Insects of Ashlyns Organic Farm

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1.0 Introduction

The benefits of organic farming to biodiversity are well known in the UK (Hole *et al*. 2005). Indeed, there may be 1.6 times as many arthropods on organic farms when compared to conventional farms, the results for non-pest butterflies are even better with twice as many on organic farms (Soil Association 2000). However, what does not seem to be known is which types of habitat may be best for insects such as grasshoppers and bumblebees. We do not have much data on the differences in species richness between different habitat types (e.g. arable vs. permanent grass and clover rich fields). It is likely that clover rich organic fields will be highly beneficial as a source of nectar/pollen to butterflies and bumblebees but we need scientific data to determine this.

Given the recent studies of insect populations on field margins under the Countryside Stewardship Scheme that show they are not necessarily beneficial to butterflies (Field *et al*. 2005; 2006; 2007) or grasshoppers (Gardiner & Hill 2005) due to low source populations in the surrounding intensively managed farmland, it seems that government money may be more wisely spent on organic systems where populations can build up in blocks of habitats (e.g. hay meadows, pastures, clover rich fields) rather than in 2-6 m strips alongside fields which receive spray drift on conventional farms.

Another question is how quickly can insects build up populations on organic farms? Do insects colonise habitats within the conversion period, when the effects of the previous intensive usage (e.g. high nitrogen fertiliser input and insecticide spraying) are more apparent, or do they require longer to increase populations (e.g. 10 years of organic management)?

It is the aim of this study of insects on Ashlyns Organic Farm in the Epping Forest District of Essex, to provide information on some of the questions posed above and to give a fairly comprehensive overview of the insects found on the farm. It is hoped that any uncommon or rare insects will be identified, and management recommendations put forward to conserve them. A range of habitats are to be studied on long-term organic farmland (10 years since conversion to organic farming) at Ashlyns Farm and in recently converted land at Newhouse Farm (habitats under organic management for 5 years or less). Educational events are also to be run for school children to introduce them to the wide array of insect life on Ashlyns Farm.

2.0 The Insect Survey

There were two major parts of the survey in 2008; the educational days for school children, and the detailed surveying of Ashlyns Farm and Newhouse Farm for insects.

2.1 Educational days

Two half day events were run on the 23rd and 25th June 2008, the days being chosen to coincide with National Insect Week, an event organised by the Royal Entomological Society (www.nationalinsectweek.co.uk/). The days were organised by the report author and educational staff from Ashlyns Farm. Two schools (St Michael's, Bishop's Stortford and Takeley Primary School) were invited for the 'Organic Bug Bonanza' and about 30 school children attended on each day. We used spotting forms downloadable from the National Insect Week (NIW) website to enable the school children to identify the wide array of insects on the farm. It also enabled a challenge to be set for the school children to identify as many different insects as possible. Three techniques were used by the children:

1. Beating of hedgerows using sticks to hit the branches and trays to collect and identify the dislodged insects (which are unharmed by the process)
2. Sweep netting of grassland to find insects such as grasshoppers and froghoppers
3. Insect walks were also led to show the school children that using their eyes can be a good technique for finding insects that are not identified by beating or sweeping (e.g. butterflies and dragonflies)

2.2 What was found?

All in all, 13 out of the 14 insects on the spotting form were found on the 23rd June, probably because the weather was largely sunny and dry, whereas, only 9 species were recorded by the school children on the 25th June (Table 1). The educational days were very successful and the children returned to their schools to carry out projects on what they had seen.

Table 1: Insects spotted (tick indicates seen) on the two educational days from the National Insect Week spotting forms

Insect	23rd June	25th June
Banded Demoiselle	√	√
Four-spotted Chaser	√	√
Seven-spot Ladybird	√	
Cockchafer (May-Bug)	√	
Red Admiral	√	
Common Green Lacewing	√	√
Common Froghopper	√	√
Green Shieldbug	√	√
Ruby-tailed Wasps		
Black Garden Ant	√	√
Common Earwig	√	
Drone-fly	√	√
Red-tailed Bumblebee	√	√
Meadow Grasshopper	√	√

The cuckoo-spit (left) created by the Common Froghopper *Philaneus spumarius***, an insect which fascinated the school children. The Four-spotted Chaser** *Libellula quadrimaculata* **was also found (below).**

Photo: Richard Bartz

2.3 The detailed insect study

After the educational days, a detailed survey was undertaken at 20 different sites on both Ashlyns Farm in Bobbingworth (OS grid reference for area studied: TL 5105) and Newhouse Farm in Little Laver and Fyfield parishes (OS grid reference for area studied: TL 5508). An effort was made to cover as many different types of habitat as possible including arable fields, clover fields, woodland, grazed pasture and reservoirs/ponds (for full details of the areas surveyed on both farms see Appendix). Two full survey days were spent on both farms, to determine accurately the full range of insects at both sites. Ashlyns Farm has been under organic management for approximately 10 years, whereas Newhouse Farm has more recently been converted to organic farming (approximately 5 years). There are sizeable areas of woodland at Newhouse Farm, including Nor Wood and Little Wood, both of which are ancient woodlands (wooded since AD 1600). The predominant soil type on both farms is boulder clay.

