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FEEDING ACTIVITY AND REGULATING FACTORS OF FORMICA PRATENSIS RETZ (HYMENOPTERA: FORMICIDAE)

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Abstract

In the field the feeding activity was measured via the number of individuals leaving the colony in a 5-minute period, and in the laboratory via the movement between an artificially created polycalic colony and the feeding arena. In the seasonal activity a maximum is observed at the end of May and the beginning of June, while within a day the maximum activity occurs at 8—9 a.m. and around 2 p.m. The daily rhythm of the ants is induced by external factors; under laboratory conditions this rhythm is progressively lost.

Introduction

Elucidation of the daily and seasonal changes in feeding activity brings us nearer to an understanding not only of the ethological-ecological character of the given species, but also of the roles of matter and energy turnover in the ecosystem. A number of authors have earlier dealt with the study of the daily and seasonal activities of ants. BARONI—URBANI (1965, 1969) investigated the nocturnal activity changes of *Camponotus nylanderi*, and the daily rhythm of the activities of the coexistent *Lasius alienus* and *Tetramorium caespitum*. ABE (1971) studied the activity variations of the species *Formica japonica, Camponotus japonicus, Tetramorium caespitum* and *Messor aciculatum* with one-day observations on each species in August 1968. PETAL (1972, 1974) examined the feeding activities of *Myrmica laevinodis* and *Lasius niger* with Barber traps dug into the soil. GALLÉ (1972) used sugar baits in research into the correlation of the temperature and the feeding activities of *Lasius niger* and *Formica cunicularia*. NIELSEN (1972) studied the effects of meteorological factors on the aboveground activity of *Lasius alienus*. HUNT (1974) investigated the activities of *Tapinoma* and *Dorymyrmex*, and HEMMINGSEN (1973) that of *Oceophylla*.

For *Formica pratensis* in South Siberian steppe ecosystems, STEBAEV and REZNIKOVA (1972) observed an activity maximum at 6 p.m., while for the same species DLUSSKY (1967) found activity minima at 1 a.m., 6 a.m. and 2 p.m., and appreciable maxima at 8 a.m. and 2—3 p.m. He brought the daily rhythm in the activity into correlation with the temperature.

Materials and Methods

A study was made of a policalic colony sited in a Festucetum vaginatae salicetosum rosmarinifoliae and *Astragalo-Festucetum sulcatae* plant association at the edge of a *Pinus silvestris* plantation. The ants largely went among the pine trees to feed, and thus, via their activity, created a material turnover contact between the grassland and woodland ecosystems. Observations were made on 8 feeding routes; the ants leaving the nest and returning to it were observed and counted in 5-minute periods on the various routes, and at the same time the temperature and humidity at the soil level were measured.

The examinations were carried out in the 4 years 1971—1974. In 1971 and 1972 nets were erected above the neststo keep away woodpeckers; in 1973 these were removed, and in 1974 measurements were made of the decrease in the number of individuals due to the activity of the woodpeckers, mainly *Picus viridis* and *Dendrocopus major*.

Besides the field studies, a „model colony" created in the laboratory was also investigated, in a relatively equilibrated climatic situation. The laboratory colony consisted of 3 nests, which were in contact with one feeding area. The nests, which were situated in glass baths with a base area of 20×30 cm, were connected to the feeding arena, with a base area of 0.5×1 m, via feeding routes constructed from wooden laths. The ant-food consisted of a mixture containing agar agar, sugar, honey, water and milk powder, which was cooked and a multivitamin mixture then added. Simultaneously with the laboratory daily activity observations, the temperature and humidity were also measured.

Results

The seasonal activity changes are depicted in Fig. 1. It can be seen that in both 1972 and 1974 the activity maximum occurred at the end of May and the beginning of June. As a result of the protection afforded by the nets, the number of individuals feeding in 1972 was several times that in 1974.

On sunny cloudless days, the daily activity pattern displayed two minima, at 4 a.m. and 11 a.m., and two maxima, at 8—9 a.m. and 2—3 p.m. (Figs. 2 and 3). In overcast weather the values of the maxima and minima were not so extreme.

