NOTORNIS

is the journal of the Ornithological Society of New Zealand (Inc.)

Editor: B. D. Heather,
10 Jocelyn Crescent
SILVERSTREAM

VOLUME 30 PART 3 SEPTEMBER, 1983

THE CHARADRIIFORMS OF A HIGH-COUNTRY RIVER VALLEY

By R. J. PIERCE

ABSTRACT

Bird numbers and habitat preferences were noted regularly for 3 years on the delta of the Cass River, Lake Tekapo. Species counted were an oystercatcher, three plovers, two stilts, two gulls and two terns. Most species left the area after breeding and numbers were highest during spring. The river mouth and lake shore were most used in late winter and early spring before all species moved away to forage and nest in other habitats, particularly on the shingle riverbed and adjacent river terraces. Seasonal patterns were modified by rapid artificial changes in lake level, by excessive river flooding, and by snow-storms.

INTRODUCTION

The shingle-bed rivers of Canterbury have a varied avifauna, dominated by species in the order Charadriiformes. Several of these species are endemic and are also sensitive to man-induced changes in the environment. The Cass River Valley, on the western side of Lake Tekapo, inland Canterbury, has been little modified by man, compared with many river valleys in lowland Canterbury. During a 3-year study of Pied and Black Stilts (*Himantopus* spp.), I was able to note the habitat use and seasonal movements of the charadriiform birds breeding in this valley. This paper provides a background for later papers on stilts and Banded Dotterels *(Charadrius bicinctus)*.

THE CASS RIVER VALLEY

The Cass River flows through a typical glaciated valley, broad and flanked by steep mountains for most of its length. In the lower reaches, before entering Lake Tekapo at about 710 m a.s.l., the river

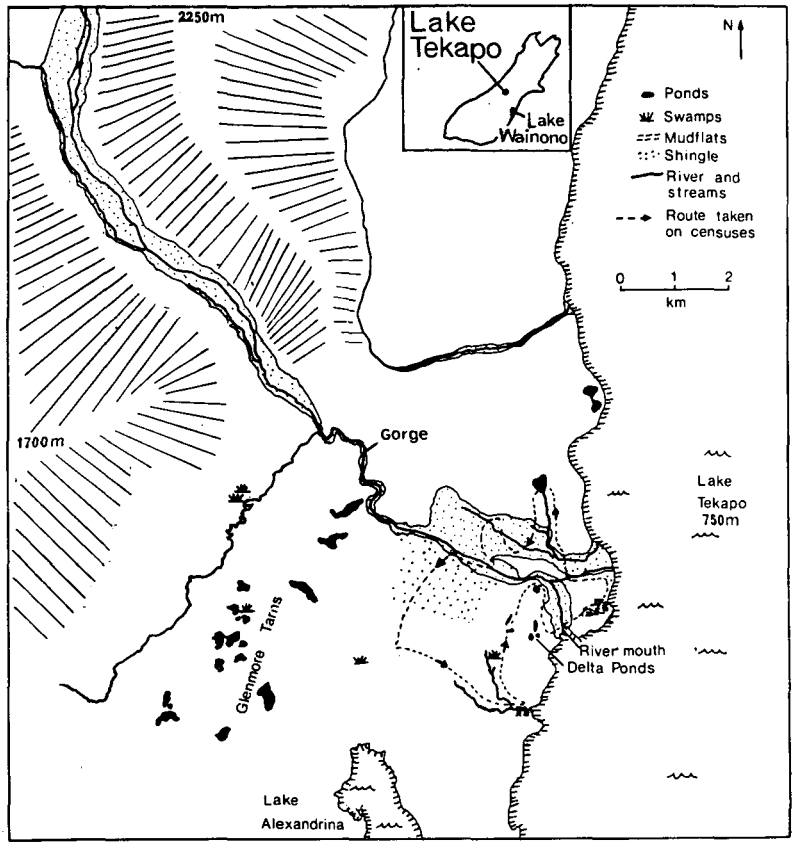

FIGURE 1 — Cass River Study area

fans out to form a wide delta, which also has several shallow ponds (Fig. 1). Other ponds, mainly kettle ponds, occur in moraine to the south-west of the river. At intervals along the valley, small tributaries with shingle beds and relatively steady flows enter the main river. The vegetation of the catchment is dominated by tussock grasses, together with small areas of scrub, particularly matagouri *(Discaria)*, and relatively little land is cultivated. The valley can be divided into three natural sections: above gorge, gorge and delta (below gorge).

Above gorge

This section, which extends for 26 km, consists of unstable shingle beds dissected by several river channels and is flanked by stable shingle banks which give way to tussock grasslands at the edge of the valley. In the upper reaches of this section the riverbed is

very bouldery, but the individual grain sizes become smaller in the lower reaches, where coarse to very coarse pebbles (Dunbar & Rodgers 1951) are predominant. Few plants grew along the main river channels, but on the stable shingle banks plants were common, particularly the mat plants *Raoulia* spp., *Muehlenbeckia axillaris, Myosotis uniflora* and *Scleranthus uniflorus,* and tussocks (*Poa* spp. and *Festuca* spp.), many species of grass and sedge, and small shrubs such as *Pimelea* spp. and *Cyathodes fraseri.* Several small streams dissected these shingle banks, especially in the section 6.5 to 14.5 km from the river mouth.

Gorge

This 3-km section was little used by birds and consisted of a single fast-flowing channel of water flanked by narrow shingle banks and steep hill sides. Boulders were common on the bed of the river channel.

