

Worcestershire Entomology Day 2012

Insect Behaviour - Saturday 24th November 2012

We were pleased to welcome all for our ninth Entomology Day. The title Insect Behaviour provided plenty of scope for talks, all of which were of great interest and stimulated much thought and discussion. About 60 of us were present to enjoy the day in Rock Village Hall, and a summary of the talks is provided here.

Insect Vision

David Skingsley



Chrysops relictus

Dr. Dave Skingsley started by saying that animals inhabit the same world of light from which they extract specific visual information such as: contrast, shape, motion, location, colour, polarisation and luminance.

Many insects utilise either three colour or two colour vision and unlike many vertebrates they have sensitivity into the ultra-violet wavelengths. Picking up the UV reflectance pattern on plants is often key to insects finding nectar sources (flowers).

Interest in insect vision goes back to the 17th Century and the dawn of microscopy and, as Dave explained, the structure and components of the compound eye and the way in which signals reach the central nervous system are strongly linked to advances in technology. The basic compound eye is made up of: eight light receptors situated below a single lens which forms the facet of the eye (as seen down our hand lenses and together are known as an ommatidium (Figure 1).

There are three ways in which images are formed, which are characteristic of different groups of insects in accordance with their visual requirements:

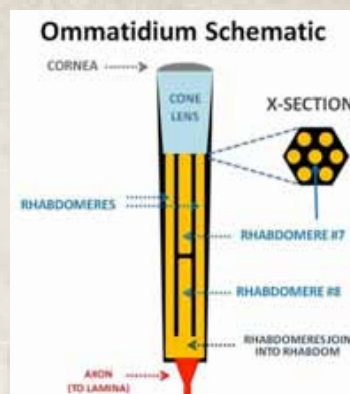


Figure 1: a simple compound eye. Rhabdomere = light collecting section of a photoreceptor

Apposition: each ommatidium feeds one neural connection. This is very expensive in terms of energy but gives good visual acuity in good light: Odonata use this type of eye (Figure 2).



Figure 2: *Sympetrum striolatum*

Superposition: Several ommatidia form a single image derived from one facet focussed on one point for onward transmission. This is good at picking up low levels of light: Lepidoptera (moths) use this very effectively (Figure 3).

Neural superposition: signals from light falling on adjacent ommatidia at the same angle are combined. This is the best of both worlds and is used by Diptera (Fig. 4).



Figure 3:
Noctua pronuba



Figure 4: *Tipula vernalis*

Once light has been turned into nerve impulses they are processed in the insects visual ganglia in order to extract information about the visual world such as motion.

Most insects also have simple eyes (ocelli), in addition to compound eyes (Figure 5). Although the ocelli detect only changes in light intensity averaged over their large visual field, they have advantages over compound eyes in terms of photic sensitivity and their fast speed of signal transmission. They are often the triggers for escape responses.

Visual constraints

The resolution of the compound eye is limited by size: for an insect to achieve the same resolution as a human eye they would need an eye about a square metre in size. Those insects that rely heavily on vision for predation tend to have increased number of facets to increase resolution. However this is limited by the metabolic cost as vision accounts for a very high proportion of the insect's brain and its energy use.

Resolution of rapidly changing images, the flicker fusion frequency (FFF), varies greatly among insects. The ability to distinguish individual items of movement in a rapidly changing visual field is very important for flight. Humans have a FFF of about 30 Hz whereas flies can have a FFF of over 300Hz.

Visual triggers to behaviour

Perhaps the behaviour most triggered by macro-photographers is the escape response as this is triggered by an expanding shape (looming) on a stationary insect's visual field. All show a darkening contrast linked to rapid motion. So to get the shot creep up on a cool insect and use your body to block the shape of the camera (good luck).

Some places to follow up this information
<http://www.cam.ac.uk/research/news/surprising-solution-to-fly-eye-mystery/>
<http://www.washington.edu/news/2012/01/17/fruit-flies-watch-the-sky-to-stay-on-course-with-video/>



Figure 5: *Drosophila melanogaster*

Some Insect Associations Kevin McGee



The theme of my presentation was broadly based to encourage members of the audience to consider in greater detail how close the interactions are between species and within habitats. These are the basis of all ecological studies and much of the underlying concepts are now well understood; however, I wanted to convey the message that there is still much to learn, even amongst widely studied insect orders in the UK. This is where interested 'amateurs' can still provide very valuable information at a local level. Discovering the presence of species 'A' may with perseverance establish the presence of associated species 'B', 'C', 'D' and so on.

