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DEUTONYMPS OF *PARASITELLUS* PHORETIC ON DANISH BUMBLEBEES
(PARASITIDAE, MESOSTIGMATA; APIDAE, HYMENOPTERA)

BY Christian SCHOUSBOE *

PARASITELLUS
DEUTONYMPS
BUMBLEBEES
DENMARK

ABSTRACT: Deutonymphs of four species of Parasitellus were found phoretic on Danish bumblebees. On overwintered queens of Bombus terrestris L. and B. lucorum L., nymphs of Parasitellus fucorum (De Geer) constituted 17.9-23.4 % of the Parasitellus fauna; correspondingly Parasitellus talparum (Oudem.) Hyatt constituted 19.7-21.6 %, Parasitellus ignotus (Vitzthum) Hyatt 45.5-48.4 %, and Parasitellus crinitus (Oudem.) Hyatt constituted 11.5-12.1 % of the phoretic Parasitellus fauna of the queens.

On worker bumblebees (B. terrestris and B. lucorum) all four Parasitellus species occurred in much smaller numbers and less frequently than on queens. Only P. fucorum was found on drones. Statistical analysis of association between presence of the four species of mites on potential nestfounding queens, showed significant positive association between each of the species P. talparum, P. ignotus and P. crinitus. Significant negative association was found between infection by the nematode *Sphaerularia bombi* Dufour and presence of deutonymphs on queens.

INTRODUCTION

Occurrence of mites on European bumblebees has been known for centuries, but still little is known about the *Parasitellus* species from bumblebees. Most of the species have been reported in only small numbers and no detailed account of the occurrence of *Parasitellus* deutonymphs on species and castes of bumblebees has been published.

The present work describes the phoretic *Parasitellus* fauna of castes and species of Danish bumblebees and cuckoo bumblebees.

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MATERIAL AND METHODS

To determine the occurrence of *Parasitellus* deutonymphs on castes (queens, workers and drones) of bumblebees, specimens of *Bombus terrestris* L. and *B. lucorum* L. were caught during the season of 1984 at a locality near Copenhagen (Amager Faelled).

As workers of *B. terrestris* in many cases could not be distinguished from workers of *B. lucorum*, and as these two species are biologically very similar, they are treated, in this study, as a single group (*B. terr/luc*).

The bees and their phoretic mites were killed immediately after capture by submersion in alcohol in individual tubes, or put in tubes and killed after cooling (7°C) for half an hour.

Overwintered queens were caught from April 13 to May 28; none of them had founded a nest. Two of the queens had parasiting “maggots” in their abdomen and were rejected, leaving 74 queens for further study. Workers were caught from July 8 to August 5. One worker had nemathelid nematodes in the abdomen and was therefore rejected, leaving 89 workers for further study. Drones were caught from July 11 to August 14. Two drones were rejected because of a tumor and “maggots” in the abdomen, leaving 37 drones for further study. All workers and drones were caught when visiting flowers.

The nemathode *Sphaerularia bombi* Dufour may infect the hibernating bumblebee queens. Infection inhibits development of the ovaries (sterilization) and changes the behavior of the queens in the spring. The *B. terr/luc* queens were examined for *Sphaerularia* infection, and statistical association between infection and presence of phoretic *Parasitellus* deutonymphs were analysed.

Apart from infection by *Sphaerularia*, other factors may prevent queens from founding nests. Therefore both *Sphaerularia* infected queens and queens that had not founded nests at the time of the first observation of workers (May 15) — all these queens were excluded from a statistical analysis concerning associations between presence of the *Parasitellus* species on the queens. After this exclusion, 46 queens — potential foundresses — were left for the analysis.

Some of the foundresses were infected with the tracheal mite *Bombacarus buchneri* Stammer or with the microsporian *Nosema bombi* Fantham & Porter, but these organisms do not prevent the queens from founding nests, and do not prevent the development of drone- and queen producing bumblebee colonies. Therefore infection by these organisms are supposed not to influence the presence of phoretic *Parasitellus* mites, and queens infected with *Bombacarus* or *Nosema* were not excluded from the statistical analysis.

