

Mistletoe (*Viscum album*); a brief review of its local status with recent observations on its insect associations and conservation problems

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Abstract

This paper reviews the established information on the distribution of mistletoe, its habitats and hosts, stressing how important our area is for the species. Conservation issues for mistletoe itself, particularly in relation to orchard loss, are discussed. Other, less well-known issues, are then reviewed, especially the increasing interest in mistletoe insects, and the conservation requirements of these. The difficulties in making generalisations, particularly when based on limited invertebrate data, are outlined. There is also a brief discussion of wider factors affecting mistletoe, including bird vectors and climate change.

Introduction

As the only aerial tree parasite in Britain, and with customs and traditions stretching back into prehistory, the European white-berried mistletoe, *Viscum album*, has always attracted special attention. Within the Gloucestershire and wider Severn Vale area it has particular relevance, as it is especially abundant here. This is the species' favoured growing area, and it becomes relatively rare in Britain in areas beyond Herefordshire, Worcestershire, Gloucestershire and Somerset.

Despite being a favourite at Christmas, and having a long and distinguished role in myth, legend and medicine, mistletoe is surprisingly little studied in Britain. In continental Europe it is better understood, with ongoing research into its potential in medicine (e.g. Bussing 2000) and wider appreciation of its historic uses. This paper briefly reviews the importance of this core area for British mistletoe and highlights growing concerns and questions regarding the conservation of the harvestable mistletoe stock. It also raises scientific and nature conservation issues relating to the insects dependent upon mistletoe.

Mistletoe distribution

Europe is at the edge of the northern range of the globally occurring mistletoe families (Viscaceae and Loranthaceae, all parasites of tree branches), with just a handful of species in southern Europe, and only

Viscum album occurring in northern Europe. The species' occurrence in Britain is especially notable, as it is rarely found at similar latitudes in mainland Europe, being almost absent from the Netherlands northwards and extremely scarce in Scandinavia.

The species' unusual distribution within Britain itself is shown in Figure 1. The dominance of the 'three counties' area is immediately obvious, with additional concentrations of mistletoe stretching southwards into Somerset. This core area is shown in more detail in Figure 2. Figure 1 also clearly shows that mistletoe occurs throughout most of the rest of England, particularly in the south, but it is absent from most of Scotland, Wales, northern England and the extreme south-west.

This distribution was assessed by BSBI in the 1970s and by BSBI and Plantlife in the 1990s (Briggs 1999). It seems fairly stable, and has been similar throughout recorded botanical history so it must be more than an artefact of human activity (many people, wrongly, have attributed this to orchard distribution – see below for comments on this). The conclusion is that this core area seems especially favourable to the growth of mistletoe. This is probably related to climate, both temperature maxima and minima and humidity.

The detailed distribution map in Figure 2 hints at some controlling factors, most notably the climatic impact of altitude. The line of the Cotswold escarpment clearly forms the eastern boundary, and the western side the valleys of the Rivers Wye and Usk can be

