Vespa velutina – The Asian Hornet

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THE ASIAN hornet *Vespa velutina nigrithoraxis* is a predator of domestic honey bees and other social hymenopterans. Its spread in France has resulted in a deep concern as well as the urgent need for research and experimentation in the world of beekeeping.

IMPACT ON AGRICULTURE AND RISKS TO HONEY BEES

All hornets are predators of honey bees but in varying degrees according to species and availability of food sources.

In Asia (Kashmir), as in China, *Vespa velutina* is considered a fearsome enemy of honey bees. According to literature, it is able to destroy up to 30% of a colony of the Asian honey bee *Apis cerana*. Hornet workers attack the honey bee guards one by one, before robbing their brood nest in order to feed their own larvae.

It is difficult to ascertain whether these descriptions refer to feral honey bee colonies or to managed colonies, nor is one told of the size or state of health of the colonies concerned.

In France, the predatory behaviour of *Vespa velutina* towards honey bees and other insects appears more significant than that of the European hornet. During the period June to September, early studies show an intensity of hornet attack activity occurring during the whole of the day. Beekeepers were justifiably distressed to see their hives repeatedly and regularly attacked by the Asian hornet and by the European hornet during the month of June.

Observers studying the behaviour of *Vespa velutina* near hives described their activity thus: the hornet hovers over the entrance to a hive at a distance of 30–40 cm, then tries to catch foragers, primarily those returning to the hive loaded down with nectar or pollen. The hornets charge at them from below and force them to drop to the ground before paralysing them and carrying them away. According to C Villemant, each hornet only consumes a portion of the prey herself. She decapitates it, removes the legs and wings, and makes the body into pulp before taking the meal to the nest and feeding it to the larvae.

The attempts by hornets to access beehives are numerous and frequent, particularly at the end of the season (September to December) when the production of new queens makes high demands on hornet workers.

Beekeepers who have visited their colonies after such an attack have found that they are generally very weak, low in foragers or queenless. Such colony conditions have not been reported, to our knowledge, under normal autumn conditions.

J Blot

The Asian hornet is spreading throughout France. It is of concern to beekeepers as it predates on honey bees

DEFENCE BEHAVIOUR OF HONEY BEE COLONIES

In Asia, *Apis cerana* has developed an efficient defence strategy. The bees pack themselves into a compact mass around the hornet, forcing the internal temperature of the mass to around 45 °C and the hornet dies because of the heat.

The European honey bee *Apis mellifera*, which has naturalised in Asia, has adopted the same defence strategy but less effectively. Fewer workers join the ball of bees – one third fewer than the Asian species. The less efficient behaviour of *Apis mellifera* in Asia is probably due to its more recent introduction to the predator.

The nest of an Asian hornet colony can be over 40 cm in diameter

JM Brandely

In France few observations describe this defence strategy and it appears that it only occurs in colonies of black bees. In the majority of colonies grouping of bees (up to 100) is seen at the entrance to the hive, anticipating attack or attempted entry. When a hornet threatens, several bees charge in her direction, causing a momentary 'backing off'.

AREA OF DISTRIBUTION

Asian Origins

The Asian hornet is normally found in the area bordered by Northern India and China, as well as the Indo-Chinese peninsula and the Indonesian archipelago. Individual hornets of the sub-species *nigrithorax* introduced into France are presumed to be of Chinese origin. The climatic conditions of continental Asia where they are normally found are similar to those of Southern Europe.

Introduction into France

The new species of European fauna, *Vespa velutina nigrithorax*, was officially recognised as resident in France in 2005. It was reported for the first time in Lot-et-Garonne. The suggestion is that the first specimens were accidentally imported with Chinese merchandise from Yunnan.

Spread of *Vespa velutina* in France

By the end of 2006, the Asian hornet was present throughout Aquitaine in the departments of Lot-et-Garonne, Gironde and Dordogne. Several sightings were subsequently made in the departments of Landes, Pyrénées- Atlantiques, Tarn-et-Garonne, Hautes-Pyrénées, Haute-Garonne, Gers, Charente, Charente-Maritime, and Corrèze.

Overall, the area of distribution measures almost 300 km from north to south and 200 km from west to east. Today the species is well established in France, most predominantly in the south-west.

