



## Pup production of the New Zealand fur seal on Otago Peninsula, New Zealand

Chris Lalas & Robert Harcourt

To cite this article: Chris Lalas & Robert Harcourt (1995) Pup production of the New Zealand fur seal on Otago Peninsula, New Zealand, *Journal of the Royal Society of New Zealand*, 25:1, 81-88, DOI: [10.1080/03014223.1995.9517483](https://doi.org/10.1080/03014223.1995.9517483)

To link to this article: <https://doi.org/10.1080/03014223.1995.9517483>



Published online: 30 Mar 2010.



Submit your article to this journal [↗](#)



Article views: 203



View related articles [↗](#)



Citing articles: 1 View citing articles [↗](#)

## **Pup production of the New Zealand fur seal on Otago Peninsula, New Zealand**

**Chris Lalas<sup>1</sup> & Robert Harcourt<sup>2</sup>**

The New Zealand fur seal (*Arctocephalus forsteri*) did not breed in Otago, south-eastern South Island, New Zealand from the 17th Century until the late 1970's. Here we report a recent dramatic increase in pup production for Otago Peninsula, from 20–30 pups born in two rookeries in 1982/83 to a minimum (from a direct count) of 673 born at eleven distinct rookeries during the 1993/94 breeding season. Adjustments for precensus mortality and for undercounting were calculated from one site and applied to all rookeries. These adjustments raised the 1993/94 production figure to an estimated  $1136 \pm 98$  pups. The implications of these adjustments, and of making pup counts based on surveys, are discussed. Future monitoring of pup numbers should be carefully timed to coincide with the end of the local pupping season.

Keywords: *Arctocephalus forsteri*; New Zealand fur seal; Otago Peninsula; pup production

### **INTRODUCTION**

The distribution of New Zealand fur seals (*Arctocephalus forsteri*) encompasses New Zealand, southern Australia and the Australasian temperate and subantarctic islands (Crawley 1990). Before the arrival of human settlers in approximately 1000 AD, fur seals bred around the North and South Islands of New Zealand (Smith 1989). By 1800 AD, the mainland distribution of fur seals had been reduced to the south-western South Island of New Zealand as a result of hunting pressure by Maori (Smith 1989). By 1820, European sealers had eliminated this mainland remnant and also drastically depleted previously untouched populations on outlying islands in the New Zealand region (Taylor 1982; Mattlin 1987). Although there have been no systematic surveys over their entire range, fur seal numbers in the New Zealand region now appear to be increasing (Mattlin 1987; Crawley 1990; Taylor 1992). For instance, Taylor (1982) reported that the population of fur seals at the Bounty Islands (47°45'S, 179° 03'E) had increased from a low of five animals in 1831, to an estimated 16,000 in 1980. There are also indications that fur seals are repopulating parts of their previous range. Cawthorn et al. (1985) reported several new rookeries on the eastern and northern coasts of the South Island at Kaikoura, Banks Peninsula and Nelson, and Dix (1993) reported that in 1991 fur seals had recommenced breeding on the North Island, although in small numbers so far.

Fur seals appear to have hauled out in moderate numbers at various sites on the Otago coast since the first reported sightings in 1913 (Wilson 1981), though none bred there since the 17th century (Smith 1989). Almost invariably, recent reports have been of hauling grounds for bachelor males, or of sites at which juveniles dispersed from other areas have come ashore (Wilson 1981). The Otago coastline is currently cited as a non-breeding area (Wilson 1981), though in an unpublished MSc thesis, Armstrong (1988) reported some

---

<sup>1</sup>Department of Conservation, PO Box 5244, Dunedin, New Zealand

<sup>2</sup>Department of Zoology, University of Otago, PO Box 56, Dunedin, New Zealand (Corresponding author)

rookeries there. In this paper, we report the results of a pup census around Otago Peninsula, and give an estimate of pup production in Otago for the 1993/94 breeding season. We also compare this estimate with some previously unreported census data on pup production from the early 1980's.

