http://dergipark.gov.tr/anatolianbryology

DOI: 10.26672/anatolianbryology.352193

Anatolian Bryology
Anadolu Briyoloji Dergisi
Research Article
e-ISSN:2458-8474 Online

A new locality for two remarkable bryophytes in Turkey

Ahmet ARSLAN[1], *Ayşe Dilek ÜNAN[1], Muhammet ÖREN[1]

[1]Bülent Ecevit University, Faculty of Art and Science, Department of Biology, 67100, İncivez, Zonguldak, Turkey

Received: 14.11.2017 **Revised:18.01.2018** **Accepted:05.02.2018**

Abstract

In this study, *Riccia cavernosa* and *Physcomitrella patens* secondly reported from Eflani district, Karabük province in Turkey. While *Riccia cavernosa* was recorded for the first time in Sinop-Boyabat, *Physcomitrella patens* was previously listed in Rize Bryophyte Checklist. Latter species is reported for the first time with detailed locality information from Turkey in this study.

Key words: *Riccia cavernosa*, *Physcomitrella patens*, Eflani, Turkey

İki dikkate değer briyofit için Türkiye'de yeni bir lokalite

Öz

Bu çalışma ile *Riccia cavernosa* ve *Physcomitrella patens* türleri Türkiye'den ikinci kez rapor edilmektedir. *Riccia cavernosa*'nın ilk defa Sinop-Boyabat'tan kaydı verilmişken, *Physcomitrella patens* ise Rize Briyofit Kontrol Listesinde yer almıştır. Ikinci tür bu makalede ilk defa Türkiye'den detaylı lokalite bilgisi ile rapor edilmektedir.

Anahtar kelimeler: *Riccia cavernosa*, *Physcomitrella patens*, Eflani, Türkiye

1. Introduction

Encircled by three seas and bordered by eight countries, Turkey is a relatively small transcontinental country bridges Asia and Europe. Due to its unique location, Turkey's climatic and geographical characteristics change within short distances across the country. This differentiation leads considerable number of varying habitats and a vast amount of biodiversity. In fact, three of the 34 biodiversity hotspots intersect in Turkey: Mediterranean, Irano-Anatolian and the Caucasus (Conservation International, 2005; Şekercioğlu et al., 2011) and there are 253 Key Biodiversity Areas (KBAs) located in the country (World Database of Key Biodiversity Areas, 2017). In addition, two of the twelve Vavilov Centers of Diversity (Mediterranean and Near East) overlap in Turkey (Vavilov, 1994). These incomparable conditions produce high amount of plant species and endemism rate: according to recent literature, the country hosts approximately 12000 vascular plant taxa and endemism rate is 34.4% (Özhatay vd.

* Corresponding author: a.dilek.ozcelik@gmail.com
© 2018 All rights reserved / Tüm hakları saklıdır.
To cite this article: Arslan A. Ünan A.D. Ören M. 2018. A new locality for two remarkable bryophytes in Turkey. Anatolian Bryology. 4(1): 1-7.

2009). In terms of bryodiversity, origin center of *Cinclidotus*/*Dialytrichia* complex includes Turkey, and there are three endemic mosses (*C. bistratosus*, *C. vardaranus* and *C. asumanie*) in this complex at the country (Erdağ and Kürschner, 2010; Ursavaş and Çetin, 2013).

With this study, two remarkable bryophytes, *Riccia cavernosa* Hoffm. and *Physcomitrella patens* (Hedw.) Bruch & Schimp. recorded secondly from Northern Turkey.

2. Study Area

Both bryophyte species collected from Eflani district of Karabük province (Figure 1) that located in Black Sea region of Turkey and A2 grid squae according to Henderson's system (1961). The overall vegetation of Eflani consists of fir and mixed deciduous forest at the north, and agricultural fields, steppes, *Quercus* sp. L. populations and sparse pine forests that dominated by *Pinus nigra* J.F. Arnold with scattered *Pinus sylvestris* L. at the south.

