

Wise Up To Weeds!

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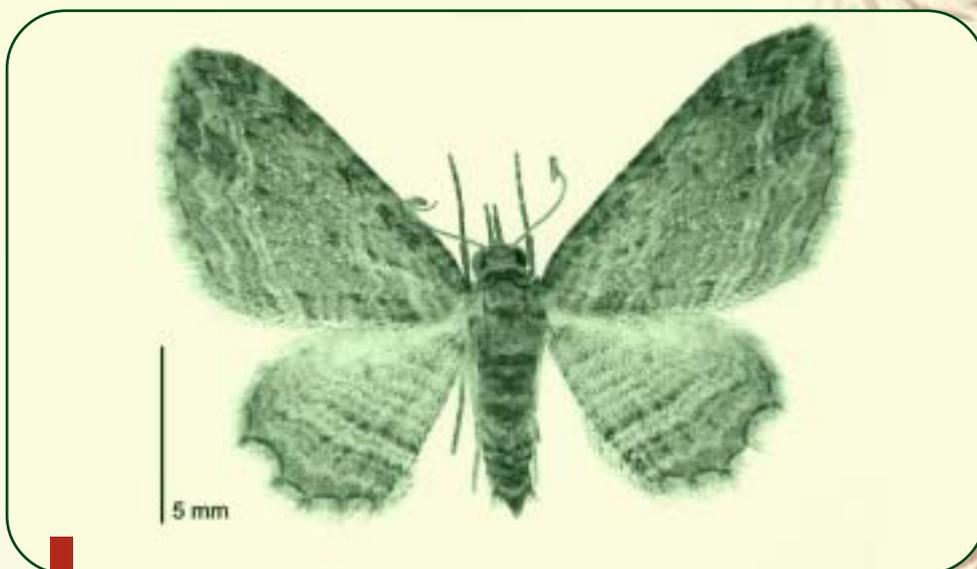
What happens to native insects when gorse replaces native scrub?

Large patches of gorse are an all too familiar sight in lowland New Zealand. The weed is replacing native mānuka (*Leptospermum scoparium*) and kānuka (*Kunzea ericoides*) at a rate of knots as the initial and successful invader of bare land created by disturbance events such as fire or landslips. When last mapped on a national scale in the 1980s the weed covered 53 000 ha compared with 155 000 ha of mānuka/kānuka scrub. However the news is not all bad, as gorse is often followed by native shrubs after several decades and is therefore of value to native forest revegetation projects.

Recently a team of researchers at Landcare Research at Nelson wanted to know what effect the replacement of native mānuka/kānuka scrub by gorse has on native insect communities. They based their study in the Wakapuaka Valley near Nelson, which offered gorse and kānuka stands on sites with similar aspect and topography and in close proximity to

each other. Here Malaise and pitfall traps were set up to catch unsuspecting insects in two sites of kānuka and two sites of gorse during December 1997.

The sheer number of species of invertebrates likely to be present in both native and exotic vegetation types means that it is usually impossible to sample the total fauna of any one site. "To overcome this logistic problem we decided to focus our attention on just four species-rich insect groups that covered all feeding guilds, from parasites and predators to herbivores, fungivores, and detritivores," explained Richard Toft. These were beetles (Coleoptera), moths and butterflies (Lepidoptera), bristle flies (Diptera: Tachinidae) and fungus gnats (Diptera: Ditomyiidae, Keroplatidae and Mycetophilidae). These four groups still yielded a staggering 34 387 specimens, which were then sorted into 564 recognisable taxonomic units. "We hoped that analysis of these would show us whether there



The Australian pug moth (*Chloroclystis filata*) arrived here in the 1960s and is now common throughout New Zealand. It can be found on a number of different plants including gorse and kānuka. Photo Credit: Birgit Rhode.

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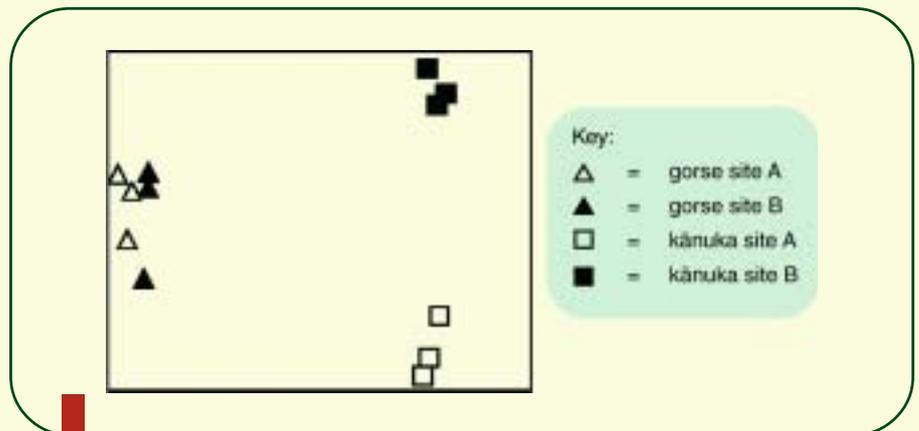
Manaaki Whenua
Landcare Research

