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Waikanae River estuary: changes to habitat and bird fauna evident from surveys thirty years apart

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A second ecological survey of the Waikanae estuary, in the North Island of New Zealand, was carried out 30 years after the first (1941-1943), and was of similar duration. The observer for the first survey participated in the second, and the same methods were used. Brief accounts are given of the prevailing climate and geology, and of physical changes at the estuary. The effect of periodic storms and of the various encroachments by man is recorded; the latter appear to be particularly important. The vegetation of the estuary is described. Records of beach patrols and of other ornithologists supplement the authors' observations on the bird life. The numbers of birds recorded in the two surveys are compared by analyses of variance. Changes in the flora deduced from aerial photographs spanning the two surveys and from notes and photographs are related to man-induced disturbance, natural physical changes, and natural succession. The total of 79 bird species recorded at the estuary and in its immediate vicinity compares favourably with the 60 species recorded during the first survey. The increase of nearly one-third is due to such factors as the appearance of new Australian bird species, the information provided by the beach patrols, and the extension of sand-flat habitat. In terms of numbers observed, 10 bird species have increased, 11 remain unchanged, and 8 have declined. The distribution of birds is considered in relation to nine areas of habitat: the beach and open sea; open dunes at the beach front; river and sand flats; unfixed and fixed dunes; saltmarsh; grassed fields; and lakelets. The most species (29) were recorded on sand flats and the least (7) on unfixed dunes. Periodic rechanneling of the river mouth has led to expansion of the sand flats as a habitat for waders and some other shore birds, but other man-induced developments, such as housing, are threatening the present ecological balance of the estuary. Use of the area for recreation and for wildlife study is increasing, and we consider that action by conservation authorities is urgently required.

INTRODUCTION

Since the early days of European settlement the Waikanae estuary has been well known for its bird life and recreational amenities, and is today one of the best documented in the North Island of New Zealand. Sir Walter Buller paid several visits to the estuary between 1878 and 1888, and other ornithologists have visited it often between 1927 and 1940. A survey of the avifauna, in the context of physical and ecological characteristics of the estuary, was carried out by one of the present authors between July 1941 and August 1943 (Kirk & Wodzicki 1943, Wodzicki 1946). Other accounts of the bird life have been given by Wodzicki (1947) and Falconer *et al.* (1973). A second ecological survey was undertaken by the present authors between December 1971 and

December 1974. Consequently, general information on the birds of this area spans nearly a century, and more detailed information covers the past 30 years.

Local surveys have been a valuable feature of the biological exploration of New Zealand. The majority, like that of Sagar (1976), were concerned with birds only, and were carried out over a short period of time. The purpose of this study was to investigate the bird life of the estuary, especially the status and numbers of the various species recorded in both surveys; the vegetation, and particularly the changes that have occurred over the past 30 years; the relationships between some bird species or groups of species and the various habitats; and the effect on the estuary's ecology of developments which have taken place since the first survey.

MATERIALS AND METHODS

Material available for this survey stems from several sources. There are records of bird carcasses collected by beach patrols organised by the Wellington Branch, Ornithological Society of New Zealand. These patrols covered long stretches of the shore, from Paekakariki in the south to the Otaki River in the north (Fig. 1), and each included the Waikanae estuary. The value of beach patrols lies in providing physical evidence of marine birds which might otherwise not be observed in an area. Beach patrols operated on 20 days between 6 June 1971 and 20 October 1973, and birds of 27 species were collected (including 5 land-bird species).

The records of Mr E. B. Jones (EBJ), kindly given to us, cover 19 visits at irregular intervals between 19 May 1956 and 9 November 1967.* These records were obtained on both sides of the estuary, but not all coincide with the survey route adopted by us. The valuable records of Sir Charles Fleming (CAF) derive from 62 visits between 27 December 1971 and 27 December 1974, virtually the same period as that covered by the 61 visits of two authors (KW, MLF). In October 1973 the estuary was not visited. Fig. 2 shows the routes followed by CAF and the authors.

The framework of our observations was similar to that used in 1941-43: the observer always followed the same route (Fig. 2), which took in those parts of the estuary frequented by the many bird species

and traversed a number of vegetation types (Fig. 3). Other areas, such as the shrub-covered dunes around the dune lakelets, were inhabited largely by introduced passerine birds, and were visited less regularly. Using 7×35 binoculars, birds were identified and counted as accurately as circumstances such as large flocks in flight permitted. Also, photographs were taken from the same vantage points as were used during the first survey, to illustrate the changes that have occurred at the estuary during the intervening 30 years. On several occasions MLF made visits which did not cover the complete circuit. These partial visits, along with the fact that CAF did not record some of the more common species on some of his visits, and also covered the north rather than the south side of the estuary, have been taken into account in the statistical analysis.

An illustration of the observational and statistical problems posed by the mobility of birds over short periods of time is provided by Table 1, which presents counts taken in December 1971 before the survey proper started. Seven counts were made (MLF) over a period of 12 days, following approximately the same route at the same time of day. They illustrate the day-to-day variations in both the numbers of species observed and the numbers of birds of various species.

The bird counts are presented as numbers per visit for complete visits, because of the problems associated with partial visits and occasional non-recording of common species, but arithmetic means should be taken merely as guides to the relative abundance of the species. The original numbers were not used

*Tables showing the dates of visits by Mr E. B. Jones, Sir Charles Fleming, and ourselves are deposited in the Ornithological Society Library, Auckland Institute and Museum, Auckland.

	Dates						
	4th	5th	7th	9th	11th	13th	16th
Little blue penguin	—	1	—	—	—	—	—
Black shag	2	5	2	9	14	3	19
White-faced heron	—	2	—	10	7	4	5
Mallard	—	—	—	15	—	—	—
Harrier	—	—	—	—	1	—	—
Spurwing plover	—	—	—	1	1	1	1
Banded dotterel	1	1	—	—	—	—	1
Godwit	2	—	1	—	—	—	—
Pied stilt	11	11	11	c.20	c.20	c.20	c.20
Black-backed gull	c.100	c.50	1	c.100	c.20	20	c.50
Red-billed gull	5	13	2	c.50	—	1	10
White-fronted tern	2	21	—	5	—	—	c.100
Caspian tern	—	2	1	1	1	—	2
Little tern	—	1	—	1	1	1	1
Sacred kingfisher	—	1	—	—	—	—	—
Skylark	1	—	—	2	6	4	4
Hedge sparrow	—	1	—	—	1	—	—
Song thrush	—	—	—	—	—	1	—
Blackbird	1	1	—	1	4	4	4
Yellow hammer	—	—	—	—	1	—	—
Goldfinch	—	—	—	—	1	1	2
House sparrow	—	—	—	—	—	2	—
Starling	4	c.50	c.100	c.100	c.100	c.50	c.30
Total species	11	14	8	14	15	14	15
Total birds (approx.)	132	160	123	323	185	115	252

Table 1. Example of short-term fluctuations in species composition and abundance of bird fauna, as recorded by a single observer; Waikanae estuary, December 1971

directly in statistical comparisons, since occasional very large counts (for some species up to 1000 or more) invalidate the usual statistical assumption of normality.

The appropriate statistical technique for handling counts of this nature is to transform them to a logarithmic scale. Because many of the recorded counts indicated that there were probably more birds than the number noted, the counts were analysed on a grouped logarithmic scale, the groups being 0, 1, 2-3, 4-7, 8-15, 16-31, etc. This enabled statistically valid comparisons to be made of the numbers recorded in the two surveys, via two-way analyses of variance, the factors being number of surveys and months of the year. The 3 years within each survey were treated as replicates, on the assumption that a 3-year period would be reasonably uniform. A basic program was written for an HP-2100A mini-computer at Applied Mathematics Division, DSIR. Significance levels used were: $p < 0.05$, significant; $p < 0.01$, highly significant; and $p < 0.001$, very highly significant.

The vegetation of the estuary was examined (PK) between December 1974 and September 1975. Maps were drawn from aerial photographs obtained from the Lands and Survey Department, Wellington.

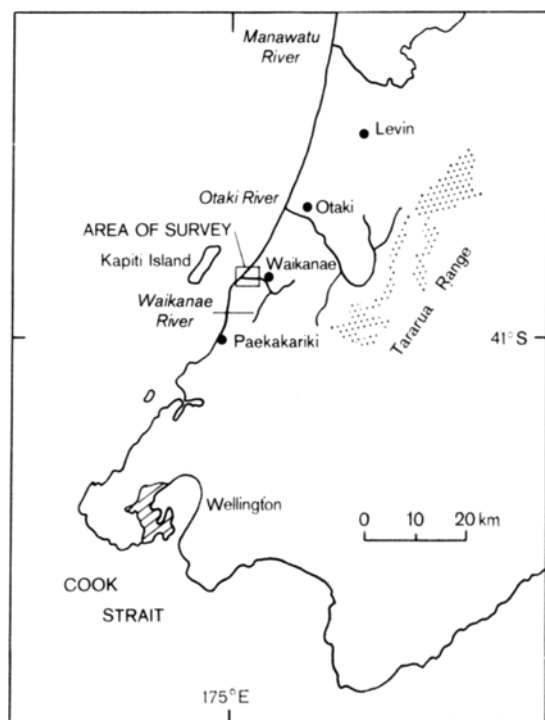


Fig. 1. Southern part of North I., New Zealand, showing position of Waikanae estuary.

GENERAL DESCRIPTION OF ESTUARY

The position of the Waikanae estuary ($40^{\circ}52'S, 175^{\circ}E$) in the south of the North Island is shown in Fig. 1. The Waikanae River flows from the southern part of the Tararua Range through undulating country to a chain of sandhills, and opens to the sea opposite Kapiti Island. As with most of the rivers flowing to the west coast of the North Island, the estuary proper turns south before it enters the sea. The general physiography of the estuary and changes that have occurred between 1941-43 and 1971-74 are mapped in Fig. 2-4 and illustrated photographically in Fig. 5-14.

CLIMATE

Waikanae has a humid temperate climate. Meteorological records from Paraparaumu aerodrome, 3 km south-east of the estuary, show an average rainfall of 1050 mm per year, 2053 sunshine hours, and a mean temperature of $12.9^{\circ}C$. The humidity at 0900 h NZST varies little throughout the year, and ground frosts are frequent in winter. The prevailing winds are from the north and north-east; surface winds are 15% from the north-west and 23% from the south-west. On average, winds of more than 96 km/h occur on 8 days per year, and of more than 63 km/h on 75 days.

Closer study of data for the period of the present study, December 1971 to December 1974, shows that 1972 and 1973 followed the usual monthly climatic trends. Both years had peaks of rainfall in March and May. July was high in rainfall in 1972, whereas June and August were high in 1973. In 1974, however, February, April, May, July, and October were unusually wet; except in February, monthly rainfall figures higher than any in 1972 and 1973 were recorded.

GEOLOGY*

During the last ice age, c.20 000 years ago, sea level was lowered so that the shallower parts of Cook Strait were bridged, linking the North and South Islands and Kapiti Island. As the ice melted throughout the world, sea level rose to a maximum a few metres above the present, about 6000 years ago. Once sea level was stable, rivers from the central North Island delivered abundant sand to the west coast, and the dominant longshore drift shifted it southward to nourish a growing beach and sand dunes that blew inland from it, as described by Fleming (1972). South of Waikanae some of the drift is northward, and in the shelter of Kapiti the sand built seaward as a promontory, which the Maori named Kenakena ('Adam's apple') from its appearance when viewed from Paekakariki Hill.

*This account was kindly provided by Sir Charles Fleming.

