

Baywide Little Penguin Monitoring Program



Quarterly Report 3 (Oct-Dec 2008)

January 2009

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Introduction

The Channel Deepening Project Baywide Monitoring Program (CDBMP) for Little Penguins (*Eudyptula minor*) examines the body weight of Little Penguins at the Phillip Island Nature Park (PINP) colony. These penguins are known to make foraging trips of up to several weeks duration, sometimes travelling hundreds of kilometres from the colony. Approximately 40-70% of the birds from the colony enter Port Phillip Bay (PPB) to forage during the winter months.

The objective of this program is to detect changes in Little Penguin body mass (an indicator of health) outside expected variability. The key variable being measured is the body weight of Little Penguins. Weight is an indicator of body condition, and is closely related to the bird's food supply and foraging behaviour. Where changes occur outside expected variability, further investigation will be undertaken (PoMC 2008).

This report provides an analysis and ecological interpretation of data collected on the body weight of Little Penguins for the CDBMP as described in the Detailed Design (PoMC 2008), for the period October – December 2008.

Methods

Data for this program are collected using an Automated Penguin Monitoring System (APMS, Australian Antarctic Division) located in the Summerland Beach penguin colony, PINP. This system uses two main sensors:

- A weighbridge to measure the animal's weight as it crosses
- A Radio Frequency Identification (RFID) system to detect the identity of the animal via an implanted passive transponder (Kernerbone 2000).

Approximately 40% of the penguins in the study area currently have RFID tags. Data from the sensors are transmitted to a control cubicle, where data processing and storage occurs. The data are uploaded periodically to a computer via a local connection.

The population monitored by the weighbridge is a subset of the total population at Phillip Island. Penguins in the study site mostly use the same path across the foreshore to reach their nests. The weighbridge across this path captures the data on most of the penguins in the study site as they enter and leave the colony. The direction of travel is inferred from the time of day that the penguin crosses. The penguins at this site have been monitored using the weighbridge since 2001, providing a historical baseline dataset against which any changes can be assessed.

Statistical analysis

The raw data were compiled and filtered to remove non-target or spurious records. Spurious records included excessively high weights which generally result from two penguins crossing the weighbridge simultaneously or excessively low weights, which generally result from one bird stepping on as the other steps off. The analysis was confined to records of penguins entering the colony, in order to minimise variation introduced by weight loss during extended stays within the colony, therefore records of birds leaving the colony are not relevant. In summary, records were removed from the raw data if they included:

- Weight readings of $\leq 700\text{g}$ (indicates one bird stepping off as the following bird steps onto the platform)
- Weight readings of $\geq 1700\text{g}$ (indicates two birds on the weighing platform at the same time)
- A time stamp of between 1am local time and sunset the following night (indicating penguins leaving the colony).

There are 7926 individual weight records from October to December 2008. Daily average weights were calculated from the filtered data, and were then de-seasonalised to adjust for known seasonal variation in Little Penguin weight at the study site. The de-seasonalised average daily weight W_i^* was calculated by taking each daily average weight for the current study period W_i and adding the difference between the historical overall average \bar{W} and the historical average for the relevant week of the year $\bar{W}_{k(i)}$, i.e.:

$$W_i^* = W_i + \bar{W} - \bar{W}_{k(i)}$$

The historical average weights (weekly and overall) were calculated from data collected between June 2001 and early February 2008. A control chart was constructed to compare the Exponentially Weighted Moving Average (EWMA) of the de-seasonalised weight to a control limit, set at 2.5 standard deviations below the long-term average, which equates to 1018g (PoMC 2008). If the EWMA crosses the control chart limit, the average weight of birds in the colony is considered to have changed beyond natural variability.

In addition to the total weight data, the individually RFID marked penguins were used to provide separate control chart analyses for penguins known to be male (1750 records) and female (2080 records). These analyses are based on a smaller overall sample size, nevertheless the sensitivity of the test is similar to that for the overall population, and the analysis is considered useful (Emphron 2008). Control limits for females and males are 955g and 1069g respectively.

Results

For the reporting period October to December 2008, there was a high degree of fluctuation in the daily average weight of penguins coming ashore, however these weights are within expected variability based on historical data.

The EWMA of the de-seasonalised weights remained above the long-term average of 1187g for October and November, and dropped slightly below for most of December (Figure 1). No average weights were recorded below the EWMA control chart limit (1018g), further confirming the generally good condition of the birds throughout the reporting period.

