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The first report of *Xenillus salamoni* Mahunka 1996 (Acari: Oribatida) in Poland, with the key to European *Xenillus*

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Original research

ABSTRACT

During ecological studies carried out in the Drawa National Park, an oribatid mite species, *Xenillus salamoni* Mahunka 1996 (Liacaridae), new for Poland was found. This species is known only from Hungary and from the Central Alps and it is considered as xerophilous and a forest taxon. Additionally, a key to the identification of European *Xenillus* species was prepared.

Keywords cormorant; Drawa National Park; fauna of Poland; new record; xerophilous; Liacaridae

Introduction

Despite several surveys, the Polish fauna of Oribatida is not fully known and new taxa are still being found (for example, Konecka and Olszanowski 2019). During ecological studies carried out in the Drawa National Park, an oribatid mite species new for Poland (*Xenillus salamoni* Mahunka, 1996), was found in a heavily transformed habitat below a former cormorant colony.

Materials and methods

The study was performed on two islands: Lech (LI) (53°04′42″N, 15°57′47″E) and Okrzeja (OI) (53°05′10″N, 15°58′44″E) on the Lake Ostrowiec in the Drawa National Park (Poland). The islands are small in surface (<5 ha), domed and primarily overgrown by acidophilus oak forests with pine, and they are 1.3 km away from each other. Since 1950, a colony of cormorants has been present on LI. Over the past 60 years, the activity of the cormorants led to the deforestation of a large part of the island and the disappearance of herbal plants. Occasionally the cormorants visited OI, but never bred there. In 2015, the cormorants abandoned the island and the slow recolonisation of plants (mainly nitrophilous species) began. Nowadays, a significant part of the island is still bare. The topsoil horizon is rich in wooden detritus and well exposed to sunlight. The soil chemistry is also a distinguishing feature of the studied island. According to Klimaszyk *et al.* (2015), the nitrogen and phosphorus concentrations in the soils beneath the colony LI compared to OI are several dozen and several hundred times higher, respectively.

On both islands, 20 soil samples were collected from steep slopes. After extraction with a Tullgren apparatus (which lasted five days), all specimens were preserved in 85% ethanol and cleared on slides with 80% lactic acid. Microscopic slides were prepared with Hoyer's

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Figure 1 Dorsal view on *Xenillus salamoni*.

mounting medium. Pictures were taken with a Nikon DS-Ri2 microscope camera and obtained with the aid of Nikon NIS-Elements D software (Nikon Corporation) and rendered with the Helicon Focus 7 program (Kozub *et al.* 2008).

To prepare the identification key of European *Xenillus,* the following publications were used: Csiszár 1961; Kulijev 1963, 1968; Mahunka 1979, 1996; Pérez-Íñigo 1987; Morell 1987, 1989; Gil-Martín and Subías 1997; Mahunka and Mahunka-Papp 1999; Subías and Arillo 2000; Grobler *et al.* 2003; Schatz 2004; Weigmann 2006; 2011; Ermilov and Kalúz 2013. Only species which were found in Europe, according to Subías (2004, updated 2020) were included in the key.

Results and discussion

In total, 44 specimens of *X. salamoni* were found, of which 40 were from LI and 4 from OI. The average frequency of *X. salamoni* on OI was 0.2 specimens per sample, while on LI, it was tenfold higher.

In Poland, only two species of *Xenillus* have been recorded so far: *X. clypeator* Robineau-Desvoidy, 1839 and *X. tegeocranus* (Hermann, 1804) (Niedbała and Olszanowski 2008). *Xenillus salamoni* differs from these species primarily by the morphology of its prodorsum (Figs. 1 and 2). The lamellar cusps of *X. salamoni* are fused at their bases, without intercuspidal mucro, which is present in many *Xenillus* species (Fig. 2A). Lamellar setae are ciliate and directed anteromedially, similar to the setae of *X. clypeator*, while interlamellar setae are short (but longer than in *X. clypeator*)(Fig. 2B, C). Sensillus is clavate with a long stalk. Another characteristic feature of *X. salamoni* is the reduced exobothridial setae, represented only by small alveoli and lack of interlamellar tubercules (which are present in *X. tegeocranus*). The body length of *X. salamoni* is 695–932 µm (Mahunka 1996; Schatz 2004).

