

FINAL

Report for CSP Project
New Zealand sea lion
monitoring at the
Auckland Islands 2016/17

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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 the CSP Project New Zealand sea lion (NZSL) monitoring at the Auckland Islands 2016/17. The field component of the work was completed on 21 January 2017. In summary:

- Pup production was estimated for NZSL colonies at Sandy Bay (n=349), Dundas Island (n=1,549), Figure of Eight Island (n=67) and South East Point (n=0); with total pup production for the Auckland Islands in 2016/17 estimated as **1,965**. The estimate for 2016/17 is 14% higher than for 2015/16 and is 31% higher than the lowest ever estimate for pup production in 2008/09. Since the lowest ever record of total pup production at the Auckland Islands in 2008/09, pup production has seen annual increases in six of the last eight years and overall production appears to have stabilised at around 1500-2000 pups per annum since 2008/09. While the stabilisation of total pup production is a positive step, it is important to note that pup production in 2016/17 still represents a 35% decline since the peak in 1997/98. The good news is that the estimate for 2016/17 is 31% higher than the lowest ever estimate for pup production of 1501 pups seen in 2008/09.
- Estimates of pup mortality to the date of the pup production estimate in mid-January are broadly comparable to previous 'non-epidemic' years. However, many of these figures do not represent full season surveys and are not directly comparable to data collected prior to 2012/13, and so should be viewed as a minimum. Pup mortality estimates to the date of pup count are: Sandy Bay 6% (to 16 January), Dundas Island 9% (to 19 January) and Figure of Eight Island 22% (to 21 January) and overall for all sites 9%.
- Mean pup weights in 2016/17 were all higher than in 2015/16. At Sandy Bay were 2% and 9% higher than for females and males respectively. Mean pup weights at Dundas Island were 13% and 4% higher for females and males respectively. Mean pup weights at Figure of Eight Island were 19% and 20% higher for females and males respectively;
- Seven hundred and seventy five pups were marked at the Auckland Islands including: Sandy Bay – 328 flipper tagged and microchipped; Dundas Island – 400 flipper tagged only; and Figure of Eight Island – 47 flipper tagged only;
- Provisional cause of death was not part of this contract and will be reported separately by DOC;
- There was only a small amount of resighting effort conducted as part of this project as there was no time allocated to it. Additional limited resighting effort is being undertaken by DOC personnel remaining on Enderby Island;
- To the date of this report, there were few reports of pup mortalities in holes due to the fact that pups at Sandy Bay have yet to reach the areas with holes and also that some additional ramps were added to key spots on Dundas Island last year which has likely contributed to the lower observed rate of mortality in holes out there;
- A helicopter (funded separately by Deepwater Group and MPI) was used for normal operations but was also used to transfer the survey team to Figure of Eight Island which was very effective reducing the survey time required from three days to one day; and
- Overall, the project was a success and all objectives were completed.

2. Methodology

Blue Planet Marine (BPM) was contracted by the Conservation Services Programme (CSP) of the Department of Conservation (DOC) to provide services for the CSP funded New Zealand sea lion Auckland Island monitoring project for 2016/17.

A full description of methods used in this field study are available in Childerhouse (2016), which is available from DOC 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). The only major differences to survey work undertaken prior to 2012/13 include:

- dead pups were removed at Sandy Bay from the start of the breeding season whenever possible to allow for autopsy and the determination of cause of death;
- a helicopter was used to transport the survey team to Figure of Eight Island for the first time rather than a vessel as has been used previously;
- the survey of Figure of Eight Island was undertaken on 21 January but the normal date is 10 January. The delay was due to the late arrival of the helicopter due to consistent and extended bad weather;
- no dedicated resighting effort was required but rather it was to be undertaken when time allowed after completion of core monitoring work; and
- only 8 days of field work were contracted for 2016/17 season compared with approximately 6-7 weeks for previous seasons (e.g. 48 days in 2015/16 – 2 weeks pup census and tagging & 5 weeks resighting).

A team of four sea lion researchers (Childerhouse, Burns, French, Muller) and one wildlife vet (Michael) undertook the counts and marking work. Several researchers will remain on Enderby Island under a separate contract until March 2017 to investigate disease and mortality in pups and this work will be reported separately.

3. Results

3.1 Logistics

A summary of key dates:

- 8 January – One researcher departed Bluff aboard *RV Baltazar* for the Auckland Islands;
- 10 January – Arrived Enderby Island, Auckland Islands and joined the three other team members already on the Island;
- 14-16 January – Survey and pup marking at Sandy Bay;
- 18 January – Helicopter arrived Enderby Island
- 18-20 January – Survey and pup marking at Dundas Island;
- 21 January – Survey & pup count at Figure of Eight Island; and
- 22 January – One researcher departed Enderby Island aboard helicopter.

The field work included 4 days on Enderby Island, 3 days on Dundas Island, 1 day on Figure of Eight Island, and no survey effort on any other Island. There were researchers on Enderby Island from mid November involved in Yellow Eyed Penguin research and from mid December involved in NZSL pup disease and mortality work. Both these projects were operating under separate DOC contracts and reported on separately.

The team of researchers undertaking the primary research included: Simon Childerhouse, Thomas Burns, Rebecca French, and Chris Muller. In addition, the following people also provide excellent support in the Auckland Islands: Sarah Michael, Shannon Taylor and Katie Clemens-Seely. The data in this report are a credit to the hard work, dedication and expertise of these people.

