

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences



**Contemporary knowledge, collection and use
of mushrooms in Bohemia**

MASTER'S THESIS

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DIPLOMA THESIS ASSIGNMENT

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International Development and Agricultural Economics

Thesis title

Contemporary knowledge, collection and use of mushrooms in Bohemia

Objectives of thesis

Rationale: Forests play important role in human livelihood all over the planet. More than 1.6 billion people are estimated to directly derive their livelihood from the collection and use of so-called non-timber forest products (NTFPs). Apart from direct benefits (food, medicine, income), forests and NTFPs collection is associated with various environmental services.

Justification: In Europe, NTFPs are especially important in the Mediterranean region and in Central and Eastern Europe. Until now, most of the published studies documented collected volumes, drivers of collection or institutional barriers related to NTFPs collection. Very little attention is given to a particular product and associated environmental services connected to its collection and use.

Aim: The thesis aims to document the knowledge of the Bohemian households about the collection of mushrooms and the provision of environmental services.

Methodology

Study site: The thesis will focus on the historical region of Bohemia. Data will be collected in selected districts, representing major collecting areas.

Data collection: A household survey will be a major type of data collection tool (either online or face-to-face). It is expected to reach at least 200 households from all nine administrative parts of Bohemia. Data will be collected during the main „harvesting“ period from July to October in cooperation with the Czech Mycological Society.

Data analysis: Standard statistical methods will be used for data processing. The thesis will combine methods from behavioural studies in combination with economic botany in order to compare results with tropical/less developed regions.

The proposed extent of the thesis

50-55 pages; 18,000 words incl. text, tables, figures and references

Keywords

motivations, environmental services, tradition, utilization, markets, household survey

Recommended information sources

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Declaration

I hereby declare that I have done this thesis entitled “Contemporary knowledge, collection and use” of mushrooms in Bohemia independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 20 April 2023

.....

Sára Kružíková

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Abstract

The study investigates the current awareness, collection, and use of mushrooms by households in Bohemia. The master's thesis aims to fill the knowledge gap on collection patterns, modes of use, preferences, and perceptions associated with their collection and use. The specific objectives are (i) to characterise the most common keywords that households in Bohemia associate with collecting and using mushrooms, (ii) to document the perceptions and attitudes of mushroom collectors, taking into account their socio-economic background, (iii) to identify groups of mushroom collectors with regard to the most common types of use, and (iv) to document the factors influencing the willingness to pay for collecting mushrooms in the wild. Data were collected from 150 respondents identified through non-random sampling methods. Several techniques were used to analyse the data. Principal Component Analysis (PCA) was used to determine the validity of the respondent group scales for analysing consumer behaviour towards mushrooms. Binary logistic regression was used to examine which factors influence respondents' attitudes toward a willingness to pay for mushroom collection. Descriptive statistics were used to compare the attitudes of Prague respondents and non-Prague respondents towards mushrooms and their use. The most common words associated with mushrooms were forest, Boletus, and Champignon. The results from Principal Component Analysis identify 4 groups of mushroom collectors regarding the most common types of use, 1) Taste; 2) Family traditional hobby; 3) Medicinal properties; and 4) Dietary substitute. The results show that Prague collectors reported fewer and less frequent visits to forests. Additionally, households outside Prague were more likely to collect mushrooms and use them as medicine, while Prague respondents tend to use mushrooms more as a meat substitute. Single women and more frequent collectors were willing to pay for collecting mushrooms in the wild. The majority of participants (43%) stated that they collect mushrooms for their taste, 31% as a long-standing family hobby, 17% for their medicinal properties, and 9% as a food substitute. The study confirms the strong tendency towards the mushroom collection and use, that people in Bohemia like to collect mushrooms and know how to use them in various ways. In addition, mushroom collecting is a long-standing family tradition and is associated with various types of ecosystems and their services, especially forests.

Keywords: consumer types, environmental services, forests, Google Online Forms motivations, tradition

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1. Introduction

Since the mid-19th century, the world has experienced rapid population growth, which has increased pressure on the use of natural resources, including forests (World Bank 2021). At the same time, forests still represent an important source of livelihood for numerous rural households and nearly 25% of the households directly depend on forests to supply their basic needs (FAO 2021; World Bank 2021). Additionally, forests have many functions due to their multipurpose nature and therefore provide various products and services, both of financial and non-financial character.

Therefore, forests are not only trees and timber for logging. All over the world, household collect and use various non-timber forest products (NTFPs). Specific products of biological origin other than timber from natural, restored or managed forested environments (Shackleton et al. 2004; Pasalodos-Tato et al. 2016). "Non-wood forest products" and "non-timber forest products" are two similar terms used for forest products (Kilchling et al. 2009; Kazungu et al. 2020). The main difference between them, however, is that NWFPs does not include any wood in its product designation, but NTFP does include wood products such as fuelwood, artisanal use of wood or charcoal in its designation (Pasalodos-Tato et al. 2016; FAO 2021). Timber products are mainly round wood and fuel wood, and can be used as fuel, paper, building material, synthetic textiles, lumber, etc (Pasalodos-Tato et al. 2016; FAO 2021). Non-timber forest products (NTFPs) are all possible services and products from the forest that are not timber (Kazungu et al. 2020). Examples of NTFPs can be nuts, mushrooms fruits, vegetables, game meat, medicinal plants, essences, and various fibers such as bamboo, and palm (Shackleton et al. 2004; Pasalodos-Tato et al. 2016; FAO 2021).

Although mushrooms are valuable NTFPs on a global scale, there is a difference in using NTFPs in Global North and Global South (FAO 2021). According to studies, mushroom collection and use in the Global North tend to be more commercially driven and concentrate on cultivated species (Zambonelli et al. 2014). In contrast, mushrooms are more frequently collected and used for food and medicine in the Global South (Boa et al 2004; Iqbal et al. 2019). Research in Pakistan reported that wild mushrooms are frequently utilized for medicinal uses, and another concluded that many indigenous communities in Africa depend on wild edible mushrooms for nutrition and income (Boa

et al. 2004; Iqbal et al. 2019). An Italian study found that commercial mushroom production, with a priority on high-value species, was a typical practice in the Global North (Zambonelli et al. 2014). Especially in the Czech Republic, the economic effects of collecting mushrooms are examined, recognizing the important contribution that the trade in wild mushrooms provides to the country's economy benefits. Mushroom collecting, according to the authors, develops an awareness of the natural world and promotes sustainable behaviours, and has great cultural and ecological importance (Brabcová et al. 2020). Other studies investigated the motivations and views of Czech mushroom collectors. It was discovered that many participants had learned about this specific hobby through family members and considered it to be a significant cultural tradition (Kalač et al. 2013; Houška et al. 2020). According to the study, mushroom collecting has changed throughout time in the Czech Republic, and modern collectors now use cutting-edge tools like smartphones, social media, and GPS systems to speed up their search for mushrooms (Ševčík et al. 2015). This diploma thesis deals with the characteristics of mushroom collectors and their motivation to collect mushrooms in the Czech Republic. The specific objectives of this work are (i) to characterise the most common keywords that households in Bohemia associate with collecting and using mushrooms, (ii) to document the perceptions and attitudes of mushroom collectors, taking into account their socio-economic background, (iii) to identify groups of mushroom collectors with regard to the most common types of use, and (iv) to document the factors influencing the willingness to pay for collecting mushrooms in the wild.

2. Literature review

2.1 Forests – Global perspective

Forests are complex ecosystems that sustain a wide variety of plant and animal species while also offering crucial ecological functions including carbon sequestration, soil stabilization, and water purification (FAO 2021; Silva et al. 2023; Pour et al. 2023). There are many different types of forests, each having their own unique features and biodiversity, such as tropical rainforests, temperate deciduous forests, boreal forests, and mixed forests (Sabanci et al. 2016; Rodriguez-Gomez et al. 2022). For instance, tropical rainforests have high temperatures and rainfall and are home to a variety of animals and plants, such as primates, birds, and insects (World Bank 2004; Rodriguez-Gomez et al. 2022). Contrarily, temperate deciduous forests are those that have different seasons and are dominated by trees like oak and maple that lose their leaves in the fall (FAO 2021). All climate zones are covered by forests, which are distributed around the planet. In the pre-industrial era, forests covered 5.9 billion hectares of land worldwide, compared to 4 billion hectares today, or 31 percent of the world's land area (World Bank 2021). As consequently, forest land area has reduced over the centuries. Also, they are not spread equally across the earth's surface and five countries manage half of the world's forests (see Figure 1).

