

The Asian Hornet: Part 1

Gay Marris, PhD, National Bee Unit (NBU)

We begin a formal risk assessment of this looming threat

Introduction – Biology

THE ASIAN hornet, *Vespa velutina*, is an aggressive predator of honey bees and other beneficial insects. Physically, it is superficially similar to the native European hornet, *V. crabro*, but despite its fearsome reputation *V. velutina* is slightly smaller (2.5–3 cm long). It has a dark 'velvety' thorax, from which the subspecies *nigrithorax* derives its name. Its clearest distinguishing features are that, while *V. crabro* has a comparatively yellow abdomen, in *V. velutina* only the third segment is yellow and it also has yellow legs (see Figures 1 and 2).

The lifecycle of the Asian hornet has been described in previous articles (see *Bee Craft*, September 2007, page 11), but can be summarised as follows (Figure 3): mated queens emerge in early spring and form embryo nests. Larger nests are established rapidly and worker hornets attend to the



Figures 1 and 2. An Asian hornet queen with (inset) a common hornet for comparison

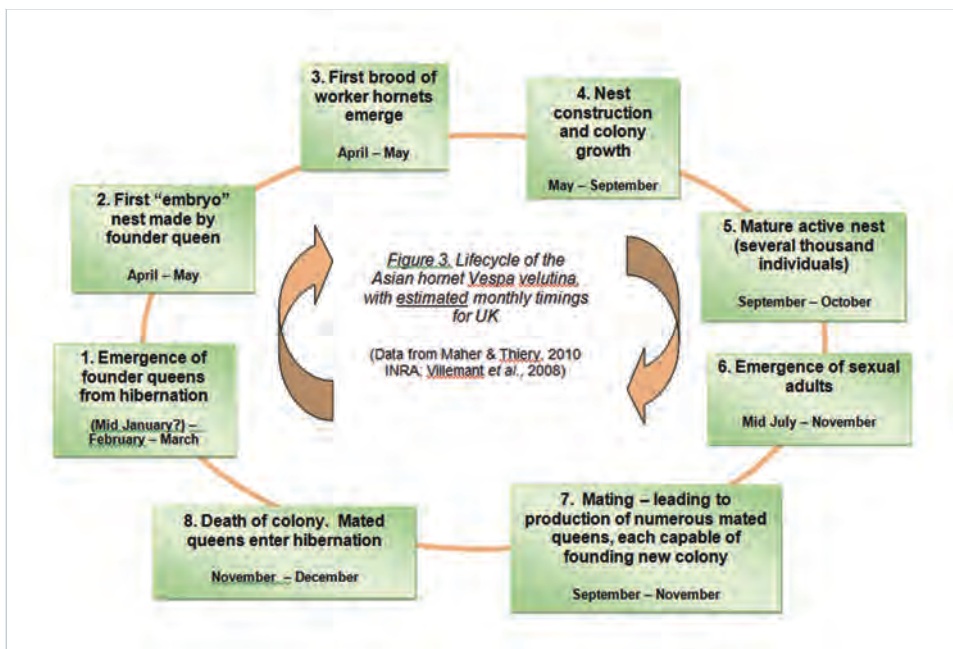
needs of the growing colony. Workers are extremely active and predate a variety of insects to obtain the protein-rich diet that the developing hornet brood requires. Prey is often caught on the wing, but hornets also enter honey bee hives to raid severely depleted colonies. Mature hornet



Jean Haxaire

Nigel Jones

Figure 3. The lifecycle of *Vespa velutina*



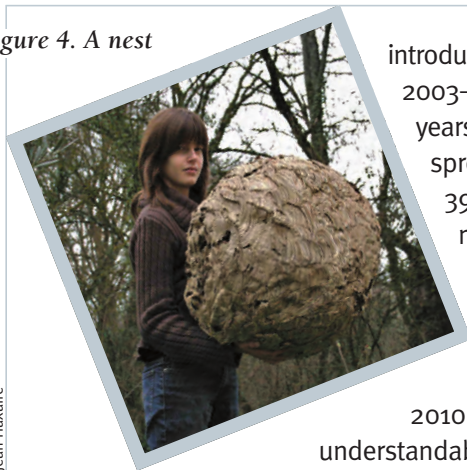
nests, which can be huge (Figure 4) and comprise several thousand individuals, are seen from May onwards.

