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Breeding biology of Gould's petrels *Pterodroma leucoptera*: predicting breeding outcomes from a physiological and morphological appraisal of adults

Terence W. O'Dwyer
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**BREEDING BIOLOGY OF GOULD'S PETRELS *PTERODROMA*
LEUCOPTERA: PREDICTING BREEDING OUTCOMES FROM A
PHYSIOLOGICAL AND MORPHOLOGICAL APPRAISAL OF ADULTS**

A thesis submitted in fulfilment of the requirements for the degree

DOCTOR OF PHILOSOPHY

from

UNIVERSITY OF WOLLONGONG

by

Terence W. O'Dwyer, BEnvSc (Hons)

SCHOOL OF BIOLOGICAL SCIENCES

2004

CERTIFICATION

I, Terence William O'Dwyer, declare that this thesis, submitted in fulfillment of the requirements for the award of Doctor of Philosophy, in the School of Biological Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

ABSTRACT

- 1) The breeding biology of Gould's petrels *Pterodroma leucoptera* was studied at Cabbage Tree Island, New South Wales over three successive breeding seasons from 2000/01. I sought to identify better reproductively performing individuals and to identify indicators of breeding success through a physiological and morphological appraisal of adult characteristics.

- 2) Gould's petrels exhibit no sex linked plumage dimorphism, however, knowledge of the sex of both adults and chicks was an integral component of this study. Blood samples were taken from 209 adults and 206 chicks and a polymerase chain reaction (PCR) based molecular technique was used to determine their sex. With the knowledge of the sex of individuals a discriminant function analysis (DFA) based on several skeletal measures was developed. The DFA could predict the sex of adults with an accuracy of about 85% and chicks with an accuracy of 66%.

- 3) Relationships between egg laying characteristics and hatching success were assessed. Egg laying occurred over a four week period from early November to early December. Egg volumes ranged from 30-42 ml and averaged approximately 37 ml in both years. Hatching success was 76% (78 of 102) and 65% (60 of 93) in 2001/02 and 2002/03 respectively. Incubation periods ranged from 42 to 64 days with an average of approximately 49 days. There were no significant relationships between either laying date and hatching success or egg volume and hatching success. There was, however, significant

interyear repeatability in individual laying dates and in egg volumes, and egg volume significantly influenced hatchling mass and size.

- 4) The influences of circulating levels of prolactin (PRL) and testosterone (T) on hatching success were examined. Throughout incubation females tended to have higher levels of PRL than males. After the onset of incubation, PRL concentration increased significantly from pre-laying levels of 2.7 ± 0.6 ng/ml in males and 3.1 ± 0.6 in females to 26.3 ± 0.7 ng/ml and 28.8 ± 0.5 ng/ml, respectively. PRL levels were significantly higher in breeding pairs that successfully hatched an egg compared to those whose egg failed to hatch. The pattern of male T secretion was typical for a species with high levels of male parental care and low male-male aggression, with T levels decreasing after the onset of incubation and then remaining relatively low up to chick fledging. Although not statistically significant, failed breeders had a tendency to have higher T levels than successful breeders.

- 5) Adult body condition and blood haemoglobin levels were measured throughout the breeding cycle. A body condition index (BCI) was calculated for each individual based on its body mass relative to structural size. The influence of BCI on hatching success was examined and interyear repeatability in BCI was assessed. There was no relationship between parental condition and egg hatchability. There was, however, a significant positive relationship between female body condition and egg volume and between male body condition and PRL level. There was also significant interyear repeatability in the body condition of both males and females.

- 6) Interannual variation in feeding frequencies and meal sizes were determined and the influence of parental body condition on provisioning rates was investigated. Mean meal sizes varied significantly between years, which suggest there are variations in food availability within Gould's petrel's foraging range. On average, foraging trips averaged approximately three days and chicks were fed every second day. Parents that went on longer foraging trips provided larger meals to their chicks. However, parents that went on shorter trips provided more food per day spent foraging, which suggests they were more effective foragers. Moreover, in 2001/02 when meal sizes suggest food was less abundant, parents that were in better body condition during incubation were the more efficient foragers. These results suggest that parental condition has an important influence on chick provisioning rates, especially when environmental conditions are suboptimal.
- 7) Interannual variations in chick growth and nestling blood haemoglobin accumulation were examined in relation to parental body condition. Chick mass and skeletal growth rate varied significantly between years. The mean age of fledglings was 90 ± 1 days in both years and fledging mass was 175 ± 2 g and 177 ± 2 g in 2001/02 and 2002/03, respectively. There was a significant positive relationship between the body condition of parents and the body condition of chicks at their peak mass (BCI_{pm}) of their chick. Parental body condition also influenced chick growth rate (g/day) and was inversely related to fledging age of the chick. There were significant positive interyear correlations between the body condition of chicks from the same parents.

Also, if parents produced a good quality chick in 2001/02 they were in relatively good body condition during incubation in 2002/03. Furthermore, these parents went on to again produce a good quality chick in 2002/03. These results suggest that good parental body condition is important for reproductive success and that certain parents are consistently able to acquire more resources that can be allocated to both self-maintenance and reproduction and are, consequently, better reproductive performers.

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