DISTRIBUTION OF THE *LEPTORHAPHIS* KÖRB. 1855 GENUS IN ROMANIA

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Abstract. The field work performed to find out the lichen species tabulated in the *Leptorhaphis* genus took place in a lot of habitats from Romania, especially within natural and seminatural forest habitats and also in man-made habitats such as orchards and shelterwoods. The lichen species taken into account were not identified in the studied sites. Based on the literature, it was found that the *Leptorhaphis* genus is rather weakly distributed on Romanian territory. Chorological data, the habitat type, substratum, cenotaxonomy, and taxonomy of the *Leptorhaphis* genus are presented in this paper. Also, the worldwide chorology of *Leptorhaphis* genus is presented. In conclusion, further field studies are needed for the identification of the lichen species of *Leptorhaphis* genus on an extended area from Romania.

Keywords: *Leptorhaphis* genus, chorology, Romania.

Rezumat. Distribuția genului *Leptorhaphis* Körb. 1855 în România. Activitatea de teren desfășurată pentru identificarea speciilor de licheni încadrate în genul *Leptorhaphis* s-a realizat in anumite habitate din România, în special în habitate forestiere naturale și seminaturale și deasemenea în habitate antropogene, cum sunt: livezile și perdelele forestiere. Speciile de licheni luate în considerare nu au fost identificate în ariile studiate. Pe baza literaturii de specialitate, genul *Leptorhaphis* este destul de slab distribuit pe teritoriul României. În acest articol sunt prezentate date corologice, tipul de habitat și substratul, cenotaxonomia și taxonomia genului *Leptorhaphis*. Deasemenea, este prezentată corologia generală a genului *Leptorhaphis*. În concluzie, este necesară continuarea studiilor pentru identificarea speciilor de licheni din genul *Leptorhaphis* pe o arie cât mai extinsă a teritoriului României.

Cuvinte cheie: genul *Leptorhaphis*, corologie, România.

INTRODUCTION

The *Leptorhaphis* genus is well known and widespread along European and American boreal and temperate areas (MARTÍNEZ & ARAGÓN, 2002) and also on the African and Asian continents (ALONSO & EGEA, 1997; KINALIOĞLU, 2009). The oldest information as regard the chorology of the *Leptorhaphis* genus in Romania dates back to 1922 (MORUZI et al., 1967). Data about the national spatial distribution of the mentioned above genus are few. All lichen species from *Leptorhaphis* genus were referred a lot in mountainous areas followed by hilly areas. Regarding the habitat where the lichen species considered within this study were found, the forest one is the most common (CODOREANU, 1966; BURLACU, 1967; BURLACU, 1969; CODOREANU, 1978).

The latest recorded data regarding the chorology of the *Leptorhaphis* genus is older, namely from the last century (CODOREANU, 1978). These historical data are important because they could help estimate the period when lichen species were not confirmed by field studies. In a similar study, *Lobaria amplissima* (Scop.) Forssell was recorded in 1870 in Latvia. Since that time and up to 2014, this species was not found again. In 2014, *L. amplissima*, a red-listed lichen species was found again on a dead wood in the North Vidzeme Biosphere Reserve of Latvia (JURCIŅŠ et al., 2014). In a study performed in London, it has been observed that a few lichen species, thoughe cited in literature, had not been discovered in the last 200 years (HAWKSWORTH & McMANUS, 1989).

The aim of this study is to update the chorological data of the *Leptorhaphis* genus in Romania by trying to find it in a field survey. The main objective of this study is the characterization of the spatial distribution of the *Leptorhaphis* genus in Romania and also its substrata, habitat type, cenotaxonomy, taxonomy and worldwide distribution.

