KUIRAU PARK AND SULPHUR BAY

Sarah M. Beadel

An enthusiastic group of fifteen set out on a fine day at the start of August to explore some of the geothermal areas of Rotorua City. We started at Kuirau Park and then moved to Sulphur Bay in the afternoon.

Geothermal activity in the Bay of Plenty Region is concentrated in the Rotorua Lakes Ecological District. There are nine geothermal fields in the ecological district, and one of the largest of these is the Rotorua geothermal field which underlies much of Rotorua City and the southern margin of Lake Rotorua. It is one of the two best known geothermal fields in New Zealand (the other is Wairakei). The natural features of the field, particularly the geysers and hot springs of Whakarewarewa, have a long history as a major New Zealand tourist attraction. Whakarewarewa has the largest remaining concentration of geysers in New Zealand, and Rotorua has also been known as a spa centre.

Over the years more than 900 shallow wells have been drilled to provide hot water and heating for private homes, hospitals, schools, motels, hotels, and other commercial and industrial uses. At peak use, around 430 wells were operating (Cave *et al*. 1993).

Although Whakarewarewa is the major area of thermal activity associated with the Rotorua field, thermal features are also found at Kuirau Park, Government Gardens, Ohinemutu, and Sulphur Point. A number of even more distant features are also probably associated with the field. There is a hot spring on Mokoia Island and several warm springs used to be present at Lake Rotokawa.

Most of the present day thermal vegetation is shrubland dominated by prostrate kanuka, manuka, mingimingi, and kanuka. A few small remnant examples of thermal wetland vegetation remain and it is likely that this type of vegetation was more extensive prior to European settlement.

There has been a substantial reduction in the extent of thermal vegetation in the ecological district, and in the Rotorua geothermal field the effects of clearing, burning and extraction of hot water and heat energy, have combined to reduce thermal vegetation to about 50% of its pre-European extent.

Kuirau Park

Thermal vegetation in Kuirau Park has been reduced to numerous, and in many cases very small narrow fringes around geothermal features in a park-like environment. Most are fenced. Many of the remnants have been planted with indigenous and exotic trees, however the park still retains a distinct indigenous character.

We first explored the south-eastern thermal areas which were generally highly modified with many planted indigenous and exotic trees interspersed with manuka and mingimingi with a few *Carex secta*. A small entanglement of *Gleichenia microphylla* occurs in this part of the Park. Moving to the northwest, we explored one of the larger remnants, which is dominated by manuka with scattered mingimingi, finding *Baumea juncea, Lycopodium cernuum, B. teretifolia, B. arthrophylla*, and *Drosera spathulata.* Two of these species (*B. juncea* and *Drosera spathulata*) are uncommon in the Rotorua Lakes Ecological District.

The geothermal area on the north-east side of the Park comprises active geothermal areas with small lakes surrounded by a mosaic of prostrate kanuka, kanuka and manuka, interspersed with indigenous plantings and local wetland communities, which include *Baumea teretifolia, B. arthrophylla, Isolepis distigmatosa*, *Schoenus maschalinus,* and *Juncus acuminatus.*

Lobelia anceps once occurred naturally in Kuirau Park on the fringes of a hot pool, however recent thermal activity destroyed the natural populations (Clarkson *et al.* 1991). *Lobelia anceps* was subsequently planted by Rotorua District Council in the Park, and one small planted population was observed during the field trip. *Lobelia anceps* is normally confined to coastal or semi-coastal areas, however it is known from several inland sites in the Bay of Plenty region, including a few lake shore localities (Clarkson *et al*. 1991).

An unusual form of the sedge *B. arthrophylla* with flattened culms was observed near several of the thermal pools. This form is known from three geothermal areas in the ecological district; Kuirau Park, Hell's Gate, and Parengarenga Hot Springs. Moore and Edgar (1976) noted that some specimens of *B. arthrophylla* collected by R. Mason (*c.*1963) from lakes near Rotorua were very robust and had flattened leaves and culms.

