

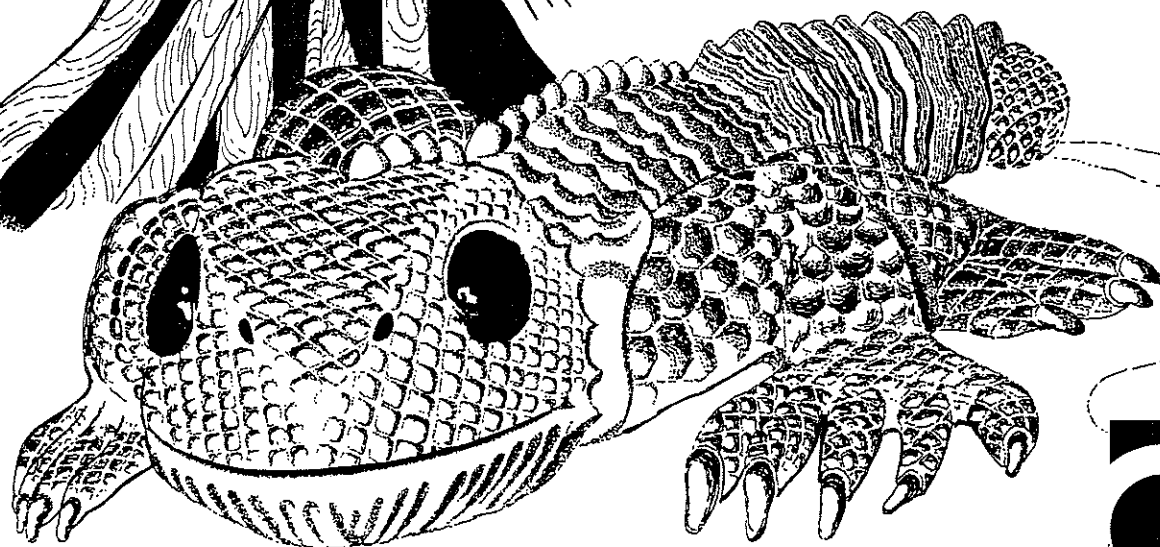


SCIENCE & RESEARCH SERIES NO.20

VASCULAR FLORA OF LAKE WAIRARAPA
AND ITS ADJACENT WETLANDS

By

Colin Ogle, Tom Moss and Tony Druce



CONSERVATION

Science and Research Directorate

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Published by
Head Office,
Department of Conservation,
P.O. Box 10-420,
Wellington,
New Zealand

ISSN 0113-3713
ISBN 0-478-01169-5

First published 1990

ACKNOWLEDGEMENTS

We thank Miss Bryony Macmillan and other staff of Botany Division, DSIR, Christchurch for their advice on plant identification and distribution based on herbarium materials. The assistance of others in fieldwork is acknowledged, particularly Mr Peter Moore (Science & Research Division, Department of Conservation, Wellington) for plant records gathered during his fieldwork on bird habitats at Lake Wairarapa; members of the Wellington Botanical Society; and Mr Ian Buchanan (Wellington Acclimatisation Society, Masterton). For comments on drafts of the script we thank the several referees in Science & Research Division, Department of Conservation, Wellington, particularly Ms Susan Timmins and Drs Philip Simpson, Rob McColl and Richard Sadleir.

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VASCULAR FLORA OF LAKE WAIRARAPA AND ITS ADJACENT WETLANDS

by

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ABSTRACT

The vascular flora of the shores of Lake Wairarapa and its adjoining wetlands totals 329 species, of which 189 are indigenous and 140 are adventive. The distribution of these is given for each of 16 discrete parts of the wetlands, and some distribution patterns are discussed in relation to habitat availability and habitat changes.

1. INTRODUCTION

The shores of Lake Wairarapa and nearby wetlands (Fig. 1) are important for their extensive and varied areas of indigenous vegetation, as well as being nationally significant for wildlife, especially wetland birds. They contain a wide range of wetland plants, some with nationally restricted distributions (Ogle and Moss 1984). Recent surveys around the lake have added to our knowledge of its vegetation and flora. This report gives some interim results and assesses their significance for future management of the wetland system.

The authors, both separately and together, have gathered data on the distribution of vascular plants around Lake Wairarapa over a period of some years. Druce (1974) completed a list of indigenous plants for the western shore, which incorporated records from a short descriptive account of the same part of the lake by Mason (1951). Other botanical work before the last decade appears to have been confined to the collecting of plants of particular species or groups of species, mainly for taxonomic studies. Some of these records have been published, e.g. Lloyd (1972) on *Cotula (Leptinella)* and Orchard (1979) on *Myriophyllum*.

In the period 1980-84, one of us (TM) surveyed the northern margins of the lake for indigenous aquatic plants and cultivated some of these such as *Glossostigma* spp., *Isoetes* sp. and *Crassula ruamahanga*.

