L A K E E L L E S M E R E

A WILDLIFE HABITAT OF INTERNATIONAL IMPORTANCE

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ABSTRACT

Lake Ellesmere is a large, brackish coastal bar-type lagoon on the east coast of the South Island, New Zealand. The lake is approximately 20,000 ha in size, has 58 km of shoreline and its shallow waters fluctuate seasonally to a depth of up to 3.6 m. Lake Ellesmere is by far the largest wetland of its type in New Zealand. It has outstanding national and international values for wildlife. A total of 158 bird species (133 native) has been recorded either using the lake or its peripheral habitat or as stragglers from along the Kaitorete Spit. About 80 species occur as regular users of the lake. Species richness appears to be greater than that so far recorded for any other locality in the country.

The lake is essential to some endemic bird species which have restricted distributions and which could become endangered. The area is essential for native species which are migratory within New Zealand, particularly as a wintering habitat and staging point for migration. The area is of national importance to some species of overseas migratory wader. The lake supports large proportions of the New Zealand populations of about 20 bird species. During 1981-1982 the lake supported 17,000 - 30,000 waterfowl and 6,000 - 14,000 waders during any one count. Over a year cumulative numbers are much higher when considering that many species are transient users of the habitat.

Some of the more notable species using the lake include cattle egret (about 20% of the New Zealand estimated population), white swan (about 25%), black swan (about 10%), Canada goose (about 30%), grey teal (about 20%), N.Z. shoveler (about 75%), banded dotterel (up to 25%), wrybill (at least 10%), golden plover (up to 17%), pectoral sandpiper (up to 33%), sharp-tailed sandpiper (up to 28%), red-necked stint (up to 68%), curlew sandpiper (up to 58%), black stilt (up to 10%), pied stilt (up to 50%), and black-billed gull (up to 20%). Other species such as the introduced mallard use the lake in numbers which probably represent a very high percentage of their total populations. Peak numbers of waders assemble on the lake before dispersing to breed, or congregate at the completion of breeding before their northward and overseas migrations.

This publication provides an extensive review of the information available on all bird species using the lake, including number of sightings, population sizes, habitat, feeding, breeding and distribution on the lake.

The publication also presents descriptive information on the physical features of the lake as they influence the wildlife habitat. Climate, soils, water quality, vegetation and lake level fluctuation regimes are described and an extensive bibliography provided.

The study discusses the relative wildlife values of fifteen study areas around the Lake Ellesmere foreshore for three groups of wetland birds, the waterfowl, waders and swamp birds. All fifteen areas are very important and collectively contribute to the outstanding wildlife values of Lake Ellesmere.

Finally, the publication summarises the reasons for designating Lake Ellesmere as a Wetland of International Importance and discusses appropriate reservation mechanisms. Management considerations and threats to wildlife are summarised. Real or potential threats to wildlife include eutrophication, artificial control of lake levels, foreshore erosion, recreation, proposed irrigation schemes, swamp drainage, farm development, and predators.

INTRODUCTION AND METHODS

1.0 INTRODUCTION

Lake Ellesmere is a large, shallow coastal lagoon on the east coast of the South Island, 20 km south of Christchurch and Banks Peninsula (Fig. 1.). Reference can be found on NZMS 1 Maps S83, S84, S93 and S84. In geological terms the lake is a bar-type lagoon (Irwin 1975) and was once the estuary of the Waimakariri River (Dwyer 1980). The lake is about 20,000 ha (the fifth largest New Zealand lake), has about 58 km of shoreline, moderately indented, and is up to 3.6 m deep. Water levels vary widely with season, and daily fluctuations occur in response to wind direction changes. The brackish lake water is separated from the sea by a shingle barrier, the Kaitorete Spit. Due to the occasional flooding of adjacent farmlands, the lake is opened to the sea by the North Canterbury Catchment Board (NCCB) two or three times a year to lower the water level.

Although the lake is close to Christchurch, very little ornithological study has been done. Stead (1923, 1927, 1932) visited the lake regularly between 1900 and 1929, but it was not until 1973 that Tunnicliffe published a comprehensive bird list for the area. During the early 1970's R. Pierce and D. Geddes visited the lake frequently.

Tunnicliffe (1973a) listed 129 bird species or subspecies including three extinct forms and 26 species of oceanic birds which straggle to the lake or are found along the Kaitorete Spit. This species list exceeded that for any other New Zealand wetland at the time. Tunnicliffe's work brought together for the first time all information which reflected the extremely high value of the lake to wildlife. Lake Ellesmere has long been recognised nationally for its high economic and recreational values for waterfowl hunting, but apart from studies of the introduced black swan, Canada goose and pukeko, little work had been done on other species. While it was known that the lake supported many thousands of waterfowl, waders and swamp bird species, and a high proportion of the New Zealand populations of some species, the relevant specific information had never been collated. Lake Ellesmere was nominated by the New Zealand Wildlife Service in 1976 as one of 11 New Zealand wetlands under consideration as areas of international importance.

At the International Union for Conservation of Nature and Natural Resources (IUCN) Conference in Christchurch in November 1981 the General Assembly approved the following Action Point:

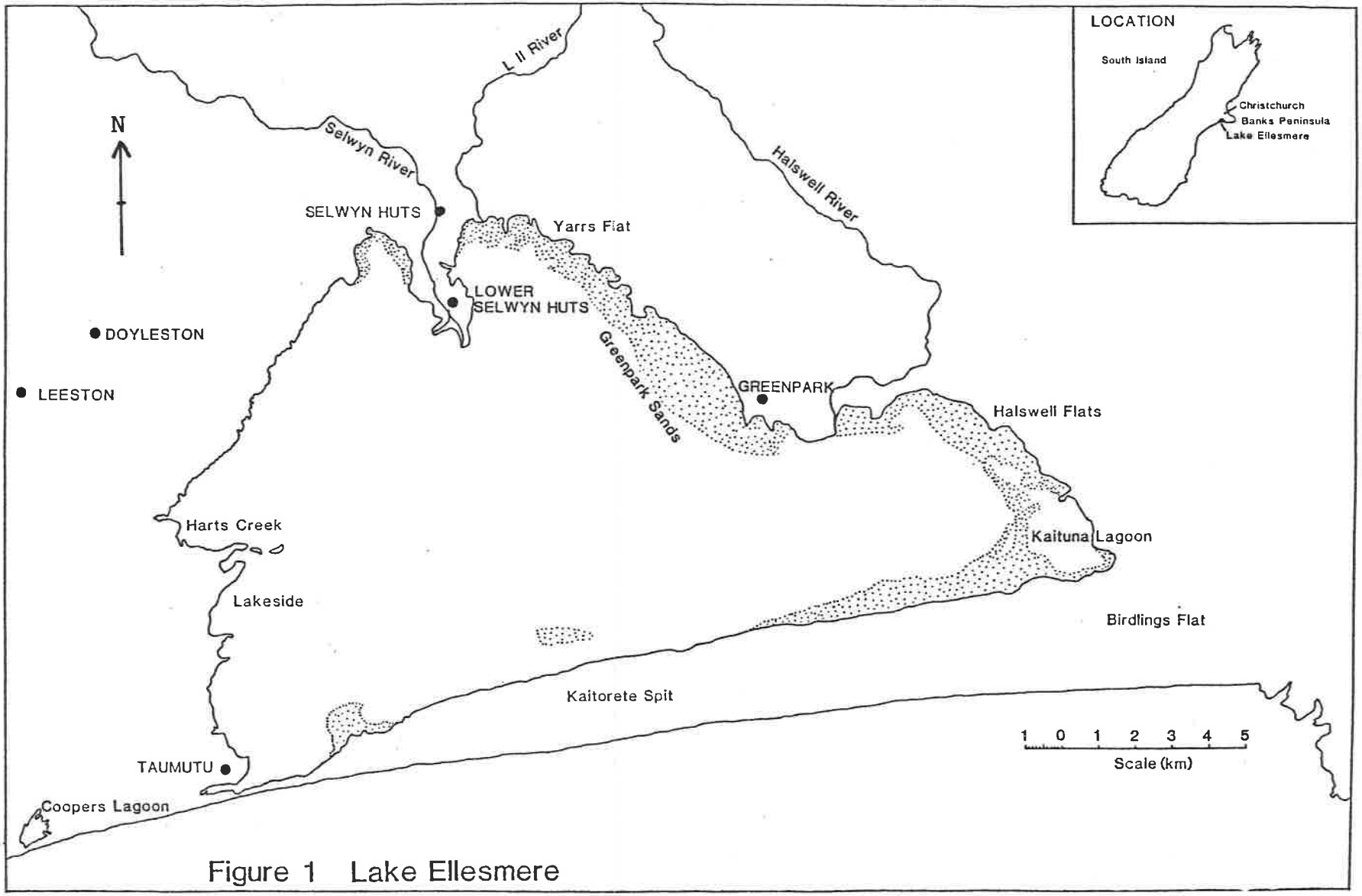


Figure 1 Lake Ellesmere

"Asking the authorities responsible for Lake Ellesmere ...
to maintain its ecological value and to have it listed as
a wetland of international importance".

As a result of the declaration the Wildlife Service began a study in late November 1981 aimed at collecting information on wildlife values of the lake, and after evaluating it, deciding whether the lake met the criteria for international wetland status. The survey was primarily of the bird life. No studies of lizards were undertaken but two common lizards, Hoplodactylus maculatus and Leiolopisma nigriplantare maccani, were seen during the survey. The specific aims of this study were to:-

1. review background information relevant to habitat management;
2. carry out bird counts around the whole lake;
3. determine relative values of different parts of the lake shore for different groups of birds;
4. make a wildlife checklist for the lake;
5. determine the size and significance of populations of different species using the lake;
6. summarise what is known about each species found on the lake;
7. determine how Ellesmere fulfils criteria for International Wetland status;
8. determine how water level fluctuations influence wader and waterfowl populations and the implications of these fluctuations for lake management (this information will be published separately);
9. compile a full bibliography on Lake Ellesmere.

Subsequent to the commencement of the Wildlife Service study the Department of Lands and Survey released a report on an extensive coastal resource investigation of the Lake Ellesmere Area (Palmer 1983). This report acknowledged the immense biological values of the lake and its fulfilment of all criteria for status as an International Wetland. Palmer (loc. cit.) identified certain features which are critical to our assessment of the Ellesmere situation. These included the rarity of the brackish wetland type in New Zealand (Ellesmere being by far the largest); the 81% reduction in area of the Ellesmere wetlands since European colonisation; the high scientific interest in remnants of ancient vegetation and invertebrates; the important fisheries values; the developing polytrophic status of lake waters; and the outstanding wildlife values.

2.0 METHODS

2.1 Review of Information

Literature relevant to the Lake Ellesmere area as a wildlife habitat has been reviewed in this publication and a full bibliography provided (Section 13). A large number of previously unpublished bird counts have been assessed and these provide information on the importance of the lake and specific areas of foreshore for many wetland bird species.

2.2 Field Survey

Extensive bird counts were undertaken by the author between October 1981 and October 1982. On occasions experienced observers from the Wildlife Service and Ornithological Society of N.Z. assisted with counts. The lake foreshore was divided into 15 study areas (Figure 2) and bird counts made in each (Appendix 2). Study area boundaries were arbitrary, based on the location of access points, natural boundaries (e.g., rivers) and natural limits of habitat types. Study areas were visited on an irregular basis although one area, "Yarr's Flat", was counted at least once a week. No counts were undertaken at night. In addition, counts of selected bird species, particularly arctic migratory waders, were undertaken over the whole lake on single days. Two counts of all wetland birds were undertaken. Counts were made using a line of up to three observers stretched across each study area and counting all birds as they walked from one end to the other. Aerial counts of black swan, mute swan and Canada goose are made annually by the Wildlife Service and these figures are presented in the text. Count data were used to derive population estimates of many species using the lake (Section 8). However, these estimates usually refer to the year 1981-1982 and cannot take into account yearly changes in usage patterns which undoubtedly exist.

In the "Yarr's Flat" study area water levels were mapped on the ground at the same time weekly counts were undertaken. Time of day, weather and wind direction were also recorded and the specific water level in metres above mean sea level was taken from the NCCB recording station at Taumutu.

2.3 Wildlife Values of Individual Study Areas

In order to identify sections of foreshore which were most important,

the wildlife values were recorded for each of the 15 study areas for each of three bird groups. These groups, the waders (sub-order Charadrii), waterfowl (family Anatidae) and swamp birds (families Rallidae and Ardeidae) were arbitrarily chosen to illustrate that wildlife values for different groups of birds, and indeed different species, can be quite different. In addition to this generalised rating the occurrence of each wetland species recorded using an area was scored using a three-tier rating of common, occasional and rare. The overall ratings for each study area were based on those used by the Wildlife Service's Fauna Survey Unit for rating whole habitats (see O'Donnell and Moore 1983).

Some areas have higher ratings because they traditionally support rare species or uncommon plant associations. Study areas with highest numbers of more important species or a larger range of species were also rated highly.

Study areas were ranked on a five point scale and the basis for classification was as follows:-

(a) outstanding : area has features which have very high national and international values and stand apart from other study areas on the lake. Very large numbers of all species typical of the lake, especially endemic species;

(b) high : area has values of national importance for native species and very high numbers of introduced species;

(c) moderate-high : all representative species present but lower bird numbers and only one or two very important populations. Rare species present only occasionally;

(d) moderate : typical common species representative of the lake present in low to moderate numbers;

(e) potential : habitat is modified with resultant decrease in bird numbers and richness. With suitable management habitat could be improved.

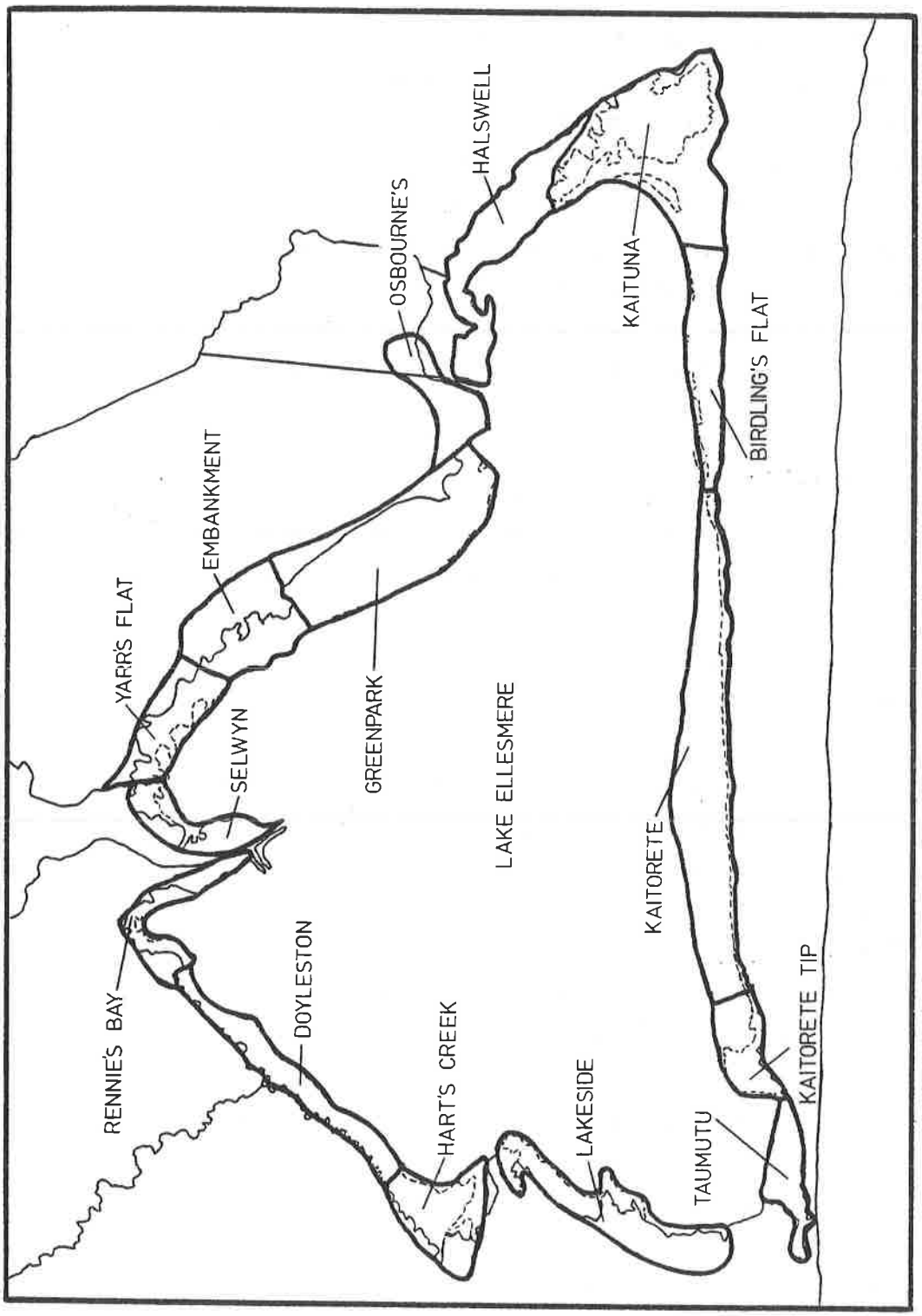


Figure 2: Location of study areas along the Lake Ellesmere foreshore.

THE HABITATS

3.0 HABITAT DESCRIPTION

3.1 Climate

No detailed climatic data for Lake Ellesmere exist although summaries for the general area are given by Hughes et al. (1974) and N.C.C.B. (1983b). Weather records from Lincoln township, c. 10 km from the lake, are probably representative of the area. Rainfall is low (c. 650 mm p.a.), and, on average, evenly distributed throughout the year (Ward et al. 1964), but actual rainfall can be highly variable from season to season. Winters are cool, with some frosts and infrequent snowfalls; and summers are warm. Prevailing winds are from the north-west (warm foehn), north-east (cold onshore) and south-west (storm). Winds influence the lake levels markedly (see 3.6). Temperatures are mild (mean monthly temperatures = 6.1 - 16.7^{o}C) because of the coastal situation. A mean maximum temperature of 22.2^{o}C and mean minimum of 0.5^{o}C were recorded by Evans (1953). Droughts occur frequently in summer and early autumn. Soil moisture is generally exhausted by late December (Burrows 1969a) because of the high evaporation rate and lack of rainfall.

3.2 Geological History

The geological history of the lake environment has been summarised by Burrows (1969a), and Smith (1979) assessed the physical implications of this on soils. Geological history of the area is important because the ages of surface layers and the materials of which they are composed determine the soil types and ultimately the nature of the habitat. Briefly, the geological history may be summarised as:-

(a) c. 15,000 years ago alluvial fans were formed during glacial periods and sea level was c. 30 m lower than today;

(b) c. 10,000 years ago the sea level was over 20 m lower than now but rising. Forest development occurred in the Lake Ellesmere-Christchurch area;

(c) c. 4,000 years ago the sea level was about 3 m above the present level and Ellesmere was a 'bay'. Sand dunes formed near Greenpark and beach ridges formed near the Irwell and Selwyn River mouths, Hart's Creek and Taumutu;

(d) c. 2,000 years ago (late post-glacial period) the sea level was at about the present mean sea level (m.s.l.) and the Kaitorete Spit was formed as the sea level dropped;

(e) c. 1,000 - 500 years ago. Erosion of the western end of the Spit occurred and development of a low outflow area at Taumutu took place.

3.3 Soils

Soils around Lake Ellesmere have been described generally by Ward et al. (1964) and Vucetich (1965) and in detail by Smith (1979), who studied soils from the Selwyn River to Yarr's Flat. Soils are an important influence on vegetation and drainage and, therefore, on wildlife habitat. Lake Ellesmere is almost entirely surrounded by Motukarara saline Gley recent soils (Fig. 3). An area of Gley recent soils extends north-east from the Selwyn Rivermouth towards Christchurch. Along part of the Kaitorete Spit, Taumutu yellow brown sands are present down to the lake shore. On the periphery of the saline Gley soils, extensive areas of older Temuka and Waterton Gley soils extend inland.

Soils around the lake are weakly-developed, with ill-defined topsoils and undeveloped subsoil. Taitapu soils are still poorly-drained today as a result of high groundwater levels in winter. These soils are moderately acid and crack when dry. Saline soils are of considerable botanical interest because they provide a series of graded habitats from salt-free to high salt content. They cannot be used effectively for agriculture until they have been drained and leached of salt.

Gley soils are poorly-drained, waterlogged mineral soils. They are characterised by excess moisture because of the impervious layers impeding percolation. Gley soils often support swamp plant associations and, by implication, the soil map (Fig. 3) indicates the extent of pre-European swamp asociations which once surrounded Lake Ellesmere. The extent of these vegetation types today is very small compared with that of the past (Burrows, 1969a, Tunnicliffe 1973a, Palmer 1983).

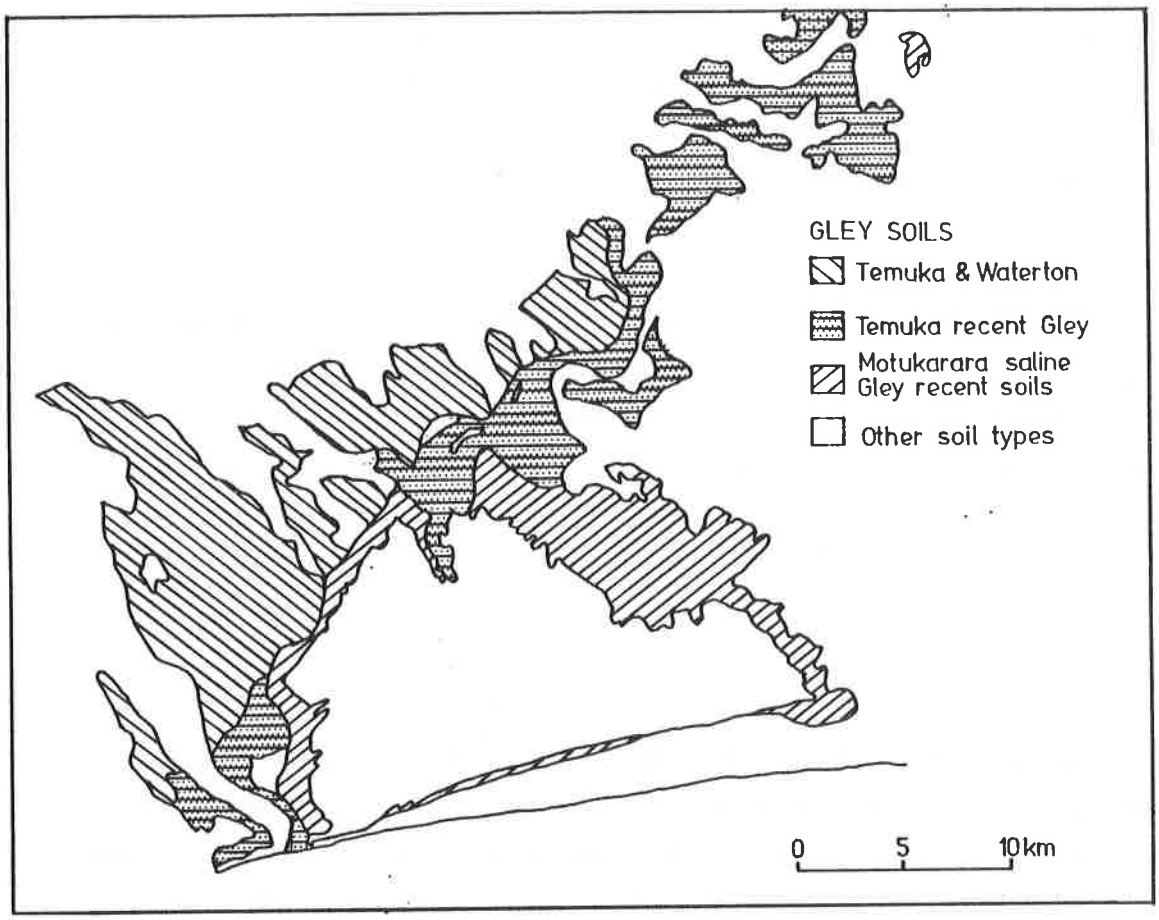


FIGURE 3 : Soil types surrounding Lake Ellesmere. (After Vucetich 1965).

3.4 Water Quality

No full documentation of chemical processes and balances in Lake Ellesmere waters has been published. Hughes et al. (1974) summarised the few chemical analyses of the lake and its inflow waters (Tables 3 and 4 in Hughes et al. 1974), giving values for soluble phosphorus and nitrate. Nutrient values change seasonally and annually and are influenced by the periodic opening of the lake outlet and precipitation. Chemical analyses between 1965 and 1972 found that phosphorus concentrations lie within the range expected in mesotrophic to eutrophic waters (see Vollenweider 1968). Nitrates, however, were in much higher concentrations than even the highly eutrophic Lake Rotorua (c.f. McColl 1972). Control of phosphorus levels was advocated

by Hughes et al. (1974) to prevent the lake becoming more eutrophic. However, by the late 1970's the lake was considered to be polytrophic (Lineham 1980). Stout (1975) summarised more general aspects of coastal lake chemistry. Sodium levels are particularly high in all coastal lakes. Magnesium concentrations are also high in Lake Ellesmere. The pH of coastal lakes is close to neutral, or slightly acid, except when algal blooms occur. Coastal lakes have high levels of total ions because of the oceanic influences of rain, wind-born nutrients, direct sea water seepage and flooding. Lake Ellesmere's ion content is generally high, but very variable because of its large area, shallow depth, large inflows and outflows and occasional opening to the sea. Sulphate, chloride and sodium are all found in high concentrations. Large numbers of waterfowl probably affect nutrient concentrations as would periodic flooding of adjacent fertilised farmlands. Lineham (in prep.) studied water quality at Ellesmere from 1978-1980 and a summary of his work is in N.C.C.B. (1983b).

3.5 Salinity

A major characteristic of Lake Ellesmere is its brackish waters. Salinity varies considerably both seasonally and in different parts of the lake. When the lake is open to the sea salinity is very high. Seawater continually seeps across the Kaitorete Spit and storm waves overtop the spit near Taumutu. Saline groundwater lies very close to the surface throughout the year. During summer droughts, salts are concentrated by evaporation and are drawn to the surface and deposited.

Salinity records have been taken by several workers but measurement has not been standardised for direct comparison. In open water when the lake is closed off to the sea, salinity values vary from 20-30% (Stout 1969a) and the maximum recorded value is 56%. Values of 0.28% in raupo at Hart's Creek, 10% along the exposed western shore, and 13% in saltmeadow at Kaituna Lagoon were recorded by Best (1975). Very low salinities were recorded by Hosking (1965) at the mouths of the Selwyn River and Hart's Creek. In 1932 chloride content dropped from 11,300 mg/1 in January to 5948 mg/1 in August after the lake had been closed to the sea for nine months (Langbein 1932).

3.6 Lake Levels

Lake Ellesmere water levels continually change throughout the year

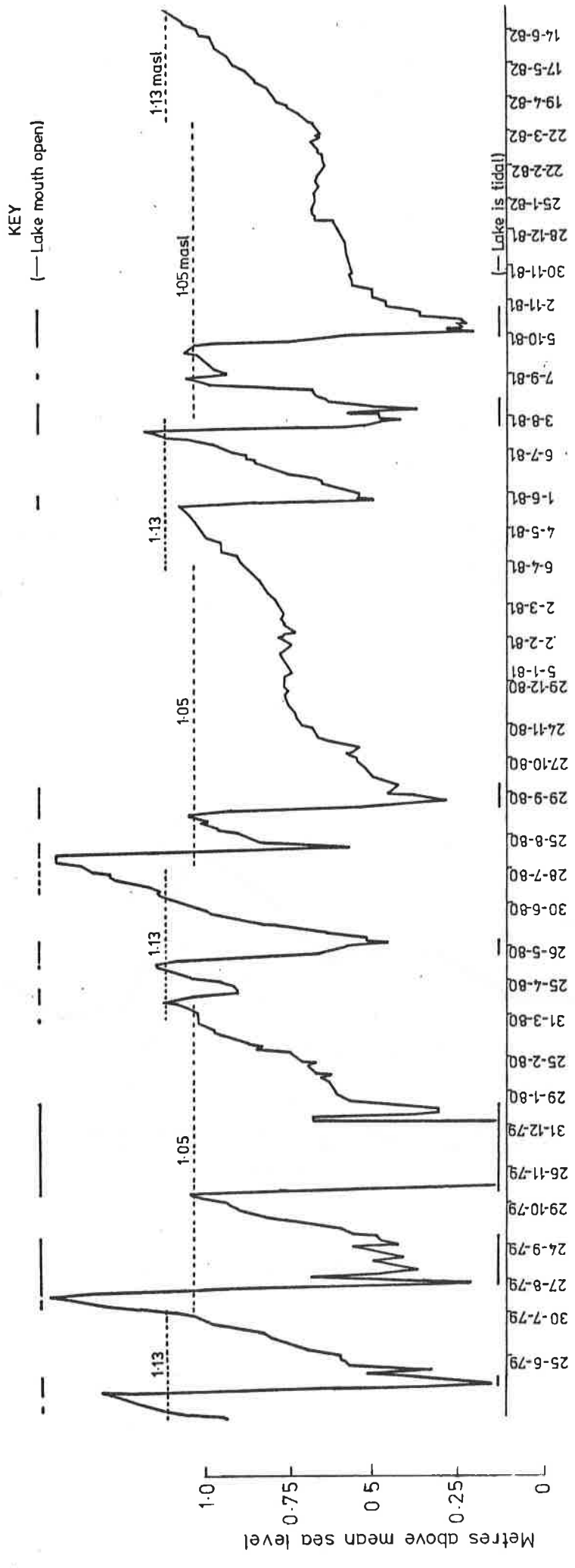


FIGURE 4 : Lake Ellesmere lake levels, 1979-1982
(Calm readings at Taumutu - expressed as metres above m.s.l.)

(Figure 4) because of seasonal changes in rainfall, catchment inputs and evaporation rates; and because of mechanical opening of the lake to the sea. Lake levels are usually very high during winter when all saltmarshes are covered with water. In spring the lake level drops rapidly and continues dropping slowly through the summer (December-January) when evaporation is high and catchment inputs are low. In late summer - early autumn the level slowly rises, covering saltmarshes again (Figs 4 and 5). During winter, water levels can become very high, flooding some pasture adjacent to the lake. The lake is opened to the sea by the Catchment Board when the water level reaches 1.13 m above m.s.l. in autumn-winter (April-July) and 1.05 m in spring-summer (August-March). The lake level drops very suddenly when the outlet is opened (Fig. 4). Local fluctuations in water level occur throughout the year, depending on wind direction, and saltmarshes can be periodically flooded many times. Water level changes result in marked changes in the surface area of the lake, ranging from 15,200 ha at 0.6 m above m.s.l. up to 21,600 ha at 1.2 m above m.s.l. (Dalmer 1980). Within the last 2000 years, and during the periods of Maori occupation, lake levels were higher than at present (Hughes et al. 1974, Dwyer 1980).

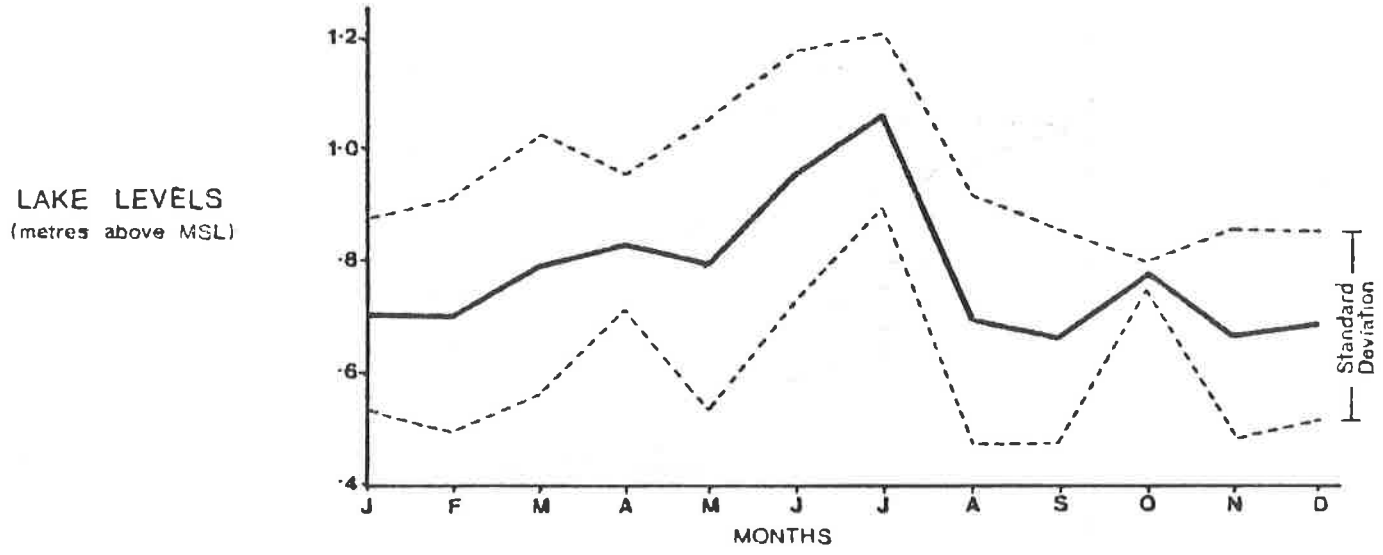


FIGURE 5 : Mean monthly lake levels, 1975-1980 (N.C.C.B)

Because Ellesmere is a shallow lake, changing wind direction from the north-east, north-west and south-west changes dramatically the area of exposed lake bed within hours, and when frequent wind changes occur the effect resembles that of a tidal cycle. Lake levels can be up to 0.6 m higher than

normal at the north end of the lake during periods of southerly winds. North-east winds have a less pronounced effect at the southern end of the lake but storms may raise the level on the western shores by 0.5-0.68 m (Flay 1950, Evans 1953, Dalmer 1980). Between 1953 and 1962, the N.C.C.B. (1962) recorded differences in lake levels in eastern and western sides of the lake ranging from 0.8 to 1.5 m during storms. Because of these conditions the lake is permanently turbid (Marshall 1922, Mason 1946).

3.7 Catchment Inputs

A total of thirty-seven rivers, streams and artifical drains flow into Lake Ellesmere. Major waterways flowing into the lake are the Selwyn, Irwell, LII, and Halswell Rivers and Hart's Creek. All except the Selwyn River originate within 19 km of the lake. The Selwyn is the only river which flows directly from the foothills of the Southern Alps. The average inflow has been calculated to be 9 cumecs, with flood peaks as high as 476 cumecs (Hughes et al. 1974). Monthly mean inflows are given in Table 1. Details of drainage patterns into the lake are best seen in N.C.C.B. (1983b).

3.8 Ground water

With low rainfall, ground-water supply is an important contributor to the lake. Ground-water levels are dependent on actual flow of groundwater from higher levels, lateral seepage from rivers, the water table peak and effect of downward percolation of rainfall (Oborn 1951, Smith 1979). Artesian water sources are within a few metres of the surface everywhere around the lake (N.C.C.B. 1983b). Availability and flow of ground water depends on lake level, inflow drains, soil moisture and amounts of ground water usage (affecting water pressure and amount of flow).

The alternation of fine and coarse layers of sediment gives rise to conditions which favour the occurrence of artesian waters. Saline ground waters are found up to 2 km from the lake edge, their source probably being ancient marine salt deposits.

TABLE 1 : AVERAGE RATE OF INFLOW OF CATCHMENT WATER TO LAKE ELLESMERE, 1947 - 1980. (From Dalmer 1980)

MONTH	MEAN INFLOW FOR MONTH Cumecs	MINIMUM INFLOW AND YEAR	
April	12	5	1966
May	18	5.5	1950
June	20	5.5	1950
July	23	6	1969
August	25	6	1969
September	20	5.5	1949
October	17	5.5	1971
November	11	5	1965
December	10	5	1965
January	11	5	1965
February	11	5	1965
March	11	5	1965

4.0 VEGETATION

4.1 Primeval Vegetation

Lake Ellesmere was once surrounded by extensive freshwater swamplands and some swamp forest (Burrows 1969a, Molloy 1969). Most of this swamp area was developed into farmland after European colonisation, and, because the lake is now held at c. 1 m lower than in pre-European and early European times, much swamp disappeared. The pre-European natural wetland area covered c.30,000 ha when the lake was at 2.7 m above m.s.l. (Palmer 1983) although, as was indicated by the soil map (Fig. 2), wetland soils extended to 4.6 m above m.s.l. and covered over 80,000 ha.

In ancient times the lake was surrounded by a mosaic of forest and swampland in a strip from Christchurch to the LII River (see figure on p.31 of Palmer 1983). Matai (Podocarpus spicatus), red beech (Nothofagus fusca), totara (Podocarpus totara) and kahikatea (Dacrydium dacrydoides) were once dominant (Burrows 1969a), but large fires during Maori times resulted in the extensive modification and reduction of these forests and by the time European settlers arrived almost all the forest was gone and had been replaced by swamp. Flax (Phormium tenax) communities became prominent (Molloy 1969), but on well-drained sites silver tussock (Poa laevis) and fescue tussock (Festuca novaeseelandiae) dominated. Scattered over tussock lands were various trees and shrubs, mainly cabbage tree (Cordyline australis), kowhai (Sophora sp.), matagouri (Discaria taumatou) and manuka (Leptospermum scoparium). Turbott (1969) suggested that these were perhaps the most extensive swamplands in the country.

4.2 Vegetation Today

Today swamps have been almost entirely drained except for some tiny areas scattered around the lake shoreline. Although still New Zealand's fifth largest lake, Ellesmere is much reduced from its original size. Palmer (1983) calculated that at least 81% had been lost or modified during the years of European contact. Most types of freshwater vegetation are almost non-existent. Vegetation maps have been drawn by Burrows (1969a) and vegetation profiles by Evans (1953) and Molloy (1969). A detailed vegetation survey was commenced in 1983 by the North Canterbury Catchment Board (N.C.C.B.). Generalised profiles of foreshore are illustrated in Fig. 6. A summary of drainage works is given by Palmer (1983) and N.C.C.B. (1983b). Main habitat

types are briefly described below:-

4.2.1 Raupo

Raupo (Typha orientalis) monocultures occur as narrow strips around Kaituna Lagoon and the Halswell River but the only extensive raupo beds occur around Hart's Creek, the LII rivermouth and Taumutu Lagoon (Fig. 5). Raupo begins its spring growth about November. Various introduced herbs, and occasionally Carex, are also present in raupo beds.

4.2.2 Rushes, Sedges, Reeds

Rushlands covered predominantly in sea rush (Juncus maritimus) dominate the shore of Lake Ellesmere and surrounding semi-developed farmlands. Juncus pallidus, Juncus gregiflorus and Carex spp. are also scattered throughout. Extensive rushlands inland from Yarr's Flat and around the Halswell River contain scattered patches of rushes, small open areas of developed pasture and numerous small ponds. Reedbeds containing monocultures of Scirpus spp. are scattered around the whole lake but these are limited in area. Three-square (Scirpus americanus) dominates, and main concentrations occur around northern Kaituna Lagoon, Birdling's Flat, Yarr's Flat, LII Rivermouth to Selwyn Rivermouth, and many places along the western shoreline. Jointed rush (Leptocarpus similis), which grows up to 2 m high and generally in shallow water, dominates the western shoreline from Rennie's Bay to Hart's Creek. Scattered throughout the jointed rush, and occasionally in areas of sea rush, is shore ribbonwood (Plagianthus divaricatus) (Fig. 6).

4.2.3 Flax

Although once the dominant swamp type, only two small areas of flax now remain, but individual plants are scattered along much of the western shore of the lake. A narrow strip of tall (2-3 m) flax exists at the tip of the Kaitorete Spit (Fig. 6). An area of flax near Timber Yard Point was recently burnt, but scattered remnants remain. Other small remnants of flax are found between Cooper's Lagoon and the Rakaia rivermouth to the south of Ellesmere and several kilometres up the Selwyn River.

4.2.4 Willow

The most extensive area of willows (Salix spp.) is found at Hart's Creek (Fig. 6). Smaller areas are present near the Irwell Rivermouth and Taumutu.

Two inlet rivers, the Selwyn and LII, are fringed with large overhanging willows for several kilometres upstream. At Hart's Creek dense stands of willows of varying ages contain tall crack willow (S. fragilis) near open water and younger willows further inland. Scattered throughout are areas of open water, blackberry (Rosa fruticosus), gorse (Ulex europeaus), and niggerhead (Carex secta).

4.2.5 Saltmarsh

There are three broad types:-

(a) low level saltmarsh, usually covered by shallow water during winter and frequently inundated during summer. Purple mimulus (Mimulus repens) and Lilaeopsis novaeselandiae are dominant on the mud substrate (Plates 1, 2 and 3). Main areas are along the Greenpark Sands, from the Halswell River to Kaituna Lagoon, and at the tip of the Kaitorete Spit;

(b) mid-level saltmarsh, a mixture of Salicornia australis, Cotula coronopifolia, Triglochin striatum, salt-tolerant pasture and herbfield which is subject to less frequent inundation (Plates 1, 2 and 3). Main areas are along the Greenpark Sands and between the Halswell River and Kaituna Lagoon;

(c) highest level marshes along the Greenpark Sands, with bare, dry mud and scattered Salicornia. At the highest level, and on the edge of developed pasture, salt-tolerant grasses (Hordeum marinum and Agrostis stolonifera) predominate (Plate 4).

4.3 Ecology of Saltmarsh Vegetation

Evans (1950, 1953) studied saltmarsh associations around Lake Ellesmere. Evans found that four main factors influenced vegetation there: flooding, salinity, soil texture and soil type. Zoning of saltmarsh types is distinct and can be attributed directly to these four physical characters. The relationship of salinity, soil type and saltmarsh zonings is summarised in Table 2. Where saltmarsh is present there is little or no natural soil, because materials are continually being eroded from, or deposited on, the surface because of frequent flooding and seasonal soil texture changes (Smith 1979).

The major factor controlling zonation of plant communities is the amount of flooding (Evans 1953). Flooding affects plants of the lower zones

TABLE 2 : SALTMARSH ZONATION

(after Evans 1953, Mason 1975)

A. SILT LOAMS:

	Soil Type	Salinity	Dominant Plant Species
Low level	Fine, silt loam	below level of highest salinity	Mimulus repens, Lilaeopsis novaezelandiae, Spergularia marginata
Mid level	sand and silt loam	highest salinity	Salicornia australis Triglochin striatum var. filifolium
	sandy soils	lower salinity	S. australis, Hordeum marinum
High level	very fine silt loam fine silt loam	low salinity	Plantago coronopus, S. australis, Cotula coronopifolia, Juncus maritimus, Selliera radicans, Puccinellia stricta,

B. CLAY LOAMS:

Low level	silty clay loam	moderate salinity	mud or some Mimulus and Lilaeopsis
		higher salinity	Scirpus pungens and associates
High level		higher salinity	S. caldwellii

directly and upper zones indirectly through the influence of salinity and other soil properties. Three-square, purple mimulus, Salicornia, Triglochin and sea rush increase the rate of silt deposition. With time, the build-up of the substrate may reduce the frequency of flooding of some zones. Flooding affects organic matter content and water-holding capacity and, therefore, plant productivity. The frequency and extent of flooding are most critical to zonation. Flooding controls lower zones by numbers of imersions and upper zones by duration of immersion (Evans 1953).

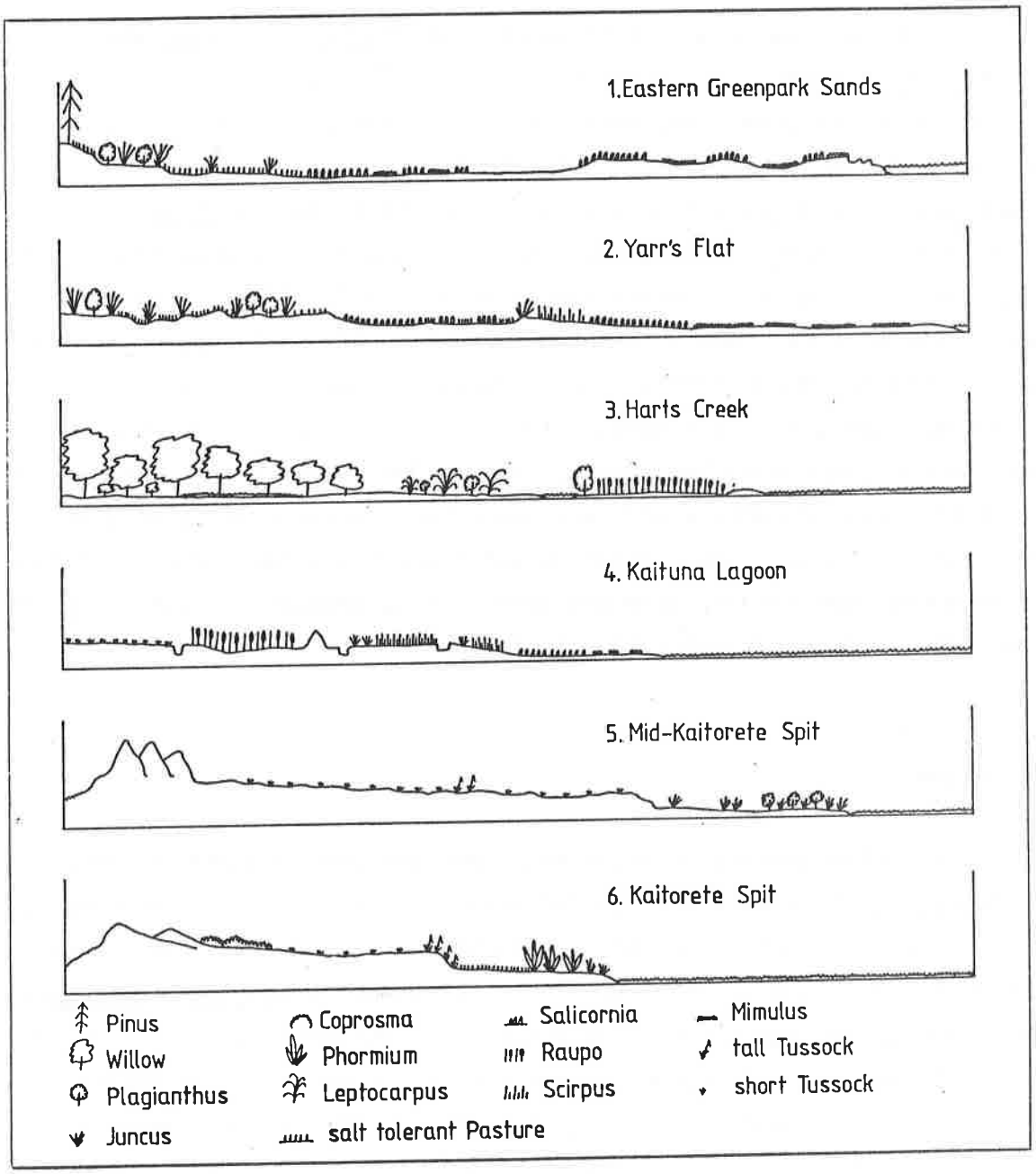


FIGURE 6 : Generalised profiles of foreshore study areas.
(Scale : 1 km profiles across base)

Sea rush and jointed rush swamps (Plate 5 and 6) exist where flooding is infrequent and salinity not at its highest (Mason 1975). Generally, in fine, more saline soils, where flooding is more frequent or long continuing, the green leafy sedge Scirpus caldwelli dominates. In permanent water, where salinity is low, Scirpus lacustris, a two metres high sedge, dominates. Three-square grows immediately below the sea jointed rush level.

4.4 Submerged Vegetation

The dominant submerged plant species are Ruppia megacarpa and Potamogeton pectinatus. Distribution of submerged vegetation is dependent on the nature of the substrate, water depth, turbidity and wave action. Grazing by black swan was an important factor in the past. Weed beds have disappeared periodically from the lake since 1904 (Hughes et al. 1974). Since 1968 they have disappeared, representing a major change from the 1960 situation (see Figure 1 - Miers and Williams 1969). Disappearance of weed beds in the past has been attributed to rotting of plants during anaerobic lake conditions (Mason 1951). The products of anaerobic decay not only kill the basesof the plants but prevent recolonisation. All weed beds were destroyed during the Wahine Storm in April 1968 and to this day they have not re-established. A decline of black swans has occurred,partly as a result (see Section 6.22). Regeneration of water weeds may have been inhibited by increased eutrophication, wind and wave action, removal of silt in which weeds grow, and use of herbicides in the catchment.

4.5 Algae

Thirty-nine species of algae have been recorded at Lake Ellesmere (Hughes et al. 1974). Algae are important colonisers of bare mud exposed when lake levels drop in summer. Composition of the algal flora is also a sensitive indication of water quality. For example, Nodularia spumigena is a toxic blue-green alga which is conspicuous in eutrophic waters. This species fixes nitrogen and may produce toxins potent enough to poison stock that drink the infected water (Hughes et al. 1974). Blooms of this alga have occurred during summer when there was little inflowing water. Algal growth is generally limited by lake turbidity (Stout 1969a).

