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Field observations of the ant *Camponotus sylvaticus* (Hym. : Formicidae) : diet and activity patterns

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ABSTRACT

Dietary spectrum and foraging activity patterns of the ant *Camponotus sylvaticus* have been studied in a savanna-like grassland in the Mediterranean coast.

C. sylvaticus has a very narrow diet, consisting almost exclusively of sugary liquids, specially the honeydew of two species of aphids and, in a much lesser extent, the nectar of flowers.

It is a species of crepuscular and nocturnal habits: foraging starts in the late afternoon, persists throughout the night and ends in the early morning, when many workers go back to the nest from the food sources. When temperatures are between certain ranges tolerated by the species (14-29 °C), light intensity is the most important factor influencing the beginning and end of foraging activity.

At the food sources, presence of workers tending aphids is continuous for the whole day, while nectar-collecting individuals end at dusk. *C. sylvaticus* is an aggressive species that interacts against other ants and prevents them from exploiting natural and artificial food sources.

KEY-WORDS: *Ant* - Camponotus sylvaticus - *Dietary spectrum* - *Foraging activity* - *Aphid-tender*.

RÉSUMÉ

Le régime trophique et l'activité de récolte chez la fourmi *Camponotus sylvaticus* ont été étudiés sur une pelouse xérophyle sur la côte Méditerranéenne.

Le régime trophique de *C. sylvaticus* est très strict, et est presque entièrement constitué par des liquides sucrés, surtout du miellat des aphidiens mais aussi du nectar de fleurs.

Ses habitudes sont crépusculaires et nocturnes. Son activité commence à la tombée du jour, se poursuit tout au long de la nuit et finit au matin, quand la plupart des ouvrières qui se trouvent sur les sources de nourriture retournent au nid. Lorsque la température est d'un ordre toléré par l'espèce (14-29 °C), l'intensité de la lumière est le facteur le plus important pour déterminer le début et la fin de l'activité extérieure.

La présence d'ouvrières à l'élevage des pucerons est constante pendant tout le jour, tandis que les ouvrières qui récoltent du nectar retournent au nid le soir. *C. sylvaticus* est une espèce agressive qui s'attaque aux autres fourmis et les empêche d'exploiter les ressources alimentaires naturelles et artificielles dont elle se nourrit.

MOTS-CLÉS : *Fourmi* - Camponotus sylvaticus - *Régime trophique* - *Activité de récolte* - *Élevage des pucerons*.

INTRODUCTION

Camponotus sylvaticus (Olivier, 1791) is a xerophilous ant, frequent in dry zones with scarce vegetation, from the coast up to 900 m a. s. l. It is a common species in the Iberian Peninsula and all over the French Mediterranean region, but it seems not to exceed the Italian Liguria (BERNARD, 1968, 1983). In the case that identification of BARONI-URBANI & AKTAC (1981) was confirmed, its distribution would extend until Turkey.

In Canet de Mar, in the Catalan coast, *C. sylvaticus* is a considerably abundant species, which may be easily seen on the vegetation but only rarely on the ground. The present study deals with its diet and its activity at the nest entrance and at the food sources.

MATERIALS AND METHODS

Fieldwork was undertaken on 12 sampling days from March to November 1985 in Canet de Mar (Catalan coast), in a savanna-like grassland of *Hyparrhenia hirta* at 50 m a. s. l. We carried out three types of observations:

1) *Observations at the nest entry*

We followed a nest of *C. sylvaticus* throughout the whole season, monitoring all open entries (from one to three according to the period of the year). During the first ten minutes of each hour we registered the number of workers leaving or returning to the nest, and from these data we estimated the number of entries and exists per hour and per day.

The activity of this species takes place mainly at night, which makes its observation in the field difficult. We utilized red light lanterns so as to disturb as little as possible the ant's behaviour. Little is known about the effect of artificial light on nocturnal ants, since sometimes it seems to alter their activity considerably, while on other occasions it seems not to affect them (CONWAY, 1980). In the case of *C. sylvaticus*, lantern light must not be directly focused on the nest entrance or on walking ants, since it causes them to stop immediately. Therefore, we used light of very low intensity, just enough to count the number of workers entering or leaving the nest.

