

論文 (Original Article)

Species Compositions and Seasonal Changes in the Number of Social Wasps Collected with Malaise traps in Natural Deciduous Forests in and near the Ogawa Research Forest, Northern Kanto, Japan (Hymenoptera, Vespidae)

TOTOK Mei Untarto¹⁾, MAKINO Shun'ichi^{2)*} and GOTO Hideaki²⁾

Abstract

Social wasps were collected with Malaise traps in 3 natural deciduous forests (ca. 660 to 750m a.s.l.) in the northern Kanto region in 2 consecutive years. The collection was made from May to November, almost completely covering the wasps' flight season. Overwintered queens or workers of 8 vespine and 2 polistine species were collected in the 2 years. *Vespula flaviceps*, *V. shidai* and *Vespa simillima* were predominant, accounting for 80 to 90% of the total catch of the social wasps. Species compositions were not significantly different among the 3 forests. Overwintered queens of *Vespula shidai* and *Vespa simillima* were collected from mid May to early August, and workers from mid August onwards. It is discussed that overwintered queens collected in late July to early August may have been individuals that had lost their nests or failed to initiate the nests.

Key words: hornet, paper wasp, *Vespa*, *Vespula*, *Polistes*, *Parapolybia*, Malaise trap

Introduction

Social wasps occurring in Japan comprise 16 species of the subfamily Vespinae and 11 of Polistinae, both belonging to the family Vespidae (Matsuura, 1995). Most vespine wasps make large, covered nests containing over 1,000 brood cells, while polistines typically live in smaller, exposed nests, which usually have less than a few hundred cells. Because these wasps principally hunt living insects to feed their larvae and because their nests often consume a great amount of prey during the nesting season, it is expected that the wasps play an important role as predators in various environments including forests.

In order to evaluate the importance of the social wasps as predators of forest insects, we need to understand not only the species compositions in particular forests but how their abundance changes through the nesting season. However, there have been only a few studies (Maetô and Makihara, 1999; Makino et al., 1999) that monitored species compositions of social wasps throughout the period when they are active in natural forests in Japan. We here report the species compositions of the social wasps and seasonal changes in their abundance in natural deciduous forests in the northern Kanto area, central Japan, based on insects collected with the Malaise trap, a non-attractive trap

designed for collecting flying insects.

Materials and methods

We selected the following 3 forests (plots) in Kitaibaraki (140°E, 36°N), located near the border between Ibaraki and Fukushima Prefecture. All forests were natural deciduous forests over 100 years old. Forest 1 (about 660m a.s.l.) was mainly composed of beeches (*Fagus crenata* Blume and *F. japonica* Maxim.), deciduous oaks (*Quercus serrata* Thunb. ex Murray and *Q. crispula* Blume), acers (*Acer* spp.) and hornbeams (*Caprinus* spp.). Forest 2 (about 700m a.s.l.) and forest 3 (about 750m a.s.l.) were both predominated by the beech *F. japonica*, and forest 3 was relatively rich in understory trees mainly of azaleas (*Rhododendron* spp.). Forest 1 was northernmost among the three, approximately 3km distant from forest 2, which in turn was 4km distant from forest 3, the southernmost plot. Forest 1 roughly corresponds to the plot "OA120" studied by Maetô and Makihara (1999).

The Malaise trap used was of the Townes type, 1m high and 1.7m long. We installed 5 traps, separated by 10m from each other, in each of the above 3 forests in 2000, but only in forest 1 in 2001. The 5 traps were aligned with the direction of the slope, and the intercepting surface was placed parallel to the contours

原稿受付：平成13年12月27日 Received Dec. 27, 2001 原稿受理：平成14年2月14日 Accepted Feb. 14, 2002

* Department of Forest Entomology, Forestry and Forest Products Research Institute, Japan, P.O.Box 16, Tsukuba Norin Kenkyu Danchi-nai, Ibaraki 305-8687, Japan; e-mail:makino@ffpri.affrc.go.jp (S.M.)

