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Autecology and conservation of *Callicera spinolae* the golden hoverfly (Diptera, Syrphidae)

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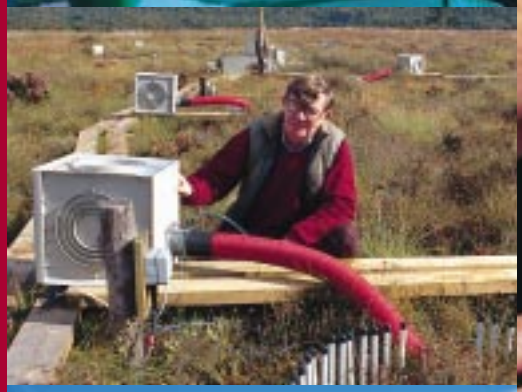

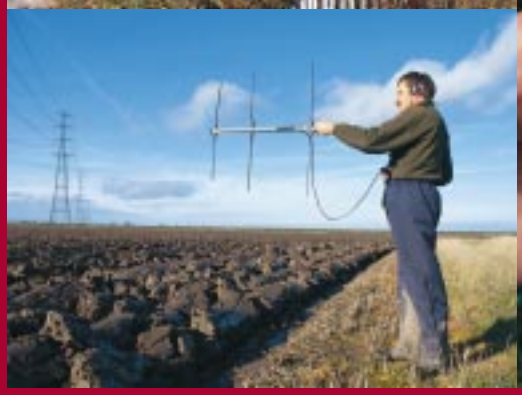

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Autecology and conservation of *Callicera spinolae* the golden hoverfly (Diptera, Syrphidae)

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Summary

1. The published Biodiversity Action Plan calls for basic research to formulate management advice for the Golden Hoverfly *Callicera spinolae* (Diptera, Syrphidae). This report gives the results of an investigation into the status, ecology and breeding biology of *C. spinolae* to provide such management advice.

2. To locate historical sites and analyse UK distribution, literature and museum collections were searched to provide data of records and captures of *C. spinolae*. Among British hoverflies, these confirmed a unique pattern of distribution and adult flight period: *C. spinolae* is confined to East Anglia and flies in September and October.

3. Previous records and captures show that it was first recorded in 1924 from Suffolk and up to 1997, was only known from 8 localities in Suffolk, Norfolk and Cambridgeshire.

4. Previous UK records and captures revealed that adults were most often observed feeding on ivy flowers, *Hedra helix* L. and larvae were found in tree holes of beech, *Fagus*. The only other rearing records are from France and Russia where larvae were found in tree holes in beech and poplar *Populus spp*. respectively.

5. Based on these adult and larval features, all 8 historical localities and 34 other East Anglian woodland and parkland localities were visited during the period 1997-2003 and adults searched for at ivy flowers and larvae searched for in tree holes. Altogether 439 tree holes and 168 patches of ivy flowers were investigated.

6. The results revealed that *C. spinolae* is very restricted both in numbers and distribution. Only eight adults were observed at three localities: six at Thornham Walks, nr Diss, Suffolk (TM 1071), one at Syleham Church, nr Diss, Norfolk (TM 2078) and one at Wimpole Hall, near Royston, Cambridgeshire (TL 3350/1). Two breeding populations were discovered: one at Thornham Walks and one at Wimpole Hall. No evidence of *C. spinolae* was found at any historical site.

7. From these results a detailed survey of tree holes and ivy patches was carried out at Thornham to investigate and assess the potential for the locality to maintain a breeding population and to determine the distribution of the *C. spinolae* population. In addition, surrounding woodland sites were similarly assessed for their potential to maintain breeding populations should natural or managed dispersal occur outwith Thornham. The results showed that both tree holes and ivy flowers were plentiful throughout Thornham Walks but the *C. spinolae* population appeared to be centred on woodland blocks surrounding the walled garden and the nearby Church. In this part of the locality, larvae were found in tree holes on ash, *Fraxinus*, and field maple, *Acer*.

8. Of 8 woodland localities surrounding Thornham, only one, East Harling Heath (TL 9884) appeared to have both ivy and tree holes in suitable condition to support *C. spinolae*. However, the area of tree holes and ivy is small in relation to other localities that have supported breeding populations. However, small, isolated breeding populations might exist in patches of woodland scattered along the banks of

the river Waveney which is only 5-6 miles to the north but this potential was only partially investigated during this project. Nonetheless the discovery of an adult at Syleham Church which borders the river and an historical record from woodland at Brandeston Marshes which borders the river Deben further to the south-east (TM 24/2559) lends support to this possibility. Furthermore, along these riverbanks plantations of mature poplars are frequent, tree holes of which are known to support breeding.

9. The Biodiversity Action Plan for *C. spinolae* suggested the use of artificial breeding media as a means to restore and boost abundance of *C. spinolae* following the discovery that both other British *Callicera* species are able to breed in artificial containers.

10. In August 2001, 20 plastic bottles filled with wet decaying sapwood and heartwood taken from fallen beech branches in Scotland were placed in woodland blocks surrounding the walled garden at Thornham. Bottles were left in situ throughout September and were collected in early October. Three larvae of *C. spinolae* were obtained, one in each of three of the 20 bottles. These larvae were maintained in culture and in August 2003, two females emerged and one larva died. These results show that *C. spinolae* will breed under artificial conditions and that artificial breeding sites can be used to investigate, boost and maintain populations.

11. Additional localities for *C. spinolae* were discovered during 2001. These were Hylands Park, near Chelmsford, Essex (TL 6804) by Mike Hanson; and Fowlmere RSPB Nature Reserve (TL 4044/5) by Colin Plant. In addition, Alan Stubbs reported a possible sighting in 2000 at Hatfield Forest, Essex (TL 5319/20, 5420). In 2002 all these sites were visited and tree holes and ivy patches investigated for evidence of *C. spinolae*. In September 2003 further searches were made at Fowlmere and more particularly at Hylands Park which is similar to Wimpole and Thornham in being a parkland with woodland blocks and mature trees. However no further evidence of *C. spinolae* was obtained from these sites.

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1. Introduction

Callicera spinolae is a little understood, possibly endangered hoverfly (Diptera, Syrphidae). It is saproxylic and breeds in tree holes. It is one of the largest and most colourful of British hoverflies and is referred to as the "Golden Hoverfly" on this account.

Among hoverflies, *C. spinolae* has a unique distribution in the British Isles being the only species apparently confined to East Anglia and bordering counties. It was first recorded in 1924 from Thorndon in Suffolk. Since then it has only been recorded from a handful of sites in Essex, Suffolk, Norfolk, Cambridgeshire and Hertfordshire. It is considered very rare in other parts of its range. Another unique feature of the biology of this species is the timing of the adult flight period which occurs late in the year, in September and early October.

Callicera spinolae is a Biodiversity Action Plan species and the published BAP calls for basic research in order to formulate management advice. This report summarises the results of six years research (1997-2003, excluding 2000 due to the fuel crisis) designed to deliver basic data on the status, ecology and breeding biology of *Callicera spinolae* that would inform management advice. The latter three years, 2001-2003, are covered specifically by English Nature Contract No. FIN/CON/111. In each year, most of the fieldwork took place in September during the flight period. The emphasis during the early years' was on locating breeding populations on which to base further work. Having located populations, the emphasis in the latter years was on testing the use of artificial breeding sites as a means to restore, maintain and investigate extant populations.

2. Methods

2.1 Investigating status: site selection

Literature and museum collections (National Museums of Scotland, Edinburgh; Natural History Museum, London; Hope Entomological Collection, Oxford and the University Museum, Cambridge) were searched to locate historical records and captures that would inform field visits of sites where *C. spinolae* was known previously. From these data each historical site was visited and searched for *C. spinolae* using the methodologies described below under, "recording adults and larvae". Additional sites in East Anglia were located by reference to OS maps, files and reports maintained by English Nature and local knowledge from naturalists and EN staff resident in East Anglia. Names of sites, roads, villages and woodlands are taken from the appropriate OS Maps Landranger series.

