

The role of males in a neotropical paper wasp, *Polistes ferreri* Saussure, 1853 (Hymenoptera, Vespidae, Polistinae)

Danielle M. S. Sinzato¹
Fábio Prezoto²
Kleber Del-Claro³

ABSTRACT: There are a few studies about the behavior of males of paper wasps in the colonies; however, some activities performed by males, such as nest maintenance and brood care, have been described in the literature. Between February and June 2001, behavioral observations were carried out on three colonies of *Polistes ferreri* Saussure, 1853, from post-emergence to decline phases. Productivity, emergence time, permanence on the combs and behavioral repertory were verified during the observations. The emergence of males took place between February and June, and the productivity was $17,66 \pm 12,05$ males per colony. Such values were smaller than those found for other species of *Polistes*. Seventeen behavioral acts were registered for males of *P. ferreri*. Males remained in the colony for a short period (average of 8,06 days). Some performed acts by males seem to be related to the tasks in the nests and to the mating behavior.

Key Words: Behavioral Ecology, production, males, *Polistes ferreri*.

¹ Mestrado em Ciências Biológicas. Comportamento e Ecologia Animal. Universidade Federal de Juiz de Fora. dsinzato@bol.com.br / Bolsista Capes

² Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, Campus Universitário Martelos, 36.036-330, Juiz de Fora, MG. fprezoto@icb.ufjf.br

³ Laboratório de Ecologia Comportamental e Interações (LECI), Instituto de Biologia, Universidade Federal de Uberlândia, CP 593, 38.400-902, Uberlândia, MG. delclaro@ufu.br

INTRODUCTION

Many studies (PARDI, 1942, 1948; WEST-EBERHARD, 1969; CORN, 1972; STRASSMANN, 1981; KASUYA, 1983; ITÔ, 1986; POST *et al.*, 1988; GIANNOTTI, 1995; GIANNOTTI & MACHADO, 1994, 1999; SINZATO & PREZOTO, 2000; ZARA & BALESTIERI, 2000; PREZOTO, 2001) refer to different biological and behavioral aspects of social wasps of the genus *Polistes*. However, reports on the behavioral activities of males are scarce, and generally focus on the male production and the mating behavior (CASTELLÓN, 1982; POST & JEANNE, 1983; MIYANO, 1986; BEANI & TURILLAZZI, 1988; REED & LANDOLT, 1990; ARÉVALO *et al.*, 1998).

In some tropical species of *Polistes* Latreille, 1802, the permanence of males in the nests can extend for variable periods. GIANNOTTI (1992) verified the presence of males in the nests of *Polistes lanio lanio* Fabricius, 1775 during almost throughout the colony cycle. From the 27 colonies of *Polistes versicolor* Olivier, 1791, SOUZA (1998) registered the production of males only in three ones, and the males remained for a short period in these nests. The permanence of males for short time, possibly allows the insemination of several females and the production of fertilized eggs (CASTELLÓN, 1982).

Several studies (CAMERON, 1986; VALADÃO, 1986; GIANNOTTI, 1992; MAKINO, 1993; O'DONNELL, 1995) have described that some behaviors, such as prey maceration, trophallaxis adult-larvae, forage of food and ventilation of the nest, usually performed by females, are also performed by males of different species of *Polistes*.

The tropical social wasp *Polistes ferreri* Saussure, 1853 is distributed in Brazil from Bahia to Rio Grande do Sul State, as it is also found in Argentina, Uruguay and Bolivia (RICHARDS, 1978). In spite of its wide distribution, the literature lacks of information about the behavior of this species.

The objective of this study was to verify the production of males in colonies of *P. ferreri* as relating the time of males' permanence in the nests and their behavioral role.

MATERIAL AND METHODS

Danielle
M. S. Sinzato
Fábio
Prezoto
Kleber
Del-Claro

From February to June 2001, we made 98 hours of behavioral observations in three colonies of *P. ferreri* (namely D-14, D-16, D-19), located in a garden of the Faculdade de Educação at the Campus of the Universidade Federal de Juiz de Fora (21°46' S, 43°21' W; 512m), Minas Gerais State, Brazil. Colonies were found in the post-emergence phase, and the observations were obtained until the decline phase.