1) Forestry Research Institute of Manokwari, Forestry Research and Development Agency, Forestry Department, Inamberi Pasir Putih

2) Department of Forest Entomology, Forestry and Forest Products Research Institute

of the slope. The collection bottle contained 95% ethanol for preserving collected insects. The traps were kept installed from late April to early November in 2000, and from early May to mid November in 2001. The catches of insects were collected every two weeks by H.G. The voucher specimens are deposited at the insect specimen depository of FFPRI.

Results and discussion

We collected a total of 280 individuals of 10 species of social wasps during the 2-year study (Table 1). All of the collected wasps were overwintered queens or workers. The number of collected individuals greatly varied among the species in both years. *Vespa shidai* Ishikawa et al. and *Vespa simillima* Smith were predominant in 2000, accounting for 93% of the total catch of the 3 forests. There was a sixfold difference in the total catch between forest 1, which had the largest catch of the three, and forest 3, which had the smallest. However, there was no significant difference in the proportions of *Vespa shidai* and *Vespa simillima* to the total number of the two species among the 3 forests ($p > 0.05$, χ^2 test). In 2001, another predominant species, *Vespa flaviceps* Smith, was added to the above 2, and these 3 species accounted for 87% of the total catch of forest 1. Species other than these 3 were relatively rare: *Vespa mandarinia* Smith, *V. analis* F., *V. dybowskii* Andr., *Vespa rufa* (L.), and *Parapolybia varia* (F.) were collected only in a single year.

Maetô and Makihara (1999) listed 7 species of social wasps collected in forest 1 (their "OA120") in 1996. Their results are similar to ours in that the predominant 3 species, *Vespa flaviceps*, *V. shidai* and *Vespa simillima*, accounted for a great majority (91%) of the total yearly catch in the forest. Although the species

compositions of social wasps thus principally did not change in forest 1 among the 3 years, 1996, 2000 and 2001, there are also differences in collected species between the results of Maetô and Makihara (1999) and ours. Their collection contained *Polistes snelleni* de Saussure and *Vespa vulgaris* (L.) that were not collected there by us in the 2 years, whereas they did not collect *Vespa dybowskii* and *Parapolybia varia* that were included in our collection. This comparison suggests the necessity of studies based on multiple-year collections and/or on a reasonably large number of traps to inventory local fauna adequately.

The vespine species compositions described above are quite different from those of insects collected with bait traps containing juice and liquor as an attractant. In some forests in Kanto and Kyushu, the predominant vespine species collected with the bait trap are *Vespa mandarinia* Smith, *V. ducalis* Smith and *V. analis*, together accounting for 70 to 90% of the total catch of social wasps (Makino et al., 1999; Makino and Koma, 2001). In addition, the catches of *Vespa flaviceps* are much poorer than these 3 *Vespa* species, and virtually no queens of *Vespa* species are collected by the bait trap. This difference between the bait and Malaise traps may reflect a possible difference in preference for the bait among the vespine species: those 3 *Vespa* species mentioned above may have much stronger preference for the bait than *Vespa* spp. However, it is also possible that geological or other differences among the study sites may be responsible. Therefore, we have to compare species compositions between the Malaise and the attractant traps installed in the same forest in the same period.

Makino et al. (1999) reported that males of *V. mandarinia*, *V. analis*, and *V. simillima* were attracted to

Table 1. Number of wasps collected with Malaise traps in forests 1 to 3 in 2000 and in forest 1 in 2001. Wasps are divided into queens (Q) and workers (W).

