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## MEASUREMENTS OF TAGGED PUPS AND A POPULATION ESTIMATE OF NEW ZEALAND FUR SEALS ON TAUMAKA, OPEN BAY ISLANDS, WESTLAND

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### ABSTRACT

In January 1970, 309 pups of the New Zealand fur seal, *Arctocephalus forsteri* (Lesson, 1828), were tagged on Taumaka Island, one of the Open Bay Islands, Westland, New Zealand (43°52' S, 168°53' E). At about 6 weeks old, male pups have longer flippers and are longer and heavier than female pups.

A population estimate of seals on Taumaka Island is based on a count of pups of the year, to which data from related species of fur seals were applied (incidence of pregnancy and age at first pupping from *Arctocephalus pusillus*, immature mortality from *Callorhinus ursinus*), and on the assumptions that the sex ratio and sexual mortalities are equal. There were at that time 2,000–3,000 seals, including pups, on the island.

### INTRODUCTION

The New Zealand fur seal, *Arctocephalus forsteri* (Lesson, 1828), inhabits the rocky coasts and off-shore islands of New Zealand and its

Subantarctic islands. Fur seal populations were greatly reduced by sealers during the nineteenth century, but between 1875 and 1894 there was a limited season, and from then until 1913 killing was by permit only. From 1913-16, a 3 month season was allowed; no fur seals have been legally killed since, except on Campbell Island in 1922 and 1924, and in southern New Zealand in 1946 (Sorensen 1969).

Recent publications (Stonehouse 1965; Stirling 1968) suggest that fur seals are increasing in number and re-colonising former summer rookeries and winter hauling-out grounds, but as yet no overall census has been attempted. Because very little is known of the biology of this fur seal, research on the behaviour, breeding biology and ecology has been started by the authors and other members of the Zoology Department, University of Canterbury, with the aid of finance from the Marine Department.

In this paper we present information on the tagging and measurement of 6-week old fur seal pups on Open Bay Islands (*see also* Stirling 1970), and also an estimate of the total population there.

#### STUDY AREA AND METHODS

Open Bay Islands (43°52' S, 168°53' E) lie 3 miles (4.8 km) offshore of the Okuru River mouth near Haast, Westland. Cliffs dominate the southern sides of the two main islands, Taumaka and Popotai, but there are mainly sloping rock platforms on the northern sides (Fig. 1). The vegetation on Taumaka consists principally of a central mass of kiekie (*Freycinetia banksii*) and a coastal fringe of *Hebe elliptica*. A detailed account of the vegetation is given by Cockayne (1904) and a brief description by Stirling and Johns (1969).

Breeding fur seals occupy the sloping shores on both main islands, and non-breeding males congregate on offshore stacks at the north-east of Taumaka. Non-breeders haul up onto patches of sedge (*Carex comans*) above the bare rock and also penetrate the bush extensively.

In the 1969-70 season, tagging took place in January 1970. The 6-week old pups had already formed pods (i.e., separate groups) and were easy to catch and restrain by hand. All pups caught were tagged with numbered monel metal tags on the caudal edge of the left fore-flipper near the axilla, and about 30% of the pups were also fitted with four H-shaped coloured plastic tags (of 9 colours), two in each hind-flipper, for individual recognition at a distance, as described by Stirling (1970).

Pups were sexed and then weighed to the nearest 50 g on a 0-10 kg Salter spring balance. Standard measurements (American Society of Mammalogists 1967) of the curvilinear length of the animal, the anterior edge of the left fore-flipper, and the anterior edge of the left hind-flipper were taken to the nearest 0.5 cm by D.L.B., using a steel measuring tape.

