

Dispersal of southern black-backed gulls (*Larus dominicanus dominicanus*) banded in Canterbury, New Zealand, 1959-1993

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Abstract A total of 3455 southern black-backed gull (*Larus dominicanus dominicanus*) chicks were banded at 4 Canterbury localities between 1959 and 1993: Ashley River 1239; Waimakariri River 219; Motunau Island 1997. Only 180 (5.2%) of these chicks were recovered, 3.0% of the river colony chicks and 6.9% of the Motunau Island chicks. Three-quarters of recoveries were in rural environments with most others on the coast; 14 had been shot or trapped and killed. The oldest recovery from the river colonies was 6.1 years old but this may be an underestimate due to wear and loss of aluminium bands used early in the study period; Motunau Island birds were found up to 25.7 years after banding. Birds dispersed widely from the Wairarapa to Southland travelling up to 486 km. Recoveries of first year birds off-colony averaged 96 km which is more than the older birds, 54 km; 7/10 birds that travelled over 200 km were first year birds. On average, Motunau Island birds were found further from the natal colony than birds from the river colonies. My results indicate that dispersal distances and direction of black-backed gulls are variable, and that dispersal can occur between the North and South Islands.

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Keywords Ashley River; banding; dispersal; *Larus dominicanus dominicanus*; Motunau Island, recoveries; southern black-backed gull; Waimakariri River

INTRODUCTION

In the late 1950s through 1970s, the late Ken Rowe held a general banding permit that allowed him to band almost everything apart from game birds providing he had suitable bands. Banding was carried out at home, rivers, coasts, offshore islands, in fact, wherever a bird could be caught, often in the company of staff from the, then, Wildlife Service of the Ecology Division, Department of Scientific and Industrial Research (DSIR). The aim of his

programme was simple: band anything that could be caught, see what resulted, and make the data available for anyone who wished to use it. The best example was banding red-billed gulls at Kaikoura from 1959 to 1964 which progressed into a 50+ year study being continued by Jim Mills through to the present day. The author took over this permit in later years until the days of "band and fling" were over and more specific programmes were required. This paper is one of a series in which I present information, mainly recovery and dispersal data, from that banding programme in order to have it the public domain.

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Table 1. Numbers of southern black-backed gull chicks banded at some South I sites, 1959 to 1993.

Locality	Coordinates	Number banded	Permit holder	Year(s)
Lake Grassmere	41° 44' S 174° 09' E	1	K. Rowe	1961
Grey River, Westland	42° 17' S 171° 22' E	1	K. Rowe	1963
Kaikoura Peninsula	42° 26' S 173° 42' E	5	K. Rowe	1965
Motunau I	43° 03' S 173° 05' E	277	K. Rowe	1959-1972
Motunau I	43° 03' S 173° 05' E	452	L.K. Rowe	1976-1985
Motunau I	43° 03' S 173° 05' E	398	C.N. Challies	1974-1993
Motunau I	43° 03' S 173° 05' E	785	R.H. Taylor	1962-1977
Motunau I	43° 03' S 173° 05' E	85	3 others	1962-1983
Harper River	43° 11' S 171° 33' E	1	K. Rowe	1966
Loburn	43° 15' S 172° 32' E	1	K. Rowe	1982
Ashley River – gorge	43° 14' S 172° 14' E	44	K. Rowe	1964-1965
Ashley River – airfield	43° 16' S 172° 29' E	1150	K. Rowe	1959-1972
Ashley River – airfield	43° 16' S 172° 29' E	45	L.K. Rowe	1980-1983
Waimakariri River – gorge	43° 22' S 172° 03' E	219	K. Rowe	1959-1962
Total		3464		

In New Zealand, southern black-backed gulls (*Larus d. dominicanus*) breed in colonies or as solitary pairs along the coast, on islands, up riverbeds and in the high country up to 1500 m asl (Kinsky 1963; Fordham 1985; Heather & Robertson 1996; Higgins & Davies 1996; Checklist Committee (OSNZ) 2010). The southern black-backed gull has been given an IUCN ranking “lower risk, least concern” (Taylor 2000) and New Zealand threat classifications of “endangered, not threatened” (Miskelly *et al.* 2008).

