FINAL REPORT

CSP Project 4522 New Zealand sea lion ground component 2013/14

BPM-14-Final report for CSP project 4522 NZ sea lion ground component 2013-14 v1.1

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BLUE PLANET MARINE

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1. Executive Summary

Blue Planet Marine (BPM) was contracted by the Conservation Services Programme (CSP) of the Department of Conservation (DOC) to provide services for CSP Project 4522 – New Zealand sea lion ground component for the 2013/14 summer field season. The field component of the work was undertaken from January 6 until 11 March 2014 and was completed successfully. This report provides a summary of the work completed. In summary:

- New Zealand sea lion monitoring was undertaken between 9 January and 9 March 2014 at Figure of Eight Island (n=1d), Dundas Island (n=3d) and Enderby Island (n=59d) in the Auckland Islands group. The research closely followed previously used methodology with a few minor exceptions (e.g. monitoring at Dundas Island was 2 days earlier than previously). Overall, the research went well and achieved all stated objectives.
- Pup production was estimated for New Zealand sea lion colonies at Sandy Bay (n=290), Dundas Island (n=1,213), Figure of Eight Island (n=72) and South East Point (n=0) with total pup production for the Auckland Islands in 2013/14 estimated as 1575. This total represents an 18% decline on the estimate from 2013 and is the third lowest total pup production recorded for the Auckland Islands.
- 711 pups were double flipper tagged at Sandy Bay (n=287), Dundas Island (n=400), Figure of Eight Island (n=24) and South East Point (n=0) up until 20th January 2014.
- A total of 11,076 individual tag, brand and micro-chip resightings were made during the field season. Most of the resighting records were from tags (n=9,982; 90%) with brand and micro-chip resighting comprising approximately 5% each (n=530 and 560 respectively). This season represents the highest ever number of resighting records collected; five times more than in 2012/13 and 1.4 times more than the previously highest season in 2002/03 (2012/13 = 2,262; 2011/12 = 6,914; 2002/03 = 8,139). Most resightings (99%) were collected on Enderby Island and most (95%) of these at Sandy Bay.
- Preliminary estimates of pup mortality to the date of the mark recapture are comparable to previous 'non-epidemic' years with the caveat that these figures do not represent full season surveys as in previous years and so should be viewed as a minimum. Pup mortality estimates to the date of the mark recapture are: Sandy Bay 2%, Dundas Island 6% and Figure of Eight Island 14%. Total pup mortality to 8 March was 73 pups. Data on the cause of death were not included as a deliverable of the DOC CSP contract but this work was undertaken independently by Massey University and Deepwater Group Ltd. It will be reported separately.
- Mean pup weights at Sandy Bay were 5% lower than 2012/13 for males and females. Mean pup weights at Dundas Island were 8% and 5% lower than 2012/13 for males and females respectively.

2. Introduction

Blue Planet Marine (BPM) was contracted by the Conservation Services Programme (CSP) of the Department of Conservation (DOC) to undertake CSP project 4522 – New Zealand sea lion ground component for the 2013/14 summer field season. This is the final report for the project.

The project objectives were:

- To estimate New Zealand sea lion pup production at Enderby, Figure of Eight and Dundas Islands;
- To mark New Zealand sea lion pups at Enderby and Dundas Islands following established techniques; and
- To conduct a five-week period of resighting previously marked animals at Enderby Island.

3. Methods

A full description of methods used in this field study are available in Childerhouse (2013), which is available from the CSP website and the author upon request. The research outlined here follows almost exactly the same methods as undertaken previously by DOC and as described in Chilvers (2012) and with reference to the aerial survey methods in Baker *et al*. (2012).

The 2013/14 survey was very similar to that undertaken in 2012/13 (Childerhouse et al. 2013) but was quite different from surveys prior to 2012/13 (e.g. Chilvers 2012). The major differences with surveys prior to 2012/13 included:

- Reduced team size (6 to 4);
- Reduced field season (e.g. planned 6 weeks rather than 12 weeks; 10 January – 23 February 2014) however the field season was extended until 9 March 2014 for additional monitoring of a potential pup mortality event;
- Dundas mark-recapture estimate undertaken two days earlier than previously (i.e. 19 January rather than 21 January) for logistical efficiency at the request of DOC and agreed to by the CSP Technical Working Group; and
- Helicopter, rather than boat, transport for Dundas survey.

During the planned field season (i.e. 10 January – 23 February 2014) the team varied between four and five sea lion researchers who undertook the CSP work with two researchers remaining until 9 March 2014. In addition, a wildlife vet was present for the entire period and undertook independent research funded by Massey University and Deepwater Group Ltd.

4. Results

4.1 Logistics

The team assembled in Bluff on 4 January 2014 and, following discussions with the Master of *RV Tiama*, decided to leave one day earlier for the Auckland Islands than originally planned in order to benefit from a more favourable weather window. The team departed on 6 January rather than 7 January. A summary of key dates:

- 6 January – departed Bluff aboard *RV Tiama* for the Auckland Islands;
- 8 January – Arrived Carnley Harbour, Auckland Islands;
- 9 January – Surveyed Figure of Eight Island;
- 10 January – Arrived at Enderby Island and dropped the team off;
- 24 February – Two team members departed for the mainland;
- 9 March – Remaining team members departed Auckland Islands for mainland; and
- 11 March – arrived Bluff.

The field work included 59 days on Enderby Island, 3 days on Dundas Island and 1 day on Figure of Eight Island.

The field team comprised experienced NZ sea lion researchers: Dr Simon Childerhouse, Dr Derek Hamer, Andy Maloney, David Donnelly and Dr Natalie Schmitt. In addition, Sarah Michael from Massey University joined the team to undertake autopsies of dead New Zealand sea lion adults and pups. She was funded by Massey University and the Deepwater Group Ltd. As this work is not part of the CSP contract, it is not reported here. Michael also helped with other aspects of the CSP work programme when not involved in her autopsy work.

The size of the field team varied throughout the season (e.g. 11-23 January 5 people; 24 January – 23 February 4 people; 24 February – 7 March 3 people). Childerhouse returned to the mainland on 22 January and Hamer led the team from that time. Maloney and Donnelly returned to the mainland on 24 February and Hamer, Schmitt and Michael returned to the mainland on 9 March. The team worked very well and achieved all the required tasks.

4.2 General approach and timing of field work

As stated previously, these results follow the methodology previously described in Childerhouse (2013) unless otherwise stated. In order to maintain consistency in data collection, the team planned to conduct work on the same key dates used for previous surveys:

- Figure of Eight Island – the aim was to undertake a pup census on 10 January, however, unfavourable weather predictions for the date of departure to Figure of Eight Island resulted in the team leaving one day earlier than planned. The census was, therefore, undertaken one day earlier (9 January rather than 10 January). It is unlikely that this will cause comparability issues with previous surveys as the dates for counts at Figure of Eight Island have varied considerably over the years;
- Sandy Bay, Enderby Island – the mark-recapture was undertaken on 15 (marking) and 16 (recapture) January as planned.
- Dundas Island – the mark-recapture was undertaken on 18 (marking) and 19 (recapture) January as planned. This was two days earlier than the surveys have been undertaken previously due to a reqruiement to coordinate with the available helicopter for transport to and from Dundas island. This change was agreed by the CSP Technical Working Group.

4.3 Estimates of pup production

Annual estimates of pup production for each colony and for total Auckland Islands pup production from 1994/95 until 2013/14 are shown in Appendix 1. Figures showing annual estimates for pup production by colony and overall are shown in Appendix 2.

4.3.1 Sandy Bay, Enderby Island

Table 1: Summary of pup production estimates for Sandy Bay for 2013/14.

Method	Date	Start/end time	No. of counts	Estimate (SE)
Mean direct live count	16 Jan	09:23/10:43	9	273 (5.0)
Cumulative dead count to the day of the mark-recapture	16 Jan	09:23/10:43	1	6
Mean mark-recapture estimate	16 Jan	09:23/10:43	9	284 (7.0)
Total estimated pup production	16 Jan	N/A	N/A	290
Total number pups tagged	16-17 Jan	N/A	N/A	287

The full data series for annual pup production at Sandy Bay is shown in Appendix 1 and Appendix 2. Raw data for counts at Sandy Bay are provided in Appendix 3.

Estimates of pup production at Sandy Bay were completed successfully. Description of breeding area searched during pup counts at Sandy Bay is provided in Appendix 4. Nine mark-recapture counts were undertaken (i.e. three counts by one person plus two each by three different people) and 12 direct counts were undertaken (i.e. two counts each by six people) of live pups (Appendix 3). In addition, a single direct count of live pups was undertaken daily between 11 and 20 January (Appendix 5), but counts of dead pups continued until the team left for the mainland on 9 March.

