

**Distribution, morphology and ecology of the Carpathian endemic,
relict species *Otiorhynchus (Elechranus) remotegranulatus* Stierlin, 1891,
compared to *O. (Elechranus) chrysonus* Boheman, 1843**

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Abstract. New data concerning the distribution, morphology, intraspecific variability and ecology of *Otiorhynchus (Elechranus) remotegranulatus* Stierlin, 1891 are presented. We describe for the first time the aedeagus of the species. The distribution data show that the species is endemic to the western Carpathians, Romania. This extremely small distribution area is a good sign of the relictary character of the species. The species is polyphagous, found mainly on *Picea abies*, *Rubus idaeus*, *Salix caprea* and *Fagus silvatica*. Adults prefer young spruce. For comparison, we present aspects of morphology, distribution and ecology of the closely related species *Otiorhynchus (Elechranus) chrysonus* Boheman, 1843. This species has a wider distribution, found from Austria, Hungary, Romania and Bulgaria. We highlight its presence on *Fraxinus excelsior*. These species, although morphologically similar, have clearly different distribution as well as ecological preferences.

Key words: endemic species, relicts, Carpathians, distribution range, morphology, ecology

The *Otiorhynchus* weevil genus (Insecta, Coleoptera: Curculionoidea, Curculionidae, Entiminae, Otiorhynchini) is one of the largest in Europe, containing 1036 species and subspecies (Rheinheimer & Hassler 2010, Magnano & Alonso-Zarazaga 2013). In the Carpathian Basin 163 species/subspecies are present, 129 of which can be also found in Romania, 48 of these being endemic to the Carpathians (Endrődi 1960, 1961 a,b, Teodor & Antonie Vlad 2007). One of these Carpathian endemic species is *Otiorhynchus (Elechranus) remotegranulatus* Stierlin, 1891. In Europe, 10 species of the *Elechranus* (Magnano & Alonso-Zarazaga 2013) subgenus can be found, 4 of which can be found in the Carpathians: *Otiorhynchus (Elechranus) chrysonus* Boheman, 1843, *O. (Elechranus) ormayi* Stierlin, 1888, *O. (Elechranus) remotegranulatus* Stierlin, 1891 and *O. (Elechranus) roubali* Penecke, 1931, the latter three being endemic to the Carpathians (Endrődi 1960, 1961a,b, Teodor & Antonie Vlad 2007).

A number of recent publications concerning *Otiorhynchus* contains morphological data, or data about the distribution, ecology or biology of endemic species of this group, some of these being new species for science (e.g. Germann 2010, Colonnelli & Casalini 2014, Davidian & Gültekin 2015, Białooki 2015, Białooki & Germann 2016). None of these articles however presents data concerning *O. remotegranulatus*.

Data concerning *O. remotegranulatus* are incomplete. These are mainly taxonomic and faunistic data (Stierlin 1891, Bielz 1887, Mallász 1903, Petri 1925/1926, Endrődi 1960, 1961a,b, Teodor et al. 2002, Teodor & Crișan 2004, Teodor & Antonie Vlad 2007, German & Sprick 2008, Magnano & Alonso-Zarazaga 2013, Merkl et al. 2016) with some studies presenting aspects of the morphology, biology and ecology of the species (Teodor & Antonie Vlad 2005, Teodor 2011). Therefore, it is necessary to conduct a study that completes these aspects.

As objectives of our study we proposed: (1) identification of the *Otiorhynchus remotegranulatus* populations and their characteristic habitats; (2) identification of the host plants used; (3) information about the period of activity of adults and their distribution within their habitat; (4) documentation

of the general distribution of the species, in order to check its relict character; (5) observation of the eventual intraspecific and interspecific variability between *O. remotegranulatus* and *O. chrysonus*; (6) characterization of the aedeagus of these species. In the closely related species *O. chrysonus*, we intend to identify characteristic habitats, gathering distribution data and comparative morphological characterization in contrast to *O. remotegranulatus*.

In order to study the *Otiorhynchus remotegranulatus* populations, we made observations in the Carpathian Mountains in Romania. We have collected individuals of *O. remotegranulatus* between 2012 and 2014, and used also our earlier collections from 1998-2001 and 2007-2008. For a comparison, in 2015 we collected individuals of the closely related *O. chrysonus*.

