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NEW RECORDS ON THE BRYOPHYTES OF MT VORAS, NORTH GREECE

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During a brief study trip to document *Sphagnum* habitats on two sites of Mt Voras in Central Macedonia, North Greece, our collections revealed a number of new records. Three taxa (*Ditrichum pusillum*, *Polytrichum commune* var. *perigoniale*, and *Sphagnum angustifolium*) are first recorded in Greece. Areas covered with *Sphagnum* species are rare in the country and these represent the southern distribution limit of this habitat type so relevant in more northerly areas of Europe.

Key words: bryophytes, Mt Voras, new and interesting species, North Greece

INTRODUCTION

With regard to its bryophyte flora Greece is a poorly explored country; this is also true for the whole region of southeastern Europe. The knowledge on bryophytes can mainly be thanked to foreign scientists who occasionally visit Greece and report on their findings (SABOVLJEVIĆ *et al.* 2001). Despite the somewhat random research done on bryophytes, until now *ca* 730 bryophyte taxa were reported for the country (PRESTON 1981, 1984*a*, *b*, DÜLL 1995). Additional data can be gathered from older papers (overlooked by the above mentioned authors) as well as in recently published articles (*e.g.* MAVROMMATIS 1972, ATHANASIADIS 1977, GALLEGO and CANO 1998, PAPP *et al.* 1998, 1999, ROS *et al.* 2001, BLOCKEEL *et al.* 2002, PAPP 2002, 2003, LARA *et al.* 2003, LÜTH 2002, TSAKIRI *et al.* 2006, PARENT and DE ZUTTERE 2006). Almost every publication provides new records for the country and even more can be expected (DÜLL 1996, SÖDERSTRÖM *et al.* 1998).

From the overall distribution data of the bryophytes it is evident that most of the information is referring to island areas (Aegean and Ionian islands) with the island of Crete, which is probably the bryologically best investigated area in Greece. But the continental parts of Greece have not been explored at the same level, and the available publications are limited in number and scope.

For the northern part of the mainland of Greece, more specifically the administrative region of North Greece (Districts of Macedonia and Thrace, including the islands of Thasos and Samothraki), approximately 500 bryophyte taxa are re-

ported. Since the first publication concerning North Greece, the "*Florae Graecae Prodromus*" (SIBTHORP and SMITH 1806–1813) with a collection from Mt Athos, the total number of bryophyte publications for the area, unfortunately, is less than thirty in number, even though North Greece provides much better natural conditions for the bryophyte vegetation than the island areas. Here are located some of the highest mountains of the country (*e.g.* Olympos (2,917 m), Smolikas (2,637 m), etc.), and a large number of aquatic habitats (rivers, lakes, lagoons) (DÜLL 1995, TSAKIRI *et al.* 1998).

Sphagnum data for Greece

Generally speaking, *Sphagnum* is extremely rare in Greece. Reports on *Sphagnum* occurrences are scarce, and such areas represent a very rare vegetation type of extremely great scientific interest in Greece, because they represent the southern distribution limit of this genus characteristic in more northerly habitat types of Europe.

To date, only eight species of *Sphagnum* have been reported from Greece. Their presence for the country was first reported by MAZZIARI (1851), who collected *Sphagnum palustre* L. (= *S. cymbifolium* (Ehrh.) Hedw.) and *S. subsecundum* Nees on the island of Corfu. Mazziari's publication was followed by:

– JURATZKA (1861) who reported *S. capillifolium* (Ehrh.) Hedw. from the Ionian and the Aegean Islands (in PRESTON 1984*b*). Recently, this species was also reported by DÜLL (1995) from Corfu,

– MAVROMMATIS (1972) reported the presence of any *Sphagnum* species for the first time in North Greece (*S. subsecundum* Nees, from the Rhodope mountain range, "Elatia" area, N Drama Prefecture),

– ATHANASIADIS (1977) collected four species of *Sphagnum* from seven different areas of North Greece (*S. contortum* Schultz – Rhodope Mts: "Elatia" area, Mt Lailias, Mt Voras: "Mplatsa" area; *S. subsecundum* Nees – Mt Chaidou, Mt Voras: "Kampos" area; *S. palustre* – Mt Lailias, Mt Voras: "Kampos" area, Mt Pieria: "Kokkini Vrysi" area; *S. squarrosum* Pers. (Cr.) – Mt Pieria: "Kokkini Vrysi" and "Flambouro" areas. Athanasiadis also suggested the correction of Mavrommatis' taxa from the Rhodope Mts to *S. contortum*.

