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Weed Biocontrol

WHAT'S NEW?

Contents

Key contacts

EDITOR: Angela Bownes
Any enquiries to Angela Bownes
bownesa@landcareresearch.co.nz

THANKS TO: Ray Prebble

LAYOUT: Cissy Pan

CONTRIBUTIONS:
Angela Bownes, Paul Peterson,
Simon Fowler

COVER IMAGE:
Purple loosestrife inflorescence
Photo by: Trevor James

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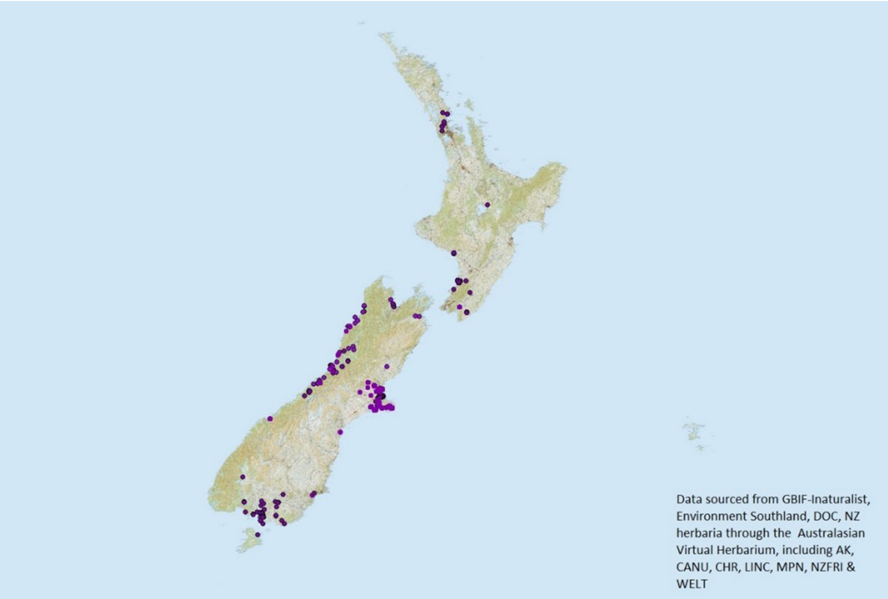
It's Time To Take On Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) has been a tantalising biocontrol target for many years, but up until recently this weed was an eradication or progressive containment pest in all regions of the country. This work was undertaken by regional councils and unitary authorities as part of their local, specialised pest management plans, with the aim of containing or reducing the geographical distribution of the weed. In some cases, eradication of purple loosestrife was deemed feasible.

Then in 2021, Horizons Regional Council (HRC) approached us to undertake a feasibility study and surveys of the weed in New Zealand to assess the potential for developing a successful biocontrol programme for purple loosestrife. The worst infestations occur in Horowhenua in the Manawatū-Whanganui region on the west coast of the North Island. Fully naturalised populations occur in Canterbury, and scattered and isolated populations occur in Auckland, Taranaki, Bay of Plenty, the Wellington Region, Southland, the West Coast and Marlborough.

"Eradication of purple loosestrife in Manawatū-Whanganui (Lakes Horowhenua and Papaitonga, Hokio stream and Lake Virginia) was originally part of HRC's pest management plan, when infestations were estimated to cover less than 30 ha. But the purple loosestrife population in Lake Horowhenua – the largest in the country – became difficult to manage due to accessibility issues and limited herbicide tools available for use in wetlands," explained Craig Davey, Biodiversity, Biosecurity & Partnerships Manager at HRC. "The expanding populations of purple loosestrife on the margins of Lake Horowhenua are also putting pressure on nearby lakes, with new sites being discovered and previously well-managed infestations at a higher risk of re-invasion," he added.

Purple loosestrife originates from throughout Europe and Asia, except for the high mountainous regions and most northerly latitudes, and from south-eastern Australia and Tasmania. It was introduced here as a garden ornamental and was first recorded as naturalised in 1958. It is an erect, herbaceous, perennial herb with tall shoots (20–300 cm) and large, spiked inflorescences with clusters of showy, purple flowers. It was particularly popular as a residential pond plant and for stream plantings, and from



Current distribution of purple loosestrife

Department of Conservation

there it escaped to invade aquatic and semi-aquatic habitats, roadside ditches, and even pastures on farmland. Seeds are mainly spread via waterways, but also by birds, livestock, contaminated machinery, hay and footwear. The illegal sharing of garden cuttings may also be an issue.