Delta

This 3.5-Km section of the valley has the greatest diversity of habitats and the highest density of birds. The following habitats were used by charadriiforms on the Cass River Delta.

River mouth: The level of Lake Tekapo has been artificially controlled since 1954 by means of a dam at the lake's outlet to the Tekapo River. The lake rises in late spring and summer, but drops again during winter when water is being released from the lake to generate hydroelectric power. Most of Lake Tekapo's shore is steep and bouldery, but at the Cass River Delta (and Godley River Delta) it is gently sloping with deposits of shingle, sand and silt. During the study the most common invertebrates were *Deleatidium* spp., chironomids and tibificids, although all three were not common simultaneously (Fig. 2). Most charadriiform species foraged in this habitat in winter and spring.

Mudflats: Two areas of mud were exposed during winter and spring as the lake level dropped. Vegetation was scarce, apart from *Potamogeton* sp. which occurred in some of the pools. The dominant invertebrates were chironomids and tubificids, which were eaten by several species of charadriiforms.

River: As with the above-gorge section, the below-gorge section of the river is braided and flows fluctuate widely. From late autumn (April and May) to early spring (September) mean daily surface flows were less than those for the rest of the year (Ministry of Works data). Heavy rain in the upper catchment could cause flash floods in any month, but these occur most often in summer and autumn. The aquatic fauna of the entire Cass River was dominated by *Deleatidium* spp., which accounted for over 96% of invertebrate numbers in the lower reaches of the river. Wrybills, Black-fronted Terns and stilts fed heavily on *Deleatidium* in the river.

Stable shingle: Extensive areas of shingle, rarely flooded by the river, occurred along the valley edges and particularly on the delta.

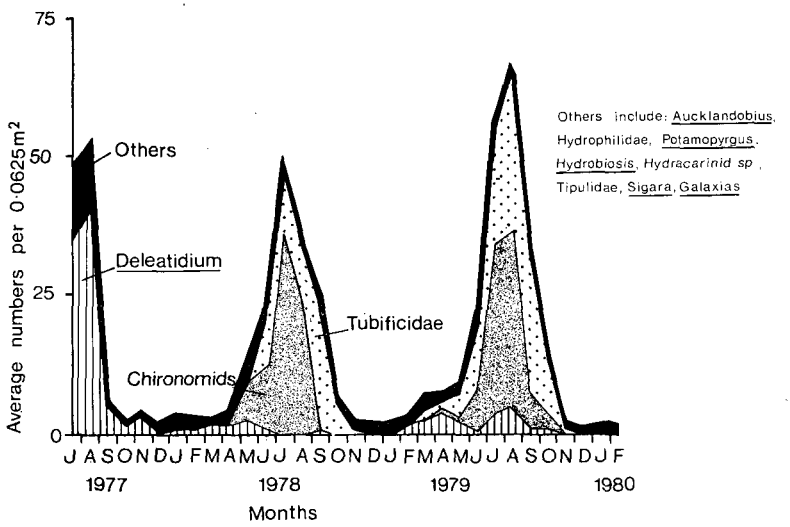

FIGURE 2 — Prey species of the Cass River mouth, 1977-1980

The dominant plants were cushion plants (*Raoulia* spp.), *Muehlenbeckia axillaris* and *Epilobium* spp., a favoured nesting place of Banded Dotterels. After many years of stability other colonisers included tussocks (*Poa* and *Festuco*), many species of grass and sedge, and shrubs such as *Discaria, Hebe* and *Pimelea.* In many places small streams less than 6 metres wide dissected these shingle banks. The beds of the streams supported several species of plants including *Glycera fluitans, Myosotis* sp., *Myriophyllum elatinoides* and *Potamogeton.* Unlike the main river these streams had a diverse aquatic fauna, the most common forms being *Deleatidium* spp., *Aoteapsyche colonica, Pycnocentrodes* sp., *Olinga* sp., *Austrosimulium* sp., and chironomids, favoured by stilts and oystercatchers.

Swamps and marshes: Small swamps (permanently wet or spongy ground) were common on the Cass River Delta. Marshes (seasonal wetland) were formerly more extensive than the swamps, but recently (1981-82) much has been drained and cultivated. All swamps and marshes were dissected by small, sluggish, muddy streams and some also had small ponds. The vegetation was dominated by *Juncus articulatus* and *J. effusus* up to 1 metre high, *Carex sinclairii, Schoenus pauciflorus,* and mosses and several aquatic species. Marshland also had many species of introduced grasses. Common swamp and marsh invertebrates were *Sigara arguata, Anisops assimilis, Potamopyrgus* sp., *Lymnaea* sp. and oligochaetes, favoured by oystercatchers, Spur-winged Plovers and stilts.

Ponds: The ponds usually retained water throughout the year, but one of the delta ponds and its surrounding pools was ephemeral.

Grassland plants such as *Festuca* grew to within a few metres of all ponds, from where there was a rapid succession of plant zones to the water's edge. Aquatic plants included *Potamogeton* and *Myriophyllum* and the most common large invertebrates were *Sigara, Anisops, Xanthocnemis zelandica,* chironomids, tubificids, *Potamopyrgus* and *Lymnaea.* Stilts, Black-billed Gulls and Black-fronted Terns were the most common species foraging at the ponds.

Grassland: Most of the land flanking the riverbed was uncultivated pasture dominated by tussocks separated by mat plants, herbs, grasses and bare patches of soil and shingle. Cultivated pasture, consisting of several introduced grasses, occurred in several areas adjacent to the river delta. The growing season for grass was from September to February.