– GEISSLER (1977) reported *S. palustre* and *S. subsecundum* from Mt Lailias (Serres Prefecture, East Macedonia District),

– GIANNITSAROS and KOUMPLI-SOVANTZI (1990) reported *S. cuspidatum* Ehrh. ex Hoffm. from Lesvos (Mytilini) island (NE Aegean),

– TURLAND and WILSON (1995) collected *S. auriculatum* Schimp. from the island of Crete,

– PARENT and DE ZUTTERE (2006) have published the most recent report based on an earlier collection from 1984 containing *S. teres* (Schimp.) Ångstr. (Mt Voras, W–NW Pella Perfecture).

The reports of MAZZIARI (1851), JURATZKA (1861) and GEISSLER (1977) are also included in PRESTON (1984*b*) and DÜLL (1995).

Based on the existing publications four *Sphagnum* species may be connected to the Mt Voras area: *Sphagnum subsecundum* and *S. palustre* from "Kali Pediada" (or "Kampos") area, NW of Loutraki and *S. contortum* from "Mplatsa" area, N of Aridea (Pella Prefecture) (ATHANASIADIS 1977), and *S. teres* collected W of Loutraki (PARENT and DE ZUTTERE 2006).

In addition, there are two reports by GEISSLER (1977) and ZOLLER *et al.* (1977) from Pella Prefecture, which contain bryophyte information from sites N and NW of Aridea (Mt Voras) at elevations between 1000–1500 m a.s.l.

MATERIALS AND METHODS

Study area

Mt Voras, the third highest mountain in Greece, is situated in central North Greece (Central Macedonia District, Pella Prefecture) running along the northern border of Greece as a natural border with the neighbouring country of the Former Yugoslav Republic of Macedonia (FYROM) and reaching 2,524 m in altitude (Kaimaktsalan peak).

The area is a proposed site for protection in the framework of "Natura 2000" project named "Koryfes Orous Voras" (Dir. 92/43/EEC) (DAFIS *et al.* 1996). It is a large area of about 39,000 hectares with its landscape dominated by gentle slopes, with the exception of rugged gorges around the Loutraki area. The area was not affected by excessive human population and activities until recently (around the year 2000) when they started to build a network of roads, mainly with the aim of the construction of a nearby ski centre.

Geologically, there is a great variability of substrates comprised of limestone, schist, gneiss and ophioliths.

There are extensive, densely forested areas that hold a significant asset of timber (mainly *Fagus sylvatica* subsp. *sylvatica* forests), and extensive pastures supporting stock raising and deep valleys with a variety of habitat types, such as acidophilous (*Luzulo-Fagetum*) beech forests; beech forests with *Ilex aquifolium* and *Taxus baccata* rich in epiphytes (Ilici-Fagion); nitrophilous (*Asperulo-Fagetum*) beech forests; beech forests with *Abies borisii-regis*, *Juniperus communis* formations on calcareous heaths or grasslands; active raised bogs; alkaline fens; residual alluvial forests (Alnion glutinoso-incanae); gallery forests dominated by *Salix alba* and *Populus alba*; acidophilous spruce forests (Vaccinio-Piceetea); black pine forests of *Pinus nigra* subsp. *pallasiana*, etc. The area is also significant because of the presence of relict stands of *Pinus peuce*, and some areas with *Quercus trojana* woods, both vegetation types with a very limited distribution in Greece. Also remarkable is the presence of an active bog in the "Kali Pediada" area, a unique feature for the country (DAFIS *et al.* 1996).

Bogs and fens are rare types of habitat in Greece and they appear in three forms: (i) raised bogs (habitat code 7110, represented with 2 areas in the country); (ii) alkaline fens (habitat code 7230, 12

areas); and (iii) calcareous fens (habitat code 7210, 13 areas). Raised bogs and calcareous fens are included in the priority habitat types of the Habitat Directive of the European Union (Annex I, 92/43/EEC) (DAFIS *et al.* 1996).

There are only two active (and very small-sized) bogs recorded in Greece: (i) the previously mentioned one at "Kali Pediada" (Mt Voras, Prefecture Pella), and (ii) at "Elatia" (in the Rhodope mountain range, Drama Prefecture).

Methods

A short visit was made to Mt Voras (30–31.08.2000), previously known for the presence of *Sphagnum* species (ATHANASIADIS 1977).

