ANCIENT TREE FORUM

# What do we really know about oak jewel beetle and acute oak decline?

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**Very few beetles become familiar names to arborists and the ones that do tend to achieve that status because they have somehow become perceived as 'problems'. But in the case of oak jewel beetle *Agrilus biguttatus* perceptions have been manipulated by experts who should know better; the experts have produced no evidence in support of their campaign of blackening its name within the industry. In this article I aim to outline what is actually known about the biology of this beetle – and some of what is not known – and how this has been misrepresented in the press.**

***This article is provided by the Ancient Tree Forum, which champions the biological, cultural and heritage value of Britain's ancient and veteran trees, and gives advice on their management at www.ancienttreeforum.co.uk.***

There are in excess of 2,000 different species of invertebrate known in Britain which are dependent on the process of wood decay. They are often referred to as 'deadwood' species, but this is more a name of convenience than an accurate description of their habits. The majority actually require the activity of fungi to begin breaking down the otherwise indigestible cellulose and lignin content of the woody tissues – they are wood-decay species. A small number of the species (less than 5%) are, however, able to feed directly on undecayed wood as they have micro-organisms in their gut which are capable of digesting wood. These species also tend to be specific to particular tree or shrub species. They feed on freshly dead or even dying woody tissues – very few can overcome the natural defence mechanisms of living tissues. As decay proceeds, then the woody tissues are abandoned by these early arrivals and begin to attract different species which are more associated with the broad type of fungal decay – brown rot or white rot. As the decomposition progresses further, the species composition of the invertebrate fauna changes again, when the level of moisture and volumes of accumulating debris (wood mould) become more important. Eventually the decayed material becomes indistinguishable from soil and it is typical soil invertebrates that are present. There is a clear succession of invertebrate species from undecayed wood where the host is the tree species, through early decay where the decay fungus is the host, to late decay where the fauna has become independent of tree species or fungus species.

**The oak jewel beetle *Agrilus biguttatus*. (Roger Key)**

The suitability of particular dead woody tissues for different invertebrates depends very much also on whether the tree itself is in control of the death of these woody tissues. A large proportion of such wood is heartwood which has died under the control of the tree, with accessible nutrients having been withdrawn and waste products deposited. A similar process takes place when lower branches become shaded out by the crown. A different process occurs when sapwood dies by accident, because of disease or other damage, where the tree has not been able to withdraw nutrients first. The freshly dead woody tissues are much more nutritious as a result, and it is the cambial zone that is most nutritious as this is where the living tissues had been most active, in generating new xylem and phloem. The first wave of 'deadwood' invertebrates to be attracted to this fresh habitat – all insects – target the cambial zone. They respond to airborne chemicals to orientate themselves towards freshly available habitat; insect antennae are acutely sensitive to volatile hydrocarbons given off by plants. A living healthy tree smells very different to a dying tree. Most of these insects have no interest in living healthy trees, but a dying or freshly dead tree is very attractive. As 'fresh' dead sapwood is a short-lived resource for the insects – one or two years at most – they have to be highly mobile so that the habitat can be found and exploited quickly, before it becomes 'old' deadwood.

## The biology and conservation status of oak jewel beetle

Oak jewel beetle is amongst those early-successional species whose host is the oak tree, rather than a decay fungus. Its larvae feed directly on the undecayed dead or dying cambial zone and outermost sapwood of physiologically stressed, dying or recently dead trunks or larger thick-barked boughs of mature and older oak trees. The oak jewel beetle is not alone in this habitat: other typical associates include the longhorn beetle *Phymatodes testaceus* and the bark beetle *Dryocoetes villosus*. Similarly, freshly dead smaller branch wood with thinner bark is the habitat for another jewel beetle, *Agrilus laticornis*, and another bark beetle, *Scolytus intricatus*. Many other insect species are also attracted, including predators and parasites.

