Extreme levels of mycophilia documented in Mazovia, a region of Poland

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Abstract

Background: The paper presents documentation of the traditional use of wild edible mushrooms in Mazovia (33,900 km²), a region of Poland.

Methods: A total of 695 semi-structured interviews were carried out among local informants in 38 localities proportionally distributed throughout the study area (one locality approximately every 30 km), asking which mushrooms they collected and how. The species utilized were identified using visual props, morphological identification of voucher specimens, and DNA barcoding.

Results: Altogether, 92 taxa identified to the species or genus level were recorded, among them 76 species used as food, 21 taxa known as toxic, and 11 taxa used for non-culinary purposes. Out of 76 identified edible fungi species, 47% (36 species) were identified using ITS DNA barcode method. Eleven of them were identified exclusively by molecular analysis. The mean number of edible taxa mentioned per interview was 9.5. Two species new to the mycobiota of Poland, Hydnum ellipsosporum and Paxillus cuprinus, were found. Frequent interaction with mushroom collectors enabled the transcription of local folk taxonomy into proper taxonomic classification and the definition of changes in local preferences concerning wild fungi collection.

Conclusions: The list of species utilized is the longest regional list of edible mushrooms ever recorded during ethnomycolological field research, putting the inhabitants of the studied region at the top of the mycophilia spectrum.

Keywords: Ethnomycology, Edible mushrooms, Fungi, Mycophilia, Mycophilic, Mycophilous

Introduction

Human societies vary greatly in their frequency of utilizing fungi as food. Those which traditionally have positive attitudes towards mushroom collection and consumption are considered mycophilic, in contrast to mycophobic places where mushrooms are avoided [1]. Moreover, some mycophilic communities consider selected species of wild fungi as more valuable sources of food than wild edible plants [2, 3].

Mycophilic areas include large parts of southern and eastern Europe, Turkey, parts of Africa, Mexico, and most of Asia [4]. Traditional knowledge of fungi collection is still not well documented in many parts of the world, including major centers of mycophilia. Moreover, few studies are based on thorough ethnomycological field research. Most are focused on small communities and are sometimes based on unspecified or heterogeneous methodologies [4, 5]. Only a few studies characterize territories with large surface areas (e.g., [6–9]), and none of the abovementioned studies have attempted to conduct research that was evenly distributed over the whole studied area. Some studies were conducted only in markets or with previously selected respondents, such as mushroom vendors or people connected to mushroom commerce (e.g., [6]), which can significantly distort the overall view of community knowledge about wild growing fungi.

Prime examples of mycophilic societies are the northern Slavic nations. Valentina Wasson, one of the creators of this term, was Russian herself [1]. Actually, all northern Slavic countries (Poland, Czechia, Slovakia, Ukraine, Belarus, and Russia) and nations, respectively, display a high degree of mycophilia. In spite of this, modern
ethnomycological studies documented by voucher specimens are very scarce from this area, restricted to an open air market study in south-eastern Poland [10] and a field study of Ukrainians in Romania [3]. However, the great traditions of Polish mycophilia have not gone unnoticed by ethnographers. Jerzy Wojciech Szulczewski from Poznan is the author of the first study of fungi sold in city markets in the world [11]. The use of fungi was also documented by Józef Gajek's Polish Ethnographic Atlas team in 1964–1969 during a systematic study from 330 localities throughout Poland. This was later supplemented by further interviews. Little of this data has been published, apart from distribution maps of the use of selected species from the genera Lactarius and Russula [12]. Some archival data on the use of edible mushrooms are also available [13, 14].

Although mushrooms are eagerly collected across the whole area of Poland, our preliminary observations from one locality in this region [15] showed that the central-eastern part of Poland, within the historical region of Mazovia, displays the largest number of fungi taxa collected. Thus, we designed a study which aimed to document the use of wild edible fungi in a large area, covering the whole region, based on a large number of interviews.

Ethnomycological studies pose many problems in identification of the species listed by informants. Fruiting bodies occur only seasonally, and identification to species level is sometimes difficult even for taxonomists. DNA barcoding facilitates ethnomycological research in many ways. For example, it enables a more exact identification often only from fragments of dried mushrooms collected by the interviewees and enables proper identification of voucher specimens collected during village walks and validation of the initial identification conducted by the researcher. Unfortunately, it is still not widely used in ethnomycology as a tool to eliminate possible errors related to species identification [11, 16, 17].

The main objective of this research is to create the complete ethnomycological documentation of an entire European region with evenly distributed intensity of fieldwork throughout the entire research area. It is connected with further objectives such as:

- Finding rare and protected fungi species used among people living in the Mazovia region;
- Creating a list of locally collected fungi species list with a description of their uses;
- Creating a list of species regarded as inedible or poisonous;
- Assigning proper taxonomic nomenclature to local fungi names;
- Determining folk views on the connections between particular taxa;
- Determining the cultural salience of particular fungi taxa; and
- Detecting changes in preferences concerning wild fungi collection.

**Methods**

**Study area**

Mazovia is one of the ten major Polish historical regions within the area of present-day Poland. Throughout a major part of Polish medieval history, Mazovia was an independent principality. It consists of lands which have been united over the centuries by shared history, culture, and politics, regardless of the current administrative borders [18]. In the case of the present research, the borders of the region were based on the map created for the Historical Atlas of Poland *Mazovia in the second half of XVI century* written by Palucki [19]. The sixteenth century borders are accepted as the best determinants of this region's shape and are presently used as reference points during the research conducted within its area [20, 21] (Fig. 1).

The region lies mainly within the current borders of the Mazovian Voivodeship; however, its lands extend to part of the Podlasie Voivodeship in the north-east and the Łódź Voivodeship in the south-west. It spreads over the Mazovian Lowland in the valleys of the Vistula, Narrew, and Bug rivers. The whole area of this region covers about 33,900 km², and it is inhabited by 5.03 million people, making up 13.1% of the total population of the country [22]. The climate of Mazovia is cold temperate and has a transitional character between oceanic and continental, with high annual temperature amplitudes [23]. The average temperature in summer (VI–VIII) is about 18 °C and in winter (XII–II) –1 °C. Average annual rainfall varies from 550 to 600 mm [24]. Forest vegetation covers 23.3% of the studied area [25]. The majority of these forests (64%) are coniferous, composed mainly of *Pinus sylvestris* (Scots pine). The other most abundant species in deciduous and mixed forests are *Quercus robur* (Pedunculate oak) and *Betula pendula* (silver birch).

It is currently difficult to find any shared cultural characteristics for people living in this historical region, but it is still inhabited by a few ethnographic groups which can be distinguished by their local cultures and traditions. These are the Kurpie, Łowiczanie, Mazurzy, and Podlasianie [20]. The capital city of Warszawa (Warsaw) is located in the center of Mazovia. In spite of the large urban sprawl around Warsaw, forests are present even in the city's agglomeration and mushroom picking is very popular.

