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Increase in the abundance of New Zealand fur seals at the Catlins, South Island, New Zealand

Chris Lalas*, Brian Murphy †

Distribution and abundance of New Zealand fur seals (*Arctocephalus forsteri*) were assessed along the 100 km of the Catlins coastline (46° 23' S, 169° 46' E to 46° 40' S, 168° 58' E), south-eastern tip of South Island, New Zealand. Our surveys began in 1978 but were irregular and mainly qualitative until comprehensive counts were made in four consecutive summers from 1993/94 to 1996/97. The only rookeries (breeding colonies) were at Nugget Point (46° 27' S, 169° 49' E) where breeding began in 1979 or 1980. Four annual direct counts of live pups indicated that the annual exponential rate of increase in pup numbers averaged 19% with a total of 310 pups in 1996/97. Nugget Point accounted for 60% of the total of almost 2000 seals more than 1-year old counted along the Catlins coast during a survey in January 1994. Elsewhere, only three haul-outs (non-breeding colonies) held aggregations of at least 20 seals ashore per 100 m of shoreline in summer. We termed these locations "major haul-outs" and consider them to be probable sites for future rookeries because they satisfy the main environmental criteria favoured by breeders.

Keywords: *Arctocephalus forsteri*, New Zealand fur seal, population status, pup numbers, Nugget Point

INTRODUCTION

Since New Zealand fur seals (*Arctocephalus forsteri*) have been legally protected, they have increased in abundance throughout their range, which encompasses southern Australia (Shaughnessy et al 1994, 1995, 1996) and the New Zealand mainland, temperate and subantarctic islands (Crawley & Brown 1971, Crawley 1972, 1990, Wilson 1981, Taylor 1982, 1992, Mattlin 1987, Lalas & Harcourt 1995, Taylor et al 1995, Ryan et al 1997). Their breeding distribution has spread eastward in Australia (Brothers & Pemberton 1990) and northward in New Zealand (Cawthorn et al 1985, Dix 1993, Lalas & Harcourt 1995). The first reported sighting this century of a fur seal ashore along south-eastern South Island, New Zealand, (i.e. south of latitude 45° S) was in 1913 at Otago Peninsula (45° 44' S, 170° 37' E to 45° 54' S, 170° 32' E) (Wilson 1981). Solitary pups were reported here in 1976 and 1978 (Wilson 1981) and rookeries (breeding colonies) became established before 1982 (Lalas & Harcourt 1995).

Counts of pups, preferably in association with mark-recapture techniques, offer the only definitive assessment of population size for New Zealand fur seals, because pups form the only age class that is restricted to land (Taylor 1982, Shaughnessy et al 1994, Taylor et al 1997). Absolute counts of the number of older seals ashore are difficult to interpret because not only is the proportion at sea unknown (Shaughnessy et al 1994) but also numbers ashore vary with season, time of day, state of tide and weather conditions (Stirling 1968, Wilson 1981). However, counts of non-pups (age classes other than pups) ashore at haul-outs (non-

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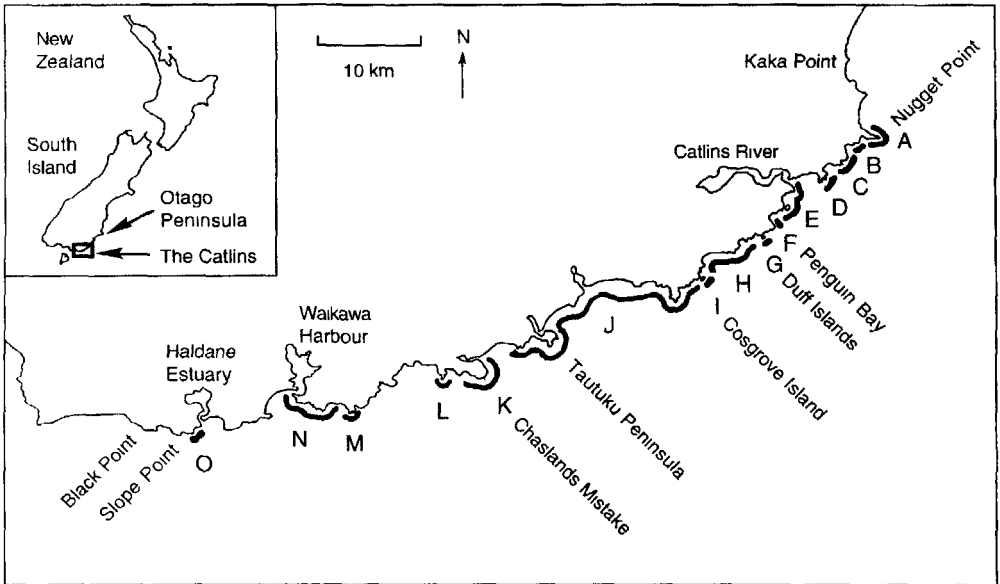


