

A three year census of wetland birds on Lake Ellesmere/Te Waihora, Canterbury during the post-breeding period

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Abstract Monitoring of wetland birds was undertaken at Lake Ellesmere/Te Waihora during the post-breeding period in February 2006, 2007 & 2008. Census totals were 38,726, 39,917 and 39,175 individual birds over the 3 years, respectively, and 46 wetland bird species were recorded. Nine species had a maximum count exceeding 1000 individuals, including 11,245 grey teal (*Anas gracilis*), 10,651 black swan (*Cygnus atratus*), 5776 pied stilt (*Himantopus himantopus*), 4899 Canada goose (*Branta canadensis*), 3405 Australasian shoveler (*Anas rhynchotis*), 1873 banded dotterel (*Charadrius bicinctus*), 1640 paradise shelduck (*Tadorna variegata*), 1592 black-billed gull (*Larus bulleri*) and 1389 mallard/grey duck (*A. platyrhynchos/A. superciliosa*). Fourteen species were recorded in numbers that met or exceeded the 1% Ramsar international significance criterion: Australasian crested grebe (*Podiceps cristatus*), black cormorant (*Phalacrocorax carbo*), white heron (*Ardea modesta*), black swan, paradise shelduck, grey teal, Australasian shoveler, pied stilt, black stilt (*Himantopus novaezelandiae*), banded dotterel, wrybill (*Anarhynchus frontalis*), black-billed gull, black-fronted tern (*Chlidonias albostrigatus*), and Caspian tern (*Hydroprogne caspia*). Lake Ellesmere also supported populations of migratory bird species that are uncommon in New Zealand including curlew sandpiper (*Calidris ferruginea*), sharp-tailed sandpiper (*C. acuminata*), red-necked stint (*C. rufficollis*), Pacific golden plover (*Pluvialis fulva*) and white-winged black tern (*Chlidonias leucopterus*). When compared to other coastal wetlands in terms of bird numbers, Lake Ellesmere ranked as the most important site in the Canterbury Region.

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INTRODUCTION

Lake Ellesmere/Te Waihora (43°46' S, 172°28' E) covers an area of 20,000 ha and is the largest brackish coastal lagoon in New Zealand (Cromarty & Scott 1996; Fig. 1). Accounts of its birdlife have been

provided by Stead (1923, 1927, 1932), Tunnicliffe (1973) and O'Donnell (1985). The latter contributed a detailed study of wetland bird populations and made a recommendation that the site be recognised as a Wetland of International Importance under the Ramsar Convention. Despite confirmation of O'Donnell's (1985) findings from a series of wetland bird surveys by the New Zealand Wildlife

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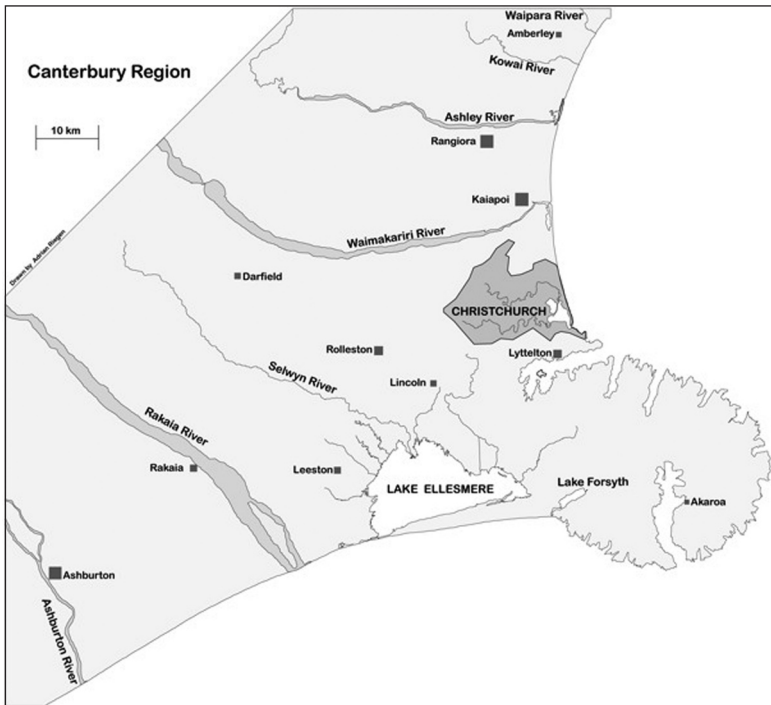