The research was carried out in 38 villages or small market towns which were dispersed evenly in a 30-km grid throughout the whole Mazovian region (Fig. 1).
These were Burakowskie, Całowanie, Chyżyny, Cieciory, Dąbrowa, Faustynowo, Flesze, Gostkowo, Kluki, Klusek, Kocierzew, Konopki (Grajewo County), Konopki (Lomża County), Korytów, Kozietuły, Kręgi, Leksyn, Łątczyn, Łękawica, Maminó, Mchowo, Mistrzewice, Nowy Gołymin, Piaski, Przedświt, Psucin, Pszczonów, Radzymin, Regnów, Sojczyn, Stare Babice, Szczaki, Szydłowo, Świerże, Węgrzynowice, Wyrzyki, Żdunek, and Żurawka (currently the district of Sulejówek). This network of settlements forms part of the larger network of the Ethnographic Atlas of Poland, where data was also collected on mushroom gathering in 1964–1969 [26]. At that time, the ethnographer chose “large moderately backward” settlements. We selected the same settlements in order to make a return study and assess the changes in mushroom gathering.

**Field research methods**

The field research took place in the months of abundance of traditionally collected wild edible fungi (IV–XI), between 2014 to 2018. Data were collected through individual semi-structured interviews with local informants, which is the classic method in ethnobiology [27]. In order to define the cultural salience of particular
The majority of folk taxa listed during interviews were identified with the support of mushroom identification guides or pictures. Some of these interviews were conducted during (or soon after) mushroom collection, which enabled us to recognize taxa on the spot and to acquire voucher specimens, whose identification was later verified with DNA barcoding [31, 32]. During interviews, the informants were also asked which species known as edible were collected currently, and which only in the past. Altogether, 695 interviews were carried out. Informants were selected during village walks or using the “snowball” sampling technique [30]. We aimed at interviewing 20 informants per locality and could not find the attempted 20 in 10 localities. These are Cieciory (10 interviews), Dąbrówka (17), Flesze (10), Konopki (Grajewo county) (10), Konopki (Lomża county) (16), Leksyn (18), Nowy Golym (10), Piaski (18), Wyrzyki (18), and Zdunek (8). This is connected with demographic changes which have taken place over the last five decades in some of the settlements. Since Gajek’s research, some sites that were included in the village grid have been visibly depopulated, while others have become parts of broader urbanized areas (Fig. 2).

Among the 695 respondents, women accounted for 52% (362) and men for 48% (333). The age of informants ranged from 17 to 95. The mean age was 63 (SD = 13.7) and median 64.

The majority of folk taxa listed during interviews were identified as edible was collected by using the freelist method [28, 29]. During interviews, respondents were asked separately about wild macrofungi known as edible, inedible, and used for non-consumption purposes. All freelists were made orally and written down. During interviews, the informants were also asked which species known as edible were collected currently, and which only in the past. Altogether, 695 interviews were carried out. Informants were selected during village walks or using the “snowball” sampling technique [30]. We aimed at interviewing 20 informants per locality and could not find the attempted 20 in 10 localities. These are Cieciory (10 interviews), Dąbrówka (17), Flesze (10), Konopki (Grajewo county) (10), Konopki (Lomża county) (16), Leksyn (18), Nowy Golym (10), Piaski (18), Wyrzyki (18), and Zdunek (8). This is connected with demographic changes which have taken place over the last five decades in some of the settlements. Since Gajek’s research, some sites that were included in the village grid have been visibly depopulated, while others have become parts of broader urbanized areas (Fig. 2).

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**Data analysis**

In order to measure the cultural importance of particular fungi taxa, we used Smith’s Salience Index [36]. Salience was derived using a salience index (Smith’s S) defined as \( S = ((L - R_j + 1)/L)/N, \) where \( L \) is the length of each list, \( R_j \) is the rank of item \( j \) in the list, and \( N \) is the number of lists in the sample (Tables 1, 2, and 3). The significance of differences in local knowledge about wild edible fungi between men and women was determined using the \( T \) test for independent samples (Fig. 3). The relation between age and local knowledge about edible fungi was analyzed by distance-weighted least squares regression (Fig. 4). Statistica version 12.5 programme was used to perform most of the statistical analyses, apart from Salience index, which was calculated from the basic data spreadsheet in Excel.

In order to compare our results with those obtained between 1964 and 1969 by Józef Gajek’s team, we analyzed 48 questionnaires gathered by the team in selected Mazovian villages (there were 38 localities but in some places the research was repeated). During the analysis, we excluded questionnaires with data collected without using the freelisting method and also questionnaires with visible identification errors. Questionnaires with data acquired without using the freelisting method were characterized by the order of listed species, which coincided with the order of species listed in the mushroom guide written by Henryk Orłos in 1963 [37]. It is known that this guide was used as a support for species identification during Gajek’s research. Determination of obvious identification errors was possible due to the very long local fungi name list created during present research in the same villages. In a few cases, popular local names were assigned to the guide’s illustrations depicting rare or locally absent species with characteristics similar to those of commonly collected and abundant species.

**Results and discussion**

**General information**

During field research, we recorded the use of 65 fungi folk taxa which were listed as edible. In these folk taxa, we identified 76 scientific taxa on the genus or species (Table 1). We identified 21 taxa of species considered as inedible or poisonous to the genus or species level and 3 folk taxa on levels higher than family (Table 2). We also recorded the uses of 11 fungi species or genera for other purposes than food (i.e., medicinal and hallucinogenic, Table 3). Bearing in mind that recorded folk taxa
correspond to different taxonomic ranks such as genera or orders, these folk classifications can actually apply to dozens of other different scientific species, which are rare (and rarely used) but similar and related to popularly recognized taxa. Considering that in a few cases the same taxon was present on more than one list (i.e., edible, toxic, other), there were altogether 92 different fungi taxa identified to the genus or species level, recorded as used or known, now or in the past, by people living in Mazovia.

The mean number of recorded edible fungal taxa is 9.5 and the median is 9, minimum 1 and maximum 28 per interview. We detected a very small, but significant difference between men and women in relation to knowledge about wild edible fungi (Fig. 3; \( p = 0.0145 \)).

