

1.0 Introduction

This is the final report on research carried out for the project BGN/170 Square-spotted clay *Xestia rhomdoidea*. The aim was to conduct autecological research to inform habitat management. Dr Paul Waring acted as Consultant on this project and much of the early work was based on his knowledge of similar species and their behaviour.

The research was based mainly in Cambridgeshire and Essex, as funding was allocated to the Cambridgeshire and Essex Branch of Butterfly Conservation. A separately funded research project took place in Scotland in March 2004, but as the results contain relevant details it will be included here. Much of the research has been carried in conjunction with the Centre for Environment and Rural Affairs (CERA) at Writtle College, Chelmsford, Essex, where the author was based.

2.0 Literature Review

Little literature exists regarding this species, but several articles and reports have been produced (Field, 2003; Field, 2004; Field & Gardiner, 2004; Green, 2002; Haggett, 2002; Parsons, 2004; Waring, 2002a; Waring & Field, 2002; Waring & Field, 2004). Much of this has been stimulated by this ongoing research.

A short extract from Ebert (1998) on behaviour in Europe suggested several larval food plants such as *Primula vulgaris* Primrose, *Primula elatior* Oxlip, *Urtica dioica* Common nettle, and *Prunus spinosa* Blackthorn. The habitats the species inhabits were bushy embankments, track margins, railway embankments, hedgerows, gardens and parklands. Ebert (1998) also listed species which the moth was seen to nectar on in mainland Europe and these included: *Origanum vulgare* Majoram, *Senecio fuchsia* Ragwort, *Buddleja davidii* Buddleia, *Junctus effusus* Soft rush and thistles (no Latin given), plus artificial bait.

3.0 Methods

The historical records of adult observations in Cambridgeshire were reviewed and likely sites identified. These sites were then visited during the periods October to April for larvae and July and August for adults. The larval searches commenced around dark and in 2002 the areas

searched were adjacent to where adults had been previously light-trapped. At that stage all the ground vegetation was searched as our only guide was the larval food plants suggested by Skinner (1998) and identified in the UK BAP (UK Biodiversity Group, 1999). All the low growing vegetation was therefore checked using torch light. Larvae identified were recorded, and surrounding vegetation noted. In 2003 and 2004, further similar searches were carried out but mainly confined to woodland and ride edges and areas of sparse scrub.

The behavioural study of captive larvae commenced in early 2003 and continued in 2004 when 200 mm diameter flower pots were planted with *U. dioica* and *P. vulgare*. Each pot had one large *U. dioica* plant and four *P. vulgare* plants planted in it. The pots were then placed in nets and put outside in a sheltered spot. One *X. rhomboidea* larva was placed in each of the pots. The behaviour of each larva was observed between February and April (2004), and March and June (2003). Observations began on some nights two hours before dusk and on others continued until dawn. Temperature and weather conditions were also recorded on each occasion.

Light trapping for adults started in 2002 and continued in 2003. Some of these sessions involved all night trapping with multiple traps, while others continued only until about midnight with single traps. In 2004 no specific light trapping took place but records were collected from Cambridgeshire and Essex moth trappers.

Searches for adults nectaring also took place about one hour before and one hour after dusk. This involved searching vegetation in flower on the edge of woodlands or in woodland rides. Adults were recorded along with time and weather conditions. While searching for adults nectaring, time was also taken to try to find females egg-laying. This involved trying to find females flying and following them to egg-laying sites. This was only carried out for the hour either side of dusk due to the difficulty of finding the moths in flight in full darkness.

Searches for eggs were carried out in August when several surveyors would search all branches, leaves and undergrowth at sites known to hold strong populations. This took place in daylight and covered several sites in Cambridgeshire in 2003 and 2004.

4.0 Results

4.1 Overhall Grove (TL 337633)

Overhall Grove is an area of ancient and secondary woodland owned by Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough Wildlife Trust (BCNPWT). Large amounts of *Ulmus* spp. Elm remain as well as *P. elatior*.

(a) Larvae

The larvae were observed at Overhall Grove on four occasions over a period of three weeks in 2002 (Waring & Field, 2002) and on 27th March 2003 in the secondary woodland (Table 1).

Table 1 : Larval observation at Overhall Grove in 2002/3

Date	Number of recorders	Time spent searching	Number of larvae	Feeding on
22/3/02	3	20.00-22.30 (150 mins)	2	<i>U. dioica</i>
29/3/02	2	20.00-21.00 (60 mins)	2	<i>P. elatior</i>
4/4/02	2	21.00-22.0 (60 mins)	2	<i>U. dioica</i>
11/4/02	16	21.00-23.00 (120 mins)	4	3 on <i>P. elatior</i> 1 on <i>U. dioica</i>
17/4/02	2	21.20-22.20 (60 mins)	0	
24/4/02	2	21.30-22.30 (60 mins)	0	
27/3/03	4	1915-20.55 (100 mins)	6	<i>U. dioica</i>

The larvae were observed feeding on both *U. dioica* and *P. elatior* and were relatively easily found (Table 2). The first of the larvae were located within a few minutes of it getting dark and could be found feeding for most of the night. The timings of observations were similar to the findings of Haggett (2002). The majority of the larvae were found on the wide central ride at the edge of the drip line from the trees and shrubs. Only one was found within the trees (22.25 on the 11th April)(Table 2) and this was observed feeding on *P. elatior*.

Table 2 : Timing of observations and weather during survey work

Date	Time larvae found	Temp °C	Weather
22/3/02	21.10, 21.55	9	Complete cloud cover, calm, mild and dry
29/3/02	20.15, 20.56	8	Clear, calm and dry
4/4/02	21.10, 21.30	8.5	Clear, calm and dry
11/4/02	21.32, 21.55, 22.09, 22.25	4	Clear, calm cool and dry
17/4/02		10.5	Clear, mild and dry
24/4/02		11	Clear, mild and dry
27/3/03	19.37, 20.05, 20.05, 20.38, 20.40, 20.45	10	Clear, mild and dry

Larvae were searched for on 18th October 2002 by beating trees near to the site of the light trapping event of 2001. No larvae were found.

