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Old Hornet Nests Acting as Hibernacula for Insects

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Abstract Old hornet nests serve as hibernacula for other insects. A total of 27 species in 6 insect orders were found to be in hibernation in 15 old aerial nests of *Vespa simillima xanthoptera* and *V. analis insularis*. Temperature in an old nest in winter fluctuated less largely than ambient temperature.

Key words: *Vespa*; old nests; hibernacula.

Introduction

In the temperate regions, hornet (*Vespa*) new queens do not hibernate in their natal nests, and each of them makes its own hibernaculum underground or inside rotten wood (MATSUURA, 1991). Thus hornet nests are completely evacuated in winter. A thick, multi-layered nest envelope of temperate aerial-nesting *Vespa* species plays an important role in nest thermoregulation (MARTIN, 1990, 1992). Subsequently, an aerial hornet nest may form a more or less adiabated space after it has been evacuated. While hibernation of insects in old aerial hornet nests has been reported by several authors (*e.g.*, TACHIKAWA, 1971), knowledge about it is still very fragmentary. This paper describes insects found in old hornet nests collected in late fall or winter.

Methods

A total of 16 evacuated aerial nests of two *Vespa* species, *V. simillima xanthoptera* CAMERON (7 nests) and *V. analis insularis* DALLA TORRE (9 nests), were collected in the late fall and winter in central Japan (Table 1). The nests were dissected in the laboratory, and insects and spiders found in them were identified. Small insects, such as Psocoptera, were extracted with TULLGREN funnels from two nests which were made on trees.

The old *V. s. xanthoptera* nest (VD9031) in which the temperature was measured was made under eaves and consisted of 8 combs (also see Table 1). Thicknesses of the envelope were 30–50 mm at the side and 60–80 mm at the bottom. Temperature measurements were made automatically every 10 minutes for the period from 16 to 26 February 1993, using fine-wire thermocouples (type T, Hayashi-Denko) connected to a data-logger (Thermodac-E, Eto-Denki). Temperatures in the nest were taken from two points; that is, between the second and third combs, and between

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Table 1. Collection data of aerial *Vespa* nests examined.

Nest code	Locality*	Date of collection	Nesting year	Nesting site	Height above ground	Direction to which nest faced	Nest size		Envelope thickness (mm)
							Width (cm)	Height (cm)	
Vespa simillima xanthoptera									
VN7801	Furumi*	'78.10. 3	1977	Under eaves	6 m	East	40.5	49	20–95
VS7803	Satomi	'78.11.19	1977	Under eaves	5 m	South	35	33	35–65
VS7805**	Satomi	'78.11.26	1978	On tree trunk	5 m	—	21	25	20–40
VY7804	Yamagata	'78.12.10	1978	Under eaves	6 m	South	16.5×23	23	—
VIt7801	Itako	'78.12. 3	1978	Under eaves	4 m	South	28×27	35	25–75
VIt7805	Itako	'78.12.16	1977?	Under evaes	5 m	West	38×29	50	20–70
VD9301	Daigo	'93. 2.26	1991	Under eaves	3 m	South	31×33	38	25–70
Vespa analis insularis									
VMn7703	Minori	'77.10.25	1977?	Under eaves	5 m	—	14	10	—
VM7704	Mito	'77.12.22	1977	On house wall	2.5 m	—	15	21.5	—
VSt7801	Satomi	'78.11. 5	1975?	Under eaves	5 m	South	11	11	12–25
VM7802	Mito	'78.12. 9	1978	Tree branches	10 m	—	15	—	—
VIt7802	Itako	'78.12. 3	1978	Under eaves	2.5 m	—	—	—	—
VIt7803	Itako	'78.12. 3	1977	Under eaves	2 m	North	16×12.5	15.5	20–30
VY7807	Yamagata	'78.12.10	1978	Under eaves	6 m	South	15.5×16.5	15	10–15
VIw7801	Iwase	'78.12.21	1978	Under eaves	3.5 m	West	22×19	21.5	10–40
VC7903	Chosei*	'79.10.20	1979	Under eaves	—	—	—	—	—

* All but two nests were collected in Ibaraki Prefecture. VN7801: Nagano Pref; VC7903: Chiba Pref.
** With a few workers and some 5th instar larvae.

