SEXUAL SIZE DIMORPHISM AND AGING CHARACTERS IN THE LESSER SHEATHBILL AT MARION ISLAND

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SUMMARY

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Mass and linear dimensions of adult, subadult and juvenile Lesser Sheathbills *Chionis minor* at Marion Island are given. Males were larger than females in all dimensions but were otherwise similar in external appearance. The larger size of males is attributed to selection favouring male dominance in aggressive territorial encounters. External features of the head and the voice could be used to differentiate adults, subadults and juveniles in the field.

INTRODUCTION

Lesser Sheathbills *Chionis minor* are endemic residents of four island groups in the southern Indian Ocean (Watson 1975). During a study of the species at Marion Island (46 57S; 37 45E), techniques for sexing and aging live birds in the field were developed and these are reported here. No previous attempts have been made to discriminate sex and age classes based on mensural data or external features in the Chionididae. Previous mensural data of Lesser Sheathbills from all four island groups were summarized by Despin *et al.* (1972) and Derenne *et al.* (1976) but there were then few data available from the Marion Island population.

Three age classes were recognized in this study: juveniles comprised all fledged birds in the first year of their lives, subadults were birds in their second and third years (*i.e.* one or two years old) and adults were birds three or more years old. Lesser Sheathbills first attempted breeding at the end of their third year at Marion Island (Burger in prep.), although many birds older than that did not attempt breeding.

METHODS

Lesser Sheathbills were captured using a hand net or baited walk-in traps. Pulli captured in nests provided data for birds of known age. All captured birds were ringed, most with colour rings. Measurements were taken from live birds or from those freshly killed. Body *masses* were obtained using Pesola spring balances, correct to 5 g. The following linear dimensions were taken: *culmen length; culmen depth* taken at the nostril just anterior to the sheath; *sheath depth* taken vertically from the highest point of the sheath to the under edge of the lower mandible; *culmen width* taken at the nostril; *tarsus length* taken from the intertarsal joint to the base of the last completed scute above the toes; and *wing length* taken flattened and straightened from non-moulting birds. A beak shape index:

$$\frac{\text{Culmen length} \times \text{Culmen width} \times \text{Sheath depth}}{10}$$

in mm (Warham 1972) was used to give a measure of gross beak size. Measurements were taken in all months.

SEXUAL SIZE DIMORPHISM

Thirty-nine adults which were known to have occupied breeding territories were sexed by dissection, by recording their role in copulation, or by having their mate so sexed. Males were significantly larger than females in all dimensions (Table 1). A larger sample of measurements from breeding adults, with equal proportions of both sexes, was obtained by assuming that the larger bird of each pair was the male (Table 2). The beak shape index provided a means of sexing adults when both members of a pair could not be measured. Within the sexed sample (Table 1) all females had beak shape indices less than 450 and 95% of males had indices greater than 450.

Adult males and females differed externally only in size; neither sex had external features which were not found in the other sex. When seen singly it was often impossible to sex birds visually, but when seen in pairs the larger size of the male was apparent.

TABLE 1

DIMENSIONS OF ADULT LESSER SHEATHBILLS WHICH WERE SEXED BY DISSECTION OR BY THEIR ROLE IN COPULATION. THE MEAN ± ONE STANDARD DEVIATION AND RANGE IN BRACKETS ARE GIVEN. (P< 0,01 FOR ALL VALUES OF t).