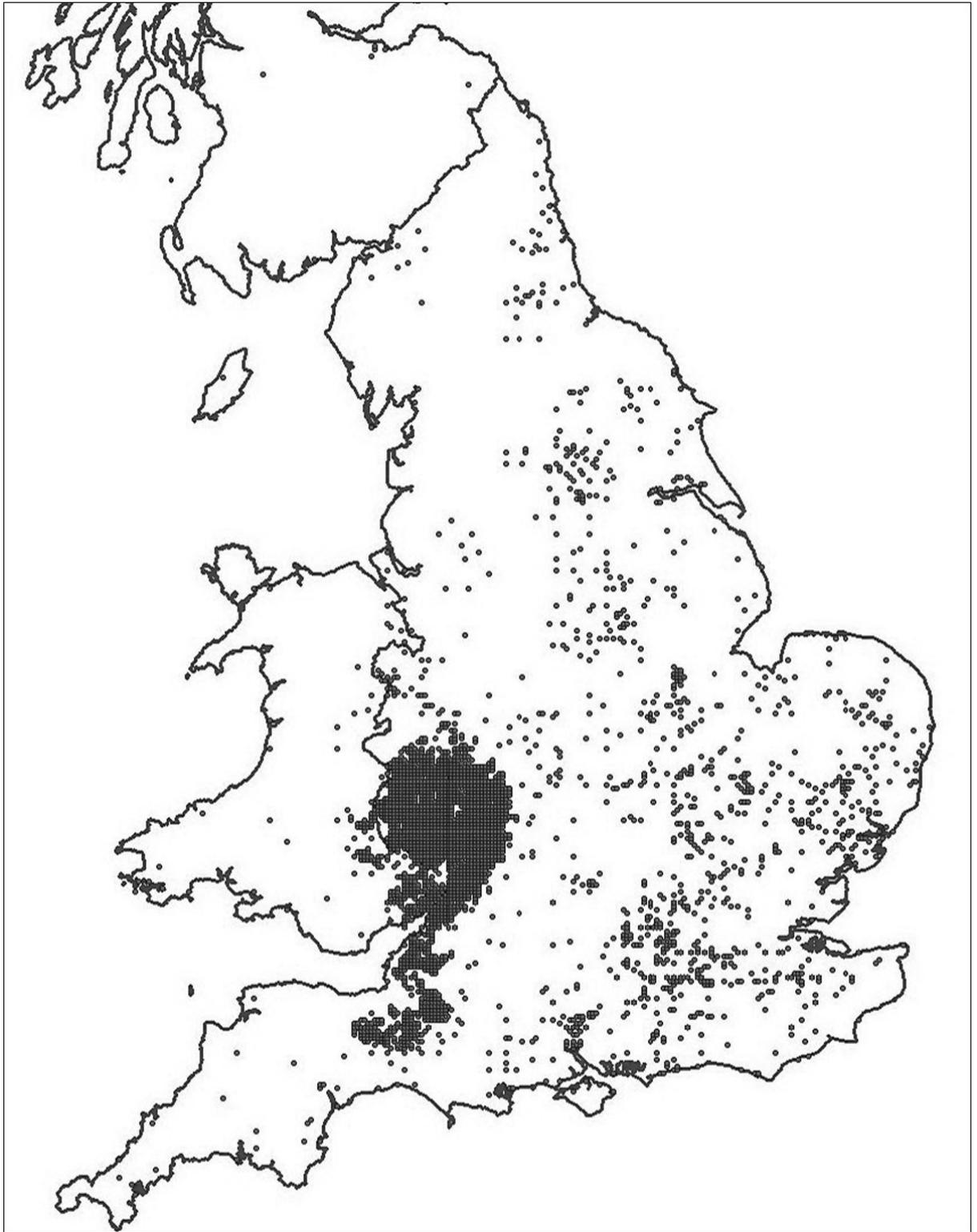


Figure 1. Distribution of Mistletoe, *Viscum album*, in Britain; re-mapped from Plantlife/BSBI data in Briggs (1999).