Both statistical analyses were carried out as general 2 × 2 contingency tests, using one degree of freedom and 5 % as the level of significance.

The host range of phoretic *Parasitellus* deutonymphs was compiled from result from investigations of bumblebees and cuckoo bumblebees continued for five seasons and including more than six hundred specimens.

RESULTS

Deutonymphs of four species of *Parasitellus* were found on the bumblebees and cuckoo bumblebees:

1) *Parasitellus lucorum* (De Geer).
2) *Parasitellus talparum* (Oudem) Hyatt. The specimens closely resemble the type described as *Parasitus anglicus* Vitzthum 1930, dtn.
3) *Parasitellus ignotus* (Vitzthum) Hyatt. The specimens closely resemble the type described as *Parasitus anglicus* Vitzthum 1930, dtn.
4) *Parasitellus crinitus* (Oudem) Hyatt. The specimens closely resemble the type described as *Parasitus crinitosimilis* Vitzthum 1930, dtn.

*Parasitellus crinitus* and *Parasitellus crinitosimilis* have not previously been recorded from Danish bumblebees.

Observed host ranges of the species, as well as frequencies and numbers found on castes of *B. terr/luc*, are presented in Tables 1-4. On castes of *B. terr/luc*, all four *Parasitellus* species were
found much more frequently and in much greater numbers on queens than on workers and on drones. On potential foundresses, specimens of *P. ignotus* occurred most often (28.3%) followed by *P. talparum* (23.9%), *P. fucorum* (21.7%) and *P. crinitus* (15.2%). The *Parasitellus* fauna of the foundresses consisted of 48.4% *P. ignotus*, 21.6% *P. talparum*, 17.9% *P. jucorum* and 12.1% *P. crinitus*.

*Parasitellus ignotus* was the most numerous species on the worker bumblebees (B. terr/luc). *P. crinitus* was the least frequent and occurred in smallest numbers on workers. Only one deutonymph (*P. fucorum*) was found on the drones.

Only one bee, an overwintered queen of *B. lucorum*, carried deutonymphs of all four *Parasitellus* species (1 *P. fucorum*, 2 *P. talparum*, 4 *P. ignotus* and 1 *P. crinitus*). When the deutonymphs are pooled, the three greatest numbers found on overwintered queens were:

101 deutonymphs (all *P. fucorum*) on a *B. lapidarius* L., 83 deutonymphs (all *P. fucorum*) on a *B. lapidarius* and 49 deutonymphs (6 *P. talparum*, 32 *P. ignotus* and 11 *P. crinitus*) on a *B. lucorum* queen.

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**Table 1:** Deutonymphs of *Parasitellus* species found phoretic on castes of bumblebees (*Bombus*) and cuckoo bumblebees (*Psithyrus*). A = *Parasitellus fucorum*; B = *P. talparum*; C = *P. ignotus*; D = *P. crinitus*.

<table>
<thead>
<tr>
<th></th>
<th>Overwintered queens</th>
<th>Workers</th>
<th>Drones</th>
<th>Young Queens</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. terrestris</em> L.</td>
<td>a b c d</td>
<td>b</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td><em>B. lucorum</em> L.</td>
<td>a b c d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>B. terr/luc</em></td>
<td>a b c d</td>
<td></td>
<td>a</td>
<td></td>
</tr>
<tr>
<td><em>B. lapidarius</em> L.</td>
<td>a b c d</td>
<td>a b c d</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td><em>B. hororum</em> L.</td>
<td>a</td>
<td>a</td>
<td>b d</td>
<td>b d</td>
</tr>
<tr>
<td><em>B. pratorum</em> L.</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>B. soroeïns var. proteus</em> Gerst.</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ps. bohemicus Seidl.</td>
<td>a b</td>
<td></td>
<td>a</td>
<td></td>
</tr>
</tbody>
</table>

Greatest pooled numbers on workers were:

4 deutonymphs (2 *P. fucorum* and 2 *P. ignotus*) on a *B. terr/luc* worker and 3 deutonymphs (1 *P. fucorum* and 2 *P. ignotus*) on a *B. terr/luc* worker.

