Acarologia is proudly non-profit, with no page charges and free open access

Please help us maintain this system by encouraging your institutes to subscribe to the print version of the journal and by sending us your high quality research on the Acari.

Subscriptions: Year 2021 (Volume 61): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2020): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

Acarologia is under free license and distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.
NOTES ON THE ECOLOGY OF CORTICOLOUS EPIPHYTE DWELLERS. 4. ACTINEDIDA (ESPECIALLY TYDEIDAE) AND GAMASIDA (ESPECIALLY PHYTOSEIIDAE)

H. M. ANDRÉ*

1. INTRODUCTION

This paper reports investigations on corticolous mite populations and extends two previous papers devoted to Collembola (ANDRÉ, 1983) and Oribatida (ANDRÉ, 1984). As previously outlined, corticolous microarthropod populations have been neglected by most ecologists. This statement definitely applies to small Acari such as Actinedida (= Prostigmata, in part) whose ecology is almost unknown. The ecology of Gamasida, the other group dealt with in this paper, is a little less obscure in so far as they have been extensively used as biological control agents against spider mites.

(*) Université Catholique de Louvain, Laboratoire d’Écologie et de Biogéographie, Place Croix du Sud 5, B-1348 Louvain-la-Neuve (Belgium) — Present address: Musée royal de l’Afrique centrale, Entomology section, B-1980 Tervuren (Belgium).

2. MATERIAL AND METHODS.

The survey was undertaken in three sites (Ruette, St-Mard A and St-Mard B) located in Belgian Lorraine (map in ANDRÉ, 1983). Briefly, a sample generally consisted of an epiphyte thallus taken with the underlying bark, possibly of a large thallus or of a tuft of thalli in the case of small fruticose lichens. A sample thus corresponds to a discrete unit representing a well-defined microhabitat and is characterized by the epiphyte, the phorophyte species and site. One hundred such samples formed a set and each set was composed of four series of 25 samples taken quarterly in relation to four seasons. Eighteen sets of samples were taken as listed in previous papers (ANDRÉ, 1983, 1984).

Samples were treated differently depending on the epiphytes (Berlese extraction, brushing, smoking, etc.) as detailed in ANDRÉ (1984). Animals were sorted under a dissecting microscope (magnification 25 to 63 x). All actinedid and gamasid mites were cleared with lactic acid, mounted in cavity slides and identified (species and stase) under a light microscope equipment with phase contrast.

3. ACTINEDIDAE

Although Actinedida represent only 9.60% of the arthropods collected, they are the richest in number of species, with 54 species of which 22 tydeid mites.

3.1. Tydeidae

The second most frequent arthropod, after the collembolan *Entomobrya nivalis*, is the tydeid mite, *Triophtydeus lebruni*, which was collected in 647 samples (out of 1770), i.e. in 36.55% of the samples. This agrees with the observations of RASMY & MACPHEE (1970) who consider a *Triophtydeus* species as the most common tydeid mite inhabiting apple trees in Nova Scotia. Its distribution is shown in figure 1. This species was found in all three study sites with a similar

![Distribution of 6 mite species in the 3 study sites (R: Ruette; S: St-Mard A; T: St-Mard B) and in the 3 types of epiphytes (Fol: foliose; Fru: fruticose; Cru: crustose) during the four seasons (4 stereograms in line represent successively spring, summer, autumn and winter data). Densities are expressed in number of individuals/dm² (foliose and crustose lichens) or in number of individuals/g of dried lichen (fruticose lichens). *: Other stases than those indicated in the diagram.](image-url)
frequency (35.61-37.97 OJo). It is more frequent in foliose lichens (53.93 %) than in crustose (23.28 %) and fruticose (22.00 %) epiphytes. Figure 1 also shows that it is the most abundant in foliose lichens during the spring and winter periods; however, T. lebruni is as abundant in crustose as in foliose epiphytes during the two other seasons.

