

Project: AFI 5/39

**THE PHYSIOLOGICAL AND ECOLOGICAL CORRELATES OF SUCCESSFUL REPRODUCTION IN THE
BLACK-BROWED ALBATROSS**

Principal Investigator: Professor Patrick Butler (University of Birmingham)

Co-Investigators: Dr Anthony Woakes (University of Birmingham),
Professor John Croxall (BAS),
Dr Richard Phillips (BAS)

Post-doctoral Research Assistant: Dr Alexander Kabat (University of Birmingham)

Location: Bird Island (South Georgia)

Rationale:

This study investigates the energetic factors that underpin the variation in long-term reproductive success in the black-browed albatross. Individual pairs of black-browed albatross (*Thalassarche melanophrys*) vary widely in their ability to successfully fledge a chick despite experiencing similar environmental conditions. Some of this variation in fecundity can be attributed to either increased age and experience or to differences in body size and condition. However, 20 years of reproductive data have shown that some breeding pairs are still inherently more likely than others to raise a chick to fledging age.

By careful application of a model incorporating data from long-term-monitoring of reproductive success, animals were allocated to a specific group depending on past breeding success. The energetics (foraging efficiency) of these selected animals will be investigated, during the over-winter (at-sea) and/or the reproductive season (chick-rearing period), to determine the underlying factors that influence the likelihood of successful breeding. By investigating the energy expended per unit foraging effort during the breeding season, compared with the quantity of resources that are partitioned directly to the chick, we will develop an index of relative parental investment. The energetic costs of long-distance migrations over the winter and the effects on body fat stores will also be examined. This approach will quantify the economics associated with different foraging strategies. Of particular interest will be the comparison of the energetics of birds that have tended to fail historically with those that are usually successful in rearing chicks. These data will also be compared to that from a closely related species, the grey headed albatross (*Thalassarche chrysostoma*), which is similar in many aspects of its ecology yet breeds biennially rather than annually (as in the black-browed albatross).

This study involves state-of-the-art technologies, which will, by remote sampling, allow the collection and comparison of relevant energetic and behavioural factors over an entire year. Using these technologies we will gain a better understanding of the individual variability in provisioning and migration strategies of these species in the field. Thus, we will determine which elements of the foraging strategy varies between pairs of black-browed albatrosses that leads to the striking disparity in reproductive success.

Highlights:

The proposed work load for the field season of November 2005 – April 2006 was ambitious, considering the large number of animals, remote field location and little or no technical support. However, the season went better than my wildest hopes. I successfully implanted:

- 24 heart rate loggers (to be retained for one year) into black browed albatross
- 10 heart rate loggers (to be retained for one year) into grey headed albatross
- 11 heart rate loggers for validation/calibration studies into black browed albatross
- 5 heart rate loggers for validation/calibration studies into grey headed albatross
- 9 heart rate loggers (for the breeding-season only) into black browed albatross
- 3 short-term behavioural loggers into black browed albatross

In addition, I successfully performed:

- 16 validations and calibrations of heart rates against metabolic rates on land for both black browed and grey headed albatrosses
- 16 validations and calibrations of heart rates against metabolic rates resting on water for both black browed and grey headed albatrosses
- 10 36-48 hour continuous respirometry studies examining metabolic rate and heart rates for both black browed and grey headed albatrosses
- 11 removal surgeries of heart-rate loggers used for validation/calibration in black browed albatross over a 10 day period
- 5 removal surgeries of heart rate loggers used for validation/calibration in grey headed albatrosses over a 10 day period
- 3 removal surgeries of short-term behavioural loggers from black browed albatrosses
- 63 sets of weights, full morphometric measurements and fat scores from black-browed albatrosses

Calibration and validation of the metabolic rate to heart rate relationship was a crucial aspect of the project, in order to ensure accurate estimates of foraging energy expenditure. This consisted of measuring metabolic and heart rates of both black browed and grey headed albatrosses during exercise on land, resting on land, and resting on water. It was also essential to perform 36-48 hour continuous recording of metabolic rates and heart rates in both species. These studies have allowed the correlation of heart rate recordings with known energy expenditure, as well as accurate estimation of daily metabolic circadian rhythms. This will allow us to understand the energy expenditure associated with field activity, including foraging.

Morphometric and body condition analysis has already demonstrated a strong relationship between adult levels of subcutaneous and peri-renal fat deposits and variation in survivorship of their chick. Current body fat levels and condition scores have also correlated well with long-term reproductive success. This suggests that body fat and condition may be important factors in determining fledging success. This emphasises the importance of determining which aspects of a particular foraging strategy provide increased foraging efficiency or economy.

This season I was also fortunate in the successful recovery of all but one of the loggers that were scheduled to be retrieved before the end of the breeding season. I am also looking forward to a high return rate for the loggers scheduled to be recovered next season. This season alone I have already amassed a large data set that will allow for extensive analysis and interpretation.

Surgically, the season could not have gone better. Of all the animals implanted, there were no more serious complications than post-operative vomiting. All animals recovered well from the surgeries and were monitored for several weeks post-operatively. There was no indication of any animals suffering from infection or harm from the procedure. All birds also returned to performing normal behaviours (e.g. preening, nest maintenance, flight) within hours of surgery. Upon removal of loggers, several days to months later, all incision sites were clean with virtually no scarring nor other signs of irritation. This not only means that the surgical protocol was the correct one, but that the data obtained from these animals will not be compromised by the surgical procedure.



A black Browed albatross meeting and bonding with its newly hatch chick for the first time, after returning from a foraging trip at sea.



Sunset from the new base over looking Fresh Water Beach