(b) Adults

Overhall Grove was identified as a site for *X. rhomboidea* after the National Moth Night in 2001. Will Kirby reported 17 adults in a single Robinson trap (Waring, 2002a). As a result further investigation took place during 2002 (Table 3).

Table 3 : Light-trapping on the 13th August 2002

Trap number	Number of <i>X. rhomboidea</i> caught	Description of trap situation
1*	1	Field margin
2	5	Field margin
3	5	Woodland clearing
4	0	Field margin
5	1	Field margin
6	1	Field margin
7	4	Field margin
8	4	Field margin
9	8	Woodland clearing
10	28	Woodland interior

* only operated until 1.00am

Adapted from Green 2002

No adults were observed nectaring during that evening, and the majority arrived in the traps after 1.00am as only one individual was noted before that time (Green, 2002). The following evening observations were made of *X. rhomboidea* adult behaviour. Four recorders searched

for adults around the areas which had been identified from previous surveys as possible nectaring and egg laying sites. Three adults were observed (Table 4) during the searches which took place between 20.30 and 23.00 that evening. One female (21.15) was observed displaying behaviour associated with egg-laying. She was flying slowly around *Ulmus* spp. but no egg-laying was observed. No *X. rhomboidea* came to sugar or to the one light trap operated (point 9) and no others were observed after 21.45. One of the main plants that *X. rhomboidea* has been seen to nectar on is *Arctium minus* Lesser burdock, but at Overhall Grove these had finished flowering by the 13th August and no adults were seen nectaring on them and *Dipsacus fullonum* Teasle was used.

Table 4 : Adult behaviour 14th August 2002

Time	Male of female	Behaviour	On or around	Position
21.15	M	nectaring	<i>D. fullonum</i>	Field margin near position of trap 2
21.15	F	flying	Around <i>Ulmus</i> spp. 2.5 m from ground	Interior of wood near trap 10 position
21.45	F	flying	Around <i>Ulmus</i> spp. 2.5 m from ground	Interior of wood near trap 10 position

Light trapping took place again on the 7th August 2003. Several traps were used and nectar plants were searched for nectaring adults. Eight adults were trapped, seven males and one female, while one male was seen nectaring on *Centaurea nigra* Black knapweed (Table 5).

Table 5 : Trapping details from 7th August 2003

Time	Male of female	Behaviour	On or around	Position
21.25	M	Attracted to light	On white sheet next to light trap	Interior of wood
22.05	M	nectaring	<i>C. nigra</i>	Field margin on edge of wood
22.25	2 M	Attracted to light	On outside of light trap	Interior of wood
22.40	2 M 1 F	Attracted to light	On outside of light trap	Interior of wood
22.43	2 M	Attracted to light	In light trap	Interior of wood

On the 11th August 2004 a further search for adults was conducted. No light traps were used as adult behaviour was being investigated. Four males and three females were seen nectaring between 21.12 and 22.07 (Table 6).

Table 6 : Adult behaviour 11th August 2004

Time	Male of female	Behaviour	On or around	Position
21.12	M	nectaring	<i>D. fullonum</i>	Field margin on edge of wood
21.15	2 M	nectaring	<i>D. fullonum</i>	Field margin on edge of wood
21.17	F	nectaring	<i>D. fullonum</i>	Field margin on edge of wood
21.35	F	nectaring	<i>D. fullonum</i>	Field margin on edge of wood
22.04	M	nectaring	<i>D. fullonum</i>	Field margin on edge of wood
22.07	F	nectaring	<i>D. fullonum</i>	Field margin on edge of wood

(c) Eggs

Searches for eggs took place on the 9th September 2002 in areas around where the females were seen flying in August. No eggs were found during a two hour search by one person. On 11th August 2004 a further search took place when five man hours were spent searching a similar area to the search area in 2002 plus around the main glade trapped by Will Kirby in 2001. Both ground vegetation and the lower branches of trees were searched but no eggs were found.

4.2 Hilly Wood TF 111047

Hilly Wood is an ancient woodland site consisting of a wide range of native broadleaved trees and shrubs that have been subjected to extensive felling (Waring and Field, 2002). Hilly Wood was searched for larvae on the 25th March 2002. The search was commenced near to a point where one *X. rhomboidea* adult was light-trapped on 17th August 1994 (Waring, 1994). Three larvae were found during the search which lasted from 20.40 to 22.15 (95 minutes), all feeding on *U. dioica*. These larvae were all observed feeding on the field side of a ditch which separates Hilly Wood from arable fields. They were found on the drip line of the trees but water within the ditch made it unlikely that the larvae moved across the ditch to feed on woody growth (Waring and Field, 2002). The same banking and an internal area of the wood were searched on the 28th March 2003 but no larvae were found. A further search of the

internal part of the wood resulted in one larva being recorded feeding on *U. dioica* on the 4th April 2003.

4.3 Gamlingay Wood TL 242535

Gamlingay Wood is a SSSI managed by the BCNPWT. It is an ancient ash/maple wood 48 ha in size, with an interesting ground flora (The Wildlife Trust, 2001).

(a) Larvae

Two searches of Gamlingay Wood took place during the spring of 2002 on the 3rd and 9th of April but no larvae were found. The main ride and entrance area were searched (seven man hours in total) on both occasions. *Ulmus* spp. were present along with *U. dioica* and *P. elatior* in these areas. The same areas were searched again on the 2nd April 2003 by four recorders (nine man hours). This time seven larvae were found (Table 7), one on *Mercurialis perennis* Dog's mercury.