Material was collected by hand or tweezers directly off host plants using an entomological swifter or by tree-beating. The collected material was labeled and kept in vials with 96% ethanol. The place and date of collection, host plant, altitude and coordinates were recorded. We also made observations about population size and distribution of individuals within the habitat, photographs of the habitats and host plants, as well as photographs of the individuals collected. The weevils were mounted, studied and identified in laboratory using a stereomicroscope. Most of the studied material can be found in the personal collection of L. A. Teodor, an important part being in the personal collection of A. Podlussány.

The distribution map (Fig. 5) was created with QGIS 2.16.2 (QGIS Development Team 2016), using freeware background material.

Besides field trips made in different locations in the Apuseni Mountains, in order to check the general distribution of the species, a series of surveys have been made in over 40 locations in the following mountains: Banat, Țarcu, Retezat, Poiana Ruscă, Mehedinți, Cernei, Vâlcău, Parâng, Lotru, Făgăraș, Bucegi, Rodna, Bărgău, Călimani, Gurghiu, Harghita, Ciuc.

Morphological data

Otiorhynchus remotegranulatus (sin. *peterfii* Mallasz, 1903), is an amphigonic species with sexual dimorphism (Fig. 1). Males have narrower elytra than females. The abdomen of males is slightly concave, while on the posterior margin of the sternites a distinct ridge can be observed. The abdomen



Figure 1. *Otiorhynchus (Elechrinus) remotegranulatus* Stierl.: a. dorsal view of a male (body length: 7.5 mm); b. dorsal view of a female (body length: 8 mm); c. ventral view of a male abdomen; d. ventral view of a female abdomen – collection: 15.06.2013, Mărișel, Gilău Mts., România.

of females is slightly convex with a much less obvious ridge on the sternites. Generally, males are darker than females (Figs. 1 and 2). In females, the color varies from light brown to dark brown (Fig. 2).

Otiorhynchus remotegranulatus is similar to *O. chrysonus* (sin. *laevigatocollis* Stierlin, 1861, sin. *banaticus* Stierlin, 1861) considering its appearance, body length and sexual dimorphism (Figs. 1 and 2). The morphological characters of the pronotum of these two species are clearly different. *O. remotegranulatus* presenting small tubercles distributed evenly without a medial longitudinal ridge (Fig. 1), while the pronotum of *O. chrysonus* is densely dotted and without tubercles, but with a distinct medial longitudinal ridge on the disk part (Fig. 3). Clear differences were also found concerning the length of the lobes at the end of the aedeagus and the ratio of the central and lateral lobes. Males of *O. remotegranulatus* presenting a slightly longer central lobe in relation to the lateral lobes (Fig. 4a,c,e,g,i), while in *O. chrysonus* the central lobe is much longer than the lateral ones (Fig. 4b,d,f,h,j).

Distribution of *Otiorhynchus remotegranulatus* (Fig. 5)

Bibliographic data: *Otiorhynchus remotegranulatus* has been described as a species by Stierlin (1891) without specifying the type location. The only information offered was that the