Sexual stages emerge from July until November and one colony may produce hundreds or even thousands of mated queens. As the colony dies, these foundresses seek out suitable sites in which to overwinter. They emerge in early spring, to begin the cycle again. A key feature of the Asian hornet's biology is that a single, mated queen can found an entire new colony.

Distribution

The Asian hornet has recently extended its native geographical range from Asia (Figure 5) to mainland Europe, following accidental

Figure 4. A nest



Jean Haxaire

introduction to France in 2003–2004. In just seven years *V velutina* has spread across at least 39 French départements (Figure 6) and was confirmed in North East Spain for the first time in November

2010. This has sparked understandable concern and some high profile media coverage

(Figure 7). Although (unlike the exotic pests the small hive beetle and *Tropilaelaps* mites) the Asian hornet is not a statutory notifiable pest of honey bees, beekeepers in the UK need to be aware that there is the potential for this species to arrive and establish itself here.

Understanding the Risks of Arrival in the UK

The Non-native Species Secretariat (NNSS) has responsibility for helping to coordinate the approach to invasive non-native species in Great Britain (GB). The NNSS is responsible to a Programme Board representing the relevant governments and agencies of England, Scotland and Wales. You can read more about the activities of the NNSS at <https://secure.fera.defra.gov.uk/nonnativespecies/home/index.cfm>. At the request of the NNSS, the NBU has undertaken a formal and extensive Non-native Organism Risk Assessment (NNORA) for *V velutina* with respect to beekeeping in the UK. The completed NNORA has recently been made public and can be viewed in full at: <https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51>. Essentially, based on detailed consideration of available literature, scientific evidence and personal accounts, we sought to answer four key questions:

- ◆ How likely is it that the Asian hornet will arrive in the UK?
- ◆ How likely is it that it will establish in the UK?
- ◆ How likely is it to spread in the UK?
- ◆ What would be its impact?

Figure 5. Approximate Asian range of *Vespa velutina*

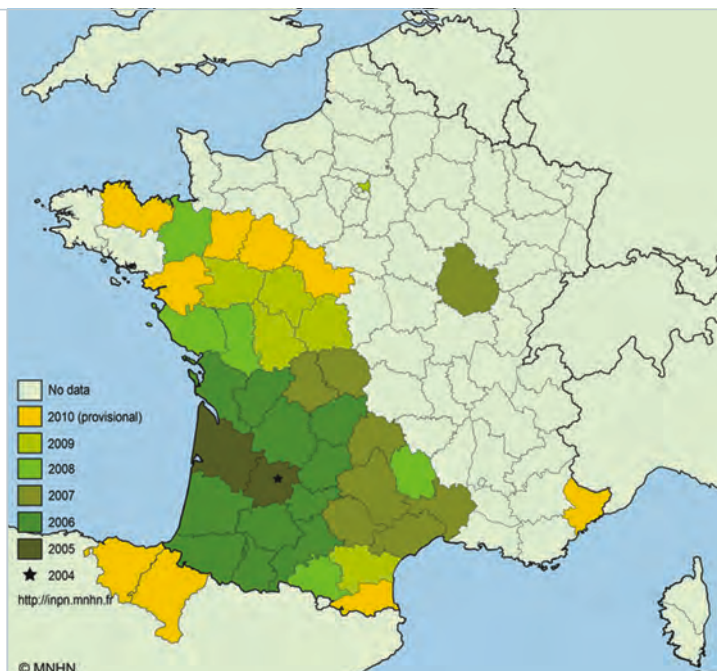


Figure 6. European range of the Asian hornet (2010). Map courtesy of Claire Villemant, Muséum National d'Histoire Naturelle, Paris, France (MNHN)

Question 1. How likely is it that the Asian hornet will arrive in the UK?

The life-stage of the Asian hornet that poses the greatest risk of entry is a newly mated queen, because just one such inseminated female will found an entire colony comprised of several thousand offspring. It is believed that the entire population of Asian hornets in France originated from a single incursion. There are multiple (seven) pathways by which Asian hornet queens could, at least in theory, enter the UK. These are summarised in Table 1. It is our view that not all pathways pose an equal risk of entry; some include inspection procedures that will detect any insects (including hornets) before arrival, others have treatment measures in place that will kill hitch-hiking pests in transit. These pathways are considered in more detail below.