4.6 Coastal Habitat (Plate 7)

The Kaitorete Spit is a shingle barrier separating the lake from the sea. The vegetation types on the Spit form a sequence which complements the value of the lake proper. Figure 6 presents a typical profile beginning with a narrow stony foreshore, Juncus - Plagianthus associations higher on the foreshore and herbfield (Rauolia dominant) above that level. The seaward shore is made up of shingle which merges into tall sand dunes higher up the shore. Dunes are dominated by marram grass and the endemic Desmoschoenus spiralis which is listed in the New Zealand Red Data Book as an endangered species (Williams and Given 1981). Locally important vegetation associations include the very extensive Scirpus reedbeds and saltmarshes at the base of the Spit (Birdling's Flat), small remnants of flax swamp at the tip of the Kaitorete Spit and native shrub associations at the base of the Spit.

4.7 Invertebrates

Most bird species occurring on Ellesmere are insectivorous and occur in habitats not directly defined by vegetation. Invertebrate surveys around the lake are limited but a list of important aquatic invertebrates is given in Hughes et al. 1974. The most numerous aquatic species include midges (Chironomus zelandicus) and a small Ephydra fly which are found swarming on the edges of ponds and on the water surface film; an hemipteran sp. found in the same areas as Ephydra; an amphipod, Paracalliope fluviatilis which is found in the water column and mud substrates; and two ostracod spp. found among aquatic vegetation and in the water column.

4.8 Fish

As with invertebrates, fish form a major food source for carnivorous birds and as such determine habitat use. Major fish species present on the lake include eels (Anguilla australis and A. dieffenbachii), flounders (Rhombosolea forsteri), whitebait (Galaxias maculatus), smelt (Retropinna retropinna) and sprat (Maugeclupea antipodum) (Stokell 1966, Ryan 1974, Hughes et al. 1974, Todd 1977, 1978, 1979, 1980).

PLATE 1 : Up to 6000 ha of saturated Mimulus and Salicornia-dominant saltmarshes are exposed when the lake levels drop in spring. Many small ponds with shallow, standing water are formed before the marshes dry out in mid-summer.

(Embankment Road - October 1983)

PLATE 2 : Discrete, somewhat larger, ponds form when surrounded by salt-tolerant pasture at a slightly higher topographical level.

(Embankment Road - October 1983)

PLATE 3 : An indented shoreline provides wildlife habitat with a diversity of water depths and degrees of saturation of marshes. This Lagoon area was one of the last to dry out during summer 1981-1982 and supported over 90% of the waders of the lake for several months.

PLATE 4 : Higher up the shoreline freshwater springs create shallow ponds which are surrounded by salt-tolerant pasture (Hordeum and Agrostis) and Salicornia. Banks Peninsula is in the background.

(Yarr's Flat - October 1983)

PLATE 5 : On some parts of the lake shore clumps of rushes (Juncus maritimus here) provide cover for wildlife, particularly breeding waterfowl.

(Yarr's Flat - October 1983)

PLATE 6 : Higher up the shore some denser stands of rushes and Plagianthus provide shelter for more secretive species such as marsh crake, and small ponds between these stands provide quiet, waterfowl-feeding areas.

(Yarr's Flat - October 1983)

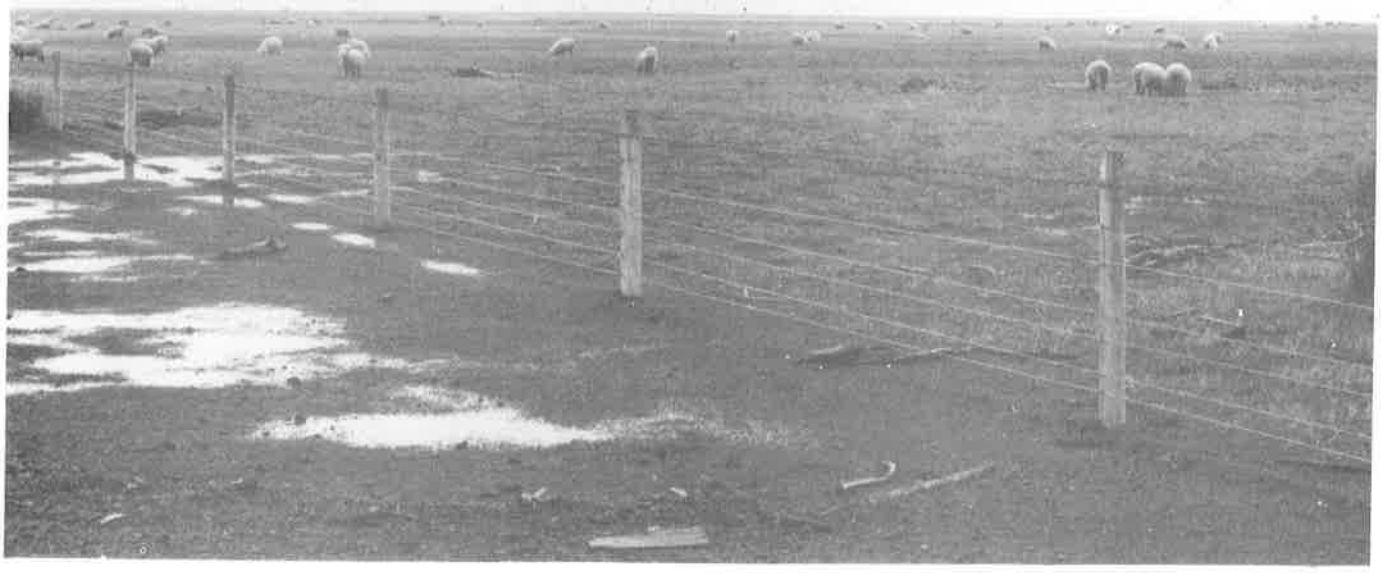
PLATE 7 : When the lake reaches a high level a cut (centre photo) is made in the Kaitorete shingle barrier for the lake to drain out to sea.

The entrance to Taumutu Lagoon is in the foreground.

(Taumutu - October 1983)

PLATE 8 : Higher level salt-tolerant pastures are grazed by sheep. For much of the year these areas are saturated with or covered in water. These higher areas are important for bird breeding and roosting.

(Yarr's Flat - October 1983)



THE WILDLIFE

5.0 INTRODUCTION TO THE BIRDLIFE

5.1 Wildlife Values

During the nationwide survey of 'Sites of Special Wildlife Interest' or 'Habitats of Note', conducted by the Fauna Survey Unit of the New Zealand Wildlife Service, Lake Ellesmere was rated as being of OUTSTANDING value to wildlife. This is the highest value on a five tier rating system applied to wildlife habitats throughout the country.

The criteria for the OUTSTANDING rating are:-

(a) presence of a breeding population of a highly endangered or rare endemic species;

(b) presence of a population of an endemic species of a very restricted distribution and which could become endangered;

(c) areas essential to species from (a) and (b) for purposes other than breeding;

(d) areas of vital importance to internationally uncommon species (breeding and/or migratory);

(e) areas of vital importance to internally migratory species with very limited distribution or abundance;

(f) largely unmodified ecosystem or example of original habitat type not represented elsewhere in the country, of large size and containing viable population of all, or almost all, species which are typical of the ecosystem or habitat type.

The following sections will illustrate the OUTSTANDING values of the Lake Ellesmere ecosystem in detail. Criterion (f) exemplifies the most important feature, as Lake Ellesmere is the only large, coastal, brackish lagoon habitat found in New Zealand. The closest comparable areas seem to be Washdyke Lagoon (c. 10 ha) and Wainono Lagoon (c. 300 ha) in South Canterbury, although strictly these are classified as estuarine environments (McLay et al. 1975). Both these areas are important wildlife habitats with up to 90 bird species recorded (Sagar 1976, Pierce 1980).

Most of the other coastal wetlands important to wildlife are tidal, estuarine systems with extensive areas of mudflat, mangrove forest and marsh. Most of these areas are situated in the north of the North Island. Ellesmere supports a wildlife community which is different in diversity and composition.

Other of the OUTSTANDING criteria are also important, with Ellesmere providing important habitat for endangered, endemic and/or migratory species such as black stilts, wrybills, banded dotterels, pied stilts, New Zealand shovelers and a large number of others. In addition to fulfilling criteria for the OUTSTANDING rating, the lake supports significant proportions of the New Zealand populations of at least 20 bird species, either all year round or in some seasons (see Section 8.0).

A total of 158 species has been recorded from the area (Table 3) - far more than for any other wetland in New Zealand). Tunnicliffe's (1973a) checklist of birds recorded 129 species and subspecies from the lake. Over the last 10 years a further 29 species have been recorded from limited ornithological surveys. Thus, about 55% of New Zealand's 305 species of birds have been recorded on or around the lake.

The checklist can be divided into 15 groups of birds:-

(a)	waterfowl	12 species
(b)	herons/spoonbills/ibis	10 species
(c)	shags	5 species
(d)	indigenous waders	10 species
(e)	migratory waders	30 species
(f)	gulls/terns/skuas	13 species
(g)	penguins, oceanic birds	31 species
(h)	quail/pheasants	3 species
(i)	terrestrial birds (indigenous)	10 species
(j)	terrestrial birds (exotic or stragglers)	18 species
(k)	raptors	2 species
(l)	rails	3 species
(m)	locally extinct birds	8 species
(n)	pelican	1 species
(o)	grebe	1 species

Altogether 116 species use the lake proper and its marginal vegetation and, of these, approximately 80 species are regular users of the lake (i.e., recorded at least once a year). The remainder are rare stragglers, oceanic species and birds which were once present but now appear not to occur. The species list is continually growing as further stragglers are found. The true status of many species will not be known fully until several years of monitoring bird populations has been completed.

Most species using the lake and its environs are dependent on the peripheral vegetation, saltmarsh, mudflats and shallow edge water of the lake margins. The quality of these areas as wildlife habitat is, however, dependent on the water level regimes of the whole lake. Species such as shags and swans are much more dependent on open water habitats than are other species. Foreshore areas are used the most and act as an interface between the natural habitat and developed marginal areas. As a result the wildlife communities in these areas can be sensitive to subtle habitat modifications and are vulnerable to disturbance and change in that zone.

Overall the key to the outstanding wildlife values of Ellesmere is the diversity of habitat types created by variations in vegetation, salinity and water level regimes and the very large size of the lake.

Table 3 lists all the species recorded for the lake, their status and the habitat types occupied. Section 6 provides technical detail on each species.

5.2 Historical Changes in Bird Numbers

There have been significant changes in the composition of the avifauna of Lake Ellesmere over the last 100 years. Some species have become locally extinct, some have been reduced greatly in numbers and new species have arrived. For most species there is little or no historical information on status, but the following section gives an indication of some of the most significant changes.

Extinction or significant decline in numbers of many species has been attributed to shooting, disease, introduced predators and habitat disappearance. A variety of species such as the banded rail, buff weka and fernbird were common throughout Canterbury in the nineteenth century (Potts 1873, Stead 1927, Turbott 1969, Tunnicliffe 1973a). With the disappearance of extensive areas of swampland, brown teal and banded rails had almost gone by 1927 and marsh crakes and pukekos had declined and had become extremely rare in some areas. The weka was abundant until it disappeared suddenly in 1917; disease was thought to be a major factor contributing to its disappearance (Stead 1927). New Zealand scaup had also almost disappeared by 1927 and this was thought to be related to increased eutrophication of lake waters. Today the only resident scaup in lowland Canterbury are small

TABLE 3 : LIST OF BIRDS RECORDED FROM LAKE ELLESMERE
THEIR HABITAT AND STATUS

KEY:

1. STATUS

1. extinct
2. locally extinct
3. regular migrant
4. resident
5. straggler

2. USE OF HABITAT

C. Common
U. Uncommon
O. Occasional
R. Rare

			USE OF HABITAT[2]						
	Breed (B)/ Moult (M)	Status[1]	Saltmarsh/ mudflat	Freshwater swamp	Lake water	Adjacent farmland	Adjacent trees and scrub	Coastal waters	Shingle/ dune beach
Pachyornis elephantopus		1							
Zelornis haasti		1							
yellow-eyed penguin	M	5						O	O
white-flippered penguin	M	4						C	C
southern blue penguin	M	5						U	U
rockhopper penguin	M	5							R
erect-crested penguin	M	5							R
southern crested grebe		5			O				
N.Z. dabchick		2			R				
wandering albatross		5						O	
black-browed mollymawk		5						O	
grey-headed mollymawk		5						O	
Buller's mollymawk		5						O	
white-capped mollymawk		5						O	
Salvin's mollymawk		5						R	
light-mantled sooty albatross		5						R	
northern giant petrel		5						O	
southern giant petrel		5						O	
cape pigeon		5						O	
grey-faced petrel		5						R	
mottled petrel		5						R	
broad-billed prion		5	R					R	
lesser broad-billed prion		5						R	
Antarctic prion		5						O	
fairy prion		5			R			O	
grey petrel		5						R	
white-chinned petrel		5						R	
flesh-footed shearwater		5						O	
Buller's shearwater		5						O	
sooty shearwater		5						O	
short-tailed shearwater		5						O	
fluttering shearwater		5						O	
Hutton's shearwater		5						O	
northern diving petrel		5						R	O
Australasian gannet		5			R			O	C
Australian pelican		5						R	U

TABLE 3 : continued

			USE OF HABITAT[2]						
	Breed (B) / Moult (M)	Status[1]	Saltmarsh/ mudflat	Freshwater swamp	Lake water	Adjacent farmland	Adjacent trees and scrub	Coastal waters	Shingle/ dune beach
black shag	B	4	O	O	C		C	O	O
pied shag		5			R				
little black shag		5						R	R
little shag	B	4	O	O	C		C	R	
spotted shag		4			R			C	C
white-faced heron	B	4	C	C	O	C	C		R
white heron		3	O	O	O				
little egret		5			R				
reef heron		5							R
nankeen night heron					R				R
cattle egret		3		U	U	U	U		
Australasian bittern	B	4	U	U	U	R	U		
glossy ibis		3		R	R				
Australian white ibis		5		R	R				
royal spoonbill		3	U		U				
mute swan	B	4	U	C	C				
black swan	B,M	4	C	C	C	O			
Cygnus sumnerensis		1							
Canada goose	B,M	4	C	C	C	C			
feral goose	B	4		U					
paradise shelduck		4	U	U	U				
chestnut-breasted shelduck		5	R						
mallard	B,M	4	C	C	C	C			
grey duck	B,M	4	C	C	C	C			
grey teal	B	4	C	U	C				
brown teal		2							
N.Z. shoveler	B	4	C	C	C				
Australian white-eyed duck		5			R				
N.Z. scaup		5			R				
harrier	B	4	C	C	C	C	C		
N.Z. falcon		5		R?			R?		
Californian quail	B	4				U	U		
grey partridge		4					R		
pheasant	B	4				U	U		
buff weka		2							
banded rail		2							
spotless crake		4		R					
marsh crake	B?	4	R	C					
pukeko	B	4	C	C		C			
Australian coot		5			R				
S.I. pied oystercatcher		3	U	U	U				
variable oystercatcher		5	R						
spur-winged plover	B	4	C	C		C			
eastern golden plover		3	C		U	U			
banded dotterel	B	4	C		C	R			O

TABLE 3 : continued

			USE OF HABITAT[2]						
	Breed (B)/ Moult (M)	Status[1]	Saltmarsh/ mudflat	Freshwater swamp	Lake water	Adjacent farmland	Adjacent trees and scrub	Coastal waters	Shingle/ dune beach
black-fronted dotterel	B?	3	O						
red-capped dotterel		3	R						
N.Z. dotterel		5	R						
large sand dotterel		5	R						
Mongolian dotterel		5	R						
wrybill		3	C		C				
far-eastern curlew		5	R		R				
Asiatic whimbrel		5	R		R				
little whimbrel		3	O						
eastern bar-tailed godwit		3	O		R				
Hudsonian godwit		5	R		R				
Asiatic black-tailed godwit		5	R		R				
greenshank		5	R		R				
lesser yellowlegs		5	R		R				
marsh sandpiper		5	R		R	R			
Siberian tattler		5	R						
terek sandpiper		5	R						
turnstone		3	O						
Japanese snipe		5	R						
lesser knot		3	O						
pectoral sandpiper		3	U	U	U	U			
sharp-tailed sandpiper		3	U	R					
curlew sandpiper		3	C	R		U			
white-rumped sandpiper		5	R						
red-necked stint		3	C	R	U	R			
sanderling		5	R		R				
broad-billed sandpiper		5	R						
ruff		5	R						
pied stilt	B	4	C	C	C	C			
black stilt		3	U		U				
banded stilt		5			R				
Australian avocet		5			R				
grey phalarope		5	R						
red-necked phalarope		5	R						
Wilson's phalarope		5	R						
southern great skua		5	R					R	R
Antarctic skua		5			R			R	R
Arctic skua		3						U	U
Pomarine skua		3						U	U
southern black-backed gull	B	4	C	U	C	C		C	C
red-billed gull	B	4	U		U			C	C
black-billed gull		3	C	U	C			C	C
white-winged black tern		5			R				
Caspian tern	B	4	C		C			C	C
black-fronted tern		3	U		U			C	C
fairy tern		5			R				

TABLE 3 : continued

			USE OF HABITAT[2]						
	Breed (B) / Moult (M)	Status[1]	Saltmarsh/ mudflat	Freshwater swamp	Lake water	Adjacent farmland	Adjacent trees and scrub	Coastal waters	Shingle/ dune beach
little tern		5	R		R				
white-fronted tern	B	4			U			C	C
N.Z. pigeon		3					R		
rock pigeon	B	4	C			C			
sulphur crested cockatoo									
shining cuckoo	B?	3					U		
long-tailed cuckoo		5					R		
little owl	B	4				C	C		
N.Z. Kingfisher	B	4		C		C	C		
skylark	B	4	C			C	C		
welcome swallow	B	4	C	C	C	C	C		
N.Z. pipit		3	U			U			C
black-faced cuckoo-shrike		5					R		
hedge sparrow	B	4	R	C		C	C		
S.I. fernbird		2							
grey warbler	B	4		C		C	C		
S.I. fantail	B	4	O	O	O	O	O		
song thrush	B	4	R	O		C	C		
blackbird	B	4	R	O		C	C		
silvereye	B	4		O		C	C		
bellbird		5					R		
yellowhammer	B	4	C	C		C	C		O
cirl bunting	B?	4?				R	R		
chaffinch	B	4	R	R		C	C		
greenfinch	B	4	C	C		C	C		
goldfinch	B	4	C	C		C	C		
redpoll	B	4	C	C		C	C		O
house sparrow	B	4				C	C		
starling	B	4	C	C		C	C		
rook		5	R	C		R	R		
white-backed magpie	B	4				C	C		

populations on Woodend Lagoon and at the Ashley river-mouth north of Christchurch. In 1898 fernbirds were fairly plentiful in Canterbury but had become extinct by 1927. Several other species are likely to have occurred in swamps and mudflats around Ellesmere, as they were in other parts of Canterbury, but became extinct before 1900 (e.g. little bittern, New Zealand quail and New Zealand dotterel) (Potts 1873, Stead 1927, 1931, Turbott 1969, Tunnicliffe 1973a).

Among species which have declined greatly are godwit, knot, grey duck and probably South Island pied oystercatcher. Disappearance of grey ducks has been attributed to drainage, reduction in plant cover and areas of secluded water, and competition and hybridisation with the mallard (Balham and Miers 1959, Turbott 1969). Godwits and knots were once present in their hundreds, and some people say in thousands. Stidolph (1954) mentions Ellesmere as one of the major haunts of godwit in New Zealand. Shooting was probably a major factor contributing to the decline as was attested by diaries kept by the local Acclimatisation Society (Stidolph 1954). More recently the black swans and white swans have declined greatly, mainly because of the loss of weed beds (Sections 6.22 and 6.23). The black-billed gull was once found in large colonies around the lake (Stead 1932) but has disappeared as a breeding species. It is, however, still found in flocks of 2,000-5,000 during winter.

There have also been new arrivals in New Zealand which have reached Ellesmere and are now common. These include spur-winged plover, which was first recorded at the lake in 1965 and became established as a common breeder after 1969 (Tunnicliffe 1973a). Today it is sometimes seen in flocks of over 300 birds. The welcome swallow was first recorded in 1964 when Turbott (1965) recorded it breeding for the first time in the South Island. Increases were documented in subsequent years (Tunnicliffe 1968, 1973a, Hughes 1973) and today the species is common around the whole lake. The cattle egret was first recorded at Ellesmere in 1964, the second record for New Zealand (Turbott 1964), and today Ellesmere supports the second largest population in the country (Heather 1978, 1982).

A variety of species appears to have slowly increased over the past 80 years. The pied stilt increased between 1900 and 1930. Stead (1932) recorded that Ellesmere had become the principal "home" of stilts in Canterbury, with one flock of 2,000-3,000 recorded. The little shag, which is now very common, was recorded only once by Stead (1927) over the previous 30 years. Although apparently occurring, Stead (1927) never recorded a pied

shag on the lake in 35 years. Several sightings since 1980 correspond with a general southwards movement of pied shags in Canterbury so that they are now frequently seen at the Ashley, Waimakariri, and Avon-Heathcote estuaries and on the Banks Peninsula coastline (pers. obs.). Black shags increased greatly on Lake Ellesmere between 1907-1927 after bounty payments made by the NCAS ceased (Stead 1932).

The impact of introduced predators (hedgehogs Erinaceus europaeus, ferrets Mustela furo, weasels M. nivalis, stoats M. erminea, cats Felis catus and rats Rattus spp.) on bird numbers around the lake has not been studied. Fitzgerald (1964) found that common food items of stoats on the Kaitorete Spit were banded dotterel and skylark. They also caught pukeko, pied stilt, house sparrow, greenfinch, redpoll, yellowhammer, goldfinch and starling. Tunnicliffe (1973a) recorded stoats taking pukeko eggs and hedgehogs taking skylark eggs, and Lamb (1964) recorded Rattus sp. taking duck eggs. Of the avian predators, black-backed gulls take black swan eggs (Miers and Williams 1969) and eggs and chicks of pukeko and mallard (Tunnicliffe 1973a). Pukeko take mallard and pied stilt eggs (Tunnicliffe 1973a) and harrier take waterfowl young (pers. obs.) and eggs (Carroll 1968).

5.3 Seasonal Changes in Bird Numbers

Most species are seasonal users of Lake Ellesmere. Some species use the lake in largest numbers as transient migrants (e.g., wrybill); others spend only the winter on the lake (e.g., white heron); and a third group use the lake during the summer months (e.g., Northern Hemisphere migrants). A large number of species uses the lake all year round but exhibits marked seasonal changes in usage (e.g., banded dotterel). Pre- or post-breeding birds congregate on the lake before dispersing to breed or after the completion of breeding and before migrating to the north of the North Island and Australia. Details of seasonal changes can be found in Section 6. Figure 7 illustrates the seasonal occurrence of 18 wetland species on the lake.

5.4 Oceanic Birds

A large number of oceanic species occur along the coast adjacent to the Kaitorete Spit. Many of these species come ashore to roost (spotted shags), moult (penguins) or breed (white-fronted tern) on the spit (Table 3). Skuas are frequently seen following terns which feed close inshore or on the

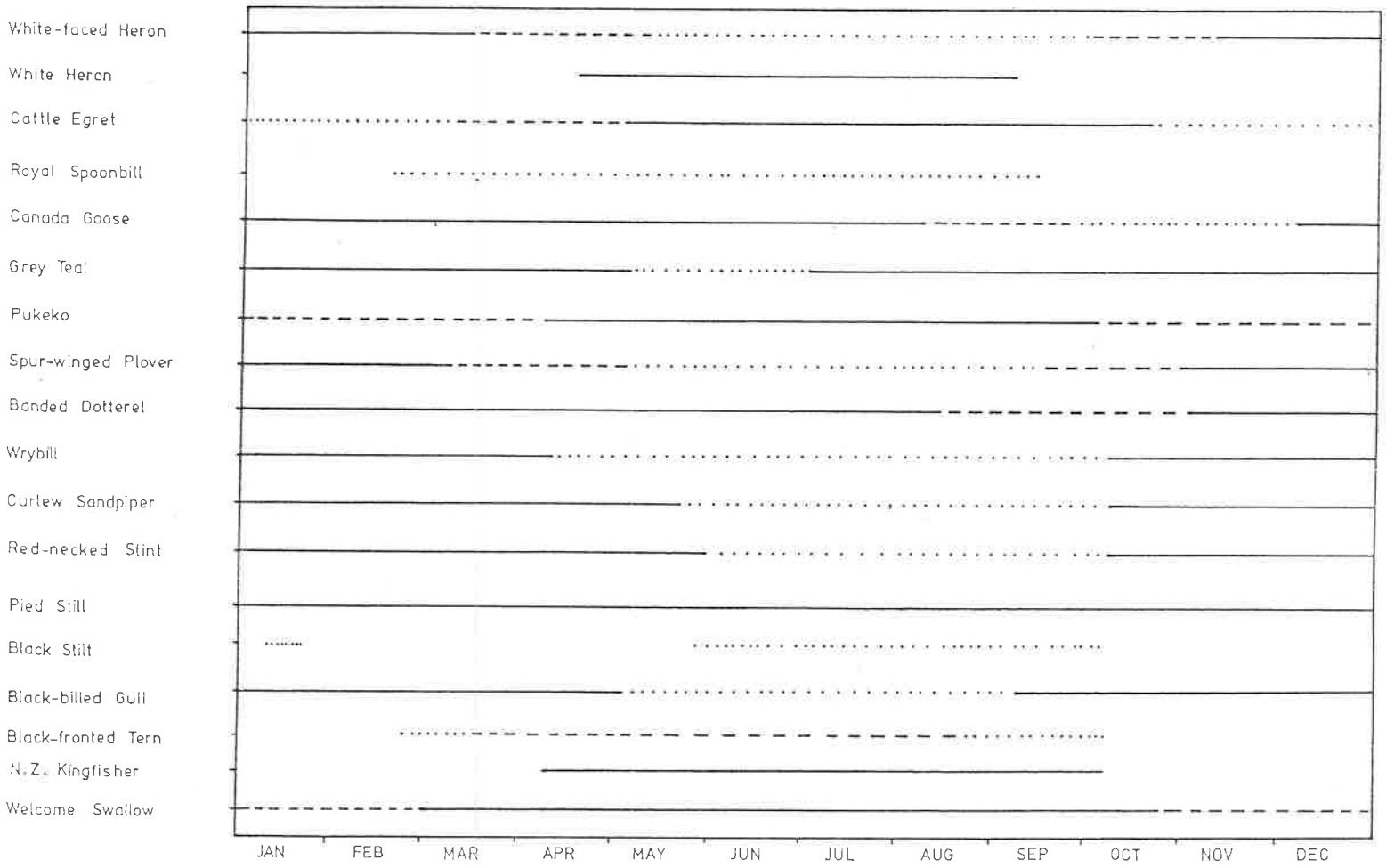


FIGURE 7 : Seasonal occurrence of some bird species at Lake Ellesmere.

Key
| | absent
|.....| rare or very low numbers
|_____| occasional, low-to-moderate numbers
|_____| always present, usually high numbers

southern edge of the lake and roost on the spit, particularly at Birdling's Flat and Taumutu. These birds move onto the lake at times and sometimes feed there. Black-backed gulls sometimes nest in large colonies amongst the sand dunes along the seaward side of the spit. Some of the strictly oceanic species (albatrosses, petrels, shearwaters and prions) have been recorded flying over the lake and these species are largely stragglers to the Ellesmere area.

5.5 Waders

Of the 53 species of wader (Charadrii) recorded in New Zealand (Kinsky 1970, 1980), 39 have been recorded at Lake Ellesmere (Table 3). For this discussion they have been divided into two groups: the overseas migratory waders, all of which come from the Northern Hemisphere for their winter; and those indigenous to New Zealand.

(a) Overseas migratory waders:

Most overseas migratory waders spending their winter (our summer) in New Zealand occur mainly on intertidal mudflats in harbours and estuaries (Veitch 1977). A major exception is the extensive saltmarsh flats surrounding Lake Ellesmere. Approximately 160,000 arctic waders visit New Zealand from September to March/April. The two common species, bar-tailed godwit and knot, make up over 95% of total numbers. The remainder consist mostly of turnstones and golden plovers (Veitch 1977). Unlike most large estuarine habitats, the lake does not now provide extensive habitat for bar-tailed godwits and knots (see Section 5.2). Lake Ellesmere is most important as a regular wintering habitat for the smaller, and rarer, migratory waders which reach New Zealand. While numbers of these species are never high by international standards, they often represent a large proportion of the national population and are a reflection of the diverse ecological value of the area.

Lake Ellesmere was the site of the first records of various species of migrant waders in this country, including little whimbrel (1900), Hudsonian godwit (1902), red-necked stint (1902), curlew sandpiper (1903), pectoral sandpiper (1903), sanderling (1917) and red-necked phalarope (1929) (Stead 1923, Oliver 1955). It is now evident, that the lake is the most important habitat in the country for curlew sandpipers and red-necked stints. From data in the OSNZ Recording Scheme I estimate that the 190-220 red-necked stints and 60-70 curlew sandpipers which reach Lake Ellesmere each year could

represent up to 60-70% of those seen annually in New Zealand (Appendix 5). Sharp-tailed sandpiper numbers represent up to 28%, pectoral sandpiper up to 33% and golden plover up to 17% of annual sightings in New Zealand (Appendix 5). However, in some cases only a fraction of those occurring each year may be sighted. Many red-necked stints occur also on harbours in the north of the North Island, at Farewell Spit and on Southland lagoons (Sibson 1968, OSNZ Recording Scheme), but numbers are much lower than at Lake Ellesmere. Stint numbers on northern harbours increased between 1941 and 1968 but the highest count was only 26 birds (Sibson 1968). Over the last 10 years, stint numbers have varied considerably but no flock has exceeded 35 birds (Karaka in Manukau Harbour in 1980). Numbers recorded on Farewell Spit have rarely exceeded 10 birds but 38 were present in 1968 and 27 in mid-May 1980 (Heather et al. 1981). On Southland lagoons up to 30-40 stints have been recorded, with a maximum of 53 in 1980 (OSNZ Recording Scheme). Numbers of curlew sandpipers reaching New Zealand are also small. Most sites where they regularly occur record fewer than 10 birds annually, even on the northern harbours and Southland lagoons. In recent years flocks of about 20 birds have been seen on the Firth of Thames. Notable exceptions include 40 birds at Paua (1978), 53 in the Firth of Thames (1978) and 42 in Southland (1980).

Migrant waders begin arriving at the lake in mid-August. Over the last three years, red-necked stints have been the first to arrive (5% of the maximum by 30 August), followed by godwits and curlew sandpipers in the first week of September. Many of these birds arrive in full breeding plumage. Most birds have arrived by late October, although some species are first noticed in December or January. The largest flocks of the common waders are seen at this time, because single birds and small flocks have grouped together. Almost all waders have left by the end of April, although a few stints and sandpipers over-winter.

Wader numbers are highest on the extensive saltmarshes along the Greenpark Sands (especially at the north-western end) and at the southern tip of the Kaitorete Spit (Sections 6.0 and 7.0).

(b) Indigenous Waders:

Many thousands of banded dotterels (up to 3000 at one time) and pied stilts (up to 10,000 at one time) and some hundreds of wrybills over-winter or pass through the lake on migration. A few individual black stilts occur in autumn and early spring. Highest numbers of dotterels and wrybills are present in autumn and largest numbers of stilts in spring and autumn.

Appearance of flocks of wrybills (up to 400 at one time) coincide with occurrence of floods on adjacent breeding grounds (braided rivers). Breeding populations on the lake are comparatively small with c.250 pairs of banded dotterels and c.100 pairs of stilts.

Unlike in many estuarine habitats around the country, only small numbers of South Island pied oystercatchers are usually at the lake, although when water levels are abnormally low, flocks can arrive suddenly, probably from the Avon-Heathcote Estuary, near Christchurch. Oystercatcher numbers are highest in early spring and also in late autumn as birds migrate to and from inland breeding areas.

5.6 Waterfowl

Of New Zealand's 18 waterfowl species, 13 have been recorded on the lake (Table 3). Lake Ellesmere is best known as a major habitat for waterfowl, especially New Zealand shoveler, mallard, black swan and Canada goose. It also has the largest of the few mute white swan breeding populations in New Zealand and is a major site for grey teal. No attempt has been made to estimate total numbers of waterfowl using the lake annually, although Williams (1980a) recorded that numbers of ducks using the lake annually would be measured in hundreds of thousands, rather than tens of thousands, of birds.

Black swan numbers have been declining for about fifteen years but still exceed 5,000 birds. The Canada goose population is also very large, with over 6,000 birds over-wintering on the lake. Since 1980 very high numbers of grey teal have been recorded on the lake. Mills (1976) estimated that the total grey teal population in New Zealand was about 20,000 birds, only a minor proportion of which was using the lake. During 1981-82 Ellesmere supported up to 25% of this estimated New Zealand population.

Waterfowl numbers fluctuate seasonally, with numbers following a pattern similar to that reported for Puke Puke Lagoon by Caithness and Pengelly (1973). Pre-breeding populations of each species peak in July or August and lowest numbers occur from late August to October when most birds are away from the lake breeding. Influxes occur again from October to December as unemployed drakes and some young of the year arrive on the lake. The total post-breeding population has arrived by February-March (Williams 1980a). Numbers drop off markedly in May (the duck-shooting season). Large numbers

spend the daylight hours at sea and fly onto the lake at night to feed (Williams 1969). The primary use of the lake is as a loafing and feeding ground with only black swan breeding in large numbers.

5.7 Swamp Birds

Lake Ellesmere is a particularly valuable habitat for four swamp bird species; marsh crake, spotless crake, pukeko and Australasian bittern. Banded rail and fernbird were once widespread in swamps of Canterbury but do not now occur. Both crake species (particularly the marsh crake) and the bittern are considered to be much less common than formerly (Ogle and Cheyne 1981, Robertson et al. 1983, O'Donnell 1983), with their decline being attributed to habitat destruction. Fauna Survey Unit and OSNZ surveys over recent years have indicated that spotless crake numbers are much higher in the North Island than the South Island, while marsh crakes seem to replace spotless crakes in the south. Bitterns are still common in a few localities in the North Island but their status is uncertain in the south.

Lake Ellesmere is possibly of national importance for marsh crakes and of "regional" (South Island) importance for spotless crakes and bitterns. The status of marsh crakes is uncertain because of the secretive nature of the species. Very few marsh crake records have been published over the last 50 years (Robertson et al. 1983) but a large proportion of these have come from Lake Ellesmere. However, recent unpublished surveys indicate that these crake are locally common in Canterbury and the MacKenzie Basin. Despite massive reductions in emergent freshwater swamp vegetation around the lake, crakes appear to be common wherever suitable habitat exists.

Pukekos are common, well dispersed and they breed at Lake Ellesmere. During winter, flocks of several hundred birds gather at various locations around the lake.

5.8 Other Species

Lake Ellesmere is very important for a wide variety of other wetland birds, supporting high numbers of gulls, terns, shags, herons and egrets. Welcome swallows, kingfishers and harriers, species often associated with wetlands, are also present in large numbers.

The black-billed gull is the most numerous gull species using the lake, with up to 5,000 birds being present after the breeding season. Red-billed gulls feed on the lake irregularly and black-backed gulls nest in colonies around the whole lake. Caspian and white-fronted terns are resident and at least 10 pairs of Caspian terns nest annually. Black-fronted and little terns visit the lake in autumn and winter and little terns occur in summer.

Usually over 500 little shags and 100 black shags are present, mostly along the western shoreline of the lake. Spotted shags visit occasionally and pied shags rarely. White-faced herons are the most common heron. They are distributed around the whole lake and pairs breed in macrocarpas and willows along the foreshore. From mid-summer onwards flocks of up to 60 birds congregate along the lake-edge. White herons and cattle egrets spend the winter at Ellesmere and the cattle egret population is the second largest in New Zealand.

6.0 THE BIRDS OF LAKE ELLESMERE AND THE KAITORETE SPIT

The following section details records of species which have been recorded from the lake area, their habitats and distribution on the lake and the significance of their populations. The full list of species recorded from the area is given in Table 3 and details of sightings are given in Appendices 1 and 2. Oceanic stragglers are not dealt with unless they have been seen using the lake.

SPENISCIDAE (penguins)

6.1 Yellow-eyed penguin (Megadyptes antipodes)

An endemic species found along the southern coast of the South Island and on southern offshore islands. The northern breeding limit of the species is Banks Peninsula (Harrow 1971) where a small population is spread over several bays. In the Ellesmere study area, fledgling and moulting birds occasionally come ashore on Birdling's Flat and the Kaitorete Spit.

6.2 White-flippered penguin (Eudyptula minor albosignata)

An endemic subspecies which only breeds on the Canterbury coast (centred on Banks Peninsula). Breeding occurs close to Birdling's Flat on coastal cliffs, and moulting and loafing birds come ashore on the Kaitorete Spit.

6.3 Erect-crested penguin (Eudyptes sclateri)

Breeds on the Antipodes, Bounty and Campbell Islands but a few pairs breed on the Otago Peninsula (Oliver 1955). Four specimens from Ellesmere are in the Canterbury Museum (Tunnicliffe 1973a). There have been two additional records of moulting birds ashore on the Kaitorete Spit in 1974 and 1976, and one beach-wrecked specimen in April 1984 (OSNZ).

PODICIPEDIDAE (grebes)

6.4 Southern crested grebe (Podiceps cristatus australis)

Records: two specimens in the Canterbury Museum are from close to Lake

Ellesmere; one from Leeston 28.8.1922 and one from Upper Riccarton 21.4.1929. Two grebes were seen on several occasions in October 1966 at the western end of lake (Westerskov 1971). A juvenile drowned in a fishing net in June 1973 (GAT)[1]. One adult was present from 26.6.1982 to 14.7.1982 (COD).

Population: a native subspecies restricted to the South Island where the population is less than 300 birds (O'Donnell 1980, Sagar 1981). The grebe is an uncommon straggler to Lake Ellesmere but it may occur more frequently than records suggest. Crested grebes probably nested on the lake in former times (Westerskov 1971). Stead (1927) indicated that the crested grebe was at one time common in Canterbury and by inference (by his statement "though gone from Lake Ellesmere..."), was possibly on Lake Ellesmere. Grebes have been seen mainly on the western side of the lake (Table 4) in open lake water, both close to, or far off the shore. These grebes appear to prefer more freshwater sites, for example, near the Selwyn and L II Rivermouths. Crested grebes dive for fish, invertebrates and waterweeds (O'Donnell 1982a), although no feeding data is available for Ellesmere.

6.5 New Zealand dabchick (Podiceps rufopectus)

An endemic species which is now confined to the North Island. Thought to have been widespread throughout the South Island in the late 1800s but is now absent. One specimen in Canterbury Museum is from Lake Ellesmere (Tunnicliffe 1973a). There are no recent records from the lake.

PROCELLARIIDAE (Fulmars, petrels, shearwaters etc)

6.6. Prion (Pachyptila sp.)

Oceanic and coastal species which are known to breed on islets along the southern side of Banks Peninsula. Beach-wrecked specimens are frequently found on the Kaitorete Spit and an unidentified prion was seen on the lake on 16.12.1972 (RP).

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[1]Initialled source of record. For names see Acknowledgements section.

TABLE 4 : OCCURRENCE OF WETLAND BIRDS IN FORESHORE STUDY AREAS.

Key: C = Common; O = Occasional; R = Rare

SPECIES	STUDY AREA														
	Yarr's Flat	Embankment	Greenpark	Osbourne's	Halswell	Kaituna	Birdling's	Kaitorete	Kaitorete Tip	Taumutu	Lakeside	Hart's Creek	Doyleston	Rennies	Selwyn
Southern crested grebe	R	R											R		R
black shag	C	O	O	R	C	C	O	O	R	C	O	C	C	C	C
pied shag	R				R	R				R					
little shag	C	O	O	O	O	C	R		R	C	C	C	C	C	C
spotted shag			R			R	R			C					R
white-faced heron	C	C	C	O	C	C	C	R	R	O	C	C	C	C	O
white heron	O	R	R			R				R	O	O	R	R	O
little egret						R									
cattle egret										R	C	C	C	O	R
Australasian bittern	R		R	O		R	R			O	R	C	O	R	O
glossy ibis			R							R	O				R
royal spoonbill	O		R		O	O					R	O		R	R
mute swan	C	O	O	O	R	C	R	R	R	C	O	C	O	O	C
black swan	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Canada goose	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
feral goose												C			
paradise shelduck	O	C	O			C	O		R	R	R	C		O	O
chestnut-breasted shelduck	R														R
mallard	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
grey duck	O	O	O	R	C	C	C	R	R	R	R	C	C	O	O
grey teal	C	C	C	R	C	C	O	R	R		R	O	O		C
N.Z. shoveler	C	C	C	R	C	C	C	R	R	R	R	C	O	O	C
spotless crake						R	R								
marsh crake	R			R	R	C	R		R	O	O	C	O	R	C
pukeko	O			C		C	C			O	C	C	C	C	C
S.I. pied oystercatcher	O	O	O			R			R	O		R		R	R
variable oystercatcher		R													
spur-winged plover	C	C	C	C	C	C	C	O	O	O	C	O	C	O	C
eastern golden plover	O	O	O	R		R			R						R
banded dotterel	C	C	C	C	C	O	C	O	C	O	O	R	R	O	C
black-fronted dotterel	R														
red-capped dotterel	R	R													
N.Z. dotterel			R												
large sand dotterel									R						
Mongolian dotterel	R								R						
wrybill	C	C	O	R				R	C		R	R			O
little whimbrel	R	R	R		R										
bar-tailed godwit	C	O	O	R	O	R	R		R	O	R	R	R	R	O
Hudsonian godwit	R	R	R		R				R						R
Asiatic black-tailed godwit	R				R										R
greenshank		R				R			R	R					
lesser yellowlegs															R
marsh sandpiper	R	R	R												
Siberian tattler			R		R										
terek sandpiper	R		R												

TABLE 4 : continued

SPECIES	STUDY AREA														
	Yarr's Flat	Embankment	Greenpark	Osbourne's	Halswell	Kaituna	Birdling's	Kaitorete	Kaitorete Tip	Taumutu	Lakeside	Hart's Creek	Doyleston	Rennies	Selwyn
turnstone	R	O	O			R		R	O	R		R		R	R
lesser knot	O	O	O			R			O						R
pectoral sandpiper	O	O	O						O						R
sharp-tailed sandpiper	O	O	O			R			O						O
curlew sandpiper	C	C	C			R	R		C		R				R
white-rumped sandpiper	R	R													
red-necked stint	C	C	C			R	R		O	R	R				O
sanderling	R	R	R						R						
broad-billed sandpiper			R												
ruff		R							R						R
pied stilt	C	C	C	C	C	C	C	R	R	C	O	C	C	C	C
black stilt	R	R	R		R	R									R
Wilson's phalarope		R							R						
southern black-backed gull	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
black-billed gull	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
red-billed gull	R	R	R			O		O	O	C	O	R		R	R
white-winged black tern						R				R					R
Caspian tern	C	C	O	O	O	C	R	C	C	O	O	O	R	O	O
black-fronted tern	O	O	R	R		O		O	R	O				R	R
little tern	R	R							R						R
white-fronted tern						O			R	C	O	O	R		R

PELECANIDAE (pelicans)

6.7 Australian pelican (Pelecanus conspicillatus conspicillatus)

Native of Australia and recorded in New Zealand a few times only (Kinsky 1970, 1980). One was seen at Birdling's Flat 16.2.1978 (Sagar 1978).

PHALACROCORACIDAE (shags)

6.8 Black shag (Phalacrocorax carbo novaehollandiae)

Records: numerous (see Appendices), resident and breeding.

Population: the black shag is found throughout New Zealand in coastal and inland habitats. It is the second most numerous shag using Ellesmere. Counts in 1981-1982 indicated that 100-150 birds were present all year.

Around the lake black shags had a wider distribution than the more numerous little shag. They occurred in all study areas (Table 4) and also far out on the lake and were most numerous in the Hart's Creek, Taumutu and Kaituna study areas.

Two breeding colonies are present in the Ellesmere area. One colony is located on cliffs at Birdling's Flat and the second colony is on the Selwyn River in willows alongside an ox-bow lake, about 2 km from the lake. Between 10 and 20 pairs nested at this colony during summer 1981-1982.

6.9 Pied shag (Phalacrocorax varius varius)

Records: two specimens in the Canterbury Museum (pre 1900); one 19.2.1974 (OSNZ); one 20.1.1980, one 31.10.1981 (COD); one 27.12.1981 (KH).

Population: a native, coastal species with a widespread but discontinuous distribution around New Zealand. The shag is uncommon in North Canterbury and absent from South Canterbury. Until recently there were only two

confirmed records from the lake. Stead (1932) stated that "according to Potts and Buller, it used to be found on Lake Ellesmere ... though I have neither seen or heard of one in the past 35 years". Tunnicliffe (1973a) also never saw this species during his study at the lake. Three recent records suggest that today the pied shag may occur more frequently.

6.10 Little shag (Phalacrocorax melanoleucos brevirostris)

Records: numerous (see Appendices), resident and breeding.

Population: a common shag found throughout New Zealand. The little shag is the most numerous shag using Lake Ellesmere and counts in 1981-1982 indicated that the population was between 400 and 500 birds. Numbers have apparently increased markedly over the past 50 years as Stead (1932) stated, "it is common on Lake Forsythe, though on Lake Ellesmere, only two miles away, I have only seen one of these shags in 30 years". Birds have been recorded from most study areas (Table 4) but are common only from the L II rivermouth to Hart's Creek. This corresponds with the occurrence of freshwater rather than brackish water habitat on the western side of the lake. At times birds feed far out onto the lake.

A breeding colony is present in willows, 2 km up the Selwyn River. In 1979 approximately 300 shags resided at the colony and approximately 80 nests were built (pers. obs.). In 1981-1982 c. 250 birds resided and at least 40 nests were present.

6.11 Spotted shag (Stictocarbo punctatus punctatus)

Records: four 22.19.1968 (Tunnicliffe 1973a); two 21.4.1968 (OSNZ); four 19.12.1971 (DG); 12 on 2.2.1970, present 31.12.1973 (OSNZ); 100+ 1.1.1977 (DG); two 18.11.1981, one 24.12.1981 (COD).

Population: a common pelagic shag found around much of the New Zealand coastline. Many thousands of spotted shag breed on adjacent parts of Banks Peninsula and large numbers regularly feed offshore of the Kaitorete Spit. Use of Lake Ellesmere is irregular and generally only by few birds at a time. However, large numbers use the lake during and after severe storms (Tunnicliffe 1973a) and also when the outlet is open to the sea when birds feed on fish leaving the lake. Birds are found mainly in the Taumutu study

area but also occur in other areas (Table 4).

These shags usually feed in open lake waters, but have also been recorded 1 km up the Selwyn River.

ARDEIDAE (herons, egrets, bitterns)

6.12 White-faced heron (Ardea novaehollandiae novaehollandiae)

Records: numerous (see Appendices), resident and breeding.
Population: this species became established in New Zealand in the late 1950's (Carroll 1970) and is now common throughout the country. Many of the New Zealand records between 1900 and 1949 were from Ellesmere. This heron was widespread around the lake after 1955 and breeding colonies and flocks of 10 or more birds were recorded after 1960 (Carrol 1970). Today the heron is numerous around Lake Ellesmere and up to 500 birds were present in 1981-1982. They were present in all study areas but most numerous along the western side of the lake. For example, in January 1981, 87 were seen at Doyleston and 96 at Yarr's Flat. Some seasonal movements appear to occur, with herons dispersing from the lake to adjacent farmland areas in spring for breeding and returning to form large flocks from November to January.

White-faced herons use a variety of habitats including lake edge, ponds on saltmarsh, inflowing drains and small streams, and damp farmland. They are commonest in sheltered areas with a freshwater influence.

They feed on fish, invertebrates and amphibians, frequently feeding in drains on the western lake shore and taking soil invertebrates on farmland. They breed all around the lake, particularly in willow, pines and macrocarpa on adjacent farmland. Some travel large distances from breeding sites to the lake to feed.

6.13 White heron (Egretta alba modesta)

Records: numerous (see Appendices 1 and 2).

Population: native subspecies. A small population of c. 100 birds occurs in New Zealand (Heather 1978), and the only breeding occurs at Okarito on the West Coast. During autumn and winter birds disperse all over the country. White herons occur annually at Lake Ellesmere where they have been found around most of the lake (Table 4). Stead (1932) implied that numbers using the lake had declined markedly, but that the area remained the most important wintering ground in Canterbury. Numbers over-wintering are variable from year to year, generally with 1-10 present (up to 10% of the New Zealand population). Andrew (1963) recorded an influx in 1957-58 with 12 birds on 23.4.1957 (Selwyn Rivermouth), 34 in late June 1957 (Kaituna), nine on 23.9.1957 (Rennie's Bay), nine on 23.9.1957 (Kaituna), 23 on 1.12.1957 (Rennie's Bay) and 28 in October 1958 (Rennie's Bay). They usually feed in shallow waters along the lake shore but also in inflowing drains and on adjacent farmland when flooded.