MATERIALS AND METHODS

Studied area. The author performed research activities within natural and semi-natural forestry habitats. Also, habitats transformed by man such as orchards and shelterwoods were investigated. Field activities were performed between 2009-2017, both in rural and urban areas. Thus, semi-natural forestry habitats were predominantly investigated in the rural areas of the following counties: Alba, Arad, Bistrița-Năsăud, Buzău, Călărași, Cluj, Giurgiu, Gorj, Ialomița, Ilfov, Maramureș, Mehedinți, Sibiu, Vaslui, and Vrancea. The natural forestry habitats, especially protected areas were sampled in the following counties: Bacău, Bihor, Botoșani, Galați, Giurgiu, Hunedoara, Iași, Neamț, Prahova, Sibiu, Suceava, Tulcea, and Vaslui. One of the sampled semi-natural forests is situated in the urban area, namely the Bucharest Municipality. Some of the studied habitats are man-made, for instance: orchards and shelterwood sampled in the Sălaj and Vaslui counties (Fig. 1). The species tabulated in *Leptorhaphis* genus were not identified by the author in any of the studied sites.

Sampling procedure. Within each investigated habitat category, all available trees found in 10 by 10 m sampling units were sampled. The trees were sampled from 1 m up to 1.5 m above the ground. The field method complies with PRIGODINA-LUKOŠIENĖ & NAUJALIS (2006).

Literature data were used to highlight historical informations on the *Leptorhaphis* genus on Romania territory (CIURCHEA, 2004).

The nomenclature of the lichen species, their taxonomy and cenotaxonomy is according to www.speciesfungorum.org. Specimens included in the Collection of the Babeș-Bolyai University Herbarium from Cluj-Napoca are abbreviated in the text as H.U.C. Also, the Mycological Herbarium from Bucharest (BUCM) was consulted for identification of the studied specimens.