## METHODS

To determine median pupping date for the Otago Peninsula, we (RH) conducted daily censuses at one rookery, Fuchsia Gully (45°52'S, 170°44'E), (Fig. 1) from 1 November 1993 through to 30 January 1994. Censuses were taken in the morning (07:30 – 09:30) and afternoon (16:00 – 17:30) from the surrounding cliff tops (5 to 15 m high) using 10 × 50 binoculars. Pup births on any one day were calculated by the formula:  $N_b = N_D - N_{D-1}$ , where  $N_b$  is the number of pups born on a single day,  $N_D$  is the number counted on a single day and  $N_{D-1}$  is the number counted the day previously. Pup mortality was determined by counting all dead pups seen during the censuses at Fuchsia Gully. Because dead pups often fall into holes and are therefore difficult to see, mortality was further checked by counting all corpses when we entered the rookery on 29 November, 4, 14, 23, 29 December and 8, 27 and 28 January. In order to adjust for undercounting during censuses, we also used capture /recapture techniques at Fuchsia Gully, capturing pups by hand. We captured 99, 103 and 95 pups on 27/28 January, 28 February and 28 March. These pups were clipped on the fur with a unique mark for each month. Population estimates for February and March at Fuchsia Gully were made using the Peterson estimator:

$$N = \frac{M(n+1)}{m+1}$$

$$S.E. = \sqrt{\frac{M^2(n+1)(n-m)}{(m+1)^2(m+2)}}$$

where  $N$  is the estimate of total population size,  $M$  is total number of marked pups,  $n$  is number of pups in sample, and  $m$  is the number of marked pups in the sample.

The results from the Fuchsia Gully Rookery were then used as estimators for the other rookeries on Otago Peninsula which each were surveyed only once.

In early 1994 we conducted censuses of the entire Otago coast by boat and land starting with a boat survey of Otago Peninsula on 23 February. Wherever seals were sighted, one observer scanned the area for pups. At haul-outs where pups were seen (hereafter called rookeries), the terrain was assessed for accessibility from land. Where access did not appear possible except by boat, two observers entered the rookery by swimming ashore, and then counted all pups by walking from one end of the rookery to the other, and recounting on the return. Every effort was made to avoid double counting of animals that ran forward of the observers. Where a double count was possible, that animal was excluded from the census, so numbers recorded are likely to be under- rather than over-estimates. Sites at which a land approach appeared possible were noted and visited by a single observer on 23 and 24 March, when censuses were conducted in the same manner. Similar surveys were carried out in January and February 1983 (by CL), but only absolute counts were made. All concentrations of fur seals elsewhere along the Otago coast, from Oamaru to Nugget Point (Fig. 1), were surveyed in the same way during February and March 1994. Surveys included two offshore islands, Green Island and Taieri Island (Moturata).

## RESULTS

The first pup was born at Fuchsia Gully on 18 November. The median pupping date was 24 December, and a minimum of 142 pups were born there, as estimated from the daily censuses (Fig. 2): 5% of pups were born by 29 November, and 95% by 21 January. Therefore, 90% of all pups were born within a period of 55 days.