Climate: The river delta has a low annual rainfall (about 700 mm) and marked diurnal and seasonal changes in air and water temperatures. In winter ice forms on all ponds and swamps and on the more sluggish streams, and snow lies for 4-6 weeks. Calm weather is normal, but desiccating north-westerly winds of up to 200 km/h frequently blow down the valley, particularly in spring. In the upper reaches of the valley annual rainfall exceeds 4000 mm.

METHODS OF STUDY

Five censuses of the river delta were carried out on the 3rd, 9th, 15th, 21st and 27th days of each month from July to February inclusive in three seasons, 1977-78, 1978-79 and 1979-80. I made fewer counts from March to June, when most birds were gone from the river valley. I began each census an hour after sunrise and walked a set route around the whole delta. This route was suitable for all water-frequenting species but tended to underestimate numbers of Banded Dotterels from October to December, when most occurred away from water. For each bird I recorded the habitat that it was first seen in, or if it was flying, the habitat that it was leaving. Two counts of the whole river valley were carried out, one in October 1979 and the other in October 1982 (Table 1), and additional notes and counts were kept for many parts of the river valley from 1969 to 1982. From these data I could map the densities of birds during their breeding seasons, and this information is held by the Ornithological Society's Recording Scheme. I recorded seasonal changes in invertebrate numbers by taking eight replicate Surber samples in the middle of each month at the river mouth and in the river. Samples were taken at the sidestreams every second month.

RESULTS

SOUTH ISLAND PIED OYSTERCATCHER *Haematopus ostralegus*

Oystercatchers were seasonal visitors to the Cass River Valley, with birds beginning to arrive in the last ten days of July (Fig. 3) and most arriving in pairs or small flocks in August, which is also

TABLE 1 — Counts of charadriiform birds, Cass River Valley

		Above gorge						Gorge	Delta	Joseph Stream	Total
Length of section (km)		4.5	4.5	4.5	4.5	4	4	3	3.5	4.5	37
Altitude at top of section (m a.s.l.)		1200	1070	990	920	850	810	770	740	850	
SPECIES											
S.I. Pied Oystercatcher	A[1]		6		2	20	19	4	36	44	131
	B		4		4	17	20	2	53	37	137
Spur-winged Plover	A					2	3		7	18	30
	B					6	9		39	23	77
Banded Dotterel	A	5	6	16	20	107	135	15	466	11	781
	B	2	11	20	20	123	158	22	563	13	932
Wrybill	A					6	25		62		93
	B					11	25		87		123
Pied Stilt	A						3		35	24	62
	B						17		53	2	72
Black Stilt[2]	A										7
	B										14
Black-backed Gull	A	19	42	3		4	19		41	3	131
	B	11	40		2	1	21		52		127
Black-billed Gull	A						2		8		10
	B				3	2	64	2	153	2	226
Black-fronted Tern	A	3	5	2	2	22	103	22	58	47	261
	B	2	7	5	1	16	231	37	147	4	450
White-winged Black Tern	A								1		1
	B								1		1
Caspian Tern	A								2		2
	B								3		3
Total	A	27	59	21	24	161	309	41	716	147	1509
	B	15	62	25	30	176	545	63	1147	81	2162
Birds per km	A	6	13	5	5	40	77	14	205	33	41
	B	3	14	6	7	44	136	21	328	18	58

Note [1] A= 20-24 October 1979; B = 15-21 October 1982

[2] Precise localities not presented

[3] Numbers underlined denote breeding confirmed

the time of maximum numbers on the South Canterbury coast (Pierce 1980). Prebreeding flocks of up to 40 birds were present until September, the main breeding month. Flocks of up to 25 non-breeding birds occurred in fields and marshland until November, and non-breeders represented possibly 15-25% of the total population of the Cass River Valley. Post-breeding flocks were relatively small and many family parties did not associate with other oystercatchers. Most birds departed in January.

Early in the season while the ground surface was still frozen, oystercatcher flocks occurred at unfrozen streams on the river delta where the birds probed deeply for worms and other prey in the shingle stream beds and in the banks. By September, pairs began to disperse to nest in several habitats in the valley, particularly stable shingle areas intersected by streams (Fig. 4, 5), where they stayed until they left the valley.

SPUR-WINGED PLOVER *Vanellus miles*

These were in the Cass River Valley all year, but a post-breeding increase occurred on the delta from January to March and numbers were high during the autumn and winter. Spur-winged Plovers began nesting earlier (August) than oystercatchers (September). Although both species favoured similar habitats, the plovers preferred grassland close to water rather than stable shingle with streams. Post-breeding flocks and wintering flocks occurred mainly in grassland. In 1977-78 these flocks contained up to 20 birds, but by 1981-82 flock sizes had increased to 120 birds, indicating that the population was still expanding in the area.

