

Diversity and Distribution of the Genus *Friesea* (Collembola: Neanuridae) in Romania with Description of Three New Species

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Cristina Fiera and Wanda Maria Weiner (2016) The Romanian Neanuridae is still not well known. In this study we review the *Friesea* species present in Romania and describe three new species, namely *Friesea posada* sp. nov., *F. mirceai* sp. nov. and *F. stampa* sp. nov. *Friesea posada* sp. nov. is unique among six other species sharing some morphological characters (6 + 6 eyes, the presence of furca and three anal spines), but the new species has one clavate tenent hair on the tibiotarsi and a reduced mucro which is sometimes absent. The other two species, *F. mirceai* sp. nov. and *F. stampa* sp. nov., belong to the group of species characterized by the presence of 5 + 5 eyes, 3 + 3 chaetae on dens and 3 anal spines on Abd. VI. In *F. stampa* sp. nov. the chaetotaxy of abdominal tergum IV differs, and in *F. mirceai* sp. nov. the mucro is present and chaeta A1 on tibiotarsus is capitated and longer than the inner edge of claw. Four species are recorded for the first time in Romania: *F. emucronata* Stach, 1922, *F. cf. tolosana* Cassagnau, 1958, *F. atypica* Cassagnau, 1958 and *F. aeolica* Dallai, 1973. A total of thirteen species of *Friesea* is reported from Romania and the distribution maps are given for all.

Key words: Chaetotaxy, New records, Distribution maps.

BACKGROUND

The species richness of Collembola, in particular within the endemic-rich Neanuridae family, is poorly known in Romania. Only 41 species of Neanuridae are known for Romania, of which only eight species of *Friesea* in the subfamily Frieseinae. These are *F. mirabilis* (Tullberg, 1871), *F. claviseta* Axelson, 1900, *F. acuminata* (Denis, 1925), *F. afurcata* (Denis, 1926), *F. stachi* Kseneman, 1936, *F. handschini* Kseneman, 1938, *F. albida* Stach, 1949: in Fiera (2007) and *F. truncata* Cassagnau, 1958 (see Fiera 2008).

The genus *Friesea* von Dalla Torre, 1895 is distinguished from other genera of Neanuridae by its characteristic elongate, parallel-sided body, hook-shaped maxilla carrying a toothed internal lamella, triangular maxillary capitulum with two

lamella, anal spines present or absent, the lack of the postantennal organ and by the presence of S-schaetae on antennal segment IV (Massoud 1967). It has diversified in a large number of species of similar habitus, characterized by a combination of regressive characters (pigment, eyes, furca, tibiotarsal chaetotaxy), and various degrees of capitulation of tibiotarsal tenent hairs and of body macrochaetae (Weiner et al. 2009). The genus comprises of 183 species globally (Queiroz and Mendonça 2015; Bellinger et al. 2016).

Many areas of Romania are poorly explored for springtails diversity due to lack of taxonomic expertise and difficulties in accessing some habitats and areas like the Carpathians Mountains or coastal dunes near the Black Sea. Many remote and poorly studied localities in Romania need to be surveyed.

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In the present study, the genus *Friesea* in this region is reviewed, three new species are described (*Friesea posada* sp. nov., *F. mirceai* sp. nov. and *F. stampa* sp. nov.) and new records for Romanian fauna are reported (*F. emucronata* Stach, 1922, *F. cf. tolosana* Cassagnau, 1958, *F. atypica* Cassagnau, 1958 and *F. aeolica* Dallai, 1973). Distribution maps for all the Romanian *Friesea* species are provided.

MATERIALS AND METHODS

Samples of leaf litter, soil and mosses from different localities in Romania were extracted with Berlese funnels (for sampling details see Supplement). The specimens were cleared in lactic acid and KOH, and subsequently mounted on slides using Marc Andre II or Swan's medium. The species were studied using an Axio Scope A1 Zeiss phase-contrast microscope. Slide-mounted springtails were drawn using a compound microscope LEICA DM2500 equipped with camera lucida as well as phase-contrast and differential interference contrast optical systems.

Nomenclature of antennae follows Yosii (1962) and D'Haese (2003), of labial chaetae follows Massoud (1967: 41A and B) and of tibiotarsal chaetotaxy follows Deharveng and Bedos (1991). Given uncertainties in the homologies of the terga chaetae numbered in the a, m, p system (Yosii 1956; Cassagnau 1974; Jordana et al. 1997), we used the chaetal group system (Potapov and Banasco 1985; Deharveng and Bedos 1991: Fig. 8).

Mapping species occurrences

Regarding Romania, we compiled and updated all species occurrences of the *Friesea* genus from our own field surveys and the available scientific literature. The occurrence records were georeferenced in ArcGIS 10.3 (ESRI 2015) and stored in an ESRI file geodatabase for additional analysis and map making. We extracted the occurrence records of *Friesea* species from published data and presented here because most of them are in Romanian language and sometimes they are not easily accessible. We added our original unpublished field data for more than 200 specimens of *Friesea* collected during the last ten years.

We initially stored and managed the records in a Microsoft Access database at the Institute of

Biology, Bucharest. We aggregated the occurrence records to the Universal Transverse Mercator (UTM) grid system at a spatial resolution of 25 km² (UTM 5 × 5 km), and assigned the corresponding UTM 5 × 5 km grid cell code to the records with a spatial resolution of ≤ 25 km² using primarily the UTM index of localities (Lehrer and Lehrer 1990).

This article was registered in the Official Register of Zoological Nomenclature (ZooBank) as 5CA6A329-8E4F-4C1B-941B-F9FA5E9DB350.

RESULTS

Collembola Lubbock, 1870
Family Neanuridae Börner, 1901
Subfamily Frieseinae Massoud, 1967
Genus *Friesea* Dalla Torre, 1895

Friesea posada sp. nov.

urn:lsid:zoobank.org:act:14F3927B-EC5D-4237-8620-912CA550A72A
(Figs. 1A-E, 8S)

Type material: Holotype: Adult male, on slide, under access number RO-Fr3-IBB, deposited in IBB.

Paratypes: 16 specimens: 13 paratypes deposited in IBB, four females, seven males and two young specimens on slides, RO-Fr5-17; three paratypes deposited in ISEA (one female RO-Fr1-ISEA and two males RO-Fr2,4-ISEA).

Type locality: Valea Largă, Prahova County, Romania (45°18'20.638"N, 25°34'19.943"E), 771 m alt., beech forest, near Posada locality, mosses, soil and litter.

Etymology: The species is named after its type locality, Posada, Prahova County.

Other material examined: Seventeen specimens from Posada locality, two juveniles (RO-Fr5,16), 7.vii.2008, one male (RO-Fr6) collected on 15.v.2008; four males (RO-Fr7;10,13,14) and two females (RO-Fr8,9) collected on 7.vii.2008; one female (RO-Fr11) and one male (RO-Fr12) collected on 8.viii.2008. Suceava County, Putna Valley, 47°29'21.685"N, 25°23'34.422"E, 992 m altitude, mosses on rocks, 26.viii.2014, two males, two females and one juvenile (RO-Fr162-166), leg. C. Fiera (IBB).

Description: Habitus and buccal cone typical for the genus *Friesea*. Length: Holotype male: 0.64 mm, Paratypes: males 0.5-0.72 mm, females 0.63-0.79 mm. Colour blue in alcohol. Integument secondary granules rather small.

Antennae about 3/4 of head length. Antennal

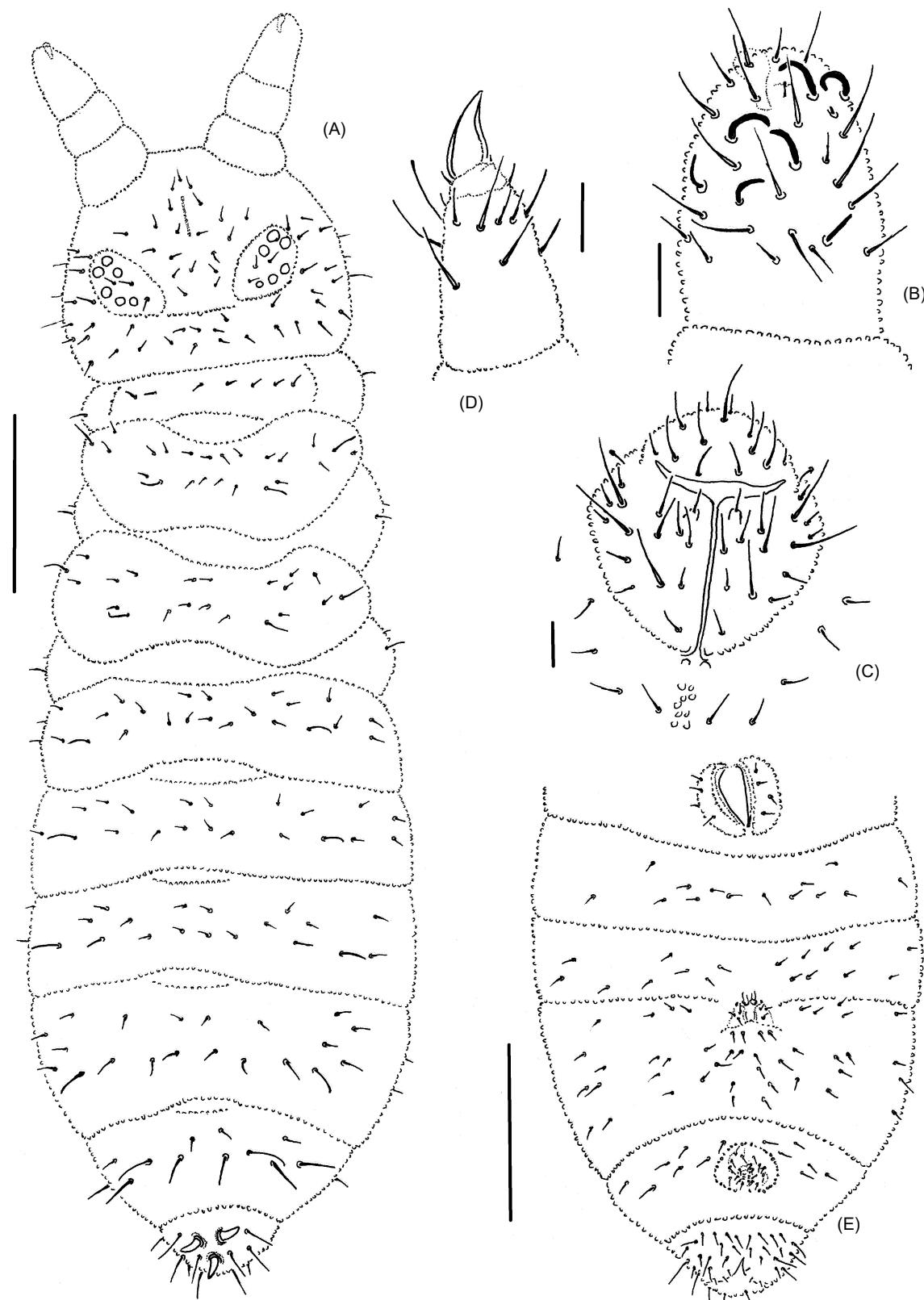


Fig. 1. *Friesea posada* sp. nov., holotype male (RO-Fr3-IBB). (A) Habitus and dorsal chaetotaxy; (B) Fourth antennal segment; (C) Labium; (D) Tibiotarsal chaetotaxy and claw of leg III; (E) Chaetotaxy of abdominal sterna II-VI and ventral tube. A and E, scale bars = 0.1 mm. B-D, scale bars = 0.01 mm.

segment I with 7 chaetae, antennal segment II with 12 chaetae. Sensory organ of antennal segment III consisting of 2 small subcylindrical internal s-chaetae, 2 subcylindrical guard s-chaetae, and 1 ventral s-microchaeta. Antennal segment IV with 6 subcylindrical s-chaetae (S1-4, S7-8 present), 1 small s-microchaeta placed between S7 and S8, and 1 small subapical organite. Apical vesicle simple (Fig. 1B).

Ocelli 6 + 6, postantennal organ absent. Chaetotaxy of labrum: 4/5,3,4, labium with papillated chaeta L (Fig. 1C).

Dorsal chaetotaxy as in figure 1A, with relatively long (longer on hind terga) subequal chaetae and slightly longer s-chaetae (subequal to longest ordinary chaetae on abdominal terga IV-V). Chaetae s relatively thick and short from thoracic tergum II to abdominal tergum III, thicker on abdominal tergum IV, longer and more slender on abdominal tergum V. Their formula per half tergum: 022/11111. Head with chaetae a0, d0 and 3 chaetae oc. Thoracic tergum I with 4 + 4 (3 + 4, 3 + 3) chaetae. Thoracic tergum II with 12 + 12 chaetae (4 chaetae Di including a2, 4 De including s-chaeta in position of p3, 3 DI including one s-chaeta and one s-microchaeta (ms)). Thoracic tergum III with 10 + 10 (11 sporadically) chaetae (same arrangement as previous tergum, without a2 and ms, sporadically with 5 chaetae De). Thoracic sterna I-III without chaetae. Abdominal tergum V with 2 + 2 chaetae between s-chaetae. Abdominal tergum VI with 3 anal spines.

