

## *Analysis of Wild Edible Mushrooms in the Regions Strandzha and the Black Sea Coast in Bulgaria*

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**Abstract.** This article attempts to summarize the available data on wild edible macromycetes in the regions Strandzha and the Black Sea coast in connection with the clarification of ethnomycology. The total number of registered species of edible mushrooms for both areas is 105. The species *Boletus caucasicus* Singer ex Alessio; *Boletus luridiformis* Rostk. var. *luridiformis* and *Laccaria bicolor* (Maire) P.D. were noted only for the region of the Black Sea coast. The species composition, ecological-trophic structure and seasonality of edible mushrooms are briefly discussed. A list of 14 macroscopic edible fungi with conservation significance for the mycota of the two territories, assessed with the latest IUCN criteria, is given. Critically Endangered (CR) according to the Red List of fungi in Bulgaria and the Red Data Book of the Republic of Bulgaria was *Boletus caucasicus* Singer ex Alessio.

**Key words:** Strandzha, Black Sea coast, edible macromycetes, fungal diversity.

### Introduction

Mushrooms play an important role in the human diet, and since ancient times, picking of wild mushrooms has been an activity directly related to the household (Singh et al., 2011; Jayachandran et al., 2017; Proskura et al., 2017; Ivanova et al., 2020). Mushrooms are considered a delicacy (Lindequist et al., 2005; De Román et al., 2006), which is highly valued for its texture and unique aromas (Kalač, 2009; Ergönül et al., 2013; Aisala et al., 2018). Mushrooms were initially known to be only a source of food, but later evidence also puts forward their medicinal effects (Wani et al., 2010; Rathee et al., 2012; Jayachan-

dran et al., 2017; Amirullah et al., 2018; Sande et al., 2019). Mushrooms possess anti-inflammatory (Khaund & Joshi, 2016; Muszyńska et al., 2017), antifungal (Phan et al., 2013), anti-diabetic (Chang & Buswell, 2001) and anti-oxidative (Maet al., 2014) properties. In addition to their pharmaceutical qualities, mushrooms are also essential in the modern human diet due to their low fat, high protein and low energy content (Khatun et al., 2012; Dospatliev et al., 2019; Dimitrov et al., 2020; Stoyanova et al., 2021). Mushroom proteins include all the essential amino acids required for humans. In addition, they contain many nutritional components such as iron, phosphorus and vitamins as

ascorbic acid, thiamin, riboflavin, niacin and ergosterol (Kumar, 2015; Lacheva et al., 2020; Stoyanova et al., 2020).

Mushrooms are believed to be major under-utilized nutrient food resource (Kumar et al., 2021). The number of fungi identified to date represents only 10% of all fungi thought to exist (Abugri et al., 2016; Jayachandran et al., 2017). Out of about 1 600 known species of mushrooms, only about 100 species are recognized for consumption (Kumar, 2021). In a number of countries, the collection and trade of wild edible mushrooms occupies a significant share of the economy. (Ivanova et al., 2020). The leading producer, consumer and exporter of wild and cultivated edible mushrooms in the world is China (Boa, 2004). In Poland in 2020, 182 900 tons of mushrooms were reported, worth over 80 million euros (FAOSTAT, 2023; UNECE, 2023). Mushroom picking is a "national hobby" in the Czech Republic, with an average of 5.6 kg of fresh mushrooms per household per year. However, some individuals consume over 10 kg per year (Šišák, 2007).

According to FAO, Bulgaria is one of the leading exporters of mushrooms in the EU – 1260 tons for 2020 (Boa, 2004; Kalač, 2010). Fresh mushroom consumption in the country exceeds 6 kg per person per year (Ivanova et al., 2020). The collection and purchase of wild edible mushrooms in Bulgaria is well organized in many areas (Bulgarian Food Safety Agency, 2023).

Despite the relatively rich species diversity of fungi in the Strandzha and Southern Black Sea

Coast regions (Denchev & Assyov, 2010), research in both zones is extremely few or completely absent (Denchev & Petrova, 2005; Hüseyin & Selçuk 2007; Hüseyin et al., 2011). Particularly unstudied for both regions were edible wild mushrooms, for which general information can only be found in the publications of Denchev & Petrova (2005) and Denchev & Assyov (2010).

The goal of this brief review was to present information on the species of wild edible mushrooms in the Strandzha and Southern Black Sea coast regions described in the literature, which will contribute to the clarification of the ethnomycology of the two regions, which is of the tasks set in the DUEkoS project.

