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**BIOLOGICAL NOTES ON VESPA LUCTUOSA LUZONENSIS FROM
LEYTE ISLAND, THE PHILIPPINES, WITH DESCRIPTIONS
OF ADULTS AND LARVAE (HYMENOPTERA: VESPIDAE)**

By JUN-ICHI KOJIMA and SEIKI YAMANE

KOJIMA, J. and YAMANE, SK. 1980. Biological notes on *Vespa luctuosa luzonensis* from Leyte Island, the Philippines, with descriptions of adults and larvae (Hymenoptera: Vespidae). *Ins. matsum. n.s.* 19: 79-87, 2 tables, 15 figs.

Biological and morphological notes on *Vespa luctuosa luzonensis* are given based on four nests collected in Leyte Island, the Philippines. The architecture of embryo and young nests is described, and is discussed in relation to the tropical environment. The caste differences in the adults are mentioned on the basis of the color pattern and biometric characters. The second to final instar larvae are described, and their morphology is compared with those of other vespine species.

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INTRODUCTION

Vespa luctuosa Saussure is the commonest hornet all over the Philippine archipelago and is confined to the region. Vecht (1957) revised this species and recognized three subspecies. Little has been studied on this species thereafter, in spite of its interesting taxonomic position and unique distributional pattern among the Vespinae. Fortunately, one of us (J.K.) had the opportunity to study one of the subspecies, *V. luctuosa luzonensis* Bequaert, at Palo, northern Leyte, in March and April, 1978. In this paper, some biological data including nest architecture are given with descriptions of adults and larvae.

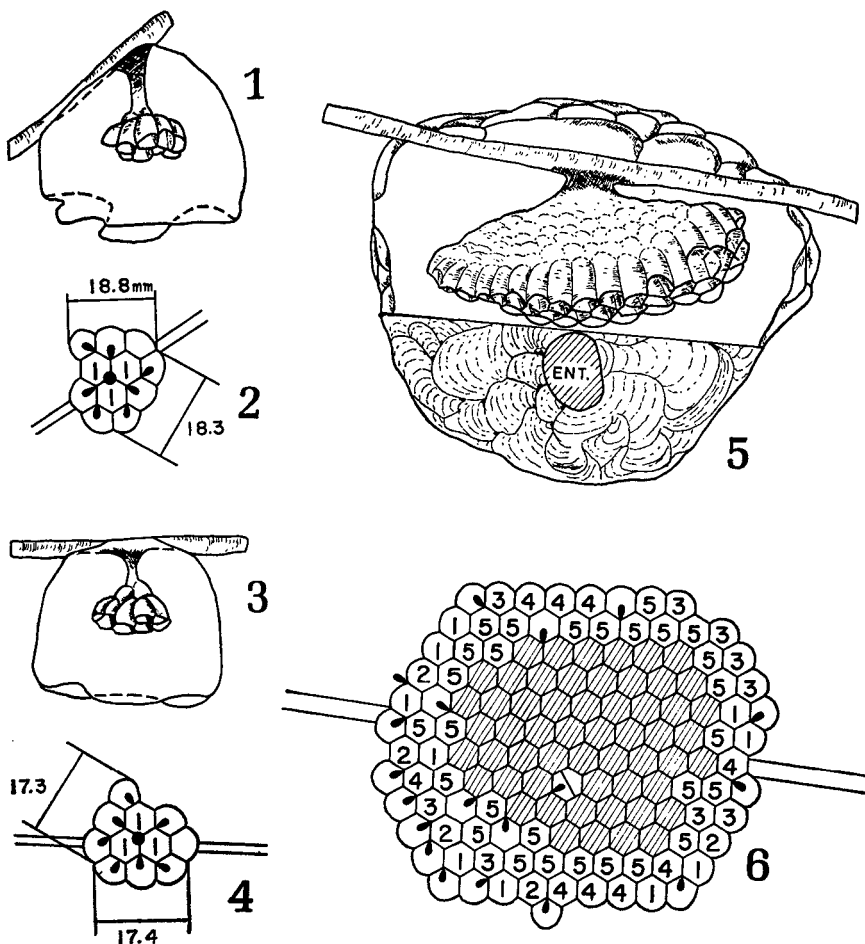
BIOLOGICAL NOTES

Williams (1919) briefly noted that *V. luctuosa* makes nests on trees and bushes. The nests we studied are in early developmental stages. Their nesting stage, site and inhabitants are given in Table 1.

