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RECOGNITION OF EPHEMERAL WETLANDS FROM THEIR PLANT SPECIES ASSEMBLAGES

by

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CONTENTS

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ABSTRACT

The conservation of wetlands, especially of areas which are only periodically inundated, can be hindered by different views of what constitutes a "wetland". This study compared the flora and vegetation of two sites in pastoral farmlands of the Manawatu region, at only one of which were the interested parties agreed that the site was a wetland. Past definitions of wetlands are based on either physical parameters or the biota. Comparisons of plant lists for both sites, and with a national list of wetland plants, showed that the two sites had similar floras of plants acknowledged to be wetland species, and hence the acceptance of one site as a wetland meant that the both should be accepted as wetlands. Both sites are ephemeral wetlands, at least in part, and allowing water levels to continue to fluctuate is important to the survival of some of their plant species, including indigenous species which are regionally uncommon.

1. INTRODUCTION

There is growing international recognition that wetlands are a valuable resource in their wetland state. However, wetlands continue to be lost as the lands they occupy are perceived to be more important to human economies by their conversion to drylands than for their retention as wetlands. Disputes about the values of particular wetlands can arise because the term "wetlands" covers a wide range of plant and animal communities, and some do not fit people's preconceptions of wetlands.

This study resulted from differences in opinion between resource managers about a site in farmland near Awahuri in the Manawatu region. The problem can be expressed simply as "Is the Awahuri site a wetland?".

Some of the most depleted types of wetland in New Zealand are natural ephemeral wetlands, viz. wetlands in which water lies on the surface for only part of the year. Many people perceive that land which is not permanently submerged is not wetland, and hence has less conservation value than "real wetland".

I have outlined previously (Ogle 1991) the importance of ephemeral wetlands in New Zealand, pointing out their variety, their distinctive (and sometimes unique) biota, and the range of threats they face. I also indicated that the term "ephemeral wetlands"

encompasses a wide range of plant communities, depending upon such factors as altitude, rainfall, parent rock material, edaphic factors and the history of disturbance. What they have in common is alternating periods, of greater or lesser length, in which water is present or absent from the surface. It is this periodic lack of water which has been largely responsible for the disproportionate loss of ephemeral wetlands compared with permanent waters.

Ephemeral wetlands are not poor quality versions of permanent wetlands. They are a distinctly different kind of habitat, used by species which are adapted to the changing conditions. It is important that ephemeral wetlands be recognised by land owners, planners, resource managers and the general public, in order to protect and manage the sites for their dynamic nature and specialised biota.

2. BACKGROUND

2.1 What is a wetland plant?

My methodology (below) employed lists of wetland plants, but this first required a definition of what constitutes a wetland plant. Authors have generally linked a definition of wetland plants to a definition of wetlands. They have either stated that a place where wetland species live is a wetland (e.g., Stephenson 1986) or that species which live in a wetland are, by definition, wetland species (e.g., Johnson and Brooke 1989).

Taken together, these definitions might be regarded as circular reasoning. Nevertheless, if a list of wetland species is derived from places which are classified as wetlands on their physical characteristics, then a list of the inhabitants of a new study site can be compared with the list of wetland species. A high level of agreement would lead to the conclusion that the new study site is a wetland also.

Johnson and Brooke (1989) illustrate 531 wetland plant species, and describe a further 153 wetland taxa which are mostly local in occurrence. These 684 taxa comprise the most comprehensive listing of wetland plants, both native and adventive, for New Zealand.

Any list of wetland plants is a matter of the compiler's view of the degree of dependence or tolerance that each species shows for survival in wetlands. There would be a large measure of agreement between plant ecologists about the species to appear on such a list, but probably not total agreement between any of them. As an example, Johnson and Brooke (1989) do not list goat's rue (*Galega officinalis*), pampas grass (*Cortaderia selloana* and C. *jubata*), *or* wheki (*Dicksonia squarrosa*), each of which, to me, is a typical inhabitant of certain types of wetland in parts of New Zealand.

2.2 Variability in wetland plants

Every plant species is different; some species obviously need much water continuously, some need intermittent submersion, and others tolerate very little submersion. This range of tolerances of or requirements for wet habitats extends to individuals within a

species. Every plant has a unique range of tolerances to wet and dry conditions, a range which will be somewhat wider for a population of those plants which have resulted from seed and hence contain genetic variation. As an example, Cook *et al.* (1980) showed that some plants of manuka (*Leptospermum scoparium*) live in water-logged soils by producing aerating tissues in their stems and roots. Their offspring are similarly adapted for wetland survival. Manuka plants which cannot produce these tissues are confined to dry ground, and their seedlings die if they germinate in wetlands. Some manuka populations are therefore wetland plants and others are not.