_Pseudotriophtydeus vegei_, whose habitus is close to that of _T. lebruni_, seems to be much more stenotopic. Out of 130 specimens, 122 (ca 94 %) were found in foliose lichens vs 8 in crustose epiphytes and none in fruticose lichens. In addition, _P. vegei_ is twice more frequent in Ruette (7.46 %) than in St-Mard B (4.07 %) and is almost absent in St-Mard A (only 2 specimens).

Among the Tydeinae, four species are worthy of comment. _Homeotydeus formosa_ is the most frequent and the most abundant Tydeinae. As _T. lebruni_, it is found in all three sites but with uneven frequencies (8.47 % in Ruette, 21.95 in St-Mard A and 26.10 % in St-Mard B). Figure 1 shows that this tydeid mite is rare in fruticose lichens and the most abundant in foliose epiphytes, especially in winter. Its frequency in foliose lichens reaches 26.64 % vs. 6.64 % in crustose epiphytes and 4.67 % in fruticose lichens.

_Tydeus bedfordiensis_ has already been found in great number on bark in orchards (MARSHALL, 1970; FOREST et al., 1981; ANDRÉ, unpublished data). This tydeid was found in all three types of epiphytes and in all three study sites. Its frequency reaches up to 17.37 % in foliose lichens vs 14.00 % in fruticose lichens vs 7.22 % in crustose epiphytes. Conversely, _Tydeus stefani_ is more frequent in crustose epiphytes (15.15 %), especially in algae on hornbeam where its frequency slightly exceeds 51 %, than in foliose (8.11 %) and fruticose lichens (8.00) (see also Fig. 1). These two tydeids are closely related taxonomically and were confused in the early part of the study. Their patterns of distribution should reflect different microhabitat requirements. In addition, _T. bedfordiensis_ is a key species in the microcoenoses living in foliose lichens while _T. stefani_ is a characteristic species in some crustose lichen microcommunities (ANDRÉ, 1985).

Besides, the bionomics of the three Tydeinae cited above is rather similar. Of 58 gravid females, all were seen with only one egg inside the body except for one _Homeotydeus formosa_ female which was bearing two eggs. The life-cycles are shown in figure 2. Reproduction occurs in summer as suggested by the percentage of gravid females and the peak of larvae and protonymphs observed during that period. In the three species, a decline in the adult proportion is observed in winter (no adult of _H. formosa_ during that season) while, conversely, the maximum of adults occurs in the spring. The spring emergence of adults is also indicated by the number of pupating tritonymphs; none in winter and highest in spring. Such a synchrony between the life cycles of three closely allied species is to be related to the impact that seasonal variations have in the corticolous fauna. This synchrony, however, obliges those species to occupy different habitats if they want to minimize the competition as suggested by the principle of competitive exclusion. The case of _T. lebruni_ is somewhat different. First, this species also has only one egg/gravid female (observed in 118 gravid females) but egg bearing females occurred three months earlier than the other three species. Second, it is quite distinct morphologically and taxonomically from the 3 tydeinae species.

A last tydeinae deserving some comments is _Metaloryia armaghensis_ described from an apple tree by BAKER (1968). This species was found to be confined to algae (124 specimens out of 143, with a frequency of 13.5 % vs 0.8 % in crustose lichens, 1.8 % in foliose lichens and 0.33 % in fruticose lichens), both on hornbeam in Ruette and chestnust in St-Mard A.

Lastly, it must be emphasized that all the species above-mentioned seem to spend their entire life cycle on bark and can be considered phloio-biontic species.

3.2. _Tetranychidae_

Only one species, _Bryobia cristata_, was collected during this survey. The highest density was observed in winter while the population seve-
rely declined during the summer period. This decline is probably due to migration on to grasses from trees at this time of the year. During the autumn and the winter, only larvae were encountered; nymphs appeared in the spring (fig. 2). *Bryobia cristata* was pretty abundant in St-

Mard B on poplars covered with foliose lichens (fig. 1). Species of this genus exhibit complex migratory behaviors associated with the life cycle (MATHYS, 1957) and *B. cristata* should be considered a philoophilous species.