With that concept in mind I talked about some of the associations between aculeate hymenoptera and their parasites, using well known and less well known examples; and I indicated that major gaps in the knowledge of even large and easily observed species still remain; for example, just exactly what is the main host species of the parasitic fly *Conops vesicularis*? It's likely to be the Hornet, *Vespa crabro*, but there is still some uncertainty. Keep your eyes peeled! There is still much to learn about the exact host species of *Sphecodes* bees, all of which are black with



Conops vesicularis

Kevin McGee

distinctive red abdomens but difficult to identify. Even if the prospect of trying to identify a captured specimen is daunting there will always be somebody willing to help, especially if the specimen is collected with its host.



Ontholestes tessellatus with prey

Kevin McGee

I continued by asking the audience to consider the importance of small 'niche' habitats such as dung, carrion and up-turned root-plates of fallen trees, all illustrated with examples of associated insect species. I took this opportunity to display an image of the rove beetle, *Ontholestes tessellatus*, capturing an adult blow-fly, *Calliphora vicina*, from horse dung. This was an observation I could find no previous evidence of in the literature and is soon to be published in the Journal of the Royal Entomological and Natural History Society. I also



Auplopus carbonarius

Kevin McGee

spoke about what is possible when a particularly rare and important habitat is specifically managed for one or two key species; I described the occurrence of vast numbers of Chalk-hill Blue butterflies at Therfield Heath NNR in Hertfordshire when the conditions are perfect. However, this is a relatively small site within a sea of arable 'deserts' and multiple golf-courses.

I gave anecdotes whereby I had observed some aspects of rarely seen insect behaviour which I had previously read in the literature. These were the incidences of *Hybomitra distinguenda*, a large horsefly, drinking water whilst in-flight from a small muddy puddle during very hot weather, and the rare pompilid wasp *Auplopus carbonarius* collecting water from a bird bath to help it moisten soil particles for cell construction within its burrow.

I concluded by encouraging members of the audience to persevere if they find themselves in the vicinity of a particularly 'ripe' looking habitat, i.e. everything seems to be in place for the possibility of a rarely seen species; the weather, time of year, geographical location and so on. I illustrated this with my observations of the White-letter Hairstreak wherever there is a profusion of healthy elm, and the scarce conopid fly, *Leopoldius signata*, at flowering ivy in autumn.



Leopoldius signata

Kevin McGee

Orthoptera and Allies - some Observations of Behaviour and Life-cycles

Gary Farmer

Grasshoppers and bushcrickets have an annual life cycle, over-wintering as eggs, passing through several young stages (instars) before maturing during the summer. All adults die off as day length shortens and temperatures fall. Eggs of bushcrickets are laid singularly into the stems of vegetation or into the ground while grasshoppers lay their eggs in batches, protected by a foam incorporating soil grains which hardens soon after laying. These egg batches are laid into soft, sandy ground or against the

base of grasses depending on species. The first instar is known as the vermiform larva and resembles a maggot. This instar sheds its first skin as soon as it emerges from the ground or vegetation and then resembles a miniature adult. In the case of grasshoppers the first few instars cannot be reliably identified to species as key features such as the pronotum detail are not well developed until about the third instar. However bushcrickets exhibit the external features required for identification right from the first instar; green with black spots (Speckled), pale green (Oak), yellow edge to pronotum and yellow spots (Roesel's), brown with indistinct markings (Dark). The exceptions are the coneheads which are instantly recognisable to genus (*Conocephalus*) as they are bright green with a black dorsal stripe but features required to split species are not visible until late instars. Any tiny coneheads feeding in buttercup flowers in early summer are most likely to be Long-winged as Short-winged are still dependant on rushes through their life cycle.



Oak Bush Cricket, early instar

Rosemary Winnall

During courtship the Orthoptera gather in leks where males sing and sometimes resorting to fighting. This consists of kicking out with their powerful back legs. The female will occasionally use this same method to repel an unsuitable would-be mate.