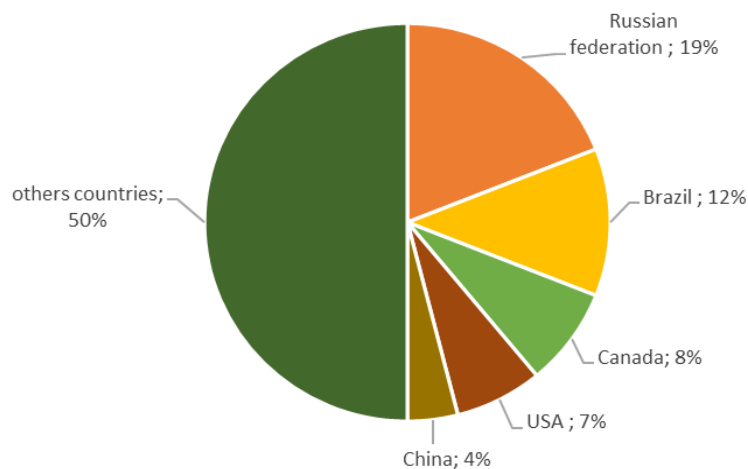


Figure 1. Global distribution of forests
Source: data from FAO (2020)

These countries are Russian Federation, Brazil, Canada, the United States of America, and China that host over fifty percent of the world's forest area, and fifty percent of forests are found in other countries (FAO & UNEP 2020).

Products and services obtained from forests that are not primarily focused on timber are known as non-timber forest products (NTFPs). They contain a wide range of products like fruits, mushrooms, nuts, fibers, and medicinal plants and are a major source of income and livelihood for millions of people worldwide (Shackleton et al. 2004; Pasalodos-Tato et al. 2016; FAO 2021). Moreover, NTFPs are essential for preserving biodiversity and maintaining forest ecosystems (FAO 2021; World Bank 2021).

2.2 Non-timber forest products: livelihood and environmental services

One of the main outputs derived from forests are non-timber forest products (NTFPs), which are a specific commodity of biological origin other than timber from natural, modified, or managed forested landscapes (Shackleton et al. 2004; Pasalodos-Tato et al. 2016; FAO 2021). There are cases where there is a situation where without the additional income from NTFPs, timber-oriented management is unprofitable. An example of this case is given in research done by Palahí et al. and Pasalodos-Tato et al. where management in Mediterranean pine areas without additional income from pine nuts or mushrooms was unprofitable (Palahí et al. 2009; Pasalodos-Tato et al. 2016).

Through livelihoods and income sources, especially for the poor (Veng et al. 2017; FAO 2021). There are also multiple sources how to access income for rural livelihoods such as agriculture, wage labor, NTFPs, social grants, and formal employment (World Bank 2021). There is an example of NTFPs collected by rural households: wild-fruits, mushrooms, honey, edible insects, medicinal plants, wild meat, and firewood which are essential for their livelihoods (Kamwi et al. 2020; Kazungu et al. 2020).

The scientific articles dealing with non-timber forest products are beginning to appear in scientific databases from Finland, Sweden, Switzerland, the Czech Republic, etc. While scientific articles that focus on NTFPs in developing countries mainly address ensuring

sustainable forest management, forest conservation that ensures rural people dependent on forest diversity in securing profit and moving out of poverty, etc. (Shackleton et al. 2015; Kazungu et al. 2020). However, the subjects of scientific articles dealing with developed countries are mostly studies that examine the interconnection of NTFP collecting with the culture of the population, comparing the dynamics of NTFPs collecting now and historically, identifying marketing strategies for NTFPs sales, etc. Very little attention is given to social aspects in scientific literature.

In times of food scarcity, local communities in Namibia make use of wild edible plants and mushrooms, which significantly enhance food security by supplementing household diets and providing alternative sources of food (Fongzossie et al. 2020). According to the Food and Agriculture Organization (FAO), mushrooms can be defined as “mushrooms that grow spontaneously in self-maintaining populations in natural or seminatural ecosystems and can exist independently of direct human action”. Since history, mushrooms have played a huge role in our lives in terms of being an important part of our diet. Scientists have been studying from all over the world for decades how mushrooms contribute significantly to our food security and contain precious nutrients that they provide (Heywood 1999; Matabaro et al. 2016). Besides the fact that wild mushrooms can supplement or replace a diet of wild exotic fruits in areas of Africa, mushrooms can also be a way to improve household resilience to environmental change (Boedecker et al. 2013; Shumsky et al. 2014). According to Fongzossie (2020) species that are consumed by local households in the North West region of Cameroon are important in the household diet. Particularly, the condition of many species collected commonly and consumed in the study area is declining due to over-collection, deforestation, or bushfires (Fongzossie et al. 2020).

Nevertheless, very little attention is given to attitudes towards the mushroom collection and use. Published studies document mainly Phytochemicals, Plant Pathology, and Nuclear Geology (WoS categories: Environmental Sciences, Food Science Technology, and Mycology). However, very little is known about the cultural, environmental, and socioeconomic drivers of the collection of mushrooms.

Moreover, forests as a natural ecosystem can provide environmental and recreational services to society (Bingham et al. 1995; Ehrlich et al. 2005; Bringye et al. 2021). Natural ecosystems shape the landscape and provide opportunities to enjoy the natural

environment and engage in recreational activities. They also, for example, control the hydrological cycle and fix carbon dioxide. Recreational uses of forests have increased significantly (Camarasa et al. 1993; de Frutos et al. 2009).

2.3 Mushrooms - special type of NTFPs and overall attitudes towards their collection and use

Mushroom collection is a common hobby that is enjoyed by people all over the world for a variety of reasons (Bringye et al. 2021). Mushroom collecting is a long tradition that has been passed down from one generation to the next in many places of the world. People frequently use it as a method to go into the countryside and collect food. Until now recently, collecting mushrooms has also gained popularity as a form of recreation and a source of money for some individuals (Camarasa et al. 1993; Yang et al. 2019).

On the Asian continent, mushroom culture occupies an important place. In East Asia in particular, many more species of mushrooms grow than in our country, which is due to natural conditions (Yang et al. 2019). The mushroom culture here is simply specific, long-standing, and traditional, China and Japan can be considered a superpower in the use of mushrooms. The Chinese cannot imagine a meal without mushrooms (Mikulcová et al. 2006). Not only mushrooms as food are earned in Asia, but also mushroom collecting itself. Mushrooms are in some cases part of local medicine and religious practices (Yang et al. 2019).

Mushroom cultivation in America is certainly worth mentioning. The attitudes there towards mushrooms changed as indigenous peoples were able to take advantage of a much wider range of mushrooms, although the experience was more spiritual (Pilz et al. 2002). In more recent times mushroom collection was the preserve of European immigrants, but more recently has changed. Demanding European cuisine is turning Americans into gourmets who enjoy mushrooms (Miles et al. 2004). They're importing thousands of tons of mushrooms, even though the local forests are literally overflowing with mushrooms. There are even species of mushrooms, such as morels, that America imports to Europe and not vice versa (Fine et al. 1998).

In the EU, forests make up 35% of the landmass these forests sequester 10% of the CO₂ in the EU and one of the benefits and advantages forests also provide rural communities

and society in general with good quality water (Camarasa et al. 1993; de Frutos et al. 2009). There is clear evidence that NTFPs are not only important in the tropics but also in Europe. In 2015, the State of Europe's Forests report estimated that the value of NTFPs in the forest Europe region reached €2.28 billion, of which 73% was generated by plant products (Wolfslehner et al. 2019).

On the European continent alone, attitudes towards mushroom collecting vary in almost every country (Turtiainen et al. 2011). According to attitudes towards mushrooms, Europeans can be divided into mycophobic, mycophilic, and mushroom lovers (Svanberg et al. 2019). There are nations and territories where mushrooms have been used in every way since time immemorial. Typical are the Slavs, some of whom are obsessed with the free collection and consumption of mushrooms. Apart from the inhabitants of our territory, there are also Poles, Russians, Hungarians, Swiss, Austrians, Swedes, and Slovaks, etc. (Kilchling et al. 2009; Stryamets et al. 2015; Svanberg et al. 2019).