Dimension	Males	Females	t-value
Mass (g)	533 ± 37 (480 — 620)	457 ± 38 (405 — 525)	6,29
Culmen Length (mm)	32,1 ± 1,0 (30,0 — 33,6)	29,9 ± 0,9 (28,4 — 31,5)	7,11
Culmen Depth (mm)	13,6 ± 0,5 (13,0 — 14,6)	12,4 ± 0,4 (11,8 — 13,5)	8,09
Sheath Depth (mm)	16,8 ± 1,0 (15,2 — 18,9)	14,8 ± 0,7 (13,4 — 16,4)	7,02
Culmen Width (mm)	9,6 ± 0,4 (8,8 — 10,1)	8,8 ± 0,4 (8,2 — 9,2)	6,19
Tarsus (mm)	47,4 ± 1,3 (45,5 — 50,5)	44,1 ± 1,2 (41,8 — 46,2)	8,03
Wing (mm) (14 males 9 females)	222 ± 4 (214 — 230)	212 ± 3 (208 — 215)	6,41
Sample sizes	22	17	

TABLE 2

MASS AND LINEAR DIMENSIONS OF LESSER SHEATHBILLS OF KNOWN AGE AT MARION ISLAND. THE MEAN ± ONE STANDARD DEVIATION, RANGE AND SAMPLE SIZE (IN PARENTHESES) ARE GIVEN

Dimension	Young birds			Breeding adults		
	Juveniles	1-year olds	2-year olds	Both sexes	Males	Females
Mass (g)	410 ± 60 269 — 577 (89)	446 ± 57 365 — 530 (17)	472 ± 44 450 — 540 (7)	492 ± 48 397 — 635 (98)	523 ± 36 470 — 635 (50)	455 ± 34 397 — 555 (48)
Culmen length (mm)	31,6 ± 1,5 28,1 — 34,5 (54)	31,5 ± 1,1 30,0 — 33,9 (13)	31,4 ± 1,0 30,5 — 32,3 (4)	31,3 ± 1,5 28,4 — 34,5 (98)	32,1 ± 1,0 30,0 — 34,5 (50)	30,2 ± 0,8 28,4 — 31,4 (48)
Culmen depth (mm)	11,5 ± 0,6 10,4 — 12,4 (54)	12,1 ± 0,6 11,4 — 13,1 (13)	12,2 ± 0,7 12,0 — 13,6 (4)	13,0 ± 0,8 11,4 — 14,6 (98)	13,7 ± 0,5 12,8 — 14,6 (50)	12,3 ± 0,4 11,4 — 13,1 (48)
Sheath depth (mm)	12,4 ± 0,6 11,3 — 13,6 (54)	14,1 ± 1,2 12,7 — 15,9 (13)	15,1 ± 1,1 14,1 — 16,5 (4)	15,9 ± 1,5 13,2 — 19,7 (98)	17,1 ± 1,0 15,2 — 19,7 (50)	14,7 ± 0,7 13,2 — 16,4 (48)
Culmen width (mm)	8,8 ± 0,5 7,8 — 10,1 (54)	9,0 ± 0,4 8,3 — 9,5 (13)	9,1 ± 0,5 8,5 — 9,5 (4)	9,2 ± 0,5 8,2 — 10,7 (98)	9,6 ± 0,4 8,7 — 10,7 (50)	8,8 ± 0,4 8,2 — 9,8 (48)
Tarsus (mm)	45,0 ± 1,9 41,3 — 49,7 (54)	45,4 ± 1,5 43,3 — 48,3 (13)	46,2 ± 1,7 43,9 — 47,6 (4)	46,0 ± 2,0 40,6 — 50,4 (98)	47,3 ± 1,3 44,5 — 50,4 (50)	44,3 ± 1,3 40,6 — 46,0 (48)
Wing (mm)	214 ± 6 201 — 225 (54)	216 ± 4 211 — 222 (9)	no data	217 ± 7 199 — 230 (63)	221 ± 4 210 — 230 (36)	211 ± 4 199 — 216 (27)

Measurements given by Murphy (1936) and Holgersen (1957) for Wattled Sheathbills *Chionis alba* indicate that in that species too males are larger than females.

AGE CHARACTERS

Very little post-fledging growth was apparent in Lesser Sheathbills (Table 2). *Mass, culmen depth* and *sheath depth* were the only dimensions to increase appreciably with age. The increase in *mass* is attributed to increased fat reserves and probably also increased musculature in older birds The pectoral and leg muscles of most juveniles felt thinner than those of adults when held in the hand.