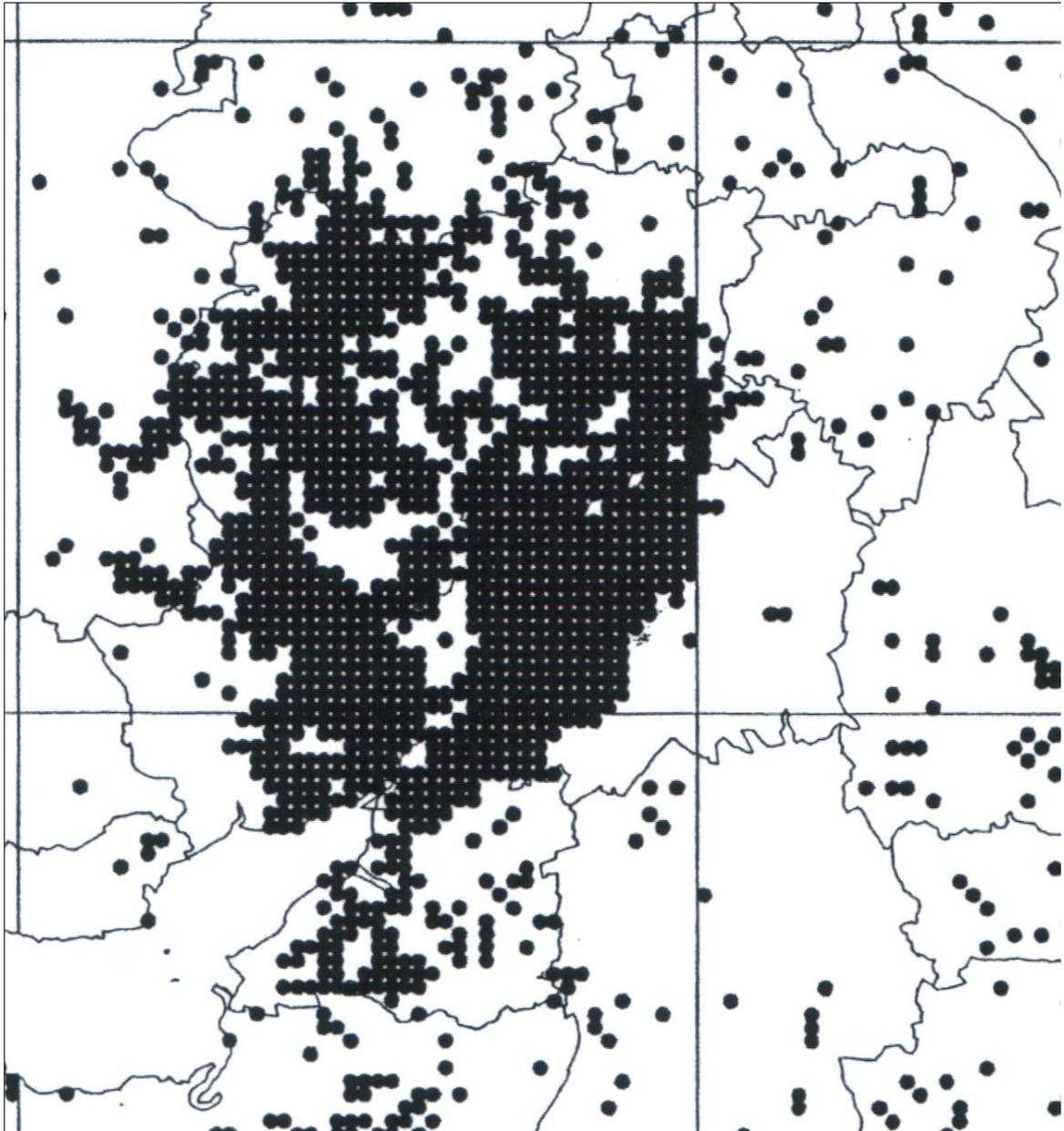


Figure 2. Detailed distribution of Mistletoe, *Viscum album*, in the English south-western Midlands, from Briggs (1999). The three most densely affected counties are Gloucestershire, Worcestershire and Herefordshire.

traced as lines of mistletoe records, taking mistletoe into the Welsh uplands. The northern boundary of the area is formed by the Clee Hills (north-west) and the Birmingham plateau (north-east).

Habitats and hosts across Britain

The habitat and host preferences of mistletoe are even more intriguing than the distribution pattern. There is a strong dependence on man-made habitats and also, to a large extent, on man-made hosts (*i.e.* hybrids and varieties created through horticulture). The histograms in Figure 3 present national data for habitats and hosts from the 1990s survey data (Briggs 1999). Preferred habitats (Figure 3a) are largely gardens, orchards and parkland and preferred hosts (Figure 3b) are largely cultivated apple and hybrid limes. Mistletoe will grow on many different hosts, but it does tend to be mostly on these few.

Many other habitats and hosts are also possible of course, but the clear preference is cultivated varieties of trees in open, man-made habitats. In a primeval forested Britain mistletoe would be much less common.

Many questions arise from this unusual distribution, habitat and host pattern. The most obvious is why is mistletoe so abundant in its core area, in the south-west Midlands? Many commentators assume it is

linked to apple orchard distribution, but this does not bear much scrutiny. Apple orchards are, or were, common in many other parts of the country but those have no association with mistletoe, currently or historically. Analysis of the 1990s data shows that it grows on more hosts within this area than anywhere else, with numbers of host species falling further away. It seems to grow better in the core area because climatic factors suit it here and the many apple orchards are probably just a coincidence, not a primary factor.

Outside the core area mistletoe seems to survive well, and can persist in small colonies for decades or even centuries, but it does not spread much, or thrive in quite the same way as it does in the core area, despite the presence of suitable hosts and habitats. Much of the mistletoe outside the core area is in gardens and parks, and is assumed to be deliberately introduced. Data from the 1990s survey support this view, with garden and park records becoming proportionately higher further away from the core area, with the overall number of hosts falling in favour of even higher proportions on apple and lime.