Ventral abdominal chaetotaxy as in figure 1E. Ventral tube with 4 + 4 chaetae.

Anal valves each with 3 chaetae hr (on lower valves as microchaetae, on upper valve central one as microchaeta and two others as mesochaetae).

Tibiotarsi I, II and III with 18, 18 and 17 chaetae respectively, of which 11 in the distal whorl, without chaetae M (Fig. 1D). Chaetae A1 (slightly capitulated and the longest one, longer than inner edge of claw), A2, A3 and A6 (blunt at the top and long, but not reaching top of the claw). Tibiotarsus III without chaeta B7. Femora I, II and III with 12, 11 and 10 chaetae respectively, trochanters I, II and III with 5, 5 and 5 chaetae, coxae I, II and III with 3, 8 and 8 chaetae, subcoxae 2 of legs I, II and III with 0, 2 and 2 chaetae, subcoxae 1 of legs I, II and III with 1, 2 and 2 chaetae. Claw untoothed.

Tenaculum with 2 teeth on each ramus, furca with 3 + 3 chaetae, mucro mostly hooked at the top (three specimens without mucronal hook).

Mucro with small lamella, well separated from dens. Chaetotaxy of manubrium as in figure 1E.

Ecology: The species lives in leaf litter, soil and mosses on soil in beech forest and also in mosses on rocks in the Posada region of Romania.

Remarks: Six species of *Friesea* were known from Romania, which share the same morphological characters (6 + 6 eyes, the presence of furca and three anal spines). Three have been described from Europe: *F. duodecimoculata* from Italy by Denis (1926), *F. atypica* from France by Cassagnau (1958), *F. isabelae* from Spain by Arbea and Jordana (1993), two from Asia: *F. paitooni* from Thailand by Deharveng and Bedos (1991), *F. loicmatilei* from Mongolia by Weiner and Najt (2001) and one from Oceania (Melanesia): *F. septem* from Vanuatu by Weiner et al. (2009). These species differ in some morphological characters (Table 1). The new species described here is most similar to *F. paitooni*, but is distinguished by the presence of clavate tenent hairs on the tibiotarsi (absent in *F. paitooni*) and the size of the mucro (small, but distinct in *F. paitooni*, reduced or absent - sometimes asymmetrically - in the new species).

Friesea posada sp. nov. differs from *F. loicmatilei* by the apical vesicle on antennal segment (bi-trilobed in *F. loicmatilei* and simple in the new species) and by the number of clavate chaetae on tibiotarsi I-III (one in the new species, five in *F. loicmatilei*). Abdomen VI is without clavate chaetae in *Friesea posada* sp. nov., like in other species of the group (Table 1) except for *F. septem*. The mucro is absent in the two European *Friesea* species (*F. isabelae* and *F. atypica*), while its presence in *F. posada* sp. nov. was inconstant.

Five species of *Friesea* of the above mentioned group (*F. posada* sp. nov., *F. paitooni*, *F. loicmatilei*, *F. isabelae* and *F. septem*) have 18,18,17 tibiotarsal chaetae (A4 and A5 present), while *F. atypica* and *F. duodecimoculata* have 17, 17,16 tibiotarsal chaetae (one A4/5 chaeta present).

The new species differs from *F. septem* by the number of sensilla on antennal segment IV (6 in *Friesea posada* sp. nov. and 7 in *F. septem*) and by the absence of clavate chaetae on abdominal segment VI.

***Friesea mirceai* sp. nov.**

urn:lsid:zoobank.org:act:A9807D5A-DF4A-444E-ABC5-A13B171A3131
(Figs. 2A-E, 8S)

Type material: Holotype: Adult female, on slide, under access number RO-Fr147-IBB, deposited at IBB. Paratypes: Two females (RO-Fr110 deposited in IBB and RO-Fr148, deposited in ISEA).

Type locality: Olt Valley, Malaia locality, Vâlcea County, Romania ($45^{\circ}21'11.18''N$, $24^{\circ}01'11.74''E$), 494 m alt., beech forest, leaf litter near rocks, 01.xi.2012, leg. C. Fiera (IBB).

Etymology: The new species is dedicated to Mircea Fiera, husband of the first author, who helped several times in the field studies of Collembola.

Description: Habitus and buccal cone typical for the genus *Friesea*. Length: Holotype female: 0.56 mm. Paratypes female: 0.65-0.78 mm. Colour blue in alcohol. Integument secondary granules rather small.

Antennae about 2/3 of head length. Antennal segment I with 7 chaetae, antennal segment II with

13 chaetae (11-14). Sensory organ of antennal segment III consisting of 2 small subcylindrical internal s-chaetae, 2 subcylindrical guard s-chaetae, (ventral one longer and "s" shaped) and s-microchaeta. Antennal segment IV with 6 subcylindrical s-chaetae (S1-4, S7-8 present), 1 small s-microchaeta placed between S7 and S8, and 1 small subapical organite. Apical vesicle simple (Fig. 2B).

Ocelli 5 + 5, postantennal organ absent. Chaetotaxy of labrum: 4/5,3,4. Labium with papillated chaeta L (Fig. 2C).

Dorsal chaetotaxy as in figure 2A, sometimes with asymmetry, with relatively short (longer on posterior abdominal terga), subequal chaetae and slightly longer s-chaetae (subequal to longest ordinary chaetae on abdominal terga IV-V. Their formula per half tergum: 022/11111. Head with (paratypes) or without (holotype) chaetae a0, with chaeta d0 and 3 chaetae oc. Thoracic tergum I with 4 + 4 chaetae. Thoracic tergum II with 12 + 12 chaetae (4 chaetae Di including a2, 4 De including s-chaeta in position of p3, 4 DI including one s-chaeta and one s-microchaeta (ms)). Thoracic

Table 1. Morphological differences between *F. posada* sp. nov. and other *Friesea* species with 6 + 6 eyes and three anal spines

Characters	<i>posada</i> sp. nov.	<i>paitooni</i>	<i>loicmatilei</i>	<i>isabelae</i>
Th. I- number of chaetae	4 + 4	4 + 4	4 + 4	4 + 4
Number of sensilla on Ant. IV	6	6	6	6
Stage of furca (acc. Cassagnau 1958) (Mucro present/absent)	2(+)*	2(+)	2(+)	3(-)
Abd. VI with clavate chaetae	-	-	-	-
Number of chaetae on tibiotarsi I-III	18,18,17	18,18,17	18,18,17	18,18,17
Tibiotarsi I-III with clavate chaetae	+ (1)	-	+ (5)	-
Apical vesicle on Ant. IV	simple	simple	bi-trilobed	simple
Number of chaetae on De of Th II	3 + s	3 + s	3 + s	4 + s
Ocelli present	ABCEFG	ABCEFG	ABCEFG	ABCDGF**

Characters	<i>septem</i>	<i>atypica</i>	<i>duodecimoculata</i>
Th. I- number of chaetae	3 + 3	4 + 4***	4 + 4
Number of sensilla on Ant. IV	7	6	6
Stage of furca (acc. Cassagnau 1958) (Mucro present/absent)	2(+)	3(-)	2(+)
Abd. VI with clavate chaetae	+	-	-
Number of chaetae on tibiotarsi I-III	18,18,17	17,17,16	17,17,16 (Fanciulli, pers. comm.)
Tibiotarsi I-III with clavate chaetae	-	-	+ (4-5)
Apical vesicle on Ant. IV	simple	simple	simple
Number of chaetae on De of Th II	3 + s	3 + s***	3 + s
Ocelli present	ABCEFG	abcefg***	ABCEFG

*Three specimens without mucronal hook--stage 3(-). **According to fig. 2h in Arbea and Jordana 1993. ***Personal communication from anonymous reviewer (R3).

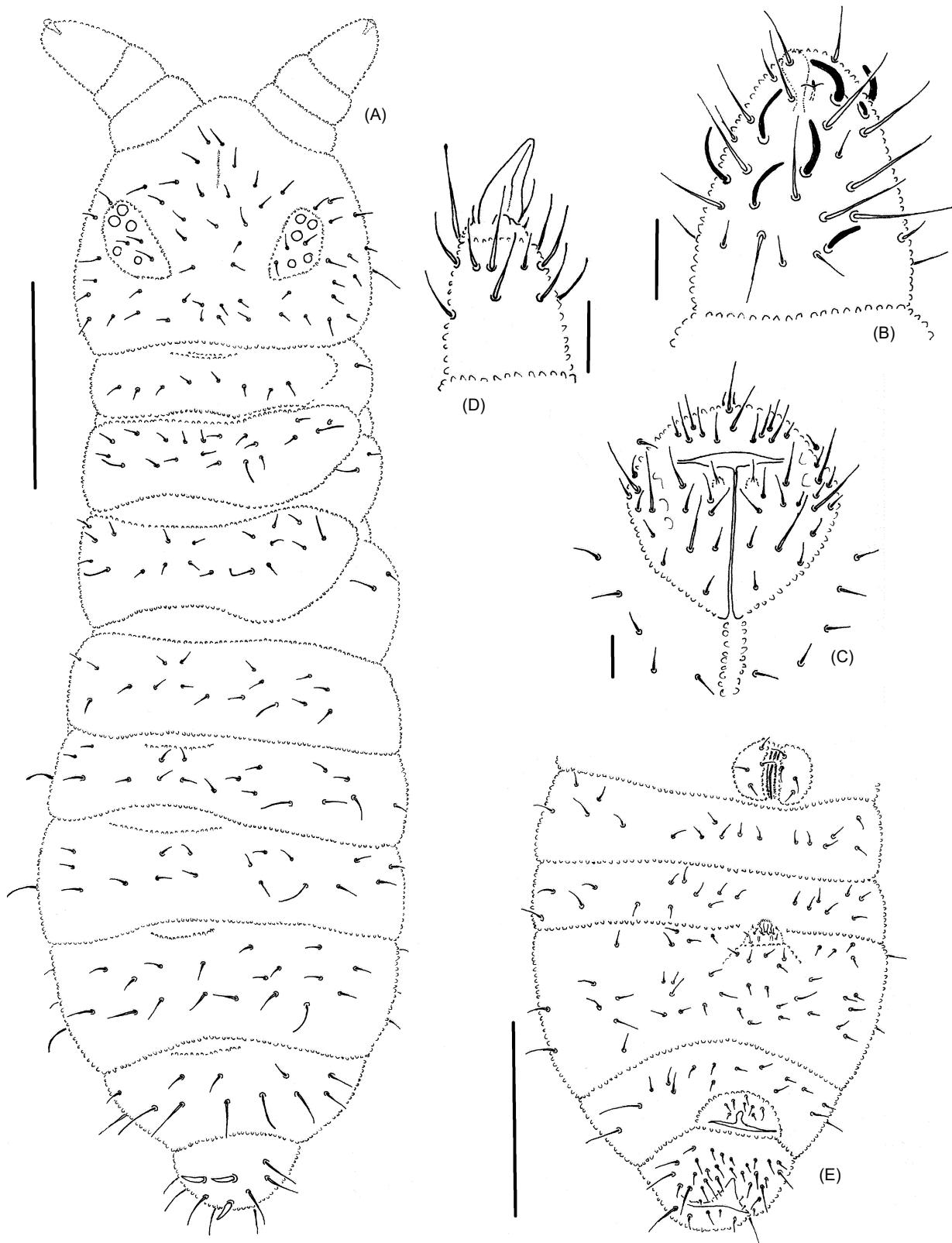


Fig. 2. *Friesea mirceai* sp. nov., holotype female (RO-Fr147-IBB). A) Habitus and dorsal chaetotaxy; (B) Fourth antennal segment; (C) Labium; (D) Tibiotarsal chaetotaxy and claw of leg III; (E) Chaetotaxy of abdominal sterna II-VI and ventral tube. A and E, scale bars = 0.1 mm. B-D, scale bars = 0.01 mm.

tergum III with 10(11) + 10(11) chaetae (same arrangement as previous tergum, without a2 and ms, sometimes with 5 chaetae De). Thoracic sterna I-III without chaetae. Abdominal tergum V with 2 + 2 chaetae between s-chaetae. Abdominal tergum VI with 3 anal spines.

