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# INVESTIGATION OF THE SEASONAL DYNAMICS OF SOIL GAMASINA MITES (ACARI: MESOSTIGMATA) IN *PINACEUM MYRTILOSUM*, LATVIA

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Abstract

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Investigation was made because of the lack of data on soil Gamasina mite seasonal dynamics in coniferous forests of Latvia and their relation to the changes of soil ecological conditions during the season. Investigations were carried out on the seasonal dynamics of some soil microarthropod groups, numbers of Gamasina species and individuals, and species diversity, in relation to soil ecological conditions. Soil microarthropods, including Gamasina mites, were shown to depend on soil ecological conditions. The soil relative humidity must be recognised as a limiting factor. It was found that when there is enough humidity, the decisive factor is soil temperature.

## Introduction

Soil-dwelling mites are a widely distributed group of soil microarthropods. Among them, a numerous group of predators is the Gamasina mites (Acari, Mesostigmata), represented by many species and widely distributed in the whole world, and found in diverse habitats such as forests, meadows, marshes, and coastal habitats. As Gamasina mites live in the soil and therefore are dependent on it's ecological conditions, they could be good indicators of soil conditions. According to the published data, soil Gamasina mites are considered to be indicators of the state of soil conditions and its pollution (Giljarov, 1965; Karg, 1968, 1982; Koehler, 1991, 1992; Lebrun, 1979; Petersen et al., 1987).

Investigation of the Gamasina in Latvia has been carried out mostly as faunistical studies (Lapina, 1988). Some fragmentary research has been dedicated to their bioindicative sig-

T a b l e 1. List of Gamasina species found in *Pinaceum myrtilosum.*

| **Gamasina species** | **Month** | | | | | | |
|---|---|---|---|---|---|---|---|
| | April | May | June | July | August | September | October |
| *Veigaia nemorensis* (C. L. K.) | x | x | x | x | x | x | x |
| *Veigaia cervus* (KRAM.) | x | x | x | x | x | x | x |
| *Hypoaspis aculeifer* (CANE.) | x | x | x | x | x | x | x |
| *Holoparasitus excipuliger* (BERL.) | x | x | x | x | x | x | x |
| *Eviphis ostrinus* (C. L. K.) | x | x | x | x | x | x | x |
| *Parazercon sarekensis* WILL. | x | x | x | x | x | x | x |
| *Prozercon kochi* SELL. | x | x | x | x | x | x | x |
| *Veigaia exigua* (BERL.) | x | x | | x | x | x | x |
| *Zercon forsslundi* SELL. | x | x | | x | x | x | x |
| *Pergamasus vagabundus* KARG | | x | x | x | x | x | x |
| *Pergamasus lapponicus* TRAG. | x | x | x | | x | x | |
| *Parasitus kraepelini* BERL. | x | x | | | | x | |
| *Pergamasus wasmanni* (OUDE.) | | x | x | x | | | |
| *Pergamasus parrunciger* BHAT. | | x | | x | x | | |
| *Zercon spatulatus* (C. L. K.) | x | | | | x | x | x |
| *Zercon zelawaiensis* SELL. | x | | | x | x | x | x |
| *Pachylaelaps longisetis* HALB. | x | | | | | | |
| *Asca bicornis* (CANE. ET FANZ.) | | | x | | x | | |
| *Hypoaspis vacua* (MICH.) | | | x | | | | x |
| *Hypoaspis praesternalis* WILL. | | | | x | | | |
| *Iphidosoma fimetaria* (MULL.) | | | | x | | | |
| *Zercon carpathicus* (SELL.) | | | | | x | | |
| *Pergamasus holzmanae* MICHE. | | | | | x | | |
| *Pergamasus suecicus* (TRÄG.) | | | | | | x | |
| *Rhodacarus reconditus* ATHI. | | | | | | | x |
| **In total 25 species** | 14 | 14 | 12 | 15 | 17 | 15 | 14 |

nificance in relation to environmental pollution (BERINA et al., 1985). The aim of our investigation was to estimate the seasonal dynamics of Gamasina mites in pine forest soils in Latvia and to determine the best sampling time for monitoring of these invertebrates.

## Study Area

The material used for investigations was obtained from a forest monitoring site in the vicinity of Mazsalaca (25°5'/57°50'). The sampling site was set up in III–IV class (BUSHS, 1981) *Pinaceum myrtilosum* on medium sandy podzolic soils.

