CANTERBURY KETTLES AND OTHER EPHEMERAL WETLANDS: COLLECTION CENTRES FOR NATIVE PLANT DIVERSITY

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INTRODUCTION

Greetings to all 'Bot Soccers' and other botanists on this occasion of the 50th anniversary of the Canterbury Botanical Society. Long live botany.

About the time the Society started, a little book was published: On the Level, Mostly Canterbury Poems, by William Hart Smith (1950). One of my favourites is called Cave Paintings, which starts:

"*I take my cave wall with me ... in a hip pocket,*
the book curved in on me while sitting
and thinking ....."

And this got me thinking about a certain cave wall, somewhere in inland Canterbury, where one of the earliest people painted a cave wall to record a great legend.

Once there was a sky, so full of birds as to partly obscure the sun. From the sky it was easy for the birds to find the green hollows and little ponds: places where the birds concentrated in great numbers to rest and roost, honk and preen, shed feathers and drop droppings, graze and peck and trample. Here too, and only here, the bird numbers were matched by the multitude of tiny plants.

Our cave painter knew that things would change. Many of the birds would become extinct. Many of their companion turf plants would become rare. But he left us with two precious symbols of these life forms, cave-wall images he knew would be persistent as reminders of what had gone before. His son putangitangi; *Tadorna variegata*; Paradise Shelduck; the parry duck, or (would you believe this name) Rangitata goose, which, as we all know, is still with us, even in harvestable populations. And his daughter: *Leptinella maniototo*; one of the gems of the bird turfs; she still grows wild around the inland ponds and

lakes, and she is nurtured also in those manicured cotula turfs where modern people play bowls and croquet.

DEFINITIONS

What is turf?

Turf is a vegetation structural type of low stature (generally < 3 cm tall) of mainly herbaceous vascular plants forming a ground-hugging and often dense carpet of intertwined plants, usually with numerous species growing together. Telling one turf species from another can be difficult, especially when flowers or fruits are not present. The close resemblance, even between genera is illustrated by *Limosella lineata* and its look-alike *Ranunculus limosella*. Turf plants can be either tufted or creeping. Their leaf shape tends to be either pinnatifid, linear, or spathulate: I call them the 'knife-fork-and-spoon' plants. The best place to find turf in Canterbury is in kettles.

What are kettles and how are they formed?

Kettles (or kettle-holes) are depressions, often bowl-shaped, formed among glacial deposits at a time of glacial retreat. They occur along lateral moraines, but more often in terminal moraines. At the onset of a glacial retreat a valley glacier ceases to deliver its transported load of rocks, gravels, and silts to the former snout. As surface fissures, channels, and glacier lakes expand and deepen, rocks and stones tumble in from their steep sides to accumulate as basal heaps and lines. Final melting of the last detached blocks of stagnant ice lowers the former glacier surface to a level below that of the adjacent accumulated heaps, thus forming kettles. These commonly lack a surface drainage outlet, so are capable of holding water, either as permanent or ephemeral ponds.

You can see kettles being formed today at the snouts of the Fox, Mueller, and Hooker Glaciers. At the youngest stage they are lined with fine silt (glacial flour), and unvegetated.

The Blue Lakes on the Tasman Glacier are nestled between moraine ridges that are around 800 to 600 years old, and these have the start of a vegetation cover of aquatic plants and marginal turf. Much older kettles, dating from the end of the last glaciation around 12 000 to 14 000 years ago, can be readily seen at the down-valley ends of Lakes Ohau and Coleridge, and in greatest diversity on the Glenmore moraines, west of Lake Tekapo. Over thousands of years, wind-carried loess has added to the depth of their silty bases, and a subsurface hard pan helps them to retain ponded water during the wet months of winter and

spring. As water level drops gradually, distinct zones of plant communities become apparent. This is good territory for 'hands-and-knees botany'!