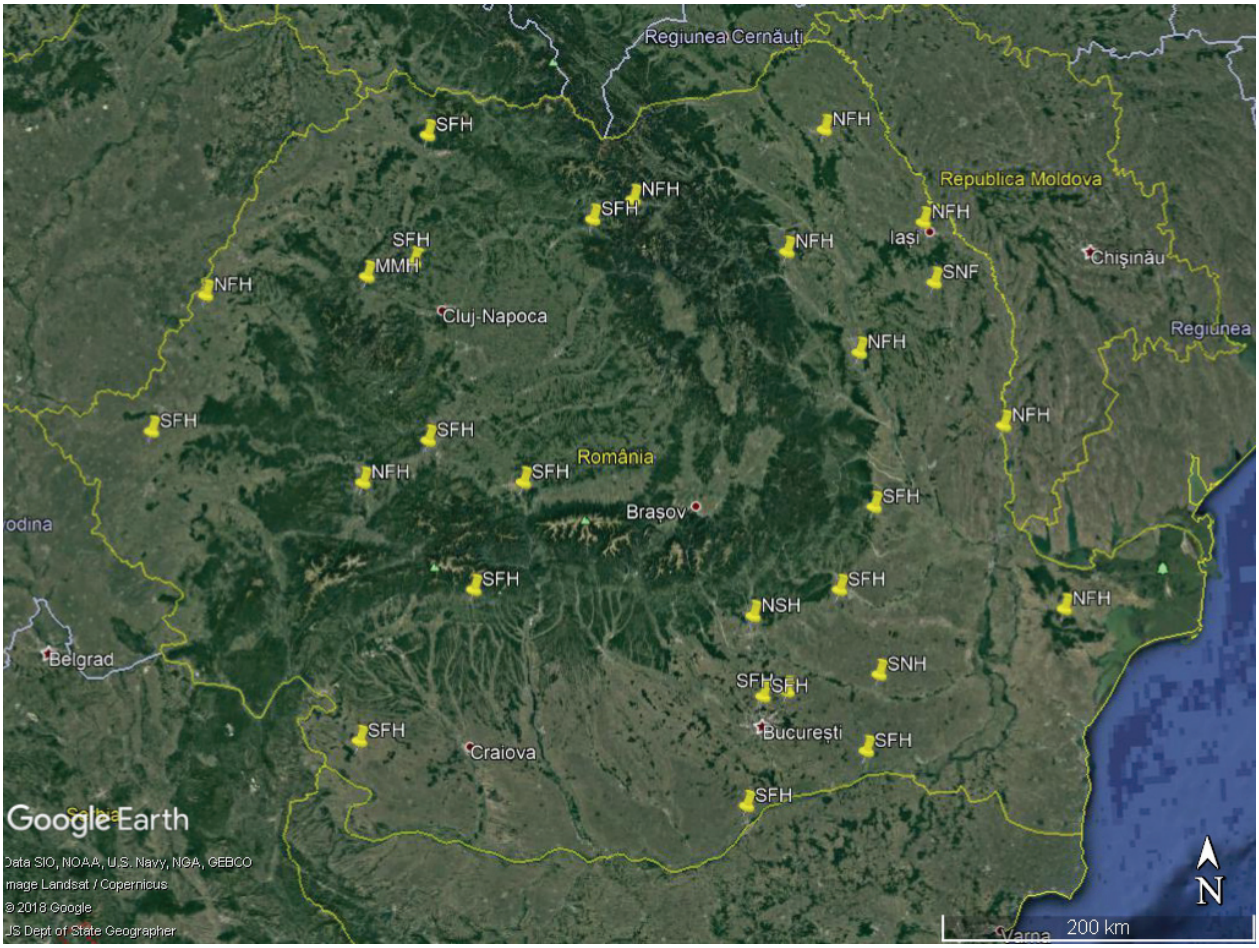

Figure 1. Original sampling sites performed in different counties from Romania (SFH-semi-natural forest habitats, NFH-natural forest habitats, MMH-man-made habitats).

RESULTS AND DISCUSSIONS

In Romania, the *Leptorhaphis* Körb. 1855 genus is represented by four species, especially epiphytic species, as follows: *Leptorhaphis atomaria* (Ach.) Szatala (1927), *Leptorhaphis epidermidis* (Ach.) Th. Fr. (1861), *Leptorhaphis quercus* (Beltr.) Körb. (1865), *Leptorhaphis tremulae* Körb. 1855 (CIURCHEA, 2004). None of these lichen species were identified during the field researches.

In literature, the distribution of the *Leptorhaphis* genus in Romania is weakly represented (CIURCHEA, 2004). Thus, only four species of this genus were identified in a few counties from Romania, as is presented below (CIURCHEA, 2004):

1) ***Leptorhaphis atomaria*** (Ach.) Szatala (Fig. 2)

Bihor County: Apuseni Mountains, Stâna de Vale, on corticolous substrata (CIURCHEA, 2004; H.U.C. nr. 553940), Defileul Crișului Repede, on corticolous substrata (CODOREANU, 1966; CIURCHEA, 2004); Caraș-Severin County: Banat Mountains, Danube Defile at Belobrești, Țigansca Reca Valley, near Remetea, Dubova Forest, on *Fraxinus* L. (CRETZOIU, 1941; MORUZI et al., 1967; CIURCHEA, 2004).

Figure 2. The spatial distribution of *Leptorhaphis atomaria* in Romania (original).

2) ***Leptorhaphis epidermidis*** (Ach.) Th. Fr. (Fig. 3)

Botoşani County: Moldova Plateau, Dersca and Lozna, on *Acer campestre* L. and *Tilia cordata* Mill. (BURLACU, 1967, CIURCHEA, 2004).

Figure 3. The spatial distribution of *Leptorhaphis epidermidis* in Romania (original).

3) ***Leptorhaphis quercus*** (Beltr.) Körb. (Fig. 4)

Arad County: Apuseni Mountains, Zarandului Mountains, Gurahonț, near Căsoaia Chalet, on corticolous substrata (CODOREANU, 1978); Bihor County: Stâna de Vale, on corticolous substrata (CIURCHEA, 2004, H.U.C. nr. 553940, 666853), Maramureș County: the locality is not indicated (MORUZI et al., 1967), Prahova County: Gârbova Mountain, Rea Valley, on corticolous substrata (CIURCHEA, 2004).

