Project Update – July to December 2017

RESEARCH HIGHLIGHTS FROM THE PAST FEW MONTHS

- Marlborough Research Centre's Specialty Wood Products (SWP) work programme has included a survey of the performance of naturally durable eucalypt posts in Marlborough vineyards.
- Growth and form assessments have been completed of 7 year old *E. bosistoana* planted at Avery's in south Marlborough.
- An assessment of flowering was completed in 6 year old *E. globoidea* at Atkinson's in Wairarapa.
- Results from wood quality assessments using cores extracted from *E. bosistoana* breeding populations are identifying top families for selection.
- Proseed has found significant variation in clonal propagation by coppice between *E. bosistoana* families.
- UC's entomologists have continued to assess the impact of EVB in NZDFI's Hawke's Bay trials.

NZDFI's SWP Tree Improvement Programme update

from Paul Millen and Ruth McConnochie

Performance of naturally durable eucalypt posts in Marlborough vineyards

Since 2003, Marlborough-based Vineyard Timbers Ltd has been working to develop a new hardwood industry based on home-grown, naturally durable timber posts for use in vineyards. Between 2006 and 2009, around 1400 posts were supplied to six vineyard owners in Marlborough's lower Wairau Valley to see how the posts would perform in service. The vineyard owners were keen to trial an alternative to the CCA-treated radiata pine posts commonly used in New Zealand's vineyards.

During winter this year a research project was completed that included a survey of the six vineyards where the durable vineyard posts had been installed. The survey had two aims:

- to gauge the vineyard owners' experience and opinion of the posts' performance.
- to test the posts for in-ground decay, and identify reasons for breakages or other poor performance in situ.

Most of the posts have been in use for the past 9-11 years. In general they were found to be performing well, with low levels of decay and minimal breakage. Vineyard owners and managers gave valuable feedback on their performance compared to various other types of posts available.

A full report of the Marlborough Vineyards survey is available on the NZDFI website www.nzdfi.org.nz:

Performance of naturally durable eucalypt posts in Marlborough vineyards. Millen, P and Altaner, C (2017). Publication No: SWP-T039, Specialty Wood Products Research Partnership, Rotorua, NZ.

2010 *E. bosistoana* breeding population growth and form assessment at Avery's

This is the last of our three 2010 *E. bosistona* breeding populations to be assessed for growth and form. Due to this being the driest of all our trial sites, the trees on the upper slope were affected by drought and wind exposure and were not fully assessed. However, the site has remained free of competing weeds with areas of high survival and good growth. See Figure 1 below.

Figure 1: E. bosistoana breeding population planted 2010 at Doug Avery's farm in Grassmere, which is one of NZ driest environments.

The diameter range of the trees is 30mm – 78.4mm with an average of 55mm. Trees with a DBH less than 30mm were recorded as too small. The mean family values for growth and form traits at the 3 trial sites of the 2010 *E.bosistoana* progeny trial are summarised in Table 1.

	DBH			Mean Straightness	Mean Form
	Min	Max	Mean		
Martins	44.6	94.1	62.8	3.6	3.2
*Cravens	63.6	138.7	86.0	4.5	5.4
Avery	35.6	78.4	54.8	2.8	3.6

Table 1. Family mean values for growth and form traits.

The growth at the Avery site is the poorest of all our trial sites and these results confirm the effects of the low annual rainfall and exposure at this site.

The mean values at the Cravens Rd are significantly higher. This site is well drained with fertile alluvial stony silt and has been thinned to remove small and poorly formed stems. This influences the direct comparison of trait values with the Martins and Avery sites shown in Table 1. However, an across-site analysis of the data from the 3 sites will produce a combined family ranking. The best families and best individuals within these families will be selected for grafting and be added to the *E. bosistoana* clonal seed orchard that Proseed has already established at Amberley with the top selections from NZDFI's 2009 breeding populations.

Flowering assessment of six year old *E. globoidea* at Atkinson's

The trial at Atkinson's includes 105 open pollinated families of *E. globoidea* planted in 2011. Following an assessment for growth and form in 2015, family and individual tree breeding values were calculated to derive a ranking of the families that was used to select the best 49 individual trees from across the top 38 families. Scion wood was collected in January 2016 and this is under propagation by Proseed to produce stock for a grafted seed orchard that is planned for planting in 2019.

