Colletes hederae Schmidt & Westrich, 1993 (the Ivy Bee) in Colchester: some observations on phenology, development and behaviour

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The Ivy Bee was first recognised as a distinct species as recently as 1993. The lateness of this discovery may in part be explained by its similarity to two other late-flying close relatives: *Colletes succinctus* and *Colletes halophilus*. First noted in Germany (Schmidt & Westrich 1993), the bee has subsequently been recorded across Europe, and was first recorded in Britain in 2001, in south Devon (Else 2002). The first Essex record was of specimens feeding on Ivy blossom noticed by Ray Reeves at East Tilbury in October 2009 (Harvey 2010). The first observation of a nesting aggregation in Essex was by Kara Hardy (Hardy 2013). The bees had made their burrows in sandy soil in a south-facing roadside verge at Purfleet. The EFC website now shows a scattering of records for the species across southern and eastern Essex, and the species appears to be spreading rapidly northwards in Britain.

Adults of *Colletes hederae* have a thick pile of ginger hair on the dorsal surface of the thorax, and fringes of ginger-buff adpressed hairs across the margins of the main abdominal segments. On average they are slightly larger than their two close relatives, but can only be distinguished with confidence by microscopic examination. However, *Colletes succinctus* specialises in Heather pollen and is rare in Essex. *C. halophilus* specialises in Sea Aster pollen and in Essex is found mostly close to the Thames Estuary, or along the coast. Bees showing the characteristic *Colletes* colour pattern and foraging on Ivy at inland sites in Essex are very likely to be Ivy Bees (Plate 1). Pollen and nectar are collected almost exclusively from Ivy blossom, and the flight

Plate 1. **Ivy Bee: female with pollen load**. Photograph © Ted Benton

period of the bee corresponds closely with the flowering period of Ivy, from late August through to late October or early November (Garbuzov & Raznieks 2014). Nests are formed by excavating burrows, usually in sandy soil, with many burrows close together as dense aggregations.

Plate 2. General aspect of the garden with the Ivy Bee colony, 26/09/2016.
Photograph © Maria Fremlin

In September 2016, one of us (MF) was contacted by a neighbour, Pat Foley, about a large aggregation of nesting bees in her garden (TL987245). The small garden is mainly lawn, with a raised area linked to a lower one by way of a steep south-facing slope (Plate 2). The owner had moved in only recently, but thought the bees had been present for at least two years. MF visited promptly on 21 September 2016. Nest burrows covered most of the lawn, including the less vegetated slope and the bees were recognised as Ivy Bees. This was well past the start of emergence, and many active nests were observed, females leaving and returning to the small mounds of excavated soil surrounding the nest entrances, while large numbers of males 'patrolled' busily across the whole area of the aggregation. At least one mating pair was observed and photographed (Plate 3), as well as an apparent mating attempt by a male on another male. On 30 September TB observed rather worn females foraging from Ivy on a nearby green space (TL986253), but these could have been associated with another aggregation discovered by MF the following year on an adjacent roadside verge. By 2 October there were fewer males present, but females were still actively nesting. On 3rd October, many females were observed by MF foraging from Ivy in a nearby old orchard, and females were still active at the nest site on 15 October. By 21 October it seemed activity had ceased.

Taking advantage of the kindness of the owner of the garden where MF had discovered the aggregation in 2016, we decided to discover what we could about the behaviour and life-cycle of the bee through 2017. On 4 May, together with two helpers, we removed the surface grass-cover from an area of approximately 1 metre square, on the lower part of the lawn. We then carefully excavated the underlying very sandy soil (the previous owner appears to have been a builder, and it may be that the soil was partly discarded sand), searching for cells of the immature Ivy Bees. The first cells were encountered at a depth of 15 cm, some entangled with grass roots. The

Plate 3. Mating Ivy Bees, 26/09/2016. Photograph © Maria Fremlin

deepest were at 35cm, sometimes 3 to 4 cells clustered together. We were unable to determine the structure of the burrows, but our findings were consistent with those of Bischoff, Eckelt & Kuhlmann (2005) that the cells are constructed in short branches at intervals from the main vertical burrow, with few, if any, side-burrows. Although, at 30-45cm down, the cells they excavated appeared to be considerably deeper than ours, this is rather misleading. Their burrows were dug into vertical slopes, so the lateral distance from the surface of the ground of the cells that they excavated was not greatly different from the vertical depth of ours.

The cells varied somewhat in size, from approximately 7.25 mm by 9.2 mm to 7.5 mm by 13.03 mm, with an impermeable cellophane-like outer membrane. The food-store in each cell showed yellow through the membrane, quite fluid, and immersing the larva if the cell was squashed; it had a strong honey-like scent. Larvae were of varying sizes, some of them seeming almost fully grown (though none had reached the 'prepupal' stage at which gut contents are excreted) (photo 4). Several undamaged cells were retained indoors. On 29 July, MF buried a voltcraft datalogger to a depth of 25cm. with the aim of detecting any temperature cues to the timing of emergence. In the process 8 cells were dislodged, two of which were dark brown inside, and contained pupae. Meanwhile, TB had been observing previously collected cells, one of which pupated on or just before 31 July. Larvae in cells retained by MF also had pupated by this date (Plate 5).

