Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 1794-1798

Received: 16-05-2018
Accepted: 17-06-2018

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Three new species of Tenuipalpidae (Acari: Prostigmata) for the fauna of Bulgaria

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Abstract
Three new species of Tenuipalpidae (Acari: Prostigmata) for the fauna of Bulgaria are reported. The material was collected between April and November, 2010 in Sofia and Karlovo on *Taxus baccata* L., *Thuja occidentalis* L. and *Juniperus sabina* L. Representatives from three families have been identified as a result, the most numerous of which are the Tenuipalpidae (three species), Cheyletidae (one species) and Stigmaeidae (one species). *Pentamerismus taxi* (Haller, 1877) associated with *Taxus baccata* L., *Pentamerismus oregonensis* (McGregor, 1949) collected from *Thuja occidentalis* L. and *Juniperus sabina* L. and *Cenopalpus lineola* (Canestrini & Fanzago, 1876) are reported as new for the mite fauna of Bulgaria. During a survey two predatory mites were identified - *Cheletogenes ornatus* (Canestrini and Fanzago, 1876) (Cheyletidae) and *Zetzellia silvicola* (Gonzalez-Rodriguez, 1965) (Stigmaeidae). The aim of this study was to determine what species of mites are present on ornamentals such as *Taxus baccata* L., *Thuja occidentalis* L. and *Juniperus sabina* L. and to increase the current knowledge of their distribution and seasonal occurrence in Bulgaria.

Keywords: Mites, Tenuipalpidae, Bulgaria

Introduction
Currently a total of 1669 mite species are known to occur in the territory of Bulgaria in 630 genera and 213 families [4]. Of them phytophagous mites belonging to the family Tenuipalpidae Berlese, 1913 (Acari:Prostigmata) comprise only 4 species in 3 genera - *Brevipalpus* Donnadieu, 1775, *Cenopalpus* Pritchard & Baker, 1958 and *Tenuipalpus* Donnadieu, 1875. In Europe the genus *Cenopalpus* is represented by 18 species, but only *Cenopalpus pulcher* (Canestrini & Fanzago, 1876) is known from Bulgaria [3, 10]. To date, representative from genus *Pentamerismus* McGregor, 1949 has not been reported in the country. According to Fauna europea database [10], 5 species of genus are known in Europe - *Pentamerismus coronatus* (Canestrini & Fanzago 1876), *Pentamerismus foliisetis* Livshitz & Mitrofanov 1967, *Pentamerismus juniperi* (Reck 1951), *Pentamerismus oregonensis* McGregor 1949 and *Pentamerismus taxi* (Haller 1877), all associated with family Cupressaceae as a host plants. The species *Cheletogenes ornatus* (Canestrini and Fanzago, 1876) (Cheyletidae) has been previously recorded in Bulgaria under the shields of some economically important scale insects such as *Sphaerolecanium prunastri* (Boyer de Fonscolombe) (Hemiptera: Coccidae), *Parlatoria oleae* (Colvee), *Diaspidiotus marani* (Zahradnik) and *Diaspidiotus pyri* (Lichtenstein) (Hemiptera: Diaspididae) [21]. A total of 12 species from family Cheyletidae and 5 from family Stigmaeidae are known in the country [3]. The other predatory mite *Zetzellia silvicola* (Gonzalez-Rodriguez, 1965) (Stigmaeidae) was previously reported by Balevski *et al*. [1]. This survey is a starting point for future investigation in Bulgaria. For some species it is unclear how their impact and distribution will increase with climate changes.
The aim of this study was to determine what species of mites are present on ornamentals such as *Taxus baccata* L., *Thuja occidentalis* L. and *Juniperus sabina* L. and to increase the current knowledge of their distribution and seasonal occurrence in Bulgaria.

Material and Methods
The mite samples were collected in private gardens, between April and November, 2010 at two locations in Bulgaria: Sofia and Karlovo. Samples were taken from the bark and needles from *Taxus baccata* L., *Thuja occidentalis* L. and *Juniperus sabina* L. The specimens were preserved in small vials containing ethyl alcohol and glycerin, until identified.