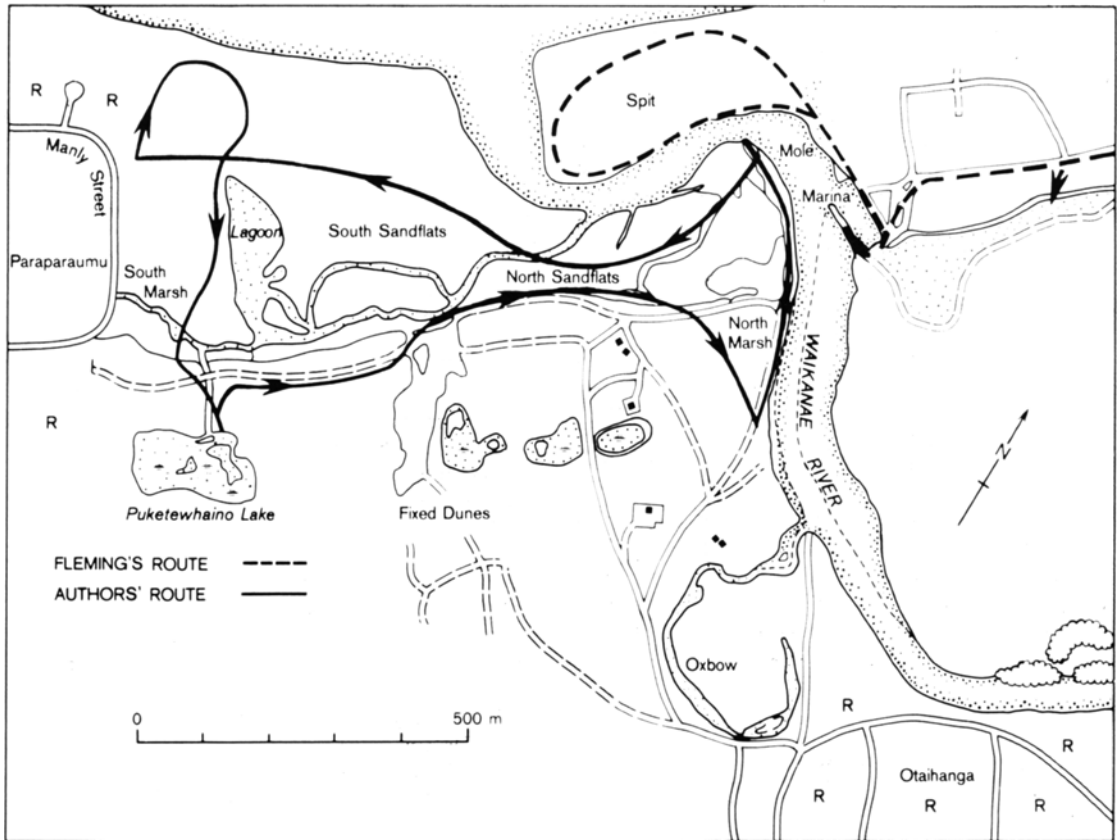
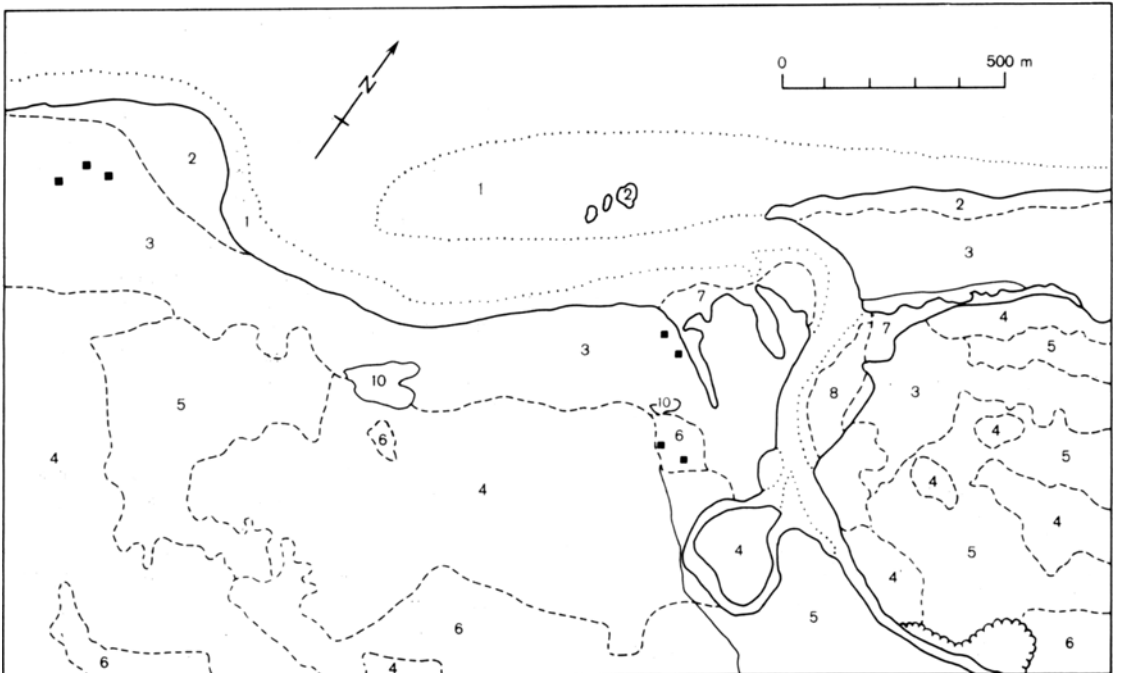
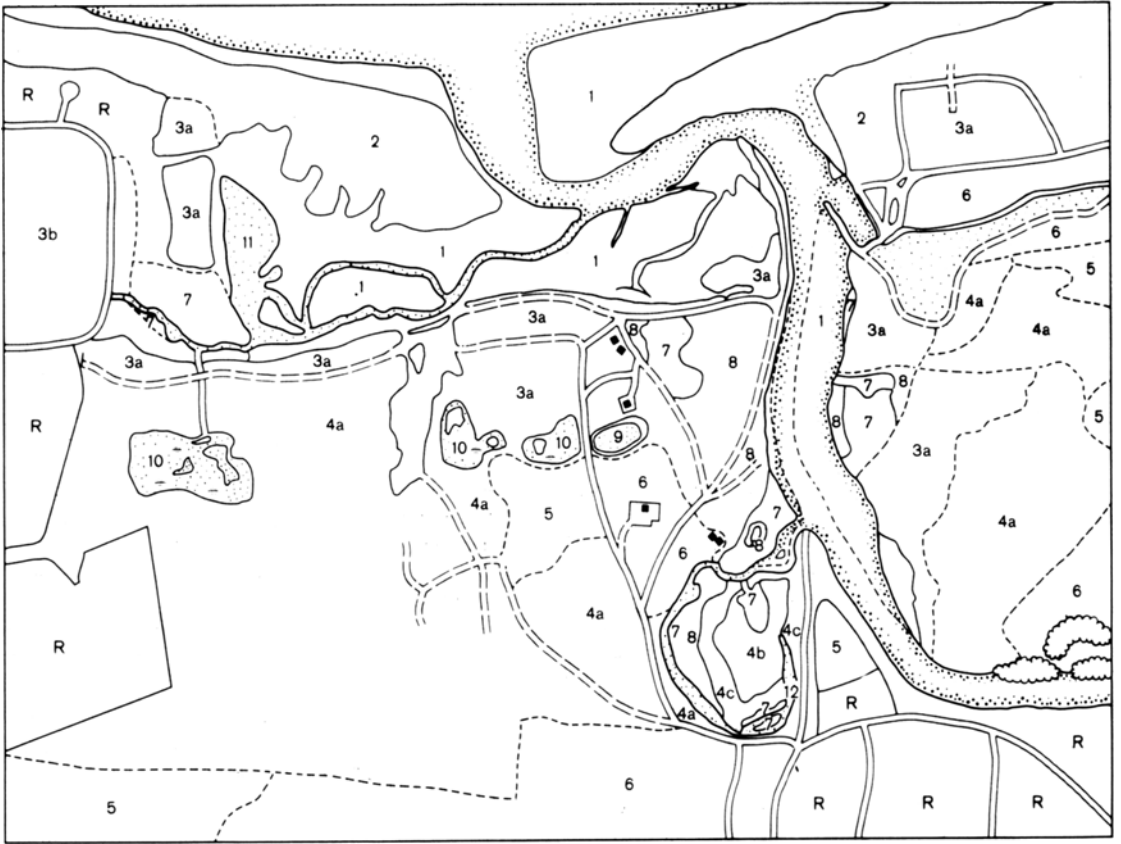


Fig. 2. Physiography of Waikanae estuary.

Fig. 3 and 4 (opposite page). Vegetation of Waikanae estuary area, early 1970s and 1943 respectively.

Table 2. Vegetation types, Waikanae estuary area; see also Fig. 3 and 4

Habitat	Map symbol	Dominant species
Bare sand flats	1	Occasional <i>Samolus repens</i> and <i>Spartina townsendii</i>
Dunes: unfixed	2	<i>Ammophila arenaria</i> , <i>Spinifex hirsutus</i>
	3a	"", <i>Lupinus arboreus</i>
fixed	3b	<i>Lupinus arboreus</i>
	4a	<i>Pteridium aquilinum</i> , <i>Lupinus arboreus</i> , and local species
Saltmarshes	4b	<i>Ulex europaeus</i>
	4c	<i>Festuca arundinacea</i>
	5	Mixed grasses, <i>Lupinus arboreus</i> , <i>Pteridium aquilinum</i>
	6	Mixed grasses
Aquatic	7	<i>Samolus repens</i> , <i>Salicornia australis</i> , <i>Juncus maritimus</i>
	8	<i>Juncus maritimus</i> , <i>Leptocarpus similis</i> , <i>Plagianthus divaricatus</i> , turf species
Aquatic	9	<i>Nitella hookeri</i> , <i>Juncus maritimus</i> , <i>Cotula coronopifolia</i>
	10	<i>Typha orientalis</i> , mixed species
	11	<i>Ruppia megacarpa</i>
	12	<i>Potamogeton pectinatus</i> , <i>Lileopsis novae-zelandiae</i>



For about 4 km upstream from its mouth the Waikanae River flows through a belt of superficial sand dunes, peat, and alluvium of late Holocene age overlying thick beach sands deposited during the past 6000 years as the coastline built seaward (or 'prograded'), when the sea had reached approximately its present level.

Inland, the oldest dunes (Foxton Dunesand) are about 5000 years old. Eighteen hundred years ago the Taupo eruption flooded central North Island rivers with pumice, which drifted down the coast to form pumice beaches from which granules were blown inland to form the Taupo pumice dune, now about 1.3 km from the coast. The beach has continued to prograde, and younger Waitare Dunes have been built during 1000 years of human occupation. Last century the Waikanae River had a double channel, a branch north of Te Moana Road rejoining the main branch by a course flowing through Waimaha Lagoon. Changes continue today as the river mouth works southward towards Paraparamu, until periodically re-channelled by man into a more direct course to the sea. The estuary is therefore geologically very young, and consists almost entirely of unconsolidated sand, shells, driftwood, and pumice. Gravel in the river further upstream barely reaches the estuary, and only after exceptional floods are layers of muddy silt deposited on the sand flats.

PHYSICAL CHANGES IN THE ESTUARY

The changes in the flow of the Waikanae River and the changing location of its mouth are of considerable importance for the plant and animal life of the estuary. For this reason, a brief account is given of these changes, and particularly of those which occurred in the period between the two surveys.

Major storms, which according to Mr Jeremy Gibb (pers. comm.) occur approximately every 20 years on the west coast of the North Island, cause large accumulations of debris and erosion of the estuary sandspit. The Waikanae River mouth historically has shown a tendency to migrate southward. According to Carkeek (1965) there was a pa built by the Ati Awa tribe in 1833 on the southern bank of the river not far from Kenakena Point. This suggests that the position of the river mouth was stable at that time. A comparison of Carkeek's description with photographs shows that in 1942 the river mouth reached the same southernmost position (some 1 km to the south). According to Mr Gibb, the Waikanae River mouth tends to migrate to Kenakena Point because this is the area of least wave energy on the coast, and therefore the most stable position for the river mouth. At one time floodwaters would disturb this stability by breaching the sandspit. To avoid flooding of land by the river not being able to escape to the sea, the Manawatu Catchment Board made cuts

through the spit approximately every 5 years. These cuts caused a considerable increase in the area of tidal flats, and the formation of the South Marsh.

In addition to the cuts through the spit, man-made changes at the estuary include a boating marina, a lakelet, and a mole (Fig. 2), all built during the period between the two surveys. The boating marina and the barren lakelet replaced the salt meadow and shrub dune existing there at the time of the first survey (Wodzicki 1946).

VEGETATION

The vegetation of the Waikanae estuary is mapped in Fig. 3. The broad habitat units, listed in Table 2, are described below; numerals in brackets refer to map symbols.

The extensive sand flats [1] carry very little vegetation. There are a few scattered plants of the introduced cord grass (*Spartina townsendii*) near the southern tidal channels, and patches of sea rush (*Juncus maritimus* var. *australiensis*) on the northern flats marking the remains of the former northern salt marsh. A lagoon [11] in the southern sand flats contains the filamentous horse's mane weed (*Ruppia megacarpa*) growing in association with the green alga *Enteromorpha intestinalis*.

The tidal channels and flats have a considerable algal flora during the summer, when *Ulva lactuca* and *Enteromorpha* become abundant.

Mobile, open sand-grass dunes [2] occur along much of the sea frontage near the estuary and around the sand flats. These low dunes are dominated by marram (*Ammophila arenaria*), with frequent spinifex (*Spinifex hirsutus*) and rare plants of pingao (*Desmoschoenus spiralis*).

