THE FUTURE OF WEEDS IN CANTERBURY LANDSCAPES

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INTRODUCTION

We were instructed to be forward looking at this meeting but we must look to the past for clues as to what may happen in the future. In the mere 30 years since I (P.A.W.) moved to Canterbury naturalized flora have overwhelmed much of the semi-natural Canterbury landscape. The following are a selection of the more obvious localised or regional changes in the distribution of the naturalized flora over that time i.e., between the early 1970's and 2003.

Most conspicuously and well-substantiated, native tussock lands below tree-line have been replaced by brown top and hieracium species (see papers in Hunter *et al.* 1992). Scotch broom was below the highway at Porters Pass and it was rare in the Waimakariri basin but now it is abundant on the roadsides all the way to Arthur's Pass and threatens the upper Waimakariri. Gorse has spread within the Waimakariri basin too. In the Ashburton basin, Russell lupin moved from the settlement at Lake Clearwater to the Potts riverbed and then down the Rangitata River. Naturalised conifers, particularly lodgepole pine, were abundant on the Amuri Range and in the McKenzie country, but uncommon in the Waimakariri away from Craigieburn experimental plots and before the Castle Hill village existed. Now they are widespread and still spreading. Douglas fir was formerly not considered an invasive species but concerns are now raised about its ability to invade beech forest. Hawthorn and rowan, once restricted to areas of human occupation such as at the foot of Porters Pass, are spreading slowly, particularly round Hanmer. Even well away from human habitations weeds spread: for example wall lettuce has spread within beech forests and hieracium species have invaded both forest and above timberline. Willows, once isolated trees only on many inland lake margins, now form continuous belts along the edges of some smaller lakes. Yellow-flowered bone-seed, once confined to the bluffs near Sumner and a few other pockets, now dominates the backdrop to this village. It has spread north to the coastal dunes and as far south as the Waitaki River, where it occupies a niche left by the demise of tree lupin. Other well-established species – such as carnation sedge, purple loosestrife, and beggars tick in

wetlands – have been brought to notice partly because greater emphasis has been placed on conserving the non-forested habitats they occupy. New weeds have appeared too, such as false tamarisk, which is spreading in the Waimakariri riverbed and elsewhere.

The continuous establishment and spread of naturalized species has been recorded in Canterbury before (Healey 1969) and similar trends can be seen throughout New Zealand. As H. H.Allen pointed out (Allen 1937), the number of naturalized species increases from south to north, reflecting the milder climate, increasing soil fertility, and greater numbers of humans. Naturalization is a critical step towards becoming invasive (spreading) and requiring control by someone (weed). By 1969 there were about 1000 taxa naturalized in Canterbury (Healey 1969); between 1989 and 2000, 41 species' first naturalization records for New Zealand were from Canterbury (e.g. Heenan et al. 2002). This is about the number of species expected, given the number of people living in Canterbury, and the number of naturalized species can be expected to increase along with the population.

Naturalized species have invaded every ecosystem in Canterbury, from the foreshore to the bottoms of lakes to the driest rock outcrop (Healey 1969). Many are weeds but mostly we know little about their impacts. While it may be stating the obvious, no two plants can occupy the same space, so where an exotic species grows, a native species cannot. For example, although gorse acts as a nurse crop for native species on Banks Peninsula, it is a poor substitute for manuka because it leads eventually to an absence of beech (Wilson 1994). Interactions such as these lead species to be classed as conservation weeds. Along with agricultural weeds they are referred to here under the generic term "weeds" and they are likely to have impacts largely according to their abundance.

ISSUES

Three broad questions are addressed here.

1. What species are of concern to weed management agencies and how extensive are they?
2. What has been the recent combined community response to these weeds?
3. What does the past response suggest for future landscapes?

To gain an insight into these issues we used the Canterbury Regional Council (ECAN) Regional Pest Management Strategy (RPMS) and related documents, Landcare Research databases, and the Department of Conservation (DOC) BioWeb database (Department of Conservation, 2003).

Many weeds of concern are well-established and widespread, and the following is not an exhaustive list. On the coast there are bone seed, boxthorn, elderberry, marram grass, tree lupin, and pine species. Adjacent to waterways there are crack willow and grey willow, blackberry, and Japanese honeysuckle. On dry open lands associated with the waterways and other places there are buddleia, Californian poppy, gorse, Montpellier broom, nodding thistle, Russell lupin, Scotch broom, yellow sweet clover, and viper's bugloss. On hillsides there are sweet brier, nassella tussock, several thistle species, and many grasses such as brown top and cocksfoot. These last two have profound effects on the regeneration of rare indigenous woody species. Further inland there are elderberry, gorse, Spanish heath, Scotch broom, and several species of exotic conifer and hieracium species. Forest remnants have Chilean flame creeper, banana passionfruit, and old man's beard on their margins, tradescantia and wall lettuce beneath their canopies, and male fern in open places.