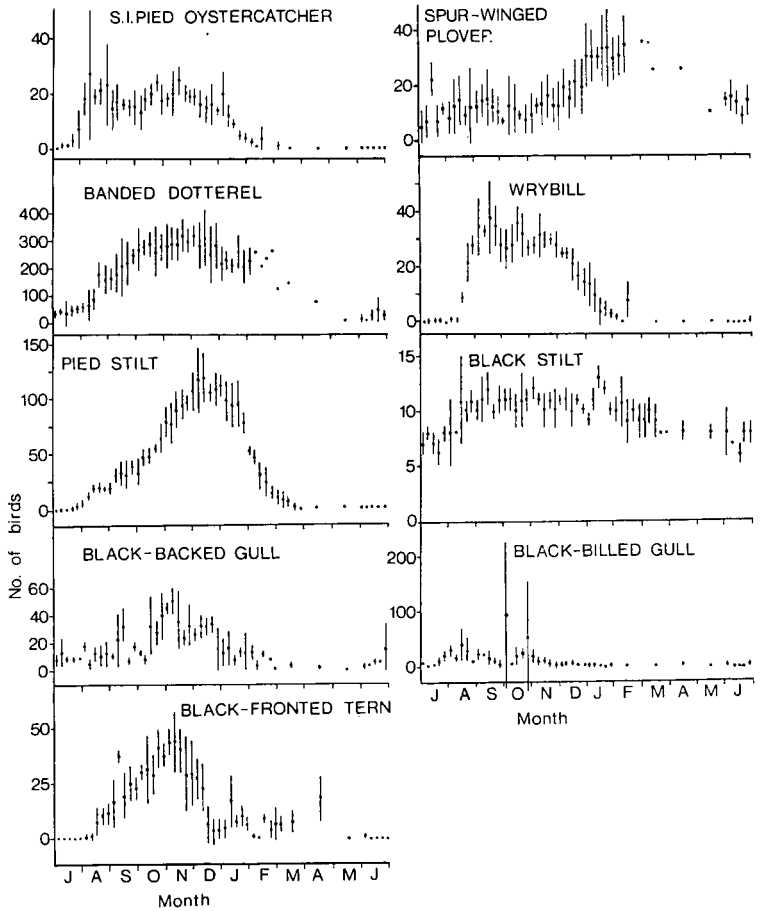

FIGURE 3 — Mean counts of birds on the Cass River Delta, 1977-1980. The vertical lines are standard deviations of the means. Counts of Pied and Black Stilts are for the whole Cass River Valley.

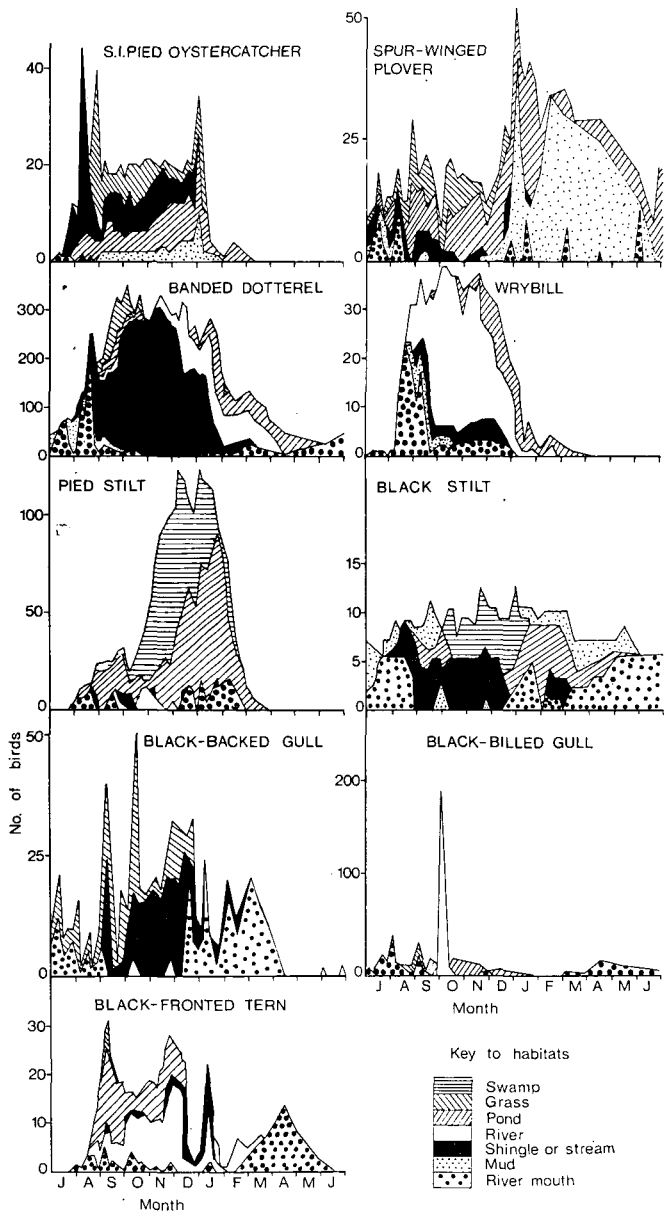

FIGURE 4 — Actual counts and habitat choice of charadriforms on the Cass River Delta in the 1979-80 season. Stilt data are for the whole valley.

BANDED DOTTEREL *Charadrius bicinctus*

Banded Dotterels accounted for about 50% of the charadriiform birds and were concentrated on the river delta (Table 1). Small numbers (3-4% of the spring population) overwintered on the delta. Inland overwintering by flocks of up to 100 birds has been recorded also at Lake Wanaka (Child 1967) and occurred at river deltas beside Lakes Benmore, Ohau, Pukaki and elsewhere on Lake Tekapo (pers. obs.). Returning migrants (all in breeding plumage) began arriving in mid-July and reached their peak in August. One-year-old birds (which were also in breeding plumage and nested) were later arriving than were older birds. Prebreeding flocks of up to 150 birds occurred until the end of September, although some nesting had begun in late August. Most laying occurred in late September and October and all young were flying by the end of January. Post-breeding flocks occurred from early December until February, with flocks being small at first but comprising up to 100 birds by late December.