Fig. 1 The Catlins coast showing subdivisions A – O for the January 1994 census. See Table 1.

breeding colonies) offer the only indication of fur seal abundance along coastlines that lack rookeries (Wilson 1981).

We surveyed New Zealand fur seals along the Catlins coast at the south-eastern tip of South Island where a 100 km strip of coastline encompasses the seaward edge of the Southland Syncline (McKellar & Speden 1978; Mutch 1978). Here folded outcrops of sedimentary strata form headlands, bays and nearshore stacks and islets intersected with long sandy beaches. Rocky shorelines are a mix of cliffs, platforms, talus (angular rocks) and boulder beaches (rounded rocks) that offer numerous potential rookery and haul-out sites as defined by Crawley & Brown (1971) and Wilson (1981). There has been only one comprehensive survey of New Zealand fur seals around New Zealand, where the only location identified along the Catlins coast was a haul-out at Nugget Point ($46^{\circ} 27'S$, $169^{\circ} 49'E$), with an estimated total of six animals, range 5–8, for January–February 1973 (Wilson 1981). Nugget Point is a narrow, steep-sided peninsula 1.5 km long, jutting out perpendicular to the coastline and terminated by a group of nearshore stacks.

Our surveys began with searches for pups at Nugget Point from 1978 to 1984. In January 1994 we surveyed the entire coastline of the Catlins and then monitored the main concentrations of New Zealand fur seals annually for the following three years. We aimed to document the rates of increase in numbers and distribution of seals in order to attempt to predict future trends.

METHODS

To standardise counts we attempted to conduct surveys during afternoons with fine weather and relatively calm seas. Rocky shorelines with talus, boulder beaches or broad platforms were inspected by walking the foreshore. The remainder of the coast was inspected from the sea, typically from within 10 m off rocky shorelines.

We aimed to time annual surveys to coincide with the end of pupping, although in practice this did not happen every year. The median pupping date at a large rookery at Otago Peninsula in the 1993/94 breeding seasons was 24 December, with 95% of pups born by 21 January (Lalas & Harcourt 1995). For the 1993/94 breeding season, Nugget Point was

surveyed on 5 January and again on 16 February in order to gain a more valid count of pups. Figures for the abundance of fur seals included direct counts both of pups and of non-pups seen during surveys. Pups were easily distinguishable by the combination of small size, black pelage and blunt snout. The category "non-pups" encompassed all seals greater than 1-year old. The certain separation of these seals into sex and age classes is impossible at haul-outs (Crawley 1972) and is subject to inference at rookeries. In addition to non-pups ashore, counts included those wallowing in the sea adjacent to haul-outs, a common activity on warm days.

From 1978 to 1985 CL conducted surveys restricted to searches for pups at Nugget Point. The foreshore was surveyed by foot and the nearshore stacks observed from an oar-powered 2 m inflatable dinghy. The first search on 18 December 1978 was repeated in the four consecutive summers from 1981/82 to 1984/85.

