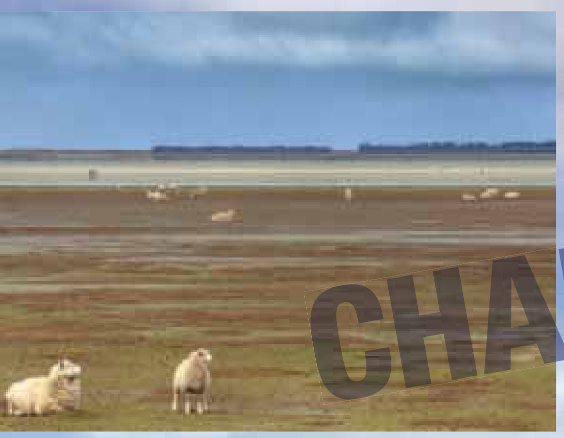
TE WAIHORA/LAKE ELLESMERE

State of the Lake and Future Management

Edited by **KENNETH F.D. HUGHEY** and **KENNETH J.W. TAYLOR**



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Edited by **KENNETH F.D. HUGHEY** and **KENNETH J.W. TAYLOR**
Lincoln University — Environment Canterbury

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SHELLEY McMURTRIE


SHUTTERSTOCK

01 INTRODUCTION

KENNETH F.D. HUGHEY Lincoln University **KENNETH J.W. TAYLOR** Environment Canterbury

Te Waihora/Lake Ellesmere[1] is a large coastal lake, intermittently open to the sea. It is highly regarded for its conservation and related values, some of which are of international significance. Its function as a sink for nutrients from its large predominantly agriculturally based catchment, currently undergoing accelerated intensification, is also recognised, at least implicitly. It is the resulting conflict from these value sets which is mainly responsible for the ongoing debate about the future of the lake, a debate long fuelled by rhetoric and informed by a body of science which highlights the lake's complexity as a biophysical system, but has many gaps. It is a debate that now has substantial statutory implications, arising from factors which include:

- the requirements of conservation, and indigenous needs and entitlements which are growing in prominence and statutory (including property rights based) legitimacy;
- public interest in legal processes associated with further major intensification of agriculture planned for the catchment;
- a recent Environment Court decision in which serious questions about the overall biological health of the lake were raised; and
- the consequences arising from the need for Environment Canterbury to obtain resource consents for the lake operating regime.

In addition, in recent times the Waihora Ellesmere Trust (WET), a community based group advocating for improved management of the lake, has been established. It is within these diverse contexts that this State of Te Waihora/Lake Ellesmere report has been prepared—it results from the 2007 Waihora/Ellesmere Living Lake Symposium, held from 31 October-3 November 2007 at Lincoln University, Canterbury. The symposium was initiated and organised by the WET (see www.wet.org.nz).

The Living Lake Symposium had several key objectives:

- To determine the overall state of the lake, by first defining the key value sets, and indicators that could be reported against;
- To suggest future management actions that would address key issues affecting the defined values;
- To provide a forum within which lay individuals, scientists and managers could openly debate issues; and
- To provide a launching pad for integrated and focused future management of the lake and its environs.

The programme incorporated three keynote speakers: Dr Larry Hildebrand from Environment Canada, Dr Hamish Rennie from Lincoln University, and Dr Bryan Jenkins from Environment Canterbury—their addresses made a major contribution to the symposium although none are included in this report, because it is focused primarily on the science and the management options associated with the lake.

The format of this report is designed to be readily updateable. Ten of the principal presentations in the main sessions of day two of the symposium are included in this report—two Power Point presentations (both regarding water quantity and related issues) are provided as appendices to improve completeness. Over time, however, topic areas not available as full papers for this report, e.g., surface water quantity, will be written up and included in detail. Similarly, the papers herein will themselves be updated as new and significant data become available. Each subject area will be reconsidered within the same structure and context as has been provided here. One paper, 'Te Waihora/Lake Ellesmere: An integrated view of the current state and possible futures', was presented on the final formal day of the symposium and it is included as the concluding chapter of this report.