were differences in species richness, abundance, and community composition between the two habitat types," related Richard. The team wanted to use this information to estimate the possible extent of species loss if kānuka-dominated communities continue to be replaced by gorse.

Their analysis of the data gathered from each of the insect groups studied showed that the insect communities associated with gorse and with kānuka were different (see ordination graph). "Just over half of the species we found in each of our four insect groups were unique to either the gorse or kānuka habitat," explained Richard. "This reflects the highly specialised nature of many insects."

Gorse proved to be a good place to find insects, both exotic and native. In fact, overall they found more species were recovered from the traps in gorse than from those placed in kānuka and this result was statistically significant. A closer look at the data from each insect group revealed that for all groups, except the beetles caught in pitfall traps, more species were consistently found in gorse than in kānuka, although these differences were not statistically significant. They also found that there were more individual specimens of bristle flies, beetles from Malaise traps, and moths and butterflies caught in gorse than in kānuka. Many species of fungal gnats were also more prevalent in gorse, although overall more fungal gnat specimens were found in kānuka because one species, called *Mycetophila dilatata* (Mycetophilidae), was very abundant at the second kānuka site.

Since gorse is an exotic plant in New Zealand it might be suspected that the insects finding a home in it would also tend to be introduced. "Interestingly this was not the case, as low numbers of adventive ('non-native') species were found in both kānuka and gorse," explained Richard. No



Ordination graph using data from all four insect groups sampled.

This ordination shows that the insect communities associated with gorse and kānuka were different for all four insect groups studied. (Graph adapted from Harris et. al. 2004)

overseas species of fungal gnats or bristle flies were found in either gorse or kānuka. Of the five species of introduced beetles identified from either kānuka or gorse, only one, the gorse seed weevil, was exclusive to gorse. Moths and butterflies bucked the trend, with 12 different adventive types being found in gorse compared with 4 in kānuka. Just to confuse the picture, the Australian pug moth (*Chloroclystis filata*) (Lepidoptera: Geometridae) was the only abundant overseas moth or butterfly to be found in both habitats and it was more common in the native kānuka. Native moths and butterflies were also present in gorse and the number of species present was similar to that found in kānuka.

It is very likely that gorse will continue to replace kānuka and mānuka at sites throughout New Zealand in the future as it has a competitive advantage in its abilities to regenerate faster after fire, to resist grazing by stock and to produce many more flowers, seeds and seedlings. "From our results we predict this replacement will lead to different insect communities at these sites and native insects that can only live in kānuka are likely to become locally extinct," concluded Richard. However, the good news from this study is that gorse can

support at least as many (if not more) native species as kānuka, indicating the value of this adventive weed as a habitat for native invertebrates.

This study was funded by the Foundation for Research, Science and Technology, New Zealand.

For the full story see:

Harris, R.J.; Toft, R.J.; Dugdale, J.S.; Williams, P.A.; Rees, J.S. 2004:

Insect assemblages in a native (kānuka ñ *Kunzea ericoides*) and an invasive (gorse ñ *Ulex europaeus*) shrubland. *New Zealand Journal of Ecology* 28(1): 35–47.



A native fungal gnat (*Mycetophila dilatata*) was very abundant at the second kānuka site. Photo Credit: Richard Toft.

Using naturalisation rates to predict weediness

New plant species are introduced to a country through a number of different avenues. They may be self-introduced, deliberately imported or we may unwittingly give them a helping hand if they are contaminants of another desirable plant or product. These activities increase the risk that some of these species may become invasive weeds in their new home, as does the wider use of existing species, or the development of new cultivars.

However, at the border or early in the invasion of a new area by a plant species, there are difficulties in assessing the weed risk these species pose because there may be minimal information available about previous weediness overseas and the likely impact of the introduced species in the new environment.