Under the influence of the Austro-Hungarian monarchy, some Austrians or Germans also turned into mushroom collectors. Yet the mushroom collection is not a mass affair there even today, similarly to Scandinavia where mushrooms have started to be recognised in the last thirty years (Antonín et al. 2003).

According to Schunko (2010) in the region of Graz, located in Austria, it was found that mainly mushrooms are collected in the forests, and it was also found that the locals use the knowledge mainly in mountain areas (Schunko et al. 2010). It is believed that the decline in knowledge has been caused by the changes that have taken place everywhere in Europe in the way of life in the countryside in the 19th and 20th centuries (Nebel et al. 2006; Pardo-de-Santayana et al. 2007). NTFPs in Switzerland face a highly competitive market with a growing number of employees and high wage levels, as is the case in countries with similar economies. Market prospects vary across countries in Europe, mainly due to factors that affect profit margins, such as wage levels and regulations. There is as yet no significantly large market for NTFPs in Switzerland (Kilchling et al. 2009). Over the last 100 years, Sweden has transformed from a mycophobic to a mycophilic society, with a passion and interest in the exploitation of mushrooms. The generation born in the 1990s, collects mushrooms in order to need for their own food. This group uses social media in particular to identify edible mushroom

species. Most of these individuals recognize only a few species. But some of them have become hobby specialists who know a wide diversity of taxa. Apart from mushroom collecting, which has become a fun and thriving activity, walking in the forest is also important for this society living in Swedish cities (Svanberg et al. 2019). For most people in the urban areas of Sweden, autumn means mushroom collecting season. Mushroom collecting is a popular activity in the months of August-November (Stryamets et al. 2015; Svanberg et al. 2019). If we compare the situation in Sweden where people usually collect mushrooms mainly for recreational activity. In Ukraine and Russia, the purpose use of NTFPs an important role of livelihoods, as a source of income and medicine. Here we can see that in the economically less developed rural areas of Ukraine and Russia, the use of NTFPs continues to be an important part of livelihoods, both as a source of income and for domestic use as food and medicine (Stryamets et al. 2015).

2.4 Factors influencing collection and use behaviour towards mushrooms

There are various factors that can influence people's behavior toward mushroom collecting, such as cultural background, personal beliefs, knowledge of mushroom species, regulations, and laws, and ecological awareness, among others (Bringye et al. 2021). Here are three examples of how people can be divided according to their behavior toward mushroom collecting:

Recreational mushroom collectors vs. commercial mushroom collectors: Recreational mushroom collectors often harvest mushrooms for personal consumption or as a hobby, while commercial mushroom collectors may harvest mushrooms for profit. Commercial mushroom collectors may be more motivated to harvest as many mushrooms as possible, which can lead to over-collecting and damage to the environment (König et al. 2018; Turtiainen et al. 2018).



Figure 2. Mushrooms - commonly sold along roadsides in Zambia

Source: LUOMUS 2013

Sustainable mushroom collectors vs. unsustainable mushroom collectors: Sustainable mushroom collectors are those who prioritize the long-term health of the environment and only harvest mushrooms responsibly and sustainably (Sena 2009; Lozano et al. 2018). They may avoid collecting certain species or only harvest a small portion of the mushrooms they find. Unsustainable mushroom collectors may pick mushrooms without regard for the impact on the environment, leading to over-collecting and depletion of mushroom populations (Ostrom 1990; Sena 2009; Lozano et al. 2018).

Some studies tried to apply factor analysis to characterise groups of consumers or collectors. One of these studies is a study in Hungary, the Hungarian population can be divided into 4 groups of mushroom consumers: 1) medicinal and functional values, 2) consumption for enjoyment, 3) supplementary food source, and 4) negative assessment of the product range (Bringye et al. 2021). People choose to pick mushrooms for a variety of reasons, such as cultural, social, economic, and ecological ones (Bringye et al. 2021). These are some examples of reasons for people to pick mushrooms. One of the reasons can be cultural and traditional uses: Mushrooms have a long history of use in many cultures for spiritual, gastronomic, and medicinal purposes (Bringye et al. 2021). For instance, mushrooms have been utilized as a symbol of longevity and good fortune in China for over 3,000 years due to their health advantages. Similarly to this,

mushrooms have long been valued in Europe both as a food source and for their medicinal effects (Oei 2003; Chang et al. 2012; Bringye et al. 2021). Many European mushrooms have a reputation for improving the immune system and improving general health (Bringye et al. 2021; Grienke et al. 2021). It has been discovered that other mushrooms have elements that could help lower cholesterol (Chang et al. 2012; Valverde et al. 2015). Mushrooms have also been researched for their ability to help the immune system during cancer therapy and are well known for their antiviral characteristics (Patel et al. 2012).

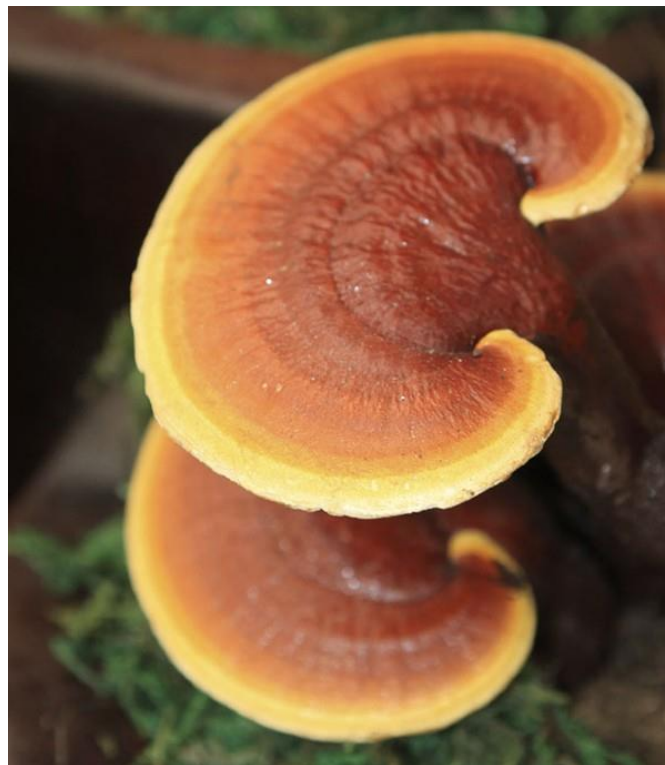


Figure 3. Reishi - medicinal mushroom used in traditional Chinese medicine
Source: Holmes 2015

Recreational hobbies are a possible second justification for collecting mushrooms: Finding mushrooms is a hobby for some people that gives them a chance to enjoy nature and spend time outside (Kalač et al. 2013; Houška et al. 2020; Bringye et al. 2021). This could involve outdoor adventures like hiking or camping, and the excitement of looking for edible mushrooms can be a unique experience (Capretz 2019). The environment is impacted by recreation and mushroom collecting, and discussion about collecting fees or permits for collection is one approach to managing natural resources responsibly. Fee-based mushroom collecting is expected to promote the ethical collection and preserves the forest's environmental balance (Vacik et al. 2020). Some wild mushrooms

in Finland must be collected with a permit and a fee, the money collected from these licenses goes toward conservation initiatives and the maintaining of mushroom habitats (Miina et al. 2023). The introduction and enforcement of mushroom collection fees are a subject of constant debate in the Czech Republic. While some argue that such fees are necessary to protect the environment and promote sustainable collecting methods, others argue that they burden the local population and can be challenging to implement (Antonín 2021). The third justification is that mushroom hunting has financial advantages: Wild mushrooms may be a valuable product that can be sold for a profit in some areas. For those who know how to recognize and collect mushrooms, this can be a significant source of cash for rural areas and open up job opportunities (Iqbal et al. 2013).