According to the results, men display more diversified knowledge considering wild edible fungi than women.
Table 1 Scientific and local names of fungi used for culinary purposes in Mazovia with their salience and frequency (Continued)

| Scientific names of folk taxa | Smith's S | Frequency \( n = 695 \) |
|-------------------------------|-----------|--------------------------|
| Tricholoma portentosum (Fr.) Quél. | 0.2967 | 231 |
| mainly: gąska siwa, prośnianka siwa; also: gąska ciemna, gąska szara, pecłonka szara, podzielonka, prośnianka seledynowa, prośnianka szara, siwka |
| Calocybe gambosa (Fr.) Donk | 0.0039 | 3 |
| gąska biała |
| Lepista nuda (Bull.) Cooke | 0.0024 | 2 |
| gąska fioletowa, gąsówka naga |
| Calvatia gigantea (Batsch) Lloyd | 0.0073 | 5 |
| bździaucha, purchawa, purchawiec |
| Lycoperdon sp. including: Lycoperdon lividum Pers. | 0.0012 | 1 |
| purchawa, pałbol |
| Cantharellus cibarius s.l. Fr. | 0.7387 | 539 |
| mainly: kurka, gąska; also: drzewiąk, gąska, kurek, kurka, lisiczka |
| Coprinus comatus (O.F. Müll.) Pers. | 0.0014 | 1 |
| kania |
| Cortinarius caperatus (Pers.) Fr. | 0.0714 | 61 |
| kolpak, niemka, płachcianka, turek |
| Cortinarius mucosus (Bull.) J. Kickx | 0.0012 | 1 |
| tłuszczyka |
| Craterellus cornucopioides (L.) Pers. | 0.0156 | 13 |
| cholewka, cholewka, czarna kurka, fioletowa trąba |
| Gyromitra esculenta (Pers.) Fr. | 0.0643 | 48 |
| babie uszy, piestrenica |
| Gyroporus cyanescens (Bull.) Quél. | 0.0721 | 58 |
| mainly: siniak, modrzak; also: modrak, modrzewiak, plaszczyk, piaskowiec |
| Hydnum repandum s.l. including: Hydnum ellipsosporum Ostrow & Beenken | 0.0046 | 4 |
| kolczak, sarenka |
| Hygrocybe hypothéjus (Fr.) Fr. | 0.033 | 25 |
| cienka łydka, listopadka, listopadowka, przylaszczka, tłuszczyka |
| Inula badia (Fr.) Fr. | 0.7959 | 572 |
| mainly: podgrzybek; also: czarny lepek, podgrzyb, podgrzybek brązowy, podgrzybka, podgrzybinka, podprawdziwiec, polgrzybek, połprawdziwiec, siniak |
| Laccaria amethystina (Huds.) Cooke | 0.0013 | 1 |
| tatarek |
| Lactarius deliciosus s.l. (L.) Pers. | 0.3115 | 242 |
| rydz |
### Table 1 Scientific and local names of fungi used for culinary purposes in Mazovia with their salience and frequency (Continued)

| Scientific names of folk taxa | Smith's S | Frequency n = 695 | Local names |
|-------------------------------|-----------|------------------|-------------|
| *Lactarius deterrimus* Gröger | 0.0026 | 2 | rydz żółty |
| *Lactarius piperatus* (L.) Pers. | 0.0046 | 4 | bil, bły, mleczał |
| *Lactarius veilureus* (Fr.) Fr. | 0.0069 | 6 | chrząszcz, grudz, kobyłka |
| *Lactarius volemus* (Fr.) Fr. | 0.0149 | 13 | dójka, krowa, krówka, krówski rydz |
| *Leccinum sp.* including: | | | |
| *Leccinum aurantiacum* s.l. (Bull.) Gray | 0.5368 | 397 | kowale, kozaki, kozerzy, kozyry, koźlaki, koźlary, koźlarze |
| | | | mainy; osak; also: czerwona główka, czerwonik, czerwoniak bordowy, czerwonogłowic, czerwonolepek, czernwony, czerwony lepek, kowalik, kozak czerwony, kozar czerwony, koźlak czerwony, koźlar czerwony, koźlarz czerwony, krawiec, Lesiak, olszak, olszyn, osniak, pamfli, pociech, pociecha, stolnygwa, zapałka |
| | | | dębniak |
| From *L. aurantiacum*, the following species are sometimes differentiated: | | | |
| *Lecinum quercinum* (Pilát) E.E. Green & Watling | 0.0081 | 6 | czerwoniak, czerwonik jasny |
| *Lecinum versipelle* (Fr. & Høk) Snell | 0.004 | 3 | koźlarz brązowy, osak brązowy, osak ciernobrązowy |
| *Lecinum vulpinum* Watling | 0.0038 | 3 | mainy; kozak szary; also: baba, brzeźniak, brzozowik, kowal siwy, kozaczek, kozak, kozak brązowy, kozak siwy, kozak siwy, kozar siwy, kozarz siwy, kozarz biały, koźlak brązowy, koźlak jasny, koźlak siwy, koźlak szary, koźlak szary, koźlar brązowy, koźlar siwy, koźlar szary, koźlarz, koźlarz ciemny, koźlarz siwy, koźlarz szary, podbrzeźniak, siwek, koźielek czarny, koźlak ciemno-szary, koźlak |
| Brown-capped species, mainly *Lecinum scabrum* s.l. (Bull.) Gray, also *L. pseudoscarbicum* (Kallenb.) Mikšík and *L. vanicolor* Watling | 0.502 | 365 | | |
| | | | | |
| Sometimes differentiated: | | | |
| | | | | |

The following species are sometimes distinguished: | | | |

| Scientific names of folk taxa | Smith's S | Frequency n = 695 | Local names |
|-------------------------------|-----------|------------------|-------------|
| *Cortinarius* (Fr.) Fr. | | | |
| *Cortinarius claviformis* (Batsch) Vellinga | 0.4195 | 323 | czerńy; kozar ciemny, koźlar czarny |
| *Macrolepiota procera* s.l. (Scop.) Singer (most often), occasionally also: | | | |
| *Clorophyllum olivieri* (Batsch) Vellinga | 0.0036 | 3 | kania czerwieniącą, kania leśna |
| *Clorophyllum rhacodes* (Vittad.) Vellinga | | | |
| *Marasmius oreades* (Bolton) Fr. | 0.1068 | 79 | mainy; przydrożka, psiak, twardziolcek, tarczownicza; also: gromadka, murawka, podróżnik, podróżniczek, podróznik, przydrożnik, przydrożniczek, psi grzyb, rzędówka, taniec, taniecnička, tarczownica, tarczownik, tątka, tuncznička, tonk, twardziolcek przydrożny, wysyndek, wysyrank, wysynddek, wywierszka, zawierszka |
| *Morchella* sp. mainly *Morchella esculenta* (L.) Pers. and *Morchella conica* s.l. Pers. | 0.0316 | 27 | smarz, smarz |
| *Neoboletus* *luniformis* (Rostk.) G. Wu & Zhu L. Yang | 0.0001 | 1 | półdzień |
| *Paxillus involutus* s.l. (Batsch) Fr. including: | | | |
| *Paxillus cuprinus* Jargeat, Gryta, J.-P. Chaumeton & Vizzini | 0.3149 | 264 | olsówka, olsówka |
| *Pleurotus ostreatus* s.l. (Jacq.) P. Kumm. including: | | | |
| *Pleurotus* | 0.0148 | 12 | boczniak |
Table 1 Scientific and local names of fungi used for culinary purposes in Mazovia with their salience and frequency (Continued)

| Scientific names of folk taxa | Smith's S | Frequency n = 695 | Local names |
|------------------------------|-----------|-------------------|-------------|
| Scleroderma citrinum (Pers.)  | 0.0083    | 7                 |             |
| Sparassis crispa (Wulf.) Fr. | 0.0083    | 7                 |             |
| Suillus luteus (L.) Roussel (mainly) and other Suillus spp. including: | 0.702 | 521 |             |
| Suillus bovinus (L.) Roussel | 0.0712    | 58                |             |

Men reported on average 9.9 ± 4.8 fungi taxa while women 9.1 ± 4.4. There was no significant correlation between age of respondents and number of listed edible species; however, the graph of weighted least squares regression suggests that informants aged between 60 and 70 have on average the largest knowledge of wild edible fungi (Fig. 4).