Two alkaline fens with *Sphagnum* species were visited (Fig. 1); both were situated in open areas. The first is located at the "Voras-Kaimaktsalan ski centre", about half a kilometre before the chalet (N of Agios Athanasios village). There were no previous collections from here before. The second is the active bog at the area of "Kali Pediada" (NW of Loutraki) by the country's northern border line, which is considered as the largest active bog in Greece (DAFIS *et al.* 1996), and it is the collection area named "Kampos" mentioned by ATHANASIADIS (1977).

All alkaline fens in Greece (*Carex davalliana* dominated) are reported mainly from high altitudes, from the mountainous areas of Macedonia and the Pindos mountain range (*e.g.* Smolikas, Agrafa and Aspropotamos Mts).

Both areas are situated in North Greece, Central Macedonia District, Pella Prefecture, Mt Voras. The exact coordinates are:

Site 1: Lat.: 40° 54' 32" N; Long.: 21° 48' 40" E, Alt.: 2,050 m a.s.l.

Site 2: Lat.: 41° 02' 14" N; Long.: 21° 53' 30" E, Alt.: 1,750 m a.s.l.

Around Site 1 there are alpine and subalpine heaths. Species-rich *Nardus* grasslands growing on siliceous substrates, *Fagus sylvatica* forests with *Abies borisii-regis*, nitrophilous (*Asperulo-Fagetum*) and acidophilous (*Luzulo-Fagetum*) beech forests and black pine stands of *Pinus nigra* subsp. *pallasiana* forests are also found in the surroundings.

Site 2 is surrounded by subalpine and alpine tall herb communities; in the broader area species-rich *Nardus* grasslands grow on siliceous substrates, along with alpine and subalpine heaths and reforested mountain slopes with acidophilous (*Luzulo-Fagetum*) and nitrophilous (*Asperulo-Fagetum*) beech forests.

The specimens collected have been deposited in the Herbarium of the Hungarian Natural History Museum, Budapest (BP), and in the Herbarium of the Aristotle University of Thessaloniki (TAU).

Nomenclature and the European distribution data follow DÜLL and MEINUNGER (1989) and DÜLL (1995).

The floristical results have been analysed according the latest available check-list of DÜLL (1995), updated with all the new records for Greece. For the distribution of bryophyte taxa the floristical regions of Greece are used, according to the "Flora Hellenica" project (STRID and TAN 1997) with the differentiation accepted for bryophytes by PRESTON (1981). The abbreviations used for the Greek floristical areas and their definitions are the following: CR (Crete), RH (Rhodos island), AE: Th (Aegean islands: Thasos), IO (Ionian islands), PE (Peloponnisos), ST (Sterea Hellas), EU (Euboea), PI (Pindos), EC (East Central), NC (North Central, Thessalia), NE: At, Ch, Rd (North East: Athos, Chalkidiki, Rhodope Mts).

RESULTS AND DISCUSSION

Seventeen taxa of mosses were identified, among which there are three new records for the bryophyte flora of Greece: *Ditrichum pusillum* (Hedw.) Hampe, *Polytrichum commune* var. *perigoniale* (Michx.) Hampe, *Sphagnum angustifolium* (C. Jens. ex Russ.) C. Jens (Table 1).

All of the collected records belong to the North-Central (NC) floristical area of Greece.

Bryum schlecheri DC., a boreal-montane species, was previously collected only by UNGER (1862) and SCHIFFNER (1915), only from island areas (Crete and Euboea correspondingly). For this species, it is the first collection from mainland Greece. Also *Palustriella decipiens* (De Not.) Ochyra, a subarctic-subalpine species, was previously collected only by COPPEY (1908) from the Pindos (PI) area. According to DÜLL (1995), both species required verification. For the North-Cen-

