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Patrolling behavior in males of Parischnogaster nigricans serrei (Du Buysson) and P. mellyi (Saussure) (Hymenoptera, Stenogastrinae)

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SEZIONE III

(Botanica, zoologia, fisiologia e patologia)

Zoologia. — *Patrolling behavior in males of* Parischnogaster nigricans serrei *(Du Buysson) and* P. mellyi *(Saussure) (Hymenoptera, Stenogastrinae).* Nota di STEFANO TURILLAZZI, presentata (*) dal Corrisp. L. PARDI.

RIASSUNTO. — I maschi di *Parischnogaster nigricans serrei* (Du Buysson) e di *P. mellyi* (Saussure) effettuano, in ore diverse del giorno, pattugliamenti volanti in aree prossime ai luoghi di nidificazione, ingaggiando combattimenti, ritualizzati e no, con conspecifici. In questo lavoro viene descritto il comportamento di pattugliamento e suggerito il suo significato.

Territorial behavior in males of some Hymenoptera is widely documented (see the reviews of Alcock *et al.*, 1978 and Eickwort & Ginsberg, 1980). Pagden (1962) reported a particular patrolling behavior in males of *Stenogaster* (*Metischnogaster*) *cilipennis* (Smith) and *Stenogaster* (*Metischnogaster*) *drewseni* (Saussure), two Malesian species of Stenogastrinae wasps. These hover like dragonflies in shady wet places during certain hours of the day, contracting and extending their abdomen. This movement reveals large white stripes on the anterior part of the abdominal tergites which are almost invisible in the rest position. Recently I studied the behavior of male *Parischnogaster nigricans serrei* (Du Buysson) and *P. mellyi* (Saussure) near Bogor, West Java, Indonesia.

Parischnogaster nigricans serrei and *P. mellyi* are very common species in West Java and their colonies can be found close to each other and even in the proximity of human dwellings. The biology and social behavior of *P. mellyi* has recently been studied by Hansell (1977, 1981), and of *P. nigricans* by Pardi & Turillazzi (1981) and Turillazzi & Pardi (1981, 1982).

Males were marked with enamel dots for recognition and their behavior observed with the aid of a 16 mm Bolex camera, filming at a speed of 48/64 fr/sec. Some specimens were also observed in captivity at the Institute of Zoology of the University of Florence.

Males of both species spend a lot of time on the nests (Turillazzi & Pardi, 1982), while *P. mellyi* may also gather in unisexual clusters near the nesting areas. Some individuals can be found flying at all hours of the day. However, at specific times of the day, all the males leave their nests and clustering places " en masse ", as is clearly from the graphs of Fig. 1. Male *P. mellyi* leave their clustering places at about 11.00 a.m. and return at about 12.45 a.m., while *P. nigricans* leave their nests at about 1.00 p.m and return at about 2.30–3.30

(*) Nella seduta del 13 marzo 1982.

p.m. These departure times coincide perfectly with the appearance of the males in the patrolling areas. Both species patrol almost in the same places, though *P. nigricans* seems to prefer wider, better-lighted areas.

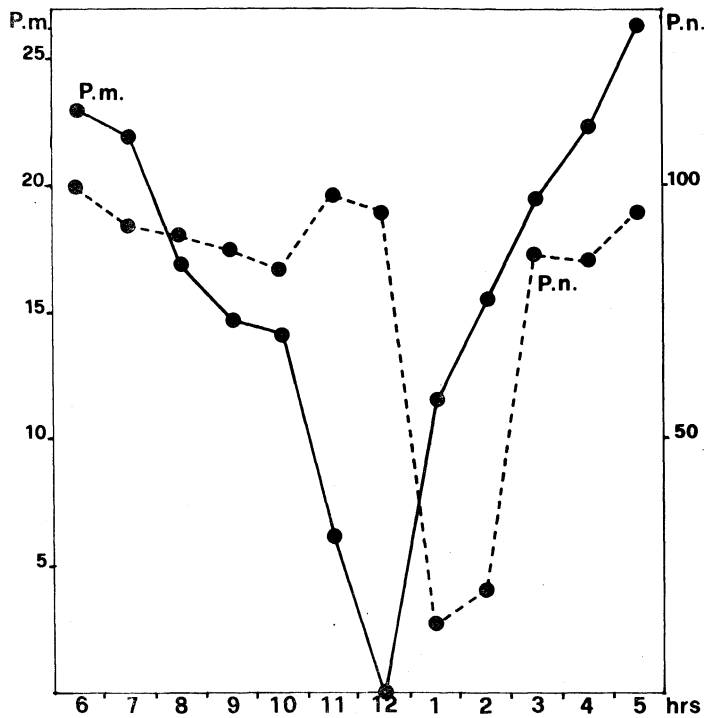

Fig. 1. - Presence of males on nests and unisexual clusters during the day. Left scale: number of male *P. mellyi* in a cluster. Right scale: % of male *P. nigricans* on nests (on total male population observed).

Patrolling flight has certain distinct features. Male *P. mellyi* hover facing a landmark represented by a leaf, a twig or something else. After a few seconds the wasp makes a large detour, usually horizontal, to the right or the left after which it returns to the landmark. During hovering, these males can extend and contract their abdomen, revealing white stripes on the abdominal tergites. With the abdomen contracted the wasp is almost invisible, while it becomes quite showy with the abdomen fully extended and bent slightly ventrally. The behavior of *P. nigricans* differs slightly as their hovering flight presents some vertical shifts, fewer horizontal flights and less display of the white stripes.