### Materials and Methods

Table 1 lists macroscopic fungi from the Strandzha Mountains and the Black Sea coast. The taxa are listed in alphabetical order (Turland et al., 2018). The names of the authors of fungal taxa were abbreviated according to Kirk & Ansell (1992) and Kirk (2004). The information in the presented lists includes available data from literature sources regarding the locality and edibility of the species. For each species, ecological-trophic type was noted, as well as the period of active formation of fruiting bodies. The conservation status of the species was based on the Red List of fungi in Bulgaria (Gyosheva et al., 2006) and the Red Data Book of the Republic Bulgaria Volume 1 (Peev et al., 2015), using the Red Book categories of IUCN (IUCN 2001, 2003a, b).

**Table 1.** Checklist of the edible wild macromycetes in Strandzha and Black Sea coast.

<i>Species</i>	<b>Edibility</b>	<b>Ecological-trophic type</b>	<b>Seasonality</b>
<i>Agaricus altipes</i> (F.H. Møller) Pilát	<b>E</b>	<b>Hu</b>	VII – X
	Gwenzi et al., 2021	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Gyosheva et al., 2006; Peev et al., 2015	
<i>Agaricus arvensis</i> Schaeff.	<b>E</b>	<b>Hu</b>	V – XI
	Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978;	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Burzakov, 1928.	
<i>Agaricus bitorquis</i> (Quél.) Sacc.	<b>E</b>	<b>Hu</b>	V – XI
	Raper, 1976.	Denchev & Assyov, 2010	
<i>Agaricus campestris</i> L.	<b>E</b>	<b>Hu</b>	V – XI
	Boccardo et al., 2008; Bon, 2012;	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	

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	Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978;		
<i>Agaricus essettei</i> Bon	<b>E</b>	<b>Hu, LeS</b>	VI - X
	Raper, 1976.	Denchev & Assyov, 2010; Peev et al., 2015	
<i>Agaricus macrocarpus</i> (F.H. Møller) F.H. Møller	<b>E</b>	<b>Hu, LeS</b>	VI - X
	Razaq & Shahzad, 2007.	Denchev & Assyov, 2010; Gyosheva et al., 2006; Peev et al., 2015	
<i>Agaricus subperonatus</i> (J.E. Lange) Singer	<b>E</b>	<b>Hu, LeS</b>	IX - XI
	Bon, 2012; Jordan, 1995; Laessoe & Del-Conte, 1996; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Agaricus squamulifer</i> (F.H. Møller) Pilát	<b>E</b>	<b>Hu</b>	IX - XI
	Boccardo et al., 2008	Denchev & Assyov, 2010; Peev et al., 2015	
<i>Agaricus sylvaticus</i> Schaeff.	<b>E</b>	<b>Hu</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Sechanov, 1957; Uzelac, 2009; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Agaricus sylvicola</i> (Vittad.) Lév.	<b>E</b>	<b>Hu, LeS</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Agrocybe cylindracea</i> (DC.) Maire	<b>E</b>	<b>LeS</b>	VII - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Hinkova et al., 1986; Jordan, 1995; Laessoe & Del-Conte, 1996; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Agrocybe molesta</i> (Lasch) Singer	<b>E</b>	<b>Hu</b>	VII - IX
	Bon, 2012; Breitenbach & Kränzlin, 1986; Jordan, 1995; Phillips, 2006; Uzelac, 2009.	Denchev & Assyov, 2010	
<i>Agrocybe praecox</i> (Pers. : Fr.) Fayod	<b>E</b>	<b>Hu, LeS</b>	V - IX
	Boccardo et al., 2008; Bon, 2012; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Amanita caesarea</i> (Scop. : Fr.) Pers.	<b>E</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Courtecuisse & Duhem, 1995;	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Gyosheva et al., 2006	