Fig. 1. Location of Lake Ellesmere/Te Waihora in the Canterbury Region (map prepared by A. Riegan).

Service and Ornithological Society of New Zealand (OSNZ) between 1985 and 1989 (Department of Conservation, *unpubl. data*), and 2-3 OSNZ wader counts undertaken each year from 1984 to present (Sagar *et al.* 1999; Dowding & Moore 2006; Li *et al.* 2009; Southey 2009), Lake Ellesmere has not been formally designated an internationally significant wetland. The only formal recognition of Ellesmere's high wildlife values is a National Water Conservation Order placed on the lake in 1988 (Cromarty & Scott 1996). The site's international importance however is widely acknowledged (Stephenson 1986; Cromarty & Scott 1996; Taylor 1996; O'Donnell 2000; Dowding & Moore 2006; Melville & Battley 2006; Sagar 2008; Li *et al.* 2009; Hughey & O'Donnell 2009; Golder Associates 2011; Hughey *et al.* 2013) and it is often recognised as New Zealand's single most important habitat for wetland birds - based on the site having the greatest species richness known for any locality in the country (O'Donnell 1985; Cromarty & Scott 1996; Hughey & O'Donnell 2009). Based on a count of 92,969 wetland birds in April 1987 (New Zealand Wildlife Service, *unpubl. data*; O'Donnell 2000), Lake Ellesmere also appears to have the highest total number of individual birds recorded on any New Zealand wetland.

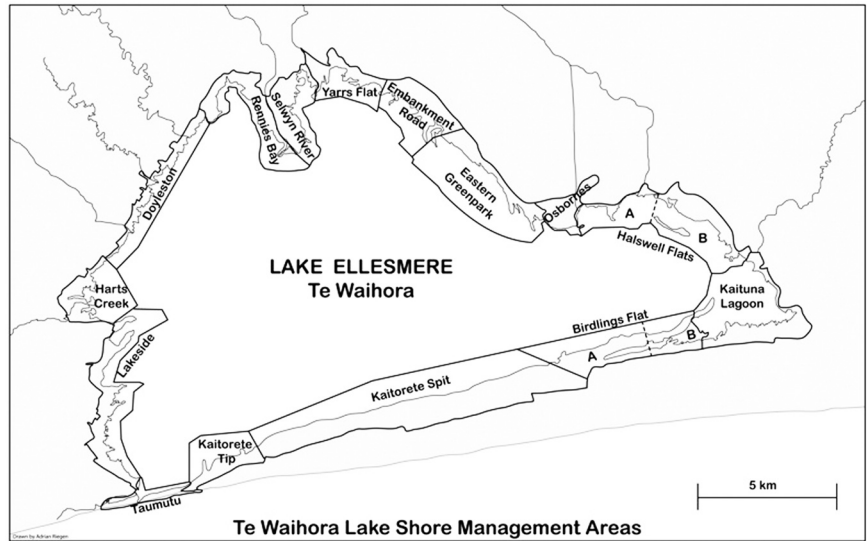
In the 26 year period since the last of the Wildlife Service/OSNZ wetland bird surveys the only regular monitoring of bird populations on Lake Ellesmere has been the OSNZ national wader counts. From 1984 to 2004 these were undertaken twice yearly - in June/