Leks are held in various places using different arenas such as a large leaf, a patch of bare ground and even dried cow pats. But do certain species favour certain types of lek and is there a typical number of males and females? Groundhoppers find areas of burned ground from brash fires to be particularly attractive. They seem to like fire sites that have been left for a year or two so vegetation has grown up enclosing them to create a humid microclimate. The vegetation must not be too tall as to not leave the site in shade. Is there a better length of time to leave these fire sites? Would increasing the number of small fire sites in a woodland increase the number of groundhoppers? As a brief aside another interesting piece of behaviour I have seen in Slender Groundhoppers is their ability to swim well and on one occasion a Slender Groundhopper



Common Groundhopper

Rosemary Winnall

swam out into a small pond and sank. I reached in and lifted it out thinking I had caused it to drown but it promptly jumped back in, swam a little way and dived down again. This, it turns out, is a known response to avoid predators and photographers. So back to the sex; in Grafton Wood last summer I encountered a mega-lek involving dozens of Dark Bush Crickets using a wooden bench and surrounding vegetation to take part in what can only be described as an Orthopteran orgy! Is this an annual event or were there so few hot days last summer that the crickets had to take advantage of that warm day and the numbers of insects involved was unnaturally high? What other lek sites do our Orthopterans favour in Wyre and the Worcestershire countryside?



Dark Bush Cricket

Rosemary Winnall

During courtship some species of bushcricket go through a series of exaggerated distortions of their bodies. Females curve their ovipositor under their body when advancing toward the male. The male arches his back and in the case of Speckled Bush Cricket, tucks his head right under his body. As with most insects the female needs a protein boost when producing eggs, in the case of the bushcrickets' cousins the mantids the males sacrifice themselves during mating and are eaten by the female. In what may well be an evolutionary shift in self preservation the male bushcricket produces a high protein package called the spermatophylax; the female consumes part of this and the remainder ferterlizes the eggs. The male then retreats to live another day.

Close relations of the Orthoptera are the Dermaptera or earwigs. We have three species in Worcestershire and these are the Common, Lesser and Lesne's Earwigs. Much is known about the habits of the ubiquitous Common Earwig but less is known of the other two species. Lesser Earwigs live in compost and dung heaps and which are not habitats favoured by the casual entomologist so are often overlooked. They resemble small Staphilinid beetles and will come to light so may be encountered in houses or at moth traps. So take a closer look at and small, erratic, elongated insects in moth traps or round house lights and look for the typical cerci (pincers) of earwigs.



Mating Speckled Bushcrickets, male below Rosemary Winnall



Mating Speckled Bushcrickets Rosemary Winnall

Lesne's Earwig appears to be a rarity in Worcestershire, favouring old hedgrows where Old-man's-beard grows in abundance. They are mature from late September so beating old hedges with this plant species between September and November may produce more records. Do they use other plants such as Ivy? Are they present in Wyre Forest? We know so little about Lesne's and Lesser Earwigs that any notes on behaviour in Worcestershire would be welcomed.

The Big Green Noble Beetle of Old Orchards Harry Green

The Noble Chafer's national status is designated 'vulnerable and declining'. Around ten years ago this led

to the production of both national and local Biodiversity Action Plans (BAPS). The Peoples' Trust for Endangered Species (PTES) became the lead organisation in research that followed. The initial aims from UKBAP were first to gather old biological records and to search again for the beetle in those areas. At the same time a programme to build up a population in culture was started with the possible outcome of re-introduction into suitable sites. The third aim was the conservation of newly discovered sites.

Earlier reports from coleopterists had shown a close association between the beetle and old traditional orchards; the larvae consuming naturally decaying heartwood, and Owen (1989) had successfully reared the beetles in decaying fruit wood. Modern records are all from decaying plum, apple, cherry and rarely pear trees. Any association with decaying 'wild' trees of other species was unknown and remain so.

How do you find this beetle?

The beetles only fly in warm weather, mainly in late June and July when they visit the flowers of Hogweed, Meadow Sweet, and Elder for feeding and mating.

Years pass without beetles being seen and in cold wet weather they probably remain within trees where they reproduce and die. The larvae take one to two years to reach maturity. However, the first studies showed that the larvae produce abundant frass as they consume decaying wood and that frass pellets are of characteristic appearance and relatively easy to identify. This has provided a very useful tool to finding trees used by the beetle larvae. Searching cavities in decaying fruit trees, if necessary by inserting a long-handled spoon to extract material, soon revealed that Noble Chafers occurred in many parts of Worcestershire, east Herefordshire and in west Gloucestershire. These searches are continuing especially in Herefordshire and elsewhere in England.