Figure 4. Mushroom collection in the Czech Republic

Source: Ekolist.cz

2.5 Mushrooms in Bohemian history and culture

Mushrooming is a local, culturally specific phenomenon of our country. It has long been a mass affair compared to most other countries. It is the deep historical rootedness and symbolic level that helps us to understand the meaning and nature of Czech mushroom collecting even in the present time. Wild mushrooms have been collected in our territory since time immemorial. One of the first indirect references to the consumption of mushrooms from the forest can be found even in the legend of the Suffering of St. Vojtěch (Mikulcová et al. 2006). In the Chronicle of Dalimil, which was written around 1314, it is written about plucking a mushroom from a tree, which is likened to an easy and effortless activity. Throughout the ages, opinions on the consumption and use of mushrooms have varied, especially in the manor courts and among the upper classes. Charles IV's attendant even warned the monarch against eating mushrooms and of their dangers, and after some time, coincidentally speculation about the emperor's poisoning by poisonous mushrooms. It should be noted, however, that the common people, despite all this, took a positive attitude to the collection and consumption of mushrooms, often with reverence. This is evidenced by recipes and advice dating back to the 15th century for the preparation of mushroom dishes (Antonín et al. 2003). Often these folk dishes became ceremonial in themselves. To this day, some families still prepare mushroom soup and during Christmas, we eat a typical mushroom meal called Kuba. The traditional Czech predilection for collecting mushrooms has begun to take on a clearer shape especially in the second half of the 19th century, a period characterised by a significant development of science, technology, and research. Among the carriers of progressive ideas in the Czech lands were teachers, who were often those who considered it their duty to spread general mushroom education. The 20th century marked the beginning of an era of promotion and education for the Czech mushroom hobby by well-known personalities. Later on, they can be referred to as mycologists. Educator doc. PhDr. František Smotlacha opened the first mushroom counselling center in Prague in 1909 (CMS 2022).



Figure 5. Basket with mushrooms collected by Czech family
Source: MYKO 2019

2.6 Perception of mushrooms in Bohemia

In the Czech forests, there is a long tradition of almost a century of foraging for food in nature (Kalač et al. 2013; Houška et al. 2020). The forest land is around 2.6mil ha, which means almost 27% to 34% of the area of the Czech Republic. The forest land in the Czech Republic has been growing long term and descending; from 2.19 mil ha in 1875, to 2.47 mil ha in 1950, to 2.66 mil ha in 2013, to 2.77 mil ha in 2020 (MoA 2014; WB 2020).

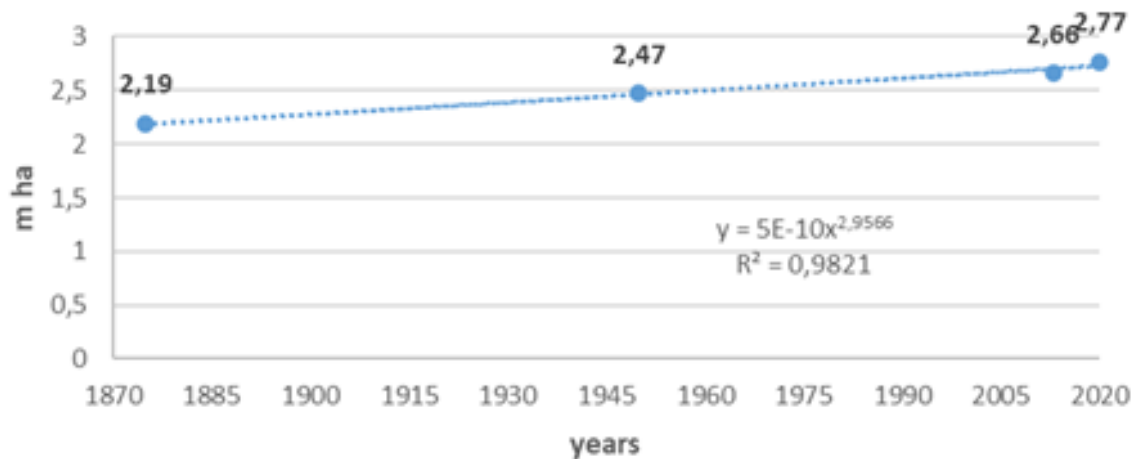


Figure 6. The forest cover in the Czech Republic between 1875-2020
Source: data from WB 2020

Major political, socio-economic, and ownership changes took place in the Czech Republic forests and forestry sector between 1994 and 2013. Almost no private forest owners existed before 1990. At the end of 2013, there were about 135 thousand private forest owners with 23% of forest land and more than five thousand municipal forest owners with 17% of forest land. State ownership of forests in the country has declined by 40%, with the remaining 60% managed by several different state-owned establishments (including four national parks and two state forest enterprises). However, these changes in ownership have no impact or influence on NTFPs collection and production (Šišák et al. 2015).

Intensive research on NTFPs has been conducted in western European countries to determine the potential of NTFPs as a subsequent source of finance in forestry. In Switzerland, a study was conducted in six cities and it was found that there is a significant demand for NTFPs from urban consumers who need organisational innovation, sales support in terms of marketing efforts, product certification (NTFP quality), which is still lacking in EU countries (Kilchling et al. 2009). In the Czech Republic, citizens have been collecting NTFPs freely and without restrictions since the Middle Ages. With a few exceptions concerning individual sites, forest owners have unrestricted access to all forests. There is a forest law No. 289 of 1995 according to which individuals are entitled to enter the forest at their own risk and collect for their own use wood, and forest fruits lying on the ground (Lesy CR 2014; Šišák et al. 2015). They must not damage, pollute or interfere with the forest in any way. They must follow the instructions of the forest manager, lessee, employee, or owner of the forest. The Forest Act does not mention mushrooms or medicinal plants, which causes confusion. Anyway, these NTFPs are dealt with in the similar manner as forest fruits. The other problem may arise from the vague wording, "for personal use", which can be interpreted as "NTFPs collected by forest visitors for free cannot be sold". NTFPs are being sold with no restrictions (with the exclusion of mandatory license vendors of mushrooms, who are controlled for the consumer's safety reasons) (Šišák et al. 2015).

For generations, the tradition of collecting mushrooms has played a significant role in the culture of the Czech Republic (Houška et al. 2020). The majority of mushroom collecting in the Czech Republic is done for personal use, but it has also developed into a popular autumn activity (Kalač et al. 2013). The Czech Republic's mushroom

collecting season normally lasts from June to November, and it takes place in a number of national forests, including the Bohemian Forest, Krkonoše, and Šumava (Kalač et al. 2013; Houška et al. 2020). The mushroom collection is not only a well-liked hobby, but it has also played a significant role in Czech traditional medicine and food (Houška et al. 2020). Various types of mushrooms are thought to offer different health benefits and have been used in traditional medicine (Boa et al 2004; Iqbal et al. 2019). Mushrooms are used in many different recipes in Czech cuisines, such as soups, sauces, and stews. They are frequently dried, frozen, or pickled for future use (Kalač et al. 2013). In several Czech Republic locations, the cultural significance of mushroom collecting has also sparked the growth of ecotourism initiatives like guided tours for mushroom collecting (Houška et al. 2020). The literature available on the topic of mushrooms in the Czech Republic deals mainly with Environmental Sciences, Food Science Technology and Mycology, social aspects and factors influencing the collection and use of mushrooms in the Czech Republic are few.



Boletus reticulatus



Phallus impudicus



Boletus chrysenteron



Chanterelle

Figure 7. Common mushrooms in Czech forests

Source: MYKO 2022

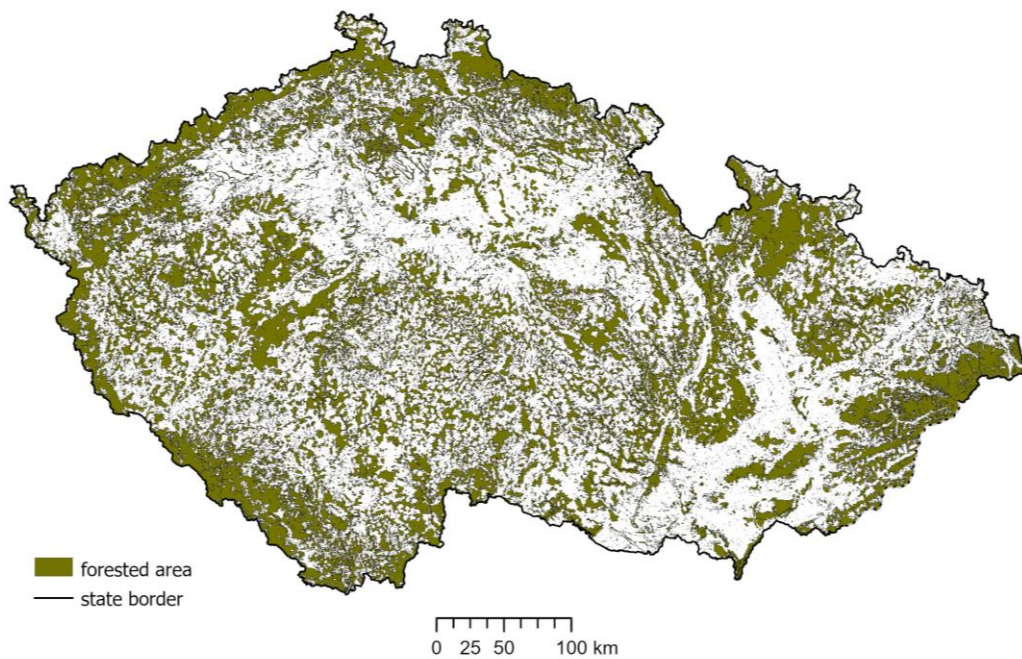


Figure 8. Forest cover in the Czech Republic in 2023

Source: data ČÚZK, 2023; data processing Bc. Denisa Vránová ArcGIS Pro

3. Aims of the thesis

The master's thesis aims to fill the gap in knowledge on how households in Bohemia collect and use mushrooms and what perceptions are associated with the collection and utilisation of mushrooms.