One hundred and twenty caps were used as marks for the mark-recapture and were put out on the 15 January (between 08:30 and 11:30). No caps were recovered from the ground prior to starting the mark-recapture counts on the 16 January. Therefore the number of marked pups was considered to be 120 for the purposes of the mark-recapture estimation (Appendix 3).

The methodology for estimating the number of dead pups in 2013/14 differed slightly from previous methods. Prior to 2012/13, all dead pups were counted daily and removed from the beach for autopsy throughout the season. In 2012/13, all dead pups were left on the beach to allow for helicopter aerial surveys to be undertaken to count both live and dead pups, and the first counts were made on January 11 when the team arrived with no counts prior to this. In 2013/14, all dead pups found on the beach during the first survey on 11 January were counted and removed. After this time, daily counts were made with all new dead pups counted, removed from the beach and most of them autopsied (depending on their condition when recovered).

The first direct dead count was undertaken on 11 January with a total of two dead pups found. This estimate is not directly comparable with most previous dead pup counts as the previous estimates represent a cumulative count of dead pups removed from the colony through the season beginning in early December. The dead pup estimate from 2013/14 should therefore be considered a minimum estimate of dead pups and the overall estimate of pup production should also be considered a minimum for the same reason.

Overall the 2013/14 estimate of total pup production for Sandy Bay was **290 pups** (284 live plus 6 dead pups), which is 21% lower than 2012/13. This is the lowest estimate recorded for this colony. Pup mortality was estimated as 2% on 16 January. This is the same level as recorded in 2012/13, although as discussed above, the estimates of dead pups for 2012/13 and 2013/14 are unlikely to represent the total number of dead pups to 16 January and so are likely to be an underestimate.

4.3.2 Dundas Island

Table 2: Summary of pup production estimates for Dundas Island for 2013/14.

Method	Date	Start/end time	No. of counts	Estimate (SE)
Mean direct live count	19 Jan	08:10/12:25	9	1078 (11.1)
Mean direct dead count	19 Jan	08:10/12:25	3	72 (0.0)
Mean mark-recapture estimate	19 Jan	08:10/12:25	9	1141 (12.0)
Total estimated pup production	19 Jan	N/A	N/A	1213
Total number pups tagged	18-20 Jan	N/A	N/A	400

Estimates of pup production at Dundas Island were completed successfully. Nine mark-recapture counts were undertaken (i.e. three counts each by three different people) and nine direct counts (i.e. three counts each by three different people) were undertaken for live pups. Three direct dead counts were undertaken by the whole four-person team working together and all pups found were marked with spray paint to confirm that they had been counted.

Four hundred mark-recapture caps were put out on pups on 18 January on Dundas Island (between 15:30 and 18:00). The approximate location of the pups which were capped is shown in Appendix 6. The aim was to mark approximately 20-25% of the live pups on the day of marking. Therefore, caps were put out amongst pups in that approximate ratio (i.e. 1 cap for every 4-5 pups) across the whole area where pups were present. Four hundred caps were put out on 18 January but one cap was recovered from the ground prior to starting the mark-recapture counts on the 19 January and therefore the number of marked pups was considered to be 399 for the purposes of the mark-recapture estimation (Appendix 3).

Overall the 2013/14 estimate of total pup production for Dundas Island was **1,213 pups** (1,141 live plus 72 dead pups), which is 19% lower than 2012/13. Pup mortality to 19 January was estimated as 6%, which is lower than the 9% recorded in 2012/13. The full data series for pup production at Dundas Island is shown in Appendix 1 and Appendix 2. Raw data for counts at Dundas Island are provided in Appendix 3.

4.3.3 Figure of Eight Island

Table 3: Summary of pup production estimates for Figure of Eight Island for 2013/14.

Method	Date	No. of counts	Estimate (SE)
Mean direct live count	9 Jan	3	62 (0.6)
Mean direct dead count	9 Jan	1	10 (0.0)
Total estimated pup production	9 Jan	N/A	72
Total number pups tagged	9 Jan	N/A	24

Estimates of pup production at Figure of Eight Island were completed successfully. As noted in Section 4.2, the counts at Figure of Eight Island were undertaken a day earlier than planned (i.e. 9 rather than 10 January). It is unlikely that there will be any comparability issues with previous surveys as the dates for counts at Figure of Eight Island have varied considerably over the years. It is unknown when pupping peaks or ceases on Figure of Eight Island, thus variability in visitation dates due to prevailing logistical and practical constraints make it difficult to determine the accuracy of the reported count. Three direct live counts were undertaken by three different people and a single direct dead count was undertaken by the whole team.

Overall the 2013/14 estimate of total pup production for Figure of Eight Island was **72 pups** (62 live plus 10 dead pups) which is 4% lower than 2012/13. Pup mortality to 11 January was estimated as 14%, which is higher than the 7% recorded in 2012/13 and was estimated using comparable methods to previous years. The full data series for pup production at Figure of Eight Island is shown in Appendix 1 and Appendix 2. Raw data for counts at Figure of Eight Island are provided in Appendix 3.

4.3.4 South East Point, Enderby Island

Table 4: Summary of pup production estimates for South East Point for 2013/14.

Method	Date	No. of counts	Estimate
Direct live count	11 Jan	6	0
Direct dead count	11 Jan	6	0
Total estimated pup production	11 Jan	N/A	0
Total number pups tagged	11 Jan	N/A	0

No pups were recorded at South East Point in 2012/13 and only a single pup was recorded there in 2011/12. The first count at South East Point in 2013/14 was undertaken on 11 January (in contrast to years prior to 2012/13 when there were regular counts from early December onwards). It is, therefore, possible that pups could have been born before 11 January but moved away or died and been washed away prior to the first visit. However, anecdotal reports from tourist vessels visiting South East Point prior to 11 January reported seeing no pups there. There were more than 10 surveys of South East Point between 11 January to 9 March and no pups were seen. With estimated pup production reaching zero for the second year in a row, this breeding site has now become functionally extinct.

Overall the 2013/14 estimate of total pup production for South East Point was **0 pups** (0 live plus 0 dead pups), which is the same as for 2012/13. The full data series for pup production at South East Point is shown in Appendix 1 and Appendix 2.

4.3.5 Total pup production for the Auckland Islands

Overall, total pup production for the Auckland Islands in 2013/14 was estimated to be **1575** pups (1487 live pups and 88 dead pups). This total represents an 18% decline on the estimate for 2012/13 and is the third lowest total pup production recorded at the Auckland Islands. Overall pup production for the Auckland Islands since 1994/95 is shown in Figure 1.

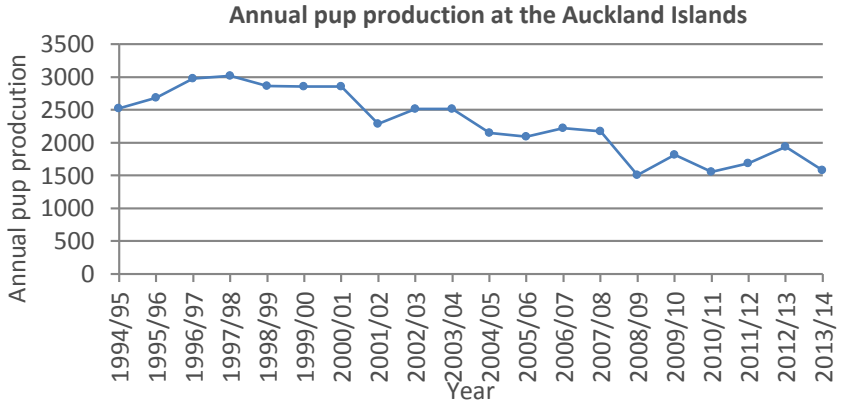

Figure 1: Total estimated pup production for New Zealand sea lions at the Auckland Islands 1994/95 – 2013/14.

NB: Data prior to 2012/13 from Chilvers (2012).

4.4 Pup weights

Table 5: Summary of mean pup weights for the Auckland Islands for 2013/14.

Location	Mean female weight (kg)	Mean male weight (kg)
Sandy Bay	11.1	12.6
Dundas Island	10.2	11.6

One hundred pups (50 of each sex) were weighed at both Sandy Bay and Dundas Island on the same day of the mark-recapture count (16 and 19 January respectively). Mean pup weights at Sandy Bay were 5% lower than 2012/13 for males and females. Mean pup weights at Dundas Island were 8% and 5% lower than 2012/13 for males and females respectively. Mean pup weights from previous surveys at Sandy Bay and Dundas Island are show in Figure 2 and Figure 3.

