Waikato Regional Council Technical Report 2015/32

A field guide to the vegetation associations of the Taupo Volcanic Zone

www.waikatoregion.govt.nz
ISSN 2230-4355 (Print)
ISSN 2230-4363 (Online)

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Prepared by:
Mark Smale and Neil Fitzgerald
Landcare Research New Zealand

For:
Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
HAMILTON 3240

July 2015

Document #: 3288112

Peer reviewed by:
Katherine Luketina Date August 2015

Approved for release by:
Dominique Noiton Date August 2015

Disclaimer

This technical report has been prepared for the use of Waikato Regional Council as a reference document and as such does not constitute Council's policy.

Council requests that if excerpts or inferences are drawn from this document for further use by individuals or organisations, due care should be taken to ensure that the appropriate context has been preserved, and is accurately reflected and referenced in any subsequent spoken or written communication.

While Waikato Regional Council has exercised all reasonable skill and care in controlling the contents of this report, Council accepts no liability in contract, tort or otherwise, for any loss, damage, injury or expense (whether direct, indirect or consequential) arising out of the provision of this information or its use by you or any other party

A field guide to the vegetation associations of the Taupo Volcanic Zone

Mark Smale, Neil Fitzgerald

Landcare Research New Zealand

Geothermal vegetation on the western side of Rainbow Mountain.

Doc #: 3288112

Table of contents

Introduction **3**

The sites **4**

The plants **4**

The vegetation **8**

The associations **8**

Campylopus introflexus mossfield 8

Campylopus pyriformis mossfield 9

Carpet grass grassland 10

Prostrate kānuka/thermal clubmoss fernland 11

Hypolepis ambigua fernland 12

Hypolepis distans fernland 13

Mānuka shrubland 14

Prostrate kānuka–mingimingi shrubland 15

Prostrate kānuka/*Campylopus pyriformis* shrubland 16

Mānuka–mingimingi–prostrate kānuka/bracken–inkberry–ring fern shrubland 17

Prostrate kānuka scrub 18

Mingimingi scrub 19

Mingimingi–prostrate kānuka/inkberry scrub 20

Wheki/inkberry treefernland 22

Kānuka/(*Coprosma rhamnoides*–mingimingi–prickly heath) treeland 23

Kāmahi/mingimingi-prickly heath-bracken forest 24

Glossary of plant names **25**

Reference **26**

List of Figures

Figure 1: The Taupō Volcanic Zone on North Island, New Zealand. The sampling locations on which this guide is based are marked in red. 3

Figure 2: Prostrate kānuka at Crown Rd, Taupo 5

Figure 3: Thermal ladder fern at Waimangu 5

Figure 4: Thermal tangle fern at Karapiti/Craters of the Moon, Wairakei (CC BY-NC-ND licence, Te Papa) 6

Figure 5: Giant hypolepis at Waimangu 7

Figure 6: *Campylopus introflexus* mossfield at Waimangu 8

Figure 7: *Campylopus pyriformis* mossfield at Karapiti/Craters of the Moon, Wairakei 9

Figure 8: Carpet grass grassland at Papakiore Springs, Tikitere 10

Figure 9: Prostrate kānuka/thermal clubmoss fernland at Karapiti/Craters of the Moon, Wairakei 11

Figure 10: *Hypolepis ambigua* fernland at Parengarenga Springs, Tikitere 12

Figure 11: *Hypolepis distans* fernland at Cemetery Reserve, Rotorua 13
Figure 12: Mānuka shrubland at Waiotapu North 14
Figure 13: Prostrate kānuka–mingimingi shrubland at Ngapuna, Rotorua 15
Figure 14: Prostrate kānuka/*Campylopus pyriformis* shrubland at Karapiti/Craters of the Moon, Wairakei 16
Figure 15: Mānuka–mingimingi–prostrate kānuka/bracken–inkberry–ring fern shrubland at Waiotapu North 17
Figure 16: Prostrate kānuka scrub at Crown Rd, Taupo 18
Figure 17: Mingimingi scrub at Ngapuna, Rotorua 19
Figure 18: Mingimingi–prostrate kānuka/inkberry scrub on Rainbow Mountain/Maungakakaramea 21
Figure 19: Wheki/inkberry treefernland at Waiotapu North 22
Figure 20: Kānuka /(*Coprosma rhamnoides*–mingimingi–prickly heath) treeland at Parimahana, Kawerau 23
Figure 21: Kāmahi/mingimingi-prickly heath-bracken forest on Rainbow Mountain/Maungakakaramea 24