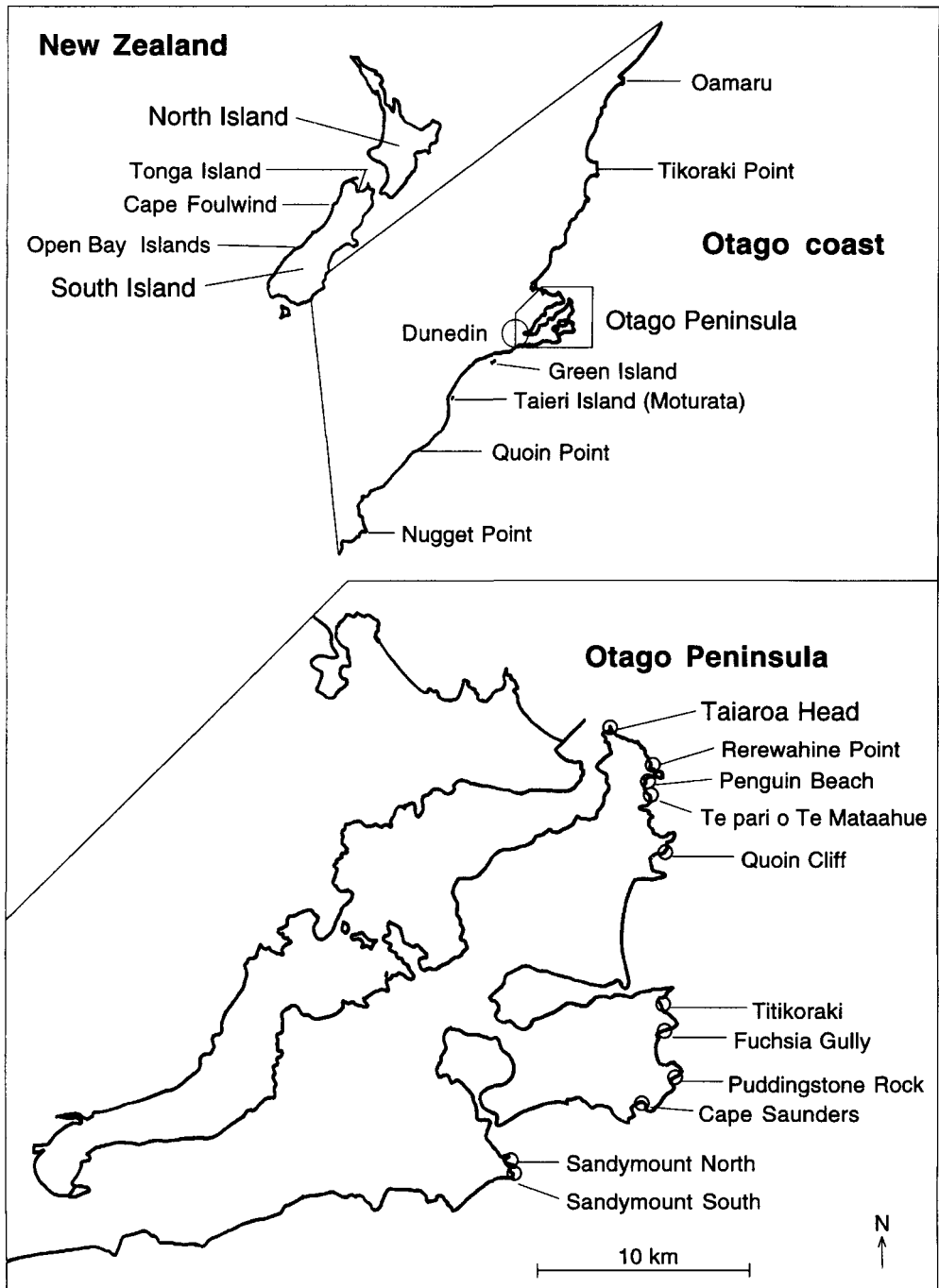


Fig. 1 – Map of the Otago Peninsula showing sites of rookeries. The inset shows the study area in relation to the New Zealand coastline, and also the location of rookeries elsewhere in New Zealand where fur seals have been tagged and later appeared in Otago.

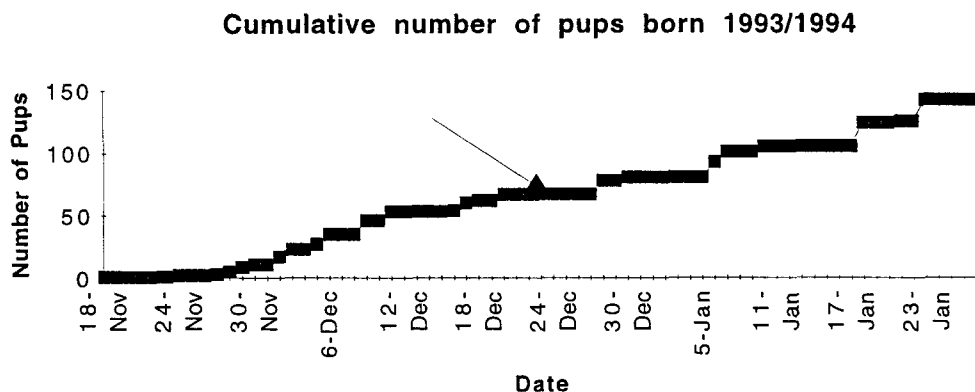


Fig. 2 – Cumulative number of pups born at Fuchsia Gully in 1993/94. Arrow indicates median pupping date.

Pup numbers at Fuchsia Gully were also estimated from the recaptures. The numbers caught at each date, and the proportion recaptured, are shown in Table 1. All losses were attributed to mortality. The estimates assume no emigration or immigration, because pups did not leave the rookery before April. From the median pupping date of 24 December, the average age of pups was 35, 66 and 94 days at the January, February and March captures, 61 days at the boat census, and 90 days at the land census.

Mortality during the breeding season (to 23 January, after the last births) was calculated by adding the minimum number of dead pups counted during the breeding season ( $n = 12$ ) to the maximum pup count (142), giving a total of 154 pups born and a mortality of 8%. Mortality to 28 February was calculated by subtracting the 118 pups counted alive from the maximum count in the breeding season of 142 (ie, 24), and adding the pups which had earlier died. Therefore, mortality to 28 February (66 days) equals  $36/154$ , or 23%.