**An adult emergence hole of oak jewel beetle from bark on a parkland oak in Tatton Park, Cheshire.**

The adults of the above beetle species are the first to arrive on the scene of recent death; the females insert their eggs into the bark and the larvae feed on the nutrient-rich tissues of the dead cambial zone. These species are different shapes and sizes, and so the emergence holes of the adult beetles are very distinctive. The emerging adult beetle appears to be aware of its cross-sectional shape and does not waste time and energy by excavating any other shape in order to emerge from the bark and fly off. Jewel beetles have flattened upper surfaces and round undersides and so excavate D-shaped holes for emergence. The longhorn has round upper and undersides, and so excavates an oval-shaped emergence hole. The distinction between D-shaped and oval can be easily seen in many cases but the two general shapes can also grade into each other making identification problematic. The bark beetles are different sizes, with the *Scolytus* larger than the *Dryocoetes*, and so broadly speaking the emergence holes are round, but of differing diameters. These are not of course the only beetles active in freshly dead oak wood and so great care needs to be taken with identification using the shape and size of emergence holes; they are an indication of species only and not 100% reliable. It is always better to find supporting evidence for the identification, by examining the type of larval galleries for example.

**Keith Alexander searching for tracks, trails and signs of beetles.**

The adults of the oak jewel beetle are rarely seen – unlike those of many other beetle species, they are not attracted to blossom for feeding; they appear to feed on leaf material high in the crowns of trees, and so the species is readily overlooked unless observers are familiar with the larval galleries and adult emergence holes in oak bark. In areas which suffer from tidiness – where dead trees are felled and removed, and where fallen branches are cleared away – the species could remain undetected for decades. The species becomes confined to aerial deadwood, where limbs are damaged but do not fall, and to patches of trunk bark which die beneath torn-out or sawn branches. There is no evidence at all that the presence of small colonies in patches of dead bark leads to the death of the living healthy tree.

The adult beetles are sun-loving insects and tend to favour oaks growing in open situations such as parkland. It has been widely noted that egg-laying tends to take place on the warmer south-facing side of host trees. As with so many other wood-decay insects, the beetle's European range is mainly central, where relatively warm continental summers are typical. The English population is near the northern edge of the range and may be expected to fluctuate according to local weather patterns, with poor performance in relatively cool and damp summers, but strengthening in relatively warm and dry sunny summers.

Oak jewel beetle has a very interesting history in England. It was until recently sufficiently rare for an assessment of its conservation status by the national authority on the group, Brian Levey, to conclude that it was 'Vulnerable' (1987 *British Red Data Books: 2. Insects*). The history of the beetle does date back a long way in England and it seems reasonable to conclude that it is a true native. Oak jewels were recorded from Sherwood Forest, the New Forest and Windsor Forest, but few other sites. The beetle was assessed as being a relict old forest indicator species on the basis of records collated through the late 1970s and early 1980s (1986 *Pasture-woodlands in Lowland Britain. A review of their importance for wildlife conservation.* ITE), although it was also noted that it was occasionally imported in timber.

A national recording scheme was set up in 1984 to collate records of all jewel beetles and soldier beetles, and it quickly became apparent that the British range of oak jewel in particular appeared to be expanding (2003 *Provisional atlas of the Cantharoidea and Buprestoidea (Coleoptera) of Britain and Ireland.* Biological Records Centre). I commented that an increase in its abundance across parts of the south-east in the early 1980s had been boosted by the great storms of the late 1980s and the (then) recent appearance of chronic oak decline. Climate change may have been a key factor in the original increase. Our oaks have subsequently shown themselves to be particularly susceptible to various diseases or decline syndromes in recent decades, and oak jewel has continued to prosper as a result. The most recent *Species Status Review* (2014) by Natural England has concluded that it is no longer scarce or threatened in England. This should be good news, that a species once confined to a few refugia in our most ancient forests has been able to expand back out into the wider countryside, but unfortunately this expansion has been the result of continued and unsustainable losses of our mature oaks.

## Scientific research on the beetle in relation to acute oak decline

It was natural, then, for suspicion to fall on the oak jewel beetle as perhaps more directly involved in the death of the oaks than had previously been supposed. But despite extensive study of the various named oak diseases and syndromes – including the current concerns over acute oak decline (AOD) – no cause-and-effect has proved demonstrable for oak jewel. This is really not surprising given that the beetle is only attracted to a tree which is already ailing or dead in part at least, and so it would have no interest in a living healthy tree other than any patches of damage. Could the adults be carrying the agents of disease with them? A reasonable question, but no supporting evidence is available. Can the suspected causal agents spread through tissues of the tree via the larval galleries? Again, this is not proven – the larval galleries do not enter the living healthy cambial zone of the tree.