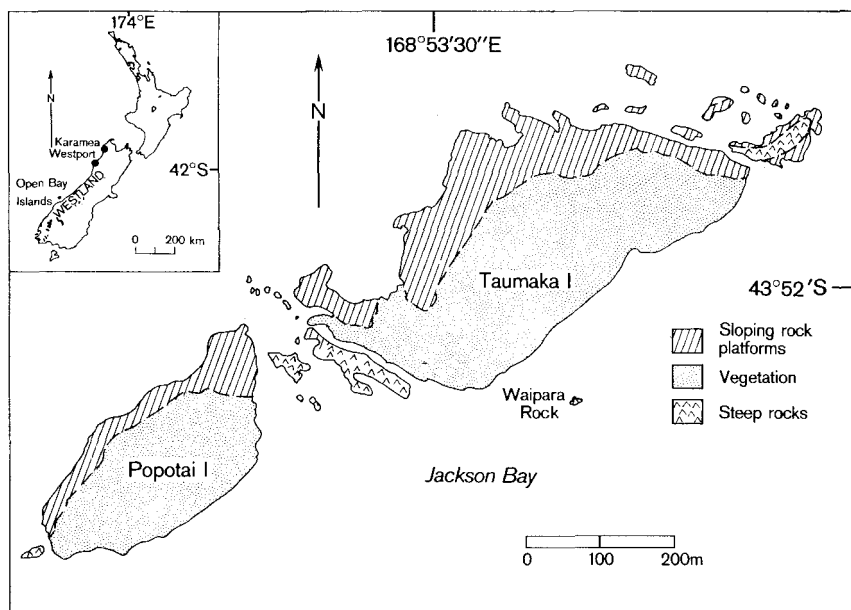


FIG. 1.—Sketch map of Open Bay Islands and New Zealand showing the main localities mentioned in the text.

To estimate the population, each author walked the length of Taumaka along the northern rocky shore and made an independent count of pups. In the calculation, a correction factor of 20% was allowed for undercounting concealed and dead pups. This figure is based upon counts of pups in small areas made before and after exhaustive searches during tagging.

## RESULTS

### NUMBER OF PUPS MARKED

Three hundred and nine pups (139 ♂♂ and 170 ♀♀) were fitted with metal tags between 18 January and 24 January 1970, bringing the total number of seals marked in this way on Open Bay Islands since 1968 to 543 (Table 1). Eighty-nine pups (32 ♂♂ and 57 ♀♀) were also given coloured plastic tags in the hind-flippers. Of the 543 seals marked, 270 have both metal and plastic tags, 220 metal tags only, and 53 plastic tags only.

At Open Bay Islands, five of the 1969–70 season pups (1 ♂ and 4 ♀♀) were found dead in January 1970, a day after they were marked, and two others (1 ♂ and 1 ♀) in April 1970 (Dr C. J. Burrows, pers. comm.). One male was found dead on Kongahu Beach, Karamea, on 14 October 1970, having travelled at least 250 miles (400 km) north,

TABLE 1—Number of New Zealand fur seals, *Arctocephalus forsteri*, tagged in each age and sex group on Open Bay Islands, 1968–70.

DATE	AGE AND SEX	NUMBER	WORKER
September 1968	10 months ♂♂	40	} Stirling (1970)
	10 months ♀♀	42	
	10 months, unsexed	1	
January 1969	2 months ♂♂	42	} Stirling (1970)
	2 months ♀♀	43	
	2 months, unsexed	1	
February 1969	Sub-adult ♀♀	3	} Stirling (1970)
	Adult ♀♀	9	
May 1969	6 months ♂♂	19	} Brown (present study)
	6 months ♀♀	31	
	Sub-adult ♂	1	
	Sub-adult ♀	2	
January 1970	2 months ♂♂	139	} Crawley and Brown (present study)
	2 months ♀♀	170	
TOTAL		543	

and a female was found dead in the water near Three Steeple Rocks, Westport, 200 miles (320 km) north, on 10 December 1970.

#### MEASUREMENTS OF PUPS

Details of body weight and linear measurements of the pups marked are given in Table 2. On average, male pups at about 6 weeks old are significantly heavier than females and are larger in all body parts measured. This sexual dimorphism is also very obvious in adults, with males weighing up to 122 kg and reaching 2.5 m in length, while females weigh about 40 kg and are seldom longer than 1.25 m (King 1964, Sorensen 1969).

