

Report on observations during SFF project L11-172 'Green thistle beetle monitoring to spread the biocontrol attack on Californian thistles' (July 2011-June2013)

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The initial releases

The green thistle beetles (*Cassida Rubiginosa*) were first released near Lawrence in November 2007. The first Southland release was a few days later in the Hokonui Hills near Browns.

There have been 31 releases in Otago (mostly South Otago, but 3 on the Otago peninsula, 2 near Oamaru, and one in the Mt Aspiring area); also 14 original releases in Southland, and one in the Horizons Regional Council area. These releases were all made under SFF project 05-010 between November 2007 and January 2011.

All these 46 releases were co-ordinated by the Californian thistle group, an associate group under the Clutha Agricultural Development Board, which has been active in biocontrol programmes for Cali thistles since 1999.

Also over this time Landcare Research raised further beetles that were distributed largely to Regional Councils in other parts of the country, e.g. Wellington, Bay of Plenty, Manawatu, Rangitikei. These were not part of this project's monitoring programme.

Aims and activity of this project L11-172

For the current project L11-172, the aims were:

- To monitor the beetles' progress at the release sites over the two recent summers.
- To see how well they have established and where they have established best.
- To see, if there are large beetle populations developing at some sites, that these beetles are harvested and re-established on other farms 'to spread the attack' on thistles as per the project title.
- To establish a record of the release sites that can be used well into the future and as a basis for further work on Californian thistles which continue to be New Zealand's most damaging pastoral weed.

The project team was able to go back to 30 of the 31 Otago sites, and with the support of Environment Southland's biocontrol contractors to 9 of the 14 Southland sites. Support from farmers throughout has been tremendous. Almost all are sticking to the initial informal agreement to avoid heavy grazing and spraying around the release sites. The beetles have to survive and adapt to current farming procedures in order to be widely successful and so we asked no more than this.

Two of the initial sites have been destroyed by re-development but even here, the beetles may have safely moved on. Finding these would have involved a larger scale search than the finances of the project allowed.

All other Otago sites were surveyed, mostly between late December and January in both of the two summers 2011-12 and 2012-13. A search was made from each initial release site outwards, generally involving firstly a close inspection of thistle plants in a 20m radius. We then had the general aim to look 50m and then 100m away from the release point. This idea had to be adapted, in light of the number and location of thistle plants within the wider area. An inspection of every plant was not feasible, so we thought it most sensible to look where we thought the beetles may have extended their range to. This may have been towards the next most promising patch of thistles, or downwind of the initial site, or towards the fence-lines in now well-grazed pasture or for some other site-specific reason. We believe that this enabled us to come to a reasonable conclusion as to how well the beetles had established at each location.

Sightings of beetle eggs/ larvae/ adults were noted. Our initial search was always for the distinctive feeding 'windows' (not holes) that identify the beetles' presence. As well as looking primarily at the Calis, we did inspect Scotch and Nodding thistles also.

The monitoring data achieved

Our two summer surveys in this project have resulted in tables for Otago and Southland which indicate our observations of beetles, eggs or larvae on the one hand and the evidence of beetle feeding through the windows on leaves. We have indicated sightings of the beetles, eggs and larvae with a star each, and categorised feeding evidence as 'minor', 'significant' or 'extensive.'

We also made a subjective judgement as to the extent of the thistles around the release site now in relation to what the site was like at thistle beetle release time. Photographs we have taken at each visit have been hugely helpful in supporting these judgements.

The tables for Otago and Southland are attached to this SFF report.

Analysis of our observations

The indication that many of our 'nursery site' farmers have been impressed by, and that all farmers would be interested in, was that at 87% of the reviewed sites in Otago and Southland there were fewer thistles than at their respective releases. When the release sites were identified and set up, farmers took us to at least one of their most troublesome thistle patches. In almost all cases, in the summer of 2012-13 these patches were no longer as troublesome.

We judged that at 63% of sites the thistle mass reduction could be described as significant or extensive. At three of our 38 applicable sites (8%), the thistles have basically disappeared altogether – from one of a farmer's worst patches to none! At 25% of sites there was 'extensive' or complete reduction of the thistles.

We hasten to add that there is no indication, and no science to show that the green thistle beetle has caused this situation. We have never seen wholesale feeding or the type of destruction of the plant's biomass as was observed in the secure glasshouse conditions when they were being bred by Landcare Research. If it is a co-incidence, then it is surely still one worth investigating.

We observed evidence of feeding (the distinctive 'windows') much more than we sighted the beetles themselves or their eggs and larvae. We did see beetles 'sunning themselves' at the tops of plants and our Southland supporters believe that the beetles are adept at dropping off leaves to the protective

grass below at the indications of a possible predator (i.e. us). At perhaps four or five sites over the two summers we observed the beetles mating, and we have observed their mating on a scotch thistle plant on at least one site. Photos of the beetles, their larvae and eggs were taken where possible, but we probably didn't have the quality of camera to take brilliant close-ups in these situations.

The evidence of feeding was much more widespread than sightings of the beetles. We saw this evidence at a fairly consistent 74% average of sites over the two summers. The evidence that we judged as significant or extensive was at 36% of sites in 2011-12 and 19% of sites in 2012-13. This decline in feeding percentage overall could be evidence that the populations are dropping off over the years. There is, however, no such trend when we looked at the windows evidence in relation to the year in which they were released. Taking beetle sightings and windows evidence together, at 41% of the sites, there was more observed in the second summer than the first, and this was the case at just as many of the earlier releases (2007-09) than the later releases (2010-11). At 31% of sites observed beetles and windows was approximately the same, and at 28% of sites there was a reduction. We stress that these numbers are made on very general observations – still they were done with consistency by experienced observers.