![Fig. 2: The stase composition (in percent) of 6 actinedid species during the four seasons (in the same order as in fig. 1). Stases are indicated with the same symbols as in Fig. 1. Small white bars in the upper right corner of hatched or dotted areas correspond to individuals in pupation; similar black bars indicate gravid females. Numbers at the bottom of columns indicate the numbers of individuals on which the percentages are based.](image)

3.3. *Eupodidae*

The next most abundant Actinedida after *B. cristata* was a eupodid species (species “A”). Unfortunately, identification of the Eupodidae is very difficult due to the confused systematics of the family. Three species were collected, among which the most important, *Eupodes* sp. A (172 specimens), was more frequent in foliose lichens (10.17%) than in fruticose (5.67%) and crustose (1.01%) epiphytes. This species is virtually absent in summer and shows a life cycle quite different from that of Tydeidae (fig. 2). The mean number of eggs/gravid female was 3.73 (estimated from 30 gravid females).

3.4. *Miscellaneous*

Less important families are Cunaxidae (with 2 species, *Cunaxa* sp. and *Cunaxoides* sp.), Bdelli-dae (*Bdelia* sp., *Bdelodes* sp. and *Spinibdella* sp.), Stigmaeidae (with 6 species among which *Mediolata mariaeaefrancae*). Two anystid species were also recorded as well as *Paracheyletia pyrifloris*. All these species are listed in the appendix.

4. *Gamasida*

The Gamasida represent only 2.41% of the corticolous Acari, i.e. about 1.49% of the Arthropods as a whole. They are however represented by 27 species among which there are 9 phytoseiid species.
4.1. Phytoseiidae

Some 91% of the Gamasida collected during this survey belong to the family Phytoseiidae which is represented by three species of Amblyseius, five species of Typhlodromus sensu Karg (1971) and Phytoseius macropilis.

The most abundant species are, in decreasing order, *T. richteri*¹, whose distribution is shown in fig. 1, *T. cf. tubifer*², *T. foenilis*³ and *T. pyri*. However, as densities of these predators are low, their distribution pattern is better represented when frequencies are considered as in fig. 3. Two species, *T. richteri* and *T. cf. tubifer*, are more frequent in foliose lichens. However, the two gamasids most frequent in foliose lichens have a distribution pattern quite distinct. Indeed, *T. cf. tubifer* is almost confined to foliose lichens growing on *Fraxinus* in Ruette (F in fig. 3). In contrast, *T. richteri* is found in the three study sites. However, the latter species is less frequent in Ruette and, besides, seems to be restricted to poplar (P in fig. 3). Lastly, *T. richteri* is also common in fruticose lichens especially in autumn.

The two other gamasid species, *T. foenilis* and *T. pyri* are both most frequent in fruticose lichens although they are not rare in crustose epiphytes, at least during certain seasons. *T. pyri* seems to be restricted to Ruette at least during the summer and autumn periods while *T. foenilis* is common in two sites, Ruette and St-Mard A (there were no fruticose lichens in St-Mard B !).

---

1. Also called *Anthoseius (Aphanoseius) richteri* (Karg).
2. This species is close to *T. tubifer* Wainstein and is a new species according to Dr. Evans.
3. Also called *Anthoseius (Amblydromellus) foenilis* (Oudemans). Dr. G. O. Evans does not consider the accepted synonymy of *T. rhenanus* and *T. foenilis* to be valid.
Little information on the gamasid phenology is available from our data for immatures were little frequent. A comparison of frequencies plotted in fig. 3 reveals however that all species, except *T. pyri*, exhibit the same cycle with a frequency peak in autumn.

4.2. Miscellaneous

No other major family emerges from the analysis of data. Species that were collected are listed in the appendix.

5. DISCUSSION AND CONCLUSIONS

The Actinedida, although they represent less than 10% of the arthropods collected, comprise a great number of species in comparison with similar taxa (e.g. Oribatida, Collembola, etc.). In addition, *Triophydeus lebruni* was found to be the most frequent mite on bark. This clearly means that the Actinedida are not a minor group the study of which can be neglected.

