elm trees under attack again

Peter Jones and **Daphne Comfort** outline the potential environmental impact of a new threat to elms in Britain, and look at current control treatments

The Conservation Foundation

English elms in Cuckmere Valley in East Sussex

From the late 1960s onwards, Dutch elm disease spread rapidly within southern Britain,[1] devastating the elm population, killing an estimated 20 million elms by 2010[2] and leading to dramatic changes in the appearance of many landscapes. While elms are still an environmentally important species within some parts of Britain, half a century later, the elm zig-zag sawfly, first identified in Britain in 2017, poses a new threat to surviving elm populations.

The elm zig-zag sawfly is a highly invasive Asian insect which was identified attacking elm trees in Poland and Hungary in 2003 and which has since spread to 17 countries on mainland Europe. It feeds on all three species of elm trees commonly found in Britain – namely, English elms, wych elms and small-leaved elms – and large populations of the insect can lead to extensive defoliation. However, there is no evidence from Europe to date of even severely defoliated elms dying. This article describes the characteristics and breeding cycle of the elm zig-zag sawfly, reports on current control treatments, and reviews its potential environmental impact within Britain.

Elm zig-zag sawfly

The female adult zig-zag sawfly measures 6-10 millimetres in length and is brownish to black in colour, with brownish translucent wings and white legs and antennae. No males have ever been recorded and the insects reproduce asexually. The females lay up to 50 eggs, which are light green in colour and less than 1 millimetre long, into the serrated edges of elm leaves. Within four to eight days, the larvae hatch and feed on the leaf tissue

between the main veins, and in so doing produce the characteristic zig-zag pattern of feeding damage on the leaf. As the larvae become more mature, they eat almost the entire leaf, thus eliminating the initial zig-zag pattern.

The larvae pass through a number of growth stages and then pupate, building either a loosely spun reticular cocoon on the underside of the leaf or, later in the year, a more substantial cocoon to protect the sawfly during the winter. These latter cocoons are usually found in the leaf litter or in the soil underneath affected elm trees.

The life cycle takes about four weeks, although in colder temperatures it can take up to 12 weeks, and the elm sawfly may be able to complete four generations in a single summer. The short and rapid succession of life cycles, which also reflects the elm sawfly's parthenogenic method of reproduction, can lead to the large-scale build-up of the insects and their larvae, which, within a locality where significant numbers of elm trees are present, might be seen to amount to an infestation within a year.

The spread of the insect

A number of vectors seem to be responsible for the spread of the elm zig-zag sawfly. Natural spread via the flight of the adult females, which are reported to have an outstanding flying ability, and passive distribution by the wind are perhaps the principal vectors. Blank *et al*.[3] have estimated a self-dispersal speed of 45-90 kilometres per year. At the same time, long-distance dispersal can be caused by the adult insects being carried on cars and lorries, as evidenced by the frequent occurrence of elm zig-zag sawflies along roads and major arterial routes. The long-distance spread of the insects could also occur in the transport of elm plants for planting. While heavily infected trees are likely to be rejected for sale, where the larvae are in the growing medium or the leaf litter the spread of the insect may occur.

Geographically, the elm zig-zag sawfly is native to East Asia and is found on the two largest Japanese islands of Hokkaido and Honshu and also in Gansu Province in North West China.[4] The insect was first recorded in Europe in 2003, in all probability having been spread on imported plants for planting. The first recorded occurrences in Europe were in Hungary and Holland in 2003, and by 2009 the insect had been recorded in Romania, Moldova, Ukraine, Slovakia, Austria, Serbia, and Italy.

In Italy, for example, Zandigiacomo *et al*.[5] reported that the elm zig-zag sawfly was observed at five sites in the Friuli-Venezia Giulia region of North Eastern Italy and that within a year the insect had spread across an area of 1,200 square kilometres and to the neighbouring Veneto region. From their study in Hungary, Vetek *et al*.[6] reported that 'the pest may be confirmed to be widely distributed throughout the country'. During the last decade, the insect has been reported in Croatia, Germany, Slovenia, the Netherlands, Belgium, the Czech Republic, Latvia, Bulgaria, Switzerland, and Britain.