Finally, the Waihora Ellesmere Trust and many of the others attending the symposium saw merit in reconvening the event around two years after the initial symposium, to report on progress with management, indicator monitoring, scientific understanding and other matters. We support that suggestion.

In terms of report format it is important that readers note the following:

- All authors were provided with 'briefs of work' and were requested to contextualise their work with that contained within the Taylor (1996) report on the lake—this was more easily achievable for some than others. Given some lack of consistency between symposium presentations and final papers it is our intention that a revised set of agreed indicators will be considered and included in any follow-up symposium and associated reports—some considerable work will be required in some areas to achieve this objective;
- Only the wildlife and integration papers included in this report have been formally peer reviewed; and
- All other papers have been standardised and style edited-some changes have been suggested by the report editors and made by the paper authors.

Finally, an attempt has been made to present the papers in a logical sequence of 11 chapters: chapter 1 sets the scene; chapters 2-7 cover the biophysical science dimensions (groundwater, water quality, native vegetation, native fisheries, trout, wildlife); chapters 8-10 deal with the human dimensions (Ngāi Tahu, recreation, economics); and chapter 11 deals with integration of the findings from the previous chapters and setting the scene for future management.

[1] Note that the Geographic Place Names Board has defined the name as Lake Ellesmere (Te Waihora). It is not our intention to debate the nomenclature, but rather to put the focus where we consider it should lie, within the lake's initial historical and cultural context for indigenous Maori.

VEGETATION of the lakeshore

SHELLEY McMURTRIE

PHILIP B. GROVE Environment Canterbury **MIRELLA POMPEI** Environment Canterbury

Te Waihora/Lake Ellesmere lakeshore vegetation was mapped and described in the early 1980s and again in 2007, allowing analysis of trends in vegetation cover around the lakeshore. Lakeshore vegetation types were categorised on the basis of habitat (brackish wetland/freshwater wetland/dryland) and canopy composition (native/exotic/mixed native-exotic). There has been an increase in total area of freshwater wetland habitats and a corresponding decline in overall cover of brackish wetland vegetation over the monitoring interval. Although the overall area of brackish wetland habitat has declined, there has actually been an increase in extent of native brackish wetland vegetation. And while there has been an increase in area of freshwater wetland habitat around the lakeshore, there has been a marked decline in extent of native freshwater wetland vegetation. Causes of these trends include the lower average lake levels and reduced lake salinity of recent years, reduced stock grazing pressure along parts of the shoreline, the spread of exotic willows in freshwater wetland habitats and human disturbance. Management actions to maintain, improve or restore the resource are suggested.

4.1 Introduction and methods

Te Waihora/Lake Ellesmere lakeshore vegetation was mapped and described in the early 1980s by Clark and Partridge (1984). The same area, approximately 4,400 ha in total, was re-surveyed in 2007. Information from both surveys has been entered into a spatial database allowing monitoring and analysis of trends in vegetation cover around the lakeshore.

A total of fifty-four vegetation types were identified and mapped by Clark and Partridge, and described in their survey report. Sixty-three vegetation types were described for the survey area in 2007. All vegetation types recorded in 1983 were present in the second survey, with nine new vegetation types identified and described.

An overview of the 2007 vegetation map is shown in Figure 1, with approximately 900 distinct mapping units delimited within the survey area. Where a mosaic of more than one vegetation type was present in a mapping unit, the types were listed in decreasing importance in terms of area. The full list of vegetation types present within each 'mosaic' mapping unit have been recorded on the spatial database. However, for purposes of trend analysis over the whole lakeshore survey area only the predominant vegetation type within each mosaic was used.

The area mapped in the 1984 report extended from the lake water's edge (at low lake level) to an upper boundary between the 1.0 and 2.0 metre contour. This upper boundary usually marked the change from lakeshore wetland vegetation to developed farmland or other dryland vegetation. While the focus of the survey, and majority of the survey area, was lakeshore wetland vegetation, some areas of farmland, raised stopbanks, sand dunes and other dryland vegetation types were also included in the vegetation maps (Clark and Partridge 1984).