Among corticolous Actinedida, the family Tydeidae, represented by 22 species, is a major group. Unfortunately, their biology is poorly known, except that of a few species common in orchards, in vineyards or on other crops of economical importance. In any case, the co-occurrence of so many species require a mode of coexistence based either on the principle of competitive exclusion, on different foraging strategies, or on both. Our data strongly suggest that closely allied species occupy in different microhabitats (foliose vs crustose vs fruticose epiphytes). Illustrative examples are offered by *Tydeus bedfordiensis*, *T. stefani* and other Tydeinae (see fig. 1). These species seem to spend all of their life cycle on bark (fig. 2) and should be considered as philobiobiontic. As for the foraging strategies, any speculation is difficult as long as the food used by Tydeidae is not precisely known. Some evidence does exist that the Pronematinae feed either upon fungi (McCoY et al., 1969) or upon pollen and occasionally on eggs of spider mites (FLAHERTY & HOY, 1971; CALVERT & HUFFAKER, 1974; KNOP & HOY, 1983). However, conflicting observations have been reported on the Pronematinae as predators of Eryophiidae (McCoY et al., 1969 vs. other authors, see LAING & KNOP, 1983). The Tydeinae and Triophydeinae have been observed to feed on honeydew but could be occasionally plant feeders or predators of other mites such as Tetranychidae (mostly on eggs) and Eriophyidae (all stages except the adults) (FLESHNER & ARAKAWA, 1953; BRICKHILL, 1958; SCHRUFT, 1972; WAHAB et al., 1974; KARG, 1975). Conflicting observations on *Tydeus californicus* (Banks) considered as a plant feeder or a predator depending on the authors are reported in the literature. According to Bayan (1984), the feeding habit of *T. californicus* varies depending on the stage: larvae and protonymphs would feed primarily on honeydew excreted by the rosy aphid while deutonymphs, tritonymphs and adults would feed and develop on apple leaves free from aphids. *Triophydeus triophthalmus* has even been reported as a predator of the eggs of *Coleophora fuscedinaella* Zeller (Lepidoptera, Coleophoridae) (RASKE, 1974) while a specie of “*Lorryia*” has been found to prey upon the eggs of *Lepidosaphes ulmi* (L.) (Homoptera: Diaspididae) (SAMARASINGHE & LEROUX, 1966). However, all these data are still fragmentary and most were collected under laboratory conditions. Some observations are conflicting and give reason to doubt regarding the phytophagy in Tydeidae as outlined by KRANTZ & LINDQUIST (1979). Few indications exists about the tydeid diet in natural conditions and about their possible specificity; tydeid mites should be investigated more thoroughly in this regard.

As for the Gamasida, the co-occurrence of four *Typhlodromus* species raises, once again, questions about their mode of coexistence. Obviously, their coexistence is made possible through the colonization of different habitats (foliose vs. fruticose lichens; *Populus* vs. *Fraxinus*). The *Typhlodromus* species offer, once again, an illustrative example of the principle of exclusive competition. However, some other questions arise about their real and respective diets. Indeed, *Typhlodromus*
species are well-known predators of spider mites. Yet, it must be stressed that only one tetranychid species has been observed during this survey, that this only one species was confined to St-Mard B and, besides, that B. cristata was little abundant during the spring and summer periods, i.e. when Typhlodromus species were the most abundant. This strongly suggests that the Phytoseiidae collected during this survey prey upon other mites than Tetranychidae, possibly upon oribatid larvae and nymphs which are pretty abundant when gamasids are so (cf. ANDRÉ, 1984) or upon tydeid mites which are well-known alternate prey for predatory mites (FLAHERTY & HOY, 1971 ; KNOP & HOY, 1983 a, b). In addition, many species of Phytoseiidae can exist on plant material and even reproduce after feeding on pollen and/or fungal spores. They seem to be more euryphagous than what is usually expected. In any case, the prey specificity of the four co-occurring gamasids together with their respective foraging strategies are problems which deserve further investigations in the future even if the biology of Phytoseiidae is pretty well known in comparison to other mites (see numerous references in HOY, 1982).

