



First records of three Pergamasinae species (Acari, Mesostigmata, Parasitidae) from Slovakia

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Abstract

We report three mite species, *Pergamasus (Thenargamasus) instatutus* Athias-Henriot, 1967, *Pergamasus (Pergamasus) laminarius* Witaliński, 1971, and *Holoparasitus ampullaris* Witaliński, 1994, from Slovakia for the first time. The genera *Pergamasus* Berlese, 1903 and *Holoparasitus* Oudemans, 1936 are predatory mites living mainly in soil and rotting organic matter of the Holarctic region, with a centre of distribution in Europe. Until now, *P. instatutus* was only recorded in Austria and Hungary, while *P. laminarius* and *H. ampullaris* were known only from Poland.

Keywords

Bird nest, Central Europe, distribution, Pergamasinae, soil mites

Academic editor: Ricarda Lehmitz | Received 14 April 2022 | Accepted 25 May 2022 | Published 27 June 2022

Citation: Ondřejková K, Fend'a P (2022) First records of three Pergamasinae species (Acari, Mesostigmata, Parasitidae) from Slovakia. Check List 18 (3): 725–731. <https://doi.org/10.15560/18.3.725>

Introduction

The family Parasitidae Oudemans, 1901 is divided into two subfamilies, Parasitinae Oudemans, 1901 and Pergamasinae Juvara-Balş, 1972. The mites of the subfamily Pergamasinae are mostly soil-inhabiting predators, but they can be found in many other habitats as nests of birds and small mammals, carcasses of small mammals, in mosses, compost, etc. (Ambros 1993; Fend'a and Mašán 2003; Fend'a and Schniererová 2005). By far the most species—32 of the genus *Pergamasus*—have been recorded in Austria (Wilmann 1953; Athias-Henriot 1967; Schmölzer 1995). Significantly fewer species have been recorded in any other country. Other countries with large numbers of recorded *Pergamasus* species are Romania and Slovakia, both with 14 species recorded (Juvara-Balş 1976; our own records). Most species of *Holoparasitus*

are known from southern and central Europe, but this genus has also been recorded from other parts of Europe, such as the British Isles and the Baltic coast (Karg 1971; Hyatt 1987; Witaliński 1994a, 1994b, 2017a; Juvara-Balş and Witaliński 2000, 2006).

The genus *Pergamasus* consists of three subgenera—*Pergamasus* s.s. Berlese, 1903, *Thenargamasus* Athias-Henriot, 1971, and *Triadogamasus* Athias-Henriot, 1971 (Athias-Henriot 1971). *Thenargamasus* species are widespread in western and central Europe, except for *Pergamasus (Thenargamasus) quisquiliarum* (Canestrini & Canestrini, 1882) which has a cosmopolitan distribution. Until now, five *Thenargamasus* species have been recorded from Slovakia (Stanko 1999; Fend'a and Mašán 2003, 2009). Four species-groups (sp.

g.) can be recognized in the subgenus *Pergamasus* s.s.: *alpinus*, *athiasae*, *beklemischevi*, and *crassipes* (Juvara-Balş 1970a). *Pergamasus laminarius* Witalinski, 1971 is included in the *beklemischevi* sp. g., which is widespread in central and eastern Europe and contains several endemic Carpathian species as well (Juvara-Balş 1970b). So far, three species of the *beklemischevi* sp. g. have been recorded from Slovakia (Fend'a and Mašan 2003; Fend'a and Ciceková 2009).

The genus *Holoparasitus* contains 60 species and does not comprise any subgenera, but nine species-groups can be recognized within it: *annulus*, *caesus*, *calcaratus*, *crassisetosus*, *hemisphaericus*, *inornatus*, *lawrencei*, *mallorcae*, and *peraltus* (Juvara-Balş 2017; Witaliński 2017b). *Holoparasitus ampullaris* Witaliński 1994 is included in the *caesus* sp. g., which contains four species. Two of them are known only from Romania, from the Southern Carpathians, while the other two species, including *H. ampullaris*, occur in Poland (Juvara-Balş 1975; Witaliński 1994a). Until now, six *Holoparasitus* species have been known from Slovakia (Willmann 1938; Gočaltovská 1963; Dudich 1994; Kalúz 1998; Fend'a and Mašan 2003, 2009).