1. *Nest architecture and inhabitants.* VP-01 (Figs. 1, 2) and VP-04 (Figs. 3, 4): Incomplete embryo nests with the foundress. Envelope brittle, uniformly buff in color, hemispherical or bell-shaped, consisting of a single sheet which starts from the substrate, not from the pedicel. Diameter of envelope sheet 55.0×56.8 mm for VP-01 and 44.5×50.4 mm for VP-04; mean thickness of paper 0.42 mm. Pedicel club-shaped, without twist, 14 mm long and 2.55×2.35 mm in diameter at the thinnest part for VP-01, and 12 mm long and 2.70×2.20 mm in diameter for VP-04; basal half with salivary coating, brown and shining. Comb brittle, uniformly buff in color, with eleven cells in each nest, all of which are yet shallow and cup like. Cell wall 0.27 mm thick on the average. Brood composition and comb size are given in the cell map (Figs. 2, 4).

VP-03 (Figs. 5, 6): Young nest with the foundress, 27 workers, one comb and envelope. Envelope brittle, buff and brown in color, nearly spherical, completely enclosing the comb except for a small elliptical entrance hole (20.5×16.5 mm in diameter) which opens in the lower part of the envelope; it is started directly from the substrate and is composed of one to three layers of irregularly arranged "shells", ranging from 2 to 15 mm in thickness. Each layer 0.31 mm thick on the average. Pedicel very short and thick, located at the center of the comb, basally with salivary coating, 9.0×7.4 mm in diameter at the thinnest part. Comb brittle, uniformly buff in color, is a circular disk with the upper surface almost flat, 85×78 mm in diameter, composed of 136 cells; diagonal widths of pupal cells at the cell top ranging from 7.73 to 8.83 mm with an average of 8.23 mm. Cell wall 0.26 mm thick on the average. Cocoon cap white, projecting above the level of the cell opening and rather strongly convex. Brood composition is given in the cell map (Fig. 6). All the brood are supposed to be of the first series except for one egg presumably of the second series. All the pupae appear to be workers. This nest contained no remnants of embryo nest.

VP-02: Architecture and material are basically as in VP-03. Unfortunately, this nest had been broken when found, with the roof of envelope and the first comb alone left. No adults were captured. Envelope composed of three layers, about 13 mm thick at the top. Comb partly broken, with 238 intact cells and two pillars. One of the pillars, the thick mainstay, is situated at the center of the comb and 21.8×16.7 mm thick at the thinnest part. The auxiliary pillar is located



Figs. 1-4. Embryo nest of *Vespa luctuosa luzonensis*. 1, 2: VP-01; 3, 4: VP-04. 2, 4: Cell map. Figs. 5 and 6. Young nest (VP-03). 6: Cell map. (Drop: egg; 1-5: 1st to 5th larval instars; shaded: cocoon.)

peripherally, connecting the comb with envelope, 5.8×3.7 mm thick at the thinnest part. Broken cells are estimated at about 20 in number; 174 central cells each with one faecal pellet at the bottom.

2. *Discussion.* In addition to the nests described above, a large nest (about twice as large as VP-03) was found at the tip of a thin bamboo twig in a bamboo grove, though this nest could not be collected because of its high position (4.5 m above the ground). The simultaneous presence of nests belonging to various developmental stages strongly suggests that the nests of this species are founded asynchronously, presumably due to the lack of dry season there.

The tropical environment is characterized by intense heat and the high level of predation. Particularly, as argued by Jeanne (1975), the ant predation pressure is so high for social wasps that it may act as the main selective force on the nest architecture, especially during the solitary stage. The following characters of the embryo nest of this form may be adaptive in this respect.