The report author was mainly concerned with determining the species richness (total number of species) of four main insect orders: butterflies and day-flying moths (Lepidoptera), grasshoppers and crickets (Orthoptera), damselflies and dragonflies (Odonata) and bumblebees (Hymenoptera). These groups are composed of conspicuous, often large insects, which are easily spotted whilst surveying on a sunny day. Groups such as butterflies and grasshoppers are also considered indicators of 'healthy' farmland habitat and their species richness will tell us about the state of the insect fauna of both farms. Where it was not possible to accurately identify similar species in the field (without capture) they were lumped together for recording purposes and treated as one species when the data was analysed. In this survey both Essex Skipper *Thymelicus lineola* and Small Skipper *Thymelicus sylvestris* were recorded as *Thymelicus* species. Common Blue Damselfly *Enallagma cyathigerum* and Azure Damselfly *Coenagrion puella* were grouped together due to difficulties in accurate field identification without capture or closer examination. And finally, Buff-tailed Bumblebee *Bombus terrestris* and White-tailed Bumblebee *Bombus lucorum* were grouped together due to difficulties in distinguishing workers in the field.

The four survey days were all chosen because they were warm (>17^{o}C) and relatively sunny, therefore insects in the target groups were likely to be found easily. All

surveys were conducted in July to ensure that a high number of species could be found on both farms (e.g. this is the month when most species of the target groups are around). Surveys were conducted between 9am and 5pm. A total of 30 minutes was spent searching each of the 20 sites on both farms, this was felt adequate to determine accurately the different species in each habitat type and to allow scientific comparison between species richness of habitat type and both farms.

2.4 Results of the detailed insect survey

A total of 47 insect species of all groups combined were found in the survey. Several insects that are localised (e.g. sporadic occurrence) in Essex were recorded in the survey and these were Ringlet *Aphantopus hyperantus* and Small Heath *Coenonympha pamphilus* for the butterflies, and White-legged Damselfly *Platycnemis pennipes* and Four-spotted Chaser for the dragonflies. All bumblebee and most grasshopper species recorded are fairly widespread and common in Essex (with the exception of Common Groundhopper *Tetrix undulata* which is localised).

Uncommon butterflies found in the survey (photos © Olaf Leillinger)

Ringlet

Small Heath

All 47 insect species were recorded from Ashlyns Farm, whereas, only 37 species were found at Newhouse Farm, suggesting that farmland that has been under organic management longer has more insects. In total, there were more butterfly, dragonfly, grasshopper and bumblebee species recorded from Ashlyns Farm (Table 2).

Table 2: Species richness (total number of species) of the four insect groups surveyed on Ashlyns Farm and Newhouse Farm

Insect group	**Ashlyns**	**Newhouse**
Butterflies and day-flying moths	18	15
Dragonflies and damselflies	13	10
Grasshoppers and crickets	9	7
Bumblebees	7	5
Total number of species	**47**	**37**

Notably, 10 species were found at Ashlyns Farm but were absent from Newhouse Farm, which suggests that they may only colonise organic farmland (such as that found at Ashlyns) that has been converted for a long time period (e.g. 10 years) (Table 3).

Table 3: Insects species recorded from Ashlyns Farm (long-term organic: 10 years) but absent from Newhouse Farm (recently converted organic farmland: 5 years)

Butterflies and day-flying moths	Scientific name
Small Heath Butterfly	*Coenonympha pamphilus*
Six-spot Burnet Moth	*Zygaena filipendulae*
Cinnabar Moth	*Tyria jacobaeae*
Dragonflies and damselflies	
Small Red-eyed Damselfly	*Erythromma viridulum*
Ruddy Darter	*Sympetrum sanguineum*
Brown Hawker	*Aeshna grandis*
Grasshoppers and crickets	
Long-winged Conehead	*Conocephalus discolor*
Common Groundhopper	*Tetrix undulata*
Bumblebees	
Cuckoo Bumblebee	*Bombus vestalis*
Early Bumblebee	*Bombus pratorum*