The eastern shores of the lake and adjacent wetlands (including those now known as J K Donald Reserve, Boggy Pond, Matthews Lagoon, Ruamahanga Cut-off, and Allsops Bay) remained little known botanically until 1982, when staff of the New Zealand Wildlife Service began a detailed study of waterbird use of wetland habitats at Lake Wairarapa. The study was in response to a proposal by the Wairarapa Catchment Board to build polders on the eastern shore and to convert most of the periodically flooded flat areas along the lake edge into farmland.

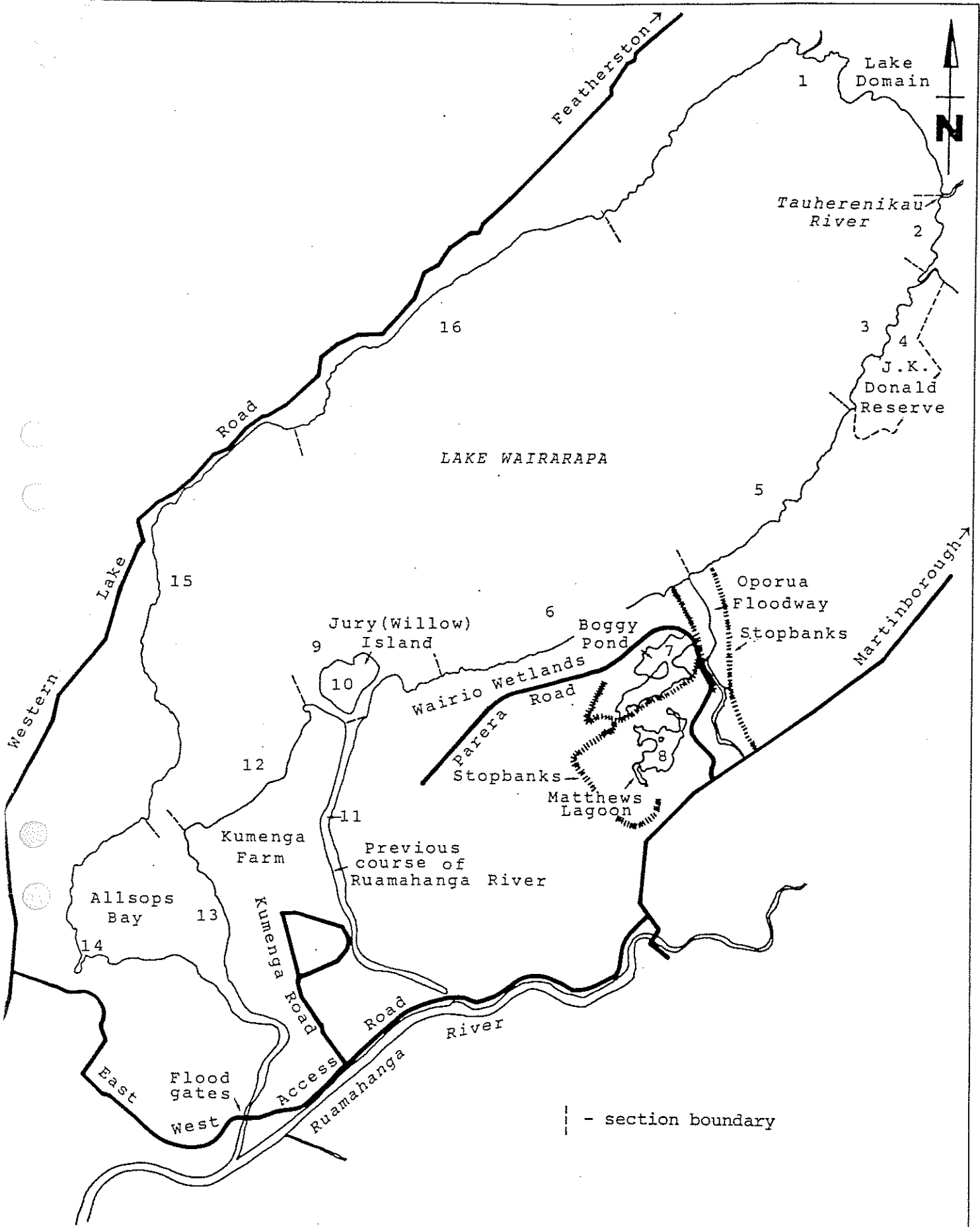
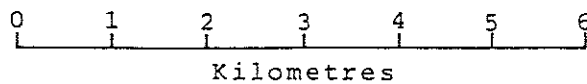


FIG.1. Main topographical features of Lake Wairarapa. Numbers 1 - 16 are subdivisions of the shore and other wetlands used in compilation of plant species list.



2. VEGETATION

Lake Wairarapa has a high diversity of wetland habitats ranging from open water of the lake; shallow water, including many backwaters; bare sandflats; marshlands, including extensive areas of native turf and short rushes; open water of ponds; emergent swamp vegetation, especially raupo; wetland forest, dominated by willows (Moore *et al.* 1984).