Kettle turf zones

A typical kettle zonation sequence in Canterbury would include the following species:

- Zone A aquatic in permanent shallow water: *Potamogeton cheesemanii, Myriophyllum propinquum, Glossostigma elatinoides.*
- Zone B muddy ground near kettle bases, exposed by late-season drop in water level: *Glossostigma elatinoides, Crassula sinclairii, Lilaeopsis ruthiana, Isolepis aucklandica, Myriophyllum pedunculatum.*
- Zone C low-elevation zone of dense turf: *Isolepis aucklandica, Plantago triandra, Hydrocotyle hydrophila, Hypsela rivalis, Carex gaudichaudiana.*
- Zone D middle zone of dense turf: *Galium perpusillum, Epilobium angustum, Pratia perpusilla, Selliera radicans.*
- Zone E uppermost zone of dense turf, abutting onto tussock grassland: *Poa lindsayi, Polytrichum juniperinum, Agrostis capillaris, Gnaphalium luteo-album* var. *compactum, Leucopogon fraseri, Stackhousia minima.*

Kettles as a type of ephemeral wetland

Kettles are found only on glacial substrates, but depressions with similar turf vegetation occur also upon a range of substrates and landforms, including sand dune hollows, volcanic ash deposits, bedrock depressions, abandoned stream and river channels, landslide surfaces, and some man-made habitats.

Despite their very widespread yet scattered occurrence through New Zealand, these closed depression habitats have the unifying features of tending to occur in climates where seasonal variation in rainfall and evaporation encourages ponding in winter and spring, alternating with a dry or even a drought phase in summer months or in dry years. Water source is mostly groundwater. Soils are of mineral rather than organic matter, and subsoils are typically gleyed, a feature which helps to maintain a perched water table for part of the year. Because of the marked seasonal alternation between being ponded and dried, these habitats can be termed ephemeral wetlands, and their distinctive combination of substrate and hydrological factors warrants their being recognised as a distinctive wetland class, alongside bog, fen, swamp, marsh, seepage, shallow water, pakihi and gumland, and saltmarsh (Johnson and Gerbeaux in press).

THE FLORA OF EPHEMERAL WETLANDS

The flora associated with New Zealand ephemeral wetlands is very large: 419 native and 171 naturalised plant taxa (Johnson and Rogers 2002). Ephemeral wetlands contain 20.6% of named taxa of native flowering plants. This is despite the extremely limited area of ephemeral wetland habitat. Many unnamed plants also occur in ephemeral wetlands.

Native plants of turf stature total 295 taxa. 207 of these are facultative, that is not wholly confined to ephemeral wetlands, but 88 are obligately so. Many genera contribute a large number of species to the native turf flora, notably *Carex* (17 taxa), *Epilobium* (14), *Ranunculus* (14), *Euchiton* (11), *Crassula* (9), *Isolepis* (8), *Hydrocotyle* (8), *Leptinella* (6), *Luzula* (6), *Gunnera* (5), *Mazus* (4), *Juncus* (4), *Plantago* (4), *Schoenus* (4), *Galium* (4), *Eleocharis* (3), *Glossostigma* (3), *Myriophyllum* (3), *Pratia* (3), and *Viola* (3).

Freshwater turf provides a principal habitat for several plants that are represented in New Zealand by just a single species, e.g. those belonging to *Centella, Elatine, Hydatella, Iphigenia, Liparophyllum, Myosurus, Potentilla, Sebaea, Stackhousia*, and *Tetrachondra*. Turf is the principal habitat for all New Zealand taxa of *Hypsela* (2 taxa), *Lilaeopsis* (2), *Glossostigma* (3), *Gratiola* (2), and *Limosella* (?3).

Many genera are represented among turf plants by one or more distinctively small species, very often the tiniest New Zealand members of their genus, notably: *Acaena rorida, Agrostis muscosa, Brachyscome linearis, Cardamine* "tarn", *C. lacustris, Carex rubicunda, Centrolepis minima, Crassula multicaulis, C. peduncularis, C. sinclairii, Dichondra* cf. *brevifolia, Eleocharis pusilla, Epilobium angustum, E. komarovianum, Euchiton ensifer, E. paludosus, Galium* sp. cf. *perpusillum, Hydrocotyle hydrophila, H. sulcata, Hypericum japonicum, H.* sp. aff. *japonicum, Isolepis basilaris, I. caligenis, Juncus pusillus, Leptinella maniototo, Microtis oligantha, Myosotis pygmaea* vars., *Myriophyllum votschii, Ourisia modesta, Parahebe canescens, Plantago triandra, Poa lindsayi, Pratia perpusilla, Ranunculus limosella, R. recens* var. *lacustris, Rytidosperma australe, R. pumilum*, and *Schizeilema cockaynei*.

