What's New In Biological Control Of Weeds?

What's Inside:

Proudly part of WEEDBUSTERS
Stopping the spread of weeds
www.weedbusters.org.nz

Issue 28 May 2004
ISSN 1173-762X

Manaaki Whenua
Landcare Research

Midges Start To Bite

The hieracium gall midge (*Macrolabis pilosellae*) has established in New Zealand. In recent months we have found galls at three sites: Glenthorne Station (Canterbury), Pisa Station (Otago) and Argo Valley (Waiouru). This is an important step towards our ultimate goal of controlling hawkweeds (*Hieracium* spp.). "This is the second of five insect agents planned for hieracium that is now known to have established – the gall wasp (*Aulacidea subterminalis*) being the first," proclaimed Lindsay Smith.

A mass-rearing programme has been underway at Lincoln over the past 2 years to allow widespread releases of the tiny midges to begin. This year we have made 52 releases in the worst-affected areas. "Because the adults are fragile, and sometimes only survive for a few days, we have been making releases by planting out infested plants. These transplants need to survive long enough for the larvae to reach adulthood," explained Lindsay. The gall midge has the potential to build up numbers relatively quickly as it is able to complete 2–3 generations during the warmer months of the year. We are not sure at this stage how effective it will be at dispersal.

Given that it would be pretty impossible to ever distinguish the adult midges from other small unidentifiable flying objects in the field it is lucky that infested plants are unmistakeable. The larvae feeding in the centre of rosettes, stolon tips, leaf axils and sometimes flowerheads result in curled leaves and swollen deformities. Three species of hawkweeds are likely to be affected; as well as mouse-ear hawkweed, king devil (*H. praealtum*) and field hawkweed (*H. caespitosum*) are expected to succumb too.

Two down now three to go. "We just need to mass-rear, release, and establish the

Hieracium gall midge adult

plume moth (*Oxyptilus pilosellae*) and the root- and crown-feeding hover flies (*Cheilosia* spp.)," concluded Lindsay. The plume moths have steadfastly refused to perform for us in captivity and it has been difficult to obtain decent nucleus populations of the hover flies from Switzerland. These kinds of teething problems are part and parcel of biocontrol, and with time, patience and money can usually be overcome.

This project is funded by the Hieracium Control Trust and a grant from the Ministry of Agriculture and Forestry's Sustainable Farming Fund.

New Contact Details

Over the Easter break Landcare Research pulled out of its old premises at Mt Albert and moved into its new purpose-built "environmentally friendly" facility at Auckland University's Tamaki Campus. Consequently some contact details have changed. The postal address remains the same (Private Bag 92170, Auckland), but the physical address is now 261 Morrin Road, Tamaki, Auckland. All email addresses are unchanged. The new phone number is 09 574 4100, and the fax number is 09 574 4101. Individual staff can also be contacted directly, as follows:

Seona Casonato – 09 574 4161
Alison Gianotti – 09 574 4158
Helen Harman – 09 574 4128
Shane Hona – 09 574 4159
Quentin Paynter – 09 574 4123
Nick Waipara – 09 574 4165
Chris Winks – 09 574 4119

Auckland weeds staff pose in front of their new premises

Margaret Stanley is housed in a separate building, the School of Geography and Environmental Science (room 304, building 733), and her address is Auckland University, Private Bag 92019, Auckland. You can call her on 09 373 7599 ext 86819, or fax her on 09 373 7042.

Hot Gossip

Pauline Syrett reports that last December when she and **Rowan Emberson** were climbing Gloriana in the Spencer Mountains, just north of Lewis Pass, they saw lots of **cinnabar moth** (*Tyria jacobaeae*) adults on the snow. "They were still alive, so we collected a few to sex them," explained Pauline. "Although I understood from work by Wren Green (in Canada, if I remember rightly) that females disperse only short distances, the moths we collected were all females (laying eggs in the tube we put them in!), and were kilometres from the nearest ragwort, and a long way from vegetation of any kind." Pauline and Rowan found the moths nearly all the way up, to over 2000 m. Perhaps passive dispersal of the moths is involved here but it is difficult to see how they would be blown so high. There were also a few moths flying around the bushline, and in the valley (Cannibal Gorge). "I guess it must have been a good year for cinnabar moth, but I certainly never expected to find them, females especially, in ice axe and crampons territory," concluded Pauline.

