Arrival of leaf-feeding willow sawfly *Nematus oligospilus* Förster in Australia – pest or beneficial?

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Summary
Willows are trees and shrubs native to the northern hemisphere and considered as either invasive weeds, or desirable for amenity purposes in temperate Australia. The leaf-feeding willow sawfly *Nematus oligospilus* was recently identified as a new incursion to Australia and its potential pest or beneficial attributes are discussed.

Keywords: *Salix*, willows, willow sawfly, *Nematus oligospilus*.

Introduction

The leaf-feeding willow sawfly *Nematus oligospilus* Förster (Hymenoptera: Tenthredinidae) is a new introduction to Australia (Rees *et al*. 2005) and is spreading rapidly.

Willows (*Salix* spp., Salicaceae) are dioecious, deciduous trees and shrubs that are principally native to the northern hemisphere. Many willow species were deliberately introduced for basket-making, cricket bat production, stream stabilization, ornament and shelter and continue to be used for a range of purposes, with over 45 taxa available in the nursery trade (ARMCANZ *et al.* 2000). Of the naturalized willows in Australia, several are highly invasive because of their sexual and vegetative reproductive ability. The problems caused by naturalized willows in Australia have been recognized by the fact that all *Salix* taxa, excluding *S. babylonica*, *S.* × *calodendron* and *S.* × *reichardtii*, have been listed as Weeds of National Significance (ARMCANZ *et al.* 2000).

Based on overseas experience, the leaf-feeding willow sawfly is likely to severely impact on a range of tree willow species in Australia. It is therefore likely to be viewed as a pest or beneficial insect depending on the species of willows it defoliates in Australia. In April 2005, the Office of the Chief Plant Protection Officer posted the following information (Anon. 2005b) 'the Consultative Committee on Emergency Plant Pests has considered that given the presence of willow sawfly in the Australian Capital Territory (Canberra), NSW and SA, and the large number of host plants in southern Australia, the pest is too widespread to be eradicated'. This note discusses the potential pest and beneficial attributes of *N. oligospilus*.

Origin and spread

Although first recorded in Canberra, ACT, in March 2004, the identification of *N. oligospilus* was only confirmed in February 2005 (Rees *et al*. 2005). The sawfly is native to the northern hemisphere, where it is found from Ireland through continental Europe to the Himalayas, and also occurs in North America from Alaska to Mexico. It was first recorded in the southern hemisphere in Argentina in 1980, in southern Africa in 1993/94, in New Zealand in 1997 (Charles *et al*. 1999) and 2004 in Australia.

In Australia, a sawfly infestation on weeping willow (*Salix babylonica*) was first noticed by one of us (EB) in Telopea Park, Manuka, ACT on 3 March 2004, and larval specimens were collected for rearing and identification. The next day, extensive defoliation was noticed on weeping and crack willow growing along the Molonglo River at Duntroon, ACT, and CSIRO Entomology and willow experts were informed. Subsequently, defoliation was recorded as far as 150 km south of Canberra in 2004 (K. Cremer personal communication).

Spread of this insect in Australia has been rapid. In January 2005 defoliation of willows was reported in the Queanbeyan Age newspaper along the Queanbeyan and Molonglo Rivers and around Lake Burley Griffin in Canberra (Anon. 2005a). The Southern Rivers Catchment Management Authority reported defoliated willows at Braidwood, 110 km east of Canberra (Exon 2005). These rates of spread approximate the New Zealand experience where dispersal of about 300 km per year has been recorded (Charles and Allan 2000). In February 2005 an infestation was found in the Adelaide Hills in South Australia (J. Virtue personal communication 2005) while in April 2005 an infestation was reported and confirmed in Victoria at East Keilor, a north-western suburb of Melbourne. These are approximately 1200 km and 650 km respectively from the main Canberra infestation.

It is not known how the sawfly has spread around the southern hemisphere in the last 25 years, nor how it reached Australia, but there is a possibility that it arrived from New Zealand where it has been widespread for at least eight years (Charles *et al*. 1999). It may have arrived as cocoons on plant material or packaging that were inadequately treated, but it is also possible that adults were blown across the Tasman Sea in the easterly wind systems associated with major weather patterns in late summer. As new single populations have been found as far away from Canberra as the Adelaide Hills and Melbourne, the wind dispersal theory is highly likely. Because of the current rapid pattern of dispersal in Australia, it is likely to spread to all willow areas in the next 2–3 years, including Tasmania and Western Australia.

Biology, impact and host range

Charles *et al*. (1999) outlines the spread, biology and host range of *N. oligospilus* in New Zealand where it has been recorded on crack willow (*S. fragilis*), twisted, corkscrew, or tortured willow (*S. matsudana* cv. 'Tortuosa'), Peking or matsudana willow (*S. matsudana*), weeping willow (*S. babylonica*), pencil willow (*S. humboldtiana* cv. Chilensis), golden willow (*S. alba* var. *vitellina*) and hybrid willow cultivars (*S. matsudana* × *S. alba* cvs. 'Tangoio', 'Moutere', 'Aokautere'). In laboratory trials in New Zealand, Charles *et al*. (1998) found that the sawfly would lay eggs in the leaves of 23 tree willow genotypes indicating that tree willows (*Salix* subgenus *Salix*) are susceptible to defoliation. However shrub willows (*Salix* subgenus *Caprisalix*) were not selected. Based on New Zealand experience, it is highly likely that the sawfly will impact on the wide range of tree willows naturalized in Australia, but the shrub willows may not be attacked.

