In search of Canopy Invertebrates

ROSEMARY WINNALL, MICK BLYTHE AND ROY FINCH

Introduction

Members of the Study Group have often, over the years, considered various methods of sampling tree canopy invertebrates. In 2008 and 2009 (through Grow With Wyre, the Landscape Partnership Scheme supported by the Heritage Lottery Fund), we were able to experiment using a cherry picker with the help of Forestry Commission staff. We spent two days sweeping insects from fruit blossom and mistletoe in orchards (see photo 1), and Dave Grundy used a Mercury Vapour light up on the platform of the cherry picker for four evenings to record moths at canopy level comparing results with those at ground level (see photo 2). Mick Blythe also used this opportunity to collect flies from the oak canopy (see photo page 64).

Photo 1. Bowcastle Farm 8 May 2008 Rosemary Winnall

Photo 2. New Parks, June 2008 Jenny Joy

Conifer canopy

Then, in the summer of 2012, we heard that the Forestry Commission had to fell some conifers that were affecting microlight flights into Pound Green airfield. After some discussion, and with the permission of Richard Boles (FC) and Albert and Tony Link (the contractors), we set off up to Hawkbatch on 4th July 2012 in very damp conditions. The site was on the western edge of the woodland north of the pipe track at SO7622 7831.

Photo 3. Tony Link felling Douglas Fir Rosemary Winnall

We spread some plastic sheets over the ground and two Douglas Firs were felled onto these in turn (see photo 3), directed with a winch to bring them down in the right place. We then scrambled amongst the foliage and branches with pooters, nets and tubes to collect as much as possible (see photo 4). We put spiders in separate individual containers to avoid predation! We were hoping for bugs particularly, but in fact we found very few, with spiders being the most common creatures collected.

Photo 4. Study Group members Rosemary Winnall

The species named from this catch can be seen in Table 1, although very little was recorded, possibly due to the wet and cold conditions. The most interesting species were 2 spider species, *Philodromus collinus* and *Araneus (Atea) sturmi*, the second and fourth county records respectively. They are known conifer specialists, but these are not trees that are sampled very often, and they may be overlooked.

Species found on 2 Douglas Fir trees on 4th July 2012, Hawkbatch GR SO76227831				
Arachnida - Spiders and Harvestmen				
Araneae	Araneidae	*Araneus (Atea) sturmi*	2f	John Partridge
Araneae	Araneidae	*Araneus diadematus*	imm f	John Partridge
Araneae	Linyphiidae	*Lepthyphantes alacris*	f	John Partridge
Araneae	Araneidae	*Nuctenea umbratica*	juv and pre-adult male	John Partridge
Araneae	Philodromidae	*Philodromus cespitum*	f	John Partridge
Araneae	Philodromidae	*Philodromus collinus*	1m and 2f	John Partridge
Araneae	Philodromidae	*Philodromus praedatus*	f	John Partridge
Hemiptera - True Bugs				
Heteroptera	Lygaeidae	*Gastrodes grossipes*	Pine Cone Bug	Dave Scott
Auchenorrhyncha	Issidae	*Issus coleopteratus*		Jane Scott
Coleoptera - Beetles				
Coleoptera	Leiodidae	*Catops grandicollis*		John Meiklejohn
Coleoptera	Tenebrionidae	*Nalassus (=Cylindronotus) laevioctostriatus*	Darkling Beetle	John Meiklejohn
Coleoptera	Coccinellidae	*Harmonia axyridis*	Harlequin ladybird	Rosemary Winnall
Coleoptera	Curculionidae	*Sitona puncticollis*		John Meiklejohn
Coleoptera	Curculionidae	*Strophosoma melanogrammum*	Nut Leaf Weevil	John Meiklejohn
Hymenoptera - Wasps and Ants				
Hymenoptera	Formicidae	*Myrmica ruginodis*		Rosemary Winnall

Table 1 - Species identified from the Douglas Fir trees.

From this exercise we realised that felling the tree was not the best way to sample tree invertebrates as it was very difficult to search amongst the dense branches and foliage and it was impossible to retrieve all the sheeting without cutting it. So a different method was discussed for a future occasion, which we realised on 5th September 2012.