July (winter) and November/December (summer). From 2005 onwards a third count in February of each year was added. Since at least the late 1990s these counts have tended to include Australasian crested grebe (see Table 1 for scientific names of species in study), white heron, royal spoonbill, glossy ibis (*Plegadis falcinellus*), mute swan (*Cygnus olor*), Caspian tern, white-winged black tern and black-fronted tern in addition to waders. Although providing some useful longitudinal population data for part of Lake Ellesmere's avifauna, many species (most notably cormorants, waterfowl, white-faced heron, white-fronted tern, gulls and rails) were not covered by the OSNZ wader counts. Over the period 1990-2012 only 3 full wetland bird counts were undertaken on Lake Ellesmere. These involved a full count of all wetland birds on the lake and its margins except secretive rails and bitterns, New Zealand kingfisher (*Todiramphus sanctus*) and welcome swallow (*Hirundo neoxena*). The counts were carried out by OSNZ and Christchurch City Council (CCC) teams and took place in February 2006, 2007 and 2008. The purpose of this paper is to present the results of these surveys and to determine which species still occur in numbers of international significance.

METHODS

For the purposes of this study, wetland birds are defined as those species associated with tidal, brackish and freshwater habitats. Wetland bird

Fig. 2. The 17 survey sectors (lake shore management areas) established by O'Donnell (1985) and followed in the 2006-2008 surveys (map prepared by A. Riegan).



surveys on Lake Ellesmere/Te Waihora were undertaken by teams of observers, each covering 1 or more of 17 sectors into which the 58 km of lake shore was divided (Fig. 2). The survey sectors were consistent between surveys and were identical to (or sub-sectors of) the sectors used by O'Donnell (1985), the 1987-89 Wildlife Service/OSNZ surveys and OSNZ national wader count surveys. If numbers of personnel were sufficient, some larger sectors like Eastern Greenpark were sub-divided further and tackled by 2 or more teams. Survey dates were 25 February 2006, 24 February 2007 and 9 February 2008.

Teams comprised at least 1 experienced observer, usually with 1-3 other people assisting. The total number of survey personnel per year was 14 in 2006, 13 in 2007 and 12 in 2008. CCC ranger teams generally covered the 7 sectors on the southern and south-eastern side of the lake (as this area lies within the Christchurch City district boundary), while OSNZ teams covered the 10 sectors on the west, northern and north-eastern parts (all of which lie within the Selwyn District). Many observers had regularly participated in OSNZ wader counts over the previous 1 to 20+ years and several had been involved in the 1985-89 Wildlife Service/OSNZ surveys. Local knowledge of sectors and bird identification skills were high amongst participants and a high proportion of wetland birds present on count days were likely to have been located and accurately counted.

Each observer carried a pair of binoculars with at least 1 spotting scope per team. Surveys commenced at ~0900 h, allowing teams sufficient time to reach the lake from Christchurch and to get into position at various points around the 58 km shoreline. The surveys took place from mid

morning to mid afternoon, the time of day when wetland birds are easiest to observe, actively feeding in loose flocks over lake waters, mudflats and salt meadows. Counting at dawn or toward dusk is problematic at Lake Ellesmere due to poor knowledge of roosting site locations, and because some species (particularly waterfowl, cormorants, gulls and terns) fly between the lake and night feeding areas or night roosting/rafting sites located inland or along the adjacent sea coast.

During the surveys, observers walked parallel to the shore in line abreast. Depending on bird density and team size, observers were usually spaced 50-400 m apart and thus were able to cover the complete width of habitat from the lake edge to the landward margin of the saltmeadow/saltmarsh zones. Much of Lake Ellesmere's shoreline is very flat and observers using binoculars could usually detect and identify most birds within 200 m of their position. In sections of lake shore difficult to walk along, but accessible from road ends (such as parts of Kaitorete Spit and the western shore), surveys were made from static positions on the shoreline with observers scanning the intermediary areas between access points. These static positions were generally 500-3000 m apart and spotting scopes were used to find and count birds. Although a proportion of birds may have been missed as distant observation will not detect concealed birds that a person walking through an area may flush out, the potential for undercounting is relatively minor as most of the sections concerned have open shorelines and the vast majority of birds were visible from the nearest access points. Throughout the lake, all likely habitat was searched (including fields and marshland adjacent to the lake shore) and all wetland birds observed were counted except New

Table 1. Wetland birds counted at Lake Ellesmere/Te Waihora in February 2006, February 2007 and February 2008.