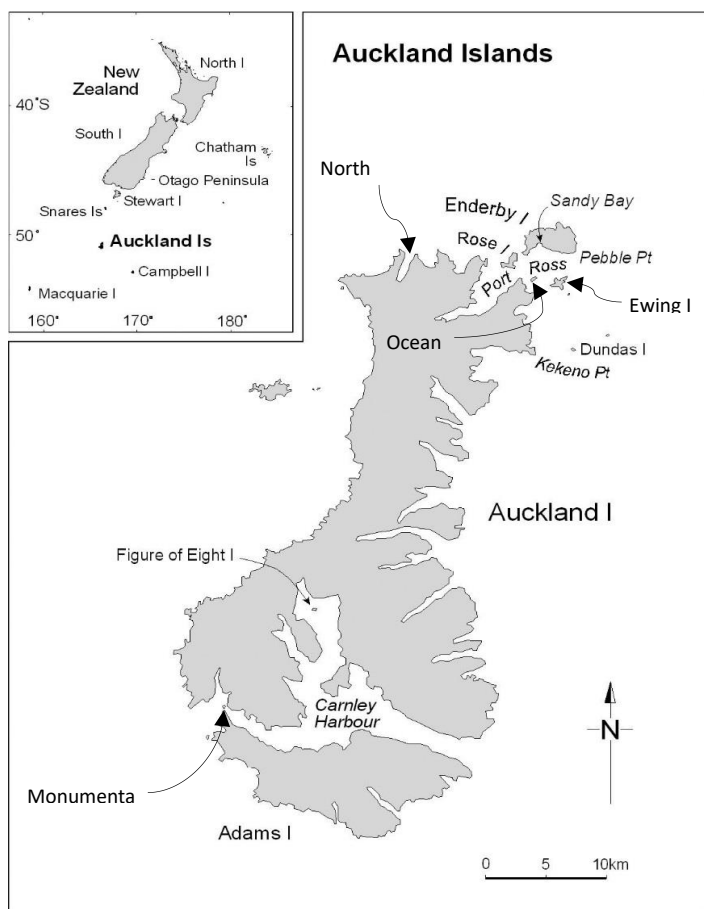


Figure 1: Map of the Auckland Islands showing sites mentioned in the text.

3.2 Estimates of pup production

Annual estimates of pup production for each colony and for total Auckland Islands pup production from 1994/95 until 2016/17 are shown in Appendix 1. Figures showing annual estimates for pup production by colony are shown in Appendix 2.

3.2.1 Sandy Bay, Enderby Island

Table 1: Summary of pup production estimates for Sandy Bay for 2016/17

Method	Date	No. counts	Start/end time	Estimate (SE)
Mean direct live count	16 Jan 2017	9	08:05/10:22	325 (3.5)
Cumulative dead count to the day of the mark-recapture ¹	16 Jan 2017	N/A	08:05/10:22	21
Mean mark-recapture estimate	16 Jan 2017	9	08:05/10:22	324 (3.7)
Total number pups individually marked	16-17 Jan 2017	N/A	N/A	328

Total pup production for Sandy Bay is estimated at **349** (328 live plus 21 dead pups) for 2016/17. This estimate uses the number of live pups tagged on the 15 and 16 January rather than the mark-recapture estimate of abundance as it is more accurate. This total is 9% higher than the estimate for

¹ This represents the cumulative total from daily observations of dead pups from observations starting on 6 December 2016 and therefore provides a good estimation of total pup mortality.

previous season and is the second year in a row with an increase in pup production. Figures showing annual estimates for Sandy Bay colony are shown in Appendix 1 and Appendix 2. Raw data for counts at each of the colonies are provided in Appendix 3. The estimate of mortality to the 16 January 2017 was 6% which broadly consistent with the long-term average (1994/95-2015/16) of 7% but noting that this year's estimate represents a complete season count whereas previously, many years only represent a count from early January onwards.

Estimates of pup production at Sandy Bay were completed successfully. Nine mark-recapture counts by four people were undertaken and 10 direct counts by six people were undertaken of live pups (Appendix 3). In addition, a daily direct count of was undertaken daily between 6 December and 18 January 2017 (Appendix 5). A description of the breeding area searched during pup counts at Sandy Bay is provided in Appendix 4. Observations at Sandy Bay provided good evidence that many mothers moved their pups away from the breeding beach and onto the sward and forest at least one week earlier than is normally the case as normally almost all pups are still on the beach for the mark recapture but this year, perhaps as many as 25% were up on the sward and even along the edge of the forest.

One hundred and thirty caps were used as marks for the mark-recapture and were put out on 15 January (between 08:30 and 16:30). One cap was recovered from the ground prior to starting the mark-recapture counts on the 16 January. The number of marked pups was, therefore, considered to be 129 for the purposes of the mark-recapture estimation (Appendix 3).

The methodology for estimating the number of dead pups has varied over the years. Prior to 2012/13, all dead pups were counted daily (generally starting early December) and removed from the beach for autopsy throughout the season. This therefore represents a cumulative and complete seasonal count of dead pups. 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 dead counts were made on January 11 when the team arrived with no counts prior to this. For 2013/14 and 2014/15, all dead pups found on the beach during the first survey on 8 January were counted and removed. Therefore between 2012/13 and 2014/15, these counts represent incomplete season counts. This year and in 2015/16, there was a cumulative and complete count from mid November until around 19 January. Overall, it is important to be aware of the different timing and methods used to estimate the number of dead pups at Sandy Bay as incomplete season counts will be underestimates.

3.2.2 Dundas Island

Table 2: Summary of pup production estimates for Dundas Island for 2016/17

Method	Date	No. of counts	Start/end time	Estimate (SE)
Mean direct live count	18 Jan 2017	4	08:35/11:45	1274 (19.9)
Mean direct dead count	18 Jan 2017	3	08:35/11:45	134 (0)
Mean mark-recapture estimate	18 Jan 2017	9	08:35/11:45	1415 (21.7)
Total number pups tagged	18-20 Jan 2017	N/A	N/A	400 (100 male, 300 female)

Total pup production for Dundas Island is estimated at **1549** (1415 live plus 134 dead pups). The estimate for 2016/17 was 15% higher than the estimate for 2015/16 and is the third year in a row of increasing pup production. Figures showing annual estimates for Dundas Island colony are shown in Appendix 2. Pup mortality to 18 January was estimated as 9%, which is slightly lower than the long-term average (1994/95-2015/16) of 10%. 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.

Estimates of pup production at Dundas Island were completed successfully. Nine mark-recapture counts were undertaken by four different people and four direct counts by four different people were undertaken for live pups. Three direct counts of dead pups were undertaken by the whole four-person team working together and all dead pups found were marked with spray paint to avoid recounting.

Four hundred mark-recapture caps were put out on pups on 18 January on Dundas Island. The approximate location of the pups that 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 and no caps were recovered from the ground prior to starting the mark-recapture counts on 19 January. The number of marked pups was, therefore, considered to be 400 for the purposes of the mark-recapture estimation (Appendix 3).