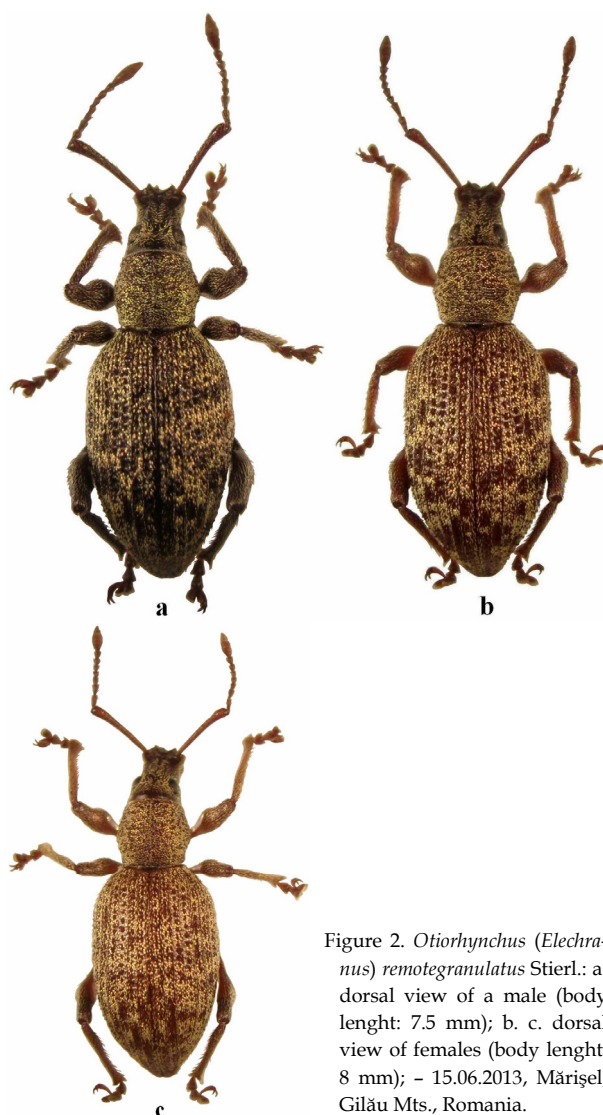


Figure 2. *Otiorhynchus (Elechrinus) remotegranulatus* Stierl.: a. dorsal view of a male (body length: 7.5 mm); b. c. dorsal view of females (body length: 8 mm); – 15.06.2013, Mărișel, Gilău Mts., Romania.



Figure 3. *Otiorhynchus (Elechrinus) chrysonus* Boh.: a. dorsal view of a male (body length: 7.5 mm); b. dorsal view of a female (body length: 8 mm) – 14.06.2015, Domogled (Băile Herculane), Mehedinți Mts., Romania.

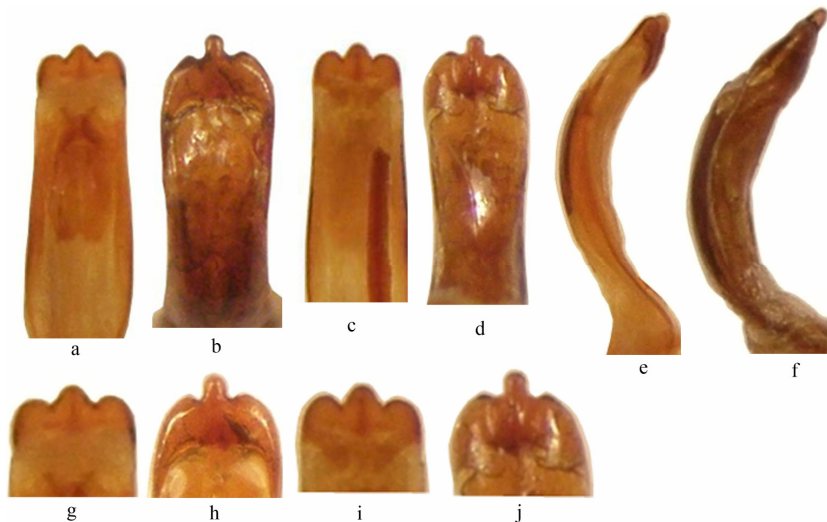


Figure 4. *Otiorynchus (Elechrans) remotegranulatus* Stierlin, 1891: a. – dorsal view of aedeagus, c. – ventral view of aedeagus, e. – lateral view of aedeagus, g. – dorsal view of distal end of aedeagus, i. – ventral view of distal end of aedeagus – 8.06.2014, Padiș, Bihor Mts., Romania; *Otiorynchus (Elechrans) chrysonus* Boheman 1843: b. – ventral view of aedeagus, d. – dorsal view of aedeagus, f. – lateral view of aedeagus, h. – dorsal view of distal end of aedeagus, j. – ventral view of distal end of aedeagus – 14.06.2015, Domogled (Băile Herculane), Mehedinți Mts., Romania.

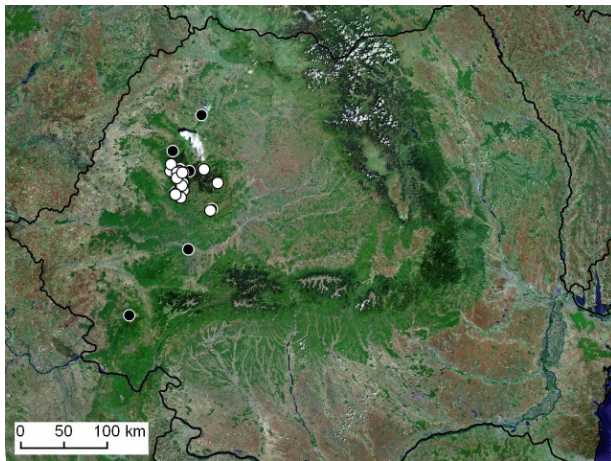


Figure 5. Distribution of *Otiorynchus (Elechrans) remotegranulatus* Stierlin, 1891 (white dots – own data, black dots – bibliographic data), map created with QGIS 2.16.2 (QGIS Development Team 2016), using freeware background material.

