A SURVEY OF BIRDS ON THE KAIKORAI ESTUARY

By MARY ANNE MILLER

ABSTRACT

Monthly bird counts were recorded for Kaikorai Estuary, Otago from July 1989 to June 1991.

Fifty species were noted, including passerines on the estuarine fringe. The predominant species was the Southern Black-backed Gull (*Larus dominicanus*), which accounted for 61% of the birds surveyed. They overwhelmed the Dunedin City Council refuse tip site at Green Island and, to a lesser extent, a tip in private use. Mallards (*Anas platyrhynchos*) and Starlings (*Sturnus vulgaris*) were the next most common species.

Numbers of birds decreased with distance from the tip sites but, conversely, the number of species increased. Numbers were highest in March-April, but declined rapidly by two-thirds to a July-August low. This decline was due to the dramatic fall in duck numbers with the opening of duckshooting season and to the onset of winter. The total annual count for the second half of the survey (July 1990 to July 1991) was 4% down on the previous 12 months, but this was not statistically significant.

INTRODUCTION

Estuaries have been increasingly the subject of landscape modification over the past 150 years. In particular, the Kaikorai Estuary has faced the dual impacts of long-term waste disposal pollution and land reclamation. Although alternative waste disposal sites are being investigated, this extensive, cheap and easily accessible land close to Dunedin City will be used for waste disposal landfill for some time to come.

Because the Kaikorai Stream catchment is within the bounds of Dunedin City and is used so extensively, it has become the focus for debate over the use, misuse or underuse of its resources. The Otago Regional Council, which administers water and soil under the Resource Management Act, wanted to devise a management plan some time after October 1991, when public submissions were due on the future of the catchment.

Although a recent consultant's report, *Kaikorai Estuary: existing environmental features and values* (Royds Garden 1988) discussed estuary bird populations there is no definitive long-term study of the birdlife. Previous studies consist of Department of Conservation counts at irregular intervals since 1980.

The Otago branch of the OSNZ formed a study group in 1989, and a series of counts began in July that year. The purpose of the survey was to furnish facts for discussion on management issues for the estuary and to provide a baseline for further study. If an estuary's "health" is to be judged by the number and diversity of its birdlife (Otago Regional Council 1991), this survey provides a guide to this estuary's well-being.

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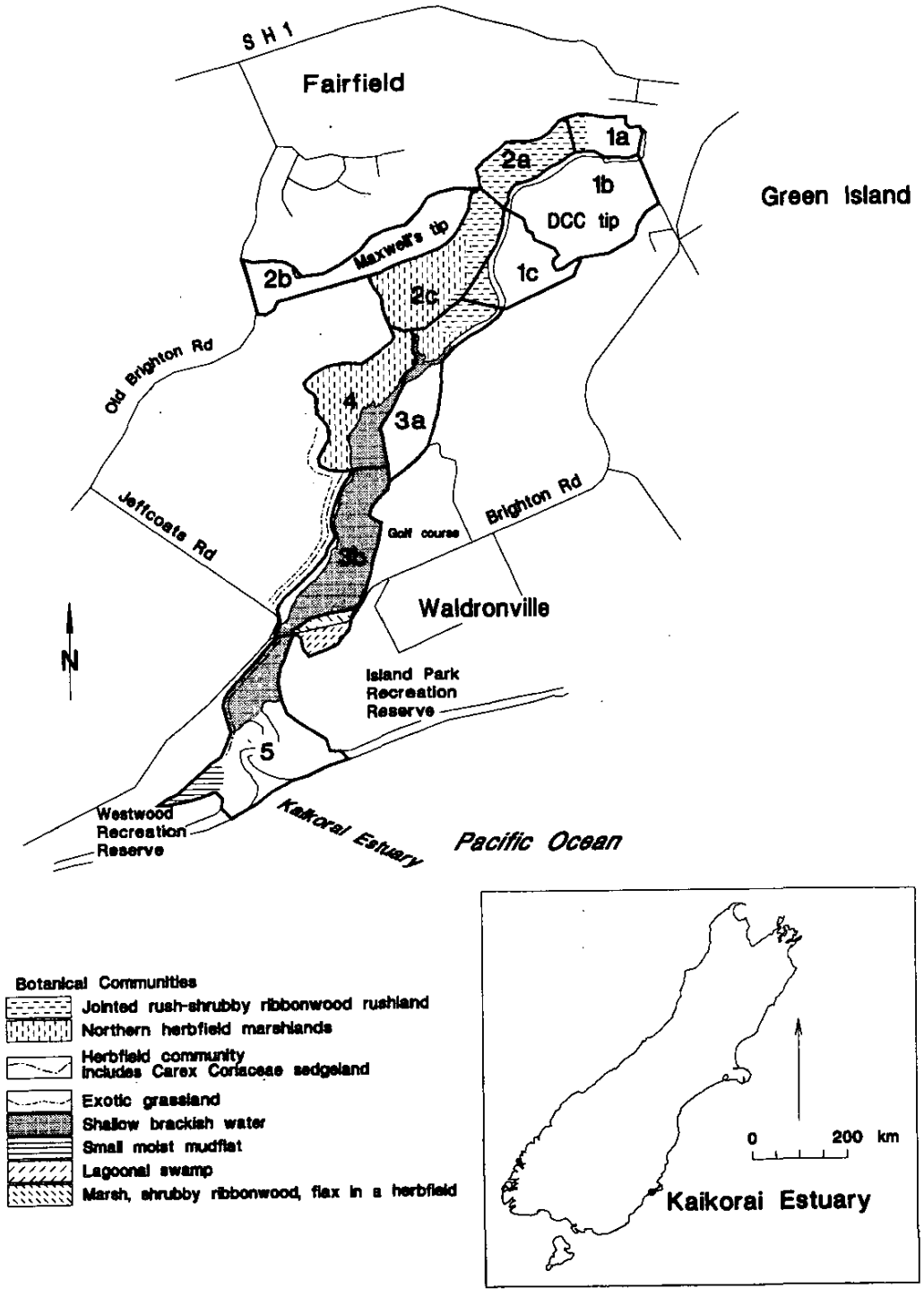