Table 1. Entry pathways by which the Asian hornet could enter the UK

Pathway	Level of risk (likelihood of entry)
1. Cross-Channel flight	High
2. Imported wood/wood products	High
3. Imported man-made goods	Intermediate
4. Imported fruit/cut flowers	Intermediate
5. Imported soil	Low
6. On freight containers/ transport vehicles	Low
7. Movement with honey bees	Extremely low

Pathway 1: Cross-Channel flight

The shortest distance between England and France over the English Channel is 34 km, between Dover and Cap Gris Nez. *Vespa velutina* is present in at least one coastal area of France (Figure 6) (Northern Brittany since 2008; Côtes d'Armor since 2010). In the highly likely event that *V. velutina* increases its European range and also spreads to other more northerly coastal regions of France, then in theory inseminated hornet queens could fly across the Channel.

Distances covered by adult *V. velutina* in single flights are unknown but unpublished data on *V. velutina*'s flight capacity in the laboratory suggests that they can fly dozens of kilometres in one flight, with certain weather conditions (wind direction) assisting natural spread.

There are no confirmed records of other social Hymenoptera crossing from continental Europe to the UK via this pathway, but the Median wasp, a non-native species established in the UK since 1980, was first recorded in the coastal area of East Sussex, implying that it flew here across the Channel. There are numerous records of other insects, including species far less sturdy than hornets (butterflies, ladybirds, etc.) making this journey each year, sometimes in vast numbers. This entry route is thus considered relatively likely for *V. velutina*.

Pathway 2: Hibernating queens in wood/ wood products

Asian hornet queens like to hibernate under bark and will cluster in small groups to overwinter. *Vespa velutina*'s preferences for particular tree types are unrecorded, so it is impossible to be specific about the likelihood that they will associate with any given species.

However, every year we import a huge volume and a wide variety of wood and wood products from countries where Asian hornets are known to be present, both within its native Asian range and from within the EU. Import regulations and potential detection measures depend on tree species, country of origin and nature of wood product. These are summarised in the Forestry Commission Plant Health Guide *Importing wood, wood products and bark* (Forestry Commission, 2007) and also Plant Health Directorate 2000/29/EC.

Regarding wood and wood products imported from outside the EU, the fact that controlled commodities lack bark and/or must be treated prior to entry greatly reduces the probability that *V. velutina* will survive existing management practices. However, most wood entering from the EU is subject to fewer controls.

Pathway 3: Import with man-made goods

Inseminated *V. velutina* queens do not only hibernate in 'natural' nooks and crannies; they will also use man-made sites as long as these provide small, well-insulated refuges in which they can hide away over the winter months. The range of imported commodities that offers suitable hibernation sites is thus extremely broad and impossible to measure or control. It is believed that *V. velutina* was imported into France from Yunnan (China) in ceramic bonsai pots. Ceramic garden goods from France, Spain or elsewhere in mainland Europe can be imported into the UK without any inspection that would reveal hibernating hornets and, like France, we also import bonsai pots from Asia. *

[This article will be concluded next month.]

Figure 7. Press coverage





THYMOVAR®

A newly-authorised Veterinary Medicine to control Varroa mites in honey bee colonies. Using natural Thymol in an easy-to-use viscose strip, Thymovar® may be used in Spring and Autumn. As part of an Integrated Control Program, Thymovar® can help minimise damage from Varroa infestations and the secondary viruses they transmit.

(VMD Marketing Authorisation No: Vm36234/4000)

- Highly effective treatment (>90%) in Spring or Autumn
- Easy to use viscose sponge strips
- Contains Thymol – approved for use in EU Organic production
- No resistance
- Long shelf-life
- Can form part of your Integrated Varroa Control program
- Registered for use in more than 20 countries
- Only available from Agri-Nova





7 Belmont Hill, Newport, Saffron Walden, Essex CB11 3RF
 T 05600 756944 F 05600 756945 E clive@agri-nova.biz W www.varroacontrol.co.uk

Agri-Nova Bee Technology is a trading style of Agri-Nova Technology Ltd
 Thymovar® is a registered trademark of Andermatt BioVetAG (www.biovet.ch)

The Asian Hornet: Part 2

Gay Marris, PhD, National Bee Unit (NBU)

We conclude our consideration of the formal risk assessment of this looming threat

[For part 1, see September, page 16.]