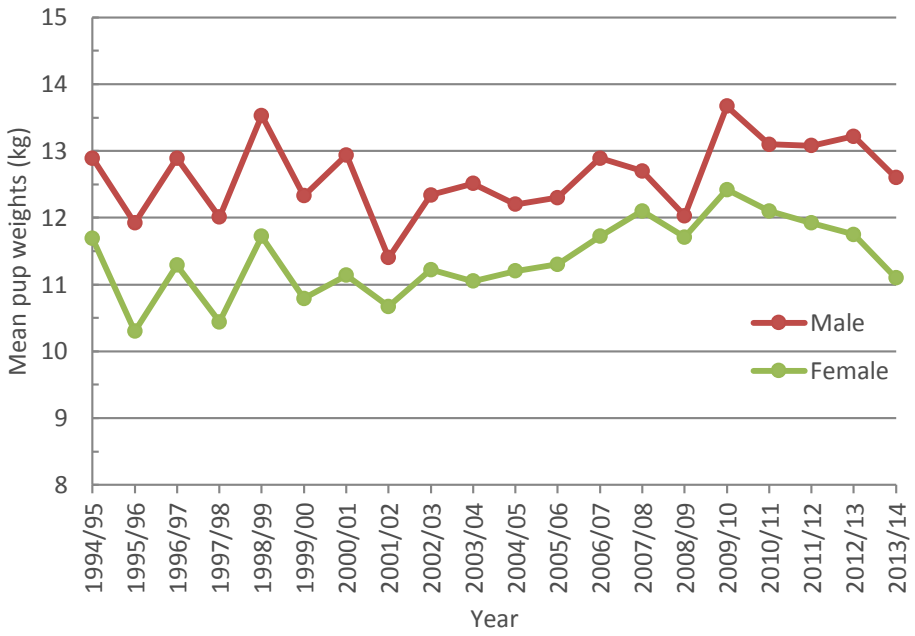

Figure 2: Mean pup weights for Sandy Bay colony by sex.

NB: Data prior to 2012/13 provided by Department of Conservation.

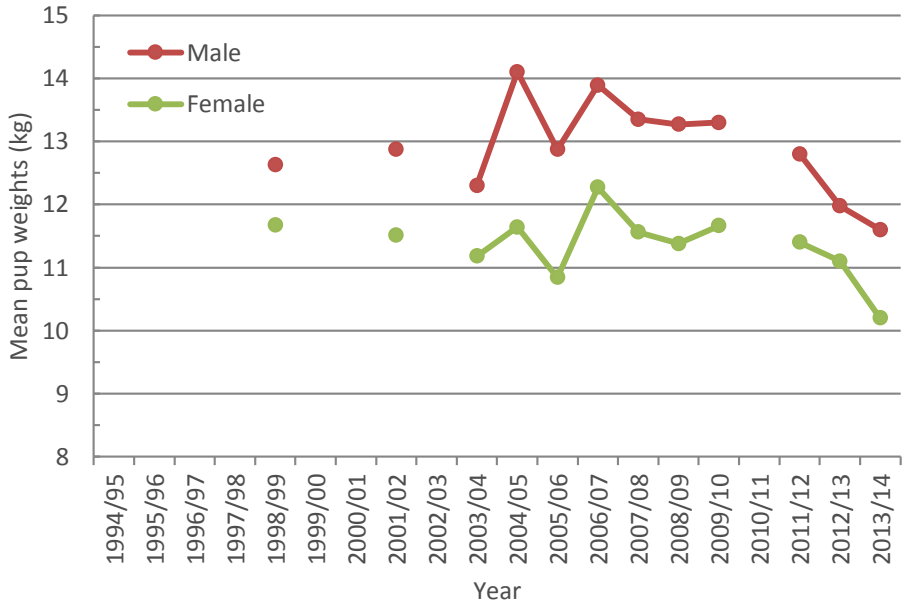

Figure 3: Mean pup weights for Dundas Island colony by sex.

NB: Data prior to 2012/13 provided by Department of Conservation.

4.5 Counts at Sandy Bay, Enderby Island

Direct counts of live and dead pups, adult females, adult and sub-adult males were made at Sandy Bay, Enderby Island from 11-20th January 2014 (Figure 4). All counts were made by a single person each day. Raw data are provided in Appendix 5.

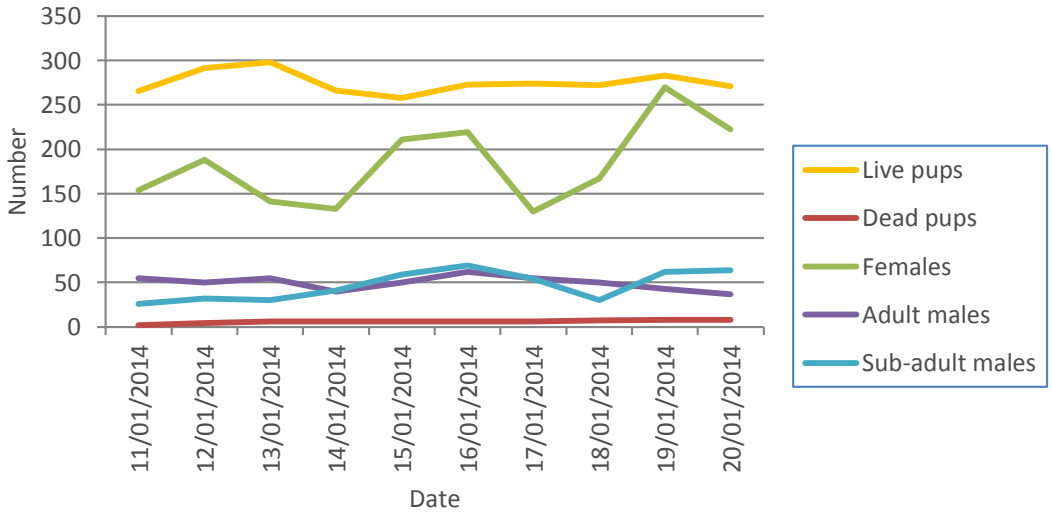

Figure 4: New Zealand sea lion counts at Sandy Bay, Enderby Island 2013/14.

4.6 Tagging and micro-chipping

Double flipper tagging and subcutaneous micro-chipping were also undertaken. Pups at Dundas Island and Figure of Eight Island were double flipper tagged and pups at Sandy Bay were double flipper tagged and micro-chipped. Summary of pup tagging was:

- Dundas Island – 400 pups tagged (comprising 100 males and 300 females);
- Figure of Eight Island – 24 pups tagged (as many as could be tagged in the time available); and
- Sandy Bay – 287 pups tagged.

The plan was for all pups born at Sandy Bay to be tagged and micro-chipped. However, incompatible micro-chips were provided, which could not be read by the standard micro-chip readers and therefore there was no way to confirm their number nor if they had been inserted successfully. As a result the decision was made not to insert the incompatible micro-chips and so 119 pups were tagged but did not have microchips inserted.

4.7 Resighting and tagging data management

A total of 11,076 individual tag, brand and micro-chip resightings were made during the field season. These records do not represent different individuals but rather the total number of all resights collected and includes multiple resights of some individuals. Most of the resighting records were from tags (n=9,982; 90%)) with brand and micro-chip resighting comprising approximately 5% each (n=530 and 560 respectively). For those individuals for which sex could be determined (83% of all sightings), 76% were records from females and 24% from males. This season represents the highest ever number of resighting records collected and is nearly five times more than was collected in 2012/13 and 1.4 times more from the previously largest season in 2002/03 (2012/13 = 2,262; 2011/12 = 6,914; 2002/03 = 8,139). Most resightings (99%) were collected on Enderby Island and most (95%) of these at Sandy Bay. A few resights were also collected from Dundas Island and Figure of Eight Island.

Table 6: Summary of NZ sea lion resightings for 2013/14.

Resight type	No.	No. of different individuals	No. of times individuals resighted
Tags	9,982	1,456	1-76
Brands	530	49	1-53
Microchips	560	167	1-15
Not recorded	4	4	1
Total	11,076	1,594	1-78

Detailed effort information was collected for the first time during resighting surveys. Collection of information including start and end of effort, personnel undertaking it, location and weather conditions. A sample of these data is available in Appendix 7. Figure 5 shows (a) the number of individual resighting records collected by the whole team per day and (b) the total number of hours of resighting effort undertaken by the whole team per day. The effort records of one team member were lost and so the effort for this person has been estimated based on a pro rata basis taken from the mean per person effort for the remainder of the team for each day. This estimated effort is shown in orange in Figure 5b. The size of the field team varied through the season (e.g. 11-23 January: 5 people; 24 January – 23 February: 4 people; 24 February – 7 March: 3 people), which should be accounted for when considering relative effort. Figure 6 shows the mean number of resighting records collected per person per day.