To evaluate the carrying of liquid food, we gently pressed the gaster of a sample of workers returning to the nest. When liquid was present in the ant's crop, it was regurgitated and appeared as a droplet between the mandibles (CHERIX, 1981; RETANA *et al.*, 1986).

2) *Observations on the vegetation*

To study the exploitation of food liquid sources by workers of *C. sylvaticus*, we marked some plants and every two hours on every sampling day we counted the number of ants that were either licking nectar or flowers or tending groups of aphids. In all, we monitored 20 branches of pine tree *(Pinus pinea)*, 13 plants of fennel *(Foeniculum vulgare)* as well as several other species where *C. sylvaticus* workers were rarely found.

After these censuses and three 100m-transects of vegetation which gave the relative abundance of every plant species, we estimated the number of worker of *C. sylvaticus* on every liquid food source.

3) *Observations on the artificial food sources (baits)*

The study of interactions between *C. sylvaticus* and other species at food sources was undertaken on baits that we laid out in the study area. A total of five series of six baits with different types of food: cheese, sausage, ham, bacon, honey and biscuit were used. Every two hours we noted the ants present at each bait and the interactions that took place between different species (ignorance, pacific coexistence, aggressiveness).

RESULTS AND DISCUSSION

a) *Dietary spectrum*

Although omnivory is a characteristic of the *Camponotus* genus (GOTWALD, 1968; SANDERS, 1970; GANO & ROGERS, 1983; CURTIS, 1985) and *C. sylvaticus* has been described in literature, at least to a certain extent, as an insectivorous species (DE HARO & COLLINGWOOD, 1977; BERNARD, 1983), during all the sampling days, only two of more than 500 workers registered returning to the nest, carried a solid item (a plant remain and a bird excrement) which indicates that this type of food is not important to the species. Furthermore, *C. sylvaticus* workers did not take any of the items we offered to them on the ground: they touched them with their antennae but abandoned them immediately. Observations made in other localities of the Catalan coast, such as Portbou (Gerona) or Torredembarra (Tarragona) confirm the mentioned results: in any case important amounts of solid items were brought to *C. sylvaticus* nests.

On the other hand, by gently pressing the gaster of 135 workers returning to the nest, we found that all of them carried liquid food in their crop. Therefore, *C. sylvaticus* has, at least in Canet de Mar, a very narrow dietary spectrum consisting almost exclusively of sugary liquids, specially the honeydew of aphids and, in the second place, the nectar of flowers. This has also been observed by ESPADALER & RODA (1984) in the Meda Gran Island. In the study area, *C. sylvaticus* workers tend two species of aphids: *Cinara maritimae* (on pine trees) and *Aphis fabae* (on fennels). More infrequently, some workers may be found (specially early in the morning and in the late afternoon) collecting nectar on inflorescences of *Foeniculum vulgare*, *Daucus carota* and *Euphorbia* sp.

The importance of these types of food in the diet of this species is shown in table I, where the proportion of workers on every food source is given. As we see there,

TABLE I. — *Presence of* C. sylvaticus *workers at the different food sources.*

(1) Relative abundance of workers of the species at each food source.
(2) Percentage of *C. sylvaticus* workers with regard to all ants counted on each food source.

Type of food source	(1) Relative abundance of C.sylvaticus	(2) Percentage of C.sylvaticus with regard to all ants
Honeydew of C.maritimae	69.7%	36.5%
Honeydew of A.fabae	27.0%	75.8%
Nectar of F.vulgare	3.2%	37.7%
Nectar of D.carota	0.1%	4.5%

nearly 97 % of workers found on vegetation tend aphids, while nectar collecting is much less important. Also in table I, it may be seen that *C. sylvaticus* workers make up more than a third of the ants found exploiting each of the three main liquid

food sources of the study zone, specially the honeydew of *Aphis fabae*, where 75.8 % of the ants counted were *C. sylvaticus*.

