Kettle tarn vegetation, Lake Coleridge area

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1. Introduction

This report is a contribution to studies on the use of herbicides for selective control of weeds in wetlands, a field trial extension of earlier pot-based trials (Champion 1998). Included among the trial vegetation types are the low-stature, floristically-rich turf communities of tarn margins, especially well-developed around kettle depressions upon moraine landforms.

My involvement was sought by the Department of Conservation, to assist with the recognition and naming of turf plants, to document the flora, explain kettle vegetation processes, help with the placement of trial sites, and to comment on possible impacts of the trials.

Field observations were made on 7 December 1998 in the company of Andrew Townsend, DOC, Wellington, and Paul Champion, NIWA, Hamilton. We spent the morning at Lake Lyndon and the very windy afternoon at the Mt Barker tarns.

2. Study sites

Lake Lyndon, just west of Porters Pass on the West Coast Road, occupies a valley head depression, in effect at the southernmost end of the Castle Hill basin. The lake itself is c. 3 x 0.5 km, and the shore exposed by relatively low summer lake levels has patches of lake-edge turf in a matrix of gravelly ground, partly vegetated by weedy colonist herbs. The north end of Lake Lyndon, a lobe now separated from the main lake by a causeway, has a marked fluctuation in level. When full of water this lobe, centred on map reference K35/ 050 680, at 840 m altitude, is 600 x 300 m, but at the time of our visit it held no ponded water. Vegetation and flora are briefly described in a report by Johnson (1992).

The Mt Barker tarns lie on moraine landforms 2-3 km south-east of Lake Coleridge, centred about map reference K35/ 965 595, around 600 m altitude. Aspects of their vegetation are described by Haines (1995). The tarn numbering system used by him, and based on Glenny et al. (1987), is referred to below.

Small lakes and tarns that occupy depressions in the undulating surfaces of old moraines often have no inflowing surface streams, nor a surface outlet. The term kettle is used for such depressions formed by the collapse and melt of underlying ice at a time of glacier disintegration and retreat. Fluctuations in ground water, which occur between seasons and to different degrees from one year to another, lead to marked concentric zonation patterns of shore vegetation, with the most aquatic vegetation in the base and an upslope sequence of turf zones having decreasing flood-tolerance. In inland Canterbury the uppermost water level, possibly reached only once every few years,

is marked by the distinct line of the lowermost elevation limits of hard tussock *(Festuca novae-zelandiae)*. Our observations and record of flora and vegetation is confined to the turf vegetation below this apparent uppermost water level.

3. Results

3.1 VEGETATION PATTERN, NORTH END OF LAKE LYNDON

Six concentric zones of turf vegetation were visually apparent, spanning the approximately 2 m vertical extent and 150 - 300 m radial distance from the base to the perimeter. Cover of predominant plants was estimated for each zone (Table 1). In summary, they are:

Zone 1: across damp silty base, mainly *Lilaeopsis ruthiana.*

Zone 2: slightly damp but firm silt, almost fully vegetated, mainly *Juncus pusillus*.

Zone 3: similar substrate, *Alopecurus geniculatus* and *Neopaxia* sp. dominant.

Zone 4: mainly gravel and dry silt with both native and weedy colonist species.

Zone 5: an extensive dry turf zone, mainly *Leptinella maniototo* and *Galium perpusillum*.

Zone 6: perimeter of dry turf with many naturalised spp., especially *Anthoxanthum odoratum* and *Hypochoeris radicata.*

3.2. VEGETATION PATTERN, MT BARKER TARNS

Four tarns were visited:

"Number 3" at map reference K35/ 964 594: a steep-sided tarn, 40 m long, full of water and with virtually no marginal turf communities exposed.

"Numbers 5 & 6", The Twins, at 968 595, each c. 10 m across. The western tarn of the adjacent pair has a narrow turf margin and is accessible to the livestock, the typical situation for most kettles in pastoral country. The eastern twin tarn has a surrounding livestock exclosure fence - part of the Haines (1995) study - and demonstrates how in the absence of grazing, a dense grass sward, in this case sweet vernal *(Anthoxanthum odoratum),* can greatly reduce the predominance of low-growing turf plants.

"Number 7" at 966 595, a tarn c. 30 x 15 m across, appeared to be the most suitable of the Mt Barker tarns visited for herbicide trials, in having a well-exposed perimeter of turf zones.

Cover of predominant plants was estimated for each zone in tarn 7 (Table 2). In summary, they are:

Zone 1: ponded water, partly covered with floating sweetgrass *(Glyceria declinata).*

Zone 2: shallow water aquatics, mainly *Myriophyllum propinquum* and *Glossostigma diandrum*.

Zone 3: a zone of moist turf, 2 m in width, above the observed water line, mainly *Glossostigma* and *Pratia perpusilla.*

Zone 4: a zone of firm turf, 1 m wide, having numerous co-dominant species.