During the four consecutive breeding seasons from 1993/94 to 1996/97, CL and BM conducted comprehensive counts along the entire Catlins coast (Fig. 1). From Kaka Point (46° 23' S, 169° 46' E) to Black Point (46° 40' S, 168° 58' E) all headlands, rocks and bays were surveyed and all visible seals counted on 5–13 January 1994. Surveys were conducted from sea with a motor-powered 3 m inflatable dinghy supplemented by landings at sites where ground searches were considered desirable. Major haul-outs were located from sea during January 1993, but no census was attempted other than a count in the vicinity of Cosgrove Island (46° 34' S, 169° 30' E). The combination of bad weather and time restraints affected the three annual surveys after 1993/94. The 1995/96 survey was restricted to Nugget Point and the 1994/95 and 1996/97 surveys were restricted to the coastline from Kaka Point to Cosgrove Island.

The average annual exponential rate of increase (r) in pup numbers was calculated as $r = (\ln N_{t_2} - \ln N_{t_1}) / (t_2 - t_1)$, where N_{t_2} and N_{t_1} are population sizes in years t_1 and t_2 , respectively (Odum 1971; Shaughnessy et al. 1995). The increases in counts of pups between consecutive years were calculated as $(N_{t_2} - N_{t_1})/N_{t_1}$.

RESULTS

Census of the Catlins

The 5–13 January 1994 survey from Kaka Point to Black Point (Fig. 1) established that New Zealand fur seals were not evenly distributed along the overall 100 km coastline of the Catlins. Nugget Point accounted for 59% of the total count of 1952 non-pups (Table 1). We noted that there were major aggregations of non-pups at three other locations: Penguin Bay (46° 31' S, 169° 41' E), Duff Islands (46° 32' S, 169° 41' E) and Cosgrove Island. The common features for all four major aggregations were nearshore stacks or islets, relatively sheltered coastline and a foreshore with rock platforms, boulders and crevices. Seals were ashore on stacks, islets and the mainland at each location. In addition, these seals were not subject to human disturbance. Nugget Point is gazetted as a scientific reserve and is visited by at least 20 000 people annually (unpublished reports, Department of Conservation, Owaka Field Centre). However, public access to sites with seals ashore is either prohibited (indicated by signs) or difficult. The Penguin Bay and Cosgrove Island locations abut farmland and permission for access is required from the landowners. The Duff Islands location is at the base of cliffs accessible only from sea.

Approximate lengths of shoreline (mainland, stacks and islets) occupied by fur seals at each location were estimated as 2.5 km at Nugget Point, 0.75 km at Penguin Bay, 0.2 km at Duff Islands and 0.75 km at Cosgrove Island.

Annual counts from Nugget Point to Cosgrove Island

The coast from Nugget Point to Cosgrove Island was only about one quarter of the Catlins coastline but it accounted for 93% of the total count of non-pups in the January 1994 survey

(Table 1). The sum for the four major congregations accounted for 90–95% of the total counts of non-pups from Nugget Point to Cosgrove Island in each of the three years when this coastline was surveyed (Table 2). However, inter-annual trends varied between locations. Counts were relatively constant at Nugget Point and Cosgrove Island, increased at Penguin Bay and were erratic at Duff Islands. Additional data available for Nugget Point highlighted

Table 1 Census of seals from Kaka Point to Black Point, southern South Island, 5–13 January 1994. Counts were zero for all other sites.

Location	Code: Fig. 1	Pups	Non-pups
Nugget Point: stacks & onshore	A	134	1158
From Roaring Bay to Sandy Bay	B	0	27
Between Sandy Bay & False Islet	C	0	97
False islet	D	0	9
Between Catlins River & Penguin Bay	E	0	8
Penguin Bay: islets & onshore	F	0	194
Duff Islands: stacks & onshore	G	0	88
Between Duff Islands & Cosgrove Island	H	0	16
Cosgrove Island: island & onshore	I	1	211
<i>Subtotal</i>			
From Nugget Point to Cosgrove Island	A – I	135	1808
Proportion of total	A – I	100%	93%
Between Cosgrove Island & Chaslands Mistake	J	0	24
Chaslands Mistake	K	0	78
Wallace Head	L	0	8
The Brothers Point: stacks & onshore	M	0	20
Between The Brothers Point & Porpoise Bay	N	0	13
Between Haldane Bay & Slope Point	O	0	1
<i>Subtotal</i>			
Between Cosgrove Island & Black Point	J – O	0	144
Proportion of total	J – O	0%	7%
<i>Total</i>	A – O	135	1952

Table 2 Annual censuses of non-pups from Nugget Point to Cosgrove Island: January or February counts of seals on stacks and onshore. Excludes the 1995/96 census that was restricted to Nugget Point and totalled 1645 on 8 January.