Data on curvilinear body length only were collected by D.L.B. in May 1969 for 50 pups (19♂♂ and 31♀♀) about 6 months old. The mean length of the males ( $72.26 \pm \text{S.E. } 1.253 \text{ cm}$ ) was greater than that of the females ( $71.84 \pm \text{S.E. } 0.985 \text{ cm}$ ) but the difference between the means is not statistically significant ( $t = 1.26$  at 48 degrees of freedom;  $P < 0.15$ ). The absence of a clear sexual dimorphism in these older pups is surprising, but only one parameter was measured, and sample sizes are too small for the results to be conclusive.

TABLE 2—Body weight and measurements of approximately six weeks old pups of the New Zealand fur seal *Arctocephalus forsteri*, on Open Bay Islands, Westland, in January 1970.

Measurement	Sex	N	Mean	S.E.	<i>t</i>	d.f.	P
Body weight (kg)	♂	139	5.126	0.107	4.651	306	<0.001
	♀	169	4.498	0.085			
Curvilinear length (cm)	♂	139	66.61	0.373	4.851	307	<0.001
	♀	170	64.50	0.303			
Anterior flipper (cm)	♂	136	23.02	0.128	3.520	300	<0.001
	♀	166	22.45	0.102			
Posterior flipper (cm)	♂	136	15.98	0.085	3.205	300	<0.01
	♀	166	15.60	0.085			

#### CENSUS AND POPULATION ESTIMATE

On 24 January 1970, each observer walked the length of the Taumaka rookery in two hours and each independently counted 545 pups, but up to 20% of pups may have been missed because of their habit of forming pods under flat slabs of rock.

The size of a seal population in an area can be calculated from the number of pups there, as Bonner (1958) did for the southern fur seal, *Arctocephalus australis*, on South Georgia. However, the incidence of pregnancy among mature females, the age at which they first give birth, the sex ratio and the mortality rates of juveniles and adults must all be known as well.

Although not for *Arctocephalus forsteri*, sufficient is known about related species to attempt a population estimate using data from them. Kenyon *et al.* (1954) record that 70% of adult female Cape fur seals, *Arctocephalus pusillus*, were pregnant in any one year, and Rand (1955) that females first give birth in their third year. Kenyon *et al.* (1954) found mortality rates for Pribilof fur seals, *Callorhinus ursinus*, to be 60% in the first year and 30% in the second. Because little is known yet of overall sex ratios and sex-specific mortalities in fur seal species, assumptions of their equality have to be made in the calculation, but observations so far on *A. forsteri* suggest that females might predominate on the breeding grounds.

#### CALCULATION

Total number of pups counted .....	545
Add 20% for undercounting (dead and missed) .....	654
Round to .....	650

This 650 equals the number of breeding females, as each bears only one pup. If 70% of adult females are pregnant each year then the total adult female population on Taumaka is:

$$650 \times \frac{100}{70} = 830$$

If the cows have their first pup in their third year, then the first and second year classes are not estimated. If the sex ratio equals unity and first year mortality is 60%, the yearling female class is:

$$\frac{650}{2} \times \frac{40}{100} = 130$$

If second year mortality is 30%, the second year female class is:

$$130 \times \frac{70}{100} = 91$$

Thus, immature cows add up to 221, and total females, excluding pups, to  $830 + 221 = 1,051$  say 1,050. If the mortality of males is equal to that of females then the total herd, excluding pups, is  $2 \times 1,050 = 2,100$ . Thus, the total population on Taumaka Island, including pups, =  $2,100 + 650 = 2,750$ .

This estimate of the total population of fur seals on Taumaka Island is doubtless inaccurate; the only firm figure in it is the number of pups actually counted. If the correction of 20% for undercounting is omitted, the estimated total population, including pups, is 2,430 animals. Also, slight inter-specific variations in the figures used for incidence of pregnancy and early mortality rates could have influenced the final totals, but only further research will show by how much. Another source of inaccuracy is the probability that the population is increasing, and therefore estimation of immature stocks ought to be based not on a percentage of the 1969-70 pups, but on an unknown smaller number.

However, after allowance for all sources of error, the Taumaka herd certainly numbers between 2,000 and 3,000 animals. Continued research should provide more reliable data on reproduction, mortality and movements of *A. forsteri* itself, and these will allow more accurate population estimates.

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