Ventral abdominal chaetotaxy as in figure 2E and with asymmetry. Ventral tube with 4 + 4 chaetae. Anal valves each with 3 chaetae hr (on paired valves as microchaetae, on upper valve medial one as microchaeta and two others as mesochaetae).

Tibiotarsi I, II and III with 17,17,16 chaetae respectively, of which 10 in the distal whorl, without chaetae M (Fig. 2D) and with chaetae A1 capitated. Tibiotarsus III without chaeta B7. Femora I, II and III with 12, 11 and 10 chaetae respectively, trochanters I, II and III with 5, 5 and 5 chaetae, coxae I, II and III with 3, 7(8) and 8 chaetae, subcoxae 2 of legs I, II and III with 0, 2 and 2 chaetae, subcoxae 1 of legs I, II and III with 1, 2 and 2 chaetae. Claw untoothed.

Tenaculum with 2 teeth on each ramus. Dens rather short, mucrodens with 3 + 3 chaetae and with hooked, tiny mucro at the top. Chaetotaxy of manubrium as in figure 2E.

Males are unknown.

Remarks: See Remarks in *F. stampa* sp. nov.

***Friesea stampa* sp. nov.**

urn:lsid:zoobank.org:act:CB5B03E1-C9B6-423B-A4B6-D0B18B62387C
(Figs. 3A-E, 8S)

Type material: Holotype: Adult female, on slide, under access number RO-Fr149-IBB, deposited at IBB. Paratypes: two specimens (RO-Fr111-IBB, 150-IBB, one juvenile and one female respectively), deposited in IBB.

Type locality: Pilugani, Poiana Stampei village, Suceava County, Romania (47°20'22.408"N, 25°09'22.658"E), 958 m alt., spruce forest, 21.viii.2013, leg. C. Fiera (IBB).

Etymology: The new species is named after the name of village, Poiana Stampei, Romania.

Other material examined: Two females from Sinaia locality, Prahova County, leaf litter, 14.xi.12; one specimen (RO-Fr112-ISEA) is deposited in ISEA and one (RO-Fr113) in IBB. Two females collected from Dorna Borcău, Suceava County, soil, 21.viii.2013, RO-Fr151-ISEA - deposited in ISEA and RO-Fr152 in IBB, leg. C. Fiera (IBB).

Description: Habitus and buccal cone typical for the genus *Friesea*. Length: Holotype female:

0.60 mm. Paratypes: female 0.57, juvenile 0.46 mm. Colour blue in alcohol. Integument secondary granules rather small.

Antennae about 2/3 of head length. Antennal segment I with 7 chaetae, antennal segment II with 13(12) chaetae. Sensory organ of antennal segment III consisting of 2 small subcylindrical internal s-chaetae, 2 subcylindrical guard s-chaetae and one ventral s-microchaeta. Antennal segment IV with 6 subcylindrical s-chaetae (S1-4, S7-8 present), one small s-microchaeta placed between S7 and S8, and 1 small subapical organite. Apical vesicle simple (Fig. 3B).

Ocelli 5 + 5, postantennal organ absent. Chaetotaxy of labrum: 4/5,3,4. Labium with papillated chaeta L (Fig. 3C).

Dorsal chaetotaxy as in figure 3A, with relatively long chaetae (longer on hind terga), subequal chaetae and slightly longer s-chaetae (subequal to longest ordinary chaetae on abdominal terga IV-V. Their formula per half tergum: 022/11111. Head with chaetae a0, d0 and 3 chaetae oc. Thoracic tergum I with 3 + 3 chaetae. Thoracic tergum II with 11 + 11 chaetae (4 chaetae Di including a2, 4 chaetae De including s-chaeta in position of p3, 4 DI including one s-chaeta and one s-microchaeta (ms)). Thoracic tergum III with 10 + 10 chaetae (same arrangement as previous tergum, but without a2 and ms).

Thoracic sterna I-III without chaetae. Abdominal tergum V with 2 + 2 chaetae between s-chaetae. Abdominal tergum VI with 3 anal spines. Ventral abdominal chaetotaxy as in figure 3E. Ventral tube with 4 + 4 chaetae. Anal valves each with 3 chaetae hr on upper and lower valves (on paired valves as microchaetae, on upper valve medial one as microchaeta and two others as mesochaetae).

Tibiotarsi I, II and III with 18,18,17 chaetae respectively, of which 11 in the distal whorl, without chaetae M (Fig. 1D). Tibiotarsus III without chaeta B7. Femora I, II and III with 11, 11 and 10 chaetae respectively, trochanters I, II and III with 5, 5 and 5 chaetae, coxae I, II and III with 3, 7 and 7 chaetae, subcoxae 2 of legs I, II and III with 0, 2 and 2 chaetae, subcoxae 1 of legs I, II and III with 1, 2 and 2 chaetae. Claw untoothed.

Tenaculum with 2 teeth on each ramus. Dens with 3 + 3 chetae (in the juvenile mucro is not present). Chaetotaxy of manubrium as in figure 3E.

Remarks: *F. mirceai* sp. nov. and *F. stampa* sp. nov. described above may be grouped with species having 5 + 5 eyes, 3 + 3 chaetae on dens

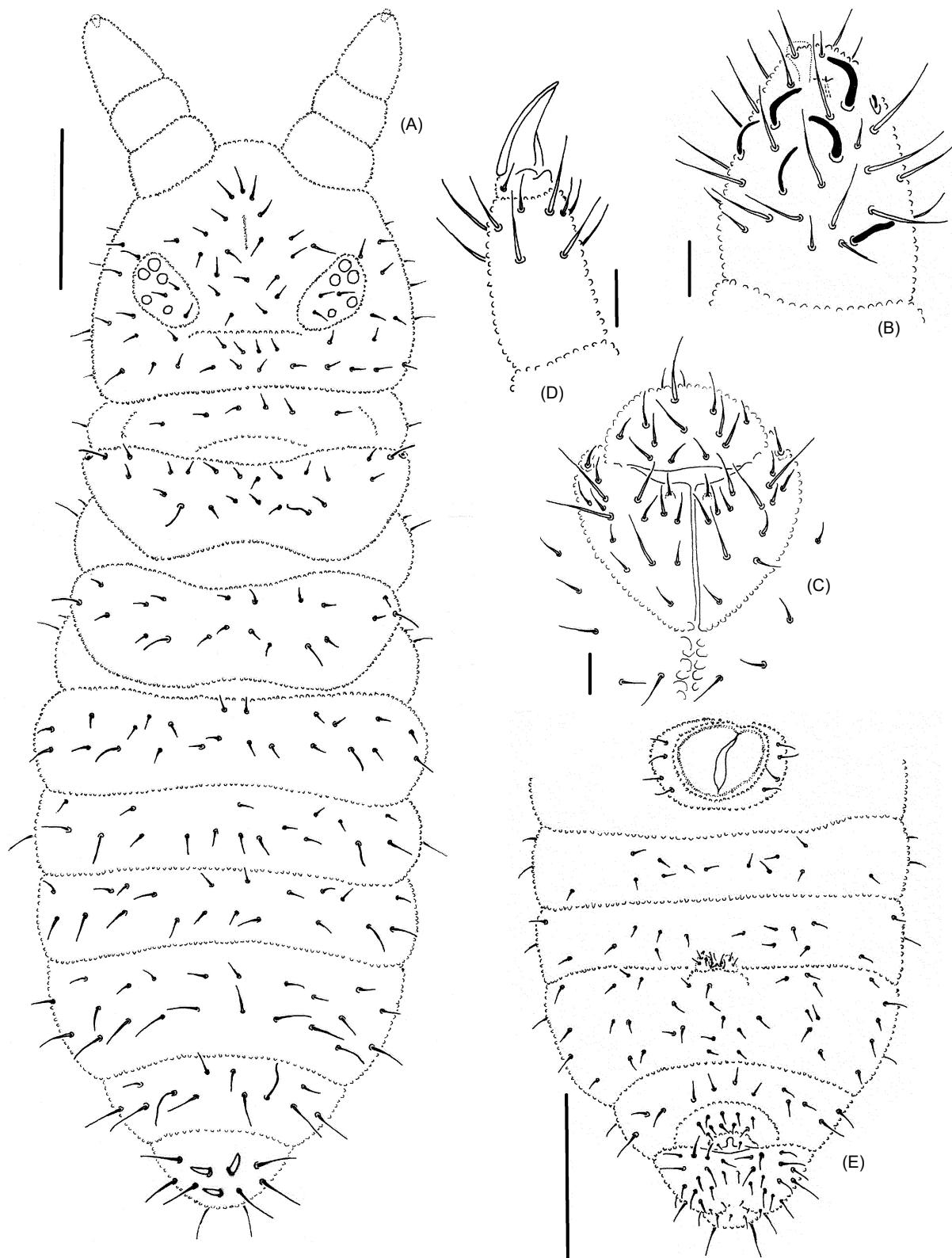


Fig. 3. *Friesea stampa* sp. nov., holotype female (RO-Fr149-IBB). (A) Habitus and dorsal chaetotaxy; (B) Fourth antennal segment; (C) Labium; (D) Tibiotarsal chaetotaxy and claw of leg III; (E) Chaetotaxy of abdominal sterna II-VI and ventral tube. A and E, scale bars = 0.1 mm. B-D, scale bars = 0.01 mm.

and three anal spines on Abd. VI. Such species are: *F. decemoculata* described from Italy by Börner (1903), *F. decipiens* from Spain by Steiner (1958), *F. albida* recorded from Ukraine, Czech Republik and Poland (Stach 1949), *F. hammeni* described from New Guinea by Massoud (1965), *F. pati* from Alaska (USA) by Fjellberg (1984), *F. kymgangsani* and *F. onphoriensis* from Noth Korea by Weiner and Najt (1985), *F. versabilis* from Natal, South Africa by Barra (1995), *F. pseudodecipiens* Arbea and Jordana from Spain (in Jordana et al. 1997) and *F. laszlooi* from Caucasus (Russia) by Palacios-Vargas and Traser (1997). Among the above mentioned species two types of tibiotarsal chaetotaxy were observed: one with 18, 18 and 17 setae (e.g. in *F. stampa*), the other one with 17, 17 and 16 setae (e.g. in *F. mirceai*). The most important characters are summarised in table 2.

F. stampa sp. nov. is similar to *F. laszlooi*, especially by the presence of 3 + 3 chaetae on thoracic tergum I, but differs in the chaetotaxy of abdominal tergum IV: the new species has Di

with 4 chaetae and De with 4 + s, while *F. laszlooi* has Di with 3 chaetae and De with 2 + s. Antennal segment IV with s-chaetae S1 and S3 thinner in *F. stampa* and subequal in *F. laszlooi*.

F. mirceai sp. nov. seems to be similar to *F. albida*, but in the new species mucro is present -generally absent in *F. albida*, after Jordana et al. (1997). On tibiotarsus chaeta A1 is capitated and longer than the inner edge of claw, while in *F. albida* it is pointed and as long as the inner edge of the claw.

DISCUSSION

The taxonomy of *Friesea* has long been based on the number of anal spines, ocelli and tibiotarsal clavate hairs and the development of furcal area (Massoud 1967). In this context several groups of *Friesea* species were established (Weiner et al. 2009) and also the species collected until now in Romania (see Supplement 1) could

Table 2. Morphological differences between *F. mirceai* sp. nov., *F. stampa* sp. nov. and other *Friesea* species with 5 + 5 eyes

Characters	<i>Mirceai</i> sp. nov.	<i>F. decipiens</i>	<i>F. versabilis</i>	<i>Stampa</i> sp. nov.	<i>F. laszlooi</i>	<i>F. kymgangsani</i>
Number of chaetae on Th. I	4 + 4	4 + 4*	2 + 2	3 + 3	3 + 3	4 + 4
Number of sensilla on Ant. IV	6	6*	5	6	6	6
Number of teeth on tenaculum	2 + 2	2 + 2	2 + 2	2 + 2	2 + 2	2 + 2
Number of chaetae on dens	3 + 3	3 + 3	3 + 3	3 + 3	3 + 3	3 + 3
Mucro	+	+	+	+	+	+
Abd. VI with clavate chaetae	-	-	-	-	-	-
Tibiotarsi I-III with clavate chaetae (1-5)	1	-	-	-	-	1
Number of chaetae on tibiotarsi I-III	17,17,16	17,17,16 (Simón-Benito 2005)	? 17,17,16	18,18,17	18,18,17	18,18,17
Tooth on claw	-	-	-	-	-	-

Characters	<i>F. onphoriensis</i>	<i>F. albida</i>	<i>F. pseudodecipiens</i>	<i>F. pati</i>	<i>F. hammeni</i>	<i>F. decemoculata</i>
Number of chaetae on Th. I	4 + 4	4 + 4	4 + 4	4 + 4	2 + 2	?
Number of sensilla on Ant. IV	6	6	6	4	6	? 3
Number of teeth on tenaculum	2 + 2	2 + 2	2 + 2	2 + 2	2 + 2	3 + 3
Number of chaetae on dens	3 + 3	3 + 3	3 + 3	3 + 3	3 + 3	3 + 3
Mucro	-	-	+ (-)	+	+	+
Abd. VI with clavate chaetae	-	-	-	-	-	+
Tibiotarsi I-III with clavate chaetae (1-5)	4	+ (-)**	- (+)***	2-3	-	5
Number of chaetae on tibiotarsi I-III	18,18,17	18,18,17****	18,18,17	18,18,17	18,18,17	?
Tooth on claw	-	-	-	-	-	(+)

*Personal communication from anonymous reviewer (R3): in Jordana et al. (1997) as *F. albida*. **According to Stach (1949): in East-Carpathian Mts. with two chaetae blunt at the top, the new specimens from type locality possess also two chaetae blunt at the top. *** Sometimes 5 macrochaetae could be blunt or slightly capitated at the top. ****After the material from type locality, *F. albida* does not have 17,17,16 chaetae as in Jordana et al. (1997).

be divided into two groups: i) *Friesea mirabilis*-group is characterized by the presence of three strong anal spines. In Romania 11 species could be recognized in this group (with different number of eyes 2-8 + 2-8 and state of furca of type 2-3 according Cassagnau 1958, Massoud 1967); ii) *Polyacanthella*-type of species characterized by the presence of more than three anal spines or spiniform chaetae: two species with 4 anal spines and two species with 6 anal spines.

