of frequently updated map records.

References

Hoffer, R.M., 1993. Airborne Video Automated Processing: Final Report. Methods Application Group, U.S. Forest Service, pp. 5/23-5/27.

Myhre, R.J., C.W. Sumpter, and L.A. Graham. 1990. Airborne Videography – A Potential Tool for Resource Managers. Proceedings of Resource Technology 90 Symposium, Washington, D.C. pp. 590-594.

Novak, K., 1992. Rectification of Digital Imagery. Photogrammetric Engineering & Remote Sensing. Vol. 53(3), pp. 339-344.

Pywell, H.R., R.J. Myhre. 1990. Monitoring Forest Health with Airborne Videography. Proceedings of Resource Technology 90 Conference, Washington, D.C. USA.

Pywell, H.R., 1994. Airborne Videography: Remote Sensing Applications in Natural Resources. Proceedings of Resource Technology 94 Conference, Melbourne, Australia, pp. 274-285.

Spurr, S.H., 1960. Photogrammetry and Photointerpretation. Chapter 12. Ronald Press Co. USA.

Gall wasp on *Eucalyptus botryoides* and *Eucalyptus saligna* and possibilities for biological control

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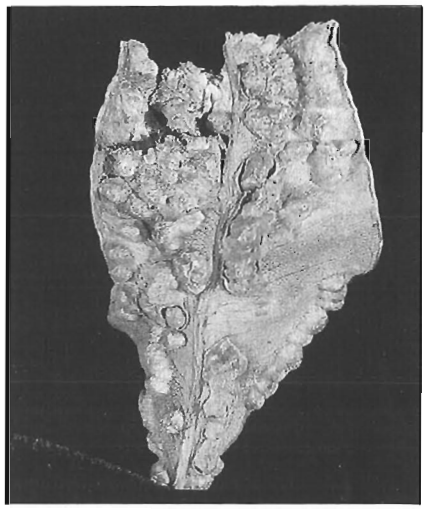
During 1987, in Wellington, a well-established specimen of *Eucalyptus botryoides* was found to be suffering from severe leaf abscission. An entomologist from the Forest Health Group, NZFRI, examined the tree and found that it was severely infested with robust, spherical galls. These galls were found to contain the larvae of a small wasp. The adults of the wasp (3-4 mm in length) were indistinguishable, with present taxonomic knowledge, from a gall wasp, *Rhicnopeltella eucalypti,* already present in New Zealand. The tree was cut down because of its poor health status.

Specimens of the adult insect were sent to the Entomology Division of CSIRO Australia, the acknowledged experts in the taxonomy of Australian Chalcidoidea (the superfamily to which these wasps belong). The reply from Australia identified the insect as *Ophelimus eucalypti.* The entomologists at NZFRI adopted this designation for some time. However, on examining a recently published key of Australian Chalcidoidea we found that *Rhicnopeltella eucalypti* was now *Ophelimus eucalypti.* What we believed to be a recent introduction was identified as a well-established NZ exotic insect. This presented us with a problem, not only was the taxonomy of this group extremely difficult, even for the experts, but also it confounded any future research we could devise.

We were fairly sure from the size and shape of the galls that this was a different, but closely-related, species. Also some of the species of eucalypts affected by the former *Rhicnopeltella eucalypti* were never recorded as being infested with this gall type. Another confounding factor was the variation in reports from field officers on the severity of infestation by the wasp, and the amount of damage caused. During 1991/92 the Ministry of Forestry still operated a Declaration of Infested Area on the west coast of the North Island, from Wellington north to Ohakea. The western boundary of this area ran along a line delimited by the foothills of the Tararua Range. A more rigorous survey by NZFRI staff demonstrated that the insect was much more widespread than first thought and that it was in most regions of the North Island. The Declaration of Infested Area was lifted. More recently (1995) the wasp has been found in Picton on the South Island and has spread to forests in the north of the South Island, where it is well established.



The insect can complete its life cycle in abscised leaves. Eulophid galls on fallen leaves. *Eucalyptus botryoides,* Otari Plant Museum, Wellington, March 17, 1988.

Our problem was to determine, by means other than classical taxonomic methods, whether this was indeed a different but closely-related species of gall wasp. We also had to determine whether it was an insect pest of potential economic importance. If it was found to be causing tree death or loss of growth increment it was also important to determine which of the affected species was the primary host. This would assist us in locating possible regions to search for a biological control agent if it was necessary.

The first stage in all new pest introduction investigations is to determine if the insect is causing enough damage to warrant control. The two tree species most often attacked, and most severely affected were *Eucalyptus botryoides* and *Eucalyptus saligna* – both special-purpose species. *Eucalyptus botryoides* is considered to be especially good for effluent and land-treatment areas. These species are very closely related taxonomically and would be expected to have similar foliage chemistry. However, the primary host of the wasp would be affected most as the insect and tree would have closely coevolved over millennia.

One site in Waikanae and one site in Foxton, were chosen for an experiment in 1992/93. Both sites had well-established populations of the gall wasp and were colonised by the wasp around the same time. The sites differed in exposure and soil type. The Waikanae site was on a very exposed hill slope with colluvium soils. The Foxton site was very sheltered with mature macrocarpa and pines surrounding the stands of eucalypts and was planted on a sandy loam.