The temperature and humidity measurements made in parallel with the observations of the changes in activity permit us to seek a correlation between the variations in the microclimatic factors and the feeding activity trends. If the feeding activity is plotted as a function of the temperature, a clear-cut correlation is not obtained for either the number of individuals leaving the nest ($r=0.2990$; $p>0.1$) or the number

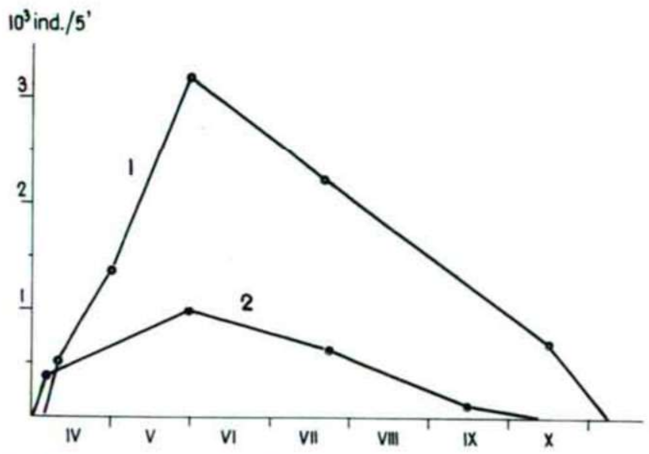

Fig. 1. Annual rhythm of feeding activity of Formica pratensis. The values given in the Figure are the average activities between 8 and 9 a.m. in the relevant seasons. Values observed in (1) 1972 and (2) 1974: numbers of ants leaving the nest during 5 minutes.

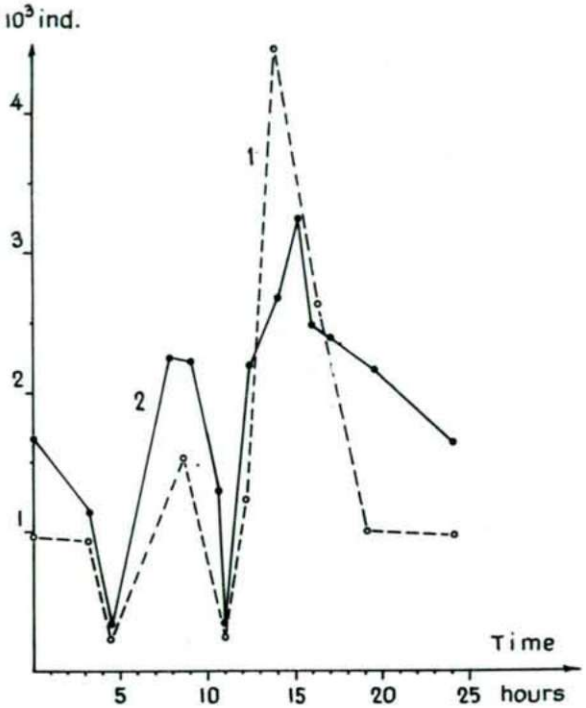

Fig. 2. Daily rhythm of the activity in the summer of 1972. (1) number of ants leaving the nest, (2) number returning to it, in a 5-minute period.

returning to it ($r=0.2063$; $p>0.1$) (Figs. 4 and 5). The activity threshold valus'e however, can be established definitely (8—10 and 39—40 °C). Similarly as for the temperature, a clear-cut correlation was not obtained with the relative humidity either. Nevertheless, if a climogram plot is prepared, it emerges that the two microclimatic factors together do determine the activity, for which a temperature of 28—35 °C and a relative humidity above 67% are optimum (Fig. 6).

In the laboratory a morning minimum could similarly be observed, at 10.30 a.m., with an early-afternoon maximum, between 12 a.m. and 2 p.m.; i.e. both occurred somewhat earlier than in nature. At the time of the examination the colony had been under laboratory conditions for more than 2 months, and it can be seen that by then the workers had largely lost their daily feeding rhythm: the values of the maxima and the minima were much less extreme than under natural conditions (Figs. 7 and 8).