In addition, this breeding population has been identified for management as a seed stand to boost early improved seed supply from the NZDFI breeding programme. Therefore, the timing of flower receptivity of our selected trees needs to be identified to ensure that out crossing between these elite selections is possible within the breeding population and within a seed orchard of grafted elite tree selections.

The Operations Manual of the CSIRO Australian Tree Seed Centre records *E. globoidea* flowering in April to November. Other Australian sources cite it as being April to June.

An initial flowering study at Atkinson's site has been underway since June to record the flowering of the 49 individual elite trees selected in January 2016. While not yet complete some key observations at this stage include:

- 29 (76%) of the 38 families have initiated flowering by displaying formation of buds in one or more the elite individuals with some trees having already fully flowered and set seed capsules.
- As in the earlier Marlborough study, during the past six months flowering and capsule development has occurred at different times between the individual trees i.e. not concurrently.
- The period of anthesis (when the flowers are open and receptive) varies from about 6 weeks for a few individuals while other individuals have been flowering continuously throughout the last 6 months.
- Bellbirds and honey bees were observed feeding in profusely flowering trees and could be important pollinators.

Figure 2: E. globoidea in full bloom - 2011 breeding population Atkinson.

Further flowering observations are planned in January and February 2018, and may continue into the autumn. A geographic analysis of the location of the original 'mother' trees will be undertaken to determine if there is a 'provenance' influence on the timing and length of anthesis.

New demonstration trials planned for 2018

NZDFI is collaborating with some of the SWP investors and farm foresters to plant new demonstration trials in 2018. Sites are currently being identified that will extend NZDFI's regional demonstration trial network into regions beyond the 30 trial sites planted from 2010-2016 to include sites in central Bay of Plenty, Manawatu and possibly Northland.

The Class 1 and 2 durable eucalypt species listed below will be included in all or some sites dependent on each site's soil and climate.

E.bosistoana
E.cladocalyx
E.globoidea
E.macrorhyncha
E.*quadrangulata*
E.tricarpa

All or a subset of the species will be planted at each site in a 49, 64 or 100-tree species randomised block design, with 3 replications per site. Seedling production is contracted to Morgans Rd Nursery, Blenheim.

In addition, UC and Proseed NZ are currently engaged in SFF project 407602 that includes testing cuttings to produce clonal *E. bosistoana*. While they are having mixed results there will be some cutting grown stock produced in sufficient quantity to be included at a select few trial sites to test the efficacy of clonal deployment and to evaluate the growth, form and growth strain through comparison with the *E. bosistoana* seedlings in these trials.

Wood quality research update

from Clemens Altaner

1. **Heartwood**

   Only heartwood is naturally durable, a wood property central to NZDFI's envisaged ground durable products. Therefore, trees should not only have a large proportion of heartwood but also heartwood, which is of good quality. As natural durability is difficult/time consuming to measure NZDFI is screening the breeding population for high extractive content.

   Extractives are the key factor in providing natural durability and can be quickly measured by NIR spectroscopy on tree cores. The prerequisite is the establishment of a correlation between wet-chemical extractive content measurements and NIR spectroscopy.

   We have by now developed calibrations for 3 NZDFI species: *E. bosistoana*, *E. argophloia* and *E. globoidea*. With this technique, we are now able to quickly assess the extractive content in heartwood of these species from tree cores with an accuracy of ~1%. This accuracy is sufficient as the extractive content in heartwood of NZDFI species was found to vary between 2 and 20%. Figure 3 shows the correlation between the NIR predicted and wet-chemically measured extractive content for *E. globoidea*.

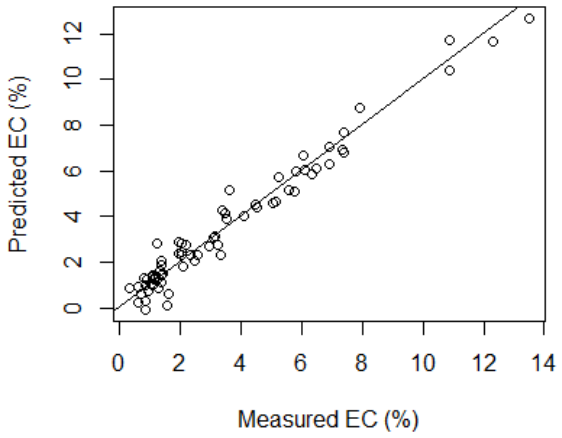

Figure 3: Measured value of extractive content (EC) of E. globoidea heartwood against the NIR predicted EC.