Species	2006	2007	2008	Species	2006	2007	2008
Black swan (<i>Cygnus atratus</i>)	10006	10651	9011	Ruddy turnstone (<i>Arenaria interpres</i>)	13	0	0
Paradise shelduck (<i>Tadorna variegata</i>)	946	1635	1640	South Island pied oystercatcher (<i>Haematopus finschi</i>)	74	2	4
Chestnut-breasted shelduck (<i>T. tadornoides</i>)	0	2	0	Pied stilt (<i>Himantopus himantopus</i>)	2937	2566	5776
Grey teal (<i>Anas gracilis</i>)	10342	10979	11245	Black stilt (<i>H. novaehollandiae</i>)	2	0	0
Australasian shoveler (<i>A. rhynchotis</i>)	3405	1946	1161	Hybrid stilt (<i>H. himantopus x H. novaehollandiae</i>)	0	6	5
Unidentified ducks (<i>Anas</i> spp.)	32	1260	700	Pacific golden plover (<i>Pluvialis fulva</i>)	122	60	29
New Zealand scaup (<i>Aythya novaeseelandiae</i>)	111	54	29	Banded dotterel (<i>Charadrius bicinctus</i>)	1757	1873	1328
Australasian crested grebe (<i>Podiceps cristatus</i>)	5	11	6	Wrybill (<i>Anarhynchus frontalis</i>)	230	459	146
Gibson's albatross (<i>Diomedea antipodensis gibsoni</i>)	1	0	0	Spur-winged plover (<i>Vanellus miles</i>)	181	42	200
Black cormorant (<i>Phalacrocorax carbo</i>)	223	254	89	Southern black-backed gull (<i>Larus dominicanus</i>)	648	145	900
Pied cormorant (<i>P. varius</i>)	24	18	6	Red-billed gull (<i>L. novaehollandiae</i>)	45	59	1
Little cormorant (<i>P. melanoleucos</i>)	18	28	14	Black-billed gull (<i>L. bulleri</i>)	1592	1332	925
White heron (<i>Ardea modesta</i>)	2	2	0	Caspian tern (<i>Hydroprogne caspia</i>)	63	38	96
White-faced heron (<i>Egretta novaehollandiae</i>)	137	115	103	White-winged black tern (<i>Chlidonias leucopterus</i>)	4	1	2
Royal spoonbill (<i>Platalea regia</i>)	104	199	145	Black-fronted tern (<i>C. albostratus</i>)	54	29	2
Swamp harrier (<i>Circus approximans</i>)	58	31	18	White-fronted tern (<i>Sterna striata</i>)	169	125	55
Pukeko (<i>Porphyrio melanotus</i>)	28	11	23	Eastern common tern (<i>S. hirundo</i>)	0	0	1
Australian coot (<i>Fulica atra</i>)	0	0	1	Total native, migrant and vagrant species	33,737	34,166	33,840
Lesser knot (<i>Calidris canutus</i>)	34	16	11	Greylag goose (<i>Anser anser</i>)	30	35	23
Curlew sandpiper (<i>C. ferruginea</i>)	2	1	3	Cape Barren goose (<i>Cereopsis novaehollandiae</i>)	2	0	0
Sharp-tailed sandpiper (<i>C. acuminata</i>)	16	27	2	Canada goose (<i>Branta canadensis</i>)	3569	4899	3923
Pectoral sandpiper (<i>C. melanotos</i>)	0	6	0	Mallard/grey duck/hybrid (<i>A. platyrhynchos/A. superciliosa</i>)	1388	817	1389
Red-necked stint (<i>C. rufficollis</i>)	26	63	18	Total introduced species	4989	5751	5335
Eastern curlew (<i>Numenius madagascariensis</i>)	1	0	0	Total all species	38,726	39,917	39,175
Eastern bar-tailed godwit (<i>Limosa lapponica</i>)	325	119	145				
Hudsonian godwit (<i>L. haemastica</i>)	0	1	0				