Conservation issues arising

The purpose of the Plantlife/BSBI 1990s assessment was to try and assess whether ongoing loss of traditional apple orchards, through agricultural

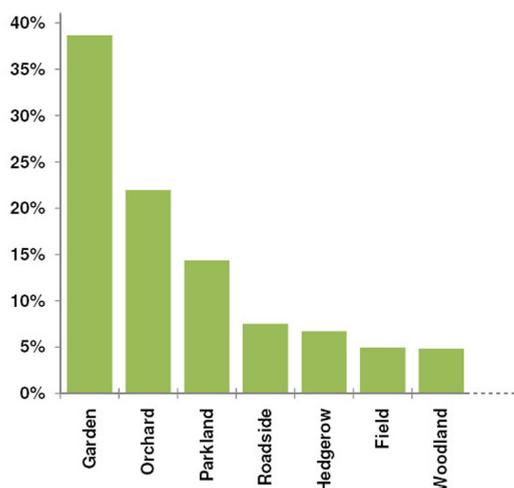


Figure 3a. Habitats for mistletoe across Britain, from Briggs (1999).

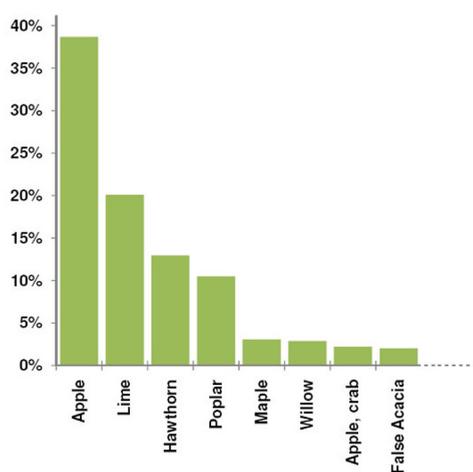


Figure 3b. Hosts of mistletoe across Britain, from Briggs (1999).

change, would lead to a similar loss of mistletoe. Over 90% of Britain's traditional orchards have now been lost, and this is continuing despite many local campaigning groups raising awareness. Their efforts have secured exemplary farms and community sites where traditional orchards can be conserved, but the loss in the wider countryside has either happened or is continuing.

But what does this actually mean for mistletoe? The distribution and host data suggest that loss of orchards might not change distribution, but surely it must mean there have been, and will be, changes in abundance.

How important is a change in abundance? An obvious economic effect would be a loss of harvestable mistletoe at Christmas, as most is sourced from apple orchards. It is much easier to harvest in apple orchards than on other hosts, and can provide a modest income at Christmas. The famous mistletoe auctions at Tenbury Wells, in north-west Worcestershire, are supplied almost entirely from apple orchards (for a general account see Briggs 2010). So, continuing loss of apple orchards will have economic effects, probably leading to a smaller mistletoe crop in future.

But has this reducing availability become a problem yet? A visit to the Tenbury mistletoe auctions will see plenty of mistletoe and no sign of a problem. This may be partly, or even largely, because of another factor; excessive growth of mistletoe in many remaining but neglected apple orchards (reviewed in Briggs 2008). This is a side-effect of reduced interest in managing orchards: where they are no longer managed for apples but left standing, mistletoe can grow unchecked, meaning there is plenty, in those neglected orchards, at Christmas.

This is, of course, unsustainable. When these orchards were actively managed for fruit production any mistletoe would have been cut back and controlled each year. Harvesting for the Christmas trade tends to select just the berried female growths, leaving the male growths uncut, so Christmas harvesting does not equate to good management. Continued neglect, or just Christmas harvesting, of major infestations on small apple trees will seriously stress the trees, and within a decade or so will result in the death of the trees and the mistletoe.

So perhaps the critical stage in loss of harvestable mistletoe has not been reached yet, and will only become truly apparent in the next 20 years or so.

The nature conservation implications of reduced mistletoe abundance are rather different and difficult to predict. Loss of abundance in itself may not be a problem, apart from in landscape terms, but there may be some subtle side-effects, perhaps for the obligate insects discussed below. The current issue of excessive growth in surviving but neglected orchards may also have nature conservation implications for associated birds and insects.