It is highly likely that the absence of the 2 dragonfly species could be due to a lack of suitable aquatic habitat at Newhouse, whereas, there is the Cripsey Brook at Ashlyns Farm, which is a major dragonfly habitat in the area. However, for insect species such as Small Red-eyed Damselfly *Erythromma viridulum*, which was first discovered in Britain in 1999 in north-east Essex, they may not have colonised the still water habitats at Newhouse, which are surrounded by more recently converted organic farmland. Bush-crickets such as the Long-winged Conehead *Conocephalus*

discolor, which was first recorded in Essex in 1995, can be a rare insect on intensively managed farmland and may take some time to colonise organic habitats after conversion. The species was recorded in 6 m field margins at Ashlyns Farm but not at Newhouse. Interestingly, the Small Heath butterfly was absent from Newhouse Farm, but was fairly widespread at Ashlyns. This may be attributable to the fact that this butterfly requires fairly short grassland swards for breeding (c. 20 cm in height), conditions that are much more likely to be found on farmland that has been under organic management for a long time (such as Ashlyns) where the effects of previous nitrogen fertiliser inputs are much reduced. The swards at Newhouse were taller and denser and consequently less favourable for Small Heath, particularly in the field margins and hay meadows, due to the more recent use of nitrogen fertiliser on this farm (conversion time only 5 years). The presence of White-legged Damselfly on both farms indicates that water quality of streams and ponds on organic farmland may be good, as this species is sensitive to pollution that may be caused by run-off of nitrogen fertilisers, which are not used under organic management.

The White-legged Damselfly *Platycnemis pennipes***, an indicator of the clean water quality present on both farms (photo: Rosenzweig).**

The Six-spot Burnet Moth *Zygaena filipendulae***, an attractive species only recorded from Ashlyns Farm (photo: Olaf Leillinger).**

Analysis of the number of sites each species appeared in (20 different sites were surveyed on each farm) reveals the most widespread and common insect species on the farms (Table 4). The Meadow Grasshopper *Chorthippus parallelus* and Meadow

Brown *Maniola jurtina* butterfly were easily the most abundant species in the survey occurring at over 75% of the sites surveyed. The abundance of the Meadow Grasshopper is particularly notable, as it is often a rare insect on intensively managed (e.g. fertilised with nitrogen and sprayed with insecticides) farmland in central Essex (Gardiner *et al*. 2002). It is suggested that the lack of chemical inputs on both farms is highly beneficial to this species, perhaps because the absence of nitrogen fertiliser input on organic farms leads to shorter, less dense grassland swards, more favourable for grasshoppers. Bumblebees such as Buff-tailed Bumblebee and the Red-tailed Bumblebee *Bombus lapidarius* were also regularly sighted and perhaps took advantage of the abundance of clovers on both farms (there was a large area of clover ley on both farms). The attractive Roesel's Bush-cricket *Metrioptera roeselii* was also regularly seen (and heard due to its high pitched singing).

Table 4: The most widespread and common species on the farms, and the rarest, determined by the number of recorded sites (maximum of 40)

Insect species	**Total number of recorded sites**
Common and widespread species	
Meadow Brown *Maniola jurtina*	35
Meadow Grasshopper *Chorthippus parallelus*	32
Large White *Pieris brassicae*	29
Buff-tailed Bumblebee *Bombus terrestris*/	
White-tailed Bumblebee *Bombus lucorum**	29
Red-tailed Bumblebee *Bombus lapidarius*	24
Common Blue Damselfly *Enallagma cyathigerum*/	
Azure Damselfly *Coenagrion puella**	23
Roesel's Bush-cricket *Metrioptera roeselii*	20
Gatekeeper *Pyronia tithonus*	19
Lesser Marsh Grasshopper *Chorthippus albomarginatus*	15
Common Carder Bumblebee *Bombus pascuorum*	14
Rare species	
Cinnabar Moth *Tyria jacobaeae*	1
Small Red-eyed Damselfly *Erythromma viridulum*	1
Ruddy Darter *Sympetrum sanguineum*	1
Brown Hawker *Aeshna grandis*	1
Common Groundhopper *Tetrix undulata*	1
Early Bumblebee *Bombus pratorum*	1

*species lumped together due to difficulties in distinguishing them quickly in the field

Roesel's Bush-cricket *Metrioptera roeselii***, a common insect © M. Andrews**

Rare species (only recorded at 1 site each) included the Small Red-eyed Damselfly and the tiny Common Groundhopper. The latter species is quite uncommonly found on farmland habitats in Essex, so its presence in grazed pastures is notable. The groundhopper probably requires the patches of bare earth created by cattle hooves in lightly grazed pastures, as it is not recorded in tall and dense vegetation.