Table 7 : Larval search details 2nd April 2003, 20.15 start

Time	Number of larvae	Feeding on	Surrounding plants
20.25	1	<i>M. perennis</i>	under <i>Ulmus</i> spp.
20.37	1	on <i>Arum maculatum</i>	around <i>U. dioica</i> under <i>Ulmus</i> spp.
22.00	1	<i>U. dioica</i> and dead stem	under <i>Corylus avellana</i> , <i>Pinus sylvestris</i> & <i>Fraxinus excelsior</i>
22.04	1	<i>U. dioica</i> and dead stem	under <i>C. avellana</i> , <i>P. sylvestris</i> & <i>Quercus</i> spp.
22.14	2	<i>U. dioica</i>	under <i>Pinus</i> . & <i>F. excelsior</i>
22.16	1	<i>U. dioica</i>	under <i>Quercus</i> spp., <i>P. sylvestris</i> & <i>F. excelsior</i>

(b) Adults

One adult had been light-trapped in August 2001, so light-trapping was carried out on the 19th August 2002 when four adults were trapped (Table 8). Traps 1 and 2 were on the main ride, north south through the wood, with trap three on the main east west ride. The main rides throughout the wood were also searched for adults nectaring but none were found. One adult was also light-trapped on the 18th August 2004.

Table 8 : Light-trapping at Gamlingay Wood 19th August 2002

Trap	Number caught	Trap type	Time	Trapping time
1	1 male	Pole	21.15	20.30-0.00
2	2 males	Skinner	21.30 24.00	20.30-0.00
3	1 male	Skinner	22.15	20.30-0.00

4.4 Grange Farm (RSPB) TL 333626

This site is the RSPB research farm adjoining Overhall Grove. The light trap is situated at least half a kilometre away from Overhall Grove at the other side of the main road through the village. On four occasions during August 2002 adults were light-trapped. These were on the: 1st, 7th, 19th and 20th. One adult was caught on the 5th August 2003 and on the 16th August 2004.

A search for larvae was conducted on the 27th March 2003 when five recorders searched four areas of the site (eight and a third man hours) and found five larvae in total (Table 9). The only one of the four areas where larvae were not located was on a stretch of ancient hedgerow surrounding one of the arable fields. The areas searched were fairly new plantations (20-30 years old), plantations 1 and 2 were between 0.5-1km away from Overhall Grove, while the shelter belt was connected to Overhall Grove but was only about 50m wide.

Table 9 : Search of RSPB Grange Farm 27th March 2003

Time	Number of larvae	Feeding on	Surrounding plants
19.45	1	<i>U. dioica</i>	under <i>Ulmus</i> spp. in plantation 1
19.50	1	<i>U. dioica</i>	under <i>Ulmus</i> spp. in plantation 1
20.12	1	<i>U. dioica</i>	under <i>Ulmus</i> spp. in plantation 2
20.30	1	<i>U. dioica</i>	under <i>Acer campestre</i> and very young <i>Ulmus</i> spp. (0.5m) in shelter belt
20.50	1	<i>U. dioica</i>	under <i>A. campestre</i> and very young <i>Ulmus</i> spp. (0.5m) in shelter belt

4.5 New Farm, Madingley TL 386609

This wood is little more than a shelter belt with *Ulmus* spp., *Quercus robur* Oak, *Crataegus monogyna* Hawthorn, *Acer pseudoplatanus* Horse chestnut and *F. excelsior* all less than 50

years old. The ground flora is *M. perennis*, *Glechoma hederacea* Ground ivy and *U. dioica* (Appendix 1).

(a) Larvae

The site was searched on the 22nd April 2002 by two recorders for one hour but nothing was found. It was searched again on 31st March 2003 by eight recorders between the period of 20.00 and 22.00 hours (eleven and one third man hours) and 30 larvae were found (Table 10). Four timed counts were completed during which time 4.125 larvae were found per man hour. On the 17th March 2004 three recorders searched between 20.42 and 21.29 (two man hours) and found three larvae all feeding on *M. perennis*.

Table 10 : Larval searches on 31st March 2003

Time 31/3/03	Number of larvae	Feeding on	Surrounding plants
20.25	1	<i>U. dioica</i>	under <i>Ulmus</i> spp.
21.23	1		
21.38	1		
21.42	1		
21.47	1		
20.30	1	<i>Anthriscus sylvestris</i>	under <i>Ulmus</i> spp.
20.38	1		under <i>Ulmus</i> spp. and <i>Larix</i> spp.
21.16	1		
21.23	1		
20.33	1	<i>M. perennis</i> flowers of <i>M. perennis</i>	under <i>Ulmus</i> spp.
20.35	2		
20.58	1		
21.03	1		
21.09	1		
21.14	1		
21.44	1		
20.59	2		
21.00	1		
21.01	2		
21.04	1		
21.05	1		
21.06	1		
21.10	2		
21.14	1		
21.37	1		
21.45	1	<i>Galium aparine</i>	under <i>Ulmus</i> spp.

(b) Adults

Six adults had been caught in 2001, so further trapping was conducted in 2002. Adults were caught on a regular basis from the 3rd until 31st August using an Actinic trap left on all night (Table 11).

Table 11 : Light-trapping at New Farm August 2002

Date	Number caught
3/8	10
4/8	4
6/8	16
8/8	14
10/8	15*
13/8	8
14/8	14
15/8	14
16/8	5
18/8	17
21/8	17
31/8	2

*only night sex ratio recorded

When Dr Paul Waring and the author visited the site on the 11th August, the catch from the previous night were all males. Further adults were trapped in 2003 and 2004.