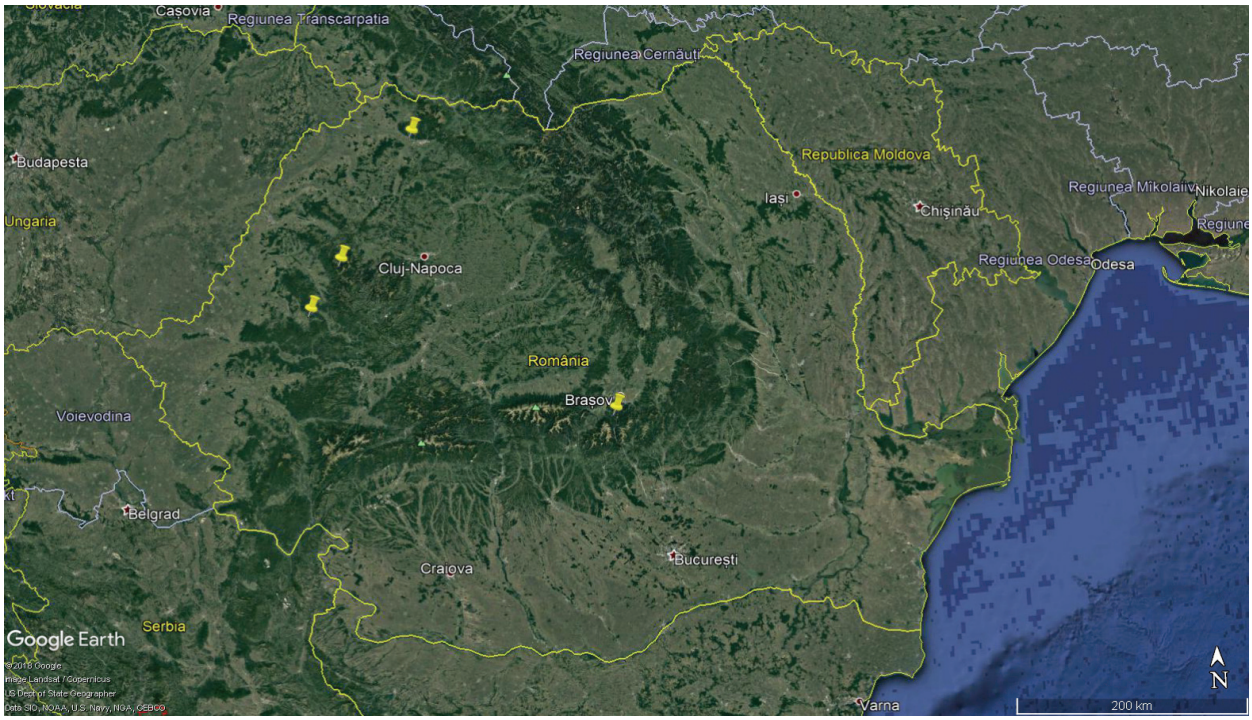

Figure 4. The spatial distribution of *Leptorhaphis quercus* in Romania (original). .

4) ***Leptorhaphis tremulae*** Körb. (Fig. 5)

Botoșani County: Moldova Plateau, Gorovei Forest, on corticolous substrata (BURLACU, 1969), Cluj County: Transilvania Basin, Cluj-Napoca, Botanical Garden, on *Berberis brachypoda* Maxim. (CODOREANU et al., 1960; MORUZI et al., 1967).

Figure 5. The spatial distribution of *Leptorhaphis tremulae* in Romania (original).

5) ***Leptorhaphis wienkampii*** J. Lahm ex Hazsl. (Fig. 6)
Cluj County: Ciucea, on corticolous substrata (CRETZOIU, 1941).