	Phillips, 2006; Yordanov et al., 1978.		
<i>Amanita rubescens</i> Pers. : Fr.	<b>CE</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Amanita strobiliformis</i> (Paulet ex Vittad.) Bertill.	<b>E</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010; Gyosheva et al., 2006; Peev et al., 2015	
<i>Amanita vaginata</i> (Bull. : Fr.) Vittad	<b>CE</b>	<b>Mr</b>	V - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Petrova, 2005.	
<i>Armillaria socialis</i> (DC. : Fr.) Fayod	<b>CE</b>	<b>LeS, LeP</b>	VII - IX
	Boccardo et al., 2008; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Aureoboletus gentilis</i> (Quél.) Pouzar	<b>E</b>	<b>Mr</b>	VII - IX
	Phillips, 2006.	Denchev & Assyov, 2010; Peev et al., 2015	
<i>Auricularia auricula-judae</i> (Bull. : Fr.) Quél.	<b>E</b>	<b>LeS, LeP</b>	VII - XI
	Kadnikova et al., 2015	Denchev & Assyov, 2010	
<i>Boletus aereus</i> Bull. : Fr.	<b>E</b>	<b>Mr</b>	V - IX
	Assyov, 2014; Boccardo et al., 2008; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Boletus appendiculatus</i> Schaeff.	<b>E</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Bon, 2012; Breitenbach, & Kränzlin, 1986 Jordan, 1995; Phillips, 2006; Uzelac, 2009.	Assyov & Denchev, 2004 Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Boletus armeniacus</i> Quél.	<b>E</b>	<b>Mr</b>	VI - IX
	Assyov & Denchev, 2004	Assyov & Denchev, 2004; Denchev & Assyov, 2010; Gyosheva et al., 2006 Peev et al., 2015	
<i>Boletus caucasicus</i> Singer ex Alessio	<b>E</b>	<b>Mr</b>	VI - IX
	Assyov & Denchev, 2004	Assyov & Denchev, 2004; Denchev & Assyov, 2010; Gyosheva et al., 2006; Peev et al., 2015	
<i>Boletus chrysenteron</i> Bull.	<b>E</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Bon, 2012;	Assyov & Denchev, 2004; Denchev & Assyov, 2010	

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	Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Uzelac, 2009; Yordanov et al., 1978.		
<i>Boletus edulis</i> Bull. : Fr.	<b>E</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Yordanov et al., 1978.	Assyov & Denchev, 2004; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993; Denchev & Petrova, 2005.	
<i>Boletus erythropus</i> (Fr. : Fr.) Krombh.	<b>CE</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Petrova, 2005.	
<i>Boletus impolitus</i> Fr.	<b>E</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus luridiformis</i> Rostk. var. <i>luridiformis</i>	<b>CE</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus luridus</i> Schaeff. : Fr. var. <i>luridus</i>	<b>CE</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus pseudoregius</i> Huber ex Estadès	<b>E</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus queletii</i> Schulzer	<b>CE</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008; Bon, 2012; Phillips, 2006; Uzelac, 2009.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus regius</i> Krombh.	<b>E</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Hinkova et al., 1986; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Petrova, 2005; Gyosheva et al., 2006; Peev et al., 2015.	
<i>Boletus reticulatus</i> Schaeff.	<b>E</b>	<b>Mr</b>	V - X
	Boccardo et al., 2008; Bon, 2012;	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	

	Courtecuisse & Duhem, 1995; Harding et al., 1996; Jordan, 1995; Phillips, 2006.		
<i>Boletus rubellus</i> Krombh.	<b>E</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008; Bon, 2012; Breitenbach & Kränzlin, 1986; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Boletus subtomentosus</i> L. : Fr. (incl. <i>B. kuthanii</i> and <i>B. lanatus</i> )	<b>E</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Uzelac, 2009; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010.	
<i>Bovista graveolens</i> Schwalb	<b>YE</b>	<b>Hu, LeS</b>	VIII - XI
	Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Assyov & Denchev, 2004; Denchev & Assyov, 2010; Gyosheva et al., 2006; Peev et al., 2015	
<i>Bovista plumbea</i> Pers.	<b>YE</b>	<b>Hu</b>	VI - X
	Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Calocybe gambosa</i> (Fr. : Fr.) Donk	<b>E</b>	<b>Mr</b>	IV - VI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Cantharellus cibarius</i> Fr. : Fr. var. <i>cibarius</i>	<b>E</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008; Harding et al., 1996.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993.	
<i>Cantharellus cinereus</i> (Pers. : Fr.) Fr.	<b>E</b>	<b>Mr</b>	VI - X
	Boccardo et al., 2008; Harding et al., 1996.	Denchev & Assyov, 2010.	
<i>Clitocybe gibba</i> (Pers. : Fr.) P. Kumm.	<b>E</b>	<b>Hu</b>	V - XI
	Vetter, 1990.	Denchev & Assyov, 2010; Burzakov, 1928.	
<i>Clitopilus prunulus</i> (Scop. : Fr.) P. Kumm.	<b>E</b>	<b>Hu</b>	V - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Coprinellus micaceus</i> (Bull. : Fr.) Vilgalys, Hopple & Jacq. Johnson	<b>CE</b>	<b>LeS</b>	III - XI
	Boccardo et al., 2008; Courtecuisse & Duhem, 1995; Hinkova et al., 1986; Jordan, 1995;	Denchev & Assyov, 2010.	