Richard Goldsbrough has been let out of school for a year to assist in the battle against weeds in New Zealand. Richard is normally based at Onslow College in Wellington but as the successful recipient of a **Royal Society Teaching Fellowship** he is turning his energies this year towards helping us and the Department of Conservation to find ways of enthusing school children about the menace weeds pose and things they can do to help. Richard will be spending some time at Lincoln learning the ins and outs of rearing and working with various biocontrol agents, as we hope this might be one activity that could be successfully transferred to the classroom.

Heather Beetle Blues

Heather (*Calluna vulgaris)* has run rife over an estimated 50,000 ha of the North Island's Central Plateau and is currently the worst weed problem in Tongariro National Park. It's also starting to worry people in other parts of the country including the Bay of Plenty. The heather beetle (*Lochmaea suturalis)* was first released here in January 1996. In Northern Europe the beetle causes significant damage to heather under a wide range of conditions. "We tried to introduce beetles that would be adapted to the climatic conditions on the Central Plateau by sourcing them from a number of locations in the United Kingdom," revealed Paul Peterson. Only material from Yorkshire has established. A grand total of 67 releases have been made but disappointingly only five releases so far seem to have established (see table).

At three sites (one at Tongariro and two at Rotorua) the amount of damage caused by large numbers of beetles feeding has been extremely promising, but at the other two Tongariro sites the beetles appear to be struggling. Feeding damage took 4 years to show up at the best Tongariro site, whereas damage at the two successful Rotorua sites could be seen after only a year or two.

Fate of heather beetle releases, March 2004

Location	Number released	Number of releases				Number established
		Adult	Egg	Larvae	Total	
Rotorua	250	3	0	0	3	2
Tongariro	10	11	0	0	11	
	100	4	2	0	6	
	132	1	0	0	1	
	200	1	0	0	1	
	250	12	0	0	12	1
	400	2	0	0	2	
	500	0	2	0	2	
	800	1	0	0	1	
	6056	0	0	1	1	
Waiouru	10	8	0	0	8	
	63	1	0	0	1	
	126	1	0	0	1	
	200	1	0	1	2	
	209	1	0	0	1	
	250	7	0	4	11	
	500	1	0	0	1	1
	525	1	0	0	1	1
	800	1	0	0	1	
Total		57	4	6	67	5 (7.5%)

> A grand total of 67 releases have been made but disappointingly only five releases so far seem to have established

The beetles released at the three successful Tongariro sites were newly emerged adults that had to survive a winter before they could get down to business. The two successful Rotorua releases comprised adults (which originated from Tongariro) that were ready to start laying eggs immediately. Almost identical releases made at Tongariro failed. None of the six releases of larvae at Tongariro appear to have established, and it is too soon to know the fate of the egg releases. As we have often found with other biocontrol agents it wasn't necessarily the largest releases that were most successful.

Despite a number of different release strategies being tried on the Central Plateau, establishment success rate has been poor (<5%) compared with Rotorua (67%). Also the much more rapid appearance of damage at the Rotorua sites suggests that something about the Central Plateau is limiting the heather beetles there. "Recent work has shown that we can rule out predation, parasitism and disease for now and that climatic conditions may be responsible for the poor performance," explained Paul.

Over the next few years we plan to take some beetles from the successful sites at Rotorua and release them into surrounding areas and some selected sites on the Central Plateau to see if we can improve establishment success. We will be making an effort to collect more detailed climate data from a number of these sites. If we can get establishment at milder sites, the beetles may be able to invade higher, more exposed, ground when conditions are favourable. It is possible that given time the beetles may adapt to conditions on the Central Plateau, but if all else fails and beetle numbers are not increasing, the last resort would be to look for beetles in continental Europe in areas with a better climate and latitudinal match to the central North Island.

This project has been funded by the Department of Conservation, the New Zealand Army, the Foundation for Research, Science and Technology, and Environment Bay of Plenty.

What Do People Really Think about Biological Control of Weeds?

There is still a widely held perception that scientists are people who have bad dress sense and a fondness for big words who hide away in laboratories doing mysterious and possibly dangerous things. This has persisted because scientists haven't traditionally been very good at talking to their communities about their research in an effective manner. They have either just gotten on with their research, assuming that they know best, or have avoided consultation with anyone but friendly stakeholders because it's too hard and scary (they might not tell them what they want to hear!), and because it uses up resources they felt would be better spent on research. When a community is left in the dark and feels unable to influence research directions then resentment and distrust can occur, and new technologies may not be adopted. Eventually everyone loses out. The Ministry for Research, Science and Technology has realised that this situation is occurring in New Zealand and needs to change. They set up a special fund in 2002 and asked for people to come up with some bright ideas for improving dialogue about science.