Clonal colonies of purple loosestrife develop from woody rootstocks, which produce new shoots each spring. Seedlings are highly competitive, and can develop an extensive rootstock and reach a height of over 1 metre in their first year of growth. The weed rapidly invades damp ground and shallow water, such as wetlands, lake margins, and streams and rivers, forming dense monocultures and excluding native vegetation. Purple loosestrife has the potential to displace all other wetland and riparian flora, drastically altering native ecosystems and reducing food sources for many species of fish and birds. The recreational and aesthetic values of wetlands, lakes, rivers and streams are reduced by dense infestations of purple loosestrife. They block a view of and access to the water and reduce native biodiversity. On farmlands, debris from purple loosestrife stands clogs irrigation pumps and drainage canals.

In 2021 a lake restoration project was initiated to restore the water quality and native biodiversity of Lake Horowhenua, which is one of New Zealand's most polluted lakes. Effective management of purple loosestrife and other invasive weeds is vital to restoring the lake's social, cultural, environmental and economic values. Biocontrol of purple loosestrife (and other weeds such as yellow flag iris [*Iris pseudacorus*]) was seen as potentially the most viable option for suppressing populations around the lake and to contain its spread to other, uninfested regions. Control with the use of chemicals is not only undesirable in wetland and other aquatic habitats, but also a deeply objectionable control method with local communities. It is also not economically viable in the long term.

In the United States of America (US) and Canada, where purple loosestrife is a widespread and damaging invasive weed, conventional control methods consistently failed to provide an acceptable level of control of the weed to mitigate its negative economic and environmental impacts. Often, wetlands with extensive purple loosestrife seedbanks ended up with worse infestations following herbicide applications due to rapid seedling recruitment and the loss of native species. A classical biocontrol programme was initiated in 1986 with the aim of reducing the demand for herbicide use in sensitive native habitats and to facilitate the recovery of native biodiversity.

Four biocontrol agents have been introduced into the US for the biocontrol of purple loosestrife, three of which were released in 1992: two leaf-feeding chrysomelid beetles (*Galerucella pusilla* and *G. calmariensis*) and a root-feeding weevil (*Hylobius transversovittatus*). The fourth agent, a flower-feeding weevil (*Nanophyes marmoratus*), was released in 1994. The weed biocontrol programme against purple loosestrife has been one of the most widely implemented programmes there. In several states, infestations of the weed were reduced by up to 90% in the first 10 years of the programme. Evidence of reduced pesticide use was indicated by a reduction in herbicide purchases. Local eradication has even been achieved at some sites, while dramatic declines in the abundance of purple loosestrife, with reduced shoot densities, were achieved at others.

Trevor James

Purple loosestrife infestation

"With the knowledge of a successful biocontrol programme in the US, we conducted a feasibility study for HRC to assess the prospects of developing a successful biocontrol programme for this weed in New Zealand, and to estimate the costs", explained Angela Bownes who is leading the project. "The study concluded that biocontrol is a highly viable option for managing purple loosestrife in New Zealand, and that all four biocontrol agents established in North America pose no risk to any native or taonga plant species," she added. Based on evidence from the field in the US, some minor, non-target feeding damage by the leaf beetles to the exotic ornamental crepe myrtle (*Lagerstroemia indica*) is likely, and feeding damage to cultivars of two other exotic ornamentals (*Lythrum virgatum* and *L. limii*) is possible. Some minor spill-over attack on exotic wild roses may also occur if growing in close proximity to purple loosestrife.

The next step of the project is to prepare a release application to the Environmental Protection Authority. Consultation with iwi and hapū in the Horowhenua region has already begun to assess the cultural impacts, and this will be expanded to other regions of the country where purple loosestrife has established. All going well, we hope to import the leaf beetles and the root weevil into New Zealand in 2023.

This project is funded by Horizons Regional Council.

