Nesting Habits of Some Hornet Species (Hymenoptera, Vespidae) in Northern Thailand

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ABSTRACT

Seven nests of four hornet (*Vespa*) species collected around Chiang Mai, northern Thailand were described. Species observed were: *V. affinis* (2 nests), *V. mocsaryana* (2), *V. velutina* (2), and *V. tropica* (1). Three species coexisted on the Campus of Chiang Mai University. First reliable record of the colony composition of *V. mocsaryana* was presented. All the nests had only one foundress queen in July/August (mid- to late polyethic stage).

Key words: *Vespa spp*, nesting sites, Vespidae

INTRODUCTION

The vespid genus *Vespa* (hornets) is principally Oriental and eastern Palearctic in distribution, and has the largest number of species in hilly and montane regions in tropics and subtropics from eastern Himalaya through Myanmar and Thailand to southern China (van der Vecht, 1957, 1959; Matsuura and Yamane, 1990; Carpenter and Kojima, 1997). The highest diversity in the nesting habit of hornets is also anticipated in this region (Nguyen and Carpenter, 2002), but information on their biology is quite restricted.

Nesting biology of some hornet species around Chiang Mai, northern Thailand during late July and early August in 2001 were studied. Seven nests of four species of *Vespa* were collected and their nesting characteristics were observed and recorded.

MATERIALS AND METHODS

Study sites and methods

Chiang Mai is located at ca. 18/N and has a tropical monsoon climate, with relatively distinct rainy and dry seasons. The material was collected in the rainy season. The Campus of Chiang Mai University, where most of the nests were located, was 315 m in altitude, while a Karen village, Mae Wang, where a nest of V. *tropica* was located, was around 1,000 m in altitude.

Hornet nests found on trees and buildings and underground were recorded and photographed, then collected using an anesthetic, an insecticide sprayer and protective suits after stuffing cotton in nest entrances. Returning wasps were netted for one hour after nest collection. Collected nests were carried to the room and cell maps (Yamane and Yamane, 1975) were taken to record colony contents. Identification of species was made, and the results were checked by Prof. Seiki Yamane of Kagoshima University.

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RESULTS

Nesting sites

Nesting sites of the collected colonies are given in Tables 1 (A-G) together with other biological information. All nests (two) of *V. affinis* (TH01-MN-01, -02) (Figure 1d, 1f) and two of *V. mocsaryana* (-03, 04) (Figure 1a, 1c) were found in the open sites. Both branch and structural nestings were recognized in these species. One of the nests of *V. mocsaryana* (-04) (Figure 1a) was located in a hidden site in a bamboo bush close to the ground. The two *V. velutina* nests (-05, -06) were made under the eaves of university buildings (Figure 1b, 1e). The single nest of *V. tropica* (-07) was found in soil of a rocky slope.

In Chiang Mai University campus four nests of three species were collected. The bigger of the two nests of *V. affinis* was only 60 m apart from a nest of *V. velutina*, and the distance between the two *V. velutina* nests was 80 m.

The single nest of *V. mocsaryana* (-03) and the two nests of *V. velutina* found on the university campus had no trace of structure constructed by the foundress, thus were suspected of having moved from the original place (nest relocation *sensu* by Matsuura, 1984 and Matsuura and Yamane 1990; or translocation of nest *sensu* by Edwards, 1980). No information was obtained on the original nesting sites of these species.

Nests of two other species, *V. mandarinia* and *V. soror*, were sold at the markets around Chiang Mai, but their origins (nesting sites) were not traced.

Nest structure

Structure of envelope and comb in the four species was summarized in Table 2. Several types of envelope were recognized. In *V. affinis* and *V. velutina* the envelope was composed of 'shells', giving a scalloped pattern. However, in the latter 'shells' were larger and less defined or wider than in the former. In both species the envelope was approximately 4.5 cm thick. The *V. mocsaryana* nests had an envelope composed of longitudinal wide tunnels rather than 'shells', and was only 1.5 cm thick. The single underground nest of *V. tropica* was damaged when collected, and the size could not be measured; the envelope was like a cylinder made of sheets of waving paper and without distinct 'shells'.