The greatest change of linear dimension with age was in *sheath depth* (Table 2). This was the result of growth in the sheath (see below) and an increase in the depth of the mandibles themselves (see *culmen depth* in Table 2). The *culmen length* appears to decrease with age but this is an artefact caused by the growth of facial caruncles covering the proximal part of the culmen.

Mass and linear dimensions cannot be used alone to age Lesser Sheathbills because of the considerable overlaps between dimensions of age classes. Leg colour was also an unreliable age character: a greater proportion of adults and subadults had pale legs than had juveniles (Table 3), but this was very variable.

TABLE 3
COLOUR OF THE LEGS OF LESSER SHEATHBILLS AT MARION ISLAND

Leg colour	Number of birds		
	Adults	Subadults	Juveniles
Pale purple or purple	74	16	15
Dark purple or black	17	6	14

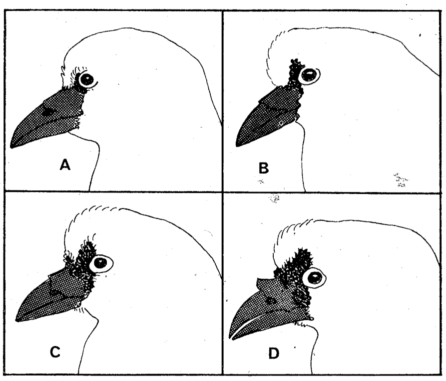

FIGURE 1

Facial features of Lesser Sheathbills at Marion Island, showing a four month old juvenile (A), a one year old subadult (B), a two year old subadult (C) and a four year old adult (D). (Drawn from close-up photographs.)

External features of the head (Fig. 1) and the voice were found to be most reliable in aging birds. These features, and others, were regularly noted in ringed birds of known age. The recognizable characteristics of each age class are summarized below.

a) Juveniles

At fledging the culmen sheath was not clearly separate from the culmen but began to grow and separate within the first year. Juveniles had little or no head crest; the caruncle around the eye was small or absent and made no lump at the proximal part of the culmen; the fleshy eye-ring was present but was small and very pale pink; the carpal spurs were small and barely protruded from the plumage; the primary feathers were more pointed than in older birds. Juveniles had feeble, high pitched cheeping calls.

b) Subadults

Lesser Sheathbills in their second and third years could be differentiated from juveniles on the following features: the culmen sheath was separate from the culmen although still small; the caruncles anterior to the eye were visible; the head crest was visible; the carpal spurs, though small, had grown. Subadults rarely vocalised and their voices were similar to those of adults.

Birds in their second year (*i.e.* one year olds) and some of those in their third year could be differentiated from adults on the following characters: the eye-ring was still pale; the facial caruncles were small and did not form a lump at the proximal part of the culmen; the sheath was smaller; the bill was smooth and not rough proximally. It was often impossible to differentiate between some two year olds and adult females on external features alone, although their behaviour often gave clear indications of their age and status.

c) Adults

At maturity Lesser Sheathbills had a large sheath, particularly males; the black facial caruncles covered a large part of the face anterior to the eye; the eye-ring was thickened and usually bright pink; the head crest was visible, although not larger than in subadults. The blunt black carpal spurs up to 10 mm long were prominent in adults when the wings were opened. Adult voices were strong and staccato and no difference could be discerned between sexes.

No apparent changes in appearance occurred in adults at the onset of breeding, although the eye-ring appeared to be brighter in colour in some birds at this time. Similarly, breeding adults could be distinguished from neighbouring non-breeding adults only on behavioural features.

TABLE 4

SEASONAL CHANGES IN BODY MASS (g) OF LESSER SHEATHBILLS AT MARION ISLAND. THE MEAN ± ONE STANDARD DEVIATION AND SAMPLE SIZE (IN PARENTHESES) ARE GIVEN.

