7 July 2011

Mr R. Harding
Manager – Marine Conservation Services
Department of Conservation
P. O. Box 10-420
Wellington
via email: rharding@doc.govt.nz

Dear Russell,

Comments on *POP2010-01 DRAFT annual report sea lions Auckland Islands.pdf*

Thank you for the opportunity to provide written comments on the above report, by Chilvers and Wilkinson, which was circulated by email on 20 June 2011 for the CSP-TWG meeting on 21 June 2011. Together with my letter of 5 May 2011, I am happy for these comments to become part of the record of the relevant meetings.

Chilvers & Wilkinson cite Kinsey (2011), the report of the DOC representative on the Otago University Trip to the Auckland Islands, 13th January to 26th January 2011. As such reports are not generally available, please could you arrange for this report to be circulated to the TWG members via the CSP website?

Our comments are in three parts. First, we provide editorial-type comments on the report. Second, we discuss whether the late estimate at Dundas is comparable with previous estimates, initially with reference to the arguments presented by Chilvers & Wilkinson and then with reference to other considerations. Third, we list some general points of relevance to the sea lion pup estimation and its data.

EDITORIAL

- **Editing:** the whole document should be proofread carefully: see, for instance, the second sentence of the second paragraph in the abstract.

- **Reported uncertainty:** The document is still reporting the uncertainty (plus and minus s.e.) on the total pup production, but this s.e. is estimated with reference to pups alive at date of estimation; the uncertainty applies to that estimate, not the total estimate, which has an unknown additional component. The difference can be seen in the multiple M-R estimates from Dundas in 2002 (shown below in Table 2). The standard deviation of the five live pup estimates is 37.5, which compares well with the average of the standard errors estimated by the surveys (35.8). The standard deviation of the total pup estimates is 48.9, which is 30% larger than for the live pups. This illustrates that the s.e. is misleading when applied to the total pup estimate.

- **Page 5:**
    - **pups marked**: Numbers are shown in the appended data as 148 (not 150) at Sandy Bay and 199 (not 200) at Dundas;

- **first unnumbered equation:** (equations should be numbered) this equation is not well-formed because of the error (= vs. +); also, the *i* should all be subscripts as in P_i above;
- **second unnumbered equation:** the P should be $\overline{P}$ for clarity;
- **third unnumbered equation:** use P_i and $\overline{P}$ as above;
- **missing equation:** there should be an equation for the combined standard error estimates.

- **Table 1:**
  - the table begins in 1998/99; it should begin in 1994/95;
  - the value for pups alive at Sandy Bay 2011 is incorrect;
  - The value reported for Dundas for 2010 should be 1369 as in the 2010 report and as in the April progress report; 1369 is the correct value from the correct data supplied last year.

- **Appendix 2:** for Dundas 21 January 2010, the number of pups marked should be 389 not 387.

- **Table 2:**
  - the total for 2009/10 should be 1814, sum alive should be 1631;
  - the %annual change from 2010 to 11 should be 14.6%, not 15%; values in this column should all have one decimal place; the value for 03/04 is not correct; other values seem incorrect: note that calculations in this table should be based on pup numbers rounded to whole numbers;
  - similarly for the mortality figures.

- **Consistency of tables and text:** after cleaning up the tables, the authors should make the various values given in the text match them.

- **Acknowledgements:** Breen should be removed; he did not do what is implied.

CORRECTION FACTOR EXPLORATION

The pup estimation has been made at almost the same time each year because of a belief that the results are sensitive to the timing: see for instance Wilkinson et al. (2003). That belief would tend to suggest that an estimate from three weeks later might be an under-estimate, and would suggest that a late estimate should be treated with appropriate caution. The report does not present any such discussion. Instead, the authors argue that the late estimate is comparable with those from previous years, and they do this by cobbling together arguments based on a variety of data, some of which are new to the Technical WG.

It would be better for the report to approach this question more objectively, to discuss the issue with reference to the literature and, where basing arguments on data, to present all the data. The late count must be examined critically with respect to whether it is a reliable count.

The arguments made by the authors are (quotations in italics):

1) **proportion dead:** the proportion of dead pups on 6 February 2011 and 21 January 2010 were similar, thus *these indicate that there was no mass dispersal of live pups from Dundas*

in 2011 which would have resulted in a higher ratio of dead to remaining live pups. However, the proportion of dead pups at Dundas shows a lot of interannual variation (see Table 1). Discarding the highest years because of epizootics, the variation is from 4.7% to 14.7%, a three-fold difference. No inference about dispersal can be made from the proportion of dead pups.

