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The population structure of *Gamasellus montanus* (Willmann, 1936) in three different forest groups in the Szczeliniec Wielki nature reserve

Jacek Kamczyc

Department of Forest and Environment Protection, August Cieszkowski Agricultural University, Poznań, Poland

Abstract

The present study was carried out on the plateau of the Szczeliniec Wielki nature reserve. The aim of this investigation was to describe the relationship between tree species and/or understorey types occuring on the organic soil and the population structure of *Gamasellus montanus* (Willmann, 1936). As a result of the investigation, 1216 specimens of *G. montanus* were found. It is concluded that tree species have no significant effect on the population structure of *G. montanus*. However, an influence of understorey species can be found. Specimens of *G. montanus* prefer the *Vaccinium vitis-idaea* microhabitat.

Keywords: mites, Mesostigmata, forest microhabitats

Zusammenfassung

Untersuchungen zur Populationsstruktur von *Gamasellus montanus* (Willmann, 1936) in drei verschiedenen Waldtypen im Naturreservat Szczeliniec Wielki – Die vorliegenden Untersuchungen wurden auf der Hochfläche des Naturreservates Szczelniec Wielki durchgeführt mit dem Ziel festzustellen, inwiefern eine Korrelation zwischen Baumarten und/ oder Unterwuchstypen und der Populationsstruktur von *Gamasellus montanus* (Willmann, 1936) besteht. Im Verlauf der Untersuchungen wurden 1216 Individuen von *G. montanus* gesammelt. Es wurde festgestellt, dass die jeweiligen Baumarten keine signifikante Auswirkung auf die Populationsstruktur von *G. montanus* haben. Der Unterwuchs ist jedoch von Bedeutung; *G. montanus* bevorzugte das *Vaccinium vitis-idaea* Mikrohabitat.

1. Introduction

Plants can differ in their effects on almost every aspect of ecosystem structure and function and are frequently associated with a specific suite of other organisms that play key roles in ecosystems (Eviner & Chapin III 2003). Forests in general have a greater influence on soil conditions than most of the other plant ecosystem types, e.g. by having a well-developed

O horizon as well as moderate temperature and humidity at the soil surface (Brüggemann et al. 2005). It has been reported that Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) Karst.) and silver birch (*Betula pendula* Roth) have differing influence on the microbial community in the rhizosphere within the organic soil (Priha et al. 1999). However, there is no information about the influence of understorey growth (especially on organic soil) on the mite communities and their populations.

The aim of this investigation was to describe the relationship between tree species and/or understorey types occuring on the organic soil and the population structure of common mite species. *Gamasellus montanus* (Willmann, 1936) was chosen for analysis due to its commonness in the mountain area and the abundance of specimens in samples. This species has been shown to occur in different types of forest, humus, litter, meadows, lichens, and grass roots (Karg 1971).

2. Materials and Methods

The study area was a plateau of the Szczeliniec Wielki nature reserve (located in the Stołowe Mountain National Park, Poland, SW) at an altitude of 900 m a.s.l. Sandstone with a thin layer of organic soil creates a reserve area. The annual average precipitation during the years 1979 – 1996 was 654 mm (meteorological station IMGW in Kudowa Zdrój), however, differences between years could reach around 400 mm (Nowicka 1998). Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) Karst.), common birch (*Betula pendula* Roth) form single-species, but uneven-aged biogroups of trees. Study areas were selected in which three types of understorey vegetation (*Vaccinium vitis-idaea*, *Vaccinium myrtillus* and Bryophyta sp.) within the abovementioned tree biogroups were found. Samples were collected from each group from June to August 2004 at 4-week intervals and gathered with a sampler (with an area of 40 cm^2) to a depth of 10 cm. Mites were extracted using Tullgren funnels and preserved in 75 % alcohol. For the purpose of maceration and microscopic inspection of the specimens, mites were selected and prepared in lactophenol. The pH of each soil sample wase measured with a pH-meter CP-104 (ELMETRON). All specimens of the order Mesostigmata were counted, however only the most numerous species (*Gamasellus montanus*) was analysed. The number of specimens was calculated per square metre of the investigated area. Statistical analyses were done with the ANOVA test (SAS 9.1.3 program).

3. Results

3883 specimens of Mesostigmata were found in 312 soil samples. Of these, 1216 specimens belonged to *Gamasellus montanus* (Willmann, 1936) (31 % of the total). All developmental stages were recorded. The most numerous developmental stage was the deutonymph (35 %). The abundance of *Gamasellus montanus* mites varied from 208 to 2749 of specimens per m^2.