CONTACT
Angela Bownes – bownesa@landcareresearch.co.nz

Aerial Surveillance For Sea Spurge Incursions

Manaaki Whenua – Landcare Research (MWLR) was recently contracted by the Department of Conservation (DOC) and the Ministry for Primary Industries to collect aerial footage of a new invasive weed, sea spurge (*Euphorbia paralias*), which was seen along New Zealand's West Coast for the first time in 2012. Sea spurge most likely arrived on New Zealand's coastline via ocean currents from Australia. Sea spurge originates in Africa and temperate Asia and has naturalised in Australia, where it is displacing native dune vegetation and changing the patterns of sand movement. Its sap is toxic to humans and other animals, causing skin irritations and temporary blindness if it comes into direct contact with eyes.

While the populations of sea spurge in New Zealand are still small and restricted in range, plants can disperse and form large monocultures very quickly. Consequently, Biosecurity NZ, DOC, Waikato Regional Council, Taranaki Regional Council, Horizons Regional Council, Greater Wellington Regional Council and Auckland Council are working together on an eradication programme. The programme is focused on early detection so that plants can be removed before they set seed. Aerial surveillance of the New Zealand coastline was regarded as a potentially useful tool to help in the early detection and removal of sea spurge incursions.

"The first step in the project is to use drones to determine whether a technique can be developed to detect this species on a small scale," said Paul Peterson, who is leading the project at MWLR. Both an RGB phantom drone and an M600 drone fitted with a hyperspectral camera were used in the pilot trial. "While the RGB footage allows us to capture visible light over three broad spectral bands, the hyperspectral camera splits the light into 269 spectral bands, including those in the near-infrared range, which are not visible to the human eye," explained Andrew McMillan (Environmental Analytics NZ Ltd).


Sea spurge

Waikawa Beach Ratepayers Association

"This allows for a more fine-tuned analysis of what spectra are being reflected by plants so that we can look for a distinctive signature. If a signature unique to sea spurge is found, then we may be able to use this over a wider scale to map the distribution of the weed," added James Griffiths (DOC), who is coordinating the programme.

Imagery was collected from approximately 1 ha of sand dunes containing sea spurge at each of three sites at Waikawa (Marlborough), Waitārere (Manawatū-Whanganui) and Paraparaumu (Kapiti Coast). Once the imagery had been collected, the data were processed by a team led by Grey Harris (Canterbury University). "From the wealth of spectral information available, three new 'diagnostic' bands were created that highlighted the differences between sea spurge and other plant species," said Grey. Machine-assisted segmentation techniques were then used to create a mask, and a pixel-based neural network was trained to find sea spurge automatically. "Object-based classification would have been faster to run, but due to the lack of training data available this was not practical," Grey added. Further pixel-based training was required to remove false positives and to focus on the centre of multiple pixel hits assumed to be sea spurge plants.

Results from this pilot trial look promising, but several questions remain if the method is to be used in different environments and/or scaled up. The hyperspectral camera mounted on the drone captured imagery at a resolution of 1–2 cm over approximately 1 ha in the pilot trial. This produced a vast amount of data at a level of detail that would not be practical or possible to collect from higher altitudes.

Not only may resolution become a limiting factor when trying to scale up the method, but many other variables, such as lighting (including sun angle and shadowing), variation in plant colour, and confusion with other vegetation may become more difficult to resolve. Furthermore, while sea spurge has been found growing up to half a metre tall in New Zealand, many plants are smaller and may be difficult to see from higher altitudes, especially new infestations. Accurate positioning of imagery to relocate individual plants also becomes more challenging.

New funding has been secured to test the method using a fixed-wing aircraft, which may provide the information we need to determine if aerial surveillance could become a realistic tool to help detect and subsequently eradicate new weed incursions in New Zealand.

This project was funded by the Department of Conservation and the Ministry for Primary Industries.

CONTACT

Paul Peterson – petersonp@landcareresearch.co.nz

Climate In The Heather Beetle Story

When surveying for candidate biocontrol agents, every effort is made to climate-match collection sites with the intended destination, but compromises often need to be made or best-case scenarios are not realised.

Heather beetles (*Lochmaea suturalis*) imported into New Zealand were sourced from multiple locations in the United Kingdom, but only beetles sourced from Oakworth in England established. This was surprising considering the relatively benign climate of Oakworth versus the relatively harsh climate of Tongariro National Park (TNP), where the beetles were released. Also, climate matching predicted that beetles sourced from Scotland would be better adapted to TNP conditions, but for unknown reasons the Scottish population did not survive.

