A new site of the March mushroom (*Hygrophorus marzuolus* (Fr.) Bres.) in Sarajevo Canton, Bosnia and Herzegovina

ANIS HASANBEGOVIĆ
National Museum of Bosnia and Herzegovina
Zmaja od Bosne 3, 71000 Sarajevo, Bosnia and Herzegovina
e-mail: anishasanbegovic@yahoo.com

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Abstract: The diversity of mushrooms in Bosnia and Herzegovina has been poorly studied. On the other hand, Bosnia and Herzegovina is one of the largest exporters of edible wild mushrooms in Europe. This paper aims to present a new site of a high-quality and edible mushroom–the March mushroom (*Hygrophorus marzuolus* (Fr.) Bres.), which is, on the other hand, a rare and protected species in many European countries. The new site was recorded in Sarajevo Canton. This site also represents the lowest altitude site for this mushroom in Bosnia and Herzegovina. However, it should be emphasized that the population of the March mushroom was only recorded in the sunniest part of the planted Scots pine forest.

Keywords: March mushroom, biodiversity, mushrooms, locality, forest

INTRODUCTION

The biodiversity of fungi in Bosnia and Herzegovina has been poorly studied. Unfortunately, there is only little recent data available, even for the most widespread mushrooms, let alone some rare and not so well-known species. This is the case with the March mushroom. There is only a limited number of publications regarding the distribution of this mushroom in Bosnia and Herzegovina. Focht (1979) mentions the Kasindol site near Sarajevo. The same author (Focht,1992) gives information about the presence of this species in eastern Bosnia as well. It should also be noted that this mushroom is not easily noticed in nature because it fruits partially or completely under a layer of needles and soil in spring, compared to common edible mushrooms that fruit in autumn (Božac, 2003).

The March mushroom belongs to a group of high-quality edible mushrooms. According to Canduso (1997), it has the following characteristics: cap 30-120 (150) mm, hemispherical, covex, waxy, convex plane, irregular, brown grax, brown, slate-light grey, blackish. The stem is cylindrical, stocky, compressed, curved, gibbous, very irregular, firm, full, then it has a fistulous cavity, especially at the base, pale grey or whitish. The flesh is tenacious, fibrous, consistent throughout the carpophore, white-greyish, grey, hygrophane; it has a light smell of withered roses and tastes pleasant. Gills are broadly adnate, sinuous, thick, spaced apart, subdecurrent, whitish, white-greyish, grey, waxy. Spore prints are white.

March mushroom is widespread in Europe, North Africa (Morocco), and North America, but it has not been recorded in Northern Europe and the area of evergreen vegetation of the Mediterranean part of Europe (Tkalčec et al., 2008).

It should be emphasized that the March mushroom is a protected species in many European countries, e.g., in Croatia it has a status of endangered species (Tkalčec et al., 2008); in Montenegro, it is on the preliminary Red List (Perić et al., 2001), and in Bosnia and Herzegovina, it also has the status of the endangered species (Đug et al., 2013).

MATERIAL AND METHODS

Sporocarps of the target species (March mushroom) were traced in the field during its fructification season in the year 2018. Sporocarps were identified following Focht (1992). For each March mushroom collection site, a phytocoenological record was made following the Braun-Blanquete (1932) method. The floral elements, life forms, indicator values, and phytocoenological affiliation of plants were provided accord-