BIOLOGY OF THE SPECIES

The species *Vespa velutina* has around a dozen known sub-species. The sub-species present in France, *Vespa velutina nigrithorax*, is easily distinguishable from the European hornet, *Vespa crabro* (the only other hornet living in France) by its size and its colour. The adult measures around 30 mm in length, its thorax is dark brown and its abdomen has gastric segments edged with a thin band of yellow. Only the fourth abdominal segment has a wide band of yellow–orange.

HABITAT AND DESCRIPTION OF THE NEST

According to current observations, *Vespa velutina* makes its nest primarily in the branches of trees but sometimes it will choose well-ventilated man-made shelters such as barns or sheds. Very occasionally, nests are found suspended from cracks in walls. Literature tells us that they may also choose an under-floor cavity.

Spotting nests is often difficult as they can remain hidden until the leaf fall in autumn and winter reveals their position.

Generally, the workers form the nest in the shape of a sphere, slightly taller than it is wide, which often exceeds 40 cm in diameter. In Lot-et-Garonne, Dordogne and Gironde, an average nest measures 60–90 cm in height and 40–70 cm in diameter. The nest has an exterior 'envelope' made up of 5–6 layers of papier-maché, spaced by gaps of 5–10 mm. The average thickness of each layer is 45 mm.

The nest generally has a single entrance, positioned half-way up the height of the nest in the case of older colonies and below that for nests which have just been started. The entrances are holes of 1.5 cm in diameter, protected by an awning of papier-maché.

Nests grow progressively from spring until autumn. At maximum height, the nest is usually made up of 6–7 'cell cakes' or strata, which contain the brood nest. Nests have been found with 14 such strata. Each stratum has a diameter of 23–29 cm. The edges of the strata are separated from the outer 'envelope' by a 15 mm space. The distance between strata is 10–12 mm.

Each individual cell measures, on average, 8.5 mm in diameter, with a depth of 26–29 mm. Up to 17,000 cells per nest have been reported.

At the time of maximum population density, an estimated 500 hornets inhabit a nest of 90 cm in height. This figure does not take account of foragers absent from the hive at the time of counting.

In the North of Thailand, scientists have collected a colony containing around 1500 insects in a nest measuring 50 cm in

The nest is made up of five to six layers of papier-maché

P Lieniard

diameter and comprising more than 6000 cells.

LIFE CYCLE

Egg laying period

The start and the end of the egg laying period of *Vespa velutina* is difficult to determine. The activity of the fertile females depends on temperature. An early return of hot weather can stimulate early laying activity but for there to be the start of a colony, it is also necessary that the queen be adequately fed. It therefore appears probable that even though queens may start laying some eggs in February, foundations of nests may well be started later.

Over-wintering

In sub-tropical Asia colonies are not perennial. The few workers left alive, along with a little of the brood, cannot maintain an adequate temperature for life to continue. In the annual life cycle of the hornet the colony is, to all extents and purposes. as dead as the individual inhabitants by the end of the year. In the normally favourable climatic conditions in the area of natural distribution the new queens over-winter, sheltering alone or in small groups in small cavities.

In France it is thought that the nest of *Vespa velutina* in winter will not contain a living colony. The hornet queens that have successfully over-wintered leave their shelters in spring to found a nest elsewhere. In Aquitaine, all the nests, even the largest, observed from outside during the month of February were deserted. Only one examined in Gironde revealed two living queens.

Normally, to over-winter, young fertile queens hide themselves in narrow crevices (rotten tree trunks, mossy river banks, etc). During the winter of 2006/7, which was relatively warm and very damp, single over-wintering queens were found in the cavities left by the larvae of *Cerambycide* (long–horned beetle) in an oak blown over by a storm, whereas the hornet's own nest was still occupied, at least until December, by the colony's workers.

Natural Enemies

The nests of *Vespa velutina* have natural predators in Aquitaine. In the period of pre-winter decline of the colony, green woodpeckers, jays and tits are often seen pillaging nests and eating the remaining larvae. It is not yet known if there are other hornet predators.

One queen per nest per year

According to the literature, one queen creates only one colony per year. She dies at the year's end and it is her descendants (fertile females) who become founders of colonies in following years. In spring each queen roughly shapes a new nest and develops a new colony which will contain only one queen.