Invertebrate associations

The obligate insects of mistletoe have received much attention since the conservation issues for mistletoe were raised in the 1990s. In the 1990s just four species were listed, all relatively unknown (Briggs 1996), but since then two more have been discovered, and there may be more to find in future (much larger numbers are known from *Viscum album* in mainland Europe).

All the mistletoe insects are considered scarce, with some listed as threatened. One of them, the Mistletoe Marble Moth *Celypha woodiana* was added to the UK Biodiversity Action Plan (UK BAP) as a Priority Species in 2008, thereby raising mistletoe conservation to a more official level.

Despite this conservation concern, not much is known about the biology and requirements of these mistletoe insects. Most entomological recording concentrates on noting their presence, with no significant studies of their needs and life-cycle. Each is described below, with notes on current knowledge, and, for some, recent observations (2009 and 2010) in the Stroud and Severn Vale areas. Note that this is not a full assessment of current records.

The current list comprises one moth (the Mistletoe Marble Moth *Celypha woodiana*), three sap-sucking bugs (*Cacopsylla visci*, *Pinalitus visciicola* and *Hypseloecus visci*), one predatory bug (*Anthocoris visci* - which feeds on the other bugs) and one beetle (the Mistletoe Weevil *Ixapion variegatum*).

***Celypha woodiana* (Barrett 1882); Tortricidae, Olethreutinae**

Recently given the new name of Mistletoe Marble Moth (following its listing in the UK BAP) this small tortricid moth was originally discovered in 1878 by Dr John Wood of Tarrington near Hereford. It was known to be associated with apple orchards, but its larval food plant remained unknown until it was found to be a leaf-miner of mistletoe leaves in 1892.

The moth (Figure 4) remained fairly obscure, with only occasional records across Herefordshire, Worcestershire, Gloucestershire, Gwent, Somerset, and Warwickshire, until it was added to the UK BAP in 2008. This has led to considerably more attention, with a 2009 national survey undertaken by Butterfly Conservation, part-funded by the National Trust and Natural England.

Finding the moth is problematic. It only flies in late summer, and so most survey effort concentrates on spotting the leaf-mines of the larvae. These start as small comma-shapes, following hatching in late summer, that last throughout the winter. The larvae develop from the spring, expanding this tiny mine into a larger blister mine that can, in theory, be spotted from the ground by late spring and early summer (Figure 5). In practice spotting these mines can be difficult, as James McGill, who undertook the 2009 survey found out. As part of that project he organised training sessions for others, showing how to look for these mines (Figure 6).

McGill (2009) also reports on the difficulty of differentiating other tortricid moths that may be seen on or near mistletoe. Most are web-spinning, binding leaves together, but confusingly, *Celypha* can also sometimes spin leaves together, so larval appearance sometimes has to be used too.

McGill concentrated on apple orchards, visiting 34 sites across mistletoe's core area. Several new sites were found, but some old sites failed to produce records. Of all the sites visited the best, in terms of number of host trees showing signs of the moth, was an orchard at Sandhurst, Gloucester, with the moth found on mistletoe in 10 trees.

The pre-occupation of the 2009 survey with apple

orchards is unsurprising but also slightly frustrating, as it would be useful to see whether the moth is as common on mistletoe on other hosts. Recording effort has always been biased towards orchards because of the original 1878 association with orchards, and the 'official' description of the moth in Bradley *et al.* (1979) stating it is 'apparently restricted to old apple orchards in the west of England'.

Some observations from the 2009 survey hint at the importance of other hosts; the highest number of larval mines seen on one host tree during the survey was 27, on a hawthorn at North Moor, Somerset. The most mines seen on apple were just 10, with most scoring well below that.

Other recent records give further information. There are Worcestershire records on mistletoe on rowan (Simpson 2005). Further south in Gloucestershire Robert Homan has been recording it on mistletoe on hawthorn at Chaceley (Homan 2007), and also on hawthorns along the banks of the Coombe Hill Canal (2005 to 2010) and on hawthorn in Hyde Lane, Cheltenham (2005 to 2007) (Homan pers. comm.).

It does seem likely that other mistletoe hosts may be just as important as apple orchards, and possibly more so. McGill (2009) noted that there seemed to be more mines on higher mistletoe growths, on the edges of the host tree. Most mistletoe outside orchards is in exactly this position, so if the moth prefers mistletoe so placed, it must surely find a lot of potential in non-orchard trees. Of course there is undeniably more mistletoe in orchards, and so greater potential for the moth, but McGill also suggests that orchards with abundant mistletoe seemed to have fewer moths; another hint that mistletoe in the wider countryside might be just as important.