Fig. 1 Dead Noble Chafer on bed of frass Harry Green

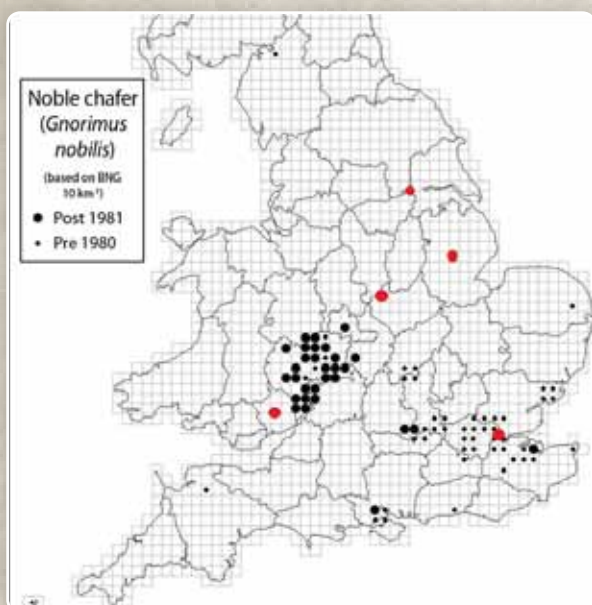


Fig 2. The current known distribution of Noble Chafers which includes all known archaeological, historical and modern records. Red dots are archaeological finds. Large black dots are modern records. Small black dots are historical biological records. Map © Max Blake.

Results

One important finding is that the three counties Worcestershire, Gloucestershire and Herefordshire are the richest and most important places known for Noble Chafers in Britain and Ireland. Noble Chafers do seem to be dependent on traditional orchards and areas where there are many orchards in close proximity seem to be the best for Noble Chafers as shown by comparing Noble Chafer distribution with mapping of traditional orchard by PTES (Juliet Hynes, Natural England, Powerpoint presentation not published 2012). However, many small patches of fruit trees may be missed as the mapping is based on aerial imagery followed when possible by ground 'truthing'. Gardens with a few old fruit trees have occasionally been found to support Noble Chafers. Nevertheless, a clear conclusion is that old traditional orchards with naturally decaying trees are an important habitat for Noble Chafers and that conservation of traditional orchards is of crucial importance. It is also known that Noble Chafers occur in the New Forest, apparently not in association with fruit trees, and this needs further research.

The current know distribution is shown in Fig 2. which includes all known archaeological, historical and modern records.

The currently known distribution in Worcestershire (Fig. 3) suggests several isolated populations (Schenke 2012). Is this true? We need to search between these areas and especially to extend searches into Herefordshire.

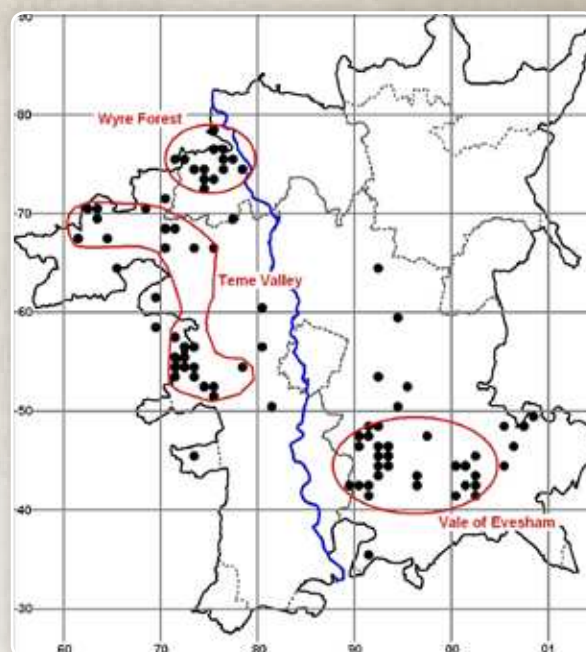


Fig. 3. The current known distribution in Worcestershire suggests several isolated populations (Schenke 2012).

All traditional orchards should be searched for evidence of Noble Chafers. It is also important to record negative results.

New and continuing research

What next?

National and local searches.

It remains important to continue to search traditional orchards for Noble Chafers to fully understand their distribution and to hopefully ensure conservation of orchards where they are found.

Genetic conservation led by Max Blake and Dr. Niall Mckeown of Aberystwyth University.

Are apparently separate populations genetically distinct or not?

Are New Forest populations different from 'orchard' beetles?

How are historical populations related to modern ones.

Detection & dispersion led by Deborah Harvey at Royal Holloway College.

Use of volatile chemicals given off by larvae and adults to detect the beetles' presence in trees.