3.2.3 Figure of Eight Island

Table 3: Summary of pup production estimates for Figure of Eight Island for 2016/17

Method	Date	No. of counts	Estimate (SE)
Mean direct live count	21 Jan 2017	3	52 (0.0)
Mean direct dead count	21 Jan 2017	3	15 (0.0)
Total number pups tagged	21 Jan 2017	N/A	47

Total pup production for Figure of Eight Island is estimated at **67** (52 live plus 15 dead pups). The estimate for 2016/17 was 14% higher than the previous year's estimate. Figures showing annual estimates for Figure of Eight Island colony are shown in Appendix 2. Pup mortality to 21 January was estimated as 22% which is the equal highest level reported (shared with 1995/96 and 2014/15) compared with the long term (1995/96-20015/16) average of 10%. Raw data for counts at Figure of Eight Island are provided in Appendix 3.

Estimates of pup production at Figure of Eight Island were completed successfully. Three direct live counts were undertaken by three different people and three direct dead counts were undertaken by the whole team.

The count at Figure of Eight Island was later than usual (e.g. 21 rather than 10 January) and most of the pups had moved away from the normal breeding area to further west on the Island. We also heard females calling pups on the main Auckland Island across from Figure of Eight Island which is highly unusual and so believe that some mothers had already taken their pups away from Figure of Eight Island prior to our arrival and so consider the estimate of live pup production to be a minimum count only. This is also consistent with observations at Sandy Bay where mothers moved their pups away from the breeding beach and onto the sward and forest at least one week earlier than is normally the case.

3.2.4 South East Point, Enderby Island

Table 4: Summary of pup production estimates for South East Point for 2016/17.

Method	Date	Estimate (SE)
Direct live count	10 Jan 2016	0
Direct dead count	10 Jan 2016	0
Total number pups tagged	10 Jan 2016	0

Total pup production for South East Point is estimated at **0** (0 live plus 0 dead pups). There has been no pup production recorded at South East Point since 2011/12. Figures showing annual estimates for South East Point colony are shown in Appendix 2.

3.2.5 Total pup production for the Auckland Islands

Overall, total pup production for the Auckland Islands in 2016/17 was estimated to be 1965 pups (1795 live pups and 170 dead pups). This total represents an overall increase of 14% from the 2015/16 estimate and is the third year in a row with a positive increase.

The long-term pattern in total Auckland Island pup production shows some clear inflection points in the series with a maximum recorded in 1997/98 and a minimum recorded in 2008/09 (Figure 2). There was a significant increase in the series from when consistent records started in 1994/95 until a peak in 1997/98, followed by a period of significant decline from 1997/98 until a low point in 2008/09. Between 2008/09 and 2016/17, total pup production has varied between 1550 and 1965 with apparently no significant trend either upward or downward over this period.

A steep decline in total pup production was seen from 1997/98 until 2008/2009 but numbers have not fallen below the 2008/09 value since that time. Since the lowest ever record of total pup production at the Auckland Islands in 2008/09, pup production has seen annual increases in six of the last eight years and overall production appears to have stabilised at around 1500-2000 pups per annum since 2008/09. While the stabilisation of total pup production is a positive step, it is important to note that pup production in 2016/17 still represents a 35% decline since the peak in 1997/98. The good news is that the estimate for 2016/17 is 31% higher than the lowest ever estimate for pup production of 1501 pups seen in 2008/09.

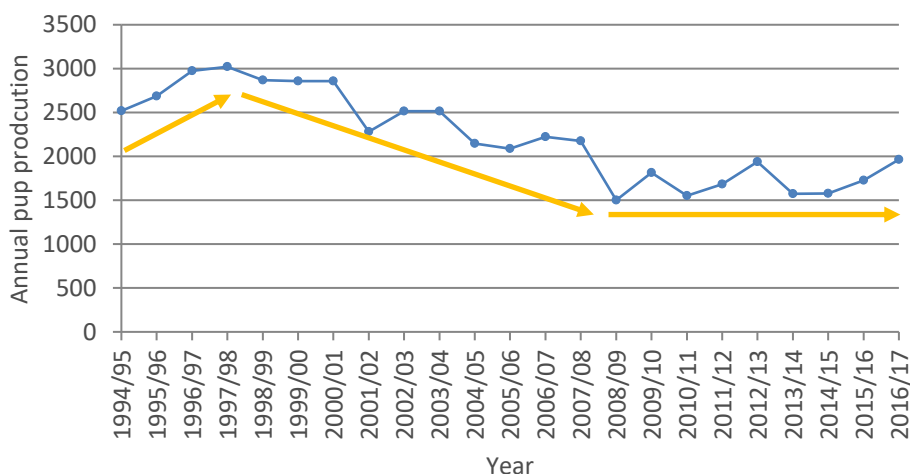


Figure 2: Total estimated pup production for New Zealand sea lions at the Auckland Islands 1994/95 – 2016/17. (Data prior to 2012/13 from Chilvers (2012)).

3.3 Pup weights

Table 5: Summary of mean pup weights for the Auckland Islands for 2016/17

Location	Mean female weight			Mean male weight		
	n	Kg (SE)	Change from 2015/16	n	kg (SE)	Change from 2015/16
Sandy Bay	50	11.9 (0.3)	+2%	50	13.6 (0.3)	+9%
Dundas Island	50	11.3 (0.3)	+13%	50	11.8 (0.3)	+4%
Figure of Eight Island	28	12.1 (0.4)	+19%	19	13.3 (0.7)	+20%

A random sample of 100 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). For the third year, pup weights were also collected from pups (n=47) at Figure of Eight Island. Mean pup weights from previous surveys at Sandy Bay, Dundas Island and Figure of Eight Island are show in Figure 3, Figure 4, and Figure 5. For the second year, length and axillary girth measurements were also taken from all individuals that were weighed.

There were positive increases from the previous year which is consistent with anecdotal observations that adult female condition was better in 2016/17 than 2015/16 although no formal measurements were collected.