Eflani has a rainy climate with no dry season, classified as Cfb (temperate oceanic climate) according to Köppen-Geiger. The average precipitation in a year is 716 mm, and average temperature is 9.9 °C (Figure 2).

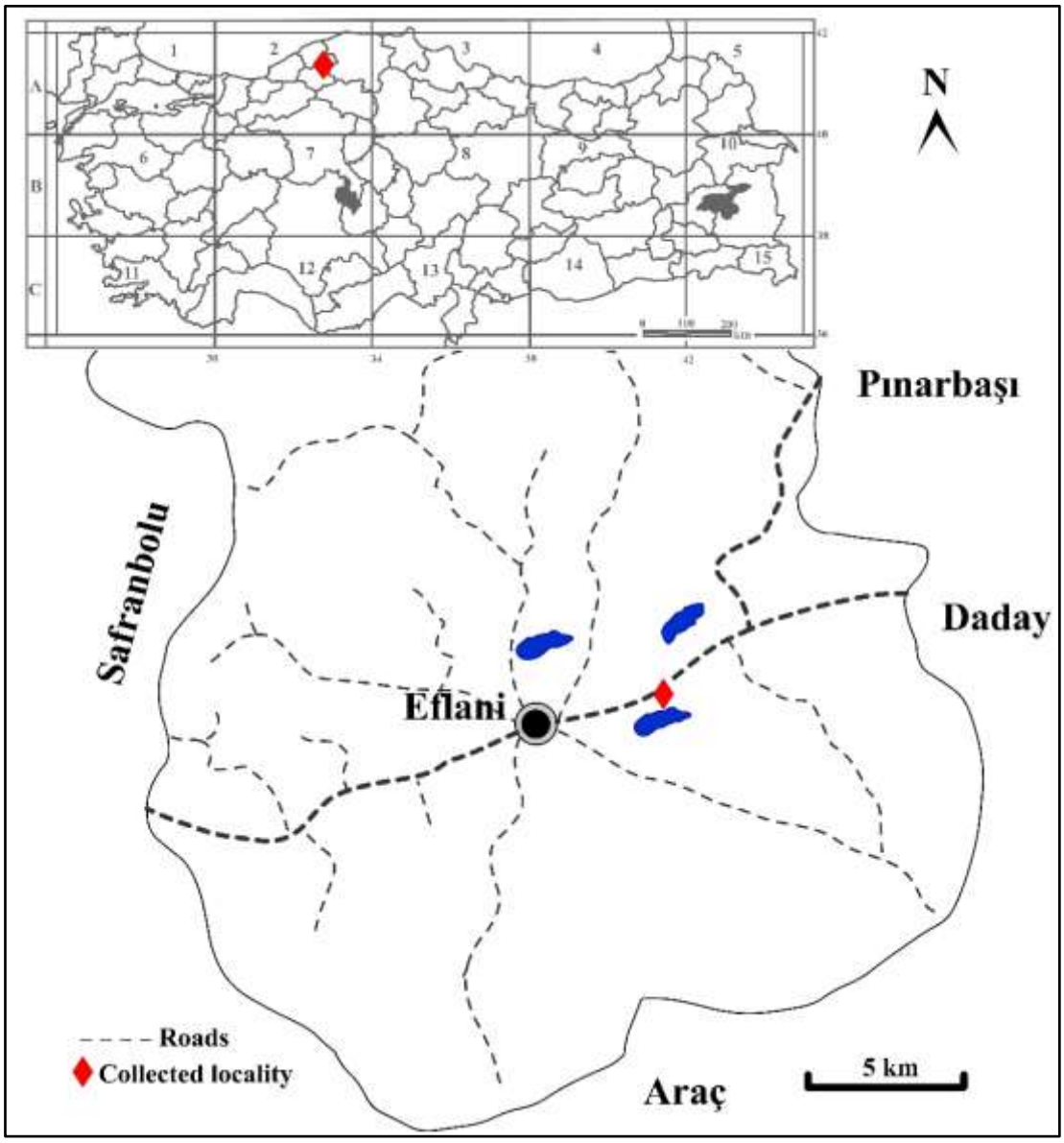

Figure 1. Map of the study area

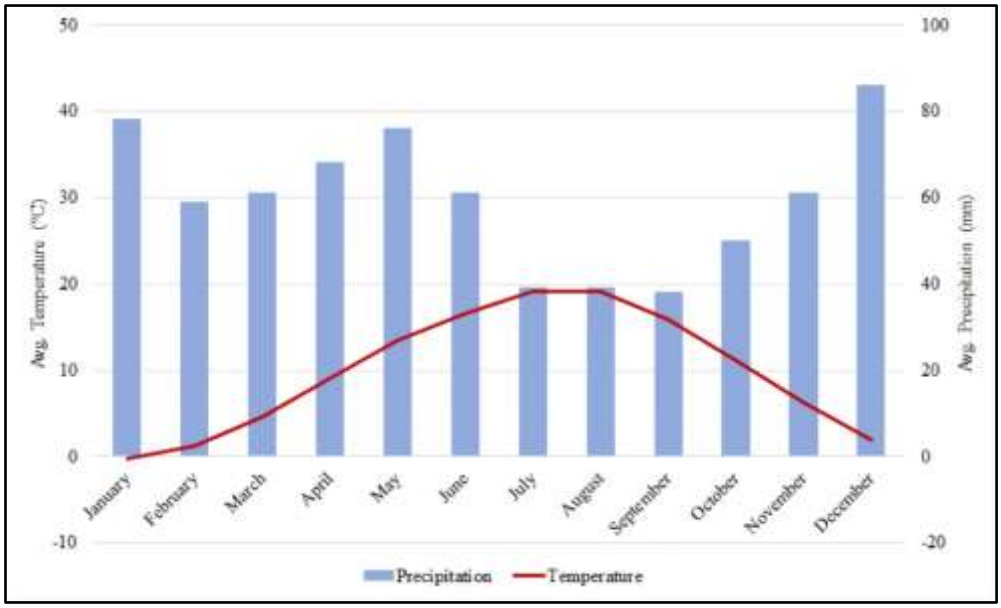

Figure 2. Climate diagram for Eflani district.

The specimens collected from lakeside marshes at Ortakçılar Lake. Geographic coordinates of the lake are 41°25'N 033°00'E and the altitude is approximately 950 m. *Salix alba* L. populations dominate the shore and the lake is surrounded by pine forest (*Pinus nigra* J.F.Arnold and *Pinus sylvestris* L.). Dense *Juncus* sp. L., *Carex* sp. L. and *Equisetum* sp. L. populations dominates the herbage of the lakeside marsh and the bryophytes were found together on small, exposed patches on wet soil, with two terrestrial green algae: *Vaucheria* sp. A.P. de Candolle and *Botrydium* sp. Wallroth (Figure 3).

Figure 3. General view of the sampling area and bryophyte specimens among algae.

3. Results and Discussion