For the identification of males, each individual was marked with plastic ink ACRILEX® on the thorax region.

The behavioral observations were undertaken according to the SCANNING method (ALTMANN, 1974), by which each individual's behavior is taken in regular intervals of five minutes, in sections of 60 to 120 minutes of duration, and following the activity schedules of the colonies.

A field record was elaborated to facilitate the weekly information registration, as biological and behavioral information of the colonies, which permitted the registration of the emergence time, the total productivity of males, the permanence in the native nest and the period in that the colonies had the presence of males.

RESULTS

The males of *P. ferreri* were smaller than the females and presented a darker coloration (Figure 1), which facilitated their discrimination. The number of segments of the antennae also was different between males and females.



Figure 1. Dorsum (A) and ventral view (B) of female and male of *Polistes ferreri*.

Rev. bras.
Zooiciências
Juiz de Fora
V. 5 N° 1
Jul/2003
p. 89-100

We registered the emergence of 53 males during this study, the pick of emergence occurred in April (Figure 2). In agreement with the results presented in the Table 1, the number of produced males was $17,66 \pm 12,05$ (5-29), and they stayed on nests for an average period of 8 ± 3 days; (3-14, n = 46 males). We verified that most of the males (56,52%) stays in the colony for at least two weeks.

Figure 2. Time of productivity of males of *Poliste ferreri* in the colonies D-14, D-16 and D-19.

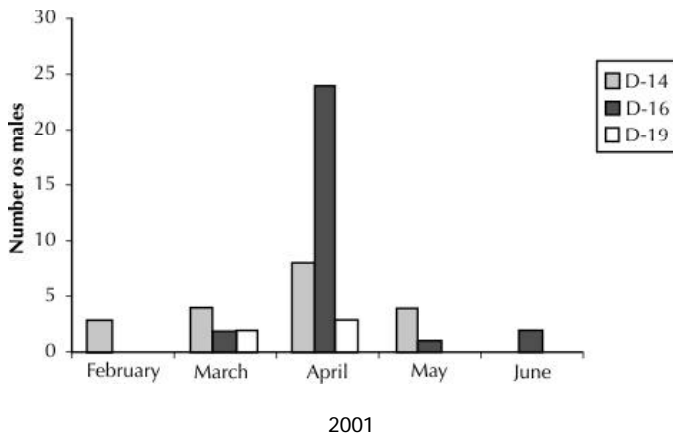


Table 1. Emergency period and number of males of *Polistes ferreri* produced in the colonies D-14, D-16 and D-19.

Colonies observed	Emergency date		Total of males produced	Presence in the colonies (total in days)
	First male	Last male		
D-14	Fev.23. 2001	May.31. 2001	19	until Jun.08. 01 (106)
D-16	Mar.21. 2001	Jun.11. 2001	29	until Jun.26. 01 (98)
D-19	Mar.23. 2001	Apr.17. 2001	5	until Apr.20. 01 (29)
x ± D.P.	-	-	17, 66 ± 12,05	77,66 ± 42,33

x = average, SD = standard deviation.

We described seventeen behavioral acts of *P. ferreri*, such as described below:

1- Staying immobile on the nest – the individual stays apparently inactive on the nest or substratum. Probably resting.

2- Walking – the individual walks on the nest or on the substratum. Probably an exploratory behavior.

3- Recognition flight – the individual flies in the proximities of the nest without standing back a lot.

4- Regurgitating liquid – the male liberates through his mouth, a small drop of translucent coloration liquid outside the nest.

5- Self-grooming – the individual cleans with the first pair of legs the antennae, head and thorax, and with the rear legs, he cleans the wings and gaster.

6- Allogrooming – the resting individual has parts of her body (head, thorax, wings and gaster) cleaned for another wasp (frequently a female), who uses her mouthpieces as licking.