(c) Eggs

The site was searched for eggs on the 18th and 19th August 2003 (Appendix 1). Five were located, all laid singly, one to one and a half metres above ground level on the undersides of leaves of *Ulmus minor*. None were found on *U. dioica* (Waring, 2002b). A further search for eggs was conducted by five recorders (six and a quarter man hours) on the 11th August 2004 but no eggs were found either on the ground vegetation or the surrounding trees. This search covered an area 75 m up the wood from the light trapping site and 50 m down the wood from the trapping site.

4.6 Duck End Farm, Dry Drayton TL 384619

This garden is monitored by regular use of a light trap throughout the flight season. It is about one kilometre from Madingley Woods. A larval search was carried out on the 17th April 2002 for two hours by two people but no larvae were found. A further search was carried out on 17th March 2003 but once again no larvae were recorded. Adults were trapped on two occasions in 2002 at this site, three on the 7th August and two on the 13th August. Small numbers were also caught in 2003.

4.7 Fulbourn Fen Nature Reserve TL 526557

This is a BCNPWT site, and comprises of a drained fen, with remnants of alder and secondary woodland, a non-native plantation and four ancient meadows. The whole site is a SSSI and is 27 ha in size (The Wildlife Trust, 2001).

(a) Larvae

A larval search was carried out on the 18th April 2002 by two recorders for two hours, but no larvae were discovered. Further searches for larvae were conducted during 2003, 2004 and 2005. On the 17th March 2003 six larvae were recorded (four man hours), while none were found on 15th October 2003 (three man hours) and ten were found on 11th February 2004 (three man hours). The earliest records was found in 2005 when two larvae were found on 10th January (two man hours) and two on 17th January (Table 12), one of which was feeding on *Ranunculus repens* Creeping buttercup. Both *R. repens* and *G. hederacea* were fed to larvae in captivity. *R. repens* was readily eaten but little sign of feeding damage was found on *G. hederacea* this backs up observations in the wild.

Table 12 : Larval searches at Fulbourn Fen Nature Reserve

Time/date	Number of larvae	Feeding on	Surrounding plants
17/3/03			
18.57	1	<i>U. dioica</i>	under <i>Ulmus</i> spp.
19.02	1		
19.25	1		
19.32	1		
19.37	1		
19.39	1	<i>G. aparine</i>	
15/10/03	0		
11/2/04			
18.31	1	<i>U. dioica</i>	under <i>Ulmus</i> spp.
18.32	1	<i>Rubus</i> spp.	
18.42	1	<i>U. dioica</i>	
18.47	1		
18.50	1	<i>A. sylvestris</i>	
19.00	1	<i>U. dioica</i>	
19.01	1		
19.02	1		
19.07	1		
19.09	1		
10/1/05			
18.15	1	<i>G. hederacea</i>	under <i>Ulmus</i> spp.
18.45	1		
17/1/2005			
	1	<i>G. hederacea</i>	
	1	<i>R. repens</i>	

(b) Adults

Adults had been light-trapped in the Fulbourn area over the past few years but the Nature Reserve had never been trapped before. Two adults were light-trapped during the trapping period 20.45 of the 21st August to 01.00 of the 22nd August 2002 (Table 13).

Table 13 : Fulbourn Fen light-trapping 21st August 2002

Trap	Type of trap	Number of adults	Sex	Time of trapping
1	Pole	0		
2	Actinic	0		
3	Skinner	1	F	22.00-22.30
4	Skinner	1	M	0.22am

4.8 Chippenham Fen TL 651691

Light-trapping was carried out on a night of mixed weather conditions on the 10th August. Heavy rain fell until about 23.00 and then it turned dry. Traps had been set but no adults were recorded before midnight, but by first light four had entered the traps. No adults came to sugar that night and none were seen nectaring.

4.9 RSPB Fowlmere

The RSPB reserve at Fowlmere was searched on the 20th August 2002 from 20.30 to 23.00 by two recorders. No adults were seen nectaring but the weather did turn wet by 21.30. A further search on 3rd August 2004 found six adults nectaring (pers com. J Chainey).

Searches for larvae were conducted on the 24th March and 12th April 2003 when five and seven were found (Table 14). At the first event eight recorders searched 12 man hours while at the second seven recorders searched for five man hours.

Table 14 : Larval searches at RSPB Fowlmere

Time	Number of larvae	Feeding on	Surrounding plants
24/3/03			
19.05	1	<i>U. dioica</i>	under <i>Ulmus</i> spp.
19.25	1		under <i>C. monogyna</i>
19.45	1		under <i>Sambucus nigra</i> and <i>Salix</i> spp.
21.05	1		under <i>F. excelsior</i>
21.20	1		under <i>C. mongyna</i> and <i>S. nigra</i>
12/4/03			
20.44	1	<i>U. dioica</i>	under <i>F. excelsior</i>
20.47	1		under <i>F. excelsior</i> and <i>Rosa</i> spp.
20.57	1		under <i>C. monogyna</i>
21.01	1		under <i>Rosa</i> spp.
21.10	1		under <i>Salix alba</i> and <i>C. monogyna</i>
20.15	1		under <i>Ulmus</i> spp.

4.10 Weaveley Wood

Five adults were light-trapped (using an actinic) at Weaveley Wood TL 225540 on the 17th August 2002 (new record). One adult was trapped on 18th August 2003.

4.11 Hail lane Abbotsley

Three adults were trapped at Hail Lane, Abbotsley TL 216575 on the 30th August 2002 (new record), but none were caught on 3rd August 2003. Two adults were caught in 2004 on the 1st August.