THREATS

What about threatened plants?

Sixty-two taxa of turf plants are classed as threatened or uncommon. That is 12.1% of New Zealand's total. These high numbers and proportions are not surprising when we consider that ephemeral wetland turfs hold 20.6% of all the

native flowering plants. But what is most notable for both the total flora and the threatened/ uncommon flora is that these plants occur in or are restricted to a habitat type that makes up an extremely small proportion of our total land area. Some of the rarities are regional endemics but most are relatively widespread. Notable examples of threatened plants of Canterbury ephemeral wetlands are *Crassula peduncularis, Gratiola nana, Iphigenia novae-zelandiae, Isolepis basilaris, Ranunculus ternatifolius*, and *Triglochin palustris*.

Threats to ephemeral wetlands

In one sense the turf communities of kettles and other ephemeral wetlands are quite resilient. They cope with grazing by birds, sheep, and rabbits, and with a certain degree of animal trampling, at least by sheep, though the wetter portions of substrate are very vulnerable to being churned by larger animals, especially cattle. Off-road vehicles have a similar impact. Broader threats to ephemeral wetland systems come from alterations to the water regime, physical modification of the landscape, and land development or intensification of productive land uses such as agriculture, horticulture, and forestry. Many naturalised plants occur within turf communities without appearing to replace native plants, but some weedy grasses, sedges, and rushes do have the ability to form dense swards, overtopping and replacing smaller turf plants, especially in situations where sheep grazing has ceased. Examples of such sward weeds in Canterbury are *Agrostis* spp., *Alopecurus geniculatus, Carex ovalis*, and *Juncus articulatus*. And of course for every weed species we are familiar with, there is another waiting somewhere in the wings for the opportunity to display its prowess. Mat grass (*Nardus stricta*) has been known from the western side of Lake Pukaki for some decades; it is now starting to show a tendency to become dominant in the wet moraine hollows in the Pukaki Scientific Reserve.

HOW SPECIAL ARE KETTLES, OTHER EPHEMERAL WETLANDS, AND THEIR TURFS?

Kettles occur on both sides of the Southern Alps. Under high rainfall of the West Coast most kettles hold bogs or swamps rather that ephemeral wetlands. East of the Alps kettles occur on large moraines at scattered localities from Marlborough to Southland, but Canterbury has the best examples, and some of the extensive ones are now protected, notably by covenants on the Ohau and Glenmore moraines. Ephemeral wetlands are special places throughout New Zealand, especially from a botanical perspective for the vast number of plant species they contain. Why is it that these habitats have vegetation of such dwarfed turf stature, and why does it comprise so many species, converged from many genera and families? Have these turfs evolved in response to grazing by birds? Remember that New Zealand was once a wonderful bird land, with bird

species rather than mammals as the grazing fauna. Many of our grazing birds, are now extinct, including inhabitants of wetlands such as species of duck, goose, and swan (Worthy and Holdaway 2002).

Ephemeral wetlands do occur in other lands. In the Northern Hemisphere ephemeral wetlands of closed depression are known by various names, such as vernal pools or prairie potholes in North America, or turloughs in Ireland. But the vegetation at the dewatered stage of those Northern Hemisphere sites seems mainly to be of taller-growing herbs, sedges, and grasses; often annuals, and including many of species which we know as wetland weeds in New Zealand. Are the floristically rich turf communities something special to New Zealand? Certainly there are similar turfs on lake margins in South America and Australia. But it does appear that they are especially well-developed in New Zealand, and for that we may well thank the birds.

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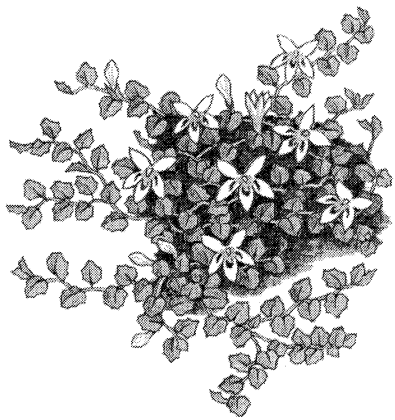

Hypsela rivalis (Lobeliaceae) – one of the extraordinarily diverse number of species characteristic of periodically inundated turfy hollows, such as kettlehole depressions. (del. Hugh Wilson)