Soon after the release it became apparent that performance of the Oakworth beetle populations in TNP was poor. Beetles that were redistributed around TNP were hard to establish, and when they did establish, populations grew slowly. Several hypotheses were developed to explain this poor performance, including a genetic bottleneck, poor food plant quality, and poor climate matching. Genetic and food quality issues will be addressed in upcoming articles.

Often biocontrol agents introduced into New Zealand come from the northern hemisphere, since many of our weeds originate from Europe and Asia. Northern hemisphere climates are generally less variable than southern hemisphere climates, due to the buffering effect of the larger land masses in the north. This means northern hemisphere insects experience consistently cold but more predictable winters, so they have evolved cold avoidance adaptations that do not protect them from sub-zero cold snaps outside of winter. By contrast, insects in the southern hemisphere have evolved cold tolerance adaptations enabling them to survive injury or death caused by unpredictable sub-zero cold snaps outside of winter.

To compare TNP and Oakworth climates as part of our climate-matching hypothesis for poor beetle performance, we measured temperatures using data loggers at both locations over several years. These data showed that beetles in TNP are exposed to five –4°C and one –8°C cold snaps on average each spring, whereas temperatures less than –4°C were never measured at Oakworth during spring.

Following two decades of disappointing results with this project, the performance of the heather beetle improved dramatically in the last 3 years, with large populations damaging vast areas of heather (*Calluna vulgaris*). "We want to know why this has happened over 20 years after the first release, so we are re-visiting the three original hypotheses for poor beetle performance to see if anything has changed," explained Paul Peterson, who leads the experimental work.

Heather beetle on a frosty spring morning

In 2007 we measured the ability of heather beetle populations in New Zealand to withstand out-of-season, sub-zero cold snaps that primarily occur in spring after beetles emerge from overwintering. To do this, we maintained overwintering adults in the lab at 5°C before exposing half of them to spring-like conditions (4 days at 18°C + food). We then exposed all the beetles to three cold temperatures (0, –4 and –8°C) for 3 hours and recorded beetle survival. While overwintering beetles showed no, low, and moderate mortality rates following exposure to 0, –4 and –8°C, respectively, beetles that had already emerged from overwintering were much less likely to survive, suffering no, moderate and high mortality at 0, –4 and –8°C, respectively. This is probably because cold avoidance adaptations to freezing no longer protect these northern hemisphere beetles after they emerge from overwintering.

These results suggested that establishment and population growth could be reduced in TNP by sub-zero cold snaps during spring, which emerging beetles are ill adapted to cope with. We recently repeated the same experiment, 14 years on, to see if any adaptation has taken place to explain the recent explosion in heather beetle numbers. While we found no significant changes, there appeared to be a trend towards the beetles being better able to withstand –4°C following emergence in spring.

This trial was a first attempt at measuring adaptation by heather beetles of Oakworth origin to climatic conditions in TNP, and it has some limitations. To verify adaptation of beetles in TNP to –4°C sub-zero cold snaps, the experiment should be repeated by comparing beetles sourced directly from Oakworth to those in TNP. Genetic bottlenecking and food quality are other variables we will explore, but for now, at least, it seems that adaptation to out-of-season cold snaps by itself cannot explain the dramatic recent improvement in heather beetle performance in TNP.

This project is funded by the Ministry of Business, Innovation and Employment as part of MWLR's Beating Weeds Programme