The unfixed dunes [3] around the estuary are still marram-dominated [3a]. Lupin (*Lupinus arboreus*) is also abundant, along with toetoe (*Cortaderia toetoe*), tauhinu (*Cassinia leptophylla*), flax (*Phormium tenax*), taupata (*Coprosma repens*), the shore bindweeds (*Calystegia* spp.), and pohuehue (*Muehlenbeckia australis*). Among these are a large number of introduced plants. Some such as inkweed (*Phytolacca octandra*), mallow (*Lavatera arborea*), and buffalo grass (*Stenotaphrum secundatum*) attain local abundance. Some of the unfixed dune is now completely covered in lupin as the result of disturbance and land clearing [3b].

The fixed dunes [4] are covered in bracken (*Pteridium aquilinum*) along with a scattered and mixed variety of introduced and native shrubs and trees [4a]. Species such as the smaller-flowered nightshade (*Solanum nodiflorum*), pohuehue (*Muehlenbeckia complexa*), blackberry (*Rubus fruticosus*), gorse (*Ulex europeus*) [4b], and tall fescue (*Festuca arundinacea*) [4c] are local dominants.

Beyond the bracken-covered dunes the dune cover is rough grassland containing scattered shrubs and bracken [5], and pasture [6].

There are four main areas of salt-marsh vegetation at the estuary (Fig. 3). All have been altered by natural and artificial changes to drainage patterns, and by mechanised earthmoving with consequent establishment of adventive plant species. In the submergent marsh [7], which is inundated at nearly every flood tide, sea primrose (*Samolus repens*), saltwort (*Salicornia australis*), and the introduced cord grass (in the South Marsh) are common. In the emergent marsh [8], which is covered only by spring tides, jointed rush (*Leptocarpus similis*) and marsh ribbonwood (*Plagianthus divaricatus*) are common. Areas of salt meadow can be found in the emergent marsh. This is turf made up of creeping herbs such as *Selliera radicans*, *Cotula* spp., and *Scirpus cernuus*. Other much larger *Scirpus* species such as American sedge or three-square (*S. americanus*), *S. fluviatilis*, and tall sedge (*S. lacustris*) are more abundant around muddy areas and areas influenced by fresh water.

The Oxbow (Fig. 2) contains a small area of *Potamogeton pectinatus* / *Lileopsis novae-zelandiae* association at the closed end, growing in extremely soft mud.

The first dunes behind the sand flats contain at present four isolated, shallow lakelets. The northernmost lakelet is tidal [9], but is constantly full. There is no permanent vegetation in this lakelet, although *Nitella hookeri*, a large alga, grows there at various times during the year. Sea rush, yellow buttons (*Cotula coronopifolia*), and salt-marsh ribbonwood grow around the edge. Puketewhaino, the largest of the freshwater lakelets [10] (see Fig. 12), is largely occupied by swamp vegetation composed of tall raupo (*Typha orientalis*), tall sedge, and medium-sized monocotyledonous herbs such as spike rush (*Elaeocharis acuta*). These lakelets contain abundant free-floating plants such as *Azolla rubra* and duckweeds (*Lemna minor* and *Spirodella oligorrhiza*) along with such rooted aquatic plants as *Polygonum*, *Miriophyllum*, *Potamogeton*, and *Nasturtium* species.

RECENT CHANGES IN THE VEGETATION

The principal vegetation types in the estuary during the first survey (L. B. Moore, in Wodzicki 1946) and the second in 1974 are compared in Fig. 3 and 4.

Since the first survey was undertaken, considerable natural changes in the main river channel have allowed the development of tidal channels in the sand flats [1] left by the northward movement of the river (Fig. 3 and 4) and the formation of a small, shallow lagoon [11]. The tidal channels contain algae and considerable detritus from the lagoon and South Marsh.

The amount of open sand-grass dune [2] has increased. The small area present on the spit during the first survey was still present in the second survey, but a larger area has been formed on the southern portion of the estuary. These low dunes are very unstable, and storm waves send seawater among them.

In 1943 there was a very large area of unfixed dunes [3] surrounding the estuary. Although the estuary changed shape between the surveys, unfixed dunes still surround it. Large areas have been cleared for housing, and some dunes are becoming stabilised and covered with bracken.

The sown pasture [6] is largely unchanged, but much of the rough pasture [5] has been used in housing developments.

Away from the estuary some fixed dune has been converted to pasture—photographs of 1942 show considerably more vegetation on the fixed dunes than occurs today, with dunes behind the estuary supporting low manuka scrub (*Leptospermum scoparium*) with some taller kanuka (*L. ericoides*). Kanuka is now absent, and manuka can be found only as rare scattered shrubs. Accidental burning around the estuary between the two surveys has maintained a grass/bracken vegetation on the dunes (Fig. 7 and 8).

Considerable changes have occurred in the salt-marsh areas. The large area of submergent marsh on the north side of the river was replaced with a recreational lakelet and boating marina in 1968 (see Fig. 5 and 6). Much of the North Marsh has disappeared since the 1943 survey, and a new marsh has formed further away from the sand flats. The Oxbow, which was cut off from the river in the winter of 1928, changed little between the surveys, though greater areas of submergent marsh were present during the second survey. The South Marsh has formed since 1943, and consists mainly of submergent marsh [7]. It contains the only established sward of the introduced cord grass in the Wellington region. This vigorous grass, which occurs at low elevations, is able to outgrow most of the native salt-marsh species.

Since 1943 two small lakelets have formed between the North Marsh and Puketewhaino. Raupo has encroached further into the open water of Puketewhaino lakelet between the surveys (Fig. 11 and 12), and likewise the vegetation cover has increased in the other, smaller, freshwater lakelets since they were formed.

Since settlers first arrived at the Waikanae estuary in 1848 and introduced lupin, other adventive plant species have become increasingly common; in 1974 they made up 47% of the plant species recorded. With greater disturbance of habitat, and the closer houses get to the estuary, it is likely that the number of adventive plant species will increase. Changes in



Fig. 5. Waikanae estuary, looking over salt swamp towards sandspit; Kapiti I. in background, right.
Photo: W. M. Hamilton 1942

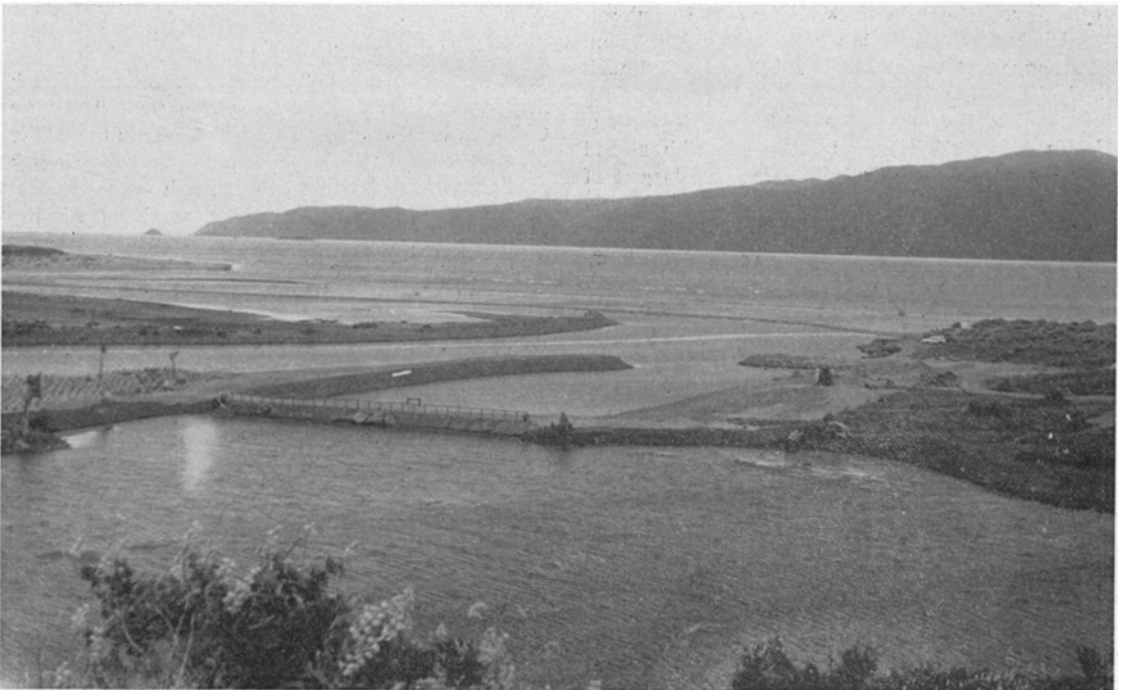


Fig. 6. The estuary at high tide, showing mole (centre) and marina with recreational lakelet (below).
Photo: K. Wodzicki 1974



Fig. 7. Waikanae estuary from wandering dune, towards Paraparaumu; Kapiti I. and sandspit in background, right.

Photo: J. M. Cunningham 1942



Fig. 8. As Fig. 7, showing approach of housing around southern edge of estuary and changes to vegetation on dunes and salt marsh at entrance to Oxbow.

Photo: P. C. Kennedy 1978

vegetation structure, such as those induced by adventive plant species entering the various habitats, will undoubtedly affect the distribution of bird species. Examples include the change from low marsh to tall marsh with the introduction of *Spartina*, and the presence of lupin on the unfixed dunes forming tall shrubland where once there was low shrub/grassland.

OBSERVATIONS ON BIRDS

RECORDS OF BEACH PATROLS

The birds described in this section differ from others recorded insofar as they were collected as dead specimens after storms. The first attempt to describe birds cast ashore by winter gales was made by

Wodzicki (1947), when three prion species (*Pachyptila vittata*, *P. belcheri*, and *P. turtur*), a diving petrel (*Pelecanoides urinatrix*), and a northern blue penguin (*Eudyptula minor*) were collected. The collections noted here were made on large sections of the coast, including the Waikanae River estuary. For these reasons it was decided to briefly describe the birds collected by beach patrols, and include them in the list of species recorded at the estuary.

The birds collected by beach patrols provide an interesting—though probably incomplete—picture of the offshore avifauna of the Waikanae estuary. Of 26 species recorded, 4 (paradise duck, mallard, black-bird, and magpie) are land birds and 22 are marine.

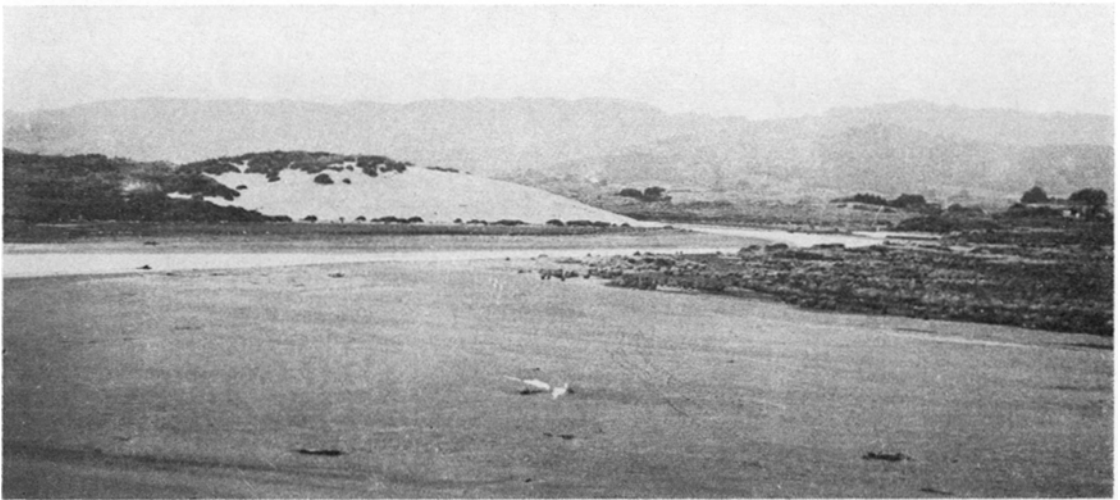


Fig. 9. Waikanae R. near estuary, showing wandering dune and North Marsh (right). Outliers of Tararua Ra. in background.

Photo: J. M. Cunningham 1942



Fig. 10. Similar to Fig. 9 (but taken from mole), showing approach of urban development at Otaihangā.