Winter residents and early-arriving migrants foraged partly at the mudflats, and mostly at the river mouth. During late August and September, these lake-margin habitats were abandoned for short-turfed grassland and ploughed fields. Courtship was not seen until the birds were on the breeding grounds — stable shingle banks. Post-breeding birds congregated in habitats otherwise not usually frequented — drying-up tarns and bare river shingle. Colour-banded birds dispersing from the Cass River Delta were found at the Glenmore Tarns in January and February, Lake Ohau in January, on the coast at Lake Wainono in January and February (when maximum numbers occur at the lake) and near Melbourne, Australia, a juvenile in March and an adult in June (C. Minton, pers. comm.; Dann & Pierce 1979). In addition two adults banded near Melbourne have nested in the Cass River Valley during the 1981 and 1982 seasons.

WRYBILL *Anarhynchus frontalis*

The Cass River Valley supported a breeding season population of about 100 Wrybills. The only record of overwintering was of one bird in 1979. Birds began arriving usually in the second week of August with most arriving in late August and September, about the time of maximum numbers at coastal Lake Wainono. Departure occurred mainly from late December to early February. Early-arriving birds congregated at the river mouth, but by September there was a dispersal upstream, where they nested (from mid-September to January) along the main river course. In most years up to 20 birds foraged and nested along the stable side streams and a few pairs nested on the shingle lake-shore margins of Lake Tekapo up to 3 km from the Cass River. After nesting most birds remained for a short period on the riverbed, but in some years, especially after flooding, flocks of up to 20 adults and juveniles occurred at drying-up ponds, often for a few weeks, in December and January.

PIED STILT *Himantopus himantopus*

Pied Stilts were in the Cass River Valley from early August to late February or March but arrival and departure were very protracted. Early-arriving birds were hampered by the low levels of prey activity (Pierce, in prep.) and most birds did not arrive until October or November, the main period of egg-laying. Only one 1-year-old bird was found in each of the three seasons of study, most birds not returning until they were 2 or 3 years old. The nesting season was protracted, beginning in late September and ending in early February. Pied Stilts occurred in loose flocks throughout their stay, although nests were well spaced within each colony. As with Wrybills, Pied Stilts frequented lake-shore habitats in August and dispersed to other habitats usually in September. During the breeding season swamps were the most-used habitat, where small colonies were formed. After breeding (and sometimes during the fledgling period), family parties and unsuccessful pairs dispersed to ponds, including ponds in the Lake Ohau region. Two colour-banded birds from the Cass River Valley were found at Lake Wainono in January, the period of maximum numbers at that lake.

BLACK STILT *Himantopus novaezealandiae*

These were resident in the Cass River Valley, but some birds moved to other localities (usually lake shores) in the Upper Waitaki River Basin after the breeding season. The latter birds returned to the river delta in August. In winter family parties and pairs frequented the river mouth and mudflats, occasionally visiting ponds (if there was no ice) plus river and stream channels if prey were common. In August or September family units were dissolved and adults moved to the breeding grounds at streams, mud-bottomed ponds and sometimes the main riverbed and swamps. Nesting began in mid-September and repeat clutches were laid up until early December, and the young flew from late November to early February. After nesting most successful and unsuccessful pairs moved to ponds on the river delta or to the Glenmore Tarns and foraged apart from Pied Stilts. During spring and summer non-breeding immature Black Stilts foraged in several habitats, but their preference was for ponds, where they mingled with other non-breeding Black Stilts and Pied Stilts.

BLACK-BACKED GULL *Larus dominicanus*

These were in the Cass River Valley throughout the year but largest numbers occurred in spring and summer. Gulls ranged over riverbed, tussock land and cultivated land, but loafing groups preferred the lake shore. The four nesting colonies were one on the delta, one in the middle reaches and two near the head of the valley. Eggs were laid from mid-October to early December and young flew from December to February.