Introduction

The Taupō Volcanic Zone in the centre of New Zealand's North Island runs from Mt Ruapehu in the south to White Island/Whakaari in the Bay of Plenty, and includes most of New Zealand's surface geothermal features and most of its geothermal vegetation. About 580 ha of geothermal vegetation (Burns 1997) occurs at some 90 sites on 25 geothermal fields in the zone (Fig. 1). There are several classifications of geothermal vegetation based on observation only, with widely varying numbers of associations. Landcare Research has randomly sampled geothermal vegetation and aspects of the environment on 15 geothermal fields, and produced an objective classification of geothermal vegetation in the Taupō Volcanic Zone. It comprises 17 vegetation associations, all but two of them confined to geothermal sites and all but one of them dominated by native species.

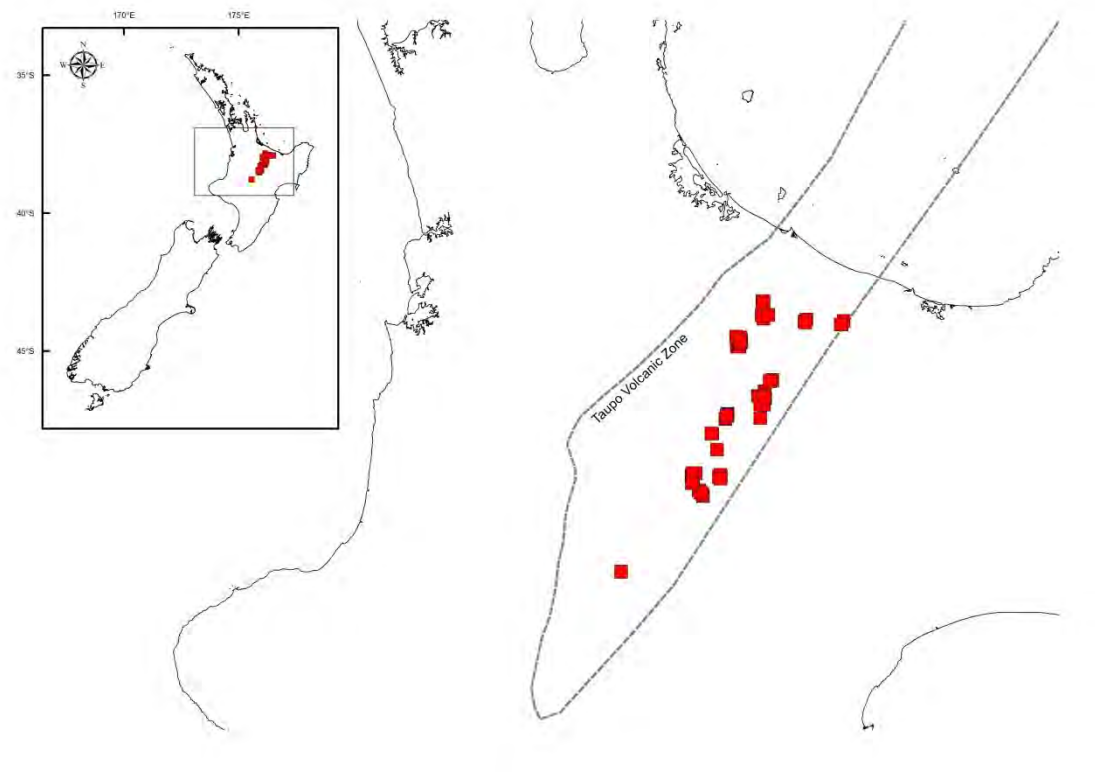

Figure 1: The Taupō Volcanic Zone on North Island, New Zealand. The sampling locations on which this guide is based are marked in red.

The sites

Geothermal areas throughout the world provide unique habitats for plants and animals through their distinctive combinations of unusual microclimates and soils. Microclimates have raised air temperatures and humidity, while soils have raised temperatures, extremely high acidity, and unusually high – even toxic – concentrations of some metals such as aluminium. The high stresses of these extreme environments exclude most plant species and lead to plant communities very different from those surrounding them. Thus geothermal vegetation – despite its frequent occurrence within forested zones – is generally dominated by bryophytes – mosses and liverworts – which are favoured by warm, moist environments, or by grasses and herbs. Geothermal vegetation in New Zealand, however, is unusual in that it is mostly dominated by shrubs.

