

Australian Marine Mammal Centre Grants Program

Final Report

(subclause 9 and Schedule Item 5 of the Funding Agreement)

- **Project No.** – 12/27
- **Title** - Australian fur seal pup production and population trends, 2013-14
- **Chief Investigators** – Duncan Sutherland*, Roger Kirkwood, John Arnould, Rachael Alderman, Sam Thalman*, Rebecca McIntosh* and Peter Dann
- **Co-Investigators** – Kris Carlyon and Steve Kirkman
- **Key Stakeholders** – Tony Mitchell, Darryl Burns, Simon Goldsworthy, Peter Shaughnessy*, DEPI Warrnambool*, Environment and Heritage NSW*, and Rob Harcourt*
- **Organisation** – Phillip Island Nature Parks

*Additional contributors brought in to complete the project.

Table of contents

1. Project Summary
2. The Outcomes and Objectives – Key Findings
3. Implications for Management
4. Other Benefits
5. Problems Encountered (if any)
6. Communication
7. Project Outputs

1. Project Summary

A clear, plain English summary of approximately 500 words outlining the work undertaken and any significant findings (for publication on the Department's web site). Include what was done, why and the key findings resulting in recommendations summarised from the sections below.

We estimated the number of live Australian fur seal pups at all known breeding colonies and pupping sites across its distribution following the pupping season of November-December 2013 to be $15,063 \pm 83$ (mean \pm se). The 2013 estimate is 6% per year less than the 2007 estimate of $21,882 \pm 185$ pups. It is not certain if the difference represents a decline over time or was caused by 2013 being a poor pupping season for the seals. Previously, pup production had increased at 5% per year between 1986 and 2002 and 0.3% per year between 2002 and 2007.

This research documents an overall reduction in pup production for the species characterised by fewer pups at established breeding colonies. Despite the drop in pup numbers we identified an expansion in range, several new sites colonised and increases in pup numbers at recently established sites.

Pups are born at breeding colonies and at haul-out sites (where pups are occasionally born), and only rarely at other locations. We designated a site as a breeding colony if at least 15 pups were born there in that season. This number was derived through discussion and is assumed to represent a level at which pups born have a good chance

of surviving the year and then surviving juvenile years and returning to the same site to breed.

Pups were recorded at 20 locations in 2013 (Table 1). Between 1986 and 2007, the species' distribution was concentrated mostly toward the Victorian coast, with 78% of pups at Victorian colonies in 2007. This remains the case in 2013 with 69% of pups born at Victorian colonies. Tasmanian islands accounted for 30% and NSW and South Australian islands 1% of pup production in 2013. The largest breeding colonies were Seal Rocks (27%), Lady Julia Percy Island (18%) and Kanowna Island (16%). Two colonies in Tasmanian Bass Strait produced a further 21% of pup production: Judgment Rocks (11%) and Reid Rocks (10%).

Prior to and including 2007, >50% of pup production was at just two sites, 25% at Seal Rocks and 25% at Lady Julia Percy. Lower pup productions at these sites in 2013 have altered this pattern. Particularly striking was the drop of 52% in pup numbers at Lady Julia Percy, which in 2013 accounted for only 18% of total pup production. The large drop in the estimate of pups at Lady Julia Percy Island is cause for concern. Lady Julia Percy Island has a high prevalence of an alopecia syndrome that may directly cause high mortality rates or be an expression of another, yet to be recognised, stressor on the population (Lynch et al., 2011).

The species' continues to colonise new sites and those recently colonised sites are increasing (Table 1). For over 100 years (prior to 2002) the species bred at 9 colonies, then in 2007 there were 13 established breeding colonies and now in 2013 there are 17 breeding colonies. One newly recognised site and breeding colony named Sloop Rocks (16 pups) is on the central west coast of Tasmania and two newly identified haul-out sites with occasional pupping, Williams Island and Baudin Rocks (2 and 6 pups respectively) are located in South Australia. The sites that have moved up in status from haul-out with occasional pupping to breeding colony are Bull Rock (21 pups) in Tasmanian Bass Strait, Cape Bridgewater (120 pups) near the Victorian border with South Australia and Montague Island (19 pups) in NSW.