We are now using these models to screen NZDFI breeding trials for heartwood quality. First assessments of E. *bosistoana* breeding trials indicate that extractive content is under genetic control and therefore can be improved through selection. Figure 4 shows the breeding values for 40 families on 2 sites. The influence of site appears to be stronger than for other traits, but families, which performed well in both sites, were present. These results contribute to the 1st selections of improved *E. bosistoana* plant material. This work will continue with assessing more species and breeding trials in the coming years. We will also start to investigate the environmental factors, which contribute to heartwood quantity and quality to inform site-species matching.

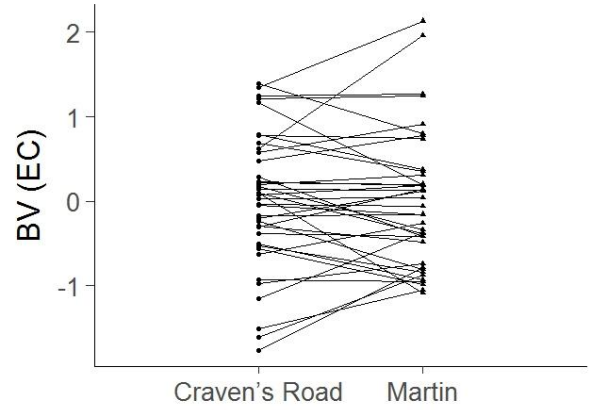

Figure 4: Changes of family rankings across sites for heartwood extractive content. Family values are expressed as deviation from the site mean. BV: Breeding value.

2. Growth strain

Eucalypts are known for high levels of growth-stresses. These pose significant challenges for solid wood processing, because when they are released during sawing the wood will warp or even split. Worldwide no viable technical solution has been developed to reduce growth-stresses. However, growth-stresses have been shown to be under genetic control and can be reduced through breeding. As growth-stresses are difficult to measure, this has prevented their inclusion in breeding programmes. However, UC has developed a novel quick test to assess growth-stresses in young trees by growing 2 year old trees in a nursery and cutting this to test for growth strain. We are using this method to screen NZDFI's *E. bosistoana*, *E. argophloia*, *E. quadrangulata* and *E. tricarpa* breeding populations and this year another 68 families of *E. bosistoana* and the first 13 families of *E. argophloia* have been assessed for growth-

strain and other wood properties. This year's data is consistent with last year's results from 81 *E. bosistoana* families (Figure 5). Growth-strain in *E. argophloia* trees was of the same magnitude as for *E. bosistoana*. Growth of *E. argophloia*, however, was slower having a similar diameter at age 3 years to *E. bosistoana* at age 2 years.

Another 22 *E. bosistoana* families and the entire NZDFI *E. quadrangulata* breeding population (84 families) will be assessed in 2018.