CONTACT
Paul Peterson – petersonp@landcareresearch.co.nz

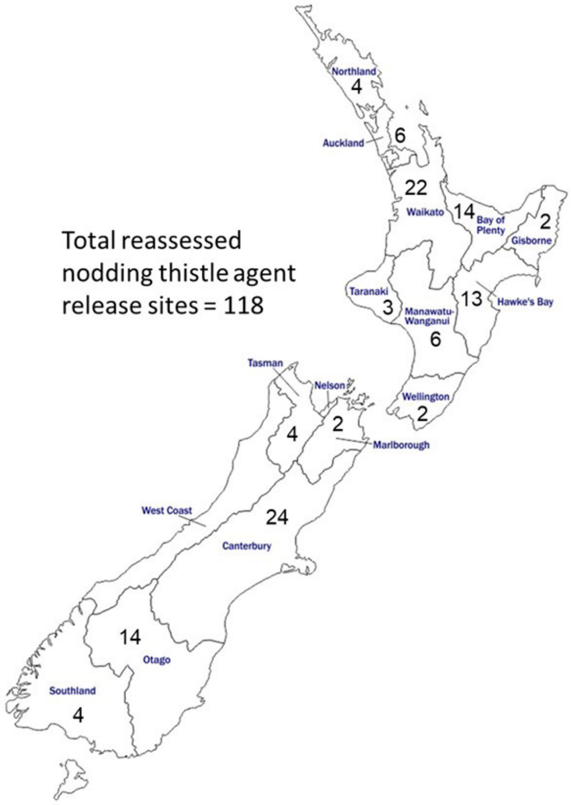
Comparing Nodding Thistle Then And Now

High-quality impact monitoring of weed biocontrol can be ideal for selected flagship projects, but it is an expensive undertaking. Also, although stakeholders like to see monitoring programmes undertaken, they have to balance their investment of resources in monitoring versus supporting new or existing operational weed biocontrol programmes. Unfortunately, a lack of post-release monitoring in the past has meant we have a small backlog of programmes that we think have been successful, but for which we lack the data to tell a good and scientifically robust story.

We have developed a uniquely New Zealand approach to achieving a cost-effective, but respectable, level of monitoring of past, apparently successful weed biocontrol programmes. This is achieved by collaborating with the National Biocontrol Collective (represented by 15 regional councils, unitary authorities and DOC) to revisit large numbers of the original release sites. Since the 1980s, Manaaki Whenua – Landcare Research, together with its stakeholders, has maintained a comprehensive database of release sites for weed biocontrol agents, particularly in the decade or so after their first release. The information stored in this database is not as high quality as we would gather for a flagship monitoring programme, but the size and geographical spread of the available data sets lend considerable statistical and interpretative power. We developed and refined this 'release site revisit' assessment method with the ragwort (*Jacobaea vulgaris*) biocontrol programme, and more recently we have applied it to the nodding thistle (*Carduus nutans*) biocontrol programme.

Nodding thistle was the most aggressive pasture weed in the drier areas of New Zealand after it spread widely in the 1950s and 1960s. New Zealand introduced biocontrol agents against nodding thistle in 1972 (nodding thistle receptacle weevil, *Rhinocyllus conicus*), 1984 (nodding thistle crown weevil, *Trichosirocalus horridus*) and 1990 (nodding thistle gall fly, *Urophora solstitialis*). There were quite widespread reports of declines in nodding thistle abundance several years after establishment of the nodding thistle crown weevil in particular, but the thistle seemed to remain a serious pasture weed in some parts of New Zealand, and rigorous quantitative, nationwide data have been conspicuously absent.

Recently, we applied our post-release monitoring approach, and mined our release database for information on release sites for nodding thistle crown weevil and nodding thistle gall fly (the release of nodding thistle receptacle weevil pre-dated the database). Then we asked our regional council collaborators to try to revisit a subset of around 70 release sites with assessment questionnaires on nodding thistle, its biocontrol agents, and various land-management issues. Revisits were planned over two consecutive – or near consecutive – years to avoid single-season anomalies or site disturbances that might have dramatic effects on the local abundance of nodding thistle as a short-lived, mostly biennial weed. Where possible, landowners were asked a range of questions on their weed and pasture management, and their awareness of biological weed control. The nodding thistle release site revisits ran from 2013 to 2021, with some later delays due to Covid restrictions. Overall, the team achieved an excellent set of returns covering the country well. The West Coast is an easily explained blank as it is too wet for nodding thistle to be a significant pasture weed.



Distribution of nodding thistle sites for assessment

d-maps.com

For the analysis we ended up combining the data sets for the nodding thistle crown weevil and nodding thistle gall fly release sites. It was obvious from the data that the agents had spread to many of the sites where the other agent was released, so distinguishing site effects that related to the original agent species released was going to be impossible. There was also no apparent difference between the data from the sites where each agent had been first released (e.g. in terms of reductions in nodding thistle density). We ended up with 118 sites across New Zealand where we had good records of nodding thistle density within 4 years of the release of either nodding thistle crown weevil or nodding thistle gall fly, and good recent surveys of thistle density over (mostly) 2 years.