3.1. *Riccia cavernosa* Hoffm.: *R. cavernosa* is quite distinguishable thalloid liverwort with spongy appearance due to perforated thallus. This species found as solitary rosettes up to 1 cm diameter. 2-3 times dichotomously branched thalli are 1.5-2 mm long and 1-2 mm wide, with 2-3 layers of air chambers in cross section (Figure 4). Sporophytes of *R. cavernosa* can be found all year round, and despite this specimen could only be found with immature spore tetrads, dark colored mature spores of *R. cavernosa* are 64-96(-120) µm in diameter (Smith, 1996; Paton, 1999; Özenoğlu Kiremit et al., 2016). The most similar species is *R. crystallina*, but thalli of *R. cavernosa* are perforated almost through, unlike proximally perforated thalli of *R. crystallina*.

Despite *R. cavernosa* was reported from most of the Mediterranean (Ros et al., 2007), Southwest Asian (Kürschner and Frey, 2011), and European countries (Hodgetts, 2015), distribution of this species is sparse and listed different IUCN Red List risk categories substantially in Europe (Hodgetts, 2015). The first record of *R. cavernosa* from Turkey was given by Özenoğlu Kiremit et al. (2016) on wet soil near Gökırmak River from Boyabat district of Sinop province (A3 grid square).

