PENGUIN PROPORTIONATE EGG WEIGHT

By ANTHONY J. WILLIAMS

Proportionate egg weight — the relation of egg weight to female body weight — is used to compare the relative cost of egg production in birds (Lack 1968). Reid (1965) and Lack (1968) calculated the proportionate egg weight of seven and 15 species of penguins respectively. Both found that the proportionate egg weight of penguins was typical of birds with altricial hatchings; yet penguins have semi-altricial, not altricial, hatchlings (Nice 1962). Both Reid (1965) and Lack (1968) used the weight of females at the time of laying for their calculations, and their error arises because the weight of penguins at laying cannot validly be compared with that of other birds.

Penguins have varying feeding regimes during the laying period: females of some species feed shortly before laying or during the laying interval, whereas females of other species lay their eggs during a period of fasting (Table 1). The extreme case is that of the Rockhopper and Macaroni Penguins, *Eudyptes chrysocome* and *E. chrysolophus,* in which the female lays the eggs in the middle of a 4-5 week fast (Warham 1963, 1971). Before starting a fast, penguins accumulate substantial fat deposits (Johnson & West 1974, Williams *et al.* 1977), which greatly enhance their weight. Consequently the weight of female penguins that lay their eggs during a fast is not comparable at the time of laying either with the weight of female penguins in species that do not fast during the laying period, or with the weight of other birds.

Healthy female birds in general have food reserves in their body tissues after laying, but in most species these reserves are unlikely to sustain the bird for more than a day or two. Penguins probably spend more of their lives in water than any other birds. One adaptation penguins possess for maintaining their body temperature higher than that of the water in which they swim is the accumulation of subdermal fat deposits which provide insulation (Frost *et al.* 1976). Such fat deposits are probably greater than those carried by most birds at the time of laying, and so the weight of female penguins which do not fast in the laying period will also be enhanced relative to that of most other birds.

Penguin body weights are probably most comparable with those of other birds at the end of the annual moult, when penguins after two or more weeks without food have minimal fat deposits (Williams *et al.* 1977). Body weight at the end of moult is known for only eight species of penguins. These data have been used to recalculate proportionate egg weight (Table 2). Application of the data in Table 2

to Lack's (1968: Fig. 17) graph comparing proportionate egg weight of several families of seabirds indicates that the proportionate egg weight of penguins calculated using lean (end of fast) weights are indeed typical of heavy birds with semi-altricial hatchlings.

TABLE 1 — The feeding regime of penguins during the laying period.

Species	Feeding regime during laying	Reference
Emperor Penguin		
Aptenodytes forsteri	Fasts	Le Maho (1977)
King Penguin		
A. patagonicus	Fasts	Stonehouse (1960)
Eudyptes penguins		
(all 5 species)	Fast	Warham (1975)
Fairy Penguin		
Eudyptula minor	Feeds	Kinsky (1960)
Yellow-eyed Penguin		
Megadyptes antipodes	No data	
Adélie Penguin		
Pygoscelis adeliae	Fasts	Sladen (1958)
Chinstrap Penguin		
P. antarctica	No data	
Gentoo Penguin		
P. papua	Feeds	This study
Jackass Penguin		
Spheniscus demersus	Feeds	J. Cooper (pers. comm.)
Magellanic Penguin		
S. magellanicus	No data	
Humboldt Penguin		
S. humboldtii	No data	
Galapagos Penguin		
S. mendiculus	Feeds	Boersma (1974)

TABLE 2 — Proportionate egg weight of eight species of penguins.

Species	Weight (g) of Female[a]		Egg[b]	Proportionate egg weight (%)	
Emperor Penguin *Aptenodytes forsteri*	20 000[1]		450[1]	2.3	(1.5)
King Penguin *A. patagonicus*	11 500[2]		302[2]	2.6	(2.0)
Rockhopper Penguin *Eudyptes chrysocome*	1 900[3]	A	76[3]	4.0	-
		B	109	5.7	(4.4)
Macaroni Penguin *E. chrysolophus*	3 200[3]	A	98.5[3]	3.1	-
		B	156.5	4.9	(3.7)
Fiordland Penguin *E. pachyrhynchus*	2 500[4]	A	100[4]	4.0	-
		B	120	4.8	-
Adélie Penguin *Pygoscelis adeliae*	3 400[5]	A	123[6]	3.6	(2.5)
		B	118	3.5	-
Gentoo Penguin *P. papua*	5 500[7]	A	141[3]	2.6	(2.2)
		B	134	2.4	-
Jackass Penguin *Spheniscus demersus*	2 300[8]	A	107[3]	4.7	(3.6)
		B	105	4.6	-

Notes: [a] Weights at end of fast.

[b] Weights of first-laid (A) and second-laid (B) eggs given when known.

[c] Calculated from data in previous columns. Lack's (1968) calculations in parentheses.

References: [1] Le Maho (1977), [2] Barrat (1976), [3] This paper, [4] Warham (1974), [5] Sladen (1958), [6] Reid (1965), [7] Stonehouse (1970), [8] Cooper (1978).

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SHORT NOTE

FEMALE BLACKBIRD DIVERTED FROM TASK

In September 1978, we found the old nest of a Song Thrush *(Turdus philomelos)* blown on to the path. We put it on top of a fence and placed in it two old eggs, one each of House Sparrow *(Passer domesticus)* and Starling *(Sturnus vulgaris)*. A short time later a female Blackbird *(T. merula)* deserted her mate, with whom she had been building a nest in a nearby shrub, to sit firmly on the foreign nest and eggs. The male Blackbird uttered continuous cries of distress while fluttering, strutting and displaying along the fence between the shrub and his mate. After about 20 minutes, he was successful in persuading his mate to rejoin him in nest-building. The offending nest and eggs were removed to the rubbish bin.

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