***Cacopsylla visci* (Curtis 1835) (syn. *Psylla visci*); Psyllidae**

This sap-sucking psyllid is the most neglected of the mistletoe insects, not least because it looks so similar to many other psyllids (*e.g. Psylla mali*, a specialist on apple). The species has been recorded from across mistletoe's core area, with records suggesting it is almost always found if it is actually looked for. Hollier & Briggs (1999) looked for it and



Figure 4. The Mistletoe Marble Moth, *Celyphoidea woodiana*, from Bristol Museum's collections (photo: Ray Barnett).



Figure 5. Larval leaf-mine of Mistletoe Marble Moth.



Figure 6. Volunteers at a Butterfly Conservation training day, learning to spot the Mistletoe Marble Moth leaf-mines at Barrington Court, Somerset, 2009.



Figure 7. *Pinalitus visicola*, one of the mistletoe bugs.



Figure 8. *Ixapion variegatum*, the mistletoe weevil.

Figure 9. Dieback damage to terminal buds of mistletoe, caused by the emergence of adult mistletoe weevils (their exit holes are clearly visible).



recorded it at all sites when sampling in Painswick, Kemerton and Little Marcle. Green & Meiklejohn (2000) found it readily at Little Comberton, and Price (1987) found it easily when it was looked for in Warwickshire.

It is often assumed to be limited to the core area as this is where most mistletoe is, but it is surprisingly widespread, being recorded across the country (e.g. Badmin (1985) bred large numbers from mistletoe that had fallen from a Field Maple near Sittingbourne). More intriguingly it has recently been recorded as a new Norwegian species at the only sizeable population of *Viscum album* in that country, at a site near Oslo (Hansen & Hodkinson 2006). This raises the interesting question of how the species can spread to such an isolated population of its host.

***Pinalitus viscicola* (Puton 1888) (syn. *Orthops viscicola*, *Lygus viscicola*); Miridae, Mirinae**

In 1888 two new species of mistletoe bug were described from apple orchards near Paris, and soon afterwards Douglas (1889a) challenged British entomologists to find them. The Woolhope Naturalists' Field Club in Herefordshire rose to this challenge and managed to describe one of the two, *Pinalitus viscicola*, as 'common' by the summer of 1889 (Douglas 1889b). They did not (then) find the other species.

At the same time, also in response to the challenge, previously collected but hitherto unidentified specimens of this species were reported from mistletoe in Dorset and Norwich (Douglas 1889c). The implication was clear; this species had been overlooked, but was actually surprisingly common on mistletoe.

Today this little bug (Figure 7) is still under-recorded, but easy to find. Most records mention it as 'frequent'. For example Hollier & Briggs (1999) found it in large numbers at Painswick, Kemerton and Little Marcle, and Price (1987) found it easily on mistletoe in apple in churchyards, allotments and gardens in Warwickshire. It occurs outside of mistletoe's core area too; Nau (1985) recorded it from mistletoe on a Field Maple in Bedfordshire.

My own observations in 2010, at various sites in Stonehouse, Standish and Haresfield, suggest it is very abundant, with instars becoming very obvious from mid-May onwards, numerous mature adults from early June, and with a second flush of adults in late August and September.

The species overwinters as eggs, with instar development in spring, so it seems likely my second flush was a second generation that had matured quickly in June-July. Having found that this is a surprisingly easy species to find and monitor, more detailed monitoring is planned for 2011.

***Anthocoris visci* Douglas 1889; Anthocoridae, Anthocorinae**

This is the oddest of the mistletoe obligate insects, for it is a predatory species. It obviously does not rely directly on mistletoe, and instead is assumed (though with little actual evidence) to specialise in feeding on the other mistletoe bugs, especially the psyllid.

It was described as a new species by Douglas (1889d), after being collected from mistletoe near Hereford. Adults appear in August to September and are thought to overwinter under bark and lay eggs in spring. The larvae, said to be a distinctive orange-red, are also carnivorous. The adult also has some red colouring, but in general appearance is very similar to other Anthocorid bugs (often called Flower Bugs) and so it can easily be confused with other, commoner, species. In 2010 I observed several Anthocorids on mistletoe, including some feeding on psyllid bugs, but I was unable to make a specific identification.