A variety of habitats differing in heat and moisture occur at geothermal sites. Heated dry ground is the most common, with other specialised habitats such as the steamy margins of hot streams and fumaroles on much smaller areas. The edges of geothermal areas can contain quite large areas with slightly heated climates and soils. Geothermal areas are very dynamic in space and time, as the movement of underground steam changes over time. Heated ground often eventually cools down, but the hydrothermally altered soils persist and provide habitat for small plants that tolerate soils that are very infertile or toxic to many other species.

The plants

Most of the plants that grow on geothermal areas are common, widespread species of scrub and young forest such as mingimingi, inkberry/turutu, bracken, and mānuka. But there are a few notable exceptions.

Prostrate kānuka (threatened) is a small shrub, sometimes small tree up to 6 m tall, confined to geothermal sites in New Zealand. It has distinctive weeping branches and unusually small flowers. It can hybridise naturally with other kānuka of non-geothermal areas, and such hybrids occur around the edges of geothermal sites (Fig. 2).

Figure 2: Prostrate kānuka at Crown Rd, Taupo

Thermal ladder fern (threatened), formerly thought to be the same as the exotic tropical ladder fern commonly growing as a weedy garden escape, is also confined to geothermal sites in New Zealand.

Figure 3: Thermal ladder fern at Waimangu

Then there is a suite of other plants that are widespread in warmer countries but in New Zealand are largely confined to geothermal sites, where the warm frost-free environment allows them to flourish. They include several ferns (thermal tangle fern, *Christella dentata*, *Cyclosorus interruptus* and giant hypolepis) and a small sedge (*Fimbristylis velata*), all threatened.

Figure 4: Thermal tangle fern at Karapiti/Craters of the Moon, Wairakei (CC BY-NC-ND licence, Te Papa)

Figure 5: Giant hypolepis at Waimangu

The vegetation

Geothermal vegetation in the Taupo Volcanic Zone falls into 9 main structural classes, determined by the dominant life form (for example, shrubs or mosses): soilfield, mossfield, grassland, fernland, shrubland, scrub, treefernland, treeland, and forest. Scrub (vegetation with over 80% cover of shrubs) is the most common, accounting for two fifths. Shrubland (vegetation with less than 80% cover of shrubs) accounts for one third. Soilfield (bare ground with little or no vegetation) accounts for about 14%, and forest (vegetation with over 80% cover of trees) for about 4%. The remaining classes are all of quite small extent. Along with main associations described below, there is a substantial number of associations that cover much smaller areas and are mostly dominated by exotic plants.

The associations

Known locations are given, but the list is not definitive.

Campylopus introflexus mossfield

Very short (average 3 cm) mossfield dominated by *Campylopus introflexus*. No other species are usually present.

Occurs on hot (average temperature at 10 cm depth 44 °C) ground at Waimangu.

Figure 6: ***Campylopus introflexus*** **mossfield at Waimangu**

Campylopus pyriformis mossfield

Very short mossfield (5 cm) dominated entirely by *Campylopus pyriformis*. No other species are usually present.

Occurs on very hot (average 72 °C) ground at Taheke and Wairakei (Karapiti/Craters of the Moon).

Figure 7: ***Campylopus pyriformis*** **mossfield at Karapiti/Craters of the Moon, Wairakei**

Carpet grass grassland

Short (50 cm) grassland dominated by exotic narrow-leaved carpet grass, with the exotic grass browntop and the moss *Campylopus introflexus* also common.

Occurs on warm (26 °C) ground on the edges of geothermal sites at Tikitere (Papakiore Springs), Rotorua (Arawa Park Racecourse), and Wairakei (Te Rautehuia Stream).

This is the only main type dominated by exotic species.

Figure 8: Carpet grass grassland at Papakiore Springs, Tikitere

Prostrate kānuka/thermal clubmoss fernland

Short (0.6 m) fernland dominated by arching clubmoss, with scattered prostrate kānuka above it. No other species are consistently present (i.e., on more than half the area.) Threatened *Cyclosorus interruptus* occurs in this association at Spa Stream.

Occurs on very hot (68 °C) ground on geothermal sites at Wairakei (Karapiti/Craters of the Moon) and Tauhara (Spa/Otumuheke Stream).