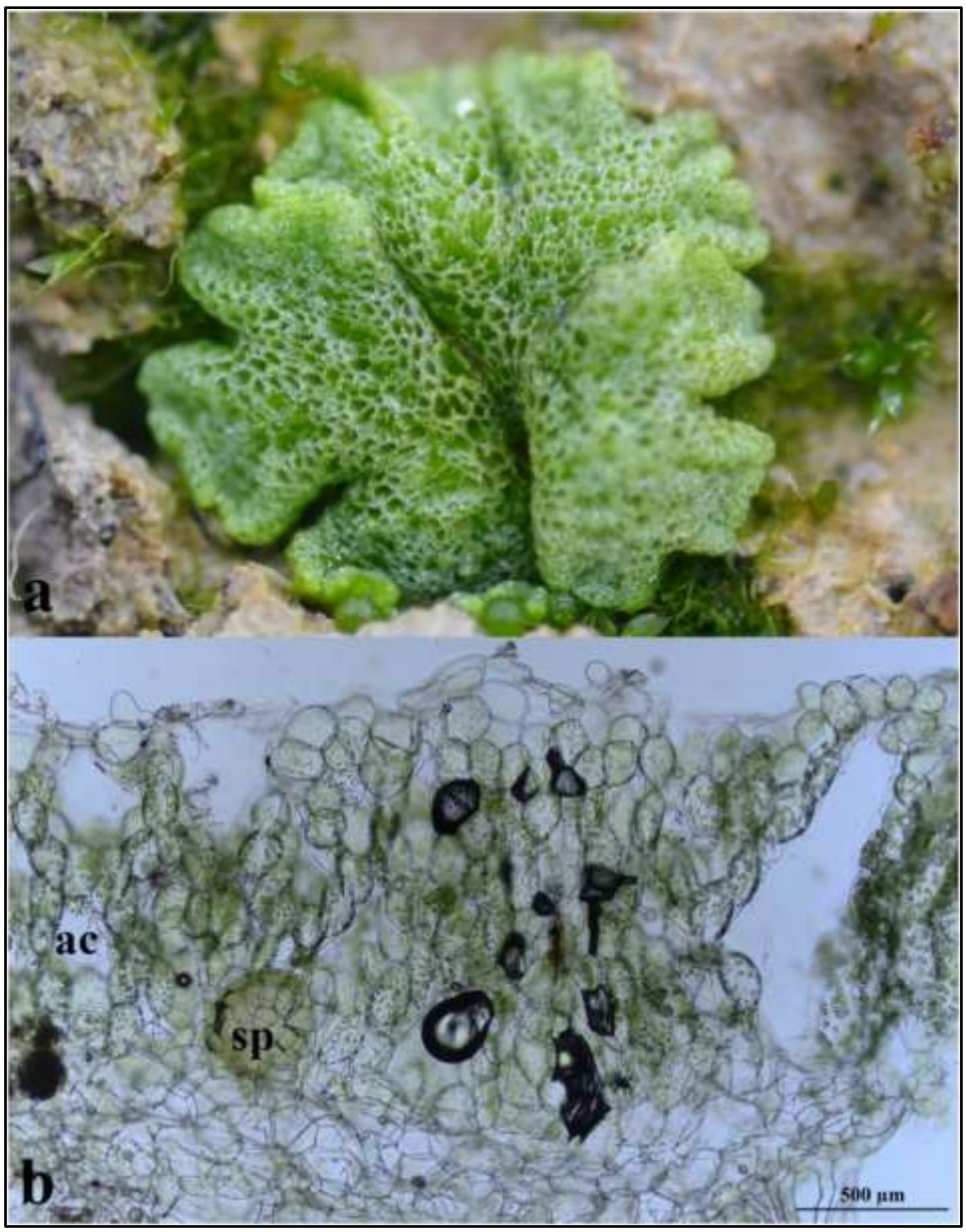

Figure 4. *Riccia cavernosa* a) Perforated thalli at habitus b) Cross section of thalli (ac: air chambers, sp: sporophyte).