The Common Groundhopper *Tetrix undulata***, a rare insect on the farms, found in only 1 grazed pasture and probably needing the broken ground created by livestock hooves © Alan Wake**

Insect species richness (total number of species) was highest surrounding the reservoirs and ponds, and in woodland habitats (Table 5). Of particular note were the reservoirs at Ashlyns (21 species) and Newhouse (19 species). Both reservoirs and their surrounding hay meadows were important habitats for Odonata (dragonflies), and Lepidoptera (Table 5). Habitats surrounding aquatic features are important for Odonata as immature damselflies such as the localised White-legged Damselfly often need significant feeding grounds away from ponds and rivers to mature sexually, before they return to mate nearer the water. Perhaps just as important as the aquatic habitats found on both farms, are the woodlands which are crucial to the persistence of the Ringlet butterfly (a localised species of damp woodland rides and edges) on both farms.

Table 5: The average number of insect species recorded in different habitats (data combined for Ashlyns and Newhouse Farms) and the species of note (generally localised in Essex)

Habitat	Average number of species	Total number of insect species	Species of note*
Reservoir/pond	17.0	29	Fs, Wl, Rl, Sh
Woodland	12.6	30	Rl
Grazed pasture	11.0	19	Cg, Fs, Sh, Wl
Beetle bank	11.0	11	Fs
Hay meadow	10.5	21	Rl
Field edge (grass margins)	8.9	26	Fs
Clover field	6.5	9	-
Arable field (middle)	6.1	19	Fs

* Species of note
Cg = Common Groundhopper *Tetrix undulata*
Fs = Four-spotted Chaser *Libellula quadrimaculata*
Sh = Small Heath *Coenonympha pamphilus*
Rl = Ringlet *Aphantopus hyperantus*
Wl = White-legged Damselfly *Platycnemis pennipes*

There were 6 woodlands surveyed in total on both farms, by far the most species rich was Nor Wood at Newhouse Farm (Fig. 1) which had over 25 species recorded around the margins and in the rides. Nor Wood was the largest woodland surveyed (over 3 ha in size) and tree species such as Wild Service *Sorbus torminalis* and Midland Hawthorn *Crataegus laevigata* indicate that the woodland is ancient (wooded since before AD 1600). The ground flora included a large carpet of

Bluebells *Hyacinthoides non-scripta* and Dog's Mercury *Mercurialis perennis*, also indicators of ancient woodland. Other interesting ground flora recorded in this woodland included Enchanter's Nightshade *Circaea lutetiana* and Square-stemmed St. John's Wort *Hypericum tetrapterum*. Interestingly, there were just as many species seen inside the woodland (17 species sighted on the grassy rides) as there were along its margins (17 species recorded on the woodland boundary which included wide grassy field margins).

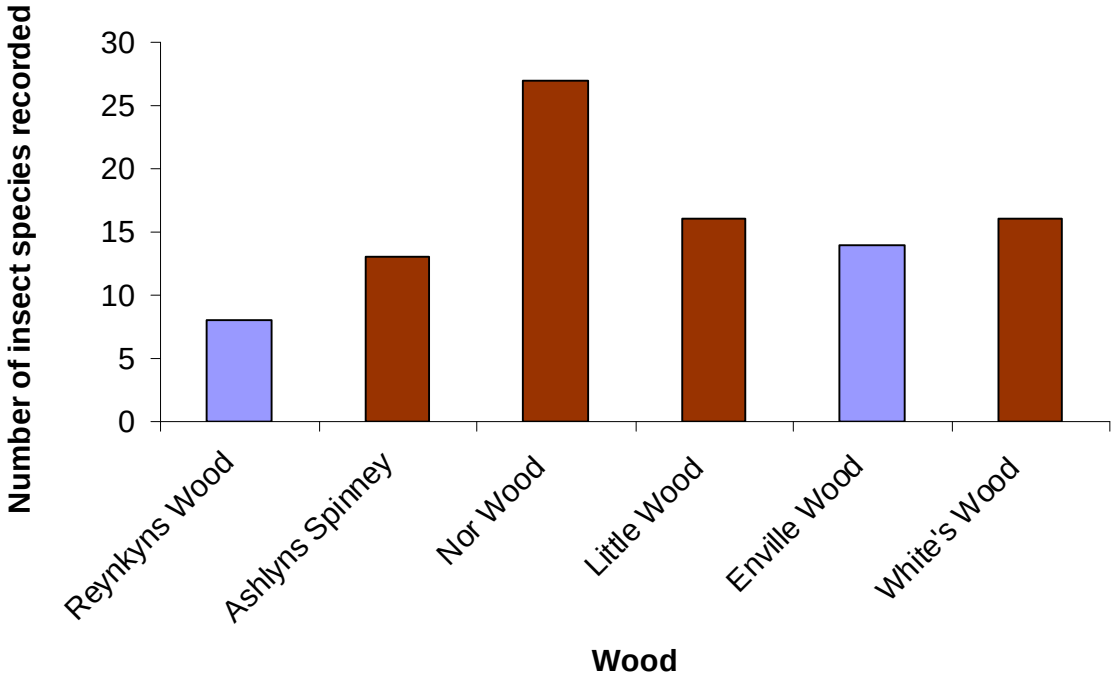


Fig. 1: Total number of insect species recorded from the 6 woodlands on the farms (brown shading indicates Ringlet *Aphantopus hyperantus* recorded in woodland)