Some wetland plants produce large populations by division or other vegetative means and can be expected to contain little or no genetic variation between individuals in one location. Examples are duckweed, crack willow, and watercress.

Among wetland species and among individuals within a species, a range of tolerances means that some plants will cope better than others with periodic submersion and drying out, low levels of soil aeration and certain nutrients (nitrogen availability is limiting in many wetlands, especially those with low soil pH), water flow, and shading by other plants. Even a seemingly simple factor like "submersion" offers a range of conditions, including how deep, for how long, how frequently, and in what season(s)? Some species which cannot survive for long out of water have seeds which can survive drought to establish a new population when water returns.

Plants of ephemeral wetlands must be capable of surviving extreme conditions of wet or dry, a situation which is similar to that for the inhabitats of intertidal zones but with less predictability in time and magnitude.

2.3 Use of plant lists

The flora (range of species) of any site reflects the history of the site and the physical conditions. For example, two or more wetlands in a district, with similar origins and histories of disturbance, should have similar floras. Comparisons of the floras, and a knowledge of the ecology of individual plant species, can be used to circumvent the need for prolonged studies of physical parameters, such as water levels, which would need to be done over a whole year, and over other years which represent the range of climates experienced at the site.

3. THE STUDY AREAS

3.1 Location

Both study sites might be described broadly as areas of rough boggy pasture which surround pools of water whose levels fluctuate widely. They were located at Awahuri, a site whose wetland nature had been disputed, and at Hamilton's Bend Lagoon, a site whose wetland character was generally accepted.

Hamilton's Bend Lagoon lies near the Manawatu River southwest o£ Longburn. It is well-known locally as a wetland and it appears in the Wildlife Service's national inventory as a Site of Special Wildlife Interest (SSWI). It is listed also in the WERI (Wetlands of Ecological and Representative Importance) database. The Awahuri site is near the Oroua River. It lacks recognition at more than local level and is not considered to be a wetland by resource managers of the Manawatu-Wanganui Regional Council.

4. THE STUDY

4.1 Rationale

The question posed near the start of this paper, "Is the Awahuri site a wetland?", was answered through an assessment of the site's flora and vegetation. My approach was to pose two related sets of questions:

1. Does the flora of Awahuri "match" some agreed list of wetland plants and/or does its vegetation contain wetland plant communities?

2. Do the plants and/or plant communities at Awahuri "match" those at one or more sites which are agreed on other criteria to be "wetlands"?

If the flora and/or vegetation at Awahuri has a high degree of similarity to either the members of some agreed list(s), or to that of some place which is accepted to be a wetland, this would support the view that the Awahuri site is itself a wetland.

4.2 Methods

Each wetland was visited on 12 November 1993 for about two hours, and a full circuit of each was made on foot. Descriptions were made of vegetation types, and a full list of vascular plants was made for each wetland. Notes were made of other features, including the terrain and wildlife.

5. RESULTS

5.1 The Awahuri Site (Cox's)

Partly visible from State Highway 3 some 12 km northwest of Palmerston North, Cox's property at Awahuri contains about 0.75 ha of boggy pasture which usually surrounds a small pond. This wet area lies on a low terrace of the Oroua River, in a shallow channel which leads into that river. All the area is accessible to stock, and the surrounding higher ground supports high quality pasture for cattle. Because water sometimes backed up into a neighbour's property, a shallow drain was re-opened through the wetland in 1993.

At the time of my visit, the open water area was surrounded by a roughly equal area of bare soft silt. A group of pied stilts (*Himantopus himantopus leucocephalus*) and a single black-fronted dotterel (*Charadrius melanops*) were feeding around the edges of the water.

During a full circuit of the pool and boggy pasture I listed all vascular plant species seen, both native and exotic (Appendix 1). The majority of these plants occurred in distinct zones, reflecting differences in the water table and, at the lowest levels, their differences in tolerance to different periods of submersion.