"Perhaps the most critical question we can answer with this new data set is the extent to which nodding thistle density declined across New Zealand since the biocontrol agents were introduced," said Simon Fowler, who conducted the data analysis. "We can reveal that average nodding thistle density at sites within 3 years of the release of the crown weevil or gall fly (1988–1998) was 3.1 plants per square metre, and that this had dropped to 0.65 plants per square metre (a 78.9% reduction) when the sites were revisited from 2013 to 2021," explained Simon. The data also showed that there are still some heavily infested nodding thistle sites, even after biocontrol. There was no apparent geographical variation in this pattern, and no obvious effect of factors (such as land use) that could readily explain the continued high densities of nodding thistle at a few sites.

It is important to emphasise that the dramatic mean reduction in nodding thistle densities of 78.9% in these data, although consistent with the time period when biocontrol would be expected to act, cannot be linked causally to biocontrol, and could be caused wholly or in part by other factors. We can, however, examine what was happening to other thistle species while this large decline in nodding thistle was happening, as we asked land managers whether the status of other thistles as weeds had increased, decreased or remained the same. The most abundant other pasture weed at our sites was Californian thistle, and this was of interest because it has not been under any significant biological control throughout the majority of the years of the current study. Our rationale is that if the 78.9% reduction in nodding thistle was due to land management changes (e.g. better thistle control methods, improved pasture management), then we would expect to see some parallel reduction in Californian thistle.

In the data there was no indication that Californian thistle increased or decreased to a greater or less extent at sites where nodding thistle had decreased compared to sites where nodding thistle had increased. The lack of change of Californian thistle in parallel to the reductions in nodding thistle adds some support to the nodding thistle reduction being caused by host-specific biocontrol agents, and also suggests there was no major 'replacement weed' effect, whereby Californian thistle infestations simply replaced nodding thistle after its successful suppression due to biocontrol.

Our recent site reassessments asked land managers about their efforts to control nodding thistle, both currently and (if known) in the past. It is clear from the data that substantial control of nodding thistle is ongoing at some sites across New Zealand. About a quarter of sites (24%) reported recent use of relatively indiscriminate spraying (boom spraying at ground level or aerial spraying), whereas over two-thirds of sites (68%) reported using spot herbicide treatments. As with the data on reductions in nodding thistle abundance, there was no obvious geographical variation in the extent of ongoing nodding thistle control by land managers, and no obvious effect of factors such as land use. At 34 sites we had sufficient information from land managers on expenditure on herbicides, labour or spray contractors for us to estimate annual nodding thistle controls costs as ranging from zero to $50,000 per site. Overall, about half of land managers (53%) reported that they now sprayed less (or didn't spray at all) for nodding thistle, and half (47%) did not report any reductions in use of herbicides against nodding thistle. No sites reported an increase in spraying for nodding thistle.


Nodding thistle crown weevil

We extended our economic analysis by assuming that the approximately 50% of sites where decreased spraying for nodding thistle was reported were benefiting from biocontrol. Conversely, we suggest that the approximately 50% of sites where spray regimes appear to be unchanged would be benefiting far less from biocontrol, because their higher use of herbicides (particularly indiscriminate boom/aerial applications) would prevent good population build-up of biocontrol agents. A measure of the annual cost savings in nodding thistle control per site from biocontrol is then the difference ($11,100) between the mean annual spray costs of the low-herbicide-use sites where biocontrol can operate ($1,700) and the high-herbicide-use sites where biocontrol is compromised ($12,800). If this annual saving in nodding thistle control costs is being achieved on just 10% of New Zealand's 23,400 sheep and beef farms, then the current, ongoing national cost saving is $26 million per year. Present-value calculations, even considering the early costs of introducing the agents in the 1970s, 80s and 90s, still give us a huge benefit:cost ratio for the complete nodding thistle biocontrol programme in New Zealand of 580:1.

This project was jointly funded by the National Biocontrol Collective and the Ministry for Primary Industries' Sustainable Food and Fibre Futures Fund (Grant #20095) on multi-weed biocontrol.

CONTACT
Simon Fowler – fowlers@landcareresearch.co.nz

Summer Activities

Summer is a busy time for many biocontrol agents, so you might need to schedule the following activities.

Broom gall mites ***(Aceria genistae)***

- Check for galls, which look like deformed lumps and range in size from 5 to 30 mm across. Very heavy galling, leading to the death of bushes, has been observed at some sites.
- Harvesting of galls is best undertaken from late spring to early summer, when predatory mites are less abundant. Aim to shift at least 50 galls to each site and tie them on to plants so the tiny mites can move across.