For the other rookeries, pup estimates were based on a single count. To adjust for precensus mortality, we assumed that Fuchsia Gully was representative of all rookeries. If so, mortality had been in the order of 21% by February in the rookeries censused by boat, and 26% in March in those censused by land. This estimate is based on the assumption that the mortality rate was not linear, rather decreased with age until weaning. In most species of fur seals the maximum mortality of pups falls in the first month (Harcourt 1992). Mattlin (1978) has shown for the Open Bay Islands that mortality to 300 days was approximately 40%.

At the smaller rookeries ( $n < 50$ ), we assumed that all pups had been counted. At the larger rookeries ( $n > 50$ ), we adjusted the number of pups for undercounting by using the estimators from Fuchsia Gully calculated in February (ie, February census = 118, Peterson estimators =  $206 \pm 20.2$ , multiplier =  $1.75 \pm 0.17$ ). The number of pups counted at each rookery, and the

Table 1 – Fur seal pup numbers from captures, and Peterson Index estimates at Fuchsia Gully for 1994.

Date	Total number of marked pups (M)	Number captured (n)	Number recaptured (m)	Peterson Index $\pm$ SE (N)
February 28	99	103	49	$206 \pm 20.2$
March 28	103	95	63	$154 \pm 11.1$

estimated number after adjustment for precensus mortality and for undercounting, are shown in Table 2.

Very few pups were sighted during the 1982/83 census of Otago Peninsula (by CL). These counts, and the corresponding unadjusted data for each rookery in 1993/94, are shown in Table 3. Also shown in Table 3 are the previously unpublished results of pup counts at some of these rookeries in 1986/87 (Armstrong 1988).

The only breeding seals we found north of Otago Peninsula were at Tikoraki Point, Moeraki, where 12 pups were seen on 16 March 1994. The first year that pups were seen (by CL) at this site was 1988/89, when four pups were born. A single pup was also born and raised in Oamaru Harbour in 1992/93 (Lalas, per. obs.). South of Otago Peninsula there is a rookery at Nugget Point, where 178 pups were counted on 5 February 1994 (by CL). Only a single pup has been sighted between Nugget Point and Otago Peninsula, at Quoin Point on 31 March 1994 (Lalas pers. obs.).

Table 2 – Pup numbers counted at each rookery on Otago Peninsula in February or March 1994. Counts of pups are presented together with adjusted figures for precensus mortality and for undercounting. Adjusted figures are derived from data collected at Fuchsia Gully (see text for details).

Rookery	Date of census	Number of pups seen	Adjusted for precensus mortality	Adjusted for undercounting
Taiaroa Head	24 Feb	64	83	112 ± 11
Rerewahine Point	24 Feb	211	275	369 ± 36
Penguin Beach	23 March	37	49	49
Te pari o Te Mataahua	23 March	6	8	8
Quoin Cliff	23 March	2	2	2
Titikoraki	24 March	22	30	30
Fuchsia Gully (Ohinepuha)	28 Feb	118	154	206 ± 20
Puddingstone Rock	24 March	85	115	149 ± 14.5
Cape Saunders	23 March	9	12	12
Sandymount, North	24 Feb	22	29	29
Sandymount, South	24 Feb	97	127	170 ± 16.5
TOTAL		673	884	1136 ± 98

Table 3 – Counts of numbers of pups at fur seal rookeries on the Otago Peninsula during February and March 1982/83, 1986/87 and 1993/94 censuses. Numbers unadjusted for precensus mortality or undercounting. \* From Armstrong (1988); – Not surveyed.

Location of Rookery	Pup Numbers		
	1982/83	1986/87 *	1993/94
Taiaroa Head	0	7	64
Rerewahine Point	0	38	211
Penguin Beach	0	–	37
Te pari o Te Mataahua	0	–	6
Quoin Cliff	–	–	2
Titikoraki	–	1	22
Fuchsia Gully (Ohinepuha)	0	12	118
Puddingstone Rock (Otewhata)	0	5	85
Cape Saunders	3	6	9
Sandymount North	0	0	22
Sandymount South	20–30	59	97
Total Counts	23–33	128	673