Diameter at breast height (DBH) was measured on 50 trees at both sites at the beginning and end of the year's work. The foliage of all these trees was sampled and scored for level of infestation.

The primary experiment was laid out in the Foxton site. Two hundred and fifty seedlings consisting of *Eucalyptus botryoides, E. saligna* and *E. nitens* were planted in five Latin square arrangements in the infested site. Half of the *E. botryoides* and half of the *E. saligna* seedlings were protected with regular spraying of an insecticide. This would allow us to identify lack of vigour due to site factors and

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insect infestations. *Eucalyptus nitens* was included in the experiment because there were no records of the new gall type being found on it, although it is a good host for *Rhicnopeltella eucalypti*. If they are the same species of insect then one would expect *E. nitens* to be attacked in an area with such a high pest population. A similar experiment was set up in the Waikanae site but several invasions by marauding sheep damaged the seedlings beyond hope of recovery.

The results from all of these experiments gave us some very good information. The level of infestation at Waikanae was only 25% of that at Foxton, indicating that what we suspected was true: exposure, i.e. increased wind effects, caused a lot of the adults to be dispersed or disturbed, leading to reduced galling. The growth increment over one year at Waikanae was almost double the rate at Foxton, although the Waikanae site was still sub optimal. The Foxton trees had almost stopped growing completely and several hundred seven-to-eight-year-old trees had died due to continual abscission of foliage. This site has since been cleared and replanted with different species by the owner.

The seedling experiment data showed that when *E. botryoides* was protected with regular applications of insecticide it had significantly greater growth increment and survival than the same species with no protection. *Eucalyptus nitens* was never galled during the whole period of the experiment and had the highest survival and growth increment rates. *Eucalyptus saligna* protected and unprotected, demonstrated an intermediate performance between *E. botryoides* at one extreme (most susceptible) and *E. nitens* at the other (least susceptible). These variations in growth were due to the depredations of the gall wasp. From these data it was postulated that *E. botryoides* was the primary host and *E. saligna*, because of its close evolutionary relationship, was also susceptible to the gall wasp.

The data also gave some insight into how this insect operates. It prefers new foliage, and if the leaves it infests are less than 12 months old, they can be abscised within four weeks of gall initiation. This is part of a tree's natural defence mechanism, but in areas of high pest population tree death can occur within three to five years because of the constant abscission of new growth. In the seedling experiment trees began to die within three to four months because they could not establish enough new growth.

Although chemical control with a synthetic pyrethroid conferred protection on the seedlings, this was not viewed as a long-term option for control. Once the trees reached two metres in height, the cost and effort of spraying every four weeks would be prohibitive. With this in mind we decided on a search for a biological control agent. Having postulated that *E. botryoides* is the primary host, we looked at the distribution of this tree on mainland Australia. The Sydney area was selected as a base for an initial search as there were large areas of coastal *E. botryoides* surrounding the city, and research facilities were available at the Research Division of State Forests of New South Wales (SF NSW) and at Macquarie University. Prior to travelling to Sydney contact was made with the research staff at both institutes and a request made for them to identify sites of *E. botryoides* and *E. saligna* before we arrived. The researchers also collected some galls for us before we arrived.

A heavily-infested tree north of Wellington (1992).

Bruce Treeby, of the Farm Forestry Association, and I travelled to Australia in November 1994. On examination of the precollected galls we immediately found larvae of the gall wasp. A great deal of time was spent field collecting galls from the two tree species around New South Wales. The species of gall wasp we were interested in was only found on *E. botryoides*. None of the galls collected from *E. saligna* contained wasps; the majority of gall causers were Cecidomyidae (a family of Diptera). During our extensive search for the galls we found that although they were widespread from just north of Sydney to Narooma in the south, they were locally rare. This indicated a strong control by indigenous natural enemies. Dissection of the field-collected galls revealed that three parasitoids were present. One of these parasitoids was found infesting 60% of the galls.

During a further visit to Sydney in September 1995 the best performing parasitoid was cultured and kept on seedling *E. botryoides* in an insectary supplied by SF NSW. The staff at SF NSW are taking care of this culture while we seek approval to import the parasitoid into quarantine for testing against our native fauna and its efficiency as a biocontrol agent. It is hoped that this will be a successful programme, as then we can anticipate releases of the parasite within two years.

In the meantime the gall wasp continues to spread, and the Forest Health group (NZFRI) receive regular reports of large plantings of *E. botryoides* and *E. saligna* seedlings, and well-established trees, being so badly affected that they are no longer a viable crop.

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INSTITUTE NEWS

MOTIONS AT THE 1996 NZIF AGM

A number of important issues were raised at the 1996 NZIF AGM, held in Invercargill on April 29. These will be reported on more fully in the August issue of NZ Forestry.

Three major items were resolved:

- The motion for the NZIF to sign the *Principles for Commercial Plantation Forest Management in New Zealand* was rejected.
- The new membership model, with the registration option was approved.
- The objectives, which accommodate the new mission, were amended and approved.

In addition, reports were received from various working parties at various stages of document development. The valuation guidelines are at a final stage before publication. A draft Indigenous Forest Policy and amendments to the NZIF Code of Ethics will soon be available for submissions.

Chris Perley