

A record of a group attack and occupation of a Vespine wasp nest by the hornet *Vespa ducalis* (Hymenoptera: Vespidae)

John X.Q. Lee

No. 2, 2/F, Sai Wang Lane, Sai Kung, N.T.

Email: vespa_bicolor@yahoo.com.sg

ABSTRACT

A record of an incident in which multiple workers of the hornet *Vespa ducalis* Smith, 1852 were found occupying a nest of another hornet species is reported. This behaviour is unusual in that this species has not previously been known to attack other vespine wasps, nor has it been recorded for more than a single forager to occupy a prey nest.

INTRODUCTION

This paper describes observations on multiple individuals of the hornet species *Vespa ducalis* Smith, 1852 occupying a nest of *Vespa bicolor* Fabricius, 1787, a smaller species in the same genus. *Vespa ducalis* is usually a specialised predator which preys almost exclusively on nests of polistine wasps and attacks them individually. This is to the author's knowledge the first published record of *V. ducalis* occupying the nest of a vespine wasp, and also the first record of it occupying a prey nest in a group.

NOTES ON *VESPA DUCALIS*

Vespa ducalis is a widely distributed hornet species with a range including India, Nepal, Burma, Thailand, Vietnam, South China, Taiwan, East Russia and Japan. It forms the smallest colonies among all known *Vespa* species (Matsuura and Yamane 1984) and has the shortest colony cycle among all species in Japan (Matsuura 1991) and Hong Kong (Lee 2009), an attribute which is possibly linked to its very specialised feeding habits (Archer 1991; Matsuura 1984; Matsuura and Yamane 1984); new queens emerge and initiate nests only after various species of polistine wasps have already established their nests, and colonies die off earlier than other *Vespa* species as polistine colonies become void of immatures and food thus becomes unavailable.

V. ducalis is known to prey almost exclusively on polistine wasps such as *Polistes* and *Parapolybia*, and to attack singly, preying only on the brood and never harming the adult occupants. Its usual hunting method involves a single individual searching around locations where polistine wasps often build nests, such as in and around small trees, shrubs and under eaves and ledges of buildings (pers. obs.). When a target nest is found, the hornet lands on it and proceeds to pull out the brood, biting off cocoon caps in the process. Prepupae appear to be the preferred choice and are often taken first, followed by pupae, and lastly large

larvae. Small larvae are usually either taken last or totally ignored. The adult occupants generally flee the nest, offering little or no resistance. They gather near the nest and return to it after the attacker leaves. *V. ducalis* is usually content to drive the original occupants away long enough for it to remove as much prey as it can; as a rule it does not harm the adult polistine wasps. This is in common with its close relative *Vespa tropica* (Linnaeus, 1758), which shows the same dependency on polistine wasp nests in Hong Kong. It must be noted that many older Japanese texts discussing "*V. tropica*" in fact refer to *V. ducalis*, as true *V. tropica* are not known from Japan.

OBSERVATIONS

A nest of *V. bicolor* was discovered at Kau Tam Tso (near Wu Kau Tang in the Northern New Territories) by the author in May 2009, as an embryo nest with several pupae. It was built within an old nest of the same species in an abandoned village house, a common habit with *V. bicolor* (pers. obs.). By August 2009, the nest was spherical and the envelope measured about 12cm in diameter and vertical length; when dissected and collected after the attack it was found to contain roughly 165 cells in two combs. The exact number of wasps in the nest was not known, though nests of similar size within the same time of the year often contained 50 to 60 workers (pers. obs.). The author regularly visited and observed the nest from May to August at intervals of one to two weeks.

On 23 August, accompanied by Chan Kam Wah, the author visited the locality and found the nest void of the original occupants. Instead, a few workers of *V. ducalis* had occupied the nest. There appeared to be a total of five or six individuals involved in the occupation. Shortly after we arrived at the locality, two individuals left the nest with their crops full of body fluids from the prey (see discussion below). Two wasps remained outside on the envelope, while another two were inside the nest, consuming the brood. Three of the wasps left shortly after, leaving one in the nest, but another two came to the nest; it is not clear if these were the two which we first saw leaving. The envelope was intact and in a good state of repair, apart from the entrance hole which appeared to have been bitten and enlarged, probably by the attackers. After observing and taking photographs for a period of approximately ten minutes, we broke the envelope to facilitate observation. While *V. ducalis* is an exceptionally placid species which often does not attack even when its own nest is disturbed (Matsuura 1984; Lee, 2009; pers. obs.), the wasps were

visibly agitated when the envelope was broken, buzzing around it but refusing to leave. This clearly showed that they were in the occupation phase.