There are indications that, since the 1940s at least, the populations of black-backed gulls have increased markedly in some regions. For example, along the south-west of the North I the population more than doubled between 1961 and 1985 (Powlesland & Robertson 1987) and some colonies increased by up to 11 times from the 1940s to 1964 (Fordham 1967b). In these instances, the increases have been related to the establishment and growth of freezing works and rubbish dumps. At Matakana I, the gull population increased from 400 to 3000 pairs in the decade from 1982 (Chudleigh, *undated*). However, in the Waitaki basin where human influences are not as marked, black-backed gulls also increased in density and range between the 1960s and 1990s while many other riverbed species were showing declines (Moloney 1999).

The breeding biology of the southern black-backed gull has been described by Fordham (1964a; 1964b). In New Zealand, the average life expectancy of adult southern black-backed gulls is 14 years (Heather & Robertson 1996) but they have been known to live up to 28 years (Fordham

1985; Heather & Robertson 1996). Fordham (1968) reported a study of the dispersal of black-backed gulls from their colonies in central New Zealand. However, it is not clear if the patterns of dispersal are the same at other localities or if recent increases in the population size of the black-backed gull has led to changes in their demographics and dispersal behaviour. This paper compares the recovery and dispersal of black-backed gulls from a number of South I localities with that reported from North I sites.

METHODS

Southern black-backed gulls were banded under permits held by the late Ken Rowe and the author at 9 localities in the South I (Table 1) between 1959 and 1985. At Motunau I (about 1300 m south of Motunau Beach on the Canterbury coast) banding was also undertaken by other permit holders who have allowed their data for the period 1962 to 1993 to be included to complete the Motunau I dataset. Visits made by the Rowes to nesting colonies in the Ashley River near the Rangiora airfield and below the gorge bridge, and in the Waimakariri River below the gorge bridge were specifically to band black-backed gull chicks. At Motunau I, early visits by DSIR staff were to study the ecology of the island including changes as a consequence of rabbit removal (DSIR 1967). Later visits by them and by other banders included banding gulls and other bird species. Opportunistic captures of black-backed gull chicks made at 5 other South I sites are

Table 2. Southern black-backed gulls nest counts at Motunau I.

Contents	22 Nov 1960 ^a	6 Dec 1961 ^a	4 Dec 1962 ^a	9 Dec 1963 ^a	11 Nov 1966 ^b	26 Oct 1970 ^b	1 Nov 1971 ^c
Empty	41	40	50	46	14	19	26
1 egg	17	17	13	16	7	26	17
2 eggs	23	51	27	21	50	33	35
3 eggs	20	25	21	9	86	50	56
4 eggs	0	0	0	0	1	-	-
1 chick	7	2	13	24	1	-	-
1 chick + 1 egg	6	2	2	8	2	-	-
1 chick + 2 eggs	0	3	3	1	-	-	-
2 chicks	2	2	19	17	-	-	-
2 chicks + 1 egg	4	1	2	4	-	-	-
3 chicks	1	1	1	3	-	-	-
Total nests	121	144	151	149	131	118	134
Nests with eggs &/or chicks	80	104	101	103	117	99	108
Chicks banded ^d	-	-	50	60	0	0	0

Sources: a, Taylor (1967); b, author; c, C.N. Challies (*pers. comm.*); d, Department of Conservation. Note that banding was not carried out in 1960 and 1961 even though chicks were present.

Table 3. Numbers of recovered southern black-backed gulls from Canterbury colonies.

Locality	Number banded	Number recovered	Percent recovered
Ashley River – gorge	44	1	2.3
Ashley River – airfield	1195	34	2.8
Waimakariri River – gorge	219	8	3.7
Motunau I	1997	137	6.9
Total	3455	180	5.2

listed in Table 1. Motunau I was the only site where accurate nest counts were undertaken.

In all cases, chicks were captured by hand when still in their nests or having left the nest but unable to fly. Aluminium bands were used between 1959 and 1966. In 1966 bands were changed to the harder-wearing monel metal and were further upgraded to stainless steel about 1970.

In the context of this paper, the term “recovery” refers to band identification at a date later than banding, whether the gull was dead or alive and includes sight readings of bands on non-handled birds. Recovery data came from the files of the Rowes or from the Department of Conservation (DoC) Banding Office archives.