Photo: K. Wodzicki 1974

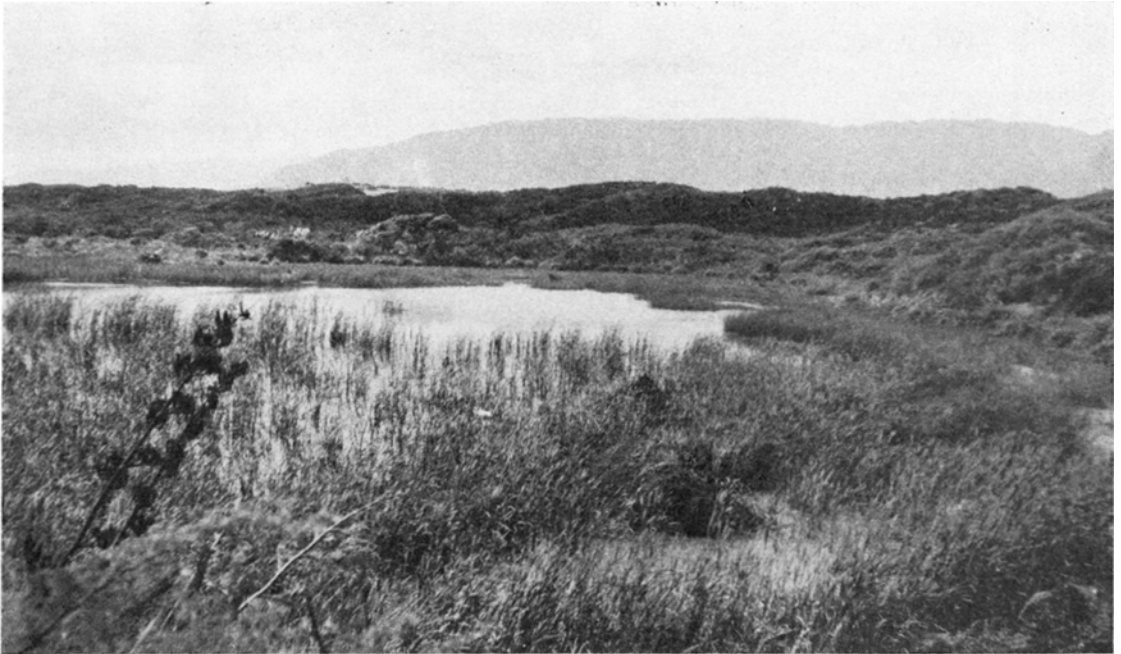


Fig. 11. Southern lakelet; Waikanae estuary to left, Tararua Ra. outliers behind. Note extent of *Typha orientalis* in lakelet.
Photo: J. M. Cunningham 1942

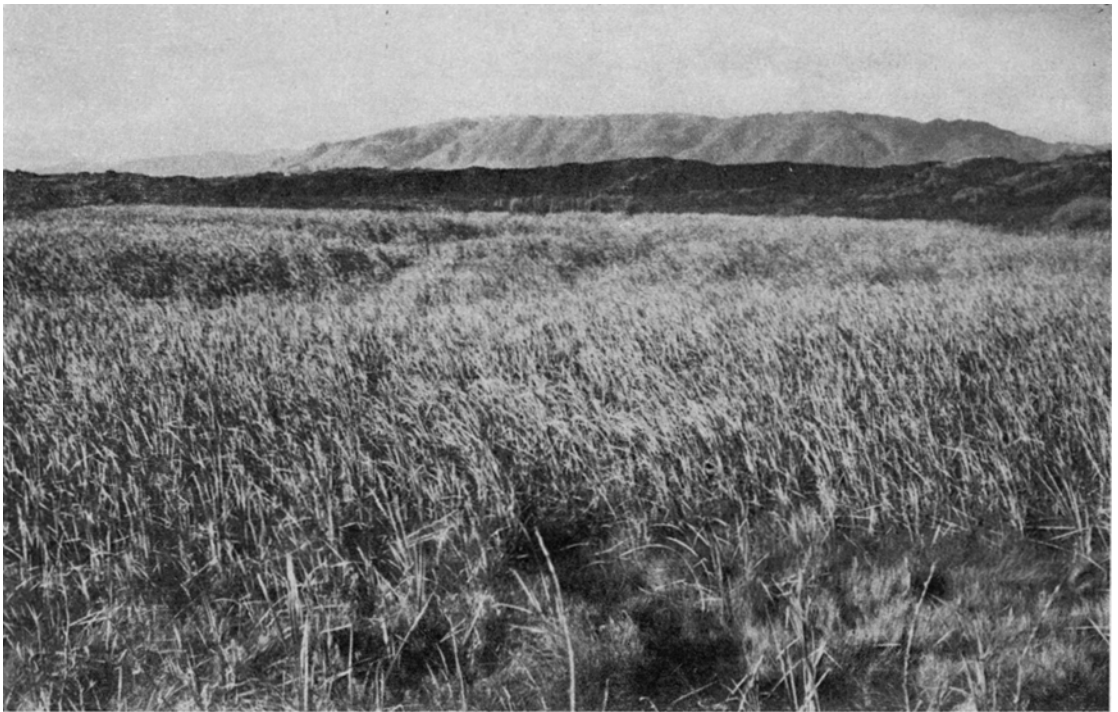


Fig. 12. As Fig. 11, showing extensive encroachment of *Typha* into lakelet, where little open water remains; housing development to immediate right of area depicted.
Photo: P. C. Kennedy 1978

Prions head the list with a total of 128 specimens (including 51 fairy prions), followed by 48 shearwaters (4 species) and 27 diving petrels. Nine species—yellow-eyed penguin, Antarctic fulmar, Cape pigeon, white-headed petrel, blue petrel, Buller's shearwater, Hutton's shearwater, and spotted shag—were not recorded previously at the estuary by Wodzicki (1946). The total of 259 birds collected in 8 days gives an average of 32 specimens per beach patrol.

LIST OF BIRDS RECORDED

The bird species listed below were recorded by the authors in the period 1971–74. Also noted are additional species seen by EBJ and CAF, and those collected by the beach patrols. Their systematic arrangement follows Kinsky (1970); Falla *et al.* (1966) was consulted also. New species, i.e., species not seen or collected during the 1941–43 survey, are marked with an asterisk. The records of species prefixed with a bold numeral are graphed in Fig. 15.



Fig. 13. Waikanae R. from sandspit, showing a shrub dune covered in *Leptospermum ericoides*; Tararua Ra. outliers in background.

Photo: J. M. Cunningham 1942



Fig. 14. Similar to Fig. 13; dune now covered in bracken and boxthorn (*Lycium ferocissimum*).

Photo: P. C. Kennedy 1978

1. **Yellow-eyed penguin** (*Megadyptes antipodes*).* Beach specimen 28 May 1972.
2. **Northern blue penguin** (*Eudyptula minor*). Beach specimens 19 Sep. 1971 (1), 5 Dec. 1971 (1), 22 Apr. 1972 (3), and 3 Jun. 1972 (1).
3. **New Zealand dabchick** (*Podiceps rufopectus*).* A single bird recorded 5 times between 1 Jan. and 7 Apr. 1973.
4. **Shy mollymawk** (*Diomedea cauta*). Beach specimens on 19 Jun. 1973 (1) and 21 Jul. 1973 (1).
5. **Giant petrel** (*Macronectes giganteus*). A very occasional visitor to the estuary during the first survey (Wodzicki 1946), but recorded more frequently during the second: 17 Jun. 1972 (1), 27 May 1973 (1), 21 Jul. 1974 (2), and 19 Dec. 1974 (4).
6. **Antarctic fulmar** (*Fulmarus glacialisoides*).* Beach specimens Sep. 1973 (7).
7. **Cape pigeon** (*Daption capense*). Beach specimens 27 Jun. 1949 (1), 5 Sep. 1971 (2), 15 Sep. 1972 (1), and 20 Oct. 1973 (1).
8. **White-headed petrel** (*Pterodroma lessoni*).* Beach specimen 15 Sep. 1972.
9. **Mottled petrel** (*Pterodroma inexpectata*).* Beach specimens 13 Mar. 1954 (2) and 21 May 1955 (1).
10. **Kerguelen petrel** (*Pterodroma brevirostris*).* Beach specimens 15 Sep. 1973 (3), 22 Sep. 1973 (1), and 20 Oct. 1973 (1).
11. **Blue petrel** (*Halobaena caerulea*).* Beach specimens 28 Nov. 1972 (1), 22 Dec. 1972 (1), 15 Sep. 1973 (1), and 22 Dec. 1973 (1).
12. **Broad-billed prion** (*Pachyptila vittata*). Specimens collected on 19 Sep. 1971 (2), 15 Oct. 1971 (4), 17 Oct. 1971 (2), 15 Sep. 1973 (17), 23 Jun. 1974 (5), 6 Jul. 1974 (2), and 11 Jul. 1974 (1).
13. **Lesser broad-billed prion** (*Pachyptila salvini*). Specimens obtained on 19 Sep. 1971 (1), 29 Jul. 1972 (1), 15 Sep. 1973 (8), and 23 Jun. 1974 (5); 6 Jul. 1974 (2) and 11 Jul. 1974 (1); and on 23 Jun. 1974 (1) and 6 Jul. 1974 (1).
14. **Antarctic prion** (*Pachyptila desolata*).* Specimens obtained on 27 Oct. 1957 (1), 23 Jun. 1974 (1), and 6 Jul. 1975 (1).
15. **Narrow-billed prion** (*Pachyptila belcheri*). Recorded 23 Jun. 1974 and 6 Jul. 1974.
16. **Fairy prion** (*Pachyptila turtur*). Apparently the most vulnerable oceanic species on the Manawatu coast, since between 6 Jun. 1971 and 20 Oct. 1973 51 specimens were collected by beach patrols. In addition, single corpses were recorded on 23 Jun. 1974 and 6 Jul. 1974 and 2 live specimens on 19 Dec. 1974.
17. **Flesh-footed shearwater** (*Puffinus carneipes*).* Single record on 30 Mar. 1970.
18. **Buller's shearwater** (*Puffinus bulleri*).* Beach specimens 27 Jun. 1971 (2) and 14 May 1972 (1).
19. **Sooty shearwater** (*Puffinus griseus*). Beach specimens 19 Sep. 1971 (2), 25 Nov. 1971 (1), 4 Dec. 1971 (1), 14 May 1972 (1), 3 Jun. 1972 (1), 1 Jan. 1973 (1), and 28 May 1973 (2), and 2 live birds 1 Sep. 1973 (MLF).
20. **Short-tailed shearwater** (*Puffinus tenuirostris*).* Single birds collected 2 Feb. 1954, 28 Oct. 1968, and 19 Nov. 1968.
21. **Fluttering shearwater** (*Puffinus gavia*). Beach specimens 4 Sep. 1971 (7), 5 Sep. 1971 (1), 25 Nov. 1971 (1), 22 Apr. 1972 (1), 3 Jun. 1972 (1), 23 Jul. 1972 (1), 29 Jul. 1972 (1), 27 May 1973 (1), 21 Jul. 1973 (1), and 23 Mar. 1974 (4).
22. **Hutton's shearwater** (*Puffinus huttoni*).* Beach specimens 4 Sep. 1971 (1), 15 Oct. 1971 (2), and 20 Oct. 1973 (2).
23. **Diving petrel** (*Pelecanoides urinatrix*). Another seabird common on the west coast of the southern part of the North Island. Beach specimens 19 Sep. 1971 (2), 4 Sep. 1971 (1), 5 Sep. 1971 (1), 15 Oct. 1971 (1), 22 Apr. 1972 (2), 25 Jun. 1972 (10), 23 Jul. 1972 (1), 29 Jul. 1972 (1), 13 Sep. 1972 (2), 15 Sep. 1972 (1), 17 Sep. 1972 (1), 23 Sep. 1972 (1), 22 Dec. 1972 (2), and 28 May 1973 (1).
24. **Australian gannet** (*Sula bassana*). Although Cook Strait is one of the migration routes of gannets from New Zealand to Australia (Wodzicki 1967), gannets were observed only very occasionally during the first survey. During the second, specimens were collected by beach patrols on 6 Sep. 1971, 19 Sep. 1971, and 19 Jun. 1972. In addition there are records on 4 Apr. 1959 (3) and 6 May 1962 (EBJ), and on 15 Dec. 1973 (KW).
25. **Black shag** (*Phalacrocorax carbo*). This most common and conspicuous species of cormorant is usually found at the estuary or feeding up the Waikanae River (see Fig. 10). During the first survey up to 30 birds were observed at a visit, and altogether 347 were seen on 29 of the visits. The average of 12.0 is very significantly higher than the 5.4 for the second survey, when 487 were counted on 90 of the visits and 15 was the greatest number seen. The pattern of numbers observed during both surveys shows no significant monthly variation.
26. **Pied shag** (*Phalacrocorax varius*).* Single birds were recorded on 5 occasions, all during winter (17 Jun. 1972, 27 May 1973, 4 Jun. 1973, 7 Jun. 1973, and 24 Jun. 1973).
27. **Little black shag** (*Phalacrocorax sulcirostris*).* The first recorded observation was on 10 Jul. 1971, when CAF counted 5 birds. During the second survey birds were seen on 6 occasions in 1973 and 1974 (total 17), all in the period