type material was collected in Hungary by S. Ormay. However, Endrődi (1961) specifies that the material in question was collected at the Ponor valley, Bihor Mts. (Romania). The species was also found at Detunata (Mallász 1903), Cibin Mts., Deva (Petri 1925/1926), Onceasa, Ponor valley, Cuciu-lata, Cucurbata peak, Zalău, Stâna de Vale, Remetei, Văliug (Endrődi 1960) and more recently Padiș, Bihor Mts. (German & Sprick 2008), Sălaj county, Tusa, above Izvorul Barcăului (the spring of the Barcău River), Plopișului Mts., Huta, Poic, Meseș Mts. (Merkel et al. 2016).

Authors' data: Material collected between 2012-2014, leg. L. A. Teodor & Z. Czekes, coll. L. A. Teodor, BBU Cluj-Napoca: Spruce forests (*Oxalo-Piceetum*): 2♂♂, 3♀♀, 30.04.2012, 6♂♂, 3♀♀, 15.06.2013, 1237 m a.s.l., Mărișel, Gilău Mts.; 68♂♂, 35♀♀, 25.05.2012, 13♂♂, 9♀♀, 8.06.2014, 1280 m a.s.l., Băișoara Mt.; 11♂♂, 9♀♀, 17.05.2013, 1231 m a.s.l., Molhașu Mare, Bihor Mts.; 18♂♂, 15♀♀, 8.06.2014, 1250 m a.s.l., Padiș, Bihor Mts.; Material collected between 1998-2001 and 2007-2008, partially published (Teodor et al., 2002; Teodor & Crișan 2004; Teodor & Antonie Vlad 2005; Teodor 2011), leg. L. A. Teodor & A. Crișan, coll. L. A. Teodor, BBU Cluj-Napoca: Spruce forests (*Oxalo-Piceetum*): 1♂, 08.06.1998, 1♀,

08.06.1998, 1♀, 08.06.1998, 1♂1♀, 08.06.1998, 1♂, 2♀♀, 03.08.1998, 1♂, 14.06.1999, 1♂, 1♀, 18.08.1999, 1♂, 18.08.1999, 1♂, 21.07.1999, 800-900 m a.s.l., Someșul Cald gorge, Bihor Mts.; 10♂♂, 6♀♀, 07.06.2007, 3♀♀, 24.07.2008, 1246 m a.s.l., Padiș, above the Padiș chalet, Bihor Mts.; Mixed spruce and beech forest: 1♀, 21.07.1999, 1♂, 1♀, 14.06.1999, 1050 m a.s.l., Someșul Cald gorge, 1♀, 04.08.1998, 1♂, 1♀, 08.06.1998, 1160 m a.s.l., Ponorului valley-Ic Ponor, 2♂♂, 1.06.2001, 1070 m a.s.l., Casa de Piatră, 1♂, 18.08.2001, 943 m a.s.l., Vulturii valley, 2♂♂, 1♀, 1.06.2001, 881 m a.s.l., Gârda Seacă, Bihor Mts.; 1♀, 2.06.2001, 1161 m a.s.l., Arieșul Mic spring, 1♂, 1♀, 2.06.2001, 851 m a.s.l., Avram Iancu, Metaliferi Mts.; Mixed hornbeam and beech forest: 3♂♂, 2.06.2000, 886 m a.s.l., Ar-ieșeni, Bihor Mts.; Willow row: 3♀♀, 2.06.2001, 1♀, 19.08.2001, 1161 m a.s.l., Arieșul Mic, Meraliferi Mts.; Alder and willow row: 1♀, 03.06.1998, 1♂, 08.06.1998, 1♂, 3♀♀, 09.06.1998, 1000 m a.s.l., Someșul Cald valley, Bihor Mts.; Meadow (*Nardo-Festucetum rubrae*): 1♂ 5.17.1997, 853 m a.s.l., Filești valley, 2♀♀, 1.06.2001, 1156 m a.s.l., Casa de Piatră, 1♂, 1♀, 1.06.2001, 921 m a.s.l., Vulturii valley, Bihor Mts.. Collection of A. Podlussány, Hungarian Natural History Museum, Budapest: Stâna de Vale, Iad valley, Bihor Mts., 1100 m a.s.l., 1♂, 1♀, 17.06.1981, leg. Szalóki Dezső; Gârda, Bihor Mts., 18♂♂, 4♀♀, 7.07. 1985, leg. A. Podlussány; Bihor county, Canton Glăvoi (Ponor), 1100 m a.s.l., 3♂♂, 13♀♀, 27.07.2005, leg. J. & A. Podlussány, 1♂, 27.07.2005, leg. Orosz András; Bucium, Alba county, Transsylvania, Metaliferi Mts., 1000 m a.s.l., 18.07.1997, leg. Horváth Edit, A. Podlussány & I. Rozner; Aleu creek valley, Bihor Mts., 800 m a.s.l., 1♂, 11.10.1990, leg. Jankovics-Vig; Padiș, Bihor county, 930 m a.s.l., 1♂, 28.07.2005, leg. A. Podlussány & Béla Tallósi; Stâna de Vale, 9♂♂, 15.05.2004, leg. Márkus András.