FIGURE 1 — Kaikorai Estuary: survey sections and botanical communities

SITE DESCRIPTION

Situated 7 km southwest of Dunedin City on the road to Brighton (Figure 1), Kaikorai Estuary is often a lagoon when the sand bar at the mouth is closed. It was closed on 9 of the 24 counts. When closed the average water level is 1.35 metres a.s.l., whereas when open, it 0.88 metres a.s.l. (Figure 2).

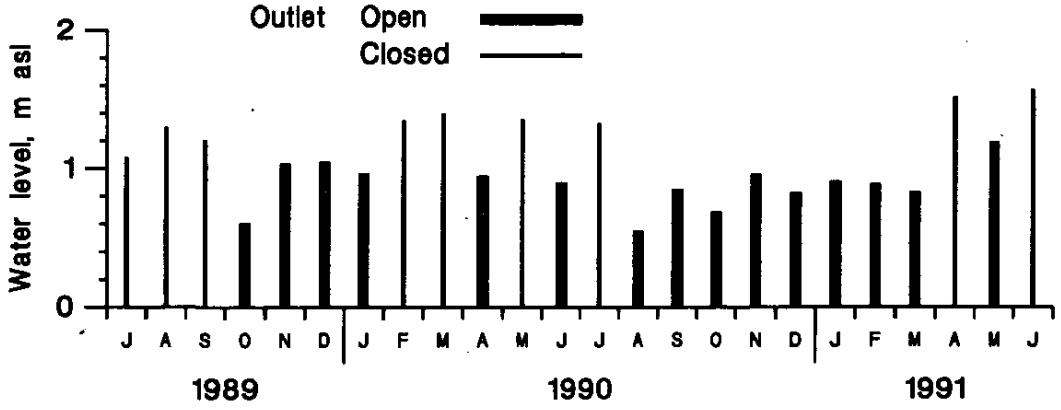

FIGURE 2 — Survey water levels

The estuary covers 1.8 km^2 (3.2% of the catchment area). It is surrounded by gently rolling land, which is mostly yellow-grey and yellow-brown earths formed on loessial deposits, with nutrient-rich alluvium and estuarine deposits from Green Island to the mouth of the Kaikorai Stream. Land not used as tips by the Dunedin City Council and Maxwell Brothers is agricultural or recreational. The Island Park golf course and Westwood and Island Park Recreation Reserves flank the middle and lower estuary. The estuary supports about 50 gamebird hunters, and so maimais are a feature of the mudflat and lagoonal areas.

Few scientific studies have been done, but a botanical report (Johnson 1990) concluded that the estuary is of high local importance because of the diversity of species and communities. Nine independent communities were identified, providing "a range of habitats that are important in sustaining the estuary's bird population" (Royds Garden 1988). Typical saltmarsh species co-exist with brackish water species, which may indicate a shift in the dynamics of the tidal compartment (Johnson 1990). Botanical communities are shown in Figure 1.

Fish stocks have been assessed only once, when species diversity was thought lower than that recorded for other Otago lagoons and estuaries (Royds Garden 1988).

The effect of the refuse tips on the wildlife has not been investigated either. Wild cats and rats were seen during the survey, and there was evidence of chemical waste products dumped without precautions. Collins (1986) found that lead concentrations in the estuarine sediment below the tip in the main channel were well above 100 micrograms per gram, except when the core sample was sandy. Concentrations of lead in sandy sediment is much less than in finer-textured sediments. The background soil lead concentration was 7 micrograms per gram compared with a global mean background of 15 micrograms per gram (Collins 1986). Lead and other leachates are toxic

to plants and animals at certain concentrations, and for organo-chlorine compounds there is evidence of biomagnification along the food chain. Lead and other heavy metals tend to accumulate within all trophic levels with several factors influencing uptake by organisms, for example, organic content of the sediment (Mance 1987). Absorption of lead from food is between 5% and 10% in animals (World Health Organization 1977). Ducks and swans, especially, could be affected by leachates in sediments.

