

# RUNT EGGS OF THE JACKASS PENGUIN *SPHENISCUS DEMERSUS*

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## INTRODUCTION

Runt eggs (abnormally small eggs : Koenig 1980a) have been reported for a number of bird species (e.g. Romanoff & Romanoff 1949, Cooper 1969, Rothstein 1973, Ricklefs 1975, Schreiber 1975, Manning & Carter 1977, Koenig 1980b). Runt eggs are known for at least four species of penguins (Hewitt 1920, Budd 1961, Zapata 1967, Dean 1984). Here I give details of runt eggs of the Jackass Penguin *Spheniscus demersus*, and compare them with those of normal-sized eggs laid by the species.

## METHODS

During 1971-1980 I measured and often collected runt eggs at several breeding localities of the Jackass Penguin. In addition, I measured such eggs collected by others and consulted the literature. Length and breadth were measured with Vernier calipers to the nearest 0,1 mm, and mass of some eggs was measured, to the nearest 1 g, using a 100 g Pesola spring balance. Eggs were not necessarily freshly laid when weighed. I measured egg shell thicknesses of three runt eggs and five normal-sized eggs using a micrometer to the nearest 0,01 mm. Five measurements were taken from various positions on each eggshell, and these measurements were then pooled. I calculated shape index using the formula  $\text{breadth/length} \times 100$  such that a perfectly spherical egg scores 100 (Coulson et al. 1969). I noted the clutch contents of all nests in which I found runt eggs. Where clutch size was two I noted whether both eggs were runts or not. It cannot be assumed that an egg had not previously been lost from single-egg clutches containing a runt egg. I analysed one fresh runt egg for wet and dry mass and % water content of shell (plus membranes), albumen and yolk following the method of Williams *et al.* (1982). I examined the contents of five other runt eggs.

## RESULTS

A total of 20 eggs has been recorded from six breeding localities of the Jackass Penguin: Halifax Island (26 38S,

15 O5E), one egg; Malgas Island (26 38S, 15 O5E), two eggs (Dean 1984); Marcus Island (33 O3S, 17 58E), four eggs; Dassen Island (33 25S, 18 O5E), seven eggs; Dyer Island (34 41S, 19 25E) five eggs; and St Croix Island (33 48S, 25 46E), one egg (Hewitt 1920).

Dimensions of runt eggs of the Jackass Penguin are given in Table 1. The smallest egg measured 33,6 X 30,2 mm and weighed 17 g. The largest runt egg collected measured 55,3 X 42,4 mm and weighed 58 g. Mean shape index was 85,4. There was no discernable pattern in size of runt eggs between the breeding localities. Eggshell thickness of three runt eggs ranged from 0,59 - 0,74 mm (mean 0,65 + 0,05 mm; Table 1) and eggshell thickness of five normal-sized eggs ranged from 0,44 - 0,68 mm (mean 0,57 + 0,07 mm). The means are significantly different ( $t = 4,36$ ;  $P < 0,001$ ). Several runt eggs examined had large protuberances, mainly clustered at the obtuse end.

Where clutch size was recorded, two runt eggs formed single-egg clutches and seven two-egg clutches contained runt eggs. Of such two-egg clutches, only one contained two runt eggs, five contained a normal-sized egg in addition to the runt egg (Fig. 1) and one contained a young chick and a runt egg. Mean clutch size of clutches containing at least one runt egg was therefore 1,78. The observed two-runt egg clutch (from Dassen Island) was of the two smallest eggs (33,6 X 30,2 mm; 17 g and 35,1 X 31,6 mm; 18 g). The largest runt egg (from Halifax Island) was in a single-egg clutch when found.

The constituents of a single runt egg are given in Table 2. This egg contained a very small yolk forming only 5,8 % of the contents (yolk + albumen) by wet mass. Four of six runt eggs contained no yolk at all so that albumen formed 100 % of the contents. The largest runt egg contained a yolk of normal-sized appearance.

No runt eggs were observed to hatch, although none was followed through the period of normal incubation. In one clutch a normal-sized egg hatched but a runt egg did not and a second clutch contained a young chick and a runt egg. These runt eggs had therefore been present throughout the egg-period. No information was obtained of the order of laying of runt eggs in two-egg clutches.

## DISCUSSION

Runt eggs have been observed over a large proportion of the breeding range of the Jackass Penguin (Shelton *et al.* 1984). That only 20 runt eggs (representing a maximum of 19 clutches) have been recorded out of several tens of thousands of nest contents I have observed, at all but a few breeding localities of the Jackass Penguin, suggests that the incidence of laying of runt eggs is very low. The available literature (see references given above for example) also suggests that runt eggs are rarely laid by other species of birds studied.