ACKNOWLEDGEMENTS

This is a part of a Sc. D. thesis achieved under Prof. Ph. LEBRUN to whom I am deeply indebted. I thank Dr. G. O. EVANS for his review and critique of an earlier draft of the MS, Drs G. O. EVANS, W. KARG and C. ATHIAS-HENRIOT for identification of some Gamasida and Dr. V. VACANTE for identification of B. cristata.

REFERENCES CITED


LAING (J. E.) & KNOP (N. F.), 1983. — Potential use of predaceous mites other than Phytoseiidae for biological control of orchard pests. — In : Biological Control of Pests by Mites. Edited by HOY (M. A.), CUNNINGHAM (G. L.) & KNOTSON (L.), University of California, Berkeley, publication no. 3304 : 28-35.
APPENDIX: LIST OF SPECIES

Acintedida and Gamasida are listed separately, species are ranked by decreasing order of abundance. Names are followed by the number of individuals recorded and the site where they were collected (R: Ruette; S: St-Mard A; T: St-Mard B).

ACTINIDIDA

<table>
<thead>
<tr>
<th>Species</th>
<th>(R, S, T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Triphytodes lebruni (André)</td>
<td>(1858 - R, S, T)</td>
</tr>
<tr>
<td>2. Homeotydeus formosa André</td>
<td>(1187 - R, S, T)</td>
</tr>
<tr>
<td>3. Tydeus stephani André</td>
<td>(512 - R, S, T)</td>
</tr>
<tr>
<td>4. Tydeus bedfordiensis (Evans)</td>
<td>(353 - R, S, T)</td>
</tr>
<tr>
<td>5. Broybia cristata Dugès</td>
<td>(265 - R, S, T)</td>
</tr>
<tr>
<td>7. Cumaxa sp.</td>
<td>(164 - R, S, T)</td>
</tr>
<tr>
<td>8. Metalorryia armaghensis (Baker)</td>
<td>(143 - R, S)</td>
</tr>
<tr>
<td>9. Pseudoitaphydeus veinii André</td>
<td>(130 - R, S, T)</td>
</tr>
<tr>
<td>11. Mediolata mariaebrasae André</td>
<td>(77 - R, S, T)</td>
</tr>
</tbody>
</table>

12. Tydaelhus sp. | (51 - R, S, T) |
| 13. Tarsonemidae (sp.) | (40 - R, S, T) |
| 14. Homeotydeus bipilis André | (38 - S, T) |
| 16. Undetermined | (31 - R, S, T) |
| 17. Tarsonemidae (sp. A) | (26 - R) |
| 18. Idiolarryia marci André | (19 - R) |
| 20. Idiolarryia sp. | (10 - S, T) |
| 21. Nanorchestes sp. | (9 - R, S) |
| 22. Pyemotidae | (9 - R, S, T) |
| 23. Orthotydeus sp. A | (7 - R, S) |
| 24. Mulebraria sp. B | (7 - R, S, T) |
| 25. Bocharia sp. | (7 - T) |
| 26. Paratydeus sp. | (6 - R, S, T) |
| 27. Tydeus sp. | (6 - R) |
| 28. Triphytodes sp. B | (5 - R, S) |
| 29. Eupodes sp. B | (4 - R, S, T) |
| 30. Riccardoletta sp. | (4 - R, S) |
| 31. Tydeus sp. C | (3 - R) |
| 32. Spinibella sp. | (3 - R) |
| 33. Mulebraria sp. A | (3 - R) |
| 34. Rhagidia sp. A | (2 - R) |
| 35. Microtydeus sp. | (2 - S, T) |
| 36. Coccydotaevolus sp. | (2 - R, T) |
| 37. Tydeus sp. D | (2 - R) |
| 38. Homeotydeus sp. D | (2 - R, S) |
| 39. Raphignathus sp. | (2 - S) |
| 40. Parachrysolela pyriformis Banks | (2 - R) |
| 41. Pachygnathus sp. | (1 - S) |
| 42. Eupodes sp. C | (1 - S) |
| 43. Riccardoletta sp. B | (1 - S) |
| 44. Triphytodes sp. C | (1 - R) |
| 45. Tydeus sp. 6F | (1 - S) |
| 46. Homeotydeus sp. C | (1 - R) |
| 47. Orthotydeus sp. B | (1 - S) |
| 48. Tydeusidae undetermined | (1 - R) |
| 49. Cunaxidae undetermined | (1 - T) |
| 50. Cryptognathus sp. | (1 - T) |
| 51. Stigmaea sp. | (1 - R) |
| 52. Stigmaeidae undetermined | (1 - S) |
| 53. Cheyletidae (sp. B) | (1 - S) |
| 54. Anystis sp. B | (1 - R) |
| 55. Abrolophus sp. | (1 - R) |
| 56. Trombidioida | (1 - R) |
| 57. Hydrachnoidea | (1 - R) |