The observations were recorded with a digital camera. In the laboratory, the specimens were mounted on microscope slides according to the technique of Keifer [14] and identified using keys and illustrations of Mitrofanov [19], Mitrofanov & Strunkova [20], Khanjani & Gotoh, [15] and Hatzinikolis [13].
Permanent slides have been deposited at University of Forestry, Plant Protection Department, Laboratory of Entomology, Sofia, Bulgaria.
The nomenclature used here for the Tenuipalpidae is given according to Fauna europaea [10].

Results

Five mite species belonging to three families were identified as a result of survey of which *Pentamerismus taxi* (Haller, 1877), *Pentamerismus oregonensis* (McGregor, 1949) and *Cenopalpus lineola* (Canestrini & Fanzago, 1876) are reported as new for the mite fauna of Bulgaria. During a survey two predatory mites were identified - *Cheletogenes ornatus* (Canestrini and Fanzago, 1876) (Cheyletidae) and *Zetzellia silvicola* (Gonzalez-Rodriguez, 1965) (Stigmaeidae) (table 1).

Table 1: List of species collected, including the sampling sites and host plants

Family/Species	Sampling sites	Host plants
Tenuipalpidae *Pentamerismus taxi* (Haller, 1877)	Sofia, Karlovo	*Taxus baccata* L.
Pentamerismus oregonensis (McGregor, 1949)	Sofia	*Thuja occidentalis* L. *Juniperus sabina* L.
Cenopalpus lineola (Canestrini and Fanzago, 1876)	Sofia	*Taxus baccata* L.
Cheyletidae *Cheletogenes ornatus* (Canestrini and Fanzago, 1876)	Karlovo	*Taxus baccata* L.
Stigmaeidae *Zetzellia silvicola* (Gonzalez-Rodriguez, 1965)	Sofia	*Taxus baccata* L.

Discussion

Family Tenuipalpidae

Genus *Pentamerismus* McGregor, 1949

Pentamerismus taxi (Haller, 1877)

The original description of *Pentamerismus taxi* (Haller, 1877) is given by Heller in 1877, as *Tenuipalpus taxi* in Switzerland [13, 12]. The most preferred host plants of *Pentamerismus taxi* are different forms of *Taxus baccata* L. (Taxaceae) [8, 9, 17, 12, 16, 23, 25, 2].

Members of this genus is characterized by a five-segmented palpus, two pairs of dorsosublateral setae, seven to eight pairs of dorsosublateral hysterosomal setae, three pairs of dorsocentral hysterosomal setae, a genital and a ventral plate, and a broadly ovate body.

Diagnosis (female): Body from above oval, widest slightly cephalad of the middle of the hysterosoma. Rostrum reaching the distal portion of femur. Palpus surpassing rostrum, with three setae on distal segment. Rostral shield broadly emarginated medially. Dorsolateral hysterosomal setae six-paired, dorsosublateral hysterosomal setae two-paired and dorsomedial setae three-paired. Dorsolateral hysterosomal setae slender and slightly serrate. Dorsum of idiosoma with distinct striae medially. Two pairs of medioventral metapodosomal setae longer than distance between them [8] (fig.1, 2).

Biology: *Pentamerismus taxi* has two generations per year in Bulgaria. The species overwinters as adult female. Ovipositing of the winter generation starts in the first ten days of April. Ovipositing of the summer generation starts at the end of June. The duration of development for the winter generation is around 4 months and 50 days for the summer generation.

Distribution: According to Fauna europea database [10] in Europe and worldwide the species is known from Britain, Spanish mainland, Greek mainland, Switzerland, Ukraine and Nearctic region.

Remarks: *P. taxi* was collected from Sofia and Karlovo on *Taxus baccata* L. This is the first record of the species in Bulgaria.

