A.O. 1988) and the results presented in this paper were obtained as part of a study designed to investigate their ecology and behaviour in relation to agricultural practices in Sierra Leone (Thompson 1986). The aim here is to describe seasonal patterns of body weight and wing moult for the two species over 19 months in coastal Sierra Leone.

Methods

The study was conducted at Lumley (8°27'58"N, 13°16'19"W) on the west coast of the Freetown Peninsula. The climate is characterised by distinct wet and dry seasons; the rains extend from May to October, with maximum rainfall in July.

Birds were mist-netted weekly between January 1984 and August 1985, in rice farms where they were regarded as pests. Nets were operated for approximately three hours on each visit, starting either towards dusk (after 16.00 h) in 1984 or just before dawn (6.30-7.00 h) in 1985. Trapped birds were weighed in the field to the nearest 0.1 g, using a Pesola spring balance, recalibrated before each netting trip. Dusk and dawn weights are treated separately below, to allow for any differences.

Primary and secondary moult scores were obtained by scoring individual feather growth on a scale from 0 (old feather) to 5 (new) (Newton 1966). Both species have nine large primaries (innermost numbered P1; the outermost reduced P10 was not scored) and six secondaries (outermost S1) on each wing, so the maximum possible primary and secondary scores are 90 and 60 respectively. The

birds were classified as adults or juveniles on the basis of body plumage (Serle & Morel 1977).

Seasonal variation in the breeding potential of the two species was determined by examination of the gonads of 490 trapped adults. The birds were killed as part of a pest control drive on farmers' fields, dissected in the field and the gonads measured with vernier calipers (Thompson 1989). Breeding activity was investigated by recording the presence of nests with eggs or nestlings, during twice-weekly standardized walks along set routes through the study area. In addition, searches for nests were made throughout the study area whenever indications of breeding activity (*e.g.* birds with nesting material) were noted during the standard walks.

Error bars on Figures are standard errors of the means.

Results

Body weight

In 1984 (observations beginning in January), the mean monthly body weights at dusk of the two species tended to be lowest towards the end of the dry season and highest towards the end of the rains (Fig. 1). In 1985, dawn weights declined from

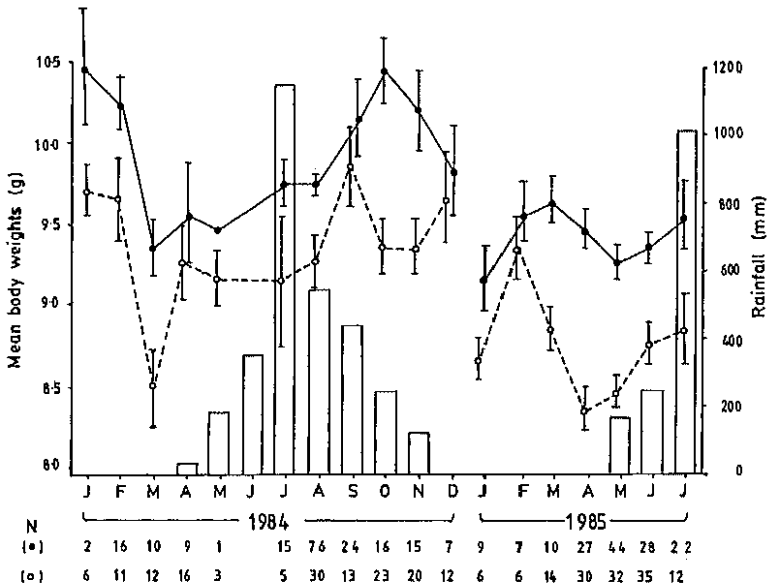

Figure 1. Seasonal variation in mannikin body weights, shown against rainfall (histograms). Open circles: Bronze Mannikin. Closed circles: Blue-billed Mannikin.