Several *Hypolepis* colonies caused much discussion as to their identity, however after vigorous debate it was concluded that they were probably all *Hypolepis ambigua*. No sign was seen of *Calochilus robertsonii*, which has been previously recorded in the Park.

The vegetation of Kuirau Park is still under threat from invasion by weeds, ongoing small-scale clearance, spraying during park maintenance, and trampling by visitors.

Sulphur Bay

After lunch we set off from the Plaza Hotel on the walking track east around the head of Sulphur Bay. A shrubby, generally indigenous vegetation which covers a relatively large area around Sulphur Bay comprises manuka and mingimingi with scattered kanuka, turutu, and rarahu. There are several colonies of bamboo, and local pines. In general, as distance from the lake margins increases, exotic species become more common. Radiata pine with distinctive short needles were observed, possibly a result of the "acid rain" effects from the adjacent geothermal activity or the acidic substrates present in this area.

Raupo reedland occurs in one place along the lake margin and one patch of *Carex geminata* sedgeland was seen.

Several dead (sprayed) African feather grass (*Pennisetum macrourum*) plants were observed, arousing the approval of the trip members, however near the end of the walk a medium sized healthy colony was found, which appeared to be spreading along the track margins. African feather grass is a total control pest plant in the Bay of Plenty Region and has been controlled for many years. Whilst

these control operations have not eliminated the species they have restricted its spread and it still only occurs very locally in the district.

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CHECKLIST OF FLORA FOR KUIRAU PARK (K), OHINEMUTU (O), AND ROTORUA LAKE FRONT (Government Gardens-Ngapuna) (L)

Compiled from field inspections in 1986 (Beadel 1986a & b and 1996); and Beadel *et al*. 1996). Additions were made during a 1998 Rotorua Botanical Society field trip.

Native Vascular Plants

Monocot. trees and shrubs

Cordyline australis (L,K)	ti kouka
Phormium tenax (L,K)	harakeke

Dicot. trees and shrubs

Coprosma repens (O)	taupata
Coprosma robusta (L,K)	karamu
Coriaria arborea (L)	tutu
Kunzea ericoides var. *ericoides* (L,K,O)	kanuka
Kunzea ericoides var. *microflora* (L,K,O)	prostrate kanuka
Leptospermum scoparium (L,K,O)	manuka
Leucopogon fasciculatus (O,K,L)	mingimingi
Pseudopanax arboreus var. *arboreus* (L,K,O)	whauwhaupaku, five finger
Solanum laciniatum (L)	poroporo
Weinmannia racemosa (K)	kamahi

Dicot. lianes

Calystegia sepium (L,O,K)	pohue
Muehlenbeckia australis (L,K)	puka

Ferns & Lycopods

Asplenium polyodon (L)	pekato
Blechnum novaezelandiae (dryland form) (K)	kiokio
Cyclosorus interruptus (O)	
Cyathea medullaris (L)	mamaku
Dicksonia squarrosa (L)	wheki
Gleichenia microphylla (K)	waewaekaka
Histiopteris incisa (L,K)	matata
Hypolepis ambigua (L)	
Hypolepis distans (L)	
Lycopodium cernuum (K)	maatukutuku
Paesia scaberula (L)	matata
Pteridium esculentum (L,K)	rarahu
Pyrrosia eleagnifolia (K)	

Orchids

Caleana minor (L)[1]	
Calochilus robertsonii (K)	
Microtis unifolia (L)	maikaika
Thelymitra sp. (L)	

Grasses

Cortaderia fulvida (L)	toetoe

[1] Found in the early 1900's in this general area, but has not been seen recently (Ecroyd 1991).

