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SHORT NOTE

First record of *Elasmus polistis* (Hymenoptera: Eulophidae), a parasitoid of *Polistes versicolor* (Hymenoptera: Vespidae), in Minas Gerais, Brazil

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Abstract

The social wasps of the order Hymenoptera, family Vespidae and subfamily Polistinae perform important ecological functions such as pollination and predation, including pest insects, and can be an important resource in biological control. Some species of parasitoids attack nests of social wasps causing mortality in the early stages of development, thus impairing the biological control by these insects. This study aimed to verify the occurrence and identify parasitoids in nests of *Polistes versicolor* Olivier, 1971, at the Instituto Federal de Educação, Ciência e Tecnologia de Minas Gerais (IFMG) – *Campus* Bambuí, Brazil. In total, 14 nests of *P. versicolor* were collected. The parasitism rate was 28.57%, and parasitoids were recorded in four of 14 nests collected. The presence of parasitized nests may be due to the absence of a protective envelope, typical of the nest of *P. versicolor*. The emerged parasitoids belong to the species *Elasmus polistis* Burks, 1971 (Hymenoptera: Eulophidae), a species identified in nests of social wasps only in the state of Rio Grande do Sul, southern Brazil. To the best of our knowledge, this is the first study showing the occurrence of *E. polistis* parasitizing social wasps in Minas Gerais, southeastern Brazil.

Social wasps belong to the order Hymenoptera and family Vespidae, distributed in the subfamilies: Stenogastrinae, Vespinae, and Polistinae (Carpenter, 1993). The subfamily Polistinae has high diversity in the Neotropical region and is the only one having eusocial wasps occur in the Brazilian territory, where we find 21 genera and 361 species (Hermes et al., 2021). The wasps of this subfamily belong to three tribes: Polistini, Mischocytarini, and Epiponini (Carpenter & Marques, 2001).

These insects act as pollinators and floral visitors, collecting nectar for adult nutrition (Hunt et al., 1991; Brodmann et al., 2008; Mello et al., 2011). Social wasps, especially from the genus *Polistes*, also act as predators of various agricultural pests, playing an important role in food chains and biological control, mainly attacking Lepidoptera caterpillars (Prezoto & Machado, 1999; Prezoto et al., 2006; Elisei et al., 2010; Jacques et al., 2019). These caterpillars are torn, macerated, and given as food to larvae, being the main nutrition of wasps in their early stages of development (Evans & West-Eberhard, 1970)

The subfamily Polistinae is divided into two groups, according to the nesting behavior and architecture: 1 - Independent Foundation - form small colonies and build unprotected combs; 2 - Swarm: wasps build larger nests, protected by an envelope, with a well-defined social organization (Carpenter & Marques, 2001).

The nests of social wasps are often invaded by parasitoids of larvae, pupae, and adults, and species of the genus *Polistes*, which behave as an independent foundation, are more vulnerable to these natural enemies (Burks, 1971; Somavilla et al., 2015). The incidence of parasitism is higher in these nests due to the shorter time that wasps spend

protecting the colony to forage, besides the absence of a nest protection envelope (Soares et al., 2006; Somavilla et al., 2015). The parasitism can compromise the colony, being the main cause of mortality among social wasps in the early stages of development (Soares et al., 2006).

This study aimed to verify the occurrence and identify parasitoids in nests of *Polistes versicolor* Olivier, 1971 (Vespidae: Polistinae), at the Instituto Federal de Educação, Ciência e Tecnologia de Minas Gerais (IFMG) - *Campus* Bambuí, Brazil.

The experiment was performed at the Bambuí Campus of the Instituto Federal de Educação, Ciência e Tecnologia de Minas Gerais (IFMG), an anthropography environment characterized by the presence of several buildings and several agricultural crops. We collected 14 nests of *P. versicolor* on the *campus.* The species *P. versicolor* was chosen since it is dominant on the *campus*, facilitating the location of their nests (Jacques et al., 2015).

The nests, without the presence of adults, were placed in plastic containers covered by a fabric structure, with ventilation, kept in an incubator type B.O.D. for approximately 40 days, at 25 °C and relative humidity of 70% (Somavilla et al., 2015). The number of cells and pupae of each nest was recorded.

Daily monitoring of nests was performed, recording the emergence of parasitoids. Those who emerged were fixed in 70% alcohol and sent to Prof. Luís Cláudio Paterno Silveira from the Federal University of Lavras for identification based on the key of Brown (2010).

The parasitism rate was estimated using the formula %TP = (NNP / NNT) × 100, where NNP represents the number of parasitized nests, and NNT, the number of total nests. Two Pearson correlation analyses were performed. One is between nest cell numbers and parasitoid numbers, and another is between pupae numbers and parasitoid numbers. We used the Past program (Hammer, 2005) to run the analyses.

The nests of *P. versicolor* had an average of 110.64 ± 34.5 cells and 11.29 ± 7.39 pupae (Table 1). We recorded a total of 301 parasitoids in four of the 14 collected nests, with an average of 75.25 ± 20.14 parasitoids/parasitized nests. The parasitism rate was 28.57% (Table 1), similar to that found in *Polistes metricus* Say, 1831, in the USA, of 23% (Hodges et al., 2003). Nests of species of the genus *Polistes* are severely parasitized because they do not have a specific caste of offspring caregivers (Clouse, 1997) and consequently spend more time foraging and less time protecting the colony. Moreover, in this genus, the nest has no protection envelope (Somavilla et al*.,* 2015).