3.2 *Physcomitrella patens* (Hedw.) Bruch & Schimp.: *P. patens* is an ephemeral and minute moss species up to 2.5 mm in height. Leaves of this species are erect-patent with bluntly dentate margins and large (15-20 µm) cells. Cleistocarpous capsules of *P. patens* are spherical and on a very short seta. Mature spores are 26-32 µm in diameter (Smith, 2004) (Figure 5). Sterile specimens of some Funariaceae members (*Physcomitrium*, *Entosthodon* and *Funaria*) can resemble *P. patens* with lax-celled leaves, but globose capsules and short seta of this species is quite distinguishable.

Although *P. patens* distributes fairly common at Europe (Hodgetts, 2015) and Mediterranean (Ros et al., 2013), it's only recorded at Iraq at Southwest Asia (Kürschner and Frey, 2011). The only Turkish record of *P. patens* was given by Abay et al. (2016) from Rize province without detailed site information. With this study, this species reported with detailed locality information for the first time in Turkey.

P. patens is a remarkable bryophyte as its usage as a model organism in many botanical studies. Whole genome of this species sequenced last decade (Reski et al., 1994; Rensing et al., 2008), and due to its homologous recombination pathway, *P. patens* is widely used for DNA repair studies (Schaefer and Zrÿd,1997; Schaefer, 2002). Also, usage of this particular moss at biotechnology is increasing rapidly (Koprivova et al., 2004; Reski and Frank, 2005; Decker and Reski, 2007). Detailed locality information of this widely used bryophyte will be useful for Turkish bryophyte researches in their further molecular, physiological and biotechnological studies.