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the lowest two combs (Fig. 1). The surface temperature was measured just beneath the outermost layer of the envelope; the part received sunlight in the afternoon. Ambient temperature was taken from a shady area near the nest.

Results

Animals obtained from old hornet nests

Insects and spiders were found in 15 nests (7 *V. simillima*, 8 *V. analis*), and are listed below together with the order, family, species, form of utilization of hornet nests according to TACHIKAWA (1971) (as an abbreviation), and number of animals obtained. TACHIKAWA's classification of animals obtained in an old *Vespa* nest is as follows: scavenger (abbreviated as "S"); insects that used the hornet nest as a hibernaculum (H); insects that made nests in the hornet nest (N); parasites on these nesting insects (P); and spiders. The nests from which insects were extracted with TULLGREN funnels were indicated with asterisks.

(1) Nests of *Vespa simillima xanthoptera*

VN7801—Hemiptera: Pentatomidae, *Halymorpha mista* (UHLER), H, 265 ♀ 238 ♂. Coleoptera: Dermestidae, *Dermestes vorax* MOTSCHULSKY, H or S, 19 ind. Lepidoptera: Noctuidae, *Amphipyra livida* (DENIS & SCHIFFERMÜLLER), H, 2 ind. Hymenoptera: Vespidae, *Polistes chinensis antennalis* PÉREZ, H, 11 ♀; Vesp., *P. mandarinus* (SAUSSURE), H, 1 ♀; Megachilidae, *Chalicodoma sculpturalis* SMITH, N, 1 ♂ emerged later; Ichneumonidae, gen. sp., P, 5 ind, emerged from pompilid nests. Arachnida: Urocteidae, *Uroctea compactilia*, 2 ind.; Clubionidae, *Clubiona* sp., 1 ind.

VS7803—Hem.: Reduviidae, *Isyndus obscurus* DALLAS, H, 4 ♀ 4 ♂ Col.: Coccinellidae, *Harmonia axyridis* PALLAS, H, 63 ind. Diptera: Syrphidae, *Eristalomyia tenax* LINNÉ, H, 3 ind.

VS7805*—Collembola: Hypogastruridae, *Hypogastrura manubrialis* (TULLBERG), H ?, 12 ind.; Hypo., *Xenylla brevispine* KINOSHITA, H ?, 1 ind.; Entomobryidae, *Janetschekbrya* sp., H ?, 3 ind. Psocoptera: unidentified, S ?, many ind. Hem.: Anthocoridae, gen. sp., H, 4 ind. Ara.: Agelenidae, *Tegenaria* sp., 7 ind.; Pholcidae, *Spermophore* sp., 1 ind.

VY7804—Blattaria: Blattidae, *Periplaneta japonica* KARNY, H, 1 immature. Hem.: Pent., *H. mista*. H, 4 ♂; Redu., *I. obscurus*, H, 5 ♀ 2 ♂. Col.: Cocc., *H. axyridis*, H, 364 ind.; Cocc., *Aiolocaria mirabilis* MOTSCHULSKY, H, 1 ind.; Chrysomelidae, *Aulacophora nigripennis* MOTSCHULSKY, H, 219 ind.; Cerambycidae, *Miccolamia* sp., H, 3 ind. Dip.: Syrp., *E. tenax*, H, 14 ind.; Muscidae, *Musca domestica* LINNÉ, H, 3 ♀; Musc., prob. *Muscina pascuorum* (MEIGEN), H, 6 ♀; Musc., prob. *M. nigra* SHINONAGA, H, 9 ♀; Musc., *M. augustifrons* (LÖW), H, 57 ♀; Musc., gen. sp., H, 3 ind.; Phoridae, gen. sp., H, 4 ind. Hym.: Chalcididae, *Brachymeria fiskei* (CRAWFORD), H, 11 ♀; Chal., *B. obscurata* (WALKER), H, 26 ♀; Chal., *Tainania hakonensis* (ASHMEAD), H, 8 ♀; Ichn., gen. sp., H, 2 ind.; Braconidae, gen. sp., H ?,

