Department of Sustainability and Environment

Baywide Little Penguin Monitoring Program

Data Report 1

May 2008

Victoria
The Place To Be

Baywide Little Penguin Monitoring Program
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Introduction

This report summarises data collected on the body mass of Little Penguins (*Eudyptula minor*) for the Channel Deepening Project Baywide Monitoring Program, for the period January to March 2008. The data were collected at Phillip Island Nature Park using an Automated Penguin Monitoring System (APMS, Australian Antarctic Division) located in the Summerland Peninsula penguin colony, Phillip Island, as described in the detailed design for the project (CDP_ENV_PR_020). The data are for penguins weighed as they arrived at the colony.

Data presentation

The raw data were filtered to remove irrelevant or spurious records. Records were removed if they included:

- a time between 1:00 am local time and sunrise (this indicates the penguin was probably leaving the colony); or
- a weight less than or equal to 700g (indicates one bird stepping off the weighbridge as another enters); or
- a weight greater than or equal to 1700g (indicates two birds on the weighing platform at one time).

The filtered weight records for each day were averaged ($63<n<162$, average sample size = 114), and these averages and their standard errors are plotted in Figure 1. The data in this figure was not standardised for natural seasonal variation in body weight.

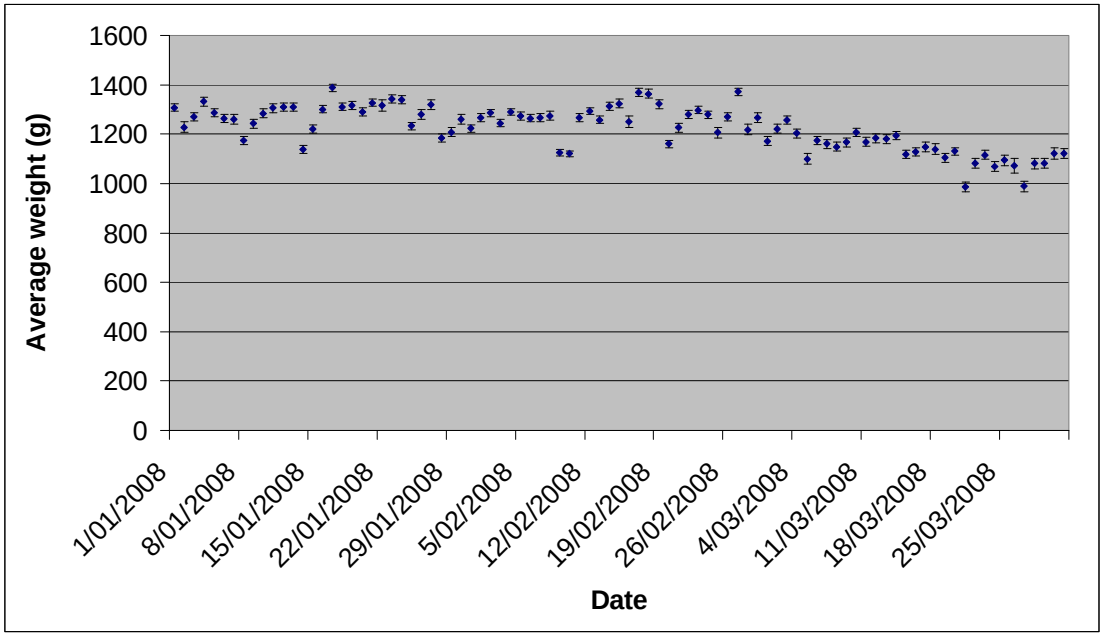

Figure 1. Average daily weight (±SE) of Little Penguins arriving at the Phillip Island study site between 1 January and 31 March 2008, collected using an APMS.

Statistical analysis

The statistical analysis is presented in the attached report (Emphron 2008), which is appended to this document. The analysis compared an Estimated Weighted Moving Average (EWMA) of de-seasonalised daily weight (to remove known seasonal fluctuations in Little Penguin weight) with a control value derived from historical data from 2002- Dec 2007. The analysis found no evidence of any reduction in de-seasonalised body weight, and all EWMA values were well above the control limit.

References

Emphron Informatics Pty Ltd 2008. Channel Deepening Project Baywide Monitoring Program: Little Penguin Progress Analysis (Attached to this report).

PoMC 2007. Little_Penguins_Detailed_Design CDP_ENV_PR_020. Port of Melbourne Corporation. Published on www.channelproject.com/environment/monitoring.asp

Channel Deepening Project Bay-Wide Monitoring Programme

Little Penguins Progress Analysis

Emphron Informatics Pty Ltd **www.emphron.com**

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1 Introduction

The Port of Melbourne Channel Deepening Project has instigated a bay-wide monitoring programme to provide information on the status of key species, habitats and ecological processes in the bay. Their objectives are to detect changes outside of expected variability. The expected variability includes both natural fluctuations and anticipated CDP- related changes as predicted in the Supplementary Environment Effects Statement (SEES) risk assessment.