The most extensive vegetation is marshland which is exposed at normal lake levels (*ibid.*). Large areas on the eastern side of the lake are covered by short rushes, which can extend in places to 500m from the shore. *Juncus articulatus* predominates on mudflats, with scattered tall rushes (*J. gregiflorus*, *J. sarophorus* and similar types), sedges (*Schoenoplectus pungens*, *Bolboschoenus caldwelli*), and grasses such as tall fescue (*Festuca arundinacea*) and creeping bent (*Agrostis stolonifera*).

"Native turf" occurs where the shore is alternately inundated and exposed. Some 55 species of highly specialised tiny native plants occur here, species adapted to this type of water regime (Ogle and Moss 1984). Representative species include *Crassula sinclairii*, *Glossostigma elatinoides*, *Isolepis cernua*, *Limosella lineata*, *Ranunculus limosella*, and *Lilaeopsis novae-zelandiae*. The turf may form relatively dense mats, though many turf areas have a low percentage of ground cover, such as those on flats south of the Oporua Floodway. The vegetative cover increases on exposure after long periods of seasonal inundation, and is more sparse on substrate that is rarely exposed.

Very little tall swamp vegetation is contiguous with the marshland. On the western shore of Allsops Bay there is a fenced-off area of swamp, much of it with surface water among the vegetation. In places, the dominant plants are quite different from those in swamps of eastern shores, and include shrubs such as manuka, and sedges such as *Baumea rubiginosa* and *Carex secta*. Swamps of the eastern shore are mainly in Boggy, Matthews and Donald Reserves, where raupo or crack willow are dominants. *Leptocarpus similis* and *Carex sinclairii* are locally common. Each pond complex has a different character and water regime. Small, shallow ponds gradually dry out through evaporation and the lowering of the water table in periods of dry weather. This allows the growth of native turf in large ponds, such as those in Boggy Pond Reserve. Small ponds such as the majority of those in Donald Reserve, are dominated by swamp grasses (e.g. *Paspalum distichum*) and robust dicotyledonous herbs (e.g. *Ludwigia palustris*).

Vegetation of permanent water in the main lake and ponds has not been surveyed in detail. *Ruppia polycarpa* occurs in the lake and Ruamahanga Cut-off, to a depth of one metre. Much of the open lake water is apparently devoid of aquatic vegetation, perhaps because of its high turbidity. The ponds tend to have more dense aquatic vegetation in the water column such as *Myriophyllum triphyllum*, and floating plants such as *Azolla filiculoides* and *Lemna* sp.. Other plants grow to the surface, for example *Glyceria declinata*.

A coarse-scale vegetation map for all the wetlands around the lake was drawn by John Heaphy (New Zealand Wildlife Service, now Department of Conservation, Raetihi) from aerial photographs and some field checks. This map was refined during the waterbird habitat study in 1982-83, and was included in Moore *et al.* (1984) as a folded map inside

the back cover. The vegetation descriptions were expanded in the text, with some notes on both conspicuous and rare component species. Annotated black and white photographs of all the main vegetation types accompanied the text. The same study provided the data for a short popular account of the vegetation and vascular flora of Lake Wairarapa, with coloured plates, which featured in "Forest and Bird" (Ogle and Moss 1984).

3. FLORA

A list of indigenous and adventive vascular plants was compiled during the wildlife habitat survey, and included as Appendix 4 by Moore *et al.* (1984). This built upon the list of Druce (1974). Among the new records for the lake made during this survey was a nationally threatened indigenous grass, *Amphibromus fluitans* (Ogle 1987). Separate lists of plants were made by Ogle for some discrete parts of the wetlands such as J K Donald and Boggy Pond Reserves, but it was not until late in 1983 that the entire lake shore and wetlands were divided into 16 sections (Fig. 1) for recording indigenous plant distributions. Since then, the distribution of adventive species has been recorded by Ogle in the same manner (Appendix 1).

The 16 sections were chosen largely for the convenience of survey, and reflect the piecemeal nature of the inventory. Some sections are lake shore only, with adjacent wetlands being listed separately (e.g. Sections 3 and 4). Others include the shore and adjacent wetlands under one list. As an example, section 1 includes lake shore, Turners Lagoon and its outlet channel, the lower end of Abbots Creek, and the Lake Domain with Bartons Lagoon (see maps in Moore *et al.* 1984). Section 2 comprises shore and Haywards Lagoons. Section 5 includes all the shore and wet areas between J K Donald Reserve and Oporua Floodway. The Wairio wetlands are included with the shore in section 6, but Section 9 comprises only the wet flats and channels surrounding Jury (Willow) Island, the island being listed separately as Section 10. Section 12 comprises wet flats and several ephemeral ponds among adjoining dunes. The lake outlet channel divides Sections 13 and 14, the latter section including extensive swamps which extend to Western Lake Road at one point. Sections 15 and 16 include lake shore and adjacent wetlands, again almost to Western Lake Road in places.