2.2 Recording adults and larvae

A twin approach was taken to investigate status based on the discovery that both larval and adult stages are found in particular places: tree holes for larvae and ivy flowers for adults. In common with other saproxylic hoverflies, *Callicera spinolae* is as easy or easier to record in the larval and pupal stages as the adult stage (Rotheray and MacGowan, 1990; Rotheray, 1993). This is because early stages are restricted to tree-holes, which are relatively easy to locate and search. Unlike adults of many saproxylic hoverflies which are elusive and rarely seen, those of *C. spinolae* are not like this. Both males and females feed on pollen and nectar and during September the most abundant flowers rich in these resources are ivy flowers

Hedra helix L. Most previous adult records come from these flowers. Thus searching ivy flowers is a convenient method of recording adults.

Each site visited was treated in a similar way. The area was walked over and mature trees located. Each mature tree, whether live, dead-standing or fallen was examined for tree holes. Tree holes above head height were reached by climbing into the tree with the aid of a small ladder. Some tree holes, however, were too high to reach. Each hole was first examined with a torch to see if puparia were present because old puparia often lie on top of material in the hole or are stuck round its interior. Puparia located by torchlight were identified in situ using a hand lens where necessary. Almost all saproxylic hoverfly puparia, including *C. spinolae*, are easy to recognise in the field with a hand lens. *Callicera* larva are recognised by the prolegs which are fused medially (separate in all other syrphid larvae with prolegs). *C. spinolae* is recognised from other British *Callicera* by the fluted posterior breathing tube (Rotheray and Perry 1994).

Following a search for puparia, the contents of the hole were searched for larvae. Handfuls of material were placed on a sheet of plastic and carefully searched until the bottom of the hole had been reached or as much material had been removed as possible. Often the decay went into the tree further than could be reached or, the diameter of the hole was too small for extracting all the material. In small holes a stick or a spoon attached to a piece of copper piping was used to stir the contents of the hole. Stirring up the hole brings larvae to the surface. Larvae were identified in situ using a hand lens where necessary. Care was particularly taken to locate small first and second stage larvae which are much less conspicuous than the larger third stage. In all cases larvae and puparia were replaced along with the contents of the hole.

2.3 Artificial breeding sites

Artificial breeding sites were made from 2 litre plastic milk bottles, approximately 28 x 11 cms. Each bottle was cleaned with tap water and left to dry. Where necessary cleaning was repeated until no scent of milk remained. The top 8 cms of the bottle was then removed to create an opening approximately 6 cms in diameter. This opening was the main source of access for female hoverflies attracted to the odours from the decaying medium within the bottle. Below this opening, five 0.5 cm diameter drainage holes were made equidistantly round the bottle. These holes were required to prevent bottles flooding during heavy rain. The number of each of 20 bottles was written in indelible ink on the base and sides. Each bottle could hold between 1.25 and 1.5 litres of wet decaying breeding medium. This amount was necessary since previous experience with artificial breeding sites revealed that bottles can dry out rapidly. Except for the openings, each bottle was covered in two layers of black plastic sheeting to ensure dark conditions inside.

Wet decaying heartwood was prepared in the following way. In March 2001 several small (about 7 cm diameter) fallen beech tree branches (*Fagus sylvatica*) were collected at Newbattle Wood, Midlothian, a site well outside the known range of the *C. spinolae*. Only beech tree branches were used as tree-holes in beech are a known breeding site for the *C. spinolae* (Rotheray and Perry 1994). Branches were taken only if the heartwood had decayed to the point where it was soft and friable. The bark was removed and the wood pulped by hand with water from the nearby River Esk. Insect larvae and other invertebrates were removed. The wet wood was stored in 3 buckets and each bucket "seeded" with about 500 mls of wet decaying heartwood taken from tree-holes in beech trees. Many tree-holes in

beech exist at Newbattle but care was taken to remove only a small amount of material from each hole and to replace insect larvae found in searches of the extracted material prior to being added to the buckets. The aim was to add bacteria and other microbes within the extracted material to promote decay in the buckets since it is odours from the decay that probably attracts gravid *C. spinolae* females to oviposit and bacteria are the main source of food for the larvae.

Each bucket was covered and stored in dark conditions at room temperature until August, about 5 months. Approximately every 4 weeks the contents were stirred and river water added to maintain wet conditions. At the end of this period the material had a distinctive "woody-decay" odour and was the consistency of porridge.

The buckets and the 20 modified plastic bottles were taken to Thornham Walks on 25 August 2001. Over two days they were placed out in the field. The area selected for placing the bottles was the area of woodland to the east and west of the Walled Garden. This area was where adults and larvae of the *C. spinolae* had been discovered previously.

In this area of woodland there are trees of various sizes from young saplings to large mature to overmature individuals. Almost all the bottles were placed on mature to overmature trees between 3-8 metres above ground. Bottles were placed in the forks of branches in shaded positions and were completely out of sight from ground level. This was a precaution to prevent vandalism as the site has open public access. Each bottle was about two thirds-filled with wet decaying material from the buckets. Dried leaves and small pieces of bark were placed on top of the wet material to close to the top of the bottle. Leaves and bark help prevent drying out of the contents and provide oviposition points for females. Where necessary, bottles were tied firmly into position with green string. The positions of each numbered bottle were noted on a map to aid subsequent collection and analysis of the results.

The bottles were left in situ until 6 October 2001 i.e. more than the predicted duration of the adult flight period (September). After this period, lasting about 40 days, they were collected and returned to Edinburgh. The contents of bottles were examined for moisture levels and river water added as necessary. They were covered with gauze and placed in cool, dark conditions. The contents were not searched until July 2002 to allow sufficient time for any larvae to have grown beyond the inconspicuous and vulnerable first instar stage.

Searching was carried out on plastic sheets and larvae identified with a hand lens. Larvae selected for onward rearing were returned to their bottles and larvae checked every two months or so. Rainwater was added as necessary. Puparia were placed on moist tissue paper in clear, plastic boxes approximately 25 x 20 x 8 cm until adults emerged. Adults were kept in these boxes until they died naturally and they were then pinned. Adults were deposited in the collections of the National Museums of Scotland.

3. Results

3.1 Investigating status: site selection

Data from literature searches and specimens in museums showed that only eight localities existed for *C. spinolae* (Table 1). The species was first recorded from Thorndon, Suffolk on 26 September 1924. A trend in the historical records is a gradual westwards movement over time (Table 1).

Table 1. Summary of data from published records of *C. spinolae* in Britain

Site	Date	Collector	Reference
Thorndon, Suffolk	26.ix.1924	HA Harris	Irwin (1975)
Southwold, Suffolk	01.x.1928	JW Bowhill	Hammond (1973)
Brandeston, Suffolk	10.ix.1942	C. Morley	Hammond (1973)
Monks Soham, Suffolk	??.x.1947	C. Morley	Hammond (1973)
Iken, Suffolk	1940s	C. Morley	Falk, (1991)
Houghton Hall, Norfolk	19.ix.1972	C. Hammond	Hammond (1973)
Houghton Hall, Norfolk	?.?.1974	C. Hammond	Hammond (1973)
Lode, Cambridgeshire	19.ix 1971	I. Perry	Perry (1974)
Lode, Cambridgeshire	08.ix 1973	I. Perry	Perry (1974)
Lode, Cambridgeshire	22.ix 1973	I. Perry	Perry (1974)
Wandlebury, Cambridgeshire	1979-1993	I. Perry	Falk (1991); Rotheray & Perry (1994)

3.2 Recording adults and larvae

All historical sites were visited (Table 1) but no evidence of *C. spinolae* was found in any of them. Up to 2001, survey results revealed that only at Thornham Walks, near Diss, Norfolk (TM 1071) did a breeding population exist. Previously a breeding site occurred at Wandlebury, near Cambridge (TL 4953) where adults were recorded consistently during the period 1988-1994. Since that time, no sightings of adults or early stages have occurred at Wandlebury. However in 2001, three new sites for the *C. spinolae* were discovered: a breeding population was discovered at Wimpole Hall, near Royston, Cambridgeshire (TL 3350/1) by the Warden at the Hall and Ivan Perry and confirmed by GER and Ivan Perry in 2002; adults on ivy flowers were seen at Hylands Park, near Chelmsford, Essex (TL 6804) by Mike Hanson; and an adult observed at Fowlmere RSPB Nature Reserve (TL 4044/5) by Colin Plant. In addition, a possible sighting of an adult occurred at Hatfield Forest, Essex (TL 5319/20, 5420) in 2000 by Alan Stubbs.