Methods

We collected mites from the nest of *Clanga pomarina* (Brehm, 1831) and from soil using three methods—soil samples, soil samples sieving, and pitfall traps. The nests of *C. pomarina* were sampled in 1999 by a student Slávka

Siryová for her diploma thesis in cooperation with the organization Raptor Protection of Slovakia. Approximately 200 cm³ of nest lining was removed from nests after nesting season, when the nests were empty, and this substrate was processed similarly to soil samples; we used Tullgren funnels for extracting mites from these samples. We used only one nest containing mites for this study. We stored the mites in 70% ethanol and separated them from other soil arthropods using a Leica EZ4 stereomicroscope. Subsequently, we mounted the mites on permanent microscopic slides using a chloralhydrate medium. We observed the mites under a Zeiss Axioscope 5 compound microscope. We took the photographs with a Zeiss Axiocam 208 color camera using Zeiss Labscope 3 software. The photographs were stacked in Adobe Photoshop 22.0. We made the map using a software QGIS 3.16. The localities are shown in Figure 1. The abbreviation “ibid.” is used for “ibidem” and indicates repetitive data. The voucher specimens are deposited in Zoological Collection of Department of Zoology, Faculty of Natural Sciences, Comenius University of Bratislava, Slovakia.

Results

Pergamasus (Thenargamasus) instatutus Athias-Henriot, 1967

Pergamasus instatutus Athias-Henriot 1967: 686; figs. 31, 68, 124, 278, 284, 317, 326.

Pergamasus (Thenargamasus) instatutus—Karg 1993: 392, fig. 310h.

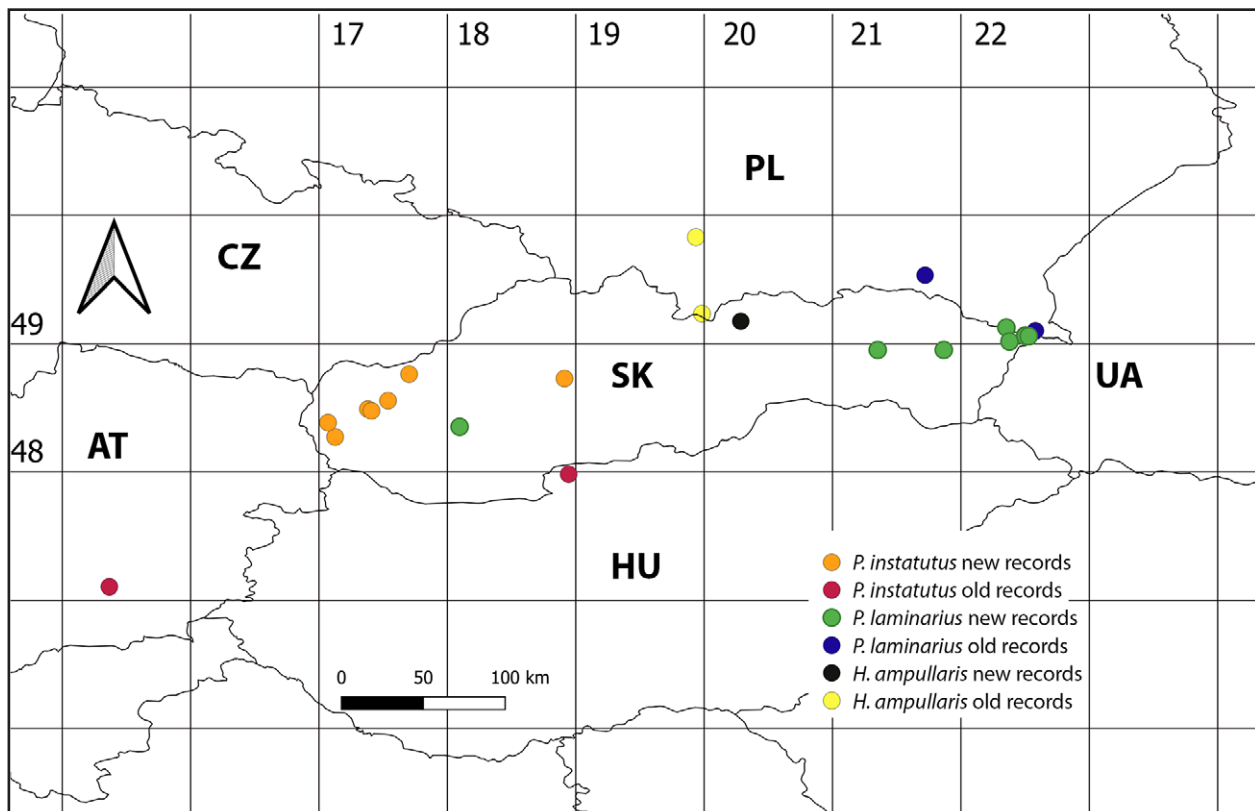


Figure 1. Map showing known distribution and new distributional records of *Pergamasus instatutus*, *P. laminarius*, and *Holoparasitus ampullaris*.