Fig 1: *Pentamerismus taxi* feeding on *Taxus baccata* L. (original)

Fig 2: *Pentamerismus taxi* - adult female (original)

Pentamerismus oregonensis (McGregor, 1949)

The original description of the species is given by McGregor in 1949 in USA, California [13]. According to Leon [18], Lehman [17], Hatzinikolis [13], Gutierrez *et al.* [12], Ripka [23], Uysal *et al.* [25], Bayram & Cobanoglu [2] the most preferred

host plants of the species are representatives from genera *Thuja, Cupressus, Juniperus, Pinus* and *Abies.*

Diagnosis (female): Body from above oval, widest slightly cephalad of the middle of the hysterosoma. Rostrum reaching the distal portion of femur. Palpus surpassing rostrum, with three setae on distal segment. Rostral shield broadly emarginated medially. All dorsal setae short, propodosomal and humeral setae slightly serrate, slender, dorsolateral hysterosomal setae six-paired, broad, strongly serrate; dorsosublateral and dorsocentral hysterosomals minute. Two pairs of medioventral metapodosomal setae longer than distance between them (fig.3).

Biology: Our observations on the biology of *Pentamerismus oregonensis* (McGregor, 1949) are incomplete, but its density on *Thuja occidentalis* L. was significantly higher than that of *Pentamerismus taxi* (Haller, 1877) on *Taxus baccata* L. The species needs future detailed study concerning its biology and distribution in the country.

Distribution: According to Fauna europea database [10] in Europe and worldwide the species is known from Britain, Greek mainland, Nearctic region, Neotropical region, Oriental region.

Comments: *P. oregonensis* was collected from Sofia on *Thuja occidentalis* L. and *Juniperus sabina* L.. This is the first record of this species in Bulgaria.

Fig 3: *Pentamerismus oregonensis* - adult female (original)

Cenopalpus Pritchard & Baker, 1958
***Cenopalpus lineola* (Canestrini & Fanzago, 1876)**
The original description of the species is given by Canestrini & Fanzago in 1876, as *Tetranychus lineola* in Italy [12]. According to Uysal *et al.* [25] and Bayram & Cobanoglu [2] the most preferred host plants of the species are several representatives from genera *Pinus* and *Juniperus.* Genus *Cenopalpus* is characterized by four-segmented palpus, five or six pairs of hysterosomal dorsolateral setae, one pair of dorsosublateral setae, one pair of humerals and three pairs of dorsocentral setae [13].

Diagnosis (female): The species is characterized by 6 pairs of dorsolateral hysterosomal setae that are strong, lanceolate and serrate, the propodosoma has a few irregular striae dorsomedially (fig.4).

Biology: *Cenopalpus lineola* (Canestrini & Fanzago, 1876) was found on *Taxus baccata* L., mostly in association with *Pentamerismus taxi* (Haller, 1877). The density of *Cenopalpus lineola* (Canestrini & Fanzago, 1876) was significantly lower, than that of *Pentamerismus taxi* (Haller, 1877) on *Taxus baccata* L. The species needs future detailed study concerning its biology and distribution in the country.

Distribution: According to Fauna europeae [10] in Europe and worldwide the species is known from European Turkey, Greek mainland, Italian mainland, Near East, Oriental region, Poland, Portuguese mainland, The Netherlands and Ukraine.

Remarks: *Cenopalpus lineola* was collected from Sofia on *Taxus baccata* L. This is the first record of this species in Bulgaria.

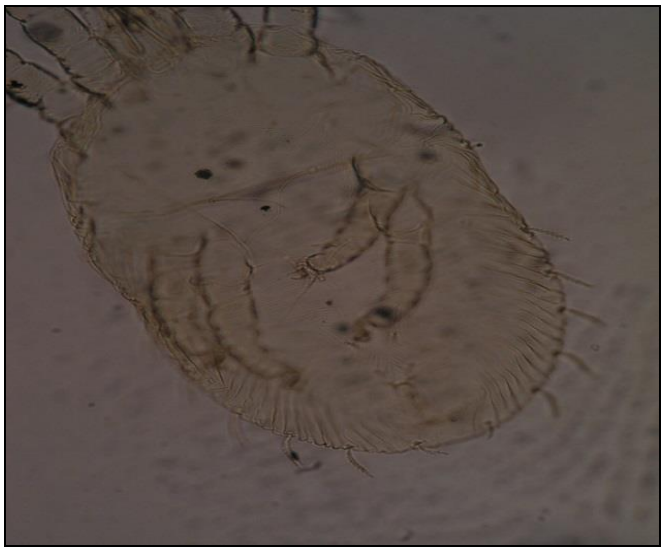

Fig 4: *Cenopalpus lineola* - adult female (original)

Family Cheyletidae
***Genus Cheletogenes* Oudemans, 1905**
***Cheletogenes ornatus* (Canestrini and Fanzago, 1876)**
The family Cheyletidae Leach (Acariformes: Prostigmata) is quite diverse, both taxonomically and ecologically (including free living predators, parasites of vertebrates, and obligate associates of invertebrates). Currently, the Cheyletidae includes about 370 species belonging to 73 genera [5].