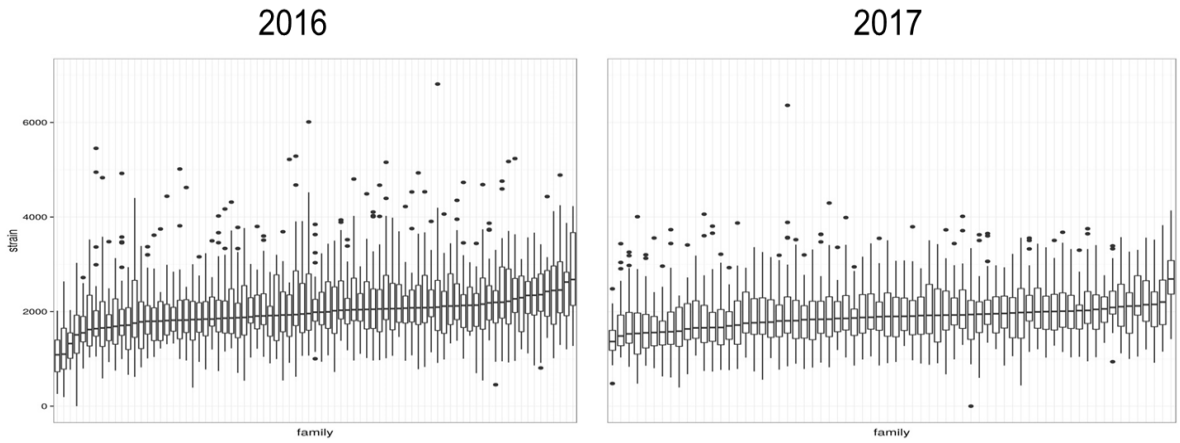

Figure 5: Rankings of E. bosistoana families for growth-strain at age <2.

3. **Proceedings for the Workshop Ground durable eucalypts: Protecting and enhancing value** are available online at: http://nzdfi.org.nz/wp-content/uploads/2017/10/Workshop-Proceedings_April-2017_Final.pdf

Propagation research by Proseed

from Paul Schroeder

Proseed is supporting the NZDFI programme with propagation of selected individuals by grafting and from cuttings. Selections from breeding population/progeny trials are being grafted for seed orchard establishment while selections from low growth strain trials are being propagated from cuttings.

E bosistoana: Around 170 ramets from 16 clones were planted spring 2015. About half of orchard positions are still vacant and will be filled with ramets from the next round of NZDFI selections.

E quadrangulata: Three hundred ramets from 28 clones were planted as an orchard in spring 2016.

E globoidea: This species has proved more difficult to graft resulting in insufficient plants to establish an orchard with all clones evenly represented and distributed throughout. Around 130 ramets of 30 clones were planted spring 2016 into an archive for further multiplication. *E globoidea* rootstock is being grown in anticipation of capturing new selections becoming available at the beginning of 2018. Earlier selections archived at Amberley will be re propagated in the summer of 2018/2019 when ramets are large enough to provide plenty of good, mature scions.

Cutting Propagation

Following encouraging results from pilot settings of non-select material in summer of 2015/2016, in summer of 2016/2017, as part of SFF project 407602, Proseed was tasked to produce 5-6 rooted cuttings from 1000 *E. bosistoana* low growth strain selections out of a trial hosted by Murrays Nursery in Woodville. Cuttings were taken from coppice shoots produced from stumps left after stems had been harvested for growth-strain testing.

By the time of cutting collection (February and March 2017) stools of 190 selections had died. Of the remaining 810 only 696 were collected since not all had produced material suitable for collection. Overall strike was 28% which included representation of 532 clones. Of those, 228 were represented by 5 or more ramets.

There was considerable variation within the low overall strike. While one third of clones produced nothing, 15% struck 60% or more. Cuttings were set in two tranches: late February and Late March. Strike from the March setting (34%) was higher than from the February setting (22%), likely due to installation of heating into the propagation environment from the outset of the later setting and to use of more concentrated IBA hormone than for the February setting (8gm/L vs 3gm/L).

Assessment of stools after winter (September), with a view to collecting more cuttings, revealed that stool mortality had increased from 19% to 29%. Existing shoots had grown little, there was no sign of any new coppice shoots and many stools were at risk of being overrun by difficult to control weed species.

While the quality of remaining shoots after overwintering was not good, in fear of losing any further propagation opportunity completely, a third collection was completed October 2017.

For the third collection protocols were put in place for two pest incursions: Myrtle Rust and Eucalyptus Variegated Beetle (EVB). Myrtle Rust has not been identified in Wairarapa but EVB is new in the trial site. Neither pest is established in Canterbury. Collection staff were briefed on both pests and signs to watch for. Most soft growth on which EVB lays its eggs was trimmed from collected shoots before packing Collected material was then sprayed with a mix of triadimenol fungicide (a standard Myrtle Rust treatment) and synthetic pyrethroid. Boxes of collected cuttings were sprayed with fly spray before closing. All waste material left after setting cuttings was bagged and burned. While a few EVB eggs, larvae and beetles did get through, larvae and beetles had already succumbed to insecticide treatment. All finds were gathered in a bucket of disinfectant before incineration.

