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THE ABUNDANCE, BREEDING DISTRIBUTION AND NEST SITES OF BLUE PENGUINS IN OTAGO, NEW ZEALAND

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ABSTRACT

A survey of Blue Penguins (*Eudyptula minor*) in 1991-92 along the coast of Otago in the South Island found at least 2073 breeding pairs between the Waitaki River and Nugget Point. The total population in this area, including immature birds, is estimated at about 9300 birds. These birds use 20 breeding sites along the coast, but most (97%) are concentrated in four areas – Taiari Island, Green Island, Otago Peninsula and Oamaru. Birds no longer breed at seven sites, have decreased on Green Island and at one site on Otago Peninsula, remained largely unchanged at Nugget Point and have recently increased at Pilot's Beach near Taiaroa Head, and possibly at Oamaru. Dogs killed at least 34% of birds breeding in one part of Oamaru. Most nests were in depressions completely covered by vegetation (39.6%) or in burrows dug into soil (36.9%) but the proportions of burrow types differed between sites. Introduced mammalian predators had little or no access to most sites; where predator access was unrestricted, some predator control was usually in place.

KEYWORDS: Blue Penguin, *Eudyptula minor*, breeding, density, New Zealand

INTRODUCTION

Blue (or Little) Penguins (*Eudyptula minor*) occur throughout the main islands of New Zealand and across southern Australia. Kinsky & Falla (1976) described the distribution of the subspecies *Eudyptula minor minor* (Southern Blue Penguin) as around the southern and western shores of the South Island of New Zealand from Oamaru on the east coast to north of Karamea on the west coast. However, the most recent New Zealand checklist (Turbott 1990) placed all of the five previously recognised subspecies in New Zealand on one taxon *E. minor* without reference to subspecies and adopted the common name "Blue Penguin".

Apart from population estimates made at Oamaru in 1985-86 (Johnstone 1986), Taiaroa Head in 1982-83 (Gales 1984), Green Island in 1984 (Lalas 1984), and Nugget Point in 1985 (Lalas pers. comm.), the distribution and numbers of Blue Penguins along the coast of Otago have not been examined. In this paper I report on a survey of the distribution, abundance and nest sites of Blue Penguins along the coast of Otago during the breeding season of 1991-92.

METHODS

This survey of Otago began at the mouth of the Waitaki River, north of Oamaru, and extended about 187 km south to Nugget Point in the Catlins. All areas were searched on foot at least once between 8 October 1991 and 17 February 1992. The 15 km of shingle beaches without backing cliffs, between 1 km south of the Waitaki River mouth and 5 km north of Oamaru, were not searched as they are unsuitable for penguins to breed. Searching effort at each site was variable. Two places (Oamaru and Taiaroa Head) were visited more frequently as a part of other studies and all birds encountered at these two sites were marked with individually numbered flipper bands. Oamaru was visited 12 times between 8 November 1991 and 25 January 1992. Most breeding areas around Oamaru were visited several times in daylight and at least once at night. Taiaroa Head was visited 12 times between 18 October 1991 and 20 February 1992 including four visits after dark. The other two important breeding areas, Green and Taieri Islands, were visited on 1-3 December (Green Island) and on 18 November and 10-11 December 1991 (Taieri Island).

Other sites where penguins were found breeding, or had been reported breeding in the past, were visited usually more than once. Usually all active burrows were counted, but quadrats were used to estimate the number on Taieri Island because the heavy cover of New Zealand flax (*Phormium tenax*) made counting individual burrows impossible. On Taieri Island, burrows were counted individually in the lightly vegetated periphery and nine 36m² quadrats were selected from randomly generated co-ordinates in the 5 ha of flax and the mean density of these taken as being representative of the whole flax area. On Green Island, each burrow was marked with paint to prevent double counting, but this was not necessary at other sites. Recent personal communications were used for estimates at the few known breeding sites that were not visited.