Other woodlands may well be very old such as Little Wood (16 insect species recorded) which has Wild Service, Midland Hawthorn, Bluebells, and Dog's Mercury as indicator species of ancient woodland. Little Wood has some very large Hazel *Corylus avellana* stools which are indicative of traditional woodland management throughout the centuries. Similarly to the larger Nor Wood, Little Wood has a strong colony of Ringlets around its margins and in its glades. However, unlike Nor Wood, there was a marked difference between the number of insect species recorded inside the wood (6 species in the glades) and along the woodland margins (16 species). I

attribute this to the dense canopy cover of the woodland due to lack of management leading to low light levels in the interior. There are a few small glades and these could benefit from opening up to increase light levels for basking insects. Resuming coppicing in Little Wood would be highly beneficial to plants and insects. Other nearby woods such as Enville Wood and White's Wood may well be ancient, although neither have Wild Service, one of the most reliable indicators of ancient woodland (Rackham 1986). Ringlet was also not seen in Enville Wood (Fig. 1).

Other notable habitats on the farms included hay meadows (Table 5). A very old unimproved meadow was discovered at Ashlyns Farm by the Cripsey Brook (Site 12 on Ashlyns, see Appendix). Ringlets were recorded from the meadow as were other grassland Lepidoptera such as Large Skipper *Ochlodes venata*, Meadow Brown *Maniola jurtina* and Six-spot Burnet moth. The sward contained plant species indicative of old meadowland such as Agrimony *Agrimonia eupatoria*, Black Knapweed *Centaurea nigra*, Hedge Bedstraw *Galium mollugo*, Meadowsweet *Filipendula ulmaria* and Meadow Vetchling *Lathyrus pratensis*. The meadow which is just outside the Ashlyns Farm boundary is relatively unmanaged, and could benefit from a summer hay cut.

The later cutting of hay meadows (August/September on Ashlyns Farm compared to July on many conventional farms) on organic farmland due to reduced (slower) grass growth in the absence of nitrogen fertiliser input, has substantial benefits to grassland insects. For example, reduced populations of grasshoppers in hay meadows cut in early July on intensively managed farmland may be due to the removal of the entire grassland habitat in one event, leaving only a very short sward (< 10 cm in height) that is unfavourable for adult grasshoppers (Gardiner *et al*. 2002). Consequently, after cutting, grasshoppers may disperse into the surrounding areas in search of tall vegetation, which provides more shelter from inclement weather and avian predation than the mown hay meadow that represents an homogenous, 'microclimatically hostile' environment similar to heavily grazed pasture (Gardiner & Hill 2004). Recently mown meadows may also have high temperatures (> 44^{o}C; unshaded air temperature at 10 cm in the sward), which may cause physiological stress to insects such as grasshoppers which overheat without tall grass to provide shade (Gardiner &

Hassall 2008). Vigorous escape responses from margins may be exhibited under these conditions.

Cutting of hay in July also leads to increased mortality of large mature grasshopper nymphs and adults that are frequent in mid summer (Wagner 2004; Gardiner & Hill 2006), leading to a low abundance of grasshoppers after mowing. Species such as the Meadow Grasshopper may be particularly susceptible to cutting blades which pass through the sward at approximately 10 cm, due to adults spending the majority of their time in the lower sward layers (< 20 cm) resting or basking. Later cutting of hay meadows on organic farmland can only be beneficial to insects when compared to conventional farmland. Leaving uncut areas will also provide a refuge for insects.

Clover fields, although low in overall numbers of insect species (Table 5), were extremely important for bumblebees, and were particularly important for *Bombus hortorum* and *Bombus pascuorum*. The main forage source used by bumblebees in the clover leys was Red Clover *Trifolium pratense* (which formed nearly 100% ground coverage in some fields), and these leys which form part of the cropping rotation due to the nitrogen fixing qualities of clover, are likely to be very important in the survival of bumblebees on organic farms (Gardiner *et al*. 2008).

