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Notes on African Rock Pipit *Anthus crenatus* biometrics

Dawid H de Swardt
Department of Ornithology, National Museum, PO Box 266, Bloemfontein 9300, South Africa
Email: dawie@nasmus.co.za

Abstract

A localized southern African endemic, African Rock Pipit *Anthus crenatus* occurs in rocky terrain with steep slopes and as a result is not easily captured. South African Bird Ringing Unit (SAFRING) data show that only 18 individuals have been caught and ringed. As a result, there are limited biometric data available for this species. I collated biometric data (culmen, tarsus, hind claw, wing and tail lengths) from ringed birds as well as museum study skins. Male African Rock Pipits were significantly longer-winged and had longer tails than females. Hind-claw lengths also differed significantly between the sexes, although this metric is probably biased owing to the small female sample size. No significant differences were evident in culmen and tarsus lengths or body mass between the sexes. Previous studies that reported the morphometrics of this species used much smaller sample sizes than the present study and only reported details for culmen, wing and tail lengths and body mass. The value of museum specimens to obtain biometric data is highlighted.

Keywords: African Rock Pipit, *Anthus crenatus*, biometrics, specimens, sexing
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Introduction

The African Rock Pipit *Anthus crenatus* is endemic to mountains, hills and escarpments in South Africa and Lesotho (Clancey 1997, de Swardt 2017, Voelcker 2005a). Once a very poorly-known species, aspects of this species' breeding biology, vocal behaviour and song have been studied by the author over the last 20 years (de Swardt 2002, 2006, 2010; unpubl. data). Published data on this species' biometrics, however, remain meagre (Hall 1961; Clancey 1990; Maclean 1993; Voelker 2005a). This small amount of published biometric data is probably due to the disjunct and comparatively small geographic range and the inaccessible terrain preferred by the species which limits the opportunity of bird-ringers to capture it.

Clancey (1990) only listed wing length measurements from small samples and Hall (1961) only gave the ranges in all biometrics of African Rock Pipits in nine males and three females. Voelker (2005) summarized biometric and mass data from 18 males and nine females, obtained from Keith *et al.* (1992) and Maclean (1993), from collected specimens. Hind-claw measurements were only recorded by Clancey (1990) and Peacock (2006). The South African Bird Ringing Unit (SAFRING) database lists 18 individuals as having been caught and ringed in southern Africa (13 of these ringed by the author and includes five nestlings) illustrating that this is not an easily captured species. Rose *et al*. (2019) reviewed and summarized biometric data from SAFRING ringers and listed the African Rock Pipit as a species for which there are very few biometric data available (the author also shared his ringing data for the publication, including those of African Rock Pipits). The author used his ringing data for this study.

The aim of this paper is to present more detailed biometric and mass data for African Rock Pipits based on data from bird-ringing activities as well as examination of museum study skins.

Methods

African Rock Pipits were captured with mist nets during general bird-ringing studies or were specifically targeted using their song vocalizations during a long-term study on this species in the Free State and Northern Cape provinces of South Africa (see de Swardt 2006, 2010). These birds were either opportunistically captured during bird-ringing activities in suitable habitat or during vocalization studies at certain localities (e.g. some Northern Cape sites). Playback of calls was implicated at certain sites to lure the birds toward mist nets. As part of an ongoing curation project of the Department of Ornithology at the National Museum in Bloemfontein that aims to obtain a representative collection of bird species that occur in the Free State Province, specimens have been collected at selected localities since 1989. The birds were collected, under permit from provincial nature conservation authorities, using either a 4.10 combination rifle or selectively euthanized after capture in mist nets, and were immediately measured and weighed after collection and later prepared as skin or skeleton specimens for long-term curation. The collecting of the bird

specimens also complied with the National Museum's Ethical Clearance policy and was approved for this research project (Project 492 & ongoing curation project). The stomach contents of each specimen were preserved in 70% ethanol and curated in a separate collection for future dietary analysis. The specimens were visually sexed by the presence of testes in males and ovaries in females.