Xenillus salamoni is considered to be a xerophilous and silvicolous species, which was first recorded in Hungary. Mahunka (1996) described this species from dry *Tilio-Sorbetum* in the Bükk National Park, and later, it was also recorded in a commercial beech forest stand in the

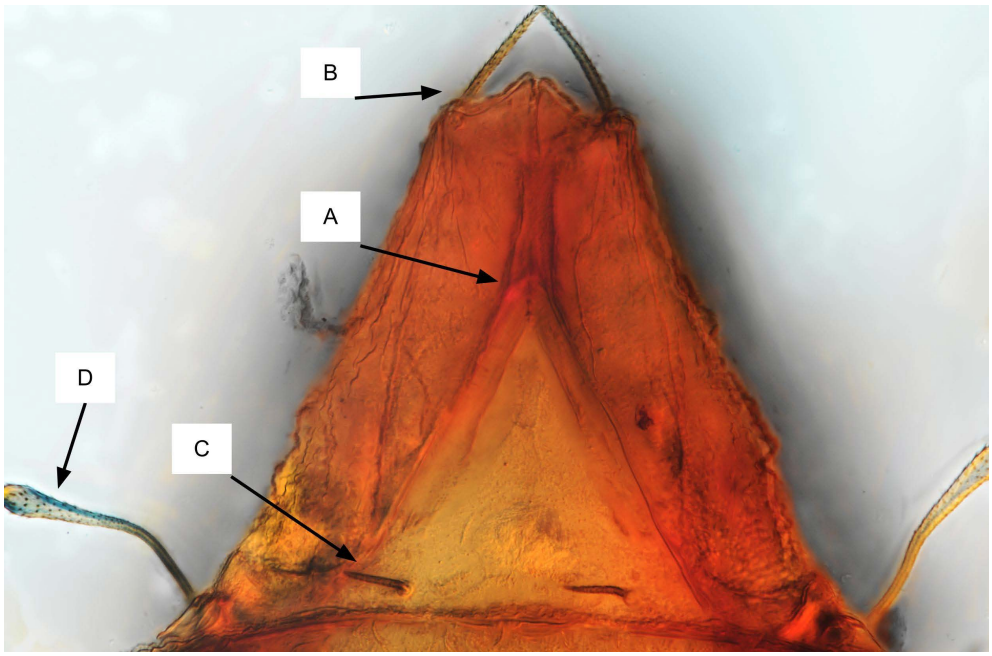

Figure 2 Prodorsum of *Xenillus salamoni,* A – fused bases of lamellar cusp; B – lamellar setae; C – interlamellar setae; D – sensillus.

Mátra Mountains (Kreszivnik and Mahunka 2000). *X. salamoni* was also noted in dry grassland and in downy scree slope oaks of the Italian and Austrian parts of the Tyrol region, which are located in the Eastern Alps (Schatz and Fischer 2015; Schatz 2016). Subías (2004, updated 2020) reported *X. salamoni* in material from Abkhazia (Caucasus), but this information was not published (L. S. Subías, personal communication). Thus, *X. salamoni* is only known from a few locations in Europe and the Caucasus. Islands on Lake Ostrowiec are the first location outside mountain areas (Alps, Bükk and Caucasus mountains) on which this species was found.

Likely, the range of occurrence of *X. salamoni* in Poland is not limited to the islands on the Lake Ostrowiec, and this species might be present in other parts of the country. Because of their narrow ecology niche, *X. salamoni* and their habitats could have been overlooked during previous research. A higher abundance of this mite on LI might have been caused by previous cormorant activity that led to the deforestation of the island and changed soil chemistry (Klimaszyk *et al.* 2015). It could create better conditions for xerophilous species like *X. salamoni*.