Control and management

Attempts to control, manage and treat the elm zig-zag sawfly face a number of challenges. In general terms, even in the event of the identification of the larvae or their characteristic feeding patterns, the quick dispersal of the females makes eradication or containment very difficult. At the same time, chemical control by insecticides is likely to be ineffective in the medium to long term, because treated elm trees may quickly become re-infested from untreated trees nearby, thus necessitating further treatment. Furthermore, chemical control may have unacceptable impacts on other invertebrate species that are harmless or even beneficial. Indeed, the Forestry Commission has suggested that 'chemical control is therefore likely to be limited to the protection of individual elm trees, or groups of elm trees, of aesthetic or cultural importance'.[7]

The Forestry Commission suggested a number of control measures that are likely to be most effective in the management of the problem.[7] These measures include limiting the movements of elm plants to the minimum number and distance necessary; inspecting elm plants, and any soil and leaf litter with them, before moving them on, and again before planting; destroying elm material arising from tree surgery or felling; and buying British-grown elm plants rather than risking the introduction of the insects or larvae by purchasing imported plants.

Potential landscape and environmental impacts in Britain

The presence of the elm zig-zag sawfly in Britain was confirmed in Britain in 2017, following the discovery of the larvaes' distinctive feeding traces near Dorking in Surrey. Since then the insect has been reported in a number of locations in the South East and the East Midlands of England, and there are fears it could spread more widely. Indeed, the Department for Environment, Food and Rural Affairs has claimed that 'the whole of the UK is endangered by the pest',[4] and the Forestry Commission has suggested that the insect 'could survive in all parts of the country'.[7]

Despite the devastation of Britain's elm population by Dutch elm disease, elms are still an environmentally important species within Britain. Joan Webber, Principal Pathologist for Forest Research, has suggested that 'in Britain we probably have more elm trees now than we did before the current epidemic which we think started in the late 1960s'.[8] The vast majority of Britain's elm population are young trees, often found in hedgerows and field margins and sometimes in woodlands. In Wiltshire,

Ptelea/Wikipedia

English elm, and leaf damage caused by the elm zig-zag sawfly

for example, there are English elms in many hedgerows, because of their ability to produce vegetative suckers, while some wych elms are found in mixed broadleaved woodlands. Hedgerows in parts of Cornwall have elm colonies and some trees are over 10 metres high.

However, while the vast majority of the mature stately elms that once graced many urban and rural landscapes have been lost, some pockets of resistance remain. Perhaps the best known is the 'National Elm Collection' in and around Brighton. Brighton and Hove City Council, which has been running a Dutch elm disease control scheme since the early 1970s, has reported[9] that there are over 17,000 elm trees within its jurisdiction, including large numbers of elms in Preston Park, Shirley Drive, Carden Hill and The Level. The so-called 'Preston Twins', for example, are believed to be the largest and oldest surviving English elms in Europe. At The Level, a busy park in the centre of Brighton, elm trees frame the perimeter of this important green open space. In Edinburgh, a number of mature elm trees have survived around Princes Street in the centre of the city and at the Palace of Holyroodhouse, close to the end of the Royal Mile.

The potentially rapid dissemination of the elm zig-zag sawfly poses a range of risks to the elm population in Britain. Current evidence from mainland Europe suggests considerable variation in the extent of defoliation. The Department for Environment, Food and Rural Affairs has suggested that 'potential impacts in the UK will be strongly influenced by how often mass occurrences of the pest occur', and has reported that mass occurrences of the insect can lead to 'complete defoliation of elms' and 'a significant reduction in the aesthetic value of the trees'.[4]

More specifically, Zandigiacomo *et al.*[5] reported that a mass occurrence of the elm zig-zag sawfly larvae in Canal de Ferro Valley in Northern Italy led to the elm trees being 'severely damaged or completely defoliated' and that 'the following year the same elm trees were heavily defoliated once again'. Blank *et al.*[10] reported damage at 14 sites in Romania. Here, the elms ranged in age from 12 to 60 years and defoliation rates varied from 74% to 97%, with an average of 87%.

