

New Zealand's pōhuehue (*Muehlenbeckia*) - a biodiversity powerhouse with an image problem

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Introduction

Here we will introduce New Zealand's five pōhuehue species of the genus *Muehlenbeckia*, highlighting both the insect biodiversity they support and the negative image they carry. Each species and its insect relationships will be briefly described and in a local context we will discuss issues facing Waimakariri pōhuehue biodiversity. Overall, the genus is host to more specialist moths and butterflies than any other New Zealand plant genus, but suffers from an image problem. Its success has come at a price, but gradually landscape architects, and others influential in what is planted in restoration projects, are recommending the planting of the relevant pōhuehue to restore the local ecology and thereby nurture the plants along with associated insects, lizards, and birds that collectively are the local biodiversity.

Taxonomy

The genus *Muehlenbeckia*, in the Polygonaceae, was erected by Carl Meissner in 1840, and was named for the Alsatian bryologist Heinrich Muehlenbeck (1798-1845). It is a genus consisting mainly of climbers and scramblers found in New Zealand, South America, Australia, and Papua New Guinea. The New Zealand species are *Muehlenbeckia axillaris*, *M. complexa*, *M. ephedroides*, *M. australis*, and *M. astonii*. Known as pōhuehue, *M. australis*, *M. axillaris*, *M. complexa* and *M. ephedroides* are all spreaders or scramblers/climbers, but *M. astonii* (tororaro) is an upright tangled, discrete, divaricating shrub. *Muehlenbeckia* species grow from the New Zealand coast through montane regions to the alpine zone, generally respond to disturbance in a successional role in a variety of habitats, and have a special ecological relationship with a wide range of invertebrates and vertebrates.

All *Muehlenbeckia* exhibit the Polygonaceae family characteristic of stipules fusing together to form a sheathing membranous ochrea, which encloses the stem just above the leaf axil. This feature is most easily seen near new growth tips and is useful in identification where plants look superficially similar to other New Zealand genera such as *Calystegia* or *Fuchsia*. *Muehlenbeckia* species

produce a nut-like seed surrounded by variably succulent tepals and are eaten and dispersed by lizards and birds (Fig. 1 & Fig. 2).



Figure 1. *Muehlenbeckia* hybrid showing the typical Polygonaceae translucent sheathing ochrea that clasps the stem just above each axil.

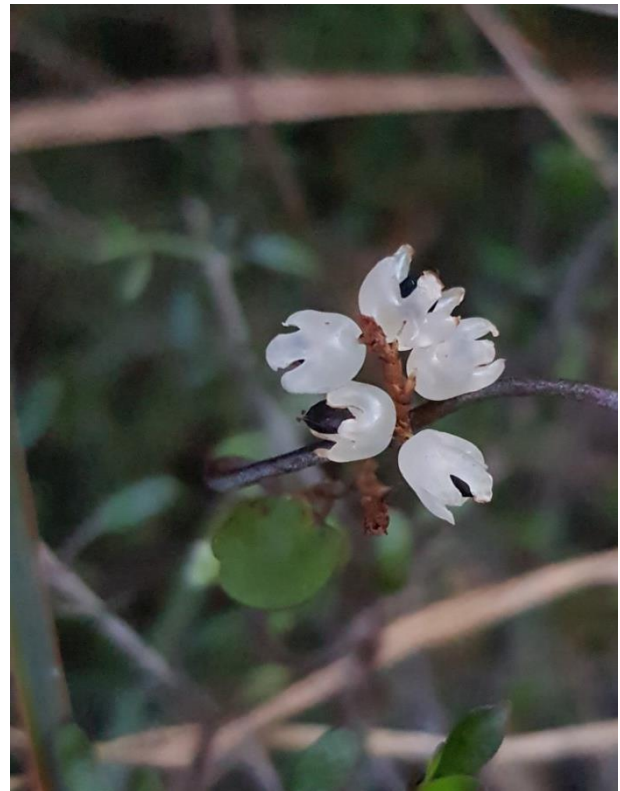


Figure 2. Typical fleshy tepals surrounding *Muehlenbeckia complexa* seeds, which are both eaten and dispersed by lizards and birds.