Peter Williams, Landcare Research, along with colleagues Richard Duncan, Lincoln University, and Rod Randall, Western Australia Dept of Agriculture, have been grappling with this problem and come up with one way of assessing the risk that an introduced plant may become a weed. This is based on historical data showing the past behaviour of relatives (plants from the same family or genera) of the potential weed and focuses on the ability of these to have naturalised in their new home.

Naturalisation occurs when a plant species escapes cultivation and forms a self-sustaining population in the wild. "We believe this is the critical step in the process of a species becoming invasive, and most often occurs before a significant adverse impact is noticed," explained Peter. "In our study we compiled lists of all the introduced and naturalised plant species of New Zealand and Australia in order to compare the probability of naturalisation in the different families and genera."

Of the 24 800 species introduced to New Zealand the trio found only 7% had naturalised here. Some families appear better able to naturalise than others, as the data revealed that approximately half the families introduced into New Zealand have no naturalised species at all, for example the Bromeliaceae or Orchidaceae.

The researchers also found that some genera within these families are better able to naturalise than others. "Using generalised linear models to analyse our New Zealand data we found that, for most large families, naturalisation is not scattered randomly through all the genera in a plant family, but is significantly clumped within certain genera," related Peter. "This may mean that species in some genera share traits that enable them to naturalise at a greater rate than species in other genera." Some of these traits are those that humans prefer, because genera that have been widely planted naturalise at a greater rate than those that are not widely planted.

One critical thing the three scientists wanted to know was the relationship between naturalisation and weediness. They found that in general families with a low naturalisation rate had a low proportion of weeds whereas those with high naturalisation rates tended to be most weedy. However, there was a lot of variation amongst the larger families that had average naturalisation rates, and it was necessary to look at the level of genera to gain an understanding of the general patterns within these families.

The plant ecologists found that in addition to naturalisation being concentrated within certain genera, weediness was also. Using their Australian data they found that genera within the same family behaved differently in terms of weediness. They compared species of the genera *Centaurea* and *Helichrysum*, both from the Asteraceae family. They found that of the 36 species of *Centaurea* that had been introduced into Australia, 15 had naturalised and 4 were



Quentin Paynter tries unsuccessfully to hide behind a large Australian fireweed plant (*Senecio bipinnatisectus*) that had taken up residence in a Rotorua front garden. Photo Credit: Chris Winks.

weeds. In contrast, no members of the genus *Helichrysum* had either naturalised or become weeds. "Understanding what happens at the level of genera is important for the study of naturalisation rates as often the available information needed to assess the risk of weediness for a newly introduced species is most comprehensive at this level," concluded Peter.

Apart from taxonomic factors there are a number of other factors that can influence the naturalisation rate of a species. Propagule pressure is a critical factor in determining whether a species is likely to naturalise. This is the number of propagules introduced into a new habitat, the number of times they are introduced, and their spatial distribution. For example, a species that is occasionally introduced on someone's sock has a low propagule pressure whereas a species that is widely planted for commercial reasons will have a high propagule pressure. "Our New Zealand and Australian data revealed that genera where the species are commonly planted are likely

to have at least one species naturalise after the introduction of only about four species," related Peter.

Another influencing factor is the range of environments available to the new invader. When the researchers compared New Zealand and Australian data it became apparent there was a higher naturalisation rate among species and genera introduced to Australia (the naturalisation rate of species in Australia is about 11% of all introduced species compared with 7% for NZ). This was despite the fact that the two countries have very similar numbers of introduced species (i.e. NZ = 24 800, Australia = 24 400). "The most obvious reason for this difference is that Australia offers foreign plants more climates and environments for establishment," explained Peter. Northern temperate genera (e.g. *Aster*, *Festuca*, *Pinus*, *Salix* and *Senecio*) naturalise at about the same rate in Australia as they do in New Zealand because the two countries have humid cold climates in common. However, tropical and arid zone

genera (e.g. *Artemisia*, *Cassia*, *Croton*, *Morea*, and *Pennisetum*) naturalise at a greater rate in Australia reflecting the greater range of these environments present there. In addition the greater human population in Australia will also be a factor in the higher naturalisation rates of introduced plants.

"As a result of our study we conclude that the rate of naturalisation and its relationship to weediness can help to assess the weed risk posed by new species," concludes Peter. Quarantine authorities require comprehensive and up-to-date lists of the introduced flora in their country and need to know whether these plants are naturalised or weeds before they can use this approach for effective weed risk assessment.

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