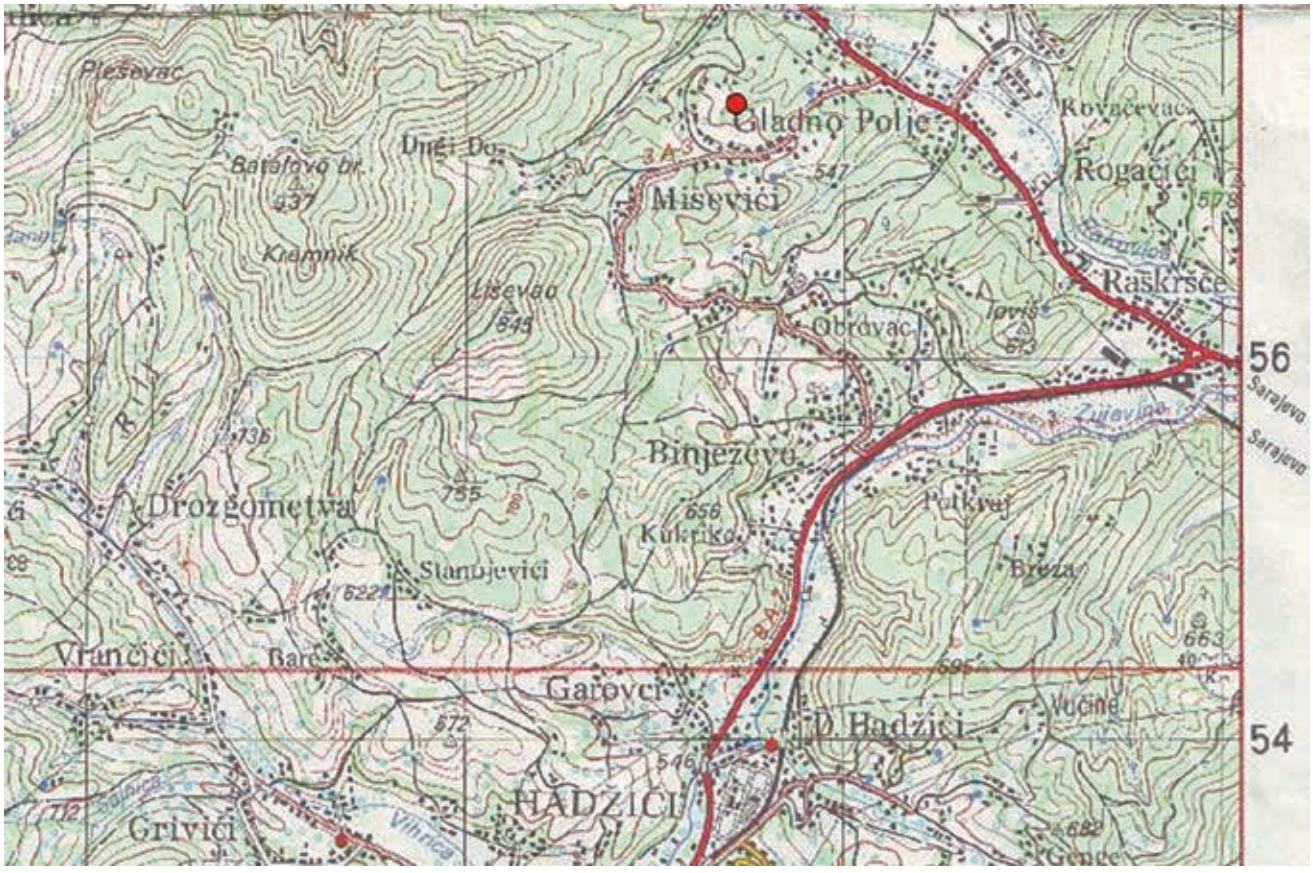

Figure 1. Geographical position of the studied site (Adopted from the map of the Military Geographical Institute 1982).

ing to Oberdorfer (2001) and Pavlović-Murarspahić (1995). In addition to the March mushroom, other mushrooms, found in the studied area, i.e., on the record, are included in the registered (Tab. 1). The number of mushrooms in the table was provided according to Tortić & Lisiewska (1971): + one sample, ++ few samples, and +++ many samples.

The altitude was recorded using the "Magelan eXplorist 500" GPS device. The terrain inclination was determined with the clinometer from the "Recta DP 6 GLOBAL" compass.

According to Jovanović et al. (1978), this region, with regard to the geological age, belongs to the Mesozoic period, specifically the Upper Cretaceous period, and as far as tectonics, it belongs to the transitional zone (Čičić, 1984). Geographically, the explored site is located to the west of Sarajevo and between N 43° 51´ 18.94" and E 18° 12´ 15.37".