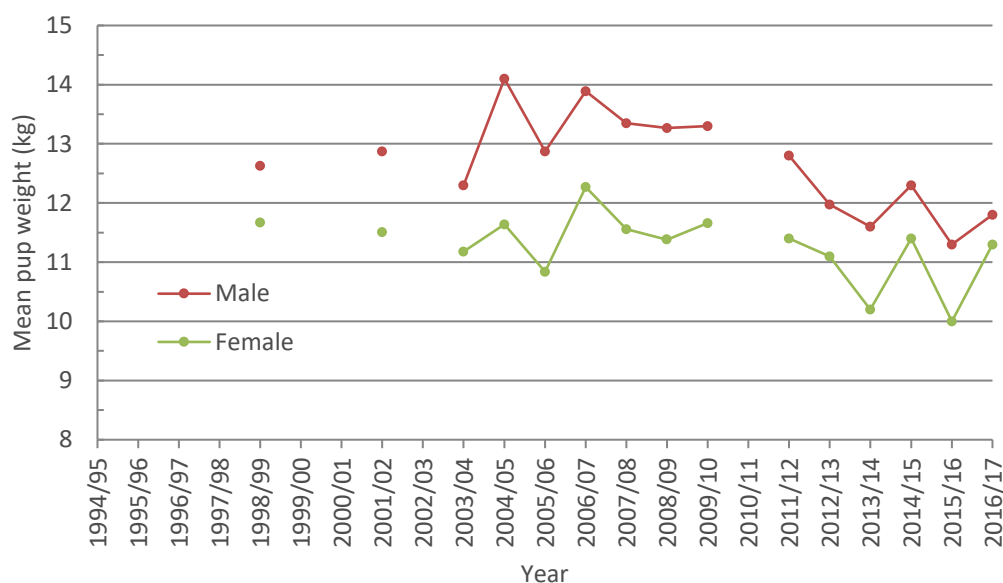


Figure 3: Mean pup weights for Dundas Island colony by sex 1994/95 – 2016/17. (Data prior to 2012/13 from Chilvers (2012)).

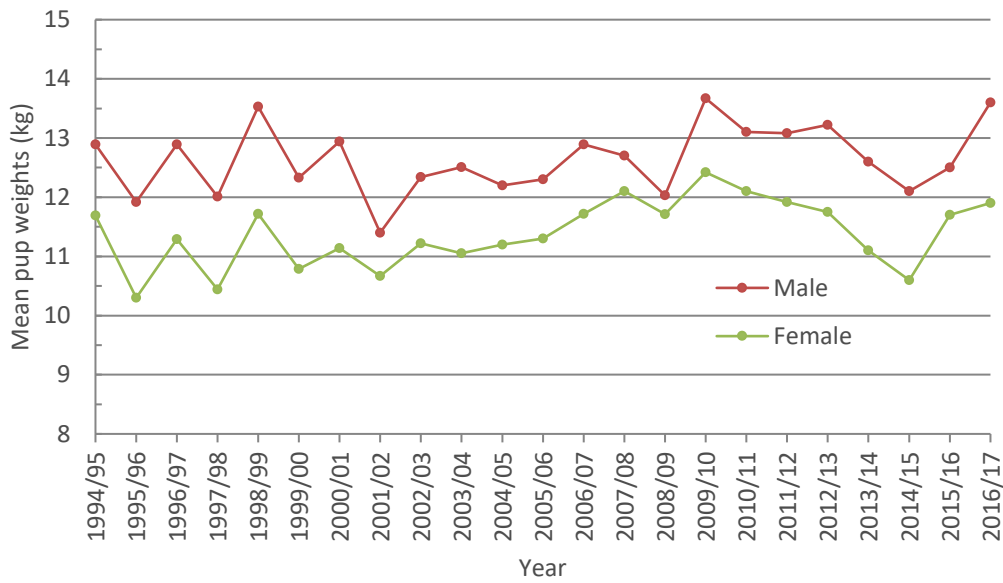


Figure 4: Mean pup weights for Sandy Bay colony by sex 1994/95 – 2016/17. (Data prior to 2012/13 from Chilvers (2012)).

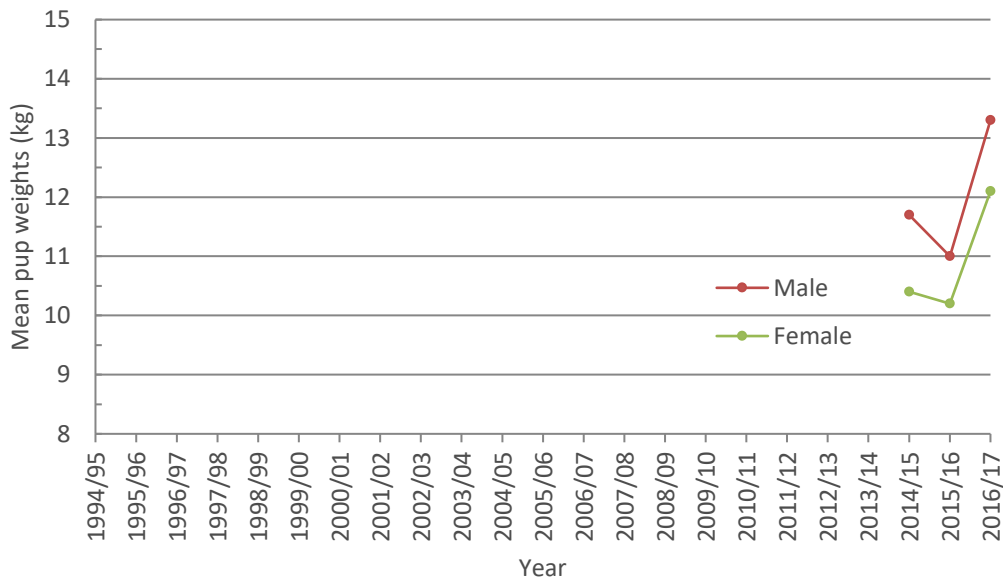


Figure 5: Mean pup weights for Figure of Eight colony by sex 1994/95 – 2016/17. (Data prior to 2012/13 from Chilvers (2012)).

3.4 Direct counts at Sandy Bay

Direct counts of live and dead pups, adult females, adult and sub-adult males were made at Sandy Bay from 11 November to 22 January 2016 (Figure 6). This is the second year since 2011/12 that there has been a complete count at Sandy Bay since the beginning of the breeding season which includes a cumulative count of dead pups. Data prior to 10 January kindly provided by Sarah Michael (University

of Sydney/Massey University). There were no counts of juvenile and adult males undertaken between 15 December and 10 January.