Figure 9: Prostrate kānuka/thermal clubmoss fernland at Karapiti/Craters of the Moon, Wairakei

Hypolepis ambigua fernland

Tall (2.1 m) fernland dominated almost entirely by *Hypolepis ambigua.* No other species are consistently present, although water fern and bracken are commonly found.

Occurs on warm (21 °C) ground on the margins of geothermal sites at Tikitere (Otutara Springs, Parengarenga Springs) and Te Kopia.

Figure 10: *Hypolepis ambigua* fernland at Parengarenga Springs, Tikitere

Hypolepis distans fernland

Tall (2.8 m) fernland, dominated almost entirely by *Hypolepis distans.* Water fern and bracken are also consistently present.

Occurs on warm (21 °C) ground on the margins of geothermal sites at Taheke, Tikitere (Parengarenga Springs), and Rotorua (Cemetery Reserve, Whakarewarewa).

Figure 11: *Hypolepis distans* fernland at Cemetery Reserve, Rotorua

Mānuka shrubland

Moderately tall (mean 3 m, range 0.3-6 m) shrubland, dominated by mānuka. Prostrate kānuka, mingimingi and water fern are also consistently present.

Occurs on warm (24 °C) ground on the margins of geothermal sites at Rotorua (Arawa Park Racecourse, Whakarewarewa) and Waiotapu (Waiotapu North).

This is one of two associations also common away from geothermal areas.

Figure 12: Mānuka shrubland at Waiotapu North

Prostrate kānuka–mingimingi shrubland

A variable association of widely varying height (average 5 m) and structure (mostly shrubland, with some scrub, forest and treeland), dominated by prostrate kānuka and mingimingi. Inkberry/turutu is consistently present in the ground layer.

Occurs on warm (25 °C) ground on the margins of geothermal sites at Kawerau (Parimahana Scenic Reserve), Taheke, Tikitere (Hell's Gate), Rotorua (Ngapuna, Sulphur Point, Whakarewarewa), Waiotapu (Waiotapu North, Waiotapu Thermal Area), and Te Kopia.

Figure 13: Prostrate kānuka–mingimingi shrubland at Ngapuna, Rotorua

Prostrate kānuka/*Campylopus pyriformis* shrubland

Short (mean 0.4 m) shrubland dominated by prostrate kānuka with a *Campylopus pyriformis* ground layer. No other species are consistently present.

Occurs on hot (50 °C) ground at Wairakei (Karapiti/Craters of the Moon, Upper Wairakei Stream).

Figure 14: Prostrate kānuka/*Campylopus pyriformis* shrubland at Karapiti/Craters of the Moon, Wairakei

Mānuka–mingimingi–prostrate kānuka/bracken–inkberry–ring fern shrubland

Tall (9 m) shrubland, dominated by mānuka, mingimingi, prostrate kānuka and bracken, over a ground layer dominated by inkberry/turutu and ring fern. Exotic broom is consistently present.

Occurs on slightly heated (17 °C) ground on the margins of geothermal sites at Waiotapu.

Figure 15: Mānuka–mingimingi–prostrate kānuka/bracken–inkberry–ring fern shrubland at Waiotapu North

Prostrate kānuka scrub

Short (1 m) scrub dominated almost entirely by prostrate kānuka. No other species are consistently present, although a range of liverworts is common. Thermal ladder fern (threatened) occurs in this association at Waimangu and Karapiti, and thermal tangle fern (threatened) at Crown Road.

Occurs on hot (39 °C) ground on geothermal sites at Kawerau (Parimahana Extension), Waiotapu (Waiotapu Thermal Area), Waimangu, Te Kopia, Orakei-Korako, Rotokawa (Rotokawa North), Wairakei (Karapiti/Craters of the Moon, Wairoa Hill), and Tauhara (Broadlands Road, Crown Road).

This is the most characteristic and widespread association of geothermal sites.

Figure 16: Prostrate kānuka scrub at Crown Rd, Taupo

Mingimingi scrub

Moderately tall (3 m) scrub and shrubland dominated by mingimingi. No other species are consistently present.

Occurs on slightly heated (17 °C) ground on the margins of geothermal sites at Taheke, Tikitere (Hell's Gate, Papakiore Springs), Rotorua (Ngapuna, Kuirau Park, Whakarewarewa), Waiotapu (Waiotapu North), and Reporoa (Longview Road).