New chaetotactic characters were introduced by Gama (1964) and later studied in the Nearctic species from North America by Grow and Christiansen (1974). Chaetotaxy of tibia and antennae are discussed in Deharveng and Bedos (1991).

The number of chaetae in thorax I has not been widely used to differentiate *Friesea* species, but Tables 1-2 show that the character has some diagnostic value. For example: 12 species of *Friesea* with 5 eyes, 3 anal spines and 3 + 3 chaetae on dens, including *F. stampa* sp. nov. and *F. mircea* sp. nov. present 2 + 2, 3 + 3 or 4 + 4 chaetae on thorax tergum I (Table 2), and among 7 known species with 6 + 6 eyes, 3 anal spines and 3 + 3 chaetae on the dens only one species has 3 + 3 chaetae on Th I, and the others 4 + 4 (Table 1). Unfortunately, for *F. decemoculata* there is no available information about this character. Nevertheless, the species can be distinguished by other characters: *F. decemoculata* has 5 clavate chaetae (tenent hairs) on tibiotarsi and is the only one species with 3 chaetae on tenaculum and clavate chaetae on abdominal segment VI.

The number of *Friesea* species in Europe has a tendency to decrease from the North to South with only 5 species in Norway, 10 species in Poland, 12 in Ukraine, 15 in Romania to 24 species in Spain and 28 in France.

CONCLUSIONS

We reviewed the number of species of the genus *Friesea* in Romania, while we also described three new species and compared these to the others. In total, 15 species of the genus *Friesea* are now recognized in Romania, increasing from only eight previously known. The knowledge about the diversity and distribution of Neanuridae family in Romania is far from complete, and more thorough explorations, especially in unsampled areas are needed to improve the comprehension of this family. The present discovery of the new

Friesea species is useful for the development of taxonomy as well as for ecology, conservation or biogeography.

List of abbreviations

ISEA: Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków

IBB: Institute of Biology, Romanian Academy, Bucharest

alt.: altitude

Th.: thoracic tergum

Abd.: abdominal tergum

Di: dorsointernal chaetae

De: dorsoexternal chaetae

Dl: dorsolateral chaetae.

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Supplement 1. Distribution of *Friesea* genus in Romania

***Friesea aeolica* Dallai, 1973**
(Fig. 1S)

Original data: first record for Romanian fauna

Călimani Mountains, Bistrița-Năsăud, Colibița Lake

Bistrița Bârgăului, near Piatra Mare, 47°09'44"N/ 24°52'40"E, 827 m *alt.*, litter, 16.viii.2012, three males RO-Fr99-101 and one female RO-Fr153, leg. C. Fiera (IBB).

Distribution in Europe

Italy (Dallai 1973) and France (meadows, rhododendron, larch forest in Mercantour National Park, 2058 m *alt.* after Kroupa (2010).

***Friesea albida* Stach, 1949**
(Fig. 2S)

Literature data

Apuseni Mountains (Zarand), Arad County

Mădrigești (Brazi village), *Carpino-Fagetum* Paucă, 1941, acid brown soil, 450 m *alt.*, 46°11'52"N/ 22°18'31"E; Mădrigești (Brazi village), *Genisto tinctoriae-Quercetum petraeae* Klika, 1932, soil, 500 m *alt.*, 46°11'52"N/ 22°18'31"E (Harșia 1995).

Trascău Mountains, Alba County

Ocoliș-Belioara, beech wood - *Deschampsio-Fagetum* Soó, 1962, brown soil, 800 m *alt.*, 46°28'33"N/ 23°27'40"E (Harșia 1995); Sălcia de Jos (Sălcia village), beech wood, *Phyllitidi-Fagetum* Vida, 1963, acid brown soil, 700 m *alt.*, 46°23'45"N/ 23°24'20"E (Harșia 1995).

Bucegi Massif, Prahova County

Piatra Arsă, *Pinus mugo* subsp. *mugo* Turra, litter, 900-1300 m *alt.*, 45°38'35"N/ 25°45'34"E

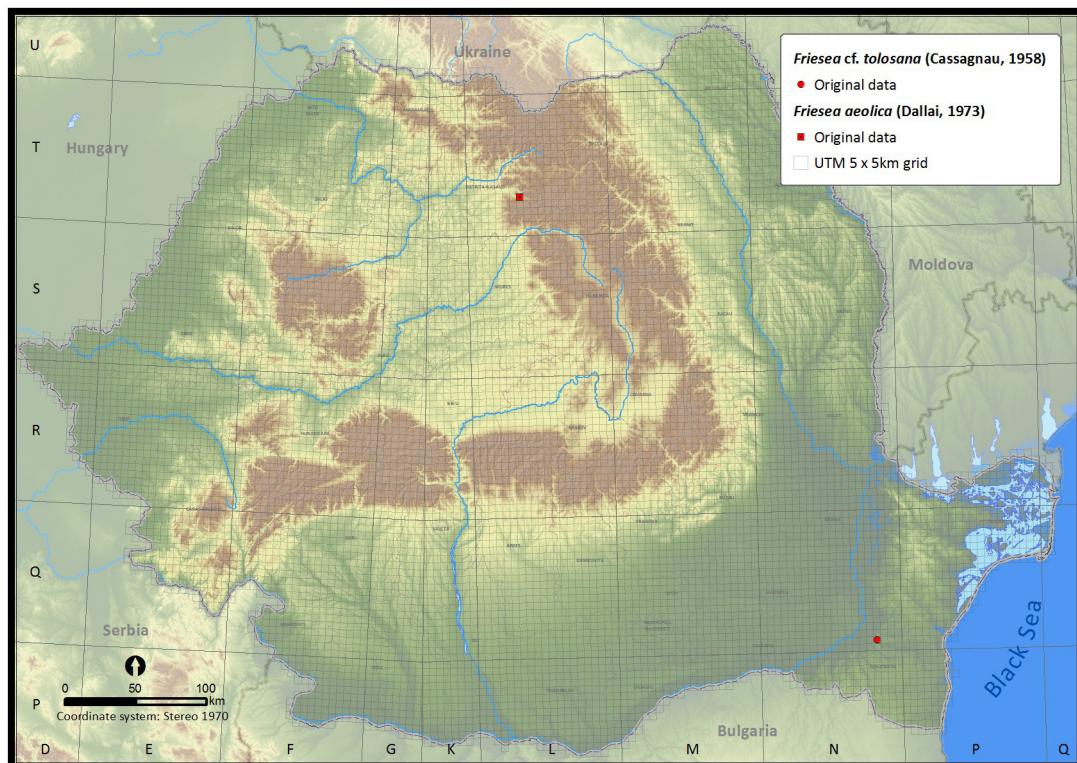


Fig. 1S. Distribution map of *Friesea aeolica* and *F. cf. tolosana* in Romania.

(Gruia and Zamfirescu 1973); Poiana Stânii, *Picea abies* (L.) Karst., litter, 1230 m alt. (Gruia and Zamfirescu 1973).

Călimani Mountains, Pietricelul Peak

Piciorul Iancului, *Cembreto-Piceetum abietis* Chifu et al., 1984, humus, 1750 m alt., 47°07'12"N/ 25°10'59"E (Bulimar 1987).

Rățitiș Peak, *Calamagrostio villosae-Pinetum mugi* Sanda and Popescu, 2002, litter, fermentation layer, humus, 1780 m alt., 47°5'29"N/ 25°14'54"E (Bulimar 1987); *Picea abies* (L.) Karst., soil, 1460-1780 m alt., 47°06'08"N/ 25°12'45"E (Bulimar 1988); *Potentillo chrysocraspedae-Festucetum aroidis* Boșcaiu, 1971, soil, 1800-1950 m alt., 47°05'47"N/ 25°13'13"E; *Juncetum trifidi* Szafer et al., 1923 em. Krajina 1933, soil, 1950-2020 m alt., 47°05'41.9"N/ 25°15'00.99"E; *Violo declinatae-Nardetum* Simon, 1966, soil, 1900-1950 m alt., 47°05'57"N/ 25°13'31"E (Bulimar 1991a); Călimani Mountains (Bulimar 1993); different habitats in Călimani Mountains: *Juniperus communis* L., *Pinus mugo* Turra, *Picea abies* (L.) H. Karst., 1780-1800 m alt., mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L., mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L. and

Pinus mugo Turra, alpine meadows with *Festuca supina* (Kiffmann, 1978), *Juncus trifidus* L., *Nardus stricta* L., shrubs with *Vaccinium vitis idaea* L., *Vaccinium myrtillus* L. (Bulimar 2008).

Rarău Mountains, Suceava County

Slătioara (Stulpicani village) - Valea lui Ion, mixt forest with spruce, fir and beech, soil, 960 m alt., 47°27'57"N/ 25°39'37"E; Slătioara (Stulpicani village), Bârca cu Plai, *Hieracio transsilvanico-Piceetum* Pawlowschi et Br.-Bl., 1939, soil, 1100 m alt., 47°26'27"N/ 25°44'29"E (Bulimar 1980); Stulpicani, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, litter, moss, soil, decaying trunk, on the right side of rivulet Ion, 1140 m alt., 47°27'29"N/ 25°45'60"E; Stulpicani, Bârca cu Plai, 960 m alt., mixt forest with spruce, fir and beech, litter and moss (Bulimar 1982).

Retezat Mountains, Zlătui Valley, Hunedoara County

Râu de Mori, *Festuco drymejae-Fagetum* Morariu et al., 1968, soil, 850 m alt., 45°28'45"N/ 22°51'15"E (Falcă 1984).

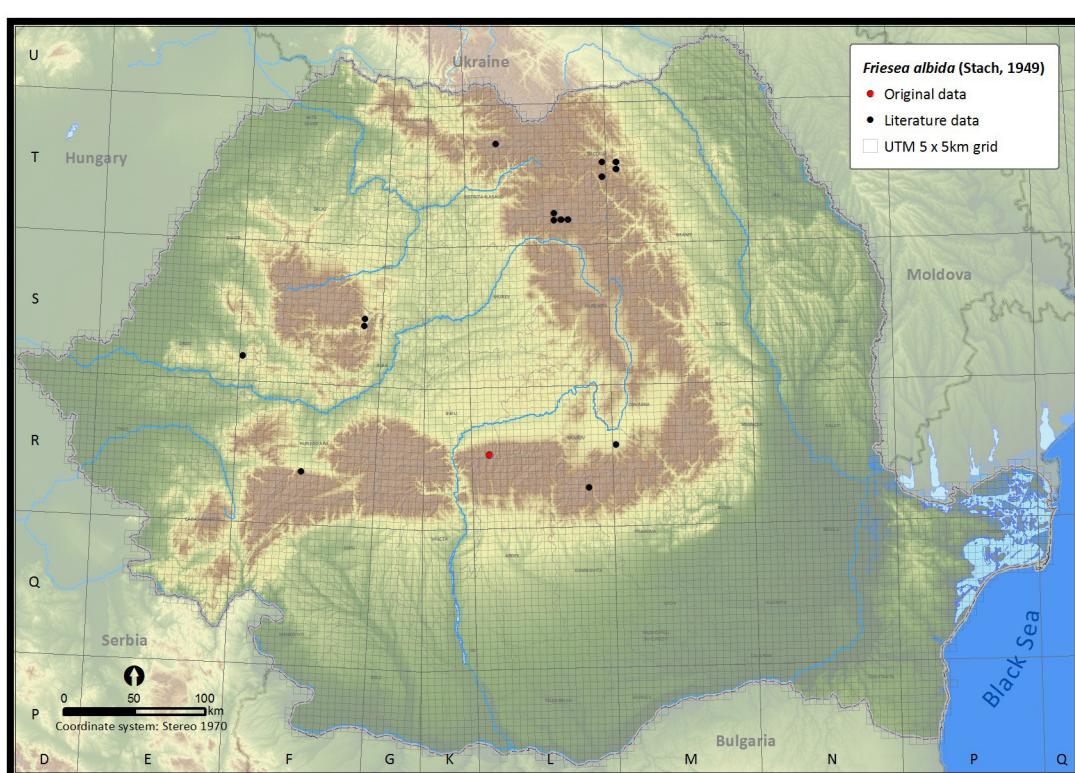


Fig. 2S. Distribution map of *Friesea albida* in Romania.