Observations at baits also demonstrate a preference for sugary liquids (table II): more than 80 % of baits occupied by *C. sylvaticus* throughout the season are honey

TABLE II. — *Number and percentage of baits of different types occupied by* C. sylvaticus *throughout the season.*

Type of bait	Baits occupied
Honey	125 (83.3%)
Biscuit	10 (6.7%)
Cheese	7 (4.7%)
Bacon	6 (4.0%)
Sausage	2 (1.3%)
Ham	0 (0.0%)

baits, all other types of food are very poorly accepted. These results are very much in agreement with those obtained by BARONI-URBANI & AKTAC (1981) in Turkey, although theirs were even more conclusive, since they found that *C. sylvaticus* was only attracted by honey baits.

b) *Foraging activity and its relationship with environmental data*

In Canet de Mar, *C. sylvaticus* is a species of crepuscular and nocturnal habits, as is shown in figure 1, where daily activity at nest entrance at three different periods of the year is represented. During sunlight time, it is extremely rare to see workers on the ground, though a considerable number of them may be found on the vegetation. Normally workers start foraging in the late afternoon (between 17.00 and 19.00 p. m. *LST*), when several exists are registered. Activity persists throughout the night and increases at dawn when many of the workers that remained at liquid food sources go back to the nest. Except for the first months of the year, when it is very low, activity persists during an important part of the day, between 14 and 16 hours each day. Similar results have been obtained in the Meda Gran Island (ESPADALER & RODA, 1984), Portbou (CERDA *et al.*, in press) and Torredembarra (pers. obs.) on the Catalan coast, and in Turkey (BARONI-URBANI & AKTAC, 1981).

Hibernation ceases towards the end of March, but during the first months (March-May) activity is minimal. In this period of the year, mean temperature are no higher than 18° C, and minimum temperatures, at night, are lower than 12° C. In the middle of June, when nights are warmer, activity increases considerably, to become maximum in August. Afterwards activity diminishes but workers may be found tending aphids as late as December, when most other ant species are hibernating.

Activity of ant colonies is normally conditioned by environmental conditions (AYRE, 1958; BRIESE & MACAULEY, 1980; NIELSEN, 1981). In the case of *C. sylvaticus*, light intensity seems to be the most important factor: without respect to the period of the year, activity starts at dusk and ceases at dawn. As in other nocturnal species

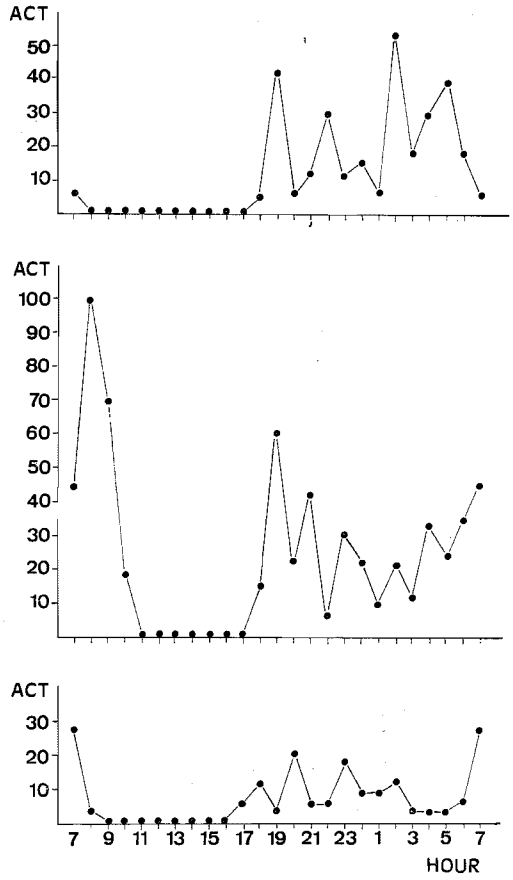

FIG. 1. — Daily activity of *C. sylvaticus* in Canet de Mar on three different sampling days. *A*) July 1. *B*) August 7. *C*) September 16. *Y*-axis: activity estimated as the average mean of entries and exits at every hour. *X*-axis: time of the day (*LST*).