Figure 17: Mingimingi scrub at Ngapuna, Rotorua

Mingimingi–prostrate kānuka/inkberry scrub

Tall (5.5 m) scrub dominated by mingimingi and prostrate kānuka,(Fig. 18) with a ground layer dominated by inkberry/turutu. Māpou, and prickly heath are also consistently present. Thermal tangle fern (threatened) occurs in this association at Te Kopia and Maungaongaonga, and *Schizaea dichotoma* (threatened) at Te Kopia and Rainbow Mountain.

Occurs on warm (24 °C) ground on the margins of geothermal sites at Kawerau (Parimahana Scenic Reserve), Tikorangi (Tikorangi North), Waiotapu (Maungaongaonga, Rainbow Mountain/Maungakakaramea), Orakei-Korako, and Te Kopia.

Figure 18: Mingimingi–prostrate kānuka/inkberry scrub on Rainbow Mountain/Maungakakaramea

Wheki/inkberry treefernland

Short (9 m) treefernland, dominated almost entirely by whekī, with a ground layer dominated by inkberry/turutu. Kāmahi, fivefinger, māpou and mingimingi are also consistently present. Thermal tangle fern (threatened) occurs in this association at Orakei-Korako.

Occurs on slightly heated (19 °C) ground on the margins of geothermal sites at Taheke, Waiotapu (Waiotapu North), and Orakei-Korako.

Figure 19: Wheki/inkberry treefernland at Waiotapu North

Kānuka/(*Coprosma rhamnoides*–mingimingi–prickly heath) treeland

Short (9 m) treeland dominated by kānuka with an understorey dominated by *Coprosma rhamnoides*, mingimingi, and prickly heath. Rewarewa, māpou, shining karamu, and inkberry/turutu, along with exotic Khasia berry and Japanese hill cherry, are consistently present.

Occurs on warm (22 °C) ground on the margins of geothermal sites at Kawerau (Parimahana).

This is one of two associations also common away from geothermal areas.

Figure 20: Kānuka /(*Coprosma rhamnoides*–mingimingi–prickly heath) treeland at Parimahana, Kawerau

Kāmahi/mingimingi-prickly heath-bracken forest

Short (9 m) forest dominated by kāmahi, with an understorey dominated by mingimingi, prickly heath and bracken, and a ground layer dominated by mosses and liverworts. A range of other trees and shrubs – fivefinger, māpou, mānuka, shining karamu, megaherb (*Astelia solandri*), and fern (thermal tangle fern, *Lycopodium deuterodensum*) species – are consistently present. *Schizaea dichotoma* (threatened) also occurs in this type.

Occurs on slightly heated (18 °C) ground on the margins of geothermal sites at Te Kopia.

Figure 21: Kāmahi/mingimingi-prickly heath-bracken forest on Rainbow Mountain/Maungakakaramea

Glossary of plant names

*denotes exotic

arching clubmoss	*Lycopodiella cernua*
bracken	*Pteridium esculentum*
*broom	*Cytisus scoparius*
*browntop	*Agrostis capillaris*
fivefinger	*Pseudopanax arboreus*
*flowering cherry	*Prunus serrulata*
giant hypolepis	*Hypolepis dicksonioides*
inkberry/turutu	*Dianella nigra*
kāmahi	*Weinmannia racemosa*
kānuka[1]	*Kunzea ericoides*
*Khasia berry	*Cotoneaster glaucophyllus*
mānuka	*Leptospermum scoparium*
māpou	*Myrsine australis*
mingimingi	*Leucopogon fasciculatus*
narrow-leaved carpet grass	*Axonopus fissifolius*
prostrate kānuka	*Kunzea ericoides* var. *microflora*
rewarewa	*Knightia excels*a
ring fern	*Paesia scaberula*
shining karamu	*Coprosma lucida*
thermal christella	*Christella* aff. *dentata*
thermal ladder fern	*Nephrolepis flexuosa*
thermal tangle fern	*Dicranopteris linearis*
water fern	*Histiopteris incisa*
whekī	*Dicksonia squarrosa.*

[1]The genus *Kunzea* has been revised for New Zealand by de Lange (2014). Prostrate kānuka (K. *ericoides* var. *microflora*) has been raised to species level as *K. tenuicaulis*, and a number of new species described within the earlier broad concept of kānuka (*K. ericoides*), more than one of which occurs on or near geothermal fields.

Reference

Burns BR 1997. Vegetation change along a geothermal stress gradient at the Te Kopia steamfield. Journal of the Royal Society of New Zealand 27: 279-293.