In 2007, some additional sites of wetland vegetation outside the original survey area were mapped. These additional mapping units were not included in the spatial analysis of trends in the vegetation 1983-2007, and are not discussed further here. For some of the lowest-elevation

Photo ***A typical view of Te Waihora/Lake Ellesmere lakeshore vegetation illustrates the influence of fluctuating water levels and salinity on vegetation patterns. Much of the present nationally-significant lakeshore vegetation has developed under the artificial lake opening regime of the last 150 years.*** *Photography* ***Shelley McMurtrie.***

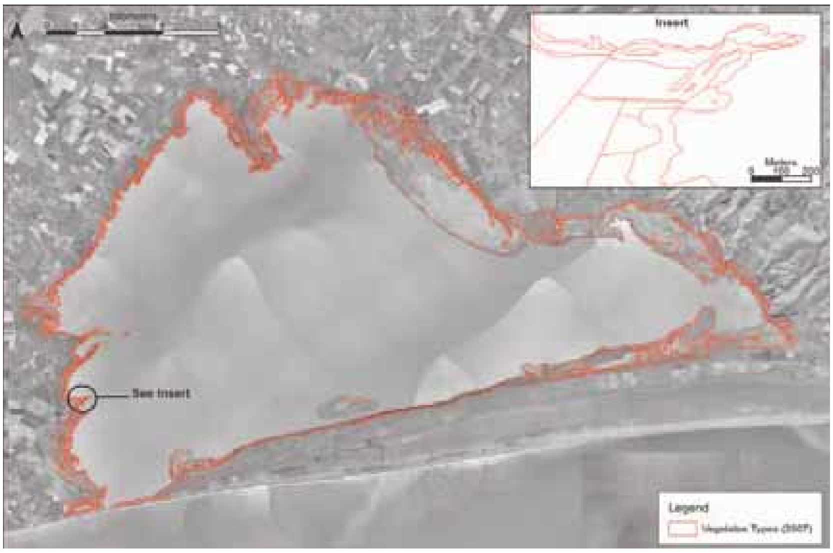

FIGURE 1. Vegetation mapping units for Te Waihora/Lake Ellesmere 2007.

FIGURE 2. Native brackish wetland vegetation: marsh ribbonwood shrubland (*Plagianthus divaricatus*) bachelor's button *(Cotula coronopifolia)* – purple mimulus (*Mimulus repens*) herbfield – Yarrs Flat.

FIGURE 3. Native brackish wetland vegetation: sea rush (*Juncus krausii*) and marsh ribbonwood at Kaitorete Spit.

FIGURE 4. Native brackish wetland at Greenpark Sands: Sea primrose (*Samolus repens*) hummocks amongst purple mimulus and arrow grass (*Triglochin striata*) on sparsely vegetated flats.

lakeshore vegetation types, mapping, and therefore total area calculations, were only approximate due to lake water levels at both survey times.

Lakeshore vegetation types were grouped into broader categories based on habitat:

- Vegetation of saltmarsh or brackish wetland habitats. These are extensive along the southern and eastern sides of the lake, but are also present on the western shoreline. Examples are shown in Figures 2-4.
- Freshwater wetland vegetation, generally around inflows and groundwater seepages and most abundant along the western side of the lake, e.g., Figures 5 and 6
- Higher-elevation dryland vegetation types.

Only native plant species occur on the lowest elevation lakeshore mud and sand flats. Most other wetland vegetation types contain both native and exotic species, but can be categorised as predominantly native, predominantly exotic or mixed native-exotic, on the basis of canopy composition. Dryland vegetation within the survey area is mostly exotic grassland and shrubland (gorse, lupin), except on Kaitorete Spit where some distinctive native dryland vegetation is also present. The minor 'miscellaneous' category includes unvegetated areas such as bare ground, stopbanks, tracks, ponds etc.

4.2 Current state of vegetation

There has been an increase in total area of freshwater wetland habitats and a corresponding decline in overall cover of brackish wetland vegetation over the monitoring interval of 1983-2007 (Table 1; Figures 7 and 8).