All these sites were visited in 2002 but no evidence of *C. spinolae* was obtained except for Wimpole where a gravid female was seen inspecting and possibly ovipositing on the rim of a tree hole on horse chestnut. In 2003 both Hylands Park and Fowlmere were visited for three and two days respectively but no adults or larvae were found. Over 30 additional sites were visited during the course of this project, details in Appendix 1. Altogether over 400 tree holes and over 150 patches of ivy flowers were investigated during 55+ site visits. Approximately 39 days were spent on fieldwork from 1997 to 2003.

3.3 Artificial breeding sites

Over 80 syrphid larvae were found in the 20 bottles. Three larvae of *C. spinolae* were found. The rest belonged to the common syrphid species, *Myathropa florea*. All three larvae pupated in June-August 2003. Two adult females emerged in September 2003. The third puparium died.

3.4 Discussion

C. spinolae does not appear to occur at any of its previous historical localities (Table 1). It was not even present at its most recent localities like Houghton Hall and Wandlebury. At Wandlebury a breeding population existed up to 1993 when a larva was discovered in the tree hole in a mature beech tree (Rotheray and Perry 1994). It is possible that populations do exist at Houghton Hall and Wandlebury but in such low numbers that the level of sampling applied could not locate them and greater efforts could be made to locate such low numbers by, for example, using artificial breeding sites. Alternatively populations at these sites may have become extinct or they may have been abandoned by dispersal.

Analysis of historical records (Table 1) suggests that *C. spinolae* has moved westwards. Within this apparent trend, we are fortunate, in one sense, to have witnessed something of this process. In the 1980's the species was recorded at Lode. It disappeared from this site and turned up a few years later several miles to the south-west at Wandlebury. Here a breeding population existed but by 1994 it had disappeared once again. A few years later the species appeared at Wimpole, Fowlmere and at Hylands, all sites to the west of Wandlebury and at Wimpole in 2000, evidence of breeding was established. Thus it appears that *C. spinolae* regularly abandons localities without leaving resident populations behind.

It is difficult to know, as pointed out above, whether populations at former localities have gone extinct or are just reduced to such low levels as to make their detection difficult. This is important because it may be possible to restore such small, reduced populations. When Houghton Hall and Wandlebury were visited during the course of this project, both had suitable quantities of tree holes and ivy flowers and there did not seem to be any obvious reason why populations should be absent.

A breeding population exists at Thornham just west of a locality where the species was first recorded in Britain in 1924. It seems unlikely that this population is the result of continuous occupation since the 1920s but owes its origin to a more recent colonisation. Woodlands bordering East Anglian rivers may be important in this respect. Small, isolated breeding populations might exist in patches of woodland scattered along the banks of the river Waveney which is only 5-6 miles to the north of Thornham and from where the species may have dispersed. The discovery of an adult at Syleham Church which borders the river and an historical record from woodland at Brandeston Marshes which borders the river Deben further to the south-east lends support to this possibility. Furthermore, along these riverbanks plantations of mature poplars are frequent, tree holes of which are known to support breeding. Further searches for *C. spinolae* in woodlands bordering East Anglian rivers is recommended.

If westwards dispersal from the current breeding populations occurs, *C. spinolae* will soon reach London. Whether enough suitable habitat exists here is doubtful and the presence of this species in Britain may be difficult to maintain. It may possibly depend on the fate of the Thornham population which being further to the north, may disperse westwards into the

Eastern Midlands and "miss" London. Whether suitable woodland/parklands localities exist in the Eastern Midlands has not been investigated. Alternatively in the absence of suitable sites to the west, *C. spinolae* may either become extinct or, more hopefully, find suitable localities in other directions. Preparing woodlands near to Thornham by ensuring suitable quantities of tree holes and ivy are present to attract and retain *C. spinolae* is recommended to cover such eventualities. Intervention by translocation of larvae in artificial breeding sites from extant breeding populations to former localities offering protection such as Wandlebury, is another more extreme way to overcome extinction. But more knowledge is required of population dynamics in *C. spinolae* so that source populations are not harmed by a reduction in numbers caused by translocation.

The range of tree species used for breeding by *C. spinolae* is greater than previous records suggest. Previous rearing records are from Russia where larvae were found in poplar tree holes (Zimina, 1986) and from tree holes in beech, *Fagus*, in Britain (Rotheray and Perry, 1994) and France (C. Dussaix, pers. comm.). At Thornham larvae were additionally found in ash and field maple. This suggests that *C. spinolae* is capable of breeding in a range of tree species though perhaps not in conifers. From the size and location of tree holes containing larvae, tree holes can be small or large and occur low down or high in the canopy. The common feature they share is containing wet, decaying wood as opposed to bark-lined water pockets. Water pockets are a different type of cavity to tree holes. They often occur between branches and being bark-lined, contain a compost of decaying leaves and woodland debris rather than decaying sapwood and heartwood. Water pockets were searched during the project but no larvae were found. They do not seem to be used for breeding by *C. spinolae*.

The artificial breeding test was a success in that three larvae were found in three separate bottles from which two adults were obtained. However it is not known whether these larvae resulted from one female visiting three bottles or if multiple oviposition occurred. Furthermore, it is unknown whether more eggs were oviposited but that only three larvae survived. Providing answers to such questions would be almost impossible as eggs and first stage larvae would be extremely difficult to find, even within the confines of the bottles and currently, no way exists to distinguish *C. spinolae* eggs from those of other species such as the very abundant, *Myathropa florea*. First stage larvae, however, would be easy to separate from this species in that those of the *C. spinolae* have black hooks on the thorax whereas *Myathropa florea* lacks hooks.

Another difficult question is whether the "quality" of such artificially-reared individuals falls within the range of natural populations i.e. that they are as robust as wild individuals being just as fecund and able to compete for food and mates etc. It was not feasible to attempt answering such questions during the course of this project. However, having demonstrated the success of the technique and assuming such considerations are more theoretical than real, the question remains of how best to utilise artificial breeding sites. The most obvious ways the technique could be used are to boost the number of breeding sites available at particular localities and to use it to test for the presence of a breeding population at localities where low populations might exist as suggested above.

Looking beyond this and building from such a foundation, work could be undertaken to investigate and quantify the circumstances under which abandonment of a locality takes place. Difficult though that may be, understanding abandonment is the key to managing restoration and recovery of this hoverfly.

We might prevent abandonment of a particular locality by for example, ensuring that the conditions favouring it are never reached. The most likely factor here is managing population densities because dispersal is probably initiated by extremely high or extremely low frequencies of contact between adults. Extremes of density might be prevented by translocating larvae in and out of localities aiming to create dynamic balances between sites. For instance, we might consider building numbers back up at Wandlebury with larvae translocated from Wimpole and Hylands at a time we estimate that numbers at these latter sites appear to be approaching levels that will trigger abandonment and vice versa. If we reach a time when populations at all these sites are high we have the choice of simply monitoring abandonment and seeing what happens or managing the process and translocating larvae to colonise fresh sites and so on.

4. Conclusions and recommendations

Based on these results and findings the following conclusions and recommendations for management and future work on *C. spinolae* are made.

Since the species was first discovered in the UK on the Suffolk coast in 1924, analysis of historical records suggest a pattern of dispersal in the general direction of east to west. A feature of this movement seems to be that previously occupied sites are abandoned, or populations reduced to such low levels that the amount of sampling effort applied is unable to detect them.

The unique distribution and dispersal pattern of *C. spinolae* in Britain is consistent with the idea that it originated via chance dispersal from continental Europe sometime around 1920. The alternative possibility, that it is a long established native species that has suffered extinction except in East Anglia, cannot be ruled out but is not congruent with other British saproxylic hoverflies. This consideration does not, however, alter its status within the UK BAP process.

