



Research Article

Further Observations on the Overwintering Habits of the Paper Wasp *Polistes (Gyrostoma) Olivaceus* (De Geer, 1773) (Hymenoptera: Vespidae) in Vietnam

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Abstract | Further observations on the overwintering habits of the paper wasp *Polistes olivaceus* (De Geer, 1773) are presented. The overwintering aggregation of the wasp took place at its former nests and involved both males and females. Whereas the females often gathered very closely on the top surface of the nests, males often roosted alone at the nest petiole or a certain site outside the nest, about 2–10 cm from the females. Under unfavorable weather conditions individuals were totally immobile. Severe weather conditions (high temperatures and the large temperature difference between day and night in the winter season) or a deficiency of added nutrition source are possibly causes inducing the death of overwintering individuals. Several discussions on the overwintering habits of the species are included.

Novelty Statement | The study is novel to suggest containing of overwintering habits of common wasp, *Polistes olivaceus*. Suggestions include severe weather conditions or/and added nutrition source deficiency.

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Introduction

Polistes is one of largest genera of the family Vespidae and distributed worldwide. *Polistes* paper wasps nest in relatively small colonies (typically less than 100 individuals) and overwinter as adults in often sheltered situations, for example, abandoned or human houses, tree hollows, burrows in soil (Rusina, 2006; Tibbetts and Sheehan, 2013). *Polistes olivaceus* (De Geer, 1773) is one of the most defensive *Polistes* species. The nesting biology of the paper wasp was studied by only Barthélémy (2008) and Pham (2015). Barthélémy (2008) contributed a very brief summary on the colony size and nest structure.

Pham (2015) produced detailed studies on nesting sites, the nest structure, the size of developmental stages, the colony size, nesting defensive habits of the queen, and the colony cycle. He divided the colony cycle into five stages (1, Post-hibernant stage; 2, Solitary stage; 3, Emergent stage; 4, Pre-hibernant stage, and 5, Hibernant stage) and showed the duration of the colony cycle about 270 days and the overwintering stage around 80 days, from the beginning of December to early March of the following year.

Studies on the overwintering habits of *P. olivaceus* have still been poor. Pham (2014) observed the overwintering habits on only a former nest built on a grill lamp tray that is embedded the ceiling of a laboratory in Institute of Ecology and Biological Resources, Ha Noi. Pham (2015)

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reported the wasp hibernating in a rotten tree trunk under the surface of the ground and in slits between tree trunk and tree bar. In the present paper, I present additional information on the overwintering habits of *P. olivaceus* and several discussions related to such overwintering habits of this paper wasp.

Materials and Methods

Observations were taken on three nests of *P. olivaceus* at Ha Noi, Vietnam. One nest at Dong 1, Co Nhue 2 ward, Bac Tu Liem district (No. 0116) was observed from the end of November 2016 to the beginning of February 2017, and one nest at Dong 1, Co Nhue 2 ward, Bac Tu Liem district (No. 0120) and one nest at Nghia Do ward, Cau Giay district (No. 0220) were observed from early December 2020 to mid-January 2021. All three nests were counted the number of nest cells and measured in diameter. The observation was carried out with a frequency of 1–2 times per day, each lasting about 5–10 minutes. Fourteen living *P. olivaceus* individuals of the nest No. 0116 picked up on the ground on 22 and 23 December 2016 were reared in three plastic jars, 20 cm high and 10 cm in diameter, with the supply of 50% diluted honey (50% of fresh water and 50% of pure honey) during seven days for observations on their living ability. Three individuals, one male and two females, of the nest No. 0220 were caught and marked by a small circular spot of red nail polish on the central part of the mesoscutum and then released for observations on orientation flights on January 4, 2021. Pictures were taken both in the field and the laboratory using a Canon SD3500IS camera, Japan.

Results and Discussion

The nest No. 0116 was built on the ceiling of the second floor, about 7.5 m from the ground. It consisted of about 320 cells and was about 15 cm in diameter. A group of thirty-three individuals found aggregating on the nest for the overwintering from the end of November 2016 to the beginning of February 2017. More than 15 often used the top surface of the nest as an overwintering site and aggregated very close together, head oriented the nest petiole. The remaining individuals roosted on the under surface, some grouping together, some alone. On December 22 and 23, 2016, 18 individuals were picked up on the ground, in 0.5–5 m from the nest. Of these, four had died but were fresh and 14 were alive and walking on the ground, often their pairs of wings nearly erect from the body axis, but some with a pair of right wings nearly erect and a pair of left wings stretching along the body (Figure 1). Of such 14 living individuals supplied with 50% diluted honey, five died after about half a day, one died after about a day, and the remaining were released after seven days of the collection. Some individuals were found either leaving

the nest or often perching upon far from the nest from mid-December 2016 to early January 2017. Only four individuals remained their overwintering on the nest until early February 2017.



Figure 1: Adult paper wasp walking on the ground with a pair of right wings nearly erect.



Figure 2: Overwintering aggregation of the paper wasp *Polistes olivaceus* (De Geer) on its former nest, arrow showing the overwintering roosting site of a male.