Phylogenetic work suggests that *M. axillaris*, *M. complexa* and *M. ephedroides* are part of the same subclade, mainly occurring in Australia and New Zealand. *M. australis* belongs in a subclade including South American species, and *M. astonii* belongs to neither of these subclades but is still considered within *Muehlenbeckia* (Schuster et al. 2011).

The observed preference by New Zealand moths and butterflies for four of the pōhuehue species over *M. astonii* clearly suggests that the latter is very different from the other four New Zealand *Muehlenbeckia* species. These observations suggest that collaboration between botanists and entomologists may prove useful in considering taxonomy.

The form of pōhuehue species is quite variable and it seems likely that hybridisation accounts for some forms of at least of *M. axillaris*, *M. complexa*, *M. ephedroides* and *M. australis* (Allan 1961, Wilson 1978). For the purposes of this work, discussion will be confined to the five species named above.

Species conservation status

The endemic shrub *Muehlenbeckia astonii* has been considered Threatened, Nationally Endangered since 2009 with “Recruitment Failure” and “Conservation Dependent” qualifiers.

M. australis (endemic) Not Threatened

M. axillaris (native) Not Threatened

M. complexa (endemic) Not Threatened

M. ephedroides (endemic) Threatened, Nationally Vulnerable with “Partial Decline” and “Sparse” qualifiers.

In most areas of New Zealand, the distribution of all of the pōhuehue species has been subjected to widespread modification as human occupation has altered the wider landscapes and the majority of habitats within it.

Discussion of species

Muehlenbeckia astonii

Muehlenbeckia astonii is unusual in the genus in that it is a compact divaricating shrub compared to its climbing, scrambling relatives. The plant is deciduous and gynodioecious, (female and hermaphroditic plants coexist within a population). It has the poorest conservation status of the genus and is the subject of The Department of Conservation’s Threatened Species Recovery Plan 31 (de Lange and Jones 2000), a document that reviewed the ecology, issues and proposed plans for its management. Despite this work, its threatened conservation status remains and even under this protection, significant loss has occurred recently at Kaitorete Spit, one of its strongholds. The remaining populations are in the southeast of the North Island, at Kaitorete Spit/Lake Forsyth area, North Canterbury and Marlborough in the South Island. This distinctive shrub is not in our experience, a host for specialist native invertebrates.

M. astonii is now cultivated widely and used for landscape plantings, though eco-sourcing seems of little consideration at many points of sale. Planted areas lack the biodiverse ecological integrity of remnant populations and carry significantly less ecological value and biodiversity in that sense.

Muehlenbeckia australis

Muehlenbeckia australis is a dioecious, stout liane up to 10 m tall. It has the largest leaves in the genus, which are semi-deciduous and borne on a tangle of interlacing branches. It grows vigorously in high light environments making a mass of leaves, flower heads and fruit. It is widely distributed throughout New Zealand from sea level to the montane zone.

It grows in a wide range of marginal/successional habitats such as forest margins, banks, disturbed native remnants, gorse hedges, river beds and behind

coastal dunes. It produces abundant dry or fruited seed, which is eaten and dispersed by birds including bellbirds, blackbirds, silvereyes and tui (Williams 2009).

Muehlenbeckia australis is competitive with short vegetation, but requires support to climb so once accompanying vegetation in forest situations becomes dense and greater than about three metres tall, its competitive ability is reduced.

It is recognised as a very important host for native invertebrate diversity (Williams 2009) (Patrick and Patrick 2012). Additionally, thickets of *M. australis* provide great food and safe nesting sites for birds (Wilson 2013). Over forty-five moth and butterfly species representing 10 families of Lepidoptera feed on it as larvae, the majority of which are specialists, so are completely reliant on it for their survival. They have diverse life-histories including feeding inside the stems, mining the leaves, feeding on the flowers, fruit or leaves, and even specialising by feeding on its dry dead leaves beneath the plant (Table 1, p. 56).

Even in pre-human times in a geologically young country like New Zealand, continual disturbance has always been present and currently, natural disturbance is augmented by human activity. This originally created plenty of opportunity for colonising successional plants such as *M. australis* whose dispersal and growth form are ideally suited to the purpose. As succession proceeds in a natural disturbance situation, such as forest wind-throw or in a dynamic forest edge, marginal species eventually give way to mature forest and successional plants play only a small role as they become dominated by taller vegetation. The vigorous growth and swamping of other shrubs and trees is countered over time by other vigorous successional species such as *Aristotelia serrata*, which in turn yield to taller vegetation as succession proceeds.