C. spinolae breeds in tree holes of a range of species including *Acer*, *Fagus*, *Fraxinus* and *Populus* and is probably capable of accepting a wider range of tree species than these records suggest. However, it is unlikely to occur in coniferous tree holes. From the size and location of tree holes containing larvae, tree holes can be small or large and occur low down or high in the canopy. The common feature they share is containing wet, decaying wood as opposed to bark-lined water pockets. Water pockets are a different type of cavity to tree holes. They often occur between branches and being bark-lined, contain a compost of decaying leaves and woodland debris rather than decaying sapwood and heartwood. Water pockets were searched during the project but no larvae were found. They do not seem to be used for breeding by *C. spinolae*.

Both male and female *C. spinolae* are frequently located feeding at ivy flowers, one of the most abundant sources of pollen and nectar during the September-October flight period. They may be found at any time during daylight and seem to prefer dry, sunny, windless conditions.

Currently, *C. spinolae* appears to exist in only two UK breeding populations, at Thornham in Suffolk and at Wimpole Hall in Cambridgeshire. Breeding populations may also exist at Hylands Park in Essex and in woodland bordering the river Waveney along the

Norfolk/Suffolk border. Future work could be undertaken to confirm these latter possibilities.

It is unclear how long breeding will continue at Thornham and Wimpole before these localities are abandoned. Nothing is understood of the conditions or circumstances triggering abandonment. From studies of other insects, a likely influence is very high or very low population density which affects intraspecific contacts between adults and at either extreme, may elicit dispersal. Obtaining an understanding of population density and its affect on dispersal in *C. spinolae* would be challenging and difficult. In the absence of such detail, formulating management prescriptions for *C. spinolae* that will ensure long term residence is not easy. At the very least, annual monitoring of tree holes and ivy patches should be undertaken to test for the continued presence of breeding at the site. Also tree holes and ivy patches should be protected from harm.

More positive actions can be undertaken in anticipation of abandonment by ensuring that not only at Wimpole and Thornham but also at localities close by, particularly to the east, that suitable numbers exist of tree holes and patches of ivy flowers. If required, artificial breeding sites could be used to boost numbers of tree holes. A further line of enquiry would be to try artificial breeding sites at historical localities that appear to have been abandoned to check if residual populations can be located.

The breeding population at Wimpole may have only become established recently, during the last five years. The species was known for 14 years, from 1979-1993, at a previous breeding stronghold, Wandlebury near Cambridge (TL 4953) which is nearby and a few miles to the east. Tree holes containing wet decaying wood and extensive patches of ivy flowers existed at Wandlebury before, during and after the period *C. spinolae* occurred there and no clue exists as to what caused abandonment.

The origin of the population at Thornham is unknown. The nearest historical record is from Thorndon which lies a few miles to the east. But the date of the record from Thorndon is 1924. Whether a breeding population at Thornham has existed continuously from the 1920s to the present day or whether it originated from a more recent colonisation is unknown. Based on the example of Wandlebury, populations at Thornham and Wimpole may continue for up to 10 more years assuming suitable levels of tree holes and ivy are maintained.

A common feature of localities supporting breeding populations is that they occur in parklands containing areas of mature woodland and plentiful ivy. Records of adults outside this type of habitat, such as at Fowlmere and Royston, may represent individuals in the process of dispersal following abandonment.

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Appendix 1. Sites visited 1997-2003

1. Bottisham Hall, nr Swaffham Bulbeck, Cambridgeshire (TL54/5561)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This site consists of parkland and surrounding farmland with small amounts of mixed woodland, which includes poplars, around the hall and between the fields. Mature beech and lime are scattered throughout the sheep-grazed area of the park. The site was visited on 24 August. A good number of tree holes in apparently suitable condition were present throughout the site.

Potential for *C. spinolae*

From the number of mature trees and tree holes there appears to be no reason why *C. spinolae* should not be able to survive at the site. Ivy is present, particularly around the hall. Given the proximity of Wandlebury, the most recent site for *C. spinolae*, Bottisham must be considered a candidate for further searching.

2. Brandeston Marshes, nr Framlingham, Suffolk (TM24/2559)

Previous records

C. spinolae was recorded from this site in 1942 by C. Morley (Coe, 1943).

1997 Survey

Two areas of mixed, damp woodland exist along the banks of the river Deben south of Brandeston. The site was visited on 25 August. Poplars, willow, alders and a small amount of beech were present within an understorey of dense herbacious vegetation. Tree holes were infrequent and were present in beech and poplar trees.

Potential for *C. spinolae*

Given the small size of the existing woodland, this site might be considered unlikely to continue to support a population of *C. spinolae*. However variously aged poplar plantations are in the vicinity and more natural tree growth occurs along the river Deben towards Wickham Market and particularly near Glevering Hall (TM2957). In future surveys this more extensive area is worth visiting for tree holes.

3. Buckingham Tofts, nr Mundford, Norfolk (TL83/8495)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This is a large site based round a hall and park with numerous, isolated, small to quite extensive areas of woodland between which are areas of grassland. The site is an army training ground and undischarged shells are a frequent hazard. The site was visited on 20 August. Large numbers of semi-mature and mature beech, sycamore, sweet chestnut, lime and pine occur at the site. The areas searched included those between the hall and Bunkershill Plantation to the north.

Tree holes in apparently suitable condition were common throughout the wooded areas. In many tree holes empty and undischarged munitions were found along with stones and paper rubbish such as empty crisp and cigarette packets.

Potential for *C. spinolae*

To judge from the number of apparently suitable tree holes, *C. spinolae* should be able to breed at the site. Despite the munitions and rubbish within many tree holes other insect larvae such as the syrphid, *Myathropa florea*, the RDB 3 muscid, *Phaonia exoleta* and its prey, mosquito larvae were found. Ivy was only present in a few restricted areas where dark damp conditions occurred in the woods round the hall.

4. Felbrigg Hall, nr Cromer, Norfolk (TG1940)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

There is an area of woodland to the north between the hall and the A148 Kings Lynn to Cromer road. It is a mixed wood with large amounts of mature and overmature beech, oak and chestnut and some areas of coniferous woodland. The main concentration of overmature beech are directly behind the hall and to the west along the Lions Mouth slip-road. Many of these beeches appear to have been pollarded in the past. Tree holes were abundant at the site, particularly in the beeches. The site was visited on 21 & 22 August.

The area has numerous paths and rides for ease of access and the wood is under active management by the National Trust. Some areas of woodland have been felled with old trees and standards left in situ. Other areas appear to be less intensively managed and large fallen beech have been left undisturbed.

Potential for *C. spinolae*

Although *C. spinolae* has not been recorded from this site, good numbers of tree holes in suitable condition exist at the site. They are particularly abundant near the back of the hall and by the Lions Mouth. The amount of vertically growing ivy suitable for flower production and thereby, providing food for adult *C. spinolae* was not great. Alternative sources of pollen and nectar require investigation. In terms of breeding sites there appears to be no reason why *C. spinolae* should not survive at the site, however, adult sources of food may be a limitation.

5. Foxley Wood, nr Reepham, Norfolk (TG0522)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This is an old oak wood, currently being restored by the Norfolk Wildlife Trust. The site was visited on 17 August. The largest trees were oak, but few wet tree holes were found.

Potential for *C. spinolae*

Given the lack of previous records and suitable tree holes it is unlikely that this site could support *C. spinolae* for at least ten years.

6. Holt Country Park, nr Holt, Norfolk (TG0837)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

The site is managed by the North Norfolk District Council. It is primarily a conifer woodland with areas of open heathland and fringes of mixed woodland including beech and birch. The site was visited on 19 August. Most of the beech is in the Edgefield Wood at the south end of the site where a few tree holes were located.

Potential for *C. spinolae*

Given the lack of previous records and suitable tree holes it is unlikely that this site could support a population of *C. spinolae.*

7. Houghton Hall, nr. East Rudham, Norfolk (TF1728)

Previous records

Callicera spinolae was recorded here by on 19.ix.1972 (Hammond, 1973). Falk (1991) states that it was also recorded in 1974, probably based on capture dates of specimens examined in Hammond's collection. Apparently, no other records exist for this site.