Where recovery sites were known to the author from recovery slips, distances from the banding sites were determined from Google Earth. For other recoveries, the distances and directions calculated by the DoC record system were used with inherent errors of about ± 9 km in distance and $\pm 11.25^\circ$ of arc in direction. All Motunau I recoveries are given as 9 km NW of the island and have been corrected for this error. There are a number of recoveries under the age of 75 days within the 9 km class that have been assumed to be deaths of chicks or juveniles on the island and adjustments made accordingly; birds older than 75 days have not been adjusted as they could be from the mainland where other birds have been recovered.

Habitats where gulls were recovered were classed as the “breeding colony”, “coastal” where birds were identified as recovered on beaches and at river mouths, “city” for Christchurch and Wellington and their suburbs except when the suburbs were coastal, and “rural” including townships for all others. Where the habitat as been classed as “indeterminate” for Motunau I birds, it has not been possible with the information I have to say whether they were recovered at the colony or on the mainland based on distance, or rural or coastal based on the inherent error in direction.

The age of recoveries is the time difference between banding and recovery, not the hatching date. This time period will have a variable, inherent error and underestimate age as chicks were banded

Table 4. Method of recovery of southern black-backed gulls.

Banding locality	Total recovered	Alive	Unwell, fate unknown	Shot or trapped & killed	Died as young on colony	Found dead	Other
Ashley River – gorge	1	-	-	-	-	1	-
Ashley River – airfield	34	1	2	8	4	18	1
Waimakariri River – gorge	8	1	-	1	-	6	-
Motunau I	137	7	3	5	18	101	4
Total	180	9	5	14	22	126	5

when big enough for the band to stay on (~10 days) through to almost flying (~6 weeks).

In total, 3464 chicks were banded (Table 1), 1997 at Motunau I, 1458 at colonies on the Ashley and Waimakariri rivers, and 9 at other South I localities. Most of the gulls on the river colonies (1195 birds) were banded at the Ashley River airfield colony. The Ashley gorge colony was the smallest of the 3 with only 19 and 25 chicks banded in the 1964-5 and 1965-6 seasons, respectively.

Numbers banded varied considerably from year to year with the largest number at any colony being 229 in summer 1962-3 at the Ashley airfield colony; at Motunau I the largest number banded in a season was 201 in summer 1972-3. Chicks were banded mostly in Dec (Motunau I 67%; rivers 76%), but at Motunau I and the Ashley River airfield, banding did take place in the second half of Nov through to early Feb. Statistical tests used were those in Conover (1971).

RESULTS

The contents of nests counted at Motunau I are given Table 2. About 100 nests with eggs and/or chicks were found each visit. Most nests had 2 or 3 eggs and chicks and 1 had 4 eggs. Counts for 1960 through 1963 had more nests with chicks than for 1966 to 1971, which reflected observations being made about 1 month later. Chicks were banded when these counts were made in 1962 and 1963; whether the higher number of empty nests up until 1963 was because some chicks had left the nests or whether this was an observer effects is unknown. Therefore, determining any trend into nest numbers is not possible.

Forty three (3.0%) of the 1458 chicks banded at the Waimakariri River and Ashley River colonies were recovered (Table 3). A greater proportion of birds banded at Motunau I, 6.9% (137 birds) were recovered. For all sites, 180 birds were recovered: 9 were live birds (caught and released or sight recoveries), 14 had been shot or trapped and killed, 5 were described as unwell and may have died, 22 died as young on the colonies and, apart from

5 instances of a band only having been found, the rest of the recoveries were dead birds (Table 4). There were no recoveries of banded gulls from the 5 smallest localities.

Nearly 45% of the birds recovered failed to reach 1 year old and only 10% were over 5 years old when recovered (Table 5). The oldest bird recovered was from the Motunau I colony and was nearly 26 years old. There were significant differences between sites using data from Table 5 grouped into < 1 y, 1 to 5 y, and > 5 y classes ($\chi^2 = 17.6$, $P < 0.05$). Of note is the larger proportion of birds recovered less than 6 months old at Motunau I compared to the 3 river sites. This is probably a reflection of a physically confined area of the island, and visits later in the summer for other ecological studies when birds were found; at the river sites there were far fewer follow up visits looking for dead birds in the widely dispersed colonies with weed growth that hindered recovery activities.

Using the same age groups as for site comparisons, there were significant differences in the recoveries between band types ($\chi^2 = 28.8$, $P < 0.05$); this is obvious for Motunau I where a greater proportion of the bands used were stainless steel and there was a higher number of older recoveries.