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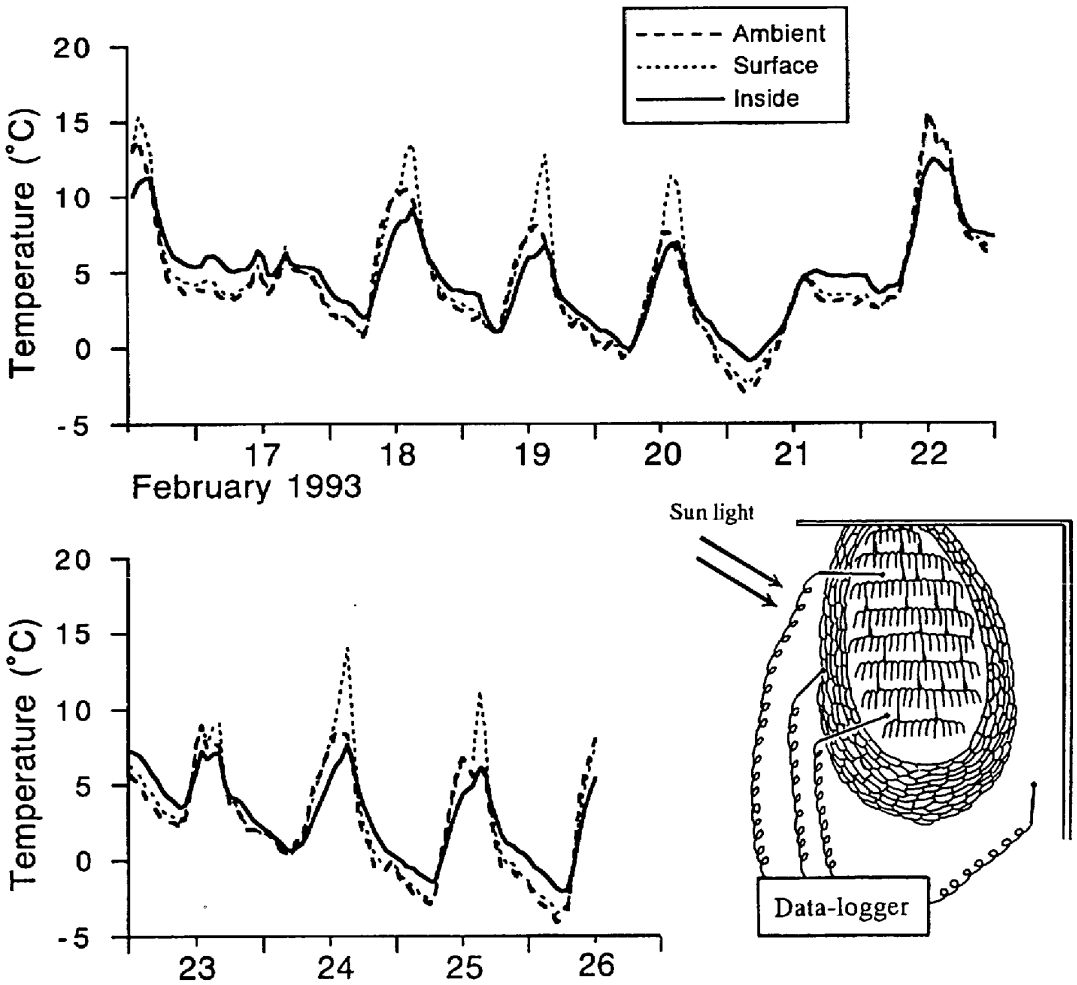

Fig. 1. Temperatures in an evacuated nest of *Vespa simillima xanthoptera* in winter, with its ambient temperature. Vertical section of the nest used in temperature measurement is shown with the positions of the thermosensors.

1 ind.

VIt801—Dip.: Syrp., *E. tenax*, H, 1 ind.; Musc., prob. *M. augustifrons*, H, 1 ind.

VIt7805—Hem.: Redu., *I. obscurus*, H, 1 ♀, Lep.: Noct., *Perinaenia accipiter* (FELDER & ROGENHOFER), H, 1 ind.; Tortricidae, *Acleris* sp., H, 1 ind. Dip.: Syrp., *E. tenax*, H, 1 ind. Hym.: Ichn., gen. sp., P, 2 ind. emerged later from pompilid nets.