Location	Code: Fig. 1	Breeding season (Dates of survey)		
		1993/94 (5–11 Jan)	1994/95 (2–16 Feb)	1996/97 (13–14 Feb)
<i>Major aggregations:</i>				
Nugget Point	A	1158	1220	1069
Penguin Bay	F	194	338	496
Duff Islands	G	88	98	8
Cosgrove Island	I	211	205	214
<i>Major aggregations:</i>				
<i>Subtotal</i>	A, F, G, I	1651	1861	1787
Proportion of total	A, F, G, I	91%	95%	93%
Other locations	B-E & H	157	92	138
<i>Total</i>	A – I	1808	1953	1925

the problem of inconsistency in counts of non-pups. Here the 5 January 1994 census that produced a count of 1158 non-pups (Tables 1 & 2) was repeated six weeks later on 16 February with a count of 1271 non-pups: a difference of 9–10%. However, the apparent relative consistency of the annual counts of non-pups at Nugget Point was destroyed by a count of 1645 on 8 January 1996, a figure 30–50% higher than that for any of the other three years.

Breeding at Nugget Point

The 5–13 January 1994 survey of the entire Catlins coast established that breeding by New Zealand fur seals was restricted to Nugget Point, with the sole exception of one pup found at Cosgrove Island (Table 1). No pups were found at Cosgrove Island either in later years in 1995 and 1997 (Table 2) or in the previous year among a count of 192 non-pups on 21 January 1993.

Surveys before 1994 recorded the initiation of breeding by New Zealand fur seals on the stacks and mainland at Nugget Point (Table 3, Fig. 2). The first record of pups was for the 1981/82 breeding season when 10–15 pups were seen on stack S1 (Fig. 2) but none elsewhere.

Table 3 Dates of first breeding, rookery substrates and annual censuses of pups at Nugget Point. Counts of numbers on stacks and onshore in January or February from 1994 to 1997. Census dates: 16 Feb 1994; 24–25 Jan & 2 Feb 1995; 8 Jan 1996; 13–14 Feb 1997.

Code: Fig. 2	First breeding season	Substrate within rookery		Direct count of live pups			
		Primary	Secondary	1993/94	1994/95	1995/96	1996/97
Stacks							
S1	1979/80 or 1980/81	bedrock platform	bedrock slope	47	49	37	71
S2	1983/84	bedrock slope	–	40	27	59	50
S3	after 1983/84 before 1992/93	bedrock platform	–	43	58	46	46
S4	after 1983/84 before 1992/93	bedrock slope	bedrock platform	10	3	17	6
S5	1993/94	bedrock platform	bedrock slope	2	4	24	14
Others		bedrock slope	–	1	0	0	0
Subtotal: All stacks (S1 – S5)				143	141	183	187
Proportion of Nugget Point total				82%	64%	70%	60%
Mainland							
M1	1986/87	talus	boulder beach	5	11	5	16
M2	1992/93	bedrock platform	–	16	38	34	51
M3	1993/94	bedrock platform	boulder beach	11	31	39	52
M4	1994/95?	boulder beach	talus	0	1	0	1
M5	1995/96?	talus	–	0	0	2	3
Subtotal: All mainland (M1 – M5)				32	81	80	123
Proportion of Nugget Point total				18%	36%	30%	40%
Nugget Point total: Stacks + Mainland				175	222	263	310
Numerical increase between years					27%	19%	18%