Gaps in these data series generally coincide with either very bad weather days (when resighting is not possible) or with visits of tourist ships to Enderby Island when the resighting programme is generally stopped so as to not work closely around sea lions while tourists are present. The number of resights collected per day is obviously a direct function of effort (i.e. time spent) but is also a function of other factors including weather, colony density (e.g. tightly packed on the beach versus spread out on the

sward and forest), number of tagged individuals available for sighting and individual animal behaviour (e.g. territorial versus dispersed). These additional factors are difficult to assess and therefore the interpretation of sighting data should not be confined to resighting effort alone.

A key element of this research was to ensure that data were collected in an accurate and robust fashion and that they are provided in an electronic format suitable for upload into the New Zealand sea lion database. All of the groomed and reviewed data will be uploaded into the New Zealand sea lion database and will be available online[1] as open access information.

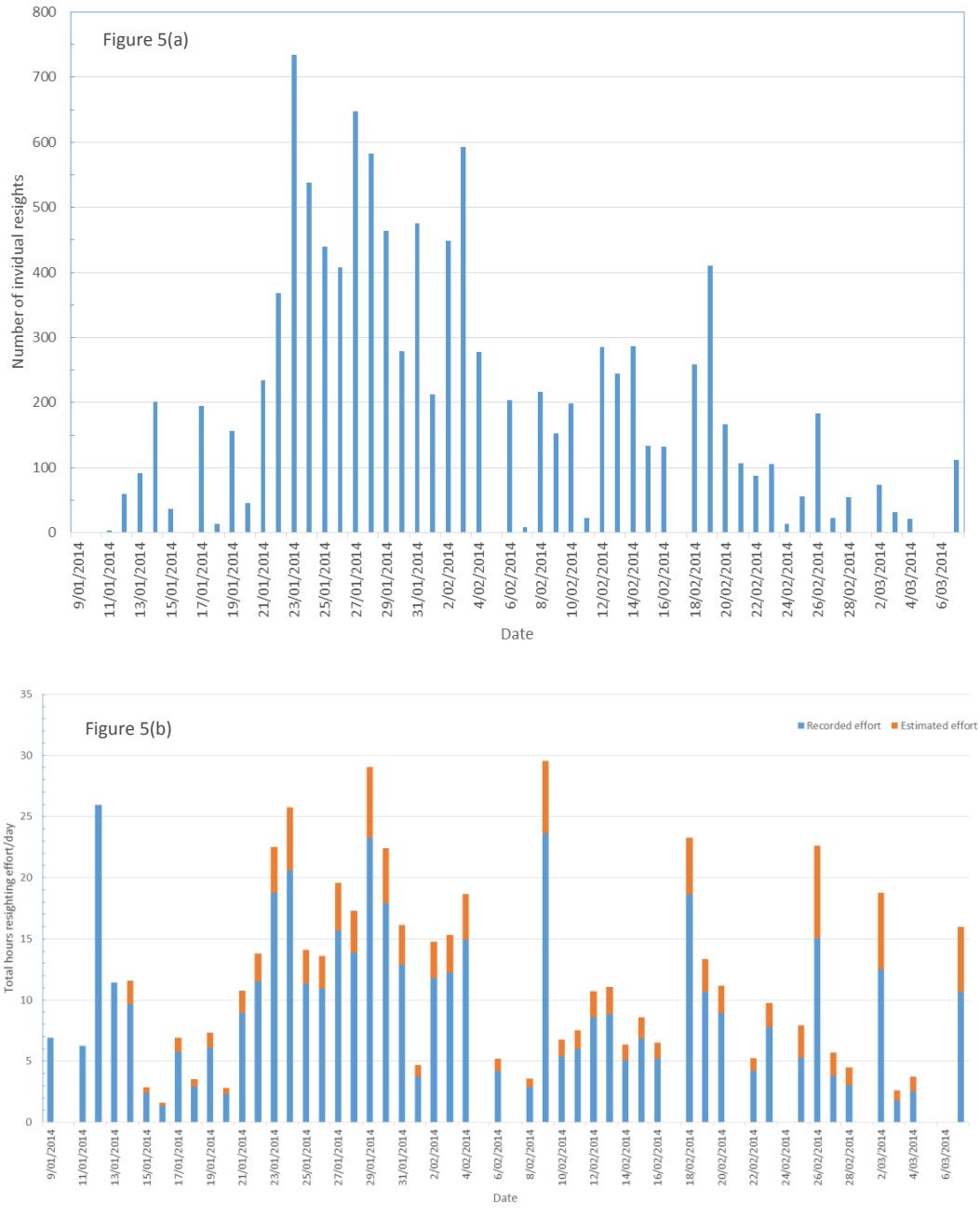

Figure 5: (a) Number of individual resighting records collected by the whole team per day, and (b) Total number of hours of resighting effort collected by the whole team per day in 2013/14.

[1] http://data.dragonfly.co.nz/nzsl-demographics/

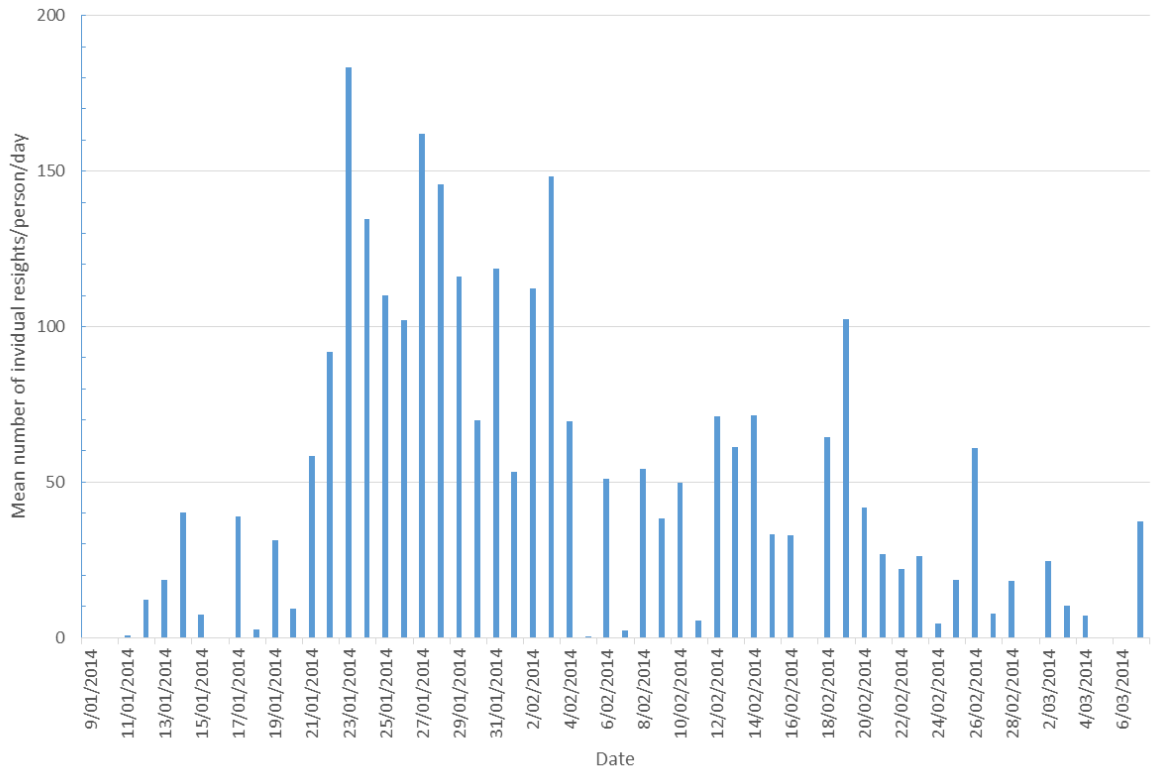

Figure 6: Mean number of individual resighting records collected per person per day in 2013/14.

4.8 Pup mortality

The season was extended in order to continue monitoring of pup mortality due to a pulse of higher than normal daily pup mortality observed around the 6-7 February 2014 (Figure 7, Figure 8). Total estimated pup mortality at Sandy Bay was 73 pups up until 8 March 2014, however, these figures do not represent full season surveys as in previous years and so should be viewed as a minimum. Preliminary data on the cause of death was not included as a deliverable of the DOC CSP contract for this work but it was undertaken independently by Massey University and the Deepwater Group Ltd. They have kindly provided preliminary results of the autopsy work for inclusion in this report (Appendix 8).