Material examined. New material. SLOVAKIA – **Banská Bystrica region** • Kremnické vrchy, Kremnické Bane, Piargy; 48.7258°N, 018.9105°E; 750 m alt.; 12.X.2013; K. Ondrejková leg.; soil sample; 1 ♀, slide KA94013A – **Bratislava region** • Malé Karpaty, Borinka, NPR Strmina; 48.2719°N, 017.1248°E; 448 m alt.; 15.XII.2014; P. Fend'a leg.; pitfall trap; 1 ♀, slide P12A0214 • *ibid.*; 19.I.2015; 2 ♀ • *ibid.*; 20.IV.2015; 4 ♀ • *ibid.*; 17.V.2015; 4 ♀ • *ibid.*; 22.VIII.2015; 7 ♀ • Malé Karpaty, Modra-Piesok; 48.3829°N, 017.0685°E; 428 m alt.; 20.V.2015; K. Ondrejková leg.; soil sample sieving; 1 ♀, slide KA3015A – **Trenčín region** • Myjavská pahorkatina, Stará Turá, Dubník; 48.7603°N, 017.7001°E; 240 m alt.; 13.VII.1997; P. Fend'a leg.; soil sample; 3 ♀, slides SU3097A, SU3097B.

Revised material (published as *P. barbarus* in Fend'a and Ciceková 2005). SLOVAKIA – **Trnava region** • Malé Karpaty, Dechtice, PR Katarínka; 48.5549°N, 017.5360°E; 340 m alt.; 10.V.2001; M. Holecová leg.; soil sample sieving; 1 ♀, slide HO6006 • *ibid.*; 12.X.2011; 3 ♀ • *ibid.*; 4.X.2002; 2 ♀ • *ibid.*; 14.V.2002; 1 ♀ • Malé Karpaty, Lošonec, PR Lošonský háj; 48.4751°N, 017.4067°E; 260 m alt.; 13.IX.1999; M. Holecová leg.; soil sample sieving; 11 ♀, slide HO1399 • *ibid.*; 2.VIII.1999; 15 ♀ • *ibid.*; 19.X.1999; 6 ♀ • Malé Karpaty, Lošonec, limestone quarry; 48.4891°N, 017.3790°E; 310 m alt.; 13.V.2002; M. Holecová leg.; soil sample sieving; 1 ♀, slide HO1805 • *ibid.*; 18.VI.2002; 2 ♀.

Identification. Only females are known. The original description provided by Athias-Henriot (1967) is concise but contains the most important and characteristic features. The most distinctive feature that distinguishes this species from all other *Pergamasus* species is the form of the endogynium (Fig. 2A): spherules are round, a stipule is deeply divided, and branches are diverged into a T-shape; trabecules are long and straight with short fingerlike or sharp protrusions that are usually located in the middle part of the trabecules and apically. Gnathotectum with five prongs and several small additional denticles between lateral prongs. Anterolateral margins of epigynium almost straight (Fig. 2B). Lyrifissures *iv2* are short and located closer to the anterior margin of a paragynial shield than to setae *st4* (Fig. 2C).

This species is very similar to *Pergamasus* (*Thenargamasus*) *barbarus* (Berlese, 1904) (Fig. 2D–F), but *P. instatutus* differs by the form of the endogynium. The stipule of *P. instatutus* only slightly exceeds the spherules while the stipule of *P. barbarus* is usually twice as long as the spherules. Branches of the stipule in *P. barbarus* are diverged into a Y-shape instead of a T-shape and there are no teeth between the branches, unlike in the species *P. instatutus*. In addition, the trabecules of *P. barbarus* are bent backwards apically, possess long sharp protrusions resembling thorns pointing adaxially, and small sharp protrusions can be present at the level of the spherules.

