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FAUNA OF SOIL-DWELLING PREDATORY GAMASINA MITES (ACARI: MESOSTIGMATA) IN SEASHORE HABITATS OF THE KURZEME COAST, LATVIA

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Abstract

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Because of the lack of data on the Gamasina mite fauna in coastal habitats of Latvia, sampling was made on the seashore of the Kurzeme Coast. An unexpectedly high total number (78) of Gamasina species was recorded. Twenty-three species were found to be new for Latvia. A previously undescribed species (new to Science) from the genus *Lasioseius* was recorded from the yellow dunes. *Leioseius bicolor, Leioseius halophilus* and *Parasitus halophilus* were recorded as the most widely distributed Gamasina species along the Kurzeme Coast.
Driftline, primary and yellow dune Gamasina faunas were investigated separately. Fourteen Gamasina species were found to be common to all three habitats. Driftline habitats were the most diverse with 55 species. Twenty-two species were recorded from the primary dunes and 50 species from the yellow dunes.
Comparison of Gamasina fauna along the coasts of the Baltic Sea and the Riga Gulf of the Kurzeme was made. Fifty species from coastal habitats of the Riga Gulf Coast and 55 from the Baltic Sea Coast were recorded. Twenty-seven Gamasina species were recorded as common for both sites, but 24 species for the Riga Gulf Coast and 29 for the Baltic Sea Coast were unique for their respective habitats.

Introduction

Seashore ecosystems vary in terms of ecological conditions and biological diversity, and can be characterised by an interaction between geomorphological and biological processes (JUNGERIUS, 1985). Biological processes in coastal habitats are complicated and the role of the soil fauna in them is important (MALLOW et al., 1984). Protozoa and Nematoda are

attracted to the active rhizosphere and may feed on bacteria, as well as on living and dead plant material and soil algae and fungi. Collembola - bacterial and fungal grazers, and Gamasina mites as predators of Collembola, other soil dwelling mites, Nematoda, Insecta larvae etc. may control this system (KOEHLER et al., 1992). This complicated system is very important for soil processes generally, but for seashore habitats in particular. Unfortunately, little is known about the soil fauna in coastal habitats of Latvia and few data are available concerning the soil Gamasina mites that live there.

The fauna of soil Gamasina mites of seashore ecosystems in Latvia is poorly investigated. Some sampling was carried out by Kadite (Lithuania). She described 35 Gamasina species from various seashore habitats (EITMINAVICHUTE, 1976). Some case studies along the seacoast of Latvia have been made by the author of the present article (MELECIS et al., 1994; SALMANE, 1996; PAULINA et al., 1999), the results of which stimulated the need for the sampling reported here, with the aim of obtaining a closer insight into the Gamasina fauna of the seashore habitats of Latvia.

Study Area

A total of 8 sampling sites were selected along the seacoast of the Kurzeme (Engure (23°15'/57°10'), Roja (22°45'/57°30'), Kolkasrags (22°30'/57°40'), Luzna (21°55'/57°35'), Ventspils (21°30'/57°25'), Pavilosta (21°15'/56°55'), Liepaja (21°0'/56°30') and Pape (21°5'/56°15') in the driftline, primary and yellow dunes.

The driftline habitats were characterised mostly by fine sand and material washed ashore, including algae and other jetsam deposited by the sea. Organic debris deposited by the sea was the main nutrient source here. *Cakile maritima, Chenopodium rubrum* or *Salsola calii* represented the vegetation in a few cases. The primary dunes were characterised by fine to medium sandy soils with minimal content of organics in the soil. Single *Calamophila baltica, Ammodenia peploides, Amophila arenaria, Leymus arenarius, Festuca arenaria* and *Juncus balticus* represented the vegetation here. The yellow dunes were characterised by medium sandy soils with a relatively high content of organics and more abundant vegetation represented by *Calamophila baltica, Amophila arenaria, Festuca arenaria, Hieracium umbellatum, Carex arenarius, Ammodenia pepoloides, Anthyllis maritima, Lathyrus japonicus* and *Salix* sp.