An estimated 18,000 pups were born in 2013, calculated from the number of live pups observed and a pup mortality rate of 15% (Kirkwood et al., 2010; Pemberton and Kirkwood, 1994; Warneke, 1975). This historically derived estimate of pup mortality was tested by counting dead pups at Seal Rocks in 2013. Carcasses of 695 pups were evident at Seal Rocks at the time of the pup census, representing 14% of pups born. However, some pups would have been washed from the rocks prior to the census, so the rate is an under-estimate. Even so, the rate provides confidence in the 15% prediction of pup mortality.

Total population size for the species (adults, juveniles and pups) could not be estimated from this census data because the current multiplier of 4.5 used to calculate population size from pup production (Gibbens and Arnould, 2009) is only relevant to an increasing population. The relationship between pup production and population size can vary according to life history parameters such as survival and birth rates (Wickens and Shelton, 1992). For example, multiplying a low pup production estimate by a constant factor will underestimate the number of adults in the population if the low pup production estimate is the result of low birth rates rather than female mortality (Kirkman et al., 2010; Wickens and Shelton, 1992). The best

population estimate available is the 2007 estimate of 120,000 seals (Kirkwood et al., 2010).

Within Victoria, Tasmanian Bass Strait and New South Wales, an estimated total of 198 ± 13 live New Zealand fur seal pups were identified at four breeding colonies (Table 2): Cape Bridgewater (102 pups), Lady Julia Percy Island (24 pups), The Skerries (37 pups) and Montague Is (35 pups). An estimate could not be obtained at Kanowna Island because of the territorial bulls excluding the researchers (J. Arnould pers. comm.). This is a slight increase on previous numbers (184 pups estimated in 2008) of New Zealand fur seals in Victoria, Tasmanian Bass Strait and New South Wales (Kirkwood et al., 2009). The largest increases were at Cape Bridgewater and Montague Island (Table 2). In 1998, one pup was identified on Montague Island (Shaughnessy et al., 2001), making the estimate of 35 New Zealand fur seal pups there in 2013 a significant finding.

Due to the dynamic nature of the population sizes and distributions for these two species and the changing patterns of interaction between the species, their environment and fisheries, it is recommended that this monitoring program be maintained at five-year intervals.

Table 1. Estimated Australian fur seal pup numbers following the Nov-Dec 2013 pup production period compared with estimates in previous species-wide surveys, following Dec-Nov. 2002 and 2007 pupping periods (Kirkwood et al. 2005, 2010). The status of the sites are identified as breeding colonies (colonies) or haul-outs with occasional pupping (HOOP) and those with a change in status or that were identified for the first time in this census are shown as ‘New’. The estimated number of pups born in 2013 (Est. pups born 2013) incorporates an estimate of 15% pup mortality accrued prior to the census (see Kirkwood et al. 2010).