- June-September, so it appears that the little black shag is a winter visitor to the estuary.
28. **Little shag** (*Phalacrocorax melanoleucos*). This species, found throughout the two main islands, was uncommon at Waikanae during the first survey. It was much more common during the second, when 365 birds were counted over 74 visits, an average of 5 birds per visit. The birds were usually either on the river or resting on logs in the river (Fig. 10). Numbers observed per visit were between 1 and 12, and birds were seen between the end of January and September.
 29. **Spotted shag** (*Stictocarbo punctatus*)*. This species is at present a frequent visitor to the estuary; 77 birds were observed over 27 visits between 8 Aug. 1970 and 8 Sep. 1974. Sightings covered the winter months April-September. The largest number seen on any one occasion was 10. Spotted shags were usually found perched on logs or feeding in the river.
 30. **White-faced heron** (*Ardea novaehollandiae*)*. Of the three Australian bird species which appeared at the estuary between the two surveys, the white-faced heron was the earliest arrival. According to Stidolph (1971), this species became common in the Wairarapa and elsewhere in the southern part of the North Island about 1961. EBJ recorded one in 1956, one in 1957, two in 1959, and three in 1961. It is now common at the estuary, and has nested in its vicinity. Usually white-faced herons were feeding on sand flats and salt marsh (see Fig. 2) when observed. It appears that this species has achieved an equilibrium, because the numbers recorded at the beginning differ little from those noted at the end of our survey. More birds were seen towards the end of the calendar year. White-faced herons were recorded on 63 visits (total 150 birds; mean 2.4 per visit).
 31. **White heron** (*Egretta alba*)*. Single birds were observed on 19 May 1962 (EBJ), 20 and 28 Jun. 1970 (CAF), and 2 Sep. 1972 (KW).
 32. **Reef heron** (*Egretta sacra*). An occasional visitor at the time of the 1941-43 survey, when altogether 12 birds were observed on 11 occasions. Single birds were recorded on 3 May 1960 by EBJ, and during our survey on 9 Apr. 1971 and 13 Jun. 1971 by CAF.
 33. **Australian bittern** (*Botaurus stellaris*). This species appeared in fair numbers towards the end of the first survey, when up to 18 birds were seen at one time. Since then, owing perhaps to the overgrowing of the swamp hollows (cf. Fig. 11 and 12), it has become less numerous and harder to observe, as shown by the sole record of two birds on 5 Feb. 1973.
 34. **Black swan** (*Cygnus atratus*). The first survey established the status of this species as an occasional visitor at the estuary, 20 birds having been counted over 6 visits, with a maximum of 7 on one occasion. In the second survey only one bird was seen, on 24 Jun. 1973.
 35. **Paradise duck** (*Tadorna variegata*). The first survey established that this species was a fairly frequent visitor to the estuary, 70 birds having been counted on 17 of the 37 visits, with a maximum of 28 on one occasion. It now seems to be only an occasional visitor, although the numbers counted are similar (70 on only 16 visits out of 123, maximum 16).
 36. **Mallard** (*Anas platyrhynchos*). Although the first survey reported this species as a "fairly frequent visitor to the estuary", only 20 were seen over 4 visits, with 12 on one of them. During the second survey they were much more numerous; 280 were counted over 29 visits, with a maximum of over 60. Since 19 of these visits were among the 34 'complete' visits by KW and MLF, and only 10 were among the 89 'partial' and CAF visits, it seems obvious that the mallard may be even more prevalent than the counts indicate. Larger numbers were noted towards the end of spring and beginning of summer, which probably coincides with the completion of nesting and flight of the ducklings.
 37. **Grey duck** (*Anas superciliosa*). This was described as the most common of New Zealand ducks and a frequent visitor to the estuary in 1941-43, when the numbers seen varied greatly from nil (18 visits) to a maximum of 325. The second survey shows an alarming decline in the numbers visiting the estuary; only 30 birds were observed, over 10 visits.
 38. **New Zealand shoveller** (*Anas rhynchotis*). During the 25 months of the first survey this species was recorded only twice, and was considered to be a rare visitor (Wodzicki 1946). Its status at the estuary seems not to have changed much, since during the second survey 11 birds were seen, over 4 visits.
 39. **Australasian harrier** (*Circus approximans*). This species was found during the first survey to be well adapted to the countryside around the estuary; two or three birds were sighted during each visit. One was recorded by EBJ on 6 Mar.

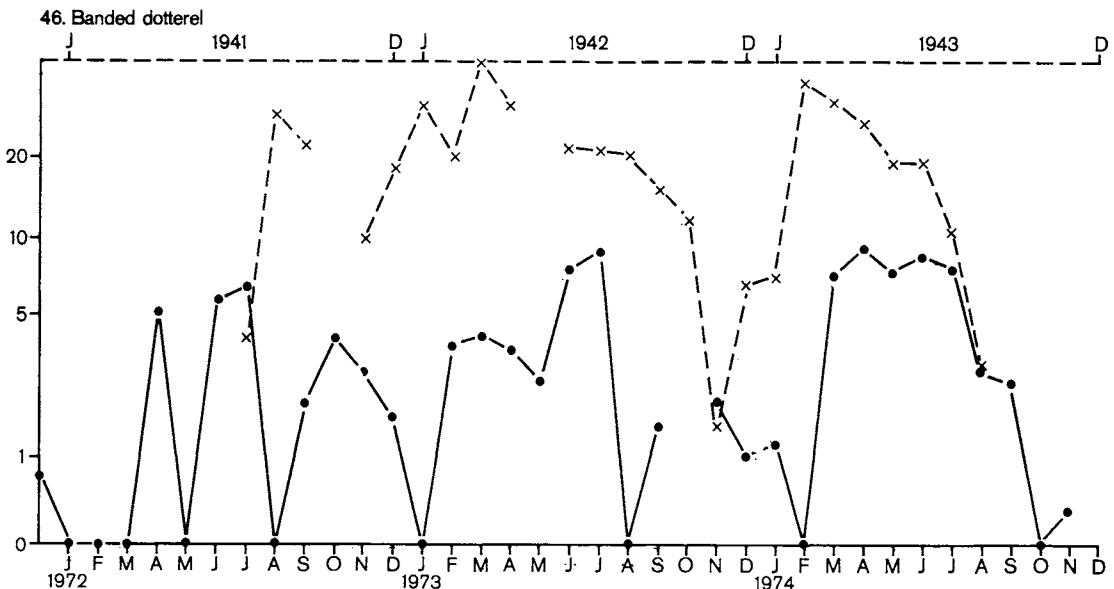
Fig. 15 (pp. 564-74). Monthly average sightings of 18 species of bird recorded from the Waikanae estuary, plotted on semi-log paper (x—x, 1941-43; o---o, 1971-74). Averages for goldfinch (No. 75) differ from all others in that nil returns are excluded from the average (relevant data lost). Plot broken where no data obtained for a particular month.

surveys have provided additional feeding habitat (Fig. 3).

- 43. **South Island pied oystercatcher** (*Haematopus ostralegus*). During the first survey this oystercatcher was relatively uncommon; only 16 birds were recorded, during 10 out of the 37 visits. The second survey has shown it to be well established and in larger numbers during all 3 years, a total of 744 being recorded on the 75 visits (maximum on one occasion 41). Its absence from the estuary during the last 4 months of the year is presumably due to nesting (in the South Island).
- 44. **Variable oystercatcher** (*Haematopus unicolor*). The first survey showed this species to be a more frequent visitor to the estuary than the South Island pied oystercatcher, in that 42 were counted during 23 visits. The second survey has revealed an increase in both numbers and frequency (573 during 105 visits) and the presence of the species over most of the year. As in the first survey, a single pair has nested at the estuary, mainly on the sandspit (Fig. 2 and 8). Two chicks were observed on 18 Nov. 1972, and a nest with three eggs was recorded on 24 Nov. 1974.
- 45. **Spur-winged plover** (*Lobibyx novaeollandiae*)*. A single bird was first recorded on 16 May 1970 (CAF, pers. comm.), since when a single bird of undetermined sex has been observed during 30 visits to the estuary, the last on 23 Nov. 1974. It was usually associated with pied stilts, and therefore fairly conspicuous. During our survey spur-winged plovers settled elsewhere in the district

and nested, rearing several broods at Paekakariki, some 6 km south-east of the estuary. However, our solitary bird remained at the estuary and apparently made no attempt to join the plovers at Paekakariki.

- 46. **Banded dotterel** (*Charadrius bicinctus*). Both surveys show a period of abundance from February to June; this significant increase in numbers is probably the result of the migration northward of birds from the South Island. Since the first survey, when birds were present on every visit and 642 were counted (average per visit 17.4), numbers have declined highly significantly; during 1971-74 birds were seen on just over half the visits, and only 453 (average 7.1) were recorded.
- 47. **Wrybill** (*Anarhynchus frontalis*). The report on the first survey mentioned occasional records of wrybill at the estuary covering almost a century. Most of the birds observed were on southward migration. During the second survey birds were observed (MLF) on 29 Aug. 1973 (2) and 25 Aug. 1974 (4).
- 48. **Eastern bar-tailed godwit** (*Limosa lapponica*). During the first survey 1-20 southbound birds were observed during some visits in spring. Records outside the surveys—10 Oct. 1957 (3), 21 Oct. 1961 (1) (EBJ); 6 June 1970 (1), 21 Sep. 1971 (1), 12 Nov. 1972 (1), 10 June 1973 (4), 8 June 1974 (7) (CAF)—plus records of 50 birds over 8 visits between 28 Oct. 1972 and 20 June 1974 during the second survey, were mostly obtained in spring. This supports the view expressed in the first survey that the majority of godwits



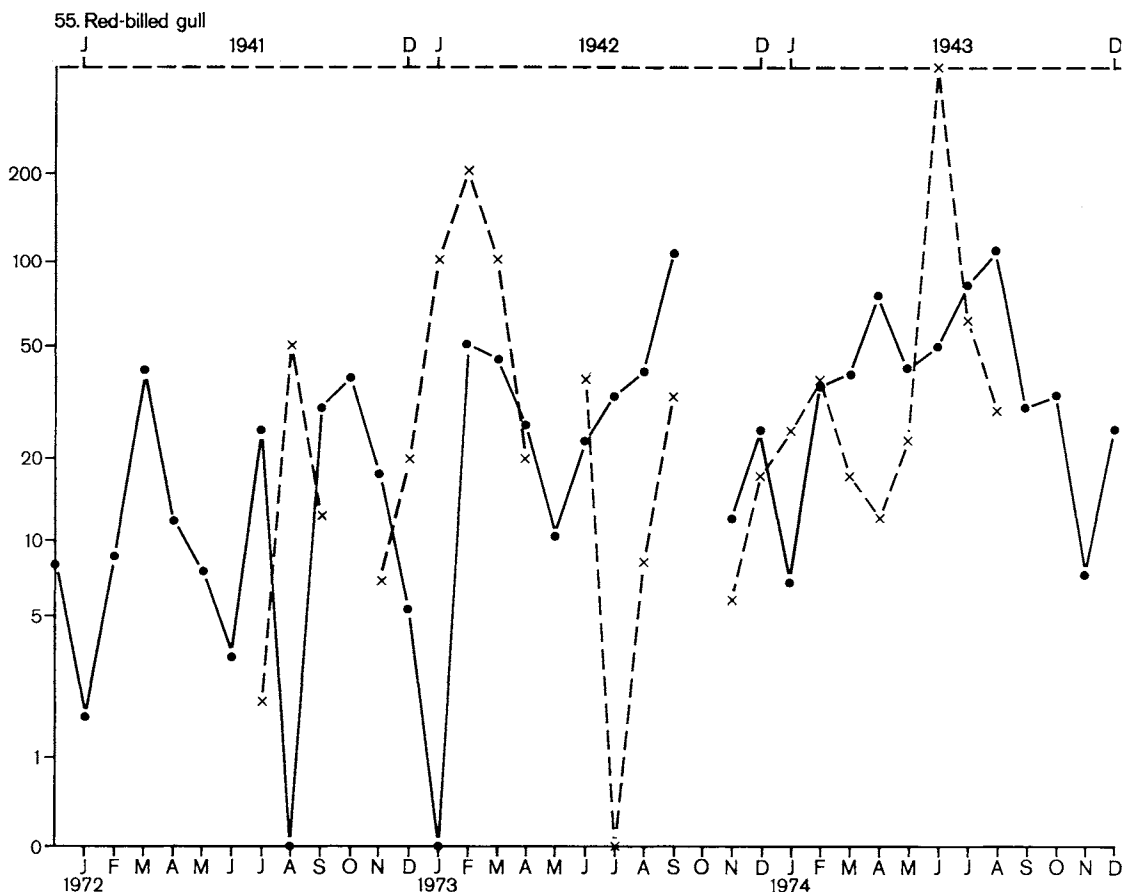
larly at the estuary. It did not associate with red-billed gulls, although often found on the same feeding grounds. In 1941-43 74 birds were counted during 20 visits (average 3.7); 30 years later 335 were counted during 32 visits (average 10.5), a significant increase.