Emergence of the adults was first observed on 28 August (MF). The first to emerge were small numbers of males, with soil temperature at 19°C at midday at a depth of 25cm. On 2 September, MF visited the site and observed 3-4 mounds of excavated soil/ sand, with females actively visiting and leaving nests. On a subsequent visit (MF & TB, 12 September 2017) large numbers of males were actively patrolling the nest aggregation, buzzing loudly, flying rapidly just a few centimetres above the ground, and weaving among grass tufts. Occasionally one would settle and investigate an exit hole, sometimes entering the burrow for several seconds before retreating. By this stage, the 'pyramids' of loose sand and soil excavated by nesting females were tightly packed across the lawn, often overlapping with one another. Numerous females were observed both collecting pollen from a nearby Ivy hedge and returning to stock their nest cells (MF noted

Plate 4. Ivy Bee cells dug up on 04/05/2017. Photograph © Maria Fremlin

Plate 5. Ivy Bee pupae; from the left, male and female, 30/08/2017. Photograph © Maria Fremlin

the time taken by females to unload their cargo and leave the nest as approximately 4 minutes). Males were observed briefly 'harrassing' even females with pollen loads. Newly emerged females face more persistent attention from males, often several clustering around to form 'a mating ball' until one secures genital contact and the others disperse (Saxton 2009). MF photographed one such incident (Plate 6). On 2 October MF succeeded in digging out several recently completed cells, one with an egg (Plate 7) and others with early instar larvae, suggesting that the eggs hatch quite soon after being laid. So far our results at this site suggest that the bee overwinters in the larval state, pupating during the summer, approximately in late July. This fits with the development of the closely related Sea Aster bee *C. halophilus* in the Netherlands (Sommeijer *et al.* 2012).

The study by Bischoff, Eckelt and Kuhlmann reported mating behaviour as taking place over a brief period of some four days, early in the closely aligned emergence period of the females, from 4 to 6 September, with females going on directly to nesting activity. In the German study

Plate 6. Ivy bees mating ball, 02/09/2017. Photograph © Maria Fremlin

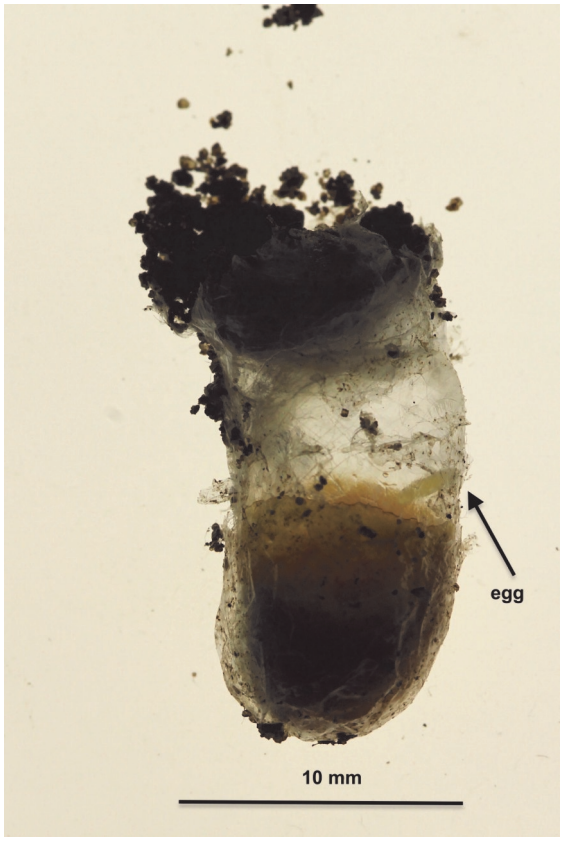

Plate 7. Ivy bee cell with egg, 02/10/2017.
Photograph © Maria Fremlin

there was a gap of some 13 days between the first emergence of the males and commencement of nesting activity by females. In our study the gap was considerably shorter, at just less than one week (it seems unlikely that earlier males were missed as the site was closely watched).

The German study gave a thorough account of the diurnal activities of the bees, using markers at individual nests to record the duration of foraging flights, the number of flights needed to stock each cell, and the average number of cells completed by the females. At their site, foraging trips by females averaged 60 minutes in duration, though the first trip of the day took longer, possibly because of the need to forage for nectar following a night in the nest. On average, between five and six pollen loads were needed to provision one cell, and this corresponded with the average number of foraging trips per day. In the extraordinarily warm and dry summer of 2003, when the study was carried out, females were able to provision up to 18 cells in their lifetime. We estimated that the density of cells at our site was over 200 per

square metre (MF excavation on 10/03/2018). This may go some way towards explaining the rapid expansion of range of this species in Europe and now in Britain, though it seems quite possible that its known parasites and kleptoparasites (notably the beetle *Stenoria analis*, and cuckoo bees of the genus *Epeolus*) may 'catch up' with it.

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