It is officially listed as 'Notable' with threats listed as destruction of old apple orchards. This is despite little knowledge of it on mistletoe outside apple orchards. Most records are in the mistletoe core area but it has also been spotted as far afield as Dorset, Denbigh and Norfolk. Like the other bugs it is fairly easily detected when looked for by experts. Nau (1985) recorded it from mistletoe from the top of a poplar tree, but he could only sample that because the tree blew down in a gale.

***Hypseloecus visci* (Puton 1888); Miridae, Phylinae**

This is second of the two species discovered near Paris in 1888 (Douglas 1889a), but this is the one the Herefordshire naturalists failed to find in 1889 (see *Pinalitus viscicola* above). It may have been here all along, or may be a new arrival, but it was not actually found in Britain until 2003, when the National Trust Biological Survey team found it in Somerset (Gibbs & Nau 2005).

The NT team found it on mistletoe in apple orchards in late July at two Somerset sites; Tintinhull House and Barrington Court. Records since have been sporadic but scattered, and they include 'large numbers' taken on mistletoe in Bushy Park, Middlesex and 'large numbers' attracted to a moth trap in Hampshire (Denton 2004; Gibbs & Nau 2005).

These latter observations suggest a wide geographic spread, well beyond the core area, and early confirmation on a variety of hosts (at Bushy Park the mistletoe is on limes and hawthorns, not apple). It is not at all clear whether this is a recent arrival or not but it certainly seems widespread. In 2010 I observed several bugs looking very like *Hypseloecus visci* on mistletoe in Stonehouse, Standish and Haresfield, but these were not collected for formal determination.

***Ixapion variegatum* (Wencker 1864); Apionidae, Apioninae**

This is another new arrival, or at least a new discovery, first recorded in Britain in 2000 by the National Trust team on mistletoe growing on apple at Brockhampton, Herefordshire. It has subsequently been recorded in Worcestershire, Gloucestershire (e.g. Lane 2009) and Monmouthshire.

As with *Hypseloecus visci* we have no real knowledge of whether this is a new arrival or not. Foster *et al.* (2001), describing the new discovery in 2000, suggest that this species is probably 'a long-established but overlooked representative of the British fauna rather than a recent arrival'. It is a very small weevil (Figure 8), about 3mm long, so could be easily overlooked. On the other hand it is

very distinctive, so if found should surely have been readily spotted as unusual.

Foster *et al.* (2001), reviewing European data for this species, suggest that it occurs at low densities (so easily missed?) and appears to increase when mistletoe is possibly under stress, perhaps on host trees that are dying. This association with 'stressed' mistletoe is also reported by others (e.g. Green & Meikelejohn 2004).

My own observations in the Stroud area in 2010, summarised in Table 1, suggest that the species is very easy to observe in mistletoe without beating, and so it should be relatively easy to find and to study. Some populations I found were very numerous. Furthermore, rather than choosing stressed mistletoe, the weevil seemed to be, in effect, the cause of the stressed mistletoe. Eggs are laid into mistletoe stems just below the terminal bud, and the larva develops within the stem before emerging as an adult later in the summer. One particular mistletoe clump I observed started the year looking healthy, but with nearly all its terminal buds dying after weevil infestation, was looking very stressed by August (Figure 9).

Conservation questions for the insects

All six mistletoe insects listed are considered rare, and there is a national Action Plan for the moth. But what are their habitat requirements, and how can mistletoe management cater for them? Are they actually rare, or just overlooked?

Certainly some (*Cacopsylla* and *Pinalitus*) seem to be very common when looked for, so rarity may not be as major a factor as often assumed. As for habitat requirements, it is probably too early to say. Much of the limited survey work has concentrated on orchards, but as suggested above, that approach risks missing the importance of mistletoe elsewhere. Indeed, as apple orchards continue to decline, the mistletoe in the wider countryside increases in importance proportionately, so perhaps it is that mistletoe that is critical to the insects' survival.