Specific objectives are:

- (i) to characterise the most common key words that households in Bohemia associate with mushroom collection and use,
- (ii) to identify groups of mushroom collectors with respect to the most common modes of use
- (iii) to document/estimate factors influencing willingness to pay fee for mushroom collection, and
- (iv) to document the perception and attitudes of mushroom collectors with special regard to their socioeconomic background

4. Methods

4.1 Study site characteristic

This thesis will focus on the historical region of Bohemia in the Czech Republic. The Czech Republic is a landlocked country located in Central Europe. The Bohemia region borders on the south by Austria, on the west by the German region Bavaria, on the north by the German region Saxony, on the northeast by Silesia, and on the east by Moravia. As of 2021, the estimated population of the Czech Republic is around 10.7 million people (CSÚ 2023). The country has a total area of approximately 78,870 km², which makes it a medium-size country within Europe. The population density of the Czech Republic represents about 136 people per square kilometer (CSÚ 2023). The historical region of Bohemia is one of three areas of Czechia. Region Bohemia is larger, more populated, and developed part of the country, population is 6.9/10.7 mil., the area: 52/78 ths km² and forest covers in Czechia = 34%, in Bohemia 35% (CSÚ 2023).

The climate zone in the Czech Republic varies depending on the season and region. The country has a temperate climate, with warm summers and cold winters. The average temperature in summer is around 20-25°C, while the average temperature in winter is around 0°C (CMES 2022).

The Czech Republic has a diverse landscape with a mix of mountains, hills, valleys, and plains. It is also one of the most forested countries in Europe, with approximately one-third of its land covered by forests (WB 2020). The Bohemian Forest and Šumava National Park are two of the largest forested areas in the country, offering opportunities for hiking, camping, and other outdoor activities. The forests are home to a variety of wildlife, including deer, wild boar, and birds (Vyskot et al. 2010; Schneider et al. 2021). The country's forests also play an important role in maintaining the natural ecosystem and helping to mitigate climate change (Šišák et al. 2015).

Coniferous forests are the most common type of forest in the Czech Republic, accounting for almost 70%, while deciduous forests are only 30% and the most common trees in coniferous forests are spruce, pine, and fir. (Lesy ČR 2022).



Figure 9. The historical regions of the Czech Republic - Bohemia, Moravia, and Silesia
Source: Czech genealogy.cz



Figure 10. Krkonoše and Šumava–forests in Czechia
Source: Lesy ČR

4.2 Data collection techniques and research design

Data were collected from 150 respondents identified through non-random sampling methods. Convenience and purposeful non random sampling methods have been used for collecting data (Stryamets et al. 2015). Purposeful non random sampling method was used for members of the Czech Mycological Association for others was used convenience non-random sampling method. The data were collected using a structured qualitative questionnaire created on the online platform google forms (Boin et al. 2018; Svanberg et al. 2019). The questionnaire was distributed by through social media to random respondents and also the Czech Mycological Society (CMS) was deliberately approached through which the questionnaire was distributed just for the CSM members. For CMS members the questionnaire was published on their website. We can categorize the questions in the questionnaire into the following areas, 1) General questions on respondents' views of the quantity of mushrooms in forests and their knowledge of mushrooms; 2) Attitudes towards purchasing and collecting mushrooms; 3) Attitudes towards utilization and consumption of mushrooms; 4) Questions about the distance and accessibility of the forest, the frequency of visits, and perceptions of the forest environment; 5) Attitudes towards willingness to pay a fee for mushroom collection and the methods of obtaining mushrooms; 6) Effects of mushroom consumption on health; 7) Socio-demographic characteristic (CMS membership, age, place of residence, level of education, and gender).

4.3 Data analysis

Data were checked, cleaned, summarized, and coded after data collection was complete through Microsoft Office Excel Software. The software IBM SPSS and MS Office 365 Excel applications were used to conduct the statistical analyses.

Table 1. Specification of model for willingness to pay for mushroom collection in the wild (Binary Regression)

Variables	Description	Measurement
Dependent variable		
Willingness to pay fee for mushroom collection	Are respondents willing to pay fee for mushroom collection	0=No; 1=Yes
Independent variables		
Gender	Gender of the respondent	0=Female; 1=Male
Age	Age of the respondent	
Education	Level of education of the respondent	1=Primary education; 2=Lower secondary education; 3=Upper secondary education; 4=Higher vocational school; 5=Universitary education
Marital status	Marital status of the respondent	0=Single; 1= In relationship
Residence	Residence of the respondent	0=Non-Prague; 1=Prague
Occupation	Occupational status of the respondent	0=Employed; 1=Unemployed; 2=Student; 3=Retirement; 4=Other
CMS membership	Membership in the CMS of the respondent	0= No; 1=Yes
Frequency of collection	Frequency of visits to the forest for mushroom collection	0=never; 1=1-3 times in year; 2=1x per month 3=1x per week; 4=2-3 times a week; 5=Daily
Frequency of consumption	I consume mushrooms regularly	1=Strongly Disagree; 2=Disagree; 3=Undecided; 4=Agree; 5=Strongly Agree
Sufficiency	Do you collect enough mushrooms for your own use over the year? (harvested per year)	0=No; 1=Yes
Travel time	Time of travel to the most visited forest by respondent	1=Up to 30 minutes; 2=30-59 min; 3=More than 60 min

Several techniques were used to analyse the data. To characterise the most common key words that households in Bohemia associate with mushroom collection and use, we asked a simple question during survey, "What is the first word association that comes to mind when you hear the word "mushroom?" The answers were processed in the online program wordcloud (Bringye et al. 2021).

In order to determine the validity of the scales of groups of respondents for analysing consumer behaviour toward mushrooms, Principal Components Analysis (PCA) was used. PCA was performed on the whole sample using a varimax rotation. To create the reliability of the indicators measuring consumer attitudes towards the mushroom number 0.50 was chosen as the minimal factor loading criterion. An important step involved weighing the overall significance of the correlation matrix through Bartlett's Test of Sphericity, which provides a measure of the statistical probability that the correlation matrix has significant correlations among some of its components. The Kaiser–Meyer–Olkin measure of sampling adequacy (MSA), which indicates the appropriateness of the data for factor analysis, values above 0.80 are considered appropriate for factor analysis. The four factors identified as part of PCA aligned with the theoretical proposition in this research. Factor 1 includes items MP1 to MP7, referring to Medicinal Properties (MP). Factor 2 gathers items TM1 to TM26, which represents Taste of the Mushroom (TM). Factor 3 includes items DS1 to DS2, referring to Dietary substitutes (DS). Factor 4 includes items THF1 to THF2 which represents Traditional Family Hobby (TFH) (Papież et al. 2018; Bringye et al. 2021).

Table 2. Specification of the factors used in PCA

Items
MP = Medicinal Properties
MP1 = Consumption of mushrooms because they have medicinal properties.
MP2 = Consumption of mushrooms because they contain important vitamins.
MP3 = Consumption of mushrooms because they contain minerals.
MP4 = Consumption of mushrooms because they lower blood pressure.
MP5 = Consumption of mushrooms because they lower cholesterol.
MP6 = Consumption of mushrooms because they support immunity.
MP7 = Consumption of mushrooms because they contain fibre.
TM = Taste
TM1 = Consumption of mushrooms because they have a distinctive taste.
TM2 = Consumption of mushrooms because they have a characteristic aroma.
TM3 = Consumption of mushrooms due to their physical structure.
DS = Dietary substitute
DS1 = Use of mushrooms to replace meat in my diet.
DS2 = Consumption of mushrooms because they are low in fat and calories.
TFH = Traditional Family Hobby
TFH1 = Collection of mushrooms because it's a long-standing family tradition.
TFH2 = Collection of mushrooms because I can spend time together with family or friends.
TFH3 = Collection of mushrooms because they are my hobby and passion.