ABBREVIATIONS:

Abbreviations for phytocoenological affiliation:
Arr. – *Arrhenatheretalia*, Bet. – *Betuletalia*, E.-P. – *Erico-Pinetalia*, F. – *Fagetalia*, Mol. – *Molinietalia*, N.-C. – *Nardo-Calunetalia*, Q. p. – *Quercetalia pubescentis*, Q. r.-p. – *Quercetalia robori-petraeae*, P. s. – *Prunetalia spinosae*, Pte. – *Pteridaceae*, V.-P. – *Vaccinio-Piceetalia*.
Abbreviations for indicator values:
P – primary, PS – primary secondary, S – secondary, SP – secondary primary
Abbreviations for life forms:
P – *phanerophyta*, H – *hemicriptophyta*, Ch – *chamaephyta*, G – *geophyta* and Ch (Pn) – *chamaephyta* (*nanophanerophyta*)
Abbreviations in the phytocoenological table: I. v. – indicator value, F. e. – floral element, F. p. – phytocoenological affiliation, L. f. – life form.

RESULTS AND DISCUSSION

In the researched terrain, March mushrooms were found in several separate groups. Some of them were covered with leaves and soil and were difficult to find.

Table 1. Phytocoenological table of the field vegetation

Locality	**Donji Miševići**				
Altitude	**535m**				
Exposition	**S-SW**				
Inclination (°)	**20-30°**				
Geological basis	**Marl limestone**				
Soil type	**Rendzina**				
General coverage (%)	**100%**				
Image size	**200 m**				
Date	**10 April 2018**				
Image number	**1**				
Phytocenosis	**Scots pine planted forest**				
Floristic composition:					
Tree layer up to 25 m:					
		I. v.	**F. e.**	**F. p.**	**L. f.**
***Pinus sylvestris* L.**	**3.3**	**P**	**no-euraskont(-smed)**	**E.-P.**	**P**
Tree layer up to 5 m:					
***Pinus sylvestris* L.**	**3.3**	**P**	**no-euraskont(-smed)**	**E.-P.**	**P**
***Quercus petraea* (Matt.) Lieb.**	**+1**	**P**	**subatl-smed**	**Q. p.**	**P**
Tree layer up to 3 m:					
***Carpinus betulus* L.**	**2.2**	**P**	**gemässkont(-smed)**	**Q. p.**	**P**
***Quercus petraea* (Matt.) Lieb.**	**1.1**	**P**	**subatl-smed**	**Q. p.**	**P**
***Prunus avium* L.**	**+2**	**P**	**subatl-smed**	**F.**	**P**
***Acer tataricum* L.**	**+2**	**P**	**sarm.**	**F.**	**P**