6.14 Little egret (Egretta garzetta immaculata)

A lone little egret was recorded at Kaituna in winter 1976 (J. Adam) and one was seen on adjacent Lake Forsythe on 30.6.1985 (COD).

6.15 Reef heron (Egretta sacra sacra)

Reef herons are present in low numbers on Banks Peninsula. There is one record from the Kaitorete Spit on 9.6.1977 (COD).

6.16 Nankeen night heron (Nycticorax caledonicus)

The one specimen in the Canterbury Museum is from Ellesmere (Tunnicliffe) 1973a).

6.17 Cattle egret (Bulbulcus ibis coromandus)

Records: numerous (see Appendices 1 and 2).

Population: a semi-cosmopolitan species first recorded in New Zealand in 1963 (Turbott et al. 1963). The second record was from Lake Ellesmere in 1964 (Turbott 1964), where a single bird was observed with three white-faced herons feeding in a pond adjacent to the lake shore. Cattle egrets have occurred each winter since 1974 and numbers increased steadily until 1981, when 94 birds were recorded (Figure 8). The Ellesmere population is the

second largest in New Zealand (after the Waikato population, Heather 1978, 1982). Since 1980 numbers have been considerably smaller, a trend which has been observed in other parts of the country. Occurrence at Ellesmere is seasonal. These egrets breed in Australia and arrive in April or early May and depart from mid-October to November. Some birds remain for the summer, e.g. eight or nine in 1977-1978, two in 1981-1982 and 15 in 1984-1985.

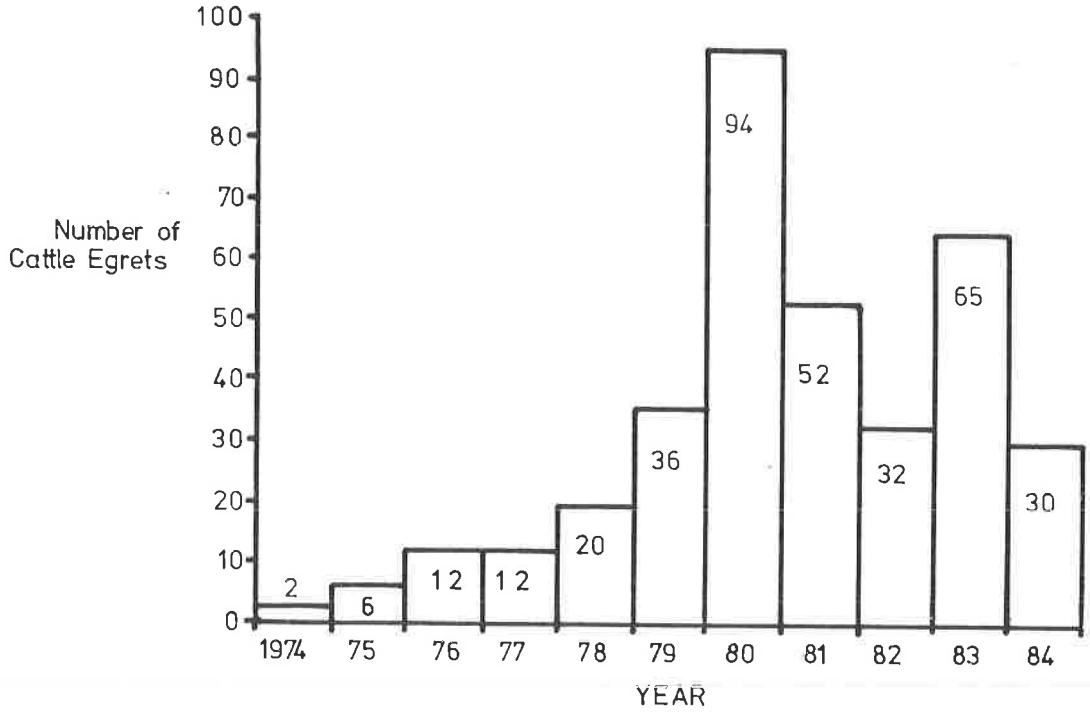


Figure 8 : Numbers of Cattle Egrets reaching L. Ellesmere each winter. 1974-1984.

The main cattle egret concentration occurs over an area of 6-8 farms (Heather 1978) in the Lakeside and Taumutu study areas. Birds occur irregularly at other areas on the western side of the lake. Of the 12 birds resident in 1976-1977, up to four would leave and spend a few days with herds of cattle up to 12 km away (Heather 1978). During winter 1980, 60-70 egrets would frequently move to the Hart's Creek and Doyleston study areas (pers. obs.) and smaller flocks would fly up to 5 km inland and as far north as the Selwyn study area. Flock composition changed frequently, with individuals moving to and from the concentration. Two birds remaining for the summer of 1981-1982 spent most of their time in the Lakeside study area, but they also visited Hart's Creek and Rennie's Bay. Birds were seen on the eastern side of the lake for the first time in 1983 (near Tai Tapu).

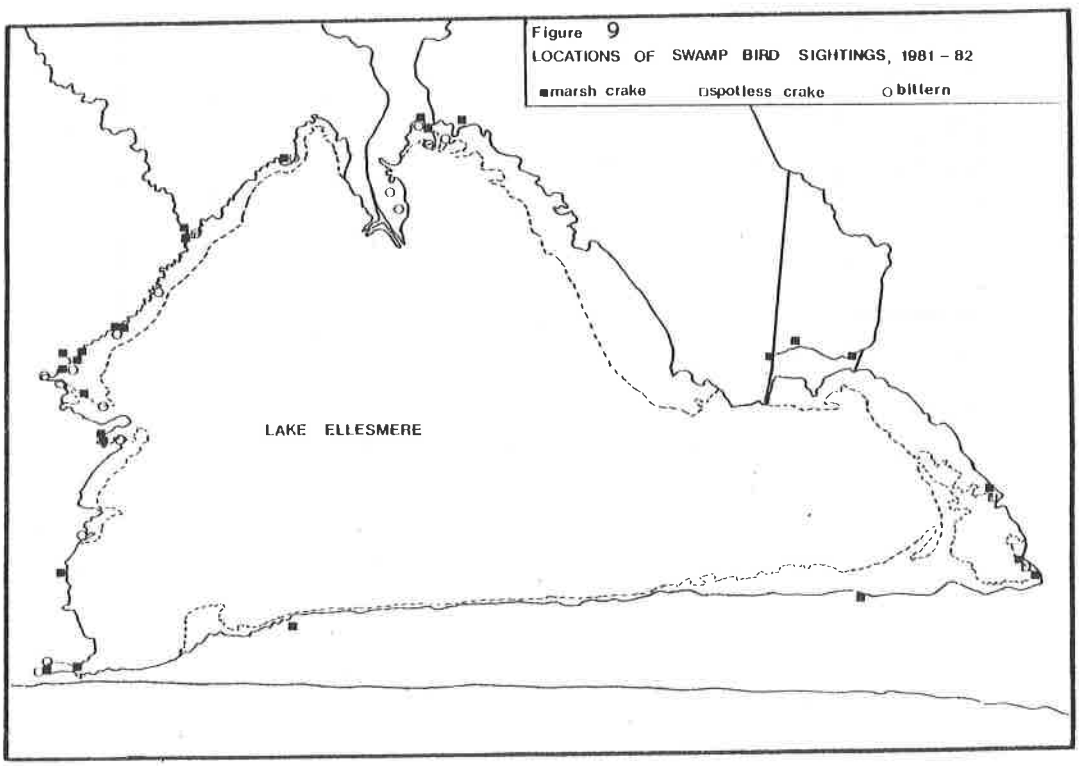
The egrets at Lake Ellesmere are usually found with herds of Jersey or

Friesian cow on farmland adjacent to the lake shore. These herds occur in areas with lush pasture growth and wet soils resulting from a high water table or some irrigation. Groups of up to 71 cattle egrets have been seen on the lake shore feeding in shallow water and among Leptocarpus. They have also been seen feeding in flooded pasture on the lake shore. Birds often fly 2-3 km to roost in an area of willows on the lake shore in the Lakeside study area. Birds also roosted in Leptocarpus and dead willows.

Their main foods at Ellesmere are soil invertebrates which are taken by shallow probing. Flies on or around cattle are also taken. When feeding on the lake shore egrets appear to take invertebrates and fish from the water column, substrate and emergent vegetation.

6.18 Australasian bittern (Botaurus stellaris poiciliptilus)

Records: 11 on 10.6.1967 (Tunnicliffe 1973a); one 7.1979 (COD); one 11.1972, one 7.1978 (NCAS); one 11.1971 (OSNZ); one 31.8.1980, one 30.8.1981 (NCAS); 18 between 10.1981 and 6.1982 (COD).



Population: the bittern is a native subspecies found throughout New Zealand but distribution and numbers have declined greatly in recent years with destruction of wetland habitat. I know of no wetlands remaining in the South Island where more than one or two bittern are ever sighted at one time. Lake Ellesmere supports an important population in Canterbury with probably at least 20 birds using the lake. The bittern was a characteristic species of the extensive swamplands originally present around Lake Ellesmere (Stead 1932).

TABLE 5 : HABITATS FROM WHICH AUSTRALASIAN BITTERNS WERE FLUSHED AT LAKE ELLESMERE. OCTOBER 1981 - AUGUST 1982

HABITAT	STUDY AREA						
	Taumutu	Lakeside	Hart's Creek	Doyleston	Selwyn	Halswell	TOTAL OBSERVATIONS
Typha orientalis	2		1		1		4
Leptocarpus similis			1	1			2
Scirpus				1			1
Scirpus-Juncus					1		1
Typha-Leptocarpus-Juncus						2	2
Salix			2				2
Salix/Typha				1			1
Mimulus		1					1
Salt tolerant water			1		2		1
Open lake water			1		1		2
TOTAL OBSERVATIONS	2	1	5	3	5	2	18

Bitterns are mainly recorded from the western side of the lake (Tables 4 and 5, Figure 9). Most records are from Hart's Creek, but as the bittern is a secretive species, it could use other study areas more extensively than is apparent. Bitterns were recorded from a variety of freshwater and brackish water habitat types (Table 5), but most often when raupo is present. Breeding has not been confirmed at Ellesmere but probably occurs.

THRESKIORNITHIDAE

6.19 Glossy ibis (Plegadis falcinellus)

Records: one 7.5.66 shot by duck-shooters, (Scarlett 1966); four 25.8.1977, one 7.1977 (Habracken 1978a); one 19.6.1984; two January 1985 (K. Hughey). Birds occurring in New Zealand are stragglers from Australia. Glossy ibis on Ellesmere have been found in three study areas (Table 4), feeding in shallow lake water.

6.20 Australian white ibis (Threskiornis molucca)

One specimen from Lake Ellesmere is in the Canterbury Museum (Tunnicliffe 1973a).

6.21 Royal spoonbill (Platalea leucorodia regia)

Records: presence cited by Oliver (1955); one 18.1.1973 (OSNZ); one 27.1.1973, one 20.10.1973 (DG); three 2.1.1974 (RP); one 27.12.1974 (DG); two 25.12.1981 (GY); six 5.12.1981, two 24.12.1981, three 26.2.1983 (COD).

Population: an uncommon species in New Zealand, self-introduced from Australia. A national count in 1977 recorded 49 birds (Heather 1978). Spoonbills were present on Ellesmere for 4 months in 1981-1982 when they were seen around most of the lake (Table 4). They also occurred on the adjacent Lake Forsyth and Cooper's Lagoon. Most records are from December - January. They fed in shallow lake water adjacent to saltmarsh and freshwater swamps and roosted on dead willows or fallen logs.

ANATIDAE (swans, geese, ducks)

6.22 Mute swan (Cygnus olor)

Records: numerous (see Appendices), resident and breeding.

Population: Lake Ellesmere supports the only sizeable wild population of mute

swans in New Zealand. The Ellesmere population reputedly developed from one pair introduced in the 1870's (Williams 1969). The population has probably always been less than 500 birds and since the "Wahine" storm in 1968 the population has declined steadily (Figure 10, Appendix 4) to between 40 and 50 birds in 1983 (pers. obs.). The decline has been attributed to poor breeding success through high incidence of egg infertility, and deterioration of food supply.

Mute swans are recorded in all study areas and on the adjacent Cooper's Lagoon. They are most numerous in the Hart's Creek and Lakeside study areas. They inhabit open lake water with a predominantly freshwater influence, and freshwater swampland (particularly raupo). Nesting has been recorded only in raupo beds. Occasionally they feed in inflowing waterways (drains and rivers).

Breeding occurs almost exclusively in the Hart's Creek study area. Isolated pairs also attempted to breed in the Taumutu, Kaituna and Selwyn study areas during summer 1981-1982. Breeding success has been poor for many years and has been virtually non-existent since 1968. Confirmed breeding over the last ten years is of one pair with two cygnets 17.2.1982, a pair with one cygnet 11.4.1983 and two pairs with cygnets 1.1984 (COD). In a previously typical breeding season (e.g., 1971-1972) eight nests were located at Hart's Creek on small raupo "islands". Nests were located 10-20 m apart (W/L file 11/5/4).

FIGURE 10 : Numbers of Mute Swan on Lake Ellesmere 1966-1983.
(Wildlife Service Records)

6.23 Black swan (Cygnus atratus)

Records: numerous (see Appendices), resident and breeding.

Population: black swans were introduced to Christchurch from Australia in 1864 and spread to Ellesmere by 1868. The lake formerly supported the largest population in New Zealand with over 110,000 individuals (Adams 1971). The population has declined since about 1959 (Figure 11, Appendix 4) with a drastic decline after the "Wahine" storm in April 1968 when c. 5,000 swans were killed by the storm and many died subsequently from starvation (Adams 1971). Recent Wildlife Service surveys indicate that the decline is continuing and today the population is c. 6000 birds. This is still one of the largest populations in the country and is about 10% of the national total. Black swans on Ellesmere have been subject to continuing studies for many years, see Cutten 1966, Bucknell 1969, Miers and Williams 1969, Adams 1971, M. Williams 1973, 1975 1977a, 1977b, 1980a, 1980b, Williams and Adams 1975 and W/L file 11/5/4. The decline of black swans has been of concern because of the recreational value of this species and because the decline may reflect a decline in the quality of lake habitat. The population decline appears to be compounded by disappearance of extensive lake weed beds (mainly Ruppia) and erratic breeding since 1968.

Population growth was extremely high in the early 1900's and the NCAS began control of black swans in 1915. Periods of "die-off" were noted when the population reached very high numbers, and the widespread deaths were attributed to very high lake levels with swans being unable to reach their food (e.g., 1958, 1965) which led to starvation and disease.

Banding studies have shown movement of swans between Lake Ellesmere and other areas such as Hawkes Bay, Rotorua, Farewell Spit, Invercargill and Tauranga and many others. The adult population on Ellesmere is relatively sedentary but young birds are more mobile, leaving the lake after reaching independence to return to breed 3-4 years later (Williams 1976).

Black swans are common on all study areas but are less common on the western side of the lake. They tend to feed in open lake waters more than any other waterfowl species. Feeding also occurs on Mimulus-dominant saltmarsh, salt tolerant pasture and in Juncus and Scirpus reedbeds. Large numbers of birds occasionally move inland, feeding along inflowing rivers and drains and pasture.

Breeding occurs mainly on the lake foreshore among scattered J. maritimus. Lake Ellesmere swans are largely colonial nesters. The main breeding colony is located in the Birdling's study area with small colonies at the L II Rivermouth and Hart's Creek and some individual pairs in other areas (Figure 12). Nesting usually occurs between September and November. Since the 1968 storm, breeding has been erratic. No breeding occurred in 1968 and 1969, but c. 2,000 nests were occupied in 1970 and c. 3,100 in 1971. In later years breeding either did not occur or the number of breeding pairs was low (e.g., 296 nests in 1973). A large proportion of the population consists of non-breeders, with birds over-summering on Ellesmere, Lake Wainono and Washdyke Lagoon (Williams 1980a). Lake water level regimes are important in initiating breeding (Section 9.1.2) and lake level is the most important factor affecting nesting success and brood survival (Adams 1972).

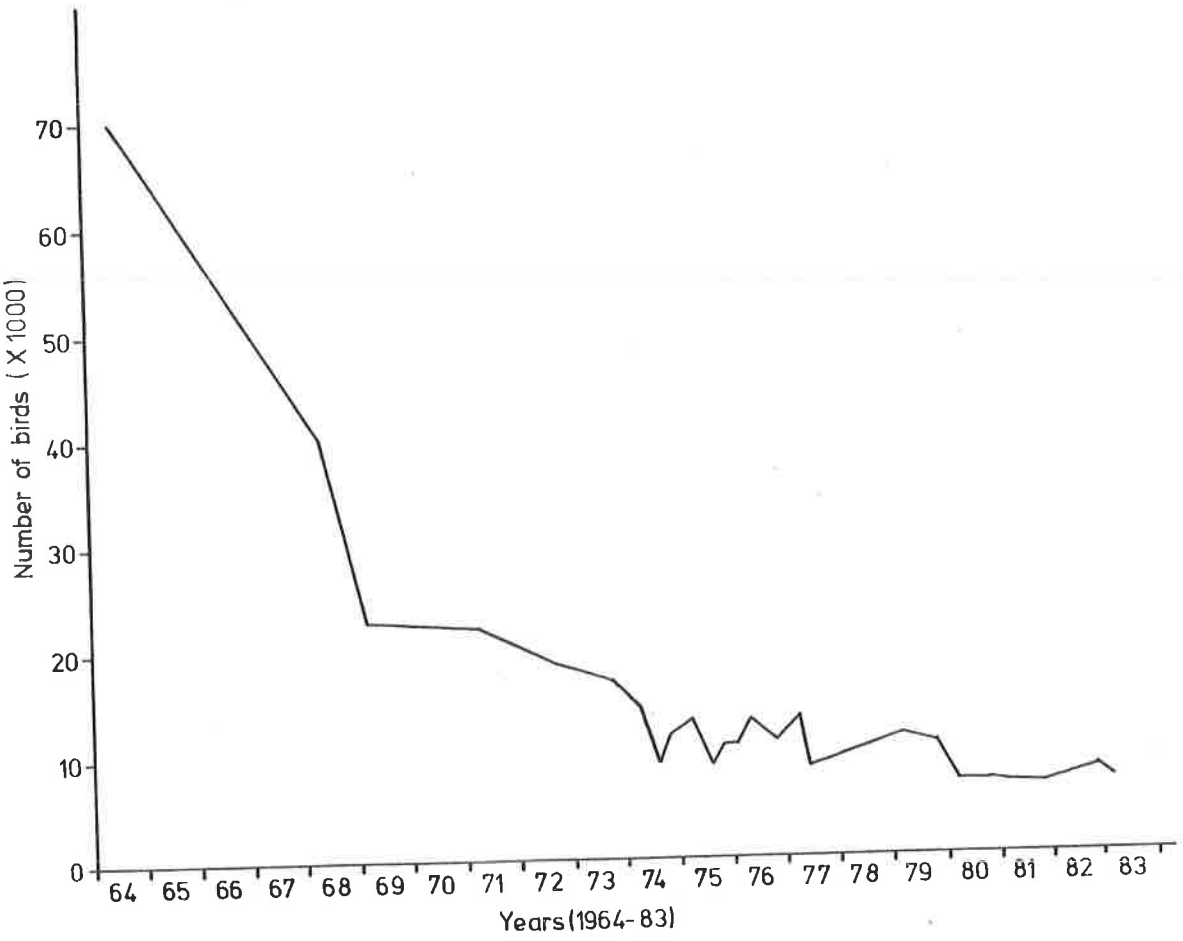


FIGURE 11 : Numbers of Black Swan on Lake Ellesmere 1964-1983.
(Wildlife Service Records)

6.24 Canada goose (Branta canadensis)

Records: numerous (see Appendices), some resident and breeding.

Population: Canada geese were introduced to New Zealand in 1876. They have since spread and become numerous, with most breeding in the high country of Canterbury, Mackenzie Country and Central Otago. Imber and Williams (1968) estimated that half the total South Island population migrate to Ellesmere annually. The population on Lake Ellesmere has fluctuated in recent years (Figure 13) and over 6,000 birds over-wintered in 1982. Non-breeders fly to Ellesmere to moult in November and December (second and third weeks of December in 1981), and remain until September the following year. Adult breeders moult in the high country with their young and then some fly to Ellesmere in February and March for the winter. A population on the adjacent Lake Forsyth is sedentary and breeds on that lake. Some of these also moult on Ellesmere annually.

The Ellesmere population has been subjected to continuing research. More detailed information has been published by Imber and Williams 1968, Imber 1968, 1969, 1970 and 1971, Williams 1980a and W/L file 11/5/10.

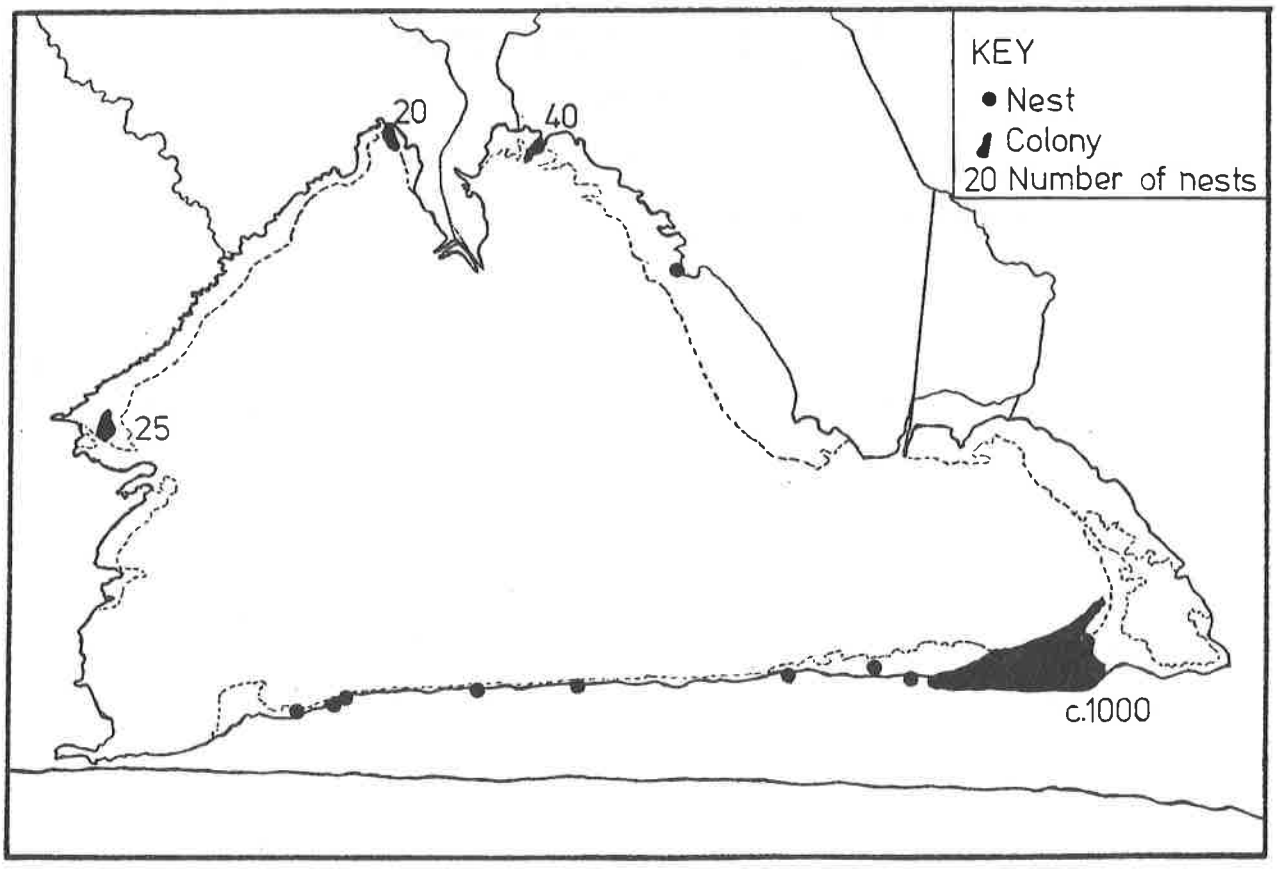


FIGURE 12 : Distribution of Breeding Black Swans on Lake Ellesmere, 1981-1982

Geese are common in all study areas particularly in the Kaituna, Halswell, Greenpark, Yarr's Flat and Selwyn areas. Flocks are mobile and all study areas periodically support groups of up to c. 2,000 birds. Breeding has been recorded on the Kaitorete Spit, Hart's Creek and the Sedgemere shoreline (Tunnicliffe 1973a), and during the 1981-1982 breeding season a few pairs nested in the Kaituna, Birdling's and Kaitorete Tip study areas. These geese feed on saltmarshes and reedbeds at the lake, the foreshore, adjacent farmland and less commonly on open water where they graze on palatable vegetation. They require suitable water conditions for optimum exposure of feeding areas (not necessarily low lake level, see Section 9.1.2).

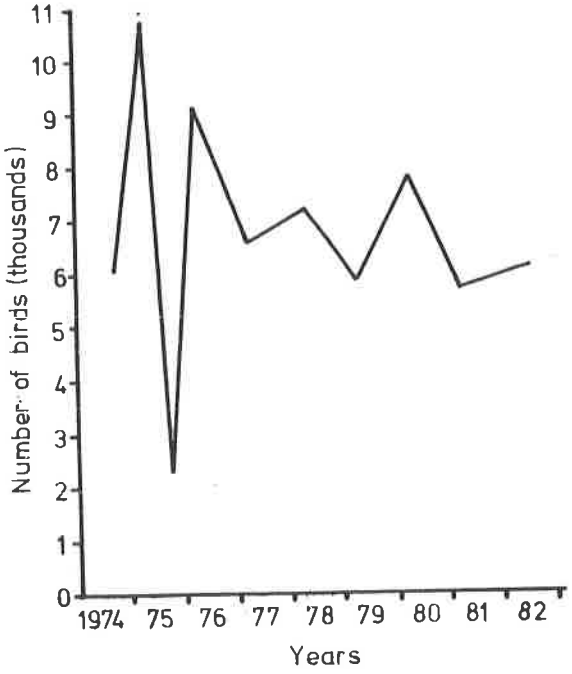


FIGURE 13 : Canada Goose population at Lake Ellesmere, 1974-1982. (Wildlife Service Records)

6.25 Feral goose (Anser anser)

A small population of feral geese is resident and breeding. Tunnicliffe (1973a) located a small nesting population at Hart's Creek (nests in Leptocarpus) and pairs nesting occasionally elsewhere on the lake. In the 1968-1969 breeding season there was a mated pair of feral geese and a Canada goose present and two matings occurred the following season (Tunnicliffe 1973a). Nesting occurred at Hart's Creek in the 1981-1982 breeding season (approximately 40 birds resident) and hybrids between the two species were found (pers. obs.).

6.26 Paradise shelduck (Tadorna variegata)

Records: numerous (see Appendices).

Population: paradise shelducks are uncommon with flocks mostly of fewer than 10 birds (maximum 88). Shelducks appear to be resident on the lake with no marked fluctuations in numbers throughout the year. They are widespread on the lake (Table 4) and are most frequently recorded from the Greenpark Sands. They almost always feed and roost on exposed Mimulus-dominant saltmarsh.

Breeding has not been recorded but fully-fledged juveniles were seen in January 1982 (pers. obs.).

6.27 Chestnut-breasted shelduck (Tadorna tadornoides)

The chestnut-breasted shelduck was first recorded in New Zealand at Lake Ellesmere on 12.12.1982 (Fennell et al. 1983). Two birds were sighted at the same location on 3.1.1983 (COD, BA). The pair (male and female) was present in the Yarr's Flat and Embankment study areas and was associated with a flock of paradise shelducks. The birds fed on Mimulus-dominant saltmarsh. A shelduck of this species in the Canterbury Museum was reportedly from Lake Ellesmere (Oliver 1955), but this record was not accepted on the New Zealand checklist (Kinsky 1970, 1980) because of some confusion about where the specimen was collected. This is an Australian species which typically inhabitats saltwater and brackish lakes and inlets, inland swamps, lagoons and open plains.

6.28 Mallard (Anas platyrhynchos platyrhynchos)

Records: numerous (see Appendices), resident and breeding.

Population: the mallard was introduced to New Zealand in the late 1800's. There is a very large resident population on Lake Ellesmere (see Section 5.6) and the lake is one of the single most important mallard habitats in New Zealand. No full census on the lake has been attempted as birds are continually passing through the area. Numbers are lowest during spring

breeding (October - November) and the shooting season (May - June). During summer 1981-1982 numbers increased markedly at the end of November and steadily increased through to April (e.g., Kaituna study area, November count = 499, December = 1044, January = 2090, March = 2750). During the shooting season mallards disappeared from the lake shore and were present in large rafts in centre lake (J. Andrew pers. comm.). From July to September ducks were too numerous to count and there may have been 15,000-20,000 on the lake at one time.

Mallards are common in all study areas but are most numerous in the Kaituna, Halswell, Greenpark, Embankment and Yarr's Flat study areas. There is also significant use of the open lake, the sea off the Kaitorete Spit, inflowing rivers and drains and adjacent farmland. They feed in most habitats including freshwater swamp, saltmarsh, salt-tolerant pasture and all waterways, where they graze on submerged and exposed algae and palatable herbs. Invertebrates are also taken.

Many mallards breed away from the lake on farmlands adjacent to wetlands. Mallards also breed all around the lake with many nests being found in Plagianthus-Juncus associations. Along the Greenpark Sands one out of three duckshooting hides contained 1-3 mallard nests each, in spring 1981-1982. Other sites frequently used include willow trees, in the open, in tall grass, under logs, old buildings, and less frequently in old black swan nests.

6.29 Grey duck (Anas superciliosa superciliosa)

Records: numerous (see Appendices), resident and breeding.
Population: a native species with a widespread distribution in New Zealand. On Lake Ellesmere grey ducks are commonly seen but are nowhere near as numerous as mallards. Of 1,472 ducks trapped at Hart's Creek 1967-1969, 1,334 (90.6%) were mallard, 96 (6.5%) were grey ducks and 42 (2.9%) were mallard x grey crosses (Tunnicliffe 1973a). My counts during 1981-1982 (see Appendices) suggest that the proportion of grey ducks may now be even lower. However, difficulties in identifying ducks on the lake may have meant I missed birds.

Grey ducks are present in all study areas but appear to be most numerous on the western side of the lake. They occur in similar habitats to mallards.

For breeding they appear to prefer more secluded nesting sites than the

mallard. The only breeding pairs recorded during the 1981-1982 breeding season inhabited vegetated drains flowing into the Doyleston and Hart's Creek study areas on the western side of the lake.

6.30 Grey teal (Anas gibberifrons gracilis)

Records: numerous (see Appendices), resident and breeding.
Population: grey teal have never been common in New Zealand despite periodic irruptions following drought in Australia (Mills 1976). Grey teal have been known from Lake Ellesmere for many years but little information on status and population size has been obtained. Tunnicliffe (1973a) stated that occasional flocks occur but did not report breeding. Mills (1976), in an assessment of the grey teal in New Zealand, estimated the total population to be approximately 20,000 birds with only a minor proportion resident on Ellesmere (3 surveys 1972-1974 estimating between 10 and 100 teal using the lake). In February 1980 flocks of 300-500 grey teal occurred on the Greenpark Sands present (pers. obs.). Throughout this study I monitored grey teal numbers on the lake (Figure 14) and maximum counts of 3,284 (24.3.1982) and 5,100 (14.4.1982) were made. Numbers fluctuated markedly throughout the study but much of 1982 over 1,000 teal were using the lake and often over 2,000. A general increase occurred during the 1981-1982 summer, a sudden disappearance during the duck-shooting season and a return to high numbers (2,000+) in July and August 1982. Thus, Ellesmere supported 10-25% of the estimated New Zealand population in 1981-1982. Grey teal did not moult on the lake, suggesting that there may have been significant immigration in the population.

Teal were recorded in all but the Taumutu and Rennie's Bay study area during 1981-1982 (Table 4). They were uncommon in study areas along the western shore of the lake.

Grey teal mainly used shallow, brackish and saline lake waters and wet, exposed Mimulus-dominant saltmarsh. They were rarely seen where the freshwater influence was high. Teal were mobile in response to changing lake levels, preferring shallow areas. For example, when the lake rose to c. 0.8 m (above m.s.l.), many teal left Yarr's Flat (despite numbers of other waterfowl increasing). During 1981-1982 Ellesmere may have provided suitable lake level conditions which do not always occur annually.

Grey teal were observed grazing on algae, and probably invertebrates, on newly-exposed and frequently flooded saltmarsh. On one occasion teal were recorded feeding on invertebrates on flooded pasture.

Breeding was confirmed for the first time at the lake during the 1981-1982 breeding season: one brood from the Kaituna study area, and two from the Hart's Creek study area (willow swampland).

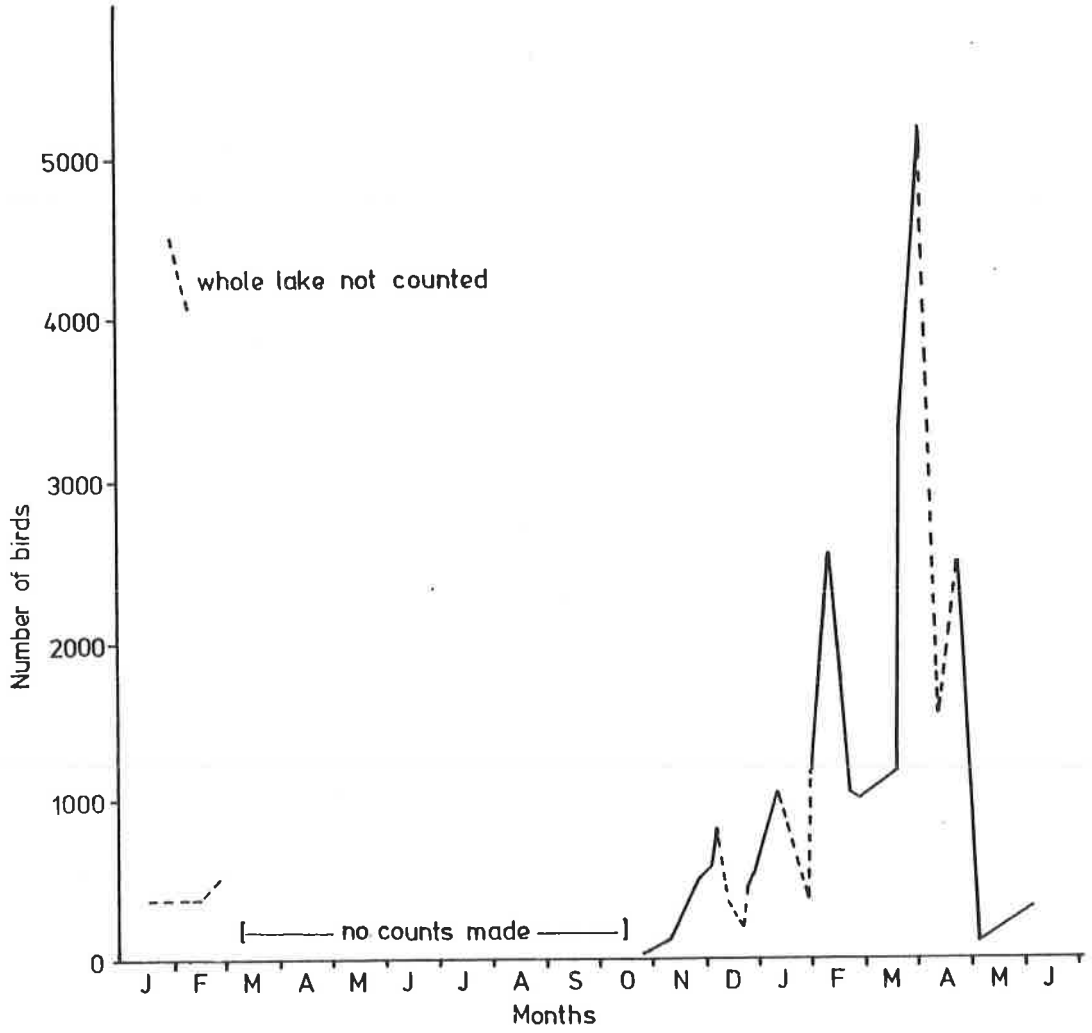


FIGURE 14 : Grey Teal Numbers on Lake Ellesmere, 1981 - 1982

6.31 Brown teal (Anas aucklandica)

Eleven specimens are in the Canterbury Museum (Tunnicliffe 1973a), but this species has not been recorded since about 1900.

6.32 New Zealand shoveler (Anas rhynchotis variegata)

Records: numerous (see Appendices), resident and breeding.
Population: an endemic sub-species which is widespread throughout the country, but uncommon in many regions. The shoveler is the second most numerous duck species in Canterbury (Tunnicliffe 1973b), with most occurring at Christchurch sewage ponds, the Avon-Heathcote estuary and Lake Ellesmere. Numbers fluctuate considerably on Ellesmere with flocks of 2,000-3,000 frequently present, but seldom remaining for long and, once gone, being replaced by another flock of different birds (Williams 1980a). Williams (1982) estimated that 75% of the national total of 100,000-125,000 shovelers pass through Lake Ellesmere annually.

Recorded from all study areas (Table 4) but generally Kaituna, Halswell and the three Greenpark Sands areas support the highest numbers. Feeding and roosting birds occur mostly in shallow open water, and less often at ponds on saltmarsh and in freshwater swampland.

Few nests have been reported at Lake Ellesmere but Tunnicliffe (1973a) recorded nests under gorse on dry ground alongside drains. During the 1981-1982 season most breeding pairs found were at Hart's Creek and the nests were found in Carex secta, willows and raupo. The majority of birds using the lake are non-breeders.

6.33 Australian white-eyed duck (Aythya australis australis)

A rare straggler to New Zealand from Australia. One Lake Ellesmere specimen is in the Canterbury Museum (Tunnicliffe 1973a).

6.34 New Zealand scaup (Aythya novaeseelandiae)

Scaup may have been common on Ellesmere in the late 1800's because Stead (1927) stated that they had "practically gone from Lake Ellesmere". Turbott (1969) suggested that in Canterbury they were unable to withstand shooting pressure as well as some other factors. It is likely that scaup still reach the lake as rare stragglers, as birds occasionally occur at other coastal wetlands in Canterbury.

ACCIPITRIDAE (eagles etc)

6.35 Australasian harrier (Circus approximans gouldi)

Records: numerous (see Appendices), resident and breeding.
Population: no census of harriers on Ellesmere has been undertaken but this species is common around the whole lake. In the Yarr's Flat study area up to 10 have been recorded at one time but 3-5 was more typical there. Harriers occur in all study areas and in all habitat types. At Lake Ellesmere they generally feed on dead swans, geese, ducks and gulls but also prey on small passerines and ducklings.

Newly fledged harriers were recorded at Hart's Creek and Yarr's Flat in summer 1981-1982, so presumably breeding occurred there.

FALCONIDAE (falcons)

6.36 New Zealand falcon (Falco novaeseelandiae)

One specimen in the Canterbury Museum is from Lake Ellesmere. This species is now absent from the lake (Tunnicliffe 1973a). Between 1977 and 1982 there were 2-3 sightings of falcons near Christchurch and on Banks Peninsula, so it is likely that falcons may occasionally reach Ellesmere.

PHASIANIDAE (pheasants etc)

6.37 California quail (Lophortyx californica brunnescens)

Uncommon but resident and breeding. All sightings by Tunnicliffe (1973a) were from the western side of the lake behind the Sedgemere shoreline. During 1981-1982 I found them around the whole lake (except the Kaitorete Spit). They were commonest in the Hart's Creek study area.

6.38 Grey partridge (Perdix perdix peridx)

First liberated in Canterbury in 1961. There are occasional sightings of

partridge on the western side of the lake and most are from behind Sedgemere shoreline (Tunnicliffe 1973a). There were no sightings during the present study.

6.39 Pheasant (Phasianus colchicus)

Relatively common, resident and breeding. Tunnicliffe (1973a) recorded birds only from the western side of the lake. During the 1981-1982 study single birds were sighted all around the lake except on the Kaitorete Spit. Cock pheasants were conspicuous and were found in farmland adjacent to the lake. The only pheasants seen on the lake shore were in the Hart's Creek study area (freshwater swamps).

RALLIDAE (rails)

6.40 Spotless crake (Porzana tabuensis plumbea)

Records: two 1.1976 (MW); one 13.9.1980 (OSNZ); one 12.11.1981, one 19.11.1981 (COD), (Figure 9).

Population: Spotless crakes are very rare on Lake Ellesmere as they are in most parts of the South Island. They have been recorded only from the Kaituna and Halswell study areas. Three sightings were in Scirpus pungens beds and two in raupo.

6.41 Marsh crake (Porzana pusilla affinis)

Records: (Tunnicliffe 1973a) records "about 15 sightings most of them in vegetation alongside freshwater streams flowing into the lake; rarely found where there is no raupo". I made 26 sightings from October 1981 to June 1982 (Figure 9). They are also present on Cooper's Lagoon (DG).

Population: Marsh crake are distributed throughout the South Island but are nowhere known to be common. No assessment of the population in New Zealand has been carried out. Most locality records are of single birds only, recorded once over many years. The fact that I made 26 sightings at Ellesmere over nine months in 1981-1982 suggests that the population is large and probably of national importance.

Marsh crakes are distributed around much of the lake (Table 4, Figure 9), but their presence appears to be dependent on the occurrence of emergent swamp vegetation with surface water.

(Tunnicliffe 1973a) recorded marsh crakes in raupo, Juncus pallidus, Scirpus pungens (formerly americanus) and Scirpus caldwelliae. I recorded crake in both saline and freshwater vegetation types (Table 6). A large number of sightings were in association with a Typha element, which agrees with Tunnicliffe's (1973a) observations.

TABLE 6 : HABITATS OF MARSH CRAKES RECORDED AT LAKE ELLESMERE OCTOBER 1981 - JUNE 1982)

HABITATS	STUDY AREAS										
	Kaitorete Tip	Taumutu	Lakeside	Hart's Creek	Doyleston	Selwyn	Yarr's Flat	Halswell	Kaituna	Birdlings	TOTAL
Typha orientalis		1		1		2		2	2		8
Leptocarpus similis				3							3
Scirpus		1			2				1		4
Typha-Scirpus-Juncus			1								1
Salix-Leptocarpus				3							3
Typha-Salix-Phormium					1						1
Plagianthus/Juncus			1				1			1	3
Mimulus			1								1
Azolla rubra on water								1			1
Phormium tenax	1										1
TOTAL	1	2	3	7	3	2	1	3	3	1	26

6.42 Pukeko (Porphyrio porphyrio melanotus)

Records: numerous (see Appendices), resident and breeding.

Population: regular counts by Tunnicliffe (1965) indicated that the total pukeko population was about 2,000. Carroll (1969) surveyed six localities and recorded 3,600 pukekos on the lake. My counts during 1981-1982 indicated that the total population on the lake is now between 300 and 500 birds. NCAS found that pukeko numbers were increasing until 1976 and birds were causing damage to crops, but there is no indication of this today.

Westerskov (1977) stated that wetland drainage has caused the decline of pukeko in recent years in some areas. Pukekos are also shot by hunters (NCAS records).

Pukekos have been recorded in all study areas (Table 4). Tunnicliffe's (1965) counts (Table 7) indicated that numbers were highest at Birdling's Flat, L II River, and Hart's Creek. In 1982 only three concentrations existed: at Kaituna Lagoon, the L II Rivermouth (Yarr's Flat and Selwyn River) and Hart's Creek, with no more than 70 birds in each area. Birds were spread evenly all along the western margin of the lake, especially during the breeding season, but they concentrated in flocks during the winter.

TABLE 7 : COUNTS OF PUKEKOS AT MAIN WINTERING AREAS
(from Tunnicliffe 1965)

AREA	JUNE	JULY	AUGUST
Birdling's Flat	246	253	-
Old Kaituna Railway Station	78	83	81
L II Rivermouth	133	251	176
Irwell Rivermouth	30	47	-
Hart's Creek Sanctuary	145	206	179
South Side Hart's Creek	43	57	40
Mathews Road	45	57	40
Rennies Bay	26	43	41
TOTAL	746	993	554+

Pukekos use all types of wetland around the lake, particularly freshwater emergent vegetation. They are most numerous around raupo, willow, Scirpus and Leptocarpus/Plagianthus associations. Water level fluctuations are important in determining habitat use (see Section 9.1.2). Pukeko forage in pasture but neither Tunnicliffe (1965) nor Craig (1974) found that they

caused any more than just incidental damage.

They breed around much of the lake. The most important breeding area during the 1981-1982 season was the large area of Juncus-dominant wetland between Yarr's Flat and Davidson's Road. Tunnicliffe (1965) contains detailed information on the breeding cycle of pukeko on the lake (see Section 10.1.2).

6.43 Australian coot (Fulica atra australis)

Rare straggler. Three specimens from Ellesmere are in the Canterbury Museum (Tunnicliffe 1973a).

HAEMATOPODIDAE

6.44 South Island pied oystercatcher (Haematopus ostralegus finschi)

Records: numerous (see Appendices).
Population: oystercatchers occur quite frequently (though erratically) in low numbers at the lake. The largest flock size recorded is c. 140 birds (12.10.1982, COD). Birds occur in all months, although largest numbers occur in autumn (Figure 15) when water levels are low. Birds arriving or leaving the lake usually fly to and from the direction of Christchurch (and probably the Avon-Heathcote estuary). Most flocks do not remain for long (often only a matter of hours). Baker (1973), in his paper on distribution of oystercatchers in New Zealand, did not record Lake Ellesmere as a site for this species.

Oystercatchers have been recorded from most study areas (Table 4) but most frequently from the Greenpark Sands. They feed on saltmarsh flats and mudflats, particularly Mimulus-dominant marshes and occasionally wet pasture adjacent to the lake.

In other areas these oystercatchers feed largely on shellfish and polychaete worms (e.g., Best 1970). There is very litle suitable food on Ellesmere which would sustain a large oystercatcher population. At low lake levels mud with polychaetes is exposed but often for brief periods. I have not seen oystercatchers take chironomids (which form the bulk of available invertebrates). When foraging on pasture they take worms and grubs.

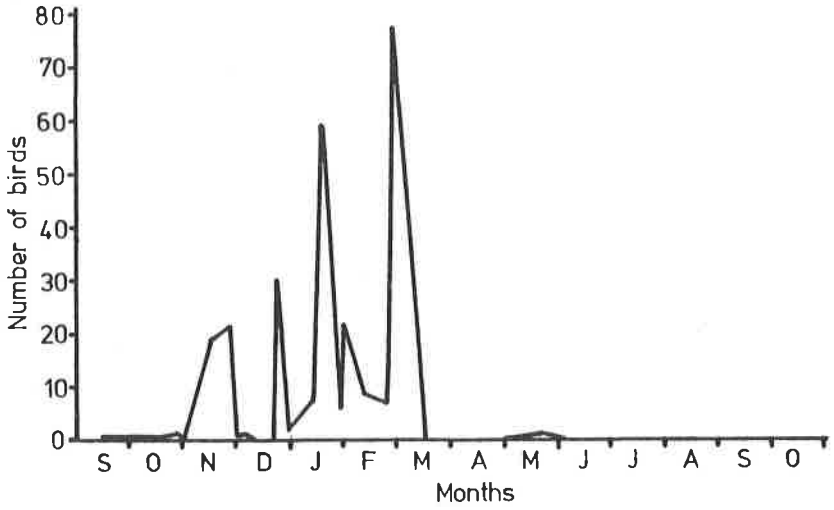


FIGURE 15 : Numbers of S.I. Pied Oystercatcher at Lake Ellesmere, 1981-1982.

6.45 Variable oystercatcher (Haematopus unicolor)

A rare straggler. One was seen with c. 100 South Island pied oystercatchers on 5.3.1983 in the Embankment study area (DB).

CHARADRIIDAE

6.46 Spur-winged plover (Vanellus miles novaehollandiae)

Records: before 1969 there were very few records with single birds in the 1940's and 1950's and two 11.1965, two 12.1967, 15 in 9.1969, seven 25.10.1969 (Tunnicliffe 1973a); post-1969 there are numerous records (see Appendices).

Population: spur-winged plovers first became established in New Zealand in the mid-1900's (G. Williams 1973). Since 1969 this species has rapidly expanded its range around the lake with breeding being first recorded at the Halswell Rivermouth in the 1969-1970 breeding season (Tunnicliffe 1973a). Today numbers are very high with flocks of over 300 recorded (pers. obs.).

During the breeding season spur-winged plovers are well distributed around the whole lake and adjacent farmland. Flocks move to the lake-edge from November onwards and remain for the winter. Daily movements occur between the lake and adjacent farmlands, with numbers on the lake being highest late in the day and at night.