The largest abundance of *Gamasellus montanus* specimens was recorded in June (1489 ± 142) and the lowest in July (593 ± 142) and the difference in the total number of specimens was significant between those months ($p < 0.01$) (Fig. 1). In the common birch biogroup the largest number of specimens (1215 ± 140) was found, the least number occurred in the Norway spruce biogroup (791 ± 139). The total number of specimens was significantly different between those two tree biogroups ($p < 0.05$) (Fig. 2). Significant differences ($p < 0.05$) were also shown between the total numbers of specimens (1226 ± 140 and 759 ± 139) in two types of understorey (*Vaccinium vitis-idaea* and *Vaccinium myrtillus*, respectively) (Fig. 3).

Juvenile specimens were numerous in June (1185 ± 111), this was significantly different ($p < 0.001$) from the number of juvenile specimens in July and August (471 ± 111 and 433 ± 111, respectively). No significant differences ($p > 0.05$) were found between the number of specimens and tree species. Juvenile specimens of *Gamasellus montanus* prefer the *Vaccinium vitis-idaea* microhabitat (881 ± 109), as shown by the understorey analysis.

Adult specimens were most numerous in August, which was significantly different ($p < 0.001$) from the number of specimens of this stage in July. Similar to the number of juvenile specimens, no significant differences were found between tree species and the number of adult specimens ($p > 0.05$). There were no significant differences in the number of adult specimens within the understorey types.

No significant differences were shown in the number of specimens in a given month and given biogroup with regard to the understorey type (Tab. 1). Differences were found only in June in the *Pinus sylvestris* biogroup between the number of juvenile as well as adult specimens in the *Vaccinium vitis-idaea* and the Bryophyta sp. understorey.

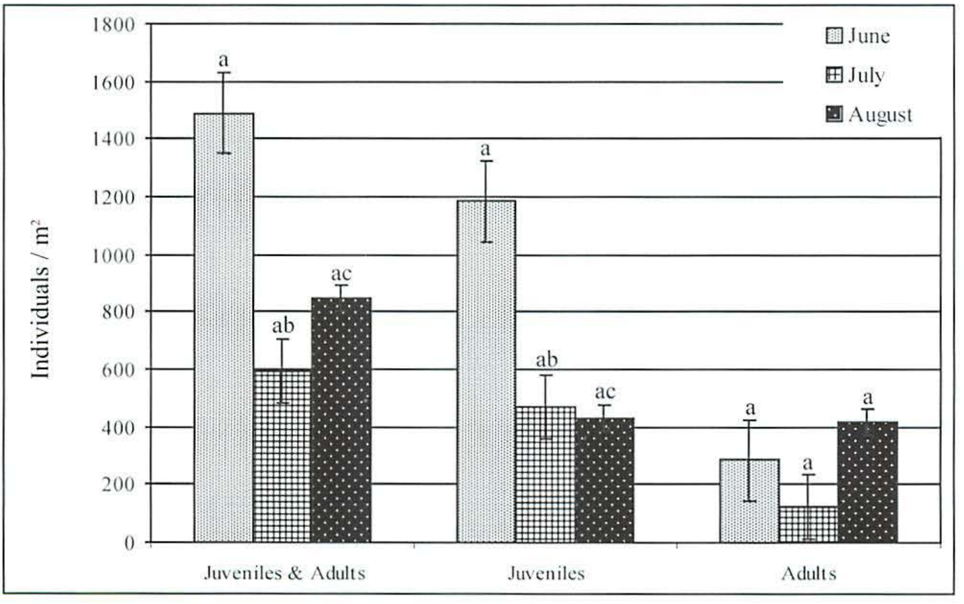

Fig. 1 Mean number of individuals per m² (± SEM) depending on the month. The mean showing significant differences between different months within the type of development stage are indicated by the same letter ($p < 0.05$).