Table 1: annual mid-January pup mortality at Dundas

	total	**live**	**dead**	**Dundas % dead**
1995	1837	1603	234	12.7%
1996	2017	1810	207	10.3%
1997	2260	2083	177	7.8%
1998	2373	1748	625	26.3%
1999	2186	1957	229	10.5%
2000	2163	2039	124	5.7%
2001	2148	1802	346	16.1%
2002	1756	1395	361	20.6%
2003	1891	1555	336	17.8%
2004	1869	1749	120	6.4%
2005	1587	1513	74	4.7%
2006	1581	1349	232	14.7%
2007	1693	1587	106	6.3%
2008	1635	1512	123	7.5%
2009	1132	1065	67	5.9%
2010	1369	1218	151	11.0%

2) **pups at Kekeno:** it is argued that Kekeno is the closest place for mothers with pups to disperse; only 8 pups were seen at Kekeno; therefore *indicating that mother pup movements away from Dundas Island had been very low or only just begun*. The observation of 8 pups at Kekeno certainly suggests that dispersal away from Dundas must have started. There is no way of knowing how many animals had dispersed or where they went; it cannot be claimed with any confidence that only 8 mothers with pups had dispersed.

3) **2010 Dundas counts:** in 2010 two mark-recapture (M-R) estimates were made at Dundas: 1337 total on 13 January and 1369 [using the correct value] on 21 January. The similarity of these estimates, made 3 days before and 5 days after the postulated peak at 16 January, can shed no light on the amount of dispersal by 6 February, three weeks after the peak.

4) **2002 multiple estimates:** data are presented (for the first time) on multiple M-R estimates made at Dundas between 21 and 29 January 2002 (Table 2), showing no decrease in the estimates over that period, as shown in the table below.

   The table shows limited change between 23 and 29 January, at least in 2002 (see the annual variability in counts at Sandy Bay in Wilkinson et al. 2003), but it does not shed much light on how much dispersal would have occurred by 6 February.

Table 2: multiple M-R estimates of pups at Dundas in January 2002

2002	live	s.e.	dead	total
21-Jan	1395.3	30.5	361	1756
23-Jan	1467.9	43.8	366	1834
25-Jan	1473.9	27.5	366	1840
27-Jan	1458.9	30.4	395	1854
29-Jan	1494.6	46.9	395	1890

Additional data: There is additional information that bears on the reliability of counts and estimates over time. Wilkinson et al. (2003) present a figure (their Figure 3) showing serial counts over time in several years at Sandy Bay. This shows a dramatic decline in pups counted after the peak in mid-January. Counts are arguably less efficient than the M-R estimates, but the trends will be similar.

Wilkinson (unpublished report to the modelling Technical WG, 2000) showed serial counts at Dundas in several years. He suggested they peak near 16 January. He fitted polynomials that obviously reflected a prediction that the pattern of counts made over time would be similar to that at Sandy Bay, as shown in Figure 1.

The pattern of pup counts or pup estimates over time during the season at Dundas is obviously not known: the requisite serial counts or estimates have not been made. Decline by early February, as at Sandy Bay, is a possibility. If arguments are to made about this, they should be based on an analysis of all the data.

Mixing: The M-R protocol is to mark pups one day and count the marked and unmarked pups the next day. In 2011 at Dundas, marking and counting were done on the same day (the report should state how long the interval was). A very important assumption of the method is that marks become well mixed within the population to be estimated. It seems likely that mixing over a period of hours will be less complete than mixing over a whole day, especially for any peripheral animals. There is no experimental evidence to show that mixing is rapid. Incomplete mixing would lead to under-estimation of the population actually present on the day.

Chilvers et al. (2007) also comment on the desirability of timing "recapture" operations for a time when pups are not clumped in "pup piles". The extent to which this was achieved in 2011 is not documented, although it is stated that the pups were "mobile". Reporting (for all counts made) the number of pups that could not be classified as either marked or unmarked may be the best approach to quantifying this issue.

Sandy Bay vs. Dundas: The trends in pup counts tend to be the same at the two main rookeries. Figure 2 shows the estimated pup production at these two rookeries: the correlation is 86%. Figure 3 shows the annual change for both rookeries: the correlation is 80%. Estimates at the two rookeries usually show the same trend, although there is some variation. The difference in annual change is largest for 2011. This is what one would expect if the 2011 estimate at Dundas were an under-estimate.

We conclude that the 2011 late estimate at Dundas needs to be treated cautiously: it may be an underestimate because of dispersal after the peak near 16 January. The report should discuss this objectively instead of trying to find reasons that the 2011 estimate is comparable with those made earlier in the year.