Landcare Research put in a bid to this new "Dialogue Fund" which was successful. During the past year Phil Lyver, Lynley Hayes and Chrys Horn have organised four hui to test a novel dialogue process involving aspects of tikanga Māori combined with Steven Covey's best-selling book and training programme "The Seven Habits of Highly Effective People". They organised two hui on a highly controversial topic, the use of 1080 poison to kill vertebrate pests, and two hui on a less controversial topic, biological control of weeds. "We decided to use a marae-based hui approach as this has traditionally been, and continues to be, the place where formal dialogue has occurred for Māori, and because it provides a neutral setting for individuals or groups to speak and allows all viewpoints to be acknowledged," explained Phil. The "Seven Habits" programme is something that Landcare Research has been working with for a number of years and suggests strategies for improving listening and understanding, and for tapping into the collective wisdom, imagination, and skills of diverse groups in order to come up with new and better ways of doing things.

Participants at the Matahiwi hui

"We invited as wide a range of stakeholders as possible to participate in these hui," said Lynley. For example at the biocontrol of weeds hui there were representatives from iwi, regional councils, the Department of Conservation, MAF Biosecurity Authority, ERMA, New Zealand Beekeepers Association, Nursery and Garden Industry Association, Forest and Bird, Association for Women in Science, Forest Research, Landcare Research, Lincoln University, Canterbury University, Federated Farmers, organic farming, and forestry. After being welcomed onto the marae everyone was given the opportunity to explain what he or she thought about the topic. Points of clarification could be asked but people were not allowed to challenge others on their viewpoints. In the evening social events were organised to allow dialogue to continue well into the night and for participants to learn more about Māori culture and history before sleeping-over in the wharenui.

On day two participants were reminded about how to listen effectively. Then, where possible, people with opposing viewpoints were paired up and given an hour to go away and prepare to present the other person's viewpoint faithfully back to the wider group. The experience of "walking in someone else's moccassins" can change people's perspectives on issues and is far more constructive than plain arguing or trying to bully someone into seeing things your way. By lunchtime the group had a much better grasp of all the issues surrounding the use of biological control of weeds or 1080 and was then able to work together to creatively come up with ideas for addressing any problems and for future research.

Some of the messages that came out of the two hui on biocontrol of weeds were:

- People are generally supportive of the use of biocontrol of weeds. They like the idea of natural control but are not so keen that this involves introducing exotic organisms. People find terminology such as "biocontrol" (biosecurity, biodiversity, biotechnology, bioterrorism etc.) a bit daunting and it may be better to find more friendly descriptors, such as perhaps "natural control".
- Many people are keen to minimise the use of chemicals. They also want to have a wide range of weed control tools at their disposal, and some new and better tools are needed (and this could involve genetic engineering).
- There is not universal agreement over which plants are weeds and people want to know more about how projects are chosen and have more say in what targets are tackled for biocontrol. Consultation processes in New Zealand at present don't tend to involve asking people for input at an early stage; instead they tend to either involve dumping a whole lot of information on people or are "box-ticking" exercises. Many stakeholders do want to be involved in true consultation and may not be able to participate for free. Meaningful consultation takes time. People want cultural, spiritual, and economic values and traditional knowledge to be taken into account, not just scientific values. Scientists' view of the world can be too narrow. Values can change and we need to be mindful of the legacy we are leaving for generations to come.
- Some in the nursery industry would be prepared to sacrifice some of the plants they sell in order to control closely related weeds. Also, beekeeping is not necessarily compromised by controlling weeds in this way since the weeds do not disappear completely.
- Safety is of paramount importance. Robust procedures are in place for controlling the importation and release of biocontrol agents. Follow-up must be done on all biocontrol agents. If there are failures people want to know about them (scientists must be honest and tell the bad news as well as the good news) and we need to try to learn from mistakes and failures. Success should be defined at the start of projects. Even if 100% guarantees can't be made about effectiveness, people want 100% guarantees about safety. People want more information about all aspects of biocontrol and especially regarding expectations.

Scientists must be honest and tell the bad news as well as the good news

Simon Fowler gets to swap notes with Morry Black (Taiwhenua ki Heretaunga).