Location and year of census	Status	2002	SE	2007	SE	2013	SE	Est. pups born 2013*
VICTORIA								
Seal Rocks	Colony	4,882	51	5,660	83	4,092	38	4,800
Lady Julia Percy	Colony	5,899	43	5,574	73	2,659	16	3,100
Kanowna Is	Colony	2,301	21	2,913	110	2,429	27	2,900
The Skerries	Colony	2,486	41	2,705	31	815	17	960
Rag Is	Colony	30		277		295		350
Cape Bridgewater	New Colony	7		7		120		140
SUB-TOTAL		17,330	78	17,137	119	10,410	52	12,000
TASMANIA								
Judgement Rocks	Colony	2,427	100	2,387	75	1,710	24	2,000
Reid Rocks	Colony	384	39	886	52	1,570	60	1,800
Moriarty Rocks	Colony	1,007	8	598	9	486	9	600
West Moncoeur	Colony	257	6	204	6	256	3	300
Wright Rocks	Colony	5		130	1	187	2	220
Double Rocks	Colony			51		157	2	180
Tenth Is	Colony	124		448	20	138	4	160
Bull Rock	New Colony	7		7		21		25
Sloop Rocks	New Colony					16		19
Iles des Phoques	HOOP	1		0		10		12
Other	HOOP	2		4				
SUB-TOTAL		4,214	108	4,715	104	4,551	65	5,300
NEW SOUTH WALES								
Montague Is	New colony	1		2		19	0	22
SUB-TOTAL		1		2		19	0	22
SOUTH AUSTRALIA								
North Casuarina Is	Colony			28	1	75		88
Williams Is	New HOOP					2		2
Baudin Rocks	New HOOP					6		7
SUB-TOTAL						83		97
TOTAL ESTIMATE		19,820	135	21,882	185	15,063	83	18,000

*Values may not add up for the Total Estimate due to rounding of data to two significant figures.

Table 2. Estimated New Zealand fur seal pup numbers following the Nov-Dec 2013 pup production period compared with estimates in the 2008 surveys (Kirkwood et al. 2009). Values without SE are counts, except for The Skerries in 2013 where the SE was derived from multiple counts. All other estimates are Capture Mark Resights. An estimate in 2013 for Kanowna Island was not available because of territorial bulls active in the area precluding access for researchers.

Location and year of census	2008	SE	2013	SE
VICTORIA				
Lady Julia Percy (Vic)	15		24	2
Cape Bridgewater (Vic)	40		102	4
Kanowna Is. (Vic)	55	4	NA	
The Skerries (Vic)	74	15	37	7
Montague Is. (NSW)			35	0.4
TOTAL	184		198	

2. The Outcomes and Objectives – Key Findings

List the Project Objectives and address each one, noting the degree to which the objective was achieved through the research and issues that may have hampered its success. Describe the key findings as they relate to the objectives and the management questions identified in the initial application.

Stated objective	Planned time-frame	Status	Key findings
a. Co-ordinate equipment and logistics	12/2012 to 12/2013	Completed	
b. Visit all sites, collect data on live pups	12/2013 to 02/2014	Completed	
c. Collate data for each site and derive estimates of numbers of live pups	02/2014 to 04/2014	Completed	Table 1
d. Combine data between sites to derive estimates of total live pups	Feb – March 2014	Completed	15,056 ± 83 total live pups estimated, 6% fewer than in 2007.
e. Estimate pup production and population size at each site	March 2014	Completed	Pup births were estimated at 18,000 for the species in 2013. Table 1 summarises estimates of pup production at each site. Population size could not be estimated from this census data because the current multiplier of 4.5

			used to calculate population size (Gibbens and Arnould, 2009) is only relevant to an increasing population. The best population estimate currently available is the 2007 estimate of 120,000 seals (Kirkwood et al., 2010).
f. Compare results with previous estimates to assess trends	March-April 2014	Completed	<p>Table 1 summarises pup production in each of three surveys from 2002 to 2013.</p> <p>First overall drop in pup production recorded since sealing in early 1800s.</p> <p>First overall drop of pup numbers since exponential increase commenced in the 1980's.</p> <p>20-50% drop in pup production at all colonies that had >2,000 pups in 2007.</p> <p>52% decrease in pup numbers at Lady Julia Percy Island compared to 2007.</p> <p>Increase in breeding range, with new colonies in NSW, western Victoria and the Tasmanian west coast.</p> <p>An increase in pup numbers in South Australia.</p>
g. Prepare report on status of Australian fur seals and send to state and federal	April-June 2014	In progress	

government departments			
h. Submit report to government agencies responsible for environment management in SE Aust. waters	June 2014	In progress	
i. Prepare manuscript and submit to scientific journal	March - Dec 2014	In progress for submission in late 2014	

3. Implications for Management

What are the key recommendations for management based on the findings.