7- Ventilating the nest – the individual takes a posture elevated with the first pair of legs lifting up and vibrates the wings to refrigerate the nest in the most hot periods of the day.

8- Checking cells with the head – the individual inserts the head inside a cell, touching its contents with the antennae.

9- Checking cells with the antennae – the individual walks on the cells of the nest, touching them with the antennae.

10- Unsuccessful foraging – when coming back to the nest, the individual does not perform any behavior that indicates the load presence.

11- Macerating prey – the individual macerates a prey piece with the mandibles for a few minutes.

12- Adult-larva trophallaxis – the individual introduces the head inside one or more cells offering food to the larvae (nectar or prey).

13- Larva-adult trophallaxis – the individual ingests the secretion produced by the larvae.

14- Adult-adult trophallaxis – transference of regurgitated liquids (nectar, honeydew of Homoptera, sugars of fruits) among adults.

15- Contact – the the resting male can be arrested by another wasp, or even he can have part of his body (antennae,

legs or wings) hold between the mandibles of a nest mate.

16- Being dominated physically – the individual receives bites on the head, thorax or gaster from another wasp, that occupies a higher hierarchical position. After the aggression, the individual can stay on the comb or leaving for a foraging flight.

17- Trying the mating – the male approaches to an immobile female, touches her thorax and head, with his antennae, the male arise slowly in her dorsum and keeps the gaster in movement, trying to insert into the genital organ of the female.

The behavior “to stay immobile on the nest” was the most frequent (82,21%), behavioral act performed by males in the posterior part of the comb (Figure 3), and all the mating attempts were driven to the female sisters. In this study, we did not observe the effective mating behavior between males and females of *P. ferreri*.

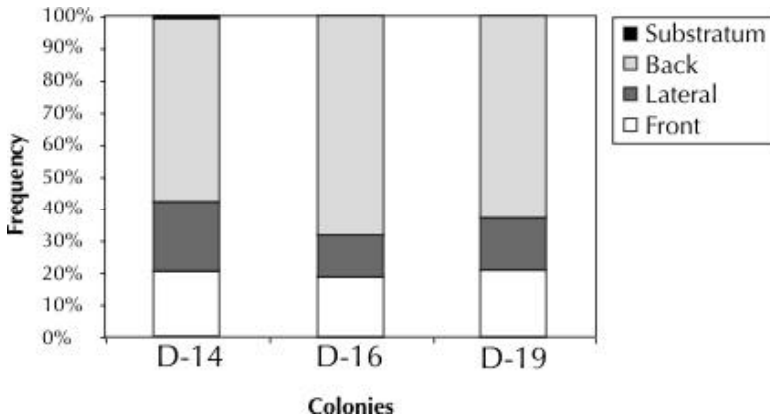


Figure 3. Positions occupied by males of *Polistes ferreri* on the different areas of the comb and on the substratum.

All the colonies were still producing females during the period of emergency of the males. On the May (23) the emergency of a male was observed in the colony D-14, and during the emergence the male was helped by a female that opened the cell. After the emergency, the male stayed immobile for some seconds and it moved for the backside part of the comb where

stays in the first days of life, exhibiting behaviors as: staying immobile on the nest; adult-adult trophallaxis; contact; self and allogrooming.

In two occasional observations (April 25 and May 08), we observed the presence of foreign males in the colony D-14. On these occasions we verified that some subordinate females were extremely aggressive with these males.

Table 2. Behavioral repertory of males of *Polistes ferreri* produced in three colonies (D-14, D-16 and D-19) during the study period.

