

A note on *Vespa soror* (Hymenoptera: Vespidae) in Hong Kong

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摘要

Vespa soror (黃紋大胡蜂) 為香港其中一種最大型並較為常見的胡蜂品種，在多數本地郊區環境均可見。然而本品種在香港尚未有記錄；這可能因為其常被誤認為 *Vespa ducalis* (黑尾胡蜂)。對於本種在其分佈範圍內的習性也尚未有任何相關資料。本文淺談本種在香港的習性及年度的蜂群生活循環。

Introduction

Vespa soror du Buysson, 1905 is one of the largest social wasps in Hong Kong and is reasonably abundant in country parks and rural areas. However, this species has not been previously recorded from Hong Kong, possibly because of its having been misidentified as *Vespa ducalis* Smith, 1852. There is also a total lack of information about the biology of this species throughout its range. This paper describes the behaviour and annual life cycle of *V. soror* for the first time.

Eight *Vespa* species are distributed in Hong Kong (personal observation); these large social wasps are commonly known as hornets and are often greatly feared due to their painful stings and supposed aggression. *V. soror* is apparently one of the largest among the *Vespa* species occurring in Hong Kong, having body lengths of 26mm to 35mm in the worker and 39mm to 46mm in the queen. Queens are, in most cases, easily distinguishable from workers by larger body size. *V. soror* can be distinguished (see figure 2) from other local species of *Vespa* by the gena strongly enlarged (in profile at least 1.8 times as wide as the eye in the female) and the vertex also prominently enlarged. These characteristics are found in *Vespa mandarinia* Smith, 1852, which is undoubtedly closely related to *V. soror* and is very rare in Hong Kong. *V. soror* was in fact once considered a subspecies of *V. mandarinia*. Archer (1991, 1995) then considered them to be two separate species, adding that both species showed no structural differences but could be separated by differences in colour. Nguyen et al. (2006) listed several morphological differences between the two, confirming them as different but closely related species.

V. soror in Hong Kong has often been labeled as either *Vespa tropica* (Linnaeus, 1758) or *Vespa ducalis* Smith, 1852. *V. ducalis* bears quite a strong resemblance to *V. soror*, but does not have the strongly developed gena as in *V. soror* (Fig. 2) and is generally smaller in body size and less stocky in shape. Finally, *V. ducalis* is usually darker in overall colour and often has a yellow apical band on the third gastral segment and the pronotum largely yellow, while these features are seldom seen on *V. soror* (personal observations). These differences in appearance allow general identification when individuals of both species are encountered in the wild, but structural characteristics are a more reliable way of identification with complete certainty. The differences between these three species can be seen clearly in figure 1.

Fig. 1D: Worker specimens of *Vespa soror*, *Vespa ducalis* and *Vespa tropica*, shown together for comparison

Fig. 1A: *Vespa soror*Fig. 1B: *Vespa ducalis*Fig. 1C: *Vespa tropica*



Fig. 2A: Head of *Vespa ducalis* (similar in proportion to other *Vespa* species besides *Vespa mandarinia*)



Fig. 2B: Head of *Vespa soror*. Note the greatly enlarged head, especially the gena (the part behind the eyes)



Fig. 3A: Nest site of *Vespa soror*, showing workers in the process of excavating soil to enlarge the nest cavity



Fig. 3B: Nest entrance

V. tropica also occurs in Hong Kong; it is very different in appearance from *V. soror* or *V. ducalis*. Nevertheless, *V. soror* has often been referred to locally as *V. tropica*, which is possibly due to that *V. ducalis* had often been treated as a subspecies of *V. tropica* until Archer (1991).

V. soror is present in North Thailand, North Vietnam and various parts of South China such as Guangdong, Fujian and Hainan Island; thus its presence in Hong Kong is not surprising. I have recorded *V. soror* from many places in Hong Kong, including Sai Kung, Ma On Shan, Sha Tin, Tai Po, Fan Ling, Sheung Shui, Yuen Long and Tuen Mun in the New Territories, as well as Repulse Bay, Aberdeen and Ocean Park in Hong Kong Island. It rarely appears around urban areas or residential districts, but is fairly common in country parks and rural areas.

Despite it being rather abundant, virtually nothing has been written on the biology of *V. soror* (Archer, 1995; Kojima, pers. comm.). The following information is based on observation of individual wasps and active colonies from 2004 to 2008.