Many well-established species are not widespread only because they are confined to specialist habitats, e.g., spartina on the coast at Lyttleton Harbour, and waterweeds such as curled pondweed, entire marshwort, oxygen weed, and egeria. Coltsfoot, false tamarisk, and yellow flag that grow on the margins of wetlands or associated habitats are also in this category. Several woody species capable of a much wider distribution include cotoneaster species, Darwin's barberry, Douglas fir, larch, rowan, and sycamore. Collomia, an annual species, is confined presently to the Mackenzie Basin but could spread.

A few species have restricted distributions and appear only occasionally in Canterbury or neighbouring areas, such as hornwort and phragmites in wetlands, bell heather and wild thyme in drier areas, and baccharis, Chilean glory creeper, and evergreen buckthorn in forest remnants.

Another group of species currently considered weeds only of agriculture, at least in Canterbury, has the potential to spread into some semi-natural environments, e.g., African feather grass, African love grass, saffron thistle, and white-edged nightshade.

These then are some of the weeds presently of concern to the various authorities attempting to control weeds in Canterbury. They number about 100 species under "active" official control (attempts are made to kill them) and another 50 under "passive" control (being monitored only). They amount to about 8 percent of the naturalized flora of New Zealand.

CONTROL MEASURES

What are the authorities doing about them? ECAN and DOC are the major parties in weed control, although the Christchurch City Council, farmer groups such as those attacking broom in the Amuri district, and private initiatives, make substantial inroads into weeds over limited areas.

In Canterbury approximately 80 species of plants are under some degree of control by DOC. An important component of DOC's strategy is to distinguish between attempting to control specific weed species *wherever* they occur, called *"weed-led control"*, and protecting specific places, called *"site-led control"*. This strategy ensures the most efficient use of resources. From DOC's point of view, most weed species in Canterbury are beyond weed-led control, e.g., bone seed and marram grass (this group is discussed further below). This strict categorisation excludes programmes against widespread weeds using biocontrol agents e.g., Scotch broom.

DOC carries out weed control at many sites in Canterbury, from the coast to the mountains, not only to protect the native flora, but also native birds and animals. Most of this effort is directed towards controlling well-established infestations of willows and Russell lupins in high-value riverbeds of the MacKenzie basin and conifers on some of the surrounding hills. Exotic conifers are also controlled in many areas of mid- and north Canterbury, particularly on Helicopter Hill immediately north of the Craigieburn Research area. A few weeds, generally widespread but in low abundance, occur in significant pockets in places DOC considers warrant control, i.e. stands of sweet cherry and associated rowan at Mt Cook, and Darwin's barberry on Banks Peninsula.

Only two species are in such low abundance that they qualify for weed-led control, namely spartina in Lyttleton harbour and purple loosestrife in the Cockayne reserve and the Halswell River in Christchurch City. The latter is still grown in the Ashburton Gardens. It does not feature in ECAN's current Pest Management strategy but interested parties have suggested it appear in the next one. Two other species of low abundance, baccharis and coltsfoot, are controlled by ECAN.

Many other species, including whole groups such as pasture grasses and species of hieracium, are controlled only in very specific places holding threatened species.

Preventing a species arrival and spread in the first place is the most efficient control. In an effort to ensure this, DOC has lists of "surveillance species", either over the whole of Canterbury (e.g., hornwort, Manchurian wild rice) or in specific areas (e.g., bell heather at Mt Cook). Serious efforts would be made to eradicate some of these species if they appeared.

Turning now to ECAN who are guided by the Biosecurity Act (1993). Their latest Regional Pest Management Strategy (RPMS) (1998–June 2003) categorised species of most concern as Pest Plants, in four subcategories:

1. ***Total control plants*:** where the aim is complete removal of these plants from the region over the course of the strategy (extermination in the short term):

African lovegrass, baccharis, bur daisy, coltsfoot, saffron thistle, entire marshwort, Taurean thistle, white edge nightshade.

With the possible exception of Taurean thistle, none of these species have been exterminated during the period of the strategy, although some have been reduced. The total expenditure was $242 000.