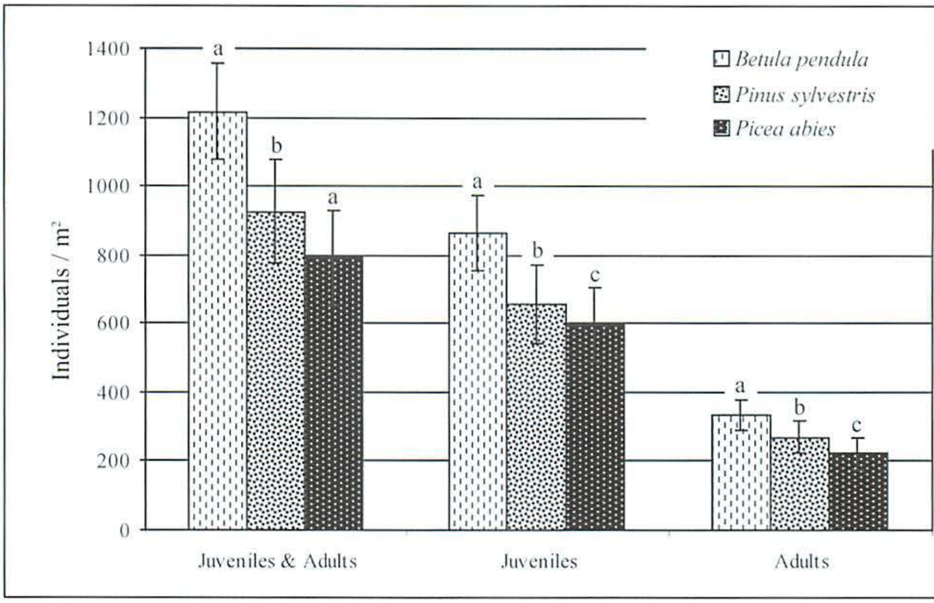

Fig. 2 Mean number of specimens per m² (± SEM) depending on the tree biogroup. The mean showing significant differences between different biogroups within the type of development stage is indicated by the same letter ($p < 0.05$).

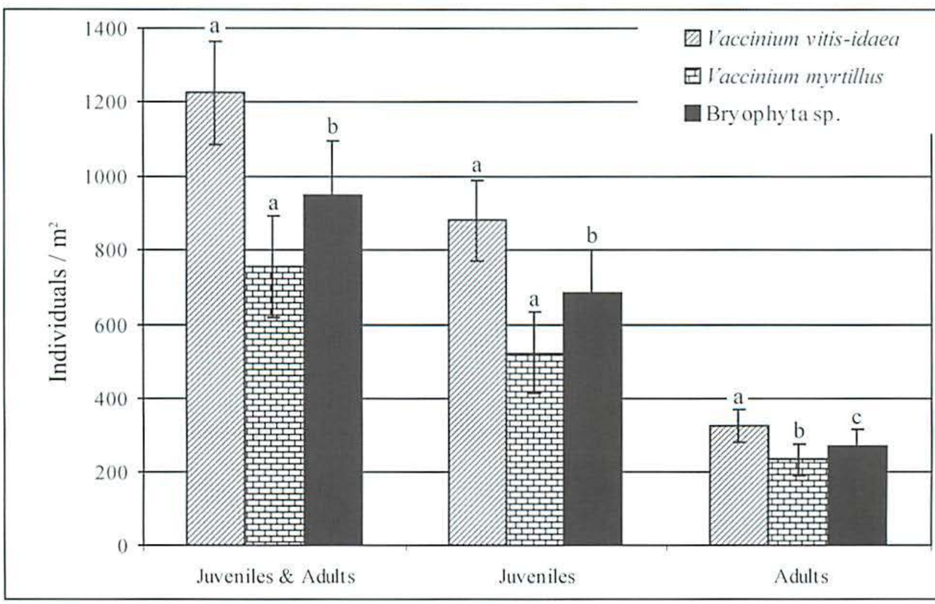

Fig. 3 Mean number of specimens per m² (± SEM) depending on the understorey species. The mean showing significant differences between different understorey species within the type of development stage is indicated by the same letter ($p < 0.05$).

Tab. 1 Mean number of specimens per m² (± SEM) depending on the tree and understorey species in each month. The symbol »*« shows significant differences ($p < 0.05$) between the number of specimens per m² and understorey species in a given month and tree biogroup.