Behaviors	Number	Percentage
Staying immobile on the nest	1548	82.21
Walking	76	4.03
Unsuccessful foraging	75	3.98
Self-grooming	73	3.89
Macerating prey	43	2.28
Larva-adult trophallaxis	13	0.69
Contact	13	0.69
Checking cells with the head	11	0.58
Being dominated physically	8	0.42
Ventilating the nest	7	0.37
Being clean	5	0.27
Trying the mating	3	0.17
Checking cells with the antennas	2	0.11
Adult-larva trophallaxis	2	0.11
Recognition flight	2	0.11
Adult-adult trophallaxis	1	0.05
Regurgitating liquid	1	0.05
TOTAL	1883	100.00

DISCUSSION

The simultaneous emergency of males and females also was observed in *Polistes chinensis antennalis* Pérez, 1905 (MIYANO, 1986), *P. versicolor* (RODRIGUES, 1968) and *P. l. lanio* (GIANNOTTI, 1992). Some studies registered a short permanence of males in the colony, as registered for *P. ferreri* (average of 8,06 days). GIANNOTTI (1992) found an average of 10 days in *P. l. lanio*. When a male leaves the satellite nests, he probably stays in foundation places or in natural shelters, which offers protection during the night (POST & JEANNE, 1983; BEANI & TURILLAZZI, 1988; GIANNOTTI, 1992).

GIANNOTTI (1992) verified males in colonies of *P. I. lanio* during the whole year (1985-1990) except for July, with a permanence for periods of 107 to 213 days. According to RA-POSO-FILHO (1987) the constant presence of males in a given area of the colonies is a mechanism that permits the fecundation of the females during every year, in function of the absence of synchronism in the biological cycle of tropical species.

The average productivity of males registered in colonies of *P. ferreri* (18 individuals) was lower than that registered in *P. chinensis antennalis* (average of 82 males) (MIYANO, 1983) and in *P. versicolor* (35 males) (RODRIGUES, 1968).

GIANNOTTI (1992) counted 12 behavioral acts exhibited by males of *P. I. lanio*. However, only "giving alarm" and "mating in the nest" were not observed in *P. ferreri*. Although the males of *P. ferreri* have exhibited behaviors that confirmed his participation in the brood care, they spend most of the time in tasks of the nest, similar to those results registered for *P. versicolor* (VALADÃO, 1986) and *P. I. lanio* (GIANNOTTI, 1992).

The participation of males in the reception activities and prey maceration, feeding on larvae, was already registered to *Polistes major* Bequaert, 1936 (CAMERON, 1986), *Polistes instabilis* Lepelletier, 1836 (O'DONNELL, 1995), *P. versicolor* (SOUZA, 1998), *Polistes jadvigae* Van Dalla Torre, 1904 (MAKINO, 1993) and *P. I. lanio* (GIANNOTTI, 1992). MAKINO (1993) observed that a similarity between the behavior of prey maceration by females and by males in *P. jadvigae*, and verified that the males pass more time macerating than the females and they generally feed an only larva. The behavior of ventilating of the nest, exhibited by males of *P. ferreri*, was also observed in *P. major* (CAMERON, 1986) and in *P. I. lanio* (GIANNOTTI, 1992).

The unsuccessful foraging, registered for males of *P. ferreri*, suggests that these flights are related to the search of alimentary resources to supply the individual needs, since in the nest, the males were fed a few times by the females, that most of the time they attacked them, forcing them to take place in the posterior part of the comb, where they could be protected. This same behavior was registered for males of *P. I. lanio* (GIANNOTTI, 1992). On the other hand O'DONNELL (1995) observed two males of *P. instabilis* bringing nectar and making trophallaxis with subordinate females.

The behaviors "contact" and "allogrooming", were not described for social paper wasps in the literature. The "contact" can probably be a behavior linked to the dominance, so that the females held the males, stopping his movement in the nest. However the behavior of "allogrooming" is rare in wasps and suggests a social interaction. WILSON (1971) mentions that many social insects clean their nest mates with the mouth apparatus in similar movements the "licked", and that during this behavior (frequent in ants, bees and termites) there is a pheromone transference.

The males of *P. ferreri* were observed trying to copulate with females of the same colony. This suggests that the mating between males and sisters (gynes) are related with readiness of females in the nest, because when they abandon the colony, the male's opportunities of mating decrease. The fact of the females is fecundated by males of the same colony, has been already mentioned by RODRIGUES (1968).

The duration of the mating between males and females of the same colony of *P. l. lanio* had average duration of 35 seconds (GIANNOTTI, 1992), however WEST-EBERHARD (1969) described in detail the mating behavior in *Polistes fuscatus* (Bequaert, 1940) in captivity, which duration was from 20 to 30 seconds.