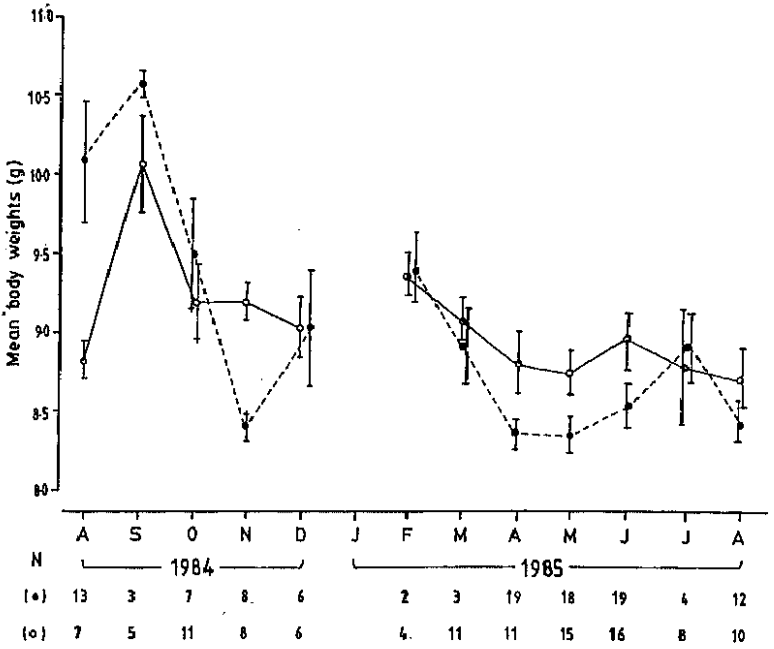

Figure 2. Monthly variation in body weight of male (open circles) and female (closed circles) Bronze Mannikins.

a peak in February-March, to the end of the dry season (Fig. 1). Annual variation in monthly means was about 1.2 g (12-13%), in each species.

Mean dusk weights in 1984 were significantly greater than dawn weights for the same period in 1985 (January-May and July, when data were available for both years). Mean differences averaged 4% in Bronze Mannikins ($t_{10} = 12.56$, $p < 0.01$) and 5.5% in Blue-billed Mannikins ($t_5 = 11.5$, $p < 0.01$).

Adult males of both species were usually slightly (but not significantly) heavier than adult females, except during the latter part of the wet season in 1984 (Figs 2 & 3) when females averaged significantly heavier than males: from August to October for Bronze Mannikins ($t_{44} = 3.35$, $p < 0.01$) and from September to November for Blue-billed Mannikins ($t_{36} = 3.34$, $p < 0.01$).

Wing moult patterns

Wing moult in both species followed the regular passerine pattern; primary moult was descendent and secondary moult ascendent, although there were marked irregularities in occasional individuals.

In adult Bronze Mannikins, primary moult was normally symmetrical, with only one growing primary on each wing at any time (Table 1). Replacement of

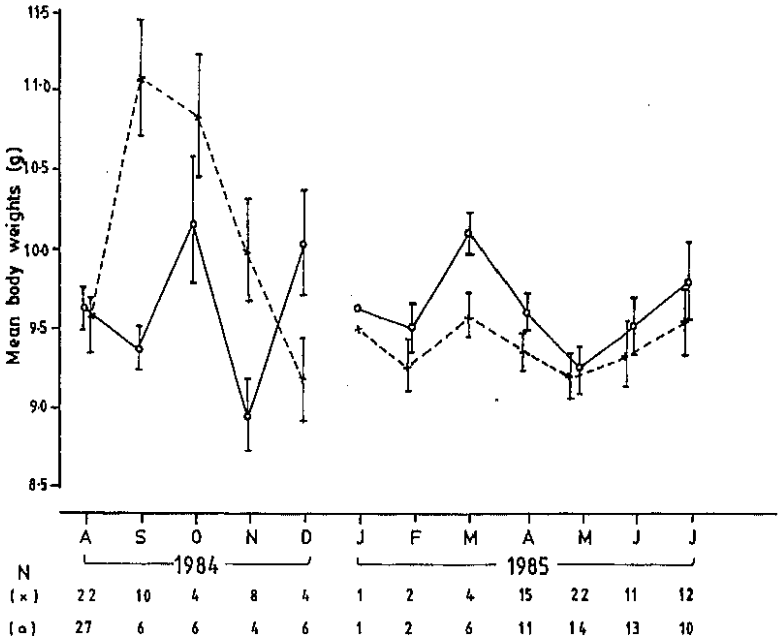

Figure 3. Monthly variation in body weight of male (open circles) and female (closed circles) Blue-billed Mannikins.