4. RESULTS AND DISCUSSION

4.1 Changes in species' presence

The vascular flora of the Lake Wairarapa wetland system is currently known to total 327 species (Appendix 1). Of these, 189 (+ 2 hybrids) are indigenous, and 138 are adventive to New Zealand. Several indigenous species recorded by Mason (1951), Lloyd (1972), or Druce (1974) have not been seen for some years, and may no longer be present. Some of these are listed in Appendix 1 without a location, e.g. *Korthalsella lindsayi*, *Gnaphalium limosum*, *Leptinella dioica*, *Cardamine* sp. (cf. *C. corymbosa*), *Mimulus repens* [possibly an error], and *Poa pusilla*. *Pterostylis micromega*, *Eryngium vesciculosum*, *Gunnera monoica*, *Selliera radicans*, *Schoenus concinnus* and *Galium* sp. (cf. *G. perpusillum*) also require recent confirmations.

Changes in the lake system may have led to the local extinction of some species. The construction of barrage gates across the lake outlet in 1974 not only led to large changes in the water regime - timing, depth, and periodicity of inundation - but also to the removal of a saline influence. *Carex pumila* and perhaps even *Leptocarpus similis*, *Lilaeopsis novae-zelandiae*, and *Myriophyllum votschii*, are survivors of previous brackish conditions. The change to a purely fresh-water system may have caused the local extinction of *Leptinella dioica*, *Eryngium vesciculosum*, *Mimulus repens*, and *Selliera radicans*, none of which have been seen at the lake in recent years.

4.2 Distribution of indigenous species

Though recognising the incomplete nature of the plant distribution data (Appendix 1), we note that the greatest range of indigenous species, particularly woody plants and ferns is in Section 14 (Fig. 1) which includes the area of fenced swamp. As this area has a lower nutrient status than other wetlands bordering the lake, it has relatively few invasive weeds, and mesotrophic indigenous species such as *Baumea rubiginosa*, *B. tenax*, *Isachne globosa*, *Coprosma tenuicaulis*, *Epilobium chionanthum*, and *Gunnera prorepens* are able to persist.

As stated above, the periodically inundated shores of the main lake contain a large range of turf-forming indigenous species. Appendix 1 shows that many of these are widespread around the lake shore, and also occur on edges of some ponds cut off from the main lake, such as J K Donald Reserve (Section 4), Boggy Pond (Section 7) and Matthews Lagoon (Section 8). Others appear to be confined to relatively small areas of the lake shore, such as *Leptinella maniototo*, *Myriophyllum votschii*, *Carex buchananii*, *C. cirrhosa*, and *Isoetes* sp., and yet other species occur solely or mainly around the sheltered edges of ponds rather than the main lake, e.g. *Viola byallii*, *Crassula ruamahanga*, *Amphibromus fluitans* and *Gratiola sexdentata*.

Why some species have local distributions is not fully known but small differences in habitat are likely to be important. For example, *Isoetes* grows mainly around the edges of submerged stones, an uncommon habitat in the wetland system.

The trunks of old crack willows at the lake provide habitat for indigenous species, such as *Crassula ruamahanga*, and some are known on willows only, including *Colobanthus apetalus*, *Drymoanthus* and *Earina* orchids, and several epiphytic fern species. Kahikatea may have provided habitat for such plants in the past, but the few remaining kahikatea near the lake are mostly young trees, and nearly all are in places grazed by livestock.

Because the variety of indigenous species seems to depend on the existence of a wide range of wetland habitats, future management should aim to keep and even create, a variety of habitats. Separate parts of the system should have different water regimes (e.g. in the depth, timing and periodicity of flooding), with variation in water nutrient levels, and under a variety of grazing regimes (including non-grazing).

4.3 Distribution of adventive species

Because records of the distribution of adventive species were not started until about 1984, Appendix 1 gives a very incomplete view of patterns of distribution. Some species found before 1984 were not found subsequently, and have no location indicated in the Appendix. The seeming abundance of adventive species in Section 4 (J K Donald Reserve) is almost certainly an artefact resulting from more intensive survey of that area for adventive plants, compared to other parts of the Lake Wairarapa wetlands. Of those known, *Carex otrubae* is the most local adventive species nationally, being recorded by Healy and Edgar (1980) from only one location (near Himatangi in the Manawatu), although it was found also on Maud Island, Pelorus Sound in 1980. Other adventive species around the wetlands which occur in few localities nationally include *Veronica scutellata*, *Ciclospermum leptophyllum*, *Solanum physalifolium*, and *Agrostis castellana*.

4.4 Threatened species

The wetlands contain several indigenous species currently listed as being either nationally threatened or of local distribution, by DSIR Land Resources (1990). With a vulnerable status are *Mazus* sp. (*M. pumilio* of New Zealand authors), *Amphibromus fluitans*, and *Pterostylis micromega*; with a rare status is *Crassula ruamahanga*; and local in New Zealand are *Centipeda minima* and *Urtica linearifolia*.