Pathway 4: Import with fruit or cut flowers

Adult *Vespa velutina* are attracted to ripe fruits and flowers as sources of sugar, especially in the autumn when mated queens are on the wing. There is thus the potential for Asian hornets to arrive with fruits/flowers imported from its known geographical range. From China alone, the UK imports at least 19 types of fruit/fruit product. In 2009, we imported over five million tonnes of fresh apples and pears from this source, both fruits that are known to be used by Asian hornets.

The volume of trade within the EU is also large. For example, in 2009, we imported 46,000 tonnes of fresh table grapes from France. Regarding the likelihood that any Asian hornets could actually enter the UK via this pathway without being detected, a number of controls are in place for the purposes of Plant Health. Controlled fruits and flowers from Asia must be accompanied by a phytosanitary certificate and a sample of every consignment is inspected by colleagues in the Plant Health and Seeds Inspectorate (PHSI) (Figure 8). Since live hornets are comparatively large and conspicuous in their behaviour, if present in large numbers, *V. velutina* is likely to be detected. However, *V. velutina* is not a listed plant health quarantine pest (Directive EC/2000/29), so this species is not specifically targeted during inspections.

Other produce entering the UK from third countries, which is not considered to present a significant risk in terms of quarantine pests and diseases, is unrestricted and not subject to routine plant health controls. The majority of fruit and flower movements within the EU are not subject to controls due to the single market which could lead to *V. velutina* entering the UK undetected. There are no records of *V. velutina* being spread via this pathway, but on eight separate occasions the Oriental hornet has been

Figure 9. These beautiful, mature Spanish olive trees are over three metres high and are imported with a comparatively large volume of soil



Sameer Bandali and Jane Goffe – PHSI/Heathrow

Figure 8. The scale of the pathway – controlled fruit imports from Bangladesh, awaiting inspection by the PHSI

intercepted on fruit and plant produce imported into the UK; at least four specimens were still alive at the time of detection (data from Plant Health Interception Records, Fera). For these reasons, this route of entry is believed to pose a significant risk.

Pathway 5: Import with soil

Asian hornets will over-winter in soil or leaf litter, so there is the potential to import hibernating queens with soil associated with plant trade from countries where these wasps are present. The volume of soil imported is governed by the size of the plants in question – whatever is essential to sustain the vitality of the plant variety. Cultivation practices, which could limit the hornet's chances of survival in soil, depend on the species in question, but heat treatment or fumigation of soil (required for imports from third countries) is likely to kill hibernating hornet queens.

There are, however, no restrictions on the movement of soil within the EU. Soil associated with plants imported from France and Spain (where *V. velutina* is present) will not be inspected (Figure 9).

Pathway 6: Movement on freight containers and transport vehicles

Asian hornet queens could either travel as active adult hitchhikers or as dormant hibernating queens. Accounts of hornet queens forming swarms are very rare and the frequency of such behaviour in Asian hornets is unknown. However, there are reports of other social Hymenoptera forming swarms on ships and hitchhiking to countries outside their normal range. Bee swarms have also

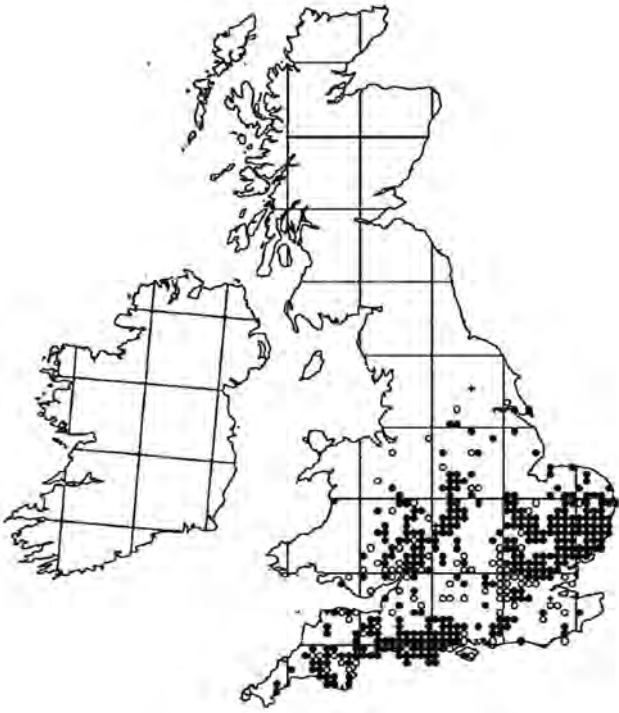


Figure 10. Recorded distribution of the European hornet in the UK – an indication of the likely distribution of *V. velutina*

occasionally been picked up on ships arriving in the UK, so there are some precedents for this mode of spread.