the secondaries started about half-way through the primary moult, during growth of P4 (primary score 31-40: Table 1). Moult of secondaries was less regular than that of primaries; in several birds examined, S6 was shed concurrently with S1 and before S2-S5, these last being shed and replaced in quick succession towards the end of primary moult. Secondary moult usually ended after primary moult.

Normally, Blue-billed Mannikins shed P1-P3 in rapid succession so that, in most individuals, all three were growing together (Table 2). In several such cases, P5 was shed at the same time as P1-P3 and before P4. In a few individuals, one or more of P6-P8 were growing at the same time as P3, even though total primary score was < 30. Primary moult thus appears relatively commonly to start at two points on the wing: P1 and P5. Replacement of the secondaries started when primary score was 31-40 (Table 2) and then proceeded rapidly, so that, unlike Bronze Mannikins, secondary moult was complete before all the primaries were replaced.

Timing and duration of wing moult

The lowest mean primary scores occurred in September (Bronze Mannikin: Fig. 4) and November (Blue-billed Mannikin: Fig. 5). Mean moult score was never zero

Table 1. The pattern of primary and secondary wing moult in Bronze Mannikins

Primary score	n	No. of birds with the following feathers growing primaries									No. of birds with the following feathers growing secondaries						Mean no. of fully-grown new primaries	Mean no. of fully-grown new secondaries
		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6		
1-10	7	6	1														0.4	0
11-20	8		8														1.5	0
21-30	14			13	1												2.3	0
31-40	12		2		10						1					2	3.0	1.7
41-50	13			1	2	10					4		1		1	2	4.1	0.4
51-60	11					2	11	4			4	2	1			4	4.9	0.7
61-70	14					1		11	3			2	7	1	1	9	6.5	1.0
71-80	23							3	20	3	3	7	6	3	2	8	6.4	2.5
81-89	51					1			4	48		1	7	22	13	9	8.0	3.2

Table 2. The pattern of primary and secondary wing moult in Blue-Billed Mannikins

Primary score	n	No. of birds with the following feathers growing primaries									No. of birds with the following feathers growing secondaries						Mean no. of fully-grown new primaries	Mean no. of fully-grown new secondaries
		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6		
1-10	5	4				1											0.4	0
11-20	9	4	3	2		2		1									1.1	0
21-30	12	3	2	7	1	6	2	2	1								1.8	0
31-40	9			2	4	1		2			2		1		1	2	3.2	0
41-50	17					14	2	1	1		1				2	4	3.6	2.8
51-60	46				6	7	32	10	1	1	3		6	8	3	5	5.0	2.4
61-70	41			2	2	3	5	27	8	1	2	13	6	2	2	7	6.1	2.0
71-80	58				2	3	7	12	37	10	8	10	14	13	2	18	7.0	3.1
81-89	54				5	4		1	13	39		5	14	13	11	15	8.0	3.7