4.5 Geographic range of species

One group of species comprises those which are more common and widespread in the South Island (particularly in the east) than in the North Island. *Leptinella maniototo* has its only North Island location at Lake Wairarapa; others with few North Island records are *Carex cirrhosa* (Kaweka Lakes, L. Rerewhakaaitu, L. Ponui), *C. buchananii* (five other records at DSIR Land Resources herbarium (CHR) in past 30 years), *Hypsela rivalis* (Kaweka Lakes, L. Waikaremoana, north-west Ruahine Range), and *Eleocharis pusilla* (three other CHR records in past 30 years). *Leptinella dispersa* subsp. *dispersa* at Lake Wairarapa is dioecious, and hence matches the type (Mikonui River mouth, Westland; Lloyd (1972), p. 312). Elsewhere in the North Island, *L. dispersa* subsp. *dispersa* is monoecious.

The flora as a whole is more similar to that of lakes with fluctuating water levels in the eastern South Island, rather than to most lakes of the North Island. However, Lake Wairarapa shares a number of herbaceous species with one of the Kaweka Lakes near Kuripapango in inland Hawkes Bay, a relatively natural lake which has marked seasonal changes in water levels, and also with certain lakes of the central North Island, including Lakes Taupo and Rerewhakaaitu.

A lack of lake habitats in the eastern North Island is a major reason for disjunct distributions of wetland plant species. Those lakes which do occur are mostly severely modified, and may have lost species. As an example, one of the largest lakes in Hawkes Bay is Lake Hatuma, near Waipukurau. Although it is shallow with fluctuating water levels, this lake is so modified by adventive plants and stock grazing that the indigenous flora comprises only a few tall reeds emergent in deeper water (raupo, *Schoenoplectus validus*, *Bolboschoenus fluviatilis*, *Carex virgata*), epiphytic ferns on willows, *Juncus gregiflorus* in wet pasture, *Urtica linearifolia* at willow bases, and the nationally widespread aquatic species, water milfoil (*Myriophyllum propinquum*), *Zannichellia palustris*, *Potamogeton pectinatus*, duckweed (*Lemna* sp.), and *Azolla filiculoides* (Ogle 1980). Hatuma has an indigenous flora of 17 species, a far cry from 189 species in the Lake Wairarapa complex.

5. CONCLUSIONS

The indigenous vegetation of wetlands in and around Lake Wairarapa is a complex mosaic of different communities. These reflect local differences in physical conditions and patterns of past and present land uses. Some of the communities are rare nationally, and are especially rare in the North Island. Adventive plants are present in most communities.

The indigenous flora is rich in species for a New Zealand wetland, especially in turf-forming species characteristic of wetlands which are periodically dry. Several species are nationally threatened, and the occurrence of others poses some interesting problems of biogeography.

This report details the present knowledge of the distribution of indigenous and adventive plants around the wetland system. The survey remains incomplete because the granting of a National Conservation Order over the lake waters, and allocation of most of the lake-edge Crown lands to the Department of Conservation, mean that there is a lower priority for the data than several years ago. Other observers may be in a position to fill gaps in the data base.

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APPENDIX 1: Vascular Plants of Lake Wairarapa and its adjacent Wetlands

Key: Indigenous (A) and adventive (B) species are listed separately. The presence of each species in one or more of 16 discrete sections of the wetlands is indicated by 'X', or, in a few instances, a numeral where the individual plants were counted. Herbarium accession numbers are cited for specimens collected for DSIR Land Resources, Christchurch (CHR), in the period 1980-1989.

(A) INDIGENOUS PLANTS

Sections* of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
GYMNOSPERMS (Family Podocarpaceae)																
<i>Dacrycarpus dacrydioides</i> (kahikatea) *				X		X	X	(2)			X			X		
<i>Podocarpus totara</i> (totara)						(4)	(1)									
<i>Prumnopitys taxifolia</i> (matai)														(1)		
DICOTYLEDONOUS TREES																
<i>Alectryon excelsum</i> var. <i>excelsum</i> (titoki)														(2)		
<i>Elaeocarpus dentatus</i> (hinau)														(1)		
<i>Hoheria angustifolia</i> (narrow-leaved lacebark) CHR																
41 7054						X										
<i>Laurelia novae-zelandiae</i> (pukatea)														(1)		
<i>Melicope ramiflorus</i> subsp. <i>ramiflorus</i> (mahoe)														X		
<i>Myoporum laetum</i> var. <i>laetum</i> (ngatio)							(1)							X		
<i>Myrsine australis</i> (mapou)														X		
<i>Nestegis lanceolata</i> (white maire)														(1)		
<i>Nothofagus menziesii</i> (silver beech)														(1)		
<i>Pennantia corymbosa</i> (kaikomako)														(1)		
<i>Plagianthus regius</i> var. <i>regius</i> (ribbonwood) CHR																
404621						(1)	(2)	(2)		(1)						
<i>Sophora microphylla</i> (kowhai) CHR 404530						(1)	(5)	(2)		(1)	(1)					