4.12 Barton

One male was light-trapped at midnight on the 31st August 2002 at the Countryside Restoration Trust (CRT) Farm in Barton TL 409550 (new record). Two adults were seen nectaring in a garden at TL399549 on the 1st August 2004. Further records include one on 4th and two on 7th August 2004 on wine ropes and one light-trapped on 14th August 2004 in the same garden.

A larval search of the area around the first record at the CRT farm on 23rd March 2003 found no larvae in any of the hedge bottoms. The search was conducted by four recorders and involved eight man hours.

4.13 The Belts, Wimpole Hall

A record from the 19th August 2000 has been found. One adult was seen nectaring on *A. minus* inside the woods at TL 339524, The Belts, North of Wimpole Hall (new record). A larval search of the area was conducted on the 5th April 2003 by two recorders for two man hours but no larvae were found.

4.14 Oxey Wood

A larval search of the wood on the 28th March 2003 found two larvae on the roadside verge and woodland edge at TF 123032. They were found at 21.21 and 21.50 both feeding on *U. dioica* under *Ulmus* spp. The site was searched by four recorders for five man hours. A larval search was carried out on 24th March 2004 for two man hours but no larvae were found.

4.15 Whitehill Plantation

Trapping was carried out at Lodge Farm, Fulbourn (TL 512536) and 12 adults were light-trapped on the 12th August, two (one male and one female) on the 23rd, and two males on the 27th August 2002. Further adults were caught in 2003 and 2004.

A larval search of the plantation on 12th March 2003 found nine larvae in two man hours. They were all feeding on *U. dioica* on the drip line under *Ulmus* spp. The sizes ranged from 11mm to 18mm. This plantation was searched on a two weekly basis from mid October 2003 until February 2004. No larvae were found until 3rd February when one was observed feeding on the top of a *U. dioica* plant. The larva was 9mm in length.

4.16 Little Paxton Pits

One adult was light trapped on the 16th August 2003 at TL 199630 and one was trapped on 6th August 2004 at TL 201634. These are new records for this area.

A larval search was carried out 2nd March 2004. The weather conditions were not ideal as the starting temperature was 2°C and a heavy frost soon formed but one larva was found at 19.40 feeding on *U. dioica* under *S. nigra*. No *Ulmus* spp. were in the area. A second area searched by the river had *Ulmus* spp. present but no larvae were found there. Nine recorders spent nine and three-quarter man hour searching between 19.15 and 20.35.

4.17 Essex

A new record for Essex was from Freewood TL 475395. Two adults were seen nectaring on *D. fullonum* on the 9th August 2002. Other records for Essex include Great Horkesley (TL 9632) 1991 to 2002, Abram's Lane Chrishall (TL 4439) where ten adults came to light and sugar during 2000 and 2001 and Langley Upper Green (TL 4435) where an adult was recorded in 2001. Full details of adults caught is provided (Table 15).

Table 15 : Essex adult records up to 2003

Site	Grid ref	Number	Date	Surveyors
Saffron Walden	TL5437	1	14/08/97	A M Emmet
Upper Green	TL4435	1	08/01	E Ponting
Chrishall	TL4439	5	08/00	P Jenner
Chrishall	TL4439	5	08/01	P Jenner
Freewood	TL475395	2	09/08/02	J Chainey & J Spence

A training session was held in Essex to help local volunteers with the larval searches as the larvae had never been found in Essex. Freewood was searched by nine recorders on the 15th March for four and a half man hours between 20.20 and 20.50. One larva was found feeding

(TL 4755839641) on *U. dioica* at 20.47 (Waring and Field, 2004). The surrounding vegetation was *A. campestre*, *C. avellana* and *C. monogyna*. Park Wood (TL 452390) was also searched for four and a half man hours but no larvae were found. Following on from that on the 17th March two larvae were found feeding on *U. dioica* at a small *Ulmus* spp. dominated copse in Langley Upper Green (TL 4535).

4.18 Melwood

On 16th March 2004 a small woodland (TL 3747) near Meldreth was searched and six larvae were discovered.

4.19 Bedford Purlieus

Two larval searches took place in 2004. The first on 26th March found no larvae but a second search on 7th April recorded one larva feeding on *U. dioica* (TF 039005) at 22.40 after a half man hour search. This is the first record of the species at this formally well recorded wood since before 1961 (J. Ward pers.com.).

4.20 Wicken Fen

One adult was recorded at a wine rope on 29th July 2004.

4.21 Eltisley

One adult was recorded at a house light on 2nd August 2003.

4.22 The Gorse

Eleven adults were recorded on 4th August 2003 and five were recorded on 19th August 2004 (TL 247614). A larval search took place on 27th February 2004 but no larvae and few larval food plants were found in a one man hour search by two recorders.

4.23 Duloe Brook

One adult was recorded on the 12th August 2004 from a site with no *Ulmus* spp. (TL 125608).

4.24 Others

Searches for larvae took place on 3rd April 2003 at Byron's Pool (TL 435545), 27th February 2004 at woodland (TL 215573), 30th March at Monks Wood (10 man hours) and Ridey

(Riddy) Wood (six man hours), but no larvae were found. Light trapping took place on 6th and 23rd August at Ditton Park Wood (TL 668573), on 18th August at Lucy Wood (TL 687568), and on 8th, 11th, 19th and 23rd August 2003 at a garden site (TL 684559) but no adults were caught. Kate's Bridge near Bourn (TF106157) was searched on 31st March, 11th and 14th April 2004 for larvae but none were found during these three half man hour searches.

4.25 Scotland

Larvae had never been recorded in Scotland before but three were found at two sites in March 2004. One site was near Kyle of Lochalsh and the other between Kilmelford and Arduaine (Appendix 2). The food plants were *P. vulgaris* at Kyle and *M. perennis* at Arduaine.

4.26 Wales

No work has been carried out in Wales but on the Scottish research visit previously unknown records from Wales were discovered and there were supported by intact specimens for confirmation.