METHODOLOGY

From July 1989 for two years, the estuary was surveyed on the third Sunday of each month. It was divided into five sections, based on broad habitat classifications and the time it took to cover the area on foot. The count was started at 10 a.m. and was usually completed by 1 p.m. Sections 1, 2 and 3 were further subdivided because they displayed distinct habitat variation (Figure 1 and Table 1).

TABLE 1 — Designated habitats for the Kaikorai Estuary

HABITAT	SURVEY SECTION	AREA(%)
Mudflat/Lagoonal	2c, 3b, 4, 5	46.0
Tip Faces & Margins	1b, 1c, 2b	36.3
Mostly Swamp	1a, 2a	8.9
Reclaimed Land	3a	8.8

The study group (local OSNZ members) were assigned sections by rotation. They recorded all birds encountered in that section, noting any birds flying through that may have been counted in another section. Water level and weather conditions and evidence of breeding were also noted.

Data was analysed on computer using the Minitab Statistical Package.

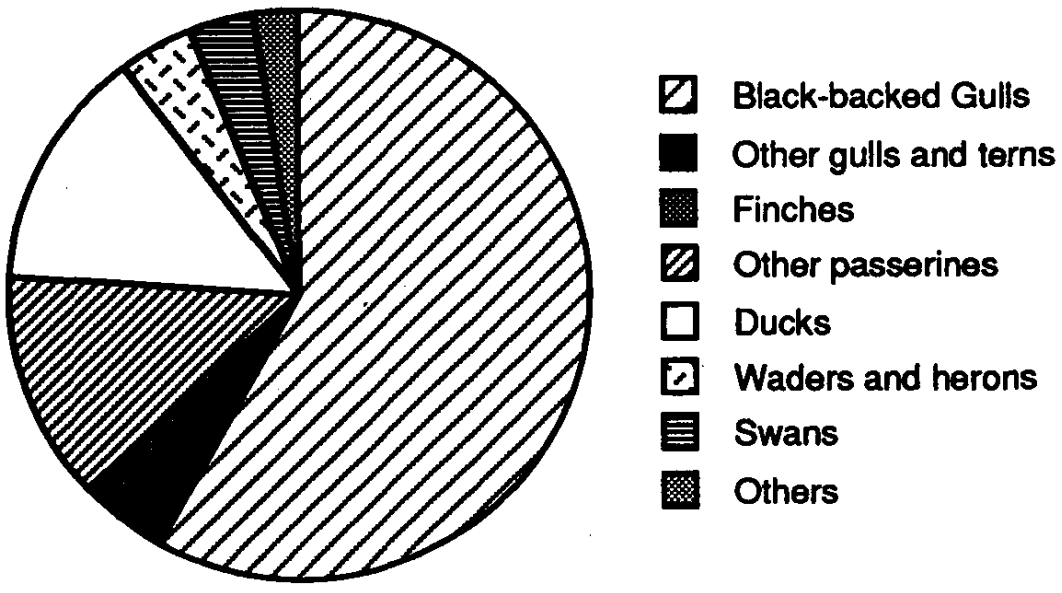

FIGURE 3 — Bird species proportions on the Kaikorai Estuary

RESULTS

Table 2 summarises the two years' overall results and Figures 3 and 4 show the proportion and distribution of species groups in the Kaikorai Estuary. However, because the estuary has different habitats, the results expressed in terms of these habitats give a better picture of the state of the estuary. A chi-square test concluded there was very strong evidence ($P < 0.001$) for a dependency between type of bird found and the habitat in which it was found.

Mudflats/lagoonal (sections 2c, 3b, 4, 5)

This, the largest habitat, was mudflat or lagoon, depending on whether the outlet was open or closed. It supported 40% of the bird population. Waterfowl and waders were prominent, 86% of Black Swans (*Cygnus atratus*), 75% of ducks and 78% of waders being in this area. The waders were mostly Pied Stilts (*Himantopus leucocephalus*) and Spur-winged Plovers (*Vanellus miles*). Seen only occasionally were: Banded Dotterel (*Charadrius bicinctus*), Black-fronted Dotterel (*C. melanops*), Eastern Bar-tailed Godwit (*Limosa lapponica*) and Royal Spoonbills (*Platalea regia*). Diversity within this habitat is reflected in the comparatively large number of species recorded here each month, an average of 15 (SD = 4.21) per month.

Tip faces and margins (sections 1b, 1c, 2b)

By contrast this habitat had on average only 9 species (SD = 1.09) per month. Southern Black-backed Gulls dominated. Of all birds counted each month over the entire estuary, 50% were here and 77% of them were Black-backed Gulls. The smaller gulls were also most numerous here. The next largest group of birds was the passerines, largely House Sparrows (*Passer domesticus*), Starlings (*Sturnus vulgaris*) and finches. These tip sites had 28% of the total finch numbers. Pukeko (*Porphyrio melanotus*) inhabited the rushland margins. Section 2b had 24%, and overall section 2 accounted for 77% of the Pukeko population.