In the 1950s, *Vespula germanica* was accidentally introduced into Tasmania via cargo; *V. germanica* entered New Zealand (NZ) when hibernating queens were shipped in with US aeroplane parts from Britain in the 1940s. Furthermore, in NZ their spread over large distances has been attributed to rail and road transport carrying hibernating queens. We have no records of *V. velutina* queens associating with transport vehicles, or of using freight, cars, lorries, trains, etc, as hibernation sites. We thus consider it quite unlikely that large numbers of *V. velutina* would enter the UK in this way. However, the volume of movement along this pathway is very large, adding considerably to the risk. Billions of standard shipping containers are transported around the world annually; millions of individual ferry trips between mainland EU and UK (car ferries) take place every year.

Pathway 7: Movement with honey bees imported for the purposes of trade

Although Asian hornets' preferred food source is honey bees, *V. velutina* are comparatively unlikely to be associated with this pathway. Adult hornet workers do not live inside colonies of *A. mellifera*, but only enter to raid eggs and larvae. Apart from early in the season, when hornets are establishing founder nests, inseminated queens do not enter beehives. Not only is it extremely unlikely that a foundress hornet could enter the UK via this pathway without detection, the volume of imports from *V. velutina*'s known geographical range is very low: no imports are permitted to enter the UK from any parts of Asia and in a typical year (2010 data for England and Wales), just six

honey bee consignments (queens or nucleus colonies) originated in France and only one from Spain.

QUESTION 2. How likely is it that the Asian hornet will establish in the UK?

Vespa velutina is highly adaptable. Although its native range is Asian (Figure 5, September, page 17), even in tropical areas this species nests in cooler highland regions that are climatically similar to Southern Europe. They have established in many regions of France, including Northern Brittany that shares the ecoclimatic conditions found over here. Climate-matching models based on records of the distribution of *V. velutina* in Asia and France predict that Occidental Europe (which includes the UK) is climatically very suitable for colonisation by the Asian hornet.

Since its entry and establishment in the EU, *V. velutina* has rapidly adapted to its new environment, colonising urban, suburban, agricultural and wooded areas. All of these man-made and/or unmanaged environments are equally available in the UK.

The Asian hornets are very polyphagous. The preferred food is *Apis mellifera*, but they predate various other social Hymenoptera, flies, butterflies, etc. Although beekeeping is widely practised in the UK, *V. velutina* would not have to rely on honey bees for establishment and spread. There is no evidence that the native European hornet or natural enemies, pests and diseases also present in France, have had any impact on its establishment on the Continent. With all of the above considerations in mind, we conclude that, should the Asian hornet arrive in the UK, it is highly likely to establish.

QUESTION 3. Once established, how likely is the Asian hornet to spread in the UK?

Based on the experiences of French beekeepers, we must assume that spread is likely to be very rapid. Adult hornets are highly mobile, with the speed of spread across France being equivalent to approximately 100 km/year. Suitable prey and habitats are present in many parts of the UK, but potential for arrival and subsequent spread may be greatest in the following areas:

- ◆ areas where winters are milder (southern English counties)
- ◆ open areas near water, hornets tending to follow rivers and watercourses
- ◆ near ports and airports, where controlled and uncontrolled consignments of commodities that may harbour overwintering queens are most likely to enter the UK
- ◆ in the event that *V. velutina* crosses the English Channel, either on shipping or by natural spread, coastal counties of southern England will be most at risk
- ◆ given that the requirements of *V. velutina* are broadly comparable to those of the European hornet, we may expect its potential geographic distribution in the UK to be similar (Figure 10).

QUESTION 4. What is the impact of the Asian hornet likely to be in the UK?

The arrival of Asian hornets in the UK has the potential to impact honey bees, the wider natural environment and it also has social implications. These potential impacts are summarised below.

Impact on honey bees

The primary food of Asian hornets is honey bees, the most obvious effect of predation by Asian hornets being death of adult workers.