Full details of records of larvae are provided in Appendix 3.

Figure 1 : Distribution map for larvae in Cambridgeshire and Essex March 2005

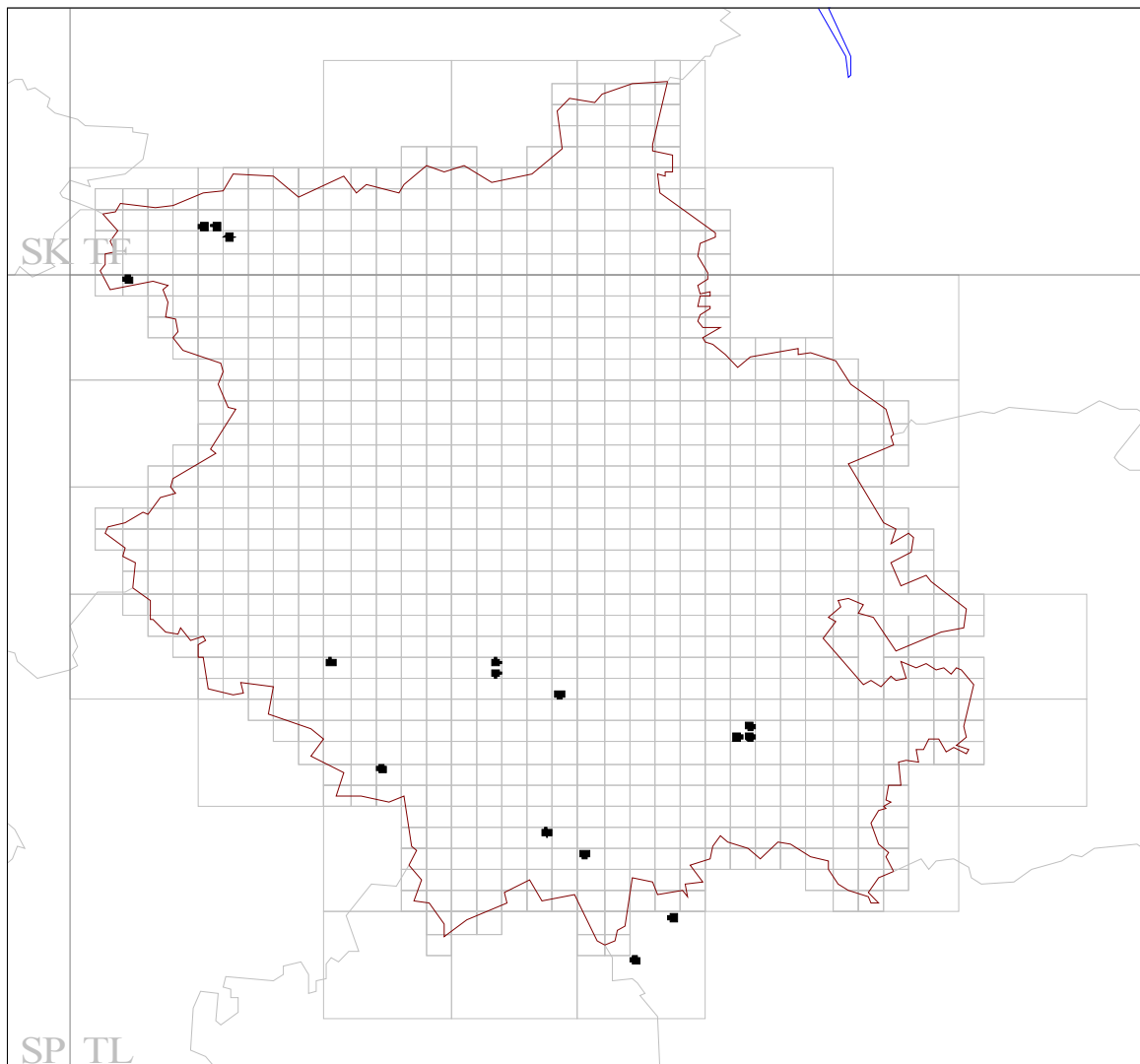
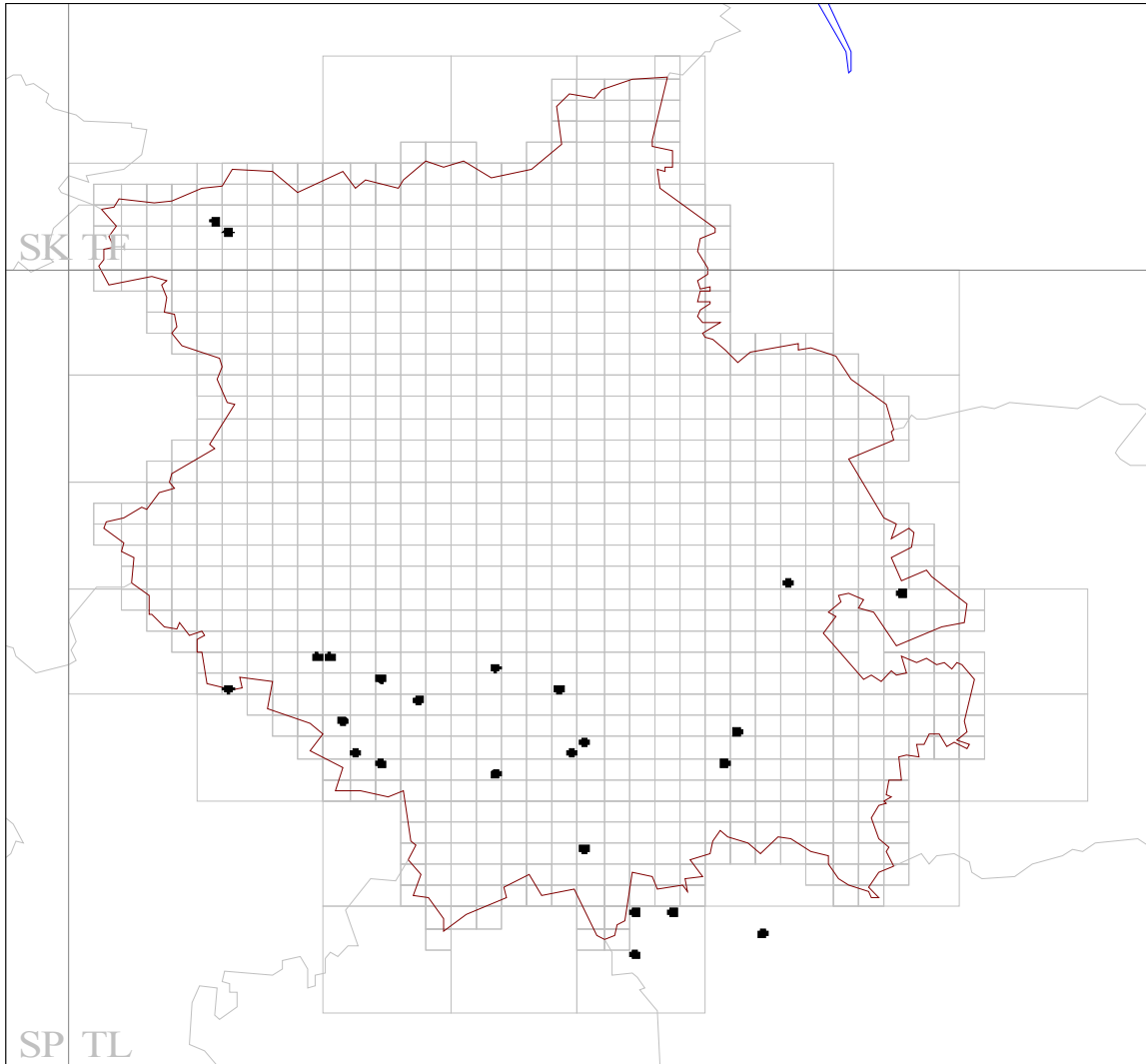