Material and methods

We focused on qualitative sampling to investigate the spectrum of Gamasina species. The sampling was performed in 8 sites along the Kurzeme Coast (Western part of Latvia), which includes the western part of the Riga Gulf Coast and the western part of the Latvian sea coast washed by the Baltic Sea. Three sampling sites in Riga Gulf Coast of the Kurzeme Coast and 5 at Baltic Sea Coast were chosen. At each site sampling was carried out by hand or by using a soil corer (23cm˛ x 10cm). A single sample included approximately 300-400 g of

substrate. Altogether 120 soil samples were taken from the organic debris of the driftline or the rhizosphere of plants in primary and yellow dunes. The collected material was taken to the laboratory in plastic bags.

Extraction was carried out using Tullgren funnels, where samples were exposed for a period of 14 days. Determination and nomenclature of Gamasina species are based upon the keys of BREGETOVA (1977), HIRSHMANN (1971), KARG (1993), KOLODOCHKA (1978) and LAPINA (1976 a, b). The quantitative comparison of Gamasina mites among sampling sites was not possible because of the unequal number of samples taken.

Results

Seventy-eight Gamasina species were recorded in the collected material, 23 of which were found for the first time in the fauna of Latvia (Table 1). One, previously undescribed species (new to Science) from the genus *Lasioseius* was found. *Leioseius bicolor* (BERLESE) (8 sampling sites), *L. halophilus* (WILLMANN) and *Parasitus halophilus* (SELLNICK) (7) and *Thinoseius spinosus* (WILLMANN) and *Leioseius insignis* HIRSCHMANN (6) were the most widely distributed species in the seashore habitats of the Kurzeme Coast (Table 2).

Comparison of Gamasina mites' fauna among the habitats was made and 14 species were revealed as common for all habitats (Table 1). Species found there were mainly ubiquitous, forest and seashore inhabitants. The driftline communities were found to be the most diverse with 55 species, 22 of which differed from the dune fauna. At the dune habitats 22 and 50 species in primary and yellow dunes, respectively, were recorded.

Fourteen species were common for all three investigated habitat types, 3 species common for driftline and primary dune, 15 species for driftline and yellow dune. Three Gamasina species were common for both primary and yellow dunes. Forty-three species were recorded only in one habitat type. Twenty-two of them were found as typical only for the driftline, 2 species for the primary and 18 species for the yellow dune habitats.

Comparison between the fauna of Gamasina mites of the Baltic Sea Coast and Riga Gulf Coast of Kurzeme was made. In these two sites 55 and 50 species, respectively, could be determined. About 1/3 of them was common for both sites, but the rest of the species were unique for one of the sites.

Discussion

Fifty-five Gamasina were recorded in the driftline habitats and the most abundant species there found were those with demands for wet soils with a high amount of organic material. Several species (*Parasitus kempersi* OUDEMANSI, *Halolaelaps balticus* WILLMANN, *H. incisus* HYATT, *Thinoseius spinosus*), known as common driftline inhabitants (KARG, 1993), were found in high numbers in the material washed ashore. Also some hygrophilous Gamasina (*Gamasolaelaps excisus* (C. L. KOCH), *Neojordensia levis* (OUDEMANS ET VOIGTS), *Cheiroseius necorniger* (OUDEMANS) and *Hypoaspis vacua* (MICHAEL)), and species from the genus *Macrocheles*, preferring habitats with high organic content, were numerous there.

T a b l e 1. Occurrence of Gamasina species on the seashore of the Kurzeme Coast. (* - species recorded for the first time in Latvia).