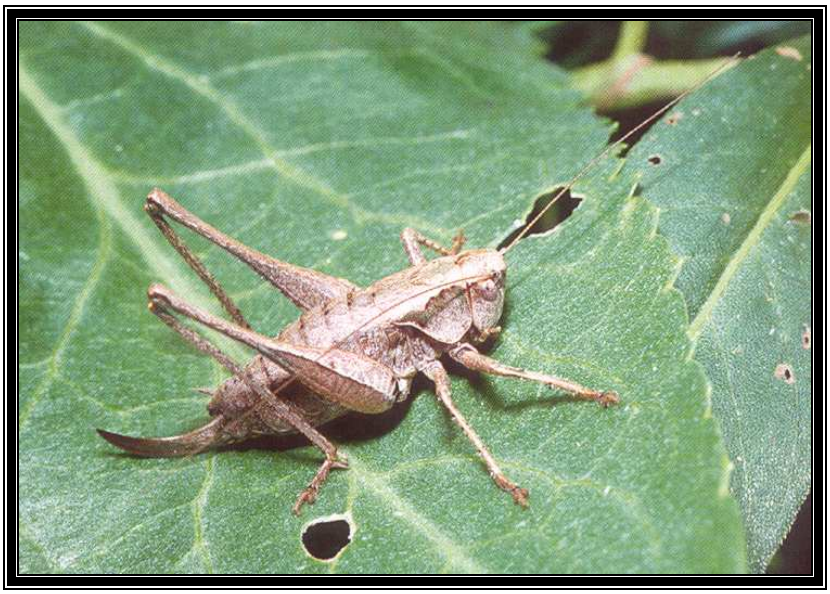
As expected there were more insects along the edges of fields than in the middle, although the Four-spotted Chaser dragonfly could be found in both habitats (Table 5). The higher number of insects around the margins of fields is mainly due to the presence of uncropped grass field margins (often established under the Countryside Stewardship Scheme and now managed under Environmental Stewardship) and mature hedgerows that provided shelter from the wind and a more favourable microclimate (particularly for Orthoptera; Gardiner & Dover 2007).

The annual cropping of fields will also destroy eggs of Orthoptera species such as the Meadow Grasshopper which are laid in the soil, by pushing them deep into the earth causing hatching failure (Gardiner *et al*. 2005; Gardiner 2007). However, several species such as Roesel's Bush-cricket and Dark Bush-cricket *Pholidoptera griseoaptera*, have not been recorded from the middle of fields on intensively managed farmland in central Essex (Gardiner 2007), therefore, the absence of

insecticide spraying and fertiliser input may provide beneficial conditions for Orthoptera in field centres on organic farmland. The later harvesting of organic fields (mid-late August compared to July on conventional farms) allows insects more time to colonise the middle of arable fields before all habitat is destroyed by harvesting and subsequent ploughing. Therefore it may be easier for insects to disperse across fields on organic farmland.

There were also many butterfly species (such as Small Tortoiseshell *Aglais urticae*) recorded nectaring on Creeping Thistle *Cirsium arvense* in field centres in this study. It is suggested that the absence of herbicide use on organic farms allows weeds to persist in crops which would have been sprayed off on conventionally managed farms. Meadow Brown was also commonly sighted in the middle of fields, this is unusual on conventional farmland where insecticides are used.

Dark Bush-cricket *Pholidoptera griseoaptera* **was recorded from the centre of arable fields, this insect is usually recorded from hedgerows © Alan Wake**



3.0 Conclusions

To sum up the findings of the insect survey, the following are how it helps to answer the questions in the introduction:

Question: Which types of habitat may be best for insects?

Answer: It would seem from this study that aquatic habitats and surrounding grasslands are particularly important for insects, especially for Odonata (damselflies and dragonflies). Woodlands, particularly the ancient ones such as Nor Wood at Newhouse Farm, are very important habitats particularly for the Ringlet butterfly. Grassland habitats such as grazed pastures and hay meadows were suitable for a wide range of insects, including some more localised species such as Common Groundhopper, Ringlet and White-legged Damselfly (particularly where the grassland is adjacent to a stream).

Question: Are organic grass field margins good for insects?

Answer: There were a higher number of insect species recorded from the 6 m grass field margins (many managed under Environmental Stewardship) than in the centre of fields suggesting that grass strips are beneficial to insects. However, several species such as Roesel's Bush-cricket and Dark Bush-cricket are not usually sighted on crossfield footpaths in intensively managed farmland in central Essex, therefore, the absence of insecticide spraying and fertiliser input may provide beneficial conditions for Orthoptera in field centres on organic farmland. Some insect species may disperse across organic fields.

Question: How quickly can insects build up populations on organic farms?

The survey revealed that there were more insect species on long-term organic farmland at Ashlyns (e.g. organic for 10 years), than on the relatively short-term organic habitats of Newhouse Farm (organic for 5 years or less). Notably, 10 species were recorded at Ashlyns but were absent from Newhouse Farm, which suggests that they may only colonise organic farmland (such as that found at Ashlyns) that has been converted for a long time period.