Honey bees are the primary managed pollinator of commercial crops in the UK (total value hundreds £ m/annum) and honey production is worth £10–35 million each year. Any exotic pest that threatens national bee stocks may have a negative economic impact. However, although described as being ‘a serious pest’ of *Apis mellifera*, data quantifying the effects of *V velutina* in its existing geographical range are lacking, so it is difficult to place any figures on the likely impact on the UK’s beekeeping sector.

Damage caused to colonies is widely recognised in Asia, *V velutina* being able to destroy 30% of an *A cerana* colony in a couple of hours. This ‘natural’ prey has defence strategies that effectively reduce potential damage, including forming a compact mass of bees around the hornet, raising the temperature to a lethal 45 °C. Western *A mellifera* is less effective at heat-balling and thus far more vulnerable to colony damage. Repeated and sometimes severe attacks from *V velutina* on French honey bee colonies have been reported, in particular in the summer and autumn.

Asian hornets also have indirect effects on honey bee health. Chronic hornet activity around a colony causes honey bees to mount a constant defence of the hive entrance, thus greatly limiting time spent foraging. Pollen reserves become depleted, leading to mortality in developing bee larvae, weakening of the colony and potential colony loss. Even low levels of hornet numbers (fewer than 5 hornets/hive) can result in significant disruption.

In France, *A mellifera* colonies predated by *V velutina* are typically left very weak, low in foragers or queenless and vulnerable to disease and infestation and robbing. Adult hornets will enter weakened colonies, decimating brood and reserves.

Environmental impact

The environmental impact of the Asian hornet within its existing geographic range has yet to be documented. However, ongoing research in France shows that it predated not just honey bees but also social wasps, other Hymenoptera, several types of fly and various unclassified insects, several of which are likely to provide beneficial unmanaged pollination services in a variety of man-made and ‘wild’ scenarios – pollinator services that will be adversely affected if predation by Asian hornets significantly reduces their numbers (Figure 11). Impact mechanisms are often complex and are not yet fully understood and

quantified, even many years after the introduction of invasive wasp species in new areas, so it is likely to be some time before environmental impacts of the Asian hornet are fully understood.

Social impact

A recent survey of Asian hornets’ nests in France shows that, in contrast to those of forest-dwelling *V crabro*, almost half (49%) are found in urban or semi-urban environments, ie, in relatively close proximity to human activity. Moreover, at least a proportion of these are located in bushes or hedges, less than two metres off the ground.

As a group, hornets possess highly poisonous venoms that they use to overcome their prey. These venoms are rich in toxins, enzymes and biologically active peptides. However, while some hornet species have been known to inflict fatal stings on humans, this is unusual; deaths occur only rarely, when victims receive multiple stings or as a result of anaphylactic shock. Generally, although very painful, the effects of hornet stings are local and short-lived.

In its Asian native range, *V velutina* is very aggressive, but observations of their behaviour in France (climatically more similar to the UK) are inconsistent. Until recently, no aggravated response to human activity or loud noises had been reported and, even when nesting in buildings (eg, terraces or barns), *V velutina* tended to remain discrete, ignoring humans. In France, in February 2009, just one envenomation had been clearly linked to *V velutina* and the French Poison Control Centre found no correlation between the expanding population of Asian hornets and any increase in numbers of reported wasp stings. However, in the autumn of the same year, at least seven people went to hospital after being attacked by a single colony of *V velutina*. As a result, French authorities are warning people not to approach the nests and to contact the police for help.

Because of its large size and partly by virtue of its appearance, like many wasp species

V velutina is intimidating to the public. Fairly or otherwise, their mere presence is likely to constitute a public nuisance, by disrupting human enjoyment of outdoor parks and gardens, etc. Hornet abundance in urban areas (and intensity of nuisance-interactions with people) will vary according to the time of year. In the autumn, Asian hornets search for sweet, carbohydrate-based foods and may be attracted to human habitation/sites where such foodstuffs are available (eg, picnic sites).