Gamasina (Acari)	Driftline	Primary dune	Yellow dune
Parasitus halophilus (SELL.)*	x	x	x
Holoparasitus excipuliger (BERL.)	x	x	x
Pergamasus vagabundus KARG	x	x	x
Veigaia nemorensis (C. L. K.)	x	x	x
Leioseius bicolor (BERL.)	x	x	x
Leioseius halophilus (WILL.)	x	x	x
Leioseius insignis HIRS.*	x	x	x
Amblyseius marinus (WILL.)*	x	x	x
Amblyseius agrestis (KARG)*	x	x	x
Dendrolaelaps nostricornutus HIRS. ET WISN.*	x	x	x
Asca bicornis (CANE. ET FANZ.)	x	x	x
Halolaelaps balticus WILL.*	x	x	x
Thinoseius spinosus (WILL.)*	x	x	x
Parazercon sarekensis WILL.	x	x	x
Veigaia cervus (KRAM.)	x	x	
Macrocheles glaber (MULL.)	x	x	
Prozercon trägardhi (HALB.)	x	x	
Parasitus kempersi OUDE.*	x		x
Pergamasus crassipes (L.)	x		x
Pergamasus septentrionalis (OUDE.)	x		x
Leioseius minutus (HALB.)	x		x
Pergamasus teutonicus WILL.	x		x
Pergamasus wasmanni (OUDE.)	x		x
Amblyseius bicaudus WAIN.	x		x
Amblyseius messor WAIN.	x		x
*Amblyseius meridionalis (*BERL.)	x		x
Dendrolaelaps foveolatus LEIT.	x		x
Macrocheles tardus (C. L. K.)	x		x
Hypoaspis aculeifer (CANE.)	x		x
Hypoaspis praesternalis WILL.	x		x
Hypoaspis vacua (MICH.)	x		x
Zercon carpathicus (SELL.)	x		x
Parasitus kraepelini BERL.	x		
Parasitus lunaris BERL.	x		
Parasitus fimetorum BERL.	x		
Pergamasus truncus SCHW.*	x		
Gamasodes bispinosus (HALB.)*	x		
Pergamasus lapponicus TRAG.	x		
Veigaia exigua (BERL.)	x		
Gamasolaelaps excisus (C. L. K.)*	x		
Neojordensia levis (OUDE. ET VOIG.)	x		

The high abundance of these species could be explained by the presence of very favourable ecological conditions. Driftline habitats are rich in the organic material (nutrients) deposited by the sea and, thus, the most favourable environmental conditions for various invertebrates, on which Gamasina are known to prey (COLEMAN, CROSSLEY, 1996; PUGH, 1985), were formed. Fresh organic material attracts various Insecta, which feed and lay eggs there. Their eggs, larvae and some specialised driftline Collembola species and other small adult Insecta form the main food source for predatory Gamasina mites. Useful food for Gamasina is also other soil mite groups, Polychaeta, Nematoda and Enchytraeidae, dwelling in the material washed ashore. These favourable ecological conditions for Gamasina mites enables them to achieve a high abundance in the driftline.

Favourable conditions determine the ex-

istence of many Gamasina species, which are not typical driftline inhabitants. Other groups recorded in the driftline comprised species characteristic mainly of various inland ecosystems (e.g. some ubiquitous species (*Pergamasus vagabundus* KARG, *Holoparasitus excipuliger* (BERLESE) and *Veigaia nemorensis* (C. L. KOCH)*)*, forest species (*Pergamasus lapponicus* TRAGARDH, *Pergamasus crassipes* (LINNAEUS), *P. wasmanni* (OUDEMANS), *Hypoaspis aculeifer* (CANESTRINI) and *Parazercon sarekensis* WILLMANN*)* and inland meadow species (*Cheiroseius borealis* (BERLESE), *Leioseius minutus* (HALBERT), *Asca bicornis* (CANESTRINI ET FANZAGO), *Hypoaspis praesternalis* WILLMANN, *H. vacua, Veigaia exigua* (BERLESE)). Some common dune inhabitants (*Leioseius bicolor, Parasitus halophilus)* were also recorded in the material from the driftline. Species of this group were not as numerous as the above-mentioned typical driftline inhabitants.

Table 1.

