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Soil free-living predatory Gamasina mites (Acari, Mesostigmata) from the coastal meadows of Riga Gulf, Latvia

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Abstract

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The present article discusses the results of investigations of soil predatory Gamasina mite fauna in coastal meadows in Latvia. In total, 91 soil samples were collected for qualitative investigations in three habitat types: hygro-mesophytic, xerophytic and driftline habitats. Eighty-five species were recorded in the collected material. Five of them were rare and 16 were found for the first time in fauna of Latvia. Selected habitats showed high diversity of Gamasina mites, including about 1/3 of all species known in Latvia. Hygro-mesophytic habitats supported 62 Gamasina species, xerophytic – 46 species and driftline – 40 species. The high diversity of Gamasina fauna can be explained by microhabitat heterogenity in relatively small areas. Comparison with inland meadows was made. About 1/3 of species were found in both coastal and inland meadows, but they differed by the structure of dominance.

Key words: Gamasina mites, coastal meadows, species diversity

Introduction

Coastal meadows are one of the most specific ecosystems in Latvia with highly diverse habitats. These meadows are included in protected nature reserves: Lake Engure Nature Park (Western part of the Riga Gulf) and Randu Meadows Nature Reserve (Eastern part of the Riga Gulf), included in the North Vidzeme Biosphere reserve). Many botanical and ornithological investigations have been made in these reserves, which reveal a lot of new and rare species for flora and fauna of Latvia (Gemste et al, 1991; Vīksne, 1994, 1997).

However, data on the insect fauna are fragmentary (Spuris, 1966; Elberg, 1968; Rēdliha, 1968; Grīnbergs, 1976; Eitminavichute *et. al*., 1976; Kuznetzova, 1987), including several studies on soil dwelling Gamasina mites in coastal meadows of Latvia (Eitminavichute et. al., 1976; Pauliņa, Salmane, 1996; Salmane et. al., 1999; Pauliņa, Salmane, 1999).

Soil dwelling Gamasina mites are an important group of soil mesofauna showing wide distribution, high abundance and species diversity. Most of the species are predators, so

playing role of regulators of some other soil fauna (saprofagous, micofagous, detritofagous), such as springtails (Collembola), soil dwelling mites, larvae and eggs of Insecta, Nematoda, Enchytraeidae etc. (Coleman, Crossley, 1996; Karg, 1961; Sardar, Murphy, 1987). In such way, predatory Gamasina indirectly affecting decomposition of organic matter, nutrient cycling and formation of mycorrhiza, thereby being an important factor in soil formation and sandy dune stabilisation processes (Koehler et. al., 1995).

The aim of our investigation was to get closer insight in the fauna of Gamasina mites in the coastal meadows of the Lake Engure Nature reserve and the Randu Meadows Nature Reserve.

Material and Methods

Site description

The North East Coast of the Riga Gulf is known for the unique Randu Meadows Nature Reserve, which occupies 198.2 ha of a 100-300 m wide band of coastal meadows, stretching South from Estonian border to Kuiviži in Latvia. Geologically, this area began to develop in the postglacial period, when the Earth crust rose and the sea gradually stepped back. Soils have been formed for thousands of years under the strong impact of coastal processes, interacting with human influence (cattle grazing and hay making). During the recent years, the intensity of human impact has decreased, and that, seems to be, one of the main reasons, why the meadows are gradually overgrowing by common reeds and shrubs. The soil moisture conditions in the Randu Meadows depending on changes of sea water level. The flooding of meadows is more intensive in the heavy rain and storm periods. Habitats are variable including local depressions, lagoons and man-made ditches, interspersed with dryer elevations. Soils are composed by fine sands and gravel to boulders, and are classified as seaside sandy marsh soils (Krūmiņš, 1951). The diversity of vegetation is very high, with many rare and endangered species (Gemste et. al., 1991).