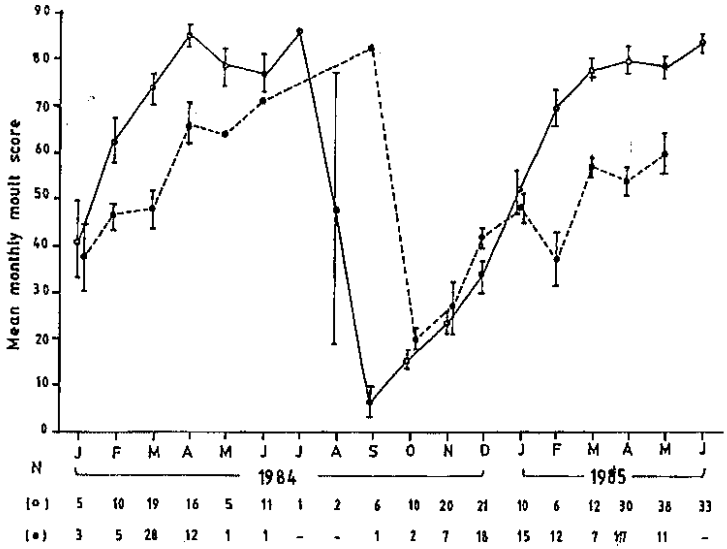

Figure 4. Monthly primary moult scores of adult (open circles) and juvenile (closed circles) Bronze Mannikins.

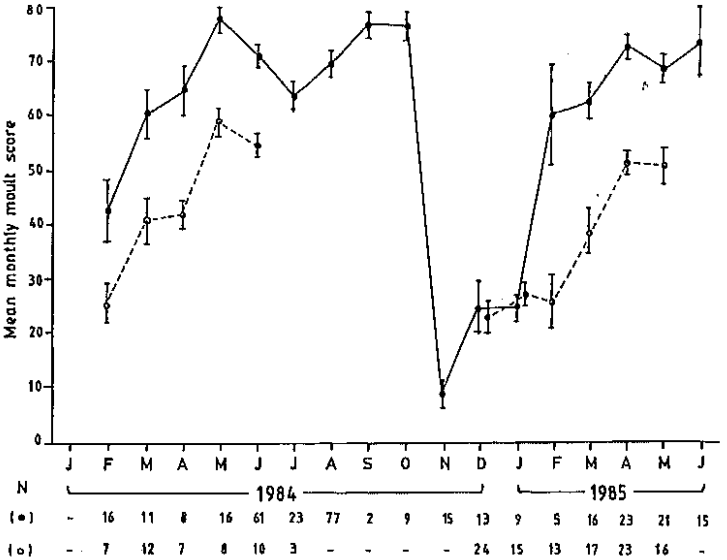

Figure 5. Monthly primary moult scores of adult (closed circles) and juvenile (open circles) Blue-billed Mannikins.

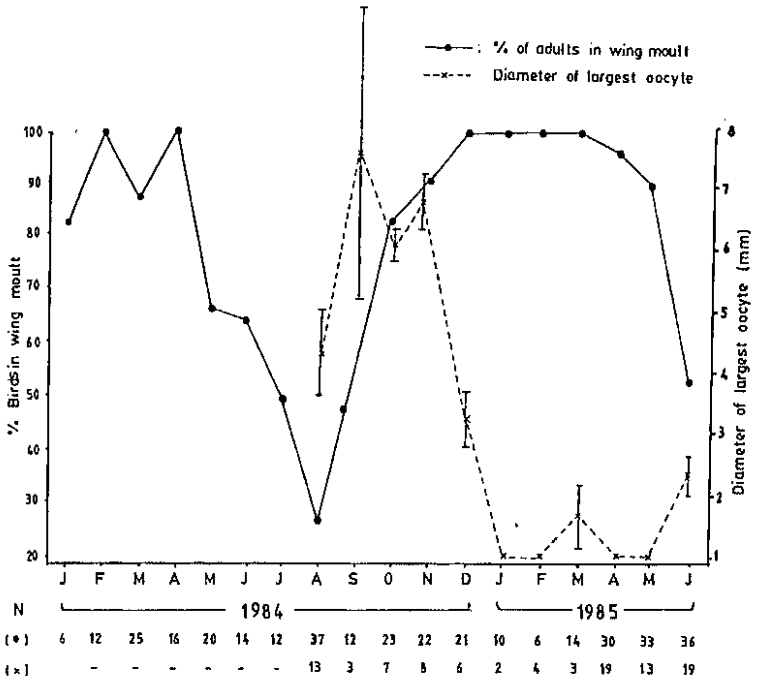

Figure 6. Timing of moult and breeding in the Bronze Mannikin.

and low mean scores were associated with lost inner primaries (Tables 1 & 2), indicating the start of moult towards the end of the rains. Juveniles of both species leave the nest in a distinct immature plumage, then moult into adult dress in the succeeding weeks (Woodall 1975, pers. obs.).