Of the 5 recoveries at the river colonies (Table 6), only 1 was a chick that died before fledging. The Motunau I records have 49 birds that are known, or can be reasonably assumed, to have died as chicks or juveniles less than 75 days after banding. There were another 50 birds found dead on the island or its vicinity (the DoC database has all known island recoveries listed as being within 9 km of the island and does not discriminate between island/non-island recoveries) of which only 4 are confirmed mainland recoveries; 17 cannot be assigned to the island or the mainland but are likely to have been at Motunau I. Of the 74 recoveries off the natal colonies where habitat can be determined, three-quarters were found in rural localities, and most of the others were at coastal sites (Table 6).

Dispersal of gulls from the colonies spanned the area from the Wairarapa to Southland (Fig. 1). The furthest a bird travelled from Motunau I was 486

Table 5. Time from date of banding until recovery for southern black-backed gulls. Band types: Al = aluminium; Mon = monel; SS = stainless steel.

Banding locality	Band type	Total banded	Total recovered	% recovered	<1 month	1-6 months	6-12 months	1-2 years	2-5 years	5-10 years	>10 years	Maximum years	Average days
Ashley River - gorge	Al	44	1	2.3				1				1.8	658
Ashley River - airfield	Al	830	29	3.5	2	7	2	3	12	3		6.1	856
Ashley River - airfield	Mon	159	2	1.3		1	1					1.0	267
Ashley River - airfield	SS	206	3	1.5	1		1		1			2.0	320
Waimakariri River - gorge	Al	219	8	3.7			1	2	4	1		5.7	978
Motunau I	Al	367	18	4.9		3	1	4	7	2	1	11.9	1220
Motunau I	Mon	200	4	2.0	2				1	1		5.1	871
Motunau I	SS	1430	115	8.0	4	47	9	5	16	17	17	25.7	1354
Total		3455	180	5.2	7	60	15	15	41	24	18	25.7	

km to Dipton, and from the river colonies one bird flew 325 km to Oriental Bay from the Waimakariri Gorge; 10 birds covered over 200 km (Table 7), and another 6 between 100 and 200 km (Table 8). First year birds recovered off-colony were found on average nearly 100 km from their natal colonies whereas older birds were found 54 km away (Table 9). There were differences between sites in that first year and older birds from Ashley airfield travelled similar distances (average 17 km) but the birds from Motunau I travelled further (average 105 km) with first year birds averaging 170 km and older birds 79 km.

Dispersal direction seems to have been non-directional in that 39 of 80 birds recovered away from the natal colonies had a northerly component and 41 a southerly component to their movements (Fig. 2). There were differing biases for the river colonies: 31 of 38 had an easterly component, and 6 of 42 from Motunau I had an easterly component. These differences reflect the alignment of the country and that Motunau I is the easternmost of the colonies whereas the river colonies lie inland.

DISCUSSION

Most nests found at Motunau I contained 2 or 3 eggs and/or chicks which is typical for southern black-backed gulls (Heather & Robertson 1966; Higgins & Davis 1996) and the same as found on Somes I (Fordham 1964a). There was one instance of a 4-egg clutch and this is rare (Heather & Robertson 1966; Higgins & Davis 1996). The number of nests with eggs and/or chicks was about 100 but there were many empty nests seen. As many nests are built and not used (Fordham 1964a), nests may have had chicks that had left, and there was possible observer bias before and after 1964, it was not possible to identify trends in the number of nests over the 11 years. This population appears to have been stable throughout the 1960s unlike some reported earlier (Fordham 1967b; Powlesland & Robertson 1987), principally because there are no major human influences nearby such as freezing works, rubbish dumps and cities for them to frequent for food. For example, Motunau I is about 60 km from Christchurch, while Waimakariri Gorge is 50 km, and the Ashley airfield is 30 km from potential sources of human food sources.

In this study, 43 (2.9%) of the 1458 chicks banded on the 3 river colonies were recovered compared to 137 (6.9%) of 1997 birds from Motunau I. Only 5 birds (0.4% of those banded) were recovered on the river colonies in my study, but not enough visits and thorough inspections were made in any season to get good counts of birds that might have died, especially those that had not fledged. A higher proportion than from the river colonies,

Table 6. Habitat frequented by southern black-backed gulls when recovered.