The Lake Engure Nature Park is located on the opposite Western coast of the Riga Gulf, which is included in the list of Wetlands of International Importance (Ramsar Convention) since 1995. The Lake Engure area is rich in valuable terrestrial and wetland biotopes. The coastal meadows (about 30 m wide, approximately 1 km long) are situated close the Mērsrags Channel connecting Lake Engure with the Riga Gulf.

The habitat structure is quite similar in both investigation sites. Growths of common reeds (*Phragmites australis*) often separate the coastal meadows from the sea and gradually stepping into the meadows. This zone is flooded by sea usually. Habitats close to it are mostly hygro-mesophytic meadows and characterized by rather high moisture and organic matter content in the soil. In the direction to inland little uplifts have been formed, where xerophytic meadows situated.

There are also several locations, where meadows are not separated by common reeds and coming close to the sea. In some cases, primary dunes separate meadows from the sea. These sites are rich in washed ashore material (seaweeds and other jetsam deposit by the sea).

Sampling sites classified by moisture conditions in three categories: hygro-mesophytic habitats (meadows on rather wet, rich in organic material soils with dominating vegetation *Carex sp., Filipendula ulmaria, Sesleria coerulae, Dactylis glomerata, Festuca rubra, Galium sp., Trifolium* sp.), xerophytic habitats (dunes and xerophytic meadows on dry podzolic sandy or gravel soils with dominating vegetation *Calamophila baltica, Amophila arenaria, Festuca arenaria, Leymus arenarius, Festuca ovina, Carex sp.*) and driftline (washed ashore material).

Sampling and processing of the material

Sampling was performed in the summers 1994, 1997 and 1998. In total, 81 soil samples from Randu Meadows Nature Reserve and 10 samples from coastal meadows from the Lake Engure Nature Park were collected. We focused on qualitative sampling to investigate the spectrum of Gamasina species.

Soil samples were collected by hand or by using a soil corer (23cm x 10cm). One sample included approximately 300-400 g of substrate. Samples were taken from organic debris of driftline or from the rhizosphere of various plants in the meadows and primary dunes. Altogether, 15 soil samples from the driftline, 30 from the xerophytic meadows and 46 from the hygro-mesophytic meadows were taken. The collected material was brought to the laboratory in plastic bags.

Extraction of soil fauna was made on Tullgren funnels during period of 10 days. To avoid sand falling into the collecting vessels, each sample was placed on a layer of fine medical gauze. After samples were sorted, specimens were mounted in Fora – Berlese media and dried at 50 ° C.

Determination and nomenclature of Gamasina species are based upon to the keys of Bregetova (1977), Hirshmann (1960), Karg (1993), Kolodochka (1978), Lapiņa (1976 a, b) and Shcherbak (1980). Data on species ecology mainly from Lapiņa (1988) and Karg (1993), as well as Bregetova (1977) and Shcherbak (1980) were used.

Results

Species composition

More than 1500 specimens from eighty-five species were identified (tab. 1). Nymphs of the different age were not taken into account because of difficulties in identification to species level.

Five rare (*Pergamasus septentrionalis, Antennoseius borrusicus, A. delicatus, Leioseius halophilus* and *Epicriopsis horridus*) and 16 new species (*Parasitus kempersi, Pergamasus truncus, Gamasolaelaps excisus, Ameroseius insignis, Cheiroseius viduus, Ch. unguiculatus, Rhodacarus clavulatus, Rhodacarus mandibularis, Rhodacarellus silesiacus, Dendrolaelaps latior, D. stammeri, D. cornutus, D. tenuipilus, Dendrolaelaspis angulosus, Halolaelaps communis* and *Pachylaelaps magnus*) were recorded.

Table 1.
Occurance of Gamasina mites in coastal meadows of Latvia

Division of habitats: HM - hygro-mesophytic, X - xerophytic, D - driftline. Remarks on Gamasina ecology (mentioned the most typical habitats): A - agrocenoses, B - bird nests, C - rotting substrates, F - forests, H - humus, L - litter, P - plants, M - inland meadows, S - seashore habitats, T - under the bark of trees, W - driftline(washed ashore material), U - ubiquitous species, hy - hygrophylous species. * - new species for fauna of Latvia.