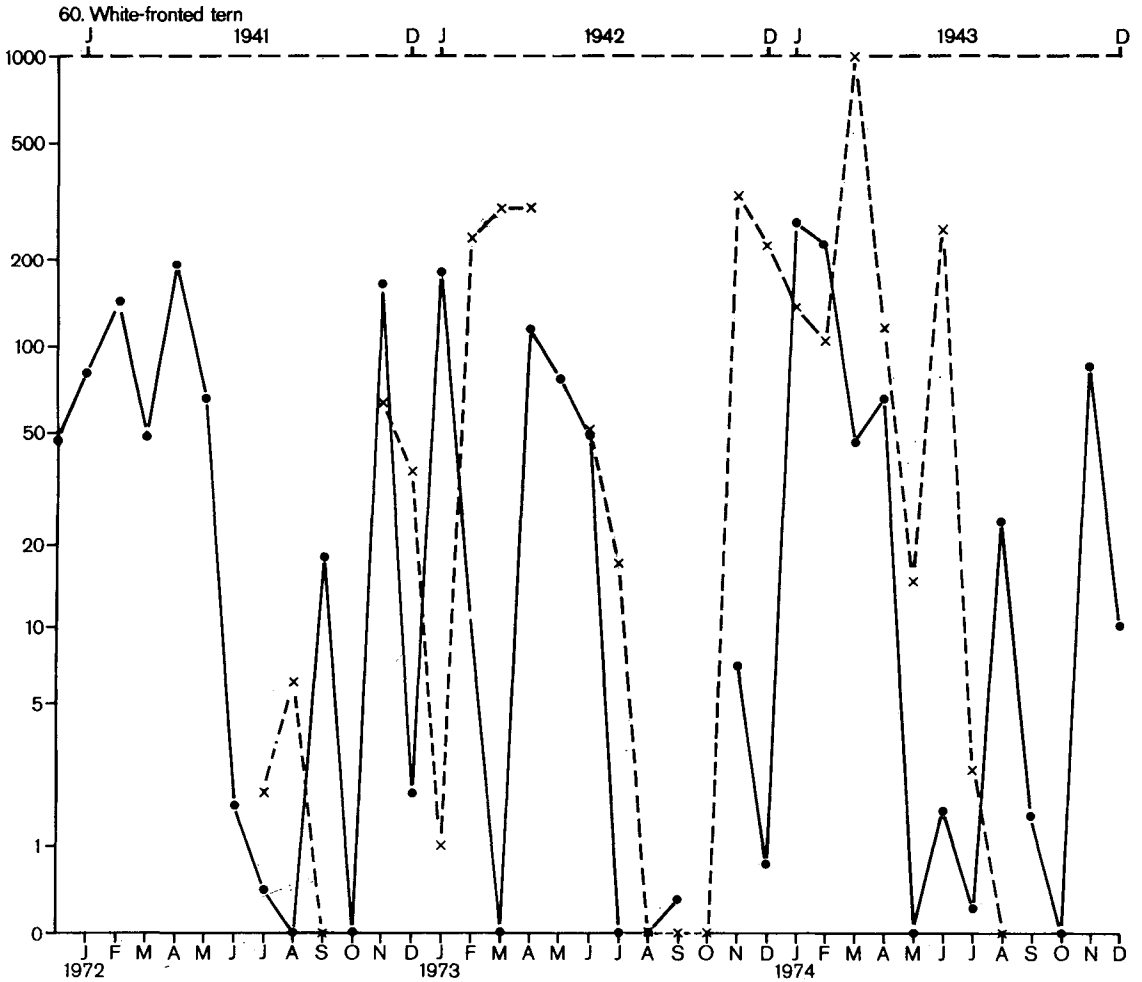
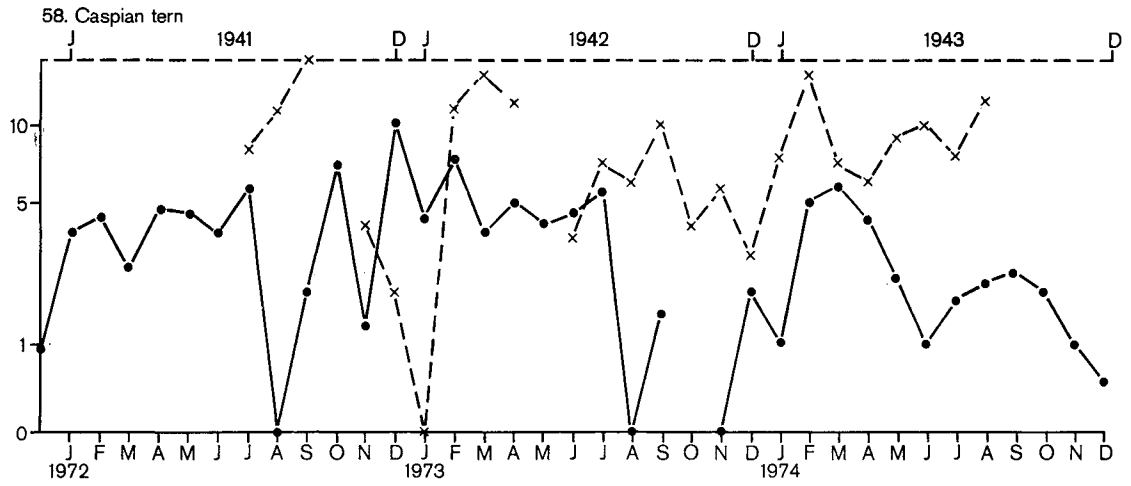
57. **Black-fronted tern** (*Chlidonias albstriata*). This tern, which breeds on shingle banks in South Island rivers, has been reported to undertake a partial migration to the coasts of the North Island during the winter (Kinsky 1970). This is confirmed by our observations: during the first survey birds were present at the estuary between February and August, apart from two records in December 1942; during the second survey birds were observed between February and July. The greatest difference between the surveys is in the number of birds counted. During the first survey the maximum per visit was well over 200, compared with 30 in 1972-74. Equally striking is the difference between the mean numbers seen per

visit: in 1941-43 18 visits produced a total of 646 birds, giving a mean of 36; in 1971-74 120 birds were counted during 17 visits, giving a mean of only 7, significantly lower than in 1941-43.

58. **Caspian tern** (*Hydroprogne caspia*). We confirm the presence of Caspian terns throughout the year as reported in the first survey, although numbers were significantly lower in November-January. Birds were usually found either about the small lagoons in the southern part of the estuary or on the sandspit at the mouth of the river (see Fig. 2), where they rested near but usually apart from black-backed gulls or white-fronted terns. Significantly fewer birds were recorded in the second survey; in 1941-43 297 were counted during 35 visits (average 8.5), as against 425 during 87 visits in 1971-74 (average 4.9).

59. **Eastern little tern** (*Sterna albifrons*)*. We recorded single birds, presumably the same one each time, during 9 visits between 4 Dec. 1971



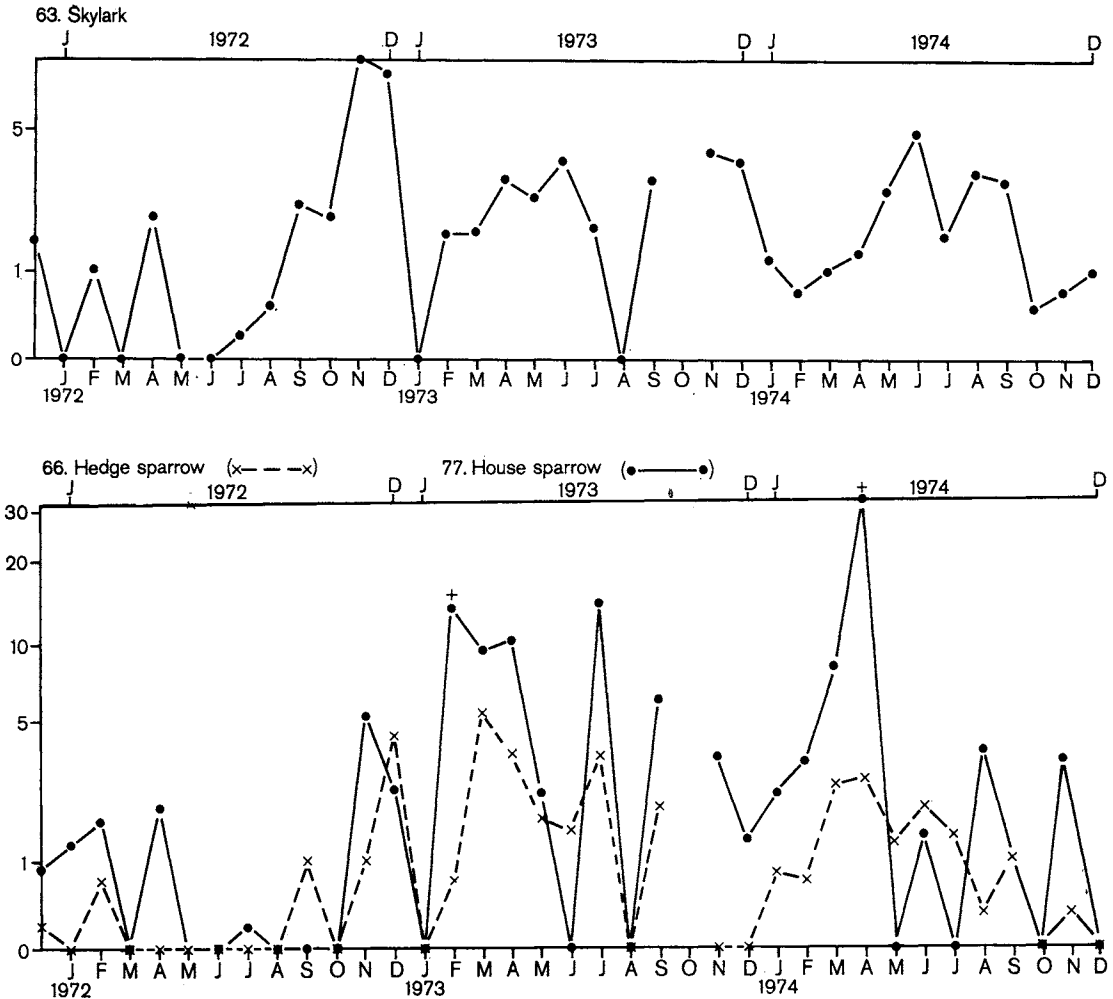


and 21 May 1972. Another was recorded between 21 Jan. 1974 and 23 Mar. 1974 (CAF). Both birds were in the company of other terns.

60. **White-fronted tern** (*Sterna striata*). This species showed marked and statistically significant fluctuations in numbers during the year in both surveys. Numbers started falling off in May and June from the peak in March-April, and were particularly low from July to October. During the second survey, as before, most birds were either resting on the spit (Fig. 2) or fishing in the sea off the estuary. Their overall abundance was not significantly different between the two surveys. In 1941-43, 4768 birds were recorded during 28 visits (average 170), whereas in 1971-74 7807 were counted during 54 visits (average 145).
61. **Rock pigeon** (*Columba livia*).* An accidental

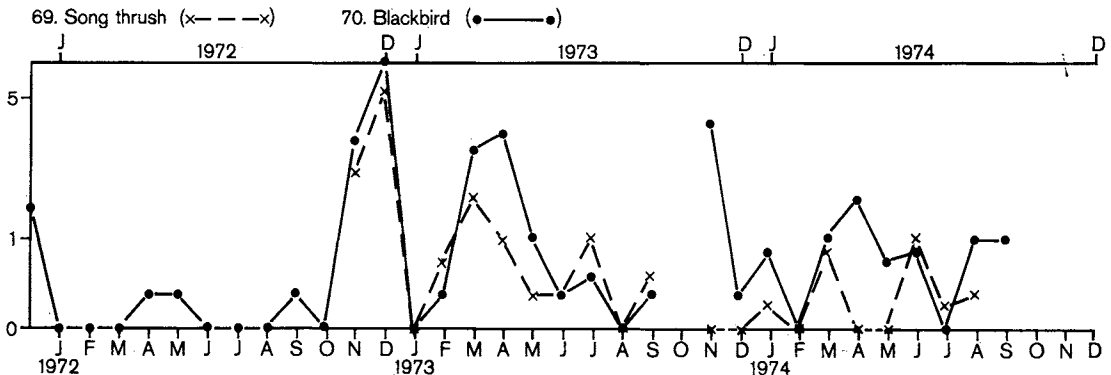
visitor to the estuary, seen on 15 Oct. 1973.