Binary logistic regression was used to examine what factors influence respondents' attitudes toward a willingness to pay fees for mushroom collection (Kostakis et al. 2012; Ntanos et al. 2018). Logistic regression involves fitting data to a logit function to predict the likelihood of an event occurring. This statistical method is particularly useful for examining the relationship between a binary response variable (e.g., willingness or unwillingness) and one or more independent variables (e.g., age, gender, marital status) (Kostakis et al. 2012). The dependent variable "willingness to pay a fee for mushroom collection" was selected for this study. In this analysis, eleven independent variables were selected (gender, age, education, marital status, residence, occupational status, membership in CMS, Frequency of visits to the forest for mushroom collection, frequency of mushroom consumption, a sufficient quantity of mushrooms for own use (harvested per year) and time travel to the most visited forest.

Descriptive statistics in MS Office 365 Excel were used to compare the attitudes of respondents from Prague or from rest of the Bohemia area, towards mushrooms and their utilization.

4.4 Characteristics of respondents

The survey had a total of 150 respondents, with 52 (34.7%) identifying as male and 98 (65.3%) as female. The mean age of the respondents was 42 years old, with the youngest respondent being 17 and the oldest being 86. Out of the total respondents, 86 (57.3%) were from Prague, while the remaining 64 (42.7%) were from other locations in the Bohemia region.

The education level of the respondents varied, with 93 (62%) reporting having a university education, 33 (22%) with upper secondary education, 13 (8.7%) with lower secondary education, and 10 (6.7%) with primary education. One respondent (0.7%) reported having a higher vocational school education. In terms of mushroom collecting habits, 33 (22%) respondents were willing to pay a fee for mushroom collection, while 32 (21.3%) were members of the CMS. Regarding travel time to the forest, 92 (61.3%) respondents reported having a travel time of less than 30 minutes, 24 (16%) had a travel time of less than 60 minutes, and 34 (22.7%) had a travel time of more than 60 minutes.

Table 3. Characteristic of respondents

Variables	n = 150		
	n		%
Gender			
Male	52		34.66
Female	98		65.33
Age			
	mean: 42	min: 17	max: 86
Education			
Primary education	10		6.66
Lower secondary education	13		8.66
Upper secondary education	33		22.00
Higher vocational school	1		0.66
University education	93		62.00
Residence			
Prague	86		57.33
Other locations in Bohemia	64		42.67
Member CMS			
Yes	32		19.04
No	118		70.23
W2P for mushroom collection			
Yes	33		22.00
No	117		78.00
Travel time to the forest			
Up to 30 minutes	92		61.33
30-59 minutes	24		16.00
More than 60 minutes	34		22.64

5.2 Attitudes of respondents towards forest and mushrooms

The most frequently mentioned month when respondents collect mushrooms is September (53%), followed by August (21%), and October (11%), while other months stated less than 10% of our respondents. Bohemian mushroom collectors travel to forest mainly by car (41%) or by foot (40%), quite a high prevalence of using bikes and trains was also observed. Further means of transportation, such as buses, motorbikes, and others were less common. According to respondents, hikers are the largest source of pollution, followed by power plants and industry.

Almost 28% of the respondents perceive the forest as a place for relaxation and recreation, 17% as a place where they like to spend time with someone close, 16% as an opportunity to collect other forest products, 14% as a place for sports activity, 13% as a place to teach children about nature, 11% of the respondents perceive the forest as a family tradition and 1% of the respondents perceive the forest as a place to discuss important topics.

When respondents were asked to name the 3 most prevalent tree species in the forest they visit most often, spruce was mentioned most by 25% of respondents, followed by beech, pine, and oak at 17% each. Next, 8% of respondents mentioned birch, and then trees such as hornbeam, linden, and maple.

At least 23% of respondents get information about mushrooms on the internet, 21% in the scientific literature, 19% from family, 16% from friends, 10% on social networks, 6% in newspapers, 4% on TV, and 1% on the radio (see Figure 12).

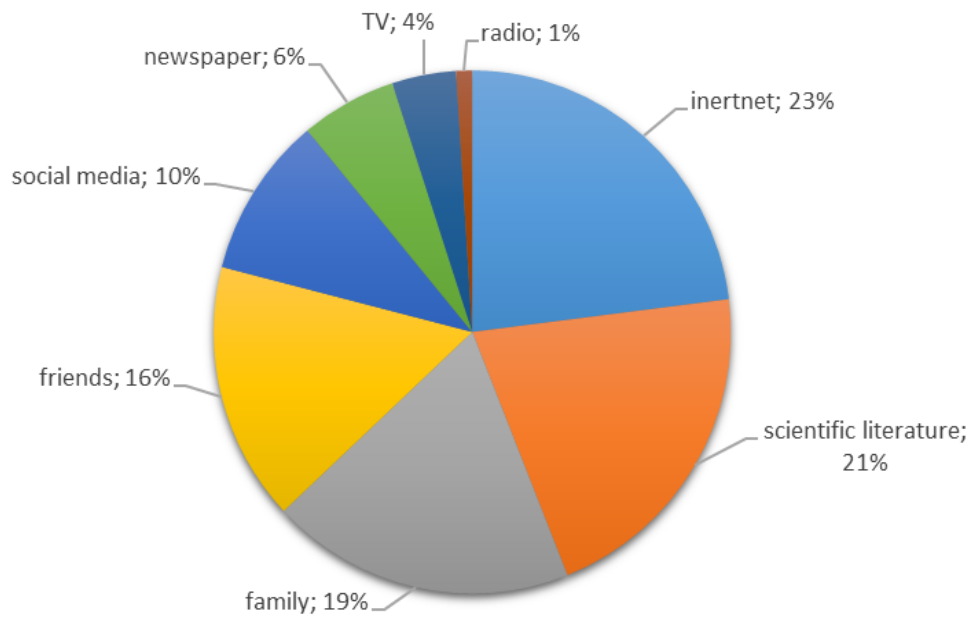
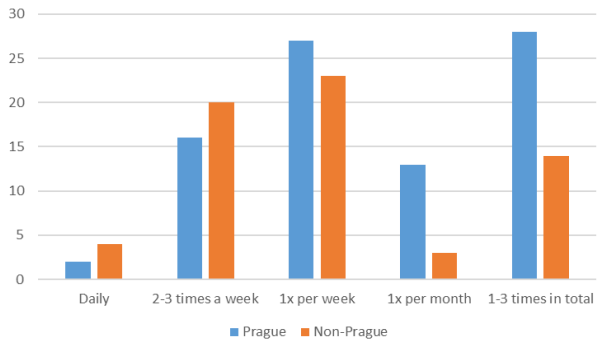
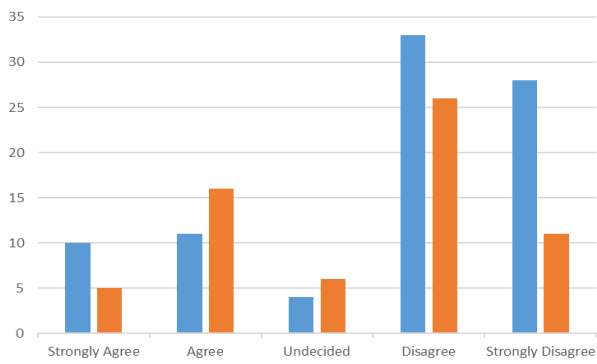