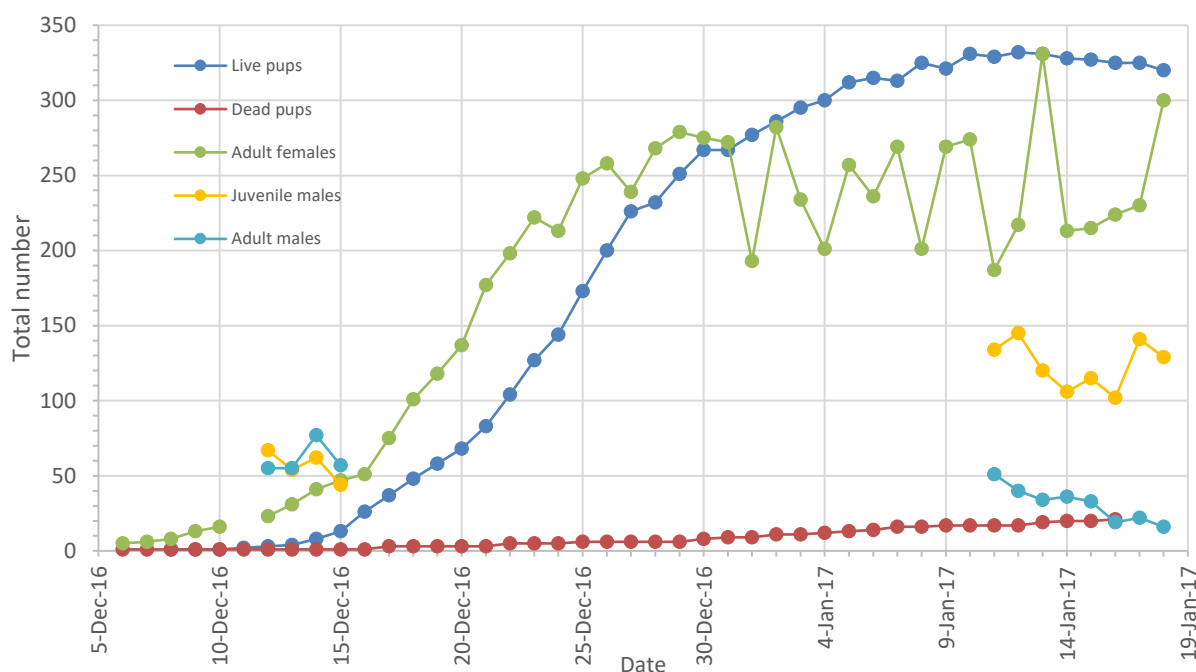


Figure 6: NZ sea lion counts at Sandy Bay, Enderby Island 2016/17

3.5 Tagging and micro-chipping

Flipper tagging and subcutaneous micro-chipping were also undertaken as part of the project. A summary of pup marking was:

- Dundas Island – 400 pups double flipper tagged (100 males and 300 females);
- Figure of Eight Island – 47 pups double flipper tagged (28 females, 19 males) which was as many as could be tagged in the time available; and
- Sandy Bay - Most pups were microchipped as close to their birth as possible but this work will be reported separately by Sarah Michael. All live pups on 16 January were double flipper tagged and microchipped (if they didn't already have one). Overall, a total of 328 live pups were tagged and microchipped.

All data (including weight, sex, length, girth) from tagged and microchipped pups will be added into the NZSL database as part of this contract.

3.6 Tagging and micro-chipping review

Most microchips at Sandy Bay were implanted close to the birth date of the pup rather than during the tagging normally undertaken during 15-17 January. Preliminary analysis of the microchip retention suggests that 100% of the microchips implanted near birth were still present when they were checked during tagging. By contrast, in 2015/16, when microchip retention rates were checked 6 days post implantation there was found to be 13% loss rate. This significant reduction in microchip loss rate is most likely due to more experienced personnel undertaking the implanting in 2016/17 and that more time was taken (e.g. >300 pups are tagged and chipped during 2 days in previous years compared with >250 pups microchipped one at a time over a one month period). This

highlights the importance of allowing sufficient time to undertake the tagging and microchipping and the importance of experience and training.

There were some issues with the flipper tags this season and so some changes to previous practices had to be made. Specifically:

- Male and female parts of the tag were different colours (they are normally the same colour) with the male part being yellow and the female part being green. This is the first time that multi-coloured tags have been used and may lead to complications in resighting in future as if the tag is seen from below it will be designated yellow but if seen from the top it will be designated as green. This may require some changes to the NZSL database to allow for the input of tag numbers with either green or yellow tag colour as, based on the present system, a record can only be uploaded if the tag number corresponds to the correct (single) tag colour; and
- The numbers on the female part of the tag were printed on the lower side of the tag rather than the upper side of the tag. This means that they would have been impossible to read if they had been put out in the normal manner. Therefore, the decision was made to put the female part of the tag upside down so that the tag number was facing outwards and not inwards. It is unknown if this may influence tag retention rates but is a factor that should be explored with the tag supplier. It may also require separate consideration in any future modelling of tag loss for demographic analysis.

It is recommended that DOC carefully review these issues and that future tags are ordered and arrive so they can be checked long before the start of the field season.

3.7 Resighting effort and data management

A total of 8 days field work were contracted for as part of the 2016/17 CSP contract compared with approximately 6-7 weeks for previous seasons (e.g. 48 days in 2015/16 – 2 weeks census & 5 weeks resighting). No dedicated resighting effort was specified in the contract but rather it was to be undertaken when time allowed after completion of core monitoring work this contract. Limited opportunistic tag and microchip resighting was undertaken as part of this contract with approximately several hundred resights collected compared with 6,411 collected in 2015/16. All resights will be checked and added into the NZSL database.

Additional limited resighting effort was undertaken by other DOC personnel working on the Island (e.g. ~4 hours per week per person) as time allowed and this will be reported separately by DOC.

3.8 Mitigation of pup mortality in holes

Death of NZSL pups in holes has been identified as a significant source of mortality for pups at both Sandy Bay and Dundas Island during previous years. At the time of writing this report, pups at Sandy Bay were only starting to move into areas where holes and ramps are present but on 21 January one pup was removed from the hole that it was stuck in. Teams still on the Island will continue to monitor this and it will be reported separately by DOC.

The survey of Dundas Island on 19 January yielded 134 dead pups but only 12 of these were attributed to pups stuck in holes which is lower than previously seen. There are few possible explanations: (i) the addition of some new ramps in problematic sites has allowed pups that would previously died to escape; (ii) this season the weather had been wetter than normal and many holes were full of water and/or mud was more liquid allowing pups to swim more easily and escape. During the three days' survey work on Dundas, 31 additional pups were removed from holes as they started to move into new areas with holes. Some of these may have been able to free themselves, but a high proportion of this number wouldn't. It is recommended that additional ramps should be placed out at Dundas in places where it is very difficult or impossible for pups to exit.

