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Additions to the bryophyte flora of the Republic of Northern Macedonia

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KEY WORDS

Chorology,
liverworts,
mosses,
new records,
Balkans,
Mediterranean,
SE Europe.

ABSTRACT

The bryophyte flora research in the Republic of Northern Macedonia has been neglected for decades. Here, we report 18 new records, namely two liverworts and 16 moss species for this territory. For each new species presented here, the next information is given: collection data, short notes on distribution in Europe, the Balkan countries and the Mediterranean Region, as well as frequency and IUCN threat categories in the Balkan countries if any. For taxonomically interesting species the peculiarities such as diagnostic morphological characters are explained. With these new records the bryophyte flora of the Republic of Northern Macedonia counts 575 species (one hornwort, 104 liverworts and 470 mosses).

RÉSUMÉ

Additions à la flore bryologique de la République de Macédoine du Nord.

L'étude de la flore bryologique de la République de Macédoine du Nord a longtemps été négligée. Dans cet article, deux hépatiques et 16 mousses ont été nouvellement récoltées sur ce territoire. Pour chacune sont précisées les données de récolte, la distribution en Europe, dans les Balkans et la Région méditerranéenne ainsi que leur fréquence et leur niveau de menace selon l'UICN dans les Balkans. Pour les espèces taxonomiquement intéressantes les particularités et les caractères morphologiques diagnostiques sont ajoutés. Avec ces nouveaux reports la flore bryologique de la République de Macédoine du Nord comprend 575 espèces (une anthocéroto, 104 hépatiques et 470 mousses).

MOTS CLÉS

Chorologie,
hépatiques,
mousses,
nouveaux signalements,
Balkans,
Méditerranée,
SE Europe.

INTRODUCTION

The Republic of Northern Macedonia (previously Former Yugoslav Republic of Macedonia or the Republic of Macedonia) is situated in SE Europe, in the central south part of the Balkan Peninsula. It occupies an area of 25 713 km², 40% of which is forested, 51% is in agriculture use and 9% is non-productive; its surface is composed of a complex mosaic of various metamorphic, sedimentary and igneous rocks; the relief structure is very diverse and rather interesting, represented by mountains, valleys, ravines, narrow gorges, saddles and other forms, being mountains cover approximately two-thirds of the land; due to specific natural and geographic characteristics, the prevailing climates country are the Mediterranean and the continental (*in* Spirovska 2003).

Mihajlov *et al.* (2011) reported the biodiversity of Macedonia to be characterized by high heterogeneity and high levels of relict and endemic species. Gaston & David (1994) and Spirovska (2003) stated that analyses of biodiversity richness for individual countries within the European continent rank the Republic of Northern Macedonia at the very top of the list of countries considered to be one of the European Hot Spots.

The first conspectus of bryophytes for the present territory of the Republic of Northern Macedonia made by Pavletić (1955) counted 213 species (no hornworts, 27 liverworts and 186 mosses). Later on, Martinčić (1968) reported 267 species (in total 285 with infraspecific taxa). Spirovska (2003) reported 349 species (one hornwort, 52 liverworts and 296 mosses) among which two were stated to be endemic (namely *Mielichhoferia paradoxa* Herzog and *Orthotrichum insidiosum* Herzog). At present *M. paradoxa* is still considered to be endemic and its accepted name is *Brachymenium paradoxum* (Herzog) A.J. Shaw (Shaw 1987), while *O. insidiosum* is considered to be a synonym of the widely distributed *O. rupestre* Schleich. *ex* Schwaegr (Lewinsky 1993). Cekova (2005) recorded 397 bryophyte species in the Republic of Northern Macedonia (one hornwort, 66 liverworts and 330 mosses). In the check-list of SE European liverworts and hornworts, Sabovljević & Natcheva (2006) reported 69 species (one hornwort and 68 liverworts), and Sabovljević *et al.* (2008) reported 345 mosses species for Northern Macedonia. In the check list of Mediterranean bryophytes that summarize the current state of knowledge for Mediterranean countries, Ros *et al.* (2007) cited one hornwort and 71 liverworts species, and Ros *et al.* (2013) enumerated 403 mosses for Northern Macedonia. Finally, in the latest known inventory made by Hodgetts (2015) for European countries, one hornwort, 102 liverworts and 454 mosses were listed for this area.