Zone 5: uppermost zone, again 1 m wide, characterised by sweet vernal and *Nertera setulosa.*

3.3 FLORA

All plant species recorded from Lake Lyndon and from several of the Mt Barker tarns are listed in Table 3, with an indication of their abundance at each area.

4. Discussion

4.1 SUITABILITY AND REPRESENTATIVENESS OF TRIAL SITES

At the time of field inspection our consensus was that the northern lobe of Lake Lyndon, and tarn 7 of the Mt Barker tarns appeared to be the most suitable in the respective locations for placement of a series of 1-metre square herbicide trials quadrats. The Lake Lyndon site offers large expanses of uniform vegetation types, and Mt Barker tarn 7 a lesser but adequate extent, and at least uniformity of vegetation sequence laterally along the shore. Both sites offer situations of numerous plant species, both native and naturalised, growing together within small areas. The vegetation composition and pattern of both trial sites is typical of inland South Island tarn and lake edge turf vegetation in general, a relevant point for purposes of extrapolating the herbicide trial results to wetland weed management at other comparable locations.

4.2 POSSIBLE IMPACTS OF HERBICIDE TRIAL MANIPULATIONS

Quite obviously, herbicides kill plants, and the trial plots will result in deaths of some or all plants in the 1 x 1 m quadrat trial plots. I am unable to comment on whether application of any of the trial herbicides would have any impacts on adjacent vegetation, soil, seed banks, groundwater or downslope aquatic communities. But it would appear most likely that the main impact would be temporary death of vegetation in turf areas that represent just a fraction of the total area at each site. Recolonisation of treated quadrat sites is likely to occur quite readily, given the availability of seed, vegetative fragments, or rhizomatous invasion immediately adjacent. Furthermore, this type of wetland turf vegetation does have an inherent ability to recover from repeated disturbances, especially from the seasonal alternation between being submerged and dewatered, as well as from factors such as silt deposition, erosion by wind and waves, and being grazed and excereted upon by water birds and mammals.

The threatened plant *Iphigenia novae-zelandiae,* categorised as "Vulnerable", is present at Mt Barker tarn 7. Trial quadrat placement should avoid those more dense aggregations of this species.

5. References

Champion, Paul D. 1998. Selective control of weeds in New Zealand wetlands using herbicides. *NIWA Client Report:* DOC80220. 25 pp.

Glenny, D., Fry, C., Stout, VM., Burrows, C.J. 1987. A biological survey of the lakes and other wetlands of the University Endowment land at Lake Coleridge 1984-1985. University of Canterbury, Christchurch.

Haines, Michael. 1995: The Mt Barker ephemeral tarns - a wetland "management experiment". Centre for Resource Management, Lincoln University. Report to Department of Conservation. 66 pp.

Johnson, P.N. 1992: Canterbury lakes and kettleholes: botanical report. Unpublished report, Landcare Research. 20 pp.

Table 1. Estimated percent cover of predominant plants in six turf vegetation zones from the base (zone 1) to the perimeter (zone 6) of the northern wetland depression of Lake Lyndon, Canterbury. * indicates naturalised species.

Turf zone:	1	2	3	4	5	6
bare ground	25	2	15	90	0	0
Lilaeopsis ruthiana	20	15				
Eleocharis pusilla	15					
Crassula sinclairii	20	10	10			
Pratia perpusilla	20	20				
Juncus pusillus		30	10			
Eleocharis acuta		5				
Potamogeton cheesemanii		2				
Leptinella maniototo		10	5		25	
**Alopecurus geniculatus*		5	20			
Neopaxia sp.			15			
* *Trifolium repens*			5		20	10
Epilobium angustum			5	2	10	2
Agrostis muscosa			5	2		
* *Sagina procumbens*			5			
Pseudognaphalium sp.			2			
* *Spergularia rubra*			2	2		
* *Rumex acetosella*				2	5	
* *Cerastium fontanum*				1		
Poa lindsayi				1		
Epilobium microphyllum				1		
Galium perpusillum					25	5
**Juncus tenuis*					10	
* *Trifolium dubium*					2	10
**Anthoxanthum odoratum*					2	25
* *Hypochoeris radicata*						25
* *Cirsium arvense*						5
* *Hieracium pilosella*						5
* *Taraxacum officinale*						5
Rumex flexuosus						5

Table 2. Estimated percent cover of predominant plants in five vegetation zones from the central pool (zone 1)-to shallow water (zone 2) up through marginal turf zones 3 to 5 at "tarn 7" of the Mt Barker tarns, east of Lake Coleridge, Canterbury. * indicates naturalised species.