An *active* breeding burrow was one that contained eggs or chicks or was judged, by disturbance and excreta, to have recently contained chicks. Empty burrows and burrows containing only unemployed adults were not included in the numbers of breeding birds. This method underestimates the size of the population by omitting failed breeders, but as the penguins use several burrows and usually breed in only one, eggs and chicks are the only available criteria of burrow activity.

RESULTS

Distribution and abundance

A total of 2073 breeding pairs was found along the coast of Otago between Waitaki River and Nugget Point (Table 1). This total is conservative because some pairs had begun breeding and lost their eggs or young before the survey began. If these birds did not reneest, they may not have been recorded in the survey. Breeding birds were recorded at 20 sites but most (97%) were concentrated in four areas (in descending order of size) – Taieri Island, Otago Peninsula, Green Island and Oamaru (Table 1).

TABLE 1 – Estimated numbers of Blue Penguins breeding along the coast of Otago in 1991-92

Location	Breeding Pairs	
	Number	%
Oamaru	218	10.5
Kakanui	2	0.1
Moeraki		
Maukiekie Island	2 ¹	0.1
Kaik	13	0.6
Katiki Point	1	0.1
Mapoutahi Pa	12	0.6
Long Beach	22	1.1
Spit Beach	2	0.1
Otago Peninsula		
Harrington Point	6	0.3
Otekiho Beach	1	0.1
Taiaroa Head	128 ²	6.2
Penguin Beach	75	3.6
Pipikaretu Beach	12 ³	0.6
Ryan's Beach	1 ¹	0.1
Victory Beach	2 ⁴	0.1
Allen's Beach	1	0.1
Sandymount Cave	6 ¹	0.3
Green Island	223	10.8
Taieri Island	1338	64.5
Nugget Point	8	0.4
TOTAL	2073	

1: Graeme Loh (pers comm.).

2: Count in albatross colony - Lyndon Perriman (pers. comm.).

3: Howard MacGrouther (pers. comm.).

4: John Darby (pers. comm.).

Taieri Island

The relatively bare, eroding periphery of the island contained 255 active burrows. Within the densely vegetated flax areas, the mean density of nine quadrats was 0.78/36 m² or 0.0217 active breeding burrows per square metre (± 0.027). These active breeding burrows made up 78% of the burrows found in the quadrats. Using Allen's (1978) estimate of flax area of 5 ha, I obtained an estimate of 1083 burrows (50,000 m² x 0.0217 burrows/m²) for the flax-covered part of the island. Therefore, the estimated total is 1338 burrows (95% confidence limits; 888 - 1788 burrows).

Otago Peninsula

Breeding penguins were found at nine sites extending from Harrington Point just inside the harbour, around Taiaroa Head and south to Sandymount Cave. Their breeding distribution was discontinuous and usually associated with headlands or adjoining beaches. During this survey, it was not possible to conduct a thorough search of breeding penguins in the albatross colony at Taiaroa Head because of concerns about disturbance to the breeding activities of the albatrosses. A thorough search in 1992-93 found 70 *active* burrows there (Lyndon Perriman, pers comm.) and that estimate has been used here.

Green Island

Most of this 4.5 ha island is bare basalt tuff but the eastern half is partially clad in coastal scrub, predominantly taupata *Coprosma repens* (Lalas 1984). Penguins were distributed over most of the eastern and southern parts of island, particularly in the coastal scrub areas and small caves. Active burrows were counted individually and marked to avoid double counting.

Oamaru

The breeding areas of penguins extended from the shore adjoining the golf links south of Oamaru to the northern end of the railway yards. Searches beyond these areas did not reveal further breeding sites. The penguins bred throughout the waterfront area of the town and a few bred in isolated sites on the western side of the railway yards. Most pairs were in the vicinity of the quarry and north of the main wharf.

A total of 218 breeding pairs was located in the vicinity of Oamaru. Of these, 187 (86%) pairs were in the town i.e. between the quarry and the end of the railway yards, and the remaining 14% (31) along the cliffs south of the waterfront. The number of pairs found breeding at the different sites in 1991-92 is shown in Table 2.