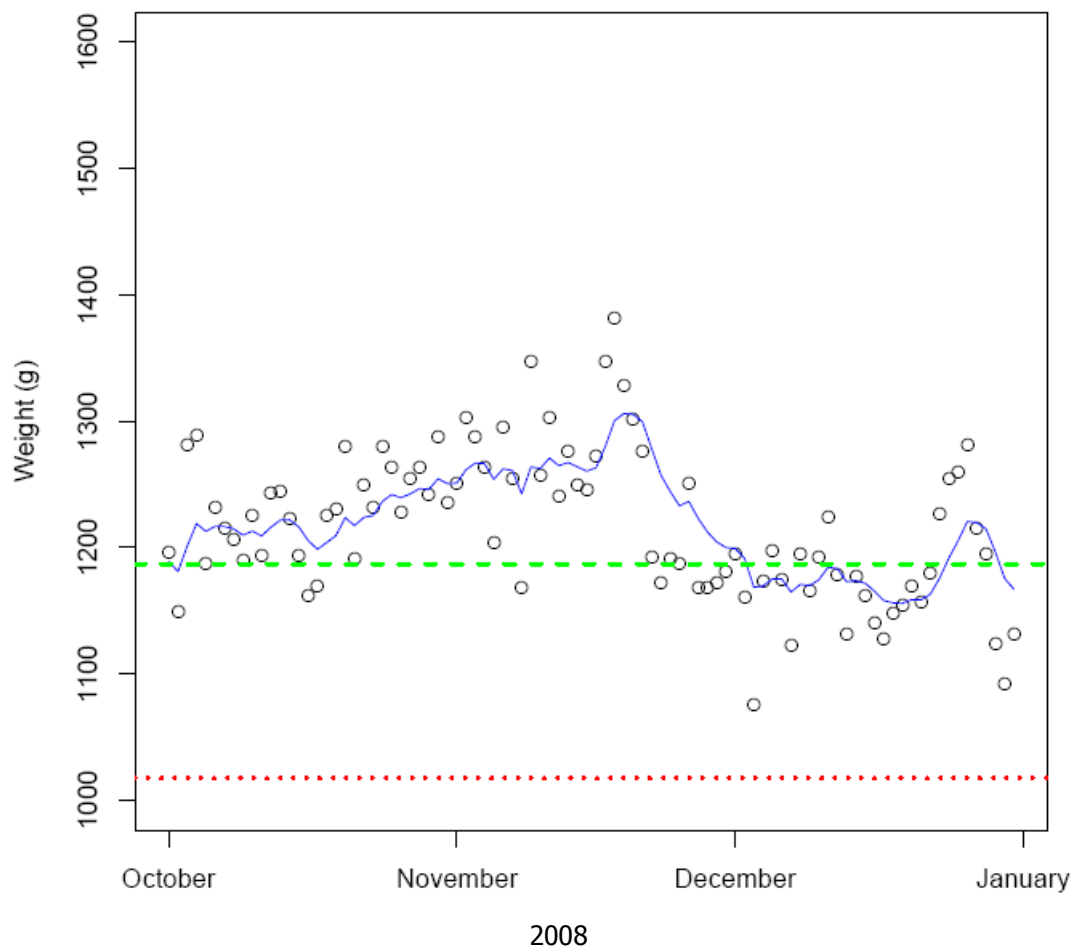


Figure 1. EWMA of de-seasonalised daily average weight of Little Penguins at PINP, 1st October to 31st December, 2008. The open circles indicate the mean daily weight; the blue line (solid) is the EWMA; the green line (dashed) is the target value of 1187g; the red line (dotted) is the control limit of 1018g (analysis prepared by Emphron Informatics Pty Ltd).

The same pattern emerged when considering males and females separately (Figure 2). The EWMA fluctuated above the long-term average weight of both female (1141g) and male (1275g) Little Penguins for October and November and was slightly below the average for much of December.