Rodnei Mountains, Maramureş County

Iezurile, near the weather station Iezer, *Pinus mugo* Turra, soil with *Polytrichum* sp., 1780 m alt., 47°36'10.15"N/ 24°38'56.52"E (Dányi et al. 2006).

Original data

Făgăraş Mountains

Near Bâlea Lake Chalet, Sibiu County, 45°36'17"N/ 24°36'57"E, 2.034 m alt., mosses on rocks, 07.vi.2009, two males, RO-Fr107,108, one juvenile RO-Fr109, leg. C. Fiera (IBB).

Distribution in Europe

Austria, Crete, French, Italy, Poland, Sicily, Slovakia, Spain, Switzerland, Poland and Ukraine (Deharveng 2007), Czech Republik (Stach 1949), Hungary (Dányi and Traser 2008).

Friesea atypica Cassagnau, 1958

(Fig. 3S)

Original data: first records for Romanian fauna

Prahova County

Peleş Valley, 45°21'50.75"N/ 25°31'29.76"E, 995 m alt., 14.xi.2012, litter and soil on rocks, four males RO-Fr92,93,95,96, two females RO-Fr97,98 and one juvenile RO-Fr94, leg. C. Fiera (IBB).

Piatra Craiului Mountains

Vârful Ascuțit Peak, 45°32'48"N/ 25°13'53"E, 2100 m alt., 13.09.2013, 2 specimens, one juvenile and one male, RO-Fr171,172, leg. Ștefanuț S. (IBB).

Distribution in Europe

France and Slovakia (Deharveng 2007).

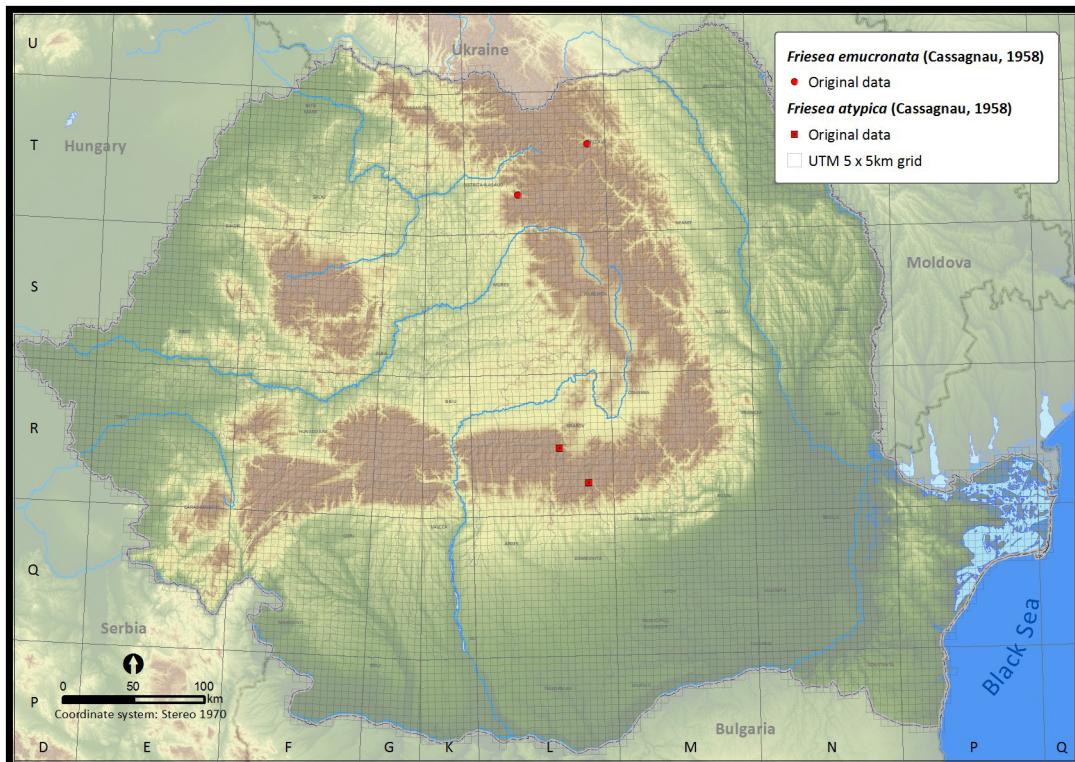


Fig. 3S. Distribution map of *F. emucronata* and *F. atypica* in Romania.

Friesea claviseta Axelsson, 1900
(Fig. 4S)

Literature data

Doftana Valley

Şotriile, 45°13'39"N/ 25°43'44"E, 600 m alt., beech forest with *Luzula luzuloides* (Lam.) Dandy and Wilmott, soil (Fiera 2013).

Giumalău Massif

Spruce forest, soil, 1496 m alt. (Nitzu et al. 2009); spruce forest (Buşmachiu et al. 2014).

Igriş Mountains, Maramureş County

Deseşti - Izvoare Station, *Picea abies* (L.) H. Karst., rotten trunk and mosses, 1000 m alt., 47°46'15"N/ 23°51'18"E (Dányi and Traser 2008).

Pădurea Craiului Mountains

Vadul Crişului cave, 46°56'43.5834"N/ 22°30'33.372"E (Viehmann et al. 1964; Pleşa et al. 1996).

Retezat Mountains, Retezatul Mic

Şaua Scorota, *Rhododendro-myrtifolii-Pinetum mugii* Borza, 1959 em Coldea, 1985, soil, 1850 m alt. (Harşa 1992).

Original data

Prahova County

Glogeasa, beech forest, 45°23'55"N/ 25°43'34"E, 950 m alt., mosses on the soil, 13.v.2009, two females RO-Fr57,59, two males RO-Fr58,61; Doftana Valley, Voila, *Quercus petraea* (Mattuschka) Liebl. and *Fagus sylvatica* L. mixed forests, 45°09'58"N/ 25°45'10"E, 500 m alt., in mushrooms on trees, one male RO-Fr15, leg. C. Fiera (IBB).

Vâlcea County, Cozia National Park

Călineşti-Brezoi forest, natural reserve, 45°21'49"N/ 24°17'39"E, 600 m alt., 8.vi.2009, lichens on trunk, one female RO-Fr14, leg. C. Fiera (IBB).

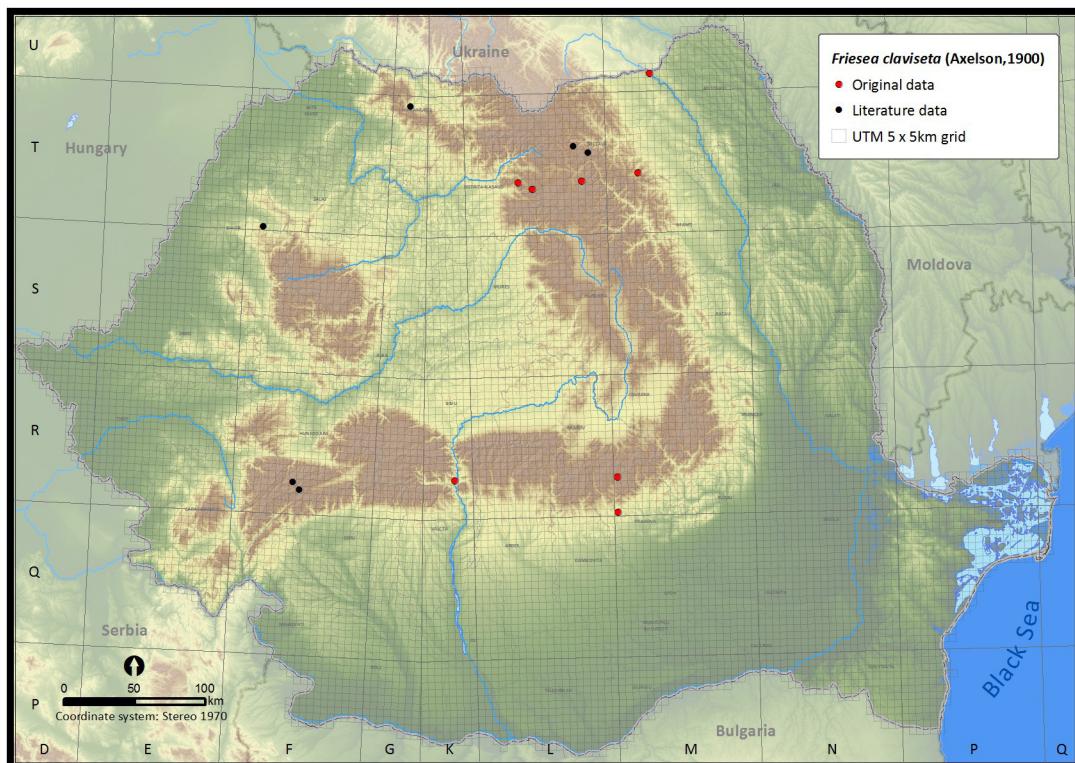


Fig. 4S. Distribution map of *Friesea claviseta* in Romania.

Suceava County

Siret (Pădureni locality), 47°56'32"N/ 26°06'47"E, 365 m alt., 26.vii.2014, mixed forest, mosses on soil, 2 males and 2 females RO-Fr167-170, leg. C. Fiera (IBB).

Bârgău Mountains

Tiha Bârgăului, spruce forest, soil, 47°14'12"N/ 24°59'59"E, 1100 m alt., 12.ix.2004, one male Ro-Fr64; Bistrița-Năsăud County, Lunca Ilvei, 47°19'37.267"N/ 25°58'20.189"E, 786 m alt., *Abies alba* Mill., 1768 and *Fagus sylvatica* L., 28.viii.2014, lichens on trees, two males, RO-Fr140,141; Tureac, 47°15'29.608"N/ 24°50'41.393"E, 782 m alt., beech forest, litter, one male RO-Fr144, leg. C. Fiera (IBB).

Călimani Mountains

Colibița Lake, Bistrița-Năsăud County, 47°16'28.04"N/ 24°87'70.22"E, 830 m alt., soil, 16.viii.2012, one female RO-Fr85, leg. C. Fiera (IBB).

Distribution in Europe

Albania, Austria, Canary Is., Czech Republic, Danish, Finland, France, Germany, Great Britain, Hungary, Iceland, Ireland, Italy, Latvia, Madeira, Northern Ireland, Netherlands, Norvegia, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Ukraine (Deharveng 2007), Slovenia (Bogojević 1968).

Friesea emucronata Stach, 1922

(Fig. 3S)

Original data: first record for Romanian fauna

Călimani Mountains, Bistrița-Năsăud

Cheile Bistriței Ardelene, natural rezerve, Bistrița Bârgăului, 47°10'08"N/ 24°51'20"E, 800 m alt., mosses on rocks, 20.viii.2013, one male RO-Fr88 and two females RO-Fr89,139.

Adam Peak, SV

47°30'58.17"N/ 25°29'09.09"E, 947 m alt., spruce forest, lichens on dead trunk, 26.viii.2014, one male RO-Fr135, one female RO-Fr138; mosses on soil, one male RO-Fr137, leg. C. Fiera (IBB).

Distribution in Europe

Czech and Slovak Republic (after Stach 1949), Hungary (Dányi and Traser 2008), Germany (Franz 1943).

Friesea handschini Kseneman, 1938

(Fig. 4S)

Literature data

Călimani Mountains - Pietricelul Peak

Cembreto-Piceetum abietis Chifu et al., 1984, litter, fermentation layer, humus, 1460-1750 m alt. (Bulimăr 1987).