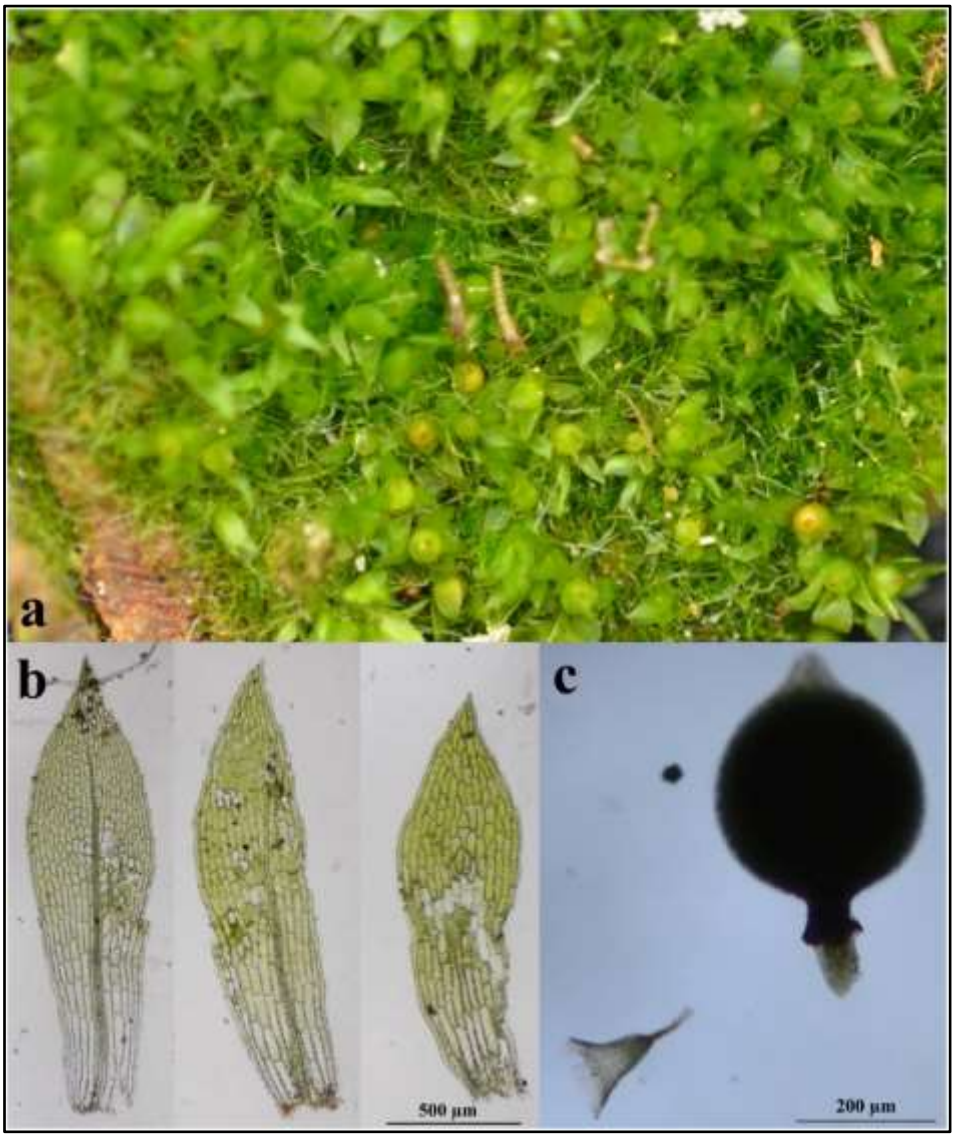

Figure 5. *Physcomitrella patens* a) Habitus b) Leaves c) Calyptra and sporophyte.

References

Abay G. Batan N. Özdemir T. 2016. Bryophyte Checklist of Rize, North-East Turkey. Artctoa. 25, 386-392.

Conservation International, 2005. Map of Biodiversity Hotspots. http://www.conservation.org/Documents/cihotspotmap.pdf Retrieved November 13, 2017.

Decker E.L. Reski R. 2007. Moss bioreactors producing improved biopharmaceuticals. Current Opinion in Biotechnology. 18:5, 393-398.

Erdağ A. Kürschner H. 2010. The *Cinclidotus* P. Beauv./*Dialitrichia* (Schimp.) Limpr. Complex (Bryopsida, Pottiaceae) in Turkey. Botanica Serbica. 35, 13-29.

Henderson D.M. 1961. Contribution to the Bryophyte Flora of Turkey: IV. Notes from Royal Botanical Garden Edinburgh. 23, 263-278

Hodgetts N.G. 2015. Checklist and country status of European bryophytes - towards a new Red List for Europe. Irish Wildlife Manuals, No. 84. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

Koprivova A. Stemmer C. Altmann F. Hoffmann A. Kopriva S. Gorr G. Reski R. Decker E.L. 2004. Targeted knockouts of *Physcomitrella* lacking plant-specific immunogenic N-glycans. Plant Biotechnology Journal. 2:6, 517-523.

Kürschner H. Frey W. 2011. Liverworts, mosses and hornworts of Southwest Asia. (Marchantiophyta, Bryophyta, Anthocerotophyta). Nova Hedwigia. 139, 1-240.

Özenoğlu Kiremit H. Kırmacı M. Kiremit F. 2016. New findings of *Riccia* species (Marchantiophyta) in Turkey and Southwest Asia. Cryptogamie, Bryologie. 37:1, 19-25.

Özhatay N. Kültür S. Aslan S. 2009. Check-list of Additional Taxa to the Supplement Flora of Turkey IV. Turkish Journal of Botany. 33, 191-226.

Paton J. 1999. The liverworts flora of the British Isles. Harley Books, Essex.