The bryophyte flora is poorly studied in the Republic of Northern Macedonia even historically when it was part of Yugoslavia (Martinčić 2009). Sabovljević *et al.* (2001) stated the Northern Macedonia to be one of the least bryologically explored countries of Europe, and Sabovljević (2004) predicted many new bryophyte records for the country with future research. Indeed, many new records have been reported in the last decades (e.g. Martinčić 2009; Papp *et al.* 2011, 2016;

Ellis *et al.* 2014, 2017). Sabovljević *et al.* (2011) concluded that the Republic of Northern Macedonia, although still very poorly explored bryologically, given the number of reported species in relation to the small surface area of the country, belongs to one of the richest countries in Europe regarding the bryophyte flora diversity.

The aim of present study was to contribute to the knowledge of underexplored bryophyte flora of Northern Macedonia, and here we present a significant contribution i.e. new national records.

MATERIAL AND METHODS

The studied samples were collected in a part of the Scardo-Pindic massive, namely Galičica Mt, where the focus of bryological investigation was in October 2016.

The voucher specimens are deposited in the Bryophyte collection of the Hungarian Natural History Museum, Budapest (BP).

The nomenclature for liverworts and mosses follows Ros *et al.* (2007, 2013) respectively, except for *Fissidens incurvus* Starke *ex* Röhl., where we accept the concept of Erzberger (2016), and the *Ephemerum serratum* (Hedw.) Hampe complex, for which we follow Ellis & Price (2015).

STUDY AREA

Galičica Mt is a National Park founded in 1958, which covers 227.5 km², situated in the SW part of Northern Macedonia between the two biggest lakes namely Ohrid (in the E) and Prespa (in the W) and the Albanian border in the S (Fig. 1). The range extends for 35 km long stretching from N to S, its highest peak is Magaro reaching 2254 m altitude; it has poor hydrology on mainly calcareous bedrock; the two above mentioned lakes are a kind of thermal regulator, which moderates the climate in this region, not permitting extremely high or low temperatures, hence this region is under the influence of moderate continental or atypical sub-Mediterranean climate (Custerevska 2016). It is a high-mountain region considered as the center of high floristic diversity of vascular plants (over 1000 species) and also the center of vascular plant endemism (15 strict endemic species) in the Republic of Northern Macedonia (Spirovska 2003). This is also reflected in the relatively frequent occurrence of the Submediterranean-subatlantic moss *Hedwigia stellata* Hedenäs, rare or missing in surrounding areas (Erzberger 1996; Martinčić 2009; Papp & Erzberger 2012).

According to Custerevska (2016), within the area of the National Park vascular plant vegetation diversity is represented by 130 forest communities, and this heterogeneity is undoubtedly a result of the spatial and environmental uniqueness of the massif, its geological history and climate specifics. Also this author mentioned that favorable climatic circumstances and the dominant limestone bedrock create good environmental conditions for the development of a number of plant



FIG. 1. — The position of the investigated area (National Park Galičica), within the Republic of Northern Macedonia (gray polygon between Ohrid lake in the west and Prespa lake in the east). The inserted map on the right corner indicates the situation of the Republic of Northern Macedonia in SE Europe.

species and plant communities typical of Mediterranean or sub-Mediterranean flora and vegetation all over Galičica, and that the geographic position, relief and mild climate allowed Galičica to harbor many species during the glacial period and it has refugial character.

The study area is situated within the Mediterranean Region according to Conservation International Biodiversity Hot-spots (2019).

RESULTS AND DISCUSSION

Here we report 18 new records for the bryophyte flora of the Republic of Northern Macedonia, which holds at present a total of 575 species: one hornwort, 104 liverworts and 470 mosses.

For each species the next information is given: collection data, short notes on general or regional distribution in Europe, the Balkan countries and the Mediterranean Region, as well as frequency and IUCN treat categories in the Balkans if any.

For taxonomically interesting species the peculiarities such as diagnostic morphological characters are explained.

Acaulon mediterraneum Limpr.

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** From Ohrid-Otoševo road towards Asan Gura, karstplateau at Suvo pole, on acidic soil, 41°00'24.1"N, 20°52'14.1"E, 1,435 m a.s.l., 18.X.2016, leg. Papp B. and Pantović J. s.n., BP[BP 193681].