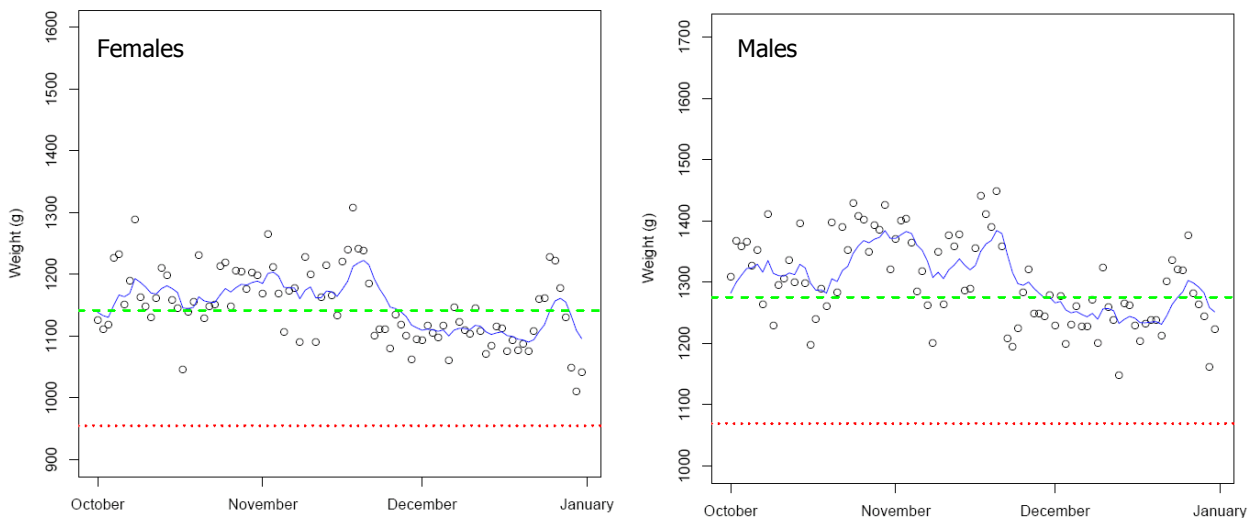


Figure 2. EWMA of de-seasonalised daily average weight for female and male Little Penguins from PINP, 1st October to 31st December, 2008. The open circles indicate the mean daily weight; the blue line (solid) is the EWMA; the green line (dashed) is the target value (long-term average) of 1141g for females and 1275g for males; the red line (dotted) is the control limit of 955g for females and 1069g for males (analysis prepared by Emphron Informatics Pty Ltd).

Discussion

Body weight fluctuates considerably according to the stage of the Little Penguin's annual breeding cycle (Dann et al. 1995). In general, moulting occurs during February-April, at which time penguins are unable to go to sea for at least 17 days, and therefore lose a considerable amount of weight. Renovation of burrows and courtship behaviour occurs during May-July, at which time birds forage at sea for long intervals and typically gain much of the weight that was lost during the moulting period. Mating can occur from August to October, with egg laying in September and October, followed by incubation lasting into December. Weight gain continues over this time, with parents alternating between incubation duties and feeding at sea. Chick feeding occurs from December into January, with parents continuing to feed at sea during the day, returning at night to feed the chicks. The variations in weight due to this annual cycle were removed from the data by de-seasonalisation, so they are not apparent in the figures.

During this current reporting period, penguins were laying and incubating eggs during October, and rearing chicks in November and December. There are two phases of chick-rearing: the guard-phase where one parent feeds during the day and returns at night to feed the chick while the other broods the young, followed by the post-guard phase where both parents feed at sea during the day, returning at night to feed the chicks. In December, most nests were in the post-guard phase, with many chicks having fledged.

The reduction in average weight during December is most likely due to a lack of food in close proximity to the penguin colony. To maintain good chick weights, adult penguins generally feed within 30-40km of the colony during the post-guard phase, returning to feed their chicks most nights (Hoskins et al. 2008). Satellite tagging of 14 birds during January however, has shown that some parents have undertaken trips lasting up five days or more, rather than the trips of one or two days that generally occur during this time (P. Dann, Phillip Island Nature Park, pers. comm.). As a result, chick weights at PINP have been reported to be variable, with some chicks having died

from starvation before fledging, whereas others having good fledged weights. This situation is not unique in that distribution of prey species such as pilchards and anchovies around Phillip Island vary significantly both between and within years (Hobday 1992). The number of fledged chicks per pair of adult birds remains close to the long-term average of one chick per pair.

Overall, the results for this reporting period indicate no evidence of a significant reduction in the de-seasonalised body weight of Little Penguins from PINP. All EWMA values are above the control limit, indicating no change in average weight outside of natural variability for Little Penguins from the PINP. Both males and females experienced favourable feeding conditions during October and November, followed by a slight decline in December.

Raw Data

- Missing data: nil
- Raw data are provided with this report electronically.

Exceptions

- None

References

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