1997 survey

The site was visited on 19 August 1997. Within the deer park is a large area of mature trees growing in avenues running in various directions from the hall. Tree species composition was varied but mostly consisted of sweet and horse chestnut, oak, beech, lime and sycamore. To the south and west of the estate, outside the deer park, were areas of woodland. A mix of species was again present including conifers and poplars. Of these wooded areas, Old Bottom, the Blackground and the Mayflower had the largest numbers of mature deciduous trees, including beech.

Good numbers of tree holes were present in oak, beech, horse chestnut and sycamore. Within the deer park trees with blown out tops were common and decay was deep and extensive. A number of tree holes were impossible to search thoroughly because they were too small, too deep or too high.

Potential for *C. spinolae*

There appears to be no reason why *C. spinolae* should not continue be present here as it was in the 1970s. The quality and quantity of trees with tree holes is good and even in the dry summer of 1997, plenty of tree holes with wet conditions were found. The number of trees with tree holes would be greater if fallen and dead standing trees were left in situ. However fallen timber and dead trees are removed from the park and surrounding woods. The impact of this will require monitoring if *C. spinolae* is ever re-discovered at this site.

8. Ickworth Park, nr Bury St Edmunds, Suffolk (TL6181)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This site is managed by the National Trust. It has a large area consisting of a mix of parkland and surrounding woodland. The site was visited on 30 August. A large number of mature beech, oak, ash, lime and horse chestnut exist at the site. Tree holes were relatively frequent.

Potential for *C. spinolae*

Given the large number of trees and tree holes the site should be able to support a population of *C. spinolae*.

9. Iken, nr Aldeburgh, Suffolk (TM4155)

Previous records

C. spinolae was apparently recorded from the site in the late 1940s (Falk, 1991).

1997 Survey

The site was visited on 26 August. Isolated woodlands exist in the area round Iken, but all of these were in the middle of fields where permission for access was not obtained. Poplars in hedgerows and in plantations were also present. A few tree holes were located at Sudbourne Great Wood (TM4153/54) which is an oak wood is to the south.

Potential for *C. spinolae*

The relative lack of trees and tree holes make it unlikely that *C. spinolae* still exists at this site.

10. Monks Soham, nr Debenham, Suffolk (TM2165)

Previous records

C. spinolae was recorded from this site by C. Morley in 1947 (Hammond, 1973).

1997 Survey

The area within and around the village was examined. The site was visited on 25 August. Very few mature trees existed. A few poplars were located in hedgerows and a few large trees, mostly horse chestnut, were in the churchyard. Two tree holes were found in these chestnuts.

Potential for *C. spinolae*

The lack of trees and tree holes make it very unlikely that *C. spinolae* could exist at this site.

11. Pampisford Hall, nr Sawston, Cambridgeshire (TL50/5148)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This site is privately owned and managed as a parkland specialising in conifers although a few beeches and limes are also present. Beech and sycamore are also common along an ancient earthwork, the Brent Ditch, and along the wide verges to the A505 Baldock to Great Abington road as it cuts across the northern boundary of the site. The site was visited on 23 August. Very few tree holes were encountered and most were dry.

Potential for *C. spinolae*

According to the Warden at Wandlebury, this site had good quantities of mature beech in the recent past. The number of such beech present at the time of our visit was less than expected and the site is unlikely to be able to support *C. spinolae*. It is worth reporting that the owners of the site were interested in the *C. spinolae* project and expressed a willingness to participate by bringing it to the attention of other landowners in the area and East Anglia generally at meetings of the Country Landowners Association.

12. Santon Downham, nr Thetford, Norfolk (TL 81/8287)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

The site was visited on 18 August and consists of poplars and willows growing along the banks of the Little Ouse river. The area examined included both north and south banks between Santon House (TL829872) in the east to the bend in the river beyond Santon Downham in the west at TL813883. Some of the poplars are in plantations. Despite the artificial nature of plantations and the tall growth form of many poplars, numerous tree holes were found. These were either situated at the point of divergence in trees consisting of two diverging trunks or in areas of exposed sapwood where branches had fallen off or where whole trees had snapped off. In the village of Santon Downham itself there were mature trees along broad road verges including beech and lime. Similar trees were also present at the Forest Walks area near Blood Hill along the nearby A134 to the north of Thetford (TL8487). In both these areas good numbers of wet tree holes were located.

Potential of *C. spinolae*

Once again the number of apparently suitable tree holes was good, suggesting that the site could support a breeding population of *C. spinolae*. Ivy was present at various places, particularly in the wooded, south bank of the Little Ouse river. The presence of tree holes in poplar is encouraging given the apparent breeding record for *C. spinolae* from this species of tree in Russia (Zimina, 1986).

13. Shadwell Park, nr Thetford, Norfolk (TL9383)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This is an area of parkland and woodland in private hands. The site was visited on 20 August. The main area of parkland has a few groups of mature beech trees, mostly close to the road that runs through the site. In these groups of trees a few tree holes were found. However on the south side of the park and round the house itself, are broad fringes of mixed woodland containing lots of mature beech. West of the site on either side of the A1066

Thetford to Diss road are more areas of mixed woodland containing beech. However in all these wooded areas access was limited due to the large number of rearing pens for pheasant. Some fallen and cut timber was noted in these areas. Tree holes were infrequently found and many were small and dry. However due to problems of access, assessment of tree holes was limited.

Potential for *C. spinolae*

At this site the quantity of mature trees and tree holes in suitable condition is encouraging. However, only a small proportion of trees could be searched due to problems of access. Ivy was in the ground flora at various points and vertically growing ivy was scattered throughout the areas searched suggesting that adult food should not be a limiting factor.

14. Shrublands Park, nr Needham Market, Suffolk (TM1252)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

This site consists of a large area of parkland within which are isolated trees and small woodlands. The site was visited on 29 August. Mature oaks, horse and sweet chestnuts and beech were present. Many of these trees were pollarded and many showed evidence of heart-rot. A few tree holes were present in beech and horse chestnut. Ivy was present in some hedgerows.

Potential for *C. spinolae*

The relative lack of tree holes suggests that this is not a suitable site for *C. spinolae*.

15. Sotterly Park, nr Beccles, Norfolk (TM4685)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

The site consists of a mix of parkland and woodland. The site was visited on 27 August. Within the parkland there are a large number of old pollarded oaks. Most of these have extensive heart-rot but lack tree holes. The mixed woodland on the east side of the site, Sotterly Wood, contained poplars, oaks, ash and beech. Tree holes were infreqently found in this wood.

Potential for *C. spinolae*

The quantity of apparently suitable tree holes was rather low given the size of the wood. It is unlikely that *C. spinolae* would occur at the site.

16. Swanton Novers, nr Melton Constable, Norfolk (TG0131)

Previous records

C. spinolae has not been recorded from the site previously.

1997 Survey

Within Swanton Great Wood, the main area visited, is a mixed area consisting of mainly oak. Along the B1110 East Dereham to Holt road as it passes between the wood on the west and Melton Hall on the east are areas of mature beech. Mature beech is also present in and around the village of Swanton Novers. The site was visited on 21 August. Tree holes were infrequent throughout the site. A few small tree holes were located in oaks in Swanton Great Wood and rather more in beech round the village and near the hall. To the south of the wood in Brown's Covert a rot-hole was found containing larvae of the notable syrphid, *Brachypalpus laphriformis*. These larvae resemble *C. spinolae* in also having black sclerotised hooks on the thorax. However the arrangement of the hooks differs between the two species and they are readily separated by this means.

Potential for *C. spinolae*

Given scarcity of tree holes at the site and the fact that *C. spinolae* has not been recorded from tree holes in oak, it is unlikely that *C. spinolae* would occur here. The beech in and round the village and hall offer better prospects and ivy is present. However the areas of beech are not particularly extensive.

17. Thorndon Walks, nr Eye, Suffolk (TM1071)

Previous records

Callicera spinolae was recorded near here by Rev H.A. Harris on 26.ix.1924 (Irwin, 1975). A voucher specimen is extant in Norwich Museum.