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<i>Coprinus comatus</i> (O.F. Müll. : Fr.) Pers.	<b>E</b>	<b>Hu</b>	V – XI
	Drumeva-Dymcheva & Gyosheva-Bogoeva, 2016; Hinkova et al., 1986; Laessoe & Del-Conte, 1996. Phillips, 2006; Semenov, 2001; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Craterellus cornucopioides</i> (L. : Fr.) Pers.	<b>E</b>	<b>Mr</b>	VI – X
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Hinkova et al., 1986; Harding et al., 1996; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Fistulina hepatica</i> (Schaeff. : Fr.) With.	<b>YE</b>	<b>LeS, LeP</b>	VII - X
	Ribeiro et al., 2009	Denchev & Assyov, 2010	
<i>Gymnopus dryophilus</i> (Bull. : Fr.) Murrill	<b>E</b>	<b>LeS, St</b>	V – XI
	Boccardo et al., 2008; Bon, 2012; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Gyroporus castaneus</i> (Bull. : Fr.) Quél.	<b>E</b>	<b>Mr</b>	VIII - X
	Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010	
<i>Hericium cirrhatum</i> (Pers. : Fr.) Nikol.	<b>YE</b>	<b>LeS</b>	VII - IX
	Bon, 2012; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Hericium coralloides</i> (Scop. : Fr.) Pers.	<b>E</b>	<b>LeS</b>	VII - IX
	Zou et al., 2012.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Gyosheva et al., 2006	
<i>Hydnum repandum</i> L. : Fr. f. <i>repandum</i>	<b>E</b>	<b>Mr</b>	VII - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993.	
<i>Hydnum rufescens</i> Pers. : Fr.	<b>E</b>	<b>Mr</b>	VII - XI
	Garrab et al., 2019	Denchev & Assyov, 2010	
<i>Hygrophorus eburneus</i> (Bull. : Fr.) Fr.	<b>E</b>	<b>Mr</b>	IX - XI
	Boccardo et al., 2008; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Uzelac, 2009; Yordanov et al., 1978.	Denchev & Assyov, 2010; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993.	
<i>Hygrophorus persoonii</i> Arnolds	<b>E</b>	<b>Mr</b>	IX - XI
	Boccardo et al., 2008	Denchev & Assyov, 2010	
<i>Hygrophorus russula</i> (Schaeff. : Fr.) Kauffman	<b>E</b>	<b>Mr</b>	IX - XI
	Boccardo et al., 2008; Bon, 2012.	Denchev & Assyov, 2010; Gyosheva et al., 2006	

<i>Kuehneromyces mutabilis</i> (Schaeff. : Fr.) Singer & A.H. Sm.	<b>E</b>	<b>LeS</b>	V - X
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Laccaria bicolor</i> (Maire) P.D. Orton	<b>E</b>	<b>Mr</b>	VI - IX
	Boccardo et al., 2008; Breitenbach & Kränzlin, 1986.	Denchev & Assyov, 2010	
<i>Laccaria laccata</i> (Scop. : Fr.) Cooke	<b>E</b>	<b>Mr</b>	VI - X
	Assyov, 2012, 2014; Boccardo et al., 2008; Breitenbach & Kränzlin, 1986; Courtecuisse & Duhem, 1995; Drumeva-Dymcheva & Gyosheva-Bogoeva, 2016; Harding et al., 1996; Jordan, 1995; Phillips, 2006; Uzelac, 2009; Vanev et al., 1998; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Lacrymaria lacrymabunda</i> (Bull. : Fr.) Pat.	<b>E</b>	<b>Hu, LeS</b>	VI - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Lactarius deliciosus</i> (L. : Fr.) Gray	<b>E</b>	<b>Mr</b>	VI - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Lactarius piperatus</i> (L. : Fr.) Pers.	<b>CE</b>	<b>Mr</b>	VI - X
	Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Burzakov, 1928.	
<i>Lactarius vellereus</i> (Fr. : Fr.) Fr.	<b>CE</b>	<b>Mr</b>	VII - IX
	Drumeva-Dymcheva & Gyosheva-Bogoeva, 2016; Hinkova et al., 1986; Sechanov, 1957; Semenov, 2001; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Lactarius volemus</i> (Fr. : Fr.) Fr.	<b>E</b>	<b>Mr</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	