Banding locality	Total	Colony	Coastal	Rural	City	Indeterminate
Ashley River – gorge	1			1		
Ashley River – airfield	34	5	4	23	2	
Waimakariri River – gorge	8		3	4	1	
Motunau I	137	78	9	27	0	23
Total	180	83	16	55	3	23

4%, were recovered on Motunau I probably because the confined area was covered more intensively for many studies although ages were often not given for these recoveries. The total on-colony recoveries were considerably less than in a 5 year Wellington region study where 7% of banded chicks died before fledging and 13% were found dead in total, and at Somes I where losses of young were 17.6% (Fordham & Cormack 1970).

Twelve river (0.8%) and 15 Motunau I banded birds (0.8%) were found dead off the colonies in their first year after banding, about a quarter the rate seen at Wellington (Fordham & Cormack 1970). A further 26 river (1.8%) and 27 Motunau I (1.4%) birds were recovered off-colony over 1 year old. About 3.7% of banded Wellington birds less than about 5 years old were recovered outside their natal areas (Fordham 1968), and for Somes I birds about 6.9% were recovered (Fordham & Cormack 1970); the equivalents for the Canterbury rivers and Motunau I colonies were much lower at 2.5% and 1.8%, respectively.

The longest period between banding and recovery for birds from the rivers was 6.1 years despite the first chicks having been banded in 1959 and 27 years having elapsed since the last were banded. This was unexpectedly short given the life expectancy of adult southern black-backed gulls is 14 years old and the oldest known bird reached 28 years old (Heather & Robertson 1996). A factor such as band loss could have contributed to this low maximum age. Band loss through wear has been recognised as a potential problem in many studies, including studies of gulls (Ludwig 1967; Mills 1972; Coulson 1976; Spear 1980). A comparative study on black brant (*Branta bernicla nigricans*, a small goose) double banded with aluminium and monel bands on different legs showed that for recaptured birds 30% and 100% of aluminium bands were illegible or lost 2 years and 6 years, respectively, after banding (Lensink 1988). In the 11 years of that experiment the monel bands exhibited little wear and were in good condition; 3 birds were found with legible monel bands 21 to 24 years after banding. Red-billed gulls (*L. novaehollandiae scopulinus*) at Kaikoura were found to have band loss after 4 to 7 years depending

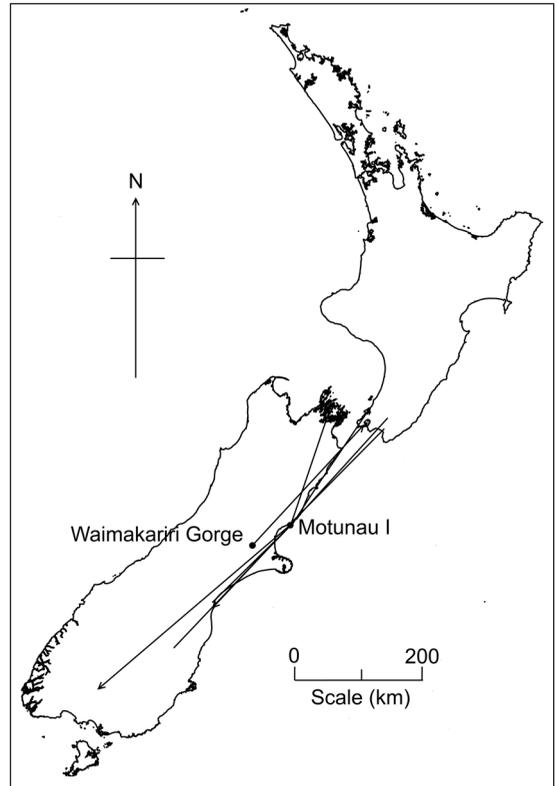


Fig. 1. Long-distance (defined as > 200 km) movements of southern black-backed gulls banded in Canterbury. Arrows indicate known recovery locations; plain lines are within 11.25° of arc.

on aluminium type and sex (Mills 1972). A study of wear on southern black-backed gulls (Fordham 1967a) found that band loss could occur in the 6th year and that there would be a marked loss of bands in the 10th year.

In this dataset, 1093 gulls were banded on the rivers with aluminium bands up until 1966. Thus, it is not surprising that no very long-lived birds were found from this group but I would have expected some recoveries in the 6-10 year age range. Of the 365 birds marked with monel and stainless steel

Table 7. Long distance recoveries, over 200 km, of southern black-backed gulls banded in Canterbury.