1997 Survey

This is an old parkland and wooded area currently managed by The Countryside Warden, Suffolk County Council. The site was visited on 25 August. Within the fenced-off parkland areas where cattle grazing is permitted, a large number of old pollarded oaks exist. The woodlands surrounding the parkland consist of various ages of trees including many old specimens of oak, ash, poplar, beech, horse and sweet chestnut. For ease of access, a system of walks and woodland rides exist throughout the site. Good numbers of tree holes were located within the parkland and woodland, many with wet conditions suitable for syrphid larvae.

Potential for *C. spinolae*

There appears to be no reason why *C. spinolae* should not be present here given the quality and quantity of trees with tree holes and the proximity of a nearby site where *C. spinolae* was previously recorded. The number of trees with tree holes would be greater if fallen and dead standing trees were left in situ. However the policy towards fallen timber and dead trees was

unclear from an inspection of the site except the lack of fallen timber in the parkland and to a lesser extent in the woodland suggest that at least some is removed. The impact of this will require monitoring if *C. spinolae* is ever re-discovered at this site.

18. Wandlebury, nr. Cambridge, Cambridgeshire (TL4953)

Previous records

It is from this site that the most recent records of *C. spinolae* were obtained. It was recorded from the site during the period 1988-1994. It was also recorded breeding here in tree holes in beech in 1992/3 (Rotheray and Perry, 1994).

1997 survey

The site contains good quantities of mature and over-mature beech and relatively large numbers of tree holes. Three years ago the Warden put up bottles containing wet decaying material from tree holes. These are attached at various heights to beech trees. *C. spinolae* has not yet been recorded from these artificial breeding sites (I. Perry, pers. comm.).

Potential for *C. spinolae*

To judge from the number of trees and tree holes there appear to be no reason why *C. spinolae* should not continue at the site. However, the lack of records over the past 2-3 years is troubling. The number of trees and quantity of ivy has declined in the 1990s due to storms and natural turnover, but this seems unlikely to have caused the demise of the population. The species may have dispersed from the site and may not return.

Sites visited 1998

19. Audley End, nr Saffron Walden, Suffolk (TL 52/338)

This extensive parkland is owned and managed by English Heritage. It is surrounded by a red-brick wall, at least on the south and east side of the parkland which borders the town. Patchily distributed throughout the site are mature deciduous trees, particularly along field margins. Some parts of the parkland could not be surveyed directly due to fences blocking off certain areas, although these could be visually inspected.

Many of the larger trees are, fortunately, on the east side of the site between the house and the town where access is via public paths. Many mature trees exist here including beech, lime and oak. Large stumps are also present. A high proportion of trees appear to have been pollarded in the past but only a few tree holes were present in which only *M. florea* was found.

Flowering ivy was fairly well distributed throughout this part of the site. Some of the most extensive areas of flowering ivy were on the east wall and on a line of mature poplars that runs close to and parallel to the wall. Flowering ivy was present on both sides of the wall and growing high into many of the trees. Considerable time was spent observing insects visiting the ivy but no *C. spinolae* appeared.

The lack of tree holes and extensive areas of mature trees and proximity to the town suggest that despite the quantity of ivy present, this site is unlikely to support a population of *C. spinolae*.

However, more generally in the area patches of mature trees were observed either side of the B1383 road between Greater Chesterford to the north of Saffron Walden and Newport in the south. This area is in the river valley of the R. Cam and is low-lying and appears to offer good prospects for *C. spinolae*. Consequently several patches of mostly poplars were visited but no evidence of *C. spinolae* was found.

Despite these negative results, the area does apparently have what is required to support a population of *C. spinolae* and might be considered as a site for artificial release and/or future monitoring.

20. Chippenham Fen, nr Newmarket, Cambridgeshire (TL 6469)

Along the farm tracks, paths and fringes of this wetland site are mature deciduous trees. Apart from plantations of conifers the dominant species are ash and poplar. Also present are a few beech, oak and occasional horse chestnut. Despite the presence of these trees few tree holes were found and only *M. florea* was present. Ivy was also scarce although patches were present in hedgerows leading into the site and was an occasional component of hedgerows around the margin of the nearby parkland.

The relative lack of tree holes and ivy at this site probably means that it is unsuitable for *C. spinolae*. However the parkland itself was only inspected visually from the outside and although mature trees were seen, it is unlikely that this site supports *C. spinolae*.

21. Croxton Park, nr St. Neots, Cambridgeshire (TL2559)

This site consists of open parkland with mixed deciduous woods containing mature trees on the north and south-west sides of the parkland. Oak, poplar, sycamore and a few beech were present. The open area of parkland has mature trees but is heavily grazed by sheep. A church is present in the middle of the parkland and has good amounts of ivy growing on yew and other trees within its grounds and in the bordering wooded hedgerows. Despite spending about 3 hours observing the ivy over two separate visits no *C. spinolae* were seen. A few tree holes were present in trees on the open areas of the park and in the surrounding woods but no evidence of *C. spinolae* was found.

Despite these negative results, the site does apparently have what is required to support a population of C spinolae and it might be given priority as a site for artificial release and/or future monitoring.

22. Hatley Park, nr Biggleswade, Cambridgeshire (TL2750/51)

The parkland is fairly well wooded with mature oak, lime and horse chestnut predominating. Few tree holes or ivy were however present.

Closeby at TL 2850, was East Hatley LNR comprising a disused church and church grounds and adjacent not very mature woodlands. Larger trees were present in hedgerows nearby. The church building was almost completely overgrown with flowering ivy. The largest

amount seen in one place. Many insects were present with hornets and wasps predominating. However *C. spinolae* was not seen. Both parkland and LNR seem unlikely to be able to support a population of *C. spinolae*.

23. Houghton Hall, nr. East Rudham, Norfolk (TF 1728)

1997 Survey

Callicera spinolae was recorded from this site in the 1970s. Results from the 1997 survey revealed that the site was potentially good with tree holes present throughout parkland and woodland areas. However, ivy flowers were relatively scarce, being present in one patch just outside the walled garden and in several patches within the hedgerow forming the southern boundary of the parkland.

1998 Survey

Due to this potential and the fact that the species had been recorded there previously, the site was revisited on 13 September 1998. Most of the time was spent searching ivy flowers along the southern boundary and near the walled garden. Flowers within the walled garden were also searched. No adults were, however, observed.

Tree holes in an accumulated pile of mostly beech fallen and cut branches and tree trunks located at the southern end of the Mayflower woodland were examined. Only larvae of the common hoverfly, *M. florea*, were found.

24. Amer (TF 7329)

Patches of ivy were present at the entrance to the churchyard and at several places within the wooded hedgerows surrounding the grounds of the church. Tree holes were present within the wood adjacent to the south side of the church grounds.

25. Flitham Abbey (TF 7226)

The Parkland associated with the Abbey had large mature oak, beech and lime. Tree holes in sycamore were present in woodland to the west of the churchyard. Around the churchyard were small patches of ivy. Larger patches of ivy were present in the hedgerows bordering the park.

26. Helhoughton Common (TF 8626/7)

This area of woodland largely comprises birch and oak with few mature trees, except in adjacent hedgerows. A few tree holes were found in these trees.

27. Raynham (TF 8725)

Matures trees and patches of ivy occurred in the grounds of the church.

28. West Newton, Sandringham (TF 6927/8)

Small amounts of ivy were found in the church yard. Larger patches were present at the west end of Commodore Wood opposite Sandringham House. Although mature deciduous trees were present in the grounds of Sandringham Estate, their frequency was relatively low and there were many more pines in the woods comprising the estate. Thus the area did not seem particularly favourable for *C. spinolae*.

29. Ickworth Park, nr Bury St. Edmunds, Suffolk (TL6181)

1997 Survey

This site was assessed to be a good prospect for finding *C. spinolae*. Good quantities of mature deciduous trees were present both in the open parkland and surrounding densely wooded areas. Tree holes are present in many of the trees. The topography varies with gentle slopes and wooded areas, buildings and wooded hedgerows which create a mosaic of dense woodland and open parkland. Sheep grazing occurs in the open parkland along with cattle and horses. Fields with various crops are also present intermingled with the woods and parkland areas.