However, after removing results for ages over 70, when the cognitive capacity of informants drops, we acquired a significant correlation between these two factors (Fig. 5).

The mean number of listed inedible or poisonous fungi taxa is 1.7 (median = 2, minimum = 0, maximum = 6), and the mean number of fungi taxa with other useful properties is 0.15 (median = 0, min = 0, max = 3).

Taking into account the mean number of species listed, the largest number of fungi taxa are collected in Żurawka, Mińsk county (mean = 14.7); Faustynowo, Ciechanów county (mean = 12.75); and Węgrynów, Tomaszów county (mean = 12.26). When all the lists from one settlement were added together, the longest lists of edible fungi taxa were acquired for Pszczonów = 41, Żurawka = 37, Szczałki = 36, and Korytów and Węgrynów = 33. All these villages are situated close to each other in the central and south-western parts of the Mazovia region.

Mushrooms are frequently used in a variety of boiled and fried dishes. Many taxa are also preserved (dried, pickled, or frozen after brief boiling). The range of mushroom dishes and their processing techniques is so diverse that it is worthy of discussion in a separate paper.
Table 2 Scientific and local names of toxic and inedible fungi known in Mazovia with their salience and frequency (Continued)

| Scientific names of folk taxa | Smith's S | Frequency, n = 695 | Local names |
|-------------------------------|-----------|-------------------|-------------|
| Pygrophoropsis aurantiaca (Wulfen) Maire | 0.0109 | 8 | fałszywa gąska, fałszywa kurka, pieprznik jadowity, trująca kurka |
| Lactarius sp. including: | | | |
| Lactarius aurantiacus (Pers.) Gray | 0.0052 | 4 | mleczaki |
| Lactarius piperatus (L.) Pers. | 0.0012 | 1 | mleczaj gorzki |
| Lactarius tomaninus (Schaeff.) Gray | 0.0013 | 1 | bil |
| Paxillus involutus s.l. (Batsch) Fr. | 0.0452 | 33 | trująca krowa morda, trująca rydz, wełnianka |
| Tapinella atratomentosa (Batsch) Štúr | 0.0081 | 6 | krzywogęba, krowia gęba, świnia, włoschata olszówka |
| Bracket fungi (Polyporales spp.) in general | | | |
| Ramaria sp. | 0.0013 | 1 | kozia bródka |
| Rubroboletus satanas (Lenz) Kuan Zhao & Zhu L. Yang | 0.0071 | 5 | borowik szatan, szatanista, borowik szataniński |
| Russula sp. including: | | | |
| Russula emeritica (Schaeff.) Pers. | 0.0137 | 10 | betka czerwona, trujący gołąbek, surowiartka, gołąbek czerwony, surowiartka trująca, czerwona siwka |
| Russula fellea (Fr.) Fr. | 0.0027 | 2 | betka żółta |
| Tylotopsis felleus (Bull.) P. Karst. | 0.3666 | 264 | main: szatan, goryczak; also: goryczak, gorzkol, gorzkiec, gorzki, gorzkwiec, gorzkwika, goszkiec, gosznia, gosztelec, piołun gorzkowiec, podgórzelec, prawdziwek szatan, prawdziwek trująca, szatan, szatan podgrzybek, świnia, zając |

Diachronic differences

In the data from the 1960s, 31 fungi folk taxa were identified as listed by Mazovian informants during Gajek's research. In comparison, current field research based only on interviews conducted in the same localities enabled the identification of 65 wild edible fungi folk species used by Mazovian communities (after the DNA barcoding, the number of identified taxa increased to
Table 3 Scientific and local names of other useful fungi known in Mazovia with their salience and frequency

| Scientific names of folk taxa | Smith's S Frequency, n = 695 Use | Local names |
|-----------------------------|----------------------------------|-------------|
| *Amanita muscaria* (L.) Lam. | 0.0934 66 | fly trap, psychoactive | Table 2 |
| *Boletus edulis* Bull. | 0.0015 1 | dye | Table 1 |
| *Claviceps purpurea* (Fr.) Tul. | 0.0015 1 | abortifacient sporysz | |
| *Gyromitra esculenta* (Pers.) Fr. | 0.0028 3 | medicine | Table 1 |
| *Polyporales* sp. | | | |
| *Piptoporus betulinus* (Bull.) B.K. Cui, M.L. Han & Y.C. Dai | 0.0161 11 | medicine, decoration | biała huba, huba brzozowa |
| *Inonotus obliquus* (Ach. ex Pers.) Pilát | 0.0015 1 | medicine | czarna huba, huba brzozowa |
| *Psilocybe* sp. (Fr.) P. Kumm. | 0.0085 8 | psychoactive | grzybek, grzybek halucynek, halucynek, łyścik |
| *Rubroboletus satanas* (Lersz) Kuan Zhao & Zhu L. Yang | 0.0015 1 | fly trap | Table 2 |
| *Scleroderma citrinum* Pers. | 0.0015 1 | fly trap | Table 1 |
| *Suillus luteus* (L.) Roussel | 0.0015 1 | axle grease | Table 1 |
| *Tapinella atromentosa* (Batsch) Šutara | 0.0015 1 | fly trap | Table 2 |

76). Only two species present on Gajek’s list were not recorded during our research (Fig. 6). These are *Sarcodon imbricatus* and *Xerocomellus chrysenteron*. Both of them were listed in Pszczonów village. In the case of *Sarcodon imbricatus*, it is possible that it was confused during identification with *Sarcodon squamosus*, which was identified in the same village during the present research and was not present in the guide used for species identification during Gajek’s research [37]. It is still possible that this species occurs and is used there. *Xerocomellus chrysenteron*, on the other hand, is very abundant in Mazovian forests. Further DNA barcode analysis shows that *Xerocomellus* species are perceived by Mazovian residents as different variants of *Boletus submentosus* and are known under one collective taxa “zając” (Table 4).