How much do these species need active conservation? Two of the six were not even known in Britain about 10 years ago, and it is widely acknowledged that all

	Dates/period	Comments
Adults present	25 th June to 9 th September	Continually present at one or more of the sites visited
Mating observed	2 nd July, 22 nd and 26 th August	
Feeding observed	July to August	Probing/feeding stems, and leaves, resulting in a speckling of small brown dots on the leaf surfaces
Egg-laying	Assumed in early July	Not definitely observed, but adults probing around areas below terminal buds assumed to be preparatory to egg-laying
Adult emergence	June onwards	Exit holes observed in increasing numbers from June. Most single, a few double. Observed <i>in vitro</i> by taking distressed but intact shoots indoors – emergence occurred within 2 days.
Die-back of infested terminal buds	June onwards	Some distress to terminal leaves and buds observed before holes appeared – the degree of dieback increased after emergence. Every bud with dieback showed an emergence hole by August. Dieback in new season growth observed in August, implying development of second generation.

Table 1. Observations on *Ixapion variegatum*, the Mistletoe Weevil, in 2010. Data pooled from observations in Stonehouse, Standish, Haresfield and Painswick.

are under-recorded. So long as there is mistletoe, it seems likely these insects will continue to thrive, unless they specifically need mistletoe in an orchard habitat, or perhaps mistletoe in dense quantities in overgrown apple trees. The literature suggests that overgrown, stressed trees are exactly what *Ixapion variegatum* needs, as it is associated with 'stressed' mistletoe, but simple observations in 2010 have implied that this 'association' may be being misread, and that the beetle does occur in (initially) unstressed mistletoe.

Management is another challenging area. McGill (2009) makes some outline suggestions for management of *Celypha woodiana* in orchards. He recommends keeping healthy mistletoe clumps on edges of the tree canopy, and restricting the numbers of mistletoe clumps per tree. This agrees reasonably well with management prescriptions for mistletoe in general (Briggs 2008) but there is a possible conflict with Christmas harvesting – the outer clumps tend

to be the most attractive and most sought-after. If those are where the moth larvae preferentially live, perhaps we should all be examining our Christmas mistletoe purchases next season to see if the tell-tale comma-shaped overwintering leaf-mine is present.

More recording, on a wider range of hosts, and more observation to assess life-cycle and habitat requirements is evidently needed for all these species. It may be some time before these insects are properly understood.

Changing environments

What might be the significance of changing environments for mistletoe, aside from apple orchard loss? The two newly recorded insects may be new arrivals, or may not be. If they are new to Britain, this could indicate other species may follow. There are already some changes for mistletoe-feeding

birds, outlined below, and there is the wider issue of climate change.

Smith *et al* (2007) undertook a review of new invertebrates in Britain assessing whether they might be, or become, 'pest' species. Their paper included passing reference to both *Hypseloecus visci* and *Ixapion variegatum*. They make no particular comment on either, and even omit *Ixapion variegatum* from their analysis because of its 'uncertain' (is it new or just previously overlooked?) status. *Hypseloecus visci* is listed as a 'natural colonist'. Their wider discussion is interesting. Many of the 160+ species they mention are assumed to have been introduced via the plant trade. They do not mention mistletoe at all in this regard, but as much mistletoe is regularly imported each season from Europe, it does seem feasible that one or both of these 'new' species could have entered Britain that way, and that more might follow. Much Christmas mistletoe is discarded outdoors, and overwintering insects might survive. As for 'pest' status, the impact of *Ixapion variegatum* in killing mistletoe terminal buds could surely, if the species is increasing in Britain, have a significant affect on the Christmas mistletoe harvest, potentially damaging the appearance of much of the crop. With so few data, such suggestions are speculative.

Another change affecting mistletoe is the increasing number of Blackcaps, *Sylvia atricapilla*, overwintering in the Severn Vale area. The wintering population has dramatically increased from a handful of birds in the 1980s to thousands now (Berthold 1995). Blackcaps are very efficient vectors of mistletoe, far more so than Mistle Thrushes, *Turdus viscivorous*, the only other bird that regularly takes the berries. It would be surprising if the newly wintering population were not taking advantage of the local mistletoe, and, as a result, changing its rate of spread. Again, there are no data, but the concept is intriguing.

Lastly, the effects of climate change on mistletoe could be dramatic, according to Jeffree & Jeffree (1996) as, instead of just extending northwards, the species is likely to vanish from Britain entirely, (though it may move north in mainland Europe) if UK winter temperature rises are greater than UK summer temperature rises. In this scenario, also speculative of course, the concerns about mistletoe

in apple orchards, loss of the mistletoe crop and details of insect requirements become insignificant.

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