## DISCUSSION

Pup production by New Zealand fur seals on Otago Peninsula has dramatically increased through the past decade. Counts are consistent with an annual rate of increase averaging 25%, equivalent to a doubling of the breeding population every three years. However, these estimations must be treated with caution, because they are based on counts from only three breeding seasons. This rate of increase is an order of magnitude greater than the 2% per year suggested by Crawley (1990) for the total population in the New Zealand region. Consistent with Crawley's estimate is the reported growth of 3.6% per annum in numbers of male New Zealand fur seals at Macquarie Island (Shaughnessy & Goldsworthy 1993), whose origins are thought to be in the New Zealand region. However, Shaughnessy et al. (in press) report increases comparable to those in Otago at Kangaroo Island, where rookeries have increased at 16–19% per annum, doubling in the five years 1988/89 to 1992/93.

It is likely that part of the increase on Otago Peninsula is the result of immigration from other areas. At least five adult females tagged as pups by Department of Conservation staff (Hugh Best pers. comm.) at the Open Bay Islands, and several immatures tagged at Tonga Island and Cape Foulwind (see Fig. 1) have settled at breeding rookeries on Otago Peninsula (R. Harcourt, pers. obs.). This is despite the fact that female fur seals usually show high fidelity to their usual pupping site (Stirling 1971; Lunn & Boyd 1991). It could be that many of the immigrants are young females pupping for the first time, but that is so far unknown.

The results of this study demonstrate that the breeding population of the New Zealand fur seal in the Otago area, as in many other parts of its range, has dramatically increased in recent years. Fur seals in the New Zealand region have been protected by legislation since 1916 (Crawley 1990). Although substantial numbers of fur seals have been caught incidentally in the hoki (*Macruronus novaezelandiae*) fishery off the west coast of the South Island (Mattlin 1989, 1991), there are no obvious threats to their numbers on the east coast of New Zealand. Fur seals have no natural land predators in New Zealand, although they may be subject to some predation at sea by sharks, killer whales (*Orcinus orca*), leopard seals (*Hydrurga leptonyx*) and Hooker's sea lions (*Phocarcos hookeri*) (Mattlin 1978). Given the rate of increase of fur seals in Otago, the impact of these marine predators is clearly minimal. With protection from interference by humans, it appears that potential future population growth of the New Zealand fur seal is not limited either by suitable breeding habitat, or by food supply (Mattlin 1987). The rapid increase in numbers breeding on the Otago coast may therefore represent a recovery unconstrained by external pressures, reversing the total elimination of seals from this region 200–400 years ago (Smith 1989).

At our main study site, Fuchsia Gully, we found that 90% of pups were born over a period of 55 days, and that the median pupping date was 24 December. This compares with a period of 34 days and median pupping date of 29 December for Cape Gantheaume, Australia (Goldsworthy 1992), and 20–34 days, and mean pupping date of 9 – 16 December for the Open Bay Islands, New Zealand (Miller 1971; Mattlin 1978). The variability between sites, both in the date of peak pupping and the duration of the pupping season, has implications for the timing of pup surveys. Given that the rate of mortality is highest in young pups (Mattlin 1978; Harcourt 1992), pup counts need to be conducted as soon after the pupping season as possible. If single counts are going to be used to estimate production at many different localities spread over large areas, their timing should be adjusted to each local pupping season. We suggest that future surveys in the Otago region should be conducted no later than the last week of January. In this paper we adjusted the number of pups using estimators derived from mark / recapture work at one site in order to correct for undercounting during a single census. We would advise caution in applying the estimators used in this paper outside the Otago Peninsula.

## CONCLUSION

We have reported a significant increase in the numbers of New Zealand fur seals breeding on the Otago coast. It was a "non-breeding" area in the early 1970's (Wilson 1981), but is now

a significant breeding area. Given continued protection, pup production is likely to continue to increase in Otago until breeding habitat or food supply become limiting. Future monitoring of pup numbers should be carefully timed to coincide with the end of the local pupping season.

## ACKNOWLEDGMENTS

This study was funded by the Department of Conservation, and through grants to RH by the New Zealand Lottery Board and the University of Otago. RH was supported by a University of Otago Post-Doctoral Fellowship. Thanks to A. Schulman and S. Hellyer for collecting the census data at Fuchsia Gully; B. Murphy, D. Wilkins and D. Nelson (Department of Conservation) for assistance with the land censuses and to Bev Dickson for her skilled boat driving. We are grateful to all the landowners for access to the seal colonies, in particular, Alan and Kay Dickson for long-term access to Fuchsia Gully. We thank Rowley Taylor, Kerry Barton, the editor Carolyn King, and Rob Mattlin and another, anonymous, reviewer for critically improving the manuscript.