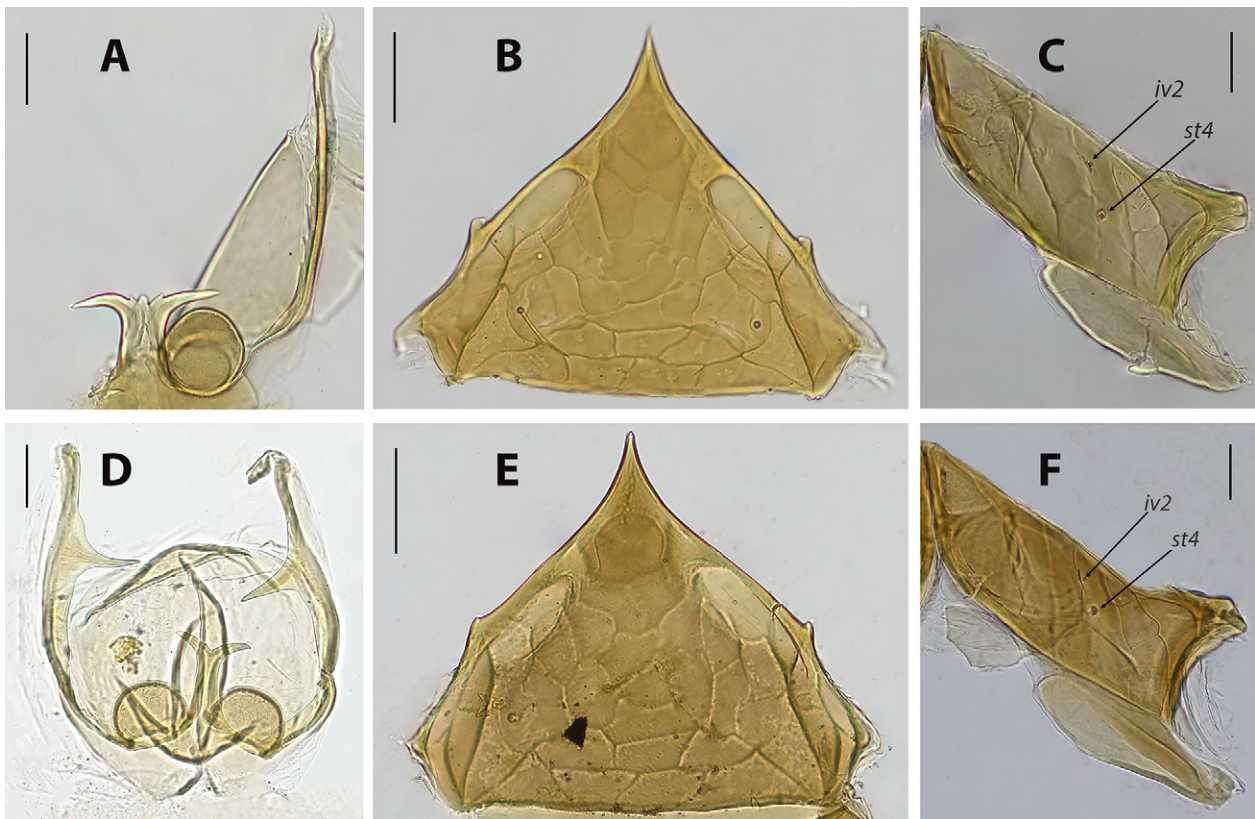


Figure 2. A comparison of females of *P. instatutus* and *P. barbarus*. **A–C.** *P. instatutus*. **D–F.** *P. barbarus*. **A, D.** Endogynium. **B, E.** Epigynium, dorsal aspect. **C, F.** Paragynium. Abbreviations: *iv2* = marking of lyrifissures, *st4* = marking of setae. Scale bars: A, C, D, F = 50 µm; B, E = 100 µm.