Australian fur seal populations may no longer be growing exponentially if this last pupping season is indicative of a more general declining trend in breeding productivity.

Numbers of pups produced may vary considerably between colonies. This is important for management because each site needs to be considered on an individual basis. Each site is likely to be affected by varying degrees by its local environment and its exposure to fisheries interactions.

Some colonies appear to have suffered a larger drop in pup production than others, in particular Lady Julia Percy Island and The Skerries (Figure 1). Lady Julia Percy Island has a high prevalence of an alopecia syndrome that may directly cause high mortality rates or be an expression of another, yet to be recognised, stressor on the population (Lynch et al., 2011). A direct ground count was performed at The Skerries rather than a capture-mark-resight (CMR) making comparisons with previous seasons difficult. However, if we multiply the count by 1.54 (the multiplicative factor between the direct count and the CMR derived at Seal Rocks in 2013) we get an estimate of 815 pups. This is very low compared to previous CMR results of 2,486 in 2002 and 2,705 in 2007 (Table 1). It is unlikely that the count underestimated pup numbers by so great a margin; hence this count indicates a drop in numbers at this site.

It is uncertain whether the reduction in total pup numbers is the result of a particularly poor season or if we have identified the beginning of an ongoing downward trend. When looking at the sites with long-term data (Figure 1 & Figure 2), the overall drop in pup numbers is clear. Comparing trends of annual data from Kanowna Island (Figure 3) and Tenth Island (Figure 4) suggests that the drop in pup numbers at those colonies could be within the normal range of inter-annual variation. Continued annual monitoring of some colonies and another species-wide census in five years will be needed to identify whether pup production continues to drop at the larger colonies, particularly at Lady Julia Percy Island.

Of management importance is the establishment of a colony of Australian fur seals

(and an increase in New Zealand fur seal pups) on the NSW coast at Montague Island, which was once a breeding site with 500 individuals in 1925, reduced to 12 in 1974 (Warneke, 1982). Typically, once breeding is established at a colony, the colony expands at that site. The elevation of the status from haul-out site to breeding colony provides the first record of a breeding colony in NSW and an expansion in latitudinal breeding range by 1.5° or ~170 km from The Skerries in Victoria (37°45'S, 149°31'E) to Montague Island in NSW (36°15'S, 150°14'E). An increase of females and pups at Montague Island may cause an increase in interest from tourists, which is complicated by the likelihood that females and pups have a greater sensitivity to disturbance caused by tourism compared to seals at a haul-out site. No pups were seen at other haul-out sites in southern NSW (Matt Carr pers. comm.). Local wildlife managers need to be made aware of the increased likelihood of interactions with fisheries and the general public.

The surveys of New Zealand fur seal pups in Bass Strait and southern NSW show minimal growth. This supports previous observations that New Zealand fur seals are not returning in big numbers to Bass Strait. This is important information for wildlife managers such as Phillip Island Nature Parks, because New Zealand fur seals predate upon Little Penguins (Page et al., 2005) and their return in large numbers could affect the Little Penguin population at Phillip Island where Phillip Island Nature Parks manage a valuable tourist venture and conservation research program.