They have been recorded from all study areas (Table 4), including the Kaitorete Spit which was the last area to be colonised by spur-winged plovers and considered by Tunnicliffe (1973a) as unsuitable habitat. Largest flocks have been recorded on the saltmarsh flats, mudflats and adjacent farmland along the Greenpark Sands. Less common on dry tussockland on the Kaitorete Spit.

Spur-winged plovers breed around the whole lake. Most nests have been observed on developed pasture and salt-tolerant pasture/saltmarsh associations, often some distance from the lake. Breeding begins in late June (RP, Kaituna 1984) and peaks in August to October.

6.47 Least golden plover (Pluvialis fulva) ...

Records: four specimens in the Canterbury Museum (Tunnicliffe 1973a); 85 on 11.3.1961 (OSNZ); counts of one, two and 16 in 2.1964, two 2.1972, 51 on 25.10.1969 (Tunnicliffe 1973a); 121 on 10.12.1972, 14 in 12.1973 (RP); 48 summer 1980-1981, 48 summer 1981-1982 (COD); 51 in 3.1983 (DB).

Population: golden plovers breed in Siberia and Alaska and some migrate annually to New Zealand in the non-breeding season. They occur at Ellesmere in variable numbers each summer (usually fewer than 100 birds). During summer 1981-1982 the first golden plovers were recorded on 5.11.1981 and last on 17.4.1982. Changes in numbers during 1981-1982 are recorded in Figure 16. Ellesmere may support up to 17% of golden plover recorded in New Zealand annually (Appendix 5).

Golden plovers were very mobile around the lake during summer 1981-1982. Birds were often spread over the whole of the Greenpark Sands while feeding but returned to roost in the Embankment study area. During summer drought conditions golden plovers flew daily to a freshwater bore 1.5 km inland from Yarr's Flat. They were also recorded on ploughed land adjacent to the Halswell study area (12.12.1981). Golden plovers have been recorded on farmland adjacent to the Greenpark Sands on many occasions (D. Braithwaite,

R. Pierce pers. comm.) but during 1981-1982 were most commonly recorded on saltmarsh habitats including wet and dry saltmarsh, wet mudflat, and wet pasture around fresh water bores. They were also observed feeding on mud and soil invertebrates and occasionally aerial insects. A regular roost for all birds during 1981-1982 was an "island" of high-level salt-tolerant pasture surrounded by saturated saltmarsh near Embankment Road.

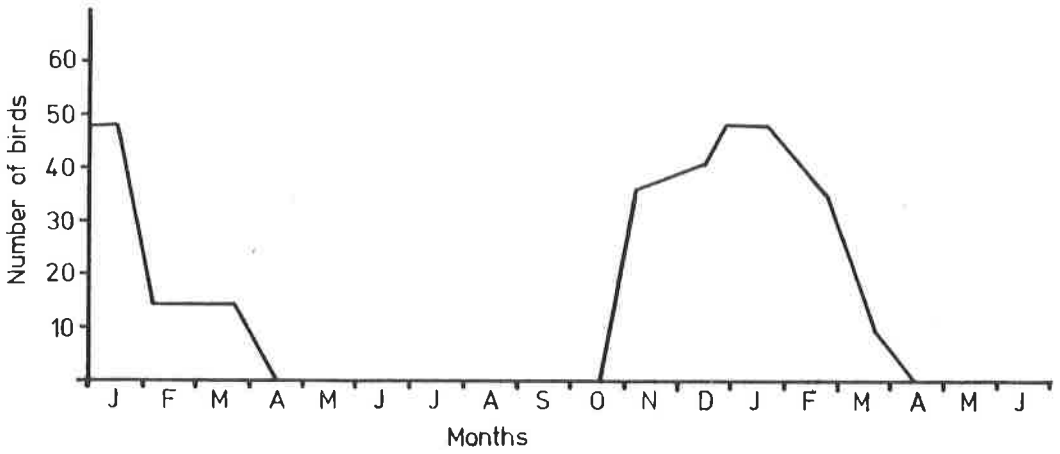


FIGURE 16 : Numbers of golden plovers around Lake Ellesmere, 1981-1982.

6.48 Banded dotterel (Charadrius bicinctus bicinctus)

Records: numerous (see Appendices).

Population: banded dotterels are one of the two most numerous wader species using Lake Ellesmere (the other is pied stilt). Several thousands use the lake annually and a sizeable proportion of the New Zealand population probably passes through the area to and from breeding grounds. Numbers build up during late summer and autumn (peak in January) and are lowest in spring. Numbers over-wintering are variable with c. 3,000 birds in 1981 but only 700-800 in 1982 and c. 1,600 in 1983. I estimated that at least 250 pairs bred during the 1981-1982 breeding season, mostly on the Kaitorete Spit. Stead (1932) records that during the first four months of the year one can see scattered flocks numbering thousands of birds each. Counts are still very large today, with numerous "part" counts of Greenpark Sands study areas reaching over 1,000 birds. Evidence that Lake Ellesmere is a staging place for migration to Australia was recorded during 1981-1982 with the sighting of three birds which had been banded near Melbourne, Australia during 1981 (pers. obs.).

numbers typically reach 500-700 (maximum 1,000) from May to August and the birds depart in late July and August (c.Minton pers. comm.).

Banded dotterels have been recorded in all study areas (Table 4) with highest numbers occurring on the Greenpark Sands and the Kaitorete Spit. Figure 17 illustrates changes in numbers at Yarr's Flat in 1981-1982. Low numbers use the western lake shore.

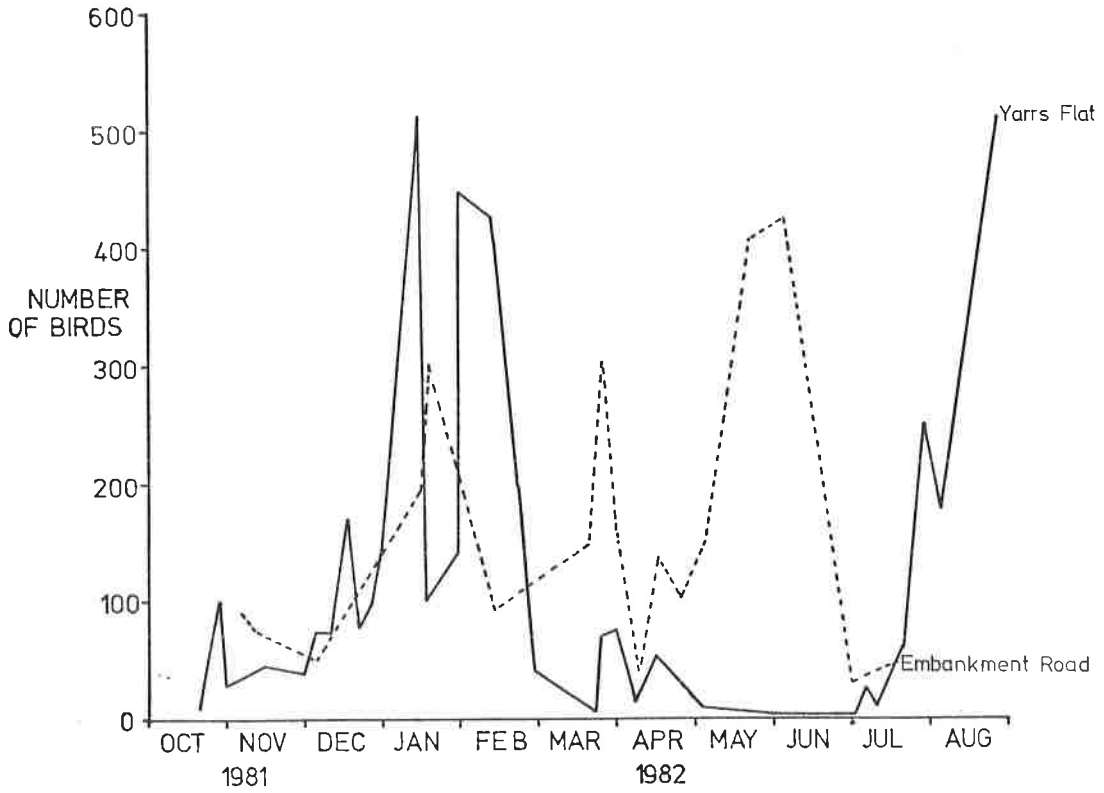


FIGURE 17 : Numbers of banded dotterels at Yarr's Flat and Embankment Road, 1981-1982.

Banded dotterels mainly use saltmarsh habitat, particularly Salicornia and Mimulus marshes. They also use wet pastures, mudflat, tussock grassland, bare shingle and herbfield. They feed largely on terrestrial insects on the saltmarsh but also invertebrates in the water column and mud substrates. Adult and larval midges appear to form a major part of the diet.

Scattered pairs breed around most of the lake on dry high-level habitats, especially along the Kaitorete Spit. Breeding began at the end of August in the 1982-1983 breeding season.

6.49 Black-fronted dotterel (Charadrius melanops)

Records: two 26.9.1981 and 3.10.1981 (PS); one 3.11.1981 (DB); one 15.4.1982 (KH).
Population: first recorded in New Zealand in 1954 and became established in several North Island districts in 1950's and 1960's. The species was first found in Canterbury in the 1960's. First recorded on the lake in 1981 from Yarr's Flat where they were seen feeding on salt-tolerant pasture around freshwater bores, on wet mud on the lake shoreline and on wet Mimulus saltmarsh.
The pair recorded in September/October 1981 was observed copulating but no nest was found.

6.50 Red-capped dotterel (Charadrius alexandrinus ruficapillus)

Records: one January-February 1981 (OSNZ). A rare straggler to New Zealand from Australia (Falla et al. 1979). On Ellesmere the bird was in the Embankment and Yarr's Flat study areas where it fed on mixed Salicornia - Mimulus - dominant saltmarsh and edges of saltmarsh ponds.

6.51 New Zealand dotterel (Charadrius obscurus)

Records: one 25.10.1969 (Tunnicliffe 1973a). A rare straggler to Lake Ellesmere. The only details of the 1969 sighting are that the bird was present on "Juncus dominant, some Agrostis and salt meadow species" habitat (Tunnicliffe 1973a).

6.52 Large sand dotterel (Charadrius leschenaulti)

Records: three on 6.11.1973 with banded dotterels on saltmarsh at the tip of the Kaitorete Spit (Gaze 1973). A very rare straggler to New Zealand.

6.53 Mongolian dotterel (Charadrius mongolus)

Records: one 1.12.1973 (DG); one 9.11.1975 (RP); one 13.1.1982 (COD).

Population: a rare visitor to New Zealand and Ellesmere.

The Ellesmere birds seen were in the Kaitorete Tip and Yarr's Flat study areas, all on Salicornia - dominant saltmarsh, pecking at invertebrates on wet mud (1982). They were associated with banded dotterels and red-necked stints in 1973 and 1975 and curlew sandpipers but not banded dotterels in 1982.

6.54 Wrybill (Anarhynchus frontalis)

Records: numerous (see Appendices).
Population: the wrybill is an endemic species with a total population of 5,000-7,000 individuals (Sibson 1963, Hay 1979). It spends the winter on harbours from the Auckland province northwards and migrates to breed on Canterbury and Otago riverbeds during the summer. Wrybills usually occur on Ellesmere as migrants although a few over-winter. The first birds arrive at the beginning of August (Figure 18, August 1st in 1982) and the last birds pass through on return migration at the end of April. Numbers using the lake fluctuate markedly throughout the summer (Figure 18), and some birds may be resident as non-breeders then. Peak numbers in November occurred during flooding of nearby riverbed. Wrybills passing through from December onwards are probably birds that have completed breeding and are migrating north, because Hay (1979) found that birds begin returning to the northern harbours about that time. Groups with fledglings appear in December and new arrivals appear as late as April. Numbers on the lake in summer 1982-1983 were much higher than the previous season, with flocks of over 100 birds recorded frequently, and in October-November 1983 c. 400 birds were present on the Greenpark Sands. Because flocks appear to be transient it is difficult to determine how many wrybill use the lake annually. The timing of flock build-ups and departures suggests that a large number of birds pass through but do not stay on the lake for long. Colour-banded birds have been seen one day and have gone the next and not been seen again that season.

Wrybills are widely distributed around the lake (Table 4) but are most numerous in Yarr's Flat, Embankment, and Kaitorete Tip study areas. They inhabit saltmarshes and mudflats. Wrybills forage on dry saltmarsh, in shallow lake water, on wet mudflat, wet saltmarsh and ponds on saltmarsh. Roosting occurs in similar habitats, and during strong winds wrybills usually shelter behind driftwood. They commonly feed by pecking insects off the water surface film and vegetation and, much less frequently,

invertebrates from the water column. Adult midges are a major food.

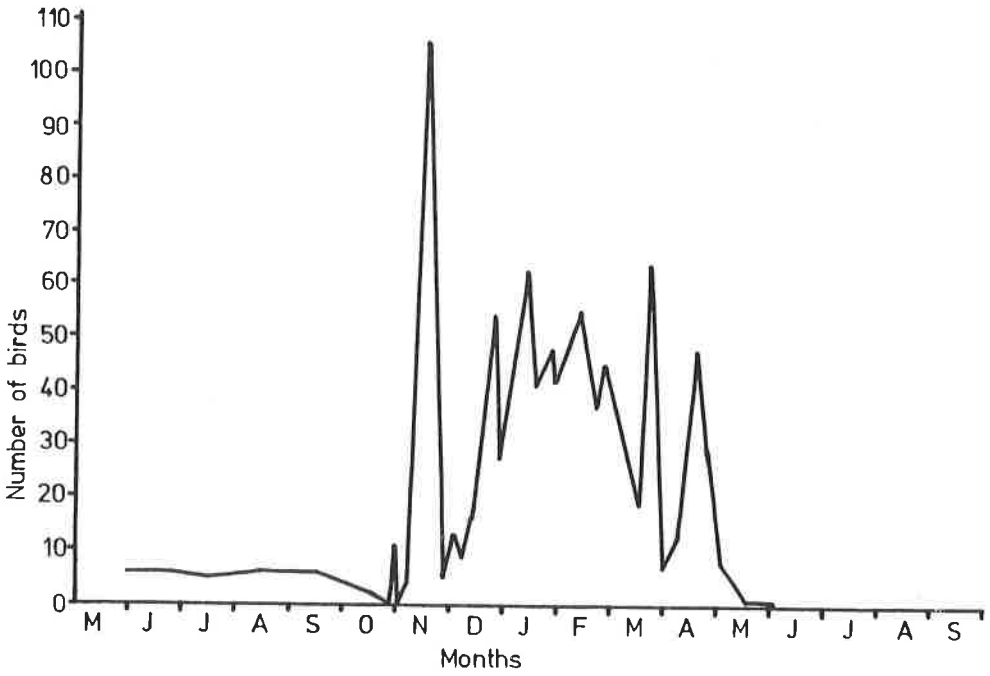


FIGURE 18 : Numbers of wrybills at Lake Ellesmere, 1981 - 1982.

SCOLOPACIDAE (curlews etc)

6.55 Far-eastern curlew (Numenius madagascariensis)

Two specimens in the Canterbury Museum are from Lake Ellesmere (Tunnicliffe 1973a). Also recorded by Oliver (1955).

6.56 Asiatic whimbrel (Numenius phaeopus variegatus)

One specimen from Ellesmere is in the Canterbury Museum (Tunnicliffe 1973a).

6.57 Little whimbrel (Numenius minutus)

Records: six specimens in the Canterbury Museum are from Lake Ellesmere; two were seen and one collected in June 1900, one 5.3.1921, four between 1921 and 1927 (E. Stead); two 6.2.1972, four 19.2.1974 (RP); two 1.2.1981 (OSNZ).

Population: first recorded in New Zealand at Lake Ellesmere and there are still very few records from the rest of the country (Falla et al. 1979). This species has occurred most frequently at Lake Ellesmere, and has been recorded in winter (Stead's June record).

Little whimbrels have been recorded from four study areas, most commonly on Agrostis-Hordeum pastureland higher up the lake shore and often around freshwater bores. Also on Salicornia - Cotula - dominant saltmarsh, on the edge of mudflats and irrigated pasture and in pools.

6.58 Eastern bar-tailed godwit (Limosa lapponica baueri)

Records: numerous, see Tunnicliffe (1973a) and appendices.
Population: a migrant from Siberia and north-western America where it breeds. Some birds spend the summer in New Zealand and they regularly visit Lake Ellesmere. Indications are that very large numbers once occurred on the lake (NCAS 1922, Stead 1932, Stidolph 1954, Lamb 1964, F. Coope pers. comm.). Stead (1932) recorded that godwit and knot "seem to be forsaking Lake Ellesmere to some extent" due in part, he thought, to "great increase in numbers of stilts on the lake during the past 20 years". Today, godwit numbers are relatively low at Ellesmere. Flocks occur frequently, but often stay for a brief period (Figure 19), and a few birds sometimes overwinter. The largest number recorded over the last ten years was 220 birds in 1973-1974 (RP). The largest flock recorded during 1981-1982 was 36 and the maximum population at the lake is usually about 50 birds.

This godwit typically inhabits estuaries in New Zealand. On Ellesmere birds feed in shallow brackish and fresh lake waters, on exposed mud and on saltmarsh around the whole lake. Godwits seem to occur mainly when the lake level is very low, when they probe in mud in areas where the polychaete worm is present.

6.59 Hudsonian godwit (Limosa haemastica)

Records: a rare migrant to New Zealand from Arctic Canada. Eight specimens in the Canterbury Museum are from Lake Ellesmere. These were shot by Stead in 1902, 1917, January 1918, February 1919, March 1921 and 1937; one in 18.2.1964 (OSNZ); one 12.3.1984 (COD).

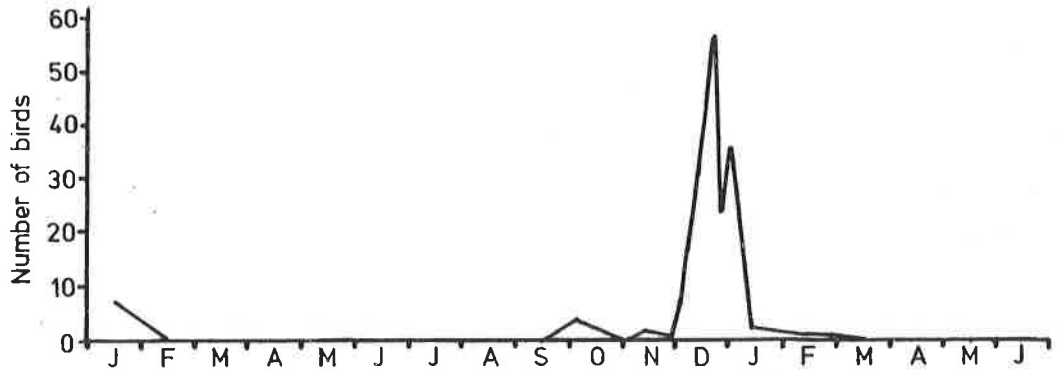


FIGURE 19 : Numbers of Bar-Tailed Godwit at Lake Ellesmere, 1981-1982

6.60 Asiatic black-tailed godwit (Limosa limosa melanuroides)

Records: an arctic migrant occurring as a straggler to Lake Ellesmere. One 25.11.1972 at Greenpark, one February 1977 on the Kaitorete Tip (RP). A flock of 13 of these godwits was present in January 1985 and was possibly the largest group of these birds ever seen in New Zealand. They were seen in the Halswell, Yarr's Flat and Selwyn study areas feeding in shallow lake waters.

6.61 Greenshank (Tringa nebularia)

Records: an arctic migrant which occurs as a straggler to New Zealand and Lake Ellesmere. Two January 1967, two 9.1.1968, two 11.12.1969 (Tunnicliffe 1973a), one 13.1.1972 Taumutu (RP); one 13.1.1973 Kaitorete Tip, one 26.12.1973 (DG), one 9.6.85 (OSNZ) in the Embankment area; additional records from the adjacent Cooper's lagoon; one 21.1.1973, one 19.2.1974 (RP).

6.62 Lesser yellowlegs (Tringa flavipes)

Records: one 20.1.1964 near lower Selwyn Huts (Selwyn study area) on lake edge with pied stilts and banded dotterels (Tunnicliffe 1964).

6.63 Marsh sandpiper (Tringa stagnatilis)

Records: a rare arctic migrant to New Zealand. Only seven sightings (one in South Island) up until 1972 (Falla et al. 1979) and only one record 1972-1980. Two birds were first seen in Ellesmere on 19.11.1981 on the Greenpark Sands and a third bird joined them on 13.1.1982. An additional bird was seen on Cooper's Lagoon (14.1.82). The sandpipers were last seen on 18.4.1982.

These sandpipers most commonly fed in ponds around freshwater bores on high level Salicornia - Hordeum marshes but also occurred in inflowing drains, wet saltmarsh, shallow brackish lake water and a few up to 1.5 km inland on areas of wet pasture. They mainly fed on water column invertebrates but had a characteristic feeding mode in which the birds crouched on their tarsi, shuffled along and "side-swiped" invertebrates, much as a wrybill would.

6.64 Siberian tattler (Tringa brevipes)

Records: arctic migratory wader, rarely reaching New Zealand. Record of one bird from Ellesmere at the Greenpark huts 25.3.1961 (OSNZ). A tattler sp. was seen in November 1984 at Halswell.

6.65 Terek sandpiper (Xenus cinereus)

Records: an arctic wader, rarely reaching New Zealand. One at Ellesmere from 12.1976 to 1.1977 at the Kaitorete Tip (RP, DG); one 29.1.1983 to 10.4.1983 at Yarr's Flat and Greenpark (BA, DB). A migratory arctic wader, rarely reaching New Zealand.

6.66 Turnstone (Arenaria interpres interpres)

Records: numerous (see Appendices).
Population: an arctic wader, about 4,000 of which annually reach New Zealand; it is the third most numerous arctic wader in this country (Veitch 1977). It occurs annually on Ellesmere (McKenzie 1968) but flock sizes vary considerably, as does duration of stay on the lake. The largest flock recorded was c. 100 birds in 1971 but usually fewer than 10 birds are present at one time.

Occurring around much of the lake but most frequent on the Greenpark Sands. On Ellesmere turnstones feed on wet Mimulus and Salicornia - dominant saltmarshes, mudflat and stoney shore (Kaitorete study area). They roost on high level pasture.

6.67 Japanese snipe (Gallinago hardwickii)

One in February 1961 (Tunnicliffe 1973a); two snipe sp. were on nearby Cooper's Lagoon from 13.1.1973 to 21.1.1973 (DG, RP). Very rare straggler to New Zealand and Lake Ellesmere.

6.68 Lesser knot (Calidris canutus canutus)

Records: numerous (see Appendices)
Population: the second most numerous arctic migratory wader reaching New Zealand with c. 50,000 occurring annually (Sibson 1979). Most are found on harbours from the Firth of Thames northwards and at Farewell Spit, with fewer reaching other parts of the North and South Islands. Stead (1932) indicated that knots were once numerous on the lake, but they declined after 1900. Today knots occur annually at Lake Ellesmere but generaly in small numbers. During summer 1981-82 numbers steadily increased from mid-November to the beginning of January (80 birds), then declined dramatically in January (Figure 20) and six birds remained over winter. About 80-90 knots occur annually on Ellesmere. They feed on wet Mimulus and Salicornia - dominant saltmarshes, wet mudflat, saturated pasture around freshwater bores and in shallow lake water by shallow probing in mud and pecking invertebrates from surface vegetation and the water column.

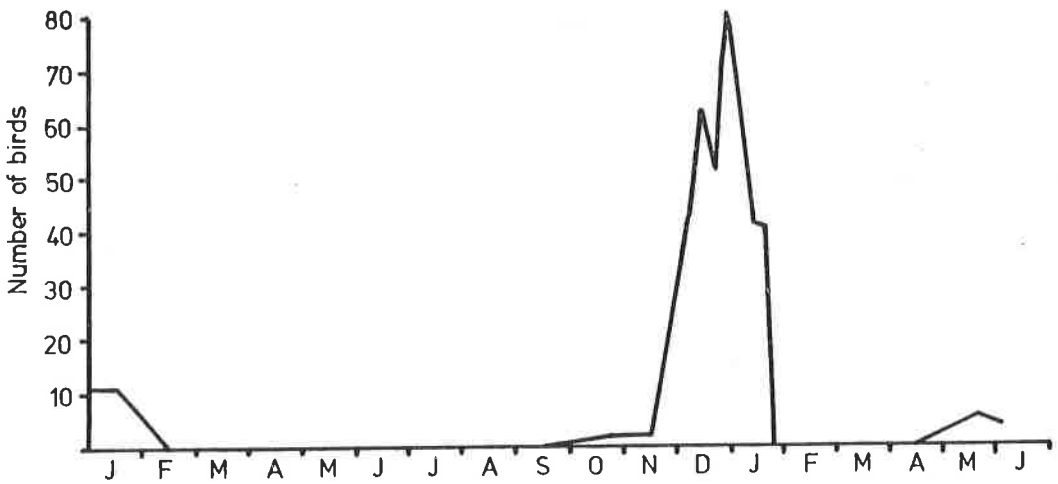


FIGURE 20 : Numbers of Knot at Lake Ellesmere, 1981-1982

6.69 Pectoral sandpiper (Calidris melanotos)

Records: eight specimens from Ellesmere in the Canterbury Museum (including specimens shot by Stead in 1903, February 1909 and 5.3.1920); two 10.2.1964 (OSNZ); one 25.11.1972 (DG); one 3.2.1974, one 19.2.1974 (RP); one 1.1.1977 (DP); one 15.1.1977 (Heather 1977); none were present summer 1980-1982, nine possibly 12, summer 1981-1982 (two overwintered), three plus, summer 1982-1983, two during summer 1983-1984, one summer 1984-1985 (COD).
Population: an arctic migrant regularly occurring in New Zealand in very low numbers. These sandpipers appear to occur at Ellesmere almost annually and birds have been known to overwinter. Birds arrive in October and leave in April (Figure 21). The group of 9 birds present during summer 1981-1982 would be one of the largest flocks ever recorded in this country. It appears that up to 33% of pectoral sandpipers recorded annually in New Zealand occur at Lake Ellesmere (Appendix 5). Birds were very mobile during 1981-1982 and often moved at least 1.5 km inland to wet farmland and swamp areas.

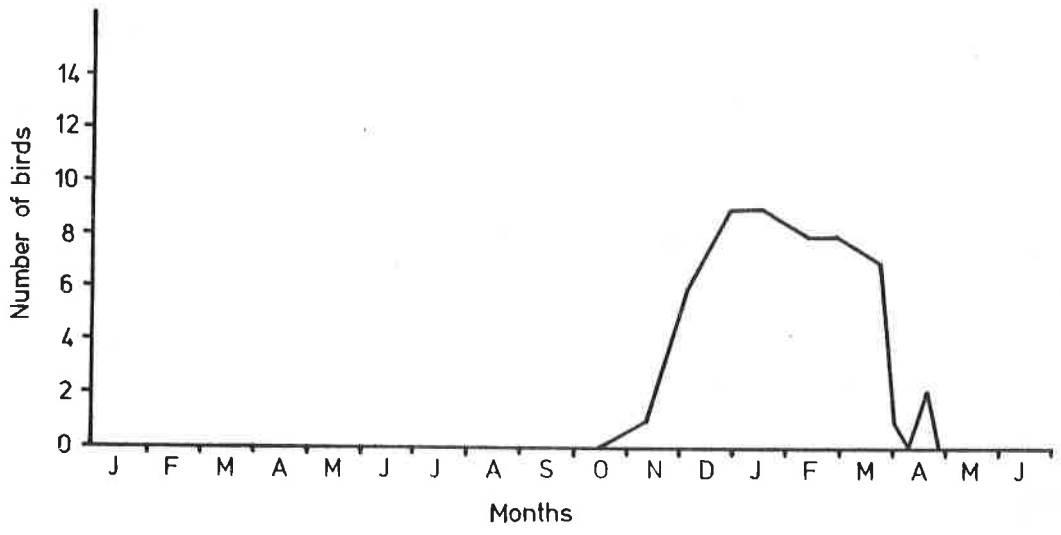


FIGURE 21 : Numbers of Pectoral Sandpiper at Lake Ellesmere, 1981-1982

Foraging occurs in saltmarsh pools, shallow lake water, saturated Mimulus-Salicornia - dominant saltmarsh, wet mudflat, freshwater ponds and saturated pastureland (e.g., especially Agrostis-Hordeum associations). Roosting occurs on dry, high-level saltmarsh and in dense pasture. On Ellesmere pectoral sandpipers feed by rapid shallow probing and pecks at invertebrates in the water column.

6.70 Sharp-tailed sandpiper (Calidris acuminata)

Records: numerous (See Appendices)
Population: an arctic migrant reaching New Zealand in low numbers each summer. Birds appear to reach Ellesmere every summer and in some years relatively large flocks occur (up to 25 at one time). Up to 28% of sharp-tailed sandpipers recorded in the country annually occur at Ellesmere (Appendix 5). Figure 22 outlines changes in population size during 1981-1982. Habitats used and foraging are similar to those of pectoral sandpipers.

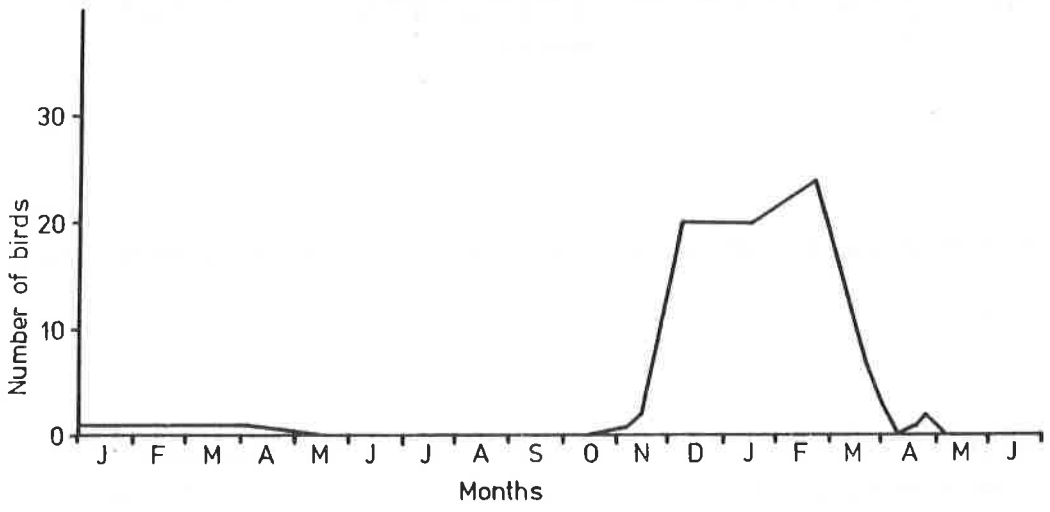


FIGURE 22 : Numbers of Sharp-tailed Sandpiper at Lake Ellesmere, 1981-1982.

6.71 Curlew sandpiper (Calidris ferruginea)

Records: numerous (see Appendices).
Population: an arctic migrant occuring in small numbers annually in New

Zealand. Recorded annually on Ellesmere where the largest concentration in the country is found (up to 60% of the national total (Appendix 5)). Population changes from 1980 to 1982 are illustrated in Figure 23. In spring 1982, the first sandpiper in breeding plumage returned at the beginning of September (c f. the beginning of November 1981). Five birds overwintered in 1982. It now appears that 60 to 70 curlew sandpipers occur on Ellesmere each summer (Appendix 1). Curlew sandpipers occur in areas where saltmarsh vegetation dominates (Table 4).

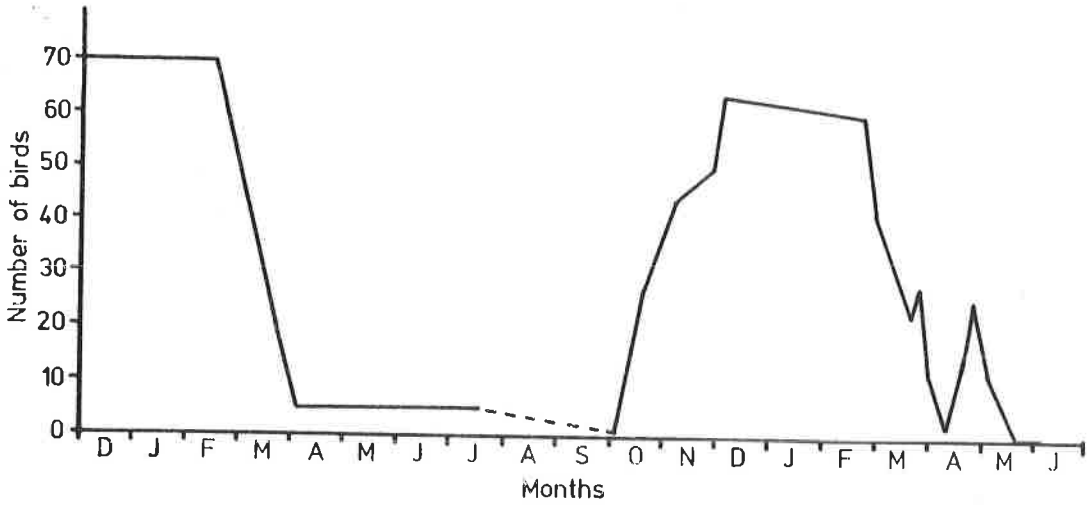


FIGURE 23 : Numbers of Curlew Sandpiper at Lake Ellesmere, 1980-1982

Curlew sandpipers forage on wet mudflat, wet pasture, Scirpus reedbeds, in shallow lake water, saltmarsh, shallow ponds on saltmarsh, dry saltmarsh and freshwater ponds. Roosting usually occurs on dry saltmarsh. They mainly feed by shallow probing in the substrate, but deep probing also occurs and some birds take invertebrates from the water column and off the surface of vegetation.

6.72 White-rumped sandpiper (Calidris fusciocollis)

Six 17.1.1981, one 31.1.1981 (KH), (provisional record).

This species has only been recorded twice in New Zealand before the Lake

Ellesmere sightings in 1981. The birds occurred on wet saltmarsh on the Greenpark Sands.

6.73 Red-necked stint (Calidris ruficollis)

Records: numerous (see Appendices).
Population: an arctic migrant reaching New Zealand annually but generally in small numbers, except at Lake Ellesmere where up to 70% of the New Zealand population may spend the summer (Appendix 5). About 200-220 stints occur on Ellesmere each summer (Appendix 1).

In 1981 the birds departed gradually from February to May and returned in October (Figure 24). Departure followed a similar pattern from February to May 1982 but the birds returned earlier in 1982, at the beginning of August. Stints overwintered in 1981 and 1982.

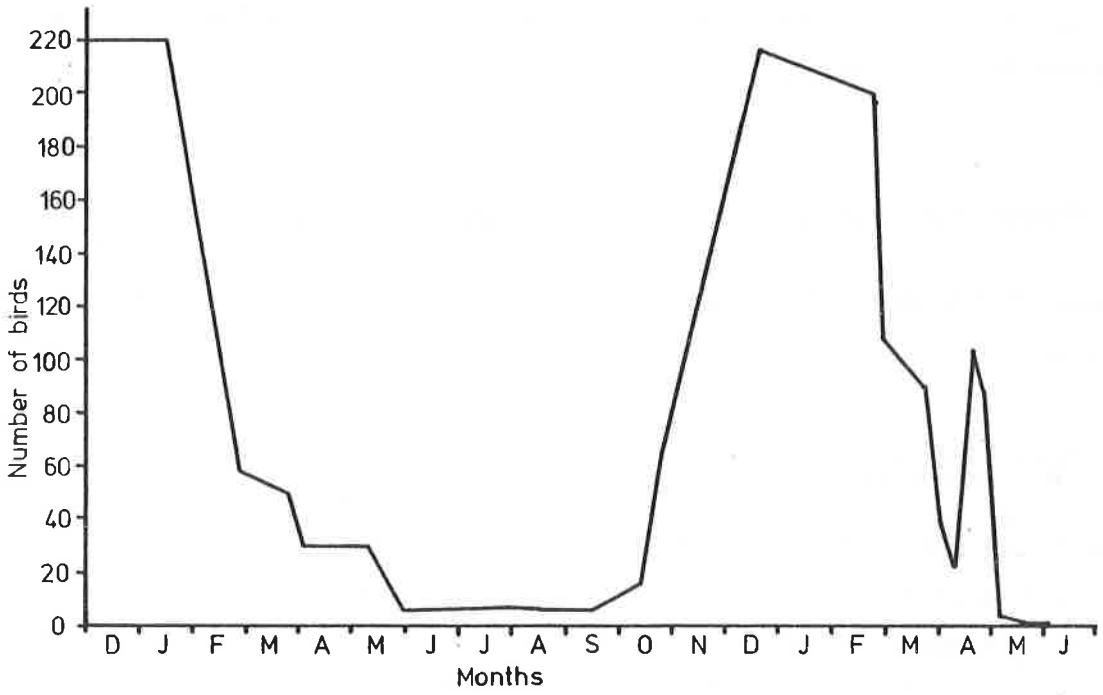


FIGURE 24 : Numbers of Red-necked Stints at Lake Ellesmere, 1980 - 1981

Red-necked stints usually occur in the Greenpark Sands and Kaitorete Tip areas (Table 4). There is some movement between the two areas. Stints disperse in small groups over a wide area to feed but roost in tight flocks. Many of the pre-1980 records probably recorded only parts of the total

population on the lake each summer.

Stints forage on wet mudflat, in ponds on saltmarsh, in freshwater ponds, on wet saltmarsh and on dry saltmarsh. A regular roost is on high-level, dry saltmarsh at Embankment Road. The stints feed with rapid pecks at the substrates and in the water column mainly in areas where ostracods, Daphnia, and amphipods are common.

6.74 Sanderling (Calidris alba)

Records: on 7.1.1917 (Canterbury Museum); one 11.3.1961 (OSNZ); one 19.12.1971 (RP); one 1.12.1973 to 26.12.1973 (RP, DG); one 13.11.1981 to 26.11.1981 (COD); three at least from 12.2.1983 to 5.3.1983 (DB, KH): one during summer 1983-1984 (COD).

Population: an arctic migratory wader rarely occurring in New Zealand. The number of sightings from Lake Ellesmere suggests that sanderling occur relatively often on the lake compared with most other wetlands in the country. The bird recorded in 1981 fed in shallow lake water and on wet mud along the lake shore.

6.75 Broad-billed sandpiper (Limicola falcinellus sibirica)

One seen in December 1962 (Tunnicliffe 1973a). A very rare visitor to New Zealand.

6.76 Ruff (Philomachus pugnax)

Two recorded during summer 1984-1985. This was the first confirmed record of this species in New Zealand. A single bird was present on the Greenpark Sands in December 1984 in the company of a variety of other waders (COD). It was joined by a second bird in January and they were resident in the Selwyn study area, usually foraging in mixed wader flocks on the lake shore (COD, K. Hughey).

RECURVIROSTRIDAE (Stilts)1

6.77 Pied stilt (Himantopus himantopus leucocephalus)

Records: numerous, resident and breeding (see Tunnicliffe 1973a and Appendix 2).

Population: the pied stilt is one of the two most numerous waders using Lake Ellesmere. At times the lake supports a sizeable proportion of the New Zealand population. The lake provides a breeding area and important staging point for migration between breeding grounds and wintering sites in the North Island, as well as providing important wintering habitat itself. Numbers of stilts using the lake can be very high, for example, a total of 3,200 were counted in five areas on 19.2.1974 and 2,400 at Kaituna in 1975 (RP), c. 3000 were overwintering in 1981, counts of 1000-2000 birds from individual study areas around the lake were regularly made and c. 10,000 birds were present for a brief period in spring 1982 (pers. obs.). Stead (1932) recorded that stilts were increasing on the lake when he recorded flocks of 2000-3000 birds. Seasonal changes in numbers occur, with peak numbers in autumn and spring and low numbers in late winter. Changes in numbers at Yarr's Flat and Embankment Road are shown in Figure 25. Numbers seem to vary from year to year, for example the winter count in 1981 was c. 3000 birds and in 1982 c. 700 birds.

Present in all study areas (Table 4) but very common at Kaituna, Hart's Creek, Selwyn, Yarr's Flat and Embankment Road. Distribution around the lake varies markedly at different times and may depend on lake levels. Stilts are common in saltmarsh, wet mud, shallow lake water, open freshwater swamp and on pasture habitats where there is surface water.

Breeding occurs around much of the lake shore and loose colonies of 5-30 pairs are sometimes formed. In 1981-82 there were concentrations of 18 pairs each on Yarr's Flat and Embankment study areas and 30 pairs at Birdling's Flat. Most nesting was at high levels on damp salt-tolerant pasture. Peak breeding occurred in October-November during summer 1981-1982.

6.78 Black stilt (Himantopus novaezealandiae)

Records: Oliver (1955) recorded the black stilt as occurring at Ellesmere; two on 7.3.1967 (Tunnicliffe 1973a), one on 30.7.1978, one from 18 to 28.11.1978, one on 21.7.1980 (COD), two in 4.1981, four on 5.9.1981, one on 10.10.1982 (KH), one in December 1981, two birds and two pied-black stilt hybrids in July-August 1981, one hybrid in December 1982 and one pure black 20.5.1984 and 19.6.1984 (COD).

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[1] Footnote: Banded stilt (Cladoryhnchus leucocephalus)
Tunnicliffe (1977a) found that one specimen of banded stilt in the Canterbury Museum was catalogued as collected at Lake Ellesmere. There is some doubt expressed by Tunnicliffe about the record, and this species has not been officially accepted on the New Zealand checklist. Cayley (1961) however, described this species as "straggling to New Zealand" and cites the preferred habitat of this species in Australia as salt lakes. In New Zealand, Ellesmere is one of the few habitats which may be suited to this species.

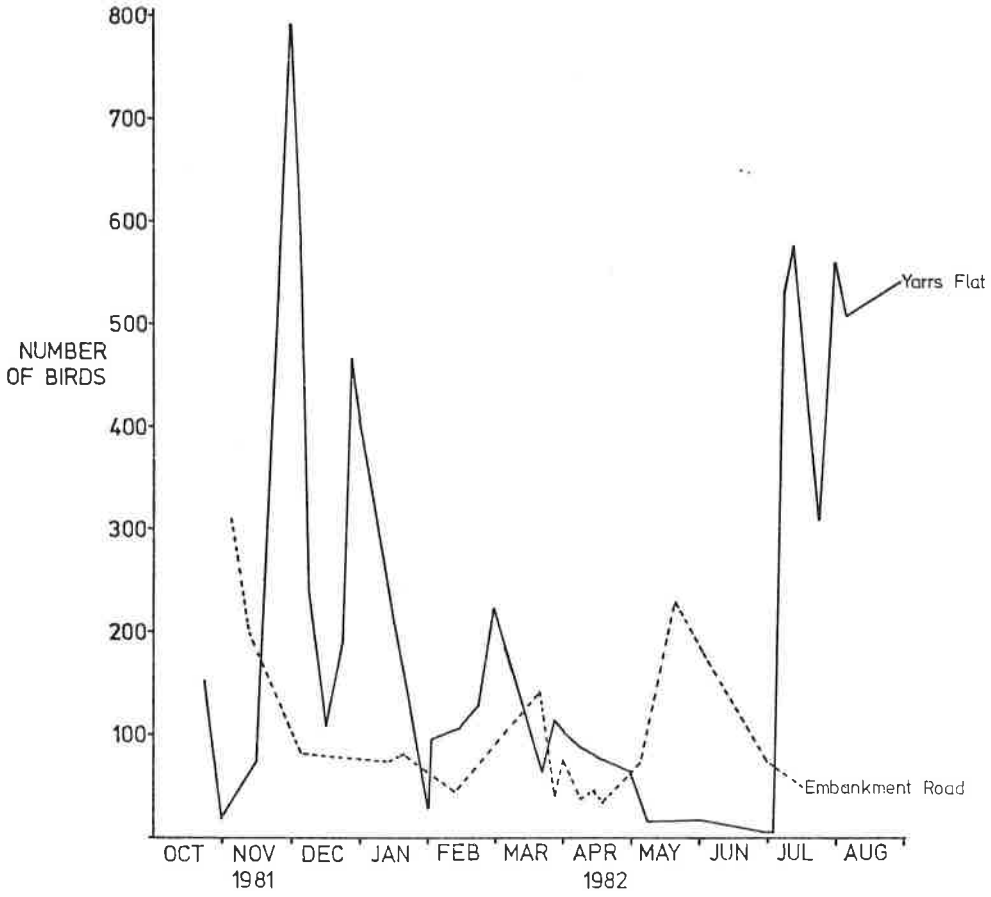

FIGURE 25 : Numbers of Pied Stilt at Yarr's Flat and Embankment Road, 1981-1982

Population: a rare endemic wader with an estimated population size of c. 50 birds (R. Pierce pers. comm.). Tunnicliffe (1973a) classed this species as a rare straggler to Ellesmere. The number of recent sightings suggest that black stilts occur frequently on Ellesmere in all seasons. Black stilts generally feed in shallow lake water, ponds on saltmarsh and in flooded Scirpus reedbeds.

6.79 Australian avocet (Recurvirostra novaehollandiae)

An Australian species which possibly established itself in this country in the late 1800's (Falla et al. 1979). One specimen in the Canterbury Museum was shot on Lake Ellesmere in 1912.

PHALAROPIDAE (Phalaropes)

6.80 Grey phalarope (Phalaropus fulicarius)

A very rare straggler to New Zealand, with only four records, including one from Lake Ellesmere in 1926 (Falla et al. 1979). This specimen is in the Canterbury Museum (Tunnicliffe 1973a).

6.81 Red-necked phalarope (Phalaropus lobatus)

A very rare straggler to New Zealand, known from only three sightings, including one at Lake Ellesmere in 1929 (Falla et al. 1979).

6.82 Wilson's phalarope (Phalaropus tricolor)

A very rare straggler to New Zealand, known only from three records, including two birds from Lake Ellesmere (Sagar and Harrison 1984). This species was first recorded from the Manawatu Estuary in 1983. On Ellesmere one bird was found at the tip of the Kaitorete Spit on 19.11.1983 (PS) and was observed several times in the following weeks. In January 1984 two birds were present on the Greenpark Sands (OSNZ). At least one bird remained until 22.4.1984 (COD). The birds fed in the water column and on saturated Mimulus-dominant saltmarsh.

STERCORARIIDAE (Skuas)

6.83 Southern great skua (Stercorarius skua lonnbergi)

An oceanic and coastal species breeding in southern New Zealand and on sub-antarctic islands. Stead (1932) recorded this species occasionally over Lake Ellesmere. The most recent published record was of one on 7.1.1967 (Tunnicliffe 1973a). The species probably occurs as a regular straggler.

6.84 Antarctic skua (Stercorarius maccormicki)

The skua of coastal Antarctica. An occasional straggler to New Zealand.

There is one record from the Ellesmere area of an immature bird along the Kaitorete Spit swimming in shallow lake water from 2-10.12.1972 (RP, DG).

6.85 Arctic skua (Stercorarius parasiticus)

A summer migrant to New Zealand where it is the most numerous skua (although not common) in coastal seas. Three records, one on 1.3.1975 (RP), two birds on 18.4.1982 (CM) and three birds on 24.4.1983 (COD).

6.86 Pomarine skua (Stercorarius pomarinus)

A summer migrant to New Zealand from the arctic. Two records, one on 13.11.1982 (CM) and two birds on 23.3.1982 (COD) all along the Kaitorete Spit.

LARIDAE (Gulls)

6.87 Southern black-backed gull (Larus dominicanus)

Records: numerous, resident and breeding (see Tunnicliffe 1973a and Appendix 2).

Population: a common gull found throughout New Zealand and which is found all around Lake Ellesmere. The summer population during 1981-1982 was about 1000 birds. During the non-breeding season, day-time numbers on the lake proper were lower, as flocks moved onto adjacent farmland. Non-breeding birds were always concentrated on adjacent farmland. An influx of first year birds not raised on the lake occurred in December 1981. Black-backed gulls are common in all study areas (Table 4). They occur on saltmarsh, farmland, open lake water and coastal habitat along the Kaitorete Spit. Black-backed gulls feed on dead birds, and farmland or saltmarsh invertebrates.

Breeding distribution in 1981-1982 is outlined in Figure 26. Additional colonies were present in coastal sand dune country along the Kaitorete Spit. Breeding occurs from October to January, and rising lake waters sometimes destroy nests.