This study brings a contribution for the understanding of the social dynamics between males and females of *P. ferreri*, even so they are necessary more investigations for the comprehension of the evolution of the social behavior of this genus.

CONCLUSION

The males of *P. ferreri* are produced in different phases of the biological cycle during a short period of the year (February to June). We verified an inferior male productivity to those registered for other species of *Polistes*. In *P. ferreri* colonies, the males receive food from the females and can perform behaviors related to the brood care, as well as the mating with females.

ACKNOWLEDGEMENTS

The authors thank the Brazilian Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the financial support and to the Doctor Fábio Santos do Nascimento for the revision of this manuscript.

REFERENCES

- ALTMANN, J. 1974. Observational study of behavior: sampling methods. *Behaviour* 49: 227-267.
- ARÉVALO, E.; J.E. STRASSMANN & D.C. QUELLER. 1998. Conflicts of interest in social insects: male production in two species of *Polistes*. *Evolution* 52(3): 797-805.
- BEANI, L. & TURILLAZZI, S. 1988. Alternative mating tactics in males of *Polistes dominulus* (Hymenoptera: Vespidae). *Behav. Ecol. Sociobiol.* 22: 257-264.
- CAMERON, S.A. 1986. Brood care by males of *Polistes major* (Hymenoptera: Vespidae) J. *Kansas Entomol. Soc.* 59(1): 183-185.
- CASTELLÓN, E.G. 1982. Evidências sobre o comportamento de cópula dos machos de *Synoeca surinama* L. (Hymenoptera: Vespidae) num ninho em construção. *Acta Amazônica* 12(3): 665-666.
- CORN, M.L. 1972. Notes of biology of *Polistes carnifex* (Hymenoptera, Vespidae) in Costa Rica and Colombia. *Psyche* 79: 150-157.
- GIANNOTTI, E. 1992. **Estudos biológicos e etológicos da vespa social neotropical *Polistes (Aphanilopterus) lanio lanio* (Fabricius, 1775) (Hymenoptera, Vespidae)**. Tese de Doutorado. UNESP, Rio Claro. 212p.
- GIANNOTTI, E. 1995. Notes on the biology of *Polistes (Epicnemius) subsericeus* Saussure, 1854 (Hym., Vespidae). *Bioikos* 9-10(1-2): 16-21.
- GIANNOTTI, E. & V.L.L. MACHADO. 1994. Longevity, life table and age polyethism in *Polistes lanio lanio* (Hymenoptera: Vespidae), a primitive eusocial wasp. *J. Adv. Zool.* 15(2): 95-101.
- GIANNOTTI, E. & V.L.L. MACHADO. 1999. Behavioral castes