"Landcare Research's biocontrol team has taken on board these messages and will be thinking about how to address them," explained Lynley. "All participants agreed that the hui were a really good initiative and allowed meaningful dialogue to take place in a safe, constructive and stimulating environment," concluded Chrys. "We will be working to fine-tune this process in 2004/05. One challenge will be to find ways of involving some of the more grass roots type stakeholders who are more reluctant or less able to take part in these kinds of dialogue processes."

Phil, Lynley and Chrys sincerely thank all the people who gave up their time to participate in these hui – we learned a lot from you! Thanks also to Rau Kirikiri and Here Wilson who acted as cultural facilitators and Wendy McPhail who was our "Seven Habits" facilitator. Finally we thank the people at Tuahiwi, Takahanga, Wairaka and Matahiwi for so generously allowing us to use their marae and for being such great hosts.

Biological Control of Broom – Is It Worth It?

For most of us it is hard to imagine that weed control could be seen as a negative thing, but in certain circles some weeds are regarded as quite useful (see *Disagreements, Delays and Big Decisions*, Issue 26). So if we are going to evaluate the overall likely impact of weed control then we need to consider both the positive and negative effects. This kind of evaluation has recently been done for broom (*Cytisus scoparius*) and a report on the economic costs and benefits to New Zealand of broom biological control is now available. "This report will be used to support an application to import a new biocontrol agent for broom, the leaf-feeding beetle *(Gonioctena olivacea),"* explained Quentin Paynter, one of the authors of the report.

A snapshot of the problem: broom-covered hillsides on the Port Hills above Lyttelton

This prospective new broom agent can be commonly found feeding on broom foliage throughout Europe. Both the adults and larvae damage the plant and large numbers can completely strip a plant of all its leaves. Seedling plants are particularly vulnerable to the beetle's attack. The broom leaf beetle seems to have lot going for it except for one small hitch – it is likely to also attack tree lucerne (*Chaemaecytisus palmensis*). Although tree lucerne is considered weedy by some, others plant it for forage and to improve soil stability. An application to release this beetle was made in 1997 to the Ministry of Agriculture and Forestry (before the Environmental Risk Management Authority (ERMA) had been set up) but was declined on the grounds of lack of information about likely economic consequences of releasing this beetle. So we set about collecting this information.

The first step was to identify the groups likely to be positively or adversely affected. Land managers, including regional councils and the Department of Conservation, and the farming and forestry industries would all benefit from saved chemical or mechanical broom-control costs. The farming sector would also benefit from increased farm production, due to land presently covered in broom being made available. The forestry industry would also gain from increased production in dry areas of the South Island, where broom is a serious competitor with young pine trees. The groups that could be adversely affected by the introduction of an agent that might attack tree lucerne are those that grow the plant for forage or soil stabilisation. Beekeepers that use broom as a spring food source may also be negatively affected by the introduction of this beetle.

The next step was to consult the affected groups about the market value of the direct costs and benefits that they would be likely to incur. Saved weed control costs across all sectors added up to between $1.093 and $4.634 million per annum, depending on the level of broom biological control achieved (see below). The costs to beekeepers, such as having to move hives or provide a pollen substitute, ranged from $1.178 to $2.408 million per annum. The cost of having to protect tree lucerne from broom leaf beetle attack, should it prove to cause serious damage, was calculated as $0.225 to $0.450 million per annum. Secondary effects, such as additional employment due to increased productivity of farmland, were not included in the assessment. Nor were benefits that are difficult to put a value on, such as improved access to rivers and enhanced natural values. The potential impact of the beetle's introduction on native pigeons (kererū), which feed on tree lucerne, is also hard to measure and was therefore also not considered in the report.

The costs of establishing the broom leaf beetle were taken into account. It is estimated this would take about 5 years and cost about $500,000. "This does not include the cost of research already undertaken, such as host-testing and life cycle studies," explained Quentin. It is expected it might take about 20 years for the beetle to become widely established throughout New Zealand and build up damaging populations.

Then three possible biological control outcomes were considered: a 25%, 50%,

and 95% reduction in broom. These scenarios reflect the uncertainty of the contribution to broom control that the leaf beetle might make. "The good news is that final calculations show a positive economic return for all three levels," revealed Quentin. Even if broom was only reduced by 25% the benefits of the programme outweigh the costs (resulting in savings of $0.573 million net annually). A 95% reduction of broom, which is less likely as it represents almost total broom control, would result in $10.135 million net savings annually.