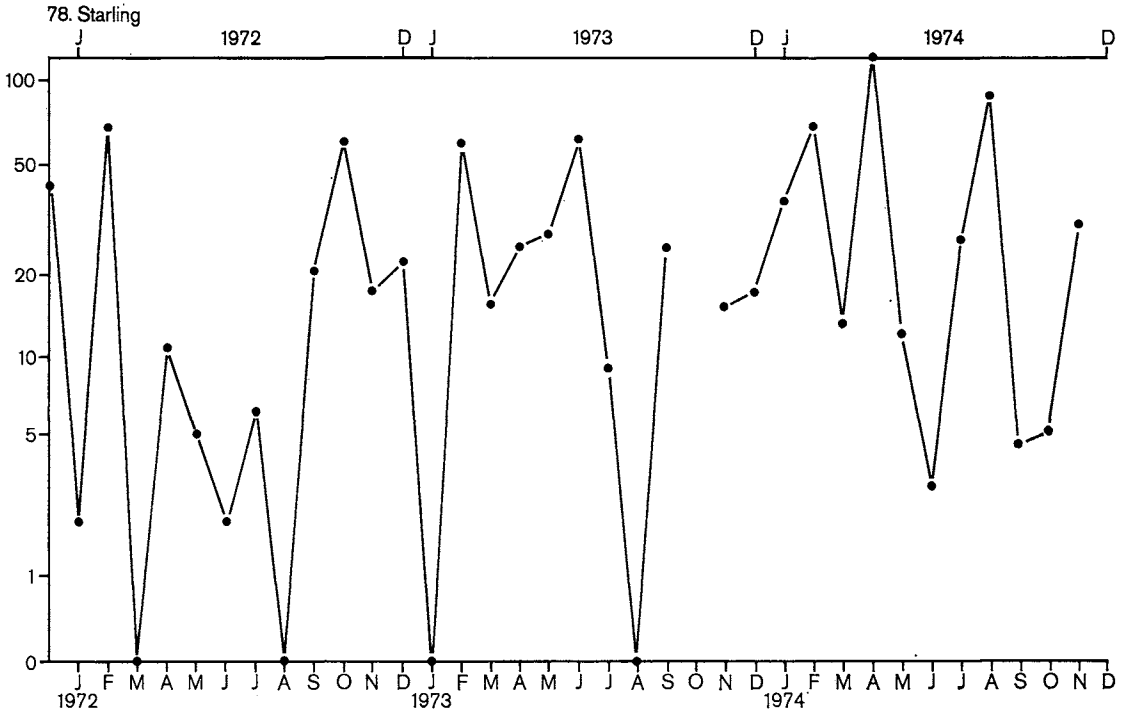
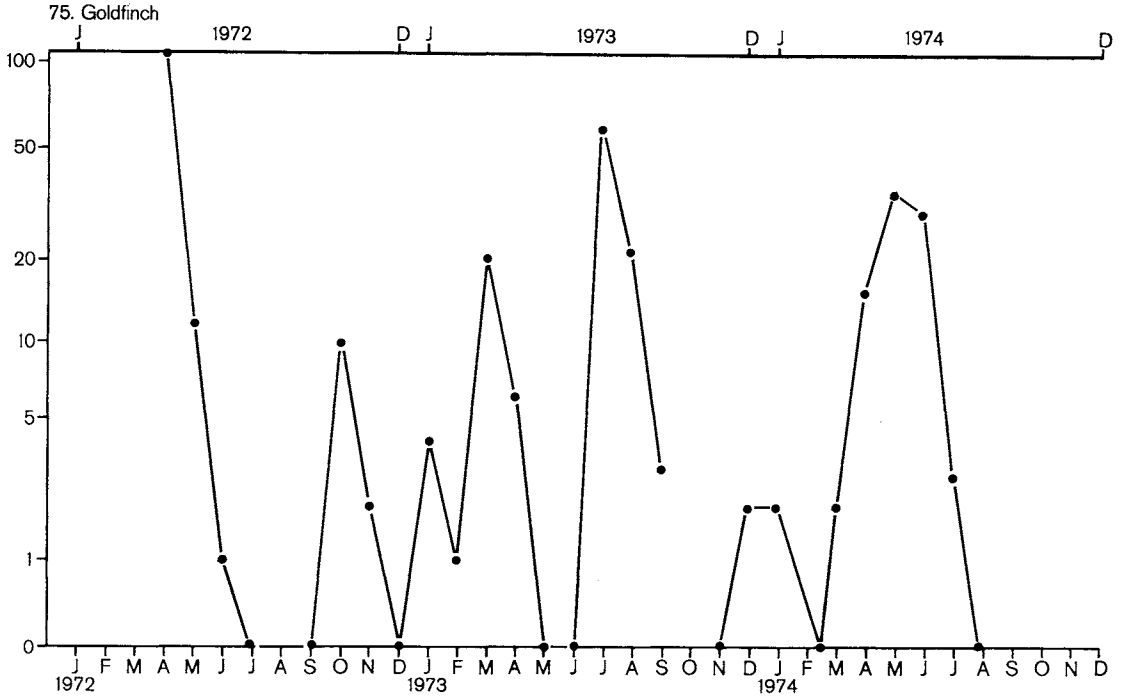
62. **New Zealand kingfisher** (*Halcyon sancta*). Though not counted, this species was regarded as "not uncommon" in the first survey (Wodzicki 1946). We recorded birds on 16 visits between 1971 and 1974, and CAF (pers. comm.) noted them on 11 visits between 1970 and 1974. The numbers seen varied from 1 to 8 and the total recorded was 65, giving a mean of 2.4 per visit.
63. **Skylark** (*Alauda arvensis*). Considered from the first survey to be "one of the most numerous species of the introduced landbirds", skylarks were found in 1971-74 to be common though perhaps less abundant. The shrubs that now cover many of the dunes are believed to have caused some decline. Birds were seen during 50 of our visits, and were recorded by CAF during 18 visits. The maximum recorded during any one



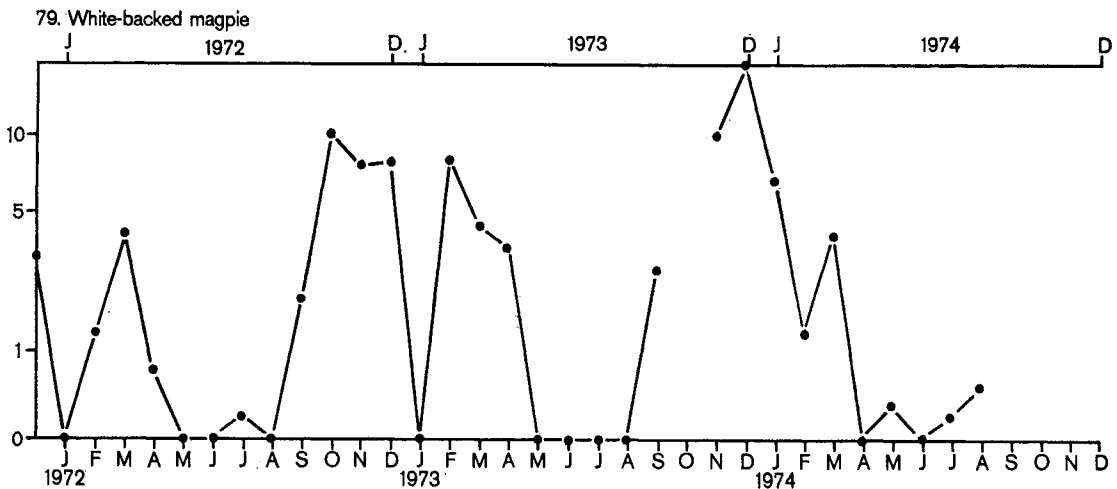
visit was 27, and the total of 259 gives an average of 5.2 birds per visit.

64. **Welcome swallow** (*Hirundo tahitica*)*. This species, at one time a straggler from Australia, has lately been spreading in New Zealand, and has bred since 1958 (Kinsky 1970). By 1965 birds had reached the Wairarapa, and in 1969–70 were common there (Stidolph 1971). At the estuary birds were first observed (CAF) on 12 Dec. 1971. They were recorded regularly between November 1973 and August 1974, when the largest number seen at one time was six. During 19 visits 50 birds were recorded, giving a mean of 2.6 per visit. Welcome swallows do not nest in the estuary's vicinity, but its relatively smooth waters seem to provide a suitable feeding area.
65. **New Zealand pipit** (*Anthus novaeseelandiae*). Particularly during the early part of the first survey pipits were observed frequently, but it now appears that numbers around the estuary have declined considerably. We observed single birds during two visits, and CAF reported two on 21 Feb. 1971 and one on 22 Jun. 1974 and 21 Jul. 1974.
66. **Hedge sparrow** (*Prunella modularis*). This species was recorded in the first survey as being "present in pairs or small flocks". During the second survey it was seen during 34 visits, usually as single birds, sometimes in pairs. Altogether 141 were counted, giving a mean of 4.1 per visit.
67. **Grey warbler** (*Gerygone igata*). In the first survey a few pairs were present throughout the year in the tree-covered parts of the fixed dunes. During the second survey birds were noted on 9 Dec. 1972, 29 Mar. 1973 (3), 16 Sep. 1973, and 6 Feb. 1974 (1).
68. **North Island fantail** (*Rhipidura fuliginosa*). During the first survey this, like the grey warbler, was estimated to be one of the less numerous species, a few pairs living in the shrub-covered
- dunes. During the second survey single birds were recorded on 7 Apr. 1973 and 15 Mar. 1974.
69. **Song thrush** (*Turdus philomelos*). Considered from the first survey to be common, though always found in small numbers. During the second survey this species was found in the same habitat as the blackbird. Because song thrushes are less conspicuous than blackbirds, their numbers may have been underestimated.
70. **Blackbird** (*Turdus merula*). The first survey found blackbirds to be "twice as common" as the song thrush (Wodzicki 1946). This species has been recorded (KW and MLF) on 29 visits to the estuary between 22 Apr. 1972 and 8 Aug. 1974. Most of the birds observed were in the shrub-covered dunes. Numbers recorded ranged from 1 to 14.
71. **Silvereye** (*Zosterops lateralis*). The first survey found silvereyes in flocks of 5–20 birds in the shrub- and tree-covered parts of the fixed dunes. They appeared to be more numerous when *Phormium tenax* was flowering. During the second survey silvereyes were again found to be numerous throughout the year, though in smaller numbers. Between 18 Nov. 1972 and 25 Aug. 1974 they were noted on 22 visits, and the numbers seen varied from single birds to flocks of 34. The total seen was 176, giving an average of 8 per visit.
72. **Yellow hammer** (*Emberiza citrinella*). Recorded as being resident at the estuary during the first survey, and occasionally seen on the beach. Noted by CAF on seven visits between 27 Jun. 1971 and 13 Jul. 1974. We have noted yellow hammers on 38 visits between 7 Dec. 1971 and 8 Sep. 1974, in numbers varying from single birds or pairs to flocks of 10, 25, and even 50. These larger numbers were recorded in June and July. The total of 163 birds gives a mean of 4.2 per visit.





73. **Chaffinch** (*Fringilla coelebs*). The first survey showed the chaffinch to be "common throughout the year on both the lupin-grown and tree-covered parts of the dunes". The latest survey found chaffinches on only 13 visits, between 21 May 1972 and 25 Aug. 1974. Altogether 38 birds were recorded, i.e., 2.9 per visit.
74. **Greenfinch** (*Carduelis chloris*). The first survey described this species as a frequent visitor "but not very numerous". Greenfinches were recorded by CAF on three occasions. Their numbers at the estuary show considerable fluctuations from year to year; in favourable years they may form flocks up to 50 strong. The total of 199 birds counted on 17 visits (MLF) gives a mean of 11.7 birds per visit. Although no comparable counts were made during the first survey, it appears that there are now more greenfinches in the estuary area than in 1941-43.
75. **Goldfinch** (*Carduelis carduelis*). Reported by Wodzicki (1946) to be common and in flocks throughout autumn and winter, mainly in the lupin-covered parts of the dunes. Our observations between December 1971 and September 1974 in general confirm this, and records by CAF between 27 Jun. 1971 and 26 Jun. 1974 provide similar figures. The numbers of goldfinches we recorded varied considerably through the year, but birds were present in all months. As noted during the first survey, the largest flocks appeared in early winter. In all, 579 birds were counted on 29 visits, which gives an average of 19.9 per visit.
76. **Redpoll** (*Acanthis flammea*). This species was recorded as an occasional visitor during the first survey. It was recorded by CAF on 20 Jun. 1970
- and 6 May 1972, and we have noted single birds on 29 Mar. 1973, 27 Jun. 1973, and 30 Apr. 1974 and a pair on 20 Jun. 1974.
77. **House sparrow** (*Passer domesticus*). Recorded as being present at the estuary and breeding in its vicinity during the first survey, and frequently observed in the company of chaffinches, feeding among the tidal debris on the beach at low tide. These observations were confirmed during the second survey. The largest numbers were usually recorded between midsummer and midwinter, when house sparrows tended to be in flocks.
78. **Starling** (*Sturnus vulgaris*). The first survey found starlings to be "present throughout the year in large numbers", and Wodzicki (1946) mentions very large flocks flying to roost on Kapiti Island (see Fig. 6), one of them comprising an estimated 20 000-25 000 birds. From our observations it appears that starlings have, if anything, increased in numbers, since often 100 or more were noted in the estuary area. It seems that there were few if any seasonal fluctuations in numbers. Only one large flock (of about 10 000 birds) was noted, but most of our visits were completed well before dusk. Excluding the above flock, 3148 birds were recorded during 63 visits.
79. **White-backed magpie** (*Gymnorhina tibicen*). This species was found to be very common during the first survey, mostly in the shrub-covered parts of the dunes. Occasionally birds appeared on the beach in pairs or groups of 4-5, and were sometimes chased by Caspian terns. Our observations show no decrease in numbers. During 42 visits 297 magpies were counted, which gives an average of 7 birds per visit.