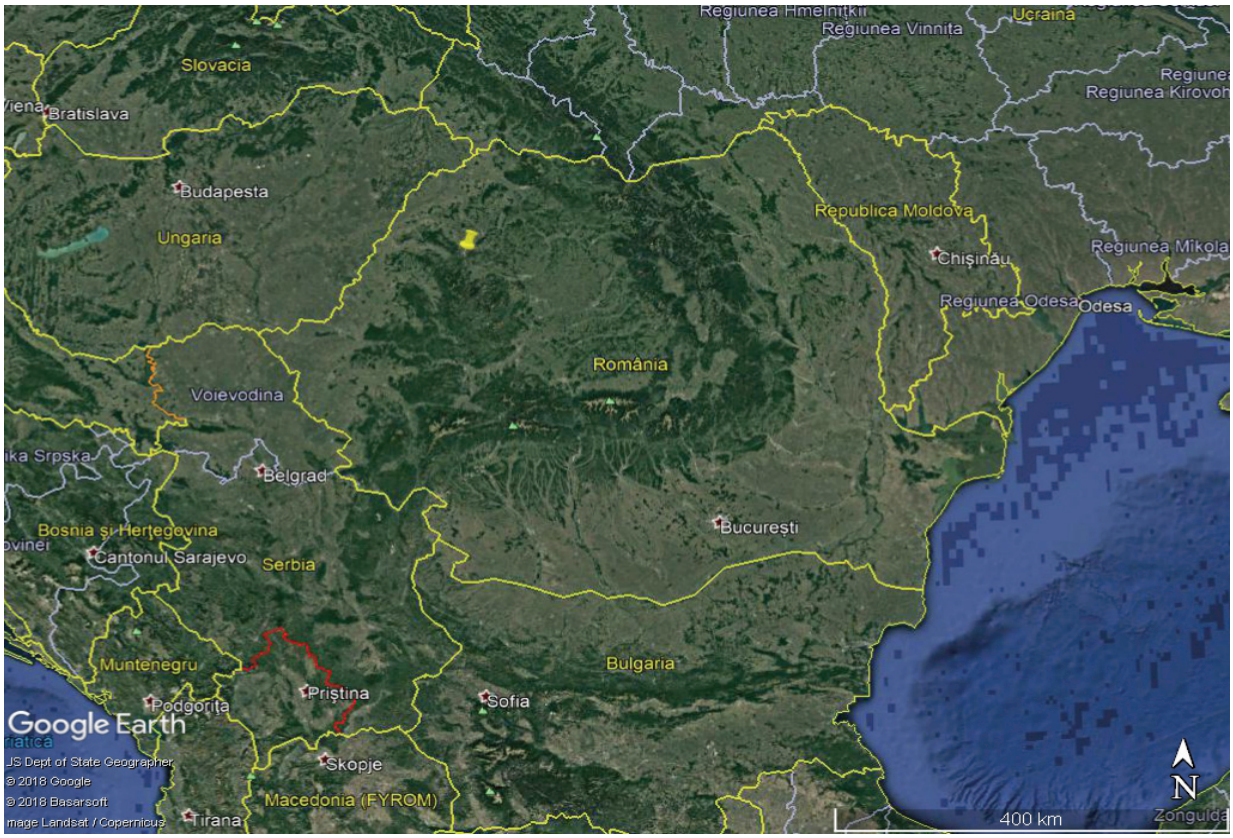

Figure 6. The spatial distribution of *Leptorhaphis wienkampii* J. Lahm ex Hazsl. in Romania (original).

The Romanian red-list of lichen species does not present any data regarding the sociological status of the species belonging to the *Leptorhaphis* genus (SÂRBU et al., 2007; ARDELEAN et al., 2013). Perhaps nowadays their distribution on the Romanian territory is limited by an intensive anthropogenic pressure on their forestry habitats.

The species of the *Leptorhaphis* genus are growing on various corticolous substrata especially from natural forestry habitats (Table 1). Although the species from the *Leptorhaphis* genus depend on wood substrata, none of the sampled trees in the research was colonized by these species. The main cause could be the conversion of primary forests into secondary ones. Lichen species are dependent especially on the substrata type. Thus, lichen species from *Leptorhaphis* genus prefer trees with a high value of the bark pH such as *Populus* L. and *Fraxinus* L. (SKYE, 1968). The substrata type is related both to bark pH and its organic enrichment. The two environmental factors are important to lichen sociology and their chorology. Based on the aspects mentioned above, the *Leptorhaphis* genus is tabulated in the *Xanthorion* community (SKYE, 1968).

Table 1. The substrata on which the species of the *Leptorhaphis* genus are growing and their habitat types (CIURCHEA, 2004).