An aspect of our observations that caused great interest was the question of how far they had spread from the respective release sites. We had a general procedure for a search as explained above, but we needed to be flexible in the field to try to find evidence if we could. We tended to attempt to 'follow a trail' at the sites where we did find good initial evidence around the release site.

We have an observant farmer near Lawrence to thank for our best find in terms of the beetle's distance travelled. On a casual look he found the windows evidence when topping near his house. This was later checked at 1.9kms from the initial release site and this was five years after release. They have also been seen at 1.6kms near the farmer's barn. A really close inspection of this property in December 2012 found windows and beetles at different points around a 120° arc from the release site. Again on a casual look on the roadside on the way out of the property the observing team found beetles and larvae along the fence line and roadside grasses.

Another site, the 'first release' site in Southland in December 2007, has always been promising with beetles, larvae and eggs found at almost every visit. It was here again eating lunch in the car park some 0.8-1.0kms from the release site that we found three mating pairs on one scotch thistle plant. As well as good population numbers, the farmer here reports a 50% reduction in thistles in a three year period.

The most remarkable report of the distance travelled by the beetles is from the Wanaka area. The March 2010 release site is now devoid of thistles (95% gone) and the windows-feeding evidence has been seen 300m in one direction, and also 2.7kms and approx 5kms up the particular valley. The situation at this site, we believe, defies current explanation.

Our "best sites"

It is certainly debateable whether our "best sites" were the ones that showed a complete reduction in thistles (3/38, 8%) or the ones that had large numbers of beetles, larvae and eggs on at least one of the observation days in one of the summers (another 3/38, 8%).

It is certainly interesting that the three 'thistles all gone' sites had releases in December 2007, February 2010 and March 2010 – they were not all early ones. However, the 'great population' sites were all part of the first releases in November & December 2007 and they are in both Otago and Southland.

Questions raised by the observations and the analysis

We were always curious as to why, especially when we saw significant feeding, we could not see any evidence of the beetles, eggs or larvae themselves. How come it appears the beetles are or have been present but are not sighted? What is the nature of the beetles' daily habits?

What is happening to the thistles in the field when minor feeding appears to be associated with a thistle population collapse? If the answer to this question could be found and replicated, there would be huge benefits for all farmers.

Were there any particular conditions where the beetles appeared to do well? We did notice a strong relationship between sites just in Otago that had trees (forest, plantation or shelterbelt) nearby (approx. 30m) and the 'loss of thistles' estimation. 83% of sites with the trees nearby had a thistle reduction estimated at 'significant' or 'extensive' compared to 76% overall for Otago. Perhaps more noticeably, on the 12 visits that beetles, larvae or eggs were seen, 10 of them were on sites with the trees nearby. That is, 83% of successful observations of beetles were on the 43% of the site visits to 'trees nearby' sites.

We certainly got considerably variable results in trying to determine how far and in what directions that the beetles were likely to fly. On 5 of the available 27 sites in Otago on the second summer's monitoring, beetle feeding evidence was observed at least 200m or more away from the release site. The two most notable stories in relation to the extent of their movement are outlined above.

There appeared to be little consistency also in which direction they flew from the release sites. We searched down-wind, down valleys, towards the trees and in all compass directions. No particular pattern was observed. Perhaps surprisingly they were found up-wind as well as down-wind. This may in time make further observations more difficult. Then again, the 'best' site in Otago in the 2011-12 searches, with beetles, larvae and eggs too numerous to count, was actually under pine trees still at the release site. They hadn't moved more than 30m in 5 years!

We suggest we also need to know more about the beetles reproductive actions and cycle. How easy is it for them to find a mate – especially where there has been wide dispersal?

Most of our releases were, in fact, late summer or autumn ones. How do the spring and autumn releases compare? There probably isn't a large enough sample, but the three sites where we have seen the most significant numbers of beetles at all stages are all from spring releases. Of the 9 sites which report extensive or virtually complete thistle reduction, three are from spring releases.

When we were searching for the windows feeding evidence in January or even earlier, we were often faced with thistle plants where the lower & younger leaves had deteriorated with age or had been infected with a fungus or pathogen. Could this deterioration have destroyed early spring thistle leaf feeding?

Are the beetles acting as a conduit to fungal pathogens, perhaps the rust fungus *Puccinia punctiformis* or *Sclerotinia sclerotiorum*, and helping to weaken emerging plants? Is this a possible explanation for the general reduction of thistles at release sites? Do the beetles actually move from plant to plant enough to make this explanation even remotely plausible? Much more science enquiry is required here.

Next steps

We believe that we have found strong evidence of significant survival of the green thistle beetles from 2-5 years after release.

Indications from a few of our monitored sites are that this biocontrol agent could be very successful in the long term in New Zealand farmers' battle with Californian thistle.

We believe that there are considerable questions to be studied soon if we are to make the most profitable use of this agent. It is doing well but we need to put some scientific endeavour behind making sure this promising start to the campaign results in the best possible outcomes.

It would be careless for us to abandon this agent to the chances of nature just yet, just at the point that a little more support might confirm its success. Further successful management of Californian thistle may well be one of the easiest ways to increase production and add dollars to the bottom lines of farmers wherever it can be achieved.

The Californian thistle group, as an associate group of the Clutha Agricultural Development Board, will continue its interest, but without supporting funds its activities will be very limited.

We acknowledge the support of Environment Southland and their biocontrol contractors in Jesse Blythell and Peter Ayson for their work in the field for the project. We also acknowledge the co-funding of Beef + Lamb New Zealand to support this important work.

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