Discussion

In the course of his observations on Formica pratensis, Dlussky (1967) found that the activity is affected by the temperature alone, the optimum being around 20 °C, i.e. essentially lower than that found in our measurements. A further differ-

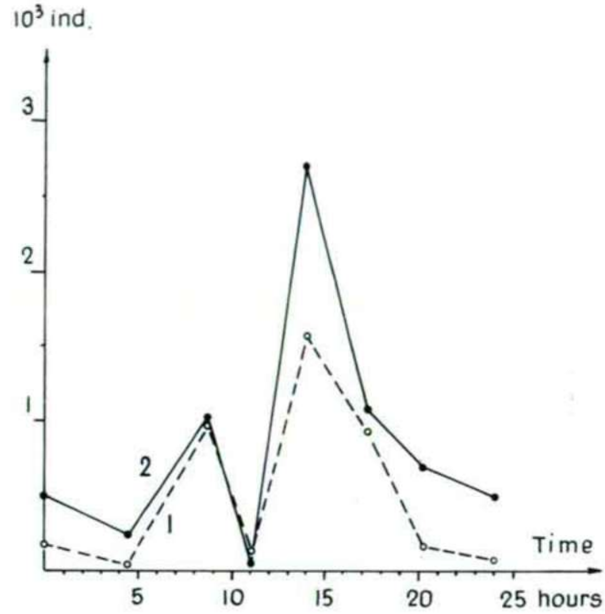

Fig. 3. Daily rhythm of the activity in 1974. Notations as in Fig. 2.

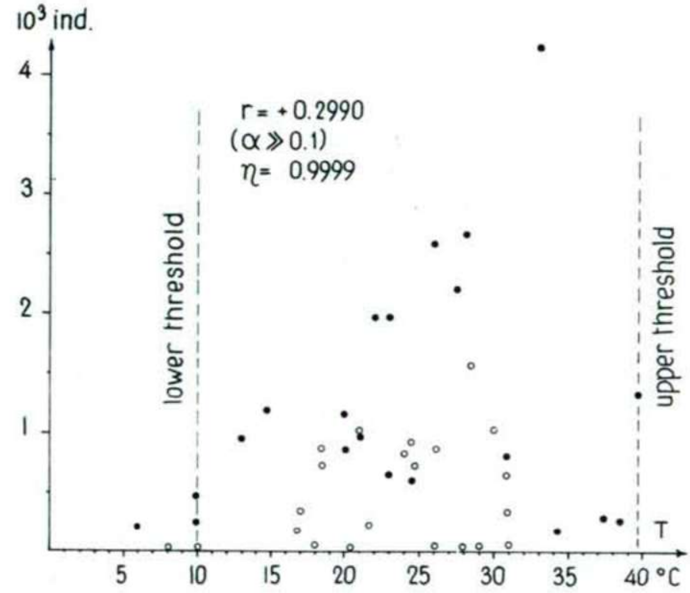

Fig. 4. Connection of the temperature and the number of ants leaving the nest. 1971—1972: dark points; 1974: circles.

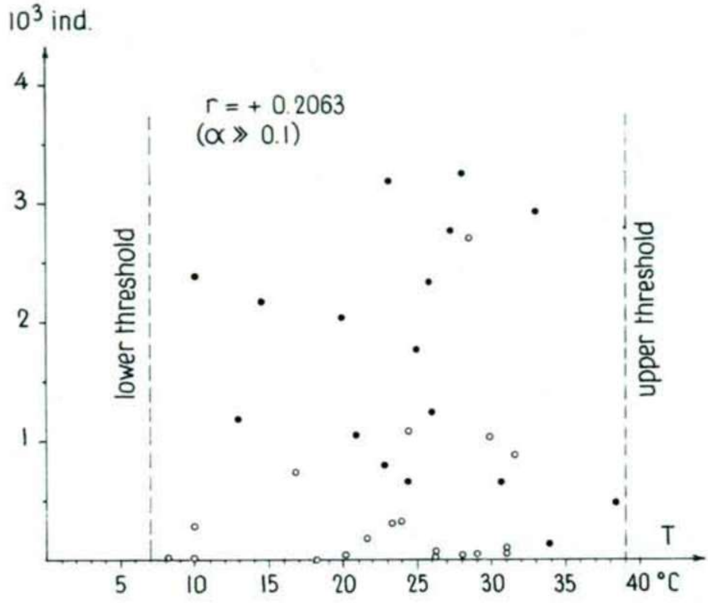

Fig. 5. Connection of the temperature and the number of ants returning to the nest.