The emerged parasitoids belonged to *Elasmus polistis* Burks, 1971 (Figure 1). The genus *Elasmus* is the only member of the Elasmini tribe (Hymenoptera: Eulophidae), having 248 described species (Noyes, 2019). Some species of *Elasmus* are secondary parasitoids (hyperparasitoids) of Braconidae and Icheneumonidae, but most are primary parasitoids of Lepidoptera, Coleoptera, and Hymenoptera (Gibson, 1993; Coote, 1997; Dorfey & Köhler, 2011). The species of this genus are characterized by the small size (1-3 mm) and the yellow body (Dorfey & Köhler, 2011).

Table 1. Number of cells and pupae of the nests of *Polistes versicolor* collected, number of *Elasmus polistis* parasitoids emerged and percentage of parasitized nests.

Nest (n°)	Cell (n°)	Pupa (n°)	Parasitoid (n°)
1	31	2	-
2	20	-	-
3	163	7	-
4	31	7	-
5	297	14	188
6	36	4	-
7	33	-	-
8	19	1	-
9	390	106	32
10	20	1	-
11	300	12	44
12	155	-	-
13	26	-	-
14	28	4	37
Mean ± standard error	110.64 ± 34.50	11.29 ± 7.39	75.25 ± 20.14
Parasitism rate (%)			28.57

Fig 1. *Elasmus polistes* emerged from the nest of *Polistes versicolor*.

The analysis showed a high correlation between the number of cells in the nests and the number of parasitoids (Person Coefficient = 0.728; $p < 0.05$). Three parasitized nests were the largest collected, with 390, 300, and 297 cells. This higher rate of parasitism found in larger nests was also reported in *Polistes myersi* Bequaert, 1934 (Mayorga & Sarmiento, 2020) and *P. versicolor* (Somavilla *et al.,* 2015). Furthermore, these nests had the highest number of pupae and showed a correlation between the number of pupae and the number of parasitoids (Person Coefficient = 0.539; $p < 0.05$). *E. polistis* is a gregarious ectoparasite that feeds on the genus *Polistes*' pupae (Nelson, 1976). Thus, the larger nests with the highest number of pupae were more likely to be parasitized because the parasitoids obtained more food for their larvae.

Females of *E. polistis* usually oviposit in wasp pupae in their early stage and with cells already covered. In this site, the parasitoids enter the pupa state and are protected from attacks by host wasps (Reed & Vinson, 1979; Lutz et al., 1984). As soon as the parasitoid larvae hatch, they feed on the entire content of the pupae. Then, the larvae migrate to the bottom of the cell, build a protection and stay apart from the host remains. Males usually appear first and wait for the females to mate (Reed & Vinson, 1979; Macom & Landolt, 1995). Females, after mating, can stay in the nests they emerged from and oviposit in a pupa. (Macom & Landolt, 1995).

E. polistis has already been identified as a parasitoid in nests of other *Polistes* species, such as *Polistes exclamans* (Viereck, 1906), *Polistes annularis* (Linnaeus, 1763), *Polistes fuscatus* (Fabricius, 1793), *Polistes major* Palisot de Beauvois, 1818, *Polistes metricus* (Reed & Vinson, 1979), *Polistes dorsalis* (Fabricius, 1775) (Macom & Landolt, 1995), *Polistes myersi* (Mayorga & Sarmiento, 2020), which are found in North and Central America. In Brazil, *E. polistis* has been recorded as a parasitoid of *Polistes cinerascens* (Saussure, 1854) and *P. versicolor* in Rio Grande do Sul, southern Brazil (Dorfey & Köhler, 2011; Somavilla et al., 2015). There is a great distance between Central America and Rio Grande do Sul in Brazil without any record of this parasitoid in wasp nests. Our first record of *E. polistis* in Minas Gerais, southeastern Brazil, is an important remark for the biogeographic comprehension of this ecological interaction.

The species of the genus *Polistes* have already been elucidated as an important tool in biological control in different crops, such as corn (Prezoto & Machado, 1999), cotton (Kirkton, 1970), tobacco (Rabb & Lawson, 1957), cabbage (Gould & Jeanne, 1984), coffee (Gravena, 1983) and kale (Jacques et al., 2018). The species *P. versicolor* stands out, for it has already been tested in different studies with biological control (Prezoto et al., 2006; Elisei et al., 2010; Jacques et al., 2019).

The attack of parasitoids can cause high mortality among host social wasps, thus impairing the biological control by these insects (Hanson & Gauld, 2006). Since *P. versicolor* is the dominant wasp in IFMG – *Campus* Bambuí (Jacques et al., 2015), these parasitoids may impair the control of agricultural pests by this species in the crops of the *campus*, and further studies are necessary to test this hypothesis.

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Author's Contribution

GCJ: conceptualization; formal analysis; resources; writing -review & editing.
SCCF: investigation; writing-original draft.
LCPS: supervision; methodology; writing-review & editing.

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