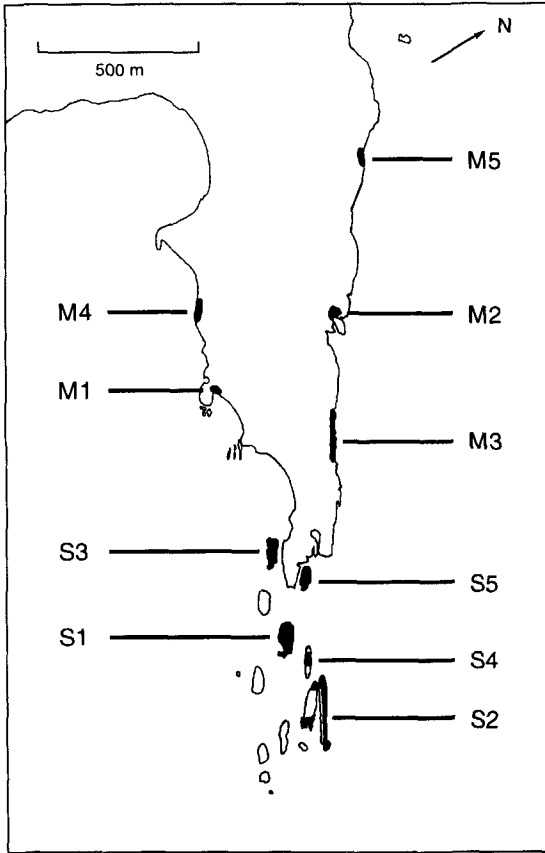


Fig. 2 Nugget Point showing sites of breeding on nearshore stacks (S 1 – S5) and on the mainland (M 1 – M5). See Table 3.

The only precise count of pups before 1994 was on 23 December 1983, when 12 were recorded at S1, eight at S2 and a solitary pup and female on the mainland adjacent S5 (Fig. 2). Given that it was done in the early stage of the breeding season, this count equated to a minimum estimate of 21 pups for the 1983/84 season. Initiation of breeding was dated to an exact breeding season (S2 and S5) or to a range of years (S1, S3 and S4) for each of the five stacks with breeding in the 1996/97 season, and to an exact breeding season for each of the five mainland sites (Table 3, Fig. 2). The allocation of a first breeding season for two mainland sites, M4 and M5, will require review if future surveys indicate that their use was transitory.

Counts of live pups seen at Nugget Point in the four consecutive breeding seasons monitored were allocated to precise sites (Table 3, Fig. 2). An additional 2–5 dead pups were seen in each survey. Two stacks, S3 and S5, are connected to the mainland at low tide by rocks or fronds of bullkelp (*Durvillaea* sp.). Pups found on the mainland adjacent to either of these stacks were allocated to the counts for the respective stacks. The totals for stack S2 refer to the combination of a pair of stacks that abut at low tide.

An indication of pup production at Nugget Point was produced from direct counts of live pups in four consecutive breeding seasons: 175 in 1993/94, 222 in 1994/95, 263 in 1995/96 and 310 in 1996/97 (Table 3). Respective annual increases in pup counts were 27%, 19% and 18%. The corresponding average annual exponential rate of increase for pup numbers at Nugget Point was 19% through the three years from 1993/94 to 1996/97.

DISCUSSION

Breeding by New Zealand fur seals along the Catlins coast began in the 1979/80 or 1980/81 breeding season at Nugget Point. Through the intervening 16 or 17 years to 1996/97, Nugget Point remained the only New Zealand fur seal rookery between those at Otago Peninsula (Lalas & Harcourt 1995; Lalas, unpublished data), 90 km to the north east and those in the vicinity Ruapuke Island (46° 46' S, 168° 31' E) (Wilson 1981), 100 km to the west.

The average annual population growth rate of pups at Nugget Point was 19% through the three years from 1993/94 to 1996/97. Has this average annual population growth rate of pups been constant since breeding began at Nugget Point? The earliest definitive record for pup numbers was a minimum of 21 in 1983/84, the 4th or 5th year of breeding. Extrapolating the 1996/97 count of 310 pups back 13 years at $r = 0.19$ predicts a 1983/84 population of 26 pups.

