The Asian Hornet Diet in the UK

By Dr Eleanor Jones, Fera Science Ltd.

The Asian hornet is a well-known threat to UK apiculture and biodiversity, with annual incursions in the UK discovered since 2016. It is well-established and spreading across continental Europe, but so far successful contingency action has prevented this in the UK. The impact the Asian hornet has had on European beekeeping has not been entirely clear, with reported colony losses of up to 40% in France, but also lower impact reported elsewhere. The effect on biodiversity is also a mixed picture, in part because of the difficulty of studying the Asian hornet diet. The most comprehensive studies in Europe so far, have been done in France, identifying the prey from food pellets captured from Asian hornets returning to their nests.[1–3] The Asian hornet lifecycle is such that the adult hornets leave the nest to hunt, bringing back prey items, typically as 'flesh pellets', to the nest to feed to the growing larvae. These studies found honey bees to be a major part of the hornet diet, ranging from 37% to 87% of prey items, with flies, wasps, spiders being other major components.

Asian hornet prey in the UK

It is relatively difficult to study the Asian hornet diet in mainland UK as there is not a resident population to study here. When the hornets are found, efforts centre around control and eradication rather than a careful study of their behaviour; although beekeepers and Animal and Plant Health Agency (APHA) inspectors have made ad hoc observations of feeding behaviours. However, what is available is an archive of the frozen nests and hornets captured by APHA from the UK (Figure 1). As the larvae feed exclusively on prey pellets and retain all the food in their gut prior to pupation, the larval stomach contents represent a good snap shot of what the Asian hornets were feeding on in the period before nest eradication. Defra provided funding to explore this dietary archive, using a method called 'DNA metabarcoding' to identify the prey items; for obvious reasons, identification of the prey by morphology was not an option.

The UK study

The study used ten individual larvae from single nests from Tetbury (found in 2016), Alderney (2016), Woolacombe (2017) and Gosport (2020), provided by the APHA and the States of Alderney. Although all the Tetbury and Woolacombe larvae worked well, useable data were only recovered from three of the Gosport larvae and six of the Alderney larvae. When interpreting the results, it is important to acknowledge this small sample set, reflective of the diet of a low number of larvae for a restricted set of nests, at one point in time.

The results from the metabarcoding are DNA sequences. These are identified to species, genus or family, based on available DNA sequence libraries, or are left as unclassified if they cannot be identified at all. The higher the number of DNA sequences for a particular species there are in a sample, the greater the amount of that species there was likely to have been in the stomach contents.

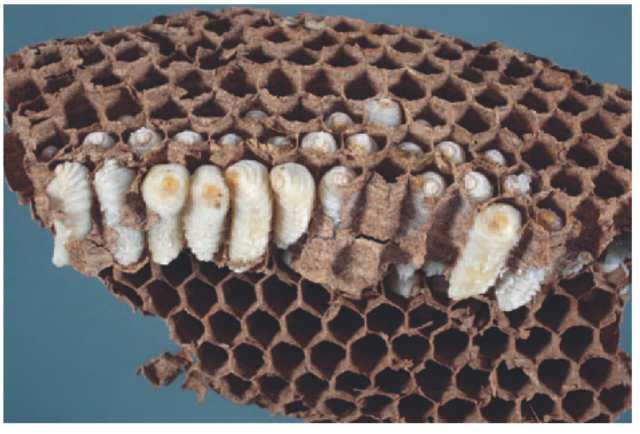

Figure 1. Side view of a comb from an Asian hornet nest with larvae. The outermost cells at the front of the picture have had the cell walls cut way to show the entire larvae, while some of the cells behind show the larvae sticking their heads out of the cells. As the combs are kept frozen, the larvae have a faint cover of frost. Image Courtesy Fera Science Limited © Copyright Fera Science Limited.

The identification to species is not always perfect, particularly for little-documented flies, and, importantly, larger species will contribute more DNA than smaller species. For example, a large-bodied spider will leave a greater number of DNA sequences in the larval gut than a small fruit fly, and the spider will therefore seem more abundant in the final data. There are caveats around the results arising from the DNA libraries, the availability of DNA from different species, and from methodological complexities, but the methods are likely to give a reasonable idea of what was being eaten, and in what approximate quantity.

Findings

With those caveats, the results are very interesting. Perhaps surprisingly, honey bees were not abundant in the data; they were entirely absent from Alderney and barely present in the Tetbury and Gosport data; only 0.3-1% of the DNA reads were from honey bees, respectively (Figure 2). Woolacombe had a greater presence of honey bee DNA, with around 7.5% of the DNA sequences coming from honey bees. Conversely, the European wasp, *Vespula vulgaris*, was the most abundant item in the DNA data from Tetbury, Alderney and Gosport, making 34–66.5% of all the DNA sequences found, while the most abundant item in the Woolacombe data were garden spiders (35% of reads) although wasps also made up 21% of the DNA sequences identified. Overall, the nests were feeding on a wide range of prey items, with between fifteen and twenty different species found in each nest. This is likely to be an underestimate of the range of prey predated, considering the low number of larvae sampled and caveats around the method. The prey were primarily wasps, bees, various species of fly, hoverflies and spiders, with single records of woodlouse,

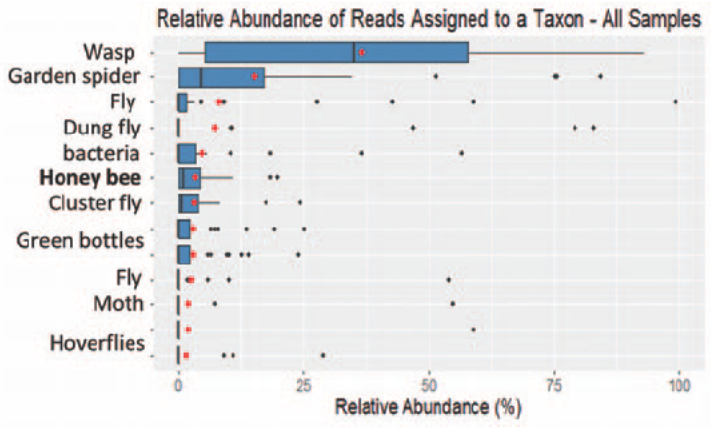

Figure 2. The relative number of DNA sequences from all the nests combined that could be identified to species or group of species.

grasshopper, moth/caterpillar and hedgehog (from carrion, one hopes). Notable absences were bumblebees and solitary bees, although this may be a result of the prey availability at the time of year when the nests were collected or the nest location. Also absent were European hornets.

Interpreting our findings

What do these results tell us about the diet of the Asian hornet in the UK? Overall, the picture is one of a generalist predator, exploiting the locally available prey. The differences in prey taken between the nests is likely to reflect the local prey availability, although there may be some learned preference for a particular prey type once individual hornets find a good source of food. Although honey bees did not feature greatly in the results, this may be because honey bees were not particularly locally abundant near the nests, or may have been harder to get compared to the other prey available.

Conclusions

If the Asian hornet does become established in the UK, their increased competition for food may lead to greater predation on honey bees, leading to a prey profile more similar to that found in France. The generalist nature of the predation is unlikely to be great news for UK biodiversity. Even where they do not compose a major component of the Asian hornet diet, these species may still be impacted should the Asian hornet become established in the UK in large numbers.

Asian hornet (by John Feltwell), surrounded by some of her favourite prey, clockwise from top left: common wasp worker (*Vespula vulgaris*) in flight (by Jeremy Early), spider (by Les Whalley/Pixabay), hoverfly on ragwort (by Dan Chapman) and honey bee (by Harriet Roberts, West Sussex).

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