EGG SHAPE WITHIN THE AUSTRALIAN PSITTACIFORMES WITH COMMENTS ON EGGS OF *NYMPHICUS HOLLANDICUS*

As part of a comparative study into aspects of the biology of several species of Australian Psittaciformes (Saunders & Smith 1981), the lengths and widths of 3407 parrot eggs from sixty-eight subspecies were measured to determine if there were differences in the shape of the eggs between taxa. Sample sizes ranged from five (*Calyptorhynchus funereus funereus*) to 152 (*Cacatua roseicapilla assimilis*). These data were obtained from museums throughout Australia, from research workers studying individual species and from several egg collectors.

The taxonomic position of *Nymphicus hollandicus* has been the subject of some controversy. Salvadori (1891), Peters (1937), Holyoak (1972), Lendon (1973), Courtney (1974), Smith (1975) and Forshaw (1981) all regard it as more closely related to the cockatoos than to any of the other parrots and include it within the Cacatuidae. Verheyen (1956), Brereton & Immelmann (1962), Brereton (1963) and Condon (1975) maintain that it is more akin to the parrots and include it in the Polytelitidae (long-tailed parrots). The aim of this paper is to show that the shape of the eggs of the cockatoos differs from that of the other parrots and to demonstrate that the shape of the eggs of *Nymphicus hollandicus* is closer to that of the cockatoos.

Size and shape of eggs were defined by maximum length and width as it was not possible to obtain a detailed series of measurements. A detailed discussion about the concepts of size and shape has been given by Mosimann & James (1979 and their references). Briefly, for two variables x_1 (length of egg) and x_2 (width of egg), size (SZ) should satisfy the relationship

$$SZ\ (ax_1,\ ax_2) = a\ SZ\ (x_1,\ x_2),$$

while shape (SH) should satisfy

$$SH\ (ax_1,\ ax_2) = SH\ (x_1,\ x_2),$$ where a is a constant.

The measures of size and shape adopted here are $(x_1, x_2)^{1/2}$ and $\frac{x_1}{x_2}$ respectively. Because there are advantages in working with the logarithmic scale (see Mosimann & James 1979: 446) the computed shape variable becomes $\log x_1 - \log x_2$.

An examination of the relationship between the shape and size of eggs within each taxonomic unit showed no significant relationship. In view of this, the remainder of the paper is devoted to an investigation of the differences in shape of eggs between taxa.

The mean values of the shape variables ranged from 0.27 to 0.41 for all of the taxonomic units of cockatoos and from 0.13 to 0.25 for all of the non-cockatoos with a pooled standard deviation of 0.046. Mean values for the taxonomic units of each genus are: *Probosciger*, 0.28; *Calyptorhynchus*, 0.33, 0.41, 0.29, 0.29, 0.33, 0.30, 0.32; *Callocephalon*, 0.27; *Cacatua*, 0.29, 0.34, 0.27, 0.32, 0.34, 0.31, 0.30, 0.33, 0.34; *Nymphicus*, 0.28; *Eclectus*, 0.24; *Trichoglossus*, 0.21, 0.19, 0.22; *Psitteuteles*, 0.18; *Glossopsitta*, 0.20, 0.17, 0.18; *Alisterus*, 0.17; *Aprosmictus*, 0.20, 0.22; *Polytelis*, 0.18, 0.22, 0.22; *Pezoporus*, 0.21; *Melopsittacus*, 0.23; *Lathamus*, 0.20; *Purpureicephalus*, 0.18; *Platycercus*, 0.19, 0.20, 0.16, 0.20, 0.20, 0.19, 0.17, 0.20, 0.20, 0.18, 0.19, 0.18; *Barnardius*, 0.25, 0.22, 0.21; *Psephotus*, 0.18, 0.21, 0.19, 0.19, 0.13, 0.18; *Northiella*, 0.20, 0.23, 0.24; and *Neophema*, 0.19, 0.20, 0.19, 0.22, 0.19, 0.18, 0.21.

Most (89%) of the variation in shape between the taxonomic units was due to variation between taxa from different genera, rather than between the taxa which make up each genera (11%). Therefore, the data were grouped for each genus. An examination of individual

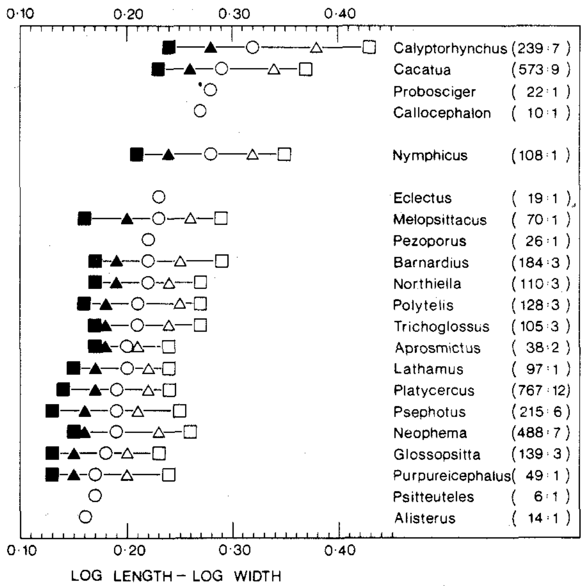

Figure 1. Egg shape in the Australian genera of Psittaciformes. Shape is expressed as log length - log width. Median value ○; ■ lower decile (10%); ▲ lower quartile (25%); △ upper quartile (75%); and □ upper decile (90%). Samples of 35 or less have only the median value plotted. Figures in brackets after the genus are the sample size and number of taxonomic units included in the genus.

shape values for each genus showed them to be unimodal, with a reasonable description of the data being provided by the median (the value at 50% of the ranked values), upper and lower quartiles (the values at 75% and 25% of the ranked values respectively) and the upper and lower deciles (90% and 10%). These are shown in Figure 1 for all genera with sample sizes greater than thirty-five, while those less than thirty-five did not provide an adequate definition of the shape of the distribution and only the median values have been plotted for those genera. The lower quartile for *Calyptorhynchus* and *Cacatua* is as great or greater than the upper quartile for any of the non-cockatoo genera and the median value of shape for *Nymphicus hollandicus* agrees closely with those of the cockatoos. The relevant summary statistics for the combined cockatoo data are 0.24 (10%), 0.27 (25%), 0.30 (50%), 0.35 (75%) and 0.39 (90%) while those for the non-cockatoo data are 0.15 (10%), 0.17 (25%), 0.20 (50%), 0.23 (75%) and 0.26 (90%). Seventy of the 108 (65%) *Nymphicus* eggs have a shape value equal or greater than 0.26 while eighty-six (80%) have a shape value equal to or greater than 0.23 (the upper quartile for the non-cockatoos).

The eggs of the cockatoos are clearly more elongate than those of the non-cockatoos, while the eggs of *Nymphicus hollandicus* more closely resemble those of the cockatoos (see also the plates in Beruldsen 1980). This is another piece of evidence favouring its inclusion in the Cacatuidae.

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