Development of pheromones to attract adult beetles. If beetles can be marked and followed this should help to determine how far the beetles can fly in search of new breeding habitats.

REFERENCES

- Owen, J.A. 1989. Breeding *Gnorimus nobilis* Linn. (Col.: Scarabidae) in captivity. *Entomologist's Record & Journal of Variation*, 101:19-20.
- Schenke, J. The autecology of the Noble Chafer *Gnorimus nobilis* within Worcestershire. *Worcestershire Record* 32:33-39.

Busy Bees and Wasps Mike Bloxham

Bees, wasps (and ants) have long had a reputation for great industry and observation of their activity has led to a wealth of accumulated literature about many aspects of their behaviour. The social bees and wasps are included in this select collection – the honey bee has been positively associated with human societies for thousands of years and insects such as social wasps have also been familiar, but the lack of honey, the effect of yellow and black warning colouration coupled with painful stings has given them a bad press. The human race is most certainly familiar with their colonies and nests! Solitary bees and wasps hardly register at all with most of humanity. They have no spectacular colony and only a really dedicated observer will have any idea how they conduct their lives. This presentation will review a wide range of nesting habits. The honey bee will not be considered, but the emphasis will be on bees and wasps that are wild in the sense that no one generally wishes to domesticate them and that many aspects of their lives are incompletely known.

It is arguable that the social wasps are well studied. Society certainly knows much about their general activity and most certainly knows how to destroy them, but detailed studies on precisely how a queen wasp chooses nest sites in spring are not abundant. Yet successful early nesting strategy is of greatest importance to the future of most species. Casual examination of the interior of a garage roof over a period of time suggests the failure rate of colonies in the wrong place is high.

In my own garage during the last ten years, some twenty failed social wasp nests adorn the interior roof and there has been no active persecution of the insects. Everything points to the siting of these having been very good from the wasp's viewpoint. Several possibilities suggest themselves. Human influence is high on the list. The garage contains various chemicals including toxic ones, but observation of the nests in early stages of construction revealed the immense stress on the young queens in their frantic effort to get the colony under way. In one case a piece of nest material was seen to fall to the floor – hours of work wasted. If the colony was in a smaller space, more support from other surfaces might have been to hand – a larger nest against a beam survived for some time. A key factor with a bearing on this may have been excessive temperature fluctuations. During one spring period, temperatures of 30°C were common in the garage - one colony was in its infancy and during the period the queen was found dead on the garage floor - maybe overcome by a combination of circumstances mentioned.



A selection of nests beneath a garage roof showing various stages reached before failure
Mike Bloxham

Humans are not usually tolerant of wasps of any sort. In most garages colonies would never have had a chance to start and the risks to wasps on human property are always considerable. The French wasp nest in a garden shrub only survived because the owner spotted it as he was about to get to work with the shears. Guests to the house enjoyed watching the nest activity for many weeks. The outcome could have been very different.

As human populations increase and excessive management of the natural environment continues to be a factor, tolerance of social wasps is likely to evaporate further. Humans and social wasps are liable to conflict in any setting, but that situation is less likely when the very numerous solitary bees and wasps are considered.

Female solitary wasps and bees are different in many respects. The females all actively make nests, lay eggs and provide them with stored food, with no help from elsewhere. There are no developing workers to help them as time passes. Their lives are much shorter than those of social queens and they will not see their young hatch. A number do come to the attention of humans. The mortar miner *Osmia rufa* is both an object of suspicion as householders watch it entering holes in mortar of some older walls, and also a source of study as they put up artificial nests to observe it. Such nests have been studied for some time and it has been demonstrated



A French wasp (*Dolichovespula media*) nest in a garden shrub
Mike Bloxham

that they soon become of interest to insects other than the intended species. The large ichneumon (Probably *Ephialtes manifestator*) seen investigating a battery of commercially produced bee tubes, is very unlikely to pose a threat to an active social wasp nest, but does to solitary wasps where it investigates nests in all sorts of situations - it is often seen checking out nests in beetle borings in timber, using its long ovipositor to lay eggs on solitary wasp and/or beetle larvae. Once again, as with social wasps, the choice of nest site may have a bearing on the overall success of a species, although some of the threats are very different.