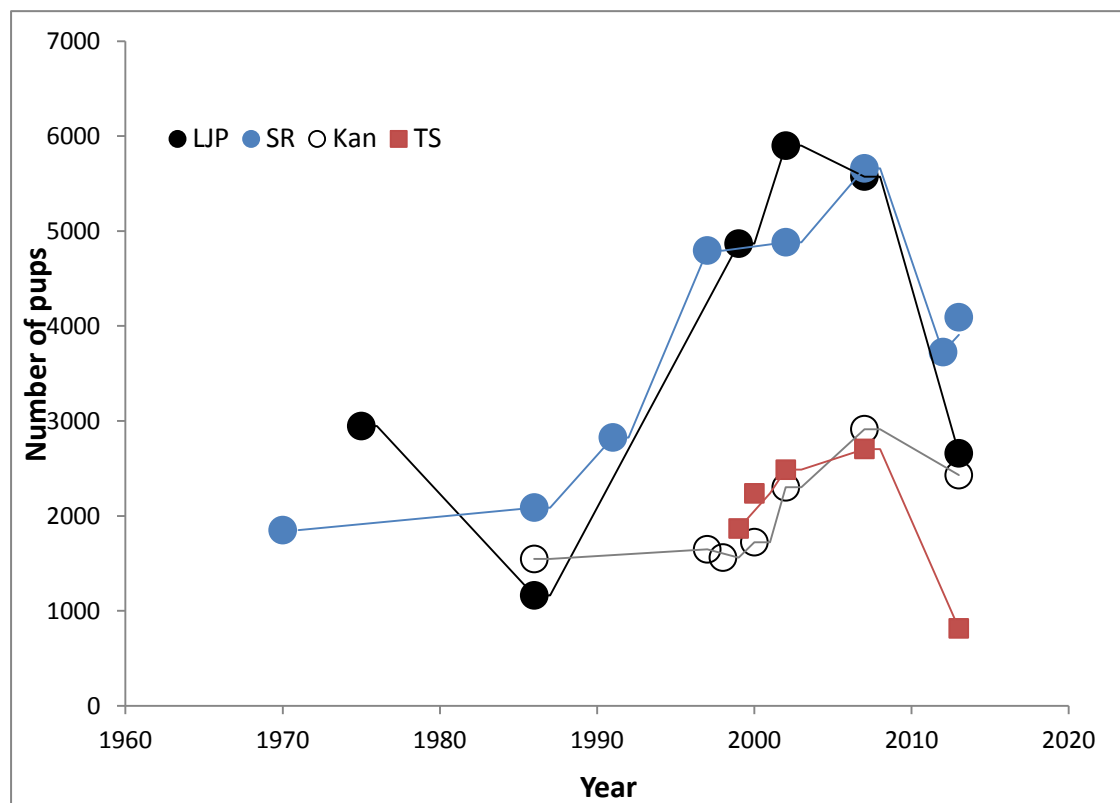


Figure 1. Estimated number of pups using capture-mark-resight (CMR) methods at Lady Julia Percy Island (LJP), Seal Rocks (SR), Kanowna (Kan) and The Skerries (TS) from 1970 to 2013. Note the 2013 data for The Skerries is a direct count multiplied by 1.54 (derived at Seal Rocks in 2013 to represent the CMR).

