Department of
Sustainability and
Environment

Baywide Little Penguin Monitoring Program

Quarterly Report 5 (Apr-Jun 2009)

July 2009

Victoria
The Place To Be

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Prepared by the Victorian Government Department of Sustainability and Environment
Melbourne, July 2009.

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Introduction

The Channel Deepening Project Baywide Monitoring Program (CDBMP) for Little Penguins examines the body weight of Little Penguins (*Eudyptula minor*) 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 April – June 2009.

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. Records were removed from the raw data if they included:

- Weight readings of ≤700g (indicates one bird stepping off as the following bird steps onto the platform)
- Weight readings of ≥1700g (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 3520 individual weight records from the period 1st April until 30th June 2009. 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 $\overline{W}$ and the historical average for the relevant week of the year $\overline{W}_{k(i)}$, i.e.:

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

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 (1028 records) and female (793 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 April through June 2009, 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 fluctuated above the long-term average of 1187g for April through to the end of June, with a general upward trend (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.

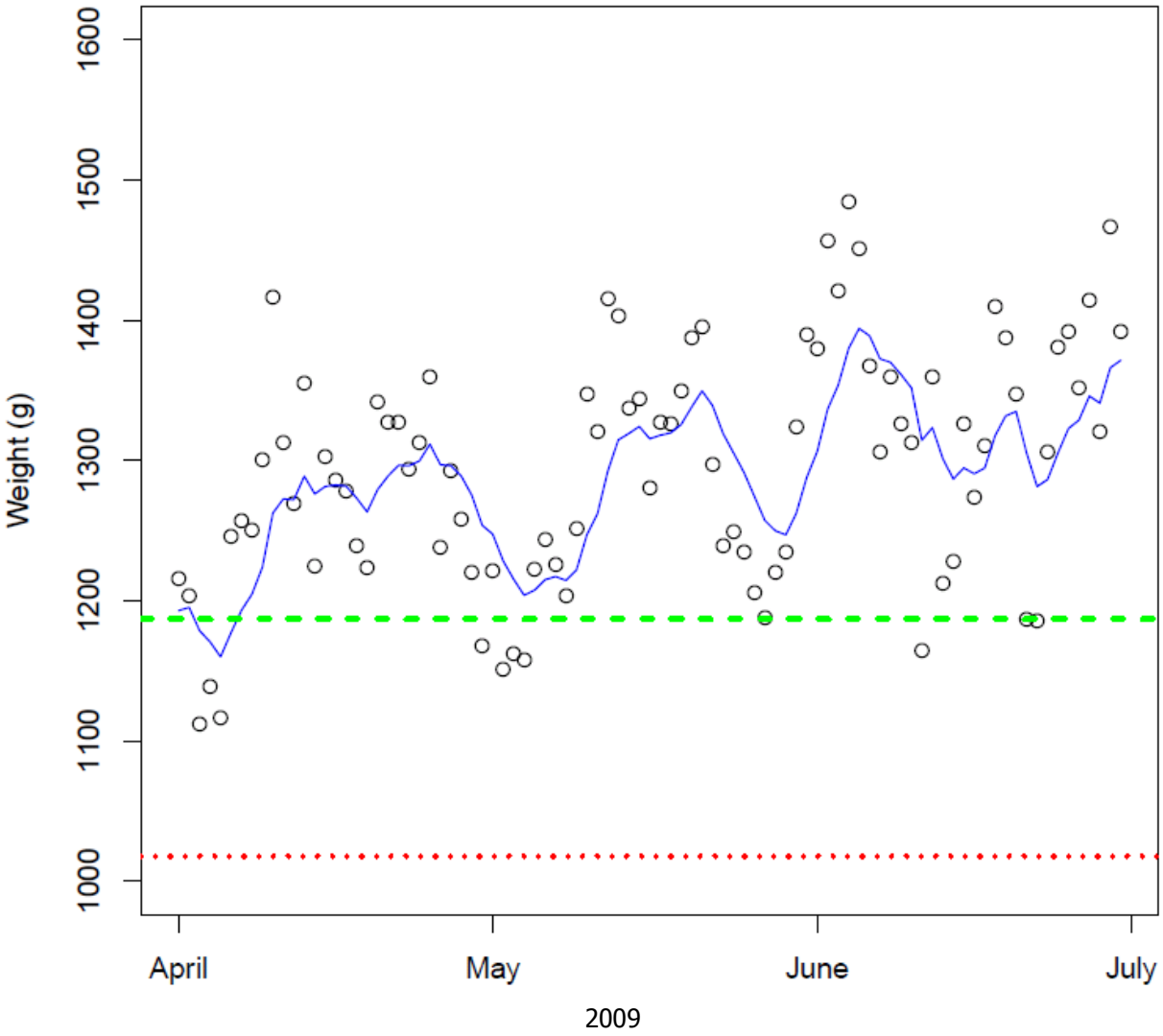

Figure 1. EWMA of de-seasonalised daily average weight of Little Penguins at PINP, 1st April to 30th June, 2009. The open circles indicate the mean daily weight; the blue line (solid) is the EWMA; the green line (dashed) is the target value of 1187g; and the red line (dotted) is the control limit of 1018g (analysis prepared by Emphron Informatics Pty Ltd).