Rensing S.A. Lang D. Zimmer A.D. Terry A. Salamov A. Shapiro H. Nishiyama T. Perroud P.F. Lindquist E.A. Kamisugi Y. Tanahashi T. Sakakibara K. Fujita T. Oishi K. Shin-I T. Kuroki Y. Toyoda A. Suzuki Y. Hashimoto S. Yamaguchi K. Sugano S. Kohara Y. Fujiyama A. Anterola A. Aoki A. Ashton N. Barbazuk W.B. Barker E. Bennetzen J.L. Blankenship R. Cho S.H. Dutcher S.K. Estelle M. Fawcett J.A. Gundlach H. Hanada K. Heyl A. Hicks K.A. Hughes J. Lohr H. Mayer K. Melkozernov A. Murata T. Nelson D.R. Pils B. Prigge M. Reiss B. Renner T. Rombauts S. Rushton P.J. Sanderfoot A. Schween G. Shiu S.H. Stueber K. Theodoulou F.L. Tu H. Van de Peer Y. Verrier P.J. Waters E. Wood A. Yang L. Cove D. Cuming A.C. Hasebe M. Lucas S. Mishler B.D. Reski R. Grigoriev I.V. Quatrano R.S. Jeffrey L. Boore J.L. 2008. The *Physcomitrella* genome reveals evolutionary insights into the conquest of land by plants. Science. 319:5859, 64-69.

Reski R. Faust M. Wang X.H. Wehe M. Abel W.O. 1994. Genome analysis of the moss *Physcomitrella patens* (Hedw.) B.S.G.. Molecular and General Genetics. 244:4, 352-359.

Reski R. Frank W. 2005. Moss (*Physcomitrella patens*) functional genomics - gene discovery and tool development with implications for crop plants and human health. Briefings in Functional Genomics and Proteomics. 4:1, 48-57.

Ros R.M. Mazimpaka V. Abou-Salama U. Aleffi M. Blockeel T.L. Brugués M. Cano M.J. Cros R.M. Dia M.G. Dirkse G.M. El Saadawi W. Erdağ A. Ganeva A. González-Mancebo J.M. Herrnstadt I. Khalil K. Kürschner H. Lanfranco E. Losada-Lima A. Refai M.S. Rodríguez-Nuñez S. Sabovljević M. Sérgio C. Shabbara H. Sim-Sim M. Söderström L. 2007. Hepatics and Anthocerotes of the Mediterranean, an annotated checklist. Cryptogamie, Bryologie. 28:4, 351-437.

Ros R.M. Mazimpaka V. Abou-Salama U. Aleffi M. Blockeel T.L. Brugués M. Cros R.M. Dia M.G. Dirkse G.M. Draper I. El-Saadawi W. Erdağ A. Ganeva A. Gabriel R. Juan M J.M. Granger C. Herrnstadt I. Hugonnot V. Khalil K. Kürschner H. Losada-Lima A. Luís L. Mifsud, S. Privitera M. Puglisi M. Sabovljević M. Sérgio C. Shabbara H.M. Sim-Sim M. Sotiaux A. Roberta Tacchi R. Vanderpoorten A. Werner O. 2013. Mosses of the Mediterranean, an annotated checklist. Cryptogamie, Bryologie. 34:2, 99-283.

Schaefer D.G. 2002. A new moss genetics: targeted mutagenesis in *Physcomitrella patens*. Annual Review of Plant Biology. 53, 477-501.

Schaefer D.G. Zrÿd J.P. 1997. Efficient gene targeting in the moss *Physcomitrella patens*. Plant Journal. 11:6, 1195-1206.

Şekercioğlu Ç.H. Anderson S. Akçay E. Bilgin R. Can Ö.E. Semiz G. Tavşanoğlu Ç. Yokes M.B. Soyumert A. İpekdal K. Sağ İ.K. Yücel M. Dalfes H.N. 2011. Turkey's globally important biodiversity in crisis. Biological Conservation. 144: 2752-2769.

Smith, A.J.E. 1996. The Liverworts of Britain and Ireland. Cambridge University Press, Cambridge.

Ursavaş S. Çetin B. 2013. *Cinclidotus asumaniae* Ursavaş & Çetin (Bryopsida, Pottiaceae), sp. nov., a new species to the hygrophytic moss flora of Southern Turkey. Nova Hedwigia. 98:3-4, 467-472.

Vavilov N.I. 1994. Origin and Geography of Cultivated Crops. Cambridge University Press, Cambridge.

World Database of Key Biodiversity Areas. 2017. http://www.keybiodiversityareas.org Retrieved November 13, 2017.