Mostly swamp (sections 1a, 2a)

This habitat, although small in area, has distinct delineation characterised by rushes, shrubs and exotic grasses interspersed with shallow ponds and wet areas (Royds Garden 1988). Only 4% of the estuary's birds were here, and of these 34% were Pukeko. Passerines and waterfowl made up most of the rest. An Australasian Bittern (*Botaurus poiciloptilus*) was seen here. One was also seen in the rushy edges of the Lower Estuary. The mean species count was 10 (SD = 3.12).

Reclaimed land (section 3a)

Although now part of a deer farm, this habitat includes swamp, pines and disturbed ground around a new water treatment station, which the Black-backed Gulls often used as an extension of the main tip. It had 6% of the total birds and on average 16 species (SD = 3.5) each month. Of the birds, 35% were passerines, 32% Black-backed Gulls and 23% ducks. The other 10% included Black-fronted and Banded Dotterels in May and June 1990.

TABLE 2 — Total number per species per month

	1989						1990					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Black Shag	4	9	7	1	3	11	6	1	6	4	5	11
Little Shag	16	32	20	25	3	4	11	8	5	9	5	5
Spotted Shag	-	-	-	-	-	-	-	-	2	1	-	-
Whitefaced Heron	2	9	9	9	3	8	12	5	9	11	4	5
White Heron	2	1	1	2	1	-	-	-	-	-	1	1
Cattle Egret	-	-	-	-	-	2	-	-	-	-	-	-
Austral. Bittern	-	-	-	-	-	-	-	-	1	1	1	-
Royal Spoonbill	-	-	-	1	11	-	-	-	-	-	-	-
Black Swan	14	109	250	321	127	198	149	132	523	640	189	322
Canada Goose	-	-	-	-	-	-	-	-	-	-	-	-
Paradise Shelduck	86	79	58	41	68	166	64	158	215	249	57	64
Mallard	21	329	208	269	519	875	671	1050	1206	1077	8	1
Grey Teal	-	144	122	19	69	85	346	485	668	154	-	-
NZ Shoveler	-	137	138	28	42	6	7	11	108	6	-	-
Austral. Harrier	11	9	5	2	4	2	13	9	10	17	20	13
Pukeko	85	41	45	32	16	17	42	47	42	64	63	59
SI Pied Oyster.	10	6	5	13	6	5	6	-	2	5	-	2
Variable Oyster.	4	-	-	-	1	-	-	4	-	-	1	2
Pied Stilt	304	169	108	171	220	214	379	139	111	132	37	64
Banded Dotterel	2	-	-	-	-	-	-	-	-	-	3	-
Black-fronted Dott.	1	-	-	-	-	-	-	-	-	-	-	-
Spur-winged Plover	57	109	143	121	65	75	79	39	14	68	30	92
Bar-tailed Godwit	-	-	-	1	-	-	-	-	-	-	-	-
Black-backed Gull	2839	2280	2710	3577	4216	3000	4324	3831	5707	3756	2956	2100
Red-billed Gull	29	193	368	236	20	83	86	901	36	605	4	145
Black-billed Gull	-	-	-	-	-	-	22	138	36	3	-	-
Caspian Tern	-	-	-	-	1	-	-	-	-	-	-	-
White-fronted Tern	-	-	-	-	-	3	1	-	7	-	-	-
Rock Pigeon	69	17	5	8	2	-	-	-	-	8	-	-
NZ Kingfisher	-	-	-	-	-	-	-	1	-	-	-	-
Skylark	22	42	30	37	30	21	5	9	14	33	26	92
Welcome Swallow	18	42	37	24	8	19	55	38	96	81	57	34
NZ Pipit	-	-	-	-	-	-	-	-	-	-	-	1
Hedge Sparrow	3	2	6	6	6	4	2	-	-	6	14	4
Blackbird	14	16	35	29	16	5	8	5	11	14	8	11
Song Thrush	8	6	20	10	7	8	7	-	2	1	2	20
Brown Creeper	-	-	-	-	-	-	-	-	-	-	-	-
Grey Warbler	3	3	1	-	-	-	-	3	1	-	6	3
SI Fantail	2	1	-	-	-	-	-	-	1	1	5	4
Silvereye	31	27	24	11	1	2	7	3	10	5	21	5
Bellbird	-	-	-	-	-	-	-	-	1	-	-	6
Yellowhammer	1	3	4	9	4	-	5	2	2	2	21	19
Chaffinch	21	26	69	47	16	12	6	2	1	3	11	64
Greenfinch	66	58	94	4	10	2	2	-	18	2	16	54
Goldfinch	99	17	14	27	11	15	11	34	19	61	43	20
Redpoll	251	59	58	60	16	4	9	6	6	13	190	77
House Sparrow	72	173	62	144	170	127	131	133	340	300	178	106
Starling	123	347	369	137	635	744	509	190	192	902	527	547
Austral. Magpie	2	2	-	-	1	2	2	2	-	-	-	1
Totals	4290	4504	5025	5422	6328	5719	6974	7386	9933	8229	4505	3996
No. of Species	35	35	31	31	34	30	31	28	34	33	31	35