Rătătiș Peak, SV

Calamagrostio villosae-Pinetum mugi Sanda and Popescu, 2002, litter, fermentation layer, humus, 1780 m alt. (Bulimăr, 1987); *Potentillo chrysocraspedae-Festucetum aroidis* Boșcăiu, 1971, soil, 1800-1950 m alt.; *Juncetum trifidi* Szafer et al., 1923 em. Krajina 1933, soil, 1950-2020 m alt. (Bulimăr, 1991a); Călimani Mountains, in different habitats with *Juniperus communis* L., *Pinus mugo* Turra, mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L., mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L. and *Pinus mugo* Turra, alpine meadows with *Festuca supina* (Kiffmann, 1978), *Juncus trifidus* L., shrubs with *Vaccinium vitis idaea* L., *Vaccinium myrtillus* L. (Bulimăr 2008).

Igniș Mountains

Maramureș County, Izvoarele (Cernești village): Izvoare Station - Cheile Tătarului, 47°35'26"N/ 23°52'19"E, 738 alt.; Izvoarele (Cernești village), near Tăul lui Dumitru, turf bog, 47°35'26"N/ 23°52'19"E, mosses, 1143 alt. (Dányi et al. 2010).

Mehedinți Mountains - Motru Valley

Izvorul Albilor and Sohodoale Valley, humus, 600-650 m alt., 45°10'21.87"N/ 23°07'26"E (Gruia 1977).

Neamț County

Podoleni, meadow, soil, 46°47'54"N/ 26°35'38"E (Călugăr et al. 1983).

Piatra Mountains, Maramureş

Săpânța: Brazi Valley, 841 *alt.*, 47°50'15"N/ 23°42'42"E, (Dányi et al. 2010).

Rodnei Mountains

Borșa, Pietrosul Rodnei, ass. *Plagiothecio-Piceetum*, litter and soil, 1200 m *alt.*, 47°39'40"N/ 24°43'18"E; Borșa, 1688-1711 m *alt.*, 47°38'51"N/ 24°39'27"E (Dányi et al. 2006); Ineu Peak, 2279 m *alt.*, 46°27'00"N/ 21°50'03"E; Borșa, near the meteorological station Iezer, *Pinus mugo* Turra, soil with *Polytrichum* sp., 1780 m *alt.*, 47°57'19"N/ 23°39'52"E (Dányi et al. 2010).

Original data

Călimani Mountains, Bistrița-Năsăud County

Cheile Bistriței Ardelene, natural rezerve, Bistrița Bârgăului, 47°10'08"N/ 24°51'20"E, 800 m *alt.*, mosses on rocks, 20.viii.2013, two females RO-Fr115-116 and one male RO-Fr117, leg. C. Fiera (IBB).

Făgăraș Mountains, Sibiu County

Near Bâlea Lake Chalet, 45°36'17"N/ 24°36'57"E, 2.034 m *alt.*, mosses on rocks, 07.vi.2009, 3 juveniles and 2 females RO-Fr118-122, leg. C. Fiera (IBB).

Hașmaș Mountains

Bicaz Gorges, 46°47'32.48"N/ 25°47'17.22"E, 1015 m *alt.*, 02.viii.2009. 3 juveniles and one female RO-Fr 123-126, leg. C. Fiera (IBB).

Distribution in Europe

Austria, France, Germany, Poland, Slovakia and Ukraine (Deharveng 2007).

***Friesea mirabilis* (Tullberg, 1871)**
(Fig. 5S)

Literature data

Dobrogea (Skolka et al. 2005); Constanța County

Năvodari, the petrochemical complex area,

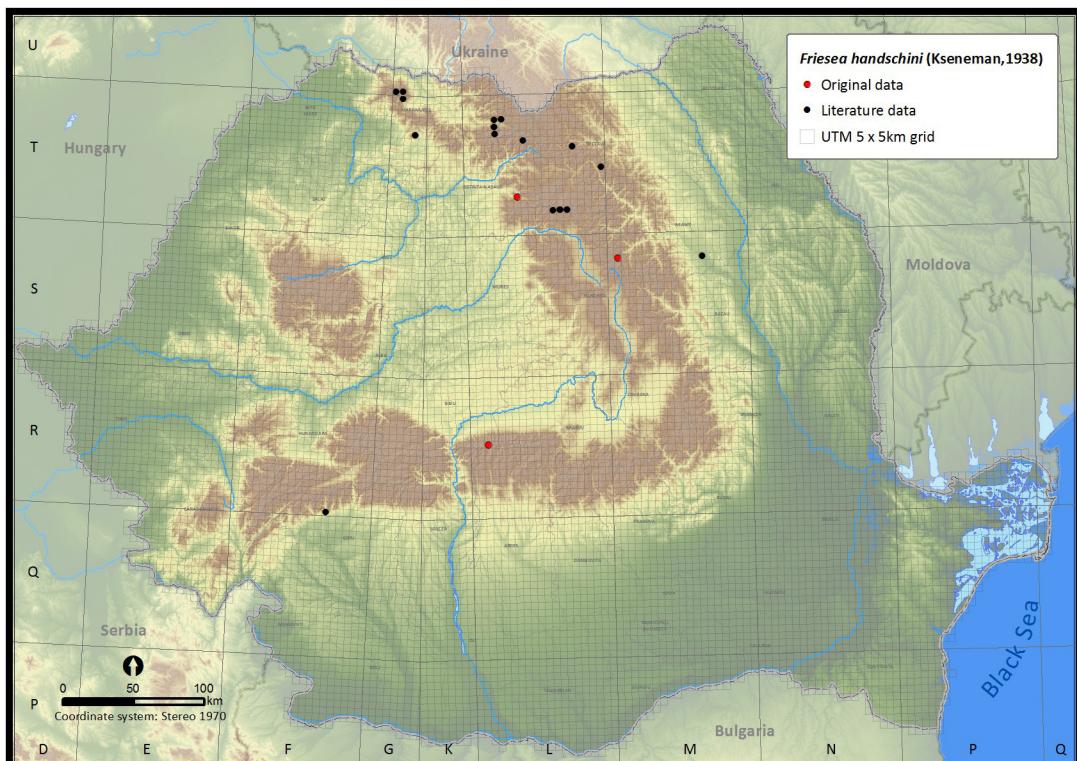


Fig. 4S. Distribution map of *Friesea handschini* in Romania.

soil, 44°19'21"N/ 28°36'16"E (Falcă 1986).

Danube Delta, Tulcea County

Busurca Canal, *Phragmitetum phragmitetosum* (Koch, 1926) Soó, 1957, soil; Caraorman Canal, *Phragmitetum phragmitetosum* (Koch, 1926) Soó, 1957, soil, 45°4'24"N/ 29°24'0"E; Ivancea Canal, *Scirpo-Phragmitetum* Koch, 1926, soil, 44°58'22"N/ 29°29'5"E; Litcov Canal- Împuțita, *Scirpo-Phragmitetum* Koch, 1926, soil, 45°9'10"N/ 29°28'47"E (Bulimar 1992a); Tătaru canal, *Scirpo-Phragmitetum* Koch, 1926, soil, 45°0'21"N/ 29°36'46"E; Japșa Lungă, *Phragmitetum phragmitetosum* (Koch, 1926) Soó, 1957, soil (Bulimar 1992a); Beștepe (Mahmudia village), oakwood, soil, 45°5'23"N/ 29°1'11"E (Harşia 1997); Letea Forest (Letea Fatana), sand dunes from the coastal area, soil, 45°21'31"N/ 29°31'37"E (Harşia 1997); Insula Mare a Brăilei, plantation with *Salicetum albae* Issler 1926, soil (Fiera 2006).

Bucegi Massif, Prahova County

Buşteni, *Pulmonario rubrae-Fagetum* (Soó,

1964) Taber, 1987, soil, 910 m alt.; Poiana Stânii, *Fagetum dacicum* Beldie, 1951, soil, 1290 m alt. (Falcă 1984); Piatra Arsă, *P. mugo* subsp. *Mugo* Turra, litter, 900-1300 m alt., 45°38'35"N/ 25°45'34"E (Gruia and Zamfirescu 1973); Poiana Stânii, *Picea abies* (L.) Karst., litter, 1230 m alt., 45°38'35"N/ 25°45'34"E (Gruia and Zamfirescu 1973).

Doftana Valley

Voila, *Quercus petraea* (Mattuschka) Liebl. and *Fagus sylvatica* L. mixed forests, 45°09'58"N/ 25°45'10"E, 500 m alt. (Fiera 2013).

Apuseni Mountains (Gilău), Cluj County

Floroiu, spruce forest, brown podzolic soil, 1500 m alt., 46°45'24"N/ 23°22'9"E (Harşia 1995).

Metaliferi Mountains, Alba County

Abrud, beech wood, soil, 46°16'3"N/ 23°4'32"E; Dealul Mare (Vălişoara village), beech wood, brown soil, 800 m alt., 46°1'46"N/ 22°46'57"E (Harşia 1995).

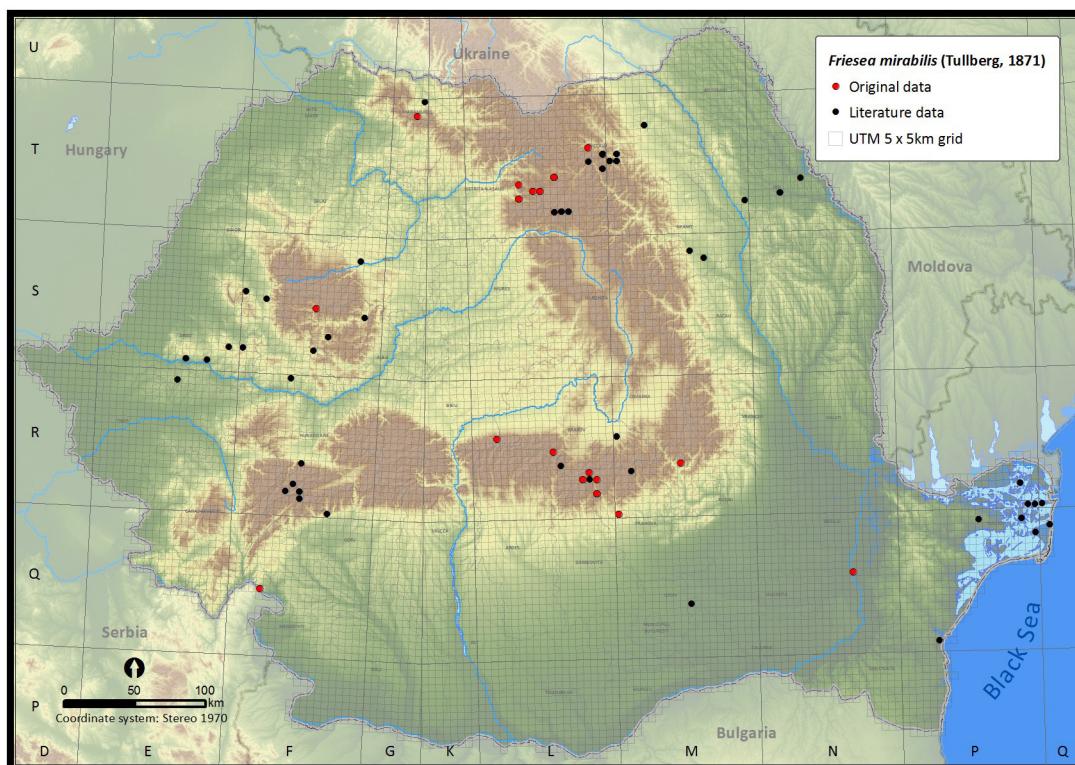


Fig. 5S. Distribution map of *Friesea mirabilis* in Romania.

Trascăului Mountains, Alba County

Sălcia de Jos (Sălcia village), beech wood - *Phyllitidi-Fagetum* Vida, 1963, soil, 700 m alt.; Buceş - Vulcan (Buceş village), beech wood, mezobasic brown soil, 550 m alt., 46°12'55"N/ 22°58'11"E (Harşa 1995).

Zarandului Mountains, Arad County

Bârzava, *Genisto-Quercetum petraeae* Klika, 1932, brown soil, 400 m alt., 46°6'8"N/ 21°58'12"E; Cladova (Păuliş village), *Carpino-Fagetum* Paucă, 1941, soil, 250 m alt., 46°8'23"N/ 21°47'22"E; Drocea, *Carpino-Fagetum* Paucă, 1941, acid brown soil, 450 m alt., 46°11'24"N/ 22°11'30"E; Mădrigeşti (Brazi village), *Carpino-Fagetum* Paucă, 1941, acid brown soil, 450 m alt., 46°11'52"N/ 22°18'31"E; Milova (Conop village), *Carpino-Fagetum* Paucă, 1941, soil, 380 m alt., 46°6'13"N/ 21°48'7"E.

Bihor County

Tărcaia (Tărcaia village), *Carpino-Fagetum* Paucă, 1941, brown soil, 530 m alt., 46°35'4"N/ 22°19'51"E (Harşa 1995).