Brackish wetlands

Native vegetation types occupied 85% of brackish wetland habitats in 1983, the balance being exotic grassland. In 2007 native vegetation occupied over 90% of brackish wetland habitats. Although the overall area of brackish wetland habitat has declined, there has actually been an increase in total area of native brackish wetland vegetation over the monitoring interval. The main contributors to these trends were expansion in cover of marsh ribbonwood shrubland (256 to 387 ha) and three square *(Schoenoplectus pungens)* sedgeland (123 to 401 ha); and a decline in cover of exotic salt-tolerant grassland (tall fescue, creeping bent, salt barley grass) from 536 to 331 ha.

Freshwater wetlands

While there has been an increase in cover of freshwater wetland habitat around the lakeshore, there has been a marked decline in extent of native freshwater wetland vegetation. In 1983 native freshwater wetland vegetation covered 245 ha, 54% of the available habitat (452 ha). By 2007, native freshwater wetland vegetation cover was reduced to 197 ha, only 35% of a larger total area (555 ha). For example, area of native harakeke / NZ flax *(Phormium tenax)* cover declined from 23 to 9 ha. Area of exotic crack- and/or grey willow- *(Salix fragilis and S. cinerea)* dominant forest and scrub vegetation has doubled, from 67 ha of the lakeshore survey area in 1983 to 140 ha in 2007.

FIGURE 5. A distinctive native freshwater vegetation type: *Baumea rubiginosa* restiad rushland with scattered flax and manuka (*Leptospermum scoparium*), at Lakeside Reserve on the western shoreline.

FIGURE 6. Grey willow invading tussock sedge (*Carex secta*) swamp near the mouth of the LII River.

TABLE 1. **Changes in proportion of vegetation types between 1983–2007.**

Habitat	Proportion of lakeshore survey area	
	1983	2007
Brackish wetland	82% (3,606 ha)	80% (3,534 ha)
Freshwater wetland	10% (452 ha)	12% (555 ha)
Dryland	8% (332 ha)	8% (337 ha)
Miscellaneous	< 1% (11 ha)	<1% (13 ha)
Total	4401 ha	4439 ha

Botanically important areas

Clark and Partridge (1984) listed several lakeshore areas as having high botanical value. Greenpark Sands, Kaitorete Spit, the west bank of the LII River and Yarrs Flat Wildlife Reserve retain the values that caused them to be identified as botanically important wetland areas almost 25 years ago. Together, these areas comprise approximately one third of the lakeshore.

However, the smaller botanically important wetlands described by Clark and Partridge on the lake's western shore, areas north of Lake Road South, the point south of Timber Yard Point, and Harts Creek Wildlife Management Area, have been reduced. Despite being only a small, and decreasing, proportion of the total area, the remaining native freshwater wetlands are

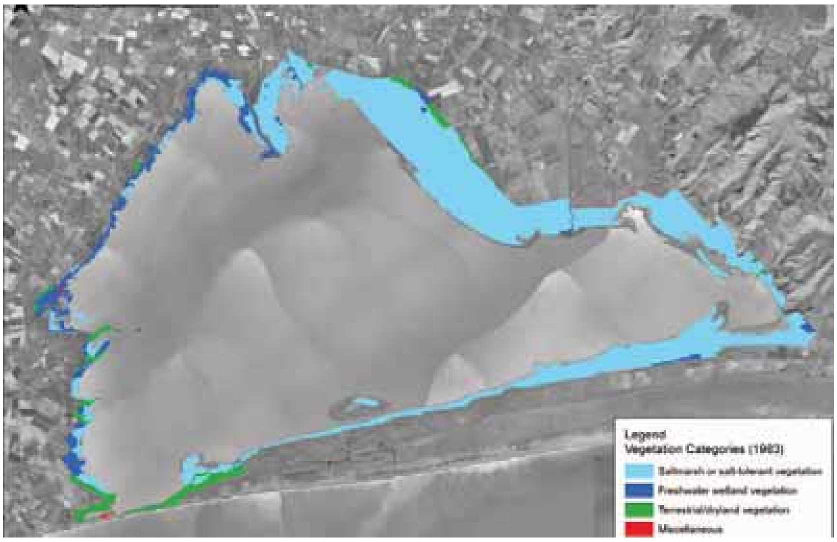

FIGURE 7. Patterns of lakeshore vegetation – 1983.

