

DISPERSION DISTANCE OF QUEENS FROM NATAL SITES IN THE
TWO HAPLOMETROTIC PAPER WASPS *POLISTES RIPARIUS*
AND *P. SNELLENI* (HYMENOPTERA: VESPIDAE)

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INTRODUCTION

Colonies of temperate *Polistes* species are started in spring by overwintered females. In some species, these females (foundresses) often show philopatry, that is, they nest near places where their parental nests were built in the previous year (KLAHN, 1979; STRASSMANN, 1979, 1983; NOONAN, 1981; HIROSE and YAMASAKI, 1984; CERVO and TURILLAZZI, 1985). On the other hand, exact information is still scanty on the distance of dispersion of new queens from the natal sites. As far as we know, such a kind of information is available only for *P. jadwigae* (HIROSE and YAMASAKI, 1984).

In this paper, we show how far new queens move from their natal nests before founding colonies in *Polistes riparius* [Note: this species has often been referred to as *Polistes biglumis* in Japanese literature (see YAMANE and YAMANE, 1987)] and *P. snelleni*, both of which only rarely show foundress association (YAMANE, 1969; MAKINO and AOKI, 1982).

MATERIALS AND METHODS

Dispersion of new queens of *Polistes riparius* and *P. snelleni* was mainly studied in four areas, area 1 to 4 (0.3–0.9 ha; Fig. 1), along the Toyohira River in Toyotaki, Sapporo, Hokkaido, northern Japan from 1976 to 1985. Areas 1 and 4, ca. 1 km apart from each other, were situated on dried riverbeds scattered with trees such as willows, birches or alders, while areas 2 and 3 were grassy patches with planted larches. In the summer of 1981, the river severely flooded area 4, making the census impossible there; this area was excluded from the study afterwards. In areas 1 and 4 nests of the two species were predominantly constructed on young trees, while in areas 2 and 3, *P. riparius* frequently nested on standing dead stems of herbaceous plants.

Census was made in late August to early September and in late May to early June

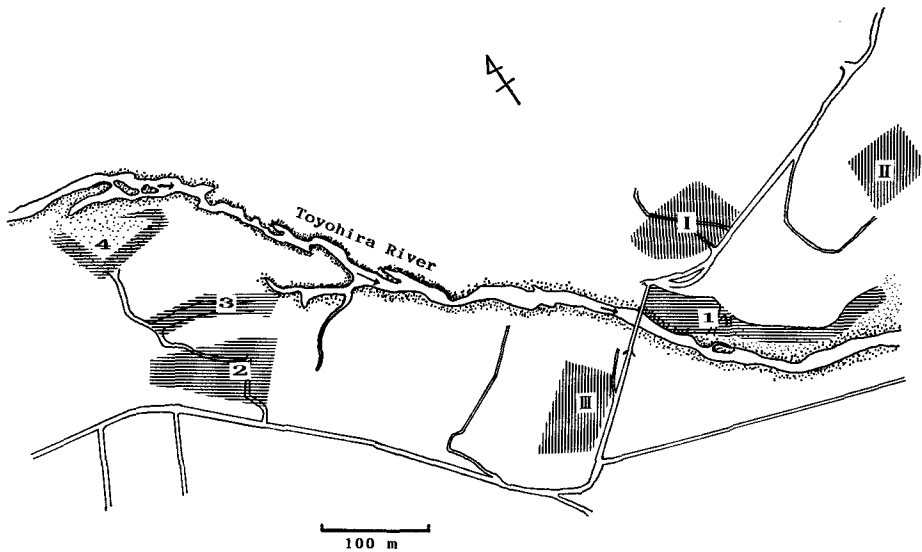


Fig. 1. Areas 1 to 4 and I to III (Toyotaki) where queen dispersal of *P. riparius* and *P. snelleni* was studied.

next spring, for two or three days each time. In summer, new queens, recognized by their sluggish behavior, were marked on nests which had been located in the spring: they were lightly anesthetized with ether, marked with a nest code with quick-drying paints, and returned to the nest. In the following spring, initiated nests were located in the four areas and also in three neighboring areas: a grassy patch (I in Fig. 1), a paddy in fallow (II), and a small plantation of todo-fir trees (III). Nests were numbered by the use of plastic tags, which were attached to the substrates. When a marked queen was recovered on her nest, the distance between the nest and her natal place was measured with a tapeline. If this was impossible, we determined the distance with a map drawn to a scale of 1/2500.