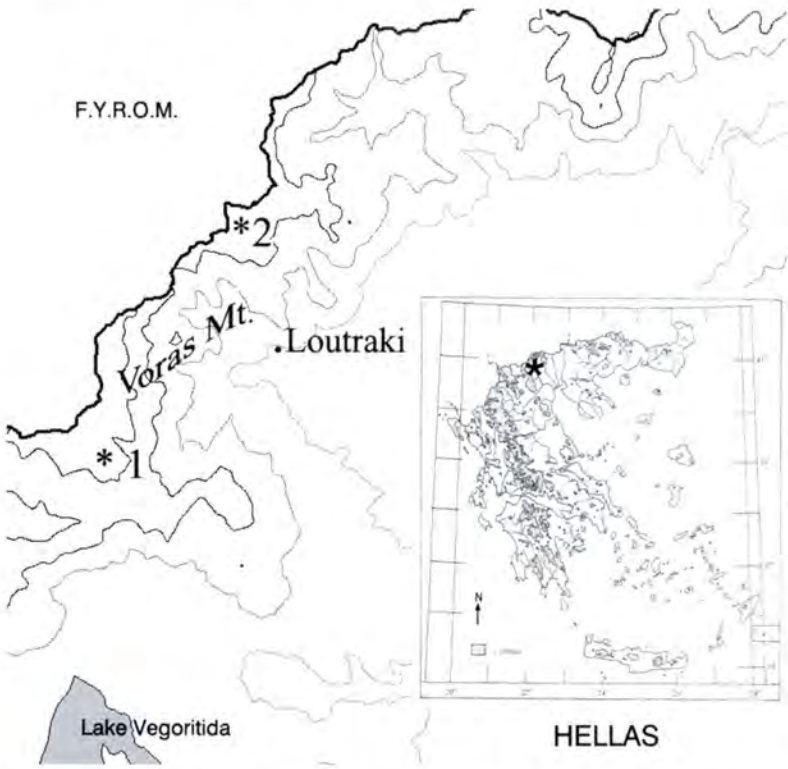


Fig. 1. North Greece and the location of the collection sites at Mt Voras (Pella Prefecture, Greece). Altitudinal lines are at 500 (pale grayish), 1,000, 1,500 and 2,000 m a.s.l. (black). The asterisks (*) indicate the sites of collection (and the location of Mt Voras in the map of Greece).

Table 1. List of the collected species. Previous reports and new data for the floristical areas of Greece are also mentioned, as well as European distribution. An asterisk (*) before the species name indicates the new reports for the bryophyte flora of Greece. The floristical areas of Greece where they were collected are also mentioned (for details of the abbreviations and definitions see the Methods). NNC = new for North Central Greece

Taxa	Sites		Previous reports	NNC	European distribution
	1	2			
Brachythecium rivulare B., S. et G.		+	RH, AE: Th, IO, PE, ST, PI, EC, NC, NE: Ch, Rd		subbor
Bryum schleicheri DC.		+	CR (SCHIFFNER 1915), EU (UNGER 1862)	+	bor-mont
Calliergonella cuspidata (Hedw.) Loeske	+		CR, AE: Th, IO, PI, NC, NE		temp
Campylium stellatum (Hedw.) C. Jens. ex J. Lange	+		NC (GANIATSAS 1937)		bor
**Ditrichum pusillum* (Hedw.) Hampe	+			+	temp
Drepanocladus aduncus (Hedw.) Warnst.		+	PE, ST, EU, PI, NE: At	+	temp
Fontinalis antipyretica Hedw.		+	CR, AE: Th, IO, PE, EU, PI, NC, NE		subbor
Palustriella decipiens (De Not.) Ochyra		+	PI (COPPEY 1908)	+	subarc-sub alp
Pogonatum aloides (Hedw.) P. Beauv.	+		CR, AE: Th, IO, PE, EU, PI, EC, NC, NE:Ch		temp
Polytrichum alpinum Hedw.	+		NC (VAJDA 1959), unlocalised (KINDBERG 1887)		subarc-sub alp
**Polytrichum commune* var. *perigoniale* (Michx.) Hampe	+			+	subbor
**Sphagnum angustifolium* (C. Jens. ex Russ.) C. Jens.		+		+	subbor
Sphagnum denticulatum Brid. (= *S. auriculatum* Schimp.)	+		CR	+	n.suboc
Sphagnum squarrosum (Pers.) Cr.	+	+	NC (ATHANASIADIS 1977)		temp
Sphagnum subsecundum Nees ex Sturm	+		IO, NE, NC (ATHANASIADIS 1977)		bor
Sphagnum teres (Schimp.) Ångstr. ex C. Hartm.	+		NC (PARENT and DE ZUTTERE 2006)		bor(-mont)
Warnstorfia exannulata (Schimp.) Loeske		+	NE	+	borp

tral (NC) floristical area there is a total of 8 taxa that have been first reported, including all of the above mentioned taxa and also *Drepanocladus aduncus* (Hedw.) Warst., *Sphagnum denticulatum* Brid. and *Warnstorfia exannulata* (Schimp.) Loeske (Table 1).

Sphagnum teres (Schimp.) Ångstr. ex C. Hartm. was recently reported from Mt Voras by PARENT and DE ZUTTERE (2006).

Campylium stellatum (Hedw.) C. Jens. ex J. Lange (GANIATSAS 1937) and *Polytrichum alpinum* Hedw. (KINDBERG 1887, VAJDA 1959) have been found again in the same (NC floristical) area after a long time since their previous reports (Table 1).