A weighted average was taken from the total costs and benefits for each of the three scenarios allowing a probability value for each level of control to be incorporated into the final estimate. This gives a more realistic figure as it takes into account varying levels of broom control in different areas. This best estimate shows a net annual benefit to New Zealand of $3.761 million.

Using discounting techniques over a future period of 50 years, these calculations show the introduction of the broom leaf beetle could provide a high return on the money spent getting it established in New Zealand (internal rate of return = 49%). The net return on the initial investment is calculated as $36.7 million in today's dollars, if the interest rate was 5%. These calculations show that it would be economically beneficial to New Zealand to introduce the broom leaf beetle even if tree lucerne is attacked and beekeepers are negatively affected.

The broom leaf beetle could provide a high return on the money spent getting it established in New Zealand

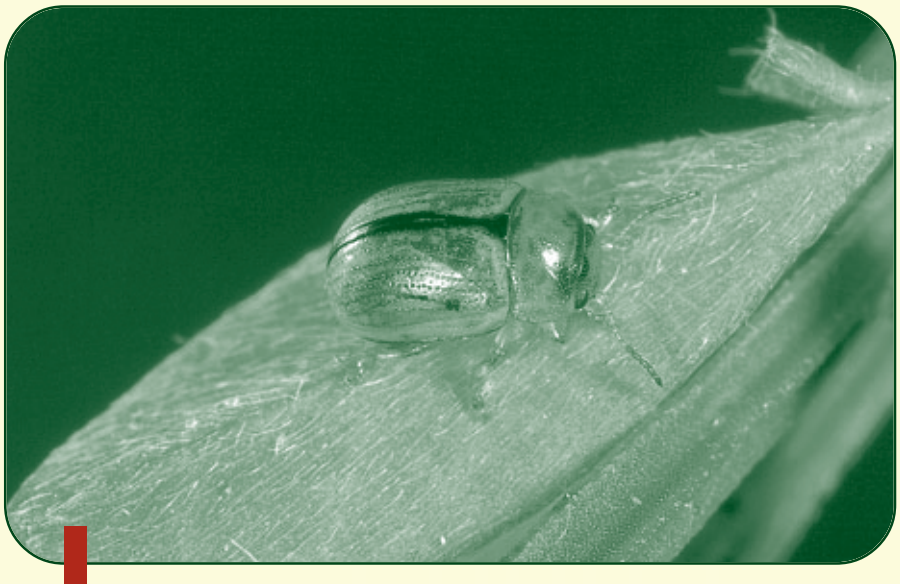
Reference: Jarvis, P.J.; Fowler, S.V.; Syrett, P.; Paynter, Q. 2003: **Economic benefits and costs of introducing a biological control agent, *Gonioctena olivacea*, for broom.** Landcare Research Contract Report LC000/034 (*This report is available electronically from Quentin Paynter (paynterq@landcareresearch.co.nz).*

What Other New Agents Might There Be for Broom?

As far as new broom agents go we are also interested in a stem-tying moth (*Agonopterix assimilella*) that is found throughout Western Europe. The larvae of this moth initially feed inside the tips of developing stem buds and then on the leaves. They make themselves a hideaway by attaching individual leaflets to the stem using silk, and this is where medium-sized larvae spend winter. After winter, large larvae can cause extensive damage as they feed on the green broom stems as well as leaves. Mature larvae pupate in the soil at the base of the plants. Adult moths remain inactive for up to 2 months over summer, prior to laying eggs (which proved somewhat of a surprise for researchers when they were trying to breed them for the first time, but is probably a useful adaptation to ensure survival). Testing shows that the host-range of this moth is restricted to the tribe Genistae, e.g. broom, Montpellier broom (*Genista monspessulana*) and gorse (*Ulex europaeus*). This means native New Zealand plants are unlikely to be at risk, but again tree lucerne may be attacked by this species.

We are also interested in a mite (*Aceria genistae*) that forms galls on broom shoots. It establishes colonies at the base of stem buds and through its feeding causes growth deformities that result in rounded galls. Overlapping generations of mites live in these galls during spring and summer. In late summer and autumn the galls wither away and the mites move into dormant stem buds for the winter. In its native range, attack by this mite over successive years can lead to stunting of broom, reproductive failure and plant death. *Aceria genistae* is thought to comprise a complex of closely related species or forms of mites. Testing of mites collected from broom suggests that they are very host-specific, and can only develop galls and survive long term on broom.

We are seeking funding to put together an application to ERMA to import all three new agents.