The results of the bay-wide monitoring programs will be reviewed quarterly as part of the bay-wide monitoring report. This review will provide a 'snap shot' of the status of the bay as a whole. This information will be incorporated into the six monthly environmental management reviews.

Little penguin monitoring is an important component of the bay-wide programme. The stated aim of the penguin component of the Channel Deepening Project bay-wide monitoring programme is to:

> *"Detect changes in Little Penguin body mass (an indicator of health) outside expected variability"*

This report summarises the results of the first quarter's data from the little Penguin monitoring programme.

Data were supplied to Emphron Informatics in a file labelled "PINP Little Penguin Data 2001-2008 (including sex, flipper length, breeding).txt". The MD5 cryptographic digest [1] of the file was 743d9a53af17d3007d5cc8f00c876691. Data are available of the weight of individual penguins from the period 1st January 2008 until 31st March 2008. There are 8,623 individual weight records. Each weight record is obtained from an automatic weighing platform. The software driving data capture on the platform supports a number of data cleaning processes (such as recognition of multiple penguins on the platform), but these processes are outside of the scope of this report.

2 Data Processing and Transformation

There are some issues associated with data format. Not all the records have the same number of fields. Some records lack individual penguin identifiers, flipper lengths and sex fields. Other records appear to have an extra field. Nevertheless, the date, time and weight fields were unambiguous on all records except one. This one ambiguous record was excluded from analysis.

Daily mean body weight was calculated for each of the 91 days in the period. Daily body weight was then de-seasonalised as follows:

$$W_i^* = W_i + \bar{W} - \bar{W}_{k(i)}, \tag{1}$$

where W_i^* is the deseasonalised weight for day i, W_i is the mean weight of day i, $\bar{W}$ is the overall mean weight for all historical records, and $\bar{W}_{k(i)}$ is the historical mean weight for week of the year $k(i)$ - the week of the year in which the i^{th} sample was taken. Historical weights (weekly and overall) were calculated using data from June 1st 2001 until December 31st 2007.

3 Calculation of EWMAs

Exponentially weighted moving averages [1] were calculated using the procedures described in the detailed design document. The target was set at 1195g, with a control limit of 1021g. The control limit was obtained using an EWMAST procedure [2]. The λ parameter was set at 0.2. Individual days EWMA values are shown in Table 1, and are charted in Figure 1. The red line in Figure 1 represents the control limit. Open circles represent daily mean weight (g) and the blue line represents the EWMA.

There is no evidence of any reduction in de-seasonalised body weight, and all EWMA values are well above the control limit.

[1] The MD5 cryptographic digest is an electronic 'signature' of the file. Changing a single character will result in an unpredictable change to the digest. Whilst not suitable for high security purposes it provides an excellent quality assurance tool for ensuring that file contents have not changed.

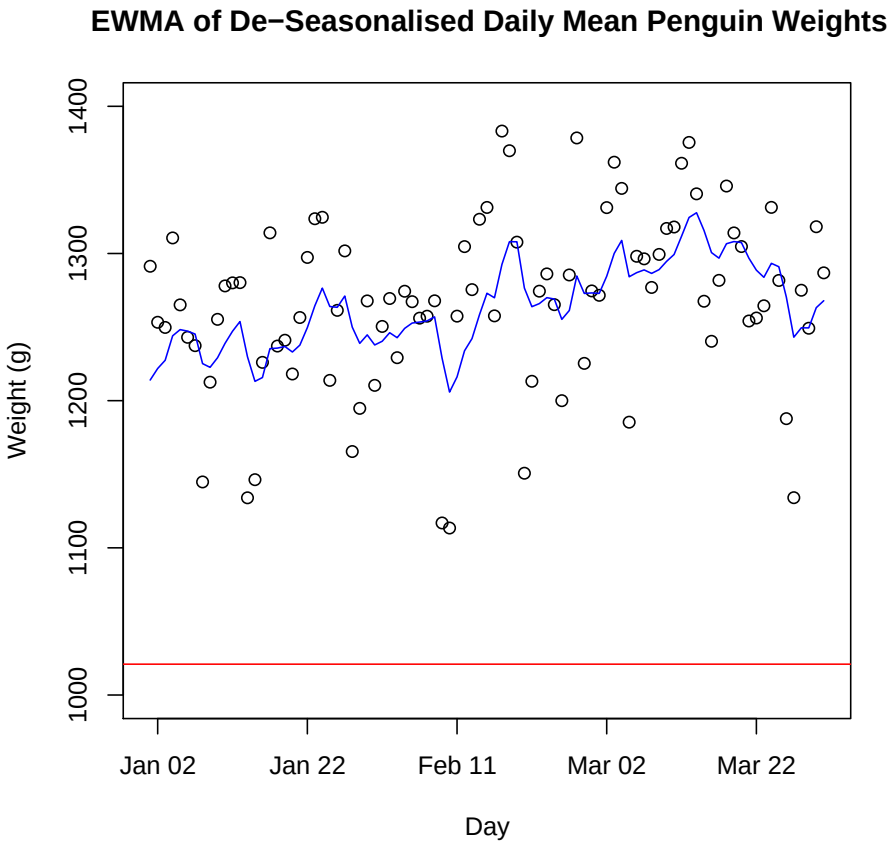

Figure 1: **EWMA and Weight by Date.** The red line represents the control limit. Open circles represent daily mean weight (g) and the blue line represents the EWMA.