3.9 Preliminary assessments of cause of death in pups

This work does not form part of this contract and will be reported separately by DOC.

3.10 Summary of other work undertaken

No additional work was undertaken this season due to the short field season but some work will be the undertaken by the other DOC research teams on the Island and will be reported separately.

4. Acknowledgements

This project is funded by the Department of Conservation's Conservation Services Programme through levies on the commercial fishing industry. This research would not have been possible without the support of many people, and for which we are very grateful:

- Andy Whittaker, master of the *RV Baltazar*, and his crew were extremely professional and accommodating and the *RV Baltazar* was an excellent vessel for the work;
- DOC staff including Katie Clemens-Seely, Laura Boren, Sharon Trainor, Jo Hiscock, Joseph Roberts;
- Deepwater Group (especially Richard Wells), Seafood New Zealand and MPI for funding to support a helicopter;
- Southern Lakes Helicopters and Mark Hayes for helicopter support;
- The Auckland Islands helicopter team of Barry Baker, Mark Hayes and Katie Clemens-Seely for excellent company and support;
- Shannon Taylor for her help with field work; and
- Members of the CSP Technical Working Group who provided useful feedback on this project.

5. References

Childerhouse SJ (2016) Methodology for New Zealand sea lion population monitoring Auckland Islands 2016/17. Unpublished paper presented to the Conservation Services Programme, Department of Conservation, New Zealand. BPM document number: BPM-16-Methodology for CSP Project NZ sea lion ground component 2016-17 v1.0. 9 p.

Chilvers BL (2012) 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.

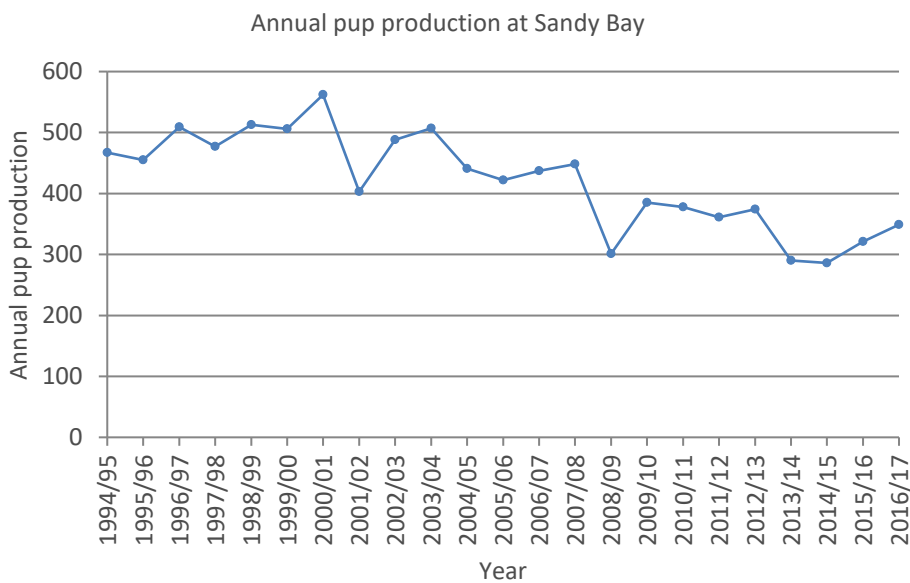
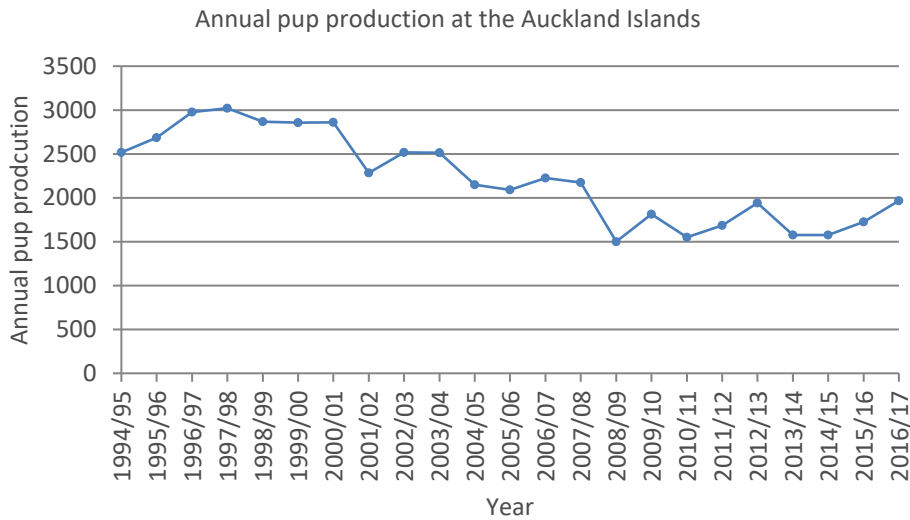
Appendix 1: Annual estimates of live, dead and total pup production for each colony and for total Auckland Islands pup production 1994/95 – 2016/17

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

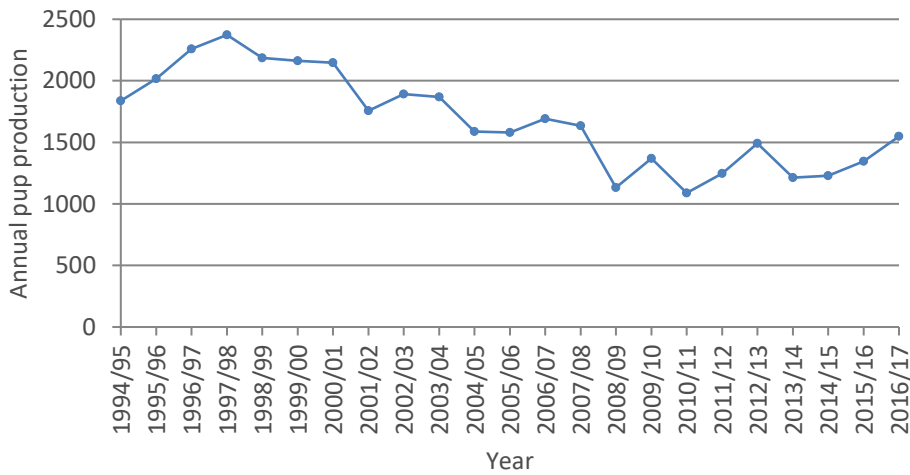
Year	Sandy Bay			Dundas Island			Figure of Eight Island			South East Point			Total Auckland Islands		
	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total	Live	Dead
1994/95	467	421	46	1837	1603	234	143	123	20	71	59	12	2518	2206	312
1995/96	455	417	38	2017	1810	207	144	113	31	69	49	20	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
2014/15	286	279	7	1230	1163	67	60	47	13	0	0	0	1576	1489	87
2015/16	321	308	13	1347	1221	126	59	53	6	0	0	0	1727	1582	145
2016/17	349	328	21	1549	1415	134	67	52	15	0	0	0	1965	1795	170