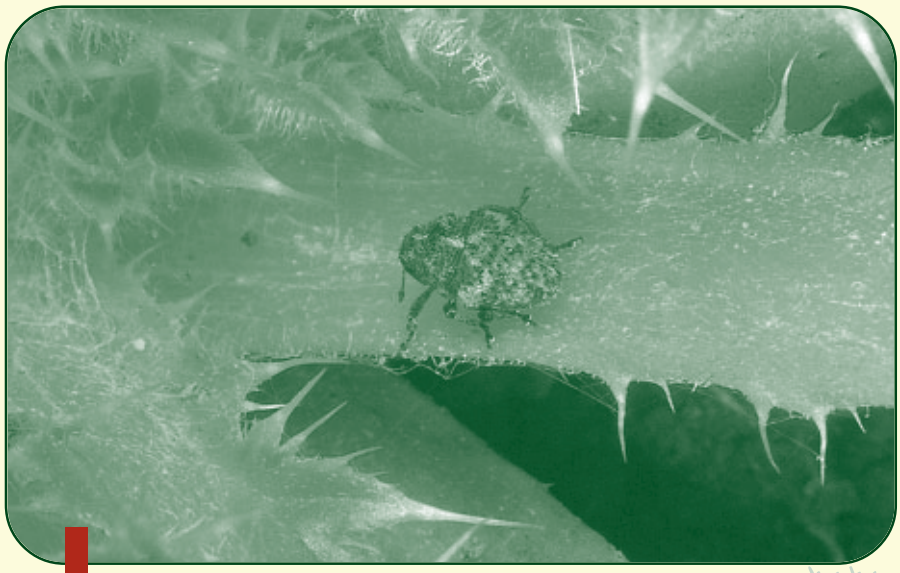


Broom leaf beetle

Winter Activities

Winter is the time when most biocontrol agents are not very active or visible so there isn't much work that you need to plan to do on the biological control front at this time of the year. However, you can still:

- Check nodding thistle crown weevil (*Trichosirocalus mortadelo* formerly *horridus*) release sites. Some weevils lay eggs all year round, but the bulk of them begin to lay in the autumn and the damage to the rosettes becomes more noticeable as the winter progresses. As the grubs feed in the crown, they produce a black waste substance (frass), and the ribs of the surrounding leaves take on a reddish-brown colour at the base. The leaves of damaged rosettes become less prickly and start to look a bit like dandelion leaves. You may see rosettes that look like this at any time of the year, but the damage is usually most obvious later in the winter and in early spring. If you dig a damaged rosette out of the ground and cut it in half with a pocket knife, you should be able to see the white grubs feeding inside. As well as nodding thistles (*Carduus nutans*) the weevil also attacks cotton (*Onopordum acanthium*), marsh (*Cirsium palustre*), plumeless (*Carduus acanthoides*), Scotch (*Cirsium vulgare*), slender-winged (*Carduus pycnocephalus*) and winged (*Carduus tenuiflorus*) thistles, so look out for damage to these plants too. Crown weevils can often be harvested and shifted around as late as June.



Nodding thistle crown weevil

- You may still be able to shift ragwort flea beetles (*Longitarsus jacobaeae*) around, provided you can find them in good numbers.
- Make sure all paper work relating to release sites is up to date. If you have been shifting agents around then we would be interested to know about this (send information to Lynley Hayes).

Contact Addresses

Lynley Hayes, Chrys Horn, Phil Lyver, Lindsay Smith
Landcare Research
PO Box 69
Lincoln 8152, New Zealand
Ph +64 3 325 6700
Fax +64 3 325 2418

Quentin Paynter
Landcare Research
Private Bag 92170
Auckland, New Zealand
Ph +64 9 574 4100
Fax +64 9 574 4101

Paul Peterson
Landcare Research
Private Bag 11052
Palmerston North, New Zealand
Ph +64 6 356 7154
Fax +64 6 355 9230

Richard Goldsbrough, email: rgoldsbrough@doc.govt.nz
Pauline Syrett, email: rockview@actrix.co.nz

PAPER STOCK
Onyx Recycled 135gsm
100% recycled
This newsletter was printed using vegetable inks.

Editor: **Lynley Hayes**
Thanks to: **Christine Bezar and Julia Wilson-Davey**
Layout: **Kirsty Cullen**
Email: surname+initial@landcareresearch.co.nz
Web: http://www.landcareresearch.co.nz

This newsletter is available on our website.