Gamasina (Acari)	**Driftline**	**Primary dune**	**Yellow dune**
Cheiroseius borealis (BERL.)	x		
Cheiroseius necorniger (OUDE.)	x		
Amblyseius obtusus (C. L. K.)	x		
Amblyseius herbarius WAIN.	x		
Dendrolaelaps latior (LEIT.)*	x		
Dendrolaelaps fallax (LEIT.)	x		
Halolaelaps incisus HYATT*	x		
Halolaelaps marinus (BRADY)*	x		
Macrocheles montanus (WILL.)	x		
Alliphis siculus (OUDE.)	x		
Eviphis ostrinus (C. L. K.)	x		
Prozercon sellnicki HALA.	x		
Zercon montanus WILL.	x		
Zercon fageticola HALA.*	x		
Rhodacarellus silesiacus WILL.		x	x
Rhodacarus reconditus ATHIAS-H.		x	x
Dendrolaelaps arenarius KARG*		x	x
Zercon zelawaiensis SELL.		x	
Leioseius montanulus HIRS.		x	
Lasioseius sp. nov.			x
Hypoaspis claviger (BERL.)			x
Hypoaspis sclerotarsa COSTA*			x
Hypoaspis similisetae KARG*			x
Hypoaspis kargi COSTA			x
Laelaspis astronomicus L. K.			x
Zercon spatulatus (C. L. K.)			x
Leioseius minusculus (BERL.)			x
Platyseius italicus (BERL.)			x
Antenoseius delicatus BERL.			x
Amblyseius aurescens ATHIAS-H.			x
Amblyseius andersoni (CHANT)			x
Amblyseius bakeri (GARM.)			x
Amblyseius graminis CHANT			x
Rhodacarus mandibularis BERL.*			x
Rhodacarus haarlovi SHCH.*			x
Minirhodacarellus minimus (KRAG)*			x
Dendrolaelaspis angulosus WILL.*			x
Totally 78 species	**55**	**22**	**50**

Fifteen species were recorded as common for the driftline and yellow dunes, and this could be explained by the relatively high organic matter content in the soils of yellow dunes. In turn, the driftline and primary dunes have only 3 common Gamasina species because of the totally different ecological conditions for soil animals.

T a b l e 2. Distribution of Gamasina species in the seashore habitats of the Kurzeme Coast. Sampling sites: 1-Engure, 2- Roja, 3- Kolkasrags, 4- Lūžņa, 5- Ventspils, 6- Pāvilosta, 7- Liepāja, 8- Pape. Nr- number of sampling sites where the respective species occur.

	Riga Gulf			Baltic Sea					Nr
Gamasina species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Leioseius bicolor (BERL.)	x	x	x	x	x	x	x	x	8
Parasitus halophilus (SELL.)	x	x	x	x	x	x	x		7
Leioseius halophilus (WILL.)	x	x	x	x	x	x	x		7
Thinoseius spinosus (WILL.)	x		x	x	x	x	x		6
Leioseius insignis HIRS.		x	x	x	x	x	x		6
Hypoaspis aculeifer (CANE.)	x			x	x	x		x	5
Halolaelaps balticus WILL.	x		x		x	x	x		5
Dendrolaelaps nostricornutus HIRS. ET WISN.		x	x	x		x	x		5
Cheiroseius necorniger (OUDE.)	x	x	x			x			4
Amblyseius marinus (WILL.)		x	x	x	x				4
Veigaia nemorensis (C. L. K.)	x			x			x	x	4
Pergamasus crassipes (L.)	x			x			x		3
Pergamasus vagabundus KARG	x			x	x				3
Amblyseius bicaudus WAIN.		x			x	x			3
Hypoaspis vacua (MICH.)		x					x	x	3
Parazercon sarekensis WILL.	x			x			x		3
Halolaelaps incisus HYATT	x		x			x			3
Pergamasus lapponicus TRAG.	x							x	2
Leioseius minutus (HALB.)	x						x		2
Rhodacarellus silesiacus WILL.		x					x		2
Rhodacarus mandibularis BERL.			x				x		2
Rhodacarus reconditus ATHIAS-H.		x			x				2
Macrocheles tardus (C. L. K.)	x			x					2
Asca bicornis (CANE. ET FANZ.)			x				x		2
Hypoaspis praesternalis WILL.			x				x		2
Hypoaspis sclerotarsa COSTA		x		x					2
Zercon spatulatus (C. L. K.)			x				x		2
Macrocheles glaber (MULL.)	x		x						2
Prozercon trägardhi (HALB.)	x	x							2
Lasioseius sp.nov.			x						1
Parasitus kraepelini BERL.	x								1
Parasitus lunaris BERL.	x								1
Parasitus fimetorum BERL.	x								1
Pergamasus truncus SCHW.	x								1
Gamasodes bispinosus (HALB.)		x							1
Veigaia exigua (BERL.)	x								1
Gamasolaelaps excisus (C. L. K.)	x								1
Neojordensia levis (OUDE. ET VOIG.)	x								1
Cheiroseius borealis (BERL.)	x								1

Table 2.