***Pergamasus (Pergamasus) laminarius* Witaliński, 1971**

Pergamasus laminarius Witaliński 1971: 675, figs. 5–9

Material examined. New material. SLOVAKIA – **Nitra region** • Tribeč, Zobor, Zoborská lesostep; 48.3501°N, 018.0935°E; 402 m alt.; 1.IV.2017; P. Fend'a leg.; soil sample; 2 ♀, slide SU3017 – **Prešov region** • Ondavská vrchovina, Myslina – Sosnina; 48.9504°N, 021.8648°E; 250 m alt.; 16.X.1999; S. Siryová leg.; nest of *Clanga pomarina* (Brehm, 1831); 2 ♀, 1 ♂, slides ND17299A–D • Slanské vrchy, Kokošovce, NPR Kokošovská dubina; 48.95°N, 021.35°E; 460 m alt.; 25.X.2000; E. Schniererová leg.; soil sample; 1 ♂, slide SU10701.

Revised material (published as *P. brevicornis* in Fend'a and Mašán 2003). SLOVAKIA – **Prešov region** • Bukovské vrchy, Nová Sedlica, Zakasarenský creek valley; 49.0568°N, 022.5256°E; 480 m alt.; 06.VI.1999; P. Fend'a leg.; soil sample; 1 ♂, slide SU4999 • Bukovské vrchy, Nová Sedlica, Zbojský creek valley; 49.0617°N, 022.4991°E; 441 m alt.; 19.VI.1998; P. Fend'a leg.; soil sample; 2 ♀ • Bukovské vrchy, Nová Sedlica, Zbojský creek valley; 49.0579°N, 022.5012°E; 470 m alt.; 06.VI.1999; P. Fend'a leg.; soil sample; 3 ♂♂ • Bukovské vrchy, Ruské – Jaforka (meadows on Kepovec); 49.1231°N, 022.3521°E; 580 m alt.; 9.VI.1999; P. Fend'a leg.; soil sample; 1 ♀, 5 ♂ • Bukovské vrchy, PR Bzaná; 49.0155°N, 022.3767°E; 400 m alt.; 10.VI.1999; P. Fend'a leg.; soil sample; 8 ♂.

Identification. *Pergamasus laminarius* is very similar to *Pergamasus brevicornis* (Berlese, 1904) but is considerably smaller, the length of idiosoma is 890–1200 µm in males of *P. laminarius* and 1130–1400 µm in males of *P. brevicornis*. The females can be distinguished on the basis of the endogynium and epigynium (Fig. 3). The endogynium possesses several small, well-discernible denticles on the wall of the endogynial sac, and the absence of adaxial processes of trabecules is characteristic (Fig. 3A, B). The epigynium (Fig. 3D) is relatively short and lacks the teeth on its inner (dorsal) surface that are present in *P. brevicornis* (Fig. 3E).

Males differ mainly by the shape of chelicerae and armature of tibia II (Fig. 4). The fixed digit is wide, thinner apically and with a dorsal hump (Fig. 4A) but not a tooth as in *P. brevicornis* (Fig. 4E). The longitudinal apophysis of tibia II is proximally higher and triangular and without transverse stripes (Fig. 4B). The males of *P. laminarius* and *P. brevicornis* can be confused due to a characteristic saddle-shaped apophysis on genu II (Fig. 4C, G). Witaliński (1971) pointed out characteristic endings of setae *pvl* on tibia and genu IV. However, the endings of these setae are similar in several species of the *beklemischevi* species-group (Fig. 4 D, H).

***Holoparasitus ampullaris* Witaliński, 1994**

Holoparasitus ampullaris Witaliński 1994b: 221.

Holoparasitus excisus (Berlese, 1906)—Micherdziński 1969: 379, figs. 275, 276 (female).