Banding locality	Destination	Distance (km)	Time since banding (yy mm dd)
Waimakariri River – gorge	Oriental Bay, Wellington	325	1 / 5 / 17
Motunau I	Timaru	208	0 / 3 / 21
Motunau I	Timaru	208	0 / 4 / 26
Motunau I	Timaru	208	0 / 6 / 3
Motunau I	South Wellington Province	257	0 / 5 / 18
Motunau I	Porirua East, Wellington	257	0 / 6 / 17
Motunau I	Marlborough Sounds	272	1 / 10 / 25
Motunau I	South Wellington Province	282	0 / 6 / 30
Motunau I	North Otago	331	2 / 2 / 27
Motunau I	Dipton, Southland	486	0 / 9 / 7

Table 8. Dispersal of southern black-backed gulls from Canterbury banding colonies (km). The mean distance is for known off-colony recoveries.

Banding locality	Number Recovered	Colony or unknown	<10	10-25	25-50	50-100	100-200	>200	Maximum distance	Mean distance
Ashley River – gorge	1		1						9	9
Ashley River – airfield	34	5	10	12	7				39	17
Waimakariri River – gorge	8		1		2	2	2	1	325	80
Motunau I	137	95	4	2	12	11	4	9	486	105
Total	180	100	16	14	21	13	6	10	486	69

Table 9. Average dispersal for first year and older southern black-backed gulls found off-colony (km).

Banding locality	First year			> 1 year		
	Number	Distance	95% confidence limit	Number	Distance	95% confidence limit
Ashley River – gorge	1	9	-			
Ashley River – airfield	13	17	7	16	17	5
Waimakariri River – gorge	1	88	-	7	79	80
Motunau I	15	170	63	27	69	29
Total	30	96	16	50	54	13

bands, only 5 were recovered and the longest of these was just 2 years old, another surprisingly low result as these bands would not have been lost until after the normal life expectancy of 14 years (Heather & Robertson 1996) and over 20 years has elapsed since the last birds were banded.

The majority of bands used at Motunau I were stainless steel but 200 monel and 367 aluminium bands were used earlier. Here, a bird with an aluminium band was recovered after 11.9 years but the significance of the replacement by stainless steel

is shown with 17 birds being recovered over 10 years old, a rate >4 times greater than for aluminium; the oldest were aged 15.9, 17.8 and 25.7 years with the latter approaching 28 years for the oldest recovery noted in Heather & Robertson (1996). It is likely, therefore, that loss of aluminium bands from birds banded mainly at the river colonies but also at Motunau I, may have meant that many longer recoveries were not found, and possibly shorter term ones as well; this will have implications for recovery totals reported here, especially the river colonies.

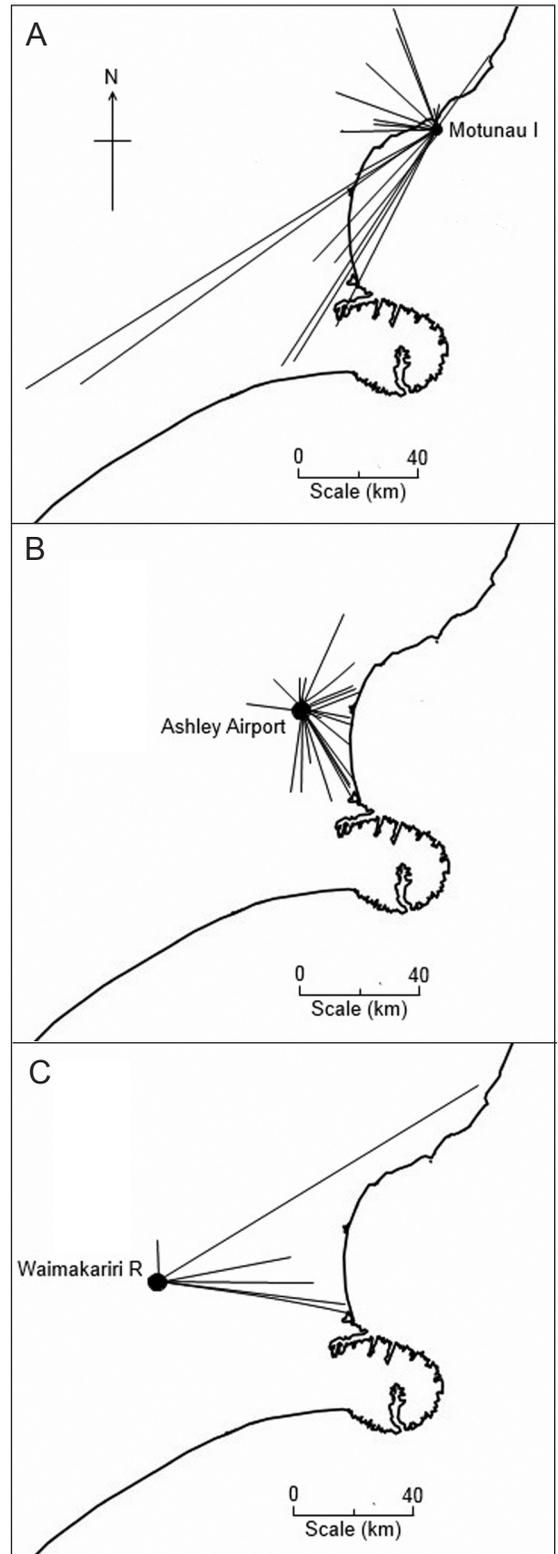
Fig. 2. A selection of short distance movements (defined as < 200 km) of southern black-backed gulls banded at A, Motunau I; B, Ashley River Airport colony; and C, the Waimakariri River gorge colony.