4.0 References

FIELD, R.G., GARDINER, T., MASON, C.F. & HILL, J. (2005) Agri-environment schemes and butterflies: the utilisation of 6 m grass margins. *Biodiversity & Conservation* **14**: 1969-1976.

FIELD, R.G., GARDINER, T., MASON, C.F. & HILL, J. (2006) Countryside Stewardship Scheme and butterflies: A study of plant and butterfly species richness. *Biodiversity & Conservation* **15**: 443-452.

FIELD, R.G., GARDINER, T., MASON, C.F. & HILL, J. (2007) Agri-environment schemes and butterflies: the utilisation of two metre arable field margins. *Biodiversity & Conservation* **16**: 465-474.

GARDINER, T. & DOVER, J. (2007) Is microclimate important for Orthoptera in open landscapes? *Journal of Insect Conservation.* Published online first, DOI: 10.1007/s10841-007-9104-7.

GARDINER, T. & HASSALL, M. (2008) Does microclimate affect grasshopper populations after cutting of hay in improved grassland? *Journal of Insect Conservation*. Published online first, DOI: 10.1007/s10841-007-9129-y.

GARDINER, T. & HILL J. (2006) Mortality of Orthoptera caused by mechanised mowing of grassland. *British Journal of Entomology and Natural History* **19**: 38–40.

GARDINER, T. & HILL, J. (2004) Directional dispersal patterns of *Chorthippus parallelus* (Orthoptera: Acrididae) in patches of grazed pastures. *Journal of Orthoptera Research* **13**: 135–141.

GARDINER, T. & HILL, J. (2005) A study of grasshopper populations in Countryside Stewardship Scheme field margins in Essex. *British Journal of Entomology & Natural History* **18**: 73-80.

GARDINER, T. (2007) Orthoptera of crossfield and headland footpaths in arable farmland. *Journal of Orthoptera Research* **16**: 127-133.

GARDINER, T., EDWARDS, M. & HILL, J. (2008) Establishment of clover-rich field margins as a forage resource for bumblebees *Bombus* spp. on Romney Marsh, Kent, England. *Conservation Evidence* **5**: 51-57.

GARDINER, T., GARDINER, M. & HILL, J. (2005) The effect of pasture improvement and burning on Orthoptera populations of Culm grasslands in northwest Devon, UK. *Journal of Orthoptera Research* **14**: 153-159.

GARDINER, T., PYE, M., FIELD, R. & HILL, J. (2002) The influence of sward height and vegetation composition in determining the habitat preferences of three *Chorthippus* species (Orthoptera: Acrididae) in Chelmsford, Essex, UK. *Journal of Orthoptera Research* **11**: 207-213.

HOLE, D.G., PERKINS, A.J., WILSON, J.D., ALEXANDER, I.H., GRICE, F. & EVANS, A.D. (2005) Does organic farming benefit biodiversity? *Biological Conservation* **122:** 113-130.

RACKHAM, O. (1986) *The History of the Countryside*. Weidenfeld & Nicolson History.

SOIL ASSOCIATION (2000) *The Biodiversity Benefits of Organic Farming*. Soil Association.

WAGNER, C. (2004) Passive dispersal of *Metrioptera bicolor* (Phillipi 1830) (Orthopteroidea: Ensifera: Tettigoniidae) by transfer of hay. *Journal of Insect Conservation* **8**: 287–296.