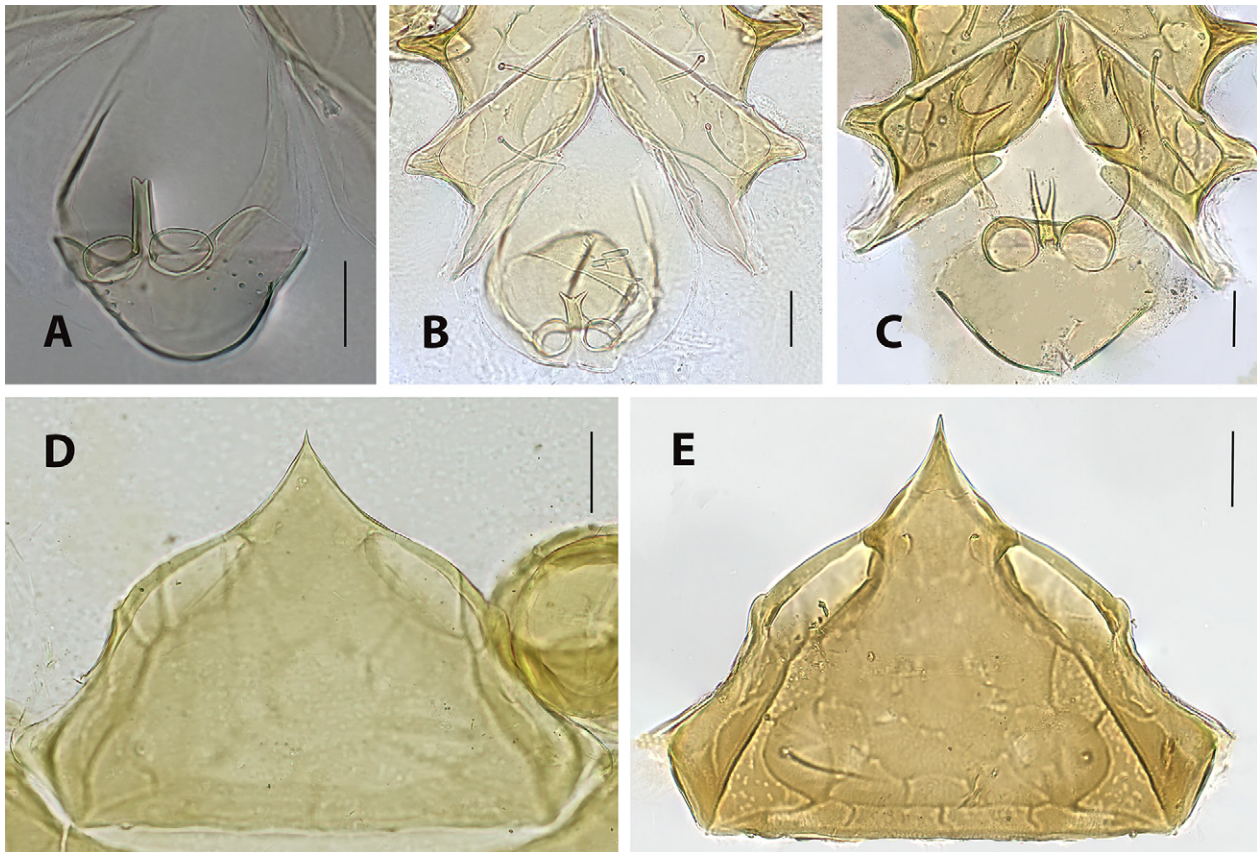


Figure 3. A comparison of females of *Pergamasus laminarius* and *P. brevicornis*. **A, B, D.** *P. laminarius*. **C, E.** *P. brevicornis*. **A.** Endogynium with denticles in endogynial sac well discernible. **B, C.** Endogynium and paragnathia. **D, E.** Epigynium, dorsal aspect. Scale bars = 50 µm.