Dogs killed 30 birds in the breeding area between the main wharf and Oamaru Creek during 1991 (David Houston, pers. comm.) and killed two chicks there during this study. Fifty-eight birds bred in this part of the colony in 1991-92 apart from the 30 killed by dogs. Therefore, dogs killed at least 34% of the breeding birds in this part of the colony during the year. Clearly, dogs are a major threat to penguins in Oamaru. Other significant causes of mortality were not obvious during this study, although one bird was killed by a car (Jim Caldwell, pers. comm.) and several others were rescued from life-threatening situations in the industrial area.

TABLE 2 – A comparison of estimated numbers of Blue Penguins in different parts of the colony at Oamaru during Johnstone's survey* in 1985-86 and this study

Part of Colony	Estimated number of breeding burrows	
	1985-86	1991-92
Golf links	3	3
Bushy Beach to Boatman's Harbour	5	11
Boatman's Harbour	6	17
Oamaru Harbour	18	53
Fletcher's yard to Oamaru Creek	27	29
Subtotal	59	113
North of Oamaru Creek**	20	105
TOTAL	79	218

* Johnstone, R. 1986. The status of the Little Blue Penguin (*Eudyptula minor minor*) at Oamaru. Unpublished report to the Royal Forest and Bird Protection Society (Waitaki Branch).

**This area was incompletely surveyed in 1985-86 and so, for the purposes of assessing the trend in numbers, the subtotals provide the best comparison.

TABLE 3 – The burrow types of Blue Penguins along the coast of Otago

Location	Burrow type						
	Rock	Soil	Artificial	Cliff base	Caves	Vegetation	Surface
Oamaru	147*	13	47	6		5	
Kakanui	2						
Moeraki	13						
Mapoutahi Pa	8	2					
Long Beach	5	5		12			
Spit Beach				2			
Otago Peninsula	1	89	9	24	11	3	
Green Island	33	120		4	8	3	51
Taieri Island	15	406		1	8	677	
Nugget Point		6		1	2		
TOTAL	224	641	56	50	29	688	51
%	12.9	36.9	3.2	2.8	1.8	39.6	2.9

*most in breakwaters and waterfront walls around the harbour

Nesting habit

Most nests were either in depressions completely covered by vegetation (39.6%) or in burrows dug into soil (36.9%), but there were significant differences in the proportions of burrow types at different sites (Table 3). At Oamaru, most burrows were either in rock retaining walls or under buildings, piles of timber etc. along the waterfront. Nests in piles of loose rock were important at all the colonies in northern Otago but were less common on and south of the Otago Peninsula. Burrows in soil were more frequent in southern Otago and were the commonest type on Otago Peninsula, on Green Island and at Nugget Point (Table 3). Depressions under flax were more common than burrows in soil on Taieri Island. Particularly unusual was the habit on Green Island of birds (51 pairs) nesting on the soil surface 1 - 2 metres below the thick canopy of taupata and often against the trunk of the shrub.

DISCUSSION

Population estimate for the coast of Otago in 1991-92

Blue Penguins do not breed until they are two or three years old (Dann & Cullen 1990) and the young non-breeders return to their natal colonies intermittently before breeding there. Dann & Cullen (1990) have estimated that young birds make up 56.9% of the total population on Phillip Island on the southeastern coast of the Australian mainland. Therefore, assuming a similar age structure, the entire population of penguins along the coast of Otago would be in the vicinity of 9619 [4146 breeding birds plus 5473 (4146 x 1.32) immature birds].