	1990							1991				
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Black Shag	2	8	-	2	1	-	-	10	2	-	-	-
Little Shag	14	7	8	28	7	11	54	26	16	13	25	1
Spotted Shag	-	1	-	1	-	-	-	-	-	-	-	1
Whitefaced Heron	9	9	8	9	10	5	8	15	5	3	4	4
White Heron	1	1	-	-	-	-	-	-	-	-	-	1
Reef Heron	-	-	-	-	-	-	-	-	-	1	-	-
Austral. Bittern	-	1	-	-	-	-	-	-	-	-	-	-
Royal Spoonbill	-	-	-	-	-	-	-	1	21	-	-	-
Black Swan	119	109	104	244	295	212	402	277	145	198	74	137
Canada Goose	-	-	-	-	-	-	-	-	2	-	-	-
Paradise Shelduck	13	51	64	101	147	149	240	191	351	113	43	141
Mallard	-	498	319	351	567	722	736	966	792	1016	195	180
Grey Teal	-	10	14	13	45	96	126	334	135	270	12	4
NZ Shoveler	-	10	87	20	28	6	16	16	46	87	-	-
Austral. Harrier	3	8	8	4	6	3	7	10	16	25	17	15
Pukeko	50	39	23	10	20	21	13	7	22	36	15	27
SI Pied Oyster.	5	7	3	3	3	2	8	-	1	-	-	3
Variable Oyster.	-	2	2	-	-	-	-	-	-	-	-	-
Pied Stilt	46	59	107	119	148	145	96	205	137	41	93	-
Banded Dotterel	1	-	-	-	-	-	-	-	-	-	-	-
Black-fronted Dott.	3	2	-	-	-	-	-	-	-	-	-	-
Spur-winged Plover	22	60	124	88	61	36	52	35	29	14	57	23
Bar-tailed Godwit	-	-	-	-	-	-	-	-	-	-	-	-
Black-backed Gull	2891	1909	2805	2781	2222	3621	3515	4025	2886	4301	5377	4916
Red-billed Gull	58	-	6	42	-	21	266	65	483	150	-	112
Black-billed Gull	-	-	-	-	-	3	3	81	35	-	-	-
Caspian Tern	-	-	-	-	-	-	-	-	-	-	1	-
White-fronted Tern	-	-	-	-	-	-	6	1	-	-	-	-
Rock Pigeon	-	-	26	9	-	-	-	6	-	-	-	-
NZ Kingfisher	-	-	-	-	-	-	-	-	-	-	-	-
Skylark	59	33	34	33	35	34	17	21	12	54	45	62
Welcome Swallow	21	23	31	21	32	9	43	90	38	28	23	9
NZ Pipit	1	12	-	-	-	-	-	-	-	-	-	-
Hedge Sparrow	4	16	3	1	2	5	4	-	1	5	-	3
Blackbird	14	42	28	21	35	21	10	6	10	4	6	25
Song Thrush	11	17	7	9	18	16	-	2	1	4	8	26
Brown Creeper	-	-	-	3	-	-	-	-	-	-	-	-
Grey Warbler	4	3	1	-	2	2	1	-	1	1	1	4
SI Fantail	3	2	1	-	3	-	-	-	2	4	-	-
Silvereye	83	278	157	1	2	8	1	-	2	12	36	36
Bellbird	-	2	-	-	-	-	-	-	-	1	-	1
Yellowhammer	12	1	10	6	11	1	8	7	1	1	25	2
Chaffinch	34	58	198	54	18	14	4	-	2	9	31	33
Greenfinch	57	27	45	22	31	3	5	-	-	-	8	29
Goldfinch	26	47	21	65	118	70	26	17	14	23	25	13
Redpoll	72	27	78	66	21	2	5	-	-	35	139	83
House Sparrow	60	90	149	212	114	184	146	90	153	100	257	752
Starling	260	168	1261	444	400	1076	849	546	191	574	258	402
Austral. Magpie	2	-	-	-	-	-	4	1	4	2	1	-
Totals	3960	3637	5732	4774	4402	6501	6671	7051	5556	7126	6776	7044
No. of Species	32	36	31	32	29	29	30	27	29	31	26	28

Seasonal change

As in other coastal environments seasonality was a feature of this estuary. Waterfowl, waders and gulls showed a similar seasonal pattern to that recorded by Pierce (1980) at Lake Wainono in South Canterbury. Total numbers varied each year from an average high of 8529 to an average low of 3963 (Figure 5). The decline in duck numbers coincided with the onset of the shooting season. Mallards were the most common species of waterfowl.

