# ELM LEAF BEETLE *XANTHOGALERUCA LUTEOLA*, (MÜLLER 1766) (COLEOPTERA: CHRYSOMELIDAE) IN NEW SOUTH WALES, AUSTRALIA IN 2009/2010.

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**Summary**

Elm Leaf Beetle was originally detected in Victoria in 1989. The beetle was subsequently detected in New South Wales and a delineating survey was initiated in 2009. Leaf damage by Elm Leaf Beetle was detected in 10 towns in southern New South Wales during May 2009. A subsequent survey from November 2009 to April 2010 found insect stages in 14 towns/localities. The rate of spread for this pest appears to be slow at about 20 km per year. A day degree model indicated that less than two generations would occur along the northern boundary of the known establishment of the beetle.

**Keywords:** delimiting survey, distribution

## INTRODUCTION

Elm Leaf Beetle (ELB) *Xanthogaleruca* (formerly =*Pyrrhalta*) *luteola* (Coleoptera: Chrysomelidae) is a native of Europe, but is now established in North America and Eurasia. ELB is one of the most serious insect pests of elm trees, particularly English Elm (*Ulmus procera* Salisbury), Siberian Elm (*U. pumila* Linnaeus.), American Elm (U. americana Linnaeus.), and Chinese Elm (*U. parvifolia* Marsham) (Dreistadt and Dahlsten 1990, Lawson and Dahlsten 2003). European elms are highly attractive to ELB for feeding and oviposition while Asiatic elms tend to exhibit moderate to high resistance to ELB attack (Bosu *et al*. 2007). Larvae feed on the leaves causing skeletonisation and possible defoliation while adults produce the characteristic "shot-hole" damage when feeding. Repeated defoliation over several years reduces tree vigour and may be fatal (Hood 1939). ELB was first detected in the eastern United States of America in 1837 (Dahlsten 1994) and has since dispersed over most of continental America (Wene 1968). However it appears to have a slow rate of dispersal, being first detected in the midwest United States in 1908 (Field and Kwong 1994), California in 1924 (Dreistadt and Dahlsten 1990), Oklahoma in 1955 (Eikenbary and Raney 1968) and Missouri in 1989 (Puttler and Bailey 2003).

The beetles overwinter as adults in sheltered sites such as bark fissures, woodpiles, garages and attics (Dahlsten 1994). As the elm foliage begins to develop in spring, the adults emerge and feed on foliage for about 2 weeks, leaving the characteristic round feeding holes (Figure 1). Adults then lay yellowish oblong eggs in clusters of up to 20 eggs (Figure 2). The larvae hatch after 7-10 days and pass through three instars taking 20-28 days before pupation. Larval feeding is readily distinguishable from adult feeding. Larvae feed on the underside of the leaves, skeletonise the foliage and leave a thin membrane (window pane effect Figure 3) instead of the holes. The colouration of the larvae ranges from green to yellow, with a black head and two black stripes on the dorsal surface. When ready to pupae, larvae typically crawl down the tree trunk to the base of the tree where they aggregate in large numbers (Lawson and Dahlsten 2003). Pupal cases are about 6 mm long and bright orange-yellow. Adult beetles (Figure 4) are approximately 6 mm long and yellowish to green-brown with a black stripe on each wing margin.

The development of a degree-day accumulation model has assisted in understanding the life cycle of the pest. The beetle development threshold is 11ºC accumulated from 1 March in the northern hemisphere (Dreistadt and Dahlsten 1990) and based on the climate, there can be one to four generations per year (Lawson and Dahlsten 2003). One to two generations per year occur in north eastern California while three or more generations occur in southern California (Kwong and Field 1994a).

In Australia, ELB was first detected on the Mornington Peninsula in Victoria during February 1989. However, due to their high density at some locations, it was considered likely that ELB had been present for up to 14 years before. All known detections had remained within a 100 km radius of the original infestation detection (Field and Kwong 1994).

Based on the American work (Dreistadt and Dahlsten 1990), the egg parasitoid *Oomyzus* (formerly Tetrastichus) *gallerucae* (Fonscolombe) (Hymenoptera, Eulophidae), and the tachinid fly *Erynniopsis antennata* (Rondani) were released in Victoria for biological control of ELB (Field and Kwong 1994). It appears that all these failed to establish and/or reproduce (Waterhouse & Sands 2001).

Victoria, South Australia, Tasmania and New South Wales (NSW) have extensively plantings of elms (Kwong and Field 1994a). In New South Wales, informal reports of ELB were received in 2008, but the presence of the pest or its damage was not verified. Subsequent reports from Albury, on the border between Victoria and NSW, suggested it had been present for some time. The existing amenity tree survey for Sycamore Lace Bug *Corythucha ciliata* (Say) (Hemiptera: Tingidae) (Dominiak *et al*. 2008) was expanded to include elm trees. This paper summarises the results of surveillance activities in NSW during 2009/2010 to positively identify the existence of ELB and to delimit its spread. A degree-day model was used to predict the number of generations per year along the known northern boundary of dispersal.