Corresponding extrapolations predict 1983/84 pup populations of 27 from 1995/96, 27 from 1994/95 and 26 from 1993/94. All four predictions produce expected numbers similar to the actual 1983/84 direct count. We conclude that the 19% average annual rate of population increase of pups at Nugget Point was consistent through the 13 years from the 4th/5th to the 17th/18th year since the instigation of breeding. This corresponds to a doubling time of 3.6 years, i.e. pup production doubled every 3–4 years.

The total population of New Zealand fur seals is considered to be increasing at about 2% annually within the New Zealand region, with localised increases as high as 5% annually (Crawley 1990). Our 19% average annual rate of increase in the pup population at Nugget Point was much higher than the general mean but similar to the annual 25% increase suggested for Otago Peninsula (Lalas & Harcourt 1995) and the 23% calculated for the north coast of the South Island bordering Cook Strait (Taylor et al. 1995). Comparable high annual increases in pup production by New Zealand fur seals have also been recorded from Australia, where they are taken to indicate a rapid recovery phase in population growth (Shaughnessy et al. 1995, 1996).

Breeding at Nugget Point began on nearshore stacks then spread to the mainland. Our direct counts of pups for the four consecutive breeding seasons 1993/94 to 1996/97 did not show a coherent trend in rates of increase at all sites. We expect that the nearshore stacks are reaching capacity but that pup numbers will continue to increase at mainland Nugget Point sites. Rather than regarding each of the 8–10 breeding sites at Nugget Point as separate rookeries, we considered Nugget Point to represent a single breeding locality. The term “breeding locality” was applied by Shaughnessy et al. (1994) to define all rookeries separated by less than 2 km.

The 1994 survey of New Zealand fur seals for the entire 100 km of Catlins coastline determined a total of almost 2000 non-pups, a 2–3 orders of magnitude increase over the 20 years since the previous population estimate of less than 10 by Wilson (1981). A huge increase in numbers is obvious even to casual observers, although direct counts of non-pups are difficult to interpret (Taylor 1982; Shaughnessy et al. 1994) and probably impossible to validate. Nugget Point, with 1158 non-pups, accounted for about 60% of non-pups in the Catlins in the January 1994 census. A repeat count in February 1994 found 1271 non-pups. January or February counts in the three following years found 1220, 1645 and 1069 non-pups respectively. In contrast to the large and sustained annual increase in pup numbers, no inter-annual trend was evident in contemporary counts of non-pups ashore at Nugget Point.

By contrast, the Catlins coast to the north and to the south-west of Nugget Point was sparsely populated by fur seals with the exception of three locations. Penguin Bay, Cosgrove Island and Duff Islands featured distinct aggregations of non-pups that we could quantify as having a minimum of 20 seals ashore per 100 m of shoreline in January–February. We term these locations “major haul-outs”. Criteria for features of breeding habitat favoured by New Zealand fur seals have been tested by Taylor et al. (1995) and Ryan et al. (1997). Although we made only qualitative assessments of foreshore habitats, all three locations appear favourable for future breeding. They each feature boulders and crevices to provide cover for pups, an aspect and topography that create a relatively sheltered coastline, and difficult or prohibited public access that minimises the likelihood of human disturbance. We therefore consider them as probable sites for future rookeries away from Nugget Point.

Annual monitoring of the Catlins coast should continue given the rapid rate of increase in pup numbers at Nugget Point and the likelihood of establishment of rookeries elsewhere. Pup mark-recapture techniques should be applied to calculate adjustments for precensus mortality and for undercounting of pups. Such data collected for each breeding site at Nugget Point should produce a more accurate figure for the numbers of pups born annually. Also, we speculate that there are regular seasonal changes in the abundance of non-pups ashore in the Catlins, with an annual peak in November, December or January. This hypothesis could be

tested with regular year-round standardised counts at readily-accessible haul-outs at Nugget Point.

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