Species	Ecology	Habitat type		
		HM	X	D
Parasitus fimetorum Berlese, 1903	A	x	x	x
Holoparasitus excipuliger (Berlese,1905)	U	x	x	x
Pergamasus vagabundus Karg,1968	F	x	x	x
Pergamasus lapponicus Tragardh,1910	F	x	x	x
Veigaia nemorensis (C.L. Koch,1839)	U	x	x	x
Neojordensia levis (Oudemans et Voigts,1904)	M	x	x	x
Cheiroseius borealis (Berlese,1904)	M	x	x	x
Leioseius bicolor (Berlese,1918)	M	x	x	x
Leioseius halophilus (Willmann,1949)	A	x	x	x
Leioseius minutus (Halbert,1915)	M	x	x	x
Amblyseius aurescens Athias-Henriot,1961	P	x	x	x
Amblyseius obtusus (C.L. Koch,1839)	P,L	x	x	x
Amblyseius marginatus Wainstein, 1961	P	x	x	x
* *Rhodacarellus silesiacus* Willmann,1936	A,M	x	x	x
Hypoaspis aculeifer (Canestrini,1883)	F	x	x	x
Thinoseius spinosus Willmann, 1939	W	x	x	x
Prozercon tragardhi (Halbert,1923)	F	x	x	x
Prozercon sellnicki Halaskova, 1963	M	x	x	x
Pergamasus crassipes (Linnaeus,1758)	F	x	x	
Pergamasus teutonicus Willmann,1956	F,M	x	x	
Pergamasus wasmanni (Oudemans,1902)	F	x	x	
Amblyseius rademacheri Dosse, 1958	P	x	x	
* *Rhodacarus mandibularis* Berlese, 1921	L	x	x	
Amblyseius messor (Wainstein, 1960)	P	x	x	
Asca aphidioides (Linnaeus,1758)	F	x	x	
Asca bicornis (Canestrini et Fanzago, 1877)	M	x	x	
* *Dendrolaelaspis angulosus* Schcherbak,1977	M	x	x	
Pachylaelaps pectinifer (G. et R. Canestrini,1882)	M	x	x	
Hypoaspis praesternalis Willmann,1949	M	x	x	
Hypoaspis vacua (Michael,1891)	M	x	x	
Laelaspis austriacus (Sellnick, 1935)	F	x	x	

continuation of table 1.

Prozercon kochi Sellnick,1943	F	x	x	
Mixozercon sellnicki Schweizer,1948	M	x	x	
Veigaia exigua (Berlese, 1917)	M	x		x
* *Gamasolaelaps excisus* (C.L. Koch,1879)	M,hy	x		x
Lasioseius youcefi Athias-Henriot,1959	B	x		x
Cheiroseius necorniger (Oudemans, 1903)	A	x		x
Cheiroseius serratus (Halbert, 1915)	A	x		x
Leioseius minusculus (Berlese,1905)	B	x		x
Amblyseius zwoelferi (Dosse,1957)	P	x		x
Macrocheles glaber (Muller,1860)	C	x		x
Eviphis ostrinus (C.L. Koch, 1836)	F	x		x
Alliphis siculus (Oudemansi, 1905)	A	x		x
Amblyseius reductus Wainstein,1962	P		x	x
Parazercon sarakensis Willmann,1939	F		x	x
Parasitus halophilus (Sellnick, 1957)	S	x		
Pergamasus septentrionalis (Oudemans,1902)	F	x		
* *Pergamasus truncus* Schweizer, 1961	C	x		
Ameroseius corbicula (Sowerby, 1806)	M	x		
* *Ameroseius insignis* Bernhard, 1963	C,hy	x		
Epicriopsis horridus (Kramer, 1876)	M,F	x		
* *Cheiroseius viduus* C.L. Koch, 1839	H,hy	x		
* *Cheiroseius unguiculatus* Berlese, 1887	H,hy	x		
* *Rhodacarus clavulatus* Athias-Henriot, 1961	L	x		
* *Dendrolaelaps stammeri* Hirschmann,1960	C	x		
Dendrolaelaps arenarius Karg,1971	W	x		
Dendrolaelaps foveolatus (Letner,1949)	M	x		
* *Dendrolaelaps cornutus* (Kramer, 1886)	T	x		
* *Dendrolaelaps tenuipilus* Hirschmann, 1960	C	x		
* *Halolaelaps communis* Hirshmann et Goetz, 1968	W	x		
Pachylaelaps furcifer Oudemans,1903	F	x		
Hypoaspis kargi Costa, 1968	F	x		
Ololaelaps placentula (Berlese,1887)	F	x		
Ololaelaps sellnicki Bregetova et Koroleva, 1964	M	x		
Arctoseius semiscissus (Berlese, 1892)	A		x	
Amblyseius bicaudus Wainstein, 1962	P		x	
Amblyseius graminis Chant, 1956	P		x	
Amblyseius meridionalis (Berlese, 1914)	P		x	
Antennoseius delicatus Berlese, 1916	M		x	
Antennoseius borrusicus Sellnicki, 1945	F		x	
Pachylaelaps magnus Halbert, 1915	L		x	