***A. pseudoplatanus* L.**	**+1**	**P**	**subatl-smed(-pralp)**	**F.**	**P**
***Sorbus torminalis* (L.) Cr.**	**+1**	**P**	**smed**	**F.**	**P**
***Populus tremula* L.**	**+1**	**PS**	**no-euras**	**Q.r.-p.**	**P**
***Rhamnus frangula* L.**	**+1**	**P**	**no-eurassubozean**	**Q. r.-p.**	**P**
***Pinus sylvestris* L.**	**+1**	**P**	**no-euraskont(-smed)**	**E.-P.**	**P**
Bush layer:					
***Carpinus betulus* L.**	**2.2**	**P**	**gemässkont(-smed)**	**Q. p.**	**P**
***Rubus hirtus* W. K.**	**1.1**	**PS**	**subatl**	**F.**	**P**
***Sorbus torminalis* (L.) Cr.**	**+2**	**P**	**smed**	**F.**	**P**
***Fagus sylvatica* L.**	**+2**	**P**	**subatl(-smed)**	**F.**	**P**
***Calluna vulgaris* (L.) Hull.**	**+2**	**SP**	**no-eurassubozean**	**N.-C.**	**Ch(Pn)**
***Betula pendula* Roth**	**+2**	**P**	**no-eurassubozean**	**Bet.**	**P**
***Lembotropis nigricans* Griseb.**	**+2**	**P**	**gemässkont-osmed**	**E.-P.**	**P**
***Pyrus pyraster* Burgsd.**	**+1**	**P**	**smed(-gemässkont)**	**F.**	**P**
***Corylus avellana* L.**	**+1**	**P**	**subatl-smed (euras-subozean)**	**Q. p.**	**P**
***Crataegus monogyna*Jacq.**	**+1**	**PS**	**submed(-subatl)**	**P. s.**	**P**
***Evonymus europaea* L.**	**+1**	**PS**	**subatl-smed**	**F.**	**P**
Herbaceous plant layer:					
***Mycelis muralis* (L.) Dum.**	**1.1**	**P**	**subatl-smed**	**F.**	**H**
***Veronica officinalis* L.**	**1.1**	**P**	**no-eurassubozean**	**V.-P.**	**Ch**
***Pteridium aquilinum* (L.) Kuhn**	**1.1**	**SP**	**(no)eurassubozean**	**Pte.**	**G**
***Festuca gigantea* (L.) Vill.**	**1.1**	**P**	**euras(subozean)**	**F.**	**H**
***Carex silvatica* Huds.**	**1.1**	**P**	**subatl-(smed)**	**F.**	**H**
***Anemone nemorosa* L.**	**1.1**	**P**	**eurassubozean**	**F.**	**G**
***Galium silvaticum* L.**	**+2**	**P**	**gemässkont(-smed)**	**F.**	**G**
***Viola silvestris* Lam.**	**+2**	**P**	**subatl-smed**	**F.**	**H**
***Inula britannica* L.**	**+2**	**S**	**euraskont-smed**	**Mol.**	**H**
***Polygonatum odoratum* (Mill.) Druce**	**+2**	**P**	**euras(kont)**	**Q. p.**	**G**
***Taraxacum officinalie* Web. in Wigg.**	**+1**	**S**	**no-euras(subozean)**	**Arr.**	**H**
***Platanthera bifolia* (L.) Rich.**	**+1**	**P**	**no-eurassubozean**	**F.**	**G**
Moss layer					
***Polytrichum commune* L.**	**1.1**				
Fungi					
***Hygrophorus marzuolus* (Fr.) Bres.**	**+++**				
***Strobilurus stephanocystis* (Hora) Sing.**	**++**				
***S. tenacellus* (Pers. ex Fr.) Singer**	**++**				
***Mycena galerniculata* (Scop. & Fr.) Gray**	**++**				
***Urnula craterium*(Schw.) Fr.**	**+**				

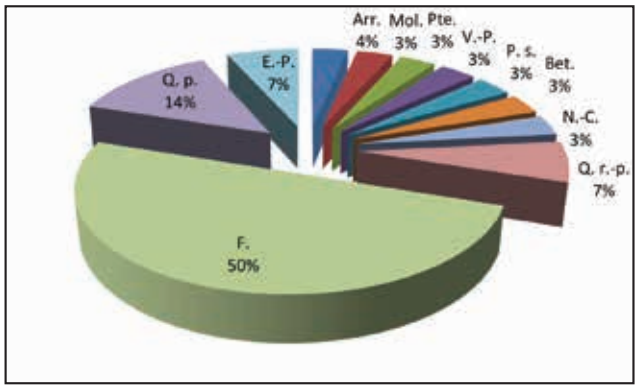

Figure 2. Phytocoenological affiliation of species in the ecosystem of the studied Scots pine forest (shown in percentages)

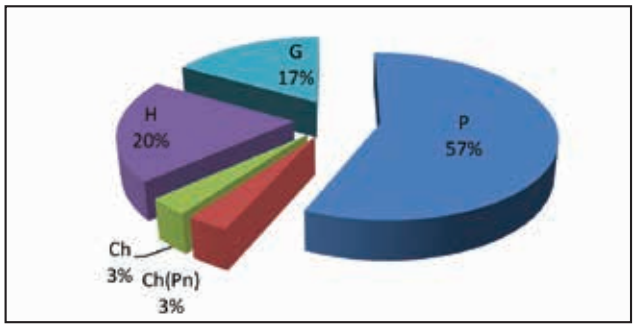

Figure 4. Ratio of life forms in the ecosystem of the studied Scots pine forest (shown in percentages)

As for the phytocoenological affiliation of the species in the studied ecosystem, most species belong to the order of *Fagetalia*. The order of *Quercetalia pubescentis* also has high values (Fig. 2). Of the indicator values, the largest number belongs to the primary and primary secondary species (Fig. 3). In the ratio of life forms, the most common are phanerophytes and chemicryptophytes (Fig. 4). The largest number of species in the studied area belongs to the Subatlantic floral element.