**Table 2:** Phoretic *Parasitellus* deutonymphs on overwintered queens of *Bombus terrestris* and *B. lucorum* (*B. terr/luc*); 74 specimens. In parenthesis: data obtained when only potential foundresses (46 specimens) are considered.

<table>
<thead>
<tr>
<th></th>
<th>% Bees with Mites</th>
<th>Range of Mite Numbers</th>
<th>Mites per Bee</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Parasitellus fucorum</em></td>
<td>18.9 (21.7)</td>
<td>0 - 13 (0 - 13)</td>
<td>0.66 (0.72)</td>
</tr>
<tr>
<td><em>P. talparum</em></td>
<td>14.9 (23.9)</td>
<td>0 - 15 (0 - 15)</td>
<td>0.55 (0.89)</td>
</tr>
<tr>
<td><em>P. ignotus</em></td>
<td>20.3 (28.3)</td>
<td>0 - 32 (0 - 32)</td>
<td>1.28 (2.0)</td>
</tr>
<tr>
<td><em>P. crinitus</em></td>
<td>10.8 (15.2)</td>
<td>0 - 11 (0 - 11)</td>
<td>0.32 (0.59)</td>
</tr>
</tbody>
</table>

**Table 3:** Phoretic *Parasitellus* deutonymphs on workers of *Bombus terrestris* and *B. lucorum* (*B. terr/luc*); 89 specimens.

<table>
<thead>
<tr>
<th></th>
<th>% Bees with Mites</th>
<th>Range of Mite Numbers</th>
<th>Mites per Bee</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Parasitellus fucorum</em></td>
<td>11.2</td>
<td>0 - 2</td>
<td>0.12</td>
</tr>
<tr>
<td><em>P. talparum</em></td>
<td>4.5</td>
<td>0 - 1</td>
<td>0.045</td>
</tr>
<tr>
<td><em>P. ignotus</em></td>
<td>12.4</td>
<td>0 - 2</td>
<td>0.15</td>
</tr>
<tr>
<td><em>P. crinitus</em></td>
<td>1.1</td>
<td>0 - 1</td>
<td>0.011</td>
</tr>
</tbody>
</table>

**Table 4:** Composition of phoretic *Parasitellus* fauna on castes of *Bombus terrestris* and *B. lucorum* (*B. terr/luc*). In parenthesis: data obtained when only potential foundresses are considered.

<table>
<thead>
<tr>
<th></th>
<th>Mites on Overwintered Queens</th>
<th>Mites on Workers</th>
<th>Mites on Drones</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Parasitellus fucorum</em></td>
<td>23.4 % (17.9 %)</td>
<td>37.9 %</td>
<td>100 %</td>
</tr>
<tr>
<td><em>P. talparum</em></td>
<td>19.7 % (21.6 %)</td>
<td>13.8 %</td>
<td></td>
</tr>
<tr>
<td><em>P. ignotus</em></td>
<td>11.5 % (12.1 %)</td>
<td>3.4 %</td>
<td></td>
</tr>
<tr>
<td><em>P. crinitus</em></td>
<td>45.5 % (48.4 %)</td>
<td>44.8 %</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>209 (190)</strong></td>
<td><strong>29</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>
Statistical analysis of association between Sphaerularia infection (24 of the 74 queens were infected) and presence of phoretic Parasitellus mites (4 species pooled) showed significant negative association ($X^2 = 7.2 ; P < 0.05$).