This probably also applies to *Xerocomellus chrysenteron*. However, because this species was not identified by the respondents during field research or by DNA barcode analysis of collected voucher specimens, it is not included in the present list of fungi taxa known as edible in the region.

From our interviews and field observations, we hypothesize that most of the taxa not recorded in the 1960s were overlooked rather than being new uses. The local inhabitants are very conservative and cautious about fungi use and field guides tend to be used to confirm the identification of already-collected species. They usually do not start collecting new species based on the field guide. Of course, some new uses cannot be excluded. One of the respondents learned to use puffballs while receiving visitors from the UK and applied the English name, “puffball” on an everyday basis! Another example is *Pleurotus ostreatus*, which has not been traditionally consumed in Poland and was not present in the guide written by Orłoś [37]. Its collection from the wild became popular in the last few decades because of its broad commercial use and its presence in many modern culinary recipes.

Changes in preferences concerning wild fungi collection

Among taxa listed as edible by Mazovian inhabitants, a few species are currently considered as poisonous in Poland. These are *Paxillus involutus*, *Amanita muscaria*, *Gyromitra esculenta*, and *Scleroderma citrinum* [38, 39]. It is worth noticing that *P. involutus* is regarded as an edible mushroom by 38% of respondents. The reason behind this is that *P. involutus* was traditionally used as food in Mazovia until the 1980s, when the first reports about *Paxillus* poisoning syndrome were published in Poland [15]. The data on which taxa are used as food currently and which were used only in the past enable the depiction of changes in preferences concerning wild fungi collection. By comparing this data, we can see that the majority of the respondents stopped collecting *P. involutus* after warnings about their toxicity. However, 9% of them still claim that *P. involutus* consumption is perfectly safe (Fig. 7).

*Gyromitra esculenta* and *Scleroderma citrinum* are usually consumed after specific preparation. *Gyromitra esculenta* is allowed for commercial use in Finland where it is considered a delicacy. However, it is sold only with attached instructions for its preparation [40]. Young and dried *Scleroderma* is used only as food flavoring, and according to some reports, it is safe to consume in very small portions [41]. It is usually used as a substitute for *Tuber* species; however, it is generally perceived as mildly toxic and unsafe for consumption [39, 42]. According to collected reports, *A. muscaria* was only used as food in the region in the past, during periods of war and famine, after long boiling and discarding of the water. This
enabled the removal of toxins from its fruiting body. This method of preparation was also recorded in Italy [43, 44]. The memory of the use of \textit{Amanita muscaria} was recorded in the villages of Klusek, Kozięty, Leksyn, Psucin, and Stare Babice. While analyzing data concerning differences between taxa collected currently and in the past, we can also notice the large decline in the collection of species from \textit{Russulaceae} family. This can be correlated with their absence on the list of fungi species allowed for commercial use in Poland [45], although they used to be widely collected (e.g., [14]).

**Cultural significance**

According to Smith's Salience Index, the most culturally significant edible fungi taxa are \textit{Boletus edulis} sensu lato (0.9157), \textit{Imleria badia} (0.7959), \textit{Cantharellus cibarius} sensu lato (0.7387), \textit{Suillus luteus} sensu lato (0.7020), and \textit{Leccinum aurantiacum} sensu lato (0.5368). The most salient inedible or poisonous taxa are \textit{Amanita} sp. (0.4804), \textit{Tylopilus felleus} (0.3666), \textit{Amanita muscaria} (0.3048), and \textit{Amanita phalloides} sensu lato (0.2767). Fungi taxa with other than culinary uses are characterized by low salience values. The most salient among them are \textit{Amanita muscaria} (0.0950), \textit{Polyporales} sp.
The large number of interviews and frequent interaction with mushroom collectors enabled the transcription of local folk taxonomy into proper taxonomic classification. The acquired information enabled us not only to assign folk taxa to scientific taxonomic nomenclature, but also to describe folk views on connections between particular taxa.

