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OBSERVATIONS ON THE BEHAVIOUR OF MALE STENOGASTRINE WASPS (HYMENOPTERA, VESPIDAE, STENOGASTRINAE)

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SUMMARY

Males of two species of stenogastrine wasps *Parischnogaster mellyi* and *P. alternata* observed in captivity perform patrolling behaviour. They also present anatomic and morphological structures which are probably related to this behaviour.

The patrolling behaviour of *P. alternata* is described for the first time and is quite similar to that of *P. mellyi* (Turillazzi, 1983a and b) with hovering flights near landmarks and displays of white stripes on the abdominal tergites. The patrolling flights occur at different times of the day with respect to *P. mellyi*.

Males of *P. mellyi* form unisexual clusters on thread-like substrata in nidification sites. Our data show that foundress females of same species probably use these clusters as indicators that the substratum is a potentially good one for nidification.

KEY WORDS : Stenogastrinae, reproductive behaviour, tegumental glands, male clusters.

RÉSUMÉ

Les mâles des guêpes sténogastrines *Parischnogaster mellyi* et *P. alternata* observés en captivité montrent un comportement de patrouille (= vol de reconnaissance). Ils prèsentent des structures anatomiques et morphologiques probablement liées à ce comportement.

Pour la première fois le comportement de patrouille de *P. alternata* est décrit et il est presque identique à celui de *P. mellyi* (Turillazzi, 1983a et b). Le mâles volent sur place près de points bien determinés et visibles du paysage. Ils découvrent des bandes blanches situées sur leurs tergites abdominaux. Le comportement de patrouille est effectué à differentes heures de la journée par rapport au comportement de *P. mellyi*.

Les mâles de *P. mellyi* forment des groupements unisexuels sur substrats filiformes dans les lieux de nidification. Nos données montrent que les femelles fondatrices de la même espèce emploient probablement ces groupements comme indicateurs de substrats convenables pour la nidification.

MOTS-CLÉS : Stenogastrinae, comportement reproductif, glandes tégumentaire, groupements de mâles.

INTRODUCTION

The behaviour of male social wasps has begun to attract the attention of researchers. As regards the stenogastrine wasps, the behaviour of two species of *Metischnogaster* (Pagden, 1962) and two of *Parischnogaster* (Turillazzi, 1983a and b) have been described so far.

In this paper we report some observations on the behaviour of males of two species of *Parischnogaster* : *P. alternata* and *P. mellyi* in captivity.

MATERIALS AND METHODS

Wasps collected in Malaysia (Gombak Field Station, University of Malaya, 25 km NE of Kuala Lumpur) were reared in a "tropical room" (4x3x3 m) in the Department of Animal Biology of the University of Firenze. The temperature in the room (which had a wall with three windows) was kept constant at about 25°C and the relative humidity at about 80%. Honey was supplied ad libitum in small dispensers and fruit flies were stuck to the window panes every day where the foraging wasps could collect them. The volume of the room was divided in 64 equal zones on paper to check the position of the individuals during patrolling.

The abdomens of male *P. alternata* were embedded in Methil-Buthil Metachrilate, sectioned 6 - 7 μ m thick and stained with Tolouidine blue or Ferrochloridiche Ematossiline + Gabe Martoja or Mallory techniques for observation under the light microscope. A Philips 515 scanning electron microscope was used for the observation of morphological structures.

RESULTS AND DISCUSSION

Patrolling behaviour of *P. alternata*

The patrolling behaviour of *P. alternata*, never described before, is quite similar to that of *P. mellyi*. It consists of a hovering flight in front of a leaf or some other prominent point of the environment followed by an almost circular detour flight beginning and ending at the hovering point (Fig. 1). When an intruder arrives on the scene, the patrolling male extends his abdomen to display the whitish stripes on the anterior part of the gastral tergites. We seldom observed flying attacks of the kind reported in *P. mellyi* and *P. nigricans,* probably because the density of the individuals in the room was very low (behavioural observations where based on 4 individuals only).

P. alternata performs aerial patrolling from about 3.30 pm to 4.30 pm, which in the field corresponds to the period these are away from the nest (Turillazzi, 1986).