Cormorants can also be hypothesised as an expansion vector for this species. *Xenillus tegeocranus* was recorded in cormorant feathers by Lebedeva *et al.* (2004), so the presence of *X. salamoni* in cormorant plumage is probable.

To verify these assumptions, further surveys on dry environments and cormorants (their colonies and feathers) should be carried out.

Key to European *Xenillus*

1. Notogastral setae short, dilated (or fan-shaped), well visible. Interlamellar setae long, not attached to lamellae or reduced 2
— Notogaster setae of different lengths and not dilated 4

2. Interlamellar setae reduced. Notogastral and adanal setae - fan-shaped. Body length: 775–1000 µm . . . . . *Xenillus arilloi* Gil-Martín & Subías, 1997. Distribution: Spain

— Interlamellar setae long 3

3. Sensillus with a long stalk. Interlamellar setae dilated at the end. Setae c1 and c2 short and similar in size. Body length: 824 µm . . . . . *Xenillus penicilliger* Csiszár, 1961. Distribution: Southeast Europe
— Sensillus with a short stalk. Setae c1 and c2 long. Seta c1 visibly longer than c2. Body length: 900–1250 µm . . . . . *Xenillus clavatopilus* Mihelčič, 1966. Distribution: Western part of the Mediterranean Sea

4. Interlamellar setae arising from lamellae 5
— Interlamellar setae not fused with lamellae and arising from the interlamellar region 6

5. Setae c1 and c2 bacilliform. Body length: 997 µm . . . . . *Xenillus mutabilis* Mahunka & Mahunka-Papp, 1999. Distribution: Hungary
— Setae c1 and c2 setiform. Body length: 860–1155 µm . . . . . *Xenillus discrepans discrepans* Grandjean, 1936. Distribution: Southern Palearctic

6. Sensillus with a short stalk 7
— Sensillus with a long stalk 9

7. Interlamellar setae minute (20–30 µm). Rostral setae facing each other. Sensillus with a short stalk, club-shaped. Body length: 1200– 1400 µm . . . . . *Xenillus clypeator* Robineau-Desvoidy, 1839. Distribution: Holarctic and Mexico
— Interlamellar setae longer 8

8. Rostrum oval. Rostral setae facing each other. Big and well visible mucro between lamellae. Body length: 990–1200 µm . . . . . *Xenillus discrepans azorensis* Pérez-Íñigo, 1987. Distribution: Southern Palearctic (Mediterranean and Central West Asia)
— Rostrum apically slightly concave with small irregular teeth. Rostral setae facing forward. Small mucro between lamellae or a lacking. Body length: 815–1000 µm (female), 610–770 µm (male) . . . . . *Xenillus halophilus* Weigmann, 2011. Distribution: Portugal

9. Lamellae completely fused or fused only with each other medially. Mucro between lamellae lacking 10
— Lamellae not fused. Usually, the presence of at least small mucro between lamellae. 13

10. Lamellae fused completely. Sensillus with a long stalk. Notogaster and interlamellar setae very short. Body length: 857–1005 µm . . . . . *Xenillus confusus* Mahunka, 1979. Distribution: Greece
— Lamellae not completely fused 11

11. Inner cuspis curved. Interlamellar setae long. Body length: 709–866 µm . . . . . *Xenillus matskasii* Mahunka, 1996. Distribution: Hungary
— Interlamellar setae short 12

12. Lamellar cuspidal short, pointed teeth, pointed, directed medially, inner margins of cusps curved. Lamellae setae long, smooth, directed medially. Exobothridial setae club-shaped. Body length: 670–870 µm (female), 410–540 µm (male) . . . . . *Xenillus athesis* Schatz, 2004. Distribution: Italian Alps
— Lamellar cuspidal teeth weakly expressed, directed anteriad, inner margins of cusps almost parallel. Lamellar setae shorter, ciliate, directed anteromedial. Exobothridial setae reduced. Body length: 695–932 µm . . . . .

