Oriental Chestnut Gall Wasp

News of a recent unwelcome discovery and how 'citizen science' can play an important role in surveying and identification.

Forest Research scientists **Simon Morath**, **Nick Fielding** and **Christine Tilbury**, with Forestry Commission Tree Health Operations Manager **Ben Jones**, provide an update on this recently discovered pest.

In June of 2015 *Dryocosmus kuriphilus*, more commonly known as the oriental chestnut gall wasp (OCGW), was discovered in Farningham Wood, Kent – an Ancient Semi Natural Woodland (ASNW) of approximately 70ha. The galls (growth irregularities) that OCGW causes on sweet chestnut (*Castanea sativa*) were initially discovered by an amateur gall enthusiast, who sent the suspect material to the Fera Science plant clinic in York. On suspicion of OCGW, the plant health contingency process was initiated by Defra and the Forestry Commission was asked to lead the response. The diagnosis was formally confirmed by Fera Science and swift action was taken by Forestry Commission England Tree Health teams to survey Farningham Woods and the surrounding area to assess the extent of infestation and inform possible management options. Shortly after the finding in Kent, observations from an Observatree voluteer led to the discovery of OCGW on six street grown sweet chestnut trees in Hertfordshire. Here we provide a description of the potential pest and how to report further possible sightings.

What is oriental chestnut gall wasp?

OCGW is considered an important pest of chestnut trees (*Castanea* species) worldwide (Matoševi and Melika, 2013) particularly because of the impact it can have on nut production. The adult wasp is only 2.5 to 3.0mm long with a black body, translucent wings and orange legs (Fig. 1). The wasp emerges in June and July but its small size means it is unlikely to be noticed especially as it does not have a sting and is harmless to humans. However, the galls that the OCGW create are conspicuous and distinctive (Figs. 2 & 3), affecting the buds and leaf tissue of sweet chestnut trees. OCGW does not attack horse chestnut or 'conker' trees, which belong to the genus *Aesculus*, or any other widely grown trees in Britain. It is not known how long OCGW has been in the UK, or indeed how the gall wasp arrived in the woodland in Kent.

Life cycle and symptoms of OCGW

OCGW is univoltine (one generation per year) and females lay eggs in the growth buds of sweet chestnut trees during the summer, with eggs typically hatching into larvae within 30 to 40 days. The early stage larvae become dormant and overwinter in the buds but resume activity in the spring, causing the formation of the characteristic galls which are

Figure 1. Oriental chestnut gall wasp (Dryocosmus kuriphilus) adult. Measuring c.2.5mm in length it is very difficult to see with the naked eye. (Photo: Gyorgy Csoka ©Hungary Forest Research Institute, Bugwood.org)

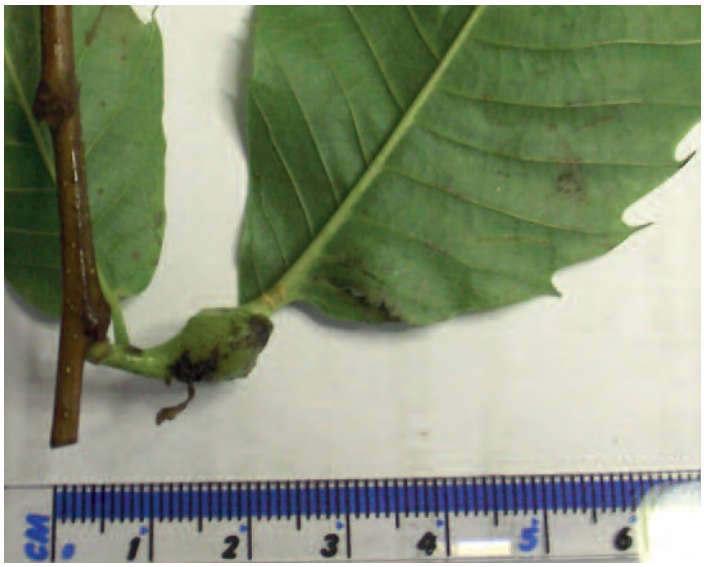

Figure 2. OCGW gall on the leaf petiole (stalk). (Photo: Forest Research)

Figure 3. OCGW gall on the leaf lamina. (Photo: Forest Research)

home to the developing larvae (Fig. 4). Galls can be formed on young twigs, on leaf petioles (Fig. 2) or on the midrib of leaves (Fig. 3). These green or rose-coloured galls start at approximately 5 to 20mm in diameter, and end up as much as 4cm in diameter on expanding leaves. The larvae feed for 20-30 days within the galls before pupating and adult wasps usually emerge during June and July, creating holes in the galls as they exit. These wasps live for approximately 10 days, completing the cycle as they lay more eggs. The galls turn red (Fig. 5) and then brown; if formed on twig material they shrink considerably and become woody over time (Fig. 6), remaining on the tree for two years or more. Galls formed on leaf material (petiole or lamina) senesce in the autumn and fall to the ground as the leaves are shed. Wasp reproduction is achieved from unfertilised eggs without any mating in a process known as thelytokous parthenogenesis. Male wasps have never been recorded.