Figure 12. Sources of information on mushrooms

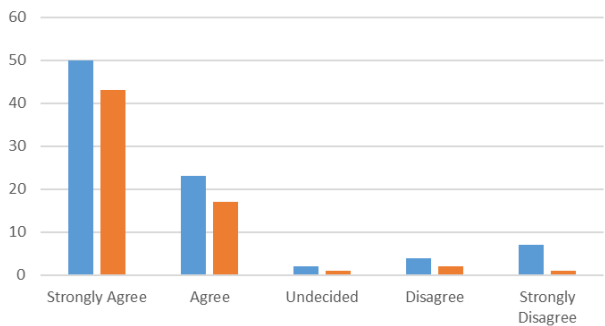
Almost 30% of respondents are searching for information on how to increase the number of mushrooms they collect, 23% are looking for new culinary preparations, 16% for the medicinal effects of mushrooms, 15% for new ways to process mushrooms, 9% for how to grow mushrooms in their garden, 3% are looking for information on whether or not mushrooms are poisonous, 2% are looking for the name of mushrooms, and 2% are not looking for any information. Almost half of the respondents (45%) purchase mushrooms in supermarkets, then 24% of respondents said they do not buy mushrooms at all, 16% at farmers' markets, 8% from friends, 7% in specialty stores and less than 1% reported street sales. Almost half of the respondents said that if they buy mushrooms, they buy them fresh, 24% do not buy mushrooms at all, 14% dried form, 10% pickled, and 3% frozen. Although, 43% of respondents said that they preserve mushrooms after collection in the form of dried, 31% frozen, 23% pickled and one percent each answered in the form of pickled, powdered, and immediate consumption. Despite the fact that the majority of respondents (65%) reported collecting mushrooms in the forest, 19% in gardens, 11% in the park, and 5% grow mushrooms. Further, 70% of the respondents reported collecting mushrooms in coniferous forests, followed by 25% in deciduous forests and 5% in mixed forests.



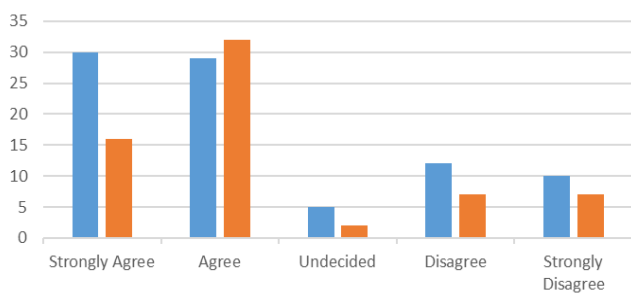
Mushroom collection frequency



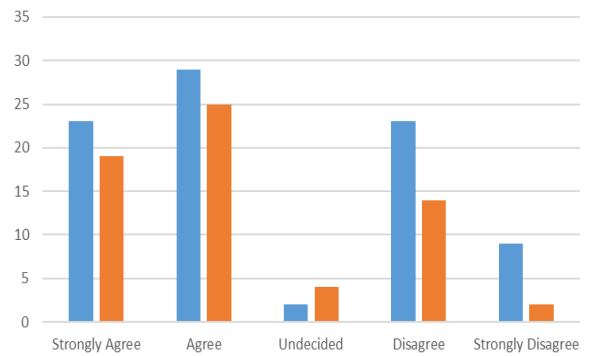
Consumption of mushrooms due to of their medicinal properties



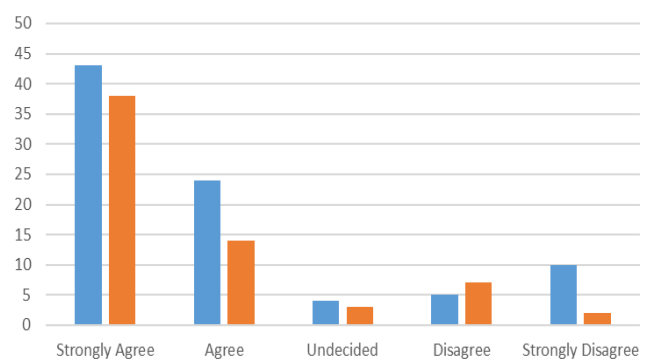
Consumption of mushrooms due to their characteristic taste



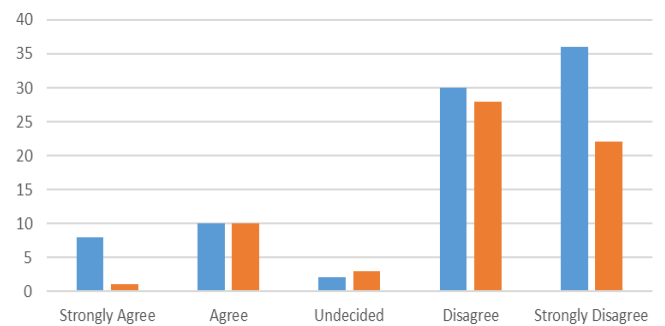
The utilization of the mushroom because it is a family tradition



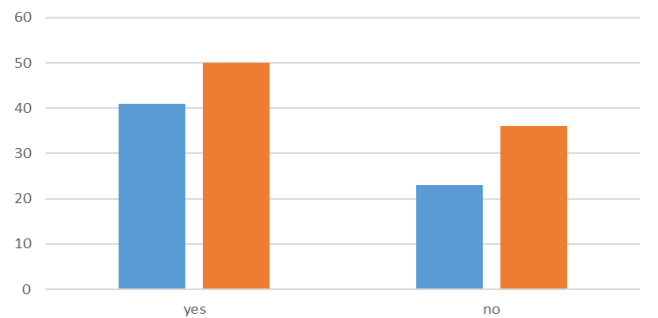
Regular consumption of mushrooms



Collecting mushrooms because it's a hobby



Consumption of mushrooms as a substitute for meat



Collecting enough mushrooms for own use during the year

Figure 13. Prague vs Non-Prague resident's attitudes towards mushroom use

Generally, in high season, a typical collector visits the forest several times per week, respondents from the metropolis reported more occasional forest visits per month and year, collectors from outside of Prague visited forests more frequently. Non-Prague respondents reported more the regular consumption of mushrooms than metropolis respondents. It is also evident that more than half of the respondents collect mushrooms because it is their hobby rather than for the medicinal benefits of mushrooms. Mushrooms are collected for their medicinal benefits by more non-Prague respondents. One-third of respondents collect mushrooms for their medicinal benefits. Most respondents answered that they do not collect mushrooms for their medicinal benefits. The great majority collect mushrooms because it's their hobby. Moreover, it is also clear that almost the absolute majority collects mushrooms precisely because of their characteristic taste, with the minor exception of a small percentage of Prague respondents who disagree. Additionally, Prague consumers tend to substitute meat for mushrooms more than rural respondents, but most respondents disagree with this statement. In the perception of the mushroom collection as a family tradition, respondents from the metropolis and rural areas more or less agreed. When asked if the respondents collected enough mushrooms for their own use, more than half of the respondents answered that they did. A larger number of respondents outside of Prague answered that they did not. In the perception of pollution, Prague respondents agree with non-Prague respondents that the biggest polluters are hikers followed by power plants and industry.

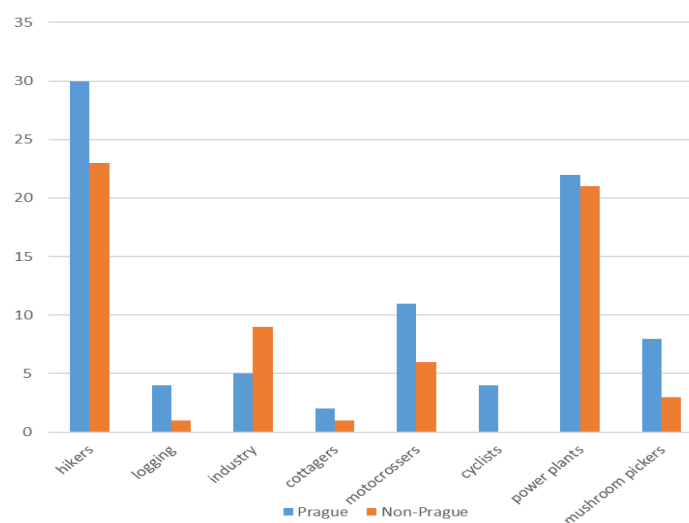


Figure 14. Perception of pollution in forests

5.3 Classification of mushroom collectors

The results from PCA show that all communalities were over 0.50. The communality of the scale, which indicates the amount of variance in each dimension, was also assessed to ensure acceptable levels of explanation.

The Bartlett’s Test of Sphericity results, were significant, $\chi^2(n=150)=1,609$ ($p<0.001$), which indicates its suitability for factor analysis. The Kaiser–Meyer–Olkin measure of sampling adequacy (MSA) was 0.846. In this regard, results are considered appropriate for factor analysis.