continuation of table 1.

Hypoaspis incertus Bernhard, 1955	F		x	
Laelaspis markewitschi Pirianyk, 1959	F		x	
Zercon spatulatus Willmann,1939	A		x	
Zercon zelawaiensis Sellnick, 1944	F		x	
Parasitus kraepelini Berlese, 1903	F			x
Parasitus lunaris Berlese, 1906	A			x
* *Parasitus kempersi* Oudemans, 1902	W			x
Parasitus celer (C.K. Koch, 1835)	A			x
* *Dendrolaelaps latior* (Leitner, 1949)	C			x
Halolaelaps incisus Hyatt, 1956	W			x
Halolaelaps balticus Willmann, 1954	W			x
Macrocheles tardus (C.L.Koch,1841)	L			x
Macrocheles montanus (Wilmann, 1951)	F,hy			x
Zercon montanus Wilmann, 1953	L			x
Totally 85 species, of them		62	46	40

Species distribution

Sixty-two species were found in hygro-mesophytic habitats, 46 species in xerophytic, and 40 species in driftline habitats (tab.1). Eighteen species have occurred in all investigated habitat types. Fifteen species were common on hygro-mesophytic and xerophytic habitats, 10 species on hygro-mesophytic habitats and driftline. About half of all species was found only in one habitat type - 19 species in hygro-mesophytic habitats, 11 species in xerophytic, and 10 in driftline habitats.

Discussion

The number of Gamasina species was surprisingly high in the coastal meadows. About 1/3 of Gamasina known in the fauna of Latvia were found in these relatively small areas.

Fourty Gamasina species were collected from the driftline habitats. Species occurring in the driftline (*Parasitus halophilus, Parasitus kempersi, Leioseius minusculus, Gamasolaelaps excisus, Neojordensia levis*, species of genera *Macrocheles, Halolaelaps*) generally characterizes by an expressed tendency to wet soils rich in organic matter. Several hygrophylous species were recorded in high numbers, such as *Thinoseius spinosus, Cheiroseius necorniger, Halolaelaps incisus* and *H. balticus.* Some species (*Parasitus kraepelini, Pergamasus vagabundus, P. lapponicus, Veigaia nemorensis)* were not numerous as they mostly are common inhabitants of various forests, inland meadows and agrocenoses. They may be dispersed from the nearby meadow soils where occur in large numbers.

Comparision was made with data collected from driftline habitats along the Kurzeme Coast in 1994 (Heldt, Salmane, in press). It was already mentioned that driftline habitats of coastal meadows are richer in species than other driftline habitats along the seacoast. Eighteen Gamasina species were collected from the driftline habitats of the Kurzeme Coast,

but 40 species - from the driftline near the coastal meadows. (As well as should be mentioned that the number of samples from Kurzeme Coast was much higher in comparison with those from coastal meadows).