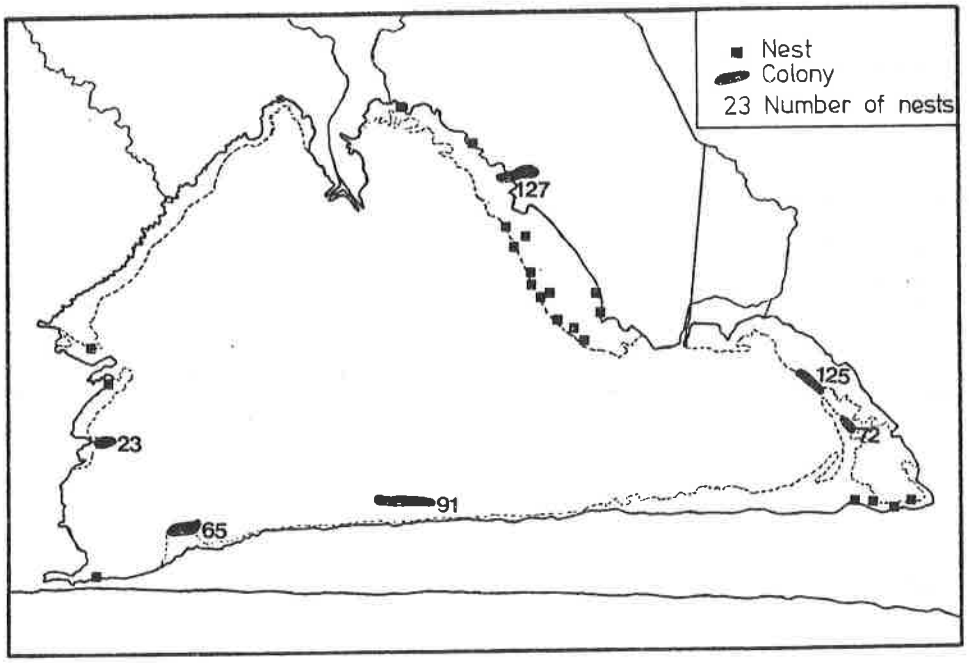

FIGURE 26 : Distribution of Breeding Black-backed Gulls at Lake Ellesmere, 1981-1982

6.88 Red-billed gull (Larus novaehollandiae scopulinus)

Records: numerous (see Tunnicliffe 1973a and Appendix 2).
Population: a common coastal gull found throughout the country. Resident along the coast of the Kaitorete Spit and frequently seen feeding over the lake. A regular roost is present in the Taumutu study area. Large flocks on the lake are infrequent, but small numbers occur in flocks of black-billed gulls. Numbers vary seasonally with most sightings in autumn.

Sightings erratic in most study areas, (Table 4) with birds feeding on wet saltmarsh, mudflat and shallow lake water. Roosting occurs on lake water and shingle spits.

A small breeding colony of 20-30 pairs was reported from the Kaitorete Spit at Birdling's Flat (Gurr and Kinsky 1965) and breeding still occurs

erratically in this locality. However, no nesting occurred in 1981-1982.

6.89 Black-billed gull (Larus bulleri)

Records: numerous (see Tunnicliffe 1973a, Appendix 2).
Population: an endemic gull, most numerous on the east coast of the South Island. Black-billed gulls breed mainly on South Island braided riverbeds (O'Donnell and Moore 1983) and migrate to the coast in the non-breeding season. Stead (1932) stated that "enormous numbers" collected on the shores of Ellesmere in summer and autumn, including flocks of 2000-3000 birds. Very large flocks still occur with c. 5000 birds present in winter 1981. Some movements occur between the lake and adjacent cultivated land.

Recorded from all study areas (Table 4), but are most numerous on the Greenpark Sands. Black-billed gulls feed mainly on saltmarshes and mud flats covered with thin surface water film. Roosting occurs in most habitats.

Stead (1932) recorded breeding colonies of "considerable size" in "most years" but this gull no longer breeds on the lake.

STERNIDAE (Terns and Noddies)

6.90 White-winged black tern (Chlidonias leucopterus)

Records: Oliver (1955) included Lake Ellesmere within the distribution of this species; Tunnicliffe (1973a) mentions that several sightings have been made; two in 4.1962 (Graham 1972); one on 6.2.1972 (RP); two in 4.1979 (COD); one on adjacent Coopers Lagoon 12.3.1984 and later at Taumutu (COD).

Population: a rare straggler to New Zealand and at least one breeding record in South Canterbury (Pierce 1974). Records from Selwyn (1972), Kaituna (1979), Taumutu (1984) and on adjacent Lake Forsythe and Coopers Lagoon.

In 1979 white-winged black terns fed over shallow brackish water, Scirpus and Juncus reedbeds and wet saltmarsh and caught insects on the wing.

6.1 Caspian tern (Hydroprogne caspia)

Records: numerous (see Tunnicliffe (1973a) and Appendix 2).
Population: a native tern found throughout New Zealand but scarce in the south of the South Island. Resident and breeding on Ellesmere where 20 birds were present during summer 1981-1982. One colony (eight pairs) was present on an island off the Kaitorete Spit. This is considered to be a large concentration for Canterbury where isolated breeding pairs occur elsewhere in the province (Pierce 1984).

Caspian terns have been recorded in small numbers in all study areas (Table 4). Breeding occurred in the Kaituna, Kaitorete and Kaitorete Tip areas during 1981-1982 and, in addition, in the Embankment area from 1982 to 1985. Tunnicliffe (1973a) recorded breeding birds along the seaward shore of the Kaitorete Spit and on the Marshall Islands on the western side of the lake. I have not confirmed breeding in these areas during this study.

These terns feed over open lake water and along the coast. They breed on sandy islands, on saltmarsh in Scirpus reedbeds, semi-grassed islands and shingle beach. All nests on Ellesmere 1981-1983 were associated with black-backed gull colonies.

7.92 Black-fronted tern (Sterna albostriata)

Records: numerous (see Tunnicliffe 1973a and Appendix 2).
Population: an endemic tern which breeds almost entirely on braided riverbeds on the east coast of the South Island (O'Donnell and Moore 1983). These terns migrate to coastal waters (a few to the North Island) in the non-breeding season (Lalas 1979). Black-fronted terns occur on Lake Ellesmere mainly from February to August (Figure 6). Small numbers used the lake in winter 1982 with the largest flock being seven birds on 1.3.1982. Groups of birds were very mobile and I think that high numbers passed through the lake. Larger flocks have been recorded in other years and flocks of up to 50 have been seen feeding along the seaward side of the Kaitorete Spit. On the lake, feeding occurs over shallow lake water and saturated saltmarsh. Aquatic or terrestrial invertebrates are taken while on the wing or by diving into water. Roosting occurs on mudflats and fence posts.

6.93 Fairy tern (Sterna nereis)

Records: "Recently observed" (Oliver 1955). Last confirmed sighting was of

one bird in March 1944 (Baily 1955).

Population: formerly much more widespread in New Zealand, this tern is now known as a breeding bird only from Northland (fewer than 10 birds Falla et al. 1979). Formerly common in Canterbury (Oliver 1955) but no recent records.

6.94 Eastern little tern (Sterna albifrons sinensis)

Records: five on 5.1.1967, seven on 27.2.1968 (Tunnicliffe 1973a); one in 11.1972, 10 on 23.12.1972 (OSNZ); eight on 16.2.1973 (RP); one on 17.11.1973 (DG); two on 1.12.1973 (RP); two on 26.12.1973 (DG); two in 1.1981 (OSNZ); one on 28.2.1981 (COD); one in 4.1981 (KH); three on 5.2.84 (COD).

Population: an uncommon but now regular migrant to New Zealand from the Pacific between November and April. Most birds appear on the northern harbours of the North Island and much less frequently in the South Island. The species is a regular visitor to Lake Ellesmere where groups of up to 10 birds have been recorded. Little terns have been observed foraging over shallow lake waters and wet saltmarsh and roosting on saltmarsh and mudflats. They hawk for insects while on the wing.

6.95 White-fronted tern (Sterna striata)

Records: numerous (see Tunnicliffe 1973a, Appendix 2).
Population: the commonest New Zealand tern. Resident on Ellesmere where a regular roost generally supports 100 or more birds. Numbers over much of the lake are low and occurrence irregular, but the species is numerous along the coast (Kaitorete Spit). Of 447 chicks banded at Ellesmere in 1954, six were recovered in Australia the following winter (Clark and Dawson 1957).

White-fronted terns are most frequent on western and southern shores of the lake with highest numbers in the Taumutu study area where birds are always present. They feed over open lake waters and along the coast and roost on shingle islands and sand spits.

Breeding has not been confirmed in recent years. In 1954 a large colony estimated at 1500 pairs nested at Ellesmere (Clark and Dawson 1957). Newly - fledged juveniles were observed at Taumutu on 15.1.1982.

COLUMBIDAE (Pigeons)

6.96 New Zealand pigeon (Hemiphaga novaeseelandiae novaeseelandiae)

A species which is generally associated with forest habitats and breeds in Christchurch and on Banks Peninsula. The New Zealand pigeon occurs as a straggler to Lake Ellesmere (e.g. one on 27.11.1967, Tunnicliffe 1973a) where it occurs in groves of introduced trees.

6.97 Rock pigeon (Columbia livia)

An introduced pigeon which is common around Ellesmere. Flocks of 30 to 40 birds are seen and are very mobile around the whole lake. They frequent farmland and saltmarsh habitats and breed on Banks Peninsula.

CACATUIDAE (Cockatoos)

6.98 White cockatoo (Cacatua galerita)

An introduced species represented by a few small populations in the North Island. One bird was seen flying over Greenpark on 26.12.1982 (GG).

CUCULIDAE (Cuckoos)

6.99 Shining cuckoo (Chrysococcyx lucidus lucidus)

A summer migrant occurring in small numbers around the lake from September to March. Frequents willow, pine and Eucalyptus habitats on lake shore and adjacent farmland.

6.100 Long-tailed cuckoo (Eudynamis taitensis)

A summer migrant to New Zealand regularly occurring but in very low

numbers in Canterbury. One record from Ellesmere (Tunnicliffe 1973a).

STRIGIDAE (Owls)

6.101 Little owl (Athene noctua)

An introduced owl which is widespread throughout Canterbury and is common around Lake Ellesmere. This owl is mainly seen roosting in willows and macrocarpa groves but is also seen in open country. On the western side of the lake breeding occurs in willows and on the margins of the Selwyn and L II Rivers. On the eastern side of the lake, breeding habitats include macrocarpa trees, old buildings and hollows in loess bluffs.

ALCEDINIDAE (Kingfishers)

6.102 New Zealand kingfisher (Halcyon sancta vagans)

An endemic subspecies, commonly associated with wetlands but which breeds in forests and other habitats. Small numbers are resident on the lake and one pair bred in summer 1981-1982 (Hart's Creek). Greater numbers arrive during autumn (February-March), probably from Banks Peninsula, and spend the winter around the lake. The Ellesmere population probably never numbers more than 50 birds.

ALAUDIDAE (Larks)

6.103 Skylark (Alauda arvensis arvensis)

An introduced species which is very common, resident and breeding throughout the area. Nesting habitats include Salicornia, Agrostis, Hordeum and Scirpus associations on high level saltmarshes. Birds commonly feed on both wet and dry saltmarshes.

HIRUNDINIDAE (Swallows)

6.104 Welcome swallow (Hirundo tahitica neoxena)

Before 1958 this swallow was a rare vagrant to New Zealand. In the late 1950's breeding was first recorded in the North Island and the species began to spread rapidly. Swallows were first recorded breeding in the South Island in 1961 at Lakeside, Lake Ellesmere (Turbott 1965). In subsequent years the swallow became well established over much of the South Island and is now numerous around all of Ellesmere. During late summer, autumn and winter, flocks of 50 + birds form and feed over saltmarsh habitats and shallow lake water.

MOTACILLIDAE (Wagtails and Pipits)

6.105 New Zealand pipit (Anthus novaeseelandiae novaeseelandiae)

Tunnicliffe (1973a) recorded pipits as resident and breeding around Ellesmere. However, during summer 1981-1982 there were very few around the lake except on the Kaitorete Spit. There was an increase in numbers around the whole lake in autumn and winter. It was concluded that the majority of Ellesmere pipits were migratory. Breeding birds on the Kaitorete Spit were restricted to herbfield and shingle habitats, although in winter pipits fed on wet and dry saltmarshes.

CAMPEHAGIDAE (Cuckoo-shrikes)

6.106 Black-faced cuckoo-shrike (Coracina novaehollandiae)

An Australian species recorded c. 12 times in New Zealand; one at Lake Ellesmere in June 1904 (Oliver 1955).

PRUNELLIDAE (Accentors)

6.107 Hedge sparrow (Prunella modularis occidentalis)

Common and breeding around the whole lake where there is emergent vegetation. Very common in Juncus-Plagianthus and willow-dominant associations.

MUSCICAPIDAE (Warblers, Flycatchers and Thrushes)

6.108 South Island fernbird (Bowdleria punctata punctata)

This species was once present in Canterbury, but now appears to be extinct there. Stead (1927) stated "as far as I know, extinct in Canterbury". In 1898 they were plentiful, (apparently throughout) and could be seen in swamps near New Brighton. A recent record of two fernbirds at Drain Road on the western shore of Lake Ellesmere in 1978 (Habraken 1978b) has not been confirmed. Neither Tunnicliffe(between 1964 and 1973) nor I have recorded this species despite numerous visits to the area.

6.109 Grey warbler (Gerygone igata igata)

Common and breeding around the whole of Lake Ellesmere (though scarce along the Kaitorete Spit). Generally frequents trees and scrub including Juncus-Plagianthus associations and willow habitat.

6.110 South Island fantail (Rhipidura fuliginosa fuliginosa)

A common breeding species around the whole lake foreshore wherever trees or low shrubs are present. Particularly common in willow woodland.

6.111 Song thrush (Turdus philomelos clarkei)

Common and breeding around the whole lake. Infrequent in saline vegetation but common in freshwater swamp associations, scrub and groves of trees.

6.112 Blackbird (Turdus merula merula)

Common and breeding around the whole lake, especially on adjacent farmland

and in willow areas. Sometimes they feed on higher-level saltmarshes.

ZOSTEROPIDAE (Silvereyes)

6.113 Silvereye (Zosterops lateralis lateralis)

Common and breeding around the whole lake, especially in willow habitats. Large, wide-ranging flocks are seen in winter.

MELIPHAGIDAE (Honeyeaters)

6.114 Bellbird (Anthornis melanura melanura)

Common and breeding in bush on Banks Peninsula. One record from Yarr's Flat on 14.7.1982 (COD).

EMBERIZIDAE (Buntings)

6.115 Yellowhammer (Emberiza citrinella caliginosa)

Very common and breeding around the whole lake. Very large flocks feed on wet saltmarshes during winter.

6.116 Cirl bunting (Emberiza cirlus cirlus)

Cirl buntings are rare around Ellesmere (as they are in other parts of Canterbury). They have been recorded most recently around the L II Rivermouth.

FRINGILLIDAE (Finches)

6.117 Chaffinch (Fringilla coelebs gengleri)

Common and breeding around the whole lake where there are trees.

6.118 Greenfinch (Carduelis chloris chloris)

The least common finch at Lake Ellesmere but none-the-less numerous, particularly in winter. Present in willow, scrub and rush-sedge associations but rarely on saltmarshes.

6.119 Goldfinch (Carduelis carduelis britannica)

Very common and breeding around the whole lake where it uses all terrestrial habitats. Large flocks feed on wet saltmarshes in autumn and winter.

6.120 Redpoll (Carduelis flammea cabaret)

Common and breeding around the whole lake where it uses all terrestrial habitats. Large flocks feed on wet saltmarshes in autumn and winter.

PLOCEIDAE (Weavers)

6.121 House sparrow (Passer domesticus domesticus)

Common and breeding around the lake. Sparrows avoid wetland habitats and concentrate around dwellings and groves of introduced trees.

STURNIDAE (Starlings)

6.122 Starling (Sturnus vulgaris vulgaris)

Common and breeding around the whole lake and flocks of many hundreds of starlings feed on wet saltmarshes. Many nest in maimais.

CRACTICIDAE (Bell Magpies)

6.123 White-backed magpie (Gymnorhina tibicen hypoleuca)

Common and breeding around the whole lake, usually on dry-land.

CORVIDAE (Crows)

6.124 Rook (Corvus frugilegus frugilegus)

Central Canterbury is one of the few areas in which this introduced species is established in New Zealand. Birds form one breeding population, centred on Lake Forsythe and Little River (Banks Peninsula), and feed along the eastern shore of Lake Ellesmere. Individual birds or small flocks straggle to other parts of the lake. Tunnicliffe (1973a) noted that these birds once frequented the western side of the lake but since control measures were introduced in the region (the rook is considered a pest) numbers have declined markedly.

7.0 WILDLIFE VALUES OF FORESHORE STUDY AREAS

Bird counts were carried out in each of the 15 study areas (Figure 2) and old counts from a variety of sources were collated (Appendix 2). During the study period the importance of each study area for wildlife was assessed; the state of, and changes in, the habitat noted; and behaviour of individual bird species investigated. Several study areas were relatively difficult to get to and survey, so fewer bird counts were made in them than elsewhere and knowledge of the wildlife is less thorough.

7.1 Eastern Greenpark Sands[1]

Location: an area of up to 1,000 ha of saltmarsh on the northern shore of Lake Ellesmere, extending from the Greenpark Huts to Jarvis Road (Figures 2 and 27).

Habitat (Figure 6): the area is completely flat and is covered with a variety of saltmarsh plant associations and bare mud. Mimulus and Lilaeopsis are dominant at low levels which are subject to frequent flooding. Higher up the shoreline Salicornia and Triglochin appear, while still higher localised patches of Cotula, Selliera, Samolous and Plantago can be found. Closest to the edge of developed farmland, saltmarsh plants merge with salt-tolerant pasture grasses and a narrow band of sea rush and shore ribbonwood is found. The area is subject to regular flooding by lake water and this generally follows a seasonal pattern (Section 3.6). During much of the winter the whole area is covered with shallow water with only highest level saltmarsh remaining uncovered. When the lake is opened in October-November much of the saltmarsh is exposed as the water level recedes, but mud remains wet and many ponds and a large central depression (Figure 27) are formed over the area. The marshes gradually dry out during a hot summer. During late November and December 1981 the area dried out completely. In late December, January and February 1982 the area occasionally became wet after rain or when lake levels rose again and eventually the saltmarshes became fully flooded. The state of the habitat can change within hours. For example, heavy rain can fill ponds temporarily or sudden wind changes may result in much of the area being covered. Under these conditions saltmarshes may be wet one day and dry the next with bird use changing markedly.

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[1] FOOTNOTE: The Eastern Greenpark Sands (7.1), Embankment Saltmarsh (7.2) and Yarr's Flat (7.3) are collectively known as the Greenpark Sands (Figure 1).

Wildlife: during 1981-82 the study area was considered to be of outstanding value to waders, high value to waterfowl, and of potential value to swamp birds (Figures 28, 29 and 30). Forty-three species of wetland bird have been recorded (Table 4, Appendix 2). Non-wetland species which commonly feed on saltmarshes include skylark, New Zealand pipit, yellowhammer and starling. This study area has particularly high use by birds (see Appendices for comparisons with other areas).

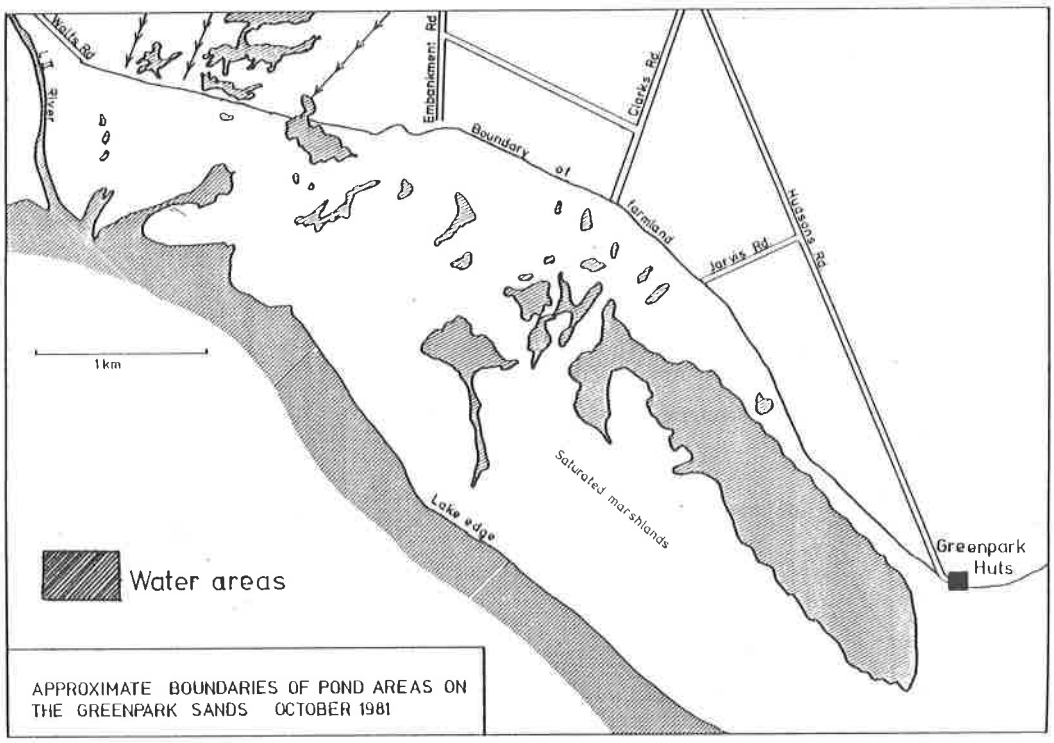
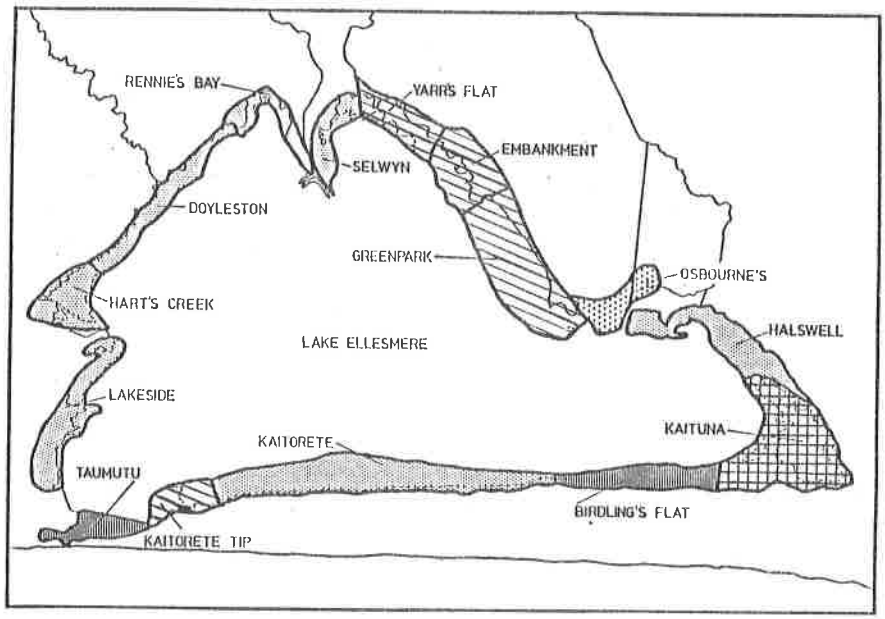


FIGURE 27 : Approximate boundaries of pond areas on the Greenpark Sands October 1981

Highest numbers of birds are present during spring and autumn, and lowest numbers if saltmarshes dry out in late summer. During dry conditions most waders and waterfowl are forced to feed along the lake edge and some species move towards the L II River where saltmarshes usually remain partly wet. Total drying occurs only in exceptionally dry years, at which time some waders still use the saltmarshes but in much lower numbers (e.g., banded dotterels, spur-winged plovers, a few wrybills and waterfowl spp.) When the marshes are wet, highest usage is of large ponds adjacent to the Greenpark Huts (Figure 27). Use of the area changes seasonally according

FIGURE 28 :

Waders



KEY

- Outstanding
- High
- Moderate-High
- Moderate
- Potential

FIGURE 29 :

Waterfowl

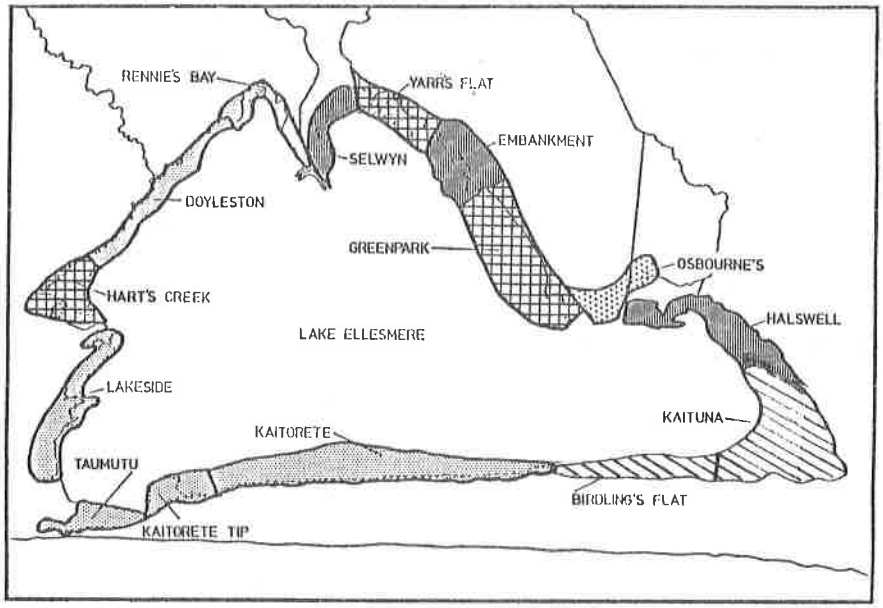
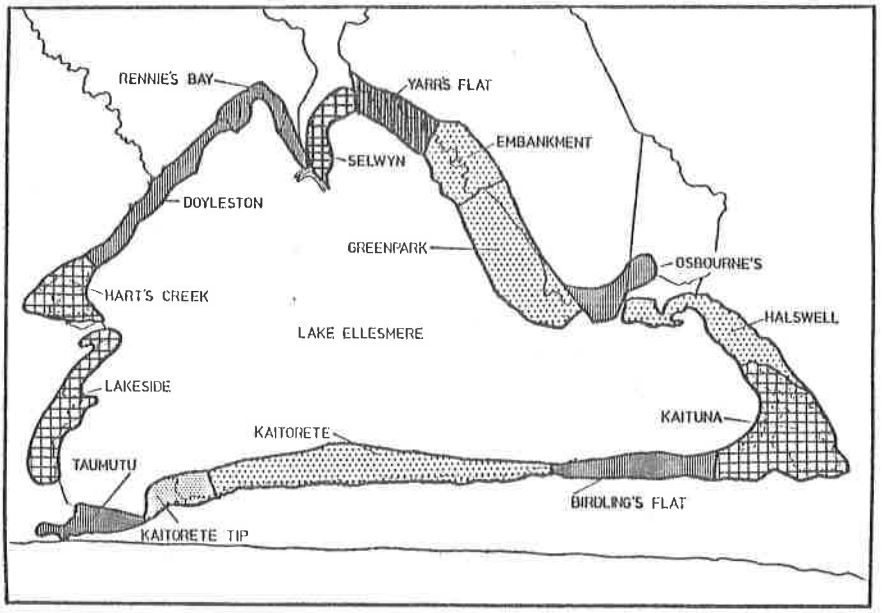


FIGURE 30 :

Swamp birds



WILDLIFE VALUES OF FORESHORE STUDY AREAS

1981–1982

to the migration patterns of birds or as water levels change over the summer. Species present in highest numbers in the study area are black swan, mallard, grey teal, New Zealand shoveler, pied stilt, white-faced heron, spur-winged plover and banded dotterel. Waterfowl numbers are highest in late winter (after duck-shooting), when over 10,000 birds may be present, and lowest in spring, when many ducks leave the area, presumably to breed inland. Black swans leave the area between August and November, when breeding is in progress at the Birdling's Flat colony, but during the non-breeding seasons up to a third of the Ellesmere swan population may be present here. Canada geese are present from December until the next spring. Grey teal numbers fluctuate widely but were high throughout the summer of 1981-82 (up to 1,000 birds). Waterfowl use the saltmarshes for grazing and loafing and a few mallard breeding pairs nest in maimais, shooters hides, and in tall sedges.

Wader numbers are highest from October to April. Pied stilts and banded dotterels are the most common indigenous waders using the area with flocks of over 3,000 of each species recorded, particularly during summer and autumn. Flocks of curlew sandpipers, sharp-tailed sandpipers and red-necked stints are among the largest seen in New Zealand. Every year much rarer waders are recorded (Appendix 2). The area provides little suitable habitat for S.I. pied oystercatchers, bar-tailed godwits and knots. Nonetheless, some of the largest flocks of these species recorded on the lake have been seen in this study area. Large numbers of black-billed gulls use the saltmarshes in autumn and winter. Black-backed gull nests are scattered over higher level saltmarshes in summer, but no large colonies occur.

7.2 Embankment Road Saltmarshes

Location: a c.500 ha area of saltmarsh north-west of the Eastern Greenpark study area, between Jarvis Road and Embankment Road (Figure 2 and 27).

Habitat: saltmarsh vegetation and topography are very similar to the Eastern Greenpark Sands but an important difference is that the area remains wetter for longer after lake levels drop because of the slightly lower topography. The pattern of water level fluctuations is similar to that of Greenpark. Southerly winds cause flooding of very large areas of marsh, while the following strong north-westerly or north-easterly winds expose the areas again. These conditions make the area attractive to a very wide range of water birds.

Wildlife: during 1981-1982 the Embankment study area was considered to be of outstanding value for waders, moderate-high value for waterfowl and potential value to swamp bird species (Figures 28, 29 and 30). Forty-three wetland bird species have been recorded (Table 4, Appendix 2) and the area appears to be the second most important for migratory waders after Yarr's Flat (Section 7.3). The importance of the area for waders varies from year to year depending on the state of the lake levels and possibly the numbers of overseas migratory waders reaching Canterbury each summer.

High numbers of pied stilts (1,000+) and banded dotterels (2,000+) were recorded during winter 1981 on several occasions. Flocks of up to 300 spur-winged plovers and wrybills have also been recorded. Mixed flocks of overseas migratory waders occur, usually around a large shallow pond close to the end of Embankment Road, but after fresh flooding of the marshes, birds become widely scattered.

Waterfowl numbers are usually slightly lower than in adjacent study areas (Greenpark and Yarr's Flat). Over 500 black swans, 300 Canada geese and 500 grey teal have been recorded and most feeding occurs in shallow water on the lake foreshore. Occasionally swans and geese range over the whole saltmarsh and ducks are seen in the isolated ponds. Low numbers of mute swans and paradise shelducks are resident. Recently the area provided the first sighting of chestnut-breasted shelduck in New Zealand (Fennell et al. 1983).

Herons, gulls, terns and shags are usually present in this area. Numbers of black-billed gulls vary greatly with very high numbers present when marshes are saturated, especially in autumn and winter. A black-backed gull colony of c. 65 pairs is present each year on salt-tolerant pasture on the upper margin of saltmarsh. Little terns and black-fronted terns use the area intermittently.

7.3 Yarr's Flat

Location: a wildlife management reserve (260 ha) located at the north-west end of the Greenpark Sands (Figures 2 and 27) between Embankment Road and the L II River mouth.

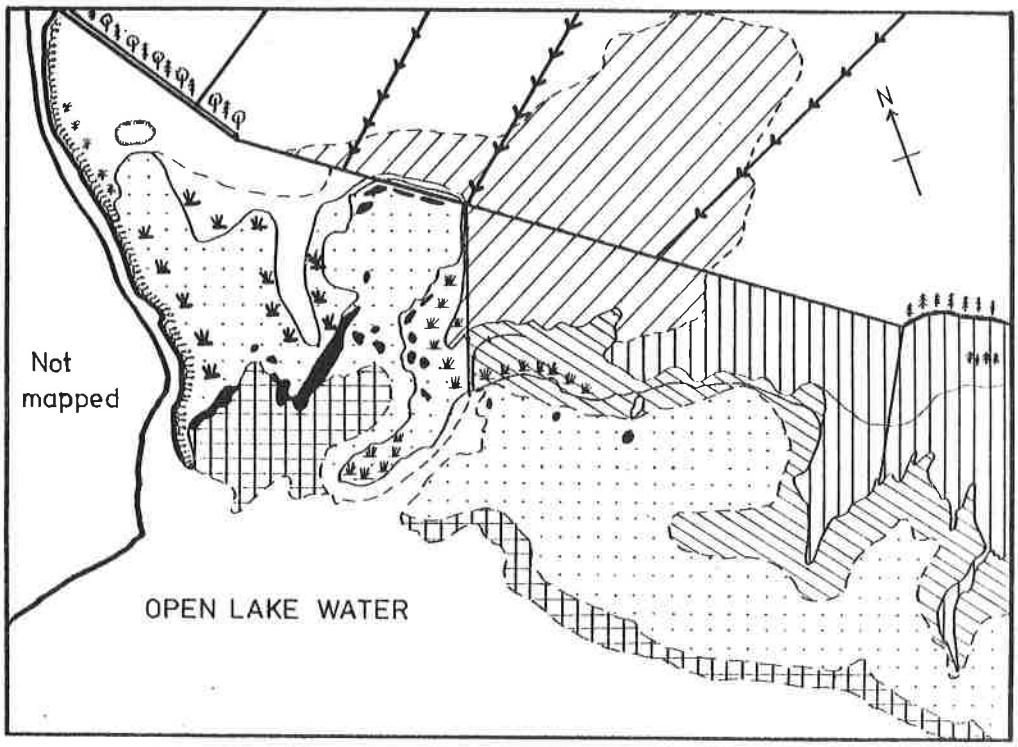
Habitat: Figure 6.2 illustrates a representative profile of Yarr's Flat

habitat. Most of the study area is covered in saltmarshes of the types previously described. Again, the area is subject to frequent flooding, with short-term flooding resulting from changing wind direction being more extreme in this area than elsewhere around the lake because of its geographical location and lower topography. The whole area is affected and a complex mosaic of wet and dry areas is formed (Appendix 3). Yarr's Flat is the only saltmarsh on the lake which remains partly inundated during most drought periods. A seemingly continuous succession of north-east to south-west wind changes during December 1981 and January 1982 covered, then exposed, the flats almost daily. Maintenance of wet areas during drought is also facilitated by the presence of two drains, five artesian bores and the L II River which enter the lake on, or about, the reserve.

Inland of the saltmarsh zone are extensive areas of emergent swamp vegetation scattered over semi-developed and salt-tolerant pasture. The original swamp vegetation has been greatly reduced by draining, burning, grazing and the introduction of exotic plants species. Only tiny remnants of original Carex secta vegetation remain along the banks of the L II River. Today the dominant swamp vegetation is sea rush mixed with shore ribbonwood and it extends out of the reserve area to the north, well into areas of developed farmland, covering c. 160 ha. Vegetation of the area is illustrated in Figure 31.

Wildlife: during 1981-82 Yarr's Flat was considered to be of outstanding value to waders, high value to waterfowl and moderate-high value to swamp birds (Figures 28, 29 and 30). Habitat diversity and a favourable water level regime appear to be the keys to the high value of the area. Forty-nine wetland species have been recorded in this study area (Table 4, Appendix 2) and the majority of arctic waders are present either regularly or continuously. In summer 1981-82, (a very dry year), over 95% of waders on the lake were resident in this area when all other saltmarshes around the lake dried up. Farther inland, fresh-water ponds surrounded by pasture provided important habitat for golden plovers, sharp-tailed sandpipers, pectoral sandpipers and pied stilts.

As in the Embankment and Greenpark study areas the most numerous waders are banded dotterel and pied stilt (up to c. 1,000 of each) with highest numbers in autumn, early winter and early spring (Figures 17 and 25). Only c. 20 pairs of stilts and five pairs of dotterels nested there during the 1981-82 season. Numbers of two overseas migrants are particlarly significant. In summer of 1980-81 c. 70 curlew sandpipers and c. 220



KEY:

- Exotic trees
- Willows
- Niggerhead
- Scattered rushes
- Dense rushes and ribbonwood
- Scirpus americanus (pungens)
- Developed Pasture
- Salt tolerant pasture and saltmarsh
- Salicornia dominant saltmarsh
- Mimulus dominant saltmarsh or mix associations
- Bare Mud

FIGURE 31 : Generalised vegetation pattern, Yarr's Flat, February 1982

red-necked stints used the area and in 1981-82 c. 60 curlew sandpipers and c. 214 red-necked stints were present. These numbers probably represent up to 60% of the New Zealand populations (Appendix 5). Rare waders have been frequently recorded (Appendix 2).

Waterfowl numbers can be very high at Yarr's Flat, especially during southerly storms when many thousands of ducks may shelter close to the L II River. Numbers of black swans usually range from 300-1,000 birds. A small colony of c. 40 swans nests on a Juncus-covered island close to the L II River. In 1981-1982 early nests were flooded by high lake levels, but later nests and/or second clutches were successful. From October 1981 to February 1982, particularly high numbers of grey teal were present with flocks of 600-1,000+ birds recorded. Shovelers are also present in high numbers, with a maximum flock size of 500 birds. Canada geese, paradise shelducks and grey ducks are present only in low numbers. Numbers of mallards are variable with very low numbers in October-November, a marked increase to c. 500 birds at the beginning of January and highest numbers in winter (after the duck-shooting season).

Numbers of herons, gulls, terns and shags are higher than in other study areas along the Greenpark Sands. Royal spoonbills, white herons and bitterns occasionally visit the area. Up to 500 black-billed gulls were recorded feeding on saltmarshes during summer 1981-1982. Little terns (max. 8) are rare visitors and marsh crakes are present in Juncus areas behind Yarr's Flat.

7.4 Selwyn River Area

Location: an area of up to c. 300 ha between the L II and Selwyn rivermouths (Figure 2).

Habitat: the Selwyn study area contains a complex mosaic of reedbeds, mudlands, semi-developed pasture and saltmarsh. Reedbeds are concentrated close to the L II River and include monocultures of raupo (2 m high), Scirpus spp. (1 m high) and Juncus spp. (0.3 m high). Pond areas and water channels are present between reedbeds. Only small saltmarsh areas are present, but relatively extensive areas of mud are present along the shoreline. Surrounding developed and semi-developed farmlands are flooded during the winter. Willows and small areas of Carex secta are present along the banks of the L II River. The fluctuating water level follows a similar pattern to

that of the previously-described study areas.

Wildlife: during 1981-1982 the Selwyn study area was considered to be of moderate value to waders, moderate-high value to waterfowl and high value to swamp birds (Figures 28, 29 and 30). Forty-six wetland bird species have been recorded (Table 4, Appendix 2), but numbers are not as high as on the Greenpark Sands. Use by waders is irregular, with only pied stilts being present in high numbers. During 1981-1982 over 700 stilts were seen moving several times to and from this area and Yarr's Flat. Banded dotterels are usually present but only in low numbers.

All species of waterfowl present on the lake use the area. Most ducks feed and loaf on sheltered ponds among reedbeds or along the L II River. Canada geese and black swans graze semi-developed farmland in winter. Grey teal are almost always present but usually number fewer than 200 birds. The area appears to be a more important feeding area for waterfowl than Yarr's Flat. Unlike in most other study areas, mute swans are always present and breeding is attempted. Reedbeds in the study area are particularly important to marsh crakes and pukekos. Marsh crakes appear to occur in much higher numbers than in most other study areas but no quantitative study was undertaken. Bitterns are occasionally seen. Post-breeding flocks of over 60 white-faced herons occur in autumn.

7.5 Rennie's Bay

Location: a large bay at the north-western tip of the lake, covering c. 200 ha of shore west of the Selwyn River (Figure 2).

Habitat: unlike the previously described study areas, Rennie's Bay has a relatively narrow area of foreshore mudflat, saltmarsh and rushland, even over a wide range of lake levels, because of a steep drop-off into the lake. In November 1981 the area was covered with small ponds between patches of Salicornia but most of these ponds dried out in December. For much of the year the foreshore is completely flooded. Above the saltmarsh-mudflat zone there is a narrow band of sea rush and three-square, which grades into developed farmland. Willows are present at the Selwyn rivermouth and the south-western tip of the study area.

Wildlife: during 1981-1982 the area was considered to be of moderate value to waterfowl and waders and moderate-high value to swamp birds (Figures

28, 29 and 30). Twenty-seven wetland bird species have been recorded (Table 4, Appendix 2). Despite being a long stretch of shoreline, the Bay has a limited number and area of habitats suitable for birds, particularly for waders. Wader numbers are low with only pied stilts always being resident. Royal spoonbills, cattle egrets and turnstones are occasionally seen, suggesting that important habitat may be present at times. High numbers of little shag are recorded, as this area is closest to the large breeding colony located on the Selwyn River.

All the common waterfowl species are represented, with Canada geese being the most numerous during the winter.

7.6 Doyleston

Location: a long stretch of indented shoreline on the western side of the lake between Rennie's Bay and Drain Road (Figure 2).

Habitat: this area has no extensive saltmarsh flats. A narrow band of reedbeds stretches down the whole shoreline, with three-square dominating in the north, and jointed rush, sea rush and shore ribbonwood in the south. Several small areas of willow-dominant swampland are also present. These areas have flax, Scirpus spp. Carex spp. and Juncus spp. below emergent crack willows. Scirpus reedbeds are quite extensive at the mouths of some drains and places such as the Irwell Rivermouth. At very low lake levels, small mudflat areas are also formed at the drain-mouths. In this area the inflowing drains themselves are important habitat, providing cover in the form of willows and Scirpus spp.

Wildlife: during 1981-1982 the area was considered to be of moderate value to waders and waterfowl and moderate-high value to swamp birds (Figures 28, 29 and 30). Twenty-four wetland bird species have been recorded (Table 4, Appendix 2). Most of the species typical of the lake, excluding overseas migratory waders, are resident in the area. The most numerous species are black swan, Canada geese, mallard, shoveler, pukeko, pied stilt, black-backed and black-billed gulls. The area provides important habitat for marsh crakes and bitterns. The area is a regular haunt of cattle egrets. Birds from the Taumutu cattle egret population are occasionally seen in this area, most frequently on the farmland adjacent to the lake but also feeding along the lake shore and roosting on rushes.

TABLE 8 : HART'S CREEK BIRD COUNTS 1964 - 1981

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Black shag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	8
White-faced heron	7	2	6	-	2	1	-	-	-	2	-	3	-	-	-	-	5	0
Bittern	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Black swan	956	167	268	557	220	74	68	299	230	601	102	461	154	178	107	64	33	102
White swan	53	31	75	61	49	38	22	35	23	28	6	15	17	6	11	12	5	14
Canada goose	580	104	-	434	601	41	3	4	20	16	11	-	16	12	15	-	15	0
Duck sp.	2158	369	504	532	457	1261	3027	1269	136	351	130	87	358	156	387	334	711	-
Paradise duck	4	-	-	-	2	11	-	7	-	-	-	-	-	-	-	-	-	-
Shoveler	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	14	-
Pied stilt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-
Pukeko	87	51	107	100	179	247	127	77	5	67	47	33	60	76	28	39	21	26

Counts by N.C.A.S. in August of each year

7.7 Hart's Creek

Location: an area of c. 300 ha of dense swampland between Drain Road and Timberyard Point (Figure 2). Much of the area is a Wildlife Refuge.

Habitat (Figure 6.3): most of the area is dominated by dense willow swamplands of varying stand age, found in association with Carex secta, jointed rush or scrub (e.g., blackberry, gorse) and introduced grasses. A series of ephemeral lagoons surrounded by willows and rushes is spread throughout the area and along the foreshore a large number of stands of raupo are present. Willows are scattered near the lake edge but rushes extend into the lake. Many of the central ponds dry out during the spring and summer but areas of mudflats are very small compared to those of the Greenpark Sands. Saltmarsh plant species (mainly Mimulus) become established over a limited area.

Wildlife: during 1981-1982 the area was assessed as being of moderate value to waders and high value to waterfowl and swamp birds (Figures 28, 29 and 30). Thirty wetland species have been recorded (Table 4, Appendix 2). The area supports high numbers of pied stilts in all seasons, but numbers of other waders are very low (Appendix 2). The area is one of the most important areas on the lake for waterfowl, especially ducks. The area is the main site for breeding of mute swans on the lake, and is therefore of national significance. Black swans also breed but usually in lower numbers than mute swans. Large numbers of ducks, especially mallards, feed, loaf and breed in the area, and at times can be seen in thousands. Most sightings of marsh crakes and bitterns on the lake are made at Hart's Creek. Pukeko numbers are also high. The area is of high value to terrestrial bird species which feed and nest in the willowlands.

7.8 Lakeside

Location: a long stretch of shoreline on the south-western side of the lake from Timberyard Point to Taumutu township (Figure 2).

Habitat: the shoreline is similar to that of the Doyleston study area, but with more patches of mudflats. About half the shoreline is composed of narrow shingle beach. Three small areas of saltmarsh surrounded by Juncus-Scirpus reedbeds are exposed at low lake levels. Localised swamp

areas are also present and contain raupo, Carex secta, flax, Juncus spp., willow and cabbage tree. Several islands (grass and willow-covered) are c. 50-100 m offshore.

Wildlife: during 1981-1982 the area was considered to be of moderate value to waders and waterfowl and high value to swamp birds (Figures 28, 29 and 30). Thirty wetland species have been recorded (Table 4, Appendix 2). Although the study area provides diverse habitat for wetland species the extent of habitat is limited. The most numerous waders are pied stilts and wrybills, with peak numbers occurring in summer. Waterfowl species are typical of the lake as a whole but only mallards and Canada geese appear to reach high numbers (e.g., 1,500 and 1,800 respectively on 23 April 1982). Marsh crakes again occur wherever swamp vegetation is present. Of note is that the main site for cattle egrets at the lake is in this study area, with the highest number ever recorded being 94 birds in 1980 (Figure 8). Egrets mainly forage on pastures adjacent to the lake shore and roost in willows. Occasionally, however, they will be seen feeding in the lake. During winter flocks containing up to 2,500 black-billed gulls foraged close to the lake shore, and a black-backed gull breeding colony is on one of the offshore islands.

7.9 Taumutu

Location: a small lagoon located at the south-western tip of the lake and separated from the ocean by a narrow shingle barrier (Figure 2). This area includes Taumutu township and Fisherman's Point.

Habitat: directly opposite the township, the shingle barrier is where the Catchment Board opens the lake (Plate 7). As such this area has very saline waters and is tidal when the lake is open. The lagoon has mainly open water with a narrow shingle beach and Scirpus (max. 3 m wide) reedbed around the edge. At the head of the lagoon is a large raupo bed.

Wildlife: during 1981-1982 the area was considered to be of moderate-high value to waders and swamp birds and moderate value to waterfowl (Figures 28, 29 and 30). Thirty-three wetland species have been recorded (Table 4, Appendix 2). The lagoon provides habitat for waders when the lake is low but few species occur. Godwits and oystercatchers pass through during migration in early spring and late autumn. Flocks of herons are present late in the summer when breeding has finished. The common waterfowl species are always present although numbers of birds are low with flocks of black swans,

mallards and shovelers rarely being larger than c. 100 birds each. A pair of mute swans breeds in the raupo at the head of the lagoon. Marsh crakes and one pair of bitterns live in the raupo. The area is an important roost for white-fronted and black-fronted terns, black-backed, red-billed and black-billed gulls. During winter 1981 a mixed-species flock of over 1,000 gulls (mostly of the latter two species) roosted and fed in the area. Skuas are often seen offshore.

7.10 Kaitorete Tip

Location: an area of c. 130 ha of saltmarsh flats at the south-western tip of the Kaitorete Spit (Figure 2).

Habitat: an area of Mimulus- and Salicornia-dominant saltmarsh and mudflat extending out into the lake. The flats are low-lying and regularly flooded with small ponds about a narrow band of Scirpus around the upper edge of the marsh. Only during very dry summers does the saltmarsh dry out completely. For most of the summer mudflats on the edge of the lake are covered with 10-20 mm of water and other ground remains saturated. The saltmarsh merges into semi-developed farmland and Rauolia-dominant herbfield. A tiny remnant of flax is also present.

Wildlife: during 1981-1982 the area was considered to be of outstanding value to waders and moderate value to waterfowl and swamp birds (Figures 28, 29 and 30). Forty wetland species have been recorded (Table 4, Appendix 2). Numbers of arctic migratory waders are comparable with those found on the Greenpark Sands. However, because the area of saltmarsh is much smaller, when the habitat dries out completely birds move elsewhere. There was considerable movement of waders between the Kaitorete Tip and the Greenpark Sands. Banded dotterels are common even when saltmarshes dry out and up to c. 200 pairs breed on the Kaitorete Spit proper. Pied stilts, on the other hand, are usually absent and wrybill flocks are often the largest to be seen on the lake. Many rare waders occur (Table 4, Appendix 2). Most palearctic waders feed in the small ponds, wrybills feed along the lake shore and dotterels feed over the whole area. Waterfowl numbers are generally very low, although all the species typical of the lake have been recorded. Several pairs of Canada geese nest in the saltmarsh and a marsh crake has been recorded in the flax. A black-backed gull colony is occupied annually and a single pair of caspian terns also nests.

7.11 Kaitorete Spit

Location: c. 10 km stretch of shoreline along most of the Kaitorete Spit (Figure 2).

