



Small hive beetle: the next threat to British honey bees?

The small hive beetle (Aethina tumida) is an endemic parasitic pest and scavenger of colonies of social bees indigenous to sub-Saharan Africa. In this region the beetles rarely inflict severe damage on strong colonies since the bees have developed strategies to combat them. However, A. tumida has since 'escaped' from its native home and has recently invaded areas such as North America and Australia where its economic impact on the apiculture industry has been significant. Small hive beetle, should it become established within Europe, represents a real and live threat to the UK bee keeping industry.

Small hive beetles (SHB) (*Aethina tumida* Murray, Coleoptera: Nitidulidae) are native to sub-Saharan Africa where they exist as scavengers in colonies of African subspecies of western honey bees (*Apis mellifera* L.) (Neumann and Elzen, 2004). The beetle feeds on pollen, honey as well as both adult bees and larval stages. However, SHB within their native range rarely inflict severe damage on strong bee colonies (Lundie, 1940; Ellis *et al.*, 2002). In extreme circumstances, feeding grubs certainly can destroy

weakened or diseased hives, but this scenario is the exception rather than the rule. African honey bees, even if heavily infested, can usually prevent or postpone beetle reproduction.

Increasing international trade

With the continuing increase in the international trade of bees and bee products, the threat of exotic pests becoming established within the European Union (EU) and, more

**Andrew G S Cuthbertson,
James J Mathers,
Lisa F Blackburn,
Mike A Brown and
Gay Marris**

Food and
Environment
Research Agency,
York, UK

Title image: Adult small hive beetle (*Aethina tumida*)

specifically, the United Kingdom is growing. Small hive beetle has now 'escaped' from its native habitat of sub-Saharan Africa and has invaded areas such as North America, where it has caused considerable damage to the bee populations (Hood, 2004). In Florida in 1998 alone, estimates of colony losses and economic damage attributed to SHB infestations and resulting honey contamination cost the industry \$3 million, with over 30,000 colonies lost (Neumann and Elzen, 2004).

Within the UK, honey bees (Figure 1) are estimated to be worth approximately £200 million per annum to the economy, due to the key role they play as pollinators of agricultural and horticultural crops; the value of honey production fluctuates between £15-25 million per annum (Carreck and Williams, 1998; Cuthbertson and Brown, 2006). Should SHB become established in the UK and EU, a scale of impact similar to that seen in North America can be expected.

Small hive beetle poses a major threat to the long-term sustainability and economic prosperity of EU and UK apiculture, and to agriculture and the environment, through disruption to pollination services (Cuthbertson and Brown, 2009). In recognition of its seriousness, SHB has recently been made a notifiable pest (Commission Decision 2003/881/EC) within EU member states. Currently, no SHB populations have been reported to be established within Europe (Ellis and Hepburn, 2006). However, the fact that SHB was intercepted in Portugal in October 2004 (Murilhas, 2005) and a further suspected case identified in November 2006, again in

Portugal, highlights the increased risk of introduction to Europe of this pest through the international bee trade. It has the potential to become a problem for apiculture on a global scale (Brown *et al*, 2002).

Reducing the threat of invasion in the UK

The UK Government, through the Department for Environment, Food and Rural Affairs (Defra), has contingency planning for the eradication and containment of exotic pests should they arrive within the UK. Part of this process involves importing, under special licence, potentially threatening exotic pests into the secure Plant Health Quarantine Entomology Laboratory facilities at The Food and Environment Research Agency (Fera) in York. Here, research is carried out, under stringent conditions of containment, to support Defra Plant Health and Bee Health Policy decisions in regard to contingency planning.

Fera has a strong history in the research and development of containment/eradication strategies against several non-indigenous insects threatening the UK's agricultural and horticultural industry: for example, *Thrips palmi* Karny (Thysanoptera: Thripidae), the sweetpotato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) and the South American leafminer, *Liriomyza huidobrensis* (Diptera: Agromyzidae) (Cuthbertson *et al*, 2005; 2007). All three of these species can cause considerable plant damage, both directly via feeding and indirectly through the transmission of plant viruses (Alegbejo, 2000). Small hive beetle is the latest addition to the list of exotic invertebrate pests requiring investigation under contained laboratory conditions (Cuthbertson *et al*, 2008).

Containment for research purposes

To date, all medication control measures employed against the SHB have been inadequate, and the success rates highly variable. In an effort to control the beetles, beekeepers in the USA use an in-hive organophosphate originally approved for use against adult *Varroa* mites ('Checkmite', active ingredient: Coumaphos) as well as a soil drench (Permethrin) to kill pupal stages. This, of course, has long-term consequences in terms of honey purity and residues which in turn affect consumer perception of honey as a clean natural product. Moreover, excessive or long term pesticide usage can produce resistant beetle populations.

Experiments to develop traps or exclusion devices for the beetles have not been completely successful either. Therefore, it is essential to obtain, and increase, knowledge on

Figure 1. The honey bee, *Apis mellifera*.