Currently, the vigorous, colonising attributes of pōhuehue (*M. australis*) are regarded in a variety of ways. In gardens or where particular plantings are prized, *M. australis* is often seen as a nuisance. In some sense these situations can be seen as “controlled successions” where chosen management dictates what will grow where, rather than a natural succession of native plants. This is understandable, but often leads to *M. australis* being removed. Even in forest restorations where *M. australis* is a legitimate successional coloniser and weed suppressor, it is sometimes regarded as undesirable as early plantings may be swamped by *M. australis* fulfilling its ecological role of “healing” open ground. In nature, this would sort its way through to taller vegetation as normal forest succession proceeded. However, in small areas such as reserves and restorations, which often lack successional seed sources or dispersal vectors, this natural process may never happen and human management will dictate the outcome.

In Matawai Park, Rangiora, a native plants park of 4.4 hectares first planted from scratch in the early 1970s, *M. australis* was self-introduced by birds and began to thrive on margins and in light gaps. Despite being in an urban area, Matawai Park is managed (within bounds) to encourage successional processes

and *M. australis* is abundant (Henderson and Giller 1994). It has been possible to develop the biodiversity advantage that *M. australis* brings with an understanding of its ecology and with some careful control to allow long lived podocarps and hardwoods to grow well.

M. australis, host to several copper butterfly species, has been abundant in Matawai Park for over 20 years, although it should be noted that no copper butterflies have been seen in the park. This helps demonstrate the importance of *Muehlenbeckia* landscape distribution patterns for invertebrates with limited dispersal capacity. It also illustrates how planted areas lack the ecological integrity and biodiversity of remnant original vegetation.

In the local Waimakariri district, *M. australis* is largely confined to hedges, undeveloped remnant patches or braided riverbed edges. These areas often have little environmental protection, and rely on serendipity for their survival and yet are a vital network for invertebrates depending on plant hosts. On margins of braided river and stream beds *M. australis* can be seen competing well with blackberry, elderberry, old man's beard, ivy and others. Copper butterflies are often present, but the combination of exotic weeds and *M. australis* often means these areas are either merely tolerated or seen as weedy zones to be controlled. The more intensive the land use, the less *M. australis* is likely to be present.

As *M. australis* is a vital host for a large range of invertebrates, it is important that patches within a region are big enough to support healthy populations, and that they are also close enough together to allow host corridors for many invertebrates. Recent ecological education and awareness of the value of pōhūehue for birds and invertebrates has begun to have an impact on societal attitudes to *M. australis*. It is likely, however, that there is insufficient institutional knowledge of the network of populations, their value, and degree of protection, or of their associated invertebrate populations.

We have recently begun a road-side survey of local populations of *Muehlenbeckia* species in the Waimakariri District. This will go a little way towards learning about the distribution patterns of remnant associations and could inform decisions about the value and management of existing populations.

Examples of the chance survival of *Muehlenbeckia* remnants have recently been revealed by this survey. On one roadside is a small remnant patch of dryland plains plants that unusually includes *M. australis*, *M. axillaris*, *M. complexa* and *M. ephedroides* together with *Leucopogon fraseri*. Having four of the species present is a real bonus. The patch is a narrow strip between the road and the railway line. It is sprayed with herbicide from both the railway line side and the road verge, and survives in the "no man's land" in-between.

Muehlenbeckia complexa

Muehlenbeckia complexa is a dioecious liane which, when self-supported, forms dense and flexible mounds and is shrub-like in habit. Leaves are more or less

deciduous, although some populations on the Canterbury Plains retain their leaves during winter. The young stems twine and commonly climb to 6 metres with support. *M. complexa* grows from coastal to montane zones in rocky places and shrublands, and survives locally on fence lines, hedges, undeveloped ground and road/rail-side ‘reserves’. It produces bird- and lizard-dispersed fruit in as little as 2-3 years from germination, often grows with a range of divaricating shrubs, and is capable of growing in drier zones than *M. australis*.