By Pugh and King (1988) was found that driftline fauna has especially high diversity due to their migration if washed ashore material was situated close to the terrestrial vegetation. That was clearly shown in our study as well.

The highest species number (62) was found in the hygro-mesophytic habitats. Similar to the driftline hygro-mesophytic habitats have favourable life conditions for soil fauna (sufficient content of organics and moisture in the soil). However, hygro-mesophytic habitats have even improved conditions because of their more distant situation (separated by reeds or primary dunes) from the direct sea influence. That makes more stable moisture (less inundation, better aeration) and salt conditions in the soil. So these habitats have favourable life conditions for soil gamasins, as well as for the soil fauna, on which they prey on (Collembola, various Insecta eggs and larvae, other soil mites, Enchytraeidae, Nematoda).

The highest numbers of specimens had common forest species (*Pergamasus vagabundus, P. lapponicus, Hypoaspis aculeifer, Asca aphidioides, Cheiroseius viduus, Ch. unguiculatus*) and inland meadow species (*Hypoaspis vacua, H. praesternalis,* grass inhabitants from the genus *Amblyseius*,*).* Some ubiquitous species such as *Veigaia nemorensis* and *Holoparasitus excipuliger* also were found here. The last was found almost in all samples, but in comparatively low numbers. Some seashore inhabitants - *Parasitus halophilus* and *Dendrolaelaps arenarius* and hygrophylous species - *Neojordensia levis, Leioseius minusculus* and *Gamasolaelaps excisus* were found here, too. Species *Zercon montanus* known from the literature as inhabitant of Alpine zone in Central Europe (Bregetova, 1977) also was found in hygro-mesophytic habitats.

Xerophytic habitats were represented by 46 species. Species typical for humid and rich in organics soils were rare here. The vast majority of species in dry habitats were common for various inland meadows, for example, *Amblyseius* sp., *Hypoaspis vacua, H. praesternalis, Pachylaelaps pectinifer, Leioseius minutus* and *Cheiroseius borealis*. *Veigaia nemorensis* in previous investigations was recorded as the most widely distributed Gamasina species in Latvia (Lapiņa, 1988), occurring in variable habitats and often showing high numbers of specimens. In xerophytic habitats this species was found in rather low numbers. *Holoparasitus excipuliger* is known as widely distributed in Latvia, but not numerous species (Lapiņa, 1988). It was found almost in each sample from xerophytic habitats, but in low numbers. *Zercon zelawaiensis* was recorded only in xerophytic habitats from coastal meadows. From the previous investigations it is known as common for wet habitats and forest soils in Latvia (Lapiņa, 1988). Common seashore species like *Dendrolaelaps arenarius, Leioseius minusculus, Neojordensia levis, Parasitus halophilus* and *P. kempersi* also were recorded here. Drought resistant *Leioseius bicolor* was found almost in all samples and in dune habitats it had especially high number of specimens. Hygrophylous species *Neojordensia levis, Rhodacarellus silesiacus* and *Thinoseius spinosus* were found in xerophytic habitats in low numbers, too.

Comparison of species lists among habitat types showed that species common for all habitat types mostly were ubiquitous or typical forest species, as well as some inland meadow and hygrophylous species. Numbers of them were not high with exception of *Thinoseius spinosus*, which was represented by a large number of specimens in washed

ashore material, which is a typical habitat for this species. *Pergamasus lapponicus* is a common forest species and in inland meadow soils was found in very low densities (about 3% from total number) (Lapiņa, 1988). In coastal meadows this species was found in all habitat types in rather high numbers.

Species typical for hygro-mesophytic and xerophytic habitats mostly were common forest or inland meadow species, as well as various plant inhabitants from the genus *Amblyseius*. Species *Asca aphidioides* is a common forest species. In the inland meadows its relative abundance was found to be about 0,2% (Lapiņa, 1988).