## Material and methods

Thirty soil samples were taken once a month from April to October, using a soil corer (20 cm$^2$ x 15 cm); in total 210 samples were taken. They were placed in plastic containers and taken to the laboratory. In addition, the soil temperature was measured 5 cm below the moss cover and the soil relative humidity estimated gravimetrically. Extraction was made by Tullgren funnels, with samples extracted for a period of 14 days. Determination and nomenclature of Gamasina species are based upon to the keys of Bregetova (1977), Hirshmann (1971), Karg (1993), Kolodochka (1978) and Lapina (1976 a, b). The dominance structure of Gamasina species was determined according to Engelman's classification (Engelmann, 1978). The Shannon index was used to characterise species diversity. The abundances of individuals were transformed to logarithmic values ($x'=\log_{10}(x+1)$), where x = number of individuals in the soil sample (Bizova et al., 1987).

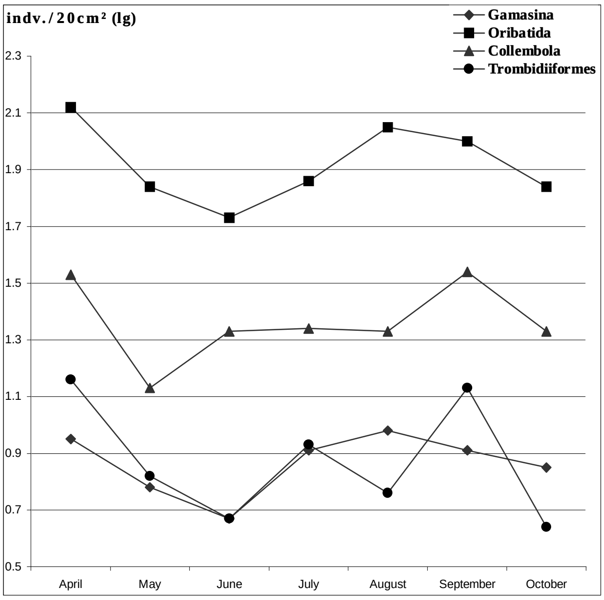


Fig. 1. Seasonal dynamics of soil microarthropd groups.

## Results and discussion

From the total number of microarthropods (276000) 67% were Oribatida, 21% – Collembola, 6% – Trombidiformes and 5% – Gamasina. 25 Gamasina species were found (Table 1). Total number of Gamasina mites was 1560 specimens.

All the above-mentioned microarthropod groups showed high numbers in April (Fig. 1). During the following months their number decreased and in June it was the lowest (the only exception was for Collembola; they were at a minimum in May, and thereafter increased).

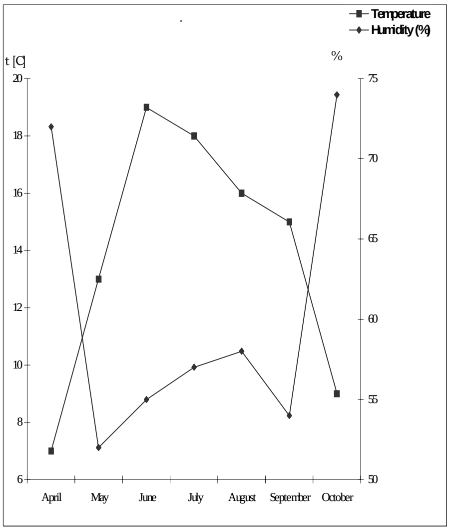


Fig. 2. Seasonal dynamics of soil temperature and relative humidity.

There again followed a gradual increase, and for Oribatida and Gamasina another was reached in August (but in September for Collembola). Trombidiiformes showed a slightly different density fluctuation – they had three maxima.

Analysing soil temperature and relative humidity data (Fig. 2), it can be seen that up to June the temperature increased rapidly, then declined gradually until September, but dropped suddenly from September to October. The relative humidity of the soil had two pronounced maxima in April and October and two minima in May and September. Such dynamics of ecological conditions are rather typical for the climate of Latvia and have been observed frequently.

Comparing the seasonal dynamics of microarthropods with changes in soil ecological conditions, the relationship is clear (Figs 1, 2). The decrease of the number of microarthropods, including Gamasina, up to June is caused by the spring drought, which reaches its maximum in May, when the soil temperature is the highest, but the amount of moisture is decreasing fast. This drought brings about the minimum of microarthropods in June. Later the amount of precipitation, and relative humidity of the soil, increases furthering an increase of the number of microarthropods until August. In September – October the soil humidity continues to increase, but as the temperature drops sharply, the number of microarthropods decreases.