Distribution of *O. chrysonus*

Bibliografic data: General distribution: Austria, Hungary, Romania and Bulgaria (Magnano and Alonso-Zarazaga, 2013). In Romania, it has been found in: Cluj-Napoca: probably Făget forest, Feleac hill (Bielz 1887, Petri 1912), Gurghiu Mts.: Sub Cetate (Kocs & Podlussány 1997), Cibin Mts.: (Petri 1912), Mehedinți Mts.: Băile Herculane, Mehădia (Endrődi 1960), - Vâlcan Mts.: Tismana (Marcu 1929), Suceava plains: Ponoare natural Reserve (Teodor & Dănilă 1994, 2011).

Authors' data: Collection of L. A. Teodor, BBU Cluj-Napoca: Rubble with shrubs and *Fraxinus excelsior*: 4♂♂, 6♀♀, 14.06.2015, Băile Herculane, 600 m a.s.l., Domogled, Mehedinți Mts., leg. L. A. Teodor & Zs. Czekes; 1♂, 26.06.2005, Băile Herculane, 550 m a.s.l., Domogled, Mehedinți Mts., leg. A. Crișan; 1♀, 17.05.1970, Băile Herculane, leg. I. Dănilă. Collection of A. Podlussány, Hungarian Natural History Museum, Budapest: Băile Herculane, 1♂, 25.05.2004, coll. J. Fodor; Băile Herculane, 1♂, 06.1916, coll. J. Fodor; Caras-Severin, Mehadia Mts., Valea Cernei, 1♂, 1♀, 1-2.05.1995, leg. A. Podlussány, 2♂♂, 1-2.05.1995, leg. Szalóki Dezső, 1♀, 1-2.05.1995, leg. Nádaí László;

Harghita county, Subcetate, Szencsed valley, 1♀, 9-10.05.1995, leg. A. Podlussány (published data: Podlussány & Kocs 1998); Caras-Severin county, Băile Herculane, Cerna valley, 3♂♂, 8♀♀, 23.05.1994, leg. A. Podlussány; Mehadia Mts., Domogled, Băile Herculane, 15♂♂, 6♀♀, 30.04.1995, leg. A. Podlussány; Băile Herculane, 2♀♀, 10.06.1984, leg. Medvegy Mihály; Gorj county, Telesti, 1♂, 4.05.1995, leg. A. Podlussány, 1♂, 4.05.1995, leg. Rozner István.