Population trends and threats

No evidence of breeding was found during this survey at seven sites where breeding had been recorded previously. At Shag Point, two burrows containing eggs were dug out by a dog in 1989 and two chicks were found under a house in 1986 (Joy Steicke, pers. comm.). Four nests (at least one with two eggs) were found at the mouth of Stony Creek near Palmerston on 26-27 December 1981 (Ken Gager, pers. comm.). In addition a few penguins bred at Katiki Beach, south of Katiki Point, *circa* 1977 (Malcolm Foord pers. comm.) and in November 1971, one bird (probably breeding) was banded at Reid's Beach on Otago Peninsula (Alan Wright, pers. comm.) and one pair of birds bred at Hampden *circa* 1985 (Chris Lalas, pers. comm.). Two pairs bred at the northern end of Bobby's Head between 1983 and 1985 (Chris Lalas, pers. comm.). In 1969, there were about 20 pairs nesting at Sandfly Bay (not present in early 1980) on Otago Peninsula (John Darby, pers. comm.). Thorough searches during the breeding season (November-February) found no sign of penguins breeding at these sites.

There is fragmentary evidence that breeding numbers may have decreased overall on Otago Peninsula also, despite an increase being recorded at one site (Taiaroa Head). Richdale (1940) noted that "This little Penguin exists on the Otago Peninsula in far greater numbers than all the other species grouped together, but as yet I have little idea of the population" and "I should

estimate that there are probably well over a thousand around the whole coast." Although these comments are a long way from precise, they imply that numbers were greater than the 464 birds estimated to breed on Otago Peninsula at present. More recent evidence shows a decline at one site on the Peninsula. In February 1971, 12 adults were banded (presumably breeding at that time of year) at Allen's Beach on Otago Peninsula (Alan Wright, pers. comm.) but during this survey only one pair bred there, at the end of a 19 m long cave.

Numbers appeared relatively unchanged at Nugget Point where Lalas (pers. comm.) found about 12 pairs in 1985 and there is evidence that some colonies elsewhere along the coast have increased in size in recent years. Gales (1984) studied the breeding biology of Blue Penguins at Taiaroa Head in 1982-83. Her extensive search of the area produced an estimate of 17 pairs, and so the 128 pairs found in the current study represent a considerable increase, particularly in the vicinity of Pilot's Beach [where over a dozen artificial burrows have been installed and have been occupied by penguins], where only one pair bred in 1982-83 (Rosemary Gales, pers. comm.).

Johnstone¹ surveyed the distribution and abundance of penguins in Oamaru in 1985-86 for the Royal Forest and Bird Protection Society. Although his census did not involve flipper-banded birds and did not locate all breeding pairs, most areas can be compared with the current survey. Some interpretation of his numbers has been necessary to provide an estimate of breeding pairs at that time.

The penguins in Oamaru appear to have increased in the past six years. Some of the difference in numbers can be attributed to different survey methods. There was some disruption to the penguins at the time of Johnstone's survey, when many of the birds breeding at the quarry were fenced off from their burrows, making an accurate assessment of numbers difficult while the daily pattern of the birds' behaviour was disrupted. However, on the present numbers, the population has certainly not declined over the past few years despite high predation by dogs in at least one area.

There is a considerable discrepancy between the present estimate of breeding pairs on Green Island (223) and Lalas's (1984) estimate (1500) in 1983-84. Lalas, who took part in the present survey on Green Island, believes that the first estimate was less accurate but, even so, that numbers have declined appreciably. Possible reasons for this decline are not known although the high mortality of Yellow-eyed Penguins (*Megadyptes antipodes*) in 1990 was accompanied by unusually high numbers of dead Blue Penguins in Otago (John Darby, pers. comm.).

There are no earlier estimates at Taieri Island for comparison but erosion, probably caused by rabbits is causing obvious degradation. In some areas extensive amounts of topsoil were being lost and some loss of flax was obvious. Coastal hebe (*Hebe elliptica*) and cabbage trees (*Cordyline australis*) were not regenerating. Rabbit eradication would seem an important step in keeping Taieri Island as the most important site for Blue Penguins in Otago.

¹Johnstone, R. 1986. The status of the Little Blue Penguin (*Eudyptula minor minor*) at Oamaru. Unpublished report to the Royal Forest and Bird Protection Society (Waitaki Branch).