* (see Fig. 1)

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MONOCOTYLEDONOUS TREE																
<i>Cordyline australis</i> (cabbage tree)	X	X		X	X	X		X	X		X	X				
DICOTYLEDONOUS SHRUBS																
<i>Brachyglottis repanda</i> (rangiora)														X	X	X
<i>Coprosma propinqua</i> subsp. <i>propinqua</i>				X	X	X	X	X		X				X	X	X
<i>C. robusta</i> (karamu)				X	X	X	X	X						X	X	X
<i>C. tenuicaulis</i>	X													X	X	X
<i>C. propinqua</i> x <i>C. robusta</i>						X				X				X	X	X
<i>Hebe stricta</i> var. <i>atkinsonii</i> (koromiko)														X	X	X
<i>Korhalsella lindsayi</i> (mistletoe)														X	X	X
<i>K. salicornioides</i> (mistletoe) CHR 415947, 417045														X	X	X
<i>Kunzea ericoides</i> var. <i>ericoides</i> (kanuka)				X	X		(1)			X				X	X	X
<i>Leptospermum scoparium</i> (manuka)				X	X					X				X	X	X
<i>Macropiper excelsum</i> var. <i>excelsum</i> (kawakawa)										X				X	X	X
<i>Solanum laciniatum</i> (poroporo)										X				X	X	X
DICOTYLEDONOUS WOODY LIANES																
<i>Calystegia tugurionum</i> CHR 404622										X				X	X	X
<i>C. sp.</i> [<i>C. sepium</i> agg. : pink flowers]				X	X					X				X	X	X
<i>Muehlenbeckia australis</i> (pohuehue)				X	X	X	X							X	X	X
<i>M. complexa</i> (pohuehue)				X	X	X	X							X	X	X
<i>M. australis</i> x <i>M. complexa</i>				X	X	X	X							X	X	X
<i>Parsonsia heterophylla</i> (NZ jasmine)				X	X									X	X	X
<i>Passiflora tetrandra</i> (NZ passion flower)				X	X									X	X	X
<i>Rubus schmidtioides</i> var. <i>schmidtioides</i> (bush lawyer)				X	(1)		(1)							X		X

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DICOTYLEDONOUS HERBS (Family Compositae)																
<i>Cenipeda minima</i>				X	?	?	X	?	?		?	?	?			
<i>Cottula australis</i>				X	X	X	X	X	X							
<i>C. coronopifolia</i> (bachelor's button)			X	X	X	X	X	X	X							
<i>Gnaphalium auidax</i> (cudweed) CHR 404618			X	X	X	X	X	X	X							
<i>G. involucreatum</i> (cudweed) CHR 404617, 404619			X	X	X		X		X							
<i>G. limosum</i> (cudweed)																
<i>G. sphaericum</i> (cudweed)			X								X		X			
<i>Leptimella dioica</i> subsp. <i>dioica</i> [see Lloyd (1972) p. 321]																
<i>L. dispersa</i> subsp. <i>dispersa</i>					X	X			X		X	X				
<i>L. maniototo</i>												X				
<i>L. squalida</i> subsp. <i>squalida</i>																X
<i>Pseudognaphalium</i> sp. [<i>P. luteoalbum</i> agg.] (cudweed)																X
<i>Senecio glomeratus</i> (fireweed)														X		
<i>S. hispidulus</i> (fireweed)																
<i>S. minimus</i> (fireweed)																X

(1)

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DICOTYLEDONOUS HERBS (other than Family Compositae)																
<i>Callitriche petriei</i> subsp. <i>petriei</i>			X		X	X	X	X	X		X	X	X			
<i>Cardamine</i> sp. (a) [<i>C. debilis</i> agg., C. "Narrow petal" of Pritchard 1957] (bittercrass)			X	X												
C. sp. (b) [<i>C. debilis</i> agg., C. "Long style" of Pritchard 1957] (bittercrass)					X									?		
C. sp. (c) [cf. <i>C. corymbosa</i> : "Mainland Coastal Race" of Pritchard 1957]			X	X		X				X				X		X
<i>Centella uniflora</i>			X													
<i>Colobanthus apetatus</i>				X		X				X						
<i>Crassula ruamahanga</i>	X			X	X	X	X	X	X		X	X				
<i>C. sinclairii</i>			X	X	X	X	X	X	X		X	X				
<i>Dichondra</i> sp. (<i>D. brevifolia</i> agg.)				X			X	X			X	X				
<i>Elatine gratioloides</i>			X	X			X	X			X	X				
<i>Epilobium chionanthum</i> (willow herb)				X							X	X				
<i>E. insulare</i> (willow herb)					X						X	X				
<i>E. komarovianum</i> (willow herb)											X	X				
<i>E. nerteroides</i> (willow herb)											X	X				
<i>E. nummulariifolium</i> (willow herb)											X	X			X	
<i>E. pallidiflorum</i> (willow herb)							X				X	X			X	
<i>Eryngium vesiculosum</i> (sea holly)								X						X		
<i>Galium propinquum</i>														X		
<i>G. trilobum</i>														X		
<i>G.</i> sp. [unnamed; cf. <i>G. perpusillum</i> ; see Mason (1951)]														X		
<i>Glossostigma elatinooides</i>			X	X		X		X			X	X				
<i>G. diandrum</i>			X	X	X	X					X	X				
<i>G.</i> sp. [cf. <i>G. diandrum</i> ; cleistogamic flowers, decurved peduncle]					X						X	X				