5.1.1 Vegetation The following three plant communities were the most extensive. They are named from the species contributing most cover in each community, and the communities are listed in order, progressing outwards from soft, bare silt (species with the greatest cover are listed first; where the vegetation comprised a tier of tall plants above a tier of ground cover plants, the names are separated, with lower growing plants to the right of "/ "; formal names are listed with common names in Appendix 1):

1. Starwort - *Azolla* - *Centipeda* herbfield
2. *Juncus effusus* - water pepper / floating sweetgrass - kneed foxtail rushland
3. Jointed-leaved rush - floating sweetgrass - creeping buttercup - curled dock herbfield

Wetland grasses and rushes were sparse in the semi-shade of overhanging willow trees. Two hummocks, possibly peaty, and each no more than 2m diameter were surrounded by communities 2 and 3. The hummocks had clumps of *Juncus effusus,* and several native and exotic plant species not seen elsewhere in the area. The most notable was the native sedge, Carex sinclairii (see below).

5.1.2 Flora Twelve indigenous plant species were listed and 26 exotic species (Appendix 1). Only two of these species do not appear in Johnson and Brooke (1989), namely puwha and white clover. For the purposes of this paper, these two are retained as wetland species.

Most of the 38 species are widespread in the Manawatu and beyond, but two of the indigenous species, Carex sinclairii and *Centipeda* minima, are regionally rare and are also indicator species of ephemeral wetlands. For these reasons, their habits, distributions and habitat needs are discussed in detail below.

Carex sinclairii: this sedge has grass-like leaves and forms patches by virtue of its rhizomatous habit. In the North Island it is mostly a plant of mountain wetlands. It is prominent in the Reporoa Bog, "Irirangi Swamp" and numerous other wetlands of the Moawhango Ecological District. Esler (1978) gives its Manawatu locations as "apparently confined to Browns Flat, Kahuterawa Flat, and land adjacent to Forest Hill Road". Moore and Edgar (1970) give its range as "southwards from lat. 38 degrees, usually between 600 and 1500 m altitude, but descending to sea level near Wellington". East of Wellington it forms swards around the edges of Lake Wairarapa and subsidiary ponds with fluctuating water levels (Ogle et al. 1990). 1 found it recently on farmland near Virginia Lake at Wanganui on peaty sand in old dune hollows subject to high water tables in winter.

Centipeda minima: this prostrate native daisy was prominent among the scattered plants on seasonally bared silt around the edges of the pool in Awahuri wetland. Esler (1978) makes no mention of any species of *Centipeda* in the Manawatu. The next nearest site where I have seen this species is Koitiata at the mouth of the Turakina River where it grows on silt deposited by floods.

5.2 Hamilton's Bend Lagoon

Hamilton's Bend Lagoon occupies some 3 ha, and lies in an ox-bow of the Manawatu River, about 6 km southwest of Longburn at the end of Hamilton's Line. The whole wetland is subject to inundation when the Manawatu river is in high flood. Three large floods between the winters of 1988 and 1992 left up to 2 m of silt over this wetland. A deep drain was cut through it in January 1993 (Peter Taylor, pers. comm.) to facilitate land drainage on the inland side of the stop bank which borders the western side of the lagoon.

The area is surrounded by pasture, with willow thickets along parts of the western edge. Much of the eastern side of the wetland had been electric fenced to exclude cattle when I visited on 12 November 1993. During that visit I noted a core area occupied by shallow water with a roughly equal area of bare silt exposed around its fringes. Numerous pied stilts and two black-fronted dotterels were feeding on this silty edge.

5.2.1 Vegetation The fringes of the wetland were walked and a list was made of the vascular plants (Appendix 1). Notes were made on the more extensive plant communities (named as for Awahuri wetland, above).

1. Starwort - parrot's feather herbfield
2. Jointed-leaved rush - kneed foxtail - floating sweetgrass - Mercer grass rush grassland
3. Water speedwell - *Rorippa* spp. / jointed-leaved rush herbfield
4. Willow scrub and treeland

A greater mixture of mostly annual "weeds" was noted near the farm road and on spoil excavated from the drain some nine months previously.

5.2.2 Flora Fifteen indigenous species and 41 adventive species were recorded (Appendix 1). Sixteen of these 56 species do not appear in Johnson and Brooke (1989), and 10 of these 16 species were confined to recently excavated spoil. If they are excluded, the wetland flora comprises 11 indigenous species and 35 adventive species. This list of 46 species retains the following species which were in the wetland proper, but which are not listed by Johnson and Brookes (1989): stinking mayweed, goat's rue, Italian and perennial ryegrasses, puwha, white clover. For the purposes of this paper, these six species are retained as wetland plants.