A similar study was carried out by one of us (S.M.) in Misumai, ca. 2 km from Toyotaki from 1982 to 1985 for *P. riparius*. In spring, initiated nests were located in three grassy fields (0.3–0.4 ha) scattered with small trees, and the dispersion distance was measured for recovered queens as in Toyotaki. The nests were censused usually at 2-day or 3-day intervals, and at nearly every census, emerged adults were marked with individual and nest codes on the thorax. Thus, in Misumai, most adults that were produced from the nests were marked, while in Toyotaki, adults that had left colonies before the census in summer were left unmarked.

RESULTS

Toyotaki: In the four areas, 1,315 new queens were marked on 152 nests of *P. riparius* and 1,857 on 152 nests of *P. snelleni* from 1976 to 1984. Of these individuals, 25 of *P. riparius* and nine of *P. snelleni* were recovered during the study (Table 1).

Table 1. Number of new queens of *Polistes riparius* and *P. snelleni* marked in Toyotaki in the late summer and of foundresses recovered in the following spring.

Year	<i>Polistes riparius</i>		<i>Polistes snelleni</i>	
	No. new queens marked*	No. recovered queens**	No. new queens marked*	No. recovered queens**
1976	15 (6)	1 (6.7%)	432 (24)	1 (0.2%)
1977	276 (22)	3 (1.9%)	211 (13)	1 (0.5%)
1978	63 (17)	1 (1.6%)	111 (11)	2 (1.8%)
1979	231 (25)	11 (4.8%)	345 (34)	3 (0.9%)
1980	492 (50)	7 (1.4%)	119 (17)	1 (0.8%)
1981	98 (15)	1 (1.0%)	122 (15)	0
1982	69 (4)	1 (1.0%)	181 (13)	0
1983	51 (10)	0	194 (14)	1 (0.5%)
1984	20 (3)	0	142 (11)	0
Total	1315 (152)	25 (1.9%)	1857 (152)	9 (0.5%)

* Figures in parentheses show the number of nests on which new queens were marked.

** Figures in parentheses show the percent recovery of marked individuals.

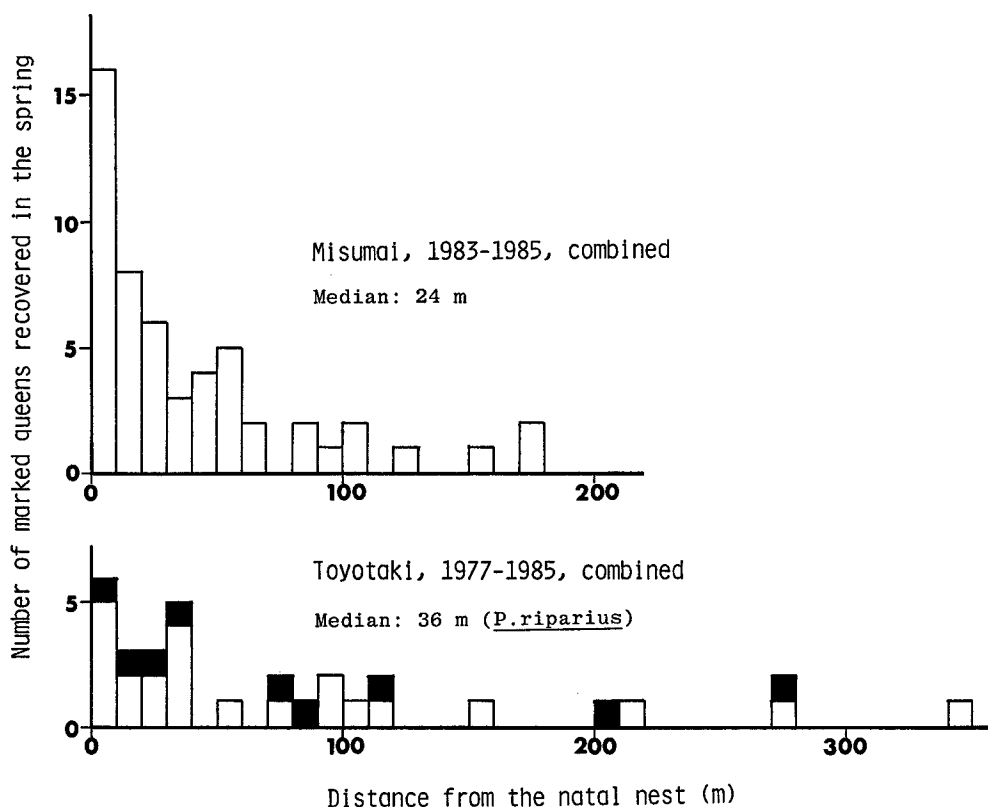


Fig. 2. Frequency distribution of distances between nests of recovered queens and their natal nest sites in *P. riparius* in Misumai (upper) and in *P. riparius* and *P. snelleni* in Toyotaki (lower). In the lower histogram, blank columns represent the number of *P. riparius* queens, while solid ones that of *P. snelleni*.