Anatomical structures related to patrolling

Males of *P. mellyi* and *P. nigricans* exhibit a band of gland cells (of the third type of Noirot and Quennedy, 1974) provided with peculiar cuticle-lined reservoirs, and accessory ducts cells resting under the anterior part of the 3rd gastral tergite (Turillazzi and Calloni, 1983). *P. alternata* has a conspicuous depression filled with hairs on the median part of the 2nd gastral tergite (Fig. 2) (Yoshikawa et. al. 1969). A para-sagittal

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Fig. 1. A male of *P. alternata* during the patrolling flight. The abdominal white stripes (abdomen not fully extended) and the tuft of hairs on the depression of the 2nd gastral tergite can be seen.

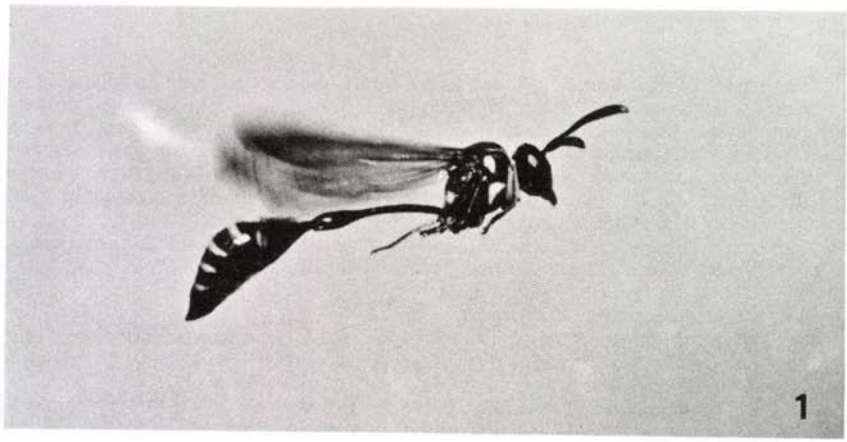
Un mâle de *P. alternata* pendant le vol de patrouille. On peut observer les bandes blanches abdominales (l'abdomen n'est pas complètement allongé) et la touffe de poils sur la dépression du deuxième tergite gastral.

Fig. 2. The depression with hairs of the second gastral tergite of male *P. alternata.*

La dépression avec les poils sur le deuxième tergite gastral du mâle de *P. alternata.*

Fig. 3-4. Para-sagittal section of the abdomen of male *P. alternata.* Glandular cells (GC) under the depression of the 2nd gastral tergite (HR= hairs; CC= channels opening onto the external surface).

Section parasagitale de l'abdomen du mâle de *P. alternata.* Cellules glandulaires (GC) sous la dépression du deuxième tergite gastral (HR= poils; CC= canaux s'ouvrant sur la superficie externe).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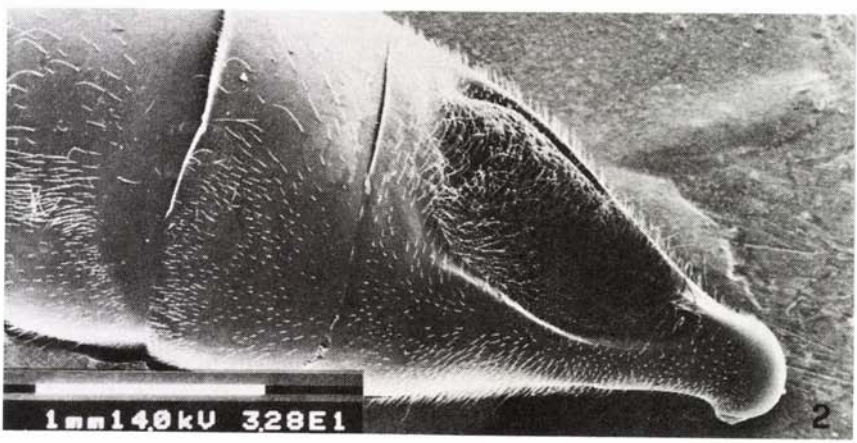
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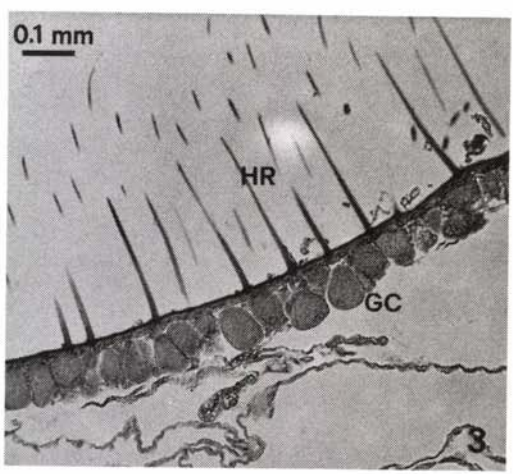
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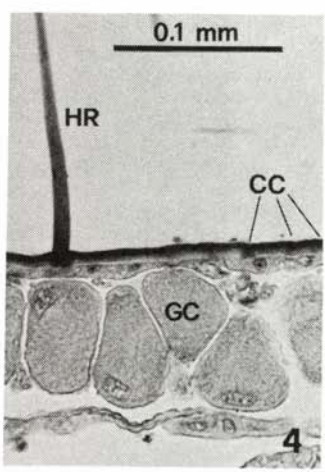
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section of the abdomen (Fig. 3 and 4) shows that clusters of single or double layered large glandular cells exist under the depression. The cuticle layer in this area is drilled by thin, oblique channels which open onto the external surface through outlets. The gland cells are polhyedric or rounded in shape and the nucleus generally lies in the basal cytoplasm. As a rule the cytoplasm appears dense and homogeneous and in some sections the inner canalicular end-apparatus is evident, which confirms the secretory function of these cells (class three glands according to Noirot and Quennedy, 1984).