Diagnosis (female): Body is oval-rounded, dorso-ventral flattened, yellow-red colored. It is developed by a transverse fold of two parts – propodosoma and hysterosoma. Dorsum of idiosoma has two shields – propodosomal – with 12 setaes and hysterosomal with 6 setaes. The palps are enlarged with distinct thumb-claw processes [21] (fig.5).

Distribution: World distribution – Cosmopolitan [24].

Remarks: *Cheletogenes ornatus* is a predator of eggs, larvae, nymphs and adult mites of *Pentamerismus taxi*. The species has been previously reported by Nachev and Trenchev [21] under the shields of some scale insects such as *Sphaerolecanium prunastri* (Boyer de Fonscolombe) (Hemiptera: Coccidae), *Parlatoria oleae* (Colvee), *Diaspidiotus marani* (Zahradnik) and *Diaspidiotus pyri*

(Lichtenstein) (Hemiptera: Diaspididae). It was found on *Taxus baccata* L. in Karlovo.

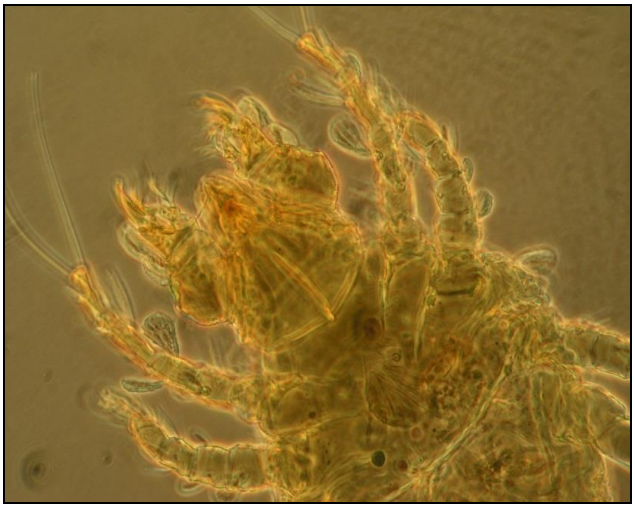

Fig 5: *Cheletogenes ornatus* - adult female (original)

Family Stigmaeidae
Genus *Zetzellia* Oudemans, 1927
***Zetzellia silvicola* (Gonzalez-Rodriguez) (Stigmaeidae)**

The family Stigmaeidae is a large cosmopolitan group in the superfamily Raphignathoidea (Acari: Prostigmata). They live in or on soil, grass, leaf, mulch, lichen, bark, beetle frass, crevices in rock, and leaf cavities, a few of them are parasitic on phlebotomine flies [7] (Donel & Doğan 2011). Currently, this family consists of 32 valid genera and about 500 species [11, 6].

Diagnosis (female): Body is oval extended, dorso-ventral flattened. Dorsal shields have a specific net structure. Dorsal setaes are slightly serrated. Legs are well-developed, second pair of legs are longer [1] (fig.6).

Remarks: *Zetzellia silvicola* was found in all colonies of *Pentamerismus taxi*. The species has a potential to reduce its population. It was found on *Taxus baccata* L. in Sofia. The other 2 species known from Bulgaria are *Zetzellia mali* (Ewing) and *Zetzellia graeciana* Gonzales [1].

Fig 6: *Zetzellia silvicola* - adult female (original)

Conclusion

From the practical and research perspective regarding all species of mites found on ornamentals such as *Taxus baccata* L., *Thuja occidentalis* L. and *Juniperus sabina* L. in Bulgaria, further research is required in order to evaluate the biology, ecology and measures for effective control, as well as its spreading rate and habitat in the country.

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