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<i>Laetiporus sulphureus</i> (Bull. : Fr.) Murrill	<b>E</b>	<b>LeS</b>	VII - X
	Klaus et al., 2013	Denchev & Assyov, 2010	
<i>Leccinum aurantiacum</i> (Bull.) Gray	<b>E</b>	<b>Mr</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Leccinum carpini</i> (Schulzer) M.M. Moser ex D.A. Reid.	<b>E</b>	<b>Mr</b>	VI - VIII
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Petrova, 2005.	
<i>Leccinum crocipodium</i> (Letell.) Watling	<b>E</b>	<b>Mr</b>	VII - IX
	Boccardo et al., 2008; Bon, 2012; Phillips, 2006.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Leccinum duriusculum</i> (Schulzer ex Kalchbr.) Singer	<b>E</b>	<b>Mr</b>	VII - XI
	Phillips, 2006; Boccardo et al., 2008; Bon, 2012.	Denchev & Assyov, 2010	
<i>Leccinum pseudoscabrum</i> (Kallenb.) Šutara	<b>E</b>	<b>Mr</b>	VI - VIII
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Lepista nuda</i> (Bull. : Fr.) Cooke	<b>CE</b>	<b>Hu</b>	IX - XI
	Erbiai et al., 2023	Denchev & Assyov, 2010	
<i>Leucopaxillus lepistoides</i> (Maire) Singer	<b>E</b>	<b>Hu</b>	IV - VI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Lycoperdon echinatum</i> Pers. : Pers	<b>YE</b>	<b>Hu</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Lycoperdon mammiforme</i> Pers. : Pers	<b>YE</b>	<b>Hu</b>	VII - XI
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Lycoperdon perlatum</i> Pers. : Pers.	<b>YE</b>	<b>Hu</b>	VII - XI
	Boccardo et al., 2008; Bon, 2012;	Denchev & Assyov, 2010	

	Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.		
<i>Lycoperdon pyriforme</i> Schaeff. : Pers. var. <i>pyriforme</i>	<b>YE</b>	<b>LeS</b>	VII - XII
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Lyophyllum decastes</i> (Fr. : Fr.) Singer	<b>E</b>	<b>Hu</b>	VIII - XI
	Boccardo et al., 2008; Bon, 2012; Breitenbach & Kränzlin, 1986; Drumeva-Dymcheva & Gyosheva-Bogoeva, 2016; Hinkova et al., 1986; Laessoe & Del-Conte, 1996; Jordan, 1995; Phillips, 2006; Semenov, 2001; Uzelac, 2009; Vanev et al., 1998.	Denchev & Assyov, 2010	
<i>Macrolepiota mastoidea</i> (Fr. : Fr.) Singer (incl. <i>M. gracilentata</i> )	<b>E</b>	<b>Hu</b>	IX - XI
	Assyov, 2014; Breitenbach & Kränzlin, 1986; Hinkova et al., 1986; Laessoe & Del-Conte, 1996; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Macrolepiota procera</i> (Scop. : Fr.) Singer	<b>E</b>	<b>Hu</b>	V - XI
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Jordan, 1995; Phillips, 2006; Uzelac, 2009.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Burzakov, 1928.	
<i>Marasmius oreades</i> (Bolton : Fr.) Fr.	<b>E</b>	<b>Mr</b>	V - X
	Razaq et al., 2013.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Burzakov, 1928; Kuthan & Kotlaba, 1989.	
<i>Phallus impudicus</i> L. : Pers. f. <i>impudicus</i>	<b>YE</b>	<b>St</b>	VI - X
	Boccardo et al., 2008; Courtecuisse & Duhem, 1995; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Pleurotus cornucopiae</i> (Paulet) Rolland	<b>E</b>	<b>LeS</b>	V - IX
	Boccardo et al., 2008; Bon, 2012; Courtecuisse & Duhem, 1995; Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Pleurotus dryinus</i> (Pers. : Fr.) P. Kumm.	<b>CYE</b>	<b>LeS</b>	VII - X
	Courtecuisse & Duhem, 1995;	Denchev & Assyov, 2010	
<i>Pleurotus ostreatus</i> (Jacq. : Fr.) P. Kumm.	<b>E</b>	<b>LeS, LeP</b>	VIII - XI
	Sánchez, 2010	Denchev & Assyov, 2010;	