Statistical analysis of association between presence of the four species of Parasitellus on potential foundresses, showed non-significant associations between P. fucorum and each of the other three species. Significant positive associations were found between P. talparum and P. ignotus ($X^2 = 28.0 ; P < 0.05$), between P. talparum and P. crinitus ($X^2 = 17.3 ; P < 0.05$) and between P. ignotus and P. crinitus ($X^2 = 14.5 ; P < 0.05$).

**DISCUSSION**

*Parasitellus fucorum* is usually considered to be by far the most common *Parasitellus* deutonymph on bumblebees in Europe. Vitzthum (1930) found *P. ignotus* (= *Parasitus crinitus* Oudemans sensu Vitzthum 1930, dtn.) on bumblebees in Germany, and describes the species as "ziemlich häufig". Only few specimens of *P. ignotus* and *crinitus* have been found on bumblebees. The present study shows that deutonymphs of *P. ignotus* and *P. talparum* may constitute larger proportions of the phoretic fauna on foundresses, than *P. fucorum*. Changes from year to year in the relative frequency of the species may be the reason why Chmielewski (1971) and Skou et al. (1963) mention no other *Parasitellus* species than *P. fucorum* from bumblebees in Poland and Denmark.

The *Parasitellus* fauna of overwintered bumblebee queens (foundresses) is considered to be a close reflection of the fauna of *Parasitellus* deutonymphs in the parental nest of the previous year.

In the spring the new nests are infested with deutonymphs from the foundresses (primary infestation). Secondary infestation may occur when other Bombus or Psithyrus queens invade the nest; invading queens may supersede the nests. As *Parasitellus* nymphs on workers and drones are rare and mainly occur as single individuals, drifting between families (tertiary infestation) will have very little influence on the population of *Parasitellus* mites in the nests.

The results of the statistical analysis of association between the species, indicate that *P. talparum, P. ignotus* and *P. crinitus* has somewhat similar needs with respect to the ecology of the bumblebee nest. Various factors such as depth in soil, type of soil, exposure to sun and rain etc., will, in spite of the climate regulation of the bees, cause differences in microclimate of the nests.

The fauna of *Parasitellus* deutonymphs in the nests and on the queen offspring, is directly influenced by what nymphs are brought into the nests (primary and secondary infestation), and indirectly and directly influenced by the microclimate of the nests. Composition of the phoretic *Parasitellus* fauna of overwintered queens, will probably fluctuate widely from year to year and from one geographical region to another.

It is unknown what factors induce the phoretic deutonymphs to leave their hosts. The significant negative association between Sphaerularia infection and presence of nymphs on the queens, indicate that some changes in the physiology or behavior of infected queens, induce the mites to leave them. This is however only an indication, since it may be argued, that the majority of the infected queens were caught late in the spring, and that the mites may die and drop off the queen when she has not founded or invaded a nest within certain time limits. The present material is too small to judge, whether such a time factor may be of any importance.

The association of deutonymphs of *P. talparum, P. ignotus* and *P. crinitus* coincides with morphological similarities: small and not saw-like teeth of chelicera, tectum with three distinct points, structures of sternale with more or less equilateral meshes and the posterior dorsal shield being polytrichous. *Parasitellus fucorum* has chelicera with big saw-like teeth, rounded tectum with none, or at the most inconspicuous points, sternale structure with short but very broad meshes, and no polytrichy of the posterior dorsal shield. The group of *P. talparum, P. ignotus*
and *P. crinitus* will probably prove to have biological as well as morphological similarities, and to have life strategies that at some major points differ from that of *P. fucorum*.

Deutonymphs of *P. fucorum*, *P. talparum* and *P. crinitus* have been found in Danish honeybee hives (SCHOUSBOE 1984, SCHOUSBOE unpubl.). The mites have probably been brought there by bumblebee queens attracted by the smell of honey.

A key for identification of *Parasitellus (Parasitus)* deutonymphs associated with European bumblebees is presented by KARG (1985).

**BIBLIOGRAPHY**


*Paru en mars 1987.*