There were only a few smaller larvae left in the nest by the time the occupation was discovered. As it is normal for *V. ducalis* to attack pupae and larger larvae first, this isn't considered unusual. The following day, I returned and found the nest totally void of brood, with only eggs remaining untouched. The occupiers had completely abandoned the nest. This suggests that they had progressed to the final stage of the occupation phase by the time we came upon it. Two weeks had elapsed since the last time the nest was observed, and it was not possible to estimate the total length of the occupation phase. It is not clear how the *V. ducalis* came to occupy the nest, nor could we confirm that the slaughter phase took place or that the original occupants were in fact killed by the *V. ducalis* and not by something else. However, we did find numerous dead *V. bicolor* with mutilated bodies scattered on the ground below the nest, most with missing legs, wings and antennae and some even with severed heads and abdomens. Thus it is highly probable that the group of *V. ducalis* did actually attack and overpower all the occupants of the nest (see discussion).

DISCUSSION

Many species of hornets have been known to attack honeybees at their nests (Matsuura and Sakagami 1973), and also to prey on other social wasps (pers. obs.), although most species hunt individually, capturing and killing individual foragers leaving their nests or at external food sources (Matsuura 1984; pers. obs.). However, some large species, notably *Vespa mandarinia* Smith, 1852 and *Vespa soror* du Buysson, 1905, are capable of launching coordinated attacks on nests of honeybees and other social wasps, killing off the majority of the adult occupants, and then occupying the nest over a certain period of time, during which workers shuttle back and forth, transporting the brood to their own nest. The process is described in detail in Matsuura and Sakagami 1973, and generally speaking consists of three distinct phases; namely the hunting phase, slaughter phase and occupation phase. In the hunting phase, the hornets attack individually, loitering around the nest entrance and catching individual workers of the target species one by one, bringing each one back to the nest upon capture. During this period several workers from the same colony may be present at the prey nest, but each one hunts individually. The slaughter phase commences when attackers from the same nest stop capturing prey individually, but instead attack and kill the defending workers one after the other, biting and maiming them with their mandibles. This phase ranges in duration from less than an hour to over a day, depending on the number of attacking hornets and the number of occupants in the target nest as well as the intensity of their defence. When most

of the original occupants are killed or cease to defend the nest, the occupation phase begins, in which the attackers occupy the nest over a period ranging from several hours to two weeks, while the captured brood is transported as described above. Some hornets remain in the occupied nest at night, and the entrance is now guarded against intrusion by hornets from other colonies and other animals, including humans. While social wasps do not generally attack people away from their nests, *V. mandarinia* and *V. soror* will guard an occupied nest as ferociously as their own, and will attack and sting anyone who approaches the nest too closely (Matsuura and Sakagami 1973; pers. obs.).

Apart from *V. mandarinia* and *V. soror*, the only other species known to occupy nests of honeybees are *Vespa orientalis* Linnaeus, 1761 (Matsuura and Sakagami 1973) and *V. tropica* (Burgett and Akwatanakul 1982; Ritter and Akwatanakul 2006; pers. obs. unpublished).

The observations reported above therefore represent a valuable record of a presumed group attack by *V. ducalis* on the nest of another social wasp, leading up to the annihilation of the colony and occupation of the nest. In close to nine years of observing social wasps in Hong Kong, I have never encountered any nests of *Vespa* species being attacked by *V. ducalis*. To the best of my knowledge, there are also no published records of such attacks. While it is not surprising that there have been no observations or reports on such behaviour, it is all the more interesting because *V. ducalis* is the species least likely to attack en masse, due to its small colony size, its hunting habits and the the manner by which it feeds its larvae (see below).