1) Large envelope: The structure of the completed embryo nest of this form has not been reported and the two embryo nests here described are supposed to be still incomplete judging from their brood composition. However, it is obvious that the first envelope sheet is fairly large as compared with that in some temperate vespines. For example, it measures in maximum diameter between 41 and 45 mm in *V. simillima simillima* (Makino & Sk. Yamane, 1980), or between 44 and 46 mm in *V. s. xanthoptera* (Matsuura, 1971)*. Large envelope may serve for increasing the chance for the foundress to find searching ants on the envelope, while reducing the chance for the searching ants to find the brood. A similar type of envelope is also known in *Vespa analis insularis* which is a temperate race of the originally subtropical species; the completed embryo nest of this form has a large single envelope sheet with a cylindrical vestibule. The vestibule is found in the completed embryo nest of the Taiwanese *Vespa affinis affinis*, and also expected to occur in some other tropical species.

2) Nest site: Shady and ventilative places, as suggested by the nesting sites of the examined nests (Table 1), are no doubt advantageous in keeping the nest cool. In some temperate vespines the foundress is known to incubate immatures when resting in a characteristic posture (curling) during the solitary stage (Makino & Sk. Yamane, 1980). It is interesting to know whether this behavior can also be seen in tropical species, but we failed to settle this question in *V. luctuosa luzonensis*. The tip of a twig may be less frequently visited by ants as compared with the base of a branch or the main trunk.

In VP-03 the workers captured, 27 in total, remarkably exceed the number of the emerged estimated by examining the faecal pellet (cf. S. & Sk. Yamane, 1975) — one. The embryo nests VP-01 and VP-04 suggest that this form is haplometrotic.

Table 1. Data for the collected nests of *Vespa luctuosa luzonensis* at Palo, Leyte Is., the Philippines.

Nest no.	Stage	Date of collection	Nest site and substrate	Height above the ground	Nest site condition	No. of adults captured
VP-01	Embryo nest	March 13, 1978	Tip of a <i>Psidium</i> tree in a garden of a farm	3.5 m	Shady, ventilative	1 ♀
VP-04	Embryo nest	April 1, 1978	Tip of a <i>Psidium</i> tree in a coconut garden	3.0 m	Shady, ventilative	1 ♀
VP-03	Young nest	March 29, 1978	Branch of an undetermined shrub in a coconut garden	0.7 m	Shady, a little ventilative	1 ♀, 27 ♂
VP-02	Abandoned nest	March 22, 1978	Branch of an undetermined tree on a steep slope of a hill	1.0 m	Shady, dump	

♀ and ♂ represent the foundress and worker, respectively.

* Recently Prof. J. van der Vecht (personal communication) and one of us (Sk. Y.) have reached the same conclusion that *simillima* and *xanthoptera* are conspecific and represent different geographical races, and that *Vespa mongolica* is a synonym of *V. simillima*.

VP-03, therefore, is concluded to have been reconstructed passively or positively. VP-02 may also be a reconstructed nest because of the lack of any remnants of the embryo nest. This assumption is also supported by the presence of only one faecal pellet per cell in the first comb; for cells of the first comb are commonly reused several times in vespine wasps.

The term "passive reconstruction", or absconding, is here used for the case of nest reconstruction in which the original nest is destroyed in an accident or severely infested by parasites. On the other hand, the "positive reconstruction" of nest takes place after the emergence of an adequate number of workers from the nest founded by queen(s) at a place free from ants (or other predators) or stable physically; the original nest is abandoned and the new one is built nearby at a place secure against larger predators such as mammals and birds.

A type of positive nest reconstruction has been reported in *Vespa crabro flavofasciata*, *V. simillima xanthoptera* (Matsuura, 1976; also see Sk. Yamane, 1977) and *V. s. simillima* (Sk. Yamane & Makino, unpub.), and this nesting habit is expected to occur in some tropical species. Absconding may be more general throughout the social wasps and positive nest reconstruction may have derived from absconding.

MORPHOLOGICAL NOTES

1. *Adults*. As pointed out by Vecht (1957) this form is characterized by the conspicuous queen-worker caste differentiation, not only in body size and color pattern but also in the proportions of body parts. Some important differences in color pattern and biometric characters between them are described based on the inhabitants of the collected nests and some field-captured individuals (1 ♀, 13 Mar.; 1 ♀ 2 ♂, 1 Apr.).