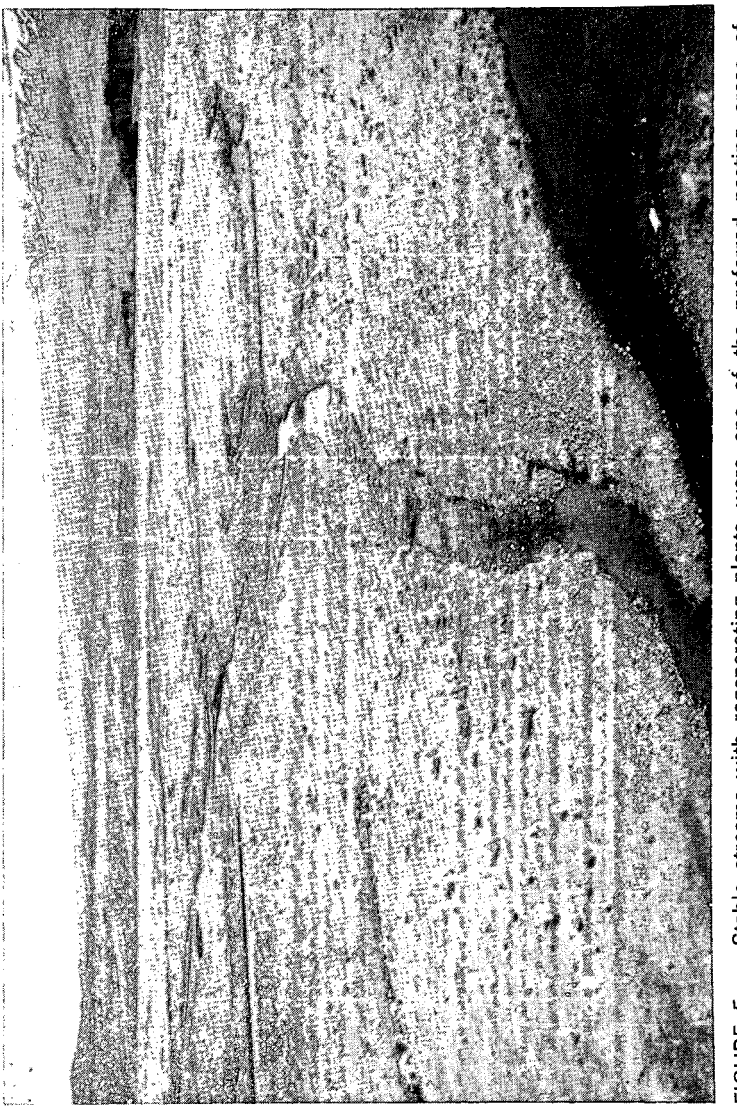

FIGURE 5 — Stable streams with regenerating plants were one of the preferred nesting areas of oystercatchers and Black Stilts

BLACK-BILLED GULL *Larus bulleri*

These were erratic in the Cass River Valley, being most regular in late winter and spring, when they used several habitats. Largest numbers in the riverbed were on days when larvae or emerging subimagines of *Deleatiduim* were drifting abundantly. Nests with eggs were found in October and November 1977 and November 1982, but none appeared to be successful.

BLACK-FRONTED TERN *Sterna albostriata*

These were recorded in all months in the Cass River Valley, but they were rare from mid-May to mid-August. The return of migrants began in mid-August and the population was at its highest from October to January, later than on the Tekapo River to the south where from August to October up to 1000 birds foraged on the emergence of mayflies, which was at its height during that time. This later return to the higher-altitude valley is consistent with patterns observed elsewhere in South Canterbury (Lalas 1979). In the Cass River Valley terns foraged over standing and running water and over grassland and ploughed land. Flocks of 50+ were sometimes seen over the river when *Deleatidium* was emerging in the early afternoon (especially in September and October), over ponds when *Chironomus* was emerging in the middle of the day, and in the evening over fields when moths and beetles were emerging and over streams when caddisflies (Hydrobiosinae) were emerging. Birds above the gorge foraged over the main river channels more than did birds on the river delta where the range of habitats was wider.

Six to eight nesting colonies and a few isolated nests were found each year, usually in the same localities from year to year. Nest scrapes were made on shingled sections of riverbed ranging from bare shingle to almost complete cover of *Raoulia, Muehlenbeckia* and *Cyathodes* and rarely on completely vegetated river terraces. Egg-laying began in mid-October and young flew in December and January. One-year-old birds were often seen at colonies, but none was found nesting.

Associating with the Black-fronted Terns in all habitats of the Cass River Valley since at least 1969 has been a solitary White-winged Black Tern *(Chlidonias leucopterus)*. This bird, presumably the same one, would arrive in breeding plumage in October (once in September) and leave in February, by which time it would be undergoing body moult into non-breeding plumage.

CASPIAN TERN *Hydroprogne caspia*

The few Caspian Terns were in the Cass River Valley from August to February, apart from a record of one bird on 12 July 1979. One pair has nested annually since at least 1970, always in association with nesting Black-backed Gulls, and usually on the river delta, but twice 8 km from the river mouth. Nests were on vegetated shingle

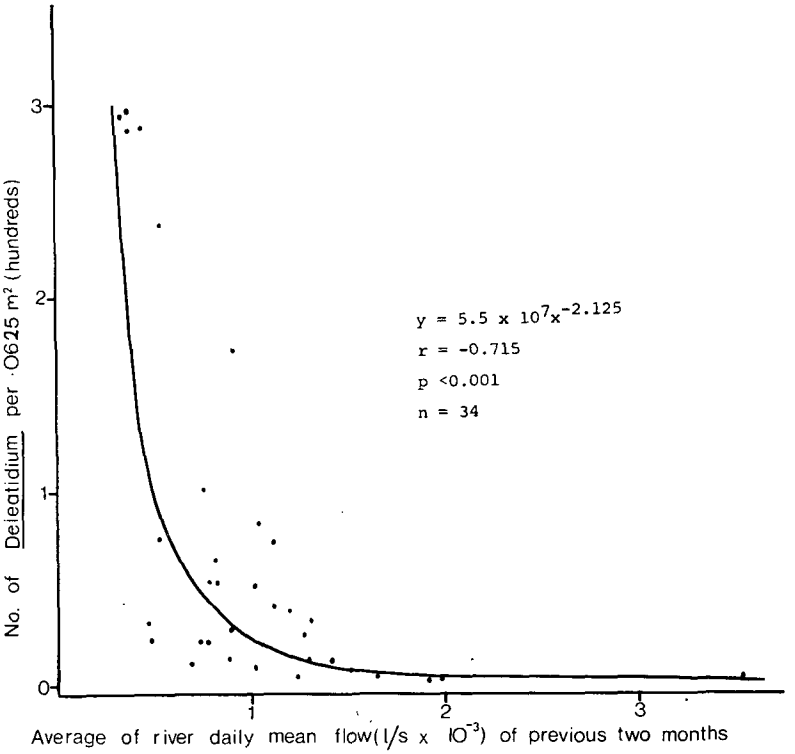

FIGURE 6 — The relationship between mean river flow and density of *Deleatidium*

banks and eggs were laid in mid-October, usually before the gulls laid. For their young the terns caught trout (*Salmo* sp.) and probably other fish, mainly along the shallow lake margin and in the river. Isolated pairs nest (usually successfully) at gull colonies on five (formerly six) rivers in the Upper Waitaki River Basin.