Zealand kingfisher and welcome swallow. These were excluded because they range well beyond the immediate environs of the lake and shoreline totals alone would not give meaningful population data. Swamp harrier also ranges well beyond the lake, but this species was included because it has a strong association with lake habitats such as reed beds, saltmarsh, rushlands and open lake shore (Crossland & Crutchley, *unpubl. data*). Unlike kingfisher and swallow, it is a very conspicuous bird and easily countable. Throughout the surveys,

the priority was to count individual birds, but block counting in multiples of 10 was occasionally necessary for large flocks over 1000 individuals.

RESULTS AND DISCUSSION

Total numbers and species richness

Census totals averaged 39,272 birds across the 3 years and were remarkably similar between surveys with a total of 38,726 birds counted in 2006, 39,917 birds in 2007 and 39,175 birds in 2008 (Table 1). Native,

Table 2. Total numbers of individuals observed in each species group at Lake Ellsmere over the 3 years of the study.

Species Group	2006	2007	2008
Waterfowl	29,831	32,278	29,121
Grebes	5	11	6
Pelagic seabirds	1	0	0
Cormorants & shags	265	300	109
Hérons & allies	243	316	248
Raptors	58	31	18
Rails	28	11	23
Arctic waders	539	293	208
Native waders	5181	4948	7459
Gulls	2285	1536	1826
Terns	290	193	156
Total	38,726	39,917	39,175

migrant and vagrant species combined averaged 33,914 across the 3 years, while introduced species averaged 5358 individuals. We have followed Robertson *et al.* (2013) in classifying black swan as a native rather than as an introduced species.

A total of 46 wetland bird species were recorded over the 3 years (excluding hybrid stilt, but including grey duck which was part of the mallard/grey duck hybrid grouping). The total number of wetland bird species recorded per year was 41 in 2006, 39 in 2007 and 37 in 2008. Thirty five species were recorded in all 3 years. An additional 11 species were recorded in only 1 or 2 of the surveys including Gibson's albatross, white heron, Cape Barren goose, chestnut-breasted shelduck, Australian coot, black stilt, ruddy turnstone, pectoral sandpiper, eastern curlew, Hudsonian godwit and eastern common tern. Unusual bird reports submitted for the chestnut-breasted shelduck and eastern common tern were accepted by the OSNZ Records Appraisal Committee (UBR 2011/64 & UBR 2011/65).

Species group accounts

Waterfowl

The most numerous species group were waterfowl with 29,831 individuals counted in 2006, 32,278 in 2007 and 29,121 in 2008 (Table 2). This group represents 74.3% to 80.9% of the total bird population of the area. Two species were abundant in all 3 years: grey teal (10,342-11,245 birds) and black swan (9011-10,651 birds). These 2 species together averaged 68.3% of all waterfowl and 52.8% of all wetland birds on the 3 counts combined. Next most abundant were Canada goose (3569-4899), Australasian shoveler



Fig. 3. Juvenile Gibson's albatross at Kaitorete Spit tip during the 25 February 2006 census.

(1161 – 3405), paradise shelduck (946-1640) and mallard/grey duck hybrids (817 – 1389). New Zealand scaup, a species which had been rare on the lake for the entire 20th century (Stead 1927; O'Donnell 1985), re-colonised prior to the study and was found in relatively low numbers (29–111). The “unidentified ducks” category (32-1260 individuals) comprised birds too distant to identify. These were probably mainly shoveler and grey teal as these species tend to flock tightly together and the identity of individual birds cannot be discerned when seen at a distance (P.C., *pers. obs.*).