Figure 4. OCGW gall dissected to reveal the developing larvae. (Photo: Forestry Commission)

Figure 5. Rose coloured OCGW gall. (Photo: Forestry Commission)

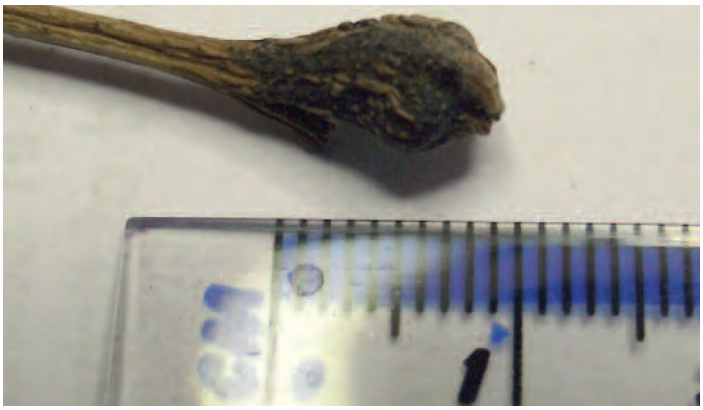

Figure 6. OCGW gall over 1 year old, shrunken and lignified and far more difficult to spot than the fresh galls. (Photo: Forest Research)

Invasion history

OCGW is thought to originate from China and was first formally recorded from Japan in 1958, where it spread across the entire country in 25 years and has had a significant impact on chestnut production (Shiraga, 1951). Around the same time it was also causing similar problems in Korea. OCGW was confirmed in eastern USA in 1974, apparently after being introduced on infested plants and it now affects the chestnut industry already devastated by the exotic fungal disease, chestnut blight (*Cryphonectria parasitica*) (Anagnostakis, 2014).

In Europe OCGW was first recorded in 2002 in Italy (Brussino et al., 2002). The initial introduction is thought to have originated from imports of eight Chinese chestnut cultivars in 1995-1996 (Aebi et al., 2005). Since then it has spread steadily and OCGW is now present in Croatia, Czech Republic, Finland, France, Corsica, Germany, Hungary, Italy, Sardinia, Sicily, Netherlands, Portugal, Slovenia, Spain, Switzerland and most recently the UK. Further reading on the invasion history of OCGW can be found in Aebi et al. (2005), Graziosi et al. (2008) and Gibbs et al. (2011).

Tree health implications of OCGW in the UK

In areas of the world where sweet chestnut is grown for nut production, attack from OCGW can reduce yield by 50-70% (Payne et al., 2003). Heavy attack reduces tree vigour and wood production (Aebi et al., 2005) and in some instances can kill the tree (Moriya et al., 2003). The UK is not a major producer of sweet chestnuts, partly due to climatic constraints, although the potential to do so in the future may now have been diminished. Evidence from its distribution in Asia suggests that OCGW is likely to survive winter temperatures that do not already limit the distribution of *C. sativa*. However, insufficient warm summer days (estimated by degree day accumulation above its known minimum development threshold of 10°C) may prevent successful development and reproduction beyond southeast England.

Thought to be introduced into the UK two millennia ago by the Romans, sweet chestnut has since naturalised in the UK and is considered by some as an 'honorary native'. It is most widely planted and grown as woodland in the south east of England. In this area sweet chestnut is estimated to cover 18,000ha and approximately half of this is ancient semi natural woodland. An additional 1,000ha of sweet chestnut occurs in eastern England and the southwest and about 90% is thought to be predominantly coppice. Sweet chestnut is also valued as a street and parkland tree.

Concern has been raised in the UK coppice industry about what effect OCGW might have on timber quality. To start to address this question 1,422 OCGW galls formed in the current year (2015) were analysed at Forest Research (Alice Holt, Farnham). Almost all were found to be on the leaf petiole or lamina and therefore would have no detrimental effect on timber quality in terms of affecting the grain, which could occur with galls formed on twigs. Leaf borne galls abscise with leaf senescence during the autumn, leaving no trace on the tree. From the sample material received at Forest Research, only 0.6% of galls were older than one year and these were on the twigs. However, this is just a preliminary result and more systematic sampling is required. The presence of older galls on twigs could be higher as they are quite easily dislodged when samples are collected and much smaller than fresh galls.