Over 42 moth and butterfly species representing ten families of Lepidoptera, feed on *M. complexa* as larvae, many of which are specialists, so completely rely on it for survival. As with *M. australis*, they have diverse life-histories including feeding on the flowers, fruit or leaves, mining the leaves, and even specialising on feeding on its dry dead leaves. Together with *M. australis*, three of the four groups of copper butterfly feed on the foliage of *M. complexa* and are often found together on the same pōhuehue population (Patrick and Patrick 2012) (Fig. 3a & 3b).



Figure 3. The Canterbury Plains are home to four copper butterflies, two of which are undescribed species that are locally abundant in semi-natural areas where pōhuehue species survive. Here are shown **a)** the male, with the distinctive thin double line of the fore-wing veins, and **b)** the female, with blue dots, of the Winter Copper (Canterbury Common Copper).

Similar to *M. australis*, remnant *M. complexa* tends to be removed from the landscape with increasing intensity of land use from either agriculture or lifestyle/housing development. Removal of old gorse and other hedges, spraying of roadsides and railway lines and assorted land use has left *M. complexa* inhabiting essentially little patches and corners less affected by these factors. Quite often small patches are centred on bird seed drop from perches, such fence posts, trees, etc. The size of, and distance between, these patches is very variable. Once mature it can dominate exotic pasture and ungrazed grass swards,

though discrete local patches suggest that establishment in a thick grass sward is difficult.

Some patches support copper butterfly and specialist moths while others are too isolated or small to support normal biodiversity. Recent education has meant that *M. complexa* is now planted in local motorway centre and margin plots and is finding its way into landscaping plans for playgrounds and parks. These efforts, while lacking initial ecological integrity as an association, may in the end prove useful corridors to help support invertebrate populations and increase knowledge of their role in the landscape.

Muehlenbeckia axillaris

Muehlenbeckia axillaris is a dioecious, variably deciduous, usually mat-like but occasionally straggling plant, forming loose to dense patches up to 1-2 metres across. It grows from the coast to alpine regions often in river beds, gravelly and rocky places south of 38° latitude. In braided river beds it is common on terraces that were disturbed some years earlier, provided weeds such as lupin, broom and gorse have not dominated. Tolerant of conditions where aridity and or low fertility prevent herbaceous exotics from dominating, it survives in rough grazing or rough mowing regimes. It can straggle weakly through gorse but doesn't thrive in those conditions, preferring lower, sparse vegetation.

M. axillaris is the host for all of our 10 boulder copper butterflies from coastal gravel spits and river mouths through lowland and montane grasslands to 1500 m in the alpine zone of the South Island mountains (Patrick and Patrick 2012). A few noctuid and crambid moths specialise as larvae on it too, as do many cricket and grasshopper species.

One of the reasons for the survival of *M. axillaris* in the human modified landscape of Waimakariri District is its ability to cope well with a rough mowing regime. It forms mats under these conditions and the mowing, while cutting the *M. axillaris*, prevents inundation by the mix of grass, herbs and even some gorse under these conditions. At Silverstream Reserve, near Kaiapoi, enough *M. axillaris* is growing in this way to have retained a healthy population of the Canterbury Plains Boulder Copper Butterfly, an undescribed but well-known and widespread species of the Canterbury Plains and adjacent hillsides. There are populations of *M. axillaris* on mown roadsides as well, although herbicide treatment denudes those areas. The Rakahuri/Ashley braided river bed older terraces have good populations where gorse, lupins and broom are not dominant (Fig. 4, p. 54).



Figure 4. The unnamed Canterbury Boulder Copper is locally abundant in semi-natural areas, river terraces and Kaitorete Spit. Its caterpillars feed on the sprawling *Muehlenbeckia axillaris*. Pictured is a shining purple male while the female is orange in colour.

