

## *Volucella inanis* host testing results

The two invasive species of *Vespula* wasps in New Zealand, commonly called the German wasps and common wasps, are native to Europe, western-Asia and northern Africa. Genetic tests have shown that the populations of both species present here were introduced from southern England. Because these wasps are having a major impact on primary industries, native ecosystems and human health, we are pursuing options for the biological control of these wasps. This process began by first doing an extensive literature review to get an idea of what is already known and develop a list of candidate agents. By working through the candidate agents, we could easily eliminate any that are known to not be host specific, such as generalist predators (robber flies, badgers, honey buzzards, etc.), as well as generalist parasites like wax moths that go for wasps, honeybees and bumblebees. The next phase was to go to their native range and survey the natural enemies present in the nests. This quickly narrowed the list of potential biological control agents even further.

At the top of the list of potential agents is a species of hoverfly, *Volucella inanis*. Globally, there are over forty species of *Volucella* most occurring in Asia. According to the literature, larvae of these *Volucella* species feed in one of four ways: 1. at sap-runs (filtering microorganisms from the sap), 2. are detritivores/opportunistic predators of brood in bumblebee nests, 3. are detritivores/opportunistic predators of brood in social wasp nests and, 4. are parasitoids of brood in social wasp nests. The order of the above feeding types is also likely the order in which these flies have evolved with the parasitoids being the most specialized. *Volucella inanis* is a parasitoid of wasp brood that was found in most wasp nests surveyed in the UK.

New Zealand does not have any native social wasp or bumblebee species. However, there are four species of *Bombus* that were purposefully introduced and are considered as beneficial insects because of their pollination services. To test whether *Volucella inanis* could be safely used as biological control agents against invasive social wasps, we had to make sure the flies would not attack bumblebees. The first type of host test tested is called a no choice-starvation trial and is considered to be the most conservative host test available for evaluating biological control agents because during these tests, the subject often becomes desperate due to starvation and will feed on hosts that they would never normally feed on. So, if you have a negative result of a host selection, this is very strong evidence that the subject will not feed on the test host.

## Methods

Nests of buff-tailed bumblebees, *Bombus terrestris audax*, were purchased from Agrilan UK. This species of bumblebee was chosen because it is present in New Zealand and is commercially available, unlike the other 3 species present in NZ (one is now extinct in the UK, and another is very rare there). Naïve wasp nest material was obtained from excavated parasite-free wild *Vespula vulgaris* nests. For each replicate, brood were placed in the centre of a terrarium (Exo Terra, medium Breeder Box) and one *Volucella inanis* larva was added at least 4 cm away from the brood. The *V. inanis* larva was allowed 1 hr to make a choice of whether to begin feeding on the brood. In preliminary trials, young *V. inanis* larvae began to perish one hour after being away from wasp brood. The bumblebee brood was placed in their normal orientation, i.e. with the brood facing upward. Wasp brood are normally orientated head down but for this experiment, the brood was faced upward to match that of the bumblebees. Six replicates of each treatment were performed.

## Results/discussion

All six replicates showed the *V. inanis* larvae go for the wasp brood and none go for the bumblebee brood after one hour. Towards the end of the test, three of the *V. inanis* larvae sought shelter under the bumblebee nest material, possibly to avoid the light. Since the wasp nest was orientated in an unnatural position, this would have added a level of difficulty for the host location. All the *V. inanis* larvae that went for the wasps had to locate the brood and climb onto the nest material (see photo below) and then squeeze into the wasp larva's cell.

A *Volucella inanis* larva looking for an appropriate wasp grub to visit.

