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Introductory research on mites of the order Mesostigmata in a forest stand with an admixture of yew (*Taxus baccata* L.) in the Tychowo Forest District

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Abstract: Common yew (*Taxus baccata* L.) populations are rare in Poland and for this reason they have been covered by reserve protection. Large-scale project of yew's protection and restoration is implemented by the State Forests in Poland. It can be expect, therefore, that its role will increase as an admixture species in tree stands. Several number of studies have been published on the impact of yew on different groups of animals. So far, little is known about mite's fauna in stands with an admixture of yew. The aim of current study was to determine the influence of the presence in the common yew on mite composition of the order Mesostigmata. Using a soil sampler we collected 20 samples were taken three times (throughout the growing season) in two types of forest: forest reserve (with yews), and managed forest (without). In next step they were laid out in Tullgren apparatus to displace the mites by dynamic extraction method. On the study area 47 species of Mesostigmata mites belonging to 20 families were marked. In total, 782 specimens of mites were collected, of which the most numerous was *Veigaia nemorensis*. Taking into account the obtained results, it can be concluded that: (1) The very low share of pioneer mites species and the first phases of secondary succession indicate stable soil conditions on both surfaces; (2) A relatively high proportion of species of the suborder Uropodina points to the good condition of the soil environment within the surveyed forests with the participation of both yew and without his participation; (3) No negative impact of the yew's share in stand on composition of Mesostigmata mites was observed.

Key words: Common yew, *Taxus baccata*, Mesostigmata, acarofauna, forest biodiversity, habitats of wet forest,

INTRODUCTION

Preserving biodiversity is one of the basic tasks of forest management. It is carried out by taking actions aimed at preservation, recreation and enrichment of natural biological resources. One of the ways to protect biodiversity understood as a variety of species, genetic intraspecific variation, as well as a variety of multi-species nature systems - ecosystems and landscapes, is to enrich the species composition of forest stands. This can be done by restitution of valuable species whose preservation based on natural processes is no longer possible.

These species include the common yew (*Taxus baccata* L.), whose populations are rare in Poland and for this reason they have been covered by reserve protection. The yew is the most shadowy of our conifers and is characterized by resistance to environmental pollution. The yew protection and restoration program implemented by the State Forests in Poland since 2006 is aimed at ensuring its presistence in the composition of forest ecosystems as well as maintaining population and individual variability, and in the future sustainable use.

Several number of studies have been published on the impact of yew on entomofauna (Karpiński and Strawiński 1948, Kawecki 1954, Łabędzki 1995) as well as dependence of this species on pathogenic and endophytic fungi (Orłoś 1951, Peace 1962, Hepting 1971). However, there are few papers on the fauna associated with this tree species (Seniczak and Seniczak 2012). More extensive research on mite fauna of the order Mesostigmata in yew stands was conducted in Great Britain (Skorupski and Luxton 1996, 1998). The aim of current study was to determine the influence of the presence in the common yew on mite composition of the order Mesostigmata.

MATERIALS AND METHODS

The research was carried out on the basis of a set of soil samples in the Tychowski Cisy yew reserve, which were compared with the samples taken in the reference in managed forest stands. The research areas were located within the territory of the Tychowo Forest District (GPS: 53.94; 16.27), which is within the reach of the Regional Directorate of State Forests in Szczecinek in the West Pomeranian Voivodeship (north-western part of Poland).

The areas are located in the Czarnikowo Forestr area, in the subarea 579r (forest reserve) and subarea 580f (manged forest; Fig 1). Both stands grow in the wet forest habitat. In the forest reserve, the share of species in the stand is as follows: silver birch (*Betula pendula* Roth.) -

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50%, black alder (*Alnus glutinosa* L.) - 40% and common beech (Fagus sylvatica L.) - 10%. As adolescent species other than yew (*Taxus baccat*a L.), there are: English oak (*Quercus robur* L.), Norway spruce (*Picea abies* (L.) H.Karst.), Aspen (*Populus tremula* L.) and hornbeam (*Carpinus betulus* L.). In the Managed Forest stand the main species are: black alder (70%) and silver birch (30%). Admixture species are: Scots pine (*Pinus sylvestris* L.), aspen and hornbeam (Bank Danych o Lasach 2019).

A sampler with an area of 40 cm2 was used for collecting material from the soil. Using this device the mineral soil was taken up to a depth of 5 cm, along with litter and humus. From both stands, 20 samples were taken three times: in autumn 2015, in spring 2016 and in summer 2017, in order to know the species of the entire growing season. The collected samples were transported in foil bags to the laboratory of the Department of Game Management and Forest Protection, where they were laid out in Tullgren apparatus to displace the mites by dynamic extraction method. The Tullgren apparatus is a device that uses a vertical temperature gradient to dry the habitat sample with the soil organisms present in it for displacement (Coleman et al. 2004, Koehler 1991). It consists of a funnel, the upper opening of which is covered with a sieve, to which soil samples were taught. Above them there is a light source (an electric bulb), which is also a heat emitter in order to gradually dry the sample from above. This causes that soil animals, going deeper and deeper in the soil, to search for a place with greater humidity eventually found their way to the funnel and fell into a collection vessel filled with preservative fluid (75% ethyl alcohol).