VD9301—Hem.: Pent., *H. mista*, H, 14 ♀ 17 ♂; Redu., *I. obscurus*, H, 1 ♀. Col.: Cera., *Miccolamia* sp., H, 1 ind. Dip.: Phoridae, gen. sp., H, 3 ind. Hym.: Ichn., gen. sp., H, 4 ♀ 4 ♂. Ara.: Salticidae, gen. sp., 1 ind.

(2) Nests of *Vespa analis insularis*

VMn7703—Hym.: Vesp., *Vespula flaviceps lewisii* CAMERON, H, 2 inseminated

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queens.

VM7704—Col.: Cocc., *H. axyridis*, H, 20 ind.

VM7802*—Pso.: Peripsocidae, gen. sp., S ?, 16 larvae; Liposcelidae, *Liposcelis bostrychophilis* BADONNEL, S ?, 38 ind. Hem.: Urostylidae, gen. sp., H, 1 ind. Ara.: Salt., *Myrmarachne* sp., 3 ind.; Salt., gen. sp., 1 ind.

VIt7802—Col.: Chry., *A. nigripennis*, H, 1 ind. Dip.: Syrp., *E. tenax*, H, 4 ind.; Calliphoridae, *Lucilia ampullacea* VILLENEUVE, H, 39 ind. Lep.: Noct., *P. accipiter*, H, 3 ind.

VIt7803—Dip.: Syrp., *E. tenax*, H, 3 ind. Hym.: Vesp., *Polistes rothneyi iwatai* VAN DER VECHT, H, 1 ♀ (dead); Pompilidae, *Auplopus carbonarius* SCOPOLI, N, 1 ♀ 2 ♂, emerged later from nests.

VY7807—Hym.: Vesp., *V. flaviceps lewisii*, H, 1 inseminated queen.

VIw7801—Dip.: Syrp., *E. tenax*, H, 2 ind.

VC7903—Col.: Chry., *A. nigripennis*, H, 20 ind. Hym.: Vesp., *Vespa analis insularis*, H, 1 inseminated queen.

Nest temperature in winter

During the 10 days of temperature measurements, the maximum and minimum temperatures that were recorded inside the nest were respectively 13.7°C and −2.3°C (difference, 16.0°C). Ambient temperature varied more greatly with the maximum of 16.3°C and the minimum of −4.6°C (difference, 20.9°C). Range of temperature during a given day varied 10.3–16.2°C in ambient temperature, 6.2–11.7°C between the upper two combs, and 6.1–9.7°C above the lowest comb; range in a given day was larger in ambient than in nest temperature throughout the observation. Temperature at the surface of the envelope fluctuated more greatly than ambient temperature, with daily ranges varying from 10.2 to 18.7°C; on 8 out of 10 days of measurements, the range in the nest surface temperature was larger than that in ambient temperature.

Discussion

The present study showed that insects of various taxa (27 species in 7 orders) used old hornet nests as hibernacula and that the old nests provided more or less adiabated spaces. On average, 5.4 species and 200.9 individuals of insects hibernated in a *V. simillima* nest ($n=7$), and 1.4 species and 10.9 individuals in a *V. analis* nest ($n=9$, including VSt7801, from which no insects were obtained): there were significant differences in both values (MANN-WHITNEY U-test: $p<0.05$). Not only because the nest size (or space inside the envelope) is larger in *V. simillima*, but also because *V. simillima* nests have thicker envelopes (20–95 mm) than *V. analis* nests (10–40 mm) and thus are possibly more effectively adiabated, *V. simillima* nests would serve as better hibernacula for insects than *V. analis* nests.

The *Vespa analis* new queen found in VC7903, which was in the state of hiber-

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nation, is an unusual case (MATSUURA, 1991). On the other hand, this finding suggests that vespine new queens might hibernate in their own natal nests.

Besides providing hibernacula for insects, old vespine nests, particularly meconia accumulated in brood rearing cells, are attractive food source for scavengers. *Dermestes vorax*, which was found in VN7801, is a scavenger, especially in its larval stage (TACHIKAWA, 1971). The insect may repeat generations in the hornet nest as far as the nest keeps its shape.

Some collembolans are known to be arboreal and even seasonally migrate between trees and forest floor (ITOH, 1991). This study gave the first record of collembolans from an old aerial hornet nest. Yet it is not clear how these small insects use hornet nests.

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