. . . . . *Xenillus salamoni* Mahunka, 1996. Distribution: Central Europe and Caucasus

13. Lamellar, interlamellar and notogaster setae distally ciliate 14
— Setae smooth and slightly ciliate along entire length 15

14. Cusp with one tooth. Body length: 612–984 µm. . . . . *Xenillus selgae* Morell, 1987. Distribution: Western part of Mediterranean Sea and Vietnam
— Cusp with two teeth. Body length: 648–912 µm . . . . . *Xenillus ybarrai* Morell, 1987. Distribution: Spain

15. Rostrum round. Prodorsal and notogastral seatae long and ciliate. Body length: 624–900 µm . . . . . *Xenillus fernandoi* Morell Zandalinas, 1989. Distribution: Western part of Mediterranean Sea
— Rostrum with a recess in the middle or two teeth along the entire length 16

16. Notogaster nearly oval. Body sculpture tuberculate. Body length: 900 µm . . . . . *Xenillus tuberculatus* Subías & Arillo, 2000. Distribution: Spain
— Punctate body sculpture 17

17. Setae c1 and c2 setae short, bacilliform, both similar in size. Rostrum medially slightly or distinctly concave, laterally with small teeth. Body length: 720–1100 µm . . . . . *Xenillus tegeocranus* (Hermann, 1804). Distribution: Palearctic and Oriental
— Setae c1 and c2 long, c2 considerably longer than c1 18

18. Rostrum apically oval, with two side projections on which rostral setae are situated. Ventral setae short, needle-like. Body length: 945 µm . . . . . *Xenillus sculptrus* Kulijev, 1963. Distribution: Southern Palearctic: Caucasus, Spain and Iran
— Rostrum apically slightly concave, with two small teeth. Ventral setae long, ciliate (except genital setae). Body length: 940 µm . . . . . *Xenillus setosus* Grobler, Ozman & Çobanoglu, 2003. Distribution: Turkey and Iran

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References

Csiszár J. 1961. Neue Oribatiden (Acari). Folia Ent. Hung., 14(31): 447-450.
Ermilov S.G., Kalúz S. 2013. Additions to the Moroccan Oribatid mite fauna, with a supplementary description of *Xenillus clavatopilus* (Acari: Oribatida: Liacaridae). Acarina, 21(1): 76-80.
Gil-Martín J., Subías L.S. 1997. Cinco nuevas especies de Acaros Oribátidos (Acari, Oribatida) de pinares incendiados de la Sierra de Gredos (Avila, Espana). Graellsia, 52: 81-90 (1996). doi:10.3989/graellsia.1996.v52.i0.378
Grobler L., Ozman S.K., Çobanoglu S. 2003. The genera *Liacarus, Stenoxenillus* and *Xenillus* (Oribatida: Gustavioidea) from Turkey. Acarologia, 43(1): 133-149.
Klimaszyk P., Brzeg A., Rzymski P., Piotrowicz R. 2015. Black spots for aquatic and terrestrial ecosystems: impact of a perennial cormorant colony on the environment. Sci. Total Environ., 517: 222-231. doi:10.1016/j.scitotenv.2015.02.067