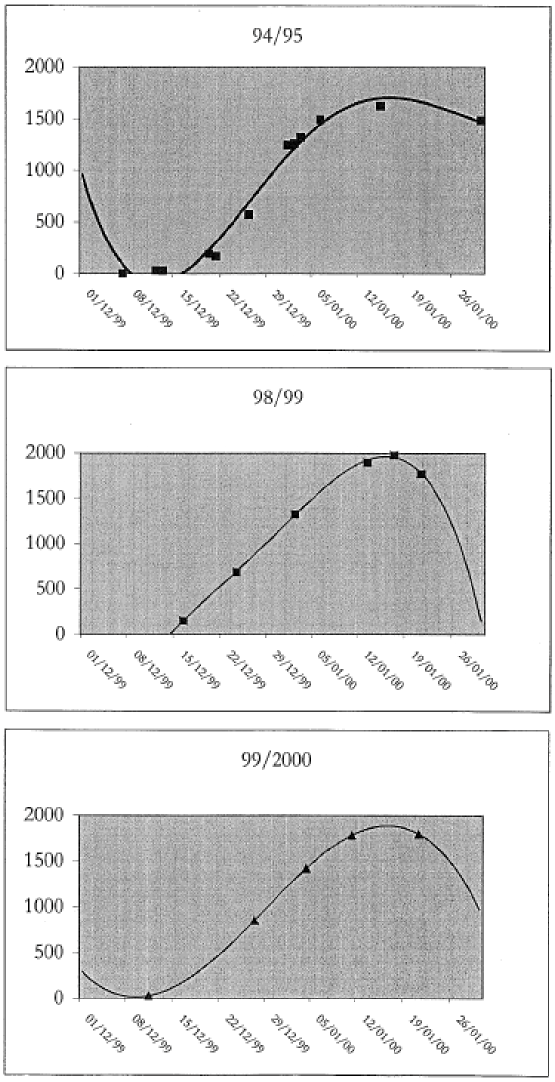


Figure 1: serial pup counts at Dundas in the years indicated, with a fourth-order polynomial relation fitted (from Wilkinson, 2000).

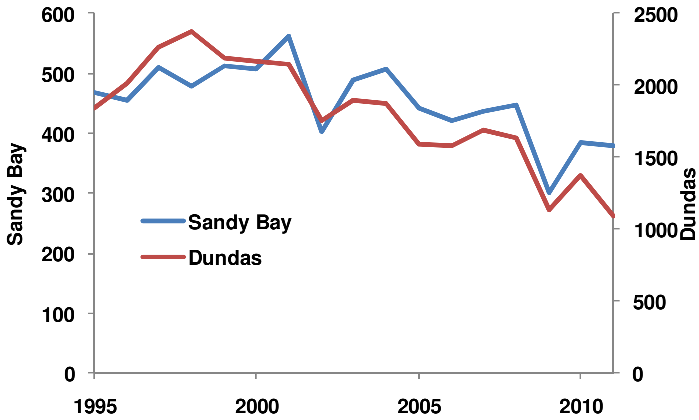


Figure 2: pup production estimates at Sandy Bay and Dundas rookeries: note the different y-axes.

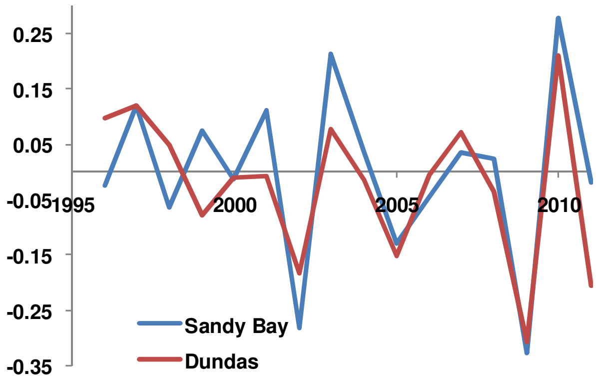


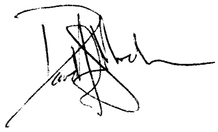
Figure 3: annual changes in pup production estimates at Sandy Bay and Dundas rookeries.

RELATED ISSUES

Independent validation of earlier estimates: Handling of the mark-resightings data suggests that independent validation is necessary. SeaFIC has been provided the marked/unmarked data for 2005 through 2011 and has verified the estimates and their s.e. estimates, but this needs to be done for the 1995 through 2004 estimates. Given the confusion this year about the 2010 Dundas data, the verifying party should verify the data against original records. Verified numbers should be made available to the Technical WG.

Unpublished data: In 2010 it became apparent that more than one M-R estimate had been made at Dundas; this was not reported in the documentation. In 2011 it became apparent that more than one M-R estimate had been made at Dundas in 2002; this had not been reported anywhere. There is information in these estimates that is relevant to interpreting the results as a whole: for instance, the 2002 series provides information on the precision. All counts and verified M-R estimates should be made available to the Technical WG, and ideally should be published in the equivalent of the MFish Aquatic Environment and Biodiversity Report series.

Yours sincerely,



Dr. David A.J. Middleton

Dr. Paul A. Breen

cc. Igor Debski, CSP; Jeremy Helson, MFish

REFERENCES

Chilvers, B.L., Wilkinson, I.S., and Childerhouse, S. (2007). New Zealand sea lion, *Phocarctos hookeri*, pup production — 1995 to 2006. New Zealand Journal of Marine and Freshwater Research, 41: 205–213.

Wilkinson, I. (2000). New Zealand sea lion pup counts. Report for the New Zealand sea lion Technical Working Group, 8 June 2000. (Wilkinson et al. 2003 cite a 7 July 2000 update).

Wilkinson, I., Burgess, J., and Cawthorn, M. (2003). New Zealand sea lions and squid: managing fisheries impacts on a threatened marine mammal. Pages 192 – 207 in Gales, N., Hindell, M. and Kirkwood, R. (eds.) Marine Mammals: Fisheries, Tourism and Management Issues. Melbourne, CSIRO Publishing.