Research Note

Studies on the ecology of social wasps and bees in urban environments

1. Records on aerial nests of the giant hornet, *Vespa mandarinia japonica* (Hymenoptera: Vespidae) within human buildings

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Abstract: Three nests of the giant hornet, *Vespa mandarinia*, have been recorded for the first time in man-made structures in urban areas after 1998. One was in the wall cavity of a wooden house, one was under the floor and one was in the roof space. The nest structure was peculiar in that the top comb was strengthened with a highly developed roof envelope which had many ribbon-like pillars. The biggest nest contained 4,677 cells including 670 queen cells in 4 combs with 540 workers and the foundress queen.

INTRODUCTION

In Japan both the stings and the nests of some hornet (*Vespa*) species have become a social problem since the early 1970s, especially in residential or urban areas (Makino et al., 1981; Matsuura, 1992). The giant hornet *Vespa mandarinia* are usually abundant in rural areas and hillsides which may provide characteristic nest sites or suitable food sources (Matsuura and Sakagami, 1973; Matsuura, 1995).

This paper records for the first time the aerial nests of *V. mandarinia* built in man-made structures in urban environments, and gives information about the colony size and a peculiar nest structure which these nests develop.

NESTS SURVEYED

Data were collected from 1,756 nest sites, during the period 1954–2001, mainly in central to southwestern Japan. These

nests were located by an extensive search, or by following queens and/or workers flying from bait stations or food sources to the nesting sites. Some nest locations were reported by local pest control operators and beekeepers.

As already reported by Matsuura (1984), the queens of *V. mandarinia* usually select underground cavities as nest sites. The cavities are either associated with rotten tree roots or are made by small vertebrates such as rodents or by snakes. Occasionally, nest sites occur in tree hollows close to the surface or 1–2 m above the ground.

Since 1998 we have found three nests of this species in man-made structures in residential areas, and the composition of these nests is shown in Table 1.

The characteristics of these nests are as follows:

1. Nest 9805 (Figs. 1, 2). This nest was collected by one of the authors, K. Koike, in a residential area of Nanago, Iwai City, Ibaraki Prefecture, central Japan.

Table 1. Composition of *Vespa mandarinia* nests built in man-made structures.

Nest cord	Date of collection	Nest size width×height (cm)	No. of combs	No. of cells	No. of adults	
					Foundress queen	Workers
9805	5 Aug. 1998	31×48	5	≈2,100	1	266
9904	16 July 1999	10×5	2	116	1	11
0022	10 Sept. 2000	84×23	4	4,677	1	540

The nest was in an east-facing wall cavity of an old wooden house at a height of about 1.8 m. The wall cavity space measured nearly 15 cm in width and 60 cm in height. A pre-existing slit in the wall was used as the entrance leading to the nest cavity. The length of the tunnel to the nest was about 90 cm.

The nest was characterized by the poor development of the envelope, which consisted of one plate-like sheet of rough and imperfect texture as seen in subterranean cavity nests. The nest primordium was attached to a wooden bar in the wall cavity about 10 cm wide. The first comb was connected with the roof envelope by nine pillars which were ribbon-like in structure, 2–3.5 mm thick, 8–14 cm long, extending from the mainstay.

2. Nest 9904 (Figs. 3, 4). This nest was taken by K. Koike in a residential area of Shinko, Iruma City, Saitama Prefecture, central Japan. It was built at a height of about 50 cm under the first floor of a two-story house. The nest primordium was attached to the surface of glass fiber used as heat-insulating material under the floor. An air vent (40×20 cm) in the west-facing concrete foundation was used as the nest entrance. The foundress queen and workers walked 35 cm on the floor to reach the nest from the entrance.

3. Nest 0022 (Figs. 5, 6). This nest was taken by Mr. Shoei Nishi in a densely built-up area of Shimoobata, Obata Town, Mie Prefecture, western Japan. The nest was found at a height of about 2.5 m in the south-facing roof-space of the first floor of a two-story wooden house. A preexisting slit in the wooden wall was used as the nest entrance, and the tunnel length to the

nest was about 45 cm.

The top comb was 84×72 cm in diameter, with 3,020 cells, being larger than the second comb (54×52 cm, with 1,350 cells). These two combs were the largest so far recorded in Japan (cf. Matsuura and Sakagami, 1973; Matsuura, 1995), and contained 670 queen cells.

The envelope consisted of one plate-like sheet of rough and imperfect texture, and was absent where the combs were adjacent to the wall or other obstacles in the roof space. Each comb was connected to another by one main pillar (1.4–2.1 cm long) and 6–52 auxillary pillars (1.2–2.4 cm long). The nest primordium was attached to a wooden bar about 8 cm wide, which was used as a mainstay. The top comb was connected with the roof envelope by 22 pillars which were ribbon-like structure, 3–6 mm thick and 10–34 cm long, extending from the mainstay.

The ceiling boards under the nest were very damp and fouled with hornet faeces (Fig. 6), which provided food for scavenging insects such as *Volucella* spp. (Diptera, Syrphidae), *Ptecticus tenebrifer* (Diptera, Stratiomyidae) and *Velleius dilatatus* (Coleoptera, Staphylinidae).

DISCUSSION

Matsuura (1992) suggested that the fixed selection of nesting sites of *V. mandarinia* has been one of the most important factors responsible for the unsuccessful transition of this species from natural environments to urban environments. However, it is now evident that in human environments buildings may be used by this species as successful nesting sites.

Fig. 1-6. Various nests of *Vespa mandarinia* in man-made structures in urban areas. Adult hornets were removed after having been killed with insecticides.

Figs. 1 and 2. Nest 9805 built between wooden walls of house. Fig. 3. Nest 9904 built under the floor. Fig. 4. Entrance to the Nest 9904. Fig. 5. Nest 0022 built in roof spaces. Fig. 6. Wet and fouled ceiling boards (arrow) under the Nest 0022 with hornet faeces.

The proximity of urban habitats in Japan to natural habitats may also provide conditions more suitable for the establishment of the colonies of this species.

Archer (1989) showed that for three vespine species of British *Paravespula vulgaris*, *Vespula rufa* and *Dolichovespula*

sylvestris, aerial nests were absent in rural areas but were associated with buildings and other man-made structures in urban/semiurban areas. Akre et al. (1981) noticed an increased use of aerial nest sites in man-made structures by *P. germanica*, which has been recently introduced into

North America, and is well able to make use of man-made aerial nest sites. *V. mandarinia* may have succeeded in adapting to more varied conditions in urban environments.

Nest activity of *V. mandarinia* continues until November and the mean number of cells finally reaches 2,712.4 (SD±984.7) in natural environments in central to southwestern Japan (Matsuura, 1984). Though Nest 0022, which was collected in September, had already constructed 4,677 cells, the colony would probably have grown for another month if it had not been collected.

A particular feature of these nests was the strengthening of the top comb through a roof envelope with many ribbon-like pillars extending from the mainstay. In subterranean nests the top comb is usually abandoned after summer and is rotted by molds (Matsuura and Sakagami, 1973; Matsuura and Yamane, 1990).

The problem of *V. mandarinia* invasion into urban environments in Japan may have three aspects: (1) they are the stinging pests of humans known as the most venomous insects (Schmidt et al., 1986), (2) they may contaminate wooden house walls and roof spaces just under the nests through great volumes of adult fluid excretions, (3) they may have effects on urban ecosystems as hyperpredators (Matsuura, 1991). Further work is required on the impact of this species in urban environments.

This paper reports a preliminary investigation. Since giant hornets are a potentially pest species it is important to gather information on the biology and impact of this species in urban environments from various localities, over several years.

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