Oak canopy

Two members of the Study Group, Roy and Frances Finch own some woodland in Wyre, and as Roy is a retired tree surgeon and arboricultural consultant, they kindly offered to help with the search for invertebrates within an oak canopy.

Roy Finch provides background to his woodland:

"Frances and I purchased the woodland in 1975 from Christopher Tangye of Sodington Hall. It comprises of 5 acres of oak coppice that appears to have been clear felled at the start of the Second World War. There are a few larger trees situated on the boundaries of our woodland that appear to be about 150 years old. Our area of woodland stands on the eastern side of 200+ acres of oak coppice known as Cleobury Coppice that was designated an SSSI by the Nature Conservancy around 1985.

During the last 37 years the woodland has only been thinned once (circa 1990) and as a result most of the surviving trees have developed tall, narrow stems and small canopies with very little in the way of under-storey. Despite many mast years and good germination the dense closed canopies and low light levels together with increasing numbers of browsing Fallow and Muntjac Deer, have prevented the development of any reasonable under-storey. Ground cover comprises mainly Bilberry that is now slowly being shaded out by vigorous Holly. The summer of 2012 saw the commencement of a heavier commercial thinning of approximately 4 acres with a small area of trees around the camp being retained for personal use. Some 50 tons of thinnings have been removed to date leaving the steep sided valley on the Lem Brook boundary to be completed when an access track has been created.

The oak tree selected for the meeting of the Wyre Forest Study Group on the 5th September 2012 stood on the north side of a clearing known as 'the camp' created for the family gatherings and camping in the late 1970s prior to it being designated an SSSI. Over the years this tree has developed a lopsided canopy with most of its branches on its southern side giving the tree a maximum crown spread radius of its upper canopy of about 7m.

The tree comprised of a single stem with a girth of 139.5 cms and a stem diameter (at 1.5m) of 42 cms. The irregular swellings of its root buttress suggest the tree had been coppiced in the past. Its lower canopy (small branches) started at approximately 5m above ground level with the underside of the upper canopy (larger branches) at 10m above ground level. The tree had attained a height of 21m and was observed to be similar in height to that of the surrounding trees. A ring count of the stump at a later date confirmed this tree to be approximately 70-73 years of age.

Method of branch removal

Safety access rope and heavy duty lowering rope were set up high in the canopy prior to the group's arrival. Plastic sheets were then laid out on the ground beneath the canopy to lay out the branches. Using climbing irons (spikes) and a pole strop the tree was then accessed removing the branches from the lower canopy one at a time, gradually progressing up the tree (see photo 5). The individual branches were sprawled off (cut on the tension side only) to prevent heavy impact with the trunk and the bugs being disturbed, then lowered onto the sheets gently for members of the Group to closely examine (see photo 6 and 9). The day ended with the removal of the top of the tree in one section. (see photo 7).

The remaining trunk section was felled at ground level some weeks later.

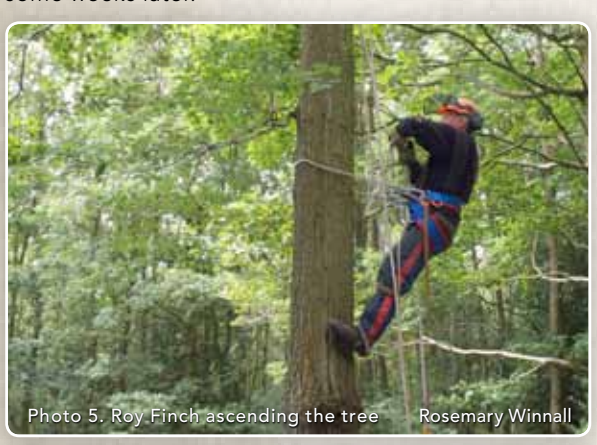

Photo 5. Roy Finch ascending the tree Rosemary Winnall

Photo 6. Members receiving the branch Rosemary Winnall

Examination of Stump

Having started life around 1940 there was no clear evidence that this tree arose from an existing coppice stool. However there were two areas of discoloured/decaying wood (see photo 8), one in the centre of the stump was approximately 7 cms in diameter with some of its bark still in situ; this appears to have been a side stem having died or been removed around 1960. The second area of discoloured/decayed wood was located towards the western edge of the stump being