Lachnagrostis filiformis (L)	
Microlaena stipoides (L)	patiti

Sedges

Baumea arthrophylla (K)	
Baumea juncea (K)	
Baumea teretifolia (L,K)	
Carex secta (L)	purei
Carex virgata (K)	purei
Carex sp. (*C. geminata* agg.) (L)	rautahi
Cyperus ustulatus (L,O)	toetoe upokotangata
Eleocharis acuta (L)	
Eleocharis gracilis (L)	
Eleocharis sphacelata (L)	
Fimbristylis squarrosa (O)	
Isolepis distigmatosa (L)	
Schoenoplectus validus (L)	kapungawha
Schoenus maschalinus (K)	

Rushes

Juncus gregiflorus (L)	wi
Juncus maritimus var. *australiensis* (L)	wi
Juncus pallidus (L,K)	wi
Juncus planifolius (L,K)	

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Dianella nigra (L,K)	turutu
Typha orientalis (L)	raupo

Dicot. herbs

Cardamine debilis (K)

Centella uniflora (K)

Drosera spathulata (K)

Gonocarpus micranthus subsp. *micranthus* (K,L,O)

Hydrocotyle microphylla (K)

Lobelia anceps (K)	punakuru
Pratia angulata (L,K)	panakenake

Adventive Vascular Plants

Gymnosperms

Chamaecyparis lawsoniana (L,K)	Lawson cypress
Pinus nigra (L)	black pine
Pinus radiata (L)	radiata pine

Dicot. trees and shrubs

Acacia dealbata (K)	silver wattle
Acacia longifolia (L)	Sydney golden wattle
Acacia mearnsii (L)	black wattle
Alnus glutinosa (L)	alder
Albizia lophantha (O)	brush wattle
Betula pendula (L)	silver birch
Buddleja davidii (L)	buddleia
Camellia sp. (L)	camellia
Cotoneaster glaucophyllus (L,K)	cotoneaster
Cytisus scoparius (L,O,K)	broom
Dendrobenthamia capitata (L)	strawberry dogwood

Erica lusitanica (K)	Spanish heath
Eucalyptus botryoides (L)	eucalyptus
Eucalyptus globulus (L)	Tasmanian blue gum
Ficus macrophylla	Moreton Bay fig
Grevillea robusta (L)	silky oak
Hydrangea macrophylla (L)	hydrangea
Leptospermum laevigatum (L)	coast tea tree
Ligustrum sinense (L)	Chinese privet
Lupinus arboreus (L,O)	lupin
Metrosideros sp. (planted) (L)	
Platanus x *hispanica* (L)	plane
Quercus robur (L,K)	oak
Rosa rubiginosa (L)	sweet brier
Rubus sp. (*R. fruticosus* agg.) (L,K,O)	blackberry
Salix cinerea (L)	grey willow
Salix fragilis (L,O)	crack willow
Salix matsudana cv. Tortusa (L)	corkscrew willow
Tamarix chinensis (L)	Chinese tamarisk
Ulex europaeus (L,K)	gorse

<u>Dicot. lianes</u>

Hedera helix (L,K)	ivy
Lonicera japonica (L,O)	Japanese honeysuckle
Philadelphus infectus (L)	

<u>Grasses</u>

Agrostis capillaris (L)	browntop
Agrostis stolonifera (L,K)	creeping bent

Anthoxanthum odoratum (L)	sweet vernal
Axonopus affinis (L,K,O)	narrow-leaved carpet grass
Bromus sp. (L)	brome
Cortaderia selloana (L,K)	pampas
Cynodon dactylis (L)	Indian doab
Digitaria sanguinalis (K)	summer grass
Elytrigia repens (L)	couch
Eragrostis brownii (L)	bay grass
Festuca arundinacea (L)	tall fescue
Holcus lanatus (L,K)	Yorkshire fog
Paspalum dilatatum (L,K)	paspalum
Paspalum distichum (L,K)	Mercer grass
Pennisetum clandestinum (L)	kikuyu grass
Pennisetum macrourum (L)	African feather grass
Pseudosasa japonica (L,K,O)	bamboo