	Forest1(2000)		Forest2(2000)		Forest3(2000)		Forest1(2001)	
	Q	W	Q	W	Q	W	Q	W
<i>Vespa simillima</i> Smith	14	3	8	2	2		5	18
<i>Vespa analis</i> Fabricius							2	
<i>Vespa crabro</i> Linnaeus		2					1	2
<i>Vespa dybowskii</i> André	1							
<i>Vespa mandarinia</i> Smith	2	2	1		1			
<i>Vespa shidai</i> Ishikawa et al.	66	30	32	11	6	10	13	10
<i>Vespa flaviceps</i> Smith		1					1	25
<i>Vespa rufa</i> (Linnaeus)			1		1			
<i>Polistes nipponensis</i> Pérez	1						2	2
<i>Parapolybia varia</i> (Fabricius)								2
Total	84	38	42	13	10	10	24	59

the same bait trap as mentioned above in and after September. However, we collected no males of these species with Malaise traps in the present study. One possible reason of the difference is that catches were very poor in the fall in our collections: the total number of wasps of the above 3 species collected in and after September were only 6 and 16 in 2000 and 2001, respectively (Table 2). According to Figure 1 in Makino et al. (1999), proportions of males were only about 10 to 30% of baited wasps in and after September in the 3 species. Then, the absence of males in our collection of Malaise traps may be due to the generally poor catches.

Vespa simillima and the two species of *Vespula* have some ecological characteristics in common (Matsuura and Yamane, 1990): they all belong to "large-colony type (Matsuura and Yamane, 1990)," building nests which usually contain 4,000 to 10,000 cells, continue nesting activity for 7 to 7.5 months, consume a wide range of food. In particular, the two *Vespula* species not only hunt various insects but even utilize carrion of vertebrates. These characteristics may allow them to be dominant in various habitats including forests, as

suggested by this study, as well as in urban and suburban areas (Matsuura, 1992).

Seasonal changes in the number of collected wasps are shown in Table 2. Almost all wasps collected before late July were overwintered queens, while those collected afterwards were mostly workers, though a few overwintered queens were still captured in late July to early August. In 2000, the number of queens of *Vespa simillima* and *Vespula shidai* peaked in early July. In 2001, although the peak of queen catch was not clear because of the smaller numbers of wasps, the number was largest in mid July in the two species.

In general, overwintered queens of the Japanese vespine species start nesting in May and nearly or totally retire from foraging activities outside the nests before late July (Matsuura and Yamane, 1990), because workers take over such activities by that time in normally developed nests. Therefore, it is expected that queens will not be captured by Malaise traps in and after August. Those overwintered queens that we collected in August may have lost their original nests and flown outside, or may have been unable to initiate nests for

Table 2. Number of social wasps collected with Malaise traps in forest 1 to 3 in 2000 and in forest 1 in 2001. Collected wasps are divided into queens (Q) and workers (W). All of the queens were overwintered females, except in *Polistes nipponensis*.

	<i>Vespa simillima</i>		<i>Vespa analis</i>		<i>Vespa crabro</i>		<i>Vespa dybowskii</i>		<i>Vespa mandarinia</i>		<i>Vespula shidai</i>		<i>Vespula flaviceps</i>		<i>Vespula rufa</i>		<i>Polistes* nipponensis</i>		<i>Parapolybia varia</i>	
	Q	W	Q	W	Q	W	Q	W	Q	W	Q	W	Q	W	Q	W	Q**	W	Q	W
2000																				
5/11	1										1									
5/27	1										3									
6/9	3										13									
6/20	1										27									
7/5	12						1		2		32				2					
7/18	5	1							1		25									
8/1	1								1		3									
8/13													3							
9/4													8							
9/22						2				2	18									
10/4		2									5									
11/9		2									16			1				1		
11/19	1																			
2001																				
5/18	1													1						
6/2	1										2									
6/28						1					6									
7/12	3		2								5	2								
7/26																				1
8/9		1													10					
8/24		1											5	5						
9/7		1					2						2	7						
9/24		12										1		2						
10/4		2												1				2		
10/20		1																	2	
11/15																				1

* This species has often been incorrectly referred to as "*P. mandarinus*" in Japanese literature (Kojima, personal communication.)