Habitat: (Figure 6.5 and 6.6): this study area differs from all the others in that the area of foreshore habitat is extremely limited. For much of the year lake waters cover any edge habitat and a narrow band of sea rush and shore ribbonwood separates the shore from developed farmland. With lowering of the lake level in spring there appears a narrow stony shore with underlying mud. Some small pools also form. Towards the western end of the study area a small low-lying island is present c. 200 m offshore. The island is mainly bare mud with a few saltmarsh plants along its crest.

Wildlife: during 1981-1982 the area was considered to be of moderate value to waders and waterfowl and potential value to swamp birds. Eighteen wetland species have been recorded (Table 4, Appendix 2). While only a few counts have been made, periodic inspections indicate that only common waders and waterfowl use the area, generally in moderate to low numbers. The most notable feature is the presence of a caspian tern breeding colony of 8-10 pairs on the offshore island. This is by far the largest breeding concentration in the Canterbury region, with all other known breeding birds occurring as isolated pairs (Pierce 1984). A colony of c. 125 pairs of black-backed gulls breeds on the same island.

7.12 Birdling's Flat

Location: c. 300 ha of foreshore at the base of the Kaitorete Spit (Figure 2).

Habitat: developed farmland on the Spit merges into sea rush, Scirpus reedbeds and Mimulus-dominant saltmarsh. The area contains the most extensive Scirpus beds (up to 100 m wide) at the lake. The Scirpus beds remain wet almost all the time. Lake waters in this area are shallow and the amount of available habitat varies depending on lake level and prevailing winds.

Wildlife: during 1981-1982 the area was considered to be of outstanding value

to waterfowl and moderate-high value to waders and swamp birds (Figures 28, 29 and 30). Twenty-four wetland species have been recorded (Table 4, Appendix 2), which partly reflects the fact that few visits were made. Wader habitat, however, is not as extensive as on the Greenpark Sands and palearctic waders appear less regularly and in much lower numbers. Pied stilts and banded dotterels are the most numerous waders, but they number in hundreds rather than thousands. The most notable feature is the annual presence of the largest colony of black swans in New Zealand at the lake. Thousands of geese and mallards are present during autumn and winter but usually low numbers of grey teal and shovelers.

7.13 Kaituna Lagoon

Location: a lagoon covering c. 900 ha at the north-eastern corner of the lake adjacent to the foothills of Banks Peninsula and the Akaroa highway (Figure 2).

Habitat: (Figure 6.4): the "lagoon" is bounded by farmland on three sides and a series of small islands, sand spits and mudflats on the lake side. The lagoon has permanent water even during very low lake levels. There is usually little development of saltmarsh plants, except on the southern shores. The small islands on the western side of the lagoon are covered with introduced grasses and herbs and some rushes. Other flats occasionally exposed have bare mud substrates. An area of c. 50 ha of Scirpus grows on the northern side of the lagoon. Several patches of raupo are located along the eastern shore and these merge into sea rush and salt-tolerant pastures. In this zone small ponds form after rain.

Wildlife: during 1981-1982 the area was considered to be of outstanding value to waterfowl and high value to waders and swamp birds. Forty wetland species have been recorded, (Table 4, Appendix 2). Kaituna is of particular value for pied stilts, with up to 2,400 recorded at one time. Overseas migrants are recorded from time to time, but these are mainly the larger species. A study of the area by Tunnicliffe (1973a) found that the most frequently recorded species were shovelers, pied stilts, black swans, pukekos and mallards. The lagoon provides the best waterfowl habitat on the lake, possibly because of the permanent, partly-sheltered, shallow waters in the lagoon. During 1982 the maximum number of all waterfowl species recorded on one day was c. 12,500 birds in February. Maximum counts for individual species on one day were c. 3,500 shovelers, c. 3,000 black swans, c. 2,750

mallards, c. 2,700 grey teals, c. 2,150 Canada geese, c. 60 grey ducks, c. 30 paradise shelducks and two mute swans. Marsh crakes occur in swamps and drains surrounding the lagoon and this is the only area in which spotless crakes have been recorded on the lake.

7.14 Halswell Flats

Location: c. 500 ha of saltmarsh on the eastern shore of the lake between the Halswell River in the north and Kaituna Lagoon in the south (Figure 2).

Habitat: extensive saltmarsh flats similar to those of the Greenpark Sands. The saltmarshes appear to dry out more quickly than those of the Greenpark Sands and during summer saturated ground is often restricted to the immediate foreshore. Small ponds are formed when lake levels recede, but these are generally close to the shoreline also. At the south end of the area several small islands form during high lake levels, but they are linked with the saltmarsh at other times.

Wildlife: during 1981-1982 the area was considered to be of moderate value to waders, moderate-high value to waterfowl and potential value to swamp birds (Figures 28, 29 and 30). Twenty-six wetland species have been recorded (Table 4, Appendix 2). The Halswell Flats provide important habitat for stilts but usually not for other waders. One feature is that the largest flocks of godwits (up to 200 birds) recorded in the last 10 years have been in this area. Waterfowl numbers, particularly of Canada geese, shovelers and mallards, are often high (c. 1,000 birds each) but overall individual species, numbers are lower than at Kaituna. Habitats for swamp birds are limited but crakes have been recorded along inflowing waterways. A black-backed gull colony occurs annually on one of the islands.

7.15 Osbourne's

Location: an area of shoreline between the Greenpark Huts and the Halswell rivermouth and extending up the Halswell River (Figure 2).

Habitat: the area is a mosaic of Salicornia-dominant saltmarsh, sea rush - shore ribbonwood and developed pasture. Rushlands are extensive along the Halswell River and Canal, and in the water courses emergent swamp plants

(Juncus spp., Scirpus, raupo) are present. The area was once similar to the Eastern Greenpark study area, but it has been modified by stop-banking along the lake shore. No longer are saltmarshes flooded by fluctuating lake levels although shallow brackish pools are formed after rain.

Wildlife: during 1981-1982 the area was considered to be of potential value to waders and waterfowls and moderate-high value to swamp birds (Figures 28, 29 and 30). No bird counts were undertaken but 23 wetland species have been recorded (Table 4). Very few waterfowl and waders use the area, with black swans and banded dotterels being the most frequent. The swamps centred on the Halswell River are especially important for bitterns (a pair of which are resident), marsh crakes and flocks of 30-40 pukekos.

7.16 Summary

(a) Waders

Of the 15 study areas, four were rated as outstanding, one high, two moderate-high, seven moderate and one potential. The outstanding areas have some of the largest populations of some species nationally (e.g., pied stilts, banded dotterels, curlew sandpipers, red-necked stints). Table 9 summarises the most important features of each study area. Highest concentrations of waders occur on the Salicornia- Mimulus-dominant saltmarshes of the Greenpark Sands, and of the tip of the Kaitorete Spit. Distribution of waders varies within these areas depending on the amount of saturated saltmarsh present. Pied stilts are the most widespread wader on the lake because they use a much greater range of water depths than other species. The areas rated moderate have waders which are typical of the lake. In these areas extent of suitable habitat appears to limit the number of waders and the duration of their stays.

(b) Waterfowl

Two areas were rated outstanding, three high, three moderate-high, six moderate and one potential. Areas with high ratings supported very large numbers of feeding, loafing and/or breeding waterfowl of all common species. The Birdling's study area was notable in that it supported a nationally important black swan breeding colony. Numbers of grey teal and N.Z. shoveler using the Greenpark Sands and Kaituna were also notable. Table 9 summarises

the special features of study areas for waterfowl. Areas rated moderate-high supported high numbers of loafing birds but feeding and breeding habitat was much more limited. Those areas rated moderate supported typical waterfowl species but in much lower numbers (10's - 100's rather than 1,000's).

(c) Swamp Birds

Five study areas were rated high, five areas moderate-high, one area moderate and four areas potential. These latter areas contained very limited swamp habitat and no crakes or bitterns were recorded. Hart's Creek was the best area and contained the most extensive swamplands on the lake. While much of the vegetation is exotic (willows) the value of the area lies with the extent of suitable habitat. Overall the western side of the lake was most valuable for swamp birds, but of limited value to most other waterfowl, waders and other species.

(c) Other Species

A large number of species other than those noted above also use the study areas. Shags, herons, gulls and terns are widespread around the whole lake and high numbers of one or other type of bird are present in each study area. Table 9 itemises the most notable species in a regional and national context but for more details refer to Section 6 and the Appendices.

TABLE 9 : SPECIAL WILDLIFE FEATURES OF FORESHORE STUDY AREAS FOR 1981-1982.

STUDY AREA	WADERS	WATERFOWL	SWAMPBIRDS	OTHERS
Eastern Greenpark	- all overseas migratory waders - banded dotterel	- all waterfowl in high numbers		
Embankment	- overseas migratory waders - pied & black stilt - banded dotterel	- waterfowl spp. in moderate to high numbers - grey teal		
Yarr's Flat	- highest numbers and greatest range of overseas migrants on lake - pied stilt - wrybill - banded dotterel	- all waterfowl spp. in high numbers - grey teal	- marsh crake present	- tern spp.
Selwyn		- mute swan breeding	- marsh crake & bittern	
Rennie's Bay				- little shag
Doyleston			- marsh crake & bittern	- cattle egret

TABLE 9 : (continued)

STUDY AREA	WADERS	WATERFOWL	SWAMPBIRDS	OTHERS
Hart's Creek	- pied stilt	- all waterfowl especially ducks in high numbers - mute swan breeding	- marsh, crake and bittern	- white heron and spoonbill regular
Lakeside			- marsh crake	- cattle egret - glossy ibis - black-billed gull
Taumutu	- occasional arctic migrants	- white swan breeding	- crake and bittern breeding	- tern, gull and skua spp. - white-fronted tern breeding intermittently
Kaitorete Tip	- banded dotterel - all overseas migratory waders		- marsh crake	
Kaitorete	- banded dotterels breeding			- caspian tern breeding colony
Birdling's Flat	- occasional overseas migrants	- large black swan breeding colony	- marsh crake and bittern in moderate numbers	

TABLE 9 : (Continued)

STUDY AREA	WADERS	WATERFOWL	SWAMPBIRDS	OTHERS
Kaituna	- occasionally high numbers of migrants - pied and black stilt	- very high numbers of all waterfowl spp.	- spotless and marsh crake	
Halswell	- black stilt regular	- occasionally high waterfowl numbers		
Osbourne's			- marsh crake and bittern	

INTERNATIONAL WETLAND STATUS

8.0 LAKE ELLESMERE AS A WETLAND OF INTERNATIONAL IMPORTANCE

8.1 Introduction

As has been stated earlier (Section 5.1), most of the important coastal wildlife habitats in New Zealand are estuarine. Some of these areas fulfil criteria for international wetland status and the Wildlife Service proposes to have approximately ten areas designated as Wetlands of International Importance. Two areas, Farewell Spit and Waituna Lagoon, both in the South Island, have so far been designated (Palmer 1983). In 1981 the IUCN General Assembly asked the authorities responsible for a complex of northern harbours and Lake Ellesmere to have them listed as Wetlands of International Importance. To date, this has not been achieved.

The wildlife values of some of the northern harbours have been well documented (Veitch 1977, 1978, 1979; Bellingham and Davis 1983). In most cases, the important species present on these wetlands are northern hemisphere migratory waders, especially bar-tailed godwits, knots and turnstones (Veitch 1977). These areas collectively support the majority of the populations of these three species with, for example, 10,000 birds on Rangaunu Harbour (Bellingham and Davis 1983), 17,000 birds on Kaipara Harbour (Veitch 1979) and collectively up to 44,000 birds on Manukau Harbour and the Firth of Thames (Veitch 1978). A further 40,000 birds occur on Farewell Spit (Edgar 1974, Dennison and Robertson 1979). These areas are also important for endemic waders such as New Zealand dotterels, wrybills, a variety of internally migratory species, shags, herons, swamp birds and small numbers of many other northern hemisphere waders.

Lake Ellesmere has different wildlife habitats from those of the northern habours in a number of ways and supports a different type of bird fauna. Ellesmere is similar to those harbours, in that it is a very large water body (20,000 ha) but it is quite different in type, being a brackish bar-type lagoon (Sections 3.0 and 5.1). Ellesmere supports only small numbers of those species which make the northern harbours and Farewell Spit so important. However, Ellesmere supports much larger numbers of waterfowl and some waders, particularly pied stilts and banded dotterels, and black-billed gulls. To date, more bird species have been recorded from Ellesmere (158 species) than from any other wetland in the country (c f. Farewell Spit with 110 species, Dennison and Robertson 1979; Rangaunu Harbour with 70 spp, Bellingham and Davis 1983). Many species are, admittedly, stragglers or have small populations on the lake, but at least 80 wetland species are regular users of

the area in substantial numbers. The lake is very important as a habitat for waterfowl with up to 31,000 ducks, swans and geese recorded at one time during 1981-1982. The area is also very important to indigenous waders, especially banded dotterel (up to 3,000 at one time) and pied stilt (up to 10,000 at one time). The significance of the lake to small migratory northern hemisphere waders seems to be more of national rather than international importance. For example, while the majority of the New Zealand populations of curlew sandpipers and red-necked stints are found on the lake, these populations are small compared to those found in Australia. Nevertheless, the regular appearance of these species at the same sites on the lake is indicative of the outstanding values of the area. Table 10 summarises the estimated population sizes of various species and groups of birds on Ellesmere during 1981-1982. A maximum of just over 50,000 birds at one time was recorded.

8.2 Criteria for Identifying Wetlands of International Importance (International Waterfowl Research Bureau 1980).

Eight criteria have been set out by the International Union for the Conservation of Nature to identify wetlands of international importance. Fulfilment of any one criterion can justify the appropriate designation.

1. Quantitative criteria for identifying wetlands of importance to waterfowl.

   A wetland should be considered internationally important if it:-

   (a) Regularly supports either 10,000 ducks, geese and swans; or 10,000 coots; or 20,000 waders;

or (b) Regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl;

or (c) Regularly supports 1% of the breeding pairs in a population of one species or subspecies of waterfowl.

2. General criteria for identifying wetlands of importance to plants and animals.

TABLE 10 : ESTIMATES OF TOTAL POPULATIONS OF WETLAND BIRD SPECIES USING LAKE ELLESMERE AT ONE TIME, 1981 - 1982.[1]

	Normal Range (rounded nos.)	Minimum Number Recorded
Little shag	400 - 500*	400 - 500*
Black shag	100 - 500*	100 - 150
White-faced heron	500*	100
Other herons, etc.	60*	20
Mute swan	40 - 50*	40 - 50*
Black swan	7,000*	7,000
Canada goose	6,000*	500
Paradise shelduck	50*	50
Mallard/grey duck	3,000 - 10,000	1,000
Grey teal	1,000 - 5,000	80
New Zealand shoveler	500 - 3,000*	200
Pukeko	250* - 500[2]	250
Marsh crake	No data	No data
Oystercatcher	80*	0
Spur-winged plover	300* - 500	300
Golden plover	50	0
Banded dotterel	700* - 3,000	400
Godwit/knot	150	0
Curlew sandpiper	70	5
Red-necked stint	220	1
Other small waders	150*	10
Stilts	3,000 - 10,000	750
Black-billed gull	800* - 5,000	200
Other gulls	1,000*	1,000
Terns	50* - 100[2]	50
TOTALS:	25,470 - 52,130	12,456 - 12,616

Footnotes:

1. In reality there appear to be much greater numbers involved when transient birds are included.

2. Up to 3,000 in the past (Clark and Dawson 1957; Carroll 1969).

* Estimates of population sizes were made after attempting to count all individuals on the lake. On most occasions counts were made of single species on survey days. On 17-19.8.1982 a full count of all species was attempted and c. 41,640 birds were recorded (*).

A wetland should be considered internationally important if it:-

(a) Supports an appreciable number of rare, vulnerable or endangered species or subspecies of plants or animals;

or (b) Is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna;

or (c) Is of special value as the habitat of plants or animals at a critical stage of their biological cycles;

or (d) Is of special value for its endemic plant or animal species of communities.

3. Criteria for assessing the value of representative or unique wetlands.

A wetland should be considered internationally important if it is a particularly good example of a specific type of wetland characteristic of its region.

8.3 How Lake Ellesmere Fulfils Criteria for International Wetland Status

The following section briefly outlines how Ellesmere fulfils all the above criteria for International Wetland Status. Lake Ellesmere fulfils all eight criteria (when any one can justify the appropriate designation), each in more than one way. The previous sections provide the inventory of the wildlife resource which formsthe basis for the following statements.

1. Quantitative criteria for identifying wetlands of importance

(a) A wetland should be considered internationally important if it regularly supports either 10,000 ducks, geese and swans; or 10,000 coots; or 20,000 waders.

Fulfilment of criterion: Ellesmere generally supported between 17,590 and 30,100 ducks, geese and swans at one time during 1981-1982 (Table 10). Over a year many hundreds of thousands of waterfowl pass through Ellesmere

(Williams 1980a). Williams (1982) estimated that 75% of the endemic New Zealand shoveler (total estimated population of 100,000-125,000) pass through Ellesmere annually.

The normal range of wader numbers on Ellesmere was 4,720-14,220 birds at one time during 1981-1982 (Table 10). However, it was estimated that many thousands more passed through the lake annually as passage migrants.

(b) Or if it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

Fulfilment of criterion: Lake Ellesmere supports a sizeable proportion of the New Zealand populations of at least 17 species of wetland bird (Table 11), including 1-20% of two species of heron, between 10 and 75% of six species of swans, geese or ducks, 2-68% of five species of international migratory waders, 8-50 % of four species of indigenous wader and 20% of one endemic species of gull. Without further data it is difficult to determine what proportion of the populations of some other species use the lake as numbers are low at any one time. It may be that species such as little shags, white-faced herons, royal spoonbills and black-fronted terns are represented by over 1% of their populations, however, no reliable population estimates are available.

(c) Or if it regularly supports 1% of the breeding pairs in a population of one species or subspecies of waterfowl.

Fulfilment of criterion: Ellesmere would support over 1% of the New Zealand breeding populations of both mute (25%) and black swans (10%) and possibly banded dotterel (3%) and mallard (further data required on other species).

2. General criteria for identifying wetlands of importance to plants or animals.

(a) A wetland should be considered internationally important if it supports an appreciable number of rare, vulnerable or endangered species or subspecies of plants or animals.

TABLE 11 : ESTIMATED POPULATION SIZES OF SOME LAKE ELLESMERE BIRD SPECIES AND THEIR NATIONAL SIGNIFICANCE,
(from 1981 - 1982 data, number of birds present at one time)

SPECIES	SEASON	ESTIMATED NUMBERS	APPROXIMATE PERCENT OF NEW ZEALAND POPULATION	SOURCE OF N.Z. POPULATION ESTIMATE
White heron	Winter	1 - 10	1 - 10	Unpubl. Wildlife Service data, Robertson 1985
Cattle egret	Winter	Maximum 94	20	Heather 1978, 1982
Mute swan	All Year	40-50	Largest New Zealand population (25%)	Unpubl. Wildlife Service data, Bull, et al. 1985
Black swan	All Year	c. 6850	10	Williams 1980
Canada goose	Winter	c. 6000	30	Unpubl. Wildlife Service data, Bull, et al. 1985
Mallard	All Year	Hundreds of thousands	? very large percentage	Williams 1980
Grey teal	All Year	Maximum 5100	26	Mills 1975
New Zealand shoveler	All Year	75,000 to 100,000	75	Williams 1982
Golden plover	Summer	40-50	2-17	Appendix 5
Banded dotterel	Winter	3000+	20+	Sagar 1984
Wrybill	Spring Autumn	Many hundreds (>500)	> 10	Hay 1979
Pectoral sandpiper	Summer	Maximum 9-12	6-33 (?)	Appendix 5
Sharp-tailed sandpiper	Summer	Maximum 25(+)	2-28	Appendix 5
Curlew sandpiper	Summer	60-70	19-59	Appendix 5
Red-necked stint	Summer	200+	21-68	Appendix 5
Pied stilt	Spring	10,000	50	Sagar 1984
Pied stilt	Winter	3,000	15	Sagar 1984
Black stilt	Winter	Maximum 4	8-10	Robertson et al. 1984
Black-billed gull	Spring	5,000	10	Unpubl. data

Fulfilment of criterion: bird species which would be included within this criterion in New Zealand include Australasian bittern (vulnerable), grey teal (vulnerable?), marsh crake (vulnerable), wrybill (vulnerable) and black stilt (rare). The lake also provides habitat for species of international migratory waders considered rare only in New Zealand. In addition one of the 66 species of plant listed in the New Zealand Red Data Book for endangered plants and animals (Williams and Given 1981) is present on the Kaitorete Spit (Pingao - Desmoschoenus spiralis).

(b) Or if it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.

Fulfilment of criterion: the large size of the Ellesmere habitat (20,000 ha, 58 km shoreline), diversity of micro-habitats, and high species richness (47% of bird species on the New Zealand checklist) contribute to the outstanding value of the lake. The large number of species passing through the area, and the number of different species of migratory wader resident during summer, indicate that the lake may be an important link in maintaining national and international diversity (genetic and ecological) in many species of bird.

(c) Or if it is of special value as the habitat of plants or animals at a critical stage of their biological cycles.

Fulfilment of criterion: the lake provides wintering habitat for arctic migratory waders (during the New Zealand summer) and very important wintering habitat for a variety of indigenous bird species, particularly two species of wader (banded dotterels and pied stilts). The lake is more important as a roosting and feeding habitat than as a breeding habitat. The lake may be briefly, but critically, important for a large number of transient birds while migrating (e.g., wrybills, pied stilts and banded dotterels).

(d) Or if it is of special value for its endemic plant or animal species or communities.

Fulfilment of criterion: the lake is of notable value to the endemic New Zealand shoveler, and less importantly to wrybill, black stilt and

black-billed gull.

3. Criteria for assessing the value of representative or unique wetlands.

(a) A wetland should be considered internationally important if it is a particularly good example of a specific type of wetland characteristic of its region.

Fulfilment of criterion: one of its most significant features is that Lake Ellesmere is the only brackish lagoon habitat of very large size in New Zealand. The habitat type in itself is uncommon in New Zealand and most brackish lagoons are very small. The only other habitats of any size are Wainono (c. 300 ha) and Washdyke (c. 10 ha) lagoons (see Section 5.1). Ellesmere waters cover the whole range of salinity gradients and marked vegetation changes are associated with this factor. The area of 3,500 ha of Salicornia and Mimulus-dominant saltmarshes is also one of the most important features of the lake.

LAKE ELLESMERE

PRINCIPLES OF WILDLIFE MANAGEMENT

9.0 WILDLIFE MANAGEMENT AT LAKE ELLESMERE - GENERAL PERSPECTIVE

The aims of the New Zealand Wildlife Service for the future management of Lake Ellesmere are similar to those outlined by Palmer (1983):

1. to preserve and manage water margin areas providing a variety of habitats and values for wildlife;

2. to ensure as far as possible the survival of all indigenous species of flora and fauna, both rare and common-place, in their natural communities and habitats;

3. to preserve representative samples of all classes of natural ecosystems and landscape which together originally gave New Zealand its own recognisable character;

4. to ensure, as far as possible, the preservation of access for the public to and along the coast, lake shores and river banks; to assist public, ornithologists etc., to see/view wildlife;

5. to assist other administering agencies and individuals in furthering these aims.

The following section summarises very broadly the important management considerations for the wildlife of the Ellesmere wetland.

9.1 Threats to Wildlife

Lake Ellesmere is the largest area of standing water in Canterbury and as such is one of the most important water resources in the region. Like many such areas the lake is subject to multiple uses, some of which conflict with wildlife preservation. The major factors which have a real or potential adverse affect on wildlife values and other natural features are summarised in the following section.

10.1.1 Eutrophication:

Lake Ellesmere and the waters flowing into it are nutrient rich and the

lake is now considered to be highly eutrophic (Lineham 1980). A major indication of this eutrophic state has been the regular occurrence of algal blooms in summer, including blooms of the toxic blue-green alga, Nodularia spumigena (Hughes et al. 1974). A variety of sources of nutrient enrichment has been identified. These include pig and dairy wastes discharged into drains mainly in the Irwell area (NCCB 1972); sprays used on adjacent farms (paraquat, dalaphon, 240); fertiliser nutrient and underground nitrate discharge (Blair 1980); partly-treated sewage from the overloaded Lincoln treatment station since 1968 (Anon. 1977, 1981); and septic tank effluent from Leeston which is discharged into water-bearing strata and finds its way into inflow drains. As a result there are particularly high concentrations of phosphorus and nitrate in inflowing waters. The eutrophication process is kept in check because wave action constantly re-oxygenates the waters and artificial lake openings serve to flush the lake.

Little has been done to control nutrient inflows to the lake and the lake has changed from a "suspected" state of eutrophication in 1974 (Hughes et al. 1974) to its polytrophic state today. Research has identified the sources of pollution and some recommendations have been formulated (Hughes et al. 1974). No research has been undertaken to determine how changes in water quality might be affecting wildlife communities and particularly their food sources.

9.1.2 Artificial Control of Lake Level:

(a) Effect of Water Level Fluctuations on Wildlife

The water levels of Lake Ellesmere fluctuate from season to season (Figure 4, Section 3.6) and from day to day, depending on wind direction and catchment inputs, and are manipulated by artificial lake openings. As a result of these lake openings water levels are drastically lowered (Figure 4). The timing of the lake openings and magnitude of the drop in lake level are critical to the wildlife community. Management of lake levels requires monitoring so that lake edge habitat remains suitable for wetland birds during critical periods.

Suitable water level regimes are critical to the successful breeding of water birds and to habitat productivity and determine the amount of feeding habitat available to different species. Today, with Ellesmere lake levels being maintained at 1 m below those of pre-European times, it seems reasonable

to postulate that there has been a decrease in wetland habitat. Before European occupation very large areas of swamp lands existed (Palmer 1983) and during periods of high water levels there was probably an extensive flood plain caused by seepage and overflow from adjacent waterways (Tunnicliffe 1973a).

Rapidly fluctuating water levels can adversely affect aquatic birds by flooding nests or by drying out feeding habitat. Species whose nests are sometimes flooded include black swans, mute swans, mallards, Canada geese, pukekos, pied stilts, banded dotterels, black-backed gulls, caspian terns, skylarks and New Zealand pipits and probably marsh crakes, grey ducks, shovelers and grey teal. The effects of water level fluctuations on black swans and pukekos have been studied around Lake Ellesmere. Williams (1980) found that the onset of breeding of black swans closely followed the lowering of water levels from the winter peak. The land on which the swans nest is exposed and food sources which were previously unavailable can then be reached. Nesting duration was also determined by water levels. If the level dropped rapidly, food was available for a shorter period and breeding ceased. This situation may result from a sudden drop in water levels after a lake opening.

In the case of the pukekos, Tunnicliffe (1965, 1973a) found that with a much greater area of shoreline exposed when the lake level drops, pairs dispersed to breed. Two peaks in egg laying occurred, one in October and one in December. The second breeding peak was dependent on low lake levels exposing greater areas of feeding habitat. The pukeko nested when the foreshore was saturated, as this provided abundant food and tall emergent vegetation for cover. Flooding was comparatively uncommon at localities with a pronounced freshwater influence, where vegetation such as Carex secta raupo and Juncus pallidus is tall and robust and nest sites were high. Nests were more flood-prone in brackish waters where Scirpus reedbeds were shorter and less robust.

Other waterfowl species are probably influenced just as much by water level fluctuations affecting both breeding and food supply. Areas around the lake which are periodically inundated, and thus remain saturated, provide high value feeding areas. Mills (1976) stated that grey teal are very mobile, partly due to fluctuating water levels (preferring areas with shallow waters) and resultant changes in food availability. During 1981-1982, grey teal moved around the lake, feeding in areas which had been most recently exposed after a local water level fluctuation.

Caithness and Pengelly (1973) reported on the effects of water level fluctuations on waterfowl productivity at Pukepuke Lagoon in the North Island. Water level fluctuations followed a similar pattern to those at Lake Ellesmere. Water levels were high during winter and gradually decreased (with some fluctuations) from September to February. Rises in water levels in late September 1970, when mallard egg laying and incubation were near a peak, had adverse effects on hatching. In 1971 a sudden rise in water level in October reduced the number of broods markedly. As a consequence December broods were more numerous than normal because of re-nesting.

Caithness (1975) reported that the nesting period of shovelers at Pukepuke Lagoon was dependent on lake level. When the water level was high, nesting extended into January. When water level was low, nesting ceased in December.

Potts (1977) found that abundance of food for wetland birds at Pukepuke Lagoon was directly related to seasonal changes in water level during the previous year. When water levels gradually fall through spring and rise in winter, wetland plants continue to grow when flooded and provide excellent habitat for invertebrates. Both productivity of vegetation and number of invertebrates living on plants vary from year to year with different water level regimes. At Lake Ellesmere the drying of saltmarshes during the summer is necessary for flower develpment in many saltmarsh plant species. The exposure of lake beds normally under water is necessary to allow the summer growth stage of plant species which, when flooded, again provide feed for waterfowl (Anon. 1980). Different plant associations are generally specific to particular water depths (Martin 1953, Green et al. 1964) and such associations may provide critical food supplies at different water levels.

The lake level management is very complex from the wildlife view-point. Critical factors are the timing and duration of differing lake levels. For wildlife, the summer drop in water level should be gradual, not sudden. A drop in lake level which is not synchronised with breeding of wetland species can detrimentally affect breeding success.

(b) Effect of water level fluctuations on saltmarsh productivity

Frequency and duration of flooding are two factors which are critical in maintaining productivity of saltmarshes. They influence soil water salinity, the amount of photosynthesis which occurs and root environment (Clarke and

Hannan 1969). If flooding is prolonged, root aeration is poor and plants may die. Flooding appears to be critical for seedling establishment in Salicornia (Wiehe 1935). Salinity can be greatly reduced in soils which become exposed for long periods when evaporation is high and the character of habitat can change very quickly (Clarke and Hannan 1967). Lake levels need to be high at certain times of the year, and low at others. For example, Juncus maritimus occurs only where flooding is relatively infrequent. However, when seeds are shed between January and March they are dispersed only if the lake level is high. There is therefore, potential conflict between the needs of some plants and some nesting birds at Ellesmere. Juncus seeds germinate under several centimetres of water (Clarke and Hannan 1969). Species such as Triglochin grow best in depressions where rain water accumulates and this species dies back when evaporation is high and soils dry out.

However, there is considerable variation in flooding tolerance among flowering plants (Pereira and Kozlowski 1977). Increased frequency and duration of water-logging during autumn and winter cause die-off of saltmarsh plant species (Gill 1970). Herbaceous angiosperms which grow on saltflats are tolerant of prolonged water-logging to a degree and adapt to reduced oxygen levels by metabolic change or can increase oxygen supply to roots through modification of root anatomy (Gill 1970, Ladiges et al. 1981).

(c) Lake level control

Lake Ellesmere water levels are managed by the North Canterbury Catchment Board by means of periodic openings of the lake to the sea through the Kaitorete Spit near Taumutu. When open, the lake level drops rapidly and stabilises at about 0.45 m above mean sea level (m.s.l.). The lake is opened when the lake reaches 1.05 m above m.s.l. between the months of September and April and is generally open for at least six weeks. From May to August the lake is opened when levels reach 1.13 m above m.s.l. During periods of high water level some agricultural land is flooded around the lake edge. Technical reports have concluded that the lake would not naturally break out across the Kaitorete Spit until the lake reached at least 2.7 m above m.s.l. Under this circumstance large areas of farmland would be flooded and drainage from the catchment impeded.

Since European settlement there has been significant interest in controlling the maximum height of the lake, and in its reclamation. Early

Maori were known to let the lake out every two or three years to protect their pa sites and betwen 1852 and 1867 Europeans opened the lake several times (Bray 1875). Earlier this century the lake was opened when it reached 1.4 to 1.6 m above m.s.l.

The N.C.C.B. took control of lake openings in 1947. A temporary cut is dug mechanically through the Kaitorete Spit near Taumutu and a 20 m width of beach is removed. The length of time the lake remains open to the sea depends on weather conditions, off-shore currents and stability of the spit. Southerly storms close the opening very quickly. Controversy has developed over the method of lake level control. Some local farmers have asked for a permanent lake opening and a lowered lake level so that large areas of lake bed can be reclaimed. One proposal is for the level to be held at 30 cm above m.s.l. (Rennie 1980). The N.C.C.B. has adopted a policy of continuing the established system of periodic openings with a secondary policy of protecting surrounding lands above 0.91 m above m.s.l. (Dwyer 1980). Many schemes have been proposed for lowering the lake level to bring large areas of lake shore into year-round agricultural production (Bray 1875, Grant 1945, Flay 1950, Collins 1954, Commissioner of Crown Lands 1954, Dick and Norton 1954, District Interdepartmental Committee on Irrigation 1956 and Canterbury Progress League 1969). The most recent, Dalmer (1970) and Morris and Wilson (1980), concluded that a permanent opening was not feasible; engineering and financial considerations being the most important factors against such a scheme. Such a scheme would have cost $12 million in 1980 and would have enabled about a third of the lake to be reclaimed.

Modifications of water levels by stabilising the level or by draining large areas of the lake would reduce the size and value of the wildlife habitat and threaten the outstanding wildlife values. General effects of drainage would include such things as:-

(i) altering the diverse salinity levels of the lake - diversity of salinity gradients is a major factor contributing to the diversity of wetland birds using the lake;

(ii) loss of very large areas of optimum wildlife habitat, such as the saltmarsh flats along the Greenpark Sands, the Halswell Flats, the tip of the Kaitorete Spit and Birdling's Flat, and remaining areas of emergent swamp vegetation;

(iii) changing productivity of plant and invertebrate communities and

hence wildlife food sources by loss of the fluctuating water regime which successively floods and exposes areas of saltmarsh.

9.1.3 Foreshore Erosion:

Lake Ellesmere foreshore soils are prone to erosion (Smith 1979). In recent years the problem of foreshore erosion has intensified. Since the destruction of lake weed beds in 1968 and resultant increase in wave action on the lake, erosion has increased around the foreshore, particularly along the Kaitorete Spit, around Kaituna Lagoon and along the western shore. The problem has been increased with removal of marginal vegetation through farm development practices. Rotary slashing of sea rush and shore ribbonwood has occurred along the Kaitorete Spit, and burning of flax and Carex swamps has been carried out along the western shore. Some lateral erosion results from winter flooding where cover vegetation has already been removed.

9.1.4 Recreation:

Lake Ellesmere is a major recreational resource in Canterbury. It is particularly well known as a waterfowl-shooting area and over 2500 licences are sold annually. The lake is also an important area for trout fishing, boating, water-skiing, land-yachting, bird watching and picnicing. A wide range of activities may affect wildlife and recreational users need to be aware that some activities directly or indirectly affect wildlife, particularly through inadvertent disturbance of breeding or feeding birds, destruction of nests and modification of critical feeding habitat. Some activities are more likely to cause disturbance than others, with passive recreation probably causing less disturbance than active recreation, particularly the use of vehicles.

(a) Duck Shooting

During the shooting season, from May to June or July, some species of wading birds leave the lake. Waterfowl move to refuge areas, out to sea and to urban areas, during the day and return at night.

There is local disturbance of saltmarsh habitat where duck shooting stands are constructed, vehicles are driven over the marshes and some rushes are cut. Non-target species have been shot in the past, including pied

stilts, banded dotterels, grey teal, paradise shelducks, black swans, black-backed gulls, knot and white-faced herons, although it is not known if populations are significantly affected by the activity. However, the lake continues to provide habitat for vast numbers of waterfowl, and with proper education and provision of adequate refuge areas the resource should be maintained.

(b) Land Yachting, trail biking and car racing

These activities cause disturbance to feeding or loafing birds. Movement of a large number of vehicles at high speed over saltmarsh may cause significant damage to the wildlife habitat. There is concern that these vehicles may significantly increase wind-assisted soil erosion, destroy saltmarsh plants and possibly invertebrates, destroy nests and cause birds to leave areas used for yachting during periods when feeding habitat is limited. These activities may impede any active management of wildlife habitats, e.g., the retention of soaks during summer drought.

9.1.5 Proposed Irrigation Schemes:

N.C.C.B. (1983b) has shown that the Rakaia River, which lies just to the south of Lake Ellesmere, is intimately linked by groundwater and surface flow regimes to the lake. Proposed use of Rakaia water for a large irrigation scheme in the Central Canterbury Plains (the catchment area of Lake Ellesmere) could change Ellesmere wildlife habitat markedly. Irrigation run-off would drain into Ellesmere. Increased run-off of nutrient-rich waters would adversely affect water quality, in an already high eutrophic lake, and the pattern of water level fluctuations, both of which are critical to the feeding and breeding of birds. The water table could be raised on average, covering saltmarshes during critical periods and facilitating more frequent lake openings. N.C.C.B. (1983b) predicted that irrigation run-off would increase phosphorus in winter and nitrogen in summer, which would accelerate the eutrophication process and produce prolonged periods of algal bloom. At present the windy climate stops blooms occurring more frequently and high levels of green, rather than toxic blue-green, algae are present. Increased irrigation of sea waters into the lake caused by more frequent openings could create brackish conditions more suitable for toxic algae. On the other hand, increased flushing of nutrients could improve habitat quality.

9.1.6 Swamp Drainage and Foreshore Farm Development:

The continued development of lake foreshore which is currently classified as outstanding wildlife habitat would detrimentally affect wildlife and, in particular, some sensitive swamp birds (e.g. crakes), waders (e.g. wrybills) and waterfowl (e.g. grey teal). Practices such as burning, rotary slashing and stocking of swamplands either reduce the quality of swamp habitat or destroy it completely. Stop-banking around areas of the foreshore, especially in areas of extensive saltmarshes, disrupt the periodic inundations which make the habitat so valuable. Where saltmarshes dry out completely as a result, wildlife use of the areas is minimal.

9.1.7 Predators

Natural predators of wetland birds include black-backed gulls and harriers. These species are known to prey upon the eggs, young and adults of a variety of wetland species. The most damaging predators are those introduced by man, particularly the mustelids (ferrets, stoats, weasels), rats, cats and hedgehogs. All are known to take wetland birds (Section 5.2), although the long-term effect has not been quantified.

9.2 Management for Wildlife

Active management of wetlands is undertaken by the Wildlife Service, often in an effort to maintain or improve areas for wildlife. In many cases management has been undertaken to aid reversion of an area to its natural state or to halt habitat decline caused by an unnatural factor. Around Lake Ellesmere there has been a substantial reduction in wildlife habitats, particularly emergent swamp vegetation types. When considering management of the lake for wildlife this factor is of paramount importance. In addition the Wildlife Service must look at providing optimum habitat within reserve areas in an effort to compensate for past and future losses of habitat in other parts of the lake. The following section provides a brief summary of the most appropriate methods of enhancing small areas of habitat locally around the lake. If such management practices were to be considered in the future the suitability of the options would need to be critically assessed. We must be cautious when planning management, because in other countries many problems with saltmarsh management have developed from a poor understanding of

inter-dependence within the ecosystem which may mean that management may adversely affect one area while improving another (Walton 1973). Another consideration is that management which may be beneficial for one species or group of birds may be detrimental to others. For example, controlling raupo to maintain open water areas for ducks (Williams and Imber 1970) destroys habitat of marsh and spotless crakes. On Lake Ellesmere, as elsewhere, requirements of waders and waterfowl are often quite different and any management, particularly of water levels, must consider this factor.

9.2.1 Habitat Manipulation:

(a) Use of Artificial Water Supplies

During droughts small areas of saltmarsh can be made productive by trickle application of water from artesian bores. While it would be possible to flood large open areas of marsh using pump-assisted bores or by forming small dykes across the marsh and erecting small pond areas, this may not be necessary. The use of small amounts of water trickling over tiny patches of saltmarsh can provide enough habitat for all the waders and grey teal using the lake at one time. This method is most desirable because saltmarsh plant and invertebrate communities would not be modified over large areas and no earthworks would be needed. With a trickle water supply, areas of marsh would remain saturated and tiny ponds can be formed in natural hollows to provide feeding habitat for a variety of waders and teal.

(b) Scrapes

The use of scrapes (i.e., small depressions scraped out mechanically) to provide small ponds and mudflats has been used extensively overseas. However, this form of enhancement may not be advisable at Lake Ellesmere. A problem encountered overseas is that when scraping soils where sub-surface layers are anaerobic with high concentrations of sulphides, and the sub-soils are allowed to dry and become exposed to air, the sulphides oxidise to form sulphate and sulphuric acid (Shoemaker 1966). Plant growth and subsequent invertebrate colonisation are then restricted. Drying marsh soils can also develop pH values as low as 3.5 and hinder the invasion of plants and invertebrates (Allan 1950). Thus full use of natural depressions should probably be made.

Artificial lagooning can be expensive and totally destructive to natural

marsh vegetation (Cooper 1969) and large-scale earthworks, dredging, scraping and stop-banking of shallow water flats can smother existing benthic communities (Marshall 1968).

(c) Fencing Swamplands and Stock Grazing

Huge areas of swampland have been drained around Ellesmere and the few remaining swamps, particularly those with Carex secta, are being slowly modified, mainly by cattle grazing. Exclusion of cattle from good swamp areas would facilitate reversion of these areas to a more natural state. If habitat quality improved, it may even be possible to reintroduce species such as fernbird to the lake. On the other hand, sheep grazing (if kept within well-defined stocking levels) can be used as a management tool to provide open habitat for waders. Regulation of grazing is most important.

(d) Sacrificial Crops

On a lake with so many waterfowl, some species encroach upon surrounding farmland to feed during periods when food is scarce. One way to tackle this problem is to plant crops in appropriate areas for use by feeding waterfowl.

(e) Public Education

With proper management, reserve areas can be opened to the public. The main requirement for areas where public use is high is to provide hides for watching birds and access ways which do not disturb feeding or breeding. Educational displays are also desirable.

9.2.2. Water Level Control:

The naturally fluctuating water levels of Lake Ellesmere have been seen as a threat to agricultural development since European colonisation. These fluctuations are a major feature which contribute to the outstanding wildlife values of the area. As was indicated in Section 9.1.22 the manipulation of lake levels could be harmful to the breeding success of birds and reduce the amount of feeding habitat available. A variable water level range appears to be necessary to maintain saltmarsh productivity and bird communities. A fluctuating water level following a natural regime is a highly desirable feature of any wetland (Williams 1980b).

I am preparing a paper on the effects of changing lake levels on waders and waterfowl around the lake. Therefore this section will only briefly outline the type of controls required to maintain wildlife values of foreshore study areas.

A fluctuating water regime is necessary to maintain saltmarsh productivity and the foreshore areas in a condition suitable for wildlife. The current water level management regime appears to be largely satisfactory in maintaining wildlife habitat. Over 3500 ha of saltmarsh are directly affected by the rise and fall of Lake Ellesmere, mainly along the Greenpark Sands and between the Halswell rivermouth and Birdling's Flat. Most wildlife habitat is located below the 1.2 m contour, within the main area currently affected by fluctuations and windlash.

The critical considerations for wildlife management are the duration of the lake openings, the magnitude of the drop in water level, the prescribed levels at which the lake is opened, the timing of openings and whether or not the lake should at any time be closed.

The first two factors are inter-related. If the lake remains open for a long time, the lake level becomes so low that foreshore areas dry out completely and usable habitat is limited to a strip within about 10 m of the lake shore. On the other hand, if the lake is not opened for a long time lake levels may become so high that waters are only suitable for waterfowl, being too deep for wading birds.

Recommendations as to an optimum operating range will be made at a later time.

The timing of openings is highly important, as was mentioned in 9.1.2. Timing must cater for the breeding cycles of wetland birds and food requirements over the summer. A lake opening just before peak breeding and again before the arrival of migratory waders, (i.e. in August - September) would probably be most suitable. The sudden drop produced by artificial openings is not ideal.

During autumn and winter, when waterfowl numbers are high on the lake, high water levels appear to be more suitable. However, regular openings during this period ensure that some habitat exists all year round for stilts and dotterels. Foods necessary to induce breeding in waterbirds are produced when marshes are flooded. The effect of flooding appears to be related to

the area covered by water, not the actual rise in water level (National Parks and Wildlife Service 1981), and during winter the whole Ellesmere saltmarshes covered in shallow water provide feeding habitat.

9.3 Reservation of Wildlife Habitat

Jackson (1983) put the case for protection of Lake Ellesmere as a biological resource. Like O'Donnell and Moore (1983) he pointed out the poor representation of wetlands within the New Zealand "representative" reserve system. Since the arrival of European man to New Zealand at least 80% of New Zealand's wetlands have disappeared. A Wildlife Service survey in 1964 showed that at least 160,000 ha had been lost. Since then, continued drainage has boosted this amount to 263,000 ha in 1976 (Burns 1982). In this light, and considering the tremendous biological value of Lake Ellesmere, it seems opportune to pursue reservation procedures for the Ellesmere Wetlands.

9.3.1 International Wetland Status:

In New Zealand, government policy has been that for wetlands to be declared "Wetlands of International Importance", they should be restricted to a limited number, be clearly of international importance and be publicly owned and reserved (Palmer 1983). Lake Ellesmere fulfils all criteria for this status and its importance is clear. The lake lands are also largely under public ownership, mainly unoccupied lands covering the lake bed (c. 20,000 ha, mainly Reserve 959, Reserve 4385 and Reserve 5121). Designation of the Ellesmere wetlands under International Wetland status and in conjunction with reservation would be appropriate considering these factors. Such action is advisable if the wildlife habitat types present are to be protected adequately, and if the regional, national and international values of the area are to be fully recognised.

9.3.2 Reservation of Lake Bed and Foreshore:

The means to reserve outstanding areas of wildlife habitat are spread across a wide range of legislation viz. Wildlife Act 1953, Reserves Act 1977, Land Act 1948, Water and Soil Conservation Act 1967, National Parks Act 1980, Public Works Act, and Town and Country Planning Act 1977. The Wildlife and Reserves Act contain provisions for wildlife sanctuaries, wildlife refuges

and wildlife management reserves.

Established wildlife reserves, Yarr's Flat and Hart's Creek, cover c. 500 ha of the 20,000 ha of wildlife habitat available. While foreshore areas are largely Lease in Perpetuity Lands (L.I.P.) and freehold with smaller areas of Public Body Endowment Lands, Crown Leasehold, Maori Land and Legal Road (Palmer 1983), two very large areas of Unoccupied Crown Land exist, the bulk of the Greenpark Sands and the lake bed itself (below 0.76 m above m.s.l.). Some areas designated as L.I.P. land in the 1800's are still undeveloped saltmarsh, mudflat or are even under permanent water.

Section 7 of this publication has attempted to establish priority areas around the lake for the conservation of different groups of wetland birds. On a lake which is considered to be of outstanding value on scientific and biological grounds (Palmer 1983) it seems inappropriate that only such small areas have been designated for the protection of wildlife. In 1976 the Wildlife Service requested that areas of Unoccupied Crown Land, the Greenpark Sands and Kaituna Lagoon be considered for reservation as Wildlife Management Reserves but to date there has been no action on this proposal. To maintain at least a representative range of wildlife communities with viable bird populations, full consideration must be given in the near future to the provision of adequate reserves around the lake. Where reserves are limited in extent, consideration must be given to methods of habitat enhancement where wildlife habitat is sometimes limited (e.g., during periods of drought in the Embankment and Greenpark study areas).

9.3.3 Conservation Order:

Within the mechanisms of legislation such as the Wildlife Act and Reserves Act it was possible only to reserve land; for example in the case of lakes, only the lake bed. With the passing of the Water and Soil Conservation Amendment Act 1981 it is now possible to seek legislative protection for waters of New Zealand's lakes and rivers. The object of the amendment is to recognise and sustain the amenity afforded by waters in their natural state. It provides for the issuing of national and regional Water Conservation Orders and Notices giving protection to the natural characteristics of waters. Wildlife policy with regard to making application for Water Conservation Orders and Notices is summarised by Adams (1982).

10.0 CONCLUSION

This publication has produced a resource inventory for the Lake Ellesmere wetland which identifies the outstanding value of this wetland for birds and illustrates its international significance. Data has been provided with which to assess relative values of wetland areas within the ecosystem.

The Lake Ellesmere wetland is large enough to cater for a variety of land uses. Wildlife management and conservation are achievable objectives which at the same time cater for agricultural and recreational needs. Already 81% of the wetland has been modified for agriculture (Palmer 1983) leaving about 20,000 ha of wildlife habitat. The most important areas are those on the lake foreshore, on the interface between farmland and open lake water. The area should be primarily managed for its biological resources and appropriate protective reservation pursued. However, with adequate planning and discussion wildlife conservation should not exclude other uses. The managers of Lake Ellesmere should be able to learn from the management of an area such as the Camargue Regional Nature Park in southern France. This is an 85,000 ha wetland devoted to wildlife protection but including a wide spectrum of other uses such as tourism, agriculture, saltmining, reed cutting, fishing and shooting. In this situation forward planning has created a "balance" between man's influence and the environment without compromising the values of either significantly. The Camargue Park exists so that a balance can be maintained between different activities, while the prime objective remains the protection of nature and the environment.