The March mushroom is mostly found in the mountain region, and this site currently has the lowest recorded altitude for their habitat in Bosnia and Herzegovina. Mushrooms are recorded only in the part of the forest, oriented towards the S-SW, which is under extensive solar insolation. The March mushroom has been found in a planted forest of Scots pine (*Pinus sylvestris* L.). Otherwise, this area is clima zonally determined by the natural forest of *Quercetalia pubescentis* order. Table 2 shows that the largest number of species belongs to the Subatlantic and Nordic eurassubocean floral elements.

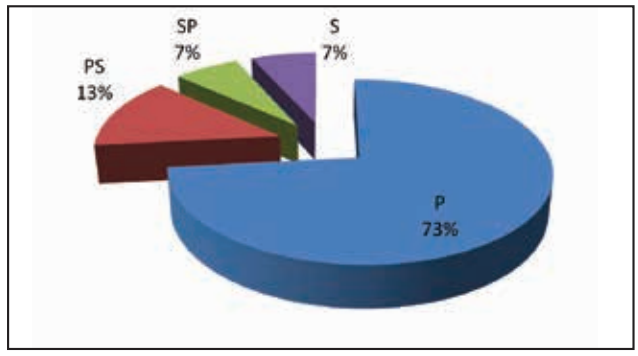

Figure 3. Ratio of indicator values in the studied area (shown in percentages)

Table 2. Relations of floral elements in the studied Scots pine forest

Floral element	Individual values	Total	%
smed	1		
smed(-gemässkont)	1		
submed(-subatl)	1		
	Σ	3	10
subatl	1		
subatl(-pralp)	1		
subatl(-smed)	1		
subatl-(smed)	1		
subatl-smed	5		
subatl-smed (euras-subozean)	1		
	Σ	10	33
euras(subozean)	1		
euras(kont)	1		
	Σ	2	7
no-euras	1		
no-eurassubozean	5		
no-euras(subozean)	1		
no-euraskont(-smed)	1		
	Σ	8	27
(no)eurassubozean	1		
eurassubozean	1		
	Σ	2	7
euraskont-smed	1		
	Σ	1	3
gemässkont-osmed	2		
gemässkont(smed)	1		
	Σ	3	10
sarm	1		
	Σ	1	3
Total	30	30	100%

CONCLUSIONS

1. This is the first record of the March mushroom found at lower altitudes in Canton Sarajevo.
2. The collection site is located in the area of the planted forest of Scots pine (*Pinus sylvestris* L.) in Donji Miševići.
3. Mushrooms were recorded at the lowest known altitude for this species in Bosnia and Herzegovina.
4. Mushrooms were found only in the sunny part of the forest with exposition towards S-SW.

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Figure 5. March mushroom (*Hygrophorus marzuolus*) in the ecosystem of the planted Scots pine (*Pinus sylvestris* L.) forest

Figure 6. The appearance of the planted Scots pine forest ecosystem in which March mushroom was recorded

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Figure 1:

Topographic map 1: 50 000 (TK 50) Sarajevo 1 (525-1) – The second edition 1982, Military Geographical Institute, Belgrade

SAŽETAK

Diverzitet gljiva u BiH je vrlo slabo istražen. S druge strane, BiH je jedan od najvećih izvoznika samoniklih gljiva u Evropi. Ovaj rad ima za cilj da opiše novi lokalitet za jednu vrlo kvalitetnu i jestivu gljivu a sa druge strane rijetku i u mnogim zemljama Evrope zaštićenu vrstu. Ovo je novi lokalitet ove gljive a ujedno i lokalitet na najnižoj nadmorskoj visinina kojoj je ova gljiva zabilježena u BiH. Također, treba istaći i da je riječ o sađenoj šumi bijelog bora i da je populacija martovke zabilježena samo na najsunčanijem dijelu šume.

Ključne riječi: Martovka, biodiverzitet, gljive, lokalitet, šuma