Appendix 2: Annual estimates of total pup production for each colony and for total Auckland Islands pup production to 2016/17

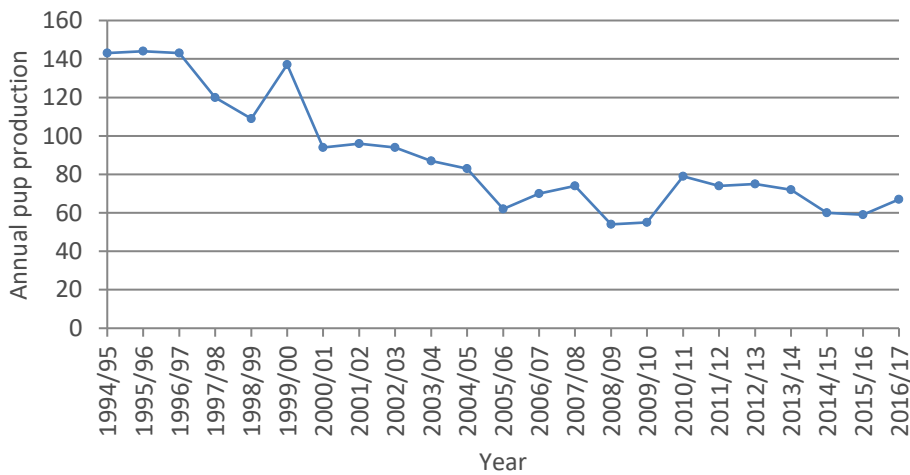
(NB. Data prior to 2012/13 from Chilvers (2012))



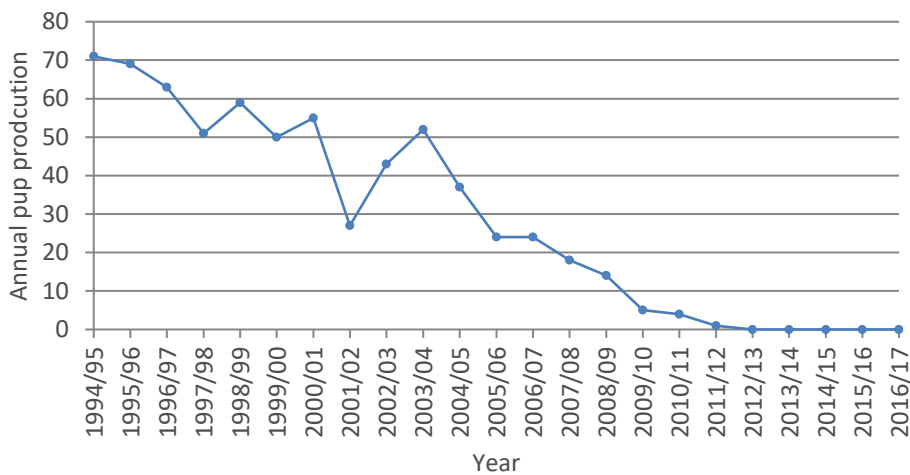
Annual pup production at Dundas Island



Annual pup production at Figure of Eight Island



Annual pup production at South East Point



Appendix 3: Raw data for pup production estimates for Sandy Bay, Dundas Island and Figure of Eight Island²

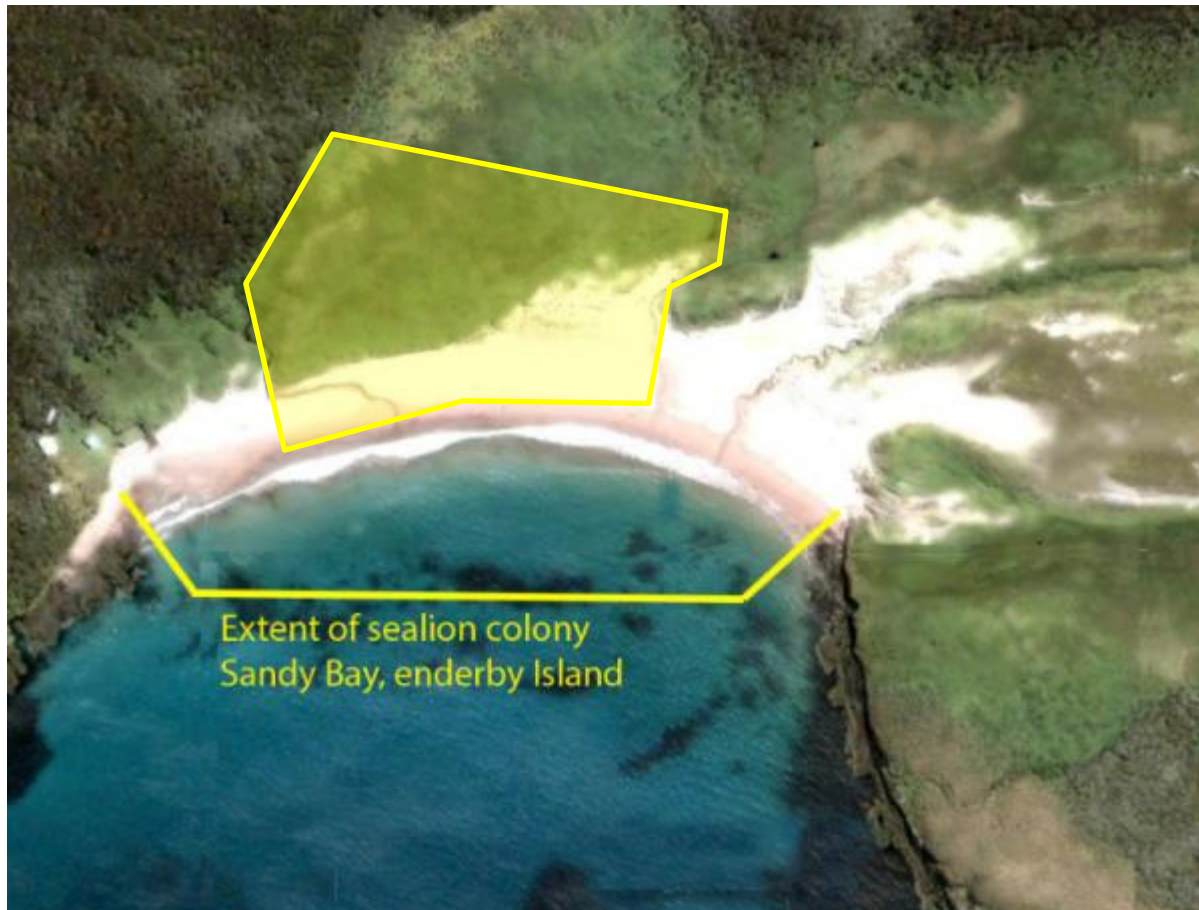
Mark recapture individual counts for Sandy Bay, 16 January 2017		
No. of animals marked = 129 (i.e. 1 cap found (i.e. fell off) before MR)		
	Number marked counted	Number unmarked counted
Counter 1-1	116	164
Counter 1-2	108	170
Counter 1-3	115	175
Counter 2-1	92	140
Counter 2-2	97	159
Counter 3-1	107	173
Counter 3-2	107	164
Counter 4-1	92	127
Counter 4-2	104	152
Direct live pups counts for Sandy Bay, 16 January 2016		
	Number counted	
Counter 1-1	318	
Counter 2-1	302	
Counter 3-1	323	
Counter 4-1	322	
Counter 4-2	330	
Counter 5-1	327	
Counter 5-2	344	
Counter 6-1	322	
Counter 6-2	326	
Counter 6-3	336	
Cumulative dead pup counts for Sandy Bay to 16 January 2017		
	Cumulative number counted	
Cumulative count	21	