RESPONSES OF BIRDS TO ENVIRONMENTAL CHANGES

Lake level

The level of Lake Tekapo was high (710-711 m a.s.l.) in late summer and autumn, dropping in winter and early spring to 702-704 m a.s.l. and rising often suddenly in late spring and summer. Greatest use by birds of the lake-shore habitats was in late July and August, when migrants were returning. The dropping water levels at this time exposed high densities of invertebrate food (Fig. 2), ideal for feeding. In all years, birds had left the lake shore by September, despite food

being common until early October in 1978 and 1979. Thus, regular movements in August were made to the breeding grounds by Spur-winged Plovers, Wrybills, Black Stilts and some Banded Dotterels and oystercatchers, and to other feeding areas by oystercatchers, Banded Dotterels, Pied Stilts and Black-billed Gulls.

During the cold winter of 1977, however, the lake had dropped to 702 m a.s.l. by mid-August, and the main areas of mud and shingle were dried out and eroded. Birds then left the lake shore 2 weeks earlier than usual, and the unusually low lake level may also have caused the decline in numbers of Banded Dotterels and Pied Stilts on the delta at that time.

For optimum conditions of winter feeding the lake needs to be high and stable in late summer and autumn and to drop slowly in winter. This would provide a continuous supply of winter food for Black Stilts and early-arriving migrants. Thus, gradual discharge of water from all hydro lakes in winter, rather than rapid discharge from one or two only, would be fitting. The fluctuating levels in spring killed most invertebrates, but this had little effect on birds because by then most had moved to their nesting grounds and were not using the lake shore. The few pairs of Wrybills that nested along the shingled lake shore, however, did need moderately low lake levels that were stable or slowly dropping.

River flows

Invertebrate density in the Cass River was inversely related to river discharge (Fig. 6), with floods scouring out the beds of the channels and the animals living in them. In the flood-affected years of 1978 and 1979 larval densities in spring were 5% that of the 1977 spring. Pied and Black Stilts, Black-billed Gulls, Black-fronted Terns and to a lesser extent Wrybills were the species most affected by this reduction in available prey, all five species frequenting other habitats more heavily. Floods were common in 1980 and 1981 but in 1982 the river was stable for most of the year. Figure 7 shows the relationship between prey density and the numbers of birds occurring along the main river channels in the six seasons from 1977 to 1982. Black-billed Gulls were found nesting in the Cass River Valley in the 1977 and 1982 seasons only, the years of high prey density, while in 1979 Wrybills abandoned nesting by late November.

Floods kept the riverbed fairly clear of vegetation. If shingle banks were not flooded during summer, plants such as *Raoulia* spp., *Epilobium* spp. and *Trifolium* spp. became established. Thus, the boundary between preferred Wrybill habitat (mainly bare shingle) and Banded Dotterel habitat (shingle banks with regenerating plants) changed frequently according to changes in the course of the river (Fig. 8). The main threat to this natural process of erosion and plant succession is the growth of exotic trees, particularly willows, which confine the river to a more definite course and prevent it from

periodically flooding and clearing extensive areas of shingle. These areas become colonised within a few years by tall tussocks and several species of grass and sedge (unsuitable for Wrybills) and, after many years, by shrubs (unsuitable for dotterels). Permanent regeneration is one of the major long-term threats to the stability of populations of Wrybills, Banded Dotterels and Black-fronted Terns. Approximately 30% of Banded Dotterels in the river valley currently nest on shingle flats that recently have been separated from the main river channels and so will eventually be unsuitable for them.

Snow-storms

A heavy fall of snow in November 1967 killed large numbers of introduced passerines in South Canterbury (Bull & Dawson 1969). I found several instances of snow-storms killing adult passerines, particularly House Sparrows *(Passer domesticus)*, Yellowhammers *(Emberiza citrinella)* and Skylarks *(Alauda arvensis)*, but none in which adult charadriiforms were killed. Pied Stilt numbers declined after each of 13 snow-storms from August to January in the 1977,