## MATERIALS AND METHODS

The survey of host trees was conducted by New South Wales Department of Industry and Investment (I&I NSW) staff. The initial survey period was in May 2009 (168 sites) with a second survey period from November 2009 to April 2010 (77 sites). Each site inspection consisted of sampling a single tree. Inspectors examined the undersides of leaves, looking for skeletionisation (larval damage), leaf holes (adult damage) or insect stages. A minimum of 20 leaves per tree were examined. A minimum of 10 leaves were collected per tree, particularly any leaves showing leaf damage. Leaves were cut from the tree using secateurs and leaves placed in a sealable plastic bag. Where possible, ten sites were sampled within each town. In avenues of trees, every fifth tree was sampled.

Suspect leaves and insects were sent to I&I NSW’s Agricultural Scientific Collections Unit (ASCU) at the Orange Agricultural Institute, Orange, NSW, for identification. Trained taxonomic ASCU staff identified ELB and positive detections were vouchered at ASCU. The illustrations in this paper were produced using compact digital cameras (Canon PowerShot S5IS 8MP) and a Micropublisher 5 RTV digital camera (QImaging) attached to a Leica MZ12.5 dissecting microscope and montaged images produced with AutoMontage Pro (Synchroscopy P/L).

The day degree formula proposed by Kwong and Field (1994a) and Arnold (1960) was used to estimate the number of generations per year. Climatic data was retrieved from SILO (Jeffery *et al.* 2001) for the 2009 calendar year for the towns of Griffith, Gundagai and Wagga Wagga. The formula was:
day degrees = (maximum temperature + minimum temperature)/2 – Developmental threshold (=11ºC)
Negative values were removed from the table and all positive values were added. For the number of generations per year for each town, the total positive day degrees were divided by 1785, the total day degrees established for Mt Eliza, Victoria by Kwong and Field (1994a).

## RESULTS

Based on the data accumulated by the survey collectors and the identification at ASCU, the distribution of positive and negative samples is given in Figure 5. The survey of 168 sites in May 2009 found leaf damage at 39 sites in 10 towns {Albury (2 sites), Cootamundra (2), Culcairn (5), Gundagai (8), Holbrook (3), Howlong (2), Junee (1), Narrandera (2), Tumut (8) and Wagga Wagga (6)} but no insect stages were found.

A survey of 77 sites from November 2009 to April 2010 found ELB at 22 sites in 14 towns {Albury (1 site), Bombala (3), Cooma (1), Cootamundra (2), Deniliquin (2), Griffith (1), Gundagai (3), Hay (1), Holbrook (1), Jugong (1), Tumblong (1), Tumut (1), Wagga Wagga (3) and Yaouk (1)}. Eggs, larvae or pupae were found during November/December (15 sites) and larvae in March (3 sites).

The day degree model was run for temperature data from the towns of Griffith, Gundagai and Wagga Wagga in NSW, along the northern margin of the current ELB distribution. Data for these towns indicated that 2814, 2217 and 2357 day degrees respectively were accumulated during the 2009 year, equating to 1.6, 1.2 and 1.3 generations of ELB per year, respectively.

Figure 1: Foliage with characteristic round feeding holes caused by adults


Figure 2: ELB eggs


Figure 3: ELB larvae and feeding damage (leaf skeletonisation).

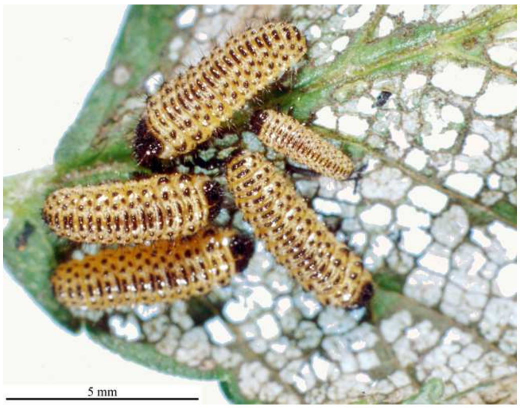
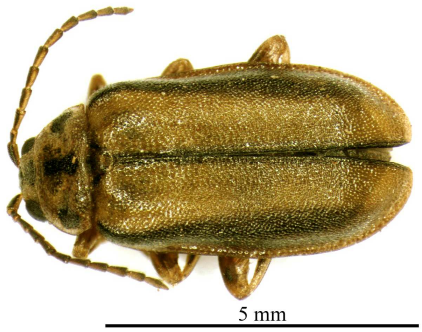



Figure 4: Adult ELB




## DISCUSSION

In Australia, ELB was discovered in February 1989 about 40 km south of Melbourne, Victoria. A detailed survey in 1991 found the pest had colonised elms in most parts of the Mornington Peninsula. The beetles had established in Melbourne suburbs by 1994 (Kwong and Field 1994a).