Breeding

Breeding was noted for the following species: Black Swan, Paradise Shelduck (*Tadorna variegata*), Mallard, NZ Shoveler (*Anas rhynchotis*), Pied Stilt, Pukeko, Spur-winged Plover, Black-backed Gull, Skylark (*Alauda arvensis*), Chaffinch (*Fringilla coelebs*), Blackbird (*Turdus merula*), Song Thrush (*T. philomelos*), and nests of the Welcome Swallow (*Hirundo tahitica neoxena*) were found under the Brighton Road bridge. Other species would almost certainly be breeding there too, e.g. House Sparrow, Starling and other finches.

DISCUSSION

Two striking features emerged from the survey: the dominance of Black-backed Gulls on the estuary and the increase in species diversity with increasing distance from the tip sites (Figures 3 & 4). The latter feature seems related to gross modification of habitat, which occurs when tips are created, and to the ability of Black-backed Gulls to thrive at tip sites. A one-way analysis of variance shows strong evidence ($P < 0.01$) for a difference in number of species seen among the sections, with the tip and those sections near them having the least diversity. On average, on each survey, 31 species (SD = 2.71) were seen on the estuary. Section 4 averaged highest with 19 species (SD = 2.76), whereas sections 1a and 1b were lowest, averaging only 9 (SD = 2.8).

Of the average 5897 birds (SD = 1543) counted each month 61% were gulls, dominating sections 1b, 1c and 2b. The Dunedin City Council has since tried to reduce the number of Black-backed Gulls by smashing eggs and reducing the area of exposed tip face. About 200 eggs were smashed in the 1991-1992 season (Henderson 1992).

Finches also favoured the tip environment. In winter they like to congregate on coastal wastelands (Falla *et al.* 1978), and the undisturbed tip faces are good feeding grounds for the five species of finch found there.

Waders accounted for only 4.2% of the total population, Pied Stilts being the most common species. Noticeable is the virtual absence of Arctic waders. A study at Aramoana found that the inlets of the Otago coast provide the only large area of wader habitat between Invercargill and Christchurch (Hamel & Barr 1974). It is the continuum of feeding reaches near one another and the temporally staggered tidal influences that make these inlets significant, but it seems the Kaikorai Estuary is not part of this network, probably because the tidal flats are not extensive and are unreliable as feeding grounds due to periodic outlet closure. However, it is part of the network of feeding grounds for Royal Spoonbills. Eleven were seen in November