About half of all Gamasina species were found only in one habitat type: 19 species in hygro-mesophytic habitats, 11 species in xerophytic habitats and 10 in driftlines. So, obvious is a fact that about half of species found in coastal meadows are adapted to diverse life conditions in various habitats (from wet and rich in organic matter to xerophytic, poor in vegetation and organic matter). They were found in more than one habitat type. The species remain were found in one habitat type only, suggesting that these species are more selective. Exception could be made only in some cases, when because of some reasons (wind, animals) specimens could be transferred from their normal habitats.

Due to the lack of data on Gamasina in coastal meadows, we compared our data with inland meadow fauna (Lapiņa, 1988). About 1/3 of species recorded in coastal meadows was the same with inland meadow fauna. Differences were observed only in their relative dominance structure. All common inland meadow species were found in hygro-mesophytic and xerophytic habitats of coastal meadows. Only *Parasitus kraepelini* was collected from the untypical habitat (driftline). The most numerous species in coastal meadows were *Holoparasitus excipuliger, Pergamasus vagabundus, Hypoaspis praesternalis, H. aculeifer, Cheiroseius borealis, Dendrolaelaspis angulosus, Prozercon kochi* and *Thinoseius spinosus.* One of the most frequent species in coastal meadows *Hypoaspis praesternalis* was rare in the inland meadows. *Veigaia nemorensis* was found as dominant species in the inland habitats. In coastal meadows it was quite frequent, but not dominant. Some species like *Pergamasus teutonicus* and *Hypoaspis vacua* were found as numerous in the inland meadows, but in coastal meadows they were rare.

Twelve from 16 new species were found in hygro-mesophytic habitats. They are known as common for wet habitats with high content of organics (Bregetova, 1977; Karg, 1993). The only exception is species *Dendrolaelaps cornutus*, which has been recorded by several authors under the bark of various trees (Shcherbak, 1980; Karg, 1993). The rest two species *Parasitus kempersi* and *Dendrolaelaps latior* were collected from washed ashore material.

Combination of habitats with various ecological conditions (xerophytic, mesophytic and hygrophytic) is the main reason for such high variability of Gamasina in coastal meadows. The highest species diversity and number was found in hygro-mesophytic habitats. The dominant species there were forest, inland meadow and ubiquitous species; in xerophytic habitats – inland meadow species and in the driftline – hygrophylous species.

Due to the closeness of various habitats fauna of Gamasina was mixed. As evidence for that is a finding of hygrophylous species in xerophytic habitats, drought resistant species in washed ashore material and common driftline species in terrestrial soils. However, fauna showed differences between habitats in relation to various demands of species to life conditions. This was obvious for species, which were found in high numbers in habitats, where the most favourable conditions exist.

Our investigations showed that the coastal meadows belonging to the ecosystems with high biological diversity due to the specific combination of various habitats. An unexpected high diversity and species composition of Gamasina mites was recorded here.

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Kopsavilkums

Augsnes plēsīgo gamazīnērču pētījumi tika veikti Latvijas piejūras pļavās. Kopumā 91 augsnes paraugs tika ievākts higro-mesofītiskos un kserofītiskos biotopos, kā arī priekškāpās un liedegā esošajos izskalojumos piejūras pļavu teritorijā. Kopumā tika noteiktas 85 gamazīnu sugas no 12 dzimtām. No tām tika konstatētas 16 jaunas un 5 retas sugas Latvijas faunai. Piejūras pļavās konstatēta liela Gamasina sugu daudzveidība. Šeit vienkopus tika atrastas gan dažādiem mežu tipiem, gan iekšzemes pļavām, gan kāpām, gan plūdmaiņas zonai raksturīgas sugas. Šo sugu bioloģisko daudzveidību var izskaidrot ar lielo biotopu dažādību. Tika veikts salīdzinājums ar iekšzemes pļavu faunu un noskaidrots, ka apmēram trešā daļa no piejūras pļavu faunas ir kopēja ar piejūras pļavu gamazīnērču faunu, bet sugu dominances struktūra tajās ir atšķirīga.

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