Month	Juveniles	Subadults	Adult males	Adult females
December — January	—	435 ± 34 (7)	503 ± 26 (19)	442 ± 25 (16)
February — March	—	453 ± 53 (5)	513 ± 54 (16)	456 ± 65 (20)
April — May	437 ± 57 (65)	469 ± 51 (29)	521 ± 41 (28)	467 ± 33 (21)
June — July	427 ± 88 (9)	480 ± 70 (13)	564 ± 34 (18)	455 ± 50 (13)
August — September	404 ± 41 (12)	406 ± 49 (23)	523 ± 32 (19)	461 ± 32 (10)
October — November	392 ± 70 (11)	416 ± 55 (11)	509 ± 34 (14)	451 ± 24 (9)

SEASONAL CHANGES IN MASS

The sampling distribution of adult *masses* was approximately even throughout the year (Table 4). Mean *masses* of adult females did not change significantly during the year (analysis of variance, $P>0,05$) but those of males did ($P<0,01$), being highest in winter (April to September). The lower mean *mass* of males during the summer might be due to increased activity, and thus decreased fat reserves during the breeding season (October to March).

Most *masses* of juveniles were measured in April and May, after they had fledged (Table 4) Their mean *mass* decreased during late winter and spring but these changes were not significant ($P>0,05$). Subadults were sampled relatively evenly throughout the year and their mean *mass* changed significantly ($P<0,01$) decreasing sharply in late winter. The most severe, cold weather during the sampling period occurred in August when several subadults and juveniles were found starved.

DISCUSSION

Sexual size dimorphism is apparently an adaptation for alleviating intersexual competition for food in some bird species (Selander 1966). This does not seem probable in Lesser Sheathbills, however, as the foraging habits and food items of both sexes were similar and the sexes played equal roles in feeding the chicks (Burger in prep.). Sexual size dimorphism has also been shown to facilitate recognition of sexes, which permits rapid pair formation in certain species having very short breeding seasons (Jehl 1970). This does not apply to Lesser Sheathbills since breeding adults re-mate at every fourth year on average, pairs use the same breeding sites every season and re-occupy these sites at least five weeks before laying.

Breeding males were involved in significantly more agonistic territorial behaviour than females (Table 5), particularly in fighting and in ritualized boundary disputes, when fighting was probable. The larger size of males is attributed to selection favouring male dominance in aggressive territorial encounters.

The most noticeable differences between adult and immature Lesser Sheathbills were in facial features and voice. Similarly, adult Wattled Sheathbills had larger sheaths, greater areas of facial caruncles (pink in this species) and deeper, harsher voices than juveniles (Jones 1963).

TABLE 5

THE RELATIVE FREQUENCY WITH WHICH INDIVIDUALLY MARKED LESSER SHEATHBILLS PERFORMED AGONISTIC DISPLAYS IN THEIR TERRITORIES. ($P < 0,01$ FOR ALL VALUES OF χ^2).

Display	No. of displays by		χ^2-values
	Males	Females	
Threat posture	56	19	18,25
Chasing intruders	117	73	10,19
Ritualized boundary disputes	94	7	74,94
Fighting	33	1	30,12
All displays	300	100	100,00

The black bill, culmen sheath and facial caruncles and pink eye-rings of adult Lesser Sheathbills contrast with the pure white plumage. These features appear to be adaptations to facilitate intra-specific visual communication, since agonistic and sexual displays of Lesser Sheathbills all involve ritualized movements or postures of the head (Burger in prep.). The less conspicuous facial features of immature birds might elicit fewer aggressive responses from conspecifics. The cheeping calls of juveniles, given when in appeasement postures or when soliciting food, are believed to differ from the harsh, staccato adult calls for the same reasons. In this species, features which are useful to ornithologists to classify age classes appear to be those used by the birds themselves for social communication.

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