Photo 7. Roy Finch descending the tree Rosemary Winnall

approximately 14 cms in diameter. During felling part of a smaller dark coloured stump was left protruding above the stump of the live tree. A count of its rings revealed some 35 years of growth at the time it started to decay. Close examination of the butt of the felled live stem and the discoloured/decayed stump revealed a lateral grooved surface at the inter-face suggesting this side stem had been removed with a chainsaw at or about the time we purchased the wood in 1975. This resultant small stump had eventually become included in the buttresses of the parent tree."

Photo 8. Decayed wood within the trunk Roy Finch

Results

The Epiphytes

The epiphytes of the oak may be classified into the algae, the bryophytes, the lichens and the fungi, the latter more or less pathogenic. Here only the bryophytes and the lichens were examined.

Photo 9. Study Group members examining a lowered branch Roy Finch.

Our tree yielded six species of moss and one liverwort, all identified by Mark Lawley as follows.

Photo 10. *Metzgeria furcata* with *Hydnum cupressiforme* Rosemary Winnall

Mosses at the base of the trunk

Orthotrichum affine	Wood Bristle-moss
Hypnum cupressiforme	Cypress-leaved Plait-moss
Dicranum scoparium	Broom Fork-moss
Dicranoweisia cirrata	Common Pincushion

Bryophytes on canopy branches

Metzgeria furcata	Forked Veilwort
Orthotrichum diaphanum	White-tipped Bristle-moss
Ulota crispa	Crisped Pincushion
Orthotrichum affine	Wood Bristle-moss
Hypnum cupressiforme	Cypress-leaved Plait-moss

It was interesting to see so many branches covered with lichen in the tree canopy, presumably where more light could reach. Some of the lichens were collected and sent to Joy Ricketts who kindly identified 15 species as follows. If Joy had been present she would have undoubtably found a lot more!

Evernia prunastri
Hypogymnia physodes
Hypogymnia tubulosa
Lecanora chlarotera
Melanelixia subaurifera {was Parmelia subaurifera}
Parmelia perlatum
Parmelia sulcata
Parmelia saxatilis
Physcia aipolia
Physcia tenella
Punctelia subrudecta {was Parmelia subrudecta}
Ramalina farinacea
Scoliciosporum chlorococcum
Usnea cornuta
Xanthoria parietina

Photo 11. *Usnea cornuta* Rosemary Winnall.

Francis Rose notes that the majority of lichen species epiphytic on oak, and to a lesser extent the bryophytes, are light-demanding species.

The Invertebrates

The invertebrate numbers were rather disappointing, perhaps reflecting the lateness of the season or the low temperatures and continuous rainfall of the gloomy summer of 2012. The species identified can be seen in table 2.

The invertebrates of the tree canopy were studied by Southwood, Moran and others and published in a series of papers from 1982 onwards. In these studies they used the concept of guilds which classified the organisms according to how they exploited the habitat. It must be admitted that many of the invertebrates do not fit particularly neatly into these guilds. Those feeding on the leaves are clearly members of the phytophage guild, but presumably the guild will have to be extended to include gall causers, those feeding on the wood of the tree, on epiphytic plants or even on lichens and fungi. In some cases they merge into the decomposers guild when they feed on dead branches or rotting bark in the canopy. The tourist guild are only using the tree canopy for rest and shelter, but they still may have significance in providing prey for members of the predaceous guild. Following the Southwood tradition for tree canopy studies we have used the guilds here in our consideration of the invertebrate fauna.

The Phytophage Guild

Young oak leaves are the most vulnerable to those insects such as the caterpillars of Lepidoptera which eat them, and in those years when the trees are almost defoliated this will tend to occur early in the season. Older oak leaves are tough and tannins build up in them. These tannins bind to proteins, inactivating enzymes and rendering food proteins unavailable. (Gradwell, 1974). Later flushes of young leaves (such as the 'lammas shoots') will in their turn be vulnerable to the phytophages and give members of the guild another growth opportunity. However by September, the month when our investigation was made, tannins will make up around 5% of the dry weight of the leaf, (Feeny, 1970) and caterpillars eating them will experience a significant reduction in their growth rate. (Feeny, 1968). Many of the Lepidoptera were recorded as leaf mines and of these many were empty relicts of feeding earlier in the season. The leaf mines were most abundant in the lower and middle parts of the canopy and fewer were seen near the top.