Muehlenbeckia ephedroides

The prostrate and sprawling *Muehlenbeckia ephedroides* is inconspicuous, growing in grasslands and nowadays often found on mown roadsides. It has grooved, rigid, wiry stems which bear occasional small, grey-green linear leaves at the nodes. Stems have deep stomatal grooves which help control moisture loss and help the plant to favour free draining and or dry conditions (Wardle 2002). *M. ephedroides* grows in sandy/gravelly/rocky places from coastal back-beach environments through to montane zones from 39°S to 45°S east of the main divide. Plants are predominantly male or female, but usually with flowers of the other sex and hermaphrodite flowers present. Once widespread over the plains, *M. ephedroides* belongs to a dry plains association, which would have formed a successional mosaic as the Canterbury Plains developed and changed. Similar to all organisms of this dry plains association, *M. ephedroides* has declined to its present conservation status through habitat loss. Agricultural cultivation, increased soil fertility, irrigation and intensity of land use all bring about its decline on the local plains. In some eastern South Island dry grasslands *M. ephedroides* along with *M. axillaris* growing with it or nearby, supports populations of boulder copper butterflies.

Conclusions

As a genus, *Muehlenbeckia* plays a vital role in supporting New Zealand's distinctive and valuable biodiversity. In fact, collectively these pōhuehue species support the caterpillars of more specialist moths and butterflies (Lepidoptera) than any other genus of New Zealand native plant with collectively over 60 moth and butterfly species depending on four of the pōhuehue species. Other insect groups, including stick insects, crickets and grasshoppers, praying mantis, lacewings, many families of beetles, flies, wasps and bugs, also contain specialists on pōhuehue across our landscapes.

As a common, widespread and conspicuous genus of New Zealand's flora, *Muehlenbeckia* does not receive the respect it deserves for the ecological role it plays in many different communities from coastal gravels and shrublands, through riverbed and river terrace communities, dry open grasslands, forest edge and montane environments to alpine grasslands and herbfields. The pōhuehue species play a pivotal role in supporting biodiversity of more invertebrate species than any other part of our flora, and therefore also support our indigenous reptiles and bird species.

From a conservation perspective *Muehlenbeckia astonii* is Threatened and Nationally Endangered, *M. ephedroides* is Threatened and Nationally Vulnerable; both need care and focussed management. The other species have a healthier status, but in local areas, their distribution across the landscape is commonly in variably sized patches. This pattern has a significant effect on associated, dependent biodiversity, such as lepidoptera, birds and lizards. Recognising the value of these remnants, their strengths and limitations, informs decision making and ultimately the existence and health of these unique ecosystems.

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Table 1. Key pōhuehue Lepidoptera

Family	Species	Pōhuehue species	Location
Lycaenidae	<i>Lycaena boldenarum</i>	<i>Muehlenbeckia axillaris</i>	foliage
(Copper butterflies)	<i>Lycaena tama</i>	<i>Muehlenbeckia axillaris</i>	foliage
	<i>Lycaena ianthina</i>	<i>Muehlenbeckia axillaris</i>	foliage
	<i>Lycaena caerulea</i>	<i>Muehlenbeckia axillaris</i>	foliage
	Five undescribed boulder coppers	<i>M. axillaris</i> & <i>M. ephedroides</i>	foliage

	<i>Lycaena salustius</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Lycaena rauparaha</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Lycaena feredayi</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Lycaena enysii</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	Four undescribed glade coppers	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Lycaena edna</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	At least six undescribed common coppers	<i>M. complexa</i> & <i>M. australis</i>	foliage
Noctuidae	<i>Meterana coelena</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Meterana stipata</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Meterana alcyone</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Bityla defigurata</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
Geometridae	<i>Pseudocoremia indistincta</i>	<i>Muehlenbeckia australis</i>	foliage
	<i>Pasiphila muscosata</i>	<i>M. complexa</i> & <i>M. australis</i>	foliage
	<i>Chloroclystis sphragitis</i>	<i>Muehlenbeckia australis</i>	flowers
Thyrididae	<i>Morova subfasciata</i>	<i>Muehlenbeckia australis</i>	inside stems
Momphidae	<i>Zapyrastra calliphana</i>	<i>Muehlenbeckia australis</i>	leaf mining
	<i>Zapyrastra stellata</i>	<i>Muehlenbeckia complexa</i>	leaf mining
Yponomeutidae	<i>Orthenches prasinodes</i>	<i>Muehlenbeckia australis</i>	foliage
Carposinidae	<i>Heterocrossa exochana</i>	<i>Muehlenbeckia australis</i>	seeds