Because it is regionally rare and is a characteristic plant of ephemeral wetlands, *Glossostigma elatinoides* deserves special mention.

Glossostigma elatinoides: This is a widespread creeping herb of wetlands in New Zealand, particularly on the edges of fluctuating wetlands where other plants are sparse. It is seemingly rare in the Manawatu, however, as evidenced by Esler (1978) who noted it only from "mud on the edge of Kaikokopu Lagoon and on the Manawatu River bed". At Hamilton's Bend Lagoon it grew on the edges of the pool where a shrinking water level had exposed areas of silt.

Hamilton's Bend Lagoon was identified as a Site of Special Wildlife Interest (SSWI) by the NZ Wildlife Service in 1986. It was stated at that time to be "a shallow lagoon that apparently dries out in summer". Two plant species noted in 1986 but not in 1993 were curled pondweed (*Potamogeton crispus*) and duckweed (*Lemna minor*), the former being recorded as >50% cover in water. Raupo may have been more common in 1986 than now.

6. DISCUSSION

6.1 Plant distribution

Awahuri and Hamilton's Bend wetlands share 45% of their species. For Awahuri wetland 68% of the species occur also at Hamilton's Bend; Hamilton's Bend has 57% of its flora in common with Awahuri wetland.

6.2 The shared species

Rather than examine all 26 shared plant species individually, the list has been scanned for some possible trends and comments are made on particular species. Firstly, several of the shared species are those of the wettest habitats. That is, they are plants which are the least tolerant of drying out. These include starwort, floating water fern, bachelor's button, water forget-me-not, willow weed, watercress, and *Isolepis prolifer*. Some of these are known to be carried by waterfowl, either externally (e.g., floating water fern) or as seed (e.g., willow weed).

A number of the remaining shared species are pasture plants which tolerate a wide range of wet and dry conditions, and which are likely to have been sown in or near the wetland and/or reached both wetlands as seed in hay, or by passage through the gut of livestock. This group includes Yorkshire fog, white clover, lotus, dock, and pasture

invading rushes (*Juncus* spp.). Crack willow was planted at Awahuri, but probably established from flood-borne fragments at Hamilton's Bend.

6.3 The exclusive species

6.3.1 Awahuri The presence of *Carex sinclairii* at Awahuri is significant, as it is (now) a regional rarity whose habitat is almost exclusively wetlands with fluctuating water levels. It does not seem to survive mechanical cultivation of its habitat, and it has little or no ability to invade "new" wetlands. On its presence alone, I conclude that Awahuri wetland has been a wetland with varying water levels since before European farming practices were established here.

This view is supported by the presence of *Centipeda minima,* a daisy which is apparently unknown elsewhere in the Manawatu. The seeds of many daisies have a pappus (parachute) of hairs for wind dispersal. This means that daisies tend to occupy any suitable habitat once they are in a district. *Centipeda* species, however, lack this pappus on their seeds, which means that wind dispersal is unlikely and the distribution of *Centipede* will be more limited. *C. minima* is an annual plant and needs bare ground for the establishment of its seeds each year. Bare silt, such as that provided by a wetland subject to periodic submersion, provides such a habitat. The corollary to this is that the presence of *C. minima* at Awahuri supports my view that its habitat is an ephemeral wetland, and that the wetland has been here for a long time.

Some other species at Awahuri but not at Hamilton's Bend are widespread in the region's wetlands, and even appear without human intervention in artificially constructed wetlands. These species include the native water milfoil and the exotic celery-leaved buttercup, marsh bedstraw and *Ludwigia palustris.* Their absence from Hamilton's Bend Lagoon may simply be that they were temporarily eliminated from that site by deposits of silt in recent floods.

As noted above, I did not see two other species of wetland herbs noted during the Wildlife Service's survey of Hamilton's Bend Lagoon. They, too, may have been lost under silt.

6.3.2 Hamilton's Bend Lagoon A proportion of the plants present at Hamilton's Bend but not at Awahuri will have arrived in flood waters as seeds or plant fragments from other parts of the Manawatu River catchment. The following quotes from Ester (1978) show that these include *Glossostigma elatinoides* ("on the Manawatu River bed"); parrot's feather ("a major weed in silty waterways in the lower reaches of the Manawatu River"); *Rorippa sylvestris* (in "wet areas mostly close to the Manawatu River"); and water speedwell ("appears on occasions on the Manawatu River bed"). Other flood home species probably include *Rorippa palustris*, stinking mayweed (like *Centipeda,* the mayweeds are daisies whose seeds lack a pappus to aid wind dispersal), goat's rue, Mercer grass, monkey musk and *Cyperus eragrostis.*

The larger size of Hamilton's Bend Lagoon as compared with Awahuri wetland and, perhaps, its elongated shape should provide more opportunities for species to establish. Plants with wind carried seeds are more abundant at Hamilton's Bend, and include

woolly cudweed, two species of native fireweeds, gravel groundsel, prickly sowthistle, willowherb, purple cudweed, catsear, and raupo, all of which are absent from the Awahuri wetland.