Most colonies are found in forested areas. I have observed foraging individuals at altitudes ranging from sea level to over 700m, but nests appear most abundant at elevations of 60m to 500m, being rarer near sea level or at higher altitudes. The nest is usually located underground, often in the well-drained soil of a slope, with the entrance hole dug downwards into the soil surface at an angle, and often located among roots or stumps of large trees (fig. 3B). It is not known if cavities in which nests are built in are pre-existing or dug by the founding queens, although new queens can be seen searching for and entering all sorts of pre-existing cavities each Spring. As the nest grows in size, the workers constantly enlarge the cavity by excavating the soil inside. They usually carry pellets of hardened, compacted earth out and dump them some distance from the nest (fig. 3A). Colonies can often be spotted by the procession of wasps going in and out, some carrying pellets of soil, and by the pile of accumulated earth pellets outside the nest entrance. The depth at which the nest is located varies. Some nests are located in a fairly shallow situation and digging away the surface soil. Others are located deep underground, with a tunnel which may be 60cm or more in length between the nest and the entrance. Sometimes there are more than one tunnel and entrance leading to the nest, and the wasps can be seen emerging from two or three entrances in the soil surface. In many respects, the nesting behaviour of *V. soror* is similar to that of the closely related *V. mandarinia* (as described in Archer, 1995).

A very small number of nests are built inside buildings such as abandoned village houses. I have personally seen and heard of only such three or four instances, marked by the wasps going in and out from gaps in the walls or roof of the structures in question, but have never seen the actual nest because the interiors in all cases were inaccessible.

The nest comprises of several combs covered by a protective envelope. The envelope is thin, brittle and comprised of distinct, separate sheets, and is incomplete, exposing the bottommost combs. The combs in contrast are very heavy and sturdy. The maximum number of combs in a nest is not yet known. In December 2006 I collected a mature nest at Lam Tsuen, Tai Po, which had been treated with insecticide and thus no wasps were present. There were five combs, the first of which contained approximately 370 cells, and the last contained roughly 250 cells. The three middle combs contained approximately 700 cells each. Cells ranged from 9mm to 13.5mm in diameter, with a strong tendency towards distinctly larger cells on the last comb. Based on the activity observed from September till December, the colony which inhabited this nest was not exceptionally populous, so it is probable that the largest nests of this species can reach even larger sizes. The larger combs measured were circular and were approximately 45cm in diameter.

An immature colony was collected in the beginning of August 2008 at a village in Tuen Mun, after paralyzing the wasps with smoke and digging the nest out. Due to hurried conditions in the field, the combs were broken and some of the workers were not captured, but the colony probably contained approximately 60 workers. The nest consisted of three combs, of which the first two contained roughly 200 cells and were of a roughly oval shape, approximately 17cm by 13cm. The third comb had just been constructed and consisted of 12 or 13 incomplete cells. The nest was located roughly 40cm underground, and the entrance was at the base of a tree (**fig. 4A**) – the nest itself was affixed to part of the tree's roots. A thin sheet of envelope had been made across part of the roots, nearly 20cm from the nest itself, blocking the nest from view (**fig. 4B**). Another layer of envelope enclosed the sides of the combs in a neatly semi-circular shape.

In Hong Kong, the queens usually emerge from late March to April each year, and soon start searching for suitable nesting sites. The nest initiation probably begins in early May, while the first workers usually appear in June. Growth of the colony appears slow at first, with roughly up to an estimated hundred or more workers in the average colony in early September. At this point, the colony grows rapidly, all the way till December. I am not able to estimate the number of workers in an average mature colony, but most colonies seem quite large and active, with large numbers of wasps leaving and returning to the nest. Males and new queens (or gynes) emerge from November to early January, after which all colony activity ceases and the new queens enter a short hibernation period. There are roughly 7 months of colony activity, and *V. soror* can thus be considered to have a long colony cycle. During the early stages of the colony cycle, up till September, workers of *V. soror* are usually tolerant of people in the vicinity if the nest is not actually provoked, but can become ferociously defensive if there is any disturbance near the nest, and this species, like other large ground-dwelling hornets, has the potential to pose a serious threat if a nest is inadvertently disturbed. During September to December, the period leading up to the emergence of males and new queens, colonies become highly territorial and defensive. The workers maintain a defensive radius of around 2m or 3m from the nest, and individuals circle this territory. I have also observed them landing on vegetation surrounding the area and rubbing their abdomens on leaves and branches, a possible indication of use of pheromones to define territory. Workers aggressively circle any moving object within the defended area during this period, and will sting if one does not calmly retreat. The sting of *V. soror* is very painful and with long-lasting effects; it possibly has potent venom like *V. tropica* and *V. mandarinia*, both of which are considered the most dangerous among all stinging insects (Schmidt et al., 1986).