In terms of the number of combs and comb size *V. affinis* constructed the largest nests, while *V. tropica* did the smallest. But in the number of cells *V. velutina* rivalled *V. affinis*.

Colony composition

Colony composition of the seven nests was given in Table 1 (A-F). In all the nests the founding queen was still alive; polygyny was not seen. In the foundress of *V. tropica* the wings were almost worn out and the body shined black.

The number of workers was large in *V. affinis* and *V. velutina* (1381-1457), while less than 300 were present in the nests of *V. mocsaryana* and *V. tropica*. A clear relation was seen between the numbers of workers and cells. From a nest of *V. affinis* a male and a new queen were collected, and in a nest of *V. mocsaryana* a male was seen.

In the three species (excluding *V. tropica*), the first comb (sometimes also second) almost ceased to be used with few eggs and young larvae. In *V. tropica*, however, the first comb was still being used to rear young, the numbers of eggs and young larvae matching those in the second comb.

DISCUSSION

The Campus of the Chiang Mai University has an area of only approximately 2.9 km^2, but harbours at least three species of hornet. Although the number represented only minor part of the whole hornet fauna in Thailand (13 species; Carpenter and Kojima, 1997), the fact that three predaceous species with similar nesting sites coexisted in a small area might give one of the

Table 1 Colony composition of the collected nests.

1-A. *Vespa affinis*: TH01-MN-01 (on a bamboo stem, at 1.5 m above ground; Mae Wang suburbs of Chiang Mai).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	20.0	18.0	5	5	2	0	0	0	2	458	472
2	25.0	19.0	92	14	19	5	2	5	5	447	586
3	25.0	23.5	138	28	42	70	25	26	58	304	701
4	28.0	24.5	238	74	61	74	27	38	69	298	879
5	32.5	27.0	382	98	68	194	72	64	104	142	1124
6	40.5	32.0	628(5)*	179	234	426	119	124	256	64	1958
7	35.0	28.5	473(16)	77	136	305	83	91	211	12	1376
8	24.0	20.5	17(2)	25	47	181	91	70	125	7	563
Total			1968(23)	500	609	1255	328	425	830	1732	7647

Adults. Foundress: 1, females: 1376, males: 3, new queen: 1 Numerals in parentheses: no. new queens

1-B. *Vespa affinis*: TH01-MN-02 (on the window frame; Campus of Chiang Mai Univ.).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	7.5	7.0	1	0	0	0	0	0	0	103	104
2	13.0	8.0	25	0	0	0	0	0	0	98	125
3	20.0	14.0	84	27	36	8	5	4	36	170	370
4	25.0	13.0	112	26	43	18	14	10	43	119	385
5	28.0	13.0	141	58	31	23	12	13	96	107	481
6	30.0	17.0	202	73	34	21	10	15	125	190	670
7	28.0	15.0	111	71	35	18	12	33	94	61	454
8	20.0	11.0	51	42	36	38	18	27	51	30	301
9	6.0	5.0	0	0	0	0	0	1	12	28	41
Total			727	297	215	126	71	103	457	906	2913

Adults. Foundress: 1, females: 486, males: 0, new queen: 0

1-C. *Vespa mocsaryana*: TH01-MN-03 (on the ceilings of a building; Campus of Chiang Mai Univ.).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	8.0	7.0	30	10	9	6	5	3	7	0	70
2	12.0	12.0	116	50	21	19	16	11	52	0	285
3	13.5	13.5	129	70	42	41	18	20	69	0	389
4	10.0	10.0	64	30	30	27	20	20	25	3	219
Total			339	160	102	93	59	54	153	3	963