It has also been reported that heavy OCGW gall infestations can weaken trees making them more susceptible to other pests and diseases. For example, the presence of

OCGW galls may increase the likelihood of infection from sweet chestnut blight (*Cryphonectria parasitica*) via the exit holes left by the wasp after it matures and exits the gall (Prospero and Forster, 2011). Chestnut blight is a quarantine organism and has been found in the UK on recently planted trees (Hunter et al., 2013) although it is now considered eradicated. Further information on sweet chestnut blight can be found on the Forestry Commission web pages (www.forestry.gov.uk/chestnutblight).

Surveys and response

Annual surveys for OCGW were undertaken prior to its discovery in Farningham Wood and the UK had protected zone status against it. The most recent UK survey was conducted in 2014 and no findings of the insect were made. However, immediately after the discovery in Farningham Wood in 2015, the core 1km diameter inner zone, a 5km zone and an outer zone to 10km were surveyed with varying intensity between 16th and 26th June. There were approximately 3200 sweet chestnut trees within the three zones (photographs from the survey and operations can be seen in Fig. 7). The survey identified 20 infested trees in the 1km core zone but none outside this area. One tree, a coppice stool with c.20 stems, contained 3237 OCGW galls whilst other sweet chestnuts contained a wide range between 4 and 500 OCGW galls. Fig. 8 shows the distribution of OCGW infested trees in Farningham Wood.

Directly after the initial confirmation of OCGW in Kent, the Forestry Commission produced a symptom guide (www.forestry.gov.uk/gallwasp) and Observatree volunteers were mobilised to search for OCGW galls elsewhere in England. Observatree is a multi-partnered citizen science project led by Forest Research that has involved the training of around 200 volunteers in the identification of pests and diseases as part of a 'tree health early warning system' (www.observatree.org.uk). The volunteers are managed by the Woodland Trust and operate across the UK. It was an Observatree volunteer that subsequently discovered OCGW galls on a sweet chestnut street tree in St. Albans, Hertfordshire, and reported the finding via TreeAlert (details below). FC Tree Health teams quickly followed up the report and identified a total of six OCGW infested trees in the same

Figure 7. Operations in Farningham Wood, Kent. From right to left, top to bottom: a) OCGW survey, b) Farningham wood cordon, c) felling of infested sweet chestnut and mulching of gall material on site, d) forwarder removing sweet chestnut logs. (Photos: Forestry Commission)

location. The trees were promptly removed and further surveys were also conducted out to 10km with approximately 235 sweet chestnuts over 110 sites surveyed. No further OCGW galls were discovered. Tree wardens co-ordinated by the Tree Council were also mobilised for additional surveillance.

With the co-operation of the owners and managers, about 4ha of the most-affected trees at Farningham, were quickly felled to prevent or minimise any expansion of the outbreak area as adult wasps were likely to start emerging in early July. Foliage from infested trees at Farningham was mulched on site to destroy the galls and larvae, while the logs were recovered for the chestnut timber market. Sticky traps were sited around the outbreak area to monitor any adult OCGW emergence, and very few adults had been caught by the time this article was written.

In August ministers approved the felling and mulching of sweet chestnut trees in a further 7ha of Farningham Woods to destroy trees in which any emergent adults might have laid eggs, thereby preventing, or minimising the extent of, another generation developing. Farningham Woods are well used by the chestnut coppice industry, and some of the felled trees were already due for coppice harvesting later in the year. By August most of the stools of the felled trees were regenerating healthily.

Protected zone surveys for chestnut blight and OCGW in the southeast are planned to take place in September 2015. Furthermore, the Observatree volunteers that have received formal training in recognising the signs and symptoms of chestnut blight will continue to look for OCGW galls on sweet chestnut.

Future management of OCGW

Pesticides are generally not effective against OCGW because the insects are protected inside the galls. Instead efforts have been concentrated on testing parasitoids as biological pest control against the gall wasp in Japan, the USA and Italy. An evaluation of the OCGW gall material from Farningham Wood, led by Chris Malumphy at Fera Science, has revealed that OCGW is already being parasitised by