Mean burrow density in the flax areas of Taieri Island (2.17 breeding burrows per 100 m²) was lower than that found on Phillip Island, Victoria, Australia [mean 4.1 / 100 m² (Dann, incorrectly cited as 4.1 / m² in Marchant & Higgins 1990)] and on Bowen Island, NSW, Australia [9.0 - 12.0 / 100 m² (Fortescue 1991)].

Predator access to breeding sites

Predation by introduced mammalian carnivores appears to have been a factor in population declines of *E. minor* on the Australian mainland and on those offshore islands that have these predators (Dann 1992). In New Zealand, since dogs and mustelids (particularly ferrets and stoats) were introduced, predation may have been altering the breeding distribution of Blue Penguins.

TABLE 4 – Access available to introduced mammalian predators for various parts of each colony along the coast of Otago. Those places where some dog and mustelid control occur are marked with asterisks.

Location	Site Description	Predator Access
Oamaru	Rock piles	Unrestricted
	Soil fall at cliff base	Low tide
	Industrial	Unrestricted
Kakanui	Rock piles	Unrestricted
Maukiekie Island	Island	None
Kaik	Soil Fall at cliff base	Low tide
	Rock piles	Low tide
Katiki Point	Nesting box	Low tide
	Soil fall at cliff base	Low tide
Mapoutahi Pa	Rock piles	Low tide
	Sea cave	None
Long Beach	Sea cave	Low tide
Spit Beach	Rock piles	Low tide
Harrington Point	Soil fall at cliff base	Unrestricted
Otekiho Beach	Rock piles	Unrestricted*
Taiaeroa Head	Soil fall at cliff base	Unrestricted*
	Sea cave	Low tide
	Nesting boxes	Unrestricted*
Penguin Beach	Soil fall at cliff base	Unrestricted*
Pipikaretu Beach	Soil fall at cliff base	Unrestricted*
Ryan's Beach	Soil fall at cliff base	Unrestricted*
Victory Beach	Soil fall at cliff base	Unrestricted
Allen's Beach	Sea cave	Unrestricted
Sandymount Cave	Sea cave	None
Green Island	Island	None
Taieri Island	Island	None**
Nugget Point	Sea cave	Unrestricted*
	Soil fall at cliff base	Unrestricted*

* some mustelid and dog control occurs.

** access at low tide was available some years ago.

The role of cats in determining the distribution and abundance of Blue (Little) Penguins varies in Australia, being apparently unimportant on Phillip Island (Dann 1992) but possibly significant on Wedge Island in Tasmania (Stahel & Gales 1987) and requires further study.

Most breeding sites along the coast of Otago were islands, in places accessible to mammalian predators only at low tide, or places where some predator trapping occurred (Table 4). The exceptions were an isolated pair at Allen's Beach (probably a colony in decline), several pairs at Kakanui, Victory Beach and Harrington Point, and the much larger colony in Oamaru. The small numbers of birds breeding at Victory and Allen's Beaches and Kakanui appear to be relicts or vagrants that have escaped predation by chance and may not persist much longer without active management. The Harrington Point group has been at the present site for at least two decades (Chris Lalas, pers. comm.) despite being close to a small settlement and its resident dogs. It may benefit from the mustelid control programmes carried out at adjoining sites on Otago Peninsula, but these are relatively recent. It is surprising that the breeding population at Oamaru is surviving well despite being accessible to mustelids and dogs. Dogs may be deterred by many of the burrows being amid large boulders but this did not appear to be true in 1991 and has been a problem for some years (David Houston, pers. comm.). Mustelid activity may be low in Oamaru because urban and industrial areas are nearby.

The status of Blue Penguins along the coast of Otago appears secure at present with 78% of the breeding population on two islands free of introduced mammalian predators. Predation will probably eliminate some smaller mainland colonies, but where dog and mustelid control is effective, penguin numbers may be stable or increase. Blue Penguins should benefit from the predator control and habitat management programmes being instigated for the protection of Yellow-eyed Penguins throughout Otago.

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