Folk taxonomy

The majority of folk fungi classifications in the study area taxa were based on units defined as folk genera [46] (or generic species [47]). Sometimes, these folk genera were universally divided into two or more folk species using folk binominals (e.g., in the case of *Leccinum*). Usually one, the most frequent, of the scientific species was taken as the model ("core") of the folk genus representing its "essence" (compare [47]) and a few more closely related species from the same section were classified in the same folk genus. However, there were also instances when informants were able to distinguish other species with different local names from the core taxon based on model species. These species were divided in two groups—in a broad sense (sensu lato) and in a strict sense (sensu stricto). One such example is “prawdziwek” (porcini), identified as *Boletus edulis* sensu lato, within which some respondents were able to distinguish "prawdziwek dębowy" (oak porcini)—*Boletus reticulatus*, and "prawdziwek piaskowy" (sand porcini)—*Gyroporus castaneus*, though most respondents would not distinguish them. There were also cases when informants were able to distinguish a group consisting of separate taxa whose fruiting bodies had a similar appearance. This occurred with the taxa named "kozaki," which corresponds to the *Leccinum* genus. Within this taxon, on the basis of different coloring, two model species, *Leccinum aurantiacum* sensu lato and *Leccinum scabrum* sensu lato were distinguished. Within the collective taxon *Leccinum aurantiacum* sensu lato, some of the respondents distinguished *L. quercinum*, *L. versipelle*, and *L. vulpinum*. Furthermore, within the group of *L. scabrum* sensu lato, 14 respondents were able to distinguish *L. pseudoscabrum*. All these species were differentiated
| Voucher no. | Molecular identification | Accession number | Similarity sequences | Reference sequences | Specimen’s local name |
|------------|--------------------------|------------------|----------------------|---------------------|-----------------------|
| WA0000071001 | Russula nitida (Pers.) Fr. | MK028864 | 99.85 | KU205349 | Betka czerwona |
| WA0000071002 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028865 | 99.86 | UDB002180 | Zajączek |
| WA0000071003 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028866 | 100 | UDB002180 | Zajączek |
| WA0000071004 | Cantharellus cibarius Fr. | MK028867 | 99.31 | LC085408 | Kurka |
| WA0000071005 | Amanita fulva Fr. | MK028868 | 100 | UDB002417 | Panienka |
| WA0000071006 | Tricholoma equestre (L.) P. Kumm. | MK028869 | 99.84 | UDB000341 | Gołąbek |
| WA0000071007 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028870 | 99.84 | UDB000341 | Gołąbek |
| WA0000071008 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028871 | 100 | UDB000341 | Gołąbek |
| WA0000071009 | Leccinum versipelle (Fr. & Hök) Snell | MK028872 | 99.76 | UDB019772 | Koźlak |
| WA0000071010 | Leccinum scabrum (Bull.) Gray | MK028873 | 99.76 | UDB019772 | Koźlak |
| WA0000071011 | Leccinum scabrum (Bull.) Gray | MK028874 | 99.75 | KT822312 | Opieńka |
| WA0000071012 | Armillaria gallica Maxm. & Romagn. | MK028875 | 99.75 | DQ131623 | Prawdziwek |
| WA0000071013 | Boletus edulis Bull. | MK028876 | 99.70 | KY595992 | Prawdziwek |
| WA0000071014 | Boletus reticulatus Schaeff. | MK028877 | 99.70 | AY083208 | Kania |
| WA0000071015 | Chlorophyllum brunneum (Farl. & Burt) Vellinga | MK028878 | 99.70 | UDB02180 | Gołąbek |
| WA0000071016 | Suillus bovinus (L.) Roussel | MK028879 | 99.51 | KF482482 | Pieczarka |
| WA0000071017 | Suillus luteus (L.) Roussel | MK028880 | 99.51 | JF797194 | Pieczarka |
| WA0000071018 | Craterellus cornucopoides (L.) Pers. | MK028881 | 99.51 | UDB000341 | Gołąbek |
| WA0000071019 | Russula aeruginea Lindbl. ex Fr. | MK028882 | 99.51 | UDB000341 | Gołąbek |
| WA0000071020 | Russula aeruginea Lindbl. ex Fr. | MK028883 | 99.51 | UDB000341 | Gołąbek |
| WA0000071021 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028884 | 99.51 | UDB000341 | Gołąbek |
| WA0000071022 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028885 | 99.51 | UDB000341 | Gołąbek |
| WA0000071023 | Agaricus arvensis Schaeff. | MK028886 | 99.51 | UDB000341 | Gołąbek |
| WA0000071024 | Chlorophyllum olivieri (Barla) Vellinga | MK028887 | 99.51 | UDB000341 | Gołąbek |
| WA0000071025 | Macrolepiota procera (Scop.) Singer | MK028888 | 99.51 | UDB000341 | Gołąbek |
| WA0000071026 | Suillus grevillei (Klotzsch) Singer | MK028889 | 99.51 | UDB000341 | Gołąbek |
| WA0000071027 | Gyroporus castaneus (Bull.) Quél. | MK028890 | 99.51 | UDB000341 | Gołąbek |
| WA0000071028 | Paxillus cuprinus (L.) Roussel | MK028891 | 99.51 | UDB000341 | Gołąbek |
| WA0000071029 | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028892 | 99.51 | UDB000341 | Gołąbek |
| WA0000071030 | Hydnum ellipsosporum Ostrow & Beenken | MK028893 | 99.51 | UDB000341 | Gołąbek |
| WA0000071031 | Russula nigricans Fr. | MK028894 | 99.51 | UDB000341 | Gołąbek |
| WA0000071032 | Gyroporus cyanescens (Bull.) Quél. | MK028895 | 99.51 | UDB000341 | Gołąbek |
| WA0000071033 | Calocybe gambosa (Fr.) Donk | MK028896 | 99.51 | UDB000341 | Gołąbek |
| WA0000071034 | Calvatia gigantea (Batsch) Lloyd | MK028897 | 99.51 | UDB000341 | Gołąbek |
| WA0000071035 | Calvatia gigantea (Batsch) Lloyd | MK028898 | 99.51 | UDB000341 | Gołąbek |
| WA0000071036 | Calvatia gigantea (Batsch) Lloyd | MK028899 | 99.51 | UDB000341 | Gołąbek |
| WA0000071037 | Agaricus arvensis Schaeff. | MK028900 | 99.51 | UDB000341 | Gołąbek |
| WA0000071038 | Leccinum pseudocabrum (Kallenb.) Miksiš | a.f. | – | – | Kozłak |
| WA0000071039 | Leccinum scabrum (Bull.) Gray | a.f. | – | – | Kozłak |
| WA0000071040 | Agaricus arvensis Schaeff. | MK028901 | 99.51 | EF460362 | Pieczarka |
| Voucher no.       | Molecular identification                  | Accession number | Similarity | Reference sequences         | Specimen's local name       |
|------------------|------------------------------------------|------------------|------------|-----------------------------|----------------------------|
| WA0000071041     | Imleria badia (Fr.) Fr.                  | MK028900         | 100        | KX756408                    | Podgrzybek                 |
| WA0000071042     | Imleria badia (Fr.) Fr.                  | MK028901         | 99.65      | KX756408                    | Podgrzybek                 |
| WA0000071043     | Lycoperdon lividum Pers.                 | MK028902         | 100        | DQ112600                    | Puchawka, pafbol            |
| WA0000071044     | Coprinus comatus (O.F. Müll.) Pers.      | a.f.             | –          | –                           | Kania                      |
| WA0000071045     | Leccinum pseudosabrum (Kallenb.) Mikšik  | a.f.             | –          | –                           | Kozlarz ciemny              |
| WA0000071046     | Agaricus arvensis Schaeff.               | MK028903         | 98.72      | EF460362                    | Pieczarka                  |
| WA0000071047     | Boletus reticulatus Schaeff.             | MK028904         | 99.46      | DQ131610                    | Prawdziwek dębowy           |
| WA0000071048     | Boletus reticulatus Schaeff.             | MK028905         | 99.46      | DQ131610                    | Prawdziwek                 |
| WA0000071049     | Boletus edulis Bull.                     | MK028906         | 99.72      | KP031595                    | Borowik                    |
| WA0000071050     | Boletus edulis Bull.                     | MK028907         | 99.58      | KP031595                    | Borowik                    |
| WA0000071051     | Leccinum aurantiacum (Bull.) Gray        | MK028908         | 98.94      | UDB019627                   | Osak                       |
| WA0000071052     | Cortinarius caperatus (Pers.) Fr.        | MK028909         | 99.69      | DQ367911                    | Turek                      |
| WA0000071053     | Suillus luteus (L.) Roussel              | MK028910         | 100        | KX230614                    | Maślak                     |
| WA0000071054     | Boletus edulis Bull.                     | a.f.             | –          | –                           | Prawdziwek                 |
| WA0000071055     | Boletus edulis Bull.                     | MK028911         | 99.71      | KX756408                    | Borowik                    |
| WA0000071056     | Imleria badia (Fr.) Fr.                  | MK028912         | 99.81      | KX756408                    | Podgrzybek                 |
| WA0000071057     | Boletus ferrugineus Schaeff.             | MK028913         | 99.84      | UDB001674                   | Zając                      |
| WA0000071058     | Leccinum aurantiacum (Bull.) Gray        | MK028914         | 98.94      | UDB011697                   | Osniak                     |
| WA0000071059     | Sarcodon squamosus (Schaeff.) Quél.      | MK028915         | 100        | UDB001707                   | Sarno                      |
| WA0000071060     | Boletus edulis Bull.                     | MK028916         | 99.72      | KP031595                    | Prawdziwek                 |
| WA0000071061     | Suillus luteus (L.) Roussel              | MK028917         | 100        | KX230614                    | Maślak                     |
| WA0000071062     | Armillaria borealis Marxm. & Korhonen     | MK028918         | 99.75      | UDB015538                   | Opierka                    |
| WA0000071063     | Leccinum varicolor Watling               | MK028919         | 99.75      | AF454572                    | Kożłak                     |
| WA0000071064     | Marasmius oreades (Bolton) Fr.           | MK028920         | 99.57      | UDB017590                   | Tarćowniczka               |
| WA0000071065     | Suillus luteus (L.) Roussel              | MK028921         | 100        | KX230614                    | Maślak                     |
| WA0000071066     | Boletus edulis Bull.                     | MK028922         | 100        | KP031595                    | Prawdziwek                 |
| WA0000071067     | Imleria badia (Fr.) Fr.                  | MK028923         | 99.82      | KX756408                    | Podgrzybek                 |
| WA0000071068     | Imleria badia (Fr.) Fr.                  | MK028924         | 99.82      | KX756408                    | Podgrzybek                 |
| WA0000071069     | Boletus edulis Bull.                     | MK028925         | 100        | KP031595                    | Prawdziwek                 |
| WA0000071070     | Suillus bovinus (L.) Roussel             | MK028926         | 99.85      | KF482482                    | Maślak                     |
| WA0000071071     | Cantharellus cibarius Fr.                | MK028927         | 99.31      | LCD85408                    | Kurka                      |
| WA0000071072     | Morchella esculenta (L.) Pers.           | MK028928         | 99.43      | MF228808                    | Smardz                     |
| WA0000071073     | Boletus edulis Bull.                     | MK028929         | 100        | KP031595                    | Prawdziwek                 |
| WA0000071074     | Imleria badia (Fr.) Fr.                  | MK028930         | 99.82      | KX756408                    | Podgrzybek                 |
| WA0000071075     | Imleria badia (Fr.) Fr.                  | MK028931         | 100        | KX756408                    | Podgrzybek                 |
| WA0000071076     | Imleria badia (Fr.) Fr.                  | MK028932         | 100        | KX756408                    | Podgrzybek                 |
| WA0000071077     | Imleria badia (Fr.) Fr.                  | MK028933         | 100        | KX756401                    | Podgrzybek                 |
| WA0000071078     | Imleria badia (Fr.) Fr.                  | MK028934         | 99.82      | KX756408                    | Podgrzybek                 |
| WA0000071079     | Imleria badia (Fr.) Fr.                  | MK028935         | 100        | KX756401                    | Podgrzybek                 |
| WA0000071080     | Imleria badia (Fr.) Fr.                  | a.f.             | –          | –                           | Podgrzybek                 |
| WA0000071081     | Boletus edulis Bull.                     | MK028936         | 100        | KP031595                    | Prawdziwek                 |
| WA0000071082     | Boletus edulis Bull.                     | MK028937         | 100        | KP031595                    | Prawdziwek                 |
| WA0000071083     | Imleria badia (Fr.) Fr.                  | MK028938         | 100        | KX334754                    | Podgrzybek                 |
Table 4: The list of voucher specimens and the results of DNA barcoding (Continued)