Life span of workers

We are led to believe that the life expectancy of the Asian hornet is the same in France as it is in Asia. A study carried out in 1895 by Charles Janet on a nest of *Vespa crabro* demonstrated the development of hornet workers only. This he found to be very variable depending on exterior temperature, lasting 55 days during the month of May, and 30 days during the month of August.

The development of *Vespa velutina* workers follows the same pattern: 30 days in summer but probably less than 55 days during the warm spring weather of the period of observation.

Anna Legrand

The huge size of the nest can be seen here. The inner structure of strata is visible on the right

Queen Mating

The individual flights of the fertile males and, later, the new generation virgin queens, take place at the end of the summer. The males seek out the females in order to mate.

The sexual pheromones produced by the virgin queen appear to play a part in bringing together the sexes.

The mating itself has only rarely been observed, except during conditions set up by the observer.

DIET

The diet of *Vespa velutina* is as yet undetermined. In general hornets eat not only bees but also crickets, butterflies, flies and other insects. They also eat spiders.

At the end of the season they are particularly attracted to ripe fruit.

Their diet depends on what is locally available, on the state of the colony's development and on the level of competition from other predators.

Hornets, in common with honey bees, have two basic dietary requirements: sugars – for energy for the adults, and proteins – for the nourishment of the brood.

BEHAVIOUR AND RISK TO HUMANS

According to initial observations of *Vespa velutina* in France, the Asian hornet is not generally aggressive towards humans. They have shown no sign of aggressive behaviour, either in flight or in response to human activity or loud noises.

Throughout spring and summer, nocturnal behaviour is characterised by a concentration of several hornets on the exterior surface of the nest. It is only when the first frosts occur that these hornets will enter the nest itself during the night.

The daily rhythm of the species is characterised by their first flights taken at first light (or at sunrise during frosty periods). The intensity of the comings and

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ADAAQ is the Association de développement de l'apiculture en Aquitaine. CNDA is the Centre National de développement apicole.

OPIDA is the Office pour l'information et la documentation en apiculture

goings does not appear to vary throughout the day.

Protection strategies

To date, the extent of the invasion is such that all attempts to eradicate *Vespa velutina* seem ineffective. The control measures oultined below are still in the process of research and will be the subject of further studies in 2007.

Protection of hives

- Reduce entrances to 6 mm high. Traditional metal entrance strips will not stop entry.
- It seems that tall grass in front of the hives hinders hornet activity when capturing flying bees.
- Refrain from leaving wet frames in the open, after extraction. They will attract hornets.

Control of the insect

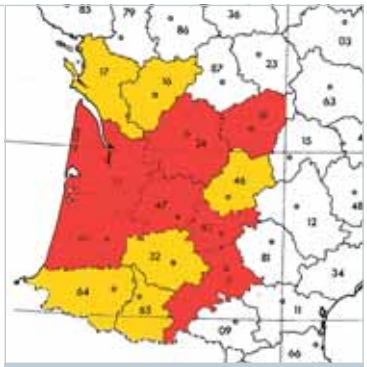
- Search out and kill new queens in the area of the hives, particularly in February and March.
- Set up all-year-round traps, particularly near honey bee mating hives, to reduce the level of predation (use classic wasp trap equipment).
- Destroy nests in order to limit reproduction of the species. This is particularly important before the annual migration of the new queens in autumn. Take care to avoid personal danger or danger to others.

CONCLUSIONS

It appears that the whole world expects that we should aim to eradicate *Vespa velutina* from France in view of the speed of expansion and the rapidly enlarging area of its presence. Further, its expansion into the rest of Southern Europe seems inevitable. But we are forgetting for the moment the need to study and learn more about the insect and the consequences of its presence, in order to assess correctly the degree of danger from *Vespa velutina* to beekeeping.

Currently professional beekeepers are not reporting the more extreme results of encounters between honey bee populations and the hornet. However, it may be that an increase in the effects of this species becomes economically worrying, not only to beekeepers but also to those who make their living from all crops that need honey bee pollination. That the hornet attacks foragers and, more precisely, the pollen collectors, is a cause for concern, in that they are yet another threat to our honey bee colonies in the modern world.

Further research studies are already in place for 2007.◆



The spread of the Asian hornet through France

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The debate as to the role of hornets continues. See Letters (page 27) for Peter Hutton's thoughts.