Gamasina species	Riga Gulf 1	2	3	Baltic Sea 4	5	6	7	8	Nr
Amblyseius agrestis (KARG)			x						1
Amblyseius bakeri (GARM.)		x							1
Amblyseius graminis CHANT			x						1
Dendrolaelaspis angulosus WILL.		x							1
Dendrolaelaps latior (LEIT.)	x								1
Dendrolaelaps fallax (LEIT.)		x							1
Macrocheles montanus (WILL.)	x								1
Alliphis siculus (OUDE.)	x								1
Eviphis ostrinus (C. L. K.)	x								1
Prozercon sellnicki HALA.	x								1
Zercon montanus WILL.	x								1
Rhodacarus haarlovi SHCH.				x	x	x	x		4
Minirhodacarellus minimus (KRAG)				x	x	x	x		4
Holoparasitus excipuliger (BERL.)				x			x	x	3
Dendrolaelaps arenarius KARG					x	x	x		3
Parasitus kempersi OUDE.					x	x			2
Pergamasus septentrionalis (OUDE.)				x				x	2
Pergamasus teutonicus WILL.							x	x	2
Pergamasus wasmanni (OUDE.)							x	x	2
Amblyseius messor WAIN.							x	x	2
Amblyseius meridionalis (BERL.)							x	x	2
Dendrolaelaps foveolatus LEIT.							x	x	2
Zercon carpathicus (SELL.)							x	x	2
Veigaia cervus (KRAM.)								x	1
Leioseius minusculus (BERL.)							x		1
Leioseius montanulus HIRS.							x		1
Platyseius italicus (BERL.)				x					1
Antenoseius delicatus BERL.							x		1
Amblyseius obtusus (C. L. K.)								x	1
Amblyseius aurescens ATHIAS-H.							x		1
Amblyseius andersoni (CHANT)							x		1
Amblyseius herbarius WAIN.								x	1
Halolaelaps marinus (BRADY)						x			1
Hypoaspis claviger (BERL.)							x		1
Hypoaspis similisetae KARG				x					1
Hypoaspis kargi COSTA						x			1
Laelaspis astronomicus L. K.							x		1
Zercon zelawaiensis SELL.				x					1
Zercon fageticola HALA.								x	1
In total 78 species		**50**				**55**			

Gamasina species in dune habitats, in comparison with driftline habitats, were not so abundant, with the exception of two species (*Minirhodacarellus minimus* (KRAG) and *Dendrolaelaps arenarius* KARG*)*. Gamasina species occurring in the dune habitats were rather different from those in the driftline habitats. That is not surprising, if we take into account the different ecological conditions there. The impact of the sea decreases roughly in an inland direction, which leads to the absence of organic material deposited by the sea in the dune habitats. Vegetation in the primary dunes was poorly represented, on the whole only single plants were found and there were few places where they formed small communities. Thus vegetation is the main factor, which determines the organic matter content in the soil (JUNGERIUS, 1990). The production of organics in the soil is relatively slow and the primary dunes are poor in nutrients. As known from the literature (ANDRÉ et al., 1994), the dispersion of Gamasina in sandy habitats shows aggregation to the rhizosphere of plants, and the density of individuals in bare sand is very low. As is clear from Table 1, the fauna of the primary dunes was poor. The number of species recorded in the primary dunes was the lowest among the habitats investigated. The species *Rhodacarus reconditus* ATHIAS-HENRIOT, found there, is known as being characteristic for the pioneer stage of succession (CHRISTIAN, 1995). This gives evidence of the initiation of soil-forming processes there.

In the dunes occur species like *Leioseius bicolor*, *Dendrolaelaps arenarius* and plant inhabitants from the genus *Amblyseius*, which are more or less adapted to the dry soil conditions with low organic matter content. However, there are also species common for variable habitats like the ubiquitous Gamasina species (*Holoparasitus excipuliger, Rhodacarellus silesiacus* WILMANN, *Veigaia nemorensis* and *Pergamasus vagabundus)*; species inhabiting various agroecosystems (*Rhodacarus mandibularis* BERLESE*, R. haarlovi* SHCHERBAK, *R. reconditus);* forest species (*Pergamasus crassipes, P. wasmanni, Hypoaspis aculeifer* and *Parazercon sarekensis)* and meadow species (*Hypoaspis vacua, H. praesternalis* and *Dendrolaelaps angulosus* WILMANN).