V. ducalis is unique among hornets in that it feeds its larvae exclusively with regurgitated crop contents and never with anything solid (pers. obs.). In several observation colonies I reared indoors, workers would ignore any whole insects presented to them, and while they would accept items such as the thoraxes of dragonflies or honeybees cut open to expose the flesh, the wasps would chew on them for a period of time, but would then drop them, and did not feed anything to the larvae at all. Through long periods of time spent watching my observation colonies as well as those in the wild, it was also apparent that workers returning to the nest never carried any solid food or fed any visible object to the larvae, but instead would return with their gasters distended by the engorged crop and feed the larvae through regurgitation. This is in contrast with *V. tropica*, which is recorded to have similar predatory habits throughout its range, although it is known to attack and occupy nests of honeybees en masse in tropical regions such as Thailand and Singapore (Burgett and Akwatanakul 1982; Ritter and Akwatanakul 2006; pers. obs. unpublished). Although *V. tropica* appears to prey exclusively on polistine wasps in Hong Kong, imbibing the body fluids of polistine wasp immatures and feeding its own larvae by regurgitation, workers in observation colonies reared indoors by the author readily took prey such as the thoracic

flesh of dragonflies, crickets and even pieces of prawn meat, and fed these to the larvae after 30 to 120 seconds of mastication. Thus the aspect of the hunting phase in this instance is highly puzzling. It seems unlikely that the gathering of attackers from the same colony leading up to the slaughter and occupation could have developed without the hunting phase. However, while it is perfectly conceivable that *V. tropica* could first begin hunting honeybees or other wasps at their nests independently of each other before proceeding to the slaughter phase once enough individuals from the same nest are present, it is highly unlikely for *V. ducalis* to do the same. Since *V. ducalis* feeds its larvae only on liquid crop contents obtained from the larvae and pupae of other wasps, and unlike other hornets does not feed the flesh of insects to its larvae, it is highly unlikely that it would hunt honeybees or other wasps since the solid flesh would be useless to it.

Since I did not witness the original attack, I have considered the possibility that the *V. bicolor* nest was first attacked by another species such as *V. soror* or *V. tropica*. However, this is unlikely for three reasons. Firstly, it does not make sense that another species such as *V. soror* or *V. tropica* attacked and gained occupation of the *V. bicolor* nest only to have *V. ducalis* take over and take the prey for themselves; if another species were to have attacked and occupied the nest they would have remained in the nest till they consumed all the brood, and there would be nothing left in the empty nest which would warrant subsequent occupation by *V. ducalis* to obtain. Secondly, while I have also considered the possibility that the nest could have first been attacked and occupied by another species, which in turn was driven away by *V. ducalis*, this is also highly unlikely due to the fact that among the six common *Vespa* species in Hong Kong *V. ducalis* is always at the lowest level of the dominance hierarchy at external food sources such as fallen fruit and tree sap in Hong Kong (pers. obs.) and this also holds true in Japan, where it is the least dominant among five common species at sources of tree sap (Matsuura 1984). From numerous personal observations it is often chased away by workers of other *Vespa* species, and is always at the losing end of any physical combat. As hornets guard conquered nests fiercely during the occupation phase, it is unlikely that *V. ducalis* would be able to enter and take over a nest guarded by either *V. soror* or *V. tropica*. One might argue that if *V. ducalis* is presumed capable of overpowering a *V. bicolor* colony, it should also be able to take over a colony occupied by another species, but with *V. bicolor* being the smallest local hornet species, the size difference between the two species would make it far easier and more likely for individuals of *V. ducalis* workers to overpower *V. bicolor* than to overpower either *V. soror* or *V. tropica*. At food sources such as fallen fruit or tree sap, individuals of *V. ducalis* sustain no damage in combat with *V. bicolor*, which often gives up attempting to drive them away if they persist in attempting to feed from the same fruit or tree, but are often injured by *V. soror* and even *V. tropica* under similar

circumstances (pers. obs.). Lastly, hornets generally forage individually; even in species like *V. mandarinia* or *V. soror*, they work independently of each other before the slaughter phase begins. If another species had first attacked the *V. bicolor* nest and taken the prepupae, pupae and large larvae, it is possible that a single individual of *V. ducalis* could find the nest and take the remaining small larvae, but it is highly unlikely that more individuals would be recruited to occupy and guard a nest with such a small remaining amount of prey inside. Therefore, although I cannot prove that *V. ducalis* was responsible for the original attack which led to the demise of the colony due to a lack of direct observations, these three reasons suggest that the group of *V. ducalis* were indeed the original attackers and not opportunists moving in only after another species first invaded the prey nest.