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		Denchev & Petrova, 2005	
<i>Pleurotus pulmonarius</i> (Fr. : Fr.) Quél.	<b>E</b>	<b>LeS</b>	V - X
	Boccardo et al., 2008; Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Pluteus cervinus</i> (Schaeff.) P. Kumm.	<b>E</b>	<b>LeS</b>	IV - XI
	Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Uzelac, 2009; Yordanov et al., 1978.	Denchev & Assyov, 2010	
<i>Pluteus petasatus</i> (Fr.) Gillet	<b>E</b>	<b>LeS, St</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Breitenbach & Kränzlin, 1986; Courtecuisse & Duhem, 1995; Laessoe & Del-Conte, 1996. Phillips, 2006; Uzelac, 2009.	Denchev & Assyov, 2010	
<i>Polyporus squamosus</i> (Huds. : Fr.) Fr.	<b>YE</b>	<b>LeP, LeS</b>	V - X
	Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Pseudocraterellus undulatus</i> (Pers. : Fr.) Rauscher	<b>E</b>	<b>LeS</b>	VII - X
	Boccardo et al., 2008; Bon, 2012; Jordan, 1995.	Denchev & Assyov, 2010	
<i>Ramaria flava</i> (Schaeff. : Fr.) Quél.	<b>E</b>	<b>Hu</b>	VI - VIII
	Hinkova et al., 1986; Phillips, 2006; Sechanov, 1957; Semenov, 2001; Uzelac, 2009; Vanev et al., 1998.	Denchev & Assyov, 2010; Denchev & Petrova, 2005	
<i>Russula atropurpurea</i> (Krombh.) Britzelm.	<b>QE</b>	<b>Mr</b>	VII - X
	Boccardo et al., 2008; Breitenbach & Kränzlin, 1986; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Russula cyanoxantha</i> (Schaeff.) Fr.	<b>E</b>	<b>Mr</b>	V - XI
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993.	
<i>Russula delica</i> Fr. s. lat.	<b>E</b>	<b>Mr</b>	VI - X
	Bon, 2012; Breitenbach & Kränzlin, 1986; Hinkova et al., 1986; Phillips, 2006.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993.	
<i>Russula grisea</i> (Pers.) Fr.	<b>E</b>	<b>Mr</b>	VI - X
	Bon, 2012; Breitenbach & Kränzlin, 1986;	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Russula heterophylla</i> (Fr. : Fr.) Fr.	<b>E</b>	<b>Mr</b>	VII - XI
	Boccardo et al., 2008; Breitenbach & Kränzlin, 1986.	Denchev & Assyov, 2010	
<i>Russula risigallina</i> (Batsch) Sacc	<b>E</b>	<b>Mr</b>	VI - VIII
	Sarikurkcu et al., 2021.	Denchev & Assyov, 2010	
<i>Russula rosea</i> Pers	<b>E</b>	<b>Mr</b>	VII - XI
	Boccardo et al., 2008;	Denchev & Assyov, 2010;	

	Bon, 2012; Breitenbach & Kränzlin, 1986.	Denchev & Petrova, 2005.	
<i>Russula vesca</i> Fr.	<b>E</b>	<b>Mr</b>	VI - XI
	Boccardo et al., 2008; Bon, 2012; Breitenbach & Kränzlin, 1986; Harding et al., 1996; Jordan, 1995; Phillips, 2006; Uzelac, 2009.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Russula virescens</i> (Schaeff.) Fr.	<b>E</b>	<b>Mr</b>	VI - VIII
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Suillus granulatus</i> (L. : Fr.) Roussel	<b>E</b>	<b>Mr</b>	VI - XI
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Denchev & Assyov, 2010; Assyov & Denchev, 2004.	
<i>Suillus luteus</i> (L. : Fr.) Roussel	<b>E</b>	<b>Mr</b>	VI - XII
	Boccardo et al., 2008; Bon, 2012; Harding et al., 1996; Hinkova et al., 1986; Jordan, 1995; Phillips, 2006; Yordanov et al., 1978.	Assyov & Denchev, 2004; Denchev & Assyov, 2010; Denchev & Petrova, 2005.	
<i>Tricholoma sculpturatum</i> (Fr.) Quél.	<b>E</b>	<b>Mr</b>	VIII - XI
	Boccardo et al., 2008; Bon, 2012; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Vascellum pratense</i> (Pers. : Pers.) Kreisel	<b>YE</b>	<b>Hu</b>	VI - XI
	Boccardo et al., 2008; Harding et al., 1996; Jordan, 1995; Phillips, 2006.	Denchev & Assyov, 2010	
<i>Volvariella bombycina</i> (Schaeff. : Fr.) Singer var. <i>bombycina</i>	<b>E</b>	<b>LeS</b>	VI - IX
	Phillips, 2006.	Denchev & Assyov, 2010	
<i>Xerula radicata</i> (Relhan : Fr.) Dörfelt	<b>E</b>	<b>LeS</b>	VI - XI
	Boccardo et al., 2008; Bon, 2012; Hinkova et al., 1986; Phillips, 2006.	Denchev & Assyov, 2010; Denchev & Petrova, 2005; Drumeva-Dimcheva & Gyosheva-Bogoeva, 1993; Vanev & Reid, 1986.	

*Edibility*: E - edible; CE - conditional edible; YE - edible at a young age; QE - questionable edibility.

*Ecological-trophic type*: St - litter saprotrophs, Hu - humus saprotrophs, Mr - mycorrhizal fungi, LeP - wood parasites;

## Results and Discussion

### *Species composition*

The literature data on the macroscopic fungi of the areas of Strandzha and the Black Sea coast (southern and northern) comprises 105 edible

species (Table 1). Of these, Denchev & Assyov (2010) indicated 80 species for the Black Sea coast (south and north) and 50 species for Strandzha. In the publication of Denchev & Petrova (2005), 35 species of edible macromycetes were listed for

Strandzha. The species: *Boletus causicus*; *Boletus luridiformis* var. *luridiformis* and *Laccaria bicolor* were noted by Denchev & Assyov (2010) only for the region of the Black Sea coast.