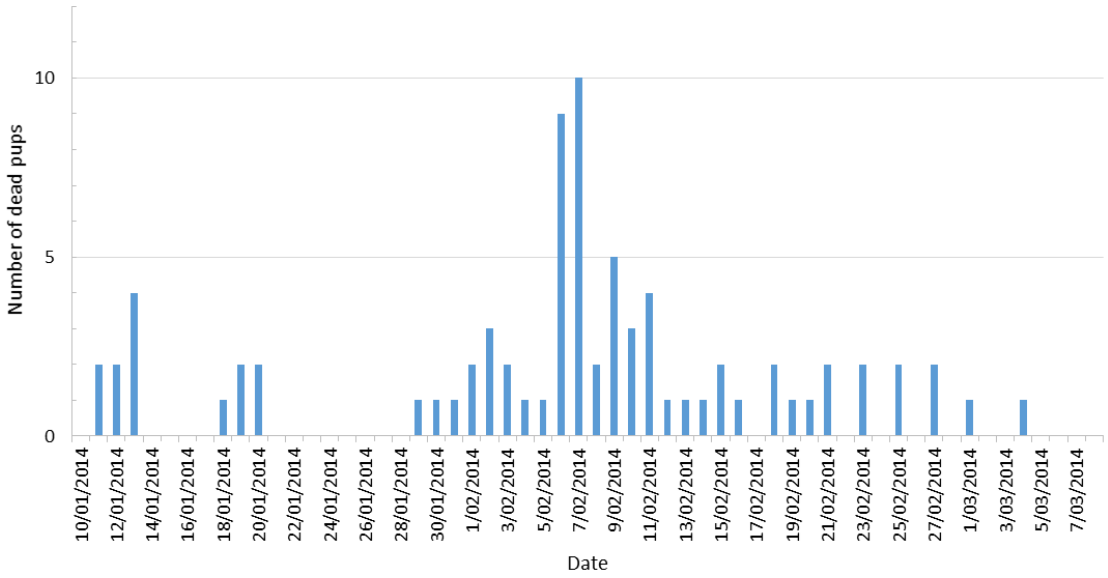

Figure 7: Number of dead pups recorded at Sandy Bay, Enderby Island in 2013/14.

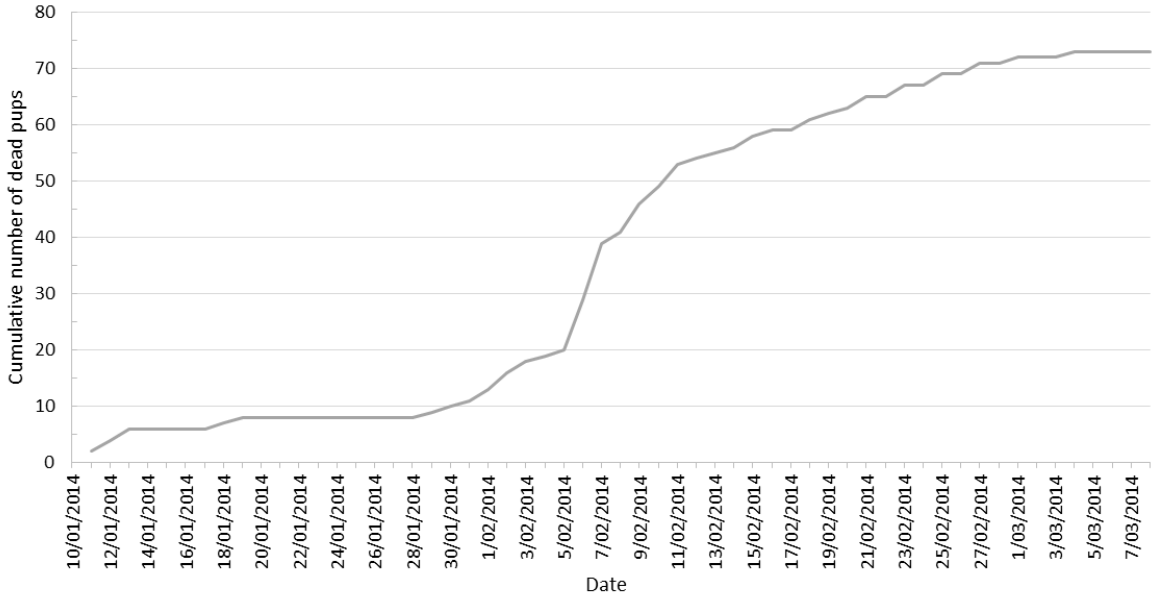

Figure 8: Cumulative number of dead pups recorded at Sandy Bay, Enderby Island in 2013/14.

A brief follow-up survey was undertaken at Dundas Island on 10 March 2014 prior to the team returning back home in order to investigate whether there was likely to have been an unusual mortality event there also. Overall, 19 live pups and 70 dead pups were seen with no evidence of an unusually high level of pup mortality. Of the 70 dead pups recorded on 10 March, 17 were found in the muddy moat around the centre of the Island. The previous visit to Dundas Island on 19 January 2014 had a live pup count of 1078 and a dead pup count of 72. The numbers of dead pups between the two surveys should not be directly compared as it is likely that not all of the pups that had died after 19 January 2014 would have been available for counting on 10 March 2014, as over time they would have been scavenged, decomposed and/or washed away.

4.9 Mitigation of pup mortality at Sandy Bay

The team noted many pups falling into large holes and bogs on the sward at Sandy Bay. At the eastern end of Sandy Bay, approximately 1 km from the beach, there is a series of large holes in the peat. Pups get into these holes, cannot get out and will likely drown/starve if they are not removed. Estimates from the team were that more than 75 pups were rescued from these holes over the survey period but it is not known how many of these may represent the same individuals being removed multiple times. Also, a small number of additional pups were removed before the team started recording each of these events, so the stated number should be viewed as a minimum. While it was mainly pups falling into these holes, some yearlings/juveniles were also recorded as caught.

The team removed any individuals caught and also made access ways (e.g. either ramps or steps) so that any individuals caught subsequently would be able to make their own way out (Figure 9). As such, an unrecorded number of pups likely escaped by using the ramps, which is in addition to those manually removed before the ramps were constructed. Is it also important to note that while 75 pups were rescued from holes this season, there are no records of pup mortalities in holes at Sandy Bay in previous years (other than some shortly after the removal of rabbits in the early 1990s when rabbit holes were still present). The sea lion team undertook regular surveys of the holes once this issue was identified and all pups found alive were successfully removed and ramps/steps dug to allow subsequent trapped pups to get out on their own.

Figure 9(a)

Figure 9(b)

Figure 9: (a) Example of a hole at Sandy Bay into which pups fell and would have died if not rescued by the team, and (b) pup successfully climbing out of this hole using a boardwalk ramp constructed and installed by the sea lion team.

There are also a series of holes forming a moat around the centre of Dundas Island, which has in the past been a significant source of mortality for pups. In the early 2000s, we installed boardwalk ramps (very much like the one in Figure 9a) throughout most of the moat, and we believe these have led to reduced mortality of pups in the moats. Observations since the ramps were introduced suggest that some pups still die in the moat and other already dead pups are dragged into the moat by scavenging sea birds.

4.10 Tourist ship visits

Visits by tourists to Enderby Island have regularly occurred since the 1990s. However, this year there was a higher than usual number of visits. The resighting programme is generally stopped while tourists visit as it is DOC policy which is primarily based around the idea that that researchers seen working in close proximity to sea lions would encourage tourists and operators to violate approach limits (e.g. tourists are not allowed to be on the beach or approach sea lions closer than 5m). Resighting surveys

by researchers generally require close approaches and beach work. Overall, approximately 7.5 days of field effort were lost due to resighting being halted for tourist visits. This policy should be reviewed for future seasons.