Table 2. Number of new queens of *Polistes riparius* marked in Misumai in the late summer, and the number of nests located in the following spring.

Year	Number of queens marked*	No. nests located in the following spring		
		with marked foundresses**	with unmarked foundresses	without foundresses***
1982	343 (18)	23 (6.7%)	97	19
1983	191 (17)	7 (3.7%)	37	6
1984	319 (10)	31 (9.7%)	51	15
Total	853 (45)	61 (7.2%)	185	40

* As in Table 1.

** As in Table 1.

*** Probably abandoned.

These recovered queens nested at distances 1 to 340 m ($\bar{x} \pm \text{SD}$; 81 ± 99) from their natal places in *P. riparius* and 4 to 278 m (92 ± 93) in *P. snelleni* (Fig. 2). No tendency was clear for these queens to nest on substrates of the same kinds as used by their natal nests.

Besides the nests with the marked foundresses, we found 865 and 747 nests with unmarked queens of *P. riparius* and *P. snelleni*, respectively. Thus, the marked queens constituted only a small portion of the spring population of foundresses in the survey areas.

Misumai: During the three years from 1982 to 1984, 853 new queens of *P. riparius* were marked on 45 nests. Sixty-one of these were recovered in the following spring (Table 2), and natal nests were known by markings for 53 of them. Of eight of them the markings were worn, so that their natal nests were not identified.

Percentage recovery was below 10% every year (Table 2). Dispersion distance of

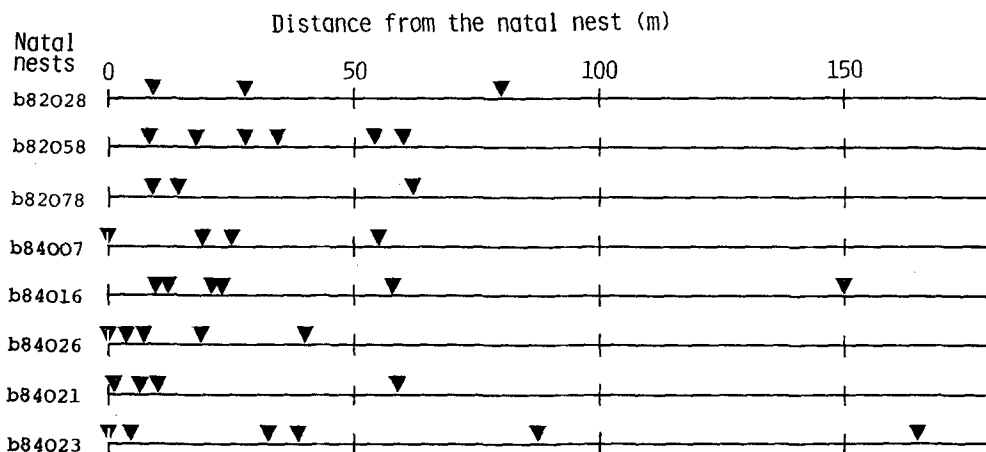


Fig. 3. Dispersion of nestmate queens of *P. riparius* in Misumai. Distances from the natal nest site to spring nests of queens originating from the same parental colony are each pointed by a triangle.

the recovered queens from their natal places was 3 to 175 m ($\bar{x} \pm \text{SD}$; 46 ± 42 ; $n=19$) in 1983, 1 to 120 m (36 ± 53 ; $n=7$) in 1984 and 0 to 175 m (34 ± 43 ; $n=27$) in 1985. The distances did not differ significantly among the three years ($p > 0.05$: Kruskal-Wallis test); the mean of the three years was 39 ± 43 m. Although this was rather smaller than the mean in Toyotaki, the difference in dispersion distances was not significant between the two localities ($p > 0.05$: Mann-Whitney U-test).

About 30% of the recovered queens nested within a 10-m radius of their natal nest sites, and five (9%) within a 1-m radius, while six (11%) nested at distances over 100 m from the natal places (Fig. 2).