Month	Tree species	Understorey species	Number of samples (n)	Juveniles		Adults	
				ind./ m²	± SEM	ind./ m²	± SEM
June	*Pinus sylvestris*	*Vaccinium vitis-idaea*	12	1437	479	354	105
		Vaccinium myrtillus	12	375	479	166	105
		Bryophyta sp.	8	375	587	156	128
	Picea abies	*Vaccinium vitis-idaea*	12	625	426	62	99
		Vaccinium myrtillus	12	708	426	166	99
		Bryophyta sp.	12	1229	426	270	99
	Betula pendula	*Vaccinium vitis-idaea*	12	2166	508	583	201
		Vaccinium myrtillus	12	1500	508	312	201
		Bryophyta sp.	12	2000	508	458	201
July	*Pinus sylvestris*	*Vaccinium vitis-idaea*	12	1312*	229	270*	68
		Vaccinium myrtillus	12	291	229	62	68
		Bryophyta sp.	8	125*	280	31*	68
	Picea abies	*Vaccinium vitis-idaea*	12	395	191	83	76
		Vaccinium myrtillus	12	583	191	125	76
		Bryophyta sp.	12	604	191	229	76
	Betula pendula	*Vaccinium vitis-idaea*	12	354	121	145	55
		Vaccinium myrtillus	12	125	121	83	55
		Bryophyta sp.	12	354	121	41	55
August	*Pinus sylvestris*	*Vaccinium vitis-idaea*	12	854	355	708	215
		Vaccinium myrtillus	12	562	355	375	215
		Bryophyta sp.	8	156	435	156	263
	Picea abies	*Vaccinium vitis-idaea*	12	187	101	270	109
		Vaccinium myrtillus	12	354	101	354	109
		Bryophyta sp.	12	437	101	437	109
	Betula pendula	*Vaccinium vitis-idaea*	12	604	147	458	176
		Vaccinium myrtillus	12	229	147	437	176
		Bryophyta sp.	12	437	147	479	176
Total number of samples (n)			312				

4. Discussion

The abundance of mites in the forestry area per m^2 depends on the type of forest and is connected with the humus type. In humid forests with the mor humus type 100 000 to almost a half million of these arthropods can be found. In the other types of forests numbers vary from several thousand to over one hundred thousand (Boczek & Błaszak 2005). In the present research, the maximum abundance of mesostigmatic mites was 8875 and that of *Gamasellus montanus* was 2750 specimens per square metre. Deposit thickness of organic soil (from 5 to 20 cm) on the Szczeliniec Wielki plateau can be a reason for the sparse number of individuals per square metre. According to Bedano et al. (2005), it can be due to the amount of organic material, soil humidity throughout the year, soil temperature with the high amplitude during the summer and also a pH close to neutral. It must be considered that the response of a species to the soil pH can change with changing environmental factors (Bedano et al. 2005).

However, initial measurements of the soil acidity showed no significant differences between the forest groups and their microhabitats, the pH was between 3.6 and 4.1.

The number of specimens in mite populations changes within the course of a year. According to Niedbała (1980) there are two peaks in the specimen numbers, one in spring (April/May) and the other in autumn (September/October). In this study, the first peak in the total number of specimens occurred in June. This is also shown by the number of juvenile specimens in June. It can be considered that the peak in the specimen number had shifted. It could be due to a long period of snow linger (up to the middle of May) on the Szczeliniec Wielki plateau.

The lowest humidity during the period of observation of forest litter was in July, which could account for that month having the lowest number of specimens of *Gamasellus montanus*. Boczek & Błaszak (2005) pointed out the mites' migration as a result of changes in environmental conditions. This can suggest that mites migrate to more stable microhabitats as, for example rock cracks (with high humidity and low but stable temperatures).

According to Priha et al. (1999), different tree species (*Betula pendula*, *Picea abies* and *Pinus sylvestris*) had a significant influence on soil microbes in the rhizospheres within the organic soil, but in those studies understorey influence had not been investigated. A significant effect of tree species on the number of *Gamasellus montanus* specimens was not shown in the present investigation. However, a significant ($p < 0.05$) effect between two microhabitats (*Vaccinium vitis-idaea* and Bryophyta sp.) and the total number of specimens as well as the number of juvenile specimens of *Gamasellus montanus* was found. Environmental preferences of adult specimens were not observed.

No significant differences were shown in the number of specimens in a given month and given biogroup with regard to the understorey type. Differences were found only in June in the Scots pine biogroup between the number of juvenile as well as the number of adult specimens in the *Vaccinium vitis-idaea* and the Bryophyta sp. understorey. This can be due to different reactions of understorey species to light conditions. The understorey in the biogroups of common birch and Norway spruce seems to be more shaded, because of the dense canopy layers.

In conclusion, the tree species has no significant effect on the population structure of *Gamasellus montanus*. However, influence of the understorey vegetation can be found. Specimens of *Gamasellus montanus* prefer the microhabitat of *Vaccinium vitis-idaea*.

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Author's address:

M. Sc. Jacek Kamczyc
Department of Forest and Environment Protection
August Cieszkowski Agricultural University
Wojska Polskiego 71c
60-625 Poznań; Poland
e-mail: jacek_kamczyc@tlen.pl