<u>Sedges</u>

Carex ovalis (L)

Cyperus eragrostis (K)

<u>Rushes</u>

Juncus acuminatus (K,L)	
Juncus articulatus (L)	
Juncus bufonius (L)	
Juncus effusus (L,K)	rush
Juncus microcephalus (L)	
Juncus tenuis (L)	track rush

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Agapanthus orientalis (O,L)	agapanthus
Agave sp. (L)	agave
Crocosmia x *crocosmiiflora* (L)	montbretia
Hedychium gardnerianum (L,O)	wild ginger
Iris sp. (L)	iris
Kniphofia uvaria (K)	red hot poker
Tradescantia fluminensis (L)	tradescantia
Zantedeschia aethiopica (L)	arum lily

Composite herbs

Bidens frondosa (L)	beggars ticks
Cirsium arvense (L)	California thistle
Cirsium vulgare (L)	Scotch thistle
Conyza albida (L,O)	fleabane
Crepis capillaris (L)	hawksear
Erigeron karvinskianus (O)	Mexican daisy
Gnaphalium coarctatum (L)	cudweed
Hypochaeris radicata (K)	catsear
Senecio bipinnatisectus (L)	Australian fireweed
Senecio jacobaea (L)	ragwort

Dicot. herbs (other than composites)

Achillea millefolium (L)	yarrow
Callitriche stagnalis (L)	starwort
Echium vulgare (L)	viper's bugloss
Fumaria muralis (L)	scrambling fumitory
Galium palustre (L)	marsh bedstraw

Geranium sp. (L,O)	geranium
Lathyrus latifolius (L)	everlasting pea
Lotus pedunculatus (L)	lotus
Mentha sp. (O)	mint
Opuntia vulgaris (L)	prickly pear
Ornithopus perpusillus (K)	wild serradella
Oxalis sp. (O)	oxalis
Phytolacca octandra (L)	inkweed
Plantago lanceolata (L)	narrow-leaved plantain
Polygonum capitatum (K)	pink-head knotweed
Polygonum persicaria (L)	willow weed
Ranunculus repens (L)	creeping buttercup
Reynoutria japonica	Asiatic knotweed
Rumex acetosella (L)	sheep's sorrel
Rumex obtusifolius (L)	dock
Solanum nigrum (L)	black nightshade
Solanum tuberosum (L)	potato
Stachys arvensis (K)	staggerweed
Trifolium pratense (L)	red clover
Trifolium repens (L)	white clover
Verbena bonariensis (L)	purpletop
Yucca sp.	yucca

Species Found By Kirk 1872 At Ohinemutu, But Now Thought To Be Extinct There

Chenopodium glaucum
Juncus maritimus var. *australiensis*
Leptocarpus similis
Lycopodium laterale
Potentilla anserinoides
Thelymitra pulchella
Viola cunninghamii

Kuirau Park - Planted Indigenous Species

Gymnosperms

Dacrycarpus dacrydioides	kahikatea
Dacrydium cupressinum	rimu
Podocarpus totara	totara

Monocot. trees and shrubs

Coprosma lucida	karamu
Coprosma robusta	karamu
Dodonaea viscosa	akeake
Kunzea ericoides var. *ericoides*	kanuka
Leptospermum scoparium	manuka
Pittosporum eugenioides	tarata
Pittosporum tenuifolium subsp. *tenuifolium*	kohuhu
Pseudopanax arboreus var. *arboreus*	whauwhaupaku

Pseudopanax laetus	
Weinmannia racemosa	kamahi
Dicot. lianes	
Metrosideros diffusa	rata
Ferns	
Asplenium flaccidum	
Cyathea dealbata	ponga
Dicksonia fibrosa	wheki-ponga
Dicksonia squarrosa	
Phymatosorus pustulatus	