The patterns for males and females are very similar over the period April through June 2009 (Figure 2). From early April onwards, the EWMA fluctuated above the long-term average weight for males (1275g) and females (1141g) respectively, with a generally increasing trend.

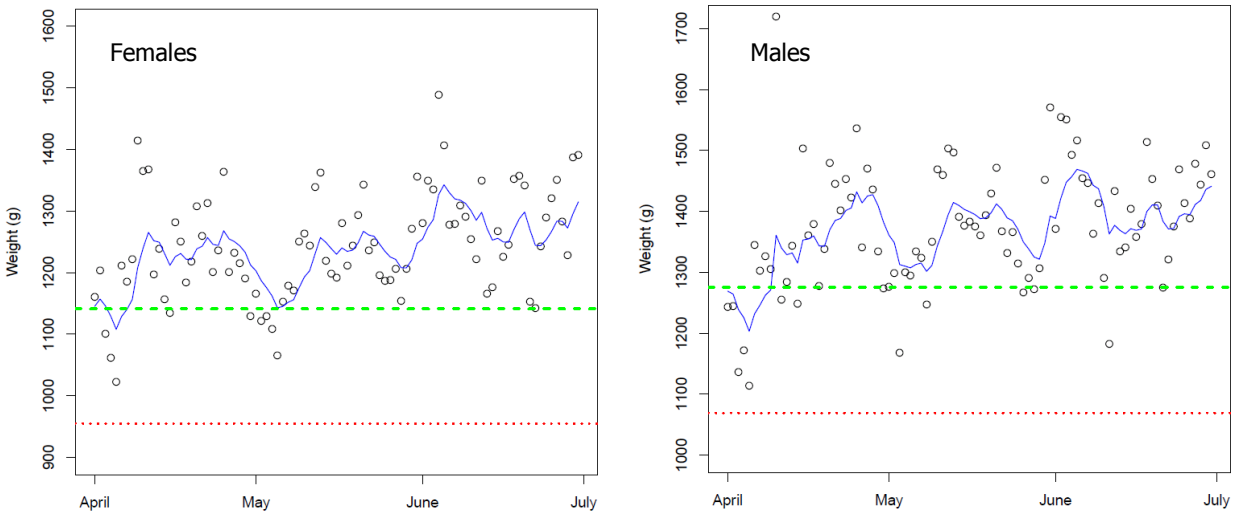

Figure 2. EWMA of de-seasonalised daily average weight for female and male Little Penguins from PINP, 1st April to 30th June. The open circles indicate the mean daily weight; the blue line (solid) is the EWMA; the green line (dashed) is the target value (long-term average) of 1141g for females and 1275g 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). Little penguin weights tend to remain relatively stable throughout the mating period (August – October), followed by an increase during the egg laying period (September – October) and incubation period (November – December). Maximum weights occur during chick feeding and subsequent fledging (January – February). 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. 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.

The moulting period this year was relatively synchronous compared to previous years, due in part to an earlier end to the breeding season. The peak moulting period this year was mid-March, with most penguins having finished their moult by mid-April.

After the moult, it is not uncommon for birds to be at sea foraging for extended periods of four weeks or more (Gormley & Dann 2009). The location and duration of winter foraging trips is primarily driven by the availability of food (Collins et al 1999). The main prey items of little penguins, such as pilchards (*Sardinops neopilchardus*) and anchovies (*Engraulis australis*), have a highly variable distribution both between and within years (Hobday 1992). Preliminary analysis of penguins that were fitted with satellite trackers indicate that the length of foraging trips in June 2009 was similar to penguins tracked in June 2008. Foraging locations were also similar, concentrated around areas to the south west of Phillip Island as well as Port Phillip Bay.

There has been a relative increase in average weights over the reporting time compared to the historical weight data. The average weights of little penguins for the same period in 2008 were also above the long-term average (DSE 2008). Penguins actively search for food during daylight hours while they are at sea (Chiaradia et al 2007). Given that little penguins forage with relatively consistent effort when at sea, relative weight increases are believed to be indicative of improvements in the availability of food rather than an increase in foraging effort.

Overall, the results for this reporting period indicate no evidence of a reduction in the de-seasonalised body weight of Little Penguins from PINP. All EWMA values are above the control limit, indicating no decrease in average weight outside of natural variability for Little Penguins from the PINP.

Raw Data

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

Exceptions

- None

References

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