Konecka E., Olszanowski Z. 2019. First evidence of intracellular bacteria *Cardinium* in thermophilic mite *Microzetorchestes emeryi* (Acari: Oribatida): molecular screening of bacterial endosymbiont species. Curr. Microbiol., 76(9): 1038-1044. doi:10.1007/s00284-019-01717-5
Kozub D., Khmelik V., Shapoval Y., Chentsov V., Yatsenko S., Litovchenko B., Starykh V. 2008. Helicon Focus Software.
Kreszivnik V., Mahunka S. 2000. A Kékes-Észak erdőrezervátum (Mátrahegység) páncélosatka-faunája. Folia Hist. Natur. Mus. Matra., 24: 283-288.
Kulijev K.A. 1963. [Family Liacaridae in the Fauna of Azerbaijan]. Doklady Akad. Nauk Azerb. SSR, 19(11): 71-74. [In Russian]
Kulijev K.A. 1968. [New Species and Subspecies of Oribatid Mites from Azerbaijan Forests]. Uchenye Zapiski Azerb. Gos. Univ. Ser. Biol., 2: 84-101. [In Russian]
Lebedeva N.V., Krivolutsky D.A., Lebedev V.D. 2004. [New data on the oribatid in the plumage of birds of basin of the Azov Sea]. In: Matishov, G.G. (Eds.): Integrated monitoring of environment and boita of the Azov basin. Vol. 6. Publisher Kola Scientific Center of Russia. Apatity: 272-278. [In Russian]
Mahunka S. 1979. Neue und interessante Milben aus dem Genfer Museum. XLI: Vierter Beitrag zur Kenntnis der Oribatiden-Fauna Griechenlands (Acari: Oribatida). Rev. Suisse Zool., 86(2): 541-571. doi:10.5962/bhl.part.82319
Mahunka S. 1996. Oribatids of the Bükk National Park (Acari: Oribatida). In: Mahunka, S. (Eds.) The Fauna of the Bükk National Park II. Budapest: Hungarian Natural History Museum. p. 491-532.
Mahunka S., Mahunka-Papp L. 1999. Oribatids (Acari: Oribatida) from the Aggtelek National Park (NE Hungary). - In: Mahunka S. (Eds.): The fauna of the Aggtelek National Park II. Hungarian Natural History Museum, Budapest. p. 619-651.
Morell M.J. 1987. Dos nuevas especies ndel género *Xenillus* Robineau-Desvoidy, 1839 (Acari, Oribatei) del Mediterraneo Español. Redia, 70: 407-419.
Morell Zandalinas M.J. 1989. *Xenillus fernandoi* n. sp. de Valencia (España)(Acari, Oribatei). Eos, 65(1): 103-109
Niedbała W., Olszanowski Z. 2008. Mechowce (Oribatida) [Moss mites (Oribatida)]. In: Bogdanowicz, W., Chudzicka, E., Pilipiuk, I. and Skibińska, E. (Eds.) Fauna of Poland - characteristics and checklist of species. Museum and Institute of Zoology at the Polish Academy of Sciences, Warszawa. p. 79-83.
Pérez-Íñigo C. 1987. Oribátidos de las islas Azores (I) (Acari, Oribatei). Eos, 63: 197-228.
Schatz H. 2004. The genus *Xenillus* Robineau-Desvoidy, 1839 in Trentino-Alto Adige (Italian Alps), with description of *Xenillus athesis* n. sp. (Acari, Oribatida). Redia, 86: 39-45.
Schatz H. 2016. Oribatid mites (Acari, Oribatida) from the biodiversity days in South Tyrol (Prov. Bolzano, Italy). Gredleriana, 16: 113-132.
Schatz H., Fischer B.M. 2015. Neumeldungen von Hornmilben (Acari: Oribatida) für Nordtirol (Österreich) aus Trockenrasen. Gredleriana, 15: 65-76.
Subías L.S. 2004, updated 2020. Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del mundo (Excepto fósiles)(12ª actualización). Graellsia. 60: 3-305. http://escalera.bio.ucm.es/usuarios/bba/cont/docs. (In Spanish) doi:10.3989/graellsia.2004.v60.iExtra.218
Subías L.S., Arillo A. 2000. Ácaros oribátidos (Acariformes, Oribatida) de la Sierra de Mira (este de España). Bol. Asoc. Esp. Entomol., 24. 3-4: 85-104.
Weigmann G. 2006. Hornmilben (Oribatida). Die Tierwelt Deutschlands. 76. Teil. Goecke & Evers. Keltern. pp. 520.
Weigmann G. 2011. Oribatid mites (Acari: Oribatida) from the coastal region of Portugal. V. *Xenillus*, *Oribatella*, *Galumna*, *Eupelops* and *Lucoppia*. Soil Org., 83(2): 287-306.