² The identity of the individual counters is indicated by “Counter 1” being the first person, “Counter 2” being the second, etc. This identifier is used throughout all the counts in this Appendix but is not consistent with previous years. Details of counters is available from DOC.

Mark recapture estimates for Dundas Island, 19 January 2017		
No. of animals marked = 400 (i.e. 0 caps found (i.e. fell off) before MR)		
	Number marked counted	Number unmarked counted
Counter 1-1	281	691
Counter 1-2	243	677
Counter 1-3	283	782
Counter 3-1	290	698
Counter 3-2	293	682
Counter 4-1	298	710
Counter 4-2	288	744
Counter 5-1	210	551
Counter 5-2	261	662
Direct counts for number of live pups for Dundas Island, 19 January 2017		
	Number counted	
Counter 1-1	1316	
Counter 3-1	1277	
Counter 4-1	1283	
Counter 5-1	1220	
Direct counts for number of dead pups for Dundas Island, 19 January 2017		
	Number counted	
Count 1	134	
Count 2	134	
Count 3	134	
Direct counts for number of live pups for Figure of Eight Island, 21 January 2017		
	Number counted	
Counter 1-1	52	
Counter 3-1	52	
Counter 4-1	52	
Direct counts for number of dead pups for Figure of Eight Island, 21 January 2017		
	Number counted	
Counter 1-1	15	
Counter 3-1	15	
Counter 4-1	15	

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, the areas over which pups were spread and the was mark-recapture undertaken is indicated by the yellow shape.



This image is taken with permission 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 and Forestry, Deepwater Group Limited and Department of Conservation. 11 p.

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

Date	Location	Live pups	Daily dead pups	Cumulative dead pups	Adult females	Sub-adult males	Adult males
6-Dec-16			1	1	5		
7-Dec-16	SB		0	1	6		
8-Dec-16	SB	1	0	1	8		
9-Dec-16	SB	1	0	1	13		
10-Dec-16	SB	1	0	1	16		
11-Dec-16	SB	2	0	1			
12-Dec-16	SB	3	0	1	23	67	55
13-Dec-16	SB	4	0	1	31	54	55
14-Dec-16	SB	8	0	1	41	62	77
15-Dec-16	SB	13	0	1	47	44	57
16-Dec-16	SB	26	0	1	51		
17-Dec-16	SB	37	2	3	75		
18-Dec-16	SB	48	0	3	101		
19-Dec-16	SB	58	0	3	118		
20-Dec-16	SB	68	0	3	137		
21-Dec-16	SB	83	0	3	177		
22-Dec-16	SB	104	2	5	198		
23-Dec-16	SB	127	0	5	222		
24-Dec-16	SB	144	0	5	213		
25-Dec-16	SB	173	1	6	248		
26-Dec-16	SB	200	0	6	258		
27-Dec-16	SB	226	0	6	239		
28-Dec-16	SB	232	0	6	268		
29-Dec-16	SB	251	0	6	279		
30-Dec-16	SB	267	2	8	275		
31-Dec-16	SB	267	1	9	272		
1-Jan-17	SB	277	0	9	193		
2-Jan-17	SB	286	2	11	282		
3-Jan-17	SB	295	0	11	234		
4-Jan-17	SB	300	1	12	201		
5-Jan-17	SB	312	1	13	257		
6-Jan-17	SB	315	1	14	236		
7-Jan-17	SB	313	2	16	269		
8-Jan-17	SB	325	0	16	201		
9-Jan-17	SB	321	1	17	269		
10-Jan-17	SB	331	0	17	274		
11-Jan-17	SB	329	0	17	187	134	51
12-Jan-17	SB	332	0	17	217	145	40
13-Jan-17	SB	331	2	19	331	120	34
14-Jan-17	SB	328	1	20	213	106	36
15-Jan-17	SB	327	0	20	215	115	33

Date	Location	Live pups	Daily dead pups	Cumulative dead pups	Adult females	Sub-adult males	Adult males
16-Jan-17	SB	325	1	21	224	102	19
17-Jan-17	SB	325	0	21	230	141	22
18-Jan-17	SB	320	2	23	300	129	16

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 were put out on Dundas Island for the mark phase of the mark-recapture. Please note that this aerial image of Dundas Island was provided by Barry Baker (Latitude 42) but is from 2011/12 and therefore the location of pups shown on this image does not reflect the location of pups in 2016/17 but has been used here for illustrative purposes.