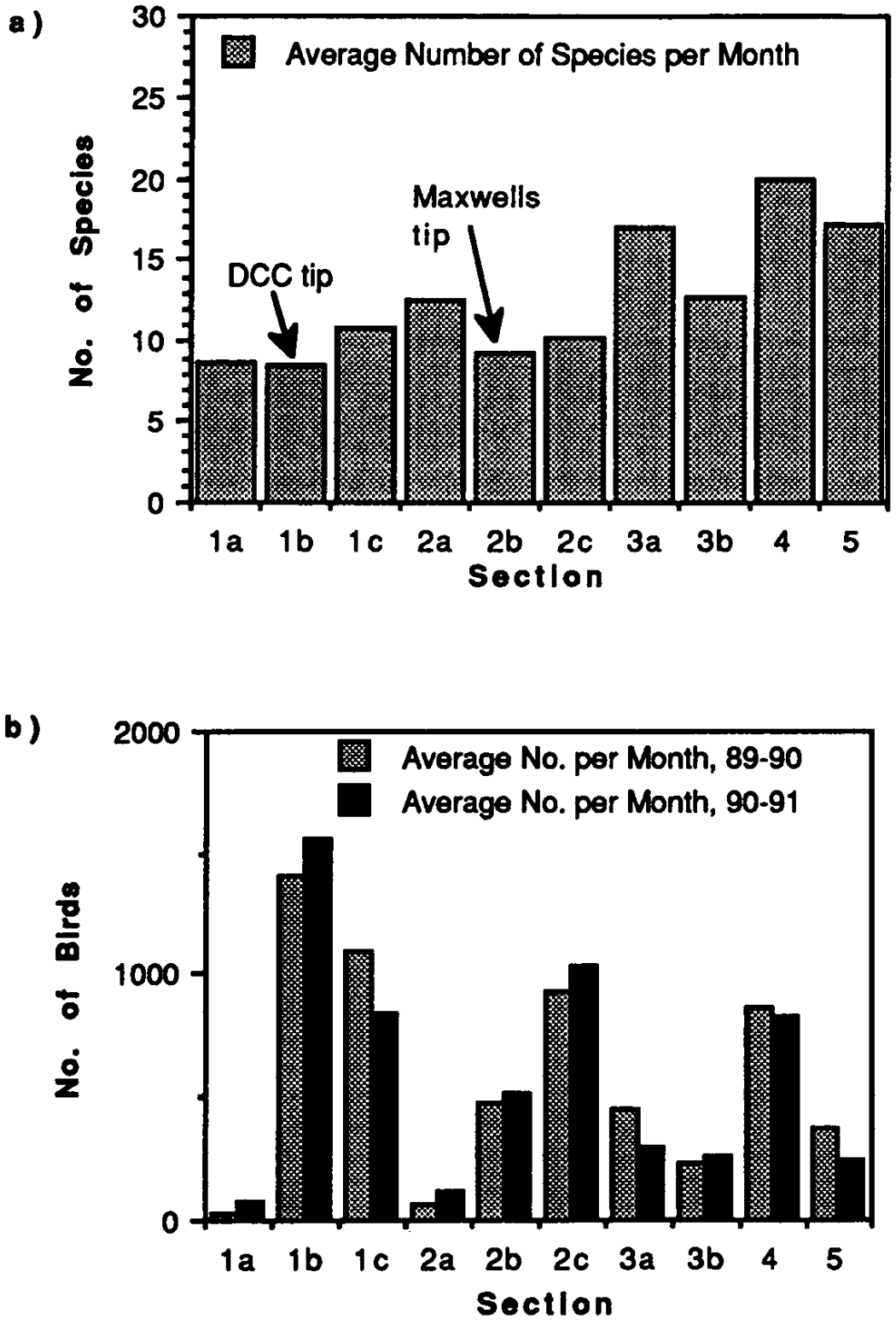

FIGURE 4 — (a) Number of species and (b) the number of birds per section

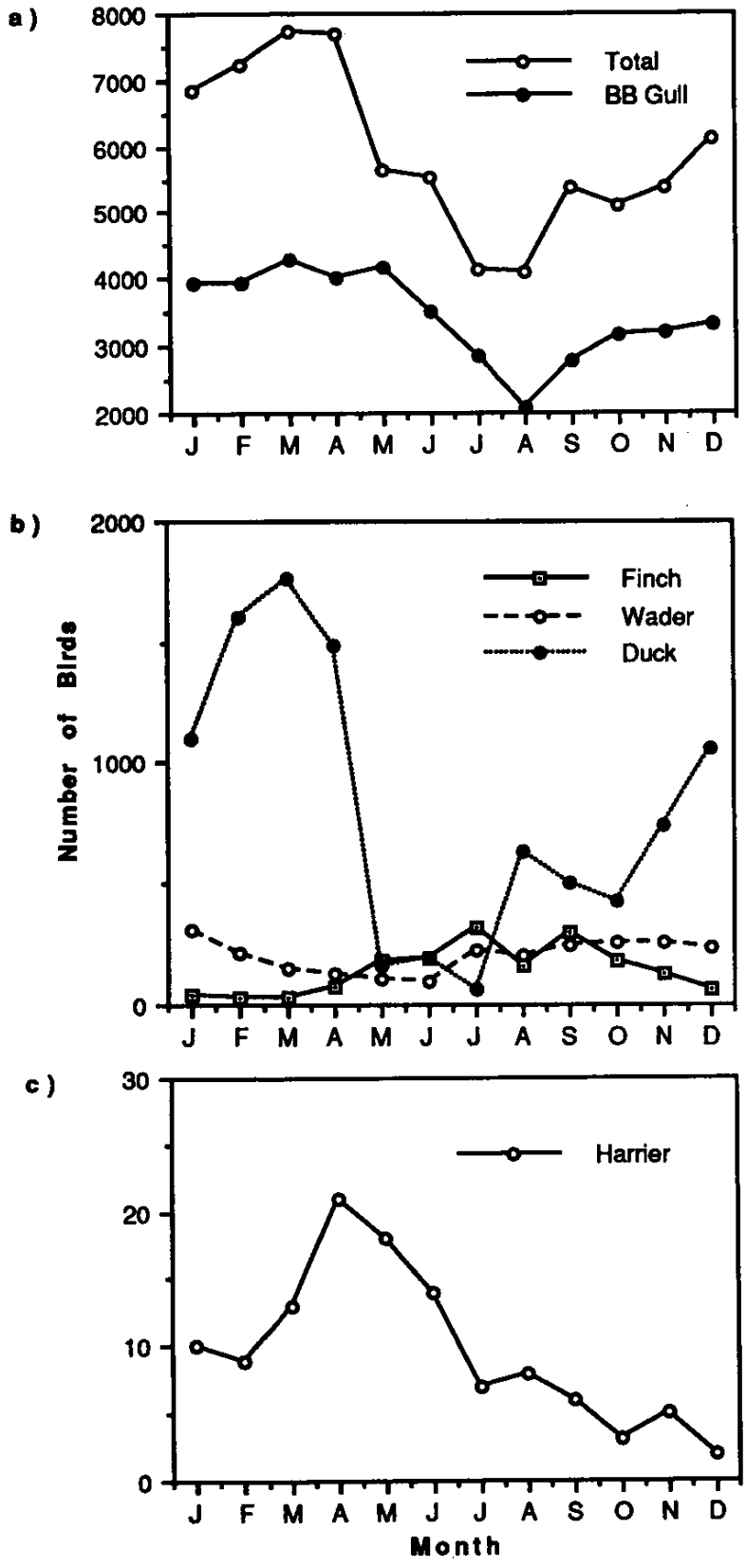

FIGURE 5 — Seasonality of species populations: (a) total birds and Black-backed Gulls, (b) finch, wader and duck, and (c) Harrier

1989 and 21 in March 1991. These birds are breeding on Green Island, 2 km south of the estuary's mouth. Stilts and shovelers use it too as a stopover point on their migration.