Giant reed gall wasp ***(Tetramesa romana)***

- Check release sites for swellings on the stems caused by the gall wasps. These look like small corn cobs on large, vigorous stems, or like broadened, deformed shoot tips when side shoots are attacked. The galls often have small, circular exit holes made by emerging wasps.
- It will probably be too soon to consider harvesting and redistribution if you do see evidence of the gall wasp establishing.

Green thistle beetles ***(Cassida rubiginosa)***

- December is often when green thistle beetle activity is at its peak. Look for adult beetles, which are 6–7.5 mm long and green, so they are well camouflaged. Both the adults and the larvae make windows in the leaves. Larvae have a protective covering of old moulted skins and excrement. You may also see brownish clusters of eggs on the undersides of leaves.
- If you find good numbers, use a garden leaf vacuum machine to shift at least 100 adults to new sites. Be careful to separate the beetles from other material collected, which may include pasture pests. Please let us know if you discover an outbreak of these beetles.

Honshu white admiral ***(Limentitis glorifica)***

- Look for the adult butterflies from late spring. Look also for pale yellow eggs laid singly on the upper and lower surfaces of the leaves, and for the caterpillars. When small, the caterpillars are brown and found at the tips of leaves, where they construct pontoon-like extensions to the mid-rib. As they grow, the caterpillars turn green, with spiky, brown, horn-like protrusions.
- Unless you find lots of caterpillars, don't consider harvesting and redistribution activities. You will need to aim to shift at least 1,000 caterpillars to start new sites. The butterflies are strong fliers and are likely to disperse quite rapidly without any assistance.

Moth plant beetle ***(Freudeita cupripennis)***

- This beetle has established in Northland and possibly in the Bay of Plenty and Waikato but it may still be at low densities due to a limited number of releases so far. Look for adult beetles on the foliage and stems of moth plant. The adults are about 10mm long with metallic orangey-red elytra (wings) and a black head, thorax and legs. The larvae feed on the roots of moth plant so you won't find them easily.
- It will probably be too soon to consider harvesting and redistribution if you do find the beetles.

Tradescantia yellow leaf spot ***(Kordyana brasiliensis)***

- Look for the distinctive yellow spots on the upper surface of the leaves with corresponding white spots underneath, especially after wet, humid weather.
- The fungus is likely to disperse readily via spores on air currents. If human-assisted distribution is necessary, again you will need permission from MPI to propagate and transport tradescantia plants. These plants can then be put out at sites where the fungus is present until they show signs of infection, and then planted out at new sites.

Tutsan beetle ***(Chrysolina abchasica)***

- The best time to look for this agent is spring through to mid-summer. Look for leaves with notched edges or whole leaves that have been eaten away. The iridescent purple adults are around 10–15 mm in size, but they spend most of the day hiding away so the damage may be easier to spot. Look also for the creamy-coloured larvae, which are often on the undersides of the leaves. They turn bright green just before they pupate.
- It will be too soon to consider harvesting and redistribution if you do find the beetles.

Tutsan moth ***(Lathronympha strigana)***

- Look for the small, orange adults flying about flowering tutsan plants. They have a similar look and corkscrew flight pattern to the gorse pod moth (*Cydia succedana*). Look also for fruits infested with the larvae.
- It will be too soon to consider harvesting and redistribution if you do find the moths.

National Assessment Protocol

For those taking part in the National Assessment Protocol, summer is the appropriate time to check for establishment and/or assess population damage levels for the species listed in the table below. You can find out more information about the protocol and instructions for each agent at: www.landcareresearch.co.nz/publications/books/biocontrol-of-weeds-book

CONTACT

Angela Bownes – bownesa@landcareresearch.co.nz

Target	When	Agents
Broom	Dec–April	Gall mite *(Aceria genistae)*
Privet	Feb–April	Lace bug *(Leptoypha hospita)*
Tradescantia	Nov–April	Leaf beetle *(Neolema ogloblini)* Stem beetle *(Lema basicostata)* Tip beetle *(Neolema abbreviata)*
	Anytime	Yellow leaf spot fungus *(Kordyana brasiliensis)*
Woolly nightshade	Feb–April	Lace bug *(Gargaphia decoris)*