1998 Survey

Ivy was abundant in the churchyard which is beyond the main house towards the River Linnet. It was growing over the surrounding waist-high and up yew and pine trees in the grounds of the church. Although wasps and hornets were abundant, no *C. spinolae* were seen. Flowering ivy was also present in large patches growing over the walls of the walled garden near the ornamental lake which is part of the River Linnet. Despite 2 hours observations here, no *C. spinolae* were seen.

In other parts of the site flowering ivy was found, in and around most of the wooded areas and particularly in the deciduous parts of the woodland and lake near Lady Catherine's Wood at the southern end of the site and in Albana Wood just to the west of Ickworth House.

Although no *C. spinolae* were seen, the site does have a combination of factors comprising mixed areas of mature woodland and open parkland with ivy fairly well distributed throughout to suggest that the area could maintain populations of the hoverfly. Thus the site might be given priority for artificial release and/or future monitoring.

30. Sandy Warren, RSPB Headquarters, nr Sandy, Bedfordshire (TL18/1947)

This is a mixed area of heathland, woodland and parkland. Most of the mature deciduous trees are scattered throughout the site. Tree holes were present in beech and oak trees. Most of the ivy was located along the south-west border of the site either growing over low growing shrubs, bushes and fences or growing up dead standing elm tree trunks or live oak trees. Many wasps, hoverflies and hornets were seen but no *C. spinolae*.

The site does not appear to have enough deciduous woodland and trees with tree holes to support a population of *C. spinolae*. Flowering ivy appears to be confined to the south-west border and its restricted distribution may be a further barrier to the effective colonisation of the site by *C. spinolae*.

31. Santon Downham, nr Thetford, Norfolk (TL 81/287)

1997 Survey

This site had good numbers of mature trees and patches of flowering ivy dispersed through the village and outlying areas particularly to the south of the Little Ouse River. Tree holes were also found in poplar trees occurring in plantations, mostly on the north bank of the river. The presence of poplar tree holes is encouraging given the record of larvae being found in them in Russia (Zimina 1986).

1998 Survey

The tree holes in poplar were revisited but no evidence of *C. spinolae* was discovered. About 17 tree holes were searched of which 8 were wet and/or had standing water.
Flowering ivy was found occurring in large patches in the wooded areas of the south bank of the Little Ouse River. Particularly good patches were present either side of the road leading from the Church to the river but no adult *C. spinolae* were seen.

Despite these negative results, the site does apparently have what is required to support a population of *C. spinolae* and might be considered as a site for artificial release and/or future monitoring.

32. Thornham Walks, nr Eye, Suffolk (TM1071)

1997 Survey

The quality and quantity of mature trees, tree holes and ivy suggested that this site was one of the better prospects for *C. spinolae* of those visited in 1997. This is all the more so because of an early record from the nearby church at Thorndon.

1998 Survey

Adult *C. spinolae* were observed on two occasions at this site. The first occasion took place on 14 September 1998 on an ivy flower about 2m high on an oak tree near the east wall of the walled garden at Thornham Walks, Suffolk. A male was seen for about 5 seconds before it flew off in a southerly direction. It was clearly recognisable from the characteristic long, white-tipped antennae and general body shape and colour.

The second occasion was on 19 September 1998. A dense patch of ivy flowers was being observed on the opposite side of the Old School House just to the west of a line of pylons. A male *C. spinolae* was first spotted by Ivan Perry moving over the flowers. We both watched this individual for several minutes, noting that it was rather small and that its behaviour (eg folding and "flitting" its wings over the abdomen when walking) and its general colouration and shape were remarkably similar to the numerous wasps (*Vespula*) that were numerically dominant.

33 Thorndon Church, Thorndon

This was the site of the earliest record for *C. spinolae* in Britain (Irwin 1975). The site was visited on two occasions. Flowering ivy was found growing up the church to the east of the main door, on trees in the churchyard and in hedgerows bordering the church. A few tree holes were present in some of the churchyard trees however, mature trees were not particularly frequent within the nearby areas of the village and farmland.

The lack of trees with tree holes today make this site unlikely to be able to support a population of *C. spinolae*.

34. Wandlebury, nr Cambridge, Cambridgeshire (TL4953)

1997 Survey

Callicera spinolae has been recorded from this site during the period 1988-1994. Good quantities of mature and over-mature beech occurred throughout the site and many tree holes were present. Ivy was common, particularly growing on the walls of the walled garden.

1998 Survey

The site was visited on three occasions and considerable time spent searching ivy flowers for *C. spinolae*. Flowering ivy is widespread throughout the site, as are mature beech trees with tree holes. The largest patches of ivy grow over the walls of the walled garden and it is here that Ivan Perry had not infrequently observed adult *C. spinolae* in the past. However on this occasion, we were unable to find adults. The ivy was visited by large numbers of insects including various hoverflies and wasps. The sheer quantity of ivy flowers throughout Wandlebury made it difficult to search adequately within the time constraints of the current survey. Even though we gave this site more attention than any other, only a small proportion of the available ivy could be visited and observed.

About 15 tree holes were searched and it was encouraging to find that water was present in many of them, including a few that had been dry last year. Numerous *M. florea* were the only syrphid species encountered.

Despite these negative results, the site is considered to be one of three most likely to have extant populations of *C. spinolae* in East Anglia and is worthy of future investigation.

35. Woods nr Babraham, (TL 5150)

Just down the hill from Wandlebury are a number of woodlands containing mature trees including beech surrounded by agricultural land, particularly between Meggs Hill and Babraham. Permission to visit these woodlands was not sought as part of this survey, however one woodland was visually inspected from the road which leads from Babraham village to Worsted Lodge in the north and which bisects it. Mature beech and flowering ivy was seen. This suggests that suitable conditions may exist within the woodland, and possibly others nearby and that these should be included in future survey and recovery work involving *C. spinolae*.

36. Wimpole Hall, nr Royston, Cambridgeshire (TL 3350/1)

This site consists of a large parkland and surrounding densely wooded areas. Mature trees with tree holes are present both within the parkland and wooded areas. Only small amounts of ivy were found, mostly in the woodland opposite the hall on the south side. Only *M. florea* were found in the tree holes and wasps on the ivy.

Despite these negative results Wimpole Hall does have good conditions for *C. spinolae* in terms of mature trees, woodland and tree holes. However there was a lack of ivy flowers. If this factor was addressed the site might be suitable for artificial release of *C. spinolae*. The site is given a low to middle priority for future survey and monitoring.

Visits to sites adjacent to Thornham Walks, 1999

37 Big Wood, TM0874

This is an isolated block of woodland divided by a path and a field to the north-west of Thornham Walks. It comprises mostly middle-aged oaks with few tree holes present. It is unlikely to be important as a breeding site for *C. spinolae*.

38. Burgate Wood TM0775

This is another isolated block of mostly oak woodland with few tree holes north-west of the Big Wood It is unlikely to be important as a breeding site for *C. spinolae*.

39 East Harling Common TL9987

This is an area with patches of mostly broadleaved trees just north of East Harling. Few tree holes in good condition were found. It is unlikely to be important as a breeding site for *C. spinolae*.

40. East Harling Heath TL9884

A broad strip of land occurs alongside the Roman road as it runs through the heath from Gasthorpe in the south to East Harling in the north. A few dozen mature broadleaved trees are present in this strip of land. Tree holes were infrequent but several were in good condition being wet with decaying heartwood. Extensive patches of ivy are also present along this road, particularly at the Gasthorpe end. However no adults or larvae of *C. spinolae* were found. Possibly the small number of trees and tree holes deters breeding but the ivy might be attractive to adults dispersing from other areas.

41. Fakenham Woods TL9378

This is a relatively large area of woodland to the south of Knettishall Heath Country Park to which there is access by a public footpath. It is a mixed oak and conifer wood. Tree holes were very scarce. Several patches of ivy were noted throughout the site. It is unlikely to be important as a breeding site for *C. spinolae*.

42. Knettishall Heath Country Park TL9515

This is a fairly extensive area of heaths, woods and fields. Mature broadleaved trees are infrequent. Conifer plantations predominate. A group of mature beech are alongside the road leading to the main car park in which several tree holes were present. Ivy patches are also infrequent. It is unlikely to be important as a breeding site for *C. spinolae*.