Of recent scientific papers that I have seen, only one has examined the biology of oak jewel objectively – a review in *Forestry* (Brown *et al.*, 2014) which notes that:

- Despite the recent emphasis on it as a pest insect, it has been relatively little studied.

**A dying mature oak in Moccas Park. There are many medium-aged oaks dying or dead in this nationally important old parkland which is amongst the richest English sites for saproxylic beetles. The oak trees had been dying prematurely long before oak jewel beetle recently colonised the site.**

- Only a few *Agrilus* species globally are considered pests; typically these are exotic introductions, e.g. emerald ash borer, an east Asian species introduced to North America and western Eurasia via wood packing material.

- Where host and pest species have co-evolved, healthy trees are generally able to resist attack, so trees tend to be physiologically stressed or altered in biochemical status before they become susceptible.

- Female beetles are thought to select oviposition sites on host trees that are physiologically stressed by one or a combination of factors.

At present the cause-and-effect order remains unclear; oak jewel may be attracted to trees affected by AOD or may simply be selecting weakened hosts predisposed to decline; host condition may be the critical factor in determining which trees suffer from AOD.

To date, no *Agrilus* species has been demonstrated to actively vector a plant pathogen.

At this time, there is no evidence to contradict its status as a secondary stem-boring beetle attacking weakened oak.

Any proposed management programme should consider that *Agrilus biguttatus* is a native British beetle and, until recently, considered rare.

Unfortunately for people who only read abstracts, the key points only appear in the main text; this is a common problem in the pest management industry where the language itself is tainted with value-judgements – notably 'attack' when they really mean 'attracted to'. Once one understands the biology of oak jewel, the frequent association of AOD with the larval galleries and distinctive adult exit holes is not at all surprising but does not indicate cause and effect. Brown *et al.* (2014) correctly refer to this lack of evidence for cause and effect in the main text but not in the abstract.

In contrast to the objectivity of this review is a parallel paper (Denman *et al.*, 2014) which claims to describe the symptoms of AOD and yet includes the larval galleries of oak jewel. There are many dictionary definitions of 'symptom' but the one that covers most people's understanding of the term is: evidence of disease or physical disturbance. But in the case of oak jewel there is no evidence for cause and effect – as clearly stated in the paper by Brown *et al.*; our current understanding of oak jewel biology is that the beetle follows the disease, not that it is involved causally. So, while oak jewel might conceivably be considered a symptom of a dead tree, it is illogical and unhelpful to describe it as a symptom of AOD.

Denman *et al.* (2014) note that oak jewel has been reported from 90% of trees with AOD (19 out of the 21 randomly selected trees over 16 sites) – a rather biased statement which implies that most AOD has co-occurrence with the beetle. But turn that same figure around and 10% of trees showing AOD have no co-occurrence with the beetle. So if the beetle is involved in AOD, how did those 10% become infected? Given that the beetle is attracted to diseased trees it is surprising that the figure of co-occurrence is so low! But, so far as AOD is concerned – and according to evidence currently available – the presence or absence of oak jewel is irrelevant. Denman *et al.* (2014) comment that a key issue is to determine whether the high co-occurrence of oak jewel and AOD is merely a coincidental relationship or an essential part of the disease. The authors admit that they have found no evidence, but only after they have argued that the presence of the beetle is a sign of AOD.

The oval-shaped exit holes of a longhorn beetle – presumably *Phymatodes testaceus* – are also noted by Denman *et al.* (2014) in their sample trees, but this fact is not commented on further. What was the level of co-occurrence between this beetle species and AOD? Not surprisingly, populations of this longhorn beetle have also been increasing over the same period as has oak jewel beetle – why is it being ignored by the researchers? Why have they chosen to pick on oak jewel rather than this longhorn – or any other insect species that happens to show obvious signs of its presence?