REMARKS

This species is known from a few localities in western and northern Europe, but is more widely distributed in southern Europe (Hassel 2003; Hodgetts 2015). In the Balkans, it was previously known from Bulgaria, Croatia, Greece, Montenegro and European Turkey (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015), although it was not frequently reported. In the rest of the Mediterranean Region, it was also recorded in Balears, Canary Islands, Corsica, Creta, France, Italy, Morocco, Portugal, Sardinia, Sicily and Spain (Ros *et al.* 2013; Hodgetts

2015). At the same time, this is the first record of the genus *Acaulon* Müll. Hal. in the Republic of Northern Macedonia.

Bryum radiculosum Brid.

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on limestone rock crevice, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, *conf. Erzberger, P.*, BP[BP 193479].

REMARKS

This species has a wide distribution in western, central and southern Europe (Smith 2004; Hodgetts 2015). It was known from all SE European countries except Northern Macedonia and the European part of Turkey (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). However, according to our opinion this is an often overlooked species in the Balkans. According to Ros *et al.* (2013), in the rest of Mediterranean Region, it is only absent in Andorra and Syria. It is red-listed in Bulgaria as VU (Natcheva *et al.* 2006) and in Romania as EN (Ștefănuț & Goia 2012).

Dicranella howei Renauld & Cardot

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** After Sveta Petka church in Sveti Naum monastery complex at Ohrid lake, source area of the Crni Drim river, on soil, 40°54'43.7"N, 20°44'32.1"E, 715 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193579] — Dolno Konjsko village at Ohrid lake, lime containing schistose rock on the roadside, 41°03'37.6"N, 20°48'11.6"E, 705 m a.s.l., 21.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193728] — Towards Otoševo from Ohrid lake, at the roadside before Vidikovec, conglomerate rock, 40°57'57.1"N, 20°48'20.8"E, 1135 m a.s.l., 21.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193735].

REMARKS

This species is widely distributed in Europe in areas of Mediterranean influence (Smith 2004), being also present in central Europe (Hodgetts 2015). It was reported previously from Bosnia-Herzegovina, Croatia, Greece, Montenegro and European Turkey among Balkan countries (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015), where it seems not to be very rare in adequate sites. According to Ros *et al.* (2013), in the other Mediterranean territories, it was not recorded only in Andorra, Egypt, Jordan and Syria.

Ephemerum serratum (Hedw.) Hampe

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** From Ohrid-Otoševo road to Velestovo through the plateau, before the junction to Velestovo and Resen, acidic soil around a pond, 41°03'17.0"N, 20°51'22.8"E, 1470 m a.s.l., 18.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193723].

REMARKS

This species has scattered European reports (Hodgetts 2015). It was rarely documented from the Balkans and this is the

first record of the genus *Ephemerum* Hampe in the Republic of Northern Macedonia. It is known from Bulgaria where it is considered as DD (Papp *et al.* 2018), Croatia (Düll 1999; Alegro *et al.* 2014) and Montenegro (Sabovljević *et al.* 2008), but possibly overlooked across SE Europe due to its minute size, seasonal appearance and controversial taxonomic status. In the rest of Mediterranean areas, it is known from Corsica, France, Israel, Italy, Morocco, Portugal, Sardinia, Sicily, Spain and Turkey (Ros *et al.* 2013; Hodgetts 2015). Some authors included it in *E. stoloniferum* (Hedw.) L.T. Ellis and M.J. Price (syn. *E. serratum* auct. non (Hedw.) Hampe in the traditional sense).

The specimen is characterized by the possession of finely papillose spores (40-70 µm in diameter), with an external hyaline veil (Price 2011). After the typification by Ellis & Price (2015), *E. serratum* became the earliest valid name for the entity, most frequently referred to as *E. minutissimum* with the above mentioned characters, while *Phascum stoloniferum* Hedw. provides the earliest available epithet for the moss presently referred to by European authors as *E. serratum*. The checklists of Ros *et al.* (2013) and Hodgetts (2015) still use the earlier nomenclature.

Fissidens gracilifolius Brugg.-Nann. & Nyholm

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** Sveta Bogorodica church in Sveti Naum monastery complex at Ohrid lake, source area of Crni Drim river, limestone rock near the water, 40°54'36.7"N, 20°44'42.8"E, 710 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193625].