| Voucher no.        | Molecular identification                        | Accession number | Similarity | Reference sequences | Specimen's local name |
|--------------------|-------------------------------------------------|------------------|------------|--------------------|------------------------|
| WA0000071084       | Imleria badia (Fr.) Fr.                         |                  |            |                    | Podgrzybek             |
| WA0000071085       | Suillus luteus (L.) Roussel                    | MK028939         | 100        | KX230614           | Maślak                 |
| WA0000071086       | Imleria badia (Fr.) Fr.                         | MK028940         | 100        | KX756408           | Podgrzybek             |
| WA0000071087       | Sarcodon squamosus (Schaeff.) Quél.             | MK028941         | 99.34      | UDB001707          | Krowia gęba            |
| WA0000071088       | Suillus bovinus (L.) Roussel                    | MK028942         | 100        | KF482482           | Sitak                  |
| WA0000071089       | Suillus luteus (L.) Roussel                    | MK028943         | 100        | UDB002180          | Maślak                 |
| WA0000071090       | Sarcodon squamosus (Schaeff.) Quél.             | a.f.             |            |                    |                        |
| WA0000071091       | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028944         | 100        | KX230614           | Zajęczek               |
| WA0000071092       | Suillus luteus (L.) Roussel                    | MK028945         | 100        | KX230614           | Maślak                 |
| WA0000071093       | Imleria badia (Fr.) Fr.                         | MK028946         | 100        | KX756408           | Podgrzybek             |
| WA0000071094       | Boletus edulis Bull.                           | MK028947         | 100        | KP031595           | Prawdziwek             |
| WA0000071095       | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | a.f.             |            |                    |                        |
| WA0000071096       | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028948         | 100        | UDB002180          | Zajęczek               |
| WA0000071097       | Xerocomellus cisalpinus (Simonini, H. Ladurner & Peintner) Klofac | MK028949         | 99.70      | UDB002181          | Zajęczek               |
| WA0000071098       | Imleria badia (Fr.) Fr.                         | a.f.             |            |                    | Podgrzybek             |
| WA0000071099       | Imleria badia (Fr.) Fr.                         | MK028950         | 100        | KX756408           | Podgrzybek             |
| WA0000071100       | Xerocomellus pruinatus (Fr. & Hök) Šutara       | MK028951         | 100        | UDB000008          | Zajęczek               |
| WA0000071101       | Imleria badia (Fr.) Fr.                         | a.f.             |            |                    | Podgrzybek             |

a.f. molecular analysis failed

Fig. 7: Fungi taxa collected currently (blue) and only in the past (red)
on the basis of such characteristics as color, symbiotic relations, flesh characteristics (dyscoloration and density), and habitat. A similar model of classification applies to other genera such as Russula.

Classification of fungal species on the basis of the shape of fruiting bodies does not always coincide with one individual scientific genus. This happens in the case of folk taxa, known across most of the Mazovia region under the name “gąski” (literally “geese”). Because of the similarity in the shapes of their fruiting bodies, this folk taxon consists of three genera—Calocybe, Lepista, and Tricholoma. Within this taxon, Mazovian inhabitants identify species such as Calocybe gambosa, Lepista nuda, Tricholoma equestre, and Tricholoma portentosum. This was observed in the villages of Korytów, Klusek, Szczaki, and Węgrzynowice.

In the case of species from the genus Suillus, the majority of collected species are associated with the model species Suillus luteus. In folk taxonomy, Suillus variegatus is not perceived as a species associated with other Suillus species, and has different names, due to its distinctive form.