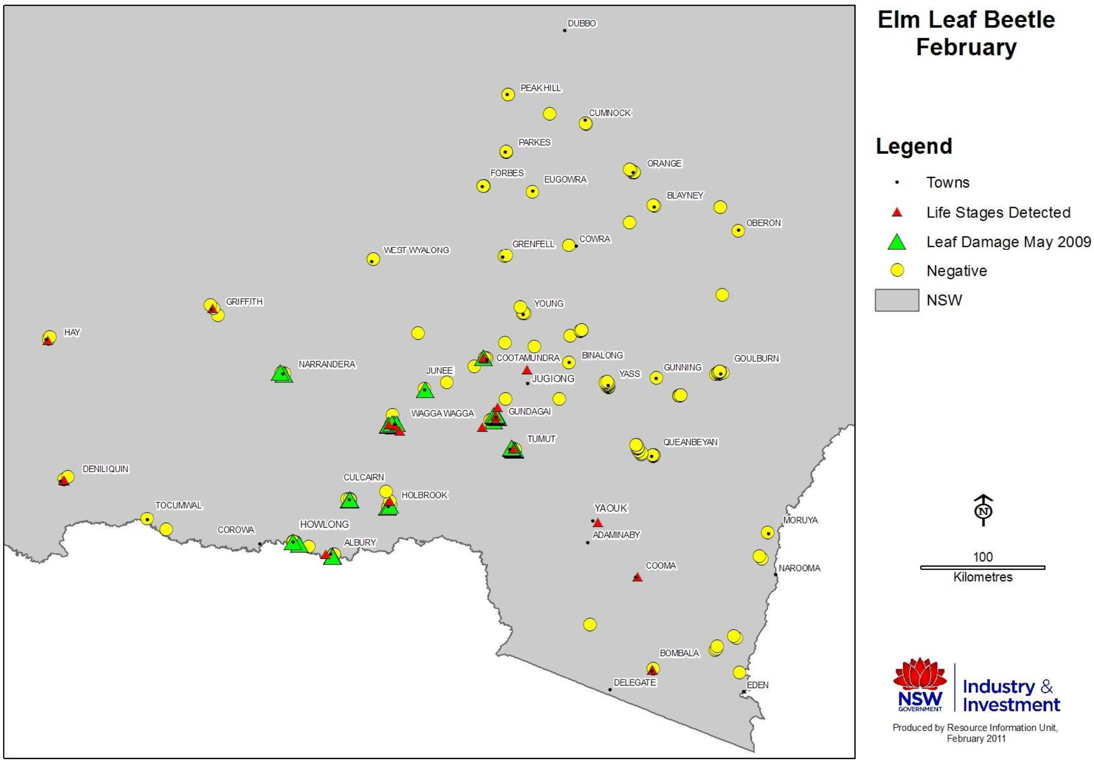
Another amenity tree pest, Sycamore Lace Bug, had recently established in Sydney and parts of NSW (Dominiak *et al*. 2008). ELB has become the latest example of the establishment of an exotic insect in NSW and this paper is the first published peer reviewed report of this pest outside Victoria. As in America, ELB has been slow in dispersal. Both amenity tree pests are strongly suspected to be hitch hikers on vehicular traffic and both have a very strong affinity for trees that provide shade for drivers, campers and picnickers (Dominiak *et al*. 2008, Kwong and Field 1994a).

In Victoria, life studies indicated that most individuals only complete one generation per year (Kwong and Field 1994a). In our study, generation times based on the day degree model indicates that less than two generations occur each year and this may contribute to the slow rate of dispersal of ELB. In Victoria, larvae were detected on tree trucks in November to January (Kwong and Field 1994a, b, Wells *et al*. 1994). In our survey, immature stages of ELB were detected in only November/December and March. The distance from the original detection in Victoria to Griffith and similar localities is about

460km. This dispersal over about 22 years equates to about 20 km per year.

Surveillance for exotic pests remains important for NSW, particularly with the globalisation of trade. Continuous surveillance for exotic pests occurs in the Sydney basin by I&I NSW (Dominiak *et al*. 2009, Gillespie *et al*. 2003) and is an attempt to detect pest incursions early and increase the chances of successfully eradicating the more serious pests.

Figure 5: Distribution map of positive and negative leaf sample

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