The Psocoptera (barklice) have scraping mouthparts. They do not feed on the oak leaves themselves but graze the film of microscopic epiphytic algae and fungi which forms on the surfaces of leaves or bark. There were many small nymphs concentrated about half way up the tree. The higher sections had relatively fewer nymphs but more winged adults. It appeared that the distribution of nymphs was clumped. Many of the wingless nymphs were under a matrix of thin sheet of webbing near the edge of the leaf from which they could be easily pootered.

Photo 12. Psocopterans *Graphopsocus cruciatus* Rosemary Winnall

The true phytophages most commonly found were the Hemiptera with piercing mouthparts. Many small Cicadellidae were present. On soft-leaved plants these often feed by piercing the leaf cells and sucking out the contents, leaving a characteristic pattern of clear spots on the leaf, but there was little evidence of that on the tough oak leaves and perhaps they were feeding directly from the phloem vessels. The larger Auchenorrhyncha were likely to have been phloem feeders. Many species of aphid are recorded from oak but none were seen here and no ants.

Spangle galls were present at all levels in the tree. Their distribution was notably clumped with many individual leaves distinctly over-populated.

Photo 13. Homopteran *Iassus lanio* Rosemary Winnall

Invertebrate Species found on one oak tree in Finch's Wood on 5th September 2012 GR SO71555 7459