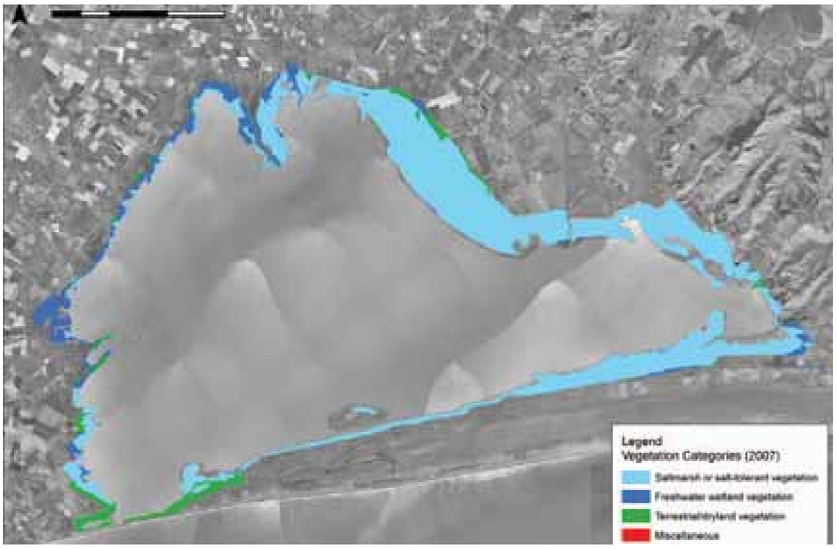

FIGURE 8. Patterns of lakeshore vegetation – 2007.

FIGURE 9 An example of the effect of even small differences in elevation on the distribution of lakeshore saltmarsh vegetation.

an important component of the lakeshore environment. They include significant examples of regionally uncommon and distinctive vegetation types, e.g., Figure 5, and are critical habitat for a number of rare/threatened plant and bird species.

4.3 What has caused the state and recent trends

Clark and Partridge (1984) attributed variation in the lakeshore vegetation to three main factors: elevation in relation to lake level; degree of salinity; and the effects of human disturbance (Taylor, 1996). Human disturbance includes direct clearance of vegetation, construction of drains and stopbanks and the spread of introduced plants and animals. These factors continue to drive lakeshore vegetation patterns. Other factors are substrate physical composition (sand, silt, gravel) and nutrient concentrations.

Present lakeshore vegetation has developed under the artificial lake opening regime of the last 150 or so years. Vegetation zonation patterns along the lakeshore reflect the varying tolerance to inundation and exposure of different plant species (Figure 9). There is also a gradient from freshwater to brackish to saline conditions at different times and places around the lakeshore, influenced both by water salinity and substrate type (sandy soils are more saline than silt/mud).

Freshwater wetlands occur in the vicinity of surface and groundwater inflows. Brackish wetlands, supporting species tolerant of fluctuating salinity, occupy most of the lakeshore. The most saline conditions around the lakeshore are on mid-elevation sand flats, where brackish lake water forms shallow ponds during high lake levels, and salts are concentrated by subsequent evaporation. Only a few of the most salt-tolerant plant species can grow here: native glasswort *(Sarcocornia quinqueflora)* and salt grass *(Puccinellia stricta)*, and introduced salt barley grass *(Hordeum marinum)*. Figure 10 in shows an example of this vegetation.

4.4 Recent trends

The overall decrease in brackish wetland and increase in freshwater wetland area of the last 25 years is probably a response to the lower average lake levels and reduced lake water salinity (due to fewer lake openings) of recent years. In spite of this, cover of native brackish wetland vegetation, specifically marsh ribbonwood and three square, has increased over the same time, owing to reduced pressure from stock grazing along parts of the lakeshore. Figure 11 in illustrates the effect of cattle grazing on three square at a site on Kaitorete Spit.