5. Issues for Future Consideration

Based on the experience of the 2013/14 team, we would recommend the following issues be reviewed for the 2014/2015 field season:

- Tour ships – A considerable amount of work time was lost due to halting work when tourist vessels visited. The policy of halting work has been in place for a long time but should be reviewed now that tourist visits are increasing in frequency and starting to significantly impact on work. Work could continue while tourists are present as long as the importance of the work and why researchers have different rules to tourists is explained clearly;
- Autopsy – At present the project does not include any requirement for undertaking autopsy of pups or adults. This work has been undertaken in the past but was funded separately, as it was in 2013/14. Given the importance of understanding the causes of mortality to the decline in pup production, consideration should be given to incorporating this work into the existing project;
- Guidelines as to whether or not post mortems can proceed while tourists or other visitors are present on the Island. At present, post mortems are undertaken in the open on a table in front of the post mortem/boat shed and there is no other suitable location where this can be done out of the public view. Due to the high volume of tourist traffic this season, bodies were unable to be retrieved and several post mortems were delayed so as not to occur concurrently with tourist operations. This delay may compromise the results of autopsy as tissues will have decomposed further. If autopsies are to be undertaken in the future, then a review of autopsy facilities could occur;
- If a vet is present on the Island, consideration should be given to prior approval for injectable humane euthanasia of moribund pups. When performed correctly, this would not significantly impact on post mortem findings and would prevent prolonged suffering of pups. These pups would need to be buried to prevent scavenging;
- Sample size justification – a detailed justification for the proposed sample size for tagging and micro-chipping for any work undertaken in 2014/15 is likely to be required to support an application for an animal ethics approval. This issue will need to be reviewed and considered by CPS and the Technical Working Group well in advance of next season to confirm that sample sizes proposed for next season address the aims of the programme and are the minimum required;
- Confidence intervals for total pup production estimates – Confidence intervals for estimates of total pup production have never been provided. A total pup production estimate is comprised of several different estimates generated from different techniques, some of which have no estimates of variance associated with them. It would be useful to develop a standardised method for the estimation of confidence intervals for pup production and one that could also be used for all previous data;
- Electronic data entry – The New Zealand sea lion database has been designed as a data repository and is working well. Entry of resighting and tagging records into the database is by way of field data sheets to excel spreadsheets to the database. Consideration should be given to the electronic collection of data in the field that can then be directly uploaded into

the database. This would prevent duplication of work and potential data entry issues including transcription errors. It would also reduce the time required for this task. Electronic data recording and entry could be undertaken by a standalone application for a tablet that researchers could use in the field to record all data. This would improve the quality assurance around the data collection and entry process; and

- Active management – Some sources of pup mortality could be mitigated through active management. This includes such things as:
    - the number of pups dying in holes could be reduced by filling in holes or building ramps so they could get out;
    - veterinary treatment of sources of mortality such as injury (e.g. relocation of dislocated flippers);
    - hookworm or disease (e.g. immunisation drug treatment); and/or
    - supplementary feeding (e.g. in cases a pup may not be getting sufficient food from its mother).

  This is a very complex issue and would require careful consideration before any actions are agreed. Active management may offer the most promising avenue for active conservation management to make a positive contribution to survivorship of individual pups and potentially yield positive flow on benefits for the species as a whole. Elements of active management such as those identified here should be reviewed as a minimum, as part of the development of a Threat Management Plan, but also perhaps as a wider issue that could lead to immediate changes to the research programme for the 2014/15 season.

6. Acknowledgements

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- Members of the CSP Technical Working Group who provided useful feedback on this project;
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7. References

Baker B, Jensz K, Chilvers BL (2012)[2] Aerial survey of New Zealand sea lions – Auckland Islands. DOCDM-872849. Report prepared for Ministry of Agriculture & Forestry, Deepwater Group Limited & Department of Conservation. 11 p. Available at www.doc.govt.nz.

Childerhouse S (2012)[3] Methodology for CSP Project 4426 New Zealand sea lion ground component 2012/13. Unpublished paper presented to the Conservation Services Programme, Department of Conservation, New Zealand. 8th November 2012. BPM document number: BPM-TAS-12-Methodology for CSP project 4426 NZ sea lion ground component 2012-13 v1.0. 8 p. Available at www.doc.govt.nz.

Childerhouse S (2013)[4] Methodology for CSP Project 4522 New Zealand sea lion ground component 2013/14. Unpublished paper presented to the Conservation Services Programme, Department of Conservation, New Zealand. 18th November 2012. BPM document number: BPM-13-Methodology for CSP project 4522 NZ sea lion ground component 2013-14 v1.0. 9 p. Available at www.doc.govt.nz.

Childerhouse SJ, Amey J, Hamer D, McCrone A (2013)[5] Final report for CSP Project 4426 New Zealand sea lion ground component 2012/13. Unpublished Report to the Conservation Services Programme, Department of Conservation, Wellington, New Zealand. Version 1.2. 26 p.

Chilvers BL (2012)[6] Research to assess the demographic parameters of New Zealand sea lions, Auckland Islands 2011/12 Contract Number: POP 2011/01 Final Research Report, November 2012. Report prepared for the Conservation Services Programme, Department of Conservation. 11 p. Available at www.doc.govt.nz.

Hamer D, Michael S, Childerhouse S (2014)[7] NZ sea lion programme 2013/14 - Preliminary end of trip report. Report to DOC CSP. 14 March 2014. 4 p.

[2] http://www.doc.govt.nz/documents/conservation/marine-and-coastal/marine-conservation-services/nz-sea-lion-aerial-survey-2012-draft-report.pdf

[3] http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/bpm-4426-nz-sea-lion-ground-component-methodology-2012-13-draft.pdf

[4] http://www.doc.govt.nz/pagefiles/113436/methodology-for-csp-project-4522-nz-sea-lion-ground-component.pdf

[5] http://www.doc.govt.nz/conservation/marine-and-coastal/conservation-services-programme/csp-reports/2012-13/new-zealand-sea-lion-ground-survey-2013/

[6] http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/pop-2011-01-nz-sea-lion-field-report-2011-12.pdf

[7] http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/meetings/prelim-end-of-trip-report-auckland-islands.pdf

8. Appendices

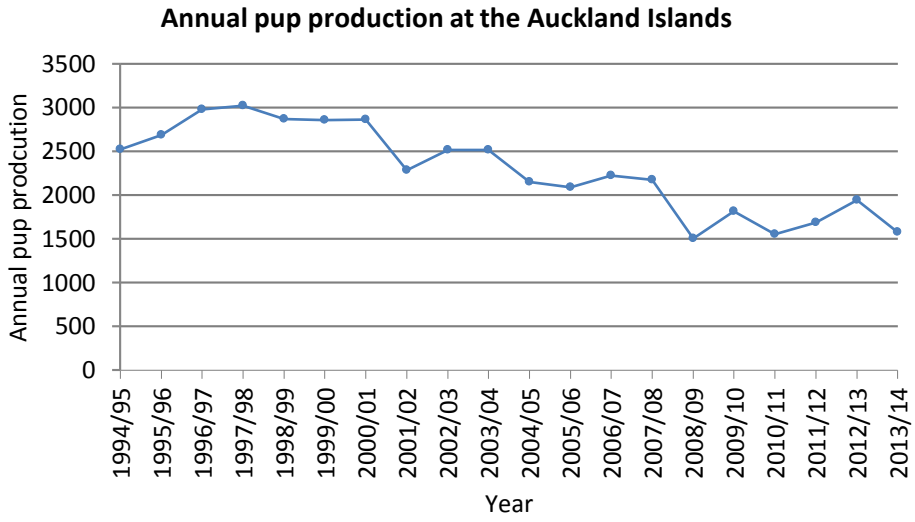
Appendix 1: Annual estimates of live, dead and total pup production for each colony and for total Auckland Islands pup production 1994/95 – 2013/14.

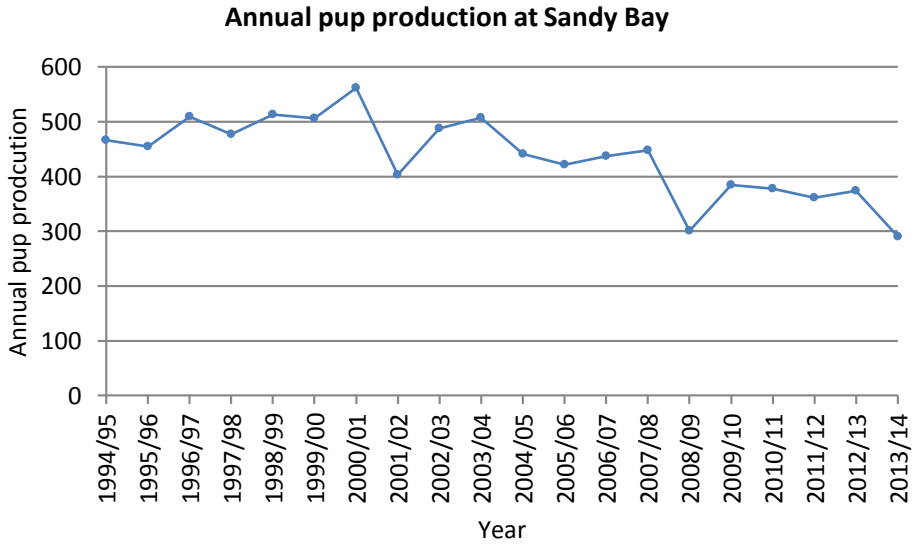
(NB. Data prior to 2012/13 from Chilvers (2012))