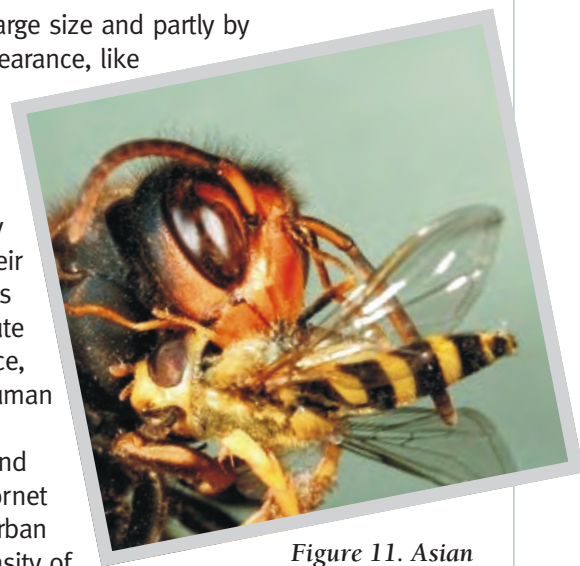


Figure 11. Asian hornets eat a range of beneficial insects besides honey bees

Conclusions and Reporting Suspect Sightings

There are multiple routes by which the Asian hornet could enter the UK. In the event that it does arrive, it is highly likely to establish and spread. It is difficult reliably to assess the full impacts of arrival, but it is likely to have implications for the UK's beekeeping sector.

You may report sightings, along with a photograph and details of where you saw them, to: alert_nonnative@ceh.ac.uk If possible, send in a sample to the National Bee Unit for examination to confirm identity (details at: www.nationalbeehiveunit.co.uk). However, do not under any circumstances disturb or provoke an active hornets' nest.

Further Information

BeeBase (www.nationalbeehiveunit.com) is regularly updated with the latest news and information. Address enquiries about honey bees to nbu@fera.gsi.gov.uk For enquiries regarding Bee Health Policy and Regulatory issues, contact beehealthinfo@fera.gsi.gov.uk

Other Reading

Mollet & de la Torre (2007). *Vespa velutina* – The Asian Hornet. *Bee Craft*, September 2007, 11–14.
<https://secure.fera.defra.gov.uk/beebase/index.cfm?pageid=208>

Villemant, Perrard, Rome, Gargominy, Haxaire, Darrouzet & Rortais (2008). A new enemy of honeybees in Europe: the invasive

Asian hornet *Vespa velutina*.

<http://inpn.mnhn.fr/gargo/Vespa%20velutina%20CZ%202008.pdf>

Chauzat & Martin (2009). A foreigner in France: the Asian hornet. *Biologist*, 56(2), 86–91.

<https://secure.fera.defra.gov.uk/beebase/index.cfm?pageid=208>

Maher & Thiery (2010). Comparison of trap designs against the Yellow-legged hornet *Vespa velutina*.

<http://www.docstoc.com/docs/47924527/Microsoft-PowerPoint-Apimondia>

Phillips & Roberts (2010). Information sheet no. 8 – Hornet (*Vespa crabro*).

http://hymettus.org.uk/downloads/Info_sheets_2010/08_Vespa_crabro_1col_infosheet.pdf

Phillips & Roberts (2010). Information sheet no. 9 – Median wasp (*Dolichovespula media*).

http://hymettus.org.uk/downloads/Info_sheets_2010/09_Dolichovespula_media_1col_infosheet.pdf

Roberts, Rome & Villemant (2010). Information Sheet no. 12 – Asian hornet (*Vespa velutina*).

http://hymettus.org.uk/downloads/Info_sheets_2010/12_Vespa_velutina_1col_infosheet.pdf

Villemant, Barbet-Massin, Perrard, Muller, Gargominy, Jiguet & Rome (2011). Predicting the invasion risk by the alien bee-hawking Yellow-legged hornet *Vespa velutina nigrithorax* across Europe and other continents with niche models. *Biological Conservation*. In press.

http://www.elsevier.com/wps/find/journaldescription.cws_home/405853/description

The 80th National Honey Show 2011

Thursday 27th October – Saturday 29th October 2011

International classes and beekeepers' lecture convention

The 2011 National Honey Show will once again be held at the superb St George's College venue in Weybridge

2011 will offer a splendid programme of our overwhelmingly popular workshops

*** Join now ***
be sure to receive your 2011 Show Schedule (available August) contact Sandra Rickwood: srhoneyshow@googlemail.com
Tel: 020 33 55 8716

All enquiries exhibition space and for sponsoring our prestigious lectures, and educational workshops, to showsec@zbee.com



St George's College, Weybridge, Surrey KT15 2QS

www.honeyshow.co.uk E-mail: showsec@zbee.com