2. ***Progressive control plants*:** where the aim is to make systematic progress towards eradication:

African feather grass, nassella tussock.

There has been a reduction in African feather grass but the amount of nassella is little changed. The cost of inspecting and monitoring these two weeds was $1.25 million. Most of this was spent on nassella with arguably a net economic benefit to Canterbury (Denne 1988). However, the stated goal of eradication in the long term using existing techniques has long been unrealistic (Bourdôt et al. 1992).

3. ***Containment plants*:** where the treatment will restrict the spread of the infestation (no further spread):

gorse, Montpellier broom, nodding thistle, old man's beard, ragwort, Scotch broom.

The main activity here is to inspect properties and encourage owners to undertake weed control. However there was no monitoring of the distribution of these already widespread species so it is impossible to know whether their spread has been contained or not. The cost was $1.471 million.

It is worth noting that this is the group of species on which many millions of dollars was spent during the 1980s when large Government subsidies were available for weed control.

4. ***Surveillance Plant Pests***. This is a national list of about 100 species or species groups that were prohibited from sale or distribution and it was a breach of the Biosecurity Act to harbour them (legislation governing such species has since been changed). Fifty or so of these occur in the Canterbury region. For the most part, the only action taken was to check for their illegal sale by nurseries. Ninety-three inspections of nurseries were made, at a cost of $57 000 (i.e. less than 4% of total ECAN expenditure on weeds). In most cases compliance with the law was achieved but whether there has been any reduction in the rate of spread of these surveillance species is unknown, as their distribution is mostly not monitored.

In a separate document published in 2002, but still under the same legislation, ECAN listed a group of plants accorded pest status because of their potential to cause serious and unintended damage to biodiversity values:

Boneseed, egeria, field hawkweed, king devil, mouse-ear hawkweed, lodgepole pine, phragmites, wild thyme.

Various management goals are stated for these species, ranging from containment (egeria) to reducing their abundance at a range of sites, but in reality very little has been spent on them.

A second group, not considered pests under the legislation because doing so would conflict with their economic values, were designated for control on areas of high conservation value. This does not include Crown land unless there are significant spill-over benefits to adjoining landowners:

Corsican pine, Douglas fir, larch, mountain pine, Scots pine.

The stated objective here is to control all self-sown conifers in (unstated) targeted high conservation areas. Again, little money has been spent on controlling this group. A recent (April 2003) TV1 news item outlining ECAN's efforts to control the spread of pines indicated it would cost $1 million to cut known infestations. The combined experience of DOC and the New Zealand Army in the central North Island with contorta pine suggests expenditure of this order would be required indefinitely merely to reduce the rate of spread.

In the current RPMS discussion document (Anon, 2003) (available on the ECAN web site) a further 29 species are proposed for addition to the new strategy. The list includes species for which widespread control was abandoned many decades ago (e.g., blackberry), others that received attention 20–30 years ago by the Noxious Plants Council and their operatives (e.g., hawthorn, Spanish heath, variegated thistle), and species that were made the subject of control attempts by DOC's precursor, the Department of Lands and Survey (e.g., boxthorn, sycamore). Some relatively new weeds are already controlled to some extent (e.g., purple loosestrife), while others have never been systematically controlled in Canterbury to our knowledge (e.g., banana passion vine, pigs ear). These proposals are aimed largely at well established species and given the funding available they are likely to be ineffective, while diverting funds from new or restricted species where a real difference could be made.

One area of activity that does not show in these accounts, and is not elaborated here, is the support provided by DOC and ECAN to research organisations involved in testing and releasing biocontrol agents against widespread weeds such as Scotch broom and tradescantia.

THE FUTURE

The last question was, what does the likely efficacy of the response, past and present, suggest for future landscapes?

The official control of weeds in New Zealand goes back to 1854 when attempts were made to control thistles. Overall, the considerable efforts since have probably reduced the impact of some species but many others have continued to spread.

The abundance and widespread distribution of most species in the first three groupings of plant pests in the ECAN strategy is shown in Figure 1. Very few species subject to any sort of serious control effort have been naturalized for less than 50 years and occupy less than 100 ha. This figure is significant because a summary of Californian weed eradication programmes (Rejmanek and Pitcairn 2002) shows that eradication of noxious weeds covering less than 1 ha is usually possible, that the chance slips to 30% for those between 1ha and 100 ha, to 25% for those between 100 ha and 1000 ha, and infestations greater than 1000 ha are unlikely to be eradicated. Certainly the experience of ECAN in recent years, as described above, would confirm this rather gloomy outlook. Most weeds on ECAN's Plant Pest list are therefore likely to be present for the foreseeable future. At best, perhaps one or two might be eradicated, and a few agricultural

weeds presently occupying less than 1000 ha may be prevented from spreading further and infesting semi-natural environments.