Codru Moma Mountains

Arad County, Ursul Hill, *Carpino-Fagetum* Paucă, 1941, acid brown soil, 45°58'8"N/ 21°45'40"E *Genisto-Quercetum petraeae* Klika, 1932 (Harşa 1995); Sighiştel (Câmpani village), beech woodt, acid brown soil, 46°31'7"N/ 22°33'3"E (Harşa 1995).

Călimani Mountains, Rătătiş Peak

Calamagrostio villosae-Pinetum mugi Sanda and Popescu, 2002, litter, fermentation layer, humus, 1780 m alt. (Bulimar 1987).

Pietricelul Peak, Peak

Cembreto-Piceetum abietis Chifu et al., 1984, litter, fermentation layer, humus, 1460-1750 m alt. (Bulimar 1987); *Potentillo chrysocraspedae-Festucetum airoidis* Boșcaiu, 1971, soil, 1800-1950 m alt. (Bulimar 1991a); *Picea abies* (L.) Karst., soil, 1460-1780 m alt. and *Pinus cembra* L., soil, 1460-1780 m alt. (Bulimar 1988); Călimani Mountains (Bulimar 1993); different habitats in Călimani Mountains: *Juniperus communis* L.,

Pinus mugo Turra, *Picea abies* (L.) H. Karst., mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L., mixed forests with *Picea abies* (L.) H. Karst., *Pinus cembra* L. and *Pinus mugo* Turra, alpine meadows with *Festuca supina* (Kiffmann, 1978), shrubs with *Vaccinium vitis idaea* L., *Vaccinium myrtillus* L. (Bulimar 2008).

Igniş Mountains, Maramureş County

Ocna Şugatag, Brazilar bog, on rotten wood and *Sphagnum* moss, 800 m alt., 47°46'40"N/ 23°56'8"E (Dányi and Traser 2008).

Mehedinți Mountains, Motru Valley

Izvorul Albiilor and Sohodoale Valley, humus, 600-650 m alt. (Gruia 1977);

Piatra Craiului Mountains, Argeş County

Brusturet chalet, Cerdacul Stanciului, Marele Grohotiş, Seacă Valley, soil, 45°28'18"N/ 25°13'21"E (Popa 2010).

Rarău Mountains, Suceava County

Gemenea (Stulpicani village), Bârca Leşii, *Hieracio transilvanico-Piceetum* Pawlowschi et Br.-Bl. 1939, litter, fermentation layer, 1300 m alt., 47°26'22"N/ 25°42'3"E (Bulimar 1983); Gemenea - Măgura Hill, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, litter, fermentation layer, 890 m alt., 47°26'22"N / 25°42'3"E; Gemenea - Măgura Hill, mixt forest with spruce, fir and beach, litter, fermentation layer, 890 m alt., 47°26'22"N/ 25°42'3"E (Bulimar 1983); Gemenea - Grosului Hill, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, litter, fermentation layer, 750 m alt., 47°26'22"N/ 25°42'3"E; Stulpicani, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, moss, litter, soil, decaying trunk, 960 m alt., 47°27'29"N/ 25°45'60"E; Stulpicani, mixt forest with spruce, fir and beach, litter, moss, soil, decaying trunk, 960 m alt., 47°27'29"N/ 25°45'60"E (Bulimar 1982); Slătioara - Bârca cu Plai, *Hieracio transilvanico-Piceetum* Pawlowschi et Br.-Bl., 1939, soil, 47°27'57"N/ 25°39'37"E; Slătioara - Valea lui Ion, mixt forest with spruce, fir and beach, soil, 960 m alt., 47°27'57"N/ 25°39'37"E (Bulimar 1980).

Giumalău Massif

Spruce forest, soil, 1268 m alt. (Nitzu et al. 2009); spruce forest (Bușmachi et al. 2014).

Retezat Mountains, Zlătui Valley, Hunedoara County

Râu de Mori, *Festuco drymeiae-Fagetum* Morariu et al., 1968, soil, 850 m alt., 45°28'45"N/ 22°51'15"E; *Hieracio transilvanico-Piceetum* Pawłowschi et Br.-Bl., 1939, soil, 1250 m alt. (Falcă 1984).

Retezatul Mic

Phyllitidi-Fagetum Vida 1963, near Câmpușel, soil, 1150 m alt.; *Leucacanthemo waldsteinii-Piceo-Fagetum* Soó 1964 *saxifragetosum* Coldea 1991, soil, 1350 m alt.; Șaua Scorota, between Piule and Drăgșan, *Potentillo Festucetum airoidis* Boșcariu, 1971 *poetosum alpinae* Coldea 1991, soil, 1850 m alt.; Drăgșan, to Șaua Plaiului Mic, *Bruckenthalio-Piceetum* Borh. 1969, soil, 1700 m alt.; in the right side of Scocul Iarului Valley, *Leucacanthemo waldsteinii-Piceo-Fagetum* Soó 1964 *saxifragetosum* Coldea 1991, soil, 1200 m alt.; left side of Dobrun Valley, *Pulmonario-rubro-Abieti Fagetum* Soó 1964, soil, 1100 m alt. (Harșia 1992).

Central Plateau of Moldavia, Iași County

Strunga, *Aro orientalis-Carpinetum* (Dobrescu and Kovács, 1973) Täuber, 1992, fermentation layer, litter, 890 m alt., 47°9'32"N/ 26°57'38"E; Sinești, mixt forest with spruce, fir and beech, fermentation layer, litter (Bulimar 1992b).

Plain and Central Plateau of Moldavia, Iași County

Podu Iloaiei (Podu Iloaiei), oakwood and holm, soil, 160-270 m alt., 47°13'17"N/ 27°17'26"E (Bulimar 1991b).

Iași County

Popricani (Vulturi), plum orchard, soil, 47°17'1"N/ 27°30'56"E (Călugăr et al. 1989b); Scobâltenei (Podu Iloaiei village), vegetables and maize, soil, 47°11'40"N/ 27°15'50"E (Călugăr et al. 1987).

Neamț County

Podoleni, rye field, soil, 46°47'54"N/ 26°35'38"E; Săvinești-Roznov, rye field, soil, 46°50'34"N/ 26°27'45"E (Călugăr et al. 1983).

Suceava County

Bălăceana (Ciprian Porumbescu village), *Agrostis capillaris* L. and *Festuca rubra* L., soil, 47°38'26"N/ 26°2'31"E (Călugăr et al. 1989a); Bălăceana (Ciprian Porumbescu), meadow, ass. *Festuceto-Agrostetum tenuis montanum* Csürös and Kaptalan, 1964, soil, 47°38'26"N/ 26°2'31"E (Bulimar and Huțu 1984).

Suceava, Neamț, Vrancea

Fir forest, soil, between 440-970 m alt. (Bulimar 1991c).

Original data

Alba County, Albac

46°26'42.78"N/ 22°58'29.65"E, 781 m alt., spruce forest, soil, 10.viii.2007, two males RO-Fr38, RO-Fr105 and one juvenile RO-Fr106, leg. C. Fiera (IBB).

Brașov County

Near Plaiul Foii chalet, 13 km to Zărnești, 45°33'44.91"N/ 25°11'45"E, 871 m alt., soil, 22.iv.2013, one male RO-Fr35 and two females RO-Fr16, RO-Fr102, leg. Fiera C (IBB).

Buzău Mountains, Siriu Massif

Near Izvorul Bucuriei chalet, beech forest, 45°28'28"N/ 26°19'20"E, 1430 m alt., soil, 12vii.2012, four males RO-Fr7-10, leg. C. Fiera (IBB).

Prahova County

Bușteni, 45°24'48"N/ 25°32'37"E, 850 m alt., *Abies alba* Mill., 1768 and *Fagus sylvatica* L., litter, 29.viii.2009, two juveniles RO-Fr32, RO-Fr104 and one male RO-Fr30; near Kalinder pension, Bușteni, 45°25'14.3"N/ 25°31'25.3"E, 1000 m, soil, 14.xi.2012, one male RO-Fr81, two juveniles RO-Fr82-83, one female RO-Fr84; Valea Largă, 45°18'20.638"N/ 25°34'19.943"E, 771 m alt.,

beech forest, litter, 13.xi.2013, one male preadult RO-Fr158; in dead trunk, one male RO-Fr159 and one juvenile RO-Fr156; soil two females RO-Fr154,157, 12.v.2009; soil, one juvenile RO-Fr155, 10.vii.2008, leg. C. Fiera (IBB).

Suceava County

Dorna Borcuț, Poiana Stampei village, 47°41'53"N/ 23°53'28"E, 880 m *alt.*, spruce forest, dead trunk, 21.viii.2013, three males RO-Fr62,63,80; Dornișoara, 47°12'52.833"N/ 25°03'51.173"E, 1130 m *alt.*, 21.viii.2013, dead trunk and mosses, one male, RO-Fr73; in litter, three juveniles RO-Fr25-27, three males RO-Fr28,29,51 and one female RO-Fr50; Pilugani I, Poiana Stampei village, 47°20'22.408"N / 25°09'22.658"E, 958 m *alt.*, spruce forest, soil, 21.viii.2013, three females RO-Fr74,77,78; mosses on soil, one female, RO-Fr17 and one male preadult RO-Fr22; dead trunk, one male RO-Fr18; soil, two males RO-Fr19,75; one juvenile RO-Fr76; Pilugani II, Poiana Stampei village, in mosses growing on peat, 47°20'03.786"N/ 25°09'20.722"E, 958 m *alt.*, 21.viii.2013, five females RO-Fr23, 24, 90,91,160 two males RO-Fr 86,161, one juvenile RO-Fr87, leg. C. Fiera (IBB);

Bârgău Mountains

Tiha Bârgăului, Bistrița-Năsăud County, 47°14'12"N/ 24°59'59"E, 1100 m *alt.*, spruce forest, soil, 12.ix.2004, one juvenile RO-Fr33; two males RO-Fr34,35.

Bistrița-Năsăud County

Tureac, 47°15'29.608"N/ 24°50'41.393"E, 782 m *alt.*, 29.viii.2014, beech forest, litter, two males RO-Fr142,145, one female RO-Fr143, leg. C. Fiera (IBB).

Bucegi Massif, Dâmbovița County

Lăptici Peat Bog, 45°22'16.8"N/ 25°26'12.4"E, 1600 m *alt.* 12.v.2010, lichens, one male RO-Fr11; soil, one male RO-Fr55, two females RO-Fr53,54, leg. C. Fiera (IBB); Bucegi Massif, soil, 10.x.2005, two females RO-Fr127,129 and one juvenile RO-Fr128, leg. Manu M. (IBB).

Călimani Mountains, Bistrița-Năsăud County

Colibița Lake, Bistrița Bârgăului, near

Piatra Mare, 47°09'44"N/ 24°52'40"E, 827 m *alt.*, mosses on dead trunk, 12.viii.2012, five males RO-Fr42-45,79,103 and one female on soil, RO-Fr86; Cheile Bistriței Ardelene, Bistrița Bârgăului, 47°10'08"N/ 24°51'20"E, 800 m *alt.*, mosses on rocks, 20.viii.2013, one female RO-Fr86 and one juvenile RO-Fr36; in litter, one female RO-Fr87, leg. C. Fiera (IBB).

Iron Gates Natural Park, MH

Drobeta-Turnu Severin, 44°41'02.09"N/ 22°31'09.48"E, 114 m *alt.*, 19.xi.2006, soil, one male preadult RO-Fr37, leg. C. Fiera (IBB).

Rarău Mountains

Slătioara Secular High Forest, 47°27'23.81"N/ 25°40'13.05"E, 827 m *alt.*, soil, 26.vi.2013, two juveniles RO-Fr39,40, leg. Vicol I. (IBB).

Făgăraș Mountains

Arpaș Valley, 45°39'21.937"N/ 24°40'13.930"E, 852 m *alt.*, 10.ix.2014, *Abies alba* Mill., 1768 and *Fagus sylvatica* L., litter, female RO-Fr146; Arpaș Valley, 45°40'01.337"N/ 24°40'15.289"E, 823 m *alt.*, cutting forest with *Abies alba* Mill., 1768, litter, three females RO-Fr147,148,149, leg. C. Fiera (IBB).

PH

Brebu Gorges North, 45°12'31.1"N/ 25°44'23.5"E, mosses on rocks, 11.v.2009, male juvenile RO-Fr130; soil, 4.viii.2010, two females RO-Fr131,132, leg. C. Fiera (IBB).

Adam Peak

SV, 47°30'58.17"N/ 25°29'09.09"E, 947 m *alt.*, spruce forest, mosses on soil 26.viii.2014, one male and one female, RO-Fr134,136, leg. C. Fiera (IBB).