REMARKS

This species is widely but scatterly distributed in Europe, from south to north and west, reaching Ukraine in the east (Frey *et al.* 2006; Hodgetts 2015). Among the Balkan countries, it was rarely reported: Albania (Papp *et al.* 2010), Bulgaria, Croatia, Greece, Romania, Slovenia and Serbia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). In the rest of Mediterranean countries, it is present in Balears, Corsica, Crete, France, Italy, Madeira, Malta, Portugal, Sicily, Spain and Turkey (Ros *et al.* 2013; Hodgetts 2015). In Bulgaria and Romania it is considered to be VU (Natcheva *et al.* 2006; Ștefănuț & Goia 2012).

Fissidens incurvus Starke ex Röhl.

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** Source area of the Crni Drim river at Sveti Atanasij church in Sveti Naum monastery complex at Ohrid lake, on soil, 40°54'37.8"N, 20°44'53.1"E, 715 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193629].

REMARKS

This species is widely reported from Europe (Hodgetts 2015) and the Mediterranean area (Ros *et al.* 2013). It is recorded in many Balkan states: Bosnia-Herzegovina, Bulgaria, Greece, Montenegro, Romania, Serbia, Slovenia and European Turkey

(Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015), so it was expected to be recorded in Northern Macedonia, as well. However, since it is often considered as an infraspecific taxon within the variable *Fissidens viridulus* group, it is surely overlooked in the Balkans and can be more frequent than reported. In Ros *et al.* (2013) and Hodgetts (2015) it is also considered as infraspecific taxon as *F. viridulus* var. *incurvus* (Starke ex Röhl.) Waldh.

Grimmia dissimulata E. Maier

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on exposed limestone rock, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193484] — *Quercus-Carpinetum orientalis* Horvatić, 1939 forest between Trpejca and Peštani at Ohrid lake, on exposed limestone rock, 40°58'17.3"N, 20°47'24.0"E, 795 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193664].

REMARKS

Records for this species come from southern, central, western and even northern Europe (Lüth 2012; Hodgetts 2015). In the Balkans, where it can be more frequent than reported, was already known from Albania, Croatia, Greece, Montenegro and Serbia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). In the rest of the Mediterranean area, it was reported from Balears, Crete, Cyprus, France, Italy, Madeira, Morocco, Portugal, Sardinia, Spain, Syria and Turkey (Ros *et al.* 2013; Hodgetts 2015).

Gymnostomum viridulum Brid.

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on limestone rock crevices, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193487] — From Otoševo to the hill, eastern slope limestone rocky grassland, 40°58'30.0"N, 20°53'02.7"E, 1165 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193531] — Dolno Konjsko village at Ohrid lake, lime containing schistose rock on roadside, 41°03'37.6"N, 20°48'11.6"E, 705 m a.s.l., 21.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193731] — towards Otoševo from Ohrid lake, at the roadside before Vidikovec, on conglomerate rock 40°57'57.1"N, 20°48'20.8"E, 1135 m a.s.l., 21.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193742].

REMARKS

This species was recorded in central and southern parts of Europe, generally missing in northern and eastern (Hodgetts 2015). Only few records of this species are known in the Balkans, where it is rather rare, being reported from Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Romania and Slovenia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). In the rest of Mediterranean areas, Ros *et al.* (2013) stated the records in almost all other areas except Libya and Malta. According to Natcheva *et al.* (2006), it is VU in Bulgaria and according to Martinčič (2006), it is EN in Slovenia.

Plagiothecium laetum Schimp.

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** Source area of Crni Drim river at Sveti Atanasij church in Sveti Naum monastery complex at Ohrid lake, on the base of *Alnus glutinosa*, 40°54'37.8"N, 20°44'53.1"E, 715 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193652].

REMARKS

This is a widespread European species rather less present in the Mediterranean areas (Hodgetts 2015). In the Balkans, it is known from Albania (Marka *et al.* 2018), Bosnia-Herzegovina, Bulgaria, Greece, Montenegro, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015), although in general it was not frequently reported from these countries. In the rest of the Mediterranean area, it was recorded in Andorra, France, Italy, Madeira (although excluded in Hodgetts 2015), Portugal, Spain and Turkey (Ros *et al.* 2013). Here, this taxon is treated in the sense of Smith (2004), for which the diagnostic character is the not curved downwards leaf apices.