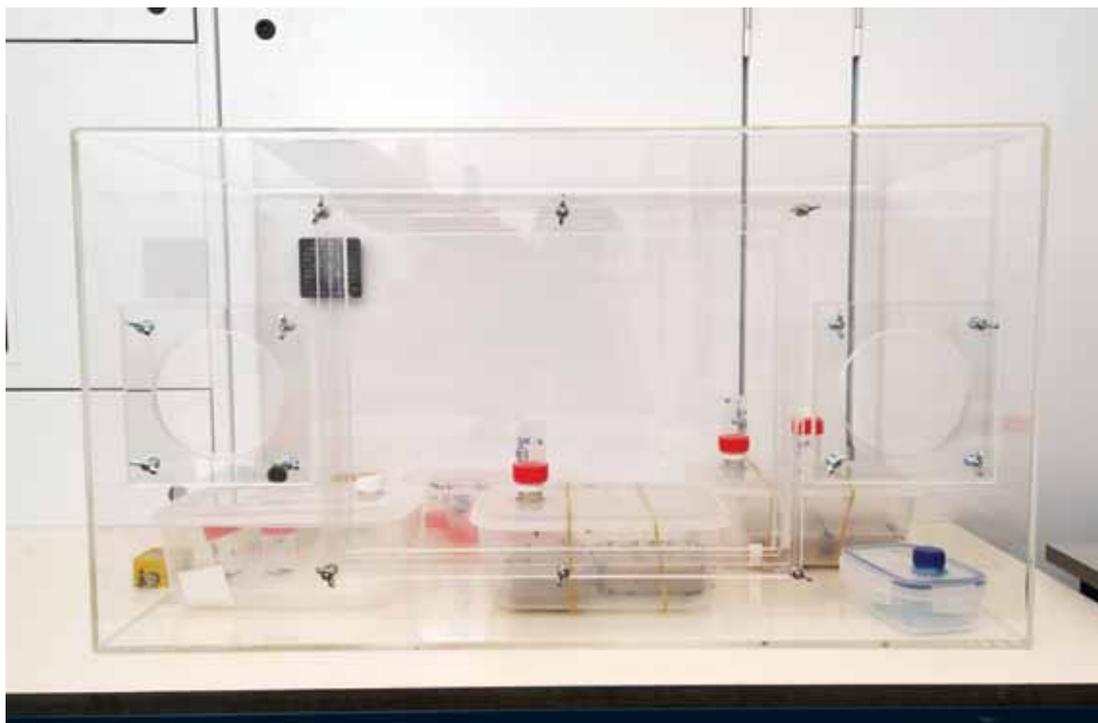


Figure 2. Secure perspex cages for maintaining small hive beetle cultures.

the biology and lifecycle of the SHB in order to investigate possible novel means of control. Laboratory-based cultures of the beetle are therefore essential for such research purposes.

Culturing small hive beetle

At Fera, beetles are cultured in secure, closed, rigid containers that are themselves held within sealed Perspex cages (Figure 2). Wandering SHB larvae (Schmolke, 1974) are placed on sand within the culturing containers (Figure 3a,b) so allowing the larvae to burrow down to pupate (Figure 4). Adult beetles then emerge from the sand into secure collecting jars on top of the containers (Figure 5). The Perspex cages are themselves maintained within a completely sealed, controlled environment (CE)

room, access to which can only be made via a freezing corridor set at a constant temperature of -15°C . To further minimise the risk of insect escape, access to the freezing corridor is through two further rooms, both held under negative pressure. Therefore, as for all non-indigenous invertebrates held at Fera, there is a minimum of six layers of containment in holding SHB.

Population development observations

Preliminary observations obtained during the development of culturing techniques in regard to the beetle's lifecycle and behaviour are proving of much interest and value for the development of contingency plans. Cultures raised between $20\text{-}30^{\circ}\text{C}$ showed a wide range

Figure 3a. Small hive beetle wandering larvae. **Figure 3b.** Larvae placed on sand for pupation.





Figure 4. Small hive beetle pupation chamber in sand.

of adult emergence timings.

For these cultures (714 adult beetles in total) emergence began after 18 days and continued up until 84 days with peak beetle emergence occurring after 36 ± 15.5 days (Cuthbertson *et al.*, 2008). Development of SHB is known to be affected by temperature (Schmolke, 1974). At 34°C, DeGuzman and Frake (2007) observed a total development time of 23 days. Lundie (1940) described development periods of about 80 days at unreported temperatures. Our current observations have found viable adult emergence after 84 days. This would suggest that changes in temperature could have a significant impact on SHB abundance, and that over-wintering of SHB under the UK's temperate climatic conditions is a distinct possibility.

The National Bee Unit currently has viable cultures of SHB within the quarantine entomology facilities at Fera. Research is well under way, and making valuable progress, investigat-

ing the biology and lifecycle of this exotic pest in relation to UK climatic conditions and also into the development of potential control measures for controlling/eradicating SHB should it become established here.

Continued research and development into exotic pest and disease control in relation to honey bees will ensure that populations of this vital environmental component remain preserved and well maintained.

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Figure 5. Adult small hive beetle emerging from sand into collecting container.



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Useful website

www.nationalbeeunit.com – This website contains useful information concerning all aspects of issues relating to honey bees.

Andrew G S Cuthbertson, James J Mathers, Lisa F Blackburn and Gay Marris are research entomologists who investigate the development of integrated pest management strategies against both indigenous and non-indigenous invertebrate pest species. Email: andrew.cuthbertson@fera.gsi.gov.uk; **Mike A Brown** is Head of the National Bee Unit based at the Food and Environment Research Agency. He manages the Bee Health Programme for England and Wales from research and development of laboratory diagnostics through to statutory colony inspection and extension services. Email: mike.brown@fera.gsi.gov.uk

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