Both golden willow and osier may have been planted at Hamilton's Bend lagoon. Alternatively they are capable of arriving as seed or fragments in floods, because Esler (1978) notes that both have been planted beside the region's waterways.

7. IS "AWAHURI WETLAND" A WETLAND?

The study of the Awahuri site and Hamilton's Bend Lagoon revealed the following:

1. 95% of the species at Awahuri feature in the wetland plant list of Johnson and Brookes (1989); 87% of plants of wet land at Hamilton's Bend appear in the same list.
2. 68% of the plant species at Awahuri occur in the Hamilton's Bend Lagoon.
3. Plant species which are shared include some of those most dependant upon very wet conditions.
4. The larger flora of Hamilton's Bend results more from easier access for plants and disturbance which aids their establishment at Hamilton's Bend (e.g., periodic floods in the Manawatu River) than from differences in wetland habitats.
4. The Awahuri site has at least two native wetland plant species which must have survived on the site for a very long period (possibly pre-dating European settlement); one of these (*Centipede*) requires bare substrate each year, indicating that the Awahuri site has fluctuating water levels.
5. Vegetation types at Awahuri were similar to some of those at Hamilton's Bend, although the latter had a greater range of types.

It is noted in support of the above botanical observations that during the inspection of Awahuri and Hamilton's Bend sites on 12 November 1993, the same species of wetland wading birds were seen on both sites, viz. pied stilt and black-fronted dotterel.

8. CONCLUSIONS

The Awahuri and Hamilton's Bend sites examined on 12 November 1993 are so similar in their floras and vegetation (and avifauna, to the degree that it was noted) that the recognition of the Hamilton's Bend Lagoon as a wetland must lead to the conclusion that the Awahuri site is also a wetland. This is supported by the fact that 95% of the Awahuri site's flora appear in a national listing of wetland plants.

Intrinsic aspects of the flora at the Awahuri site support the view that the wetland has existed for a long time. The areas of surface water in both wetlands fluctuate widely and are reduced to small pools in dry years; the periodically submerged parts of the sites can be termed ephemeral wetlands.

9. CONSEQUENCES FOR MANAGEMENT

Periodic fluctuations in water level contribute in large measure to the biological interest and importance of the sites in this study. If water levels were to be stabilised, the wetlands' characteristics would change and at least some species of both plants and animals would disappear. No harm is caused if water fluctuations lead to a total absence of surface water in parts of some years or, indeed, every year, provided inundation occurs periodically as well, to eliminate plants of drier habitats which would establish in temporarily dry sites.

Further examples of ephemeral wetlands undoubtedly exist in the Manawatu region, on sites which have not been identified as wetlands to date. Floristic studies of each could be used to establish degrees of similarity between them and the two which were part of this study.

Any listing of the region's wetlands must recognise that significant ephemeral wetlands will be discovered in seemingly unpromising sites, and such a list must always be open to additions.

10. ACKNOWLEDGEMENTS

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11. REFERENCES

Cook, J.M., Mark, A.E, Shore, B.E 1980. Responses of *Leptospermum scoparium* and *L.ericoides* (Myrtaceae) to waterlogging. *New Zealand Journal of Botany* 18: 233-46.

Esler, A.E. 1978. Botany of the Manawatu District, New Zealand. Government Printer, Wellington. 206p.

Johnson, P.N., and Brooke, P.A. 1989. Wetland plants in New Zealand. DSIR Publishing, Wellington. 319p.

Moore, L.B., and Edgar, E. 1970. Flora of New Zealand. VoL2. Government Printer, Wellington. 354p.

Ogle, C. C. 1991. When is dryland wetland? *Forest and Bird* 22(3): 46-49.

Ogle, C.C., Moss, TC., Druce, A.P. 1990. Vascular flora of Lake Wairarapa and its adjacent wetlands. *Science and Research Series No. 20.* Department of Conservation, Wellington. 24p.