Table 1: Mean Weight and EWMA by Date

Date	Mean Wt (g)	EWMA (g)
2008-01-01	1291.34	1214.00
2008-01-02	1253.27	1221.86
2008-01-03	1249.76	1227.44
2008-01-04	1310.59	1244.07
2008-01-05	1265.09	1248.27
2008-01-06	1243.07	1247.23
2008-01-07	1237.40	1245.27
2008-01-08	1144.78	1225.17
2008-01-09	1212.57	1222.65
2008-01-10	1255.27	1229.17
2008-01-11	1277.97	1238.93
2008-01-12	1280.05	1247.16
2008-01-13	1280.22	1253.77
2008-01-14	1134.01	1229.82
2008-01-15	1146.32	1213.12
2008-01-16	1226.04	1215.70
2008-01-17	1314.04	1235.37
2008-01-18	1237.11	1235.72
2008-01-19	1241.07	1236.79
2008-01-20	1218.13	1233.06
2008-01-21	1256.51	1237.75
2008-01-22	1297.33	1249.66
2008-01-23	1323.63	1264.46
2008-01-24	1324.60	1276.49
2008-01-25	1213.79	1263.95
2008-01-26	1261.38	1263.43
2008-01-27	1301.78	1271.10
2008-01-28	1165.45	1249.97
2008-01-29	1194.77	1238.93
2008-01-30	1267.78	1244.70
2008-01-31	1210.40	1237.84
2008-02-01	1250.44	1240.36
2008-02-02	1269.42	1246.17
2008-02-03	1229.22	1242.78
2008-02-04	1274.35	1249.10
2008-02-05	1267.26	1252.73
2008-02-06	1256.06	1253.40
2008-02-07	1257.39	1254.19
2008-02-08	1267.86	1256.93
2008-02-09	1116.91	1228.92
2008-02-10	1113.47	1205.83
2008-02-11	1257.45	1216.16
2008-02-12	1304.69	1233.86
2008-02-13	1275.45	1242.18
2008-02-14	1323.27	1258.40
2008-02-15	1331.30	1272.98

Table 1: Mean Weight and EWMA by Date Continued

Date	Mean Wt (g)	EWMA (g)
2008-02-16	1257.62	1269.91
2008-02-17	1383.20	1292.57
2008-02-18	1369.84	1308.02
2008-02-19	1307.72	1307.96
2008-02-20	1150.71	1276.51
2008-02-21	1213.17	1263.84
2008-02-22	1274.40	1265.95
2008-02-23	1286.14	1269.99
2008-02-24	1265.26	1269.04
2008-02-25	1200.01	1255.24
2008-02-26	1285.41	1261.27
2008-02-27	1378.51	1284.72
2008-02-28	1225.35	1272.85
2008-02-29	1274.57	1273.19
2008-03-01	1271.59	1272.87
2008-03-02	1331.18	1284.53
2008-03-03	1362.04	1300.03
2008-03-04	1344.24	1308.88
2008-03-05	1185.40	1284.18
2008-03-06	1298.11	1286.97
2008-03-07	1296.38	1288.85
2008-03-08	1276.94	1286.47
2008-03-09	1299.39	1289.05
2008-03-10	1317.02	1294.65
2008-03-11	1318.00	1299.32
2008-03-12	1361.32	1311.72
2008-03-13	1375.48	1324.47
2008-03-14	1340.54	1327.68
2008-03-15	1267.57	1315.66
2008-03-16	1240.35	1300.60
2008-03-17	1281.76	1296.83
2008-03-18	1345.84	1306.63
2008-03-19	1313.99	1308.10
2008-03-20	1304.74	1307.43
2008-03-21	1254.16	1296.78
2008-03-22	1256.17	1288.65
2008-03-23	1264.47	1283.82
2008-03-24	1331.35	1293.32
2008-03-25	1281.68	1291.00
2008-03-26	1187.79	1270.36
2008-03-27	1134.10	1243.10
2008-03-28	1275.03	1249.49
2008-03-29	1249.22	1249.44
2008-03-30	1318.19	1263.19
2008-03-31	1286.86	1267.92

References

[1] J. M. Lucas and M. S. Saccucci. Exponentially weighted moving average control schemes: Properties and enhancements. *Technometrics*, 32(1):1–12, 1990.

[2] N. F. Zhang. A statistical control chart for stationary process data. *Technometrics*, 40(1):24–38, 1998.