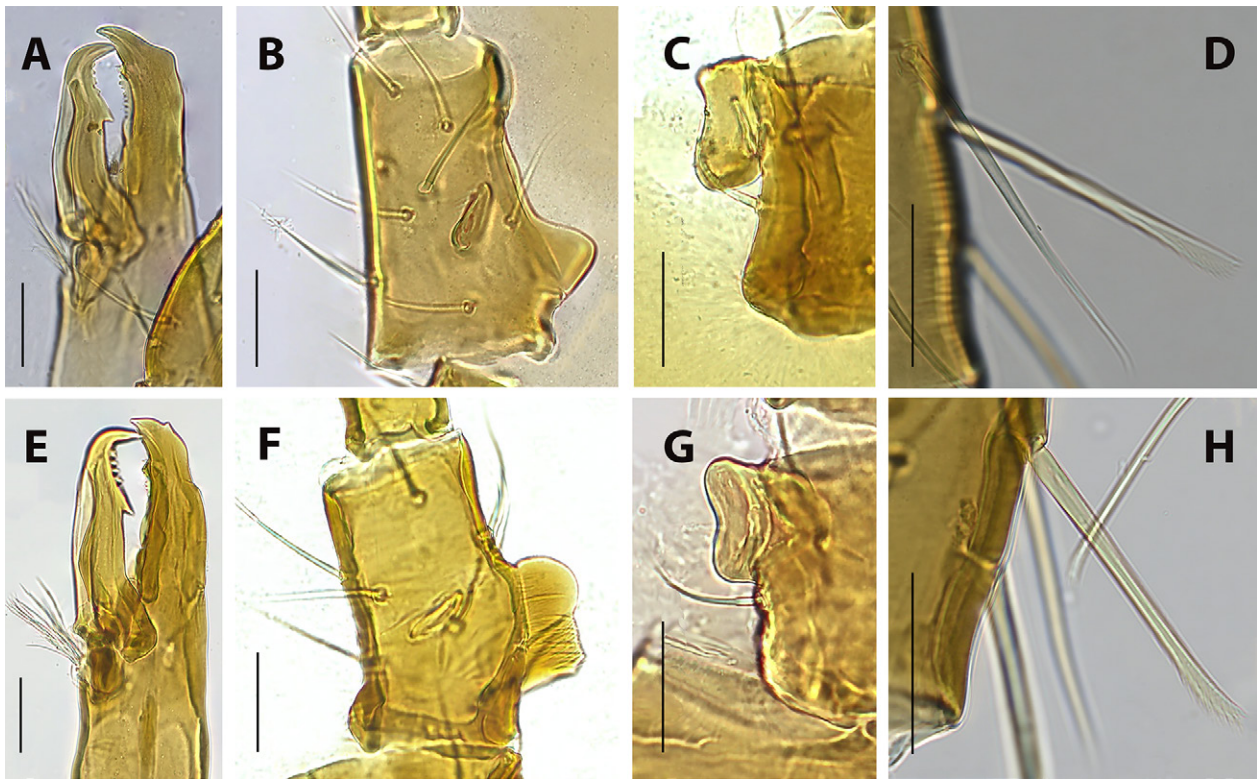


Figure 4. A comparison of males of *Pergamasus laminarius* and *P. brevicornis*. **A–D.** *P. laminarius*. **E–H.** *P. brevicornis*. **A, E.** Chelicera, lateral view. **B, F.** Tibia of leg II. **C, G.** Genual apophysis on leg II. **D, H.** Seta *pv1* on tibia IV. Scale bars = 50 µm.

Holoparasitus excisus—Witaliński 1972: 223, figs. 7–10 (female and male).

Holoparasitus excisus—Karg 1993: 380, figs. 298f, 309f (female and male).

Material examined. New material. SLOVAKIA – Prešov region • Popradská kotlina Basin, Tatranská Lomnica, Jamy; 49.1634°N, 020.2668°E; 934 m alt.; 2.VII.2020; P. Fend'a leg.; birch (*Betula pendula* Roth) groove, soil sample; 2 ♀, 5 ♂, slides SU 5320 and SU 5420 • *ibid.*; 9.X.2020; P. Fend'a leg.; soil sample with grass rhizosphere; 3 ♀, 4 ♂ • *ibid.*; wood detritus; 7 ♀, 6 ♂ • Popradská kotlina Basin, Tatranská Lomnica, Jamy; 49.1631°N, 020.2628°E; 959 m alt.; 1.VII.2020; P. Fend'a leg.; Norway spruce (*Picea abies* (L.) H. Karst) grove, wet moss in a creek; 2 ♀ • *ibid.*; moss sample; 1 ♀, 4 ♂, 1 deutonymph • *ibid.*; 2.VII.2020; P. Fend'a leg.; needle litter and humus; 2 ♂ • Popradská kotlina Basin, Tatranská Lomnica, Tri jazierka; 49.1606°N, 020.2617°E; 1019 m alt.; 2.VII.2020; P. Fend'a leg.; pine (*Pinus sylvestris* L.) grove, soil sample; 1 ♀ • *ibid.*; moss with soil; 1 ♀, 3 ♂ • *ibid.*; 9.X.2020; P. Fend'a leg.; soil sample (in depth 30 cm); 5 ♀.

Identification. The *caesus* sp. g. can be easily distinguished from other *Holoparasitus* species by entire sternum without pronounced axial band and bubble-shaped endogynium (Fig. 5A) of females, absent excipulum (an oval pattern on sternal cuticle, between coxa II and III) and present sternogenital shield with distinct reticulation between legs II of males (Fig. 5B). *Holoparasitus ampullaris* can be distinguished from other three species in the *caesus* sp. g. by wide tube leading to the

endogynial sac (ca. ½ of the sac diameter) of females and by apically pointed gnathotectum (Fig. 5C) and the presence of only one spur on tibia II of males (Fig. 5D) (Witaliński 2017b).