- in the primitively eusocial wasp *Polistes lanio lanio* Fabricius (Hymenoptera, Vespidae). **Revta. Bras. Entomol.** **43**(3/4): 185-190.
- ITÔ, Y. 1986. Observations on the social behaviour of three Polistine wasps (Hymenoptera: Vespidae). **J. Aust. Ent. Soc.** **25**: 309-314.
- KASUYA, E. 1983. Behavioral ecology of Japanese paper wasps, *Polistes* ssp. IV. Comparison of ethograms between queens and workers of *P. chinensis antennalis* in the ergonomic stage. **J. Ethol.** **1**: 34-45.
- MAKINO, S. 1993. Sexual differences in larval feeding behavior in a paper wasp, *Polistes jadvigae* (Hymenoptera, Vespidae). **J. Ethol.** **11**: 73-75.
- MIYANO, S. 1983. Number of offspring and seasonal changes of their body weight in a paper wasp, *Polistes chinensis antennalis* Pérez (Hymenoptera: Vespidae), with reference to male production by workers. **Res. Popul. Ecol.** **25**: 198-209.
- MIYANO, S. 1986. Colony development, worker behavior and male production in orphan colonies of a Japanese paper wasp, *Polistes chinensis antennalis* Pérez (Hymenoptera, Vespidae). **Res. Popul. Ecol.** **28**: 347-361.
- O'DONNELL, S. 1995. Division of labor in post-emergence colonies of the primitively eusocial wasp *Polistes instabilis* de Saussure (Hymenoptera: Vespidae). **Ins. Soc.** **42**: 17-29.
- PARDI, L. 1942. Recherche sui Polistini. V. La poliginia iniziale in *Polistes gallicus* (L.). **Boll. Inst. Ent.** **14**: 1-106.
- PARDI, L. 1948. Dominance order in *Polistes* wasps. **Physiol. Zool.** **21**: 1-13.
- POST, D.C. & R.L. JEANNE. 1983. Sternal glands in males of six species of *Polistes* (*Fuscopolistes*) (Hymenoptera: Vespidae). **J. Kansas Entomol. Soc.** **53**(1): 32-39.
- POST, D.C.; R.L. JEANNE & E.H. ERICKSON Jr. 1988. Variation in behavior among workers of the primitively social wasp *Polistes fuscatus variatus*. In: JEANNE R.L. (ed). **Interindividual behavioral variability in social insects**. Boulder, Colorado. Westview Press. p. 283-321.
- PREZOTO, F. 2001. **Estudos biológicos e etológicos de *Polistes (Aphanilopterus) simillimus* Zikán, 1951**. Tese de Doutorado. UNESP, Rio Claro. 112p.
- RAPOSO-FILHO, J.R. 1987. Atividade dos machos de *Mischocyttarus (Monocyttarus) extinctus* Zikán, 1935

- (Vespidae – Polistinae). **Bol. I.C.B.G.** **40**: 17-23.
- REED, H.C. & P.J. LANDOLT. 1990. Sex attraction in paper wasp *Polistes exclamans* Viereck (Hymenoptera: Vespidae), in a wind tunnel. **J. Chem. Ecology** **16**: 1277-1287.
- RICHARDS, O.W. 1978. **The social wasps of the Americas excluding the Vespinae**. London, British Museum (Natural History). 580p.
- RODRIGUES, V.M. 1968. **Estudos sobre vespas sociais do Brasil (Hymenoptera, Vespidae)**. Tese de Doutorado. Faculdade de Filosofia, Ciências e Letras de Rio Claro. 113p.
- SINZATO, D.M.S. & F. PREZOTO. 2000. Aspectos comportamentais de fêmeas dominantes e subordinadas de *Polistes versicolor* Olivier, 1791 (Hymenoptera: Vespidae) em colônias na fase de fundação. **Revta. Etologia** **2**(2): 121-127.
- SOUZA, G.M.C. 1998. **Estudo da idade e das condições morfofisiológicas influenciando o peso corporal de fêmeas adultas de *Polistes versicolor* Olivier, 1791 (Hymenoptera: Vespidae)**. Dissertação de Mestrado. Universidade Federal de Juiz de Fora. 81p.
- STRASSMANN, J.E. 1981. Wasp reproduction and kin selection: reproductive competition and dominance hierarchies among *Polistes annularis* foundresses. **Florida Entomologist** **64**(1): 74-88.
- VALADÃO, R. 1986. **Dados sobre a interação prole-adultas em *Polistes versicolor* Olivier (Vespidae-Polistinae)**. Dissertação de Mestrado. UNESP, Rio Claro. 136p.
- ZARA, F.J. & J.B.P. BALESTIERI. 2000. Behavioral catalogue of *Polistes versicolor* Olivier (Vespidae: Polistinae) post-emergent colonies. **Naturalia** **25**: 301-319.
- WEST-EBEHARD, M.J. 1969. The social biology of Polistine wasps. **Misc. Publ. Mus. Zool. Univ. Mich.** **140**: 1-101.
- WEST-EBERHARD, M.J. 1969. The social biology of Polistinae wasps. **Misc. Publ. Mus. Zool. Univ. Mich.** **140**: 1-101.
- WILSON, E. O. 1971. **The insect societies**. Cambridge, Belknap Press. 548p.