11.0 RECOMMENDATIONS

The main recommendations of Palmer's (1983) report relating to Lake Ellesmere were:-

1. that the Ellesmere wetlands be managed primarily to maintain these wetlands;
2. that the Ellesmere wetlands be accepted and promoted as being worthy of the status of a wetland of international importance;
3. that the protection of the Ellesmere wetlands be promoted, utilising existing legislation;
4. that encouragement be given to a means for co-ordinating appropriate Ellesmere wetland management;
5. that biological and landscape studies of all the Ellesmere wetlands be undertaken to increase understanding of the resource and to determine the relative values of various wetland areas;
6. that public access to areas appropriate for recreational use be determined;
7. that in the co-ordinated management of the Ellesmere wetlands the relationship of the Maori people and their culture and traditions with their ancestral lands be recognised;
8. that in the co-ordinated management of the Ellesmere wetlands those commercial activities based on a sustainable yield from the wetlands' resources be recognised.

The Wildlife Service supports these recommendations, and this publication provides a detailed wildlife resource summary supporting New Zealand Wildlife Service recommendations for International Wetland status as well as fulfilling requests made for detailed wildlife resource descriptions of the lake by the Department of Lands and Survey (Palmer 1983) and North Canterbury Catchment Board (N.C.C.B. & R.W.B. 1983a), the organisations responsible for the day-to-day management of the lake bed and its waters.

The specific Wildlife Service recommendations resulting from this publication are as follows:

1. That the Wildlife Service should pursue legislative designation of Lake Ellesmere as a Wetland of International Importance.

2. That the Wildlife Service should pursue protection of areas of wildlife habitat around Lake Ellesmere by forming management reserves and wildlife refuges in suitable areas, particularly in the extensive areas of unoccupied Crown land which make up the lake bed and foreshore along the Greenpark Sands and Kaituna Lagoon.

3. That because of the conflicts of interest which have been voiced between such varied interests as agriculture, wildlife, recreation, land administration and fisheries in the past, forward planning and liaison should be encouraged to ensure preservation of wildlife communities and accommodation of other interest groups.

4. That the North Canterbury Catchment Board should manage Lake Ellesmere water levels for wildlife as well as for protection of agricultural land, using advice on wildlife requirements supplied by the Wildlife Service.

5. That when further data become available, operating levels and fluctuation regimes which best suit wildlife be considered by the N.C.C.B. Of particular importance are the timing and magnitude of drops in lake level, the upper and lower limits of lake levels and the ideal fluctuation regimes. Given present knowledge, the Wildlife Service should oppose:
   (i) stabilisation of lake levels;
   (ii) stop-banking and drainage leading to loss of outstanding wildife habitat;
   (iii) encroachment of farming practices onto outstanding wildlife habitat.

6. That the Wildlife Service, a university or other Government agency study saltmarsh invertebrate communities (i.e. the wildlife food source) in relation to fluctuating water levels and possible habitat management.

7. That the N.C.C.B. or appropriate irrigation association, in conjunction with the Wildlife Service, carry out an in-depth study of the probable effects of the proposed Central Plains Irrigation Scheme on the habitat and wildlife of Lake Ellesmere.

8. That the Wildlife Service oppose any further permanent lowering of

Lake Ellesmere water levels. With 80% reduction in habitat already, at least the remaining outstanding wildlife habitat should be maintained.

9. That when further management reserves are established a critical appraisal of possible habitat management, development of refuge areas, enhancement and manipulation be undertaken by the Wildlife Service.

10. That all related agencies continue to assess possible effects of continued eutrophication, swamp development and foreshore erosion on the Ellesmere habitat as a whole and attempt to formulate realistic answers to the problems.

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APPENDIX 1

DETAILED RECORDS OF SOME WETLAND BIRDS USING LAKE ELLESMERE.

1. White heron (Egretta alba modesta)

Five specimens in the Canterbury Museum; 34 on 6.1957 (Andrew 1963); 14 on 17.4.1967 (Tunnicliffe 1973a); one 27.1.1973; five 8.9 1983 (DG); three 8.1973 (RP); eight 30.10.1973, one 10.11.1973 (DG); four 8.1977, one 26.8.1978 (OSNZ), one 9.8.1980; two resident winter 1981 (COD); two 16.11.1981 (GY); six over whole lake 19.5.1982; one resident winter 1982; one 23.4.1982 (COD).

2. Cattle egret (Bulbulcus ibis coromandus)

One 5.1.1964 (Turbott 1964); two 8.1974, six 8.1975, 12 from 8.1976 to 7.1977, eight 1.7.1977, nine 25.8.1977, ten in 12.1977, eight in 12.1978, nine in 3.1978, eight or nine in 6.1978, 20 in 8.1978, 31 in 6.1979, 36 on 25.8.1979, 13 on 1.1.1980, 14 on 30.1.1980 (OSNZ, Heather 1978); 94 in 8.1980, 48 in 8.1981, 52 in 10.1981, two summer 1981-1982, 32 maximum, winter 1982 (COD); 19 on 24.5.1983 (OSNZ); 30 on 4.6.1983 (COD); two groups of 39 and eight birds (total 47) on 25.6.1983 (KH); 65 in 8.1983 (COD).

3. Turnstone (Arenaria interpres interpres)

Eight specimens in the Canterbury Museum; c. 100 on 7.1.1971 (OSNZ); six plus in 2.1964, 29 on 15.10.1969 (Tunnicliffe 1973a); 14 on 6.2.1972, two 18.5.1972, one 10.12.1972, two 19.12.1972 (RP); 22 on 17.11.1973 (DG); five 1.12.1973 (RP); two 26.12.1973 (DG); 15 on 2.1.1974, four 27.1.1974, one 30.11.1974, one 9.11.1975, two 1.1.1977, four 5.1977 (RP), maximum five at one time during summer 1980-1981, maximum 11 during summer 1981-1982 (COD); maximum six during summer 1982-1983 (OSNZ) and 9 for summer 1983-1984 (COD).

4. Lesser knot (Calidris canutus canutus)

Five birds in the Canterbury Museum; seven 13.11.1951, six 25.3.1961 (OSNZ); nine 27.10.1969 (Tunnicliffe 1973a); one 31.10.1970 (OSNZ); 80 on 25.11.1972, 15 on 6.1.1973, six 29.9.1973, one 17.11.1973 (DG); 11 on

1.12.1973, four 9.11.1975, four 9.11.1976 (RP); seven 1.1.1977 (DG); maximum 11 at one time 1980-1981, maximum 80 summer 1981-1982, up to c. 20 summer 1982-1983, c. 90 summer 1983-1984, 85 summer 1984-1985 (COD).

5. Sharp-tailed sandpiper (Calidris acuminata)

Eleven specimens in the Canterbury Museum; 12 on 18.2.1964, one 25.10.1969 (Tunnifcliffe 1973a), two 6.2.1972 (RP), eight 25.11.1972 (DG), one 10.2.1972, 11 in 1.1973 (RP); 18 on 17.2.1973, three 29.9.1973, four 20.10.1973, three 27.12.1973 (DG); two 2.1.1974, 19 on 3.2.1974, five 19.2.1974, two 18.11.1974 (RP); four 25.1.1975 (DG); one summer 1980-81, 25 summer 1981-1982 (COD); c. 24 on 1.4.1983 (DB); four during summer 1983-1984, 13 summer 1984-1985 (COD).

6. Curlew sandpiper (Calidris ferruginea)

15 specimens from Ellesmere are in the Canterbury Museum. Stead (1927) shot two on 5.4.1903 (first New Zealand record) and determined during later years that the species was a regular migrant, observing 50 on one occasion; 27 in 2.1964, 73 on 27.10.1969 (Tunnicliffe 1973a), two 12.5.1970, three plus 6.2.1972, one 18.5.1972, 21 on 16.12.1972, 25 plus on 19.12.1972 (RP); eight 6.1.1973, eight 13.1.1973, 14 on 16.2.1973, two 8.9.1973, five 20.10.1973, 30 plus on 26.12.1973, 34 on 5.1.1974 (DG); 25 on 27.1.1974, 33 on 3.2.1974, two on 19.2.1974 (RP); four 9.11.1974 (DG); 30 on 6.1.1975 (RP); 14 on 25.1.1975, nine 14.11.1975 (DG); one 18.2.1976 (RP); two 1.1.1977, one 23.2.1977 (DG); 70 summer 1980-1981, 64 summer 1981-1982, 46 plus summer 1982-1983, 61 summer 1983-1984, 47 summer 1984-1985 (COD).

7. Red-necked stint (Calidris ruficollis)

14 specimens in the Canterbury Museum; first recorded in New Zealand from Lake Ellesmere in 1902 by Edgar Stead. Collected by Stead in January and July (overwintering) in 1902, also 1910 and 1928-1930; 33 on 18.2.1964, three 27.10.1969 (Tunnicliffe 1973a); 24 plus on 19.12.1971, three 6.2.1972, one 18.5.1972, 38 on 10.12.1972, 25 on 16.12.1972 (RP); 68 on 6.1.1973, 10 on 13.1.1973 (DG); 48 plus on 16.12.1973 (RP); two 17.2.1973, 71 on 10.11.1973, 56 on 17.11.1973 (DG); 45 on 1.12.1973 (RP); 40 plus on 26.12.1973, 34 on 5.1.1974 (DG); 52 on 3.2.1974, 61 on 19.2.1974 (RP); 10 on 9.11.1974 (DG); 4

on 18.11.1974, 8 on 30.11.1974 (RP); 28 on 25.1.1975 (DG); 37 on 9.11.1975 (RP); 15 on 15.11.1975 (DG); 25 plus on 18.2.1976 (RP), 6 on 1.1.1977 (DG); 53 on 23.2.1977 (RP); 21 on 29.12.1977, eight on 3.1.1978, 12 on 26.1.1978 (BA); maximum 220 summer 1980-1981; six overwintered, maximum 214 summer 1981-1982; one overwintered, 194 summer 1982-1983; 128 plus summer 1983-1984 and 200 summer 1984-1985 (COD).

APPENDIX 2

BIRD POPULATION COUNTS IN FOURTEEN STUDY AREAS, LAKE ELLESMERE 1969-1982

A large number of bird counts have been made at various localities around Lake Ellesmere, especially during the period of intensive study 1981-1982. Study areas referred to are those shown in Figure 2. The counts provide supporting evidence for statements provided throughout the text of this report. Not all species recorded in study areas were seen on counts (e.g., marsh crake) and some rarer species were recorded on days when counts were not made (e.g., chestnut-breasted shelduck). The majority of counts were only part counts of each study area and counts usually reflect minimum values of those areas. A large number of informal counts of small parts of each study were undertaken from 1981 onwards and figures are not presented here.

Key:	P	=	present but not counted
	*	=	full count of study area
	H	=	hybrid
	c.	=	approximate count
Sources:	BA	=	B. Armstrong
	DB	=	D. Braithwaite
	DG	=	D. Geddes
	KH	=	K. Harrison
	COD	=	C. O'Donnell
	OSNZ	=	Ornithological Society of New Zealand
	RP	=	R. Pierce
	PS	=	P. Sagar
	GT	=	G. Taylor
	GY	=	G. Ytsma
	W/L	=	Wildlife Service file

Greenpark Date Source	25/10/69 RP	6/2/72 RP	18/5/72 RP	25/11/72 DG	10/12/72 RP	27/12/72 DG	17/2/73 DG	8/9/73 DG	29/9/73 DG	20/10/73 DG	10/11/73 DG	27/12/73 DG	2/1/74 RP	3/2/74 RP	19/2/74 RP
little shag	12	1							2	10			5		
black shag	2	1	2		P		1	1					2		
white-faced heron	6	13	2						6	7			7	17	23
white heron										8	1				
Royal spoonbill										1		1			
black swan							100+	500+	P	500+	500+				
white swan										1					
Canada goose	20+						100+								
paradise shelduck	1	5					5		5			15			
mallard							20	100+	400+	500+	200+				
grey duck							2	2							
grey teal							2	3							
N.Z. shoveler							8	100+	200+	500+	200+				
Australasian harrier							3				1				
pukeko	6								2	30	4				
S.I. pied oystercatcher	32	23		8	1				11	5	20	1		92	P
spurwinged plover	7							5	6	12	6	21		41	15
golden plover	45	2			58								4		
banded dotterel	38	1580	450	P	P	100+	40	10	20	8	20+		573	600	300
N.Z. dotterel	1														
wrybill	39	4+		2		2		18	4				10	21	26
little whimbrel		2													3
asiatic black-tailed godwit				1											
bar-tailed godwit			1	120	59	1			141	26	10	3	62	16	26
turnstone	27	14											15		
marsh sandpiper															
knot				80					6						
sharp-tailed sandpiper	1	2		8			18		3	4		3	2	5	5
pectoral sandiper				1											3
curlew sandpiper		3+	1					2		5				10	2
red-necked stint		3	1		23		2							35+	61
pied stilt	42	c. 500	60		P	250+	400	4	150	60	421	150+	726		350
S. black-backed gull							3	20	20	10					
black-billed gull							80	100+	4	3				200+	
red-billed gull															
black-fronted tern		4													6
caspian tern														4	
welcome swallow	5		33+				40	2							
N.Z. kingfisher															

Greenpark Date Source	15/10/74 DG	18/11/74 RP	25/1/75 DG	9/11/75 RP	3/12/76 W/L	23/2/77 RP	19/11/81 COD	31/11/81 COD	4/12/81 COD	24/3/82 COD	4/5/82 GT	2/6/82 COD	11/12/82 COD	19/2/83 OSNZ
little shag	P													
black shag			P										2	
white-faced heron	5	18	28		2		10	4			1			
white heron														
Royal spoonbill														
black swan	P		P		1800		900	2205	800	c. 1500	300+	4000+	2000+	P
white swan	4													
Canada goose									348	c. 1000	1500+	6000+	300+	
paradise shelduck			17		6		2						18	P
mallard	P		P		3800+		576	323	69	c. 250		2	2000+	
grey duck			1		P		6	6	1	26				
grey teal							50	236		226	100+	c. 300	1500+	P
N.Z. shoveler	P		P				104	110	14	47		1	3000+	
Australasian harrier								1	1	3		2		
pukeko												35		
S.I. pied oystercatcher	1													1
spurwinged plover	4						316	36	9	2	1	5	21	
golden plover							16		3					
banded dotterel	4	P	P		50+		228	142	162	245	391	4	71	1000+
N.Z. dotterel														
wrybill		1	5	5		19	3	2	3	1			1	
little whimbrel														
asiatic black-tailed godwit						1								
bar-tailed godwit						100	2							1
turnstone														
marsh sandpiper							2							7
knot							2							
sharp-tailed sandpiper		2	4											
pectoral sandiper														
curlew sandpiper			14			1		1						16
red-necked stint		4	28	22		53		20						26
pied stilt	26	P	P		1400+	500+	704	252	68	14	70	15	80	601
S. black-backed gull	P		P		P		17	76	7	38		2	4	
black-billed gull	P		P		480		535	204	45	3			1354	
red-billed gull					P				31					
black-fronted tern			1			9				3				
caspian tern				1					1					
welcome swallow	1									2		2		
N.Z. kingfisher												1		

Embankment	Date:	25/11/72	31/12/80	4/1/81	5/1/81	11/1/81	24/1/81	15/2/81	28/2/81	19/4/81	5/11/81	13/11/81	5/12/81	13/1/82	16/1/82	11/2/81
	Source:	RP	KH	KH	PS	PS	PS	KH	COD	KH	COD	COD	COD	COD	COD	COD
little shag																
black shag								P								
white-faced heron		P		P							10	6	2		1	
white heron																
Royal spoonbill																
white swan										P						
black swan			P	P					500+	P	721	309	500	400+	P	200+
Canada goose		P						P	300+	P			30	200+	P	15
paradise shelduck				P			P				2				6	6
mallard			P	P			P	P	P	P	190	160	300	127	P	20
grey duck			P	P			P	P	P	P			10	P	P	P
grey teal				P				300+	500+	P	2	2	90	50+	P	c. 500
N.Z. shoveler				P							6	30	50	30+		80
Australasian harrier							P				2	1	1		1	2
pukeko											1	1	1		1	
S.I. pied oystercatcher		4					P	P			16	1				
spurwinged plover				4						P	116	108	4	13	20	
golden plover				42	9	29	14	7			36		2	9		11
banded dotterel		P	P	P	100+	100+		100+	600+	P	86	70	50	196	c. 300	96
red-capped dotterel							1	1	1							
black-fronted dotterel																
Mongolian dotterel																
wrybill		8		6	20	2	P	30		P	4	7		5	15	
bar-tailed godwit		170		1	2			6						4		
Asiatic black-tailed godwit		1														
marsh sandpiper								3				2				
turnstone				5		5		4			10	8				
little whimbrel					1	2										
knot		26+			11											
sharp-tailed sandpiper		8		1			1				1	2			3	
pectoral sandpiper		1										1				
curlew sandpiper			1	2		2	40+	50+		11	6+			1		
sanderling																
red-necked stint			40	100	15+	10-20	80+	100+		4	97	2			30	
little stint (?)				1			1				1					
white-rumped sandpiper							2									
pied stilt		100+	P	P			P		100+	P	311	201	79	66	70+	35
black stilt										1						
black-backed gull							P	P	P		150	170	20	132	130+	13
red-billed gull													1			
black-billed gull							P	P			337	80	50	5	c. 50	5
caspian tern				1			1		1					1		1
black-fronted tern						1	P	1								
litte tern							2									
N.Z. kingfisher							P									
welcome swallow										P						

Embankment	Date:	19/3/82	24/3/82	30/3/82	8/4/82	17/4/82	22/4/82	4/5/82	19/5/82	2/6/82	30/6/82	14/7/82	2/12/82	3/1/83	19/2/83
	Source:	COD	COD	COD	COD	COD	COD	GT	COD	COD	COD	COD	COD	COD	OSNZ
little shag							3						1		
black shag														1	
white-faced heron		2				3	1	5	5		1	4	5	11	
white heron									1						
Royal spoonbill															
white swan		2				2	2	9	6	6	2	2			
black swan		c. 900	c. 2000	c. 300	800+	1000+	c. 1600	c.1900	c.4000	c.1195	c.1600	c.3000	250		P
Canada goose		c. 225	c. 900	66	300+	300+	c. 350	c. 50	c. 100		c.1700	c.1000			P
paradise shelduck				14			6		6	2	5		30	21	24
mallard		c.1000	1227	1000+	P	1500+	c. 2100	c. 200	c. 200	57	454	c.1100	210		P
grey duck		P		2	P	P					6				
grey teal		275	295	500 +	P	600+	c. 1600			2		c.1500	25		P
N.Z. shoveler		c. 250	30	12	P	400+	c. 300		2	41	c. 400	600	40		P
Australasian harrier				1	2	2									
pukeko													2	1	
S.I. pied oystercatcher									1			27	6	118	
spurwinged plover				4	3	3		2	2		2	96	5	34	
golden plover			10									1			
banded dotterel		150	304	158	37	131	106	152	411	423	29	37	43	38	429
red-capped dotterel															
black-fronted dotterel															
Mongolian dotterel															
wrybill		19	59	19	13	45	24	8					1	44	2
bar-tailed godwit														5	
Asiatic black-tailed godwit															
marsh sandpiper							2								
turnstone															3
little whimbrel															
knot															36
sharp-tailed sandpiper				1			1								
pectoral sandpiper			2										1		
curlew sandpiper			4	20		5		12					1		30
sanderling															2
red-necked stint		47	12	2	19	93	79	3						18	10
little stint (?)															
white-rumped sandpiper															
pied stilt		137	36	72	26	43	31	67	227	170	65	50	93	120	218
black stilt											2				
black-backed gull		1	31	13	P	P	2		3	3	5	230	150	208	
red-billed gull															
black-billed gull		1	5	2							1		3	262	
caspian tern							1				1			2	2
black-fronted tern															
litte tern															
N.Z. kingfisher							8								
welcome swallow		5	2	2	2	4	22	20+	36	8	12	30		1	

Yarrs	Date:	16/2/73	3/2/74	29/12/77	3/1/78	26/1/78	14/1/81	17/1/81	21/1/81	31/1/81	Jan 1981	4/2/81	11/2/81	14/2/81
	Source:	RP	RP	BA	BA	BA	KH	KH	KH	KH	OSNZ	KH	KH	KH
little shag								P	P	P				
black shag								P		P			P	
white-faced heron			1		3	2	P		P	P				P
white heron														
Royal spoonbill														
white swan			P	3										P
black swan							P	P	P	P		P	P	P
Canada goose									P			P	P	P
paradise shelduck				42	9	9								
mallard							P		P				P	P
grey duck							P		P				P	P
grey teal					500	6		P		P	300+			
N.Z. shoveler														
Australasian harrier				1			P	P	P			P		
pukeko				2			P		P	P				
S.I. pied oystercatcher		14		12									P	
spurwinged plover		12		5	9		P	P	P	P		P	P	P
golden plover								1		2		2	2	
banded dotterel		P	150	38	99	7	P	P	P	P			P	
red-capped dotterel								1		1			1	1
black-fronted dotterel														
Mongolian dotterel														
wrybill		40	3	4	8		P	P		P		P		
bar-tailed godwit				5			4	6	1				7	P
marsh sandpiper														
turnstone														
little whimbrel		1												
knot											11			
sharp-tailed sandpiper			14							1	1			
pectoral sandpiper			1											
curlew sandpiper		14	23				12	1	15	50+	70+	30+		30+
sanderling														
red-necked stint		48+	17	21	8	12	50	50	25	200	c.220	90+	30	75+
white-rumped sandpiper							P	6		1	6			
pied stilt		P		305	269	110	P		P	P	100+	P	P	P
black stilt														
black-backed gull				P			P	P	P	P		P		
red-billed gull														
black-billed gull					P		P							P
caspian tern							1							P
little tern		8									2			
N.Z. kingfisher					P						-			
welcome swallow				1		P	P			P				
black-fronted tern		8	1				P				10		P	P

Yarrs 2 Date: / Source:	28/2/81 COD	20/3/81 KH	26/3/81 KH	3/4/81 KH	10/5/81 KH	17/5/81 KH	29/5/81	30/5/81 PS	26/6/81 KH	26/7/81 PS	27/9/81 PS	3/10/81 COD
little shag						P			-			
black shag		P		1					P			
white-faced heron	1	P		P	P		P		P	8		
white heron					4	3	2			3		
Royal spoonbill												
white swan		P	P		P	P			P			
black swan	P	P	P	P	P	P	P		P			P
Canada goose		P	P	P		P	P		P			10
paradise shelduck												1
mallard		P	P		P	P	P		P			P
grey duck		P	P		P	P	P		P			
grey teal		P	P	P		P	P					10
N.Z. shoveler		P	P	P		P						20
Australasian harrier					P	P	P					
pukeko						P						
S.I. pied oystercatcher	5							7				
spurwinged plover		P	P		P	P	P		P			
golden plover		14										
banded dotterel	c. 100	P	P	P	P	P	P	c.1000	P	230		30
red-capped dotterel	1	1		1							2	
black-fronted dotterel												
Mongolian dotterel												
wrybill	10	P	P	P	P	P		6	P			4
bar-tailed godwit	P	1	3									
marsh sandpiper												
turnstone												
little whimbrel	1											
knot												
sharp-tailed sandpiper			1	1								
pectoral sandpiper												
curlew sandpiper	14	20		5	2	4	3	2		2		1
sanderling												
red-necked stint	59	36	50	30+	30	3	2	5	1	7		16
white-rumped sandpiper												
pied stilt	100+	P	P	P	P	P			P			100+
black stilt						1					2	
black-backed gull		P	P		P	P			P			
red-billed gull												
black-billed gull			P			P		P				
caspian tern	1	P						P				2
little tern	1											
N.Z. kingfisher						P	P					
welcome swallow			P		P		P					
black-fronted tern	9	P	P									

Yarrs 3 Date: / Source:	18/10/81 PS	24/10/81 COD	26/10/81 BA	29/10/81 COD	13/11/81 COD*	28/11/81 COD*	2/12/81 COD*	5/12/81 COD*	12/12/81 COD*	19/12/81 COD*	23/12/81 COD*	28/12/81 COD*	13/1/82 COD*
little shag				3	3	12	25		1		6	1	2
black shag				1	1	1							3
white-faced heron		1	2	5	8	10	1	3		3	16	8	3
white heron													
Royal spoonbill								2					
white swan					3		2						
black swan		450		600+	430	470	350	175	750	380	350	300	1100+
Canada goose				15	2						25		
paradise shelduck					1	3				1	1		
mallard		100+		200	391	166	1008	300	240	370	517	253	1500+
grey duck				20	2			10		2	5		10
grey teal		25			50	150	500	200	350	202	302	400	1000+
N.Z. shoveler		20	66	210	556	40	300	75	100	170	101	100	500+
Australasian harrier					1			1	1	1			
pukeko		2		30	9	9	4		2	4	10	2	3
S.I. pied oystercatcher		1			19	1	1				30	2	7
spurwinged plover		10	2	4	81	1	2	15	17	41	36	2	74
golden plover						10		31	8	41	1	48	1
banded dotterel	10	100		29	47	36	66	65	164	69	93	134	521
red-capped dotterel													
black-fronted dotterel													
Mongolian dotterel													
wrybill	2				40	5	12	9	6	16	54	27	59
bar-tailed godwit		4	2		2	1	7	17	31	48	24	36	2
marsh sandpiper										2		7	74
turnstone					2			1			1	1	
little whimbrel													
knot		2					37	42	63	52	71	80	42
sharp-tailed sandpiper								20+				10	10
pectoral sandpiper					1		6	5+		1	3	9	
curlew sandpiper	1				2	12	26	25+	51	37	19	60	49
sanderling					1								
red-necked stint	68	4	2	90	55	55	174	100+	71	216	105	127	73
white-rumped sandpiper													
pied stilt		150	31	20	73	793	571	241	106	185	459	405	207
black stilt											1		
black-backed gull				30		34	11	12	5	20	4	5	8
red-billed gull		100		20	2					2	6	43	
black-billed gull			170	c.500	24	240	107	225	16	154	39	2	37
caspian tern				1		1	1			1			3
little tern													
N.Z. kingfisher							1				10		
welcome swallow										10		P	P
black-fronted tern				20	2	15							

Yarrs 4 Date: Source:	16/2/82 COD	28/1/82 COD*	29/1/82 COD*	11/2/82 COD*	24/2/82 COD*	27/2/82 COD*	19/3/82 COD*	24/3/82 COD*	30/3/82 COD*	8/4/82 COD*	17/4/82 COD*
little shag			1						3	1	1
black shag								1	1		2
white-faced heron	10	1	4	26	7	19	14	14	4		4
white heron											
Royal spoonbill											
white swan					6	6	7	2	6	2	7
black swan	P	900+	1000+	1500+	1000+	1500+	c.480	c.500		c.600	c.1000
Canada goose				17	120	500+	c.1325	9	37	c.90	c.350
paradise shelduck	4		3	51	47	31	4	7	5	1	5
mallard	P	185	500+	c.4000	c.400	500+	c.1500	c.750	1000+	c.1000	c.550
grey duck	5			P	P	10	P	19		P	20+
grey teal	P	383	900+	c.2000	c.1000	c.1000	c.800	1782	1000+	c.250	
N.Z. shoveler	12			23	c.500	187	c.1200	127	587	c.500	c.340
Australasian harrier	3	2	1	3	3		1			3	7
pukeko	5	2	2		9			2		1	1
S.I. pied oystercatcher	59	6	22	9	7	77					
spurwinged plover	93	5		11	8	20				17	28
golden plover		18		3	21	35					
banded dotterel	c.100	139	c.450	427	c.200	39	5	66	75	13	51
red-capped dotterel											
black-fronted dotterel											
Mongolian dotterel											
wrybill	25	48	42	55	37	45		5	7		3
bar-tailed godwit				1	1	1					
marsh sandpiper	3	3			3	3				3	1
turnstone											
little whimbrel											
knot	41	33	21	61	48	38					
sharp-tailed sandpiper	1	8	7	23	25+	21	1	7	3		1
pectoral sandpiper	2			8	8	8	6	5	1		2
curlew sandpiper	6	48	19	45	60	42	12	24	12	2	9
sanderling											
red-necked stint	30	82	114	125	200+	109	4	76	39	2	10
white-rumped sandpiper											
pied stilt	360	40	96	106	137	214	59	108	101	83	72
black stilt											
black-backed gull	10	7	2	21	2	7	3	4	10		7
red-billed gull											
black-billed gull	c.350	7	39	18	83	68		38	23		
caspian tern	2	1			1						
little tern											
N.Z. kingfisher											
welcome swallow	4	8	18	2	3	12	53	12	22	14	10
black-fronted tern				1	2						

Yarrs 5	Date:	28/4/82	5/5/82	28/5/82	26/6/82	28/6/82	1/7/82	5/7/82	10/7/82	20/7/82	29/7/82	5/8/82	27/8/82
	Source:	COD	COD	COD	COD	COD	COD	COD*	COD*	COD*	COD*	COD	COD
southern crested grebe					1	1			1	3			
little shag		5		7		4	3						
black shag		3		2		1	9						
white-faced heron		3	2			3	1			1	3		
white heron		3	1		1	1	1						
Royal spoonbill													
white swan		13	4	3		8	2		2				
black swan			436	c.350	P	c.1100	c.350	c.150	702	c.500	c.200	P	P
Canada goose		766				c.1600	c.1250	6		25			
paradise shelduck		14	3	25			17				4	14	12
mallard		c.600	2	12		149	c.1000	c.100	125	192	500+	P	P
grey duck				12			25			2	20		
grey teal		c.900			P	159	c.840	21	50	6	30		100+
N.Z. shoveler		c.600	55	2			c.350	c.200	500	75	500+	P	P
Australasian harrier			8	5		6	4	2					
pukeko		c.50	4	8		2	2		2	5	2		
S.I. pied oystercatcher								16					
spurwinged plover		2		2	P			5		20	50		
golden plover													
banded dotterel		18	14	3	P		5	25	10	61	254	175	512
red-capped dotterel													
black-fronted dotterel													
Mongolian dotterel													
wrybill		4						14			98	98	97
bar-tailed godwit								43	14				
marsh sandpiper													
terek sandpiper													
turnstone											1		
little whimbrel													
knot			6	4	1			10	5				
sharp-tailed sandpiper		2						4					4
pectoral sandpiper					3			1			35	14	
curlew sandpiper		26			3	2	2						
sanderling													
red-necked stint		9			1			32	2	3	143	74	
white-rumped sandpiper													
pied stilt		62	13	14	P	4	8	535	577	312	559	502	544
black stilt					1					1			
black-backed gull			2	3		6	17	4	5	8	4		
red-billed gull													
black-billed gull						2		23	37		2		
caspian tern						2	4		2	3	8		1
little tern													
N.Z. kingfisher							1						
welcome swallow			2	5		c.20	c.40						
black-fronted tern						4							

Selwyn Date: / Source:	14/9/69 OSNZ	31/10/70 OSNZ	6/2/72 RP	4/1/73 OSNZ	14/12/77 BA	28/11/81 COD	2/12/81 COD*	23/12/81 COD	26/1/82 COD
little shag		4	2		5	10	31	2	2
black shag		2	1	P	2	2			
white-faced heron		6	2		1	9	61	5	
black swan	1000	c.500		100+	100+	700+	680	350	191
white swan	3	2			4	6	4		5
Canada goose	100+			100+	100	130	130		380
paradise shelduck						7	11		
mallard	c.20	c.200		P	50	100	136	150	458
grey duck	c.100	c.100		P				2	
grey teal						85	80	60	21
N.Z. shoveler		c.100		P		20	20	70	155
Australasian harrier	5	1		P					
pukeko	c.100	4		P		2	2	10	45
S.I. pied oystercatcher		50							
spurwinged plover				1		6	2	2	10
banded dotterel	c.20	20	11		4	3	15	6	26
bar-tailed godwit		23		15					
curlew sandpiper									3
knot		1							
pied stilt	c.40	50	20	100+	21	77	269	160	39
S. black-backed gull	4	10		100+	P	151	17	6	2
black-billed gull		c.200				100	3	2	
red-billed gull	c.10			100+					
white-fronted tern		10	4	P					
black-fronted tern		2	1						
caspian tern						3	1		
white-winged black tern			1						
N.Z. kingfisher			1						
welcome swallow					2	P	2	2	9

Rennies Date: / Source:	28/11/81 COD	23/12/81 COD	24/12/81 COD	17/2/82 COD	24/4/82 COD
little shag	32	26	22	2	1
black shag	4	1	1	1	1
white-faced heron	17	2	6	1	
Royal spoonbill			2		
cattle egret	2				
black swan	500	250	188	P	195
white swan			4		8
Canada goose	295		58	P	c.1400
mallard	46	59	81	P	587
grey duck	15		11		4
N.Z. shoveler		27			7
pukeko	8				22
S.I. pied oystercatcher	1				
spurwinged plover					4
banded dotterel	31	3		P	
turnstone	1				
pied stilt		110	18		46
black-backed gull	56	2	18	?	19
black-billed gull	250	26	38	1	
red-billed gull			1		
caspian tern		3	1		3
black-fronted tern				3	
N.Z. kingfisher		2	3		

Doyleston	Date:	22/8/71	11/71	11/71	9/8/80	15/1/82
	Source:	OSNZ	OSNZ	OSNZ	COD	COD
little shag			P	P		13
black shag			P	P		5
white-faced heron						
white heron					1	
cattle egret					75	
Australian bittern			P			
black swan			100+		100+	22
white swan			P			
Canada goose			100+			10
mallard			100+	P	P	32
grey duck						1
grey teal					11	
N.Z. shoveler			100+			
Australian harrier			P	P		1
pukeko		P	100+	P		1
spurwinged plover			P		25	
banded dotterel				P	P	
pied stilt			100+		115	5
S. black-backed gull		100+	P	100+		10
black-billed gull		P	P	100+		3
white-fronted tern			P			
caspian tern			P			
welcome swallow			P	P		3
N.Z. kingfisher					1	1

Hart's Date: / Source:	26/10/69 RP	27/1/73 DG	8/9/73 DG	2/1/74 RP	5/11/80 W/L	26/10/81 COD	29/10/81 COD	16/11/81 GY	18/11/81 COD	19/11/81 COD	15/1/82 COD	23/4/85 COD
little shag	20	100				82	50		22	39	39	12
black shag	2	100	20		2	4		3	27	24	8	
white-faced heron	9				5	50		4	21	10	28	
white heron		1	5					2				
Royal spoonbill		1		2								
black swan		P	100+		72	226	100	130	192	150	266	52
white swan		P		42	2	20		10	33	25	17	6
feral goose											18	
Canada goose	50		10		5	1	15	2	10	10	8	
paradise sheldck					1		1	2				
mallard		100+	100+		52	128		80	124	24	1462	c.720
grey duck			2			1					17	
grey teal					1	4		10				4
N.Z. shoveler			2			20			3	5	25	24
Australasian harrier				4							3	
pukeko	110		13		P	6	10	7	4	5	27	32
marsh crake											1	
S.I. pied oystercatcher								19				
spurwinged plover	P			3		10	1		1			1
banded dotterel	10			P				40		2		
wrybill									1			
bar-tailed godwit					9			19		12		
turnstone				3								
knot									1			
pied stilt		P	14	P	55	30		60	39	24	82	4
S. black-backed gull			10		P	26		50	43	21	10	48
black-billed gull			30	100		269	1001		171	34	5	18
red-billed gull								40				
white-fronted tern				150				6		2		
kingfisher					1						2	
welcome swallow						2					2	2

Lakeside Date: Source:	26/10/69 RP	18/11/81 COD	19/11/81 COD	22/11/81 COD	15/1/82 COD	23/4/82 COD
little shag	20				1	
black shag	2	1	1	3	1	3
white-faced heron	9	4		16	10	3
white heron						1
cattle egret					1	
black swan		33	12	167	174	308
white swan		4				2
Canada goose	c.50			14	55	c.1800
paradise duck						8
mallard		5	125	146	111	1478
grey duck				3		4
grey teal					30	10
N.Z. shoveler				5	33	93
Australian harrier					5	
pukeko	c.100			1	1	
marsh crake					2	
spurwinged plover	P	2	1	6	1	8
banded dotterel	10	2	1	22	1	2
wrybill		31		1	1	
pied stilt		3	49	71	15	48
S. black-backed gull		1	9	96	11	
black-billed Gull		7		7	5	
caspian tern				1	1	
white-fronted tern				2		
welcome swallow	2	1			4	c.50

Taumutu Date: / Source:	12/12/71 OSNZ	19/12/71 RP	10/12/72 RP	13/1/73 DG	13/12/73 OSNZ	27/1/74 RP	30/11/74 RP	18/2/76 RP	1/1/77 DG	26/10/81 COD	18/11/81 COD	24/11/81 COD	24/12/81 COD	15/1/82 COD	23/4/82 COD
little shag		4		10							4	1		4	1
black shag	P	4			2			1			16	6	4	3	1
spotted shag					P						2		1		
pied shag										1					
white-faced heron	P	12			P	2	1	2		1	10	10	6	7	1
Australasian bittern													2	2	
black swan	100+	4		c.100	P						23	40	6	22	4
white swan	P	2				6						2	2		1
Canada goose					P										
paradise shelduck							5								
mallard	100+	P									7		1		19
grey duck		P			P						1				4
N.Z. shoveler															134
Australasian harrier	P	1													
pukeko	P	1													
marsh crake															
S.I. pied oystercatcher			15										1		
spurwinged plover													4		9
banded dotterel		18	P		P		P			2	2	2	1		
bar-tailed godwit													14		
greenshank				1											
turnstone							1		2						
red-necked stint							8								
pied stilt				9			8						3		
Antarctic skua			1												
S. black-backed gull	P	P			100+					210	46	20	7	12	9
black-billed gull	P	P								15	23		17	42	15
red-billed gull		P			100+					10	43	10	6	13	2
black-fronted tern						4			2						
white-fronted tern	P	9		150	100+	c.100	10	155		4	20		25	49	
caspian tern											2	1		3	
welcome swallow											1		15	2	

Kaitorete Tip Date: / Source:	27/10/69 RP	19/12/71 RP	10/12/72 RP	16/12/72 RP	6/1/73 DG	13/1/73 DG	10/11/73 DG	17/11/73 DG	1/12/73 RP	26/12/73 DG	5/1/74 DG	27/1/74 RP	19/2/74 RP	9/11/74 DG	6/1/75 RP
little shag		1		P	8							4			1
black shag		2	P	5	3			P				20		7	1
white-faced heron		1		18			2	10	5			3		1	1
white swan															
black swan		300+			10+		200+	2		200+				P	
Canada goose		300+			c.500+					200+					
paradise shelduck															
mallard		100+			c.30		200+			100+				P	
grey duck		10+													
grey teal		20+													
N.Z. shoveler		c.40						4							
Australasian harrier		1					1								
S.I. pied oystercatcher	1			7				1							1
spurwinged plover															
golden plover						4								1	
banded dotterel	24	100+	P	100-200	10+	P	50+	P	P	50+		140	250	P	P
Mongolian dotterel							1		1						
wrybill	79	3	3	1	17	13	10	10+	5	15+	63	14			
bar-tailed godwit	8		11		3		1		7						
greenshank										1					
terek sandpiper															
turnstone	1	2	1					22	5	2		4			
sharp-tailed sandpiper			1												
curlew sandpiper	60	25+		21	8	8				30+	34	25		4	30
pectoral sandpiper															
knot	9+				15			1	11						
sanderling		1							1	1					
red-necked stint	3	24+	15	25	68	10	71	56	45	40+	34			10	
pied stilt	32	13	2	1	123	P	4		21	141	54	13	122	3	10
S. black-backed gull		10+			2		40			19				50	
black-billed gull		c.25					4			22				17	
red-billed gull															
caspian tern									3	2	3	1	5	1	2
little tern								1	2	2					
black-fronted tern					1					1					
white-fronted tern		2			P				2						1

Kaitorete Tip Date: / Source:	1/3/75 RP	9/11/75 RP	14/11/75 DG	18/2/76 RP	1/1/77 DG	25/10/81 COD*	31/10/81 COD*	12/11/81 COD*	24/12/81 COD*	29/1/82 COD*	24/2/81 COD*	24/4/82 COD*	23/9/82 COD*
little shag	P									2			
black shag	30						1			21	1		
white-faced heron	P							1	1		1		1
white swan	2								2				
black swan					P	120	111	81	100+	36	20	87	c.220
Canada goose	P				P	3	9	4	200	100+	130	c.200	2
paradise shelduck						2							
mallard					P	20	31	35	20+	5	30+	67	42
grey duck							2	4			P		
grey teal											27		
N.Z. shoveler								2			30+	45	32
Australasian harrier							2						
S.I. pied oystercatcher	2									1			
spurwinged plover							16	3		3	2	9	24
golden plover													
banded dotterel	P	P		500+	P	30	38	72	60	200+	200+	140	46
Mongolian dotterel		1											
wrybill		29		2		7	28	9					26
bar-tailed godwit	3	2											
greenshank													
terek sandpiper					1								
turnstone		1											1
sharp-tailed sandpiper													
curlew sandpiper			9	1	2		26	12					3
pectoral sandpiper					1								
knot		4			7								
sanderling													
red-necked stint		15	15	25+	6								7
pied stilt	10		2	27	5	6	4	1	15	25	4	8	14
S. black-backed gull	P	40+	P		P		182	52	100+	20	2	4	20
black-billed gull										1	1	1	2
red-billed gull													
caspian tern	2	2		3									
little tern							2	2					
black-fronted tern	7												
white-fronted tern											1		

Kaitorete	Date:	31/10/81	12/11/81	31/11/81
	Source:	COD	COD	COD
black shag			1	1
white-faced heron		1	1	
black swan		238	133	173
Canada goose		19		
mallard			2	8
grey duck			6	
grey teal		5		
N.Z. shoveler		5	18	
spurwinged plover		2	4	11
banded dotterel		52	2	1
wrybill				1
turnstone				1
pied stilt			1	21
S. black-backed gull			248	10
red-billed gull		2		
black-billed gull		4		
caspian tern			16	

Kaituna	Date:	2/2/70	26/6/71	10/7/71	18/5/72	10/12/72	1/73	27/10/73	1/12/73	27/12/73
	Source:	OSNZ	OSNZ	OSNZ	RP	DG	OSNZ	OSNZ	OSNZ	DG
little shag		1-10						1-10		
black shag		1-10	11-100	1-10			11-100			
spotted shag		12								
pied shag									5	
white-faced heron		1-10	1-10	1-10						P
black swan		1000+	100+	100+			100+			4
white swan			1-10	1-10						
Royal spoonbill										100+
Canada goose		100+	100+	11-100			100+			2
paradise shelduck		9			2					P
mallard			100+	100+			100+			
grey duck				11-100			100+			P
grey teal										P
N.Z. shoveler							11-100			
Australasian harrier		4	11-100	1-10						2
pukeko		7	11-100	11-100			11-100			
marsh crake										
S.I. pied oystercatcher										
spurwinged plover							11-100	4		
golden plover						121			14	
banded dotterel		11-100	1-10		80	P	100			
bar-tailed godwit		6					11-100		5	
turnstone					2					
pied stilt		100	100+	11-100	40	P	100		400	1400+
black stilt										
S. black-backed gull		11-100	11-100	11-100						
black-billed gull										
red-billed gull				11-100			100			
white-fronted tern		1-10					11-100			
black-fronted tern		3					11-100			
caspian tern										
N.Z. kingfisher		2								
welcome swallow				11-100	2			11-100		

Kaituna Date: / Source:	2/74 OSNZ	19/2/74 OSNZ	1975 RP	21/9/79 GT	18/11/81 COD	31/11/81 COD	4/12/81 COD	30/12/81 COD	29/1/82 COD	24/3/82 COD
little shag				3	3	4	1	1	6	3
black shag	1-10			3	1	7	12	3	14	1
spotted shag										
pied shag		1								
white-faced heron					10	45	32	30	15	1
black swan	100+	11-100		1028	100+	2688	3017	1000	c.3000	c.2000
white swan	1-10			3	10+	2	2			1
Royal spoonbill							3			
Canada goose	11-100	1		484		7	72	2145	200+	c.1500
paradise shelduck									11	29
mallard				32+	100+	499	464	1044	2090+	c.2750
grey duck					10	5	59			
grey teal				80+		2	64	102	250+	c.2700
N.Z. shoveler	1-10					71	120	404		c.3500
Australasian harrier	1-10					3	3			
pukeko				15		31	15	5	1	24
marsh crake							2			
S.I. pied oystercatcher				11	2	106		3		
spurwinged plover							4	2	1	2
golden plover										
banded dotterel				2		3	11			5
bar-tailed godwit										
turnstone										
pied stilt	800+		2400	105	15	21	98	191	105	47
black stilt					1					
S. black-backed gull		1-10				275	62	59	32	3
black-billed gull							59	16	1	
red-billed gull	11-100						1	2		
white-fronted tern				35	10					
black-fronted tern										
caspian tern				3	2	2	2			
N.Z. kingfisher				2						
welcome swallow						5	16	1	15	

Halswell Date: / Source:	21/3/71 DB	27/12/73 DG	19/2/74 RP	13/11/81 COD	4/12/81 COD	30/12/81 COD	24/4/82 COD
little shag							4
black shag				1			
white-faced heron	P			1	3	1	
black swan	P			c.100	325	240	c.200
Canada goose	P	P			32	c.1000+	c.250
mallard	P	P		20	1020	150	c.100
grey duck	P	P			6		
grey teal					400	40	
N.Z. shoveler	P	P			c.1000	30	
Australasian harrier	P				1		
pukeko					6		21
banded dotterel	P	22		5	5		
little whimbrel			1				
bar-tailed godwit		169	200				4
pied stilt	P	150+	300		31	536	
black stilt				1			36
S. black-backed gull	P	100+		30	294	36	
black billed gull		100+		2	1	2	
caspian tern	2						
N.Z. kingfisher						1	
welcome swallow							10