Thirty-seven and 58 individuals of *P. olivaceus* were counted on the nests No. 0120 and No. 0220 from the beginning of December 2020 to mid-January 2021, respectively. The first nest was built on the roof of a thatched house, about 3.7 m from the ground. It included about 420 cells and had the diameter of 17 cm as measured at the farthest sides. The latter was built on a window of the third floor of a building, about 10 m from the ground. The nest consisted of 287 cells and had the diameter of 15 cm. Frequently about two-thirds of individuals aggregated very close together on the top surface of the two nests, head often right; some roosted on the sides, head up; and some were on the bottom surface (Figure 2). In many cases, some mounted on conspecific females. Two males were also found overwintering on these two nests, but they frequently roosted alone and maintained their site either at the nest petiole, 2–5 cm from the females, or a certain

site outside the nest, 5–10 cm from the females (Figure 2). In days that it was sunny and the temperature was above 16°C, most individuals were active, some walking around the nest, some leaving the nests for food but always taking circle-oriented flights, only about 20 cm from the nest. In days that it was cloudy and under 15°C, the individuals were totally immobile, the wings stretching along the body. In four cases, I used small bamboo branches to touch softly some individuals, but they took no movements and stings.

Three individuals of the nest No. 0220 were caught, marked, and then released about 10 cm from their nest on 4 January 2021, but none of them carried out orientation flights. All the three made a straight flight forwards the ground, one landing on the surface and walking around and then climbing on the hairy beggarticks (*Bidens pilosa* Linnaeus), about 35 cm high, two landing on leaves of the Indian almond tree, (*Terminalia catappa* Linnaeus) (about 200 cm from the ground) and immobile, and they did not return to the nest in days later.

Pham (2014, 2015) reported that the overwintering stage of *P. olivaceus* is about 80 days from late November to late February of the following year and individuals do not almost leave their overwintering site. Individuals of the wasp were found leaving their overwintering sites and dying at the end of December 2016 are possibly due to extreme weather conditions or a deficiency of added nutrition source. The fact that at the time of study, it was sunny and about 23°C in the daytime, but only about 13°C in the night. The large temperature difference between day and night is possibly a main cause leading into the death of the wasp individuals. That another cause can bring about the death is a deficiency of added nutrition source (as evidenced by rearing of 14 individuals of the wasp). The deficiency of orientation flights whenas the individuals temporarily leave their overwintering site possibly induces their death because they impossibility return the nest (as evidenced by three individuals marked) and therefore they potentially become prey to predators.

Most overwintering sites of *Polistes* wasps have been reported to be in sheltered situations, for example, *P. annularis* in crevices of rocks (Rau, 1942; Strassmann, 1979), *P. chinensis* in vacancies under roof tiles and on the ceiling (Yoshikawa, 1963), many North American *Polistes* wasps in rotting woods and under the surface of the ground (Michener and Michener, 1951), *P. dominula* in tree hollows, under the bark of dead oaks in oak-birch groves, on reeds in floodplains, burrows into loose soil and plant litter (as suggested by Rusina, 2006), *P. olivaceus* in a rotten tree trunk 15cm under the surface of the ground and in slits between tree trunk and tree bar at the beginning of January, 2010 in Quang Binh province, Vietnam (Pham, 2014). Overwintering sites at former nests are rare to be recorded, only in case of *P. dominula* (misidentified as *P.*

gallicus, Pardi, 1951) and of *P. olivaceus* (Pham, 2014). Use of former nests as overwintering sites, reported additionally here, is a feature characteristic of *P. olivaceus*.

Pham (2014) reported 20 individuals of *P. olivaceus* gathering on their former nest for the overwintering. The author suggested that this grouping is to keep warm overwintering site, but no convincing evidence is available. Strassmann (1979) stated that sisters hibernate together and may control temperature fluctuations in the hibernaculum to some extent. I believe that the aggregation of a large number of the individuals both plays a temperature control function of the hibernaculum and is also to protect them from predators. In a case of study on *Parapolybia varia*, Pham (2016) showed 135 overwintering individuals aggregating into a hollow bamboo stem put under a palm leaf-tiled roof and believed that the aggregation is to provide a measure of protection from predators. Such an aggregation may also serve a social function leading to sharing of nesting activities of the individuals (queens) in the following year. The overwintering individuals are of the last generation in year. These individuals have the body size bigger than those of other generations and become founding queens in the following year. My observations at Co Nhue 2, Bac Tu Liem from 2016 to 2018 on the solitary stage of *P. olivaceus* recorded that in several cases a nest was maintained by two founding queens, but one of them had to leave the nest soon, in some days.

Seventeen of the 20 individuals observed by Pham (2014) take the overwintering on the former nest until late January 2014. The individuals of the nest No. 0116 overwintered on their former nest to the beginning of February 2017. My colleague, Dr. Nguyen Thi Phuong Lien has informed me of an observation on many individuals of *P. olivaceus* overwintering on their former nest built into a laboratory at the Institute of Ecology and Biological Resources, Ha Noi, all of them taking this site only to late January. Pham (2015) reported the post-overwintering stage of the wasp around the end of March. Two questions that are requesting are that: (1) Where are the overwintering individuals after leaving the former nests from late January or early February to late March? and (2) Why they abandon overwintering sites on their own former nests soon? The two questions unanswerably maintain in the present study.

Males are important members in the colony organization of *P. olivaceus* nests. They emerged in the last generation of year and also took the overwintering along with females, but roosted away from the females (Figure 2). The maintenance of a distance between them is difficult to explain and further studies are, hence, necessary for our understanding of this matter.

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Conflict of interest

The authors have declared no conflict of interest.

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