Grebes

Australasian crested grebes were recorded in small numbers (5-11 birds). This species re-established a small breeding population on the lake and tributary waterways during the early 2000s. Larger numbers (up to 40) occurred in autumn-winter during the study period (A.C., *pers. obs.*), but the timing of the surveys in February missed the arrival period of these birds.

Pelagic seabirds

Pelagic seabirds occasionally stray onto Lake Ellesmere or are blown onto the lake by southerly storm events (P.C., *pers. obs.*). One apparently healthy juvenile Gibson's albatross resting on mudflats at Kaitorete Spit tip on 25 February 2006 was the only individual of this species seen during the surveys. Winds strengthened the following day and the bird was gone by 27 February 2006. Other incidences of live pelagic seabirds blown inland

Table 3. Comparison of wetland bird census totals for Lake Ellesmere and other large Canterbury coastal wetlands in the period 2006-2010. Note: February counts are used where available, with January or March counts substituted in the absence of a February count; No data available is indicated by a "-".

Site	2006	2007	2008	2009	2010	Average
Lake Ellesmere	38,726	39,917	39,175	-	-	39,272
Avon-Heathcote Estuary	30,711	27,373	32,009	-	34,292	31,096
Rangitata - Opihi RM	-	-	11,562	-	-	11,562
Brooklands Lagoon	6831	7993	7945	6944	8246	7592
Lake Forsyth	-	3050	8589	6990	5173	5950
Washdyke Lagoon	-	-	4635	-	-	4635
Ashburton RM	3888	4401	3593	-	-	3960
Ashley Estuary	-	-	986	-	1764	1375
Upper Lyttelton Harbour	998	-	1274	1023	-	1098
Upper Akaroa Harbour	-	-	1327	709	-	1018
Rakaia RM	-	-	-	-	995	995

Data Sources: Lake Ellesmere (this paper), Avon-Heathcote Estuary, Lake Forsyth, Brooklands Lagoon, Upper Lyttelton Harbour, Upper Akaroa Harbour (A.C., CCC), Ashley Estuary, Rakaia RM, Ashburton RM, Rangitata RM - Opihi RM, Washdyke Lagoon (A.C., *unpubl. data*).

around Lake Ellesmere over the approximate time of the study included Antarctic fulmar (*Fulmaris glacialoides*), sooty shearwater (*Puffinus griseus*), northern giant petrel (*Macronectes halli*) and an unidentified dark *Pterodroma* petrel (P.C., *pers. obs.*).

Cormorants and shags

Cormorants were numerous on the lake with totals of 265 in Feb 2006, 300 in 2007 and 109 in 2008 (Table 2). Black cormorants were the most abundant of the 3 species recorded with 89-254 counted (Table 2). Pied and little cormorant were less numerous. Although spotted shag (*Stictocorbo punctatus*) are an irregular visitor to the lake (O'Donnell 1985), none were recorded on these surveys.

Herons and allies

Three species were recorded with royal spoonbill (104-199) and white-faced heron (103-137) the most abundant (Table 1). Two white herons were recorded in 2006 and 2007. Although present in swampy habitat around the lake shore, Australasian bittern (*Botarus poiciloptilus*) were not observed during the counts.

Raptors

Swamp harrier (18-51) was the only bird of prey recorded (Table 1). Recent observations (A.C. & P.C., *unpubl. data*) indicate a northwards movement of harrier along Kaitorete Spit and an influx around the lake in late summer-autumn. The 2006 and 2007 counts (58 and 31 harriers, respectively), both undertaken in the last week of February, recorded

more than the 2008 count which was undertaken in the first week of February and only recorded 18 harriers. This fits with observations that the onset of the harrier influx and northward movement starts in mid-February.