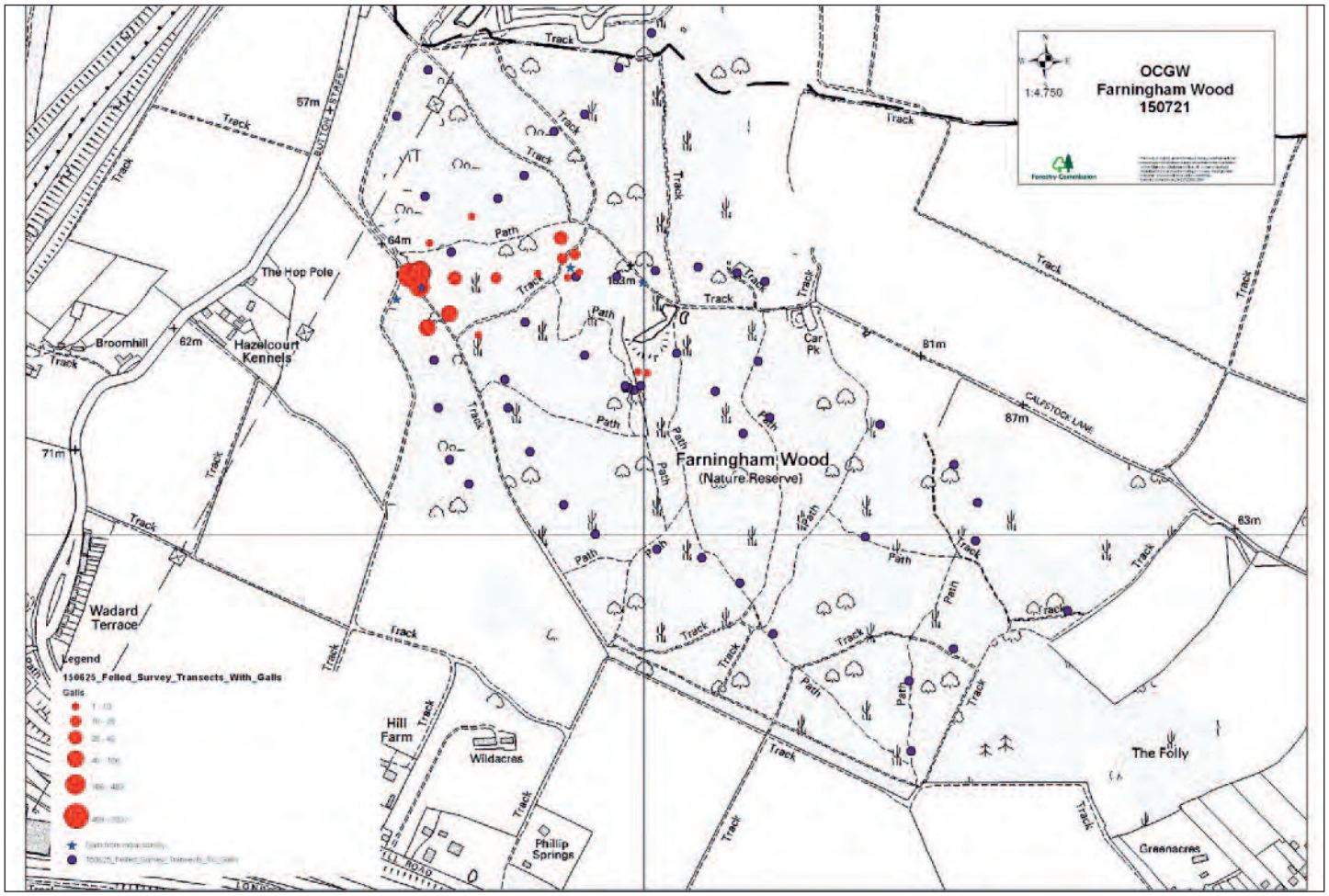

Figure 8. OCGW infested trees in Farningham Wood, Kent, in June 2015 (Photo: Forestry Commission)

some of our native chalcid parasitoids. In other countries it has been shown that parasitoids of OCGW are recruited from nearby oak trees and the lag time between introduction and recruitment of native parasitoids can be relatively short (Matoševi and Melika, 2013). It is a positive sign that some natural OCGW control is already taking place in the UK although more work is required to determine parasitism rates and the various species involved. The latest information on policy and management can be found on the Forestry Commission England website (www.forestry.gov.uk/gallwasp).

Citizen science, Observatree and TreeAlert

Using Observatree volunteers for wider surveillance efforts around OCGW is a timely example of how citizen science can help to intercept or track new pest and disease threats. The forest industry professionals and members of the public can also use TreeAlert, an online reporting system developed by the Forestry Commission, to submit tree health concerns to Forest Research for diagnosis and advice.

The Observatree project and TreeAlert reporting are vital tools that enable Forest Research and the Forestry Commission to gather information concerning the health of the nation's trees, woodlands and forests. Both underpin the prevention and early diagnosis of new pests and diseases – the importance of which can scarcely be overemphasised. You can help us with this task and submit tree health enquires via TreeAlert (www.forestry.gov.uk/treealert).

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