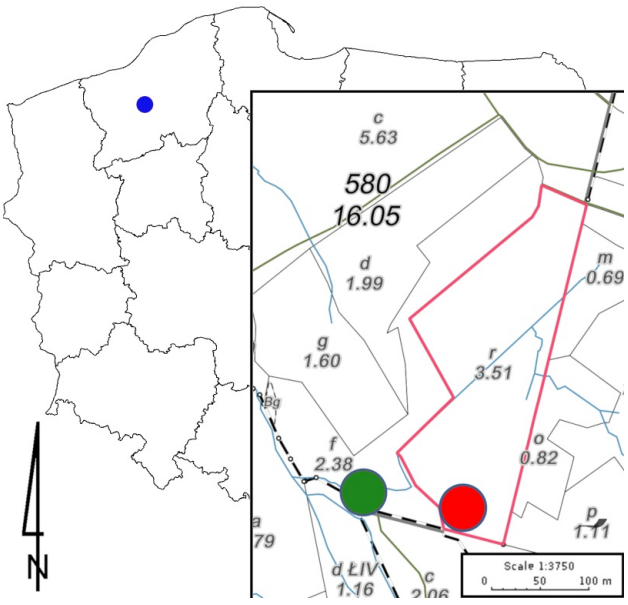

Fig.1 Map of the locations of the study area.
Blue – location in Poland of the Tychowo Forest District;
Red – Cisy Tychowskie reserve; Green – managed forest;
Pink – boundaries of the reserve.

In the next step, the obtained samples were poured into Petri dishes and transferred under the binocular to select mites of order Mesostigmata. These organisms were transferred by means of a preparative needle onto the slide glasses and placed in high-concentrated lactic acid. After this operation, the mites were covered with a coverslip thus forming unstable preparations. Each of them was marked with a label containing information about the designation of the plot from which he came. Mite names were given according to Błoszyk (2008), and Skorupski (2008).

RESULTS

On the study area 47 species of Mesostigmata mites belonging to 20 families were marked. In total, 782 specimens of mites were collected, of which the most numerous were: *Veigaia nemorensis* (C.L. Koch, 1836) 127 individuals, approximately 16% of all found mites, *Polyaspinus cylindricus* (Berlese, 1916), and *Trachytes aegrota* (C. L. Koch, 1841) 61 individuals each, representing approximately 8% of the collected mites, *Paragamasus vagabundus* (Karg, 1968) 58 individuals, representing about 7% of collected mites, and *Paragamasus conus* (Karg, 1971) 46 individuals, about 6% of collected specimens). On both surfaces, 24 joint species of mites of the order Mesostigmata were shown, 12 exclusive species were found on the management forest surface, and 11 in the reserve forest area. The dominant species in the managed forest surface were: *V. nemorensis*, *P. vagabundus*, *P. conus*, *Olodiscus minima* (Kramer, 1882) and *Trachytes aegrota*. On the other hand, the most numerous mites from the Parasitidae family (about 38%), followed by mites from the Uropodina suborder (about 25%) and from the family Veigaiidae (about 14%). On the area of reserve forest, the predominant species were: *V nemorensis*, *P. cylindricus*, *T. aegrota*, *Parazercon radiatus* (Berlese, 1914) and *Leptogamasus parvulus* (Berlese, 1903). The total mites from Uropodina suborder (about 31%), the Parasitidae family (about 22%) and the Veigaiidae family (about 19%) have been shown the most in this area.

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Table 1. List of mite species from the order Mesostigmata found on the studied areas (see Materials and Methods)