(GANO & ROGERS, 1983), when temperatures are between certain ranges tolerated by the species. light intensity is the most important factor to determine the beginning and the end of activity.

Temperature is another factor which may limit activity of *C. sylvaticus*. Normal activity of the species takes place between 14 and 29° C. So, *C. sylvaticus* remains active at temperature much lower than do most other ant species of the area (pers. obs.) which can be understood as an adaptative feature to night foraging that has also been reported in other nocturnal ants (CONWAY, 1980; GANO & ROGERS, 1983).

c) *Activity at food sources. Interaction with other ants*

Activity of workers on the three principal food sources throughout the year is different: collection of the honeydew of pine tree aphids extends throughout the whole period of activity of *C. sylvaticus*, whereas exploitation of the other two

liquid food sources related with the fennel is limited from July to October.

Throughout the day, workers of *C. sylvaticus* exploit these food sources in different ways. Figure 2 shows typical daily fluctuations of the number of workers found on

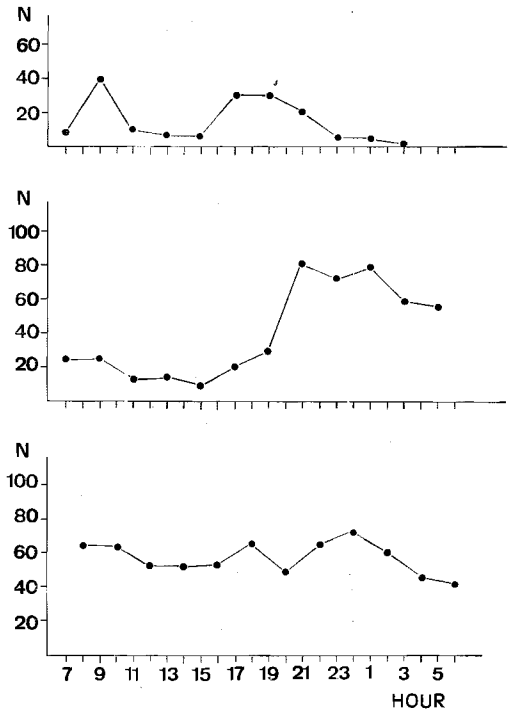

FIG. 2. — Number of workers of *C. sylvaticus* counted on August 21, on 13 fennel plants *(Foeniculum vulgare)* and 20 branches of six pine trees *(Pinus pinea)*, collecting: *A)* nectar of fennel; *B)* honeydew of *Aphis fabae* on fennel; *C)* honeydew of *Cinara maritimae* on pine trees. *X*-axis: time of the day (*LST*). *Y*-axis: number of ants.

each of them (data correspond to August 21). Curves are clearly different and illustrative of what occurs in each case:

— Workers of *C. sylvaticus* collect fennel nectar only during sunlight time (fig. 2 *A*), according to the fact that this plant only produces nectar in that period of the day (pers. obs.) A considerable decrease is observed at midday, when the weather is hotter, and unlike what happens with other species of the genus in the study zone (*C. foreli, C. cruentatus*, pers. obs.) a few ants may remain on the inflorescences during part of the night.

— On the other hand, workers remain tending *Aphis fabae* aphids on the fennel for the whole day, even though important fluctuations in the number of workers depending on the time of the day appear (fig. 2 *B*): during sunlight times, the number of workers is relatively low, to increase spectaculary at night, attaining numbers four times higher.

— As far as exploitation of the honeydew of *Cinara maritimae* aphids (on pine trees) is concerned, presence of *C. sylvaticus* workers is more constant (fig. 2 *C*), which can be understood because pine branches create a shady microenvironment where fluctuations of light and temperature are attenuated, which allows *C. sylvaticus* workers to remain there for long periods of time.