Adults. Foundress: 1, females: 230, males: 0, new queen: 0

1-D. *Vespa mocsaryana*: TH01-MN-04 (in bamboo bush, at 1.0 m above ground; Tha Tarn; suburbs of Chiang Mai).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	12.5	11.0	86	28	21	18	13	12	32	25	235
2	15.5	15.0	135	49	45	34	33	25	90	3	414
3	16.5	15.0	178	56	49	51	27	38	130	2	531
4	7.5	7.5	0	19	19	14	25	28	36	1	95
Total			399	138	134	117	98	103	288	31	1275

Adults. Foundress: 1, females: 299, male: 1, new queen: 0

1-E. *Vespa velutina*: TH01-MN-05 (under the cases of a building; Campus of Chiang Mai Univ.).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	26.0	24.0	300	20	10	5	5	2	3	393	738
2	28.0	26.0	375	75	64	80	40	28	76	219	957
3	33.0	31.0	342	308	138	112	106	118	209	138	1471
4	33.0	32.0	710	166	107	186	112	96	144	93	1614
5	26.0	25.0	350	169	137	196	140	154	179	36	1361
6	8.0	7.0	0	0	2	5	13	20	48	8	96
Total			2077	738	458	584	416	418	659	887	6237

Adults. Foundress: 1, females: 1456, male: 0, new queen: 0

1-F. *Vespa velutina*: TH01-MN-06 (on ceilings of a building; Campus of Chiang Mai Univ.).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	20.0	19.0	244	16	8	2	0	0	0	214	484
2	23.0	21.0	464	96	56	64	30	28	58	94	890
3	25.0	20.0	324	214	52	56	36	18	132	32	864
4	23.0	23.0	340	174	110	163	106	90	252	11	1246
5	19.5	16.0	111	162	56	58	50	38	168	5	648
6	13.0	10.0	0	0	0	24	18	19	33	2	96
Total			1483	662	282	367	240	193	643	358	4228

Adults. Foundress: 1, females: 802, male: 0, new queen: 0

1-G. *Vespa tropica*: TH01-MN-07 (the underground, Tha Tarn; the suburbs of Chiang Mai).

Comb No. from top	Diameter of comb (cm)		Number of immatures: I-V indicate larval instars							Number of cells	
	Long	Short	Pupae	V	IV	III	II	I	Eggs	Empty	Total
1	22.0	19.0	106	42	34	25	20	12	75	25	339
2	19.0	18.0	80	41	33	26	15	16	61	22	294
3	7.0	6.5	15	14	3	5	2	4	10	3	56
Total			201	97	70	56	37	32	146	50	689

Adults. Foundress: 1, females: 147, male: 0, new queen: 0

reasons for a rich hornet fauna in Thailand. In the Ryukyu Islands, Japan competitive exclusion of hornet species among islands has been implied (Yamane, 1988). Additional information on food preference in the three *Vespa* species and prey biomass around Chiang Mai should be collected.

Nesting sites in the four species well agreed with those reported previously, though information on the nesting habits of *V. mocsaryana* was almost lacking. For example, *V. affinis* has been known to construct nests in open spaces (mainly on small trees or in bushes) in subtropical Japan (Martin, 1992), Taiwan (Yamane, 1977), Sulawesi (Kojima *et al*., 2001), Sumatra (Matsuura, 1990), and India (Das and Gupta, 1989). In the present survey one nest was found on a window frame of a building. Matsuura (1990) also reported that in Sumatra seven of the 214 collected nests of this species were nesting on exposed sites of buildings (another 17 nests were found from attics). *V. velutina* constructs nests on the branch of big trees (but occasionally in bushes and in buildings) in Taiwan (Yamane, 1977). *V. tropica* is generally an underground nester, structural nests being rarely found in Sumatra (Matsuura, 1990). Archer (1997) mentioned that almost nothing was known of the nesting habits of *V. mocsaryana*.