The list of Mesostigmata mites species	Managed forest Czarnikowo Forestr	Forest reserve "Tychowskie Cisy" yew reserve
GAMASINA		
EPICRIIDES		
Epicriidae		
Epicrius resinae Krag,1971	X	X
Zeroconidae		
Prozercon kochi (Sellnick, 1943)	X	X
Parazercon radiatus (Berlese, 1914)		X
Zercon gurensis (Mihečič, 1962)	X	
PARASITIDES		
Parasitidae		
Holoparasitus calcaratus (C. L. Koch, 1839)		X
Leptogamasus parvulus (Berlese, 1903)	X	X
Leptogamasus semisicatus (Athias-Henriot, 1967)		X
Paragamasus conus (Krag, 1971)	X	X
Paragamasus lapponicus (Trägårdh, 1910)	X	X
Paragamasus runcatellus (Berlese, 1903)	X	X
Paragamasus sp.	X	X
Paragamasus wasmanni (Oudemans, 1902)		X
Paragamasus vagabundus (Krag, 1968)	X	
Pergamasus medicoris (Berlese, 1904)	X	X
Vulgarogamasus kraepelini (Berlese, 1904)	X	X
DERMANYSSIDES		
Ameroseiidae		
Epicriopsis berlesei (Oudemans, 1939)	X	
Ascidae		
Blattisocius dentriticus (Berlese, 1918)		X
Lasioseius berlesei Oudemans,1983	X	X
Lasioseius lawrencei (Evans, 1958)	X	X
Proctolaelaps juradeus (Schweizer, 1949)		X
Eviphididae		
Eviphs ostrinus (C. L. Koch, 1836)	X	X
Laelapidae		
Hypoaspis aculeifer (Canestrini, 1883)	X	
Hypoaspis berlesei (Hirschman, 1969)	X	
Hypoaspis lasiomyrmecophilus (Hirschmann, 1969)	X	
Hypoaspis vacua (Michael, 1891)	X	
Macrochelidae		
Geholaspis longispinosus (Kramer, 1876)	X	
Geholaspis mandibularis (Berlese, 1904)	X	
Macrocheles opacus (C. L. Koch, 1839)	X	X
Pachylaelapidae		
Pachylaelaps longisetis (Halbert, 1915)	X	X
Phytoseiidae		
Amblyseius sp.	X	X
Rhodacaridae		
Cyrtolaelaps mucronatus (Canestrini & Canestrini, 1881)		X
Gamasellus montanus (Willmann, 1936)		X
Rhodacarus calcarulatus (Berlese, 1921)		X
Rhodacarus coronatus (Berlese, 1921)	X	X
Rhodacarellus silesiacus (Willman, 1936)	X	X

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Table 1. *continuation*

The list of Mesostigmata mites species	Managed forest Czarnikowo Forestr	Forest reserve "Tiszowskie Cisy" yew reserve
Veigaiidae		
Veigaia cerva (Kramer, 1876)		X
Veigaia exigua (Berlese, 1916)	X	X
Veigaia nemorensis (C. L. Koch, 1836)	X	X
UROPODINA		
POLYASPIDOIDEA		
Trachytidae		
Polyaspinus cylindricus (Berlese,1916)	X	X
Trachytes aegrota (C. L. Koch, 1841)	X	X
Trachytes pauperior (Berlese, 1914)	X	X
UROPODOIDEA		
Dinychidae		
Dinychus perforatus (Kramer, 1882)	X	
Trematuridae		
Oodinychus ovalis (C. L. Koch, 1839)	X	
Urodinychidae		
Janetiella pulchella (Berlese, 1904)		X
Urodiaspis tecta (Kramer, 1876)	X	X
Uropodidae		
Olodiscus minima (Kramer,1882)	X	X
Uropoda sp.	X	

SUMMARY OF RESULTS AND CONCLUSIONS

The use of mites of the order Mesostigmata for bioindication of the soil environment was justified by Skorupski (2010). An important aspect of the conducted bioindication studies is the recognition of secondary succession processes and the participation in it of Mesostigmata mites (Madej 2004). Current study, referring to the above-mentioned aspects, presents the results from research areas located in forest stands in the wet forest habitat. Both surfaces, located very close to each other, are characterized by a large species diversity of soil mite groupings. A relatively large number of species, without definite dominants, indicates stable processes of secondary succession on the surface of the studied stands. Dominant mites from the family Parasitidae are typically characteristic of coniferous forest habitats of pine tree stands (Skorupski and Błaszczak 1998). In this case we observe a higher proportion of this family of mites on the surface of the managed forest, which in its admixture of pine, and are definitely closer to the adjacent pine tree stands in relation to the studied forest reserve area.

On the other hand, the mites of the first phase of succession are very rare here. For example genes *Rhodacarus*, *Rhodacarellus*, and other species known in the phases of "non-forest" succession have not been observed (Madej 2004).

The presence of the suborder Uropodina mites (primarily of the genes *Trachytes*, *Urodiaspis* or *Olodiscus*), and the family Macrochelidae (genes *Macrocheles* or *Geholaspis*) indicates a stable habitat for both studied areas. Preliminary results of these surfaces are carried out in accordance with research conducted on the British Isles, where the species composition of soil Mesostigmata mites were relatively species-rich and characterized by a high share of mites of the suborder Uropodina (Skorupski and Luxton 1998). Further faunistic and ecological analyzes will be carried out after the analysis of a larger number of acarological collections.

Based on the obtained results, it can be concluded that:

1. Species composition of the mites of the order Mesostigmata in the studied area is characteristic for the soil environment of moist forests in the area of Western Pomerania.

2. The very low share of pioneer and the first phases of secondary succession mites species indicate stable soil conditions on both surfaces.

3. A relatively high proportion of species of the suborder Uropodina points to the good condition of the soil environment within the studied forests with the participation of both yew and without his participation.

4. No negative impact of the yew's share in stand on composition of Mesostigmata mites was observed.

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