Many solitary wasps and bees depend upon the presence of open light soils for nesting purposes. The Bee Wolf *Philanthus triangulum* is usually found nesting on flat sandy surfaces - maybe the heavy prey (a honey bee) is more easily manipulated than when entering a hole in a vertical surface. Many Field Digger Wasp (*Mellinus arvensis*) nests are found in similar places - again prey items may be large. The one here has a *Pollenia* species (Diptera Calliphoridae) as prey.

A number of ground nesting solitary bees like south facing banks with light vegetation and a good deal of bare earth. Naturally existing sites of this nature (sandy cliffs, heathland etc.) are of primary importance in the conservation of such insects, but it is quite possible to set up appropriate conditions to attract a range of these creatures, which have probably benefitted greatly from man's general construction activities over the course of time. A simple south facing cutting through a bank formed of various excavation deposits was studied recently for nesting activity. Preliminary work has suggested that a population of some 50 different solitary bees and wasps has colonised the bank over the 15 or so years of its existence. Observation has enabled us to see that certain species seem to favour parts of the bank that vary in qualities such as gradient, orientation and soil composition.

Seasonal use by species is important. The large mining bee *Andrena clarkella* makes use of a considerable central

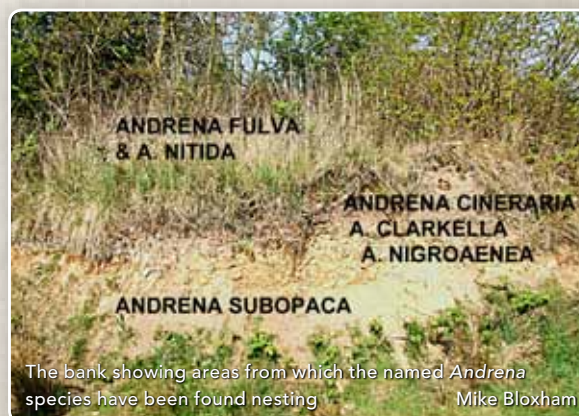


A battery of commercial solitary bee nesting tubes is visited by a parasitic pimpline Ichneumon
Rosemary Winnall



Mellinus arvensis with prey entering a nesting hole in a level spot on a sandy substrate
Mike Bloxham

area of the bank by burrowing into the face in the early part of the year. When it has died out, having dug burrows provisioned cells and laid eggs, the bank in its area is used partly by the solitary wall mining wasp *Ancistrocerus gazella* which is active from high until late summer. These large insects might well be in conflict if adults were to meet up on the face, but of course they do not. Studies to see if the species sometimes share nest burrows are contemplated. It is probable that seasonality has a bearing on the potential species composition on the bank.



The bank showing areas from which the named *Andrena* species have been found nesting
Mike Bloxham

Any bee using the bank has a number of challenges to face. Confrontation with contemporaries in time is inevitable as is intervention in the nesting process by undesirables. *Leucophora* species (Diptera Anthomyiidae) are cleptoparasitic on a number of ground nesting bees. They sit near the burrow entrances and enter when the host bee is absent. They lay eggs within the burrow and developing larvae devour stored foodstuff and very possibly the eggs of the host bee. Other more colourful *Nomada* species have similar habits. Some such as Gooden's *Nomad* bee are wasp mimics and target the nests of several species of solitary bees. Even during the short period of its existence the bank has managed to attract 7 different nomad bees - evidence that fossorial bees fairly rapidly colonise new habitats and that their

associated cleptoparasites are also quickly on site. It is important to note that the nesting bank has to be maintained annually by ensuring that nearby sallows do not shade it out and that the herb layer is vigorously controlled so it does not encroach on the bare sandy area.



The cutting back of bramble is necessary. In the course of doing this a new nesting habitat is created because a central cavity soon develops in the dead stem. A female solitary wasp *Trypoxylon attenuatum* was added to the bank lists as it emerged from such a one.

A number of factors are continually in play in this exciting habitat. Erosion sculpts the surfaces and the burrowing activities of the larger bees also add to layers of fine sand and soil at the foot which gradually provides nesting places for smaller aculeates such as *Andrena subopaca*. The various fissures also provide cover for a variety of spiders and Pompilid wasps are in evidence throughout the spring and summer. The large spring pompilid *Priocnemis perturbator* has paralysed a wolf spider and will soon drag