Crustacea - Woodlice					
Isopoda	Oniscidae	*Oniscus asellus*	1	Mick Blythe	Adult. From dead damp wood in top bough.
Isopoda	Porcellionidae	*Porcellio scaber*		Rosemary Winnall	
Chilopoda - Centipedes					
	Lithobiidae	*Lithobius forficatus*	2	Mick Blythe	Adults. From damp dead wood in top bough.
Arachnida - Spiders and Harvestmen					
Araneae	Anyphaenidae	*Anyphaena accentuata*		John Partridge	Immature but distinctive. Buzzing spider. Woodland.
Araneae	Linyphiidae	*Drapetisca socialis*		John Partridge	Usually the bark of tree trunks, sometimes in litter.
Araneae	Tetragnathidae	*Metellina mengei*		John Partridge	Lesser Garden spider. Common in gardens, waste, grassland, woods etc.
Araneae	Tetragnathidae	*Metellina segmentata*		John Partridge	Lesser Garden spider. Common in gardens, waste, grassland, woods etc.
Araneae	Theridiidae	*Paidiscura (=Theridion) pallens*		John Partridge	Common on shrubs and trees. Favours oak.
Araneae	Theridiidae	*Paidiscura (=Theridion) pallens*	Empty egg cases	Rosemary Winnall	
Araneae	Theridiidae	*Theridion varians*		John Partridge	Common on trees and shrubs and low vegetation.
Araneae	Thomisidae	*Diaea dorsata*		Rosemary Winnall	Woodland species with a preference for conifers, though found on oak.
Opiliones	Leiobunidae	*Leiobunum blackwalli*		John Partridge	
Opiliones	Leiobunidae	*Leiobunum rotundum*		John Partridge	
Opiliones	Phalangiidae	*Dicranopalpus ramosus*		John Partridge	
Opiliones	Phalangiidae	*Paroligolophus agrestris*	8m, 9f	John Partridge	
Orthoptera - Grasshoppers and Bush-crickets					
	Tettigoniidae	*Meconema thalassinum*	Oak Bush cricket	Rosemary Winnall	Found throughout the canopy
Dermaptera - Earwigs					
	Forficulidae	*Forficula auricularia*	Common Earwig	Rosemary Winnall	Completely omnivorous
Hemiptera - True Bugs					
Auchenorrhyncha	Cicadellidae	*Iassus lanio*		John Meiklejohn	Probable sapsucker
Heteroptera	Anthocoridae	*Anthocoris nemorum*		Rosemary Winnall	General predator.
Heteroptera	Anthocoridae	*Orius laticollis*		John Meiklejohn	Probable predator
Heteroptera	Pentatomidae	*Pentatoma rufipes*	Forest Bug	Rosemary Winnall	Shield bug. Partly predaceous feeding on caterpillars and fruits.
Psylloidea	Triozidae	*Trioza remota*		Rosemary Winnall	psyllid gall on oak leaves
Numerous small Cicadellidae present.					
Psocoptera - Booklice and Bark-lice					
	Caeciliusidae	*Valenzuela flavidus*	1	Mick Blythe	1 alate adult On lower tree boughs.
	Ectopsocidae	*Ectopsocus briggsi gp*	8	Mick Blythe	8 alate adults On lower tree boughs.
	Ectopsocidae	*Ectopsocus briggsi gp*	38	Mick Blythe	34 alate adults, 4 small nymphs. From top boughs.
	Stenopsocidae	*Graphopsocus cruciatus*	2	Mick Blythe	2 alate adults On lower tree boughs.
	Stenopsocidae	*Graphopsocus cruciatus*	1	Mick Blythe	1 alate adult, From top boughs.
	Stenopsocidae	*Stenopsocus immaculatus*	1	Mick Blythe	1 alate adult, On lower tree boughs.
Many unidentified nymphs present.					
Lepidoptera - Moths					
	Bucculatricidae	*Bucculatrix ulmella*		Tony Simpson	1 mine vacated and some larval windowing in upper boughs and crown
	Coleophoridae	*Coleophora flavipennella/luticomella*		Tony Simpson	1 old case, pupated on leaf midrib in lower and middle boughs
	Gracillariidae	*Phyllonorycter harrisella*		Tony Simpson	2 worn imagines in lower and middle boughs
	Nepticulidae	*Ectoedemia albifasciella*		Tony Simpson	8 mines, all tenanted in lower and middle boughs
	Nepticulidae	*Ectoedemia albifasciella*		Tony Simpson	8 mines, all tenanted in upper boughs and crown
	Nepticulidae	*Stigmella atricapitella agg.*		Tony Simpson	11 mines, all vacated in lower and middle boughs
	Nepticulidae	*Stigmella atricapitella agg*		Tony Simpson	5 mines, all vacated in upper boughs and crown
	Nepticulidae	*Stigmella ruficapitella*		Tony Simpson	2 mines, both vacated in lower and middle boughs
	Nepticulidae	*Stigmella ruficapitella*		Tony Simpson	2 vacated mines in upper boughs and crown
	Nolidae	*Pseudoips prasinana britannica*	Green Silver-lines	Tony Simpson	1 larva in lower and middle boughs
	Oecophoridae	*Diurnea fagella*		Tony Simpson	3 larvae in spinnings between leaves in lower and middle boughs
Coleoptera - Beetles					
	Carabidae	*Dromus quadrimaculatus*		Dave Scott	
	Carabidae	*Loricera pilicornis*		John Meiklejohn	feeds on springtails
	Carabidae	*Notiophilus biguttatus*		Dave Scott	
	Latridiidae	*Aridius nodifer*	Scavenger beetle	John Meiklejohn	
	Nitidulidae	*Epuraea pallescens*		John Meiklejohn	
	Staphylinidae	*Quedius maurus*		John Meiklejohn	
Hymenoptera - Wasps and Ants					
	Cynipidae	*Andricus curvator*		Rosemary Winnall	
	Cynipidae	*Andricus foecundatrix*	Artichoke Gall	Rosemary Winnall	
	Cynipidae	*Andricus kollari*	Marble Gall	Rosemary Winnall	
	Cynipidae	*Cynips quercusfolii*	Cherry Gall	Rosemary Winnall	
	Cynipidae	*Neuroterus numismalis*	Silk Button Galls	Rosemary Winnall	galls on oak leaves
	Cynipidae	*Neuroterus quercusbaccarum*	Common Spangle Galls	Rosemary Winnall	galls on oak leaves
Numerous small adult Parasitica also collected.					
Diptera - True flies and midges					
	Cecidomyiidae	*Macrodiplosis pustularis*	Leaf galls	Rosemary Winnall	
	Cecidomyiidae	*Macrodiplosis roboris*	Leaf galls	Rosemary Winnall	
	Empididae	*Rhamphomyia erythrophthalma*	1 male, high up	Mick Blythe	
	Empididae	*Rhamphomyia umbripennis*	1 female, low down	Mick Blythe	
	Hybotidae	*Platypalpus longicornis*	Pair in cop	Mick Blythe	
	Sciaridae	*Bradysia sp*	1 male nervosa gp	Mick Blythe	
	Sciaridae	*Bradysia sp*	1 male aprica gp	Mick Blythe	
	Sphaeroceridae	*Apteromyia claviventris*	1 female, contaminant?	Mick Blythe	
Numerous Sciaridae (fungus gnats) collected, 1 Chironomidae (water midge), 1 Psychodidae (hairy moth-fly) and 1 Phoridae (coffin fly)					