5.0 Acknowledgements

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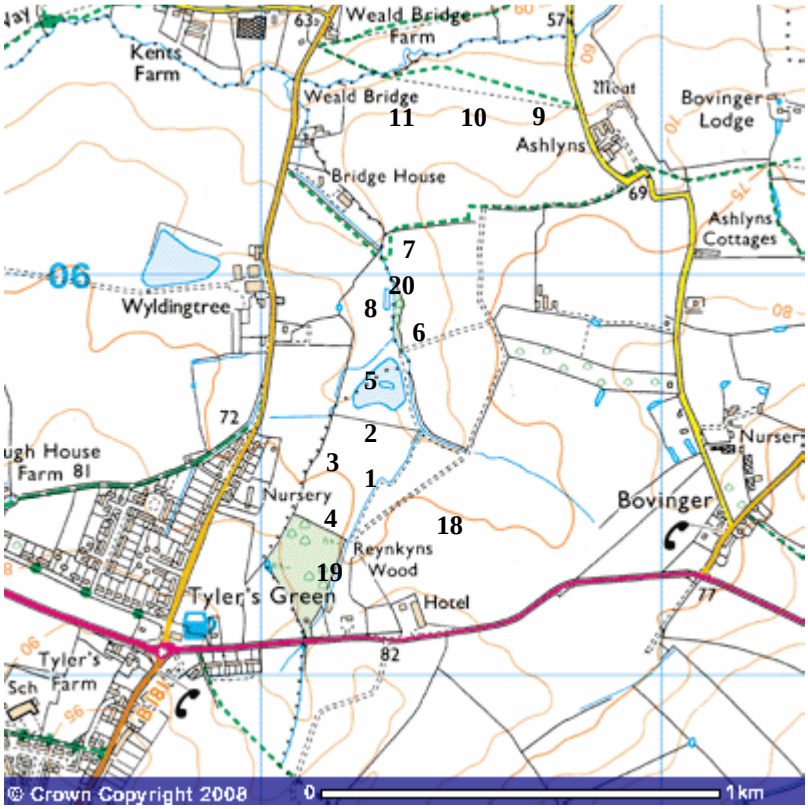
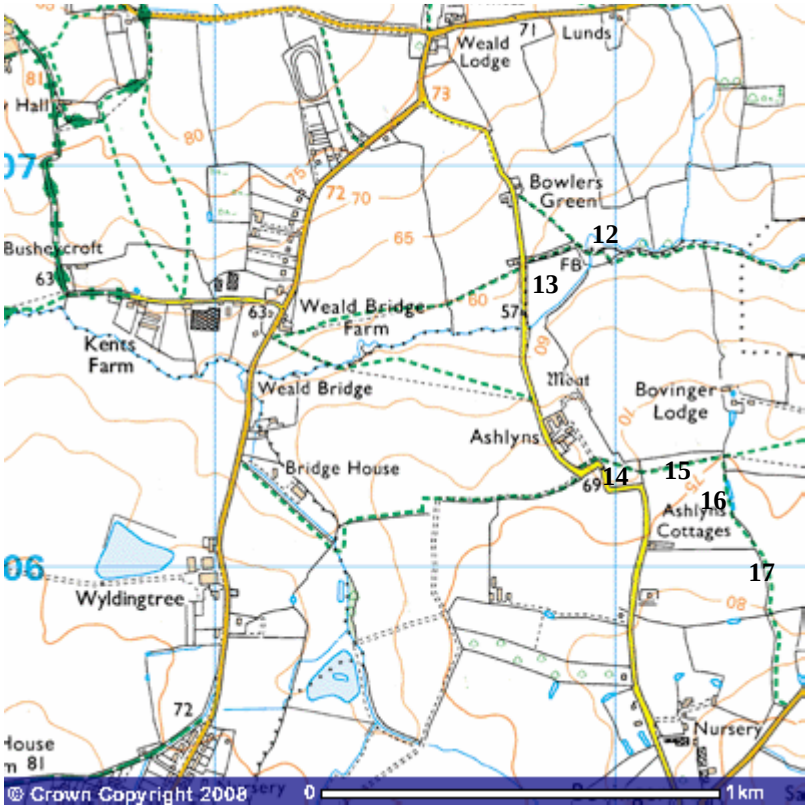
6.0 Appendix

Details of the 20 sites surveyed on Ashlyns Farm

Section number	OS grid reference	Habitat
1	TL 514054	6 m field margin
2	TL 513055	6 m field margin
3	TL 512055	6 m field margin
4	TL 512054	6 m field margin
5	TL 514057	Reservoir and surrounding hay meadow
6	TL 514058	Ashlyns Spinney – plantation
7	TL 514061	6 m field margin
8	TL 514059	Pond and surroundings
9	TL 517064	Crossfield footpath
10	TL 515065	Grazed pasture
11	TL 513064	Grazed pasture
12	TL 519067	Riverside meadow
13	TL 518067	Hay meadow
14	TL 520062	Hay meadow
15	TL 522063	Crossfield footpath
16	TL 523062	6 m field margin
17	TL 524060	6 m field margin
18	TL 514053	Clover field
19	TL 512052	Reynkyns Wood margins
20	TL 513058	Woodland/spinney

Location of the 20 Ashlyns sites





Details of the 20 sites surveyed on Newhouse Farm

Section number	OS grid reference	Habitat
1	TL 559084	Nor Wood margins
2	TL 558085	Nor Wood interior rides
3	TL 560082	Crossfield footpath
4	TL 561081	Crossfield footpath
5	TL 559083	Beetle bank
6	TL 557085	Hay meadow
7	TL 555085	Reservoir and surrounding hay meadow
8	TL 556084	Crossfield footpath
9	TL 554082	Crossfield footpath
10	TL 554085	Clover field
11	TL 553083	Clover field
12	TL 552078	6 m field margin
13	TL 550082	Grazed pasture
14	TL 553082	Clover field
15	TL 553081	6 m field margin
16	TL 554083	6 m field margin
17	TL 555089	Little Wood
18	TL 553092	Enville Wood
19	TL 555090	Crossfield footpath
20	TL 556093	White's Wood

Location of the 20 Newhouse sites