Preliminary observations

In Australia, the sawfly has, to date, been recorded on crack willow (*S. fragilis*), twisted, corkscrew, or tortured willow (*S. matsudana* cv. 'Tortuosa') and weeping willow (*S. babylonica*). A total of 52 larvae at different stages of development were collected from *S. babylonica* in Canberra on 3rd March 2004 and transported to the DPI Quarantine Facility in Frankston, Victoria where they were fed on *S. babylonica* sprigs until they spun cocoons. Fresh willow sprigs were presented every second day and cocoons collected in small plastic containers and held at 20°C until adult emergence. A total of 47 female adults and no males emerged 5–7 days after cocoons were spun. Adults were placed in wide plastic containers with fresh willow branches and died 4–6 days after emergence. Leaves were checked for eggs but none were observed. Deceased adults were pinned for later identification.

These observations confirm New Zealand observations that the species is thelytokous and only female adults emerge (Charles *et al*. 1998). This seems to be true wherever the species has invaded in the southern hemisphere while in the northern hemisphere, adults of both sexes are found (Urban and Eardley 1995).

Observations at the Victorian infestation confirm New Zealand observations that pupation takes place in cocoons on the tree, in litter and building structures surrounding the tree and in the soil. Numerous cocoons were present on 12 April as well as fully fed larvae descending the trunk to look for pupation sites. Cocoons contained mature larvae when dissected.

Pest or beneficial?

The current status of willows in Australia determines whether this insect will be considered as a pest or a beneficial.

All *Salix* spp except three taxa are listed as Weeds of National Significance because they cause water degradation and loss of biodiversity in riparian and aquatic ecosystems, and a National Strategic Plan for the management of willows has been published (ARMCANZ *et al.* 2000). It is estimated that willow management along waterways by mechanical and chemical methods costs $10 million annually. The National Strategic Plan for Willows has identified biological control as a desirable management option that can be used to suppress willows in dense, lower priority infestations.

The leaf-feeding willow sawfly is therefore likely to be considered as a beneficial by natural resources management authorities responsible for removing willows as part of stream and wetland rehabilitation. The beneficial aspects of the sawfly on weedy willows will depend on the levels of defoliation caused to the different invasive willow taxa, and the climatic requirements of the sawfly. Potential climatic range predictions would require accurate distribution information from a range of areas where the thelytokous biotype has invaded the southern hemisphere, coupled with laboratory experiments to determine temperature thresholds. The widespread distribution in New Zealand suggests that all of temperate southern Australia including Tasmania would be suitable.

It is difficult to predict whether native parasites and predators will attack this species. There are very few native Australian species in the Tenthridinidae sawfly family (Naumann *et al.* 2002) so there is probably only a small pool of family-specific parasites available but some generalist parasites and predators may be present. Significant parasitism and predation may limit the impact of the sawfly. It would be useful to start gathering information on parasitism and predation of the different life stages (egg, larvae and pupae) in different regions of Australia.

Interactions with two other species of willow sawfly already present in Australia (Naumann *et al.* 2002) are likely as all three willow sawfly species continue to spread in Australia. The other two species are the willow gall sawfly (*Pontania proxima* Lepeletier), widespread in Tasmania, and the willow bud sawfly, (*Amauronematus viduatus* (Zetterstedt)), recorded only on the south coast of New South Wales. There may also be interactions with the range of foliar fungal pathogens, particularly rust fungi already widespread on willows in Australia (Sagliocco and Bruzzese 2002).

There are indications from New Zealand that repeated defoliation by the leaf-feeding willow sawfly over a period of years has had a devastating impact on willows planted to protect riverbanks and hill country from erosion (Olsen 2005). There, willow suppression has been so severe that the Hawkes Bay Regional Council has estimated a 25–90% loss of effectiveness of willows for stream bank stabilization and is planning stream rehabilitation works (Anon. 2005c).

If the New Zealand experience is repeated here, we can expect severe yearly defoliation of most species of tree willows each summer that may ultimately kill trees. Defoliation in mid-summer leads to loss of shade with the potential of increased water temperatures, however, the additional sunlight may assist the establishment of competing native vegetation. The arrival of the sawfly provides the opportunity to monitor its impact on willows in riparian situations and the resulting changes in the aquatic and riparian environment. It would be desirable to establish a network of long-term sites to monitor the impact of the sawfly on weedy and non-weedy willow taxa growing under different climatic conditions.

Where non-invasive tree willows are valued as ornamental, amenity or heritage trees, it will be necessary to use regular insecticide treatments to protect the trees. Insecticides are currently registered for control of leaf feeding sawflies in *Eucalyptus* plantations and these should be trialled prior to registration for control of *N. oligospilus*.

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