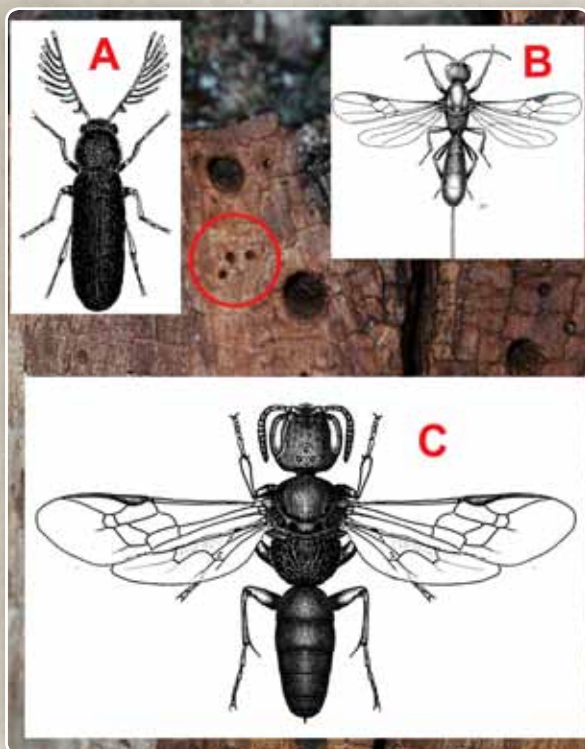
it into a cavity it has excavated, leaving an egg to develop on this unfortunate! The task dedication of many bees and wasps on the bank is so intense that species capable of causing great harm to each other often coexist without any problems.



The presentation concludes with a brief look at aculeates and timber - which can provide ideal nesting sites at most stages of development. A sizeable group of solitary wasps and bees prefer to nest in holes and cavities in timber. Holes come in all sizes and often offer free and usually secure nesting cavities. Larger species with powerful jaws can enlarge existing holes in rotten wood. Smaller bees and wasps can choose existing ones where the diameter of a hole best suits them. This is often possible because other insects such as beetles have developed in the wood and vacated breeding burrows. The very common beetle *Ptilinus pectinicornis* will develop in a variety of injured or dead tree species. It leaves holes admirably suited to some smaller bee and wasp genera (three lie within the red circle on the picture opposite). A parasitoid wasp *Hecabolus sulcatus* targets the larvae of this beetle and may be seen quartering the trees examining these holes. Small solitary wasps such as *Passaloecus singularis* (5 mm body length) are also doing the same thing but they will use a suitable hole for nesting purposes. Predation by birds is not uncommon - woodpeckers will regularly work dead timber so an apparently safe retreat is also open to additional threats. Again the human factor becomes significant where large and ancient trees are involved, because of threats to safety or persisting traditional fears that they harbour 'disease'. All present are urged to remind site managers of the important and sometimes irreplaceable species assemblages likely to be present and to conserve these trees and any large fallen branches.



Observation of the behaviour of bees and wasps will always be richly rewarded, probably because their lives are often fairly closely associated with our everyday activities. Maybe the way in which we behave towards them is a test of how closely we have noted their virtues which continue



A standing dead tree with associated insects - *Ptilinus pectinicornis* A, *Hecabolus sulcatus* B and *Passaloecus singularis* C.

to provide valuable clues as to how we might survive through an uncertain future. Their lives exhibit qualities of opportunism, economy (sustainability) and industry that have enabled their success over millions of years.

Acknowledgements: I thank Andy Purcell and Rosemary Winnall for providing some of the remarkable photographs used in this presentation.

Biting Midges Mick Blythe

The non-biting midges (Chironomidae) and the biting midges (Ceratopogonidae) are usually considered sister groups (the 'Water Midges'). The behaviour of the adults of the two groups is similar in that the males form mating swarms and females approaching the swarms are intercepted and coupled.

The biting midges differ from the chironomids in their small size (usually 3 mm or less) and their piercing mouthparts in the female. It is relatively easy to separate the biting and non-biting midges on their appearance. The female ceratopogonids are rather dumpy compared with the more elegant chironomids. Both sexes hold their wings overlapping over the abdomen whereas the wings of chironomids are held parallel, side by side and not overlapping. In the male ceratopogonids the branches of the antenna are held closely folded to the central rachis while in the chironomids they are extended in a rigid bush.



Dasyhelea female. *Dasyhelea* females are unusual amongst the biting midges in that they do not have biting mouthparts and are usually seen feeding on flower nectar.

Both sexes of the ceratopogonids feed on sugars, and are commonly seen feeding on nectar from flowers. However the females usually demand in addition a high protein food, usually blood. In many cases the blood is required for the full development of the eggs in the ovaries; in others a batch of eggs may be laid straight after mating but a protein meal is required for subsequent batches. Compared with the females, the males have mouthparts which are reduced or remain soft.