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DICOTYLEDONOUS HERBS (other than Family Compositae) (contd)																
<i>Gratiola sexdentata</i>				X			X				X					
<i>Gunnera monoica</i> (Mason 1951)														X		
<i>G. prorepens</i> CHR 417038													X	X		
<i>Haloragis erecta</i> subsp. <i>erecta</i>						X		X	X		X	X				
<i>Hydrocotyle hydrophila</i> (see Mason 1951)			X		X	X		X			X	X				
<i>H. moschata</i>					X	X		X			X	X				
<i>H. novae-zeelandiae</i> s.s.				X	X	X		X		X	X			X		
<i>H. pterocarpa</i>													X	X		
<i>Hypericum japonicum</i>															X	
<i>Hypsela rivalis</i> (see Mason 1951)				X	X	X		X		X	X			X	X	
<i>Lilaeopsis novae-zeelandiae</i>			X	X	X	X	X	X			X	X			X	
<i>Limosella lineata</i> CHR 417049			X	X	X	X	X	X			X	X			X	
<i>Lobelia anceps</i> (shore lobelia)						X		X			X	X			X	
<i>Mazus</i> sp. [<i>M. pumilio</i> auct. NZ] (see Mason 1951)																X
<i>Minutulus repens</i> (native musk)																
<i>Myriophyllum propinquum</i> (water milfoil)																
<i>M. triphyllum</i> (water milfoil) CHR 404624			X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>M. votschii</i> (see Mason 1951)									X		X	X			X	X
<i>Nertera setulosa</i>										X	X					
<i>Oxalis exilis</i>				X												
<i>Polygonum salicifolium</i> (willow weed) CHR 372254				X	X		X	X	X	X	X	X	X	X		
<i>Potentilla anserinoides</i>			X	X			X	X			X	X				
<i>Pratia angulata</i>					X	X					X	X		X	X	
<i>P. perpusilla</i> (see Mason 1951)			X	X	X	X	X	X	X		X	X	X	X	X	
<i>Ranunculus limosella</i>			X	X	X	X	X	X	X		X	X		X	X	
<i>R. macropus</i>			X	X	X	X	X	X	X		X	X		X	X	
<i>R. sp.</i> [<i>R. glabrifolius</i> or <i>R. amphitrichus</i>]						X	X	X	X		X	X		X	X	
<i>Rorippa palustris</i> CHR 404504				X			X	X			X	X				

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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DICOTYLEDONOUS HERBS (other than Family Compositae)(contd)

- Selliera radicans* (Mason 1951)
- Solanum americanum* CHR 415949
- Urtica linearifolia* (swamp nettle) CHR 416370
- Viola lyallii* (see Mason 1951)
- Wahlenbergia* sp. [cf. *W. colensoi* and *W. gracilis*]
(harebell) CHR 404615

MONOCOTYLEDONOUS HERBS: ORCHIDS (Family Orchidaceae)

- Drymoanthus adversus*
- Earina mucronata*
- Microtis unifolia* (onion-leaved orchid)
- Pterostylis micromega* (swamp hood orchid)

MONOCOTYLEDONOUS HERBS: GRASSES (Family Gramineae)

- Amphibromus fluitans* CHR 417055
- Cortaderia toetoe* (toetoe)
- Isachne globosa* CHR 415948
- Lachnagrostis filiformis* s.s. CHR 372257
- Microlaena stipoides* (meadow rice-grass)
- Poa pusilla*