Some nests of *V. velutina* and *V. mocsaryana* were found with no trace of initial nest structure retained. This suggested a high probability that these nests were relocated in open locations after moving from original sites. The nest relocation has been frequently observed in some Japanese species such as *V. simillima*, *V. crabro* and *V. dybowskii* (Makino *et al*., 1981; Matsuura, 1995). Species constructing large nests may tend to move from covered sites for initial nests to exposed sites with colony growth, though in Thailand no information is available on the site of initial (embryo) nests in *Vespa*.

The pattern of envelope varied from species to species, but it was not evident that this character had any phylogenetic implication. A difference in

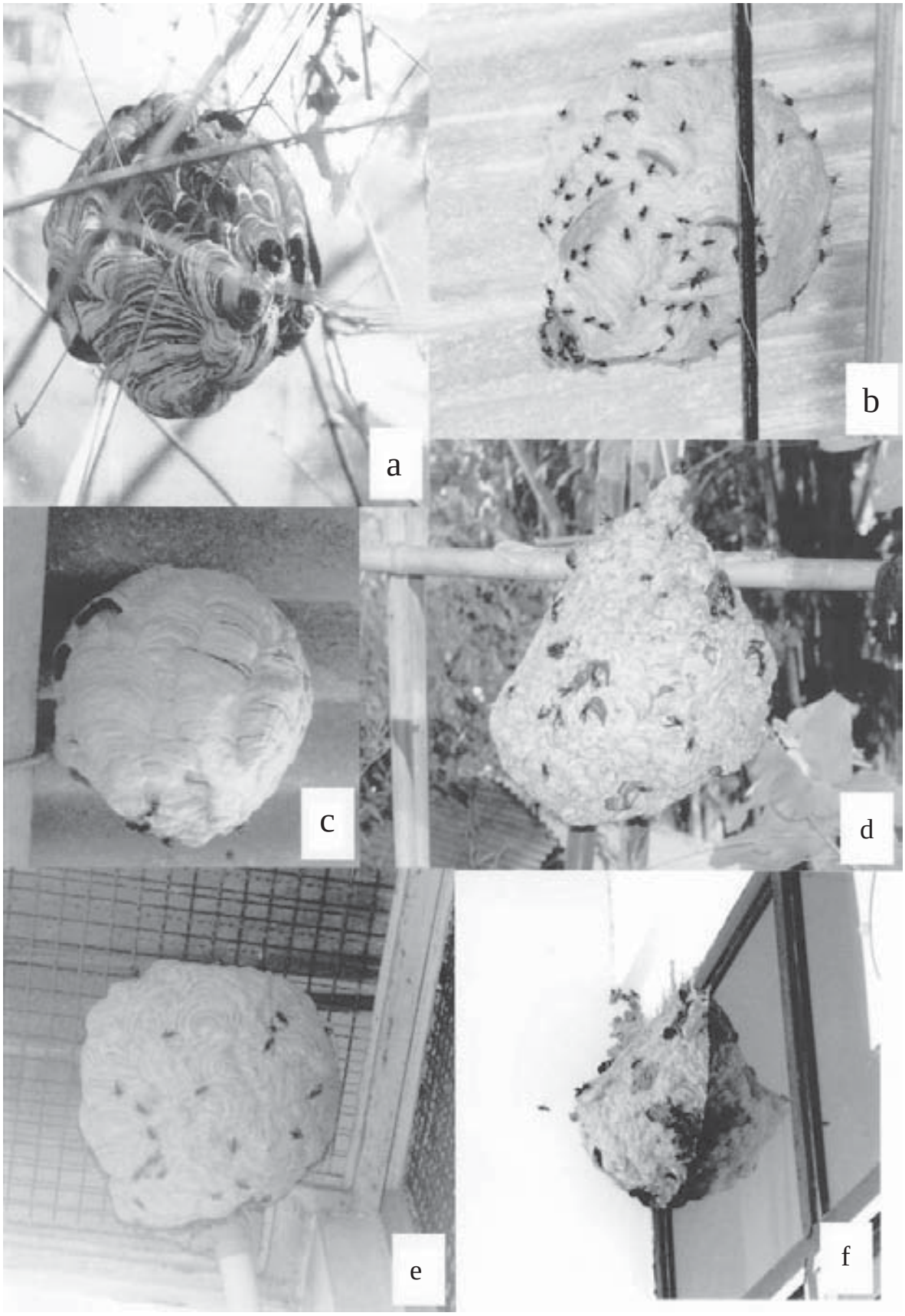

Figure 1 Nests of *Vespa spp*.
a. *V. mocsaryana* b. *V. velutina* c. *V. mocsaryana* d. *V. affinis* e. *V. velutina* f. *V. affinis*

Table 2 Nest structure of collected hornet species.

	Comb no.	No. of cells	Diameter of largest comb (cm)	Nest diameter incl. envelope (cm)	Envelope pattern	Direction of entrance	Nesting type
V. affinis (TH01-MN-01)	8	7648	32.0×40.5	55.0	Scalloped	North	Open site
V. affinis (TH01-MN-02)	9	2913	17.0×30.0	48.0	Scalloped	Northeast	Open site
V. mocsaryana (TH01-MN-03)	4	963	13.5	18.0	Tunneled	East	Open site
V. mocsaryana (TH01-MN-04)	4	1275	15.0×16.5	23.0	Tunneled	East	Open site
V. velutina (TH01-MN-05)	6	6237	32.0×33.0	51.0	Scalloped	East	Open site
V. velutina (TH01-MN-06)	6	4228	33.0	37.0	Scalloped	East	Open site
V. tropica (TH01-MN-07)	3	147	19.0×22.0	33.5	Sheet-like	West	Covered site

envelope pattern was recognized between *V. velutina* and *V. mocsaryana* which were considered to form a monophyletic group by Archer (1994, 1997). More information across all the vespine species and their geographical races.