The queen differs from the worker in color pattern in the following points: Much darker, with reduced yellow markings. Band along the inner orbit narrower. Gena entirely black (widely yellow in the worker). Pronotal band reduced to a medial short line, without branch. Propodeum with only a small spot at the center of median furrow (in the worker extensively yellow). Legs darker, more extensively black on coxa, femur, trochanter and tibia. Apical yellow band on gastral tergite I distinct but narrower; on the subsequent tergites the band very faint or entirely lost (in the worker the bands on tergites I-IV distinct and much wider).

The following parts were measured under a dissecting binocular microscope: Head width in frontal view (HWF); head width in profile (HWP); eye width in profile (EW); mesonotum width (MW) (length between posterolateral angles of scutum). The results are given in Table 2, and the relations between some measurements are given in Figs. 7, 8. As is well known, in vespine wasps the queen has a relatively large gaster as compared with the worker. In this form the relative size of the head to thorax is clearly smaller in the queen than in the worker as in some other vespines (e.g. Sk. Yamane, 1974). Further, in this form the queen is also characterized by the relatively small eyes, and by the posterolaterally strongly swollen head.

2. *Larvae*. Mature larva (♀): As to the terminology, see Sk. Yamane, 1976. Head in frontal view nearly circular (Fig. 9). Temporal band weakly margined ventrally. Relative position of temporal band as in the *Vespa velutina* group, i.e.,

Table 2. Measurements of some body parts in the adult *Vespa luctuosa luzonensis* (in mm).

Caste or sex		MW	HWF	HWP	EW	WL
♀ (4)	Mean	4.60	6.78	3.28	1.17	9.86
	Range	4.19-4.81	6.20-7.00	2.98-3.42	1.60-1.78	9.30-10.20
♂ (27)	Mean	3.30	5.30	2.64	1.54	6.92
	Range	3.17-3.48	5.12-5.56	2.44-2.88	1.45-1.71	6.40- 7.56
♂ (2)	Mean	3.52	5.53	2.48	1.72	8.10
	Range	3.39-3.66	5.38-5.69	2.45-2.50	1.71-1.73	7.80- 8.40

For abbreviations, see text.

the distance between the dorsal tip of temporal band and postoccipital sulcus nearly as long as that between the ventral tip of temporal band and mid-cranial sulcus (cf. Sk. Yamane, 1976, Fig. 34). Labrum widest at the base; the ventral border deeply notched medially (Fig. 10). Sclerotized patch on the palate developed, extending towards lateral side (Fig. 10, left); palate without median patch which is seen in the *V. velutina* group. Mandible strong, without cusps, apically tridentate; the third (innermost) tooth divided into two small teeth; IIIb as large as or smaller than IIIa (Fig. 14). Postoccipital and epistomal sulci very strong. Pleurostomal and hypostomal sulci somewhat weak. Mid-cranial sulcus distinct in the upper half, not visible just above the clypeus as in the *V. velutina* group. Spiracles as in other *Vespa* species. Collar processes thickened and complex, bearing many branches. The inside wall of the atrium with a lot of minute spines.

The structure of head in the younger larvae is basically the same as in the mature larva. In the second instar larva the third mandibular tooth is not divided into two small teeth (Fig. 11); the mandibles do not touch medially (Fig. 15). In the young larval stages the second mandibular tooth is apically pointed (Figs. 11, 12).

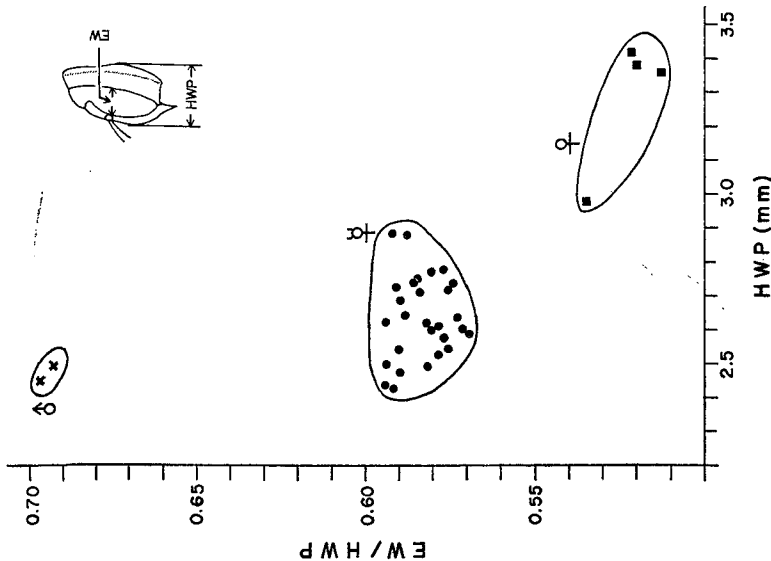


Fig. 7. Relation between head width (in profile) and eye width/head width (in profile) ratio.