Populations of both species contained moulting individuals in all months (Figs 4-7), but primary moult in adult and juvenile Bronze Mannikins occurred mainly between September and May; juveniles may not have replaced the full set of primaries, with an apparent asymptote occurring at primary score 60-70 (Fig. 4). In both adult and juvenile Bronze Mannikins, moult occupied some seven months (*c.* 210 days). In the Blue-billed Mannikin, primary moult mainly occupied November to April, with juveniles ceasing moult at primary scores 50-60 (Fig. 5); primary moult therefore lasted some five months (*c.* 150 days).

In the 1984-5 moult cycle, every adult caught was undergoing wing moult in the periods December-March (Bronze Mannikin: Fig. 6) and January-May (Blue-billed Mannikin: Fig. 7) and the highest proportions of moulting birds were found in the same periods in the 1983-4 cycle.

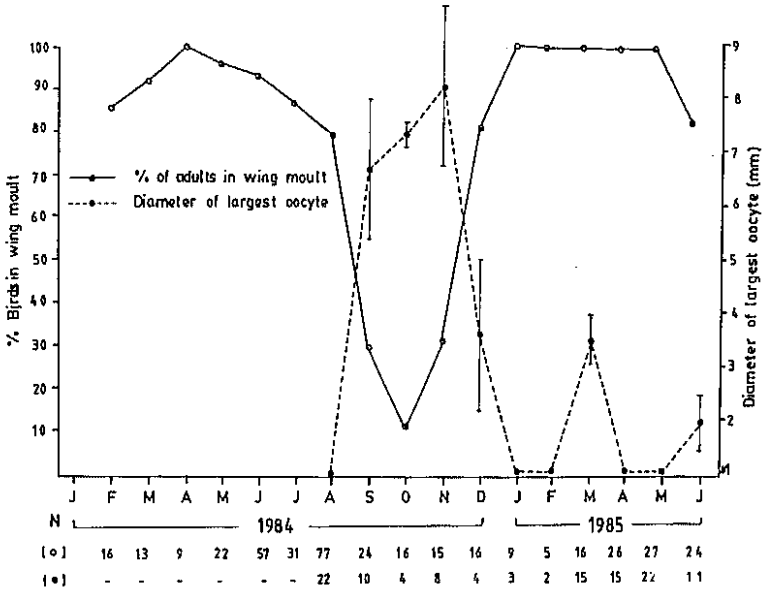

Figure 7. Timing of moult and breeding in the Blue-billed Mannikin.

Moult-breeding overlap

In 1984, the breeding season of Bronze Mannikins, as defined by nests found with eggs or young, occurred from August to November. The proportions of trapped adults moulting during these months were 27%, 48%, 83% and 90% respectively (Fig. 6). There was therefore clear overlap between the breeding and moult periods of this species.

Active nests of Blue-billed Mannikins were not found, but enlarged oocytes of both species, which indicated potential breeding activity, were found from September to November. At the end of this period, only 31% of trapped adult Blue-billed Mannikins were moulting (Fig. 7), indicating clearer separation between moult and breeding in this species.

Discussion

The body weight changes shown during the year by both species were probably influenced by three factors: food supply, reproductive state and moult. Both species are primarily granivorous, feeding on grass seeds and cereals (Thompson 1989). Most grasses produce flowers and seeds during the wet season and seeds are therefore generally most abundant in the late rains and early dry season. Similarly, cultivated crops such as rice and maize, on which the mannikins feed, ripen and

are harvested at the end of the rains. Grass seeds and cultivated grains should therefore decrease in abundance with the progress of the dry season, as the stock from the previous rains is depleted by predation and germination.