Runt eggs are noticeably smaller and more spherical than are

TABLE 1  
 DIMENSIONS OF RUNT EGGS OF THE JACKASS PENGUIN

Parameter	Mean	Standard deviation	Range	No. of eggs measured
Length (mm)	42,5	5,1	33,6-55,3	20
Breadth (mm) *	36,2	3,8	30,2-42,4	20
Shape index	85,4	4,7	75,0-91,4	20
Eggshell thickness (mm)	0,65	0,05	0,59-0,74	3
Mass (g)	32	13	17-58	9

\* Breadth/length X 100 (Coulson *et al.* 1969)

TABLE 2  
 CONSTITUENTS OF A JACKASS PENGUIN RUNT EGG

	Shell	Albumen	Yolk	Total
Wet mass (g)	5,6	19,7	1,2	26,5 *
Dry mass (g)	4,5	2,2	0,4	7,1
Water mass (g)	1,1	17,5	0,8	19,4
% water content	19,6	88,8	66,7	73,2

\* original mass 27 g (43,6 X 32,7 mm)

normal-sized Jackass Penguin eggs. Williams & Cooper (1984) give 69,6 X 52,1 mm; 106,8 g (n = 70) as mean dimensions of A (first laid) eggs, 67,7 X 52,0; 104,8 g (n = 70) for B eggs and 54,1 X 47,2 mm; 75 g as the smallest dimensions of "normal-sized" eggs. Mean shape index of normal-sized eggs is only 74,9 and 76,8 for A and B eggs respectively (calculated from Williams & Cooper 1984). Zapata (1967) reports two runt eggs of the closely-related Magellanic Penguin *S. magellanicus* to measure 62 X 50,5 mm and 46 X 40 mm. These have shape indices of 81,5 and 87,0, respectively. Mean egg size for this species (n = 75) is 74,9 X 55,3 mm (Boswell & MacIver 1975) giving a shape index of 73,8. Runt eggs in Magellanic Penguins also seem to be more spherical than normal-sized eggs as are those of Jackass Penguins. Runt eggs of several other species are also reported to be more spherical than normal eggs (Romanoff & Romanoff 1949 and references therein). Schreiber (1975) found a runt egg of the Brown Pelican *Pelecanus occidentalis* to have an eggshell thicker than that of normally-sized eggs. A runt egg of the Emperor Penguin *Aptenodytes forsteri* had a large number of protuberances scattered over the surface (Fig. 1 in Budd 1961). It seems that runt eggs, at least in Jackass Penguins, have more protuberances than do normal eggs.

The albumen of one runt egg was similar in water content (88,8 %) to that of eight normal-sized eggs (88,5 %; Williams *et al.* 1982). The yolk's water content (66,7 %; Table 2) was higher than that of normal-sized eggs (55,2 %; Williams *et al.* 1982). On a dry-mass basis the runt egg's yolk formed only 15,4 % of contents compared with 61,4 % for eight normal-sized eggs (Williams *et al.* 1982). Shell mass of the runt egg formed 21,1 % of total mass, compared with only 14,8 % for eight normal-sized eggs (mean mass 97,5 g) (Williams *et al.* 1982). Based on small samples, the eggshells of runt eggs are of greater than normal thickness, explaining why eggshell forms a higher percentage of total mass in comparison to normal-sized Jackass Penguin eggs. Williams *et al.* (1982) give means ranging from 10,8 to 15,8 for eggshell mass percentage for nine species of penguins.

Jackass Penguin runt eggs may have only a very small or no yolk at all. Yolk forms 29,0 % by wet mass of the contents of normal-sized Jackass Penguins eggs (Williams *et al.* 1982). Because of this it is unlikely that Jackass Penguin runt eggs are viable. Runt eggs of a number of species studied are yolkless or have very small yolks and are considered to be non-viable (references cited above). It is therefore reasonable to assume that the laying of runt eggs is maladaptive (e.g. Rothstein 1973). However, Koenig (1980b) has suggested that runt eggs could be adaptive in some circumstances but this remains unproven.

Even though runt eggs have been described in the scientific literature as early as 1906 (references in Romanoff & Romanoff 1949), little is known about the mechanisms leading to their occurrence. The limited evidence suggests that their occurrence is not due to genetic abnormalities and, at least in domestic fowl *Gallus gallus*, that they are laid mainly by young birds (Romanoff & Romanoff 1949). Nothing is known of the age of Jackass Penguins laying runt eggs.

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Figure 1

Two-egg clutch of the Jackass Penguin, Dassen Island, May 1971, containing a runt egg measuring 46,1 X 39,3 mm and weighing

43 g.