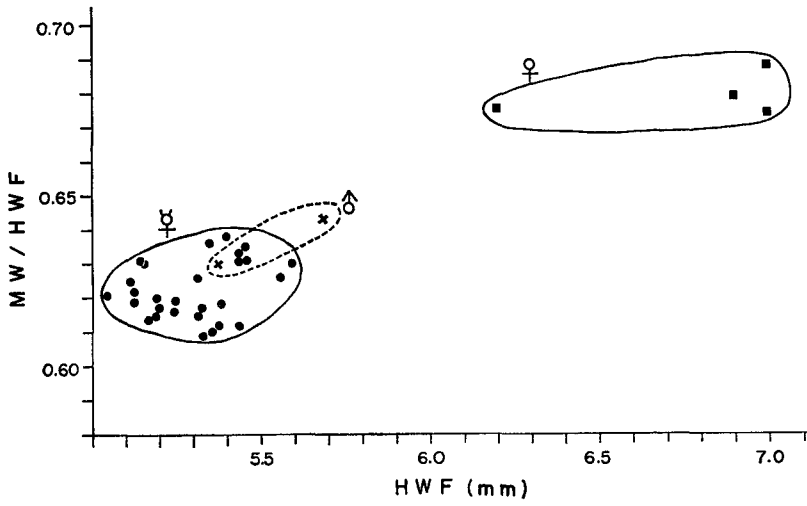
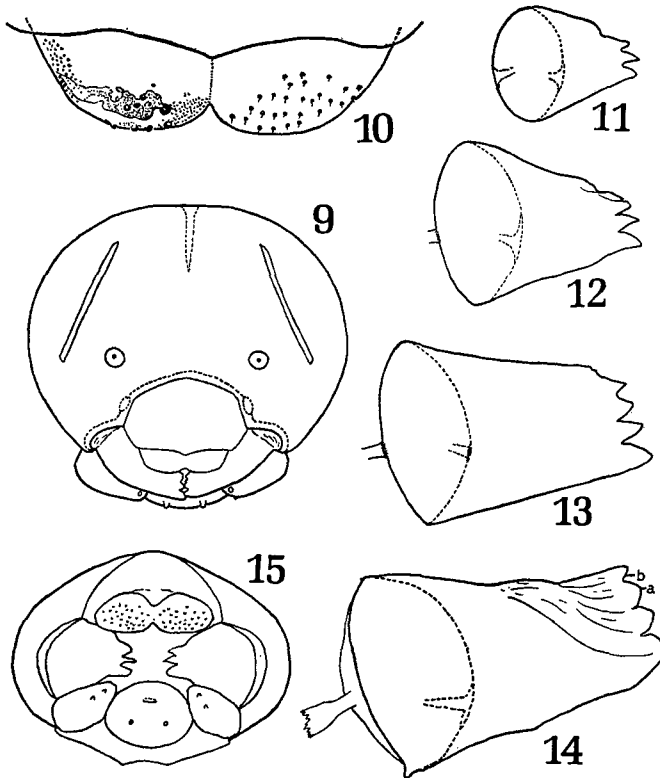


Fig. 8. Relation between head width (in frontal view) and mesonotum width/head width (in frontal view) ratio.



Figs. 9-15. Larval head. 9: Head of mature larva, frontal view; 10: Labrum (right) and palate (left) of mature larva; 11-14: Mandibles of the second to final instar larvae; 15: Head of the second instar larva, ventral view.

The mature larva of this species is in structure basically the same as in other *Vespa* species. This species, in detailed characters, has some resemblance to the *Vespa velutina* group, i.e., temporal band is located relatively more dorsally and weakly defined ventrally, and the patch on palate is rather developed. But, it differs from the latter in that mid-cranial sulcus is not visible just above clypeus and palate has no median patch.

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