Discussion

Pergamasus instatutus was previously found in Austria, near Graz and in northern Hungary, which are almost 300 km apart (Athias-Henriot 1967). The new records are a little further north but basically somewhere between these two places. However, these are the first records of this species since Athias-Henriot (1967) described it. Her material was collected in 1944 and 1952. *Pergamasus instatutus* is probably widespread in deciduous forests in the lower mountains of Austria, Hungary, and Slovakia. Intensive research on soil mites can still provide information on wider distributional range of *P. instatutus*, but it is noteworthy that this species has not been found in Romania, despite intensive research in this country (Juvara-Balş 1976). Although we found 65 individuals, we did not find males, and so the males remain unknown.

Pergamasus laminarius was previously found only in southern Poland, near the Slovak border (Witaliński 1971; Gwiazdowicz and Sznajdrowski 1999). This species was found in soil samples often together with the species *P. brevicornis*. However, while *P. brevicornis* is common and widespread in Europe, *P. laminarius* is a rarer species distributed in the Carpathians. We found it in a wide range of habitats from xerophile meadows to beech forests.

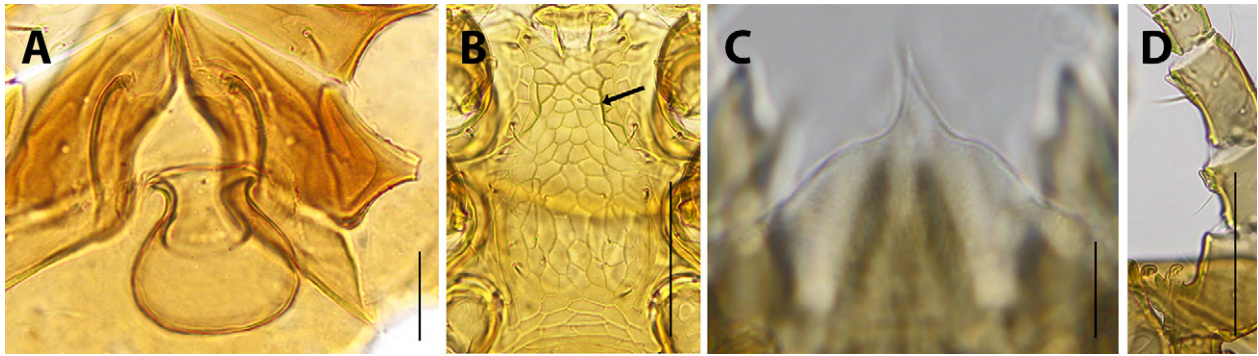


Figure 5. *Holoparasitus ampullaris*. **A.** Female endogynium. **B.** Male sternogenital shield, the arrow points to thicker reticulation between legs II. **C.** Male gnathotectum. **D.** Apophyses of male leg II. Scale bars: A = 50 µm; B, D = 100 µm; C = 20 µm.

Only two records of *Holoparasitus ampullaris* were known, both from Poland. Micherdziński (1969) found it in Kasprowy Wierch in the Tatra Mountains for the first time, but he published it as *H. excisus*. Witaliński (1972) recorded it from the environs of Krakow in southern Poland, also as *H. excisus*. He later described a new species based on those individuals (Witaliński 1994b). Kasprowy Wierch, where this species was found for the first time, is only a few meters from the Slovak border, so it was no surprise to us that we found *H. ampullaris* also on the Slovak side of the Tatras. While in Poland it was found in mosses and hummus from rock crevices, as well as in litter and mosses in young coniferous forests, we found it in soil and litter of young mixed forest. Although only nine individuals are known from Poland, we found up to 47 individuals, and this species was present in 11 of the 20 samples taken from our study area.

Acknowledgements

We thank prof. Wojciech Witaliński of Jagiellonian University (Poland) for confirming the identification of *Pergamasus laminarius*. We would also like to thank all collectors for providing the materials. And we want to thank the anonymous reviewer and the subject editor, Ricarda Lehmitz, for their comments and corrections, which contributed to the improvement of the manuscript.

Authors' Contributions

Conceptualization: KO. Investigation: KO, PF. Visualization: KO, PF. Writing – original draft: KO. Writing – review and editing: PF.

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