Biometric and mass data were obtained from ringed birds (n = 12), skin specimens housed in the National Museum, Bloemfontein (NMB; n = 22), Durban Natural Science Museum, Durban (DNSM; n = 2) and East London Museum, East London (ELM; n = 17). Of these 12 ringed birds, eight were ringed by the author and the others by SAFRING ringers (two of them joined the author on field trips). Of the 41 museum specimens used for this study, 21 were from the Free State, 12 from the Eastern Cape, two from the Northern Cape and six from Lesotho. No geographically-linked variation in morphometrics in this species was investigated. Biometric data of NMB skin specimens collected prior to 1995 were measured several years after their collection, while specimens collected after 1995 were measured at the time of collecting. Only body mass was recorded for specimens collected prior to 1995 (n = 8). Biometric data of the skins housed in the DNSM and ELM were measured by the relevant curators and made available to the author. Biometric measurements were taken according to the guidelines described by de Beer *et al.* (2000). The following biometrics were obtained using Vernier callipers: culmen length – from the featherline to the tip of the bill; tarsus length – from the notch of the inter-tarsal joint to the lower edge of the last complete scale before the toes diverge; and hind claw length – measured from the base of the claw to its tip. Wing and tail lengths were measured using a stopped wing ruler. The wing length (flattened chord) was measured from the shoulder of the closed wing to the tip of the longest primary feather, while tail length was measured from the base of the tail to the tip of the longest feather (T1). Body mass was measured to the nearest 0.1 g with a Pesola spring balance and later with an electronic scale.

Descriptive statistics (using Statistica ver 14.0 software) were undertaken for the culmen, tarsus, hind claw, wing and tail lengths and body mass. The reported descriptive statistics are mean, range and standard deviation (SD). Grouping T-tests were carried out between the sexes and a product moment partial correlation analysis was performed to compare wing and tail lengths of males and females.

Results

African Rock Pipit biometric data were obtained from 41 museum study skins and 12 ringed birds and are presented in Table 1 (39 adult males and 14 adult females).

Wing and tail lengths

Males had significantly longer wings than females (wing: $t = 5.239$; $df = 50$; $P < 0.05$; tail $t = 2.310$; $df = 50$; $P < 0.05$) (Table 1). Based on these differences, wing and tail lengths could be useful guidelines for sexing this species in the field. A significant correlation was observed between wing and tail lengths in both males and females (males: $r = 0.373$, $y = 25.855 + 0.476$; females: $r = 0.586$, $y = -72.440 + 1.653$; Figures 1 and 2).

Hind-claw length

Hind-claw lengths also differed significantly between the sexes ($t = -2.227$; $df = 29$; $P < 0.05$), with females having longer hind claws (although this may be a sampling bias as sample sizes for females was smaller).

Culmen length

Mean culmen length was longer in males than in females but this difference was not significant (Table 1).

Table 1: Biometric data for male (n = 39) and female (n = 14) African Rock Pipits *Anthus crenatus* from localities in Lesotho and the Free State, Eastern Cape and Northern Cape provinces of South Africa, obtained from ringed birds and museum specimens (the latter housed in the National Museum in Bloemfontein, Durban Natural Science Museum and East London Museum). Significant differences between males and females are indicated by an asterisk.