43. Quidenham TM0487

This is a fairly extensive area of fens, lakes and mature broadleaved woodland. Access was limited to a public path on the south-east part of the site so extensive investigation was not possible. At the time of the survey, no-one was found to ask for permission to visit the site. To judge from the path, this site deserves further investigation from the number of mature trees that were noted.

44. Syleham Church, near Brockdish east of Diss TM2078

Syleham Church lies in a flat area of meadows bordering the River Waveney. Adjacent to the church is a poplar plantation with large mature trees. Most of these trees have ivy growing up the main trunks and into the foliage. The borders of the church are heavily wooded as is the path leading from the road to the church where ivy is also present. A male *C. spinolae* was observed for about ten minutes feeding on ivy flowers at about 14.45 on Friday 17 September. Subsequent searches for tree holes were made in the poplar and other trees in the area. Several holes were found, but none had larvae.

45. Westhall Wood TM0273

This is an area of oak/birch (*Betula*) woodland to the west of Thornham Walks bounded on two sides by a by-road. Access to the interior of the wood was not possible due to lack of public paths and lack of necessary permission. To judge from the roadside this wood is unlikely to be of much value to *C. spinolae* as few mature trees with tree holes were noted. Ivy patches when present were small.

46. Santon Downham, Norfolk, TL8287; Wandlebury TL4953

These sites were visited on 11 September. The morning was spent at Santon Downham examining ivy blossom just outside the church and at the edge of the village green. In the afternoon ivy in the walled garden and on nearby beech trees at Wandlebury was examined. No *C. spinolae* were observed at either site.

47. Bottisham, Cambridgeshire, TL 550617; 48. Flitcham, Norfolk, TF7226; 49. Houghton Hall, Norfolk, TF7928; 50. Sandringham, TF6928

All these sites were visited on 25 September with varying periods of between 20 minutes up to 2 hours spent searching ivy blossom. No *C. spinolae* were observed.

Survey work, 2002

51. Thornham Walks, near Diss, Norfolk (TM 1071)

This site was visited on 20.ix.2002. The area of woodland round the Walled Garden was slowly walked through and the state of tree holes previously located was checked for wet conditions. The state of ivy in this area and in the grounds of the nearby church where adults were recorded previously, was also examined. Wet conditions were present in all nine tree holes in this area including the three where larvae of the *C. spinolae* had been found previously. One of these tree holes in an ash (*Fraxinus*) was examined and a small third stage larva located. This is the third year in succession that this particular tree hole has been occupied with larvae of the *C. spinolae*. Ivy was in partial flower at the time of the visit but no adults were located after about 2.5 hours observation time. Except for the tree hole in the ash tree, holes were not searched for larvae to minimise disturbance. A breeding population continues to exist at this site.

52. Wandlebury, near Cambridge (TL 4953)

This site was visited late afternoon on 21.ix.2002. The aim was to examine flowering ivy growing over the walls of the Walled Garden where adults were seen up to 1994. Weather conditions were good with plenty of sunshine and the ivy was in partial flower and was being visited by large numbers of wasps and other insects. However, no adults of the *C. spinolae* were seen in about one hours observation time. It would seem that the population that once existed here is either extinct or reduced to such small numbers that current levels of sampling effort are unable to detect it.

53. Wimpole Hall, near Royston, Cambridgeshire (TL 3350/1)

This site was visited in 1998 when conditions suitable for the *C. spinolae* were noted but no adults or early stages discovered (Rotheray, GE Callicera spinolae 1998, Report to English Nature). The site was visited again on the 19.ix.2002 and again on 21.ix.2002. The latter visit was with Ivan Perry. On 19.ix.2002 the belts of woodland in front of the main house were walked through. Small amounts of flowering ivy were present growing up the trunks of trees mostly on the margins of these belts of woodland and reasonable numbers of tree holes were located. Wet conditions were present in 11 of 17 holes examined but no adults or larvae of the *C. spinolae* were found.

On 21.ix.2002 we visited a large patch of ivy growing over a wall opposite the main public entrance to the site (TL 344512). Large numbers of insects were visiting these flowers but no adults of the *C. spinolae* were observed in about 1.5 hours combined observation time.

We next visited each of the many relatively isolated trees and groups of trees round the main house where the Warden, Simon Damont, had recorded either adults or larvae of the *C. spinolae* several times in 2000 or 2001, as indicated on a site map kindly supplied. We found many syrphid larvae in tree-holes, including larvae of the scarce species, *Mallota cimibiciformis*, in a tree hole at the base of a large beech pollard in front of the house. At the back of the house a large area of mature horse chestnut trees (*Aesculus*) exists. Many tree holes with wet conditions were in this area and an apparently gravid *C. spinolae* was seen flying close to the entrance of one of these holes. It landed on the bark just below the hole and appeared to going through pre-ovipostion behaviour but we could not determine

definitively whether eggs were laid before it flew off. We did not search the many tree holes in this area as we already knew that a breeding population exists, as indicated by specimens reared by the Warden and our observation of a gravid female.

54. Hylands Park, near Chelmsford, Essex (TL 6804)

This site was visited on 22.ix.2002. It is a large parkland created out of farmland in the nineteenth century and now managed and being restored by Chelmsford Borough Council. Particular attention was paid to the area of formal gardens and trees in and round the main house where Mike Hanson had recorded a male and a female *C. spinolae* feeding on ivy flowers in September 2001. He did not record further adults in 2002 (pers. comm.).

Several patches of ivy flowers were located in the formal gardens but only two tree holes with wet conditions were found. Belts of woodland were visited close to the main house and along the wall that borders the site at the main public entrance off the A12 road. Here again, small amounts of ivy were present but few tree holes were located. No adults or larvae of the *C. spinolae* were located. We have yet to demonstrate that a breeding population exists at this the most westerly site known for the species.

55. Fowlmere RSPB Nature Reserve (TL 4044/5)

This wetland site was visited during the afternoon of 21.ix.2002 with Ivan Perry. We walked slowly through the site on the numerous boardwalks and paths. Mature poplar (*Populus*) were noted and large amounts of flowering ivy occurred in many places. Only six tree holes were found, all with wet conditions but the only larvae present were those of *M. florea*. The apparent lack of tree holes at this site suggests that if a breeding population is present, it is small.

56. Hatfield Forest, Essex (TL 5319/20, 5420)

This large mostly oak forest was visited on the afternoon of 22.ix.2002. It is managed by the National Trust. The main area examined was woodland round the lakes by the Shell House and along the roads leading from the main entrance to the car parks. This woodland varied in density from closed to open canopy. Small amounts of ivy were located and a few wet tree holes in oaks were found. No adults or larvae of the *C. spinolae* were observed. The scarcity of tree holes and lack of diversity of deciduous trees other than oak in holes of which larvae of the *C. spinolae* have not yet been found, suggests that the probability of this site supporting a breeding population is low.

57. Anglesey Abbey, near Lode, Cambridgeshire (TL 5262)

This parkland site was visited on 23.ix.2002. In the late 1980's adults of the *C. spinolae* were recorded here by Ivan Perry. In company with Ivan, we walked round this site which has large numbers of young, nearly mature and mature ornamental and native trees. Small patches of flowering ivy were present throughout but tree holes were scarce. Nearly mature trees which were numerous will certainly develop holes in time and show signs of doing so but, few of any size currently exist. No adults or larvae of the *C. spinolae* were observed. The population that once existed here is either extinct or reduced to such small numbers that current levels of sampling effort are unable to detect it.

Survey work, 2003

58. Hylands Park, near Chelmsford, Essex (TL 6804)

This site was visited during 15-17.ix.2003. It is a large parkland created out of farmland in the nineteenth century and now managed and being restored by Chelmsford Borough Council. Tree holes and ivy flowers were investigated throughout this locality but no adults or larvae of the *C. spinolae* were located.

59. Fowlmere RSPB Nature Reserve (TL 4044/5)

This wetland site was visited during 18-19.ix.2003. No adults or larvae of the *C. spinolae* were located.

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Front cover photographs:
Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
Paul Glendell/English Nature 24,888