Thus, seasonal changes of the soil relative humidity and temperature seriously affected soil microarthropods, among them also Gamasina. Relatively high soil temperature (~20°C) and low relative humidity (50-55%) during the summer, as well as high soil moisture (65-75%) and comparatively low soil temperature (8°C) caused a decrease of the number of individuals. Relatively high moisture (~60%) at optimal temperature (12-16°C), however, caused a rapid increase in numbers, as happened in August-September, when it reached maximum.

Decreased numbers of Gamasina mites caught during droughts can be explained by their vertical movement and that of other soil fauna (on which they feed) into deeper soil layers under the drought pressure (Drift, 1951; Luxton, 1982; Usher, 1971; Wallwork, 1967). After periods of abundant precipitation the soil fauna returns to the upper layers of the soil.

Engelman's classification was used (Table 2) for division of Gamasina species into dominance classes. According to this classification 1 species was classified as eudominant, 1 as dominant, 2 as subdominant, 8 as recedents and 16 as subrecedents. Changes in the struc-

T a b l e 2. Seasonal dynamics of the dominance structure of Gamasina species. SR- subrecedent (bellow 1.3%), R- recedent (1.3-3.9%), SD- subdominant (4-12.4%), D- dominant (12.5-39.9%), E- eudominant (40-100%).

| **Gamasina species** | **April** | **May** | **June** | **July** | **August** | **September** | **October** |
|---|---|---|---|---|---|---|---|
| *Veigaia nemorensis* (C. L. K.) | D | E | D | E | E | E | E |
| *Zercon forsslundi* SELL. | R | SR | - | R | R | R | SD |
| Prozercon kochi SELL. | D | SD | SD | R | R | SD | SD |
| *Pergamasus vagabundus* KARG | – | SR | SD | SD | R | SD | SD |
| *Hypoaspis aculeifer* (CANE.) | R | R | SD | SD | SD | R | R |
| *Holoparasitus excipuliger* (BERL.) | R | R | SD | R | R | R | R |

ture of species dominance were observed during the course of the season. Only one species – *Parazercon sarekensis* WILLMANN preserved its status as a dominant species throughout the whole season. The dominance class of some species declined when the total number of mites reached its minimum (in June), but at the same time there were some species whose dominance class increased. Thus we can say that seasonal dynamics varies between species.

From the total number of species, 7 were found during the entire period of investigation (7 months), 3 species were found during a period of 6 months, but the other species had fewer incidences (Table 1). Moreover, some species were found in only one month – *Pachylaelaps longisetis* HALBERT (May), *Hypoaspis praesternalis* WILLMANN and *Iphidosoma fimetaria* (MULLER) (July), *Zercon carpathicus* (SELLNICK) and *Pergamasus holzmannae* MICHERDZINSKI (August) and *Pergamasus suecicus* (TRÄGARDH) and *Rhodacarus reconditus* ATHIAS-HENRIOT in September and October, respectively. Unfortunately, there is not enough material to draw conclusions, whether these are typical spring-, summer- or autumn-species. To study seasonal dynamics, the three most abundant Gamasina species in *Pinaceum myrtilosum* were chosen (Fig. 3). The greatest amplitude of change of abundance was observed for *Veigaia nemorensis* (C. L. KOCH). It was characterised by great abundance of individuals in April and May diminishing rapidly until June. During the following months it gradually increased again and reached maximum in August-September. Similar dynamics were observed also with *Parazercon sarekensis*, but the amplitude of changes in this case was less pronounced. For *Prozercon kochi* SELLNICK the April peak was replaced by a decline in summer, a minimum in July and August and a modest peak in September. Thus the differences in the individual dynamics of the species really exist. Obviously they are related to the distinctive individual development of species as well as to their diverse demands for specific ecological conditions.

In the seasonal dynamics of the number of Gamasina species and the number of specimens we can observe some similarity (Fig. 4). In spring up to June the number of specimens as well as the number of species goes down under the influence of the previously mentioned soil ecological factors and reaches a minimum in June. At this time the environmental conditions for mites are comparatively unfavourable and the number of specimens is reduced.

Some species were not sampled because of their low density. During the following months conditions improved and the number of individuals and species increased to reach a maximum in August, and after that gradually declined.

The species diversity index is characterised by different dynamics. In April, May and July the number of species was at a middle value, but the number of individuals of several species showed essential differences. That is why the values of the Shannon index are minimal for these months. The number of Gamasina species was reduced to a minimum in June (at the expense of rare species), but the remaining ones had a similar number of specimens, and that is why the value of the diversity index was high in June. In turn, in August, both the large number of species and large and relatively similar number of specimens explains the maximum value of this index.