Figure 2 : Distribution map for adults in Cambridgeshire and Essex March 2005



4.27 Captive stock

(a) Larvae

While in captivity larvae were seen to feed on *P. vulgaris* and *Prunus domestica insititi*, but showed no interest in *Rubus* spp. leaves. They commenced feeding as soon as it became dark and continued for a couple of hours. By day they hid under material provided. All four larvae had completed growth by the end of March. The larval skins were shed and pupae formed during the first week of May (Waring and Field, 2002).

Haggett (2002) suggests that larvae will eat almost any common ground plant, with larvae being reared on *Stellaria media* until midwinter and then *Plantago lanceolata*. In spring, *P. vulgaris* was eaten. The larvae appeared to be active all winter, which they pass in their third instar (Haggett, 2002).

The behaviour of the captive larvae was observed for 70 hours in the period 18th March to 27th April 2003. In this period the larvae were observed to appear about two hours before dark and lie with the front part of the body on the base of a larval food plant stem and the rest of the body on the soil. They remained in this reared up position until dusk and then climbed quickly to the top of the plant and started to feed. This was also observed by John Dawson with stock he had on *U. dioica* (J. Dawson pers com.). Feeding was observed on nearly 66% of observations, with feeding on *P. vulgare* leaves being the more popular, followed by feeding on *U. dioica* and then feeding on *P. vulgare* flowers (Table 16). As the *U. dioica* became older with less new growth, they were avoided and more feeding took place on *P. vulgare*. Feeding continued for most of the night but by 5.00 am the larvae had disappeared. During the day the larvae hid in the soil or under dead vegetation if available (also observed by J. Dawson on his stock).

Table 16 : Number of behavioural observations of captive larvae

Feeding on <i>U. dioica</i>	Feeding on <i>P. vulgaris</i> leaves	Feeding on <i>P. vulgaris</i> flowers	Climbing	Resting	No sign
25	79	16	16	12	37

In captivity, the larvae were seen feeding between 17°C and 2°C. In the wild, the lowest temperature larvae were recorded feeding was 2°C. The only night the weather seemed to have an affect on feeding was on the 1st April, when it was windy and cold. One larva was reared up on a *P. vulgare* stem before dark, but did not climb up to feed.

Neither larvae were seen during the period 24th to 29th March but on the 30th March one larva reappeared in a final instar and returned to feeding. The other was not seen feeding until 4th April (Table 17). Both larvae then continued to feed every night until 18th April, but by 26th April neither was feeding. On the 27th, one larva had turned almost completely white, with just the darker wedge shaped markings left. This larva was hiding under the vegetation and was placed in a box of soil with *P. vulgare* leaves on the top. The second larva was not seen again. It was suspected that it had been parasitised before collection and the parasite emerged between 18th to 27th April. The one remaining larva fed for the last time on 28th April and then descended into the soil, pupating on 17th June. A further study was carried out in 2004 using four larvae and four netted pots. Very similar behaviour was observed with feeding taking place most nights, the *U. dioica* seemed to be favoured when young but as they got taller and older the *P. vulgare* seemed to be the first choice for feeding.