We can suppose, as in *P. mellyi* and *P. nigricans*, that this species also uses chemical signals associated with the visual one, during aerial patrolling.

More about the patrolling of *P. mellyi*

We also had the opportunity of observing some more characteristics of the patrolling flight and other extranidal behaviours of the male *P. mellyi* over a period of approximately one year.

After emergence, males remain on the maternal nests for a period varying from 4.5 to 7 days before patrolling. This period corresponds to the pre-reproductive phase (Thornill and Alcock, 1983) of other insects where the individual trys to accumulate energy reserves before starting out on a very tiring activity.

Males of the same species observed in Indonesia began patrolling at about 11.00 am. and ended at about 12.45 pm. (Turillazzi, 1983a and b). We observed that patrolling took place at almost the same time in captivity.

The length of patrolling varies from individual to individual, from 45 to 135 min. with an average of 75 min. (n=18 wasps controlled over ten days). Younger males present a longer patrolling period than older ones and there is an inverse significative correlation between age and the daily duration of the behaviour ($n=18$, $r=-0.598$, $p<0.01$).

Patrolling flights turned out to be most frequent in zones of the room nearest the top of one of the windows. It is not clear why the males preferentially patrol here but this may be linked to the light conditions. *P. alternata* preferred different zones of the room.

In any single zone the probability of winning an encounter was positively correlated with the time spent in patrolling that zone ($n=19$, $r=0.725$, $p<0.001$).