Table 2 - Species identified from the oak tree.

Photo 14. Psocopteran *Stenopsocus immaculatus* Rosemary Winnall

The Predaceous Guild

Members of the predaceous guild were abundant and included spiders, heteropteran bugs, small predaceous flies (Empididae and Hybotidae), the predaceous larvae of Neuroptera, the small red erythraeid mites (Trombidiformes: Erythraeidae) and the Oak Bush-cricket *(Meconema thalassinum)*.

Photo 15. Lacewing eggs Rosemary Winnall

The adults of the predaceous flies have piercing mouthparts and are general predators of other small insects, often other small flies. They tend to be controlled by the physical structure of their environment rather than any particular species of tree. They are familiar inhabitants of low bushes and the lower branches of broad-leaved trees, but it was interesting to find them extending far up in the canopy.

Many of the Neuroptera larvae were disguised by carrying particles of lichen on their backs. This may have been an aid to stealthy predation but more likely a protection from the attentions of insectivorous birds. Two clumps of up to 20 neuropteran eggs were found, carried on the tips of bundles of intertwined stalks (see photo 15).

The erythraeid mites attack larger insects by perforating the cuticle with their mouthparts and sucking the blood, often without killing them.

Adult Hymenoptera (Parasitica) were present in significant numbers, but whether these were tourist guild seeking shelter (reflecting the general abundance of these organisms) or whether they were finding hosts in the tree environment it is impossible to say as identification to species was not attempted.

The Other Guilds

The midges (Sciaridae, Chironomidae and Psychodidae) and the anthomyiid flies were members of Southwood's tourist guild, using the environment provided by the structure of the tree for rest and shelter. They will often prove the prey of the small empidid and hybotid flies.

Oniscus asellus (Isopoda, decomposers guild) and *Lithobius forficatus* (Chilopoda, predaceous guild) are familiar inhabitants of the litter layer and under the bark of decomposing wood on the forest floor. It seemed incongruous to find them both under the bark of a rotting branch at the very top of the tree but this just reflects our unfamiliarity with this significant habitat, and perhaps the wetness of 2013!

The earwig *(Forficula auricularia)* feeds on both plant and animal material, and is best regarded as a general scavenger and facultative predator.

We learned much from sampling from this oak tree in this way and suggestions for the future are:
1. Additional plastic sheets to be placed at a safe distance from the tree to enable safe inspection whilst the lowering of other branches can continue.
2. Larger multi-stemmed branches including the top should be cut and lowered in smaller sections so that they can be easily carried to the sheets.
3. Next study to take place at an earlier time of year and different location within the wood.

Acknowledgements

Thanks are due to the Forestry Commission, and Albert and Tony Link who made the sampling of the conifers possible. We benefitted enormously from Roy and Frances's experience and advice when we planned the oak canopy work. They kindly provided access onto their land and it was a privilege to watch them in action to enable us to check out the canopy in this way! Thanks to John Partridge and John Meiklejohn too who identified some of the insects.

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Study Group members 'warming up' prior to oak canopy sampling! 5 September 2012 Frances Finch