It should be noted that according to my personal observations covering the same localities over seven years, foraging individuals and nests of *V. ducalis* were atypically abundant in 2009. Therefore, there is a possibility that the need for food could not be met by polistine nests alone, triggering the wasps to attack vespine wasps instead. Due to the fact that vespine wasps are far more capable of defending their nests against another *Vespa* species, an individual *V. ducalis* would not have been able to invade the *V. bicolor* nest and gain access to the brood, thus necessitating several individuals to invade and overpower the original occupants.

Besides this particular incident, I observed a single worker of *V. ducalis* circling and landing on a nest of *V. bicolor* built in a small tree in September 2010. It did not attempt to attack or capture any of the *V. bicolor* workers, but instead landed and walked on the envelope as well as the branches surrounding the nest, taking flight and circling for brief periods before landing and walking again. Occasionally it was attacked and brought to the ground by the *V. bicolor* workers, which at one point became quite agitated, resulting in a group of 15 to 20 rushing about the envelope and preventing the *V. ducalis* worker from landing. The intruder appeared to suffer no damage from these attacks. The circling, landing and walking continued for nearly 45 minutes before the wasp flew off and did not return. Unfortunately I did not find out the result of this behaviour because the nest was destroyed by people the next day. Given that the *V. ducalis* individual in question showed a distinct interest in the *V. bicolor* nest, yet made no attempt to attack or capture any of the workers, it is plausible that *V. ducalis* bypasses the hunting phase and instead, by flying near and walking on the nest envelope or nearby objects, possibly leaves chemical trails which other individuals from the same colony pick up, entering directly into the slaughter phase. This remains an open question and further observations are certainly welcome.

ACKNOWLEDGEMENTS

I would like to thank Christophe Barthélemy and Graham Reels for their skilled editing, constructive criticism and advice on this article. I also thank Chan Kam Wah for invaluable assistance in observing *V. ducalis* throughout 2009.

REFERENCES

Archer, M. E. 1991. Taxonomy and bionomics of the *Vespa tropica* group (Hymenoptera, Vespinae). *Entomologist's Monthly Magazine* 127: 225 -232.

Burgett, M. and Akwatanakul, P. 1982. Predation on the Western Honey Bee, *Apis mellifera* L., by the Hornet, *Vespa tropica* (L.). *Psyche* 89: 347 – 350.

Lee, J. X. Q. 2009. *Potentially Dangerous Bees and Wasps of Hong Kong*. Hong Kong Entomological Society Popular Entomology Book Series #2. 126pp.

Matsuura, M. 1984. Comparative biology of the five Japanese species of the genus *Vespa* (Hymenoptera, Vespidae). *Bulletin of the Faculty of Agriculture, Mie University*, 69: 1 – 131.

Matsuura, M. 1991. *Vespa* and *Provespa*. In: *The Social Biology of Wasps* (Ross, K.G. and Matthews, R. W. eds.). Cornell University Press. 678pp.

Matsuura, M. and Sakagami, S. 1973. A bionomic sketch of the giant hornet, *Vespa mandarinia*, a serious pest for Japanese apiculture. *Journal of the Faculty of Science, Hokkaido University, Series VI. Zoology*, 19(1): 12 – 162.

Matsuura, M. and Yamane, Sk. 1984. *Biology of the Vespine wasps*. Hokkaido University Press, Sapporo. 429pp.

Ritter, W. and Akwatanakul, P. 2006. Honey bee diseases and pests: a practical guide. *FAO Agricultural and Food Engineering, Technical Report 4*.

FIGURES



Figure 1: Individuals of *V. ducalis* at the occupied nest of *V. bicolor*.



Figure 2 & 3: Individuals of *V. ducalis* feeding on the larvae before returning to their own nest.



Figure 4 & 5: Other individuals not feeding on the larvae but lingering around the occupied nest



Figure 6: A worker visibly agitated after the envelope was removed to facilitate observation