The drop in body weights during the dry season could therefore be caused partly by declining food supplies. Also, the main moult periods coincided with the dry season, so the additional physiological strain of moult may have contributed further to declining weights during the dry season. The birds were heaviest in September and October, when food supply would be most plentiful. However, gonadal development probably also contributed to the relatively high body weights of females at this time, the only period when their weights surpassed those of the males.

The seasonal weight variations observed by Akinpelu (1994a) in Nigeria are the reverse of those reported here: mannikin weights increased during the dry season and declined during the rains. However, when considered in relation to the major events of the life cycle, the pattern of variation in the two studies is similar: weights increased prior to breeding and declined sharply after the breeding season, during the main moult period. These similarities suggest that the physiological demands of moult and breeding are probably more important than food availability in influencing weight cycles. Birds probably increase their food intake in preparation for breeding, then lose weight as a result of the stresses of parental care and moult. Food may not be limiting, because birds in Nigeria gained weight during the dry season, when food supplies would have been declining. Further research, monitoring food supply through the year in the two study areas, could clarify this point.

The protracted population moult periods recorded for the two species are similar to those noted in several other tropical birds (*e.g.* Ward 1969, Fogden 1972, Jones 1978, Payne 1980), including the Bronze Mannikin in Zimbabwe (Woodall 1975). This has been attributed to lack of synchrony in the onset of moult in tropical bird populations and slowness of moult in individual birds (Ward 1969) although the latter of the two factors may be the more important, since moult in many tropical species seems to be a relatively fixed annual event (*e.g.* Snow & Snow 1964, Snow 1976, Dittami & Gwinner 1985, Dittami & Knauer 1986, Dittami 1987). Slow moult may be favoured by the dangers of impaired flight accompanying rapid moult and by the reduced daily metabolic effort required (Jones 1978). The low daily metabolic demand of slow moult may permit the two mannikin species to moult during a period of declining food supply (dry season) after breeding has occupied the food peak of the late wet season.

The overlap of moult and breeding periods in the two populations, especially in that of the Bronze Mannikin, suggests that breeding and moult may have overlapped in some individuals, although our data were inadequate to confirm this. Akinpelu (1994a) found overlap in some individuals of both species. Most tropical bird species separate breeding and moult because of their high energy costs and, although overlap has been documented in several Afrotropical species,

overlap in individuals is rare (Payne 1969, Jones 1978, Wilkinson 1983). In the mannikins, initiation of moult before finishing breeding might be favoured, because the overlap period would occur when seed stocks were most abundant and the slow moult rate would minimise its energetic demands.

Acknowledgments

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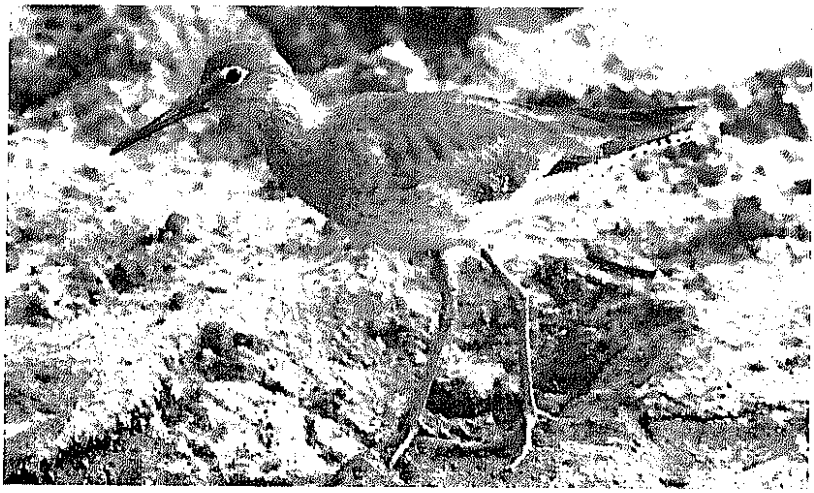

Spotted Redshank – Chevalier arlequin – *Tringa erythropus*
Photo: Michael Gore