Although most birds could be found in a particular habitat, some like the Australasian Harrier (*Circus approximans*) were evenly spread. They, too, showed seasonality with an April peak (mean = 21, SD = 5.6) which is probably due to young birds wandering in as they drift northwards (Falla *et al.* 1978). Welcome Swallows also were fairly evenly spread.

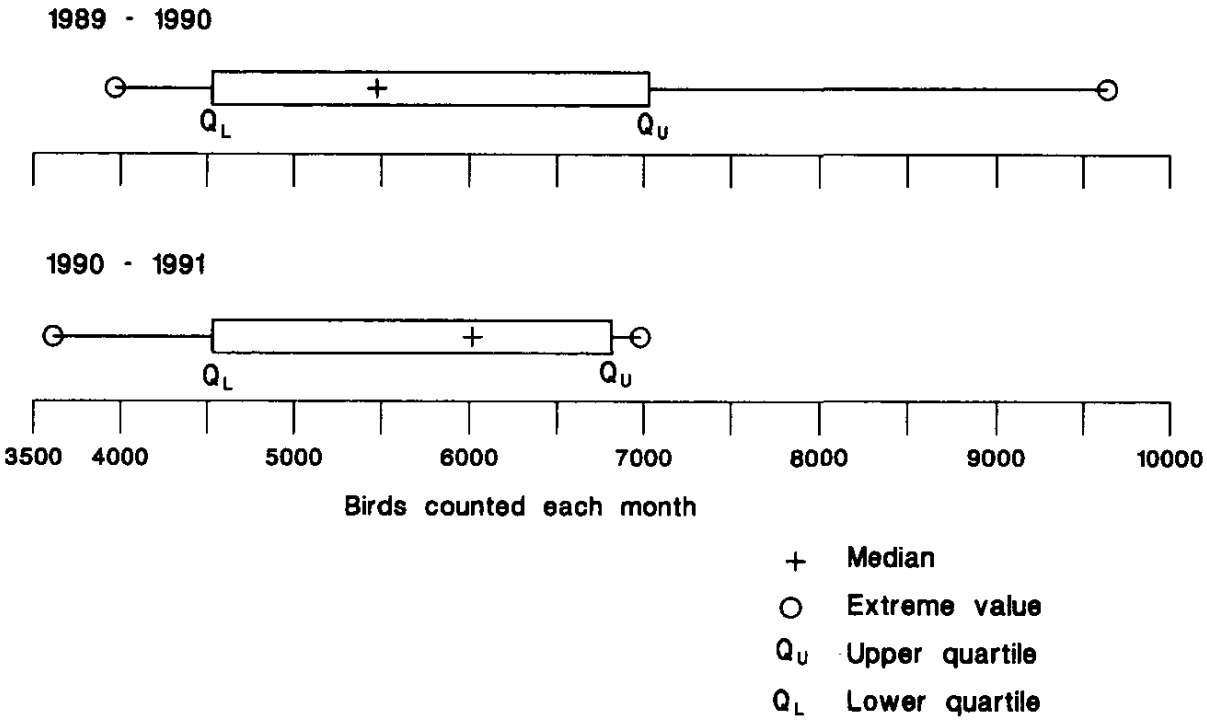

FIGURE 1 — Statistical summary of the two survey years

A comparison of the two survey years indicates a decline in total numbers by 3000 in the second half of the survey. Pukeko, finch, duck and wader numbers declined, gulls remained stable, while shags and passerines increased. Box and Whisker plots (Figure 6) show that the interquartile range for the two years was very similar. That is, in the two data sets 50% of the data values lie in the same range. The medians are dissimilar, but the means are close. For 1989/90, the mean bird count was 6026 (SD = 1814). For 1990/91 it was 5769 (SD = 1286). A t-test indicated there was no difference between the two years (P = 0.05).

CONCLUSIONS

This survey provided a comprehensive view of the bird life on Kaikorai Estuary. It is a valuable aid to management plans for the area, and it gives a base for later comparative studies.

It is obvious that landfill waste disposal has impacted on the "health" of the estuary, as shown by the large number of Black-backed Gulls and

the lack of species diversity around the tip sites. The area of habitat for birds of estuarine areas, rushlands and wetlands, has decreased.

As the waste disposal activities are not likely to lessen in the future, further monitoring of the natural resources is required to assess changes and any protective measures needed.

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MARY ANNE MILLER, *Geography Department, University of Otago, P.O.Box 56, Dunedin.*