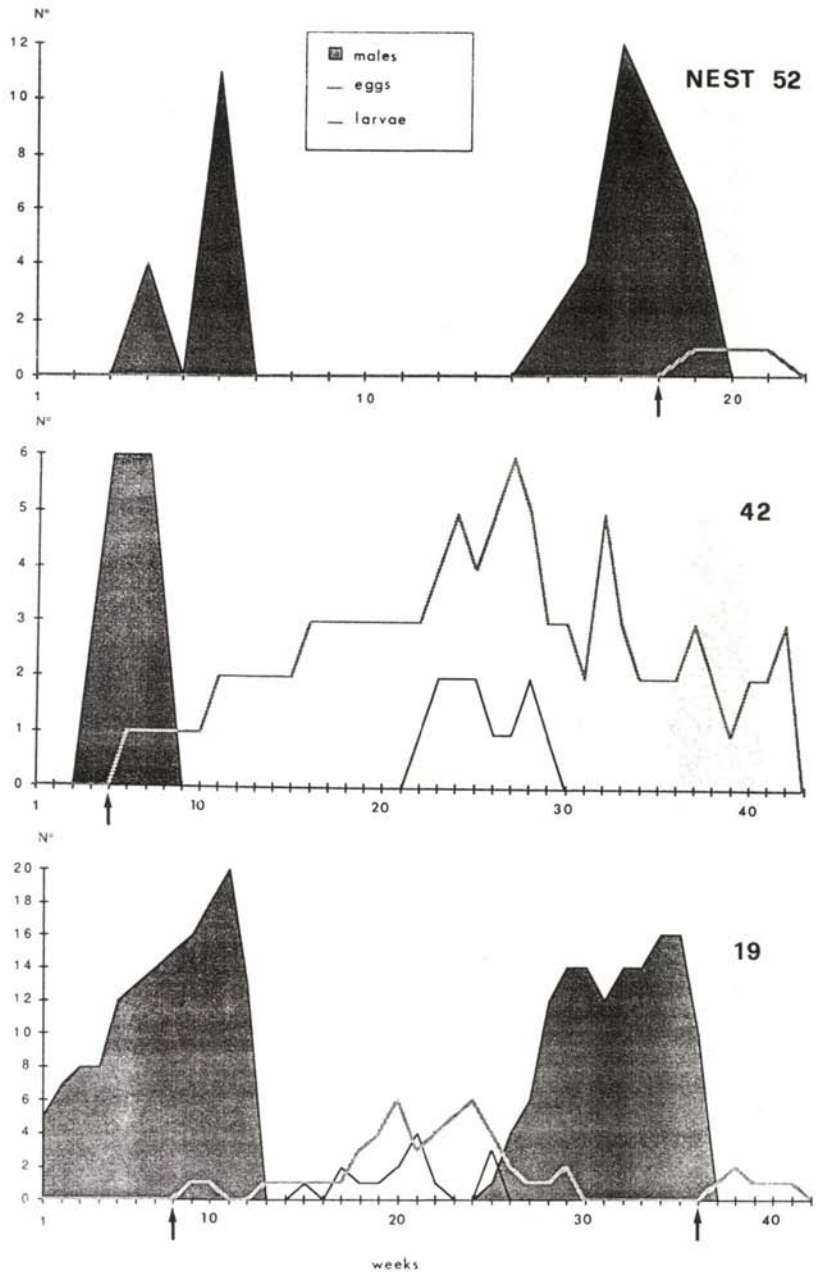
The frequency of the white stripes display was significatively related to the total amount of time spent by all the males in one zone and thus to male density in that particular zone ($n=4$, $r=0.97$, $p<0.01$). It was not possible to ascertain any other correlation between this and other biological events.

The preference for some zones rather than others in the room for the aerial patrolling and the fact that in nature the males more commonly patrol in the forest clearings, where their display is particular visible, could explain why they frequently change landmarks and perform detour flights to find suitable places and check the lighting conditions.

It is retained that this behaviour has, as many similar ones observed in other species of insectes, a reproductive function. We observed only one mating or mating attempt during the study period and it occurred at patrolling time. The extreme rarity of mating could have been due simply to the captivity condition, which could have negatively influenced female receptivity, but was more probably to the extreme dilution in time of the matings (we did not observe any seasonal variation in the patrolling over a year).

Male clusters

When the males finish patrolling they first go to feed at the honey dispensers where fights with other males and foraging females often occur. Then the males try to join the parental colony or some other nests to rest. At this point it is quite easy to observe the females on the colonies trying to prevent them from landing on their nest. The reason for this seems to be that after the appearance of the males on a nest there is usually a reduction in the number of the eggs and small larvae, as we observed in various colonies (see also Hansell, 1982).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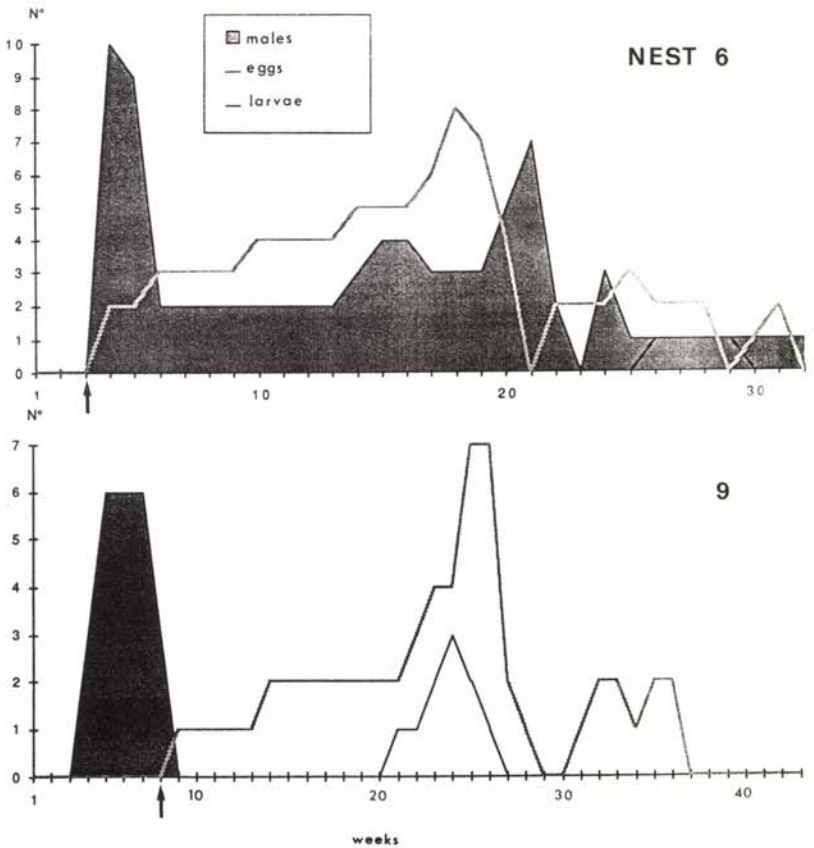