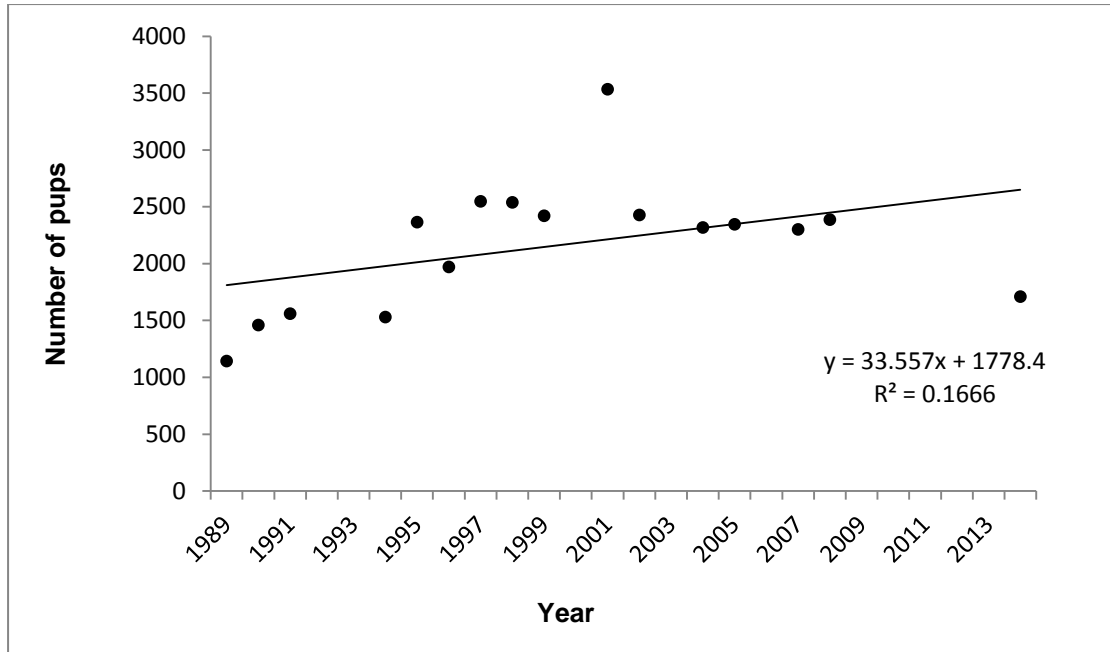


Figure 2. Estimated number of pups at Judgement Rocks between 1989 and 2013. The linear trendline, its equation and the correlation coefficient (R^2) are shown. Capture-mark-resights (CMR) began in 1995.

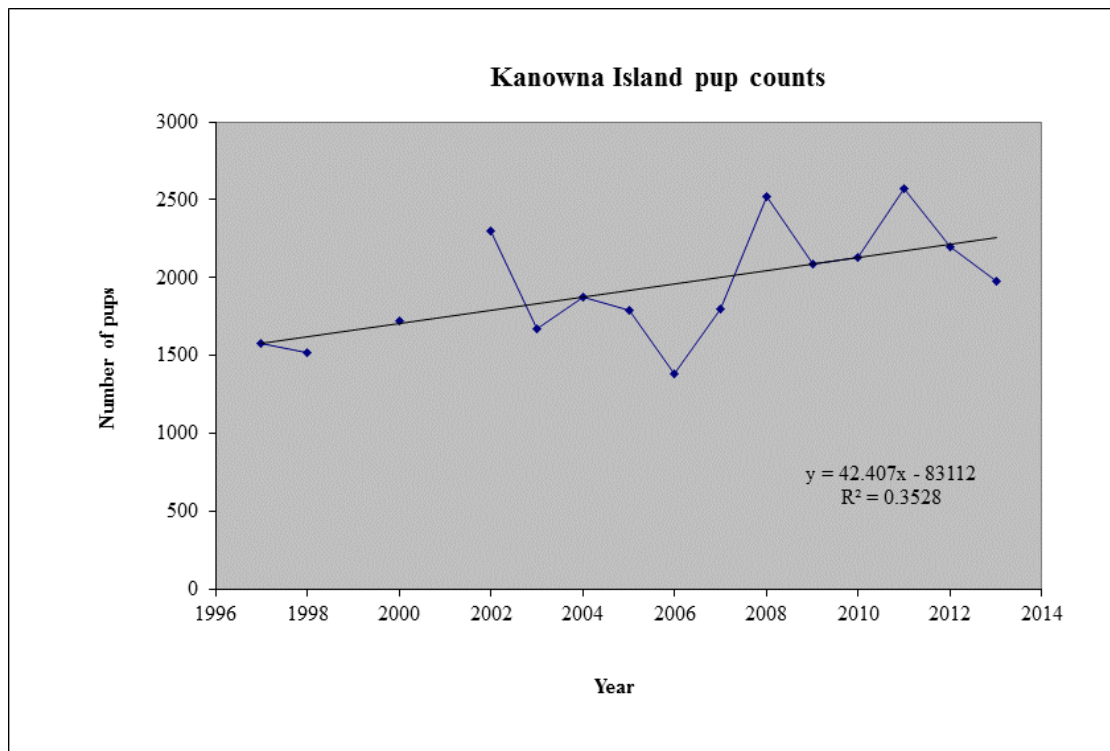


Figure 3. Annual direct counts of pups at Kanowna Island from 1997 to 2013. The linear trendline, its equation and the correlation coefficient (R^2) are shown.