From Site 1 10 taxa were identified, all of them are new reports for the site and of which 2 are new bryophyte reports for Greece. This is also the second collection site of *Sphagnum teres* (Table 1). The first collection of this species by Parent in the year 1984 was made at the same part of the mountain as "Site 1", but at a lower altitude (1,800 m a.s.l. according to Parent's description of the collection area) (PARENT and DE ZUTTERE 2006). During our visit in the area (16 years later) this place was not found again, thus we think that due to the road construction in the mountain this first collection site of the species may have disappeared forever.

From Site 2 ("Kali Pediada") 8 taxa were reported, none of them previously reported from this area, and one is a new record for the bryophyte flora of Greece (Table 1).

Interestingly, we could not find *Sphagnum subsecundum* and *S. palustre* mentioned by the only existing publication on the area by ATHANASIADIS (1977), but instead *S. angustifolium* and *S. squarrosum* were collected by us.

The three Southeast European countries close to the study area are FYROM, are Serbia and Bulgaria. Based on the available bryophyte check-lists for these countries (DÜLL *et al.* 1999, SABOVLJEVIĆ and STEVANOVIĆ 1999, NATCHEVA and GANEVA 2005) it is concluded that besides Greece, *Sphagnum denticulatum* is only reported from Bulgaria. The rest of the species has already been reported from more than one of these countries (Table 2).

According to the European distribution categories (DÜLL 1995) it is clear that our specimens reflect the northern character of the study sites. 9 taxa belong to the "boreal" group (incl. 4 subboreal, 3 boreal and 2 boreal-montane species); 2 species are subarctic-subalpine elements; 5 bryophytes are species of temperate zones of Europe, and 1 species has north-suboceanic distribution (Table 1).

Conservation information and threatening factors

The reported species are not included in the Red Data Book of European Bryophytes (ECCB 1995), and according to the Greek Legal System the bryophytes in general are not included in any law concerning nature and flora protection. In the Greek Habitat Project "Natura 2000" (Dir. 92/43/EEC) one species is included (*Buxbaumia viridis* (Moug.) Moug. et Nestl.; DAFIS *et al.* 1996). But this does not represent the "real needs" for Greek bryophyte protection. Especially in the case of all *Sphagnum* areas in Greece, which are extremely vulnerable mainly due to their extremely small size and also the disturbing human activities, which pose a great threat on these sites and even there is a real danger of extinction.

At Site 1, by the "ski centre Voras", the small alkaline fen is extremely threatened by human activities and the plans of expanding the ski centre to serve an increasing number of visitors experienced over the last years.

Table 2. Occurrence of the reported taxa in the neighbouring countries of southeastern Europe. Data available by SABOVLJEVIĆ and STEVANOVIĆ (1999) for Federal Republic of Yugoslavia (Serbia and Montenegro), DÜLL *et al.* (1999) for FYROM and NATCHEVA and GANEVA (2005) for Bulgaria.

	Serbia	Montenegro	FYROM	Bulgaria
Brachythecium rivulare	+	+	+	+
Bryum schleicheri	+	+	+	+
Calliergonella cuspidata	+	+	+	+
Campylium stellatum	+	+	+	+
Ditrichum pusillum		+		+
Drepanocladus aduncus	+	+	+	+
Fontinalis antipyretica	+	+	+	+
Palustriella decipiens	+	+		+
Pogonatum aloides	+	+		+
Polytrichum alpinum	+	+	+	+
Polytrichum commune var. *perigoniale*	+		+	+
Sphagnum angustifolium			+	+
Sphagnum denticulatum				+
Sphagnum squarrosum	+	+	+	+
Sphagnum subsecundum	+		+	+
Sphagnum teres	+		+	+
Warnstorfia exannulata	+	+	+	+

At Site 2, "Kali Pediada", plans have been laid out about the possible draining out by the Forest Service, which has various development plans for the area (pers. comm. by Prof. Dr Athanasiadis).

Although both sites are included in the Corine Biotops (biotope codes: 51.1 & 54.23) (CEC 1991) and Natura 2000 sites of Greece (DAFIS *et al.* 1996), the threats are obvious.

The area can be visited throughout the year, which means expanded possibilities of exploration and indeed there is an alarmly growing pressure on the sites.

Unique areas for Greece, like the above discussed special location for *Sphagnum*, especially Site 1 by the ski centre, being increasingly well accessed through improved road conditions, might be the most excellent display areas for ecotourism and connected activities. Such initiatives would be exemplary ways of combining the local people's prospectives with the goals of nature conservation thus preserving the local culture and well-being with the native flora and vegetation.

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