Platydictia jungermannioides (Brid.) H.A. Crum

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** Towards Otoševo from Ohrid lake, towards Lako Signaj peak opposite to Magaro peak, alpine zone, in limestone grassland, 40°57'38.3"N, 20°49'25.2"E, 1715 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193468].

REMARKS

This is a species mainly distributed in north and central parts of Europe, but reaching also the west and east (Hodgetts 2015). It is a rare species in the Balkans, where it is known to be present in Albania (Marka *et al.* 2018), Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Montenegro, Romania and Slovenia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). In the rest of Mediterranean areas, it is only known from France, Italy and Spain (Ros *et al.* 2013; Hodgetts 2015).

Pohlia lescuriana (Sull.) Ochi

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on the bank of the lake, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193513].

REMARKS

The species is widely but scatterly distributed in Europe (Smith 2004; Hodgetts 2015). In the Balkans, it was not often collected, being known only from Romania, Serbia and Slovenia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). Additionally, in the rest of the Mediterranean, it was reported only from Corse, France, Italy, Portugal and Spain (Ros *et al.* 2013; Hodgetts 2015). The specimen has leaf nerve ending below apex and rhizoidal gemmae pale brown, spherical to pyriform, 90–110 µm in diameter, while sporophytes are rare (as stated by Smith 2004).

Pseudephemerum nitidum (Hedw.) Loeske

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** From Ohrid-Otoševo road to Veľestovo through the plateau, before the junction to Veľestovo and Resen, on acidic soil around a pond, 41°03'17.0"N, 20°51'22.8"E, 1470 m a.s.l., 18.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193726].

REMARKS

The species is scattered but widespread all over Europe (Hodgetts 2015). It is rarely reported from the Balkans, apart from low intensity of field research, the reason could be its minute size and seasonal appearance. It was previously reported from Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Romania and Slovenia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015). In the rest of the Mediterranean area, it was recorded in Algeria, Azores, Corsica, France, Italy, Madeira, Morocco, Portugal and Spain (Ros *et al.* 2013; Hodgetts 2015). It is red-listed in Romania as EN (Ștefănuț & Goia 2012) and in Slovenia as VU Martinčič (2006).

Pseudocrossidium revolutum (Brid.) R.H. Zander

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on limestone rock, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193494] — From Otoševo to the hill, eastern slope limestone rocky grassland, 40°58'30.0"N, 20°53'02.7"E, 1165 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 183532] — From the asphalt road from Otoševo to Ohrid towards Asan Gura, karst plateau at the old ski lift before Suvo pole, on limestone rock, 40°59'15.8"N, 20°52'01.8"E, 1500 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193560] — *Querco-Carpinetum orientalis* Horvatić, 1939, forest between Trpejca and Peštani at Ohrid lake, on soil among limestone rocks, 40°58'17.3"N, 20°47'24.0"E, 795 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193669] — Towards Otoševo from Ohrid lake, at the roadside before Vidikovec, on conglomerate rock, 40°57'57.1"N, 20°48'20.8"E, 1135 m a.s.l., 21.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193746].

REMARKS

It is widespread but scattered in Europe decreasing from southern to northern Europe, and being also present from western to eastern till Crimea and Ukraine (Smith 2004; Hodgetts 2015). This is not a rare species in the Balkans and it has been recorded from many areas. Sabovljević *et al.* (2008) reported its presence from all their territories except Macedonia, but it is also not known from Kosovo (Pantović & Sabovljević 2017). In the rest of the Mediterranean area, it is also widely distributed, being only absent in Andorra and Egypt (Ros *et al.* 2013; Hodgetts 2015).

Rhynchostegiella tenella (Dicks.) Limpr.

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** At Prespa lake near Otoševo, on limestone rock crevices, 40°58'07.5"N, 20°54'36.7"E, 870 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193495] — Sveti Naum monastery at Ohrid lake, on a

shaded limestone rock at the lakeshore, 40°54'51.5"N, 20°44'27.7"E, 700 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193571].

REMARKS

This species is widely distributed in Europe (Hodgetts 2015; Patiño *et al.* 2017). Although it is not frequent, it appears in all countries of the Balkans; it was not reported only from Kosovo and Northern Macedonia (Sabovljević *et al.* 2008; Ros *et al.* 2013; Hodgetts 2015; Pantović & Sabovljević 2017). Also in the rest of the Mediterranean area it is widely present (Ros *et al.* 2013), being only missing in Andorra, Libya, Syria and Tunisia; Patiño *et al.* (2017) excluded it from Azores and Madeira. In Bulgaria, it is even considered to be VU (Natcheva *et al.* 2006).