Despite best efforts, the third setting is not performing well. A few cuttings are producing new axillary shoots, but most are shedding leaves and dying. It could be October was a little early to collect but most likely that the stressed and static state of shoots coming out of winter was not conducive to rooting.

Currently Proseed is preparing to collect and set material from Woodville cuttings rooted last summer. Being fresh, strong growth and setting at the beginning of peak season it is expected this will perform much better. Plant stumps will be grown on as stools to produce more cutting material. At least one additional setting is expected from this material.

A study conducted last summer demonstrated the importance of retaining basal shoots and foliage on stools when cutting them back. Nearly all plants cut back hard and trimmed to leave little or no foliage died.

More new material will become available from selections harvested at Woodville last September, hopefully within the peak setting season.

Figure 6: Well developed E. bosistoana coppice growth prior to taking cuttings.

Figure7: Rooted E. bosistoana cuttings.

The next phase of propagation work will follow the cutting and coppicing of the second tranche of a further 68 families of *E.bosistoana* and a total of 4,155 seedlings that were planted in November 2015.

Myrtle rust update

from MPI

Myrtle rust (*Austropuccinia psidii*) is a serious fungal disease that affects plants in the myrtle family. Plants in this family include a number of NZ native species including the iconic pōhutukawa and mānuka as well as eucalypts. Earlier in December the Ministry for Primary Industries (MPI) confirmed the latest positive infection in three ramarama (*Lophmyrtus bullata*) plants in a Hutt Valley garden.

While MPI have made a huge effort to contain infection where it is found they have stated they are also having to plan for the possibility that it turns out to be widespread and they are considering moving to a longer-term approach to manage myrtle rust in partnership with others, including local authorities, iwi and hapū, the plant production industry, and interested individuals and groups.

In the meantime, MPI encourages everyone to keep an eye out for the disease in myrtle species. If you think you've seen any signs of myrtle rust, don't touch it, take a photo and call 0800 80 99 66.

For more information go to MPI's web site:
https://www.mpi.govt.nz/protection-and-response/responding/alerts/myrtle-rust/

Update on Eucalyptus variegated beetle assessment in NZDFI's Hawkes Bay trials

from Tara Murray and Satoru Kuwabara

EVB defoliation and parasitism survey

The Australian eucalypt defoliating beetle *Paropsisterna variicollis* (EVB – Eucalyptus Variegated Beetle EVB) was detected in the Hawkes Bay in March 2016. In January 2017, University of Canterbury PhD student Huimin Lin assessed the impacts of EVB on 11 durable eucalypt species at three NZDFI sites (Lin et al., 2017).

In addition to assessing relative defoliation on the different species, Huimin observed that some beetle eggs appeared to be parasitised (Fig. 1), but as the beetle was under an active MPI incursion response, she could not collect eggs to confirm the parasitoid's identity.

To follow up on these observations, Satoru Kuwabara, who has just completed a Batchelor of Forestry Science at the University of Canterbury School of Forestry, conducted a three-week survey in November and December 2017 to assess defoliation on 10 species and parasitism at 8 NZDFI sites across North Island. The aim was to survey at a time when eggs and larvae would be more abundant, so any defoliation observed could be more confidently attributed to either EVB or the well-established *Paropsis charybdis*.

Satoru assessed defoliation caused by *P. charybdis* and EVB, estimated their abundance, and collected eggs to be sent to Scion (with permission from MPI) to assess parasitism. He also visited several sites that had not previously been searched for EVB. At each site, two shoots were assessed from each of about 10 trees (more at some sites) per species and numbers of EVB and *P. charybdis* eggs, larvae and adults were counted. Then for each selected shoot, % defoliation was estimated for flush and mature foliage separately, to the nearest 5%.

Figure 8. Parasitoid wasp observed on what appear to be parasitised EVB eggs in January 2017. Photo H. Lin.

Having been to all the sites the previous summer, Satoru was amazed to see some excellent growth thanks to the favourable weather in the preceding months. As the trees are about 4 – 6 years old, the growth differences between species has become quite clear. He noted some species were heavily defoliated while

others were virtually untouched, and damage varied between sites, with beetles less abundant at some, and EVB still completely absent from others (Table 2).