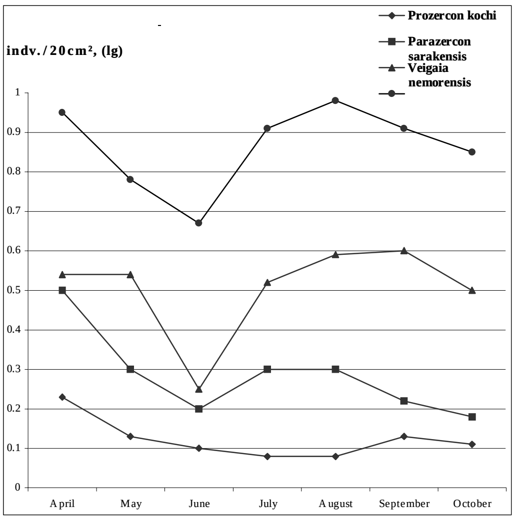


Fig. 3. Seasonal dynamics of Gamasina species.

In conclusion we can say that soil ecological factors have an influence on the seasonal dynamics of microarthropod groups, including Gamasina mites. The number of Gamasina individuals and species correlate with soil humidity and temperature. The same can be said about species diversity, which reaches a maximum in August and depends upon the seasonal dynamics of individual species. For the above reasons we can conlude that August is the optimum month for sampling soil Gamasina under the climatic conditions of Latvia.

As Gamasina mites are trophically connected with other previously-mentioned microarthropod groups, which are themselves limited by humidity and soil temperature, we may conclude that these factors influence Gamasina both directly and indirectly. Soil humidity must be recognised as a most important and limiting factor; if there is enough humidity, the decisive factor is soil temperature.

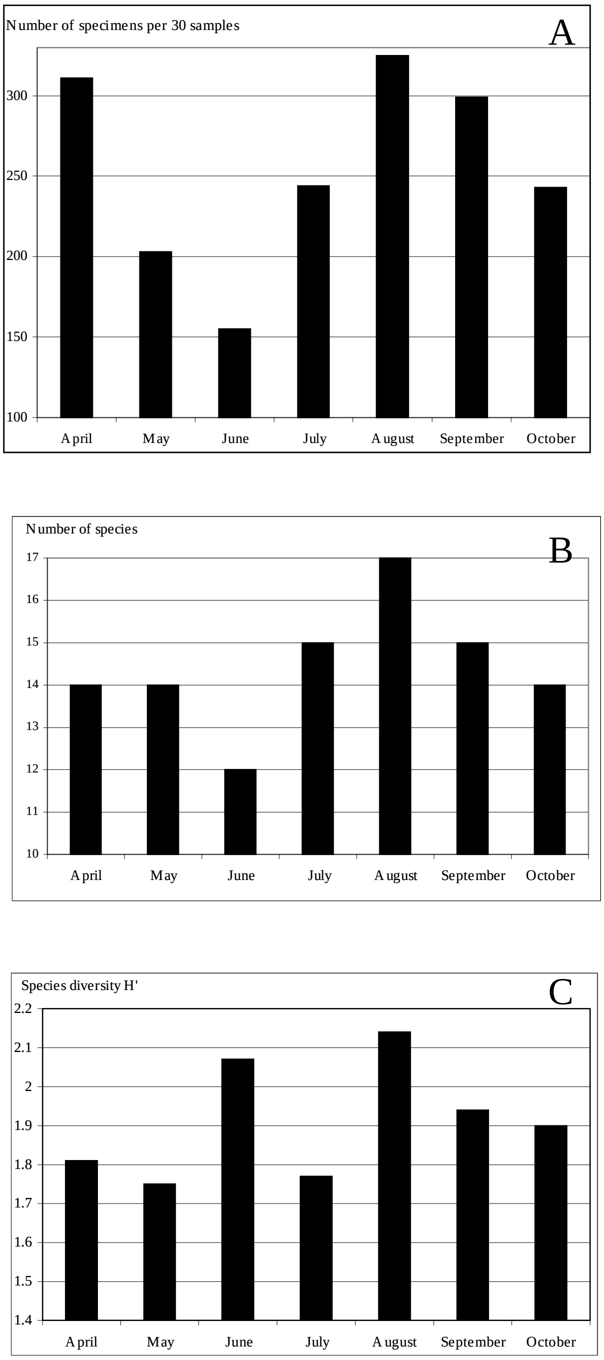


Fig. 4. Seasonal dynamics of the number of Gamasina individuals (A) and species (B) and species diversity (C).

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