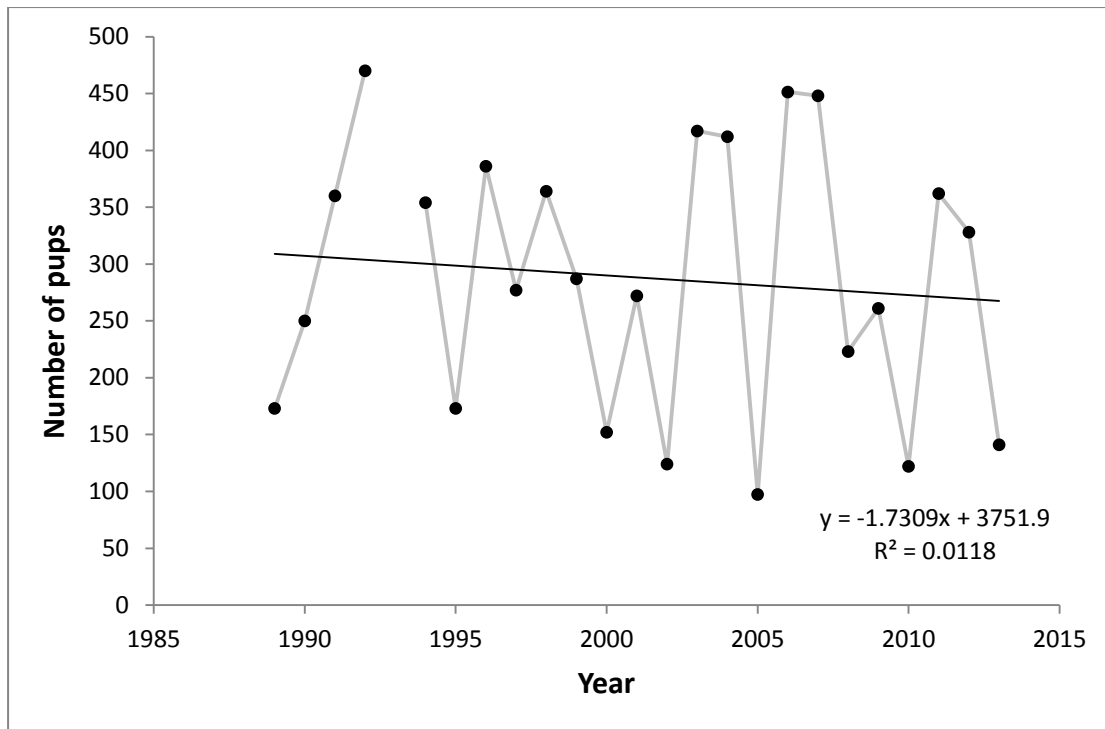


Figure 4. Estimated number of pups using capture-mark-reresight (CMR) methods at Tenth Island from 1997 to 2013. The linear trendline, its equation and the correlation coefficient (R^2) are shown.

4. Other Benefits

How has this project advanced the field of research? (e.g. scientific discoveries, new methodologies)