Year	Sandy Bay			Dundas Island			Figure of Eight Island			South East Point			Total Auckland Islands		
	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead
1994/95	467	421	46	1837	1603	234	143	123	20	71	59	12	2518	2206	312
1995/96	455	417	38	2017	1810	207	144	113	31	69	49	20	2685	2389	296
1996/97	509	473	36	2260	2083	177	143	134	9	63	39	24	2975	2729	246
1997/98	477	468	9	2373	1748	625	120	97	23	51	37	14	3021	2350	671
1998/99	513	473	40	2186	1957	229	109	100	9	59	42	17	2867	2572	295
1999/00	506	482	24	2163	2039	124	137	131	6	50	37	13	2856	2689	167
2000/01	562	527	35	2148	1802	346	94	92	2	55	47	8	2859	2468	391
2001/02	403	320	83	1756	1395	361	96	90	6	27	21	6	2282	1826	456
2002/03	488	408	80	1891	1555	336	94	89	5	43	26	17	2516	2078	438
2003/04	507	473	34	1869	1749	120	87	86	1	52	39	13	2515	2347	168
2004/05	441	411	30	1587	1513	74	83	79	4	37	31	6	2148	2034	114
2005/06	422	383	39	1581	1349	232	62	55	7	24	20	4	2089	1807	282
2006/07	437	414	23	1693	1587	106	70	67	3	24	19	5	2224	2087	137
2007/08	448	425	23	1635	1512	123	74	72	2	18	13	5	2175	2022	153
2008/09	301	289	12	1132	1065	67	54	48	6	14	8	6	1501	1410	91
2009/10	385	364	21	1369	1218	151	55	48	7	5	1	4	1814	1631	183
2010/11	378	359	19	1089	952	137	79	71	8	4	2	2	1550	1384	166
2011/12	361	343	18	1248	1189	59	74	72	2	1	0	1	1684	1604	80
2012/13	374	357	17	1491	1364	127	75	70	5	0	0	0	1940	1791	149
2013/14	**290**	**284**	**6**	**1213**	**1141**	**72**	**72**	**62**	**10**	**0**	**0**	**0**	**1575**	**1487**	**88**

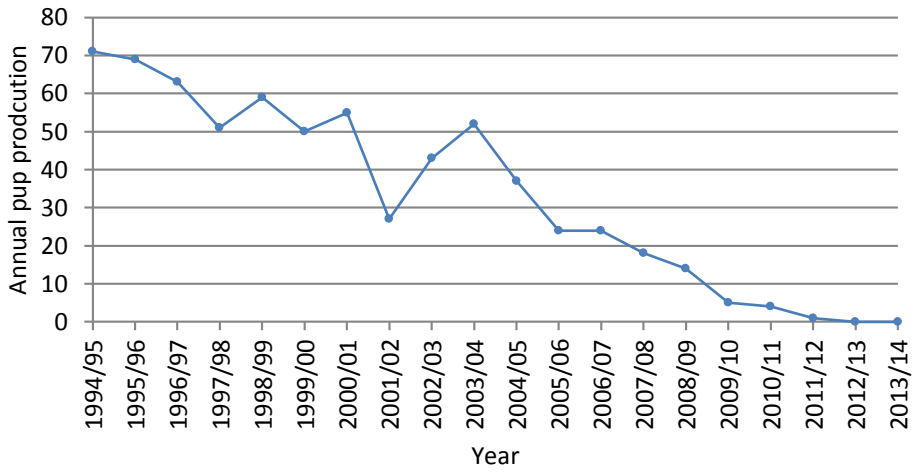
Appendix 2: Annual estimates of total pup production for each colony and for total Auckland Islands pup production.

(NB. Data prior to 2012/13 from Chilvers (2012))

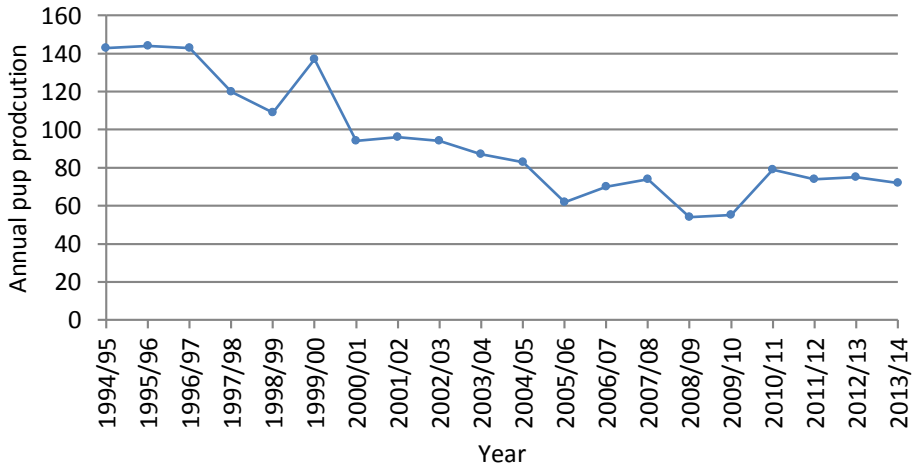




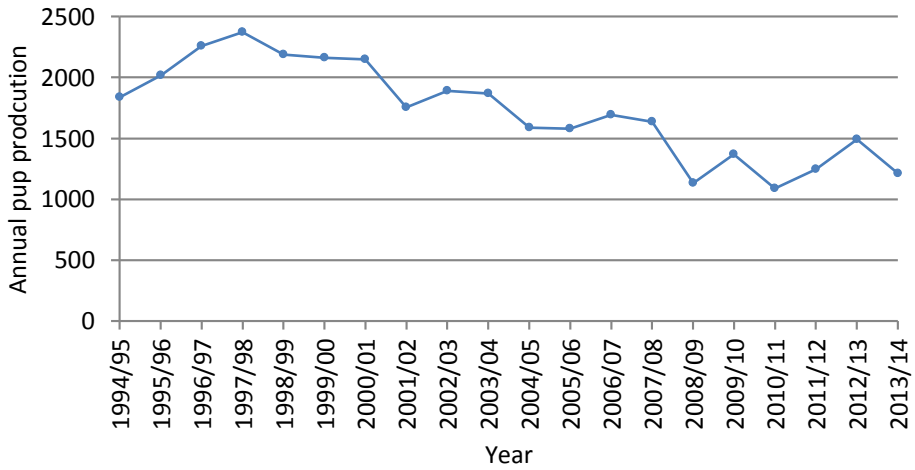
Annual pup production at South East Point



Annual pup production at Figure of Eight Island



Annual pup production at Dundas Island



Appendix 3: Raw data for pup production estimates for Sandy Bay, Dundas Island and Figure of Eight Island.