Fig. 5-6. Aggregation of male *P. mellyi* on nests and thread-like substrata. New foundations or re-activation of abandoned nests are indicated by arrows.
Aggrégation de mâles de *P. mellyi* sur les nids et sur les substrats filiformes. Les flèches indiquent de nouvelles fondations et la réactivation de nids abandonnés.

Rejected from active colonies, the males often form homosexual clusters on thread-like substrata in nidification places. Wandering females usually frequent these associations and in 6 cases we observed them founding a new nest within 15 days from the first time they were detected on the cluster (Fig. 5 and 6). Even in this case it is important for the success of the colony that foundresses manage to get rid off the males as soon as possible.

The same phenomenon of females founding new nests on substrata already held by male clubs, was observed twice in the field in Indonesia (Turillazzi and Pardi, 1982) and it was thought it had a reproductive purpose. However we never observed any copulatory attempts in these aggregations and this made us think the phenomenon has nothing to do with the mating system. Rather, we suggest that future foundresses look for male clusters and use them as indicators of suitable nesting substrata. These females, in fact, have two

ways of knowing in advance if a sustratum is strong enough, is in suitable microclimatic conditions and whether there is no much threat from predators such as ants: 1) the substratum is already occupied by an active nest or, 2) it has already been colonised by an aggregation of males. This is certainly an hypothesis to be tested by future research in the field.

REFERENCES

HANSELL M.H., 1982. - Brood development in the subsocial wasp *Parischnogaster mellyi* (Saussure) (Stenogastrinae Hymenoptera). Insectes soc. 29: 3-14

PADGEN H.T., 1962. - More about *Stenogaster*. Malay Nat. J. 16: 95-102.

NOIROT C., QUENNEDY A., 1974. - Fine structure of insect epidermal glands. Ann. Rev. Entomol. 19: 61-80.

THORNHILL R., ALCOCK J., 1983. - The evolution of insect mating sistems. Harvard Univ. Press. Cambridge Ma., and London. IX+547 pp.

TURILLAZZI S., 1983a. - Extranidal behaviour in *Parischnogaster nigricans serrei* (Du Buysson) (Hymenoptera Stenogastrinae). Z. Tierpsychol. 63: 27-36.

TURILLAZZI S., 1983b. - Patrolling behaviour in males of *Parischnogaster nigricans serrei* (Du Buysson) and *P. mellyi* (Saussure) (Hymenoptera Stenogastrinae). Accad. Naz. Lincei Rc. Cl. Sc. Fis. Nat. Mat., 72: 153-157.

TURILLAZZI S.,1986. - Colony composition and social behaviour of *Parischnogaster alternata* (Sakagami) (Hymenoptera Stenogastrinae). Monitore zool. ital. (N. S.) 20: 333-347.

TURILLAZZI S., CALLONI C., 1983. - Tegumental glands in the third gastral tergite of male *Parischnogaster nigricans serrei* (Du Buysson) and *P. mellyi* (Saussure) (Hymenoptera Stenogastrinae). Insectes soc. 30: 455-460.

TURILLAZZI S., PARDI L., 1982. - Social behaviour of *Parischnogaster nigricans serrei* (Du Buysson) (Hymenoptera Vespidae) in Java. Ann. Entomol. Soc. Am. 75: 657- 664.

YOSHIKAWA K., OHGUSHI R., SAKAGAMI S. F., 1969. - Preliminary report on entomology of the Osaka City University 5th expedition to southeast Asia 1966. Nat. Life S. E. Asia Tokyo VI: 153-182 with 75 plates.