Clashes. The males often change their hovering landmark, leaving this even after a few seconds and moving to another landmark. If this is already occupied by another male, the newcomer begins to hover behind him at a distance of 4–5 cm. The owner of the landmark at once extends his abdomen showing the white stripes (Fig. 2). This reaction is easily obtained even with a paper model on the tip of a twig. The stripes-display occurs only if the model

is presented behind and not in the front of hovering male. Following display of the stripes either (1) the newcomer or (2) owner leaves after a few seconds, or else (3) the two males begin a tandem, ascensional flight with sudden changes of position (the male in front goes behind and viceversa), mutual stripes-displays and eventual flying clashes until one of the two leaves and the other returns to hover at the landmark. The average duration of the clashes in *P. nigricans* is roughly the same in (1) and (2) (respectively 2.104 sec, ranging from 0.78 to 5.8 sec, N = 30; 2.014 sec, ranging from 0.63 to 9.14 sec, N = 54), while it is longer in (3) (21.76 sec, ranging from 2.60 to 60.31 sec, N = 10) During the latter encounters the male in front shifts 2–3 cm to the right and left, while the male behind flys in a straight line. Swift clashes occur when the front male moves quickly backwards, or when the newcomer moves forward to attack.

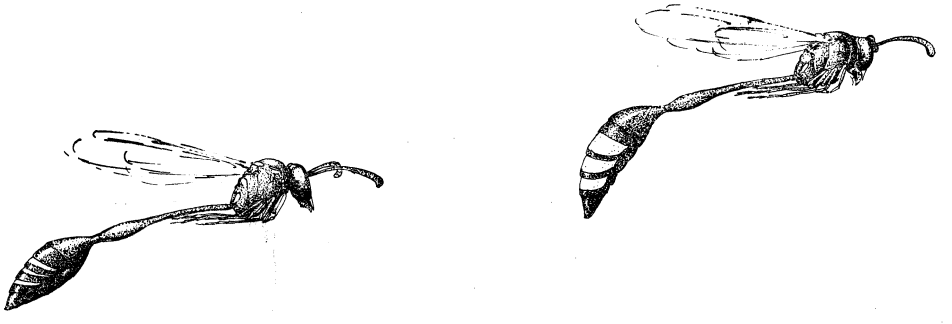

Fig. 2. – Stripes-display of *P. nigricans*.

Unfortunately clashes are so rapid that it was impossible to value their real intensity and course. I never observed behavior similar to the falling-fights of male *Polistes* (Turillazzi & Cervo, 1982) or other Hymenoptera. At the end of the daily period of patrolling, fewer and fewer males can be found in a given observation area. Twice I ascertained that the last male to remain patrolling was the one who had won the most clashes. This could not be confirmed as it was impossible to determine the limits of the patrolling area of a single male as this cannot be tracked in normal flight even if strikingly marked.

Males observed in the laboratory. The same behavior was observed in males reared in the laboratory. Due to the small size of the cage (60 × 60 × 60 cm) large detours were absent from the patrolling flight of the males. However these hovered near landmarks as when in nature. Though the encounters between various individuals were altered due to the high density of animals, these nonetheless presented the same features observed in the field. Insects were raised in 12–12 hrs L–D period, the lights were first turned on at 7.00 a.m. and off at 7.00 p.m. (time difference between Italy and Indonesia = — 6 hrs). In this situation, after several days in captivity, the males of *P. mellyi* began to patrol at about 12.00 a.m. and stopped at about 2.00 p.m., while those of *P. nigricans* began

at about 2.20 p.m and finished at about 4.00 p.m. Later the light was adjusted to turn on and off one hour earlier (according to the time of sunrise and sunset in Java). Then *P. mellyi* began to anticipate its patrolling period which stabilized around 11.00 a.m. after a few days (ending at about 1.00 p.m). It was not possible to obtain data on *P. nigricans*. This facility in adapting the period of patrolling to photoperiod seems to indicate that their behavior is regulated not by light intensity or temperature (as Pagden, 1962, supposed) but by an internal clock.

The behavior presented by male *Parischnogaster nigricans* and *P. mellyi* can be considered as a kind of territorial behavior if we accept the definition proposed by Alcock *et al.* (1978) who consider " a species territorial if the male makes contact with conspecific males that enter a specific area with the effect of driving them away ". Greater comprehension of the phenomenon can be gained by answering the following questions. (1) Is this behavior really related to the mating system of the species? (2) are the landmarks rendezvous locations only or also foraging and/or nesting areas of the species? (3) Are these landmarks intermediate stations along routes or patrol circuits? Due to the perfect temporal niche presented in the time of behavior by the males of both species (a similar phenomenon was reported by Alcock *et al.*, 1978 in males of the solitary bees *Protoxaea gloriosa* (Fox) and *Caupolicana yarrowi* (Cresson)), the complete absence of males on the nests and in clusters during the same hours, and to some copulatory attempts observed during patrolling in some individuals reared in captivity (no such attempts were ever observed in the field even on live or dead females tied near the patrolling landmarks) the anwser to (1) is affirmative. (2) Landmarks do not coincide with nesting areas and even if they are near foraging places for females (spider webs) they are generally prominent structures of the forest landscape. (3) At present it is unknown if these are intermediate points along patrolling routes or circuits. The release of marking pheromones cannot be excluded.

Encounters between various males seem to be highly ritualized. The extension of the abdomen, with the white stripes display, is probably energetically expensive and can be a signal of individual strength. Males that do not succeed in driving away a rival with their display may decide to leave the landmark or engage in a real fight with the newcomer. During patrolling a male which remains in a given area for a longer time than other males could have a greater probability of mating with receptive females and of enhancing his fitness.

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