Stephenson, G. 1986. Wetlands. Discovering New Zealand's shy places. Government Printing Office, Wellington. 117p.

APPENDIX 1
Vascular plants of wetlands near Awahuri[1] and Longburn[2], two Manawatu wetlands with fluctuating water levels

Colin Ogle and Peter Taylor
(Surveyed on 12 November 1993)

Key to symbols

*	denotes adventive species
x	present, but rare in this wetland
X	occasional to abundant in this wetland
+	species confined to spoil dug from drain in wetland '2'

Genus/species	Common name	Presence in	
		1	2
Trees and shrubs			
**Salix alba* var. *vitellina*	golden willow		X
**S fragilis*	crack willow	X	X
**S viminalis*	osier		X
Dicot herbs			
**Anagallis arvensis*	scarlet pimpernel		x+
**Anthemis cotula*	stinking mayweed		X
**Callitriche stagnalis*	starwort	X	X
Centipeda minima		X	
Cotula coronopifolia	bachelor's button	X	X
Epilobium pallidiflorum	willow-herb		x
**Galega officinalis*	goat's rue		X
**Galium palustre*	marsh bedstraw	X	
Glossostigma elatinoides			x
Gnaphalium involucratum	cudweed	X	
**G. purpuream*	purple cudweed		X+
**Hypochoeris radicata*	catsear		x+
**Lolium multiflorum*	Italian ryegrass		x
**L. perenne*	perennial ryegrass		x
**Lotus pedunculatus*		x	X
**Ludwigia palustris*		X	
**Lythrum hyssopifolia*	hyssop loosestrife		X
**Mentha pulegium*	pennyroyal	X	
**Mimulus guttatus*	monkey-musk		X
**Myosotis laxa*	water forget-me-not	X	x
**Myriophyllum aquaticum*	parrot's feather		X
M propinquum	water milfoil	X	
**Polygonum hydropiper*	water pepper	X	
P. salicifolium	willow-weed	X	X
Pseudognaphalium sp. [unnamed; *P. luteo-album* agg.]	woolly cudweed		X+

1 Near Awahuri Hotel, in hollow which drains into Oroua River, NZMS260 523/23701

2 Hamilton's Send, Manawatu River, at end of Hamiltons Line, Tiakitahuna, south-west of Longburn; NZMS260 524/215843

Genus/species	Common name	Presence in	
		1	2
Dicot herbs (continued)			
Ranunculus amphitrichus	waoriki	x	
**R. repens*	creeping buttercup	X	X
**R. sceleratus*	celery-leaved buttercup	X	x
**Raphanus raphanistrum*	wild radish		x+
**Rorippa nasturtium-aquaticum*	2-row watercress	x	X
R palustris			x
**R. sylvestris*			X
**Rumex crispus*	curled dock	X	X
**Sagina procumbens*	pearlwort	x	x
Senecio glomeratus	fireweed		X+
S. minimus	fireweed		x+
**S. skirrhodon*	gravel groundsel		X+
**Sonchus asper*	prickly sowthistle		x+
**S. oleraceus*	puwha, sowthistle	x	x
**Trifolium repens*	white clover	x	x
**Veronica anagallis-aquatica*	water speedwell		X
Monocot herbs			
**Agrosds stolonifera*	creeping bent	X	X
**Alopecurus geniculatus*	kneed (oxtail	X	X
**A. pratense*	meadow foxtail	x	
Carer sinclairii		x	
**Cyperus eragrostis*			x
Eleocharis acuta	sharp spike sedge	x	X
**Festuca arundinacea*	tall fescue		x
**Holcus lanatus*	Yorkshire fog	x	x
lsolepis prolifer		x	x
**I. sepulcralis*		x	
**I. setacea*		x	
**Juncus articulates*	jointed leaved rush	X	X
**J. bufonius*	toad rush	X	X
**J. effusus*		X	X
J. gregiflorus		X	x
**J. microcephalus* (?)			X
J. sarophorus		x	X
**J. tenuis*			x
**Paspalum distichum*	Mercer grass		X
**Poa annual*	annual poa	x	X
**P. palustris* and/or *P. trivialis*		X	X
Typha orientalis	raupo		x
Ferns			
Azolla filiculoides ssp. *rubra*	floating water fern	X	X
Hypolepis ambigua			x+
Sub totals	Indigenous	12	15
	Exotic	26	41
TOTALS		**38**	**56**[3]

[3] Or 46, if species confined to recent spoil are excluded