Rhynchostegium confertum (Dicks.) Schimp.

SPECIMEN EXAMINED. — **Republic of Northern Macedonia.** Sveta Bogorodica church in Sveti Naum monastery complex at Ohrid lake, source area of Crni Drim river, on shaded limestone rock, 40°54'36.7"N, 20°44'42.8"E, 710 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193616].

REMARKS

This species is widely distributed in Europe (Hodgetts 2015). In the Balkans, it is also widespread though it has not been frequently reported, being only not previously recorded in Kosovo and Northern Macedonia (Sabovljević *et al.* 2008; Pantović & Sabovljević 2017). In the rest of the Mediterranean area it is only absent in Andorra, Egypt, Jordan, Lebanon and Malta (Ros *et al.* 2013; Hodgetts 2015).

Rhynchostegium rotundifolium (Scop. ex Brid.) Schimp.

SPECIMENS EXAMINED. — **Republic of Northern Macedonia.** Sveta Bogorodica church in Sveti Naum monastery complex at Ohrid lake, source area of the Crni Drim river, on shaded limestone rock, 40°54'36.7"N, 20°44'42.8"E, 710 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193617] — Source area of the Crni Drim river at Sveti Atanasij church in Sveti Naum monastery complex at Ohrid lake, on shaded limestone rock, 40°54'37.8"N, 20°44'53.1"E, 715 m a.s.l., 17.X.2016, *leg. Papp B. and Pantović J. s.n.*, BP[BP 193634].

REMARKS

This is a rarely reported species in Europe with mainly central-European distribution, but reaching Great Britain in the west and Ukraine and south-eastern Russia in the east (Smith 2004; Hodgetts 2015). In the Balkans, it was not frequently reported, being known from Bulgaria, Montenegro, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008; Dragičević *et al.* 2008). In the rest of the Mediterranean Region it was reported only in France, Italy, Sicily and Turkey (Ros *et al.* 2013; Hodgetts 2015). It is considered EN in Romania (Ștefănuț & Goia 2012).

Riccia crozalsii Levier

SPECIMEN EXAMINED. — From the road from Otoševo to Ohrid towards Asan Gura, karst plateau at the old ski lift at Suvo pole, soil among limestone rocks, 40°59'15.8"N, 20°52'01.8"E, 1500 m a.s.l., 16.X.2016, *leg. Papp B. and Pantović J. s.n.*, conf. *Sérgio C.*, BP[BP 53206/H].

REMARKS

This species in Europe has mainly Mediterranean-Atlantic distribution (Frey *et al.* 2006), reaching also central Europe (Bischler 2004; Hodgetts 2015). It was known previously from the Balkans, namely Albania, Bosnia-Herzegovina, Croatia, Greece, Montenegro and European Turkey (Sabovljević & Natcheva 2006; Ros *et al.* 2007; Hodgetts 2015). In the rest of the Mediterranean Region, it is only absent in Egypt, Jordan and Libya (Ros *et al.* 2007). This is a generally rarely reported species all over Europe, due to its seasonality.

Riccia papillosa Moris

SPECIMEN EXAMINED. — Towards Otoševo from Ohrid lake, under Magaro peak from Lipova livada, alpine zone, limestone grassland, 40°56'37.4"N, 20°49'37.1"E, 1870 m a.s.l., 15.X.2016, *leg. Papp B. and Pantović J. s.n.*, conf. *Sérgio C.*, BP[BP 53191/H].

REMARKS

It is mainly distributed in the Mediterranean, central and eastern Europe (Bischler 2004; Hodgetts 2015). In the Balkans, it is known from Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Montenegro and Romania (Sabovljević & Natcheva 2006; Ros *et al.* 2007; Hodgetts 2015). In the rest of the Mediterranean Region it is widespread, being present also in Algeria, Canary Islands, Corsica, Creta, France, Italy, Morocco, Portugal, Sardinia, Sicily, Spain and Turkey (Ros *et al.* 2007; Hodgetts 2015). It is considered to be EN in Bulgaria (Natcheva *et al.* 2006) and EN in Romania (Ștefănuț & Goia 2012). This is in general a rarely reported species all over Europe due to its seasonal appearance.

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