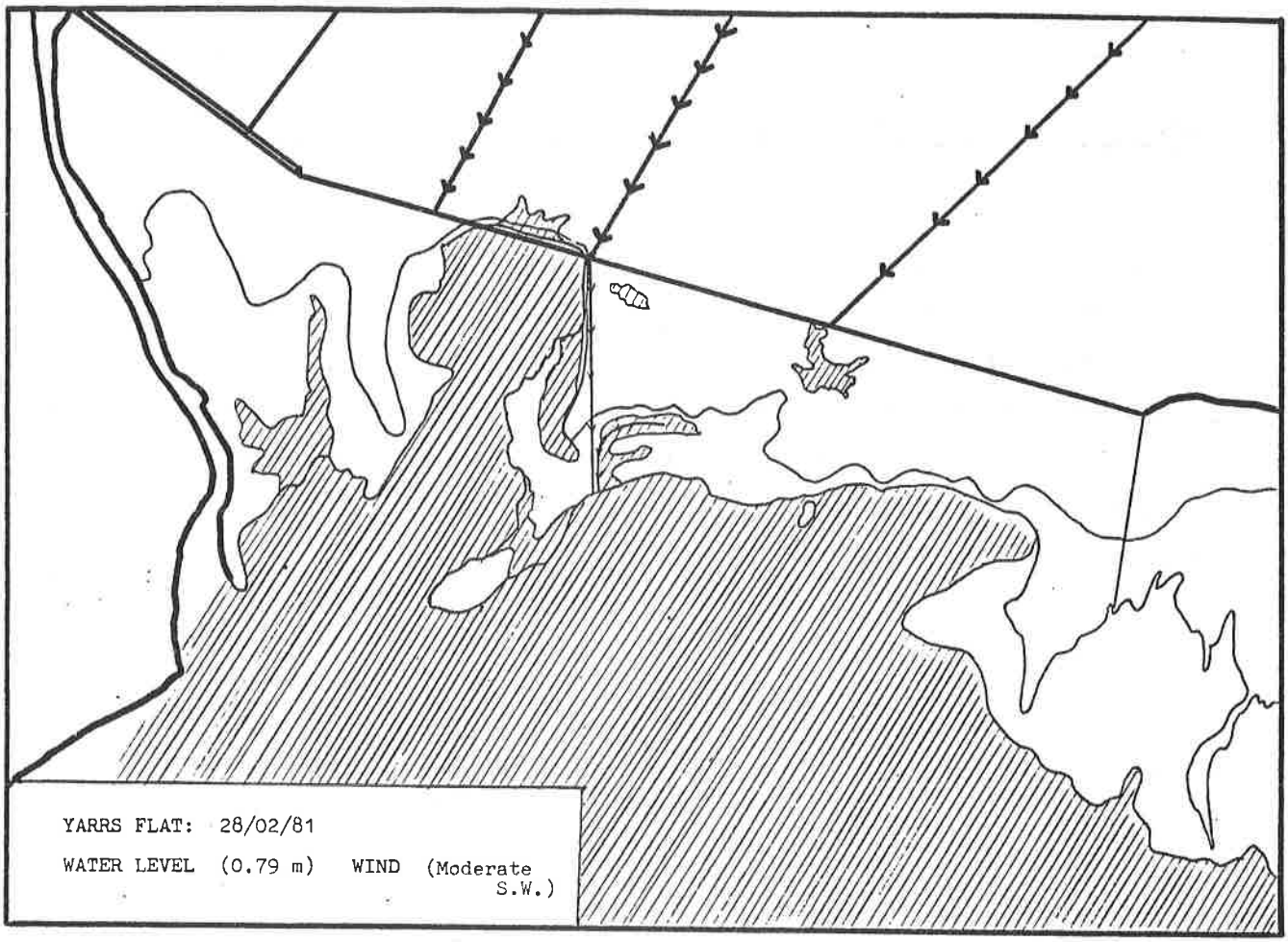
APPENDIX 3

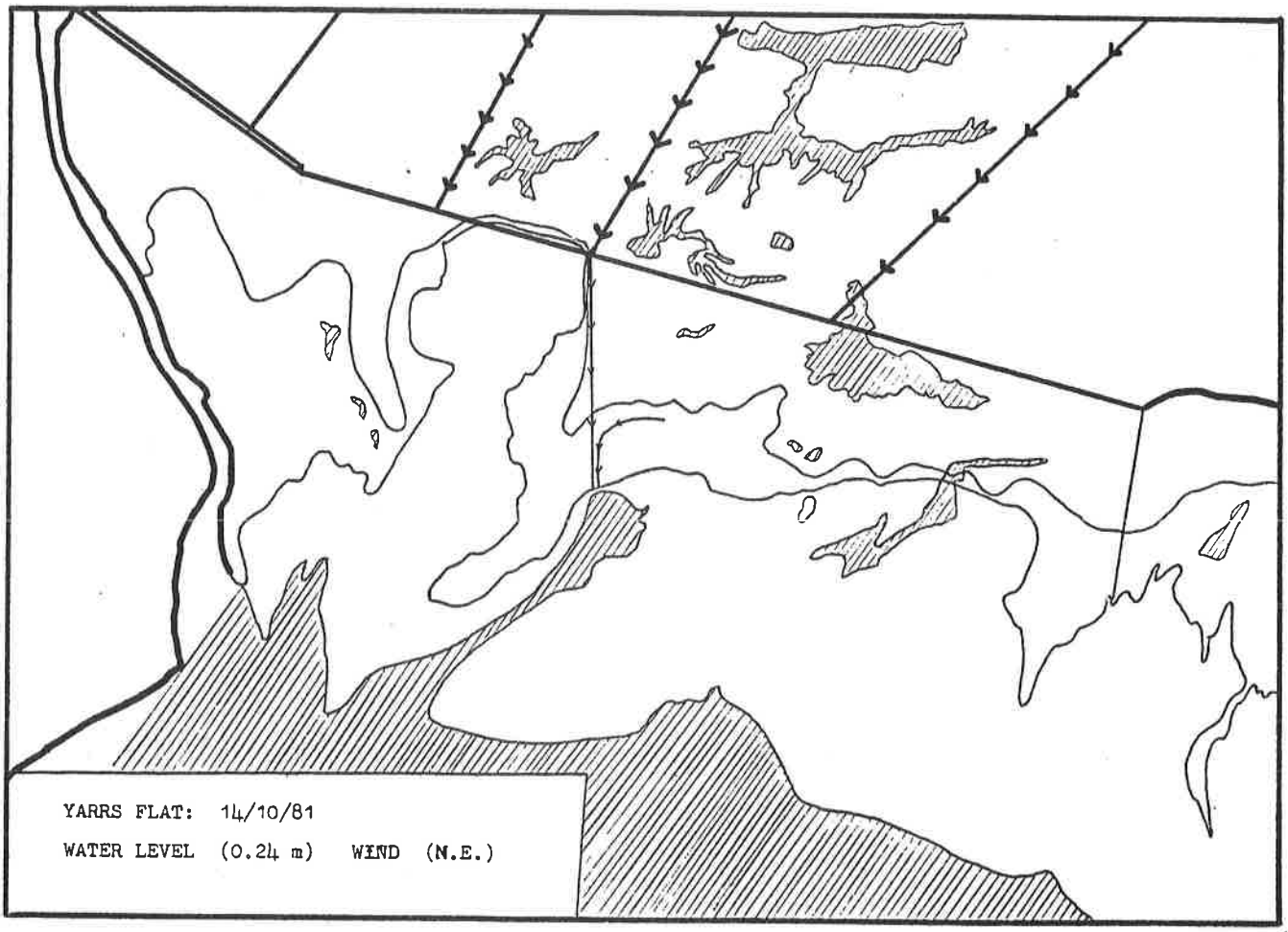
MAPS OF LAKE LEVELS ON THE GROUND AT YARR'S FLAT, LAKE ELLESMERE, 1981-1982

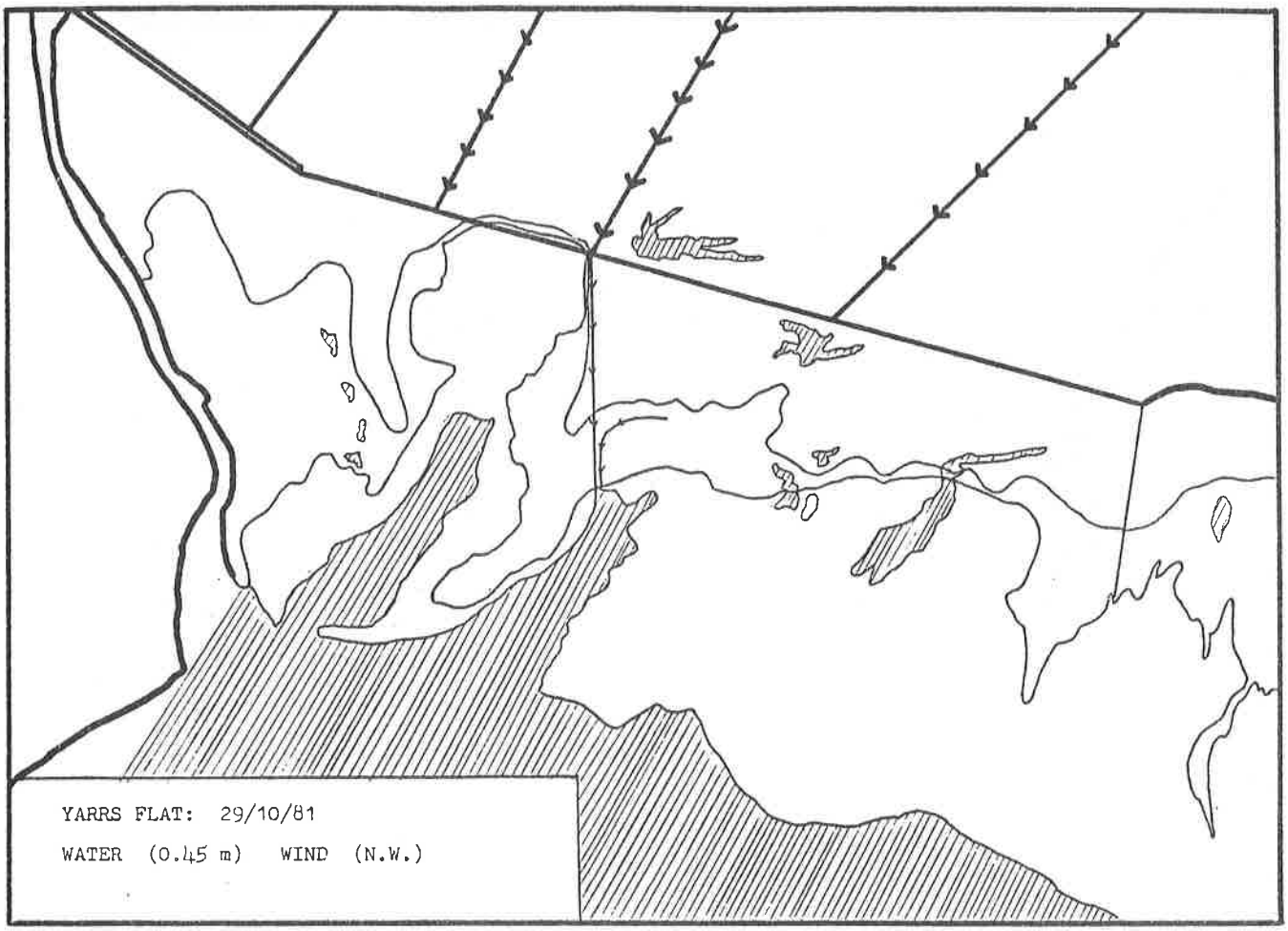
Mapping of water levels shows the extent of habitat change in the Yarr's Flat area with changes in lake level (calm reading at Taumutu) and wind direction. A third variable, rainfall is also important in that it creates pond areas that wouldn't appear just from a fluctuating water regime. Fuller exploration of these changes will accompany a paper in preparation relating to water level changes and their influence on distribution of waders and waterfowl.

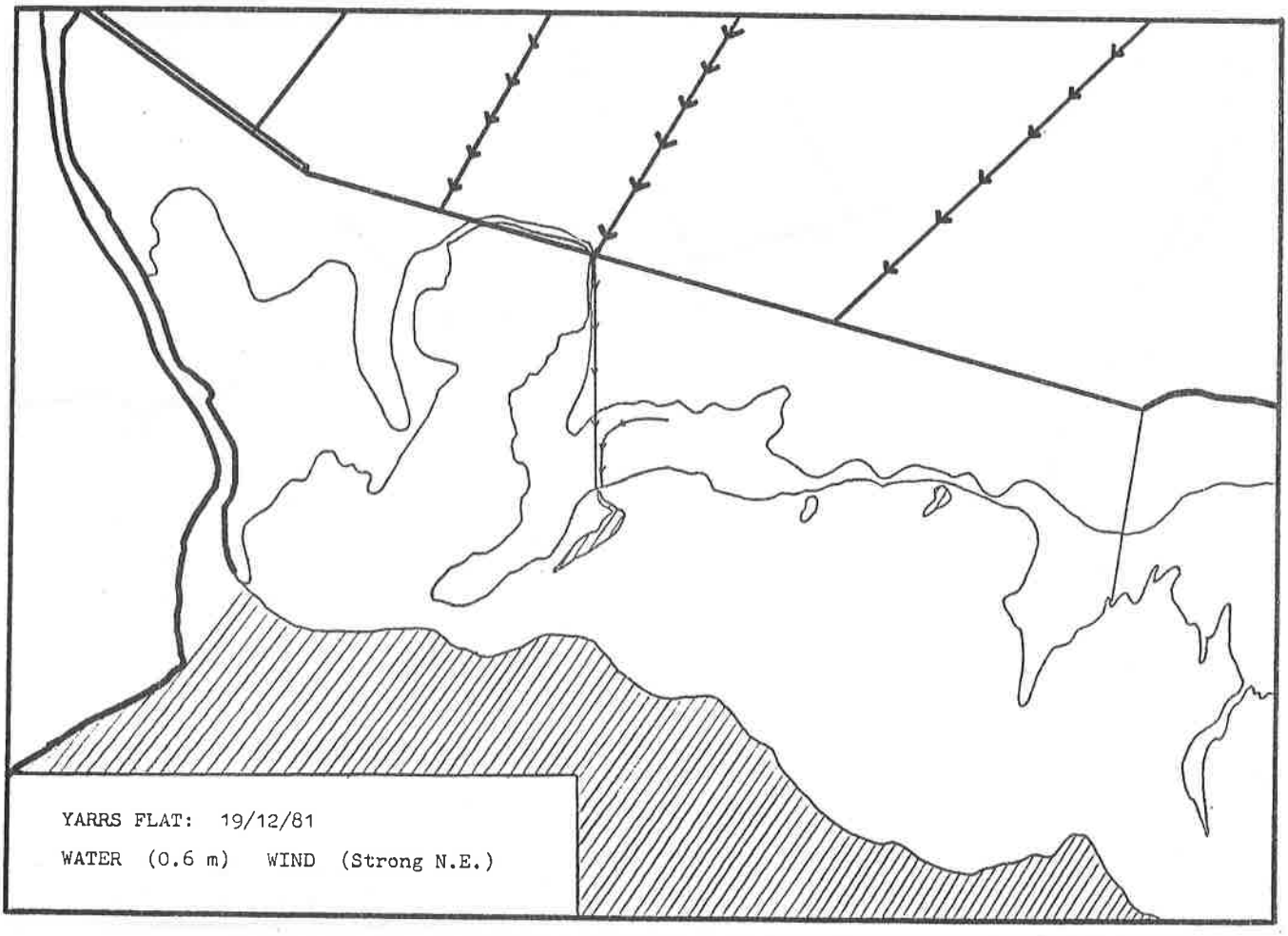
KEY:

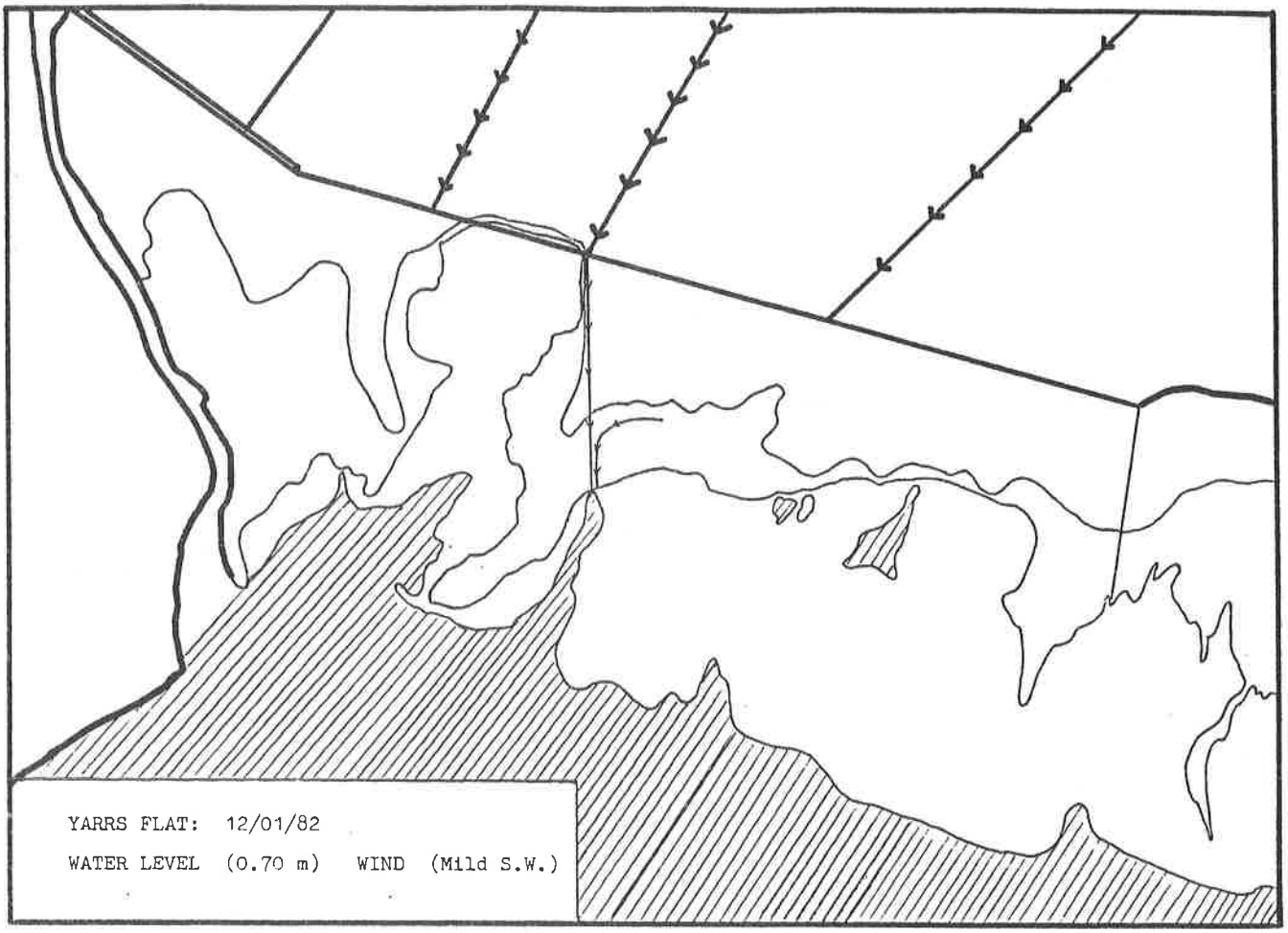
Prevailing Wind	N.E.	North-east
	N.W.	North-west
	S.W.	South-west
Water Level	Metres above m.s.l.	

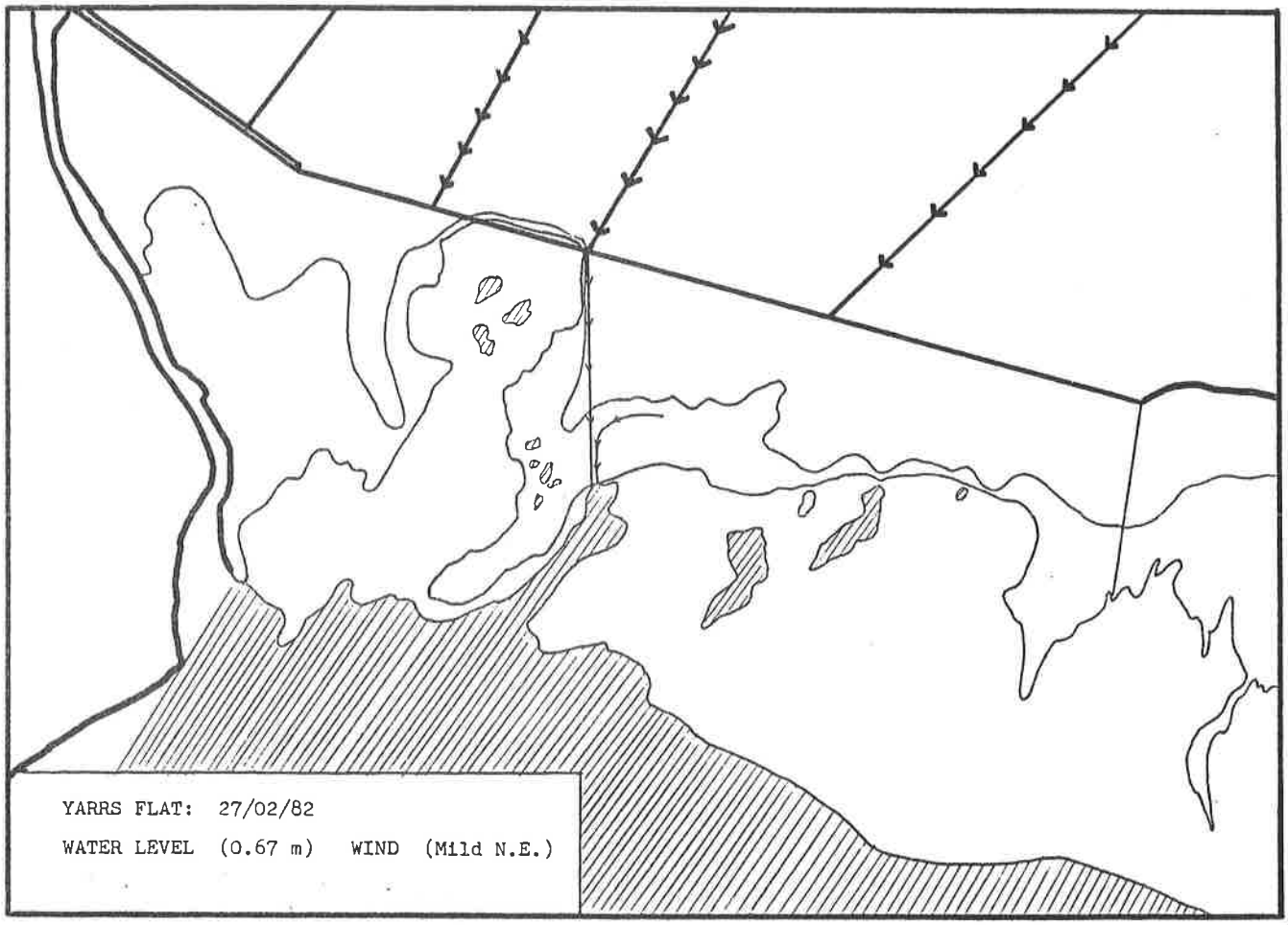

YARRS FLAT: 28/02/81
WATER LEVEL (0.79 m) WIND (Moderate S.W.)

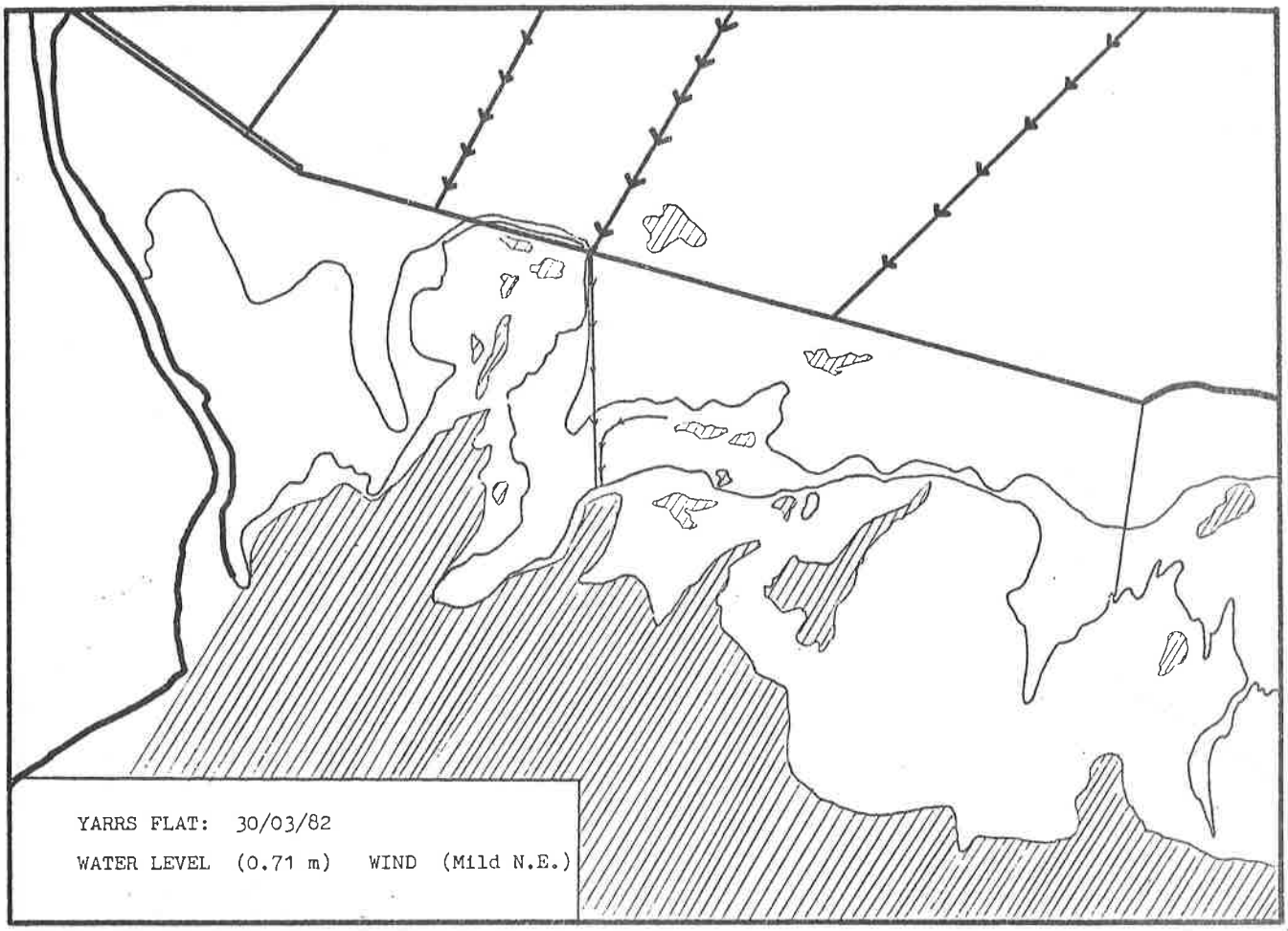

YARRS FLAT: 14/10/81
WATER LEVEL (0.24 m) WIND (N.E.)

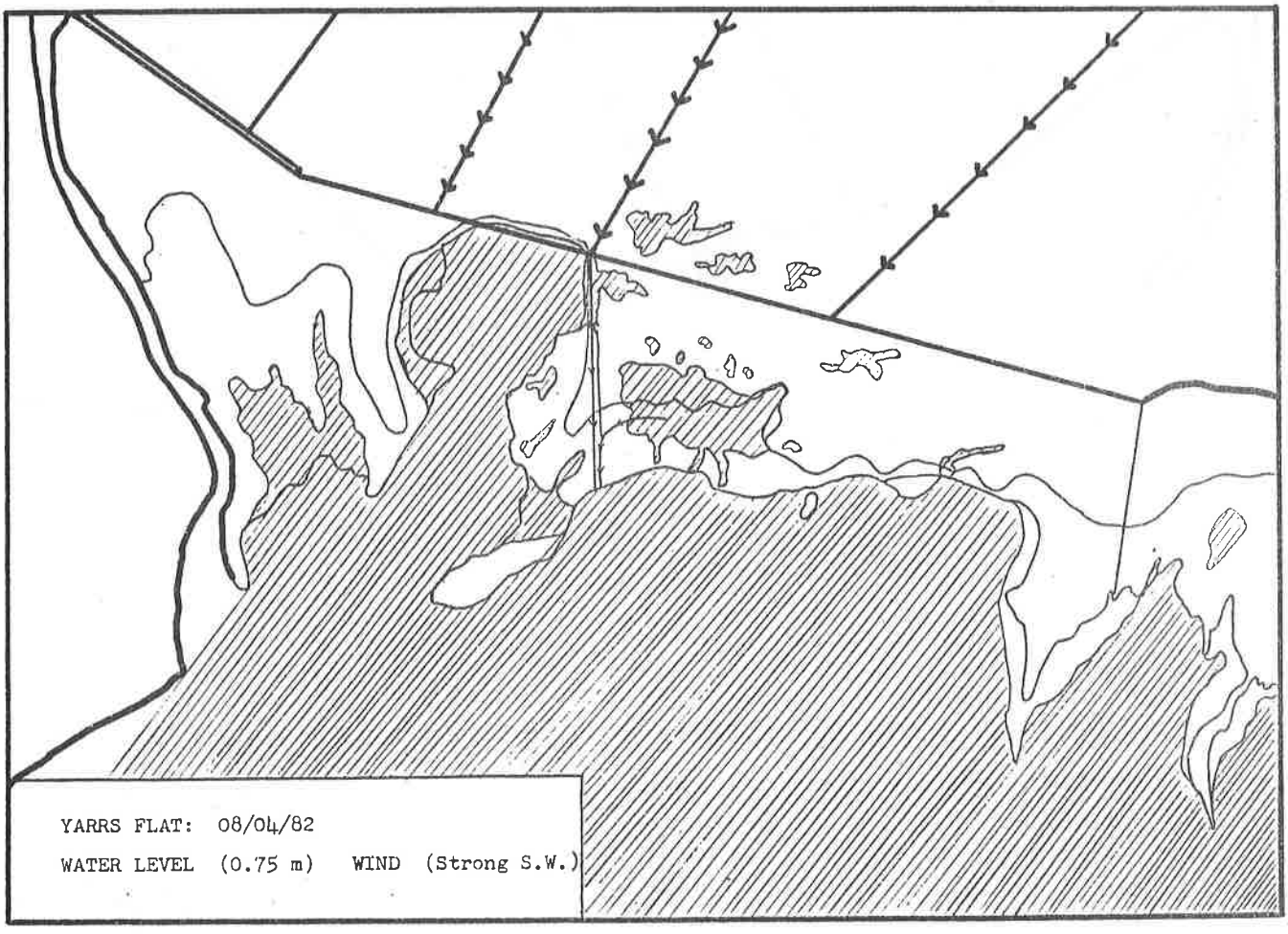

YARRS FLAT: 29/10/81
WATER (0.45 m) WIND (N.W.)

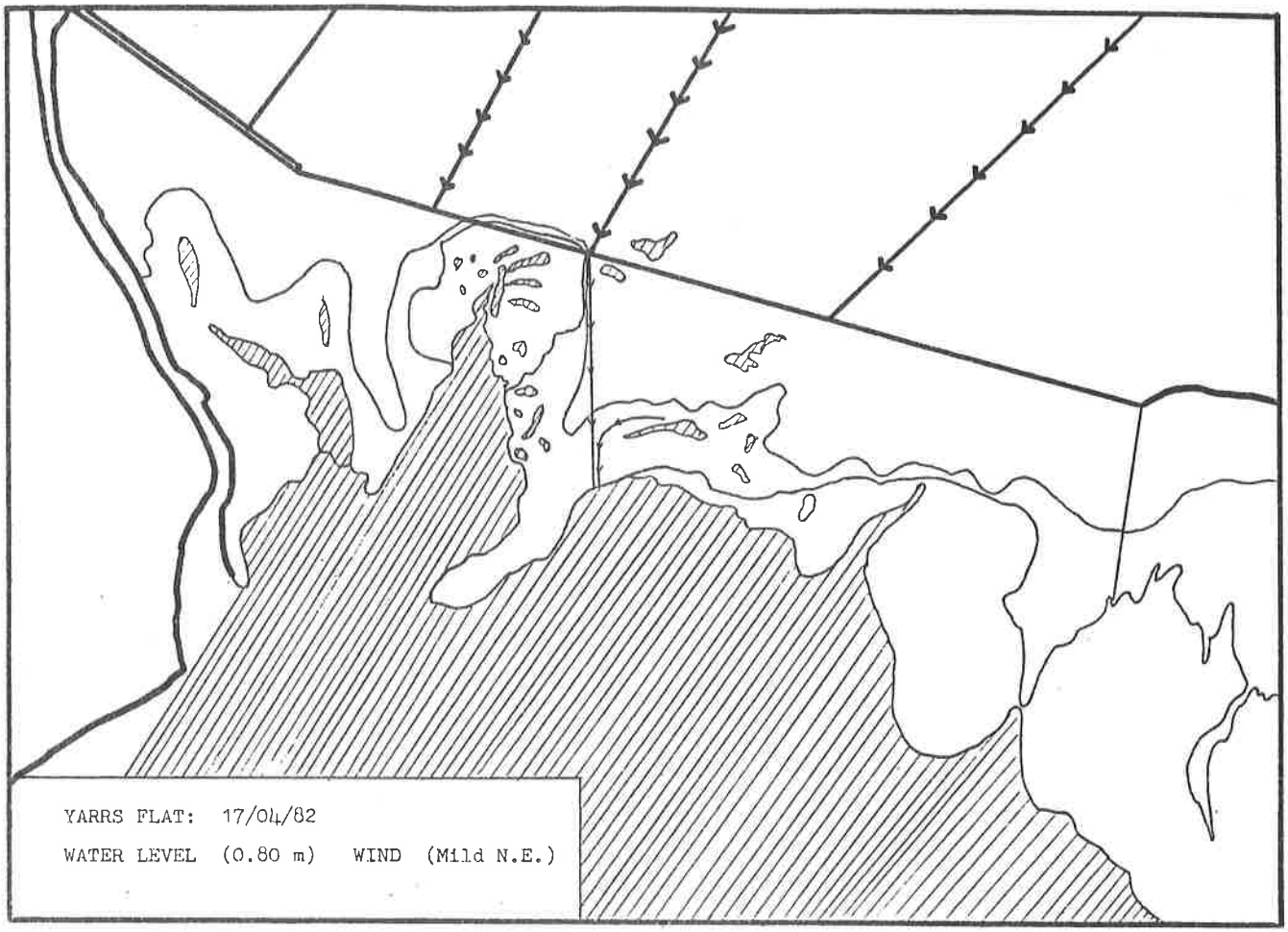

YARRS FLAT: 19/12/81
WATER (0.6 m) WIND (Strong N.E.)

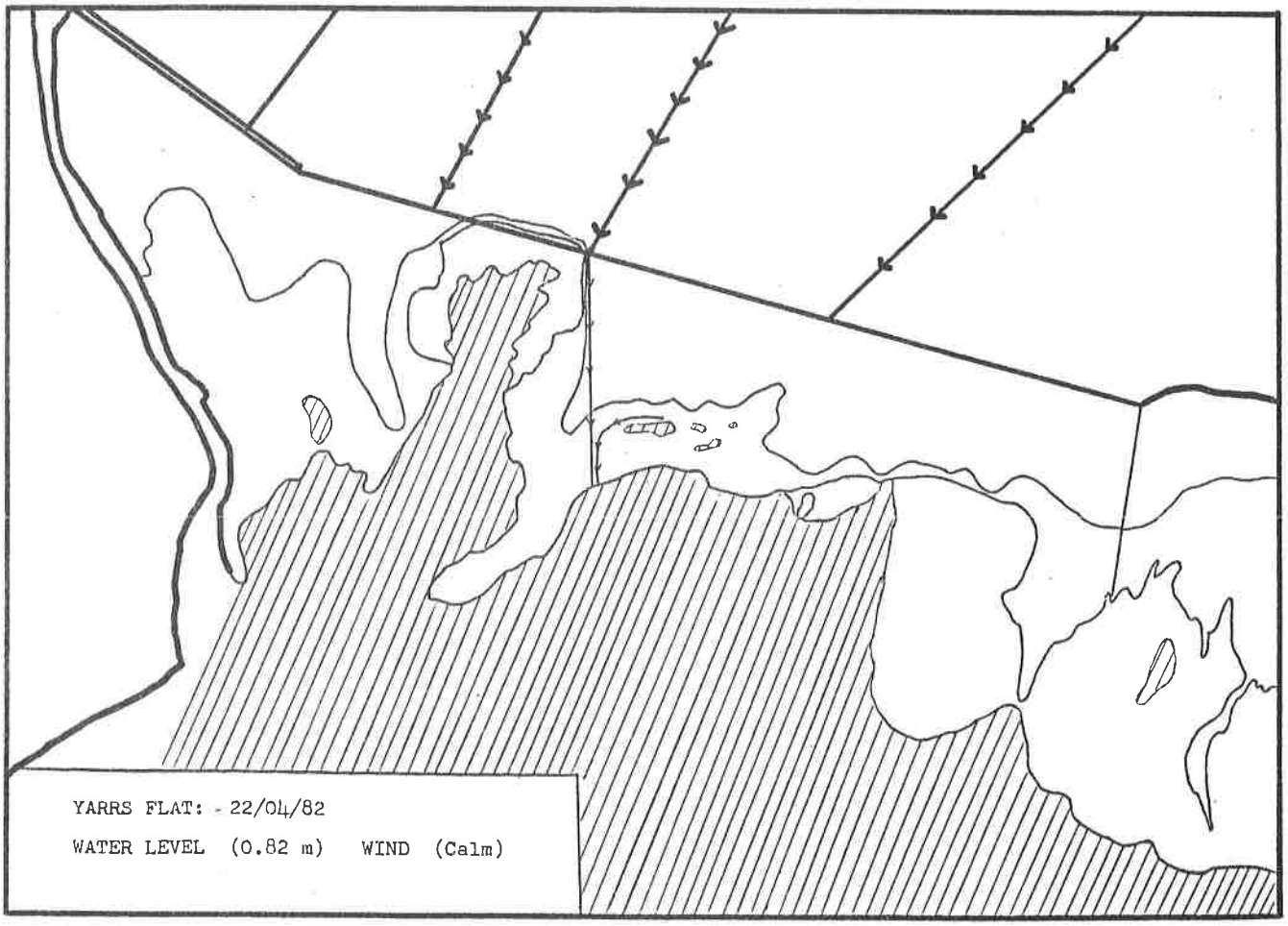

YARRS FLAT: 12/01/82
WATER LEVEL (0.70 m) WIND (Mild S.W.)

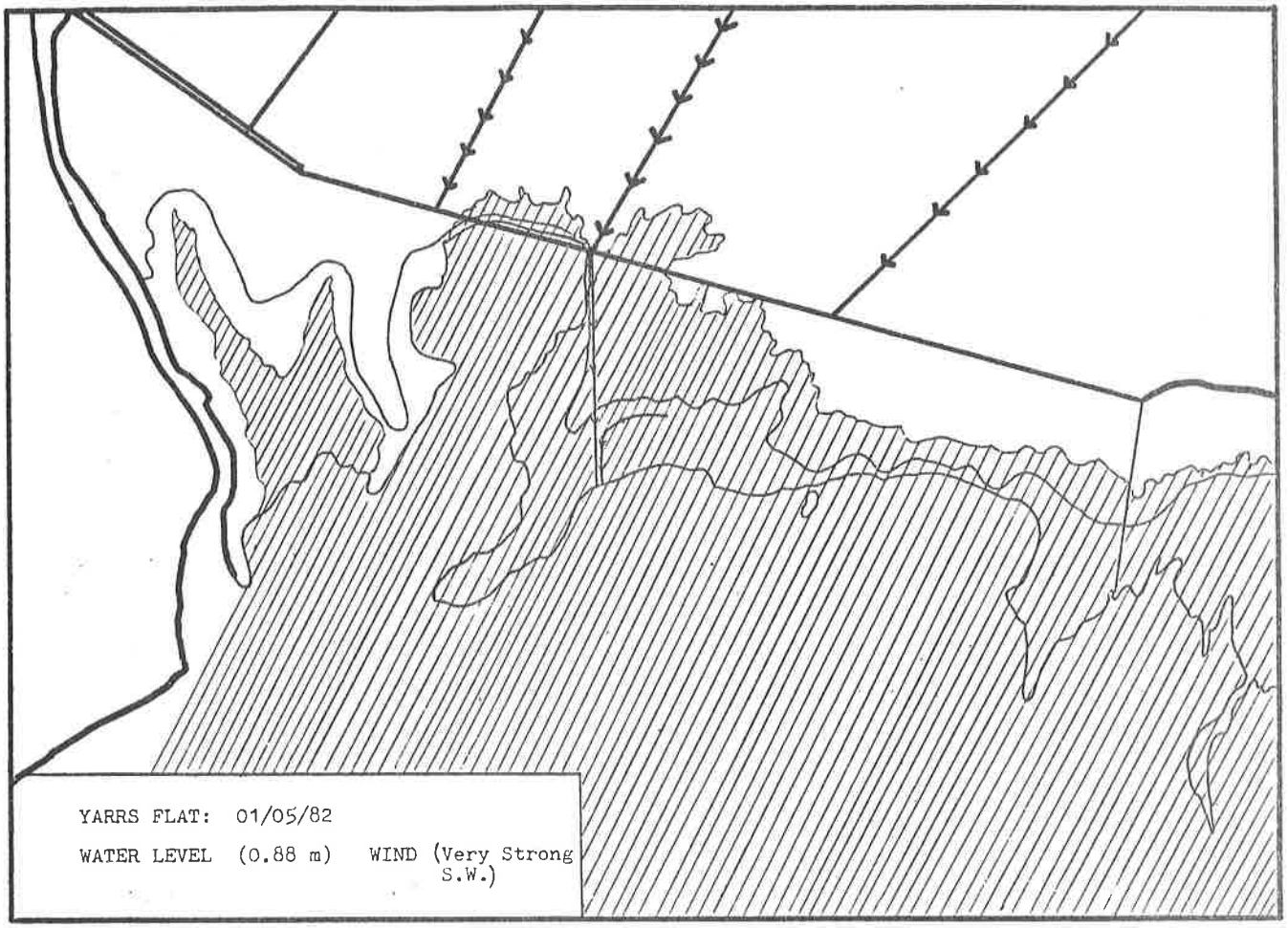

YARRS FLAT: 27/02/82
WATER LEVEL (0.67 m) WIND (Mild N.E.)

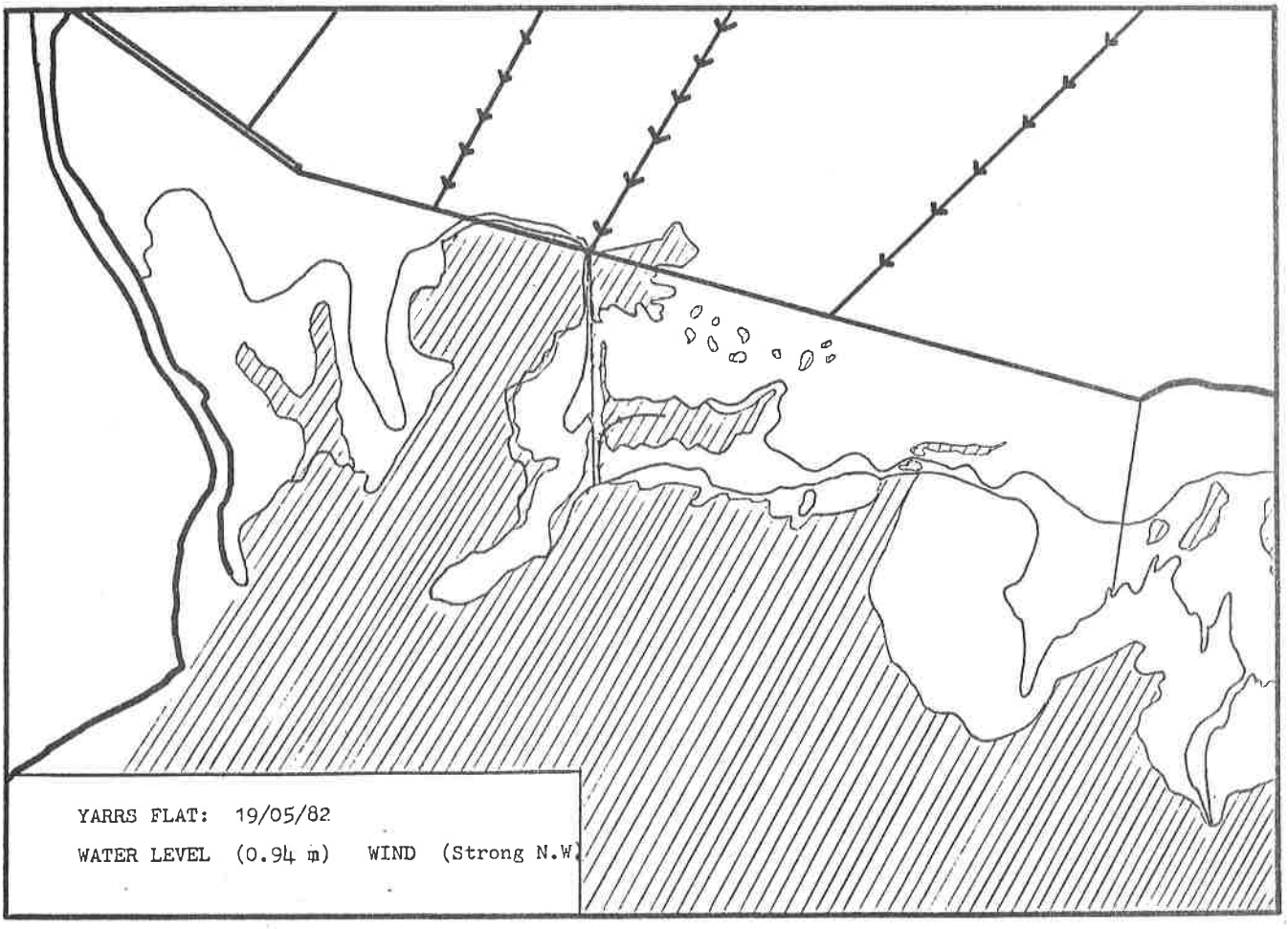

YARRS FLAT: 30/03/82
WATER LEVEL (0.71 m) WIND (Mild N.E.)


YARRS FLAT: 08/04/82
WATER LEVEL (0.75 m) WIND (Strong S.W.)


YARRS FLAT: 17/04/82
WATER LEVEL (0.80 m) WIND (Mild N.E.)


YARRS FLAT: 22/04/82
WATER LEVEL (0.82 m) WIND (Calm)


YARRS FLAT: 01/05/82
WATER LEVEL (0.88 m) WIND (Very Strong S.W.)


YARRS FLAT: 19/05/82
WATER LEVEL (0.94 m) WIND (Strong N.W.)

APPENDIX 4

BLACK SWAN AND MUTE SWAN POPULATION TREND COUNTS
LAKE ELLESMERE 1959 - 1983

YEAR	BLACK SWAN	WHITE SWAN
1959	80,000 (est.)	-
1964	70,000 (est.)	-
1966	-	300
1968	40,000 (est.)	400
1969	22,400	400
1970	-	-
1971 (Feb)	22,000	50
1972 (Aug)	18,500	-
1973 (Sep)	17,000	59
1974 (Apr)	14,500	82
1974 (Aug)	8,329	-
1974 (Nov)	11,550	-
1975 (Apr)	12,715	76
1975 (Aug)	8,987	-
1975 (Nov)	10,455	-
1976 (Jan)	10,900	-
1976 (Apr)	12,764	-
1976 (Nov)	10,959	-
1977 (Feb)	13,682	-
1977 (Apr)	8,414	-
1978	-	-
1979 (Feb)	11,350	-
1979 (Nov)	10,314	-
1980 (Jan)	6,969	-
1980 (Nov)	6,971	-
1981 (Jan)	6,583	-
1981 (Nov)	6,851	38
1982 (Nov)	8,082	38
1983 (Jan)	7,095	38

Source: W/L File 11/5/4

APPENDIX 5

PUBLISHED RECORDS OF SMALL MIGRATORY WADERS IN NEW ZEALAND

Summarised below are published records of small wader species occurring each summer in New Zealand (1971-1982). The records have been extracted from journals (mainly the OSNZ Recording Scheme in Notornis) in an effort to broadly estimate total numbers of each species which reach New Zealand each summer and then to determine the importance of Lake Ellesmere populations. The figures outlined below are subject to unspecified error due to:

(1) not all possible localities being visited each summer and counts of the whole of Lake Ellesmere have only been carried out since 1980.

(2) maximum counts for each area given, thus the same bird could be recorded at different localities over the summer.

However, by using 10 years of observations some broad trends are identified and the highest totals from each locality are summed together to give Number in New Zealand.

1. RED-NECKED STINT IN NEW ZEALAND 1971-1982 (from up to 37 localities)

	Number in New Zealand	Number at Ellesmere	% at Ellesmere
1971-1972	107	24	22.4
1972-1973	179	38	21.2
1973-1974	263	61	23.2
1974-1975	113	28	24.8
1975-1976	106	25	23.6
1976-1977	127	54	42.5
1977-1978	66	21	31.8
1978-1979	87	?	-
1979-1980	142	?	-
1980-1981	346	210	60.7
1981-1982	314	214	68.2
1982-1983	-	194	-
1983-1984	-	128+	-
1984-1985	-	200	-

2. SHARP-TAILED SANDPIPER IN NEW ZEALAND 1971-1982

(from up to 36 localities)

	Number in New Zealand	Number at Ellesmere	% at Ellesmere
1971-1972	69	2	2.9
1972-1973	136	11	8.1
1973-1974	87	19	21.8
1974-1975	65	4	6.2
1975-1976	87	?	-
1976-1977	178	?	-
1977-1978	78	?	-
1978-1979	48	?	-
1979-1980	117	?	-
1980-1981	49	1	2.0
1981-1982	88	25+	28.4
1982-1983	-	24	-
1983-1984	-	4	-
1984-1985	-	13	-

3. PECTORAL SANDPIPER IN NEW ZEALAND 1971-1982

(from up to 25 localities)

	Number in New Zealand	Number in Ellesmere	% at Ellesmere
1971-1972	11	?	-
1972-1973	14	1	7.1
1973-1974	24	5	20.8
1974-1975	10	?	-
1975-1976	9	?	-
1976-1977	17	1	5.8
1977-1978	5	?	-
1978-1979	4	?	-
1979-1980	7	?	-
1980-1981	7	0	0.0
1981-1982	27	9	33.3
1982-1983	-	3+	-
1983-1984	-	2	-
1984-1985	-	1	-

4. CURLEW SANDPIPER IN NEW ZEALAND 1971-1982 (from up to 33 localities)

	Number in New Zealand	Number at Ellesmere	% at Ellesmere
1971-1972	53	25	47.2
1972-1973	71	25+	35.2+
1973-1974	82	34+	41.5+
1974-1975	51	30	58.8+
1975-1976	29	9+	31.0+
1976-1977	137	3+	2.2+
1977-1978	127	-	-
1978-1979	56	-	-
1979-1980	103	20	19.4
1980-1981	195	70	35.9
1981-1982	112	64	57.1
1982-1983	-	46+	-
1983-1984	-	61	-
1984-1985	-	47	-

5. GOLDEN PLOVER IN NEW ZEALAND 1971-1972 (from up to 59 localities)

	Number in New Zealand	Number at Ellesmere	% at Ellesmere
1971-1972	269	2	0.7
1972-1973	712	121+	16.9
1973-1974	628	14	2.2
1974-1975	531	?	-
1975-1976	230	?	-
1976-1977	1300	?	-
1977-1978	649	?	-
1978-1979	596	?	-
1979-1980	632	?	-
1980-1981	808	48	5.9
1981-1982	341	48	14.1
1982-1983	-	51	-
1983-1984	-	7+	-