Rails

Pukeko (11-28 individuals) and Australian coot (1 bird in 2008 only) were the only species recorded (Table 2). Although both marsh crake (*Porzana pusilla*) and spotless crake (*Porzana tabuensis*) are resident at Lake Ellesmere (O'Donnell 1985), neither species was sighted during the counts.

Arctic waders

Lake Ellesmere supports a more diverse mix of Arctic waders than most New Zealand coastal wetlands and is a key site for a number of uncommon species (O'Donnell 1985; Sagar 2008; Southey 2009). Arctic waders totalled 539 in February 2006, 293 in February 2007 and 208 in February 2008 (Table 2). Ten species were recorded, including 6 counted in each of the 3 years: eastern bar-tailed godwit (119-325), Pacific golden plover (29-122), red-necked stint (18-63), lesser knot (11-34), sharp-tailed sandpiper (2-27) and curlew sandpiper (1-3) (Table 1). Species recorded on only 1 or 2 of the counts included pectoral sandpiper, eastern curlew, Hudsonian godwit and ruddy turnstone. Numbers of most arctic waders counted in this study appear lower than numbers found 20-30 years ago by O'Donnell (1985), Sagar *et al.* (1999) and the 1985-1989 series of unpublished counts by Wildlife Service/OSNZ, but an analysis of the

Table 4. Species or sub-species of wetland bird for which Lake Ellesmere/Te Waihora met the current Wetlands International/Ramsar 1% population threshold in the period February 2006-2008 (based on 1% estimates published by Wetlands International, 2014).

Species	Population considered	1% threshold	Lake Ellesmere maximum count (February)	Percentage of population
Australasian crested grebe	NZ	3	11	3.7
Black cormorant	NZ	250	254	1.0
White heron	NZ	1	2	2.0
Black swan	NZ/Australia	10,000	10,651	1.1
Paradise shelduck	NZ	1600	1640	1.0
Grey teal	NZ	1200	11,245	9.4
New Zealand shoveler	NZ	1200	3405	2.8
Pied stilt	NZ	300	5776	19.3
Black stilt	NZ	1	2	2.0
Banded dotterel	NZ/Australia	500	1873	3.7
Wrybill	NZ	45	459	10.2
Black-billed gull	NZ	960	1592	1.7
Caspian tern	NZ	40	96	2.4
Black-fronted tern	NZ	45	54	1.2

National Wader Count data for Lake Ellesmere is needed to confirm that this pattern is significant.

Native waders

The second most numerous species group were native waders with 5181 birds counted in 2006, 4948 in 2007 and 7459 in 2008 (Table 2). Native waders comprised 13.4% to 19.0% of total wetland birds counted. Of the 6 species recorded, the most abundant were pied stilt (2566-5776), banded dotterel (1328-1873) and wrybill (146-459) (Table 2). Each of these 3 species occurred in numbers of international significance (Table 3).

Gulls

Gulls comprised the third most numerous species group with 2285 birds counted in 2006, 1536 in 2007 and 1826 in 2008 (Table 2). Black-billed gull (925-1592) and southern black-backed gull (145-900) were the most abundant, and only a few red-billed gulls (1-59) were observed each year (Table 1).

Terns

Five species of tern were recorded with totals of 290 birds in 2006, 193 in 2007 and 156 in 2008. Most abundant were white-fronted tern (55-169), Caspian tern (38-96) and black-fronted tern (2-54). White-winged black tern (1-4) are an annual migrant and were observed in each of the 3 years. A single eastern common tern was observed in February 2008 (Table 1), which was a first record for the lake.

Regional context of Lake Ellesmere's bird population

The February 2006-2008 census totals averaged 39,272 wetland birds, which is slightly higher than the average of 36,147 for the 1985-1989 Wildlife Service/OSNZ counts. Other available February census totals for Lake Ellesmere include 21,721 in 1985; 36,787 in 1986; 53,275 in 1987; 38,036 in 1988 and 30,929 in 1989 (Wildlife Service/OSNZ, *unpubl. data*). The February 2006-2008 totals were less than 43% of the highest ever census total for Lake Ellesmere - 92,969 birds counted in April 1987 (Wildlife Service/OSNZ, *unpubl. data*).