Table 17 : Feeding patterns of the captive larvae

Date	Larva 1	Larva 2
18-23/3/03	feeding	feeding
24-29/3/03	no sign	no sign
30/3-1/4/03	feeding (final instar)	no sign
4-18/4/03	feeding	feeding (final instar)
26/4/03	no sign	no sign
27/4/03	Larvae put in box with soil and <i>P. vulgaris</i> leaves	no sign
28/4/03	feeding	no sign
29/4-16/6/03	resting in the soil	no sign
17/6/03	pupated	no sign

(b) Adults and eggs

The female lays its eggs singly and glues them to leaves and stems. In captivity the eggs were laid over both the upper side and undersides of *U. dioica* leaves (Paul Waring pers. com.). In 2003 one female laid eggs on the underside of *U. dioica* leaves in preference to *U. minor*

leaves. The eggs are white when laid but became dark in colour and hatch after about 9-10 days. In an experiment conducted with young larvae, three groups were fed, one with *Ulmus* spp. leaves, one with *U. dioica* leaves and a third with a mixture of the two. The larvae reached 5-6mm in 10 days and after a month were 10-11mm in length. The growth was similar from all three groups, but the group given a choice preferred *U. dioica* leaves but not exclusively (Edwards and Joy, Appendix 1).

5.0 Discussion

During the three years of research much progress in understanding the distribution and ecology of this species has been made. The larvae have been identified in the wild at fourteen sites in Cambridgeshire, Essex, Hertfordshire and Northamptonshire, two sites in Scotland and independently at one site in Norfolk (Haggett, 2002). Research has found it feeding on mainly *U. dioica*, *M. perennis* and *P. elatior*. The NBAP suggests *Stellaria media* Chickweed, *Rumex* spp. Dock, and *Plantago lanceolata* Ribwort plantain as possible larval food plants but no larvae have been observed on any of these plants even though they were present at many of the sites. Also suggested were more woody species such as *Betula* spp. Birches, *Salix caprea* Sallow, *Rubus fruticosus* agg. and these may well be used along with *Ulmus* spp. and other trees species for egg-laying habitats and food for early larval stages. However from at least January larvae feed on the range of ground vegetation identified in this study.

While Haggett (2002) found ‘one feeding at the tip of freshly sprouted *Holcus lanatus*’ (1st Feb.) and feeding on *U. dioica* (17th March). No larvae have been observed feeding or even climbing on any grass during this research. Larvae have been observed climbing up the dead stems of the previous years *U. dioica* to feed on new growth of *U. dioica*. Larvae were observed feeding from early January until the 12th April in various locations both on ride and woodland edges and within open woodland.

The adult was found in Cambridgeshire to be numerous at several sites where it had not been recently recorded. Observations of adult behaviour have commenced but more work is still required on egg-laying. Egg-laying on *U. minor* was a new finding and needs further work to confirm. There were several records of nectaring on *A. minus* and even though various accounts claim to have observed it in the past, all the *A. minus* plants seemed to have gone

over by early August and *D. fullonum* was the most common plant on which the adults were seen nectaring. It could be that early nectaring is on *A. minus*, while later they move on to *D. fullonum*.

Haggett (2002) recorded adults in Thetford forest on the 7th (seven) and 8th (11) of July 2001. This is very early and may be due to soil conditions in that area. Most records in our study and the national database indicating a late July start for the flight period. The peak period seems to be between the 6th and 21st August, with adults recorded up to the end of the month.

The NBAP suggests that the cessation of coppicing and neglect of woodland management may be factors in the decline of this moth. It is classed as Nationally Scarce as it has been lost from the west of England including Hampshire, Dorset, Devon and Cornwall. In Cambridgeshire it is not exclusively found in ancient woodland. In fact several of the better sites are modern plantations, some obviously planted on sites which have not been woodland for many years. These sites are often small or are narrow shelterbelts with an open woodland canopy. Where the moth was recorded in ancient woodland such as Overhall Grove, the surrounding secondary woodland and plantations were also found to hold populations. The moth thus must have powers of dispersal up to at least one kilometre as records from both Fulbourn, and Dry Drayton also suggest.

Two sites where the moth has been recorded had species rich hedgerows nearby. The hedge bottoms had suitable larval food plants but no larvae were found even though at RSPB Grange Farm other small plantations in the area were found to hold the larvae. It is likely that the hedgerows are too open a habitat for the moths.

In Scotland the larvae was found in slightly more open areas of woodland on south or west facing steep slopes. As many small areas of broadleaved woodland match this description and with a wide range of larval food plants used, many of which are to be found in these areas, there could be large amounts of suitable habitat available. Due to the remoteness of many of these sites and the lack of recorders in many of these areas only a large scale research project can answer whether the moth is more widespread than is presently thought.

6.0 Conclusions

The moth has two strong holds in Cambridgeshire. One is in the south between Cambridge and St Neots, and this spreads over the borders into the surrounding counties of Essex, Hertfordshire and Suffolk. Most woods in this area have been found to have populations of the moth and many which have not been searched for larvae or light trapped for adults could also hold such populations. There is then a gap as there are few woodlands between Cambridge and Huntingdon and no more records except from the north western corner of Cambridgeshire and north Northamptonshire. Here to the west of Peterborough are another set of woodlands with recent records of both adults and larvae. It is quite possible that many of the other woodlands in the area and in neighbouring areas of Northamptonshire and Lincolnshire may also hold populations.

No suggestion can be put forward as to whether the populations are in decline in these areas as prior to the commencement of this study only two or three recent records were available. There was no routine monitoring of these sites and without this research little current information would be available. However several of these sites could be under threat from future housing and road developments as the Government sees Cambridgeshire and the M11/A1 corridor as prime development areas.

In a separate study larvae of the moth were found at two sites (near Kyle and Arduaine) in the west of Scotland in 2004 and adults were light trapped at two sites (near Kyle and Taynish), thus removing fears of it's survival in Scotland. There is a vast amount of possible habitat which has never been investigated on the west coast and inland along the Great Glen and near Kinguisse. This means that the moth could be far more widespread than previously thought or it could just be found in two or three areas now.

7.0 Acknowledgements

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