For eleven parental nests, more than one marked queens which had emerged from each was recovered in the following spring, and for eight of the eleven nests (Fig. 3), three or more nestmate queens were recovered. These queens considerably dispersed, rather than aggregated around their natal places.

No individuals marked in Toyotaki were recovered in Misumai, and vice versa.

DISCUSSION

Possible factors in low recovery rates of marked queens in the present study are a high mortality rate during overwintering period after their leaving nests and before founding colonies, and their dispersion outside the censused areas (cf. KLAHN, 1979). HIROSE and YAMASAKI (1984) estimated the mortality rate at 0.52–0.78 in *P. jadvigae* on the assumption that new queens' emigration from and immigration into their study site were both negligible (but see below). Their assumption can not be applied to our species, since a few individuals did disperse over 200–300 m from their natal sites. Moreover, a much larger number of unmarked queens founded colonies than marked ones in the censused areas (Tables 1, 2). In Misumai, at least, it is very likely that a fairly large part of these unmarked queens immigrated into the censused areas from the outside, because most of females produced in this area were marked in the previous year.

Although rather a large proportion of the recovered foundresses nested in close proximity to the natal places, philopatric tendency of the two species was not so strong as those reported in other congeners. For instance, KLAHN (1979) reported that in the North American *P. fuscatus* nearly all recovered females were located just at the nest sites where they were produced in the previous summer. In *P. jadvigae* in Kyushu, southern Japan, over 80% of recovered queens nested within a 10 m radius of the natal places (HIROSE and YAMASAKI, 1984). On the other hand, in *P. riparius* and *P. snelleni*, the corresponding value was 10–30% in the present study.

It must be noted, however, that HIROSE and YAMASAKI's survey field, surrounded by urban environments, was an isolated habitat for *Polistes* and favorable nesting sites were much restricted; such conditions may have rendered the dispersion difficult. On the contrary, our study areas were open and not isolated from other nesting areas. In addition, nest substrates were abundant, hence nesting sites were not limited.

Philopatry is often discussed in connection with foundress association (e.g. KLAHN, 1979). Although, as exemplified by *P. jadwigae* (HIROSE and YAMASAKI, 1984), philopatry is not always accompanied with frequent foundress association, it still seems to facilitate the gathering of sibling females. Extremely low frequencies of foundress association in *P. riparius* and *P. snelleni* (YAMANE, 1969; MAKINO and AOKI, 1982) might be connected with their weak philopatric tendency, though the ultimate determinant of frequency of foundress association in a species or in a population should be selective advantage for foundresses (WEST, 1968).

The present study suggests that the queen of both *P. snelleni* and *P. riparius* have the capability to disperse over a long distance. This is consistent with the observation by YAMANE (1986, pp. 26–27) that these species rapidly colonize new habitats. If we had restricted the census of spring nests to small areas, we might have regarded these species as “philopatric”. The fact, however, is that some queens exhibit a philopatric trait, while others disperse. We must be careful when we speak of “philopatry”.

SUMMARY

Dispersion capabilities of new queens were studied in the two haplometrotic paper wasps *Polistes riparius* and *P. snelleni*. New queens were marked on the nests in the late summer and located in the next spring. Dispersion distances greatly varied among queens: although a large part of recovered queens nested in close proximity to their natal sites, some did disperse over 100–300 m. This suggests that queens' emigration from and immigration into the censused areas occurred to a substantial extent. On the whole, these species exhibited a weaker “philopatric” tendency than those so far studied for dispersion distance, and seem to have the potential for a long-distance dispersion.

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トガリフタモンアシナガバチとコアシナガバチにおける新女王の分散

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晩夏に羽化した新女王が翌春営巣するまでに分散する距離を上記2種で調べた。新女王には生まれた巣(母巣)でマーキングを施し、翌春、営巣している個体を探した。10年間に合計86および9の再発見個体をそれぞれトガリフタモンアシナガバチ *Polistes riparius* (全マーキング個体に対する再発見率4.0%)、コアシナガバチ *P. snelleni* (0.5%) で得た。母巣から10 m以内に営巣した再発見個体の割合は10–30%であり、この値は従来アシナガバチ属で報告されているものより小さく、また母巣から100–300 m以上離れて営巣した個体も見られた。さらに、同じ母巣から生まれた女王が、母巣周囲に集中して営巣する傾向も見られなかった。以上から本2種は他種に比して母巣から分散する傾向が強く、新たな生息場所へ侵入する能力も大きいことが示唆された。