	Males					**Females**				
	n	Mean	Min.	Max.	SD	n	Mean	Min.	Max.	SD
Culmen (mm)	37	16.6	13.9	22.8	1.715	14	15.9	14.0	17.5	0.881
Tarsus (mm)	23	28.7	27.1	32.1	1.140	5	28.2	27.3	29.0	0.725
Hind Claw (mm)*	21	9.7	8.6	11.5	0.802	10	10.5	9.0	12.5	1.215
Wing (mm)*	38	86.5	81.0	91.0	2.497	14	82.7	79.0	85.0	1.805
Tail(mm)*	38	67.0	57.5	72.0	3.156	14	64.3	54.5	75.0	5.213
Mass (g)	27	32.7	26.0	38.5	3.374	7	32.5	28.0	39.0	3.834

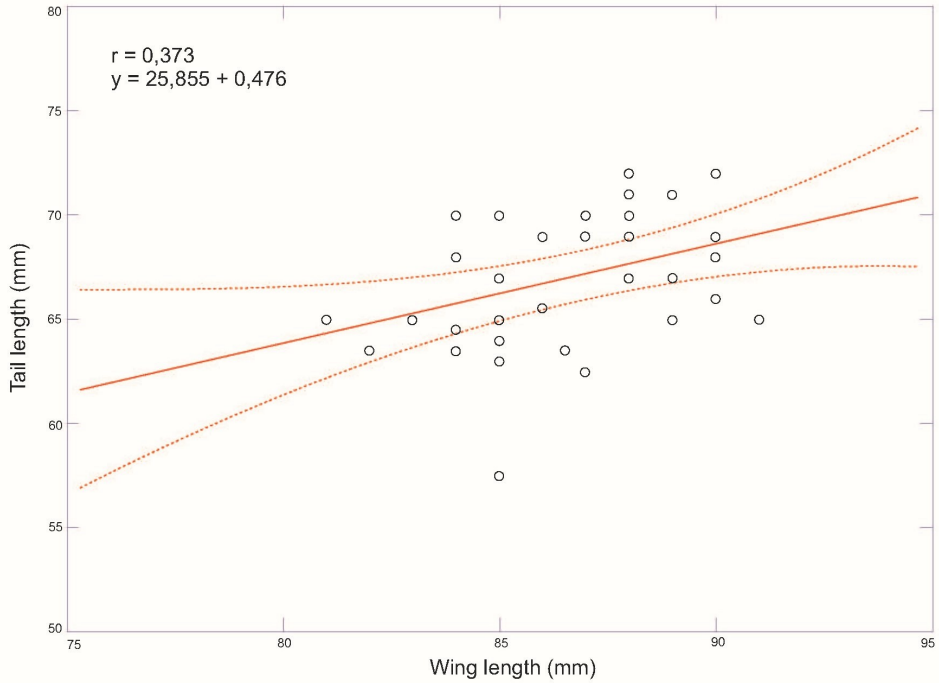

Fig. 1. Correlation between male African Rock Pipit *Anthus crenatus* wing and tail lengths (r = 0.373; 25.855 + 0.476).

Tarsus length
Mean tarsus length was slightly longer in males than in females but this difference was not significant (Table 1).

Body mass
Male and female body mass were very similar, although less data were available for females (Table 1).

Discussion

African Rock Pipit is one of the least frequently captured and ringed passerine species in South Africa, hence the low availability of biometric data for this species (Rose *et al*. 2019). It is therefore not surprising that Clancey (1990) and Maclean (1993) only had small samples of both sexes. The skew towards male samples in those publications could be attributed to the fact that males perch more prominently than females on exposed perches to sing and respond more to playbacks of calls (de Swardt 2006) leading to higher rates of capture and collection for males.

Culmen length
Longer mean culmen lengths (males: 20.9 mm, females: 20.4 mm) were recorded in both sexes by Voelker (2005a), with a sample size from seven males and five females. In this study, mean culmen lengths were 16.6 mm in males and 15.9 mm in females. These differences in mean culmen lengths between the two studies could be attributed to different techniques in culmen measurements (tip of feather line vs. skull line techniques). Maclean (1993) cites a range of 15.5 mm – 18.0 mm which fits more in the range of this study.

Tarsus length
Both Voelker (2005a) and this study found similar tarsus lengths (males: 29.0 mm vs 28.7 mm; females: 28.6 mm vs 28.2 mm) in both sexes, although the present study had a larger sample size.