	Paropsis charybdis	EVB	Cleobora
Trimble	Y	N	N
Woodville	Y	Y	N
McNeill	Y	Y	Y
Alexander	Y	Y	Y
HBRC/Tutira	Y	Y	N
Okota	Y	N	N
Steed	Y	N	N
Taupo	Y	N	N

Table 2. Presence of the two eucalypt beetle species, and the predatory biocontrol agent Cleobora, at each site.

As expected, *P. charybdis* was present at all sites but each site varied in their abundance; a great number of adults were observed in Trimble, McNeill, and Steed. A common feature of these three sites was that they all had an *E. quadrangulata* breeding population/stand right next to the demo trials. *E. quadrangulata* had by far the highest number of larvae of *P. charybdis* (Fig. 9). It was interesting to see only a few larvae present on *E. longifolia* despite extensive foliar damage. This could be because the larvae had already eaten sufficient foliage to develop before the assessment and fallen to the ground to pupate.

EVB was still confined to the Central Hawke's Bay area south to Woodville and north to Lake Tutira (HBRC site). EVB larvae were found on fewer of the assessed tree species than *P. charybdis* larvae and were more dominant on *E. bosistoana* (Fig. 9). Although present on *E. quadrangulata*, EVB larvae far less abundant on this species compared to *P. charybdis*.

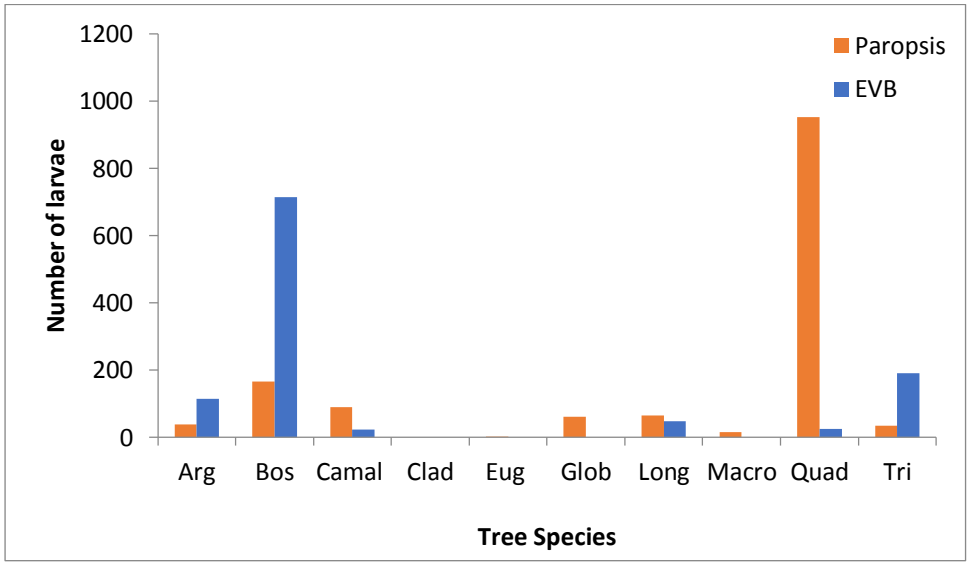

Figure 9. Total number of larvae (Orange = Paropsis, Blue = EVB) observed per species across 8 sites. Arg: E. argophloia; Bos: E. bosistoana; Camal: E. camaldulensis; Clad: E. cladocalyx; Eug: E. eugenoides; Glob: E. globoidea; Long: E. longifolia; Macro: E. macrorhyncha; Quad: E. quadrangulata; Tri: E. tricarpa.

E. camaldulensis and *E. longifolia* sustained the greatest defoliation, with mean damage of more than 50% of the juvenile leaves (Fig. 10). *E. quadrangulata, E. tricarpa, E. argophloia,* and *E. bosistoana* suffered moderate to high defoliation. This finding concurred with the results from January 2017 (Lin et al. 2017). The species with moderate to high defoliation showed greater damage on the juvenile leaves than on the adult leaves. Even though *E. longifolia* and *E. quadrangulata* suffered significant damage from the beetles, both species still showed good growth and form.