Relative to other large Canterbury coastal wetlands where census work was undertaken over approximately the same period (Table 3), the February 2006-2008 census data for Lake Ellesmere confirmed O'Donnell's (1985) findings that the lake was the most important site for wetland birds in Canterbury. Lake Ellesmere was marginally more important than the Avon-Heathcote Estuary complex (Crossland 2010, 2013) and more important than the Rangitata River mouth, Ophi River mouth complex, Brooklands Lagoon, Lake Forsyth, Washdyke Lagoon, Ashburton River mouth, Ashley Estuary, Upper Lyttelton Harbour, Upper Akaroa Harbour, and Rakaia River mouth. No recent census data for Lake Ki-Wainono, the largest coastal wetland in South Canterbury, is available, but casual observations in the January-March period

suggest wetland/coastal bird numbers usually total less than 10,000 birds (A.C., *pers. obs.*).

International context

Findings of the February 2006-2008 counts confirm the often repeated claim (*e.g.*, O'Donnell 1985; Cromarty & Scott 1996; Sagar 2008; Hughey & O'Donnell 2009) that Lake Ellesmere has international significance as a habitat for wetland/coastal birds. With an average February census total of 39,272 (Tables 1 & 2), the lake exceeds criterion 5 of the Ramsar Convention (Delaney & Scott 2006; Ramsar Convention Secretariat 2013) which states that a wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds. Even when excluding introduced species such as Canada geese and mallard, totals of native, migrant and vagrant birds totalled 33,737, 34,166 and 33,840 in the 3 consecutive study years.

Criterion 6 of the Ramsar Convention states that "a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of 1 species or subspecies of waterbird". We compared the study data with the current global and regional population estimates of wetland bird species published in Wetlands International (2014). Totals of 14 species on Lake Ellesmere met or exceeded this threshold. These included Australasian crested grebe, black cormorant, white heron, black swan, paradise shelduck, grey teal, New Zealand shoveler, pied stilt, black stilt, banded dotterel, wrybill, black-billed gull, Caspian tern and black-fronted tern (Table 4).

Threatened species

Robertson *et al.* (2008) updated the threat status of New Zealand birds and determined 3 classes of threatened species: "nationally critical", "nationally endangered", and "nationally vulnerable". Twelve species from this list were recorded on the February 2006-2008 counts, including 4 nationally critical species – white heron, black stilt, black-billed gull and grey duck. The latter is included on the basis of individual birds identified by close scrutiny of plumage features and bare-part colouration (A.C., *pers. obs.*) Recorded also were 1 nationally endangered species, black-fronted tern, and 7 nationally vulnerable species, Australasian crested grebe, pied cormorant, lesser knot, banded dotterel, wrybill, red-billed gull and Caspian tern. An additional species classified as nationally endangered, Australasian bittern, was not recorded during the formal surveys, but is a known resident on the lake (Hughey *et al.* 2013) and was regularly observed during the study period (A.C., *pers. obs.*).

Further monitoring of Lake Ellesmere's wetland/coastal birds

A multi-agency effort to monitor Lake Ellesmere's bird population and to continue with February (post-breeding period) counts commenced in 2013 (Hughey *et al.* 2013). This involves OSNZ as the core survey team along with the Christchurch City Council, Department of Conservation, Waihora Ellesmere Trust, Environment Canterbury, Selwyn District Council, North Canterbury Fish & Game Council and Ngai Tahu. Annual monitoring of wetland/coastal birds on the lake should generate sufficient longitudinal data to identify population trends and inform future management of lake water levels, habitat quality and disturbance issues around the lake. This monitoring will also provide contemporary data on Lake Ellesmere's total wetland bird population and population trends of the key species for which the lake is identified as internationally important.

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