1. A potential ceiling to the population size of Australian fur seals - at ~100-150,000 seals is flagged.
2. Northern expansion (1.5° or ~170 km) in latitudinal range for breeding colonies – representing a re-colonisation of former range (Montague was occupied as a breeding colony in early 1900s but eliminated due to shooting pressure from fishermen) (Warneke, 1982). This expansion may increase the population’s resilience to climate change or unforeseen catastrophes.
3. Pup production is colony specific; changes at one site do not necessarily mean comparable changes at other sites, even those nearby.
4. The 52% decrease in pup numbers at Lady Julia Percy Island may be caused by high mortality rates at this site.
5. Surveys of New Zealand fur seals in Bass Strait show minimal growth - supporting previous observations that they are not returning in big numbers to Bass Strait (Kirkwood et al., 2009).
6. Enabled access to colonies to continue studies on toxins in Australian fur seals.
7. Enabled access to colonies to support telemetry studies of Australian fur seals.
8. Enabled access to offshore islands for seabird monitoring studies.
9. Represented collaboration between state and federal environment management departments to improve co-ordination and monitoring of high predators in SE Australia.

5. Problems Encountered (if any)

Describe any major problems encountered during the Activity and how they were addressed.

All colonies were visited within the planned December-January period, except for The Skerries. Access to The Skerries was planned to be undertaken by Parks Victoria staff. However, severe fires in Victoria meant the staff were first delayed, then as the fire situation worsened, the staff became unavailable. Because of this, the trip to The Skerries had to be funded out of the AMMC grant, and it was conducted on 19 February 2014. By that time, pups were larger than in January and more able to flee into the water, making detection of pups more difficult. Furthermore, some pups would have died between when the visit was planned to take place (coinciding with CMRs in previous years) and when it was undertaken. The late date of the census, smaller budget and limited time available meant that a direct ground count was performed instead of CMR. All these factors in combination resulted in an under-estimate of live pup numbers in 2013 at The Skerries.

We attempted to derive a more accurate estimate of pup numbers at the Skerries so that comparisons could be made with previous years. No Skerries-specific multiplier is available, therefore the direct ground count was multiplied by 1.54 (derived from Seal Rocks in 2013) to adjust the estimate to represent a CMR result. No account is made for additional pup mortality that will have occurred in the month between the planned and actual dates of the survey. In doing this, a 70% drop in pup production was evident that was similar to the decline at LJP and larger than that for all other colonies.

Because of concern that a real and dramatic decline in pup numbers at The Skerries could be masked by the lateness of the count, and therefore under-recognised, funding will be sought as a priority to perform a CMR estimate of pup numbers at The Skerries following the 2014 pupping period.

6. Communication

How will results be communicated to management

A report will be sent to the Victorian Department of Environment and Primary Industries (DEPI), South Australian Research and Development Institute-Aquatic Sciences (SARDI), Tasmanian Department of Primary Industries, Parks, Wildlife and Environment (DPIPWE) and NSW Environment and Heritage and NSW Parks and Wildlife.

Stakeholder engagement feedback (plain English for feedback to stakeholders)

There will be a media release published by the Nature Parks resulting in newspaper articles and media interviews. Several interviews have already occurred and an article for "Bushy Tales", the Parks Victoria Newsletter, was reviewed by the Nature Parks for the author, Marcel Hoog Antink.

Students supported (if any)

This project enabled access to colonies for PhD students Marcus Salton (Macquarie University) and David Hocking (Monash University) for telemetry studies of juvenile Australian fur seals.

An honours student of Michael Lynch (Zoos Victoria) and Rachael Gray (The University of Sydney) is analysing the tissue samples obtained during the field work for

toxins.
PhD Theses and dissertations (if any)
This project has contributed to the PhD Theses being produced by Marcus Salton (Macquarie University) and David Hocking (Monash University).
Publications (other than theses and dissertations)
A manuscript for publication in a scientific journal and a report for government agencies and university collaborators are being produced.
Planned publications
Manuscript in a scientific journal and a detailed report
Presentations to date
Phillip Island Nature Parks: Scientific Research Advisory Committee Phillip Island Nature Parks: All Staff Poster at European Cetacean Society Conference, Liege, Belgium, April 2014

7. Project Outputs

A list of the actual outputs of the research including milestones, progress reports and data products such as models etc.
The study provides a current description of the status of Australian fur seals that is freely available to government departments