(A) INDIGENOUS PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MONOCOTYLEDONOUS HERBS: SEDGES (Family Cyperaceae)																
<i>Baumea rubiginosa</i> CHR 416369														X		
<i>B. tenax</i> CHR 416368				X		X	X							X		
<i>Bolboschoenus caldwellii</i> CHR 404607								X								
<i>B. fluviatilis</i> (Purua grass) CHR 404608							X									
<i>Carex buchananii</i> CHR 404616	X								X							
<i>C. cirrhosa</i>	X								X							X
<i>C. dipsacea</i> var. <i>dipsacea</i> CHR 372253, 372256				X						X						
<i>C. geminata</i> s.s. (cutty grass)				X				X								
<i>C. lessoniana</i> (cutty grass)			X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>C. maorica</i> CHR 404609								X								
<i>C. pumila</i> (sand carex)									X							
<i>C. secta</i> s.s. CHR 404611					(3)											
<i>C. sinclairii</i> (grass sedge) CHR 372255	X		X	X		X		X			X	X	X	X	X	X
<i>C. virgata</i>			X	X	X	X	X	X			X	X	X	X	X	X
<i>Cyperus ustulatus</i>																
<i>Eleocharis acuta</i> (sharp spike sedge)																
<i>E. gracilis</i> (slender spike sedge) CHR 417044															X	
<i>E. pusilla</i> CHR 417050			X	X	X	X	X	X	X	X	X	X	X	X		
<i>E. sphacelata</i> (bamboo spike sedge) CHR 404613					X	X		(1)	X			X	X	X		
<i>Isolepis cernua</i>			X	X	X	X			X		X	X		X		
<i>I. inundata</i> CHR 417042																
<i>I. nodosa</i> (clubbrush)					X	X	X		X		X	X		X		
<i>I. prolifer</i> CHR 372258			X	X	X	X	X	X								
<i>I. reticularis</i> CHR 404612										(1)						
<i>Schoenoplectus pungens</i> (three square)			X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>S. validus</i>			X	X	X	X	X	X			X	X		X		
<i>Schoenus concinnus</i> (Mason 1951; CHR 70345)																X
<i>S. maschalimus</i> CHR 417043														X		

(B) ADVENTIVE PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DICOTYLEDONOUS HERBS (other than Family Compositae)																
<i>Amaranthus retroflexus</i> CHR 417058							X									
<i>Anagallis arvensis</i> (scarlet pimpernel)	X															
<i>Callitriche stagnalis</i> (starwort)		X	X	X	X											
<i>Cardamine hirsuta</i> (bitter-cress)						X										
<i>Centipeda cunninghamii</i> CHR		X	X	X	X	X	X									
<i>Cerastium glomeratum</i> (mouse-eared chickweed)						X										
<i>Chenopodium album</i> agg. (fathen)	X															
<i>C. murale</i> (nettle-leaved fathen)							X									
<i>C. pumilio</i> (clammy goosefoot) CHR 404514							X									
<i>Cyclosporum leptophyllum</i> (slender celery) CHR 404610																
<i>Conium maculatum</i> (hemlock)					X	X										
<i>Crassula decumbens</i> (Cape crassula)	X			X	X	X				X						
<i>Datura stramonium</i> (thorn apple)																
<i>Dipsacus sylvestris</i> (wild teasle)				X		X										
<i>Epilobium ciliatum</i> (willow herb) CHR 417039																
<i>Erodium cicutarium</i> (stork's bill)	X															
<i>E. moschatum</i> (stork's bill)	X															
<i>Foeniculum vulgare</i> (fennel)																
<i>Gailium aparine</i> (cleavers)						X				X						
<i>G. palustre</i> (marsh bedstraw)	X					X	X			X						
<i>Geranium molle</i> (dove's foot cranesbill)	X					X	X			X						
<i>Lepidium bonariense</i> (Argentine cress)						X				X						
<i>Lotus pedunculatus</i> (lotus)																
<i>Ludwigia palustris</i>																
<i>Lythrum hyssopifolia</i> (hyssop loosestrife)			X	X	X	X	X		X							
<i>Malva neglecta</i> (dwarf mallow)			X	X	X	X	X							X	X	

(B) ADVENTIVE PLANTS (contd)

Sections of lake shore and individual wetlands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MONOCOTYLEDONOUS HERBS: RUSHES																
(Family Juncaceae)																
<i>Juncus articulatus</i> (jointed-leaved rush)	X		X	X	X	X			X	X						
<i>J. dichotomus</i> CHR 404515	X	X	X	X	X	X			X							
<i>J. effusus</i>	X			X	X	X			X							
<i>J. microcephalus</i>			X	X	X	X								X		
<i>J. tenuis</i>			X	X	X	X										
MONOCOTYLEDONOUS HERBS (other than grasses, sedges, and rushes)																
<i>Alisma lanceolata</i> (water plantain)	X			X					X							
<i>Aponogeton distachyus</i> (Cape pondweed): reported, I Buchanan				X												
<i>Elodea canadensis</i> (oxygen weed)				X												
<i>Iris pseudacorus</i> (flag iris)	X			X												
<i>Potamogeton crispus</i> (curled pondweed)				X						X						
<i>Sisyrinchium</i> "blue"				X						X						
<i>Spirodela punctata</i> (purple-backed duckweed)	X			X						X						
<i>Tradescantia fluminensis</i> (wandering Jew)				X						X				X		

The Science and Research Directorate uses the tuatara to symbolise the unique character of New Zealand's natural and cultural heritage. According to legend, Tane, represented on our cover as a tree of knowledge with its many contributions and interconnections, breathed life, knowledge and wisdom into the first egg which hatched as a tuatara. Through its publications the Directorate passes on this knowledge to those responsible for managing our heritage.

Our cover design for the Science and Research Series is based on a carving by the Maraeroa Carving School, and permission from the Porirua Museum to use this image is gratefully acknowledged.