## Is control premature?

Suggestions for removal of oak-jewel-colonised trees are clearly seriously premature. What evidence is there that

**The old oak pollards at Cwm Byddog Nature Reserve in Powys. One of these live and healthy oaks had a small patch of dead trunk bark below where a large limb had recently ripped out and which had been colonised by oak jewel beetle, and where a few of the distinctive adult emergence holes were noted.**

this might impact on AOD, given that researchers have yet to work out how the causal agents of AOD get around? Standing deadwood is a rare and threatened habitat throughout modern tidy-minded and risk-averse Britain. It would seem unlikely that oak jewel is the only native wildlife present. We know that mature trees are increasingly scarce in the landscape and so recommending removal of standing dead trees only adds to the sterilisation of our countryside. Brown *et al.* (2014) comment that trees standing dead for more than a year will be unlikely to yield any further individual beetles.

Brown *et al.* (2014) mention two known parasitic wasps of larval oak jewel – the ichneumonid *Deuteroxorides elevator* and the braconid *Spathius curvicaudis* – but provide little additional information. Only the latter is known from England. The two key national experts on the *Spathius* (now regarded as the same species as *Spathius erythrocephalus*) say that this wasp is almost certainly a widespread species and so will already be impacting on oak jewel populations. They do not believe that any artificial manipulation of the wasp population would have any further impact. It is a gregarious species that parasitises medium-sized beetles to be found in the subcortical area of fairly recently dead or dying trunks or branches. It is not specific to oak jewel, so any attempts to increase its impact would be misguided.

**Kedleston Park, Derbyshire. Mature oaks had been dying here prematurely for many years before the site was recently colonised by oak jewel beetle.**

## Conclusions

There is currently no evidence that oak jewel beetle has a causal role in AOD, and indeed, the known biology of oak jewel strongly suggests that it is merely attracted to dying and dead tissues AFTER trees have already been affected by AOD. The research papers have clearly demonstrated that some trees with AOD symptoms have no signs of oak jewel beetle – this is evidence that the beetle is *not* an essential causal factor. There are still questions which merit investigation, but it is very premature to be describing oak jewel beetle as a pest of oak trees and advocating its control.

# News update

## New website for the Ancient Tree Forum

The Ancient Tree Forum (ATF) has developed a new website, which is designed to be fully accessible for those on the go as it adapts for viewing on tablets and mobiles. The site, www.ancienttreeforum.co.uk, already includes a wealth of information on ancient and other veteran trees and their management, and more content will be added over the coming weeks and months.

## ATF's handbook now available online

Many *ARB Magazine* readers are likely to be familiar with the ATF's book *Ancient and other veteran trees: further guidance on management*, edited by David Lonsdale. The 212-page handbook on the management of ancient and veteran trees is widely recognised as an invaluable source of information and advice for arboriculturists, landowners and advisers. The handbook is now available to freely download from the ATF's site. For those wanting a hard copy it can also still be purchased for £30.

## Valuing and managing veteran trees: a 'training the trainer' course

The Ancient Tree Forum is running 'Valuing and managing veteran trees: A three-day advanced course for trainers' from 29 September to 1 October in Cumbria and from 8 to 10 December at Gilwell Park in Essex. The object of the course is to train people who will in turn be able to deliver a one-day course on valuing and managing veteran trees. The course is a mix of indoor and outdoor activities and is intended to be interactive and participatory. The content includes topics such as the aging process, the value of veteran trees for biodiversity and heritage, roots, management of veteran trees and site management. Participants will be given all the material needed to deliver the one-day course including presentations and handouts. Early booking is advisable, and full details and booking information can be found at www.ancienttreeforum.co.uk.

## Have you booked a place on the ATF's Summer Forum?

The 2015 Ancient Tree Forum conference is to be held in East Anglia on Thursday 18 and Friday 19 June, and it will bring together a wide range of experts and enthusiasts interested in the ecology and management of ancient and veteran trees. The two-day event will include field visits to wood pastures, orchards and other sites, presentations from expert speakers, and networking opportunities. Booking is essential. For more information and details of how to book a place, see the ATF's website or email eventsATF@aol.com.

## ATF autumn field meeting

The ATF's autumn field meeting will take place in the Lake District on Thursday 8 October. As always, the event is open to everyone, but places will be limited and booking is essential. Details will be available on the ATF's website.

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