Species	Substrata	Natural habitat	Anthropogenic habitat
Leptorhaphis atomaria	ash tree, willow, poplar	forestry	-
Leptorhaphis epidermidis	birch	forestry	Botanical garden
Leptorhaphis quercus	oak, birch	forestry	-
Leptorhaphis tremulae	poplar	forestry	Botanical garden
Leptorhaphis wienkampii	corticolous	-	-

Legend: - data are not available

From a sociological point of view, the lichen species taken into account are tabulated into two superior cenotaxons: *Arthonio-Lecidelletea elaeochromae* Drehwald 1993 and *Physcietea* Tomaselli et De Micheli 1957 (Table 2). All lichen species of *Leptorhaphis* genus are tabulated in nitrophilous communities (CIURCHEA, 2004) and their occurrence on oak, willow, and birch with a low pH of the trees bark indicates an eutrophication of substrata (LAUNDON, 1963). Also, in a study performed in Majorca (Spain), it was revealed that these lichen species are growing on nutrient enriched substrata associated to the other nitrophilous lichen species (AGUIRRE-HUDSON & FIOL, 1993). The taxonomy of *Leptorhaphis* genus is well known, but with doubtful taxons with respect to its order (Table 3).

In addition to the known species of this genus for Romania, there are other species widespread on the European, African, American and Asian continents, as follow: *Leptorhaphis amygdali* (A. Massal.) Zwackh 1862, identified in Croatia, Germany, Italy, and Hungary; *Leptorhaphis laricis* (J. Lahm) M. B. Aguirre 1991, identified in Slovakia, Spain, and Germany; *Leptorhaphis lucida* Körb. 1863, identified in Slovakia, Austria, Germany, Russia, USA, Czech Republic, Georgia, Hungary, Ukraine, Norway and Sweden; *Leptorhaphis parameca* (A. Massal.) Körb. 1865, identified in Bulgaria, Austria, Germany, Italy, Norway, Switzerland, USA, Hungary, Ukraine and Turkey. All this species are common on *Fraxinus* L., *Populus* L., and *Prunus* L. (AGUIRRE-HUDSON et al., 2005; KINALIOĞLU, 2009; INASHVILI & BATSATSASHVILI, 2010). The other species, for instance *Leptorhaphis opuntiicola* L. A. Fiol & M. B. Aguirre 1993, were found in Spain (AGUIRRE-HUDSON & FIOL, 1993) and Morocco (ALONSO & EGEA, 1997) on phorophytes; and *Leptorhaphis maggiana* (A. Massal.) Körb. 1865 was identified in Germany (DE BRUYN, 2001). Three of the four lichen species cited in Romania are also widely distributed, for instance *L. atomaria* is known from Russia, Austria, Finland, France, Germany, Italy, Norway, Poland, Slovakia, Sweden, Switzerland, UK, Bulgaria, Hungary, the Netherlands, Spain, Ukraine, USA, and Israel; *L. epidermidis* was found in Austria, Czech Republic, Slovakia, Belgium, Finland, France, Germany, Ireland, Italy, Norway, Poland, Sweden, Switzerland, UK, USA, Hungary, the Netherlands, Portugal, Spain, and Ukraine; *L. tremulae* was cited from Germany. These three lichen species were common on *Populus* and *Betula* (DE BRUYN, 2001; AGUIRRE-HUDSON et al., 2005; KONDRATYUK et al., 2005; EICHLER et al., 2010).

Table 2. The cenotaxons in which the studied lichen species occurs (CIURCHEA, 2004).

Species	Class	Order	Alliance	Association
Leptorhaphis atomaria	*Physcietea* Tomaselli et De Micheli 1957	*Physcietalia adscendentis* Hadač 1944 em Barkm. 1958	*Xanthorion parietinae* Ochsner 1928	N/A
Leptorhaphis epidermidis	*Physcietea* Tomaselli et De Micheli 1957	*Physcietalia adscendentis* Hadač 1944 em Barkm. 1958	*Xanthorion parietinae* Ochsner 1928	*Physcietum adscendentis* Frey et Ochsner 1926
Leptorhaphis quercus	*Arthonio-Lecidelletea elaeochromae* Drehwald 1993	*Graphidetalia scriptae* Hadač 1944	*Lecanorion subfuscae* Ochsner 1928	*Rinodinetum exiguae* Klem. 1951
	Physcietea Tomaselli et De Micheli 1957	*Physcietalia adscendentis* Hadač 1944 em Barkm. 1958	*Xanthorion parietinae* Ochsner 1928	*Physcietum adscendentis* Frey et Ochsner 1926
Leptorhaphis tremulae	N/A	N/A	N/A	N/A
Leptorhaphis wienkampii	N/A	N/A	N/A	N/A

Legend: N/A data are not available

Table 3. The taxonomy of the considered lichen species (www.speciesfungorum.org).