C. sylvaticus workers are present on their main food sources for the whole day to prevent other species from exploiting them. This is in agreement with the aggressiveness displayed by the species, which becomes apparent in fights with nearby co-specific colonies or with colonies of *C. cruentatus*, another aggressive and territorial species of the area (unpublished data).

Baits allowed us to observe in an easier way aggressive behaviour of *C. sylvaticus* towards other ants. Table III summarizes non-aggressive (ignorance, avoidance)

TABLE III. — *Pacific and aggressive interactions between* C. sylvaticus *and other ants at the baits.*

Species	Aggressiveness	Pacific coexistence
Pheidole pallidula	12	-
Tetramorium semilaeve	-	1
Aphaenogaster senilis	1	-
Messor bouvieri	1	-
Tapinoma nigerrimum	-	1
Plagiolepis pygmaea	-	3
Camponotus foreli	1	5

and aggressive interactions (opening of mandibles, bites, formic acid ejection) registered at baits between *C. sylvaticus* and other species of the area. Aggressive interactions are considerably underestimated in this table, because only the cases of evident aggression between ants, and not the substitution of other ants by *C. sylvaticus* workers are included.

As we can see there, *C. sylvaticus* shows no aggressiveness against certain species such as *C. foreli* or *Plagiolepis pygmaea*, which are very unaggressive ants, or in those cases when there are very few workers at the bait (for instance, non-aggressiveness towards *T. nigerrimum* was registered when there was only one worker of each species at the bait). In the remaining cases, *C. sylvaticus* appears as a very aggressive ant, particularly against *Pheidole pallidula*, another species whose activity in the study zone takes place mainly at night and which dominates all species of the area with the exception of *C. sylvaticus*, because whenever the two species coincide at a bait, *P. pallidula* is always driven away.

CONCLUSIONS

C. sylvaticus can be considered a specialist ant from the point of view of its temporal and trophic spectrum.

Diet of the species is almost exclusively composed of sugary liquids, above all

honeydew, which is obtained from aphids. They remain with the aphids throughout the entire day, even when activity at the nest's entrance ceases. Its manifest aggressiveness contributes to exclude other ants from the exploitation of this important source of nutrients, as is honeydew.

Although some workers remain outside with the aphids during the day, activity at the nest entry takes place during the hours of darkness, regardless of the season of the year. This means that outside activity is directly influenced by light intensity.

The data obtained in the laboratory at different temperatures (DELYE, 1967) indicate that, contrary to expectation, water loss in the workers of *C. sylvaticus* are less than that in other species of diurnal activity, like *Cataglyphis cursor* or *Messor barbarus*, but the fact is that the workers of *C. sylvaticus* cannot remain above ground in full sunlight for a long period of time. When baits with abundant food (for example, honey) are offered to them, these ants can arrive at prolonging their activity during the day with high temperatures, but in these cases, they must resort to behavioral mechanisms, such as seeking refuge in the shade, in every case where they spend a certain amount of time exposed to the sun's effects.

In Canet de Mar, *C. sylvaticus* is one of the few ants which maintains its nocturnal activity throughout the entire season. This causes its rhythm of activity to considerably differ from the other two sympatric species of the same genus: *C. foreli*, of diurnal activity, and *C. cruentatus*, also of diurnal activity although during its period of maximum activity, it prolongs it to the entire day. This division of the gathering hours has also been observed in other sympatric species of the *Camponotus* genus, such as what occurs in the case of five species of the African savanna (LEVIEUX, 1977), or in the case of three species of the forests of Canada (SANDERS, 1970, 1972).

According to this, the absence of *C. sylvaticus* in the daylight hours of the day could be due to, not just environmental factors, but also to the activity of these proximal species, which have similar alimentary requirements (unpublished data) and that could be better adapted to exploit them during the day.

In spite of the special which are, in Canet de Mar, its diet and its hours of activity, *C. sylvaticus* is a relatively abundant species, not only in this zone, but also in other sunny, dry and vegetation-free zones (as DE HARO (1982), BERNARD (1983), RESTREPO *et al.* (1985) have observed) for which the characteristics of this species are the appropiate for living in these xerophilous zones.

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