Vegetation zone:	1	2	3	4	5
* *Glyceria declinata*	50				
Myriophyllum propinquum		30			
Glossostigma diandrum		30	25		
Pratia perpusilla		20	25	10	
**Alopecurus geniculatus*		10	15		
Potamogeton cheesemanii		10			
Carex gaudichaudiana			15	10	
Eleocharis acuta			10		
**Juncus articulatus*			5		
Plantago triandra			2	10	
Epilobium angustum			2	10	
Hydrocotyle hydrophila			2		
Stackhousia minima				10	5
Galium perpusillum				10	
Deschampsia novae-zelandiae				10	
Gonocarpus micranthus				10	
Hypericum japonicum				5	
Hydrocotyle microphylla				5	
**Anthoxanthum odoratum*				2	30
Dichondra brevifolia				2	
Schoenus concinnus				2	
* *Hieracium pilosella*				2	5
* *Trifolium repens*				2	2
Gnaphalium traversii				1	15
Nertera setulosa					15
Coprosma atropurpurea					10
Cyathodes fraseri					5
Microtis oligantha					5
* *Hieracium praealtum*					2

Table 3. Flora of lake and tarn wetland margins, Lake Lyndon and Mt Barker tarns, Canterbury.

Key to sites:
L. Lake Lyndon
B. Mt Barker tarns

Key to symbols:
* naturalised, not native
a abundant
f frequent
o occasional
r rare

Sites:	L	B
MONOCOTS		
**Agrostis capillaris*	o	o
A. muscosa	f	r
**Aira caryophyllea*	-	r
**Alopecurus geniculatus*	a	a
**Anthoxanthum odoratum*	f	a
Carex breviculmis	r	-
C. coriacea	-	o
C. decurtata	o	-
C. gaudichaudiana	-	f
**C. ovalis*	r	r
Deschampsia novae-zelandiae	-	o
Eleocharis acuta	o	o
E. pusilla	o	-
**Elodea canadensis*	o	-
Festuca novae-zelandiae	f	f
**Glyceria declinata*	a	o
**Holcus lanatus*	o	r
Iphigenia novae-zelandiae	-	f
Isolepis aucklandica	r	-
**Juncus articulatus*	o	o
**J. bufonius*	r	r
**J. effusus*	-	o
J. pusillus	f	o
**J. tenuis*	o	-
Luzula picta	-	o
L. rufa	r	-
Microtis oligantha	o	o
M. unifolia	r	r
**Poa annua*	f	r
P. lindsayi	f	-
Potamogeton cheesemanii	o	f
Schoenus concinnus	-	o
S. pauciflorus	-	o

Sites:	L	B
HERBACEOUS DICOTS		
Acaena inermis	r	-
**Achillea millefolium*	r	-
**Anagallis arvensis*	o	-
**Arenaria serpyllifolia*	a	-
Callitriche petriei	-	o
Cardamine corymbosa	r	-
Celmisia graminifolia	-	o
Centella uniflora	-	r
**Cerastium fontanum*	o	r
**Cirsium arvense*	o	-
**C. vulgare*	o	-
Colobanthus strictus	r	-
Crassula sinclairii	f	r
Dichondra brevifolia	-	r
**Echium vulgare*	r	-
Epilobium angustum	f	f
E. brunnescens	-	r
E. microphyllum	r	-
**Erodium cicutarium*	f	-
Galium perpusillum	a	a
Glossostigma diandrum	f	f
Gnaphalium traversii	r	o
Gonocarpus micranthus	f	f
Helichrysum filicaule	-	r
**Hieracium pilosella*	r	f
**H. praealtum*	r	o
Hydrocotyle microphylla	o	o
H. sulcata	-	o
Hypericum japonicum	-	f
**Hypochoeris radicata*	o	r
Leptinella maniototo	a	r
Lilaeopsis ruthiana	o	o
Limosella lineata	o	-
**Linum catharticum*	o	o
**Myosotis discolor*	r	-
**M. laxa subsp. caespitosa*	-	o
M. pygmaea var. minutiflora	o	-
Myriophyllum propinquum	o	f
M. triphyllum	o	-
Neopaxia sp.	f	-
Nertera setulosa	-	f
**Ornithopus perpusillus*	r	-
Oxalis exilis	r	r

Sites:	L	B
Parahebe canescens	o	-
**Plantago lanceolata*	o	-
**P. major*	o	-
P. triandra	-	f
**Polygonum persicaria*	r	-
Potentilla anserinoides	r	o
Pratia angulata	-	o
P. perpusilla	o	f
**Prunella vulgaris*	f	o
Pseudognaphalium sp.	r	-
Ranunculus reflexus	-	o
Rorippa palustris	-	f
**Rumex acetosella*	o	o
R. flexuosus	o	o
**Sagina procumbens*	r	r
Scleranthus uniflorus	r	-
**Spergularia rubra*	f	-
Stackhousia minima	-	f
**Taraxacum officinale*	f	-
**Trifolium arvense*	o	-
**T. dubium*	f	o
**T. repens*	f	o
**Tripleurospermum inodorum*	r	-
**Verbascum thapsus*	o	-
**Veronica serpyllifolia*	f	o
**Viola tricolor*	r	-
SUB-SHRUBS		
Coprosma atropurpurea	o	o
Cyathodes fraseri	r	f
Muehlenbeckia axillaris	o	-
FERN		
Ophioglossum coriaceum	-	f