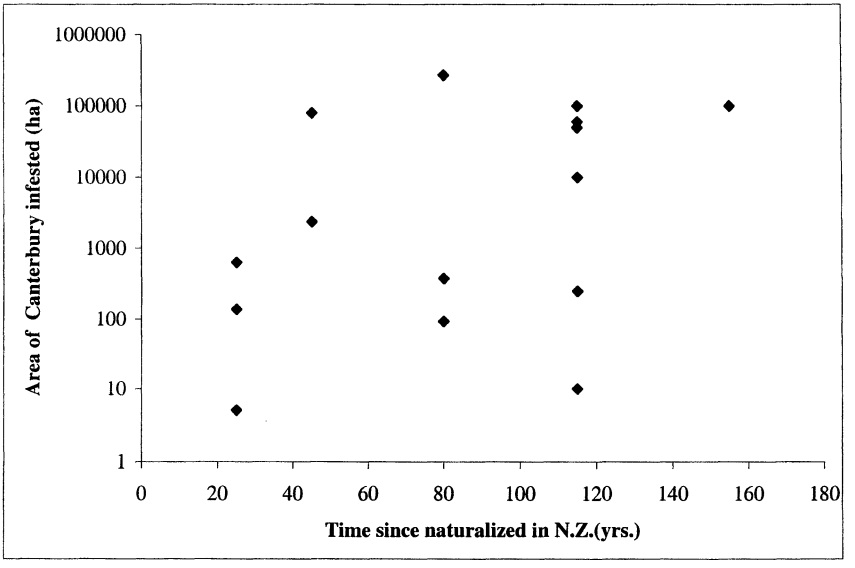

Fig. 1 The Pest Plants in ECAN'S (1998–2003) pest management strategy, with their time of naturalization in New Zealand on the horizontal axis and the area occupied in Canterbury on the vertical axis (area data from ECAN's RPMS).

Turning to the DOC weed programmes, with the exception of purple loosestrife (provided it is removed from cultivation) and Darwin's barberry, where eradication is distinctly possible, the Department is not proposing to eradicate any existing species from the region. Their objectives are therefore more realistic overall than those of ECAN. Studies such as those conducted in the Mackenzie basin nevertheless indicate huge resources are required to prevent the spread of pines in extensive "grasslands". The problem of pine invasions in Canterbury in fact consumes most of the resources available for weed control in the Conservancy, and even then, most of this effort is directed towards pines in the MacKenzie basin, where they are the largest single threat to biodiversity values (Stephens et al. 2000). Provided all seed sources are removed, it may be possible to achieve control of lodgepole pine in Canterbury, given its status as a pest in the ECAN strategy, but not other conifer species.

Neither is there evidence that well-established legume shrub weeds with persistent seed banks can in the long term be prevented from spreading virtually everywhere, and DOC is aware of this. Only rigorous control in uninfested areas such as the upper Waimakariri will even slow their spread. Perhaps seed-feeding biocontrol agents may help.

The spread of many other species of low abundance into Canterbury will certainly be slowed, and with the active surveillance programmes now underway, new species may be prevented from establishing. However, the Surveillance Plant Pests status of many of these species under ECAN's RPMS, whereby their wild populations are neither monitored nor controlled (other than on some DOC land) means that in the long term many more species will spread. Their impact on the native flora can be only speculated upon.

A discussion of the future of Canterbury vegetation must also take into consideration changing land-use patterns. The changes described in the introductory paragraph have occurred concurrently with the decline of extensive pastoral farming, the huge changes brought about by hydro-electricity generation in the Mackenzie basin, and the upsurge in holiday homes and tourism. These changes have facilitated the spread of woody weeds because there is no longer grazing pressure on existing weeds, fires are less common, and shelterbelts are maturing. Also the numerous "townies" living in the country plant species that later spread, and they may be less concerned about some of those species run holders might have attempted to control. These trends will continue both in the "high country" and on the plains where there are both dryland and wetland remnants. The flip side of the increasing population pressure is that there will be more pairs of hands to do the weeding, e.g., at the Castle Hill buttercup site. At the same time, there will need to be a much greater acknowledgment among communities that *they* are the source of the problem and that they will need to forgo some freedoms to plant what they like, where they like. The situation where, for example, seeds of Russell lupin can be sold at tourist shops then legally spread on the roadsides will need to stop. It is difficult to be optimistic about the likelihood of these social changes happening soon.