The described wild edible mushroom species belong to 27 families and 45 genera (Table 2). The family Agaricaceae had the most genera – 6. With

the most species were the family Boletaceae – 22, followed by Agaricaceae – 20 and Russulaceae – 13.

In terms of species diversity by genera, the *Boletus* genus had the most representatives - 16 species, followed by the *Agaricus* genus - 10 species and the *Russula* genus - 9 species (Table 2).

**Table 2.** Species composition of the edible wild macromycetes in Strandzha and Black Sea coast.

Family	Genus	Number of species
Agaricaceae	<i>Agaricus</i>	10
	<i>Bovista</i>	2
	<i>Coprinus</i>	1
	<i>Lycoperdon</i>	4
	<i>Macrolepiota</i>	2
	<i>Vascellum</i>	1
Amanitaceae	<i>Amanita</i>	4
Auriculariaceae	<i>Auricularia</i>	1
Boletaceae	<i>Aureoboletus</i>	1
	<i>Boletus</i>	16
	<i>Leccinum</i>	5
Cantharellaceae	<i>Cantharellus</i>	2
	<i>Craterellus</i>	1
	<i>Pseudocraterellus</i>	1
Entolomataceae	<i>Clitopilus</i>	1
Fistulinaceae	<i>Fistulina</i>	1
Fomitopsidaceae	<i>Laetiporus</i>	1
Gomphaceae	<i>Ramaria</i>	1
Gyroporaceae	<i>Gyroporus</i>	1
Hericiaceae	<i>Hericium</i>	2
Hydnaceae	<i>Hydnum</i>	2
Hydnangiaceae	<i>Laccaria</i>	2
Hygrophoraceae	<i>Hygrophorus</i>	3
	<i>Calocybe</i>	1
Lyophyllaceae	<i>Lyophyllum</i>	1
	<i>Marasmius</i>	1
Marasmiaceae	<i>Marasmius</i>	1
Omphalotaceae	<i>Gymnopus</i>	1
Phallaceae	<i>Phallus</i>	1
Physalacriaceae	<i>Armillaria</i>	1
	<i>Xerula</i>	1
Pleurotaceae	<i>Pleurotus</i>	4
Pluteaceae	<i>Pluteus</i>	2
	<i>Volvariella</i>	1
Polyporaceae	<i>Polyporus</i>	1
Psathyrellaceae	<i>Coprinellus</i>	1
	<i>Lacrymaria</i>	1
Russulaceae	<i>Lactarius</i>	4
	<i>Russula</i>	9
Strophariaceae	<i>Agrocybe</i>	3
	<i>Kuehneromyces</i>	1
Suillaceae	<i>Suillus</i>	2
Tricholomataceae	<i>Clitocybe</i>	1
	<i>Lepista</i>	1
	<i>Leucopaxillus</i>	1
	<i>Tricholoma</i>	1
<b>27</b>	<b>45</b>	<b>105</b>

### *Edibility and seasonality of mushrooms in both zones*

The analyzed literature sources determined 82 species of edible, 13 conditionally edible and 10 edible in young age macromycetes (Table 1). Drumeva-Dimcheva & Gyosheva-Bogoeva (1993) found a total of 2072 macromycetes in Bulgaria, of which 200 species are edible. This determines the species diversity of edible mushrooms for the two analyzed areas as relatively high. Which of them were used in the life of the local population and in what way may be subject of subsequent ethnomycological studies in the two regions.