Spread of willows and conversion of some areas to pasture are the main causes of increased extent of exotic freshwater wetland vegetation types, at the expense of native plant communities in these habitats (Figure 6). However, there has been an increase in abundance of some native species (e.g., bog rush *Schoenus pauciflorus* and *Carex sinclairii)* within mixed native-exotic freshwater wetland vegetation types at several sites on the western shoreline, in response to reduced grazing pressure. These may revert to native dominance in the future.

The botanically important freshwater wetlands described by Clark and Partridge (1984) on the lake's western shore continue to be reduced by both weed spread and human disturbance (including clearance for farming, herbicide and fire). A recent example was the spraying (2006-07) and subsequent burning (May 2007) of native freshwater wetland at Lakeside Scientific Reserve. The only remaining stand of manuka on the Te Waihora/Lake Ellesmere shoreline was destroyed, along with several hectares of *Baumea rubiginosa*, flax and raupo swamp.

FIGURE 10. Hyper-saline native herbfield vegetation. Halophytic glasswort and saltgrass at Greenpark.

FIGURE 11. A fenceline at Kaitorete Spit illustrates effects of grazing on three square sedgeland.

4.5 Actions required to maintain, improve or restore the resource

Maintain

- No further loss of native lakeshore wetland vegetation by human disturbance (e.g. clearance for farming, heavy stocking, herbicide, fire, earthworks, vehicles).
- No further disturbance to lakeshore hydrology through construction of drains and stopbanks.
- Prevent spread of willows and other weeds into non-infested areas. Eradicate willows and shrub weeds from lightly-infested sites in ways that do not harm existing native plants.
- Implement the Water Conservation Order lake closing regime, particularly in the event of summer openings. If the lake level gets very low in summer, it can take a long time to refill. Wetland plant communities dry out and are invaded by exotic dryland species.
- Maintain lake level fluctuations with the opening and closing regime but with higher maximum lake opening trigger levels (e.g. 1.3 m). This would help compensate for lower lake levels of recent years. A higher lake level will also help restrict willow spread.

Improve

- Eradicate willows and other weeds from moderately-infested sites in ways that do not harm existing native vegetation.
- Fence lakeshore wetlands from adjoining developed farmland to control or exclude stock grazing.

Restore

More ambitious actions, and on a wider catchment scale, would be required to achieve restoration of native lakeshore vegetation. These might include:

- Fill in drains and remove stopbanks around the lake to restore hydrological connectivity and raise water table.
- Restore quantity and quality of freshwater inflows.
- Restore native vegetation connections over the catchment; to Banks Peninsula and across the plains to the mountains.
- Eradicate willows from heavily infested sites and actively replant with appropriate native species.

4.6 Acknowledgements

Thanks to Alice Shanks for field survey and mapping of the western lakeshore, and Trevor Partridge (Christchurch City Council) for useful discussion.

4.7 References

Clark D.J. and Partridge T.R. 1984. The shoreline vegetation of Lake Ellesmere, Canterbury, New Zealand. Report prepared for the North Canterbury Catchment Board and Regional Water Board, Christhchurch.

Taylor, K.J.W. (ed.) 1996. The Natural Resources of Lake Ellesmere (Te Waihora) and its Catchment. Canterbury Regional Council Report 96(7), Canterbury Regional Council, Christchurch.

Photo ***One of the primary actions required to maintain, improve, and restore the natural lakeshore vegetation is the control of willows.***
Photography ***Shelley McMurtrie.***

Te Waihora/Lake Ellesmere is a large coastal lake, intermittently open to the sea. It is highly regarded for its conservation and related values, some of which are of international significance. Its function as a sink for nutrients from its large predominantly agriculturally based catchment, currently undergoing accelerated intensification, is also recognised, at least implicitly. It is the resulting conflict from these value sets which is mainly responsible for the ongoing debate about the future of the lake.

This book serves to quantify the nature of this debate by documenting changes to lake values, both over time and spatially. It provides a standardised approach to reporting these changes, set against indicators that are value-specific. Ultimately, it provides a template for thinking about future management scenarios for the lake and its environs. Given this approach the book ultimately serves as a resource for helping understand the ever-changing and current and possible future states of the lake, under a variety of management requirements and implications.