Gulls from all colonies dispersed widely; birds from the Ashley and Waimakariri Rivers dispersed between Oriental Bay near Wellington (325 km) and the Orari River mouth in South Canterbury (127 km) while those from Motunau I travelled further to reach Dipton in Southland (486 km) and the Wairarapa in the north (282 km). An interesting feature of the long distance (>200 km) recoveries is that all were juveniles less than 27 months old and 7 of the 10 were in their first year. These were not exceptional movements as it is not uncommon for black-backed gulls to travel long distances; for example, 1320 km from Makarewa to Auckland (Robertson 1972), 840 km from Mataura River mouth to Masterton (Robertson 1973), and 530 km from Muriwai Beach to the Ruamahanga River in South Wairarapa (Robertson 1964). Wellington gulls have been found in Auckland and near Timaru, distances of about 480 km (Fordham 1968), and 3 juveniles from the Nelson Boulder Bank were reported to have been sighted over 600 km away (Higgins & Davies 1996).

All first year birds found off-colony had dispersed an average of 96 km from the banding sites which is a considerably further than the 27 km for Wellington birds (Fordham 1968); Ashley airfield birds travelled less (17 km) and Motunau I birds the most (170 km). Older birds in this study dispersed further than the Wellington birds, 54 km *c.f.* 23 km in Fordham (1968). Ashley airfield birds covered slightly shorter distances (17 km) compared to Wellington birds and, again, Motunau I birds went further (69 km). These differences are reflected in the numbers of longer distance recoveries (>48.2 km and up to 6 years in Fordham (1968) *c.f.* > 50 km and all ages for this study), 15% for Wellington and 36% here.

There were differences in the type of localities where the birds were recovered. Fordham (1968) reported that 64% of off-colony recoveries were in Wellington and Lower Hutt cities, very few were coastal, and the balance rural. Few recoveries from birds in this study were in cities (Christchurch and Wellington, 4%), 22% were coastal and the majority, 74%, were in rural environments. The concentration of food sources (meatworks, abattoirs and refuse tips) near the Wellington region colonies is an obvious reason for the differences. With these food sources not close to Motunau I or the river colonies most birds must find adequate food in the countryside.

This paper presents data from 4 colonies of black-backed gulls located in Canterbury, 3 being river colonies and 1 an island. Differences in recovery



age and dispersal are evident and different from a 1960s study of southern black-backed gulls in the Wellington region. Loss of aluminium bands from birds in the earlier years potentially biases some of the results. Significant colonies of gulls exist throughout New Zealand. For example Robertson (1964) lists 32 localities where birds were banded in 1963-1964 and at 16 of these over 100 were banded that season. By the end of the 1973-74 season over 56 000 had been banded throughout New Zealand (Robertson 1975) and there would be many more since including over 1000 at Motunau I in this study. Thus, there must be a vast amount of data available that could add to Fordham's Wellington study in the 1960s and this Canterbury focussed study. Some aspects worthy of study could be further consideration of band-loss effects especially on lifespans, a wider investigation of potential differences in riverbed, coastal, and island colonies, and to examine if size and density of colonies has an influence on dispersion.

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