Judging from colony composition, most of the nests examined in this study were thought to be at mid- to late polyethic stages (Matsuura and Yamane, 1990). Therefore, the colony size among the species could not be compared. For example, the two nests of *V. velutina* examined were in some parameters smaller than those of *V. affinis*. *V. velutina* is, however, known to construct huge nests in Taiwan with the maximal number of cells attaining 20,000 (Yamane, 1977, 1992), while the biggest nests of *V. affinis* there has had only 6,178 cells (Matsuura, 1973). Although in tropical areas *V. affinis* might construct much larger nests (15,065 cells in Papua New Guinea recorded by Spradbery, 1986; 14,000 in the Philippines reported by Starr and Jacobson, 1990), in this species the colony life span tended to be shorter and colony size smaller than in sympatric populations of *V. velutina*.

The presence of only one foundress in each colony does not necessarily indicated the haplometrotic colony foundation. Matsuura (1990) reported that in Sumatra approximately 80% of the initial colonies of *V. affinis* were pleometrotic in colony foundation; the number of foundress ranged between 1 and 14, and in some nests multiple queens remained into the mature stage (Martin, 1995). Multiple-queen colonies in northern Thailand were not witnessed, though only a few colonies were examined for each species.

In spite of the rich species diversity of *Vespa* (13 species) in Thailand only scanty information has been available. Even the distribution range for each species is not known in detail. It is hope that this report will stimulate Thai entomologists to intensively study this ecologically

and economically important group of wasp.

CONCLUSION

Considering the short survey period and small area surveyed, the number of species (4) collected indicated that northern Thailand seemed to harbour a rich hornet fauna. Nests of three species (*V. affinis, V. mocsaryana* and *V. velutina*) were found in the open sites, while the single nest of *V. tropica* was underground. Nest relocation was suspected for *V. velutina* and *V. mocsaryana*. In the enveloped pattern, different types were recognized among species, though *V. affinis* and *V. velutina* had similar scalloped patterns.

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