At a regional level, the many millions of dollars already invested in weed control have been insufficient to eradicate most species, control the spread of others, and prevent new weeds from establishing. It has been much harder to control weeds than was imagined, and weeds are going to further spread through Canterbury landscapes with largely unknown consequences for the native flora and fauna. Resources have been spread too thinly with much of them wasted on ineffectual monitoring of already widespread weeds. There clearly needs to be greater focus on control programmes with clear achievable and monitored objectives. This will require some existing programmes to be put aside. Nature is going to have

to be left to run its course in some areas, for example, allowing natural regeneration in areas retired from farming. This will permit effort to be redirected on the one hand towards a few species with very limited distribution where circumstances suggest eradication is actually feasible (see Williams 1997), and on the other towards preventing the next generation of weeds developing in the urban environment. We also need to sharpen our tools against existing weeds in the form of modern mycoherbicides and wider application of classical biocontrol agents. Most effort will still need to be concentrated on removing all the weeds from places with the highest conservation or other values. ECAN acknowledges this approach in its lists of weeds affecting high conservation values, and has raised the issue of seeking funds for control of broom on private land for biodiversity reasons. In a similar vein, DOC has a "priority place" policy that sees weeds controlled where they will achieve the highest return for conservation. Meanwhile those who treasure the natural landscapes and native flora will have to become gardeners on a grand scale, of which the weeding efforts in Travis Swamp and the Castle Hill buttercup reserve are prime examples. This will need to be done on private land as well as the conservation estate. The areas to be gardened will need to be carefully chosen and agreed by all parties, be they on public or private lands, because it will not be possible to weed them all with existing technologies and available resources. The selection of these areas and appropriate management tactics should be as much a part of the RPMS as the selection of which species to control. This can perhaps be achieved by integrating the RPMS with other aspects of regional planning.

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Cytisus scoparius, broom, is a woody weed hated by farmers and land managers. However, like its relative gorse, it can serve a useful role as nurse canopy in the regeneration of native forest on marginal hill country. (del. Hugh Wilson).

Appendix 1. Common and scientific names of plant species mentioned in the text, listed in the ECAN Regional Pest Management Strategy, or controlled by the Department of Conservation in Canterbury. This is not an exhaustive list of the weeds of Canterbury, and a few species are not yet in Canterbury but effort is made to detect their arrival.

Common Name	Scientific Name
African feather grass	*Pennisetum macrourum*
African love grass	*Eragrostis curvula*
All Stipa (except native spp.)	*Stipa* spp.
Artillery plant	*Galeobdolon luteum*
Baccharis	*Baccharis halimifolia*
Banana passionvine	*Passiflora pinnatistipula*
Barberry	*Berberis glaucocarpa*
Bathurst bur	*Xanthium spinosum*
Bell heather	*Calluna vulgaris*
Blackberry (wild aggregates)	*Rubus fruticosus* agg.
Blue morning glory	*Ipomoea indica*
Blue passion flower	*Passiflora caerulea*
Boneseed	*Chrysanthemoides monilifera*
Boxthorn	*Lycium ferocissimum*
Brier	*Rosa rubiginosa*
Broom	*Cytisus scoparius*
Broomsedge	*Andropogon virginicus*
Browntop	*Agrostis capillaris*
Buddleia	*Buddleja davidii* (excluding hybrids)
Bur daisy	*Calotis lappulacea*
Burdock	*Arctium minus*
Californian poppy	*Eschscholzia californica*
Cape honey flower	*Melianthus major*
Cape ivy	*Senecio angulatus*
Carnation sedge	*Carex flacca*
Cathedral bells	*Cobaea scandens*
Chilean flame creeper	*Tropaeolum speciosum*
Cocksfoot	*Dactylis glomerata*
Collomia	*Collomia cavanillesii*
Coltsfoot	*Tussilago farfara*
Corsican pine	*Pinus nigra* subsp. *laricio*
Cotoneaster	*Cotoneaster glaucophyllus*
	Cotoneaster franchettii
Crack willow	*Salix fragilis*
Darwin's barberry	*Berberis darwinii*
Douglas fir	*Pseudotsuga menziesii*
Egeria	*Egeria densa*
Elaeagnus	*Elaeagnus x reflexa*
Elder berry	*Sambucus nigra*
Entire marshwort	*Nymphoides geminata*
Evergreen buckthorn	*Rhamnus alaternus*
False tamarisk	*Myricaria germanica*
Field hawkweed	*Hieracium caespitosum*
German ivy	*Senecio mikanioides*
Goats rue	*Galega officinalis*
Gorse	*Ulex europaeus*
Green cestrum	*Cestrum parqui*
Hawthorn	*Crataegus monogyna*
Hemlock	*Conium maculatum*
Himalayan honeysuckle	*Leycesteria formosa*
Horsetail	*Equisetum arvense*