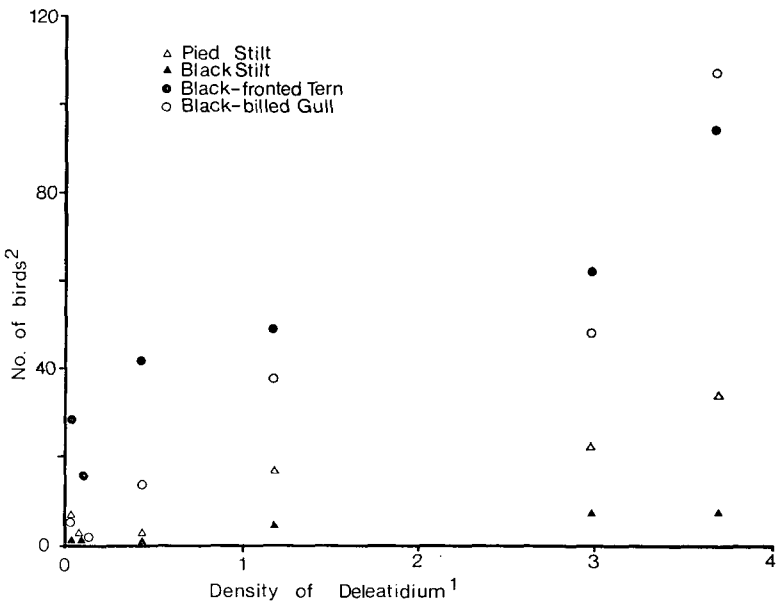

FIGURE 7 — The relationship for each November between and the density of **Deleatidium** in the river and the number of birds foraging in or over the river, Cass River Delta, 1977-1982

Note: 1. Average numbers (hundreds) of **Deleatidium** per 0.0625 m^2 in mid-November

2. Average numbers of birds counted each November

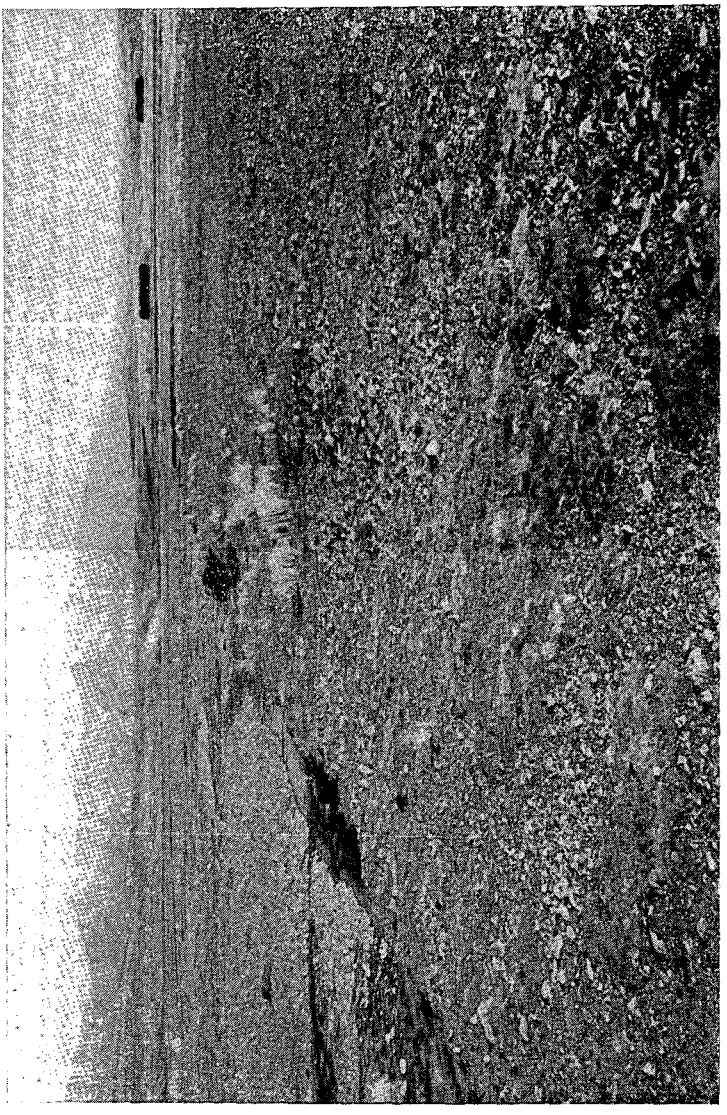

FIGURE 8 — Stable shingle banks (right foreground) were the main nesting grounds of Banded Dotterels, whereas Wrybills nested on bare shingle along the main river channels (left background)

1978 and 1979 seasons. Several colour-banded Pied Stilts left the Cass River Valley (and probably the Lake Tekapo area) during or immediately after snow-storms and took up to 2 weeks to return.

An unseasonable snowfall of 15-20 cm on 2 January 1980 killed some chicks of late-nesting Banded Dotterels and Pied Stilts, but most young birds had flown by that time. A snowfall of 25-30 cm on 23-26 October 1982 destroyed all but a few nests and young of all charadriiforms. During this storm six known oystercatcher broods, each of 2 half-grown young, were reduced to one young (4) and no young (2). Repeat laying occurred by all species (except Black-billed Gulls and Caspian Terns) in November 1982. The breeding season was synchronised and late in finishing for all species in that year.

Mammal activity

High densities of sheep did not prevent Spur-winged Plovers, oystercatchers and Banded Dotterels from foraging in fields in September. Early-nesting dotterels and oystercatchers often nested in shingle areas where hay was fed daily to sheep until the end of September, and some nests were trampled. By October, the main breeding month, fewer sheep were on the riverbed, but many nests along the banks of streams and ponds, including a Black Stilt nest, were trampled, especially by cattle. Intensive stock activity inhibited the nesting but not the feeding of stilts at the Delta Ponds.

Carnivorous nammals preyed on most eggs of stilts at ponds and side streams, particularly at those which were flanked by tussockland (Pierce, in prep.). Black-fronted Terns that nested near the edge of the riverbed seldom hatched their eggs also, except in places where the predator populations were being artificially controlled.

ACKNOWLEDGEMENTS

I am grateful to B. D. Heather and P. M. Sagar for helpful criticism of earlier drafts of this paper and to the University of Otago for institutional support.

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