Total 5352

GAMASIDA

<table>
<thead>
<tr>
<th>Species</th>
<th>(R, S, T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Typhlodromus richteri Karg</td>
<td>(314 - R, S, T)</td>
</tr>
<tr>
<td>2. Typhlodromus cf. tubifera Wainstein</td>
<td>(170 - R, T)</td>
</tr>
<tr>
<td>3. Typhlodromus foeniatis Oudemans</td>
<td>(156 - R, S, T)</td>
</tr>
<tr>
<td>4. Typhlodromus pyriflora Scheuten</td>
<td>(96 - R, S, T)</td>
</tr>
<tr>
<td>5. Parasitinae (undetermined deuteron.)</td>
<td>(22 - R, S)</td>
</tr>
<tr>
<td></td>
<td>Species</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>Phytoseiinae (undetermined proton.)</td>
</tr>
<tr>
<td>7</td>
<td>Celaenopsidae (n. gen.)</td>
</tr>
<tr>
<td>8</td>
<td>Leioseius bicolor (Berlese)</td>
</tr>
<tr>
<td>9</td>
<td>Phytoseiinae (undetermined deutron.)</td>
</tr>
<tr>
<td>10</td>
<td>Ameroseius cf. plumigerus (Oudemans)</td>
</tr>
<tr>
<td>11</td>
<td>Arctoseius elegans Bernhard</td>
</tr>
<tr>
<td>12</td>
<td>Uropodidae (sp. A)</td>
</tr>
<tr>
<td>13</td>
<td>Uropodidae (sp. B)</td>
</tr>
<tr>
<td>14</td>
<td>Lasioseius sp.</td>
</tr>
<tr>
<td>15</td>
<td>Gamasina sp. unidentified</td>
</tr>
<tr>
<td>16</td>
<td>Amblyseius cf. masseel (Newbist)</td>
</tr>
<tr>
<td>17</td>
<td>Amblyseius cf. cucumeris (Oudemans)</td>
</tr>
<tr>
<td>18</td>
<td>Amblyseius sp. C</td>
</tr>
<tr>
<td>19</td>
<td>Typhlodromus cf. aceri Collyer</td>
</tr>
<tr>
<td>20</td>
<td>Phytoseius macropilis (Banks)</td>
</tr>
<tr>
<td>21</td>
<td>Ameroseius sp. B</td>
</tr>
<tr>
<td>22</td>
<td>Proctolaelaps físeri Samsinak</td>
</tr>
<tr>
<td>23</td>
<td>Arctoseius cf. minutus (Halbert)</td>
</tr>
<tr>
<td>24</td>
<td>Dendrolaelaps sp.</td>
</tr>
<tr>
<td>25</td>
<td>Holoparasitus excipuliger (Berlese)</td>
</tr>
<tr>
<td>26</td>
<td>Pergamasus sp.</td>
</tr>
<tr>
<td>27</td>
<td>Parasitus cf. oudemansi (Berlese)</td>
</tr>
<tr>
<td>28</td>
<td>Veigaia planicola (Berlese)</td>
</tr>
<tr>
<td>29</td>
<td>Uropodidae sp. C</td>
</tr>
<tr>
<td>30</td>
<td>Trigynaspides (autre sp.)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

*Paru en avril 1986.*