Species	Kingdom	Division	Class	Order	Family
Leptorhaphis atomaria	Fungi R. T. Moore 1980	Ascomycota Caval. Sm. 1998	Dothideomycetes O. E. Erikss. et Winka 1997	Incertae sedis	Naetrocymbaceae Höhn (1909)
Leptorhaphis epidermidis					
Leptorhaphis quercus					
Leptorhaphis tremulae					
Leptorhaphis wienkampii					

CONCLUSIONS

Although the field activities were performed on a vast area on the Romanian territory, no new records about the chorology of the *Leptorhaphis* genus were obtained. For this reason, further field studies are needed to find out which lichen species belong to the *Leptorhaphis* genus.

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REFERENCES

AGUIRRE-HUDSON BEGOÑA, FARKAS E., LŐKÖS L. 2005. New recordes of *Leptorhaphis* and other ascomycete genera from the Carpathian basin (Europe). *Herzogia*. Druck-Zuck Publisher. Berlin. **18**: 47-50.

AGUIRRE-HUDSON BEGOÑA & FIOL L. 1993. A new species of *Leptorhaphis* (Arthopyreniaceae) on *Opuntia* from the Balearic Islands. *The Lichenologist*. Cambridge University Press. London. **25**: 207-209.

ALONSO F. L. & EGEA J. M. 1997. Líquenes epifíticos de algunas localidades Costeras de Marruecos. *Acta Botanica Malacitana*. Universidad Malaga Press. **22**: 13-18.

ARDELEAN IOANA-VIOLETA, KELLER CRISTINA, SCHEIDEGGER C. 2013. Lichen flora of Rodnei Mountains National Park (Eastern Carpathians, Romania) including new records for the Romanian mycoflora. *Folia Cryptogamica Estonica*. University of Tartu Press. **50**: 101-115.

BURLACU LUCIA. 1967. Contribuţii la cunoaşterea florei şi vegetaţiei lichenologice a pădurilor din raionul Dorohoi (reg. Suceava). *Analele Ştiinţifice ale Universităţii „Al. I. Cuza'' din Iaşi*. *Secţiunea II Biologie*. Edit. Universitaria. Iaşi. **13**: 167-172.

BURLACU LUCIA. 1969. Contribuţii la cunoaşterea florei şi vegetaţiei lichenologice arboricole din pădurile Horlăceni, Gorovei, Văculeşti şi Vârful Câmpului (jud. Botoşani). *Analele Ştiinţifice ale Universităţii „Al. I. Cuza'' din Iaşi*. *Secţiunea II Biologie*. Edit. Universitaria. Iaşi. **1**: 19-23.

CIURCHEA MARIA. 2004. *Determinatorul lichenilor din România*. Edit. Bit. Iaşi. 488 pp.

CODOREANU V. 1966. Flora şi vegetaţia lichenologică din Rezervaţia Naturală „Defileul Crişului Repede''. *Contribuţii Botanice*. Edit. Universitaria. Cluj-Napoca: 83-101.

CODOREANU V. 1978. Lichenoflora, flora şi vegetaţia Munţilor Zarand. *Contribuţii Botanice*. Edit. Universitaria. Cluj-Napoca: 68-75.

CODOREANU V., ŢIU-ROVENŢA E., MICLE F. 1960. Lichenii corticoli din Grădina Botanică din Cluj. *Contribuţii Botanice*. Edit. Universitaria. Cluj-Napoca. 97-108.

CRETZOIU P. 1941. Conspectul lichenilor pyrenocarpi din România. *Analele Institutului de cercetări şi experimentaţie forestieră*. *Seria I*. Buletin ştiinţific. Baia Mare. **8**: 51-158.