Fig. 4A: Entrance of an immature nest, located at the base of a tree



Fig. 4B: A thin separate layer of envelope stretched across part of the tree's roots, approximately 20cm from the nest itself



Fig. 5A: A worker of *Vespa soror* kills a captured gecko



Fig. 5B: A worker has captured an individual of *Vespa velutina*, another locally common hornet



Fig. 5C: Worker capturing a long-horned grasshopper or katydid

V. soror is an aggressive predator which will attack and kill any insect it can overpower (personal observation). I have observed workers returning to the nest with parts of mantids on several occasions, indicating that this species often kills mantids. It often forages in grassy fields and shrubs as well as in wooded areas, and frequently takes large butterflies, dragonflies and grasshoppers, as well as other wasps, including smaller species of hornets (fig. 5B). It may even prey on small vertebrates such as geckos (fig. 5A) Like *V. ducalis* and *V. tropica* (Archer 1991), *V. soror* often attacks the nests of the various Polistine wasps such as species of *Polistes* and *Parapolybia*, in order to capture the larvae and pupae as food for their own young. However, unlike *V. ducalis* and *V. tropica*, *V. soror* often attacks in groups.

On several occasions, I saw workers of *V. soror* approach large, mature nests of *Parapolybia indica* (de Saussure, 1854), *Parapolybia nodosa* Vecht, 1966 and *Parapolybia varia* (Fabricius, 1787). In each case, the hornet worker did not attack, but instead landed just inches away, usually on the branch or leaf supporting these nests, and proceeded to walk back and forth, rubbing its abdomen sideways on the surfaces near the nest. This could possibly indicate usage of pheromones or chemical signals to mark the nest for group attack. While I was never able to stay and watch, invariably I returned the following day to find the nest totally empty, with the adults gone and the brood removed. Although I have not personally observed this, several people I spoke to, including a beekeeper operating in Yuen Long, have noted multiple individuals of this species attacking honeybee hives together, resulting in hives completely ruined and piles of dead bees outside the hive, causing considerable losses. *V. soror* also appears to harm its victims considerably more than *V. tropica* and *V. ducalis*; while the latter two are usually content to drive the original occupants from the nest, *V. soror* often attacks them with its large mandibles if they resist or attempt to defend their brood, often killing or maiming them in the process.

In September 2006, I witnessed an attack on a subterranean colony of *Vespa bicolor* Fabricius, 1787, which is the smallest and apparently the most abundant hornet species in Hong Kong. This attack spanned three days. On the first day, a *V. soror* worker was seen circling the entrance of the *V. bicolor* nest and occasionally landing on the pavement and on vegetation nearby. This individual avoided contact with the *V. bicolor* workers, but two other individuals later appeared and one of these intercepted a *V. bicolor* worker returning to the nest, grabbing it and then carrying it to a nearby branch where it dismembered the *V. bicolor* and chewed the meat of its thorax with its mandibles before carrying it away. The

following day, I returned to the site and found a large number of *V. soror* workers present. At least five or six were circling the entrance and attempting to enter, while many others left or returned to the site; some emerged from the entrance, carrying what was most certainly *V. bicolor* larvae and pupae away. I could not count the exact number of workers involved, but at least twenty were involved. Large numbers of *V. bicolor* were flying in a frenzied manner around the nest entrance, and unfortunately I could not get close enough to take photographs. On the third day, there were only five or six workers returning to the site, and these were still entering the nest and taking larvae and pupae away. There were still *V. bicolor* workers swarming defensively around the nest site, and bodies of *V. bicolor* as well as one or two dead *V. soror* individuals which had possibly been killed by the defending workers were scattered around the area. On the fourth day there was absolutely no activity or any sign of both species around the nest site.

Christophe Barthelemy (personal communication) observed a group attack on a nest of *Parapolybia indica* in Sai Kung Country Park (See **figure 6**; photo copyright Christophe Barthelemy). A large, thriving colony was attacked over the course of a few hours, with five or six individuals present at any given time. As an experiment, some of these individuals were systematically netted and removed as they landed, and yet more arrived; this probably indicates that all these workers were from the same nest. Both this incident and my own observations suggest a strong possibility of *V. soror* using pheromones or other chemical signals, or otherwise having some form of communication in which they are able to direct the attention of other individuals from the same nest towards their target.

All these aspects of the predatory habits of *V. soror* are also in common with *V. mandarinia*, which is known to launch group attacks on beehives and even nests of other social wasps. However, there is still much to be learned about this little-known species.

Acknowledgements

I am grateful to Dr. Junichi Kojima (Ibaraki University, Japan) for critique and commenting on an earlier version of this paper, and to Christophe Barthelemy for sharing observations and photos.



Fig. 6: Workers attacking nest of *Parapolybia indica*.

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