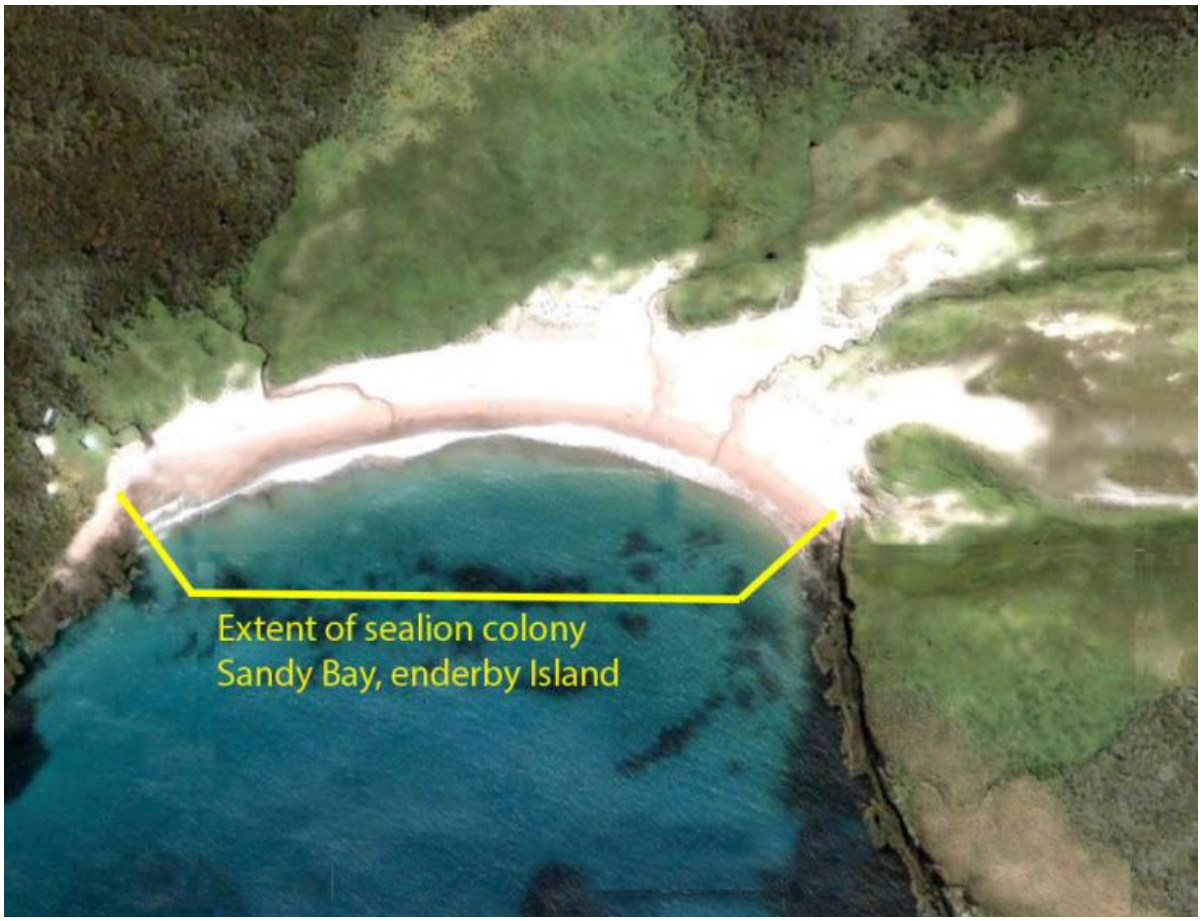
Mark recapture individual counts for Sandy Bay, 16 January 2014		
No. of animals marked = 120 (i.e. 0 caps found (i.e. fell off) before MR)		
	Number marked counted	**Number unmarked counted**
Counter 1-1	76	100
Counter 1-2	72	95
Counter 1-3	69	94
Counter 2-1	49	75
Counter 2-2	69	73
Counter 3-1	48	83
Counter 3-2	66	87
Counter 4-1	53	74
Counter 4-2	61	82
Mark recapture estimates for Dundas Island, 19 January 2014		
No. of animals marked = 399 (i.e. 1 cap found (i.e. fell off) before MR)		
	Number marked counted	**Number unmarked counted**
Counter 1-1	220	427
Counter 1-2	252	467
Counter 1-3	254	477
Counter 2-1	183	365
Counter 2-2	193	343
Counter 2-3	195	354
Counter 3-1	219	431
Counter 3-2	264	454
Counter 3-3	246	449
Direct counts for number of live pups for Dundas Island, 19 January 2014		
	Number counted	
Counter 1-1	1104	
Counter 1-2	1103	
Counter 1-3	1098	
Counter 2-1	1120	
Counter 2-2	1049	
Counter 2-3	1087	

Counter 3-1	1019	
Counter 3-2	1046	
Counter 3-3	1072	
Direct counts for number of dead pups for Dundas Island, 19 January 2014		
	Number counted	
Count 1	72	
Count 2	72	
Count 3	72	
Direct counts for number of live pups for Figure of Eight Island, 9 January 2014		
	Number counted	
Counter 1	63	
Counter 2	61	
Counter 3	62	
Direct counts for number of dead pups for Figure of Eight Island, 9 January 2014		
	Number counted	
Count 1	10	

Appendix 4: Description of breeding area searched during pup counts at Sandy Bay, Enderby Island.

The following figure provides a graphical presentation of the "entire breeding area" searched during pup counts at Sandy Bay, Enderby Island. All of the beach and surrounding sward (e.g. green, grassy area adjacent to the beach) constitutes the "entire breeding area" but the forested area is excluded. On 16 January, when the mark-recapture counts are undertaken, pups are almost exclusively restricted to the beach area, although sometimes a few pups have moved up onto the sward but no more than 20-30 m from the beach itself.

This image is taken from Baker B, Jensz J and Chilvers L (November 2012). Aerial survey of New Zealand sea lions – Auckland Islands 2011/12. Report prepared for Ministry of Agriculture & Forestry, Deepwater Group Limited and Department of Conservation. 11 p.



Appendix 5: Direct counts made at Sandy Bay, Enderby Island.

Date	Live pups			Dead pups			Adult females			Adult males			Sub-adult males		
	Beach	Sward	Total	Beach	Sward	Total	Beach	Sward	Total	Beach	Sward	Total	Beach	Sward	Total
11/01/2013	242	24	266	2	0	2	154	0	154	49	6	55	17	9	26
12/01/2013	276	15	291	4	0	4	188	0	188	40	10	50	18	14	32
13/01/2013	298	0	298	6	0	6	141	0	141	39	16	55	13	17	30
14/01/2013	265	1	266	6	0	6	133	0	133	27	13	40	12	29	41
15/01/2013	258	0	258	6	0	6	211	0	211	35	15	50	49	10	59
16/01/2013	273	0	273	6	0	6	219	0	219	54	8	62	36	33	69
17/01/2013	274	0	274	6	0	6	130	0	130	41	14	55	32	22	54
18/01/2013	267	5	272	7	0	7	167	0	167	37	13	50	9	21	30
19/01/2013	283	0	283	8	0	8	270	0	270	37	6	43	43	19	62
20/01/2013	261	10	271	8	0	8	222	0	222	19	18	37	28	36	64

Appendix 6: Approximate location of where mark-recapture caps were put out on pups on Dundas Island.

The following figure identifies the approximate number and location of where 400 mark-recapture caps where put out on Dundas Island for the mark phase of the mark-recapture. Please note that this aerial image of Dundas Island was kindly provided by Barry Baker but is from 2011/12 and therefore the location of pups shown on this image does not reflect the location of pups in 2013/14 but has been used here for illustrative purposes.

Appendix 7: Recording of effort data for resightings.

The following table provides a example of the effort data that were collected for all the resighting work during 2013/14.

Date	Location	Person	Start time	End time	Total effort	Wind	Cloud Cover	Weather	Notes
9/01/2014	F8	AM	10:30	11:30	1:00	SW20	8/8	Overcast	
9/01/2014	F8	DMD	10:02	11:30	1:28	SW20	8/8	Overcast	
9/01/2014	F8	NTS	10:30	11:30	1:00	SW20	8/8	Overcast	
9/01/2014	F8	SAM	10:30	11:30	1:00	SW20	8/8	Overcast	
9/01/2014	F8	SC	10:02	11:30	1:28	SW20	8/8	Overcast	
11/01/2014	SEP	AM	10:02	14:30	4:28	W25	8/8	Overcast	
11/01/2014	SB	DH	17:25	18:08	0:43	W15	8/8	Overcast	
11/01/2014	SB	DH	21:05	21:21	0:16	W15	8/8	Overcast	
11/01/2014	SB	DH	21:23	21:41	0:18	W15	8/8	Overcast	
11/01/2014	SB	SC	21:13	21:44	0:31	W15	8/8	Overcast	
12/01/2014	SB	AM	9:00	15:00	6:00	W20	5/8	Showers	
12/01/2014	SB	DH	9:00	9:34	0:34	W10	6/8	Overcast	
12/01/2014	SB	DMD	9:07	15:21	6:14	SW20	5/8	Overcast	
12/01/2014	SB	NTS	9:07	15:21	6:14	SW20	5/8	Overcast	
12/01/2014	SB	SAM	9:00	15:20	6:20	W10	6/8	Overcast	

Appendix 8: Preliminary cause of death for autopsied pups.

Sarah Michael & Wendi Roe (Data courtesy of Massey University and Deepwater Group Ltd)

Between the 10 January and 8 March 2014, 73 pups, 1 juvenile and 2 adults were found dead in the Sandy Bay area of Enderby Island and all except two decomposed pups found on arrival were necropsied. Four pups underwent post mortem prior to tagging with the remainder after tagging. Post tagging pup necropsies were all pups of Sandy Bay origin except for 2 tagged at Dundas Island and 6 untagged (but presumed Dundas origin) pups.

Preliminary gross necropsy results for pups indicated that 66% (n=47) had lesions consistent with infection. Histopathology and microbiology of cases processed to date (7 May 2014) have confirmed these cases as well as identified other cases that were not immediately obvious on initial necropsy. Following initial histopathological and microbiological examination, 69% (n=49) of pup deaths have so far been attributed to infectious causes, of which 68% (n=48) were specifically a result of *Klebsiella pneumoniae* infection. Further testing is continuing on remaining samples.

Primary diagnosis based on gross examination and initial histopathology is outlined in Figure 1 below. Infection was the most common cause of death, followed by open diagnosis cases (including those severely decomposed or scavenged) and starvation. Only three pups died due to trauma and no pups were thought to have died directly as a result of hookworm infestation. Although almost all pups had hookworms present in their small intestine and some had evidence of associated enteric haemorrhage, these pups also were suffering from *Klebsiella* infection, which is a more life-threatening disease process and was more likely to have caused the death of the pup acutely.

Figure 1. Primary cause of death in pups at Sandy Bay, Enderby Island