Hind-claw length
Voelker (2005a) did not list any hind-claw measurements for African Rock Pipits, although Peacock (2006) and Maclean (1993) gave hind-claw lengths of 9.0 mm – 12.0 mm ranges. Clancey (1990) gave hind-claw lengths < 10.5 mm. Hind-claw lengths obtained during this study have similar ranges in both males and females, but were slightly shorter than the values recorded by Clancey (1990) and Peacock (2006).

Wing length
The results of this study suggest that wing length may be used to sex birds when examination of the gonads is not possible.

The average male wing length of 88.3 mm cited by Voelker (2005a) is longer than the value recorded in the present study (86.5 mm), although his value is based on a smaller sample size than the present study. Clancey (1990) presents a similar wing-length mean of 89.8 mm. Female wing-length mean (84.7 mm) recorded by Voelker (2005a) was generally similar to that found during this study. Clancey (1990) recorded female mean wing length of 85.5 mm. Both studies found that males are longer winged than females. Maclean (1993) also recorded similar male and female wing lengths as found during this study, but from smaller sample sizes.

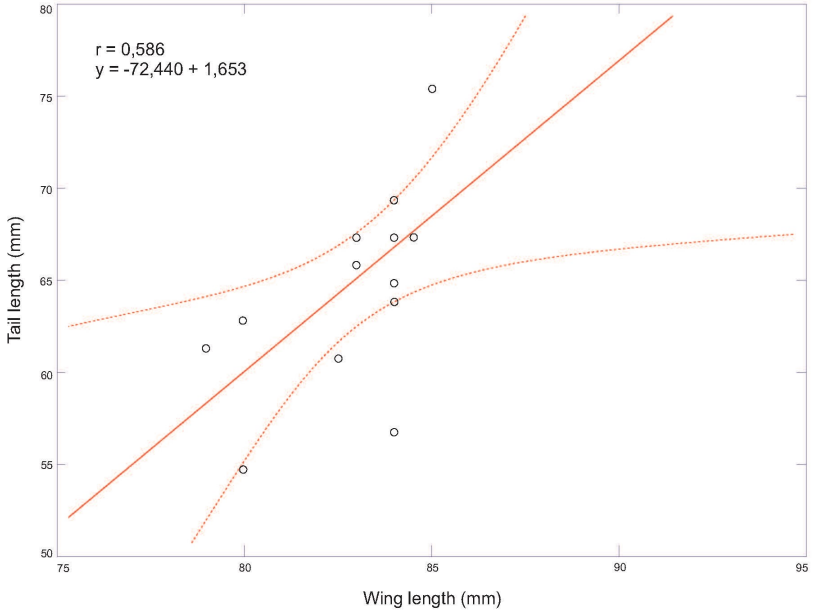

Fig. 2. Correlation between female African Rock Pipit *Anthus crenatus* wing and tail lengths (r = 0.586; -72.440 + 1.653).

Tail length

The results of this study suggest that tail length may also be used to sex birds when examination of the gonads is not possible.

Voelker (2005a) lists a small sample (males: n = 7; females: n = 5) of tail measurements which are also shorter than those found during the present study (males: mean 62.9 mm vs 67.0 mm, females: 62.1 mm vs 64.3 mm). Maclean (1993) only gives ranges in tail length in males (65.0 mm – 71.0 mm) and females (62.0 mm – 69.0 mm), with male lengths also found to be longer than females. The differences in tail lengths can also be attributed to different measuring techniques on live birds and from study skin specimens by different bird ringers/curators. Shrinking of skin specimens is known also to occur.

Body mass

In a previous study using a smaller sample size (males: n = 6; females: n = 1), Voelker (2005a) recorded smaller body masses than those recorded during the present study (males: n = 27; females: n = 7; mean male body mass 30.8 g vs 32.7 g; mean female body mass 30.5 g vs 32.5 g). Maclean (1993) lacks any body mass data.