DISTRIBUTION OF BIRDS AT ESTUARY

For purposes of relating the distribution of birds to the 12 vegetation types (Table 2), nine habitat areas were defined (Table 3 and below). All 79 bird species observed at the estuary are considered in Table 3. Some of the bird species used only one habitat, whereas others used two or more. Unusual occurrences of some species, e.g., house sparrows on the beach, were not recorded.

The first habitat includes the beach and the open sea. Among the 41 species that were recorded on the beach, 20 were marine birds collected as beach specimens (Table 3) and 5 were marine birds observed from the shore; the remaining 16 were recorded on the beach and also on other habitats such as the beach-front dunes, rivers and flats, sand flat, lagoon, or salt marsh.

Beach-front dunes (Fig. 3) naturally showed a more restricted bird fauna, of nine species observed regularly plus one using the habitat occasionally (Table 3); all these species are also found in other habitats. This habitat is the nesting place of the variable oystercatcher and banded dotterel.

The river and its flats are favoured by several birds; 17 species were observed regularly and 6 occasionally.

On sand flats and lagoon we recorded 27 bird species found regularly and 2 observed occasionally.

On the unfixed dunes (Fig. 3) we found only five species plus two that were recorded occasionally.

On the fixed dunes 18 land-bird species were regularly observed and 2 were seen occasionally.

On the salt marsh 15 species were regularly found and 6 were occasional.

On the grass field habitat only six species were regularly recorded.

Finally, on the lakelets six species of birds were observed regularly and two occasionally.

Summing up, we find (as expected) that the beach and open sea carry the largest number of bird species; in fact, about half of the species recorded at the Waikanae estuary are found in these two habitats. The remaining eight habitats carry varying numbers of bird species in the following, declining order: sand flats and lagoon (27); fixed dunes (18); river and flats (17); salt marsh (15); beach-front dunes (9); lakelets (6); grass fields (4); and unfixed dunes (4). The importance of the several habitats which are interchangeable for a number of species and which support the considerable variety of bird life found at Waikanae estuary is stressed (Table 3).

CHANGES IN BIRD LIFE, 1941–43 TO 1971–74

(i) NUMBER OF SPECIES

Seventy-nine bird species were recorded in the second

survey, as against 61 in the first. There are 25 new species (Table 3), which fall into several categories. First we have three Australian species—the white-faced heron, spur-winged plover, and welcome swallow—which comparatively recently have colonised New Zealand (Kinsky 1970). Their appearance at the estuary is described above ('List of birds recorded').

Eleven species of marine birds—yellow-eyed penguin; Antarctic fulmar; white-headed, mottled, Kerguelen, and blue petrels; Antarctic prion; flesh-footed, Buller's, short-tailed, and Hutton's shearwaters—owe their appearance on our list to beach patrols, which were not operating at the time of the first survey. The spotless crane was probably present in 1941–43 but, with no tape recordings to attract it, it passed unnoticed. The presence of a further three new species (white heron, pomarine skua, and rock pigeon) appears to be accidental. Finally, the appearance on our list of the eastern little tern may be accidental, but that of the little black, pied, and spotted shags may be due to an extension of their range in the southern part of the North Island.

With regard to species reported in the first survey but not observed during the second, the Arctic tern and fairy tern were recorded during the first survey but the red-necked stint, royal albatross, and sanderling are old records taken long before it.

(ii) CHANGES IN ABUNDANCE

One of the aims of the second survey was to compare the numbers of some bird species recorded in the first and second surveys. Species recorded occasionally or as regular visitors, residents, or breeding residents are indicated in Table 3. (The method by which the numbers of various species were recorded in the two surveys is described above.) Of the 79 species listed, 33 are residents, breeding residents, or regular visitors. They are grouped below according to whether their numbers increased, remained static, or decreased.

(a) The following species increased in numbers – mallard duck, pheasant (based on five observations only), pukeko, South Island pied oystercatcher, variable oystercatcher, New Zealand kingfisher, black-billed gull, yellow hammer, starling, and white-backed magpie.

(b) The following species showed no change in numbers – pied stilt, black-backed gull, red-billed gull, white-fronted tern, hedge sparrow, grey warbler, North Island fantail, blackbird, silvereye, goldfinch, and house sparrow.

(c) The following species decreased in numbers – black shag, banded dotterel, black-fronted tern, Caspian tern, skylark, song thrush, chaffinch, and greenfinch.

Table 3. Checklist of birds at Waikanae estuary, 1971-74, covering habitat use, status, and changes in status since 1941-43 survey. KEY: * , new record since 1941-43; +, recorded regularly in habitat; o, recorded occasionally in habitat; Beach spec., beach specimen (usually dead); Br., breeds; Mig., migrant; Occ., occasional; Reg., regular; Res., resident; Vis., visitor. Blanks in status change column indicate insufficient data to assess trend

	Beach	Beach-front dunes	River flats and flats	Sand flats, lagoon	Unfixed dunes	Fixed dunes	Salt-marsh	Grass fields	Lakelets	Status, 1971-74	Beach spec. 1971-74	Changes since 1941-43
1. Yellow-eyed penguin*	+									Beach spec.		Same
2. Blue penguin	+									Occ.		Same
3. N.Z. dabchick*				+						Beach spec.		More
4. Shy mollymawk	+									"		Same
5. Giant petrel	+									"		Same
6. Antarctic fulmar*	+									"		
7. Cape pigeon	+									"		
8. White-headed petrel*	+									"		
9. Mottled petrel*	+									"		
10. Kerguelen petrel*	+									"		
11. Blue petrel*	+									"		
12. Broad-billed prion	+									"		More
13. Lesser broad-billed prion	+									"		More
14. Antarctic prion*	+									"		
15. Narrow-billed prion*	+									"		
16. Fairy prion	+									"		Same
17. Flesh-footed shearwater*	+									"		
18. Buller's shearwater*	+									"		
19. Sooty shearwater	+									"		
20. Short-tailed shearwater*	+									"		More
21. Fluttering shearwater	+									"		
22. Hutton's shearwater*	+									"		
23. Diving petrel	+									"		
24. Australian gannet	+									Occ.		More
25. Black shag	+			+						Reg. Vis.		Many less
26. Pied shag*	+									Occ.		Same
27. Little black shag*	+									Occ.		
28. Little shag										Reg. Vis.		More
29. Spotted shag*	+									Occ.		
30. White-faced heron*		+		+						Reg. Vis.		
31. White heron*										Occ.		Less
32. Reef heron					++		++			Occ.		Less
33. Australian bittern										Occ.		Less
34. Black swan									+	Occ.		Less
35. Paradise duck							+			Occ.		Less
36. Mallard				+			+		+	Res. Br.		More

(continued)

DISCUSSION

Estuaries, the meeting place of fresh and saline waters, provide the biologist with an opportunity to study marine, freshwater, and terrestrial species of plants and animals, and their interactions, within narrow spatial limits. They are particularly susceptible to modification by man, as is shown here for the Waikanae estuary, ornithologically one of the best-studied estuaries in New Zealand.

The interval of 30 years between the 1941–43 and 1971–74 surveys provides a valuable perspective, and the fact that one of us took part in both surveys contributed greatly to the continuity and comparability of observations. While we believe that the planning and methods applied and results achieved in this survey may serve as a model for future investigations into the conservation of other estuaries in New Zealand, we acknowledge that the enduring human resource available to us must be considered exceptional.

The birdlife of the Waikanae estuary has several interesting characteristics. First, we find that the 79 species found there fall ecologically into the following categories: (i) marine birds – 36 species, of which only 5 are residents (Table 3); (ii) migratory birds – 4 species; (iii) shore birds – 11 species; and (iv) land birds – 28 species. Second, we find that the birds present use all 9 main habitats, though to a varying degree: 23 species, all marine, use only one habitat (Table 3); the remaining 56 species use several habitats, up to 8.

The changes in the numbers of various species and of the total bird population between the two surveys are of considerable interest. Table 3 records an apparent increase in 15 species, of which 11 are adequately covered by observations. Another 11 species show no change in numerical status over the 30 years. Finally, eight species have shown a decline in numbers.

The reasons for these changes at the estuary are not clear. The increases in some species can be related to recent overall increases elsewhere in New Zealand; e.g., variable oystercatcher, black-billed gull (*P. C. Bull*, pers. comm.), and the shag species first observed in the second survey. Increases in the numbers of starling, yellow hammer, and white-backed magpie are probably related to changes in dune vegetation and overall local increases in exotic vegetation (see, e.g., Fig. 13 and 14). Kingfisher numbers may have increased because food supply has increased, particularly in tidal channels and lakelets. Pukeko numbers on the south side of the river have probably increased because of habitat increases in the South Marsh, lakelets, and the Oxbow.

Increased disturbance on the beach and beach-front dunes may have disturbed breeding banded

dotterel and resulted in their smaller numbers over recent years at the estuary; but this species appears to have decreased elsewhere. A growing volume of traffic—particularly trail bikes—over the sand flats may be responsible for decline in the numbers of black-fronted tern and Caspian tern, which breed elsewhere. The virtual disappearance of grassland on the dunes may account for the smaller numbers of skylark, and possibly of song thrush, chaffinch, and greenfinch. Disturbance on the fixed dunes, particularly from trail bikes, may have contributed to the decline of these birds.

Sixty-one species were recorded in 1941–43 and 79 in 1971–74. Although new techniques account for 14 of the 18 newly recorded species, 4 of which are considered to be accidental, 7 of them have become common at the estuary. Both the number of species and the numbers of birds of the species which have increased indicate an upward trend in the bird population of the estuary since the first survey.

Summing up our evidence, it appears that during the second survey there were more birds at the estuary than were present 30 years ago. It remains to examine the present situation with a view to the future.

Several factors are likely to have a major influence on the estuary, its vegetation, and its birds. Storms have a temporary effect, but man-induced changes are often longer-lasting and deeply affect the biota. At the Waikanae estuary these changes include replacement of the salt meadow on the north side of the river with a boat marina and a recreational lakelet (Fig. 5 and 6). More important is the re-development of all land to the south and parts of the South Marsh (Fig. 7 and 8). Land has also been cleared beyond the dunes near the Puketewhaino lakelet. However, the greatest threat facing the estuary is housing, which now extends to the southern edge of the sand flats; future housing development may also claim the two central lakelets.

It should be added that a nature reserve embracing the sand flats and a small portion of land surrounding Puketewhaino was under consideration, but no further action appears to have been taken.

How can a flourishing bird population survive the above major changes? First, there is the considerable resilience of the association of bird species found on the Waikanae estuary. Second, it appears that the cuts through the spit to straighten the river and delay the gradual southward movement of the mouth help to create extensive flats and lagoons, all favourable to animal life, though disturbing roosting and nesting sites. However, the present balance is precarious, and further development around the estuary is bound to have a detrimental effect on the extent and diversity of existing habitats.

Wodzicki (1946), on completing the first survey of the Waikanae estuary, noted that “. . . several unwelcome changes cannot pass unnoticed . . . Two main factors have been responsible for these changes – the steady progress of building of new houses and holiday huts close to the estuary and also extensive shooting . . .”. The writer felt then “. . . that even now, if an area of some three or four chains wide, including the two ponds could be taken as a sanctuary . . . one could confidently hope that one more valuable New Zealand patrimony would still be preserved for future generations of New Zealanders . . .”.

While the general condition of the estuary has been gradually deteriorating, the demands of people have been escalating. Never before have so many people come to see and study birds in this area, the best of its kind conveniently close to Wellington. For botanists this place is unique in the Wellington region for study of salt-marsh vegetation and dune and lakelet areas. The estuary is also very popular during whitebait runs. And last but not least, the estuary is greatly valued as a place for passive recreation; each succeeding year brings increasing numbers of people to enjoy its aesthetic values. Our survey shows that perhaps there is still time for those in authority to take a bold step and secure the whole estuary and its surroundings as a reserve, safe for all time.

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