

FEATURE ARTICLES

THE INFLUENCE OF LAYING DATE AND MATERNAL AGE ON EGGSHELL THICKNESS AND PORE DENSITY IN YELLOW-EYED PENGUINS

MELANIE MASSARO^{1,2} AND LLOYD S. DAVIS

Department of Zoology, University of Otago, P.O. Box 56, Dunedin, New Zealand

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¹Present address: School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. E-mail: melanie.massaro@canterbury.ac.nz

Abstract. In many bird species, eggs laid late in the breeding season hatch after a shorter incubation period than eggs that were laid early. The proximate mechanisms that cause these seasonal declines in incubation length remain poorly understood. We tested in Yellow-eyed Penguins (*Megadyptes antipodes*), Hipfner's hypothesis that late-laid eggs have thinner eggshells with a higher pore density that allow embryos to develop more rapidly than in early-laid eggs. In this species incubation length declines with increasing female age, so we also investigated whether eggshell thickness and pore density varies with female age. In addition, differences in shell thickness and pore density between first- and second-laid eggs of the same clutch were examined. Eggshell thickness did not change with laying date and was not related to length of incubation. In contrast, pore density increased with laying date and was negatively related to incubation length in first-laid eggs. Eggshell thickness and pore density increased with female age. Second-laid eggs had a lower pore density and approximately 900 fewer pores than first-laid eggs of the same clutch. Our study suggests that embryos of late-laid eggs may be able to develop faster than embryos of early-laid eggs because of a greater capacity for gas exchange. Further work on eggshell porosity could provide answers to some long-standing questions about the evolutionary advantages of seasonal declines in incubation periods and their underlying mechanisms.

Key words: eggshell thickness, female age, incubation period, laying date, *Megadyptes antipodes*, pore density, Yellow-eyed Penguin.