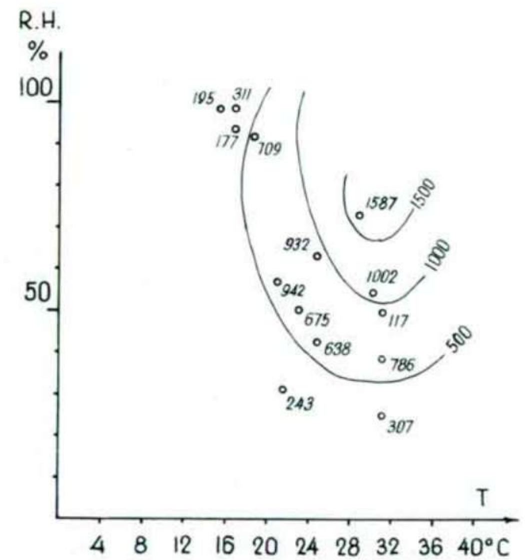

Fig. 6. Activity climogram of ants leaving the nest in 1974, with some critical experimental data.

ence between the two results is that our measurements did not reveal such a clear-cut correlation between the temperature and the activity as did those of DLUSSKY. However, our examinations fully support the finding of DLUSSKY that whereas the regulating factors have a clear effect on the number of outgoing individuals, as seen in Fig. 6, the well-fed individuals returning to the nest generally react only after some delay to changes in the microclimatic factors.

The field climate-chamber measurements of NIELSEN (1972) did not reveal a daily rhythm in *Lasius alienus* in a constant climatic situation. On the basis of our present examinations, it may be assumed that a rhythm develops in the workers of *Formica pratensis* in accordance with the daily periodic changes in the environmental factors (temperature, humidity), but that under altered conditions in the laboratory this rhythm is gradually lost. That the rhythm involved is not of endogenous origin, but is induced by external conditions, is supported by the fact that the daily cycle of nests of this species develops in a different way in a different environment (STEBAEV and REZNIKOVA, 1972).

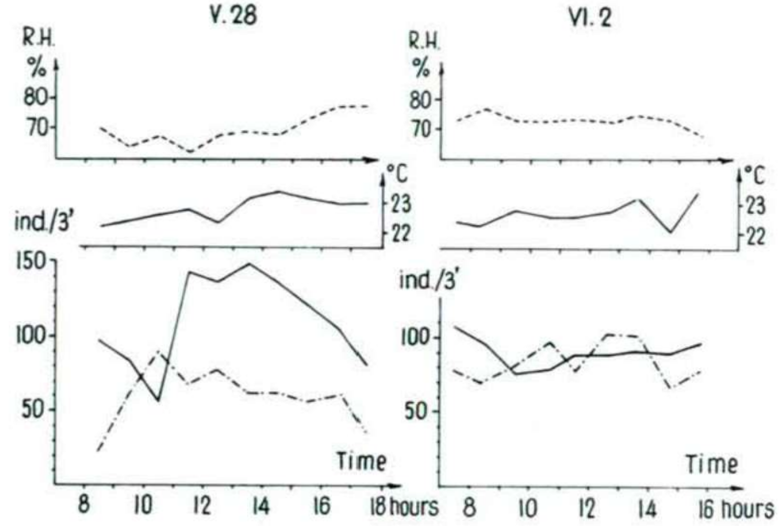

Fig. 7—8. Laboratory temperature and humidity, and daily rhythm of laboratory colony. (1) number of ants on feeding routes during 3 minutes; (2) number of ants on routes between nests during 3 minutes.

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