## REFERENCES

- Armstrong, M. R. 1988: Census and some behavioural and thermoregulatory studies of the fur seal, *Arctocephalus forsteri* (Lesson 1828), on the Otago Peninsula, New Zealand. Unpubl. MSc. thesis, University of Otago, Dunedin, New Zealand.
- Cawthorn, M. W.; Crawley, M. C.; Mattlin, R. H.; Wilson, G. J. 1985: Research on pinnipeds in New Zealand. *Wildlife research review* 7. Wildlife Research Liaison Group, Wellington.
- Crawley, M. C. 1990: New Zealand fur seal. In: King, C. M. ed.: The handbook of New Zealand mammals. Auckland, Oxford University Press. Pp. 246–255.
- Dix, B. 1993: A new record this century of a breeding colony in the North Island for the New Zealand fur seal *Arctocephalus forsteri*. *Journal of the Royal Society N. Z.* 23: 1–4.
- Goldsworthy, S. D. 1992: Maternal care in three species of southern fur seal (*Arctocephalus* spp.). Unpubl. PhD thesis. Monash University, Melbourne, Australia.
- Harcourt, R. 1992: Factors affecting early mortality in the South American fur seal (*Arctocephalus australis*) in Peru: density-related effects and predation. *Journal of zoology, London.* 226: 259–270.
- Lunn, N. J.; Boyd, I. L. 1991: Pupping-site fidelity of Antarctic fur seals at Bird Island, South Georgia. *Journal of mammalogy.* 72: 202–206.
- Mattlin, R. H. 1978: Pup mortality of the New Zealand fur seal (*Arctocephalus forsteri* Lesson). *N. Z. journal of ecology* 1: 138–144.
- Mattlin, R. H. 1987: New Zealand fur seal *Arctocephalus forsteri*, within the New Zealand region. In: Croxall, J. P.; Gentry, R. L. eds: Status, biology and ecology of fur seals: Proceedings of an international symposium and workshop, Cambridge, England, 23–27 April 1984, pp. 49–52. NOAA Tech. Rep. NMFS 51.
- Mattlin, R. H. 1989: New Zealand fur seal – fisheries interaction: a growing concern. Proceedings of the 8th Biennial conference on the biology of Marine Mammals, Pacific Grove, California, Dec 7–11, 1989.
- Mattlin, R. H. 1991: Incidental catch of fur seals in a New Zealand trawl fishery. Proceedings of the 9th Biennial conference on the biology of Marine Mammals, Chicago, Illinois, Dec 5–9, 1991.
- Miller, E. H. 1971: Social and thermoregulatory behaviour of the New Zealand fur seal, *Arctocephalus forsteri* (Lesson, 1828). Unpubl. MSc. thesis, University of Canterbury, Christchurch, New Zealand.
- Shaughnessy, P.; Goldsworthy, S. 1993: Feeding ecology of southern fur seals (*Arctocephalus* spp) and their management at Heard and Macquarie Islands. *Proceedings NIPR Symposium, Biology* 6: 173–175.
- Shaughnessy, P. D.; Goldsworthy, S. D.; Libke, J. A. in press: Changes in the abundance of New Zealand fur seals, *Arctocephalus forsteri*, on Kangaroo Island, South Australia. *Wildlife research*
- Smith, I. W. G. 1989: Maori impact on the marine megafauna: pre-European distributions of New Zealand sea mammals. In: Sutton, D. G. ed.: Saying so doesn't make it so: Papers in Honour of B. Foss Leach. *N. Z. A. A. monograph* 17. pp. 76–108.
- Stirling, I. 1971: Studies on the behaviour of the South Australian fur seal, *Arctocephalus forsteri* (Lesson). *Australian journal of zoology* 19: 267–273.
- Taylor, R. H. 1982: New Zealand fur seals at the Bounty Islands. *N. Z. journal of marine and freshwater research.* 16: 1–9.



- Taylor, R. H. 1992: New Zealand fur seals at the Antipodes Islands. *Journal of the Royal Society N. Z.* 22: 107–122.
- Wilson, G. J. 1981: Distribution and abundance of the New Zealand fur seal, *Arctocephalus forsteri*. Ministry of Agriculture and Fisheries Research Division Occasional Publication No. 20. 40p.