Distribution in Europe

Albania, Austria, Azores, Belarus, Belgium, Great Britain, Bulgaria, Canary Is., Corsica, Czech Republic, Danish, Faroe Is., Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Kaliningrad, Latvia, Madeira, Malta, Moldova, Netherlands, Ireland, Norway, Novaya Zemlya, Poland, Portugal, Slovakia, Spain, Sweden,

Switzerland, Ukraine (Deharveng 2007), Bosnia and Herzegovina, Croatia, Serbia and Montenegro (Bogojević 1968) and Lithuania (Kuznetsova 2002).

***Friesea stachi* Kseneman, 1936**
(Fig. 6S)

Literature data

Călimani Mountains - Rătătiș Peak

Calamagrostio villosae-Pinetum mugi Sanda and Popescu, 2002, litter, fermentation layer, humus, 1780 m alt. (Bulimar 1987); *Juncetum trifidi* Szafer et al., 1923 em. Krajina 1933, soil, 1950-2020 m alt. (Bulimar 1991a); Călimani Mountains, in different habitats with *Picea abies* (L.) H. Karst., *Pinus mugo* Turra, alpine meadows with *Juncus trifidus* L., (Bulimar 2008).

Rarău Mountains, Suceava County

Stulpicani, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, moss, 960 m alt., 47°27'29"N/ 25°45'60"E (Bulimar 1982); Slătioara (Stulpicani village), Valea lui Ion, mixt

forest with spruce, fir and beech, soil, 980 m alt., 47°27'57"N/ 25°39'37"E (Bulimar 1980); Gemenea (Stulpicani village), Măgura Hill, mixt forest with spruce, fir and beech, litter, fermentation layer, 890 m alt., 47°26'22"N/ 25°42'3"E; Măgura Hill, *Hieracio transsilvanici-Abietum* (Borhidi, 1971) Coldea, 1991, litter, fermentation layer, 890 m alt., 47°26'22"N / 25°42'3"E (Bulimar 1983).

Distribution in Europe

Portugal and Ukraine (Deharveng 2007), Hungary (Varga 1992)

***Friesea truncata* Cassagnau, 1958**
(Fig. 7S)

Literature data

Bucegi Massif, Dâmbovița County

Moroeni, Lăptici Peatbog, 45°22'18"N/ 25°26'11"E, 1470 m alt., litter (Fiera 2008).

Retezat Mountains

Râul Mare River, waste dumps, 45°31'27"N/

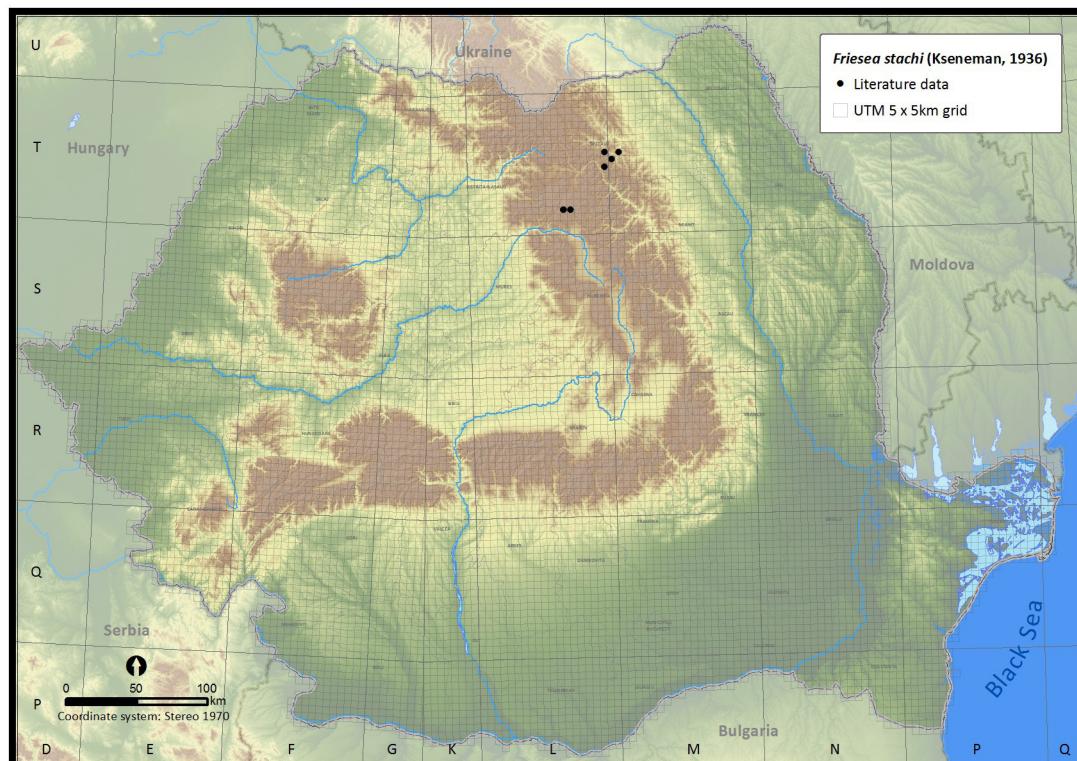


Fig. 6S. Distribution map of *Friesea stachi* in Romania.

22°52'8"E, soil (Fiera and Vasiliu-Oromulu 2009).

Original data

Tulcea County

Frecătei, 45°6'51"N/ 28°36'50"E, 120 m alt., 15.ix.2005, soil, one female RO-Fr49, leg. Oromulu-Vasiliu L. (IBB).

Călimani Mountains, Bistrița-Năsăud

Colibița Lake, Bistrița Bârgăului, near Piatra Mare, near Piatra Mare, 47°09'44"N/ 24°52'40"E, 827 m alt., moss on dead trunk, 12.viii.2012, one juvenile RO-Fr46, leg. C. Fiera (IBB).

Rarău Mountains

Slătioara Secular High Forest, 47°27'23.81"N/ 25°40'13.05"E, 827 m alt., 26.vi.2013, soil, one female RO-Fr41, litter one female RO-Fr114 leg. Vicol I. (IBB).

Distribution in Europe

Albania, Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Great Britain, Hungary, Ireland, Italy, Madeira, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Netherlands, Ukraine (Deharveng 2007), Faroe Is. (Fjellberg 2007a), Finland (Fjellberg 2007a), Iceland (Fjellberg 2007b), Latvia (Jucevica 2003), Moldova (Bușmachi 2010).

Friesea cf. tolosana Cassagnau, 1958 (Fig. 1S)

Original data: first record for Romanian fauna

Constanța County

Cernavodă, 44°20'11.92"N/ 28°01'05.211"E, 56 m alt., soil, only one male, RO-Fr173, 10.xi.2012, C. Fiera (IBB).

Distribution in Europe

France, Portugal and Spain (Deharveng 2007).

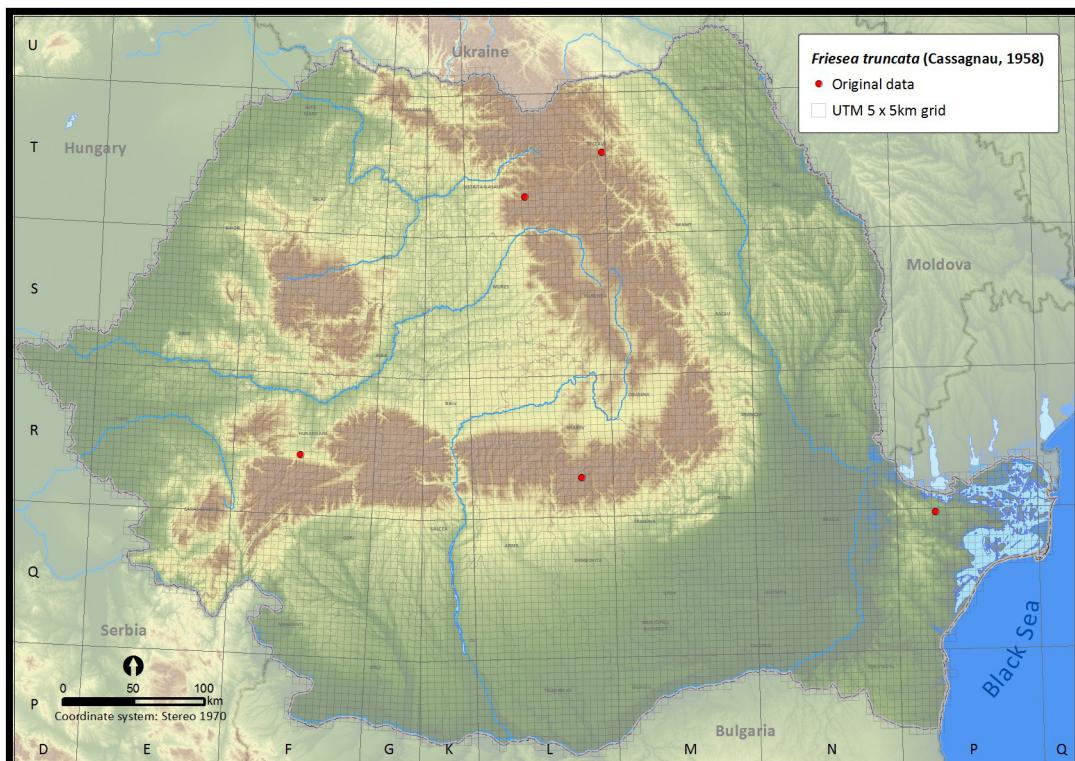


Fig. 7S. Distribution map of *Friesea truncata* in Romania.

Distribution of three new species (Fig. 8S)

Friesea posada sp. nov., *Friesea mirceai* sp. nov. and *Friesea stampa* sp. nov. were mentioned

in the description. Two other species were reported for Romanian fauna: *Friesea afurcata* (Denis, 1926) by Gruia (2000) and *Friesea acuminata* (Denis, 1925) from Dobrogea region by Skolka et al. (2005), without to mention the locality.

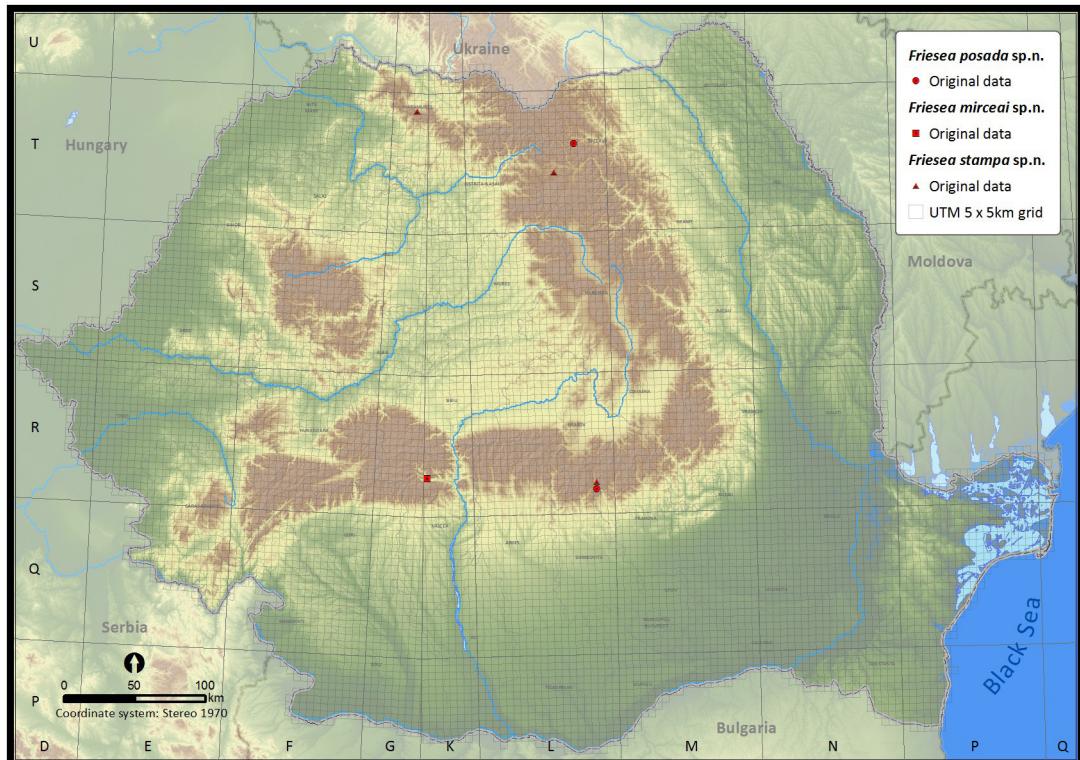


Fig. 8S. Distribution map of *Friesea posada* sp. nov., and *F. stampa* sp. nov., *F. mirceai* sp. nov. in Romania.