Twenty-three species were found as typical only for the primary and yellow dunes (Table 1). The difference in species composition between the primary and yellow dune fauna is obvious. Twenty-two species were found in the primary dunes, most of them common also to the driftline or yellow dune fauna. Two species were found to be common only to the primary dunes. From the yellow dunes a total of 50 Gamasina species were collected, 18 of which were recorded only there.

The great differences between the fauna of the primary and yellow dunes can be explained by variability of the ecological conditions. At the yellow dunes more abundant vegetation was found, which explains the formation of a larger amount of organic material in the soil. That, in turn, creates favourable environmental conditions for Gamasina mites and the number of species recorded was almost as high as in the driftline. The very high abundances of microarthropods in yellow dunes were also found by KOEHLER et al. (1992).

Comparison between the fauna of Gamasina mites of the Baltic Sea Coast and Riga Gulf Coast of Kurzeme was made. In these two sites 55 and 50 species, respectively, were recorded (Table 2). About 1/3 of Gamasina species were found to be common to both sites. The rest of the species were found only in one of the Kurzeme Coast sites. The

Baltic Sea Coast and Riga Gulf Coast of Kurzeme had 28 and 22 species, respectively. Some species, such as *Rhodacarus haarlovi* and *Minirhodacarellus minimus*, occurred in 4 sampling sites in the yellow dunes, *Dendrolaelaps arenarius* in 3 sampling sites it the primary and yellow dunes of the Baltic Sea Coast, and they could be considered as characteristic for the Baltic Sea Coast of Latvia. *Holoparasitus excipuliger* is known as ubiquitous in the fauna of Latvia. The rest of the species do not have a wide range of distribution (Table 2).

The species in the material from the Riga Gulf Coast of the Kurzeme were rather rare and could be found in one sampling site only, with the exception of *Macrocheles glaber* (MULLER) and *Prozercon trägardhi* (HALBERT), which were recorded in 2 sampling sites.

The differences between the Riga Gulf Coast and the Baltic Sea Coast of the Kurzeme could be explained by the differing ecological conditions, which are more severe in the Baltic Sea Coast habitats. They are swept by the prevailing West winds and are more exposed to sea floods, which leads to more dynamic soils with a less stable organic content and a higher salt content. The Riga Gulf Coast climate is milder. There are fewer strong storms, the water temperature is higher, and the salt content of the water is lower, and the West winds are not so strong there. Because of such differences, the diversity of Gamasina mites in both sides of the Kurzeme Coast differs greatly. Species occurring only on one of these Coasts have selected the most favourable habitats for them.

Data from the previously poorly investigated Coast of Latvia provides an explanation for such a large number (23) of new species. Thirteen new species from the family Rhodacaridae were recorded, because of the weak investigation of this family in Latvia so far. The rest of the new species were common seashore inhabitants, such as *Parasitus halophilus* and *Parasitus kempersi*, or species typical of various habitats. A new *Lasioseius sp*. was found only in one sampling site of Kolkasrags in the yellow dunes and its distribution is currently unknown.

Leioseius bicolor can be considered as the most widely distributed Gamasina mite species in the Kurzeme Coast habitats (Tables 1, 2). It was found in all the investigated habitats and sampling sites. *Leioseius halophilus* and *Parasitus halophilus* and *Thinoseius spinosus* and *Leioseius insignis* were found in all habitat types and in 7 and 6 sampling sites, respectively. The rest of the species were found in less than 6 sampling sites.

The highest numbers of Gamasina mites were found in the habitats with well-aerated and humus-enriched soils, but dry and sandy habitats had a smaller number of species. The most numerous species were those characteristic of specific habitats, but also a high number of various species known to be common in inland ecosystems was recorded.

Thus this investigation gives an insight into the diverse groups of Gamasina mites inhabiting coastal ecosystems and shows the great value of the biological diversity of soil fauna of the seashore habitats in Latvia.

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