DE BRUYN U. 2001. Zur aktuellen Verbreitung epiphytisch auftretender lichenicolor und nicht lichenisierter flechtenähnlicher Pilze im nördlichen Weser-Ems-Gebiet. *Drosera*. Springer. Berlin. 183-188.

EICHLER M., CEZANNE R., DIEDERICH P., ERTZ D., VAN DEN BROECK D., VAN DEN BOOM P., SÉRUSIAUX E. 2010. New or interesting lichens and lichenicolous fungi from Belgium, Luxembourg and northern France. XIII. *Bulletin de la Société des naturalistes luxembourgeois*. Universitas Press. Luxembourg. **111**: 33-46.

HAWKSWORTH D. L. & McMANUS P. A. 1989. Lichen recolonization in London under conditions of rapidly falling sulphur dioxide levels, and the concept of zone skipping. *Botanical Journal of the Linnean Society*. Oxford Academic Press. London. **100**: 99-109.

INASHVILI T. & BATSATSASHVILI K. 2010. New lichen records from Georgia. *Turkish Journal of Botany*.Tübitak. Ankara. **34**: 549-553.

JURCIŅŠ D., MEŽAKA A., STRAZDIŅA L., GERRA-INOHOSA L., PERŠEVICA G., PITERĀNS A. 2014. Refound of extinct lichen Lobaria amplissima (Scop.) Forssell in Latvia. *Acta Biologica Universitatis Daugavpiliensis*. University of Daugavpils. Department of Biology. Daugavpils. **14**: 59-65.

KINALIOĞLU K. 2009. Lichens from the Amasya, Çorum, and Tokat regions of Turkey. *Mycotaxon*. Ingenta Connect Publication. Ithaca, NY . **109**: 181-184.

KONDRATYUK S., NEVO E., WASSER S. 2005. New species of lichen-forming fungi from Golan Heights, Israel. *Ukrainian Botanical Journal*. Universitaria Press. Kiev. **62**: 159-169.

LAUNDON J. R. 1963. The taxonomy of sterile crustaceous lichens in the British Isles. *The Lichenologist*. Cambridge University Press. London. **2**: 101-151.

MARTÍNEZ ISABEL & ARAGÓN G. 2002. *Leptorhaphis atomaria* (Ach.) Szatala (Arthopyreniaceae, Dothideales) in the Iberian Peninsula. *Anales del Jardín Botánico de Madrid*. Universitaria Press. Madrid. **59**: 338-339.

MORUZI CONSTANŢA, PETRIA ELENA, MANTU ELENA. 1967. Catalogul Lichenilor din România. *Acta Botanica Horti Bucurestiensis*. Edit. Academiei R. S. R. Bucureşti: 1-389.

PRIGODINA-LUKOŠIENĖ INGRIDA, NAUJALIS J. R. 2006. Principal relationship among epiphytic communities on common oak (*Quercus robur* L.) trunks in Lithuania. *Ekologija* **2**: 21-25.

SÂRBU ANCA, SÂRBU I., OPREA A., NEGREAN G., CRISTEA V., GHEORGHE C., CRISTUREAN I., POPESCU G., OROIAN SILVIA, TĂNASE C., BARTÓK KATALIN., GAFTA D., ANASTASIU PAULINA, CRIŞAN, F. COSTACHE I., GOIA IRINA, MARUŞCA T., OŢEL V., SĂMĂRGHIŢAN MIHAELA, HENŢEA SORANA, PASCALE GABRIELA, RĂDUŢOIU D., BAZ ADRIANA, BORUZ VIOLETA, PUŞCAŞ M., HIRIŢIU MARIANA, STAN I., FRINK J. 2007. *Arii speciale pentru protecţia şi conservarea plantelor în România*. Edit. Victor B. Victor. Bucureşti. 397 pp.

SKYE E. 1968. Lichens and air pollution. A study of cryptogamic epiphytes and environment in the Stockholm region. *Acta Phytogeographica Suecica*. Springer. Berlin. **52**: 1-142.

***. www.speciesfungorum.org (accessed February, 2018).

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