The midges of the genus *Dasyhelea* are relatively unusual in that both sexes feed only on flower nectar and the females do not take an additional protein food.

This is also true of several species of *Atrichopogon*. However females of *Atrichopogon pavidus* have been observed by J. A. Downes in 1953 feeding on pollen grains in Honeysuckle flowers in addition to the nectar. The midges used their mouthparts to penetrate the pollen grains and suck out the contents. This is the only known example of a biting midge taking its protein food from a plant.

Culicoides is the only genus of biting midge in the UK to feed on the blood of mammals such as humans. *C. obsoletus* is the commonest species in the English midlands but most research has been carried out on the Highland Midge (*C. impunctatus*) which is an even more ferocious pest with commercial implications for the tourist industry. *Culicoides* midges are also economically important as vectors of veterinary viruses, in particular Bluetongue and Schmallenberg.

Most species of *Forcipomyia* and *Atrichopogon* feed on the blood of other insects or spiders. *Forcipomyia paludis* clings to the wings of dragonflies and has been shown to suck blood from the major wing veins, but its not been seen in Britain since 1937. *Forcipomyia eques* sucks blood from the wings of lacewings and *F. tonnoiri* takes blood from the wing veins of butterflies.



Culicoides obsoletus female. *Culicoides obsoletus* is the commonest of the human-biting midges in lowland Britain. Only the females suck blood; the males visit nectar sources. They attack at any time of the day but most commonly around dawn and dusk.

Females of *Atrichopogon oedemerarum* are attracted to cantharidin, a chemical which is found in the blood of beetles such as the oil beetles (*Meloe*). Oil beetles have been seen to be pestered by large numbers of these midges which suck their blood from between the joints of their cuticles. There is some argument as to whether other species of *Atrichopogon* of the 'cantharidin group' are involved. The reason for the attraction is unknown, nor is it known whether the relationship between the midge and cantharidin is a necessary one.

The larger biting midges are mostly predaceous. These have been studied by J. A. Downes in Canada. The female midges feed on insects which have male mating swarms. The midge locates the swarm marker of the prey species and hovers near to it. If a prey insect is detected the midge seizes it in its legs and injects powerful enzymes into its head. Feeding continues on the ground. More digestive enzymes are injected and the liquefied body contents sucked out. The body of the prey insect is soon reduced to a hollow shell. Several prey insects are usually needed to produce a batch of eggs. Prey species are most commonly Chironomidae, but predaceous ceratopogonids have been known to attack male swarms of mosquitoes, the smaller twin-tailed mayflies and even smaller ceratopogonids such as *Culicoides*.



Forcipomyia male. The males of *Forcipomyia* feed on sugary materials such as flower nectar or sap flows. The females require protein food in addition and generally suck the blood of other invertebrates such as insects or spiders.

In three tribes of the Ceratopogonidae the male is captured by the female from a male swarm and treated in exactly the same fashion as a normal insect prey. Mating takes place as the male's body is digested. The genital segments of the male, containing the sperm mass, tend to break off and remain attached to the genitalia of the female.

Many of the females which mate in this way have pairs of long processes which may be extruded from the abdomen. The function of these processes is unclear, though the females which possess them tend to have males which are reduced in size and have reduced antennae. Perhaps they disseminate pheromones to attract the males to the females for mating.



Bezzia nobilis female. *Bezzia* are fiercely predaceous midges, feeding on the males of other swarming insects such as mayflies, mosquitoes and other midges. Amongst their regular prey are the males of their own species! This specimen was collected in a light trap placed high in the canopy of a tree in the Wyre Forest.

Wyre Forest Study Group

TO CONCLUDE THE DAY Mervyn Needham congratulated the Wyre Forest Study Group committee for arranging another great day, and thanked the speakers for their interesting and thought-provoking presentations. Rosemary Winnall thanked both Mervyn for chairing the event and Jenny Stevens for bringing along her insect models which she uses in schools for teaching insect-related topics in such an imaginative way (www.beetlesandbees.co.uk). We all looked forward to entomologising in 2013!



Jenny Steven's insectmodels

Rosemary Winnall



Jenny Steven's insect masks

Rosemary Winnall



Entomology Day speakers from left back: Mick Blythe, Kevin McGee, Gary Farmer, Harry Green
From left front: David Skingsley, Mervyn Needham, Mike Bloxham

Rosemary Winnall