** Probably new queens before hibernation.

unknown reasons and been loitering in the forest.

In forest 1 where wasps were collected by the same method in 2000 and 2001, the number of wasps of the predominant species greatly changed between the years: in *Vespa simillima*, the number of queens decreased from 24 to 5, while that of workers increased from 5 to 18. Queens of *V. shidai* also showed a decline from 66 to 13 as well as workers which decreased from 30 to 10. Such yearly fluctuations in the population are rather common among the social wasps. Archer (2001), for example, reported 2-year cycle fluctuations in the catches of queens and workers in *Vespula germanica* (F.) collected by a Malaise trap in England over a 27-year period.

References

- Archer, M.E. (2001) Changes in abundance of *Vespula germanica* and *V. vulgaris* in England. *Ecol. Entomol.*, **26**, 1-7.
- Maetô, K. and Makihara, H. (1999) Changes in insect assemblages with secondary succession of temperate deciduous forests after clear-cutting. *Jpn. J. Entomol.*, (N.S.), **2**, 11-26 (in Japanese).
- Makino, S. and Koma, Y. (2001) (Monitoring of social wasp population using attractant traps in the plain and low mountainous areas in the Kanto area.) *Abs. 45th Conf. Appl. Entomol. Zool.*, 23. (In Japanese).
- Makino, S., Motokurumada, I., Yamashita, Y. and Yamaguchi, M. (1999) Species compositions and their seasonal changes in vespine wasps collected with a bait trap. *Trans. 50th Jpn. For. Soc. Kanto Branch*, 107-108 (in Japanese).
- Matsuura, M. (1992) Outbreaks of hornets in urban areas (1) *Insectarium*, **29**, 68-75 (in Japanese).
- Matsuura, M. (1992) Outbreaks of hornets in urban areas. (2) *Ibid.*, **29**, 116-125 (in Japanese).
- Matsuura, M. (1995) *Social Wasps of Japan in Color*. Hokkaido University Press, 353pp. (in Japanese).
- Matsuura, M. and Yamane, Sk. (1990) *Biology of the Vespine Wasps*. Springer-Verlag, 323pp.

小川学参林とその近辺の天然落葉樹林でマレーズトラップによって得られた社会性カリバチ類の種構成と季節消長

Totok Mei Untarto¹⁾・牧野 俊一^{2)*}・後藤 秀章²⁾

要 旨

関東北部の3つの落葉天然林(標高660~750m)で、飛翔昆虫採集用のマレーズトラップを用いて2年間にわたり社会性カリバチを採集した。採集は5月から11月まで行い、これはハチの活動期をほぼ完全にカバーする。2年間にスズメバチ亜科、アシナガバチ亜科それぞれ8種と2種が採集された。もっとも多く採集されたのはクロスズメバチ *Vespula flaviceps*、シダクロスズメバチ *V. shidai*、およびキロスズメバチ *Vespa simillima* であり、これら3種で社会性カリバチの採集個体数の80~90%をしめた。種構成には3林分で大きな違いは見られなかった。シダクロスズメバチとキロスズメバチでは越冬明け女王が5月から8月はじめまで採集され、8月以降はワーカーが採集された。7月終わりから8月はじめにかけて採集される越冬明け女王は、なんらかの原因で自巣をうしなったか、あるいは巣の創設に失敗した個体である可能性を議論した。

キーワード：スズメバチ、アシナガバチ、スズメバチ属、クロスズメバチ属、アシナガバチ属、ホソアシナガバチ属、マレーズトラップ

* 森林総合研究所 森林昆虫領域 〒305-8687 稲敷郡笠崎町松の里1 e-mail:makino@ffpri.affrc.go.jp (S.M.)

1) インドネシア林業省 林業研究開発庁 マノクワリ林業研究所

2) 森林総合研究所 森林昆虫領域