Among inedible and poisonous fungi (Table 2), a different group, which cannot be fully assigned to existing scientific taxa, is the mushrooms known as “piki” (literally “dog mushrooms”). This folk taxon contains all species with small fruiting bodies belonging to the Agaricales order. Another higher taxon distinguished in folk taxonomy is “huby,” (bracket fungi) which can be assigned to the order Polyporales (Tables 2 and 3). Rubroboletus satanas was described as poisonous by five respondents despite its absence in the local mycobiota. In this case, literature was the main source of their knowledge, as this species gained notoriety across the country as the most poisonous Boletaceae. This happened in the case of folk taxa, where respondents despite its absence in the local mycobiota. As many as 11 of analyzed samples were not identified during previous field research; thus, the number of fungi taxa identified during present research increased to 92. Among species identified using DNA barcoding are two (Hydnum elipsosporum and Paxillus cuprinus) that are new to the mycobiota of Poland [48–50]. Identification of these species among other edible fungi collected by people living in the Mazovia region is also the first direct confirmation of their use for consumption.

Comparison of the results with available data

The majority of regional ethnomycological studies have focused only on fungi species used for consumption. Examples include works from Mexico, such as the study conducted in two municipalities of the Sierra Tarahumara, with 22 recognized edible folk taxa [51]; in Tsotsil town in the Highland of Chiapas with 25 edible taxa [52]; or in Amelaco, Querétaro, where the authors were able to list 33 taxa [53]. The number of species sold in local markets in Mexico is much higher. For example, in the Ozumba market, 60 different species of fungi are sold throughout the year [54]. The same number of species was reported as sold in the markets in the city of Poznań (Poland) in the 1930s [11]. Other recent works come from the western Black Sea region of Turkey (33 edible species) [7] and Africa, such as studies from Cameroon with 22 edible fungi taxa [55], or the research conducted by Tibuhwa in rural areas of Tanzania where 75 different wild fungi species were recorded as sold as food in local markets [6]. In the case of the present research, by using both species identification in the field and DNA barcode identification, we were able to compile a total list of 76 different fungi species used as food by people living in the Mazovia region. This is the longest list of edible fungi species recorded during field ethnomycological research (one species more than the list from Tanzania). Furthermore, the complete list of 92 fungi taxa (including inedible and poisonous and taxa with other than culinary purposes) listed both during field research and molecular identification is simultaneously the longest list recorded during ethnomycological studies based on field research.
Although mushroom collecting in Poland is common and culturally salient, in other areas of Poland, only shorter lists composed of 20–30 species are known [14, 56]. Obviously, the extent of our study was relatively large, facilitating the obtaining of a longer list, but cultural factors also may play a role. Unfortunately, we do not have detailed comparative data from other Northern Slavic countries. From our preliminary unpublished observations and popular literature on fungi use, we can hypothesize that all these countries (Czech Republic, Poland, Slovakia, Belarus, Ukraine, and Russia) form something which we call the “Northern Slavic Mycophilic Belt.”

**Characteristic species documented during the research**

Among fungi recorded as used for consumption purposes in the Mazovia region are a few species whose collection is restricted only to particular locations. For example, *Scleroderma citrinum* is used as a spice for food only in villages situated in central and south-eastern Mazovia, e.g., Burakowskie, Calowanie, Łękawica, Stare Babice, and Żurawka. The collection of *Calvatia gigantea*, which was, by the way, protected in Poland until 2014, is popular in Flesze village, which is the northernmost studied location. The fruiting body of this fungus is usually cut into thick slices and pan-fried coated in grated breadcrumbs and egg. *Calocybe gambosa* is gathered in the south-western Mazovian villages of Korytów and Węgrzynowice. This species is prepared for consumption in the same way as species from the genus *Tricholoma*. It is used as an ingredient in soups and sauces and as a side-dish after pickling in vinegar. Residents of the south-western villages Korytów and Pszczonów often collect *Craterellus cornucopioides*, which is usually sautéed with scrambled eggs and used as a sauce ingredient. It is also considered a great filling for *pierogi* dumplings. We can also notice an interesting distribution of localities concerning the frequent collection of *Hygrophorus hypothejus*. The use of this species is very popular in two villages situated near the south-western border of the Mazovia region (Pszczonów, Węgrzynowice) and two villages located in the north-eastern part of Mazovia (Cieciory, Wyzyki). This species is usually consumed as a snack after pickling in vinegar, but it can also be used as an ingredient in everyday dishes. The village of Węgrzynowice is the only location with a record of *Lactarius piperatus* consumption, which was used as a food only after boiling and discarding the water. *Lactarius vellereus* is most popular in the village of Psucin where its fruiting bodies, after a long soaking in water, are salt-fermented in a large metal vessel (called *sagan*). Furthermore, the village of Dąbrowa is the only one in which inhabitants distinguish *Leccinum quercinum* species from other orange-capped *Leccinum* species, and it is considered as a delicacy on a par with *Boletus edulis*.

It is worth mentioning that men are significantly more knowledgeable about wild edible fungi species than women (Fig. 3). This opposes the general view on wild fungi pickers based on 80 ethnomycological studies with gendered data [57]. A similarly greater mushroom knowledge among men was previously recorded in Poland [56] and was also observed in China [58].

**Conclusion**

Evenly dispersed research localities and a large number of individual interviews enabled the documentation of an as yet unrecorded scope of local knowledge of 92 wild fungi taxa. This is the longest list of wild fungi ever recorded during ethnomycological research. The list includes 76 species used for consumption purposes, which is also the longest list of taxa used as food in any region on Earth. Among the taxa considered edible or conditionally edible, we can find species that are currently considered poisonous in Poland (*Amanita muscaria*, *Gyromitra esculenta*, *Paxillus involutus*, and *Scleroderma citrinum*) [38], partly protected (*Morchella conica* s.l., *Morchella esculenta*) [59], rare (*Boletus ferrugineus*, *Gyroporus castaneus*, *Hygrocybe cyanescens*, *Chlorophyllum olivieri*, *Leccinum varicolor*, *Leccinum vulpinum*, *Russula alutacea*, *Sparassis crispa*, *Xerocomellus cislpinus*, *Xerocomellus pruinatus*) [60, 61], and even absent in available checklists of macrofungi found in Poland (*Hydnellum ellipsosporum*, *Paxillus cuprinus*) [48, 61]. These results confirm the highly mycophillic character of Mazovian food culture and encourage research in adjacent areas of Poland, Belarus, and Ukraine.

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**Availability of data and materials**

Voucher specimens for species were deposited in the herbarium of Warsaw University (WAW).

**Authors’ contributions**

ŁŁ and MK contributed to the concept of the study. MK contributed to the field work, data analysis, and first draft of the paper. MP contributed to the DNA barcoding. All the authors contributed to the final draft. All authors read and approved the final manuscript.

**Ethics approval and consent to participate**

The methods of obtaining data during fieldwork followed guidelines set by International Society of Ethnobiology Code of Ethics [62] and the American Anthropological Association Code of Ethics [63] and adhere to the local traditions for such research. Prior oral informed consent was obtained from all study participants. No ethical committee permits were required. No permits were required to collect voucher specimens.
Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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