In Hungary, Blank *et al.*[10] reported that at three sites individual elm trees suffered up to 100% defoliation but that they produced new leaves in the same year. They also reported that elm trees in the centre of Budapest were 'heavily infested', and had 'lost about 70% of their leaves'. At the same time, Blank *et al.*[10] concluded that although the 'heavily defoliated trees did not seem to be dying', they were 'a significant aesthetic problem' and that while 'all the elm trees attacked in 2008 produced leaves in 2009 … several branches had died'.

By way of contrast, Zubrik *et al.*[11] reported that in Slovakia the elm zig-zag sawfly caused 'only insignificant damage to elm trees', although in some districts defoliation reached up to 20-30%. In Germany, Blank *et al.*[3] reported that, in a study conducted in areas in the north and south of the

country, there was 'insignificant damage' to elm trees, but that at one location, Schlieben, a small town in Brandenburg, many elms 'suffered severe damage, ranging from partial defoliation of twigs to defoliation of most of the crown'. Holusa *et al.*[12] reported no evidence of defoliation in their study plots in forests in the Czech Republic, where the elms were sheltered, but they suggested that the elm zig-zag sawfly was more likely to endanger solitary elms in the country's urban areas.

Infestations can also lead to potential environmental impacts by further weakening trees already affected by Dutch elm disease. Zandigiacomo *et al.*,[5] for example, suggested that 'repeated defoliations could dramatically aggravate the phytosanitary state of elms already stressed from Dutch elm disease' and thereby 'dramatically increase the decline of elms'.

'There are concerns that mass occurrences of the elm zig-zag sawfly could have a damaging impact on native insect species that rely on elm foliage for their primary source of food'

At the same time, there are concerns that mass occurrences of the elm zig-zag sawfly could have a damaging impact on native insect species that rely on elm foliage for their primary source of food. The Forestry Commission has reported[7] that the white-letter hairstreak butterfly, for example, depends entirely on elm leaves for its food supply, while the white-spotted pinion moth, which is also an elm feeder and underwent rapid decline during the Dutch elm disease outbreak from the late 1960s onwards, is a BAP (Biodiversity Action Plan) threatened species.

Finally, there could be significant cultural impacts in Britain in areas such as Brighton and Hove where the defoliation of significant numbers of mature elms would reduce their aesthetic value.

Conclusion

The elm zig-zag sawfly, an invasive Asian insect, has been spreading through many countries in mainland Europe since 2003. While it has led to severe defoliation in some areas, elsewhere its impact to date has been relatively minimal. Its occurrence in Britain was first confirmed in 2017 in Surrey, but since then it has been identified in a number of locations in the South East and East Midlands of England. At present, the speed and extent of its dispersal within Britain remain matters of conjecture. However, given its potential impact on the aesthetics of landscape and its wider environmental and cultural consequences, planners will want to maintain a watching brief on its progress, not least at a time when the effects of climate change are becoming more apparent.

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Notes

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3 S Blank *et al.*: 'Zig-zagging across Central Europe: recent range extension, dispersal speed and larval hosts of *Aproceros leucopoda* (Hymenoptera, Argidae): in Germany'. *Journal of Hymenoptera Research*, 2014, Vol. 41, 57-74. https://jhr.pensoft.net/articles.php?id=4395

4 *Rapid Pest Risk Analysis (PRA) for: Aproceros leucopoda*. Department for Environment, Food and Rural Affairs, Oct. 2016. https://planthealthportal.defra.gov.uk/ assets/pras/Aproceros-leucopoda-PRA-v4.pdf

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7 'Elm zig-zag sawfly (*Aproceros leucopoda*)'. Webpage. Forestry Commission, Sept. 2018. www.forestry.gov.uk/forestry/beeh-b3nhdy

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10 SM Blank *et al.*: '*Aproceros leucopoda* (Hymenoptera: Argidae): an East Asian pest of elms (*Ulmus* spp.) invading Europe'. *European Journal of Entomology*, 2011, Vol. 107 (3), 357-67

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12 J Holusa, P Studulkova and J Macek: 'Observations on the occurrence and phenology of the invasive elm defoliator *Aproceros leucopoda* (Hymenoptera: Argidae) in the Czech Republic'. *Urban Forestry & Urban Greening*, 2017, Vol. 21, pp. 29-33