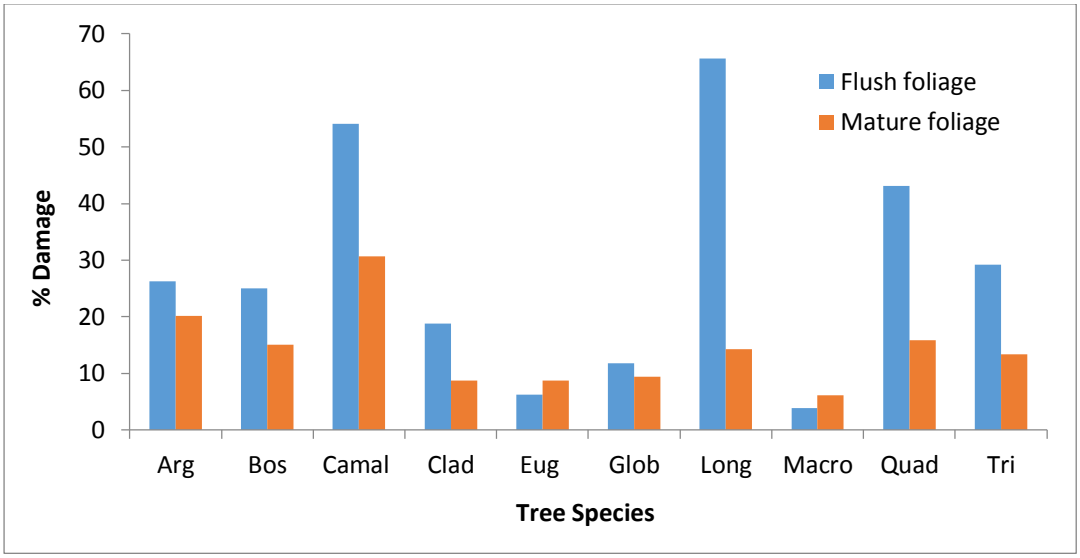

Figure 10. Estimated levels of defoliation damage on juvenile and adult leaves of each species.

A total of 26 EVB egg batches (Fig. 11) and 63 *P. charybdis* egg batches were collected to assess parasitism. Parasitised eggs of *P. charybdis* were found commonly across all sites. Initial identification by Dr Toni Withers (Scion) revealed both the known primary parasitoids (*Enoggera nassaui* and *Neopolycystus insectifurax*) and the hyperparasitoid (*Baeoanusia albifunicle*) emerged from Paropsis eggs and parasitism rates were quite high for December, possibly due to the warm spring. In contrast, only *E. nassaui* was reared from EVB eggs and rates were much lower. The parasitoids emerging from EVB eggs were also extremely small as the eggs of EVB are smaller than those *of P. charybdis*. In addition Satoru was delighted to see *Cleobora mellyi* actively feeding on EVB eggs at McNeill's and Alexander's (Fig. 12). Further collaboration is planned between UC and Scion to better understand the impacts and potential control of EVB in the future.

Figure 11. EVB adult laying fresh eggs on E. argophloia flush foliage at McNeill's.

Figure 12. Cleobora larvae feeding on the eggs of EVB.

Lin, H., Murray, T.J. & Mason, E.G., Incidence of and defoliation by a newly introduced pest, *Paropsisterna variicollis* (Coleoptera: Chrysomelidae), on eleven durable *Eucalyptus* species in Hawke's Bay, New Zealand. New Zealand Plant Protection 70, 45-51 (2017). http://journal.nzpps.org/index.php/nzpp/article/view/26

A final word from Paul

I had planned to get this update out prior to Christmas…but got delayed in the final week.

So hope you've had a good time with family and friends and no doubt it is the New Year by the time you read this so all the best for 2018.

NZDFI's research programme looks to be very exciting in 2018 with new post grad students being sought to follow on with the excellent work that is due for completion by those who have been working hard at the University of Canterbury for the past 2-3 years.

Thanks to all our landowners that keep an eye on the trial sites…it's these sites that are the backbone of NZDFI's research work and I hope the rest of summer isn't quite as dry as the first two months!!

Paul Millen