The ecology and biology of *Otiorhynchus remotegranulatus* and *O. chrysonus*

Otiorhynchus remotegranulatus is a mountain species, collected in spruce forests (Fig. 6a,b), mixed spruce and beech forests, as well as neighboring meadows and clearings. The species is polyphagous, feeding on young *Picea abies* (Fig. 6c) and on *Rubus idaeus* (Fig. 6d), but also on *Salix caprea* and *Fagus silvatica*. Within their habitats the individuals are usually grouped on a few host plants only, rarely their distribution is more uniform; in these cases they are present in small numbers on each plant. Generally, individuals can be found at a distance of 5-10 m from creeks. Adults are active between April and August, the peak of the population size being in May-June. We have found large populations in spruce forests (*Oxalo-Picetum*, Fig. 6a,b) in the Bihor Mountains: Padiș and Molhașul Mare (Apuseni National Park), Băișora Mountains: springs above the Băișora Mountains Station and in the Gilău Mountains: at Mărișel. These typical habitats have both dense and more open areas, with *Fagus silvatica* individuals. Forest clearings are numerous, with short perennial vegetation, fern shrubs and young spruce and beech, and also a distinct shrubbery consisted of *Vaccinium myrtillus* and *Vaccinium vitis-idaea*. The high level of humidity favors the presence of moss in high densities. In these clearings young individuals of *Rubus idaeus*, *Betula pendula*, *Alnus incana* and *Sorbus aucuparia* are also present near creeks.

O. chrysonus is a species populating hillsides and lower parts of mountains at altitudes between 300-700 m a.s.l., where deciduous forests and shrubs are characteristic (Fig. 7a, b). At Băile Herculane, in the lower regions of the Domogled Mountain, we observed adults on *Fraxinus excelsior*, the leaves of the plants being eaten by the weevils on their margins (Fig. 7c,d).

The data presented above demonstrate that, unlike *Otiorhynchus chrysonus*, *O. remotegranulatus* is endemic to the western Carpathians, Romania, with the majority of populations located in the Bihor Mts. (Fig. 5), similar in distribution to other endemic *Otiorhynchus* species, e.g. *Otiorhynchus* (*Mag-*

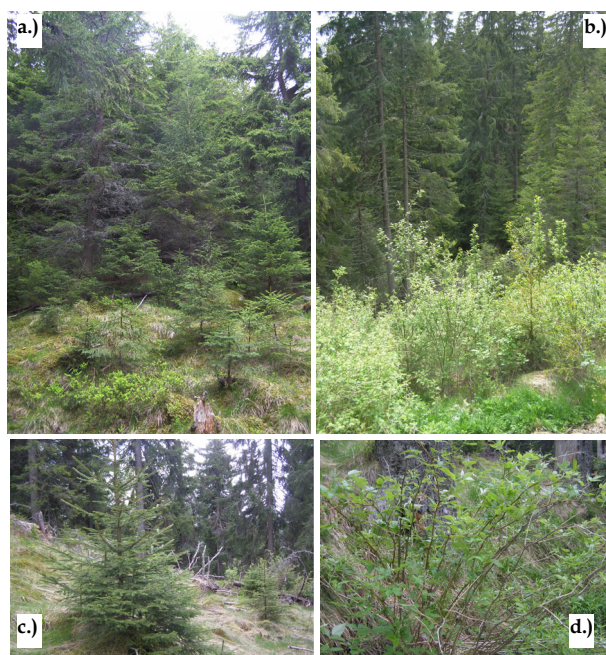


Figure 6. Characteristic habitats and host plants of *Otiorhynchus* (*El-echranus*) *remotegranulatus* Stierlin, 1891: a, b – spruce forest – *Oxalo-Picetum* (Băișora Mts., 1231 m a.s.l.), c – *Picea abies*, d – *Rubus idaeus*.



Figure 7. Characteristic habitats and host plants of *Otiorhynchus* (*El-echranus*) *chrysonus* Boheman 1843: a, b – rocky area with shrubs (Băile Herculane, cca. 600 m a.s.l., Domogled, Mehedinți Mts.), c, d – *Fraxinus excelsior*, leaves with the marginal part eaten by *O. chrysonus*.

nanotus) *rufomarginatus* Stierlin, 1883, and other insect groups, e.g. *Pedicia* (*Crunobia*) *apusenica* Ujvárosi & Starý, 2003 (Diptera, Pediciidae), both being present only in the Apuseni Mountains (Teodor & Crișan 2004, 2006; Dénes et al. 2016). This kind of distribution, restricted to only one dis-

tinct part of the Carpathians, can be observed in many other endemic insect species, but also some endemic isopod, diplopod, centipede and gastropod species, this being an argument for the role of the Carpathians as a refuge during the last glacial period and as a core for post-glacial dispersion (Varga 2010). The restricted distribution of *O. remotegranulatus*, is an argument in favor of the relictary character of this species.

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