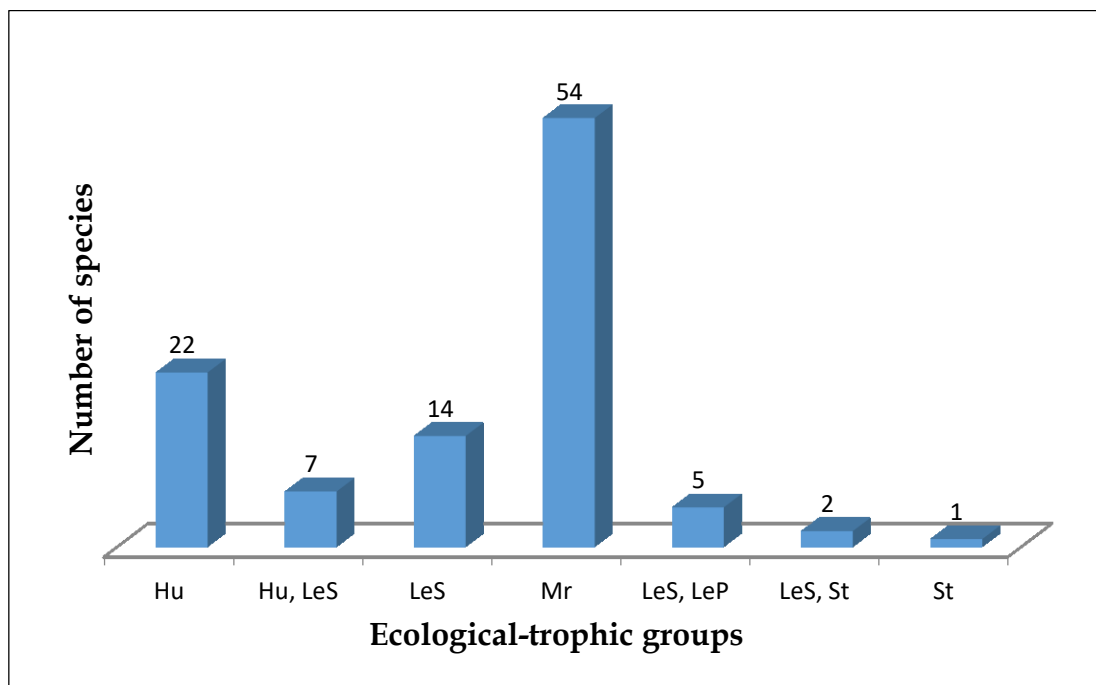
The largest part of edible wild mushrooms for both zones actively fruit during the summer-

autumn and spring-autumn seasons, 62.7% and 22.7%, respectively. Typically the fall species were 7.3% and summer species are 4.5% (Table 1).

### *Ecological-trophic structure*

The analysis of the published data regarding the ecological-trophic groups of fungi showed that in the regions of Strandzha and the Black Sea coast, mycorrhizal fungi were 51.4% of the established species of edible fungi, followed by saprotrophs of humus (20.9%) and saprotrophs of wood (13.3%)

In the plant communities of Strandzha and the Black Sea coast, edible wild mushrooms belong to 7 ecological-trophic groups (Fig. 1).



**Fig. 1.** Arrangement of fungal species in ecological-trophic groups.

### *Species of conservation significance*

For the two analyzed zones, there were 14 edible wild mushrooms with conservation value (Table 3). With the category Endangered (EN) were 8 species, such as *Aureoboletus gentilis* (Syn. *Pulveroboletus gentilis*) which was marked as CR in the Red Data Book of the Republic of Bulgaria (Peev et al., 2015) and EN in the Red List of fungi in Bulgaria (Gyosheva et al., 2006). Vulnerable (VU) were 2 species according to the RDBRB (Peev et al., 2015), such as *Hygrophorus russula* and

*Leccinum aurantiacum* which had the same degree of conservation in the RLF (Gyosheva et al., 2006), while *Hericium coralloides* is Near Threatened (NT). Critically Endangered (CR) according to both sources was *Boletus caucasicus*, which was a species noted only for the Black Sea coast area (Denchev & Assyov, 2010). Whether some of these species were collected and used by people in the marked areas, ie. what is the degree of anthropogenic threat to them, could be subject of further research and analysis among the local population.

**Table 3.** Species with conservation significance in Bulgaria.

Species	Red List of fungi in Bulgaria (Gyosheva et al., 2006)	Red Data Book of the Republic of Bulgaria (Peev et al., 2015)
<i>Agaricus altipes</i> (F.H. Møller) Pilát	EN	EN
<i>Agaricus essettei</i> Bon	EN	EN
<i>Agaricus macrocarpus</i> (F.H. Møller) F.H. Møller	EN	EN
<i>Agaricus squamulifer</i> (F.H. Møller) Pilát	EN	EN
<i>Amanita caesarea</i> (Scop. : Fr.) Pers.	VU	VU
<i>Amanita strobiliformis</i> (Paulet ex Vittad.) Bertill.	EN	EN
<i>Aureoboletus gentilis</i> (Quél.) Pouzar	EN	CR

### Conclusions

The literary analysis of wild edible mushrooms in the Strandzha and Black Sea coast regions shows a relatively large species diversity. Targeted and systematic mycological studies are needed to establish the actual fungal diversity in the two areas. In the course of these studies, many new records are expected for the two territories, which would enrich the mycological data for the country as a whole. Observations on the traditions and lifestyle of the local population regarding edible wild mushrooms would provide an opportunity to clarify the ethnomycological characteristics of the people in the two marked areas.

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