Common Name	Scientific Name
Italian buckthorn	*Rhamnus alaternus*
Japanese honeysuckle	*Lonicera japonica* (including cultivars but not hybrids)
Japanese spindle tree	*Euonymus japonicus*
King devil	*Hieracium praealtum*
Lagarosiphon (oxygen weed)	*Lagarosiphon major*
Lantana	*Lantana camara* var. *aculeata* (yellow-pink and yellow-red varieties)
Larch	*Larix decidua*
Lodgepole pine	*Pinus contorta*
Manchurian wild rice	*Zizania latifolia*
Marram grass	*Ammophila arenaria*
Mexican daisy	*Erigeron karvinskianus*
Mignonette vine	*Anredera cordifolia*
Montpellier broom	*Teline monspessulana*
Mouse-ear hawkweed	*Hieracium pilosella*
Moth plant	*Araujia sericifera*
Nardoo	*Marsilea mutica*
Nassella tussock	*Stipa trichotoma*
Nodding thistle	*Carduus nutans*
Old man's beard	*Clematis vitalba*
Pampas grass	*Cortaderia selloana*
	Cortaderia jubata
Parrots feather	*Myriophyllum aquaticum*
Perennial nettle	*Urtica dioica*
Phragmites	*Phragmites australis*
Pigs ear	*Carpobrotus edulis*
Plectranthus	*Plectranthus ecklonii*
	Plectranthus ciliatus
	Plectranthus grandis

Common Name	Scientific Name
Plumeless thistle	*Carduus acanthoides*
Privet - Chinese	*Ligustrum sinense*
Privet - tree	*Ligustrum lucidum*
Purple loosestrife	*Lythrum salicifolia*
Ragwort	*Senecio jacobaea*
Rhododendron	*Rhododendron ponticum*
Rowan	*Sorbus aucuparia*
Russel lupin	*Lupinus polyphyllus*
Sagittaria	*Sagittaria graminea* ssp. *platyphilla*
Saffron thistle	*Carthamus lanatus*
Scots pine	*Pinus sylvestris*
Senegal tea	*Gymnocoronis spilanthoides*
Sheeps bur	*Acaena agnipila*
Smilax	*Asparagus asparagoides*
Spanish heath	*Erica lusitanica* (excluding double flowered cultivars)
Spartina	*Spartina* spp.
Spiny broom	*Calicotome spinosa*
St Johns wort	*Hypericum perforatum*
Sweet briar	*Rosa rubiginosa*
Sweet cherry	*Prunus avium*
Sweet pea shrub	*Polygala myrtifolia* (excluding cultivar "Grandiflora")
Sycamore	*Acer pseudoplatanus*
Taurian thistle	*Onopordum tauricum*
Tree lupin	*Lupinus arboreus*
Tuber ladder fern	*Nephrolepis cordifolia*
Tussock hawkweed	*Hieracium lepidulum*
Tutsan	*Hypericum androsaemun*
Variegated thistle	*Silybum marianum*

Common Name	Scientific Name
Velvet groundsel	*Senecio petasitis*
Vipers bugloss	*Echium vulgare*
Wall lettuce	*Mycelis muralis*
White broom	*Cytisus multiflorus*
White-edged nightshade	*Solanum marginatum*
Wild Ginger	*Hedychium gardnerianum* *Hedychium flavescens*

Common Name	Scientific Name
Wild thyme	*Thymus vulgaris*
Yellow Flag	*Iris pseudacorus*
Yellow sweet clover	*Melilotus officinalis*

Leycesteria formosa, Himalayan honeysuckle. Introduced in to New Zealand as an ornamental garden shrub, shade-tolerant, bird-dispersed, and now abundant in the wild, Himalayan honeysuckle has caused conservation managers some angst. Observations on Hinewai Reserve, however, suggest that at least on relatively fertile soils, and in the absence of ongoing disturbance, it is steadily outcompeted by native fuchsia, wineberry and māhoe. (del. Hugh Wilson).