General conclusions and future directions

Male and female African Rock Pipit were overall similar in mass, bill and tarsus lengths, but significant differences emerged in wing and tail lengths and hind-claw lengths. These results may suggest that diet and terrestrial movement are similar between the sexes (because of similar bill and leg dimensions), but that there could be differences in flight performance. Male African Rock Pipits mostly perched at elevated song posts such as large rock boulders on higher slope or on the plateaus of hills and their behaviour was often interrupted by flying to other parts of their territories, sometimes over long distances or uphill or downhill (de Swardt 2006). The longer wing and tail lengths in the males probably assist them in being more mobile in their territories, while the females have no need for flying such distances. The longer claws could also assist the pipits in their foraging behavior which entails walking on the ground and hopping from rock to rock (pers. obs). Future fieldwork may substantiate or invalidate these tentative insights. The difference in hind-claw length may be an artifact of the small female sample size, but if valid could suggest that the type and amount of time spent in different microhabitats could differ between the sexes, e.g. aspects of perch use in male territorial behaviour has previously been investigated (see de Swardt 2006). The proportional use of rocky, bare or vegetated surfaces or differing kinds of rocks and boulders used between the sexes is also an aspect to be explored.

Research on hind-claw lengths in grassland birds has disclosed correlations between particular microhabitat usage and the length and type of hind claw (Green *et al*. 2009), specifically that grassland-dwelling species have longer toes and claws than non-grassland inhabiting passerines. The biometric data for African Rock Pipit supports the conclusions of Green *et al*. (2009) as the hind claws of this species are shorter than those of grassland-dwelling motacillids such as African Pipit *A. cinnamomeus* and Cape Longclaw *Macronyx capensis*.

Pietersen *et al.* (2019) investigated the phylogenetic relationships of the genera *Anthus* and *Macronyx* and found that African Rock Pipit grouped in the 'small-bodied pipit clade' with Striped Pipit *A. lineiventris* as the sister-species. This is not surprising as both species have similarities in

rocky habitat, biometrics (wing/tail and hind-claw lengths) and body masses. Their distribution ranges do not overlap , as the African Rock Pipit prefers grassland/karoo hill habitats and the Striped Pipit rocky woodland, gorges and hills in wooded areas (Voelker 2005b). The other pipit species (Nicholson's *A. nicholsoni*, Buffy *A. vaalensis* and Plain-backed *A. leucophrys* pipits) that geographically overlap with African Rock Pipit (other than the widespread African Pipit) were found to fall within the 'large-bodied pipit clade' (Pietersen *et al.* 2019). Only Nicholson's and Plain-backed pipits share the same rocky hilly habitats with African Rock Pipits within their range. These three species have longer wing and tail lengths in both sexes than African Rock Pipits, although body mass is similar between these species (Clancey 1990, Maclean 1993). The proportionally longer wings and tails in those species may indicate greater flight ability and thus greater propensity for nomadism and movement. In contrast, the proportionally shorter wing and tail of African Rock Pipit would suggest it to be a more sedentary species, which is consistent with atlas evidence that shows no significant nomadic or migratory movements (Clancey 1997). The isolated resident populations of this species in the Groblershoop/Tswalu Kalahari (Kuruman) areas of the Northern Cape are separated by more than 280 km from the core distribution range in the Free State and surrounding areas (de Swardt 2017).

This study is the first to publish biometric data for African Rock Pipits based on limited bird-ringing data and biometric data from museum skin specimens which were available to provide a larger sample of biometrics for this species. The value of museum study skins for biometric data analysis is shown by the current study and has been underscored by other authors. De Swardt *et al.* (2018) also used museum skin specimens in their study of Karoo *Prinia maculosa* and Drakensberg *P. hypoxantha* prinia biometrics to supplement bird-ringing biometrics. Museum specimens are particularly valuable for bird species that are difficult for bird ringers to capture or have very localized geographic ranges.

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