Table 4. Categorization of Mushroom Collectors

Items	1	2	3	4
Medicinal Properties				
MP1	0.759			
MP2	0.802			
MP3	0.860			
MP4	0.822			
MP5	0.867			
MP6	0.904			
MP7	0.761			
Taste				
TM1		0.943		
TM2		0.958		
TM3		x		
Dietary substitute				
DS1			0.907	
DS2			0.675	
Traditional Family Hobby				
TFH1				0.675
TFH2				0.907
TFH3				x

Nonetheless, in this initial PCA, two items (i.e. “TM3 = Consumption of mushrooms because they enrich dishes due to their physical structure”) failed to load on any dimension significantly. “TFH3 = I use mushrooms because they are my hobby and passion” loaded onto a factor other than its underlying factor. Hence, the two items were removed from further analysis.

The process of PCA was repeated without including these two items. The results of this new analysis confirmed the four-dimensional structure theoretically defined in the research (see Table 4). The Kaiser–Meyer–Olkin MSA was 0.827. The four dimensions explained a total of 78.05% of the variance among the items in the study. The Bartlett’s Test of sphericity proved to be significant and all communalities were over the required value of 0.500. The four factors identified as part of this PCA aligned with the theoretical proposition in this research. Factor 1 includes items MP1 to MP7, referring to Medicinal Properties (MP). Factor 2 collects items TM1 to TM26, which represents Taste of the Mushroom (TM). Next, Factor 3 includes items DS1 to DS2, referring to Dietary substitute (DS), Last, Factor 4 includes items THF1 to THF2 which represents Traditional Family Hobby (THF). Factor Loadings are presented in Table 4. Most respondents (43%) reported they collect mushrooms for their taste, followed by respondents collecting mushrooms as a family traditional hobby (31%), around 17% of collectors pick mushrooms for their medicinal properties, and 9% of collectors reported they collect mushrooms for dietary substitute see Figure 15.

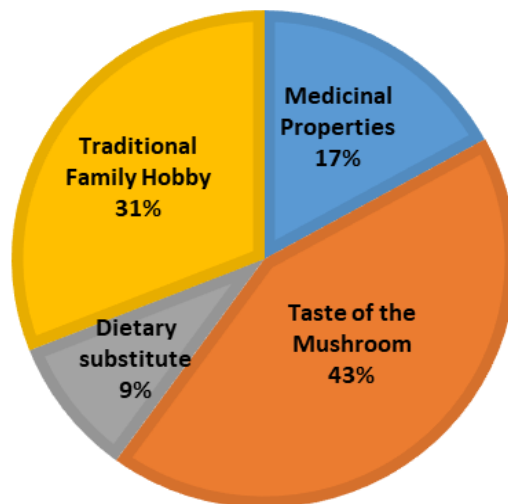


Figure 15. Mushroom usage preferences

5.4 Factors affecting respondents' attitudes towards willingness to pay for mushroom collection

Binary logistic regression was used to analyse what factors influence respondents' attitudes towards willingness to pay fees for mushroom collection. The full model containing all predictors was statistically significant, $\chi^2(9, N=150) = 299.321, p < 0.01$, indicating that the model was able to distinguish between respondent's willingness or non-willingness to pay fees for mushroom collection. The model as a whole was explained between 12.7% (Cox & Snell R Square) 20.1% (Nagelkerke R^2 and) of the variability is explained by the variables. Furthermore, the model was checked for potential multicollinearity; the values of VIF (Variance Inflation Factor) and the values are within the accepted range of collinearity.

Results from Table 5 highlight that Gender, Marital status, and Frequency of mushroom consumption are the variables that contribute significantly to the model predictions with a level of significance less than 0.05. Gender: Coefficient is negative, which indicates that men are less willing to pay fee for mushroom collection, so we can say that females are more willing to pay fee for mushroom collection. Marital status: Coefficient is negative, which indicates that people in the relationship are less willing to pay fee for mushroom collection, so we can say that single respondents are more willing to pay fee for mushroom collection. Frequency of mushroom consumption: Coefficient is negative, which means that the higher their consumption of mushrooms is the more likely they will be willing to pay fee for mushroom collection.

Odds ratio results for variable gender shows us that male willingness to pay fee for mushroom collection is 0.247 times lower than for a female. For variable marital status results of odd ratio shows us that people in relationship willingness to pay fee for mushroom collection are 0.346 times lower than for a single people. And for frequency of mushroom consumption variable results of odd ratio shows us that respondents who consume more mushrooms are 1.547 times more likely to pay a fee for mushroom collection than people who consume mushrooms less frequently.

Table 5. Factors affecting respondents' attitudes towards willingness to pay fee for mushroom collection

Variables	Coef.	S.E.	Odds ratio
Gender	-1.400 **	0.622	0.247
Age	0.011	0.19	1.011
Education	-0.078	0.198	1.081
Marital status	-1.060 **	0.476	0.346
Residence	-0.013	0.487	0.987
Occupation	- 0.076	0.119	0.927
CMS membership	-0.652	0.76	0.521
Frequency of visits to the forest for mushroom collection	-0.120	0.22	0.887
Frequency of consumption	0.436 **	0.198	1.547
Sufficient quantity of mushrooms for own use (harvested per year)	0.744	0.501	2.105
Time travel to the most visited forest	-0.197	0.289	0.821
Log-likelihood		129.731	
Cox & Snell R Square		0.127	
Nagelkerke R Square		0.201	

Note: *** Significant at $p < 0.01$, ** Significant at $p < 0.05$, * Significant at $p < 0.1$

6. Discussion

Characteristics of Bohemian collectors

Using our findings, we documented the mushroom collectors' perceptions and attitudes, specifically in light of their socioeconomic background, results obtained through a descriptive statistics. Similar to the Hungarian study done by Bringye et al. 2021, there are more females (65.3%) in our survey who responded to our questionnaire. Compared to the Hungarian study done by Bringye et al. 2021 where most respondents have a secondary education, in this research, most respondents have a university education (62%).

The place of residence among our respondents is almost divided in half, one half lives in Prague, which can be considered a metropolis, a faster, richer, and more developed place, and the other half of the respondents live in other places in the Bohemia region, which are not so developed compared to the capital Prague and we can call these places rural. According to the almost even distribution of respondents' place of residence, it seemed appropriate to find differences between people living in the metropolis or in the countryside.

Differences between Prague and non-Prague collectors

Respondents from urban areas reported visiting forests more infrequently each month and year, while collectors from areas outside of Prague did it more frequently. The same is the situation in Hungary, where people from more rural areas collect mushrooms more frequently (Bringye et al. 2021). The collectors from the metropolitan area might have less access to neighbouring forests, and those forests might be farther away than the forests outside of Prague. Another explanation might be the possibility that respondents from the metropolis have different priorities and ways of life than respondents from areas outside of Prague. It may be more difficult to find time for frequent trips to the forest for those who live in urban regions due to their busier schedules and less free time.

Further curious difference among Prague collectors and non-Prague collectors is the amount of non-Prague respondents who collect mushrooms for medicinal purposes is higher. Collecting mushrooms for medicinal purposes may be a longstanding tradition

in rural regions as it is reported by many authors e.g., Oei 2003; Chang et al. 2012, and this practice could be more common among non-Prague respondents who come from these regions.

Another interesting observation is that more Prague collectors than respondents from the countryside choose to substitute mushrooms for meat. Vegetarian and vegan diets are becoming increasingly popular in urban areas, and mushrooms are a common ingredient in vegetarian and vegan dishes. This could explain why Prague consumers are more likely to substitute meat for mushrooms compared to rural respondents. Overall, a larger proportion of our respondents do not use mushrooms as a meat substitute, in contrast to the study in Hungary and Portugal (Boin et al. 2018; Bringye et al. 2021).

Also interesting is the fact that a negligible number of around 2 respondents reported that they do not consume mushrooms at all. In contrast to the study in Portugal done by Boin et al. 2018 where the number of respondents who do not consume mushrooms at all is many times higher.

Common key words for mushroom use in Bohemian households

The results indicated that the word "forest" was the most frequently mentioned word by the respondents. This observation suggests that people associate mushrooms with the environment where mushrooms are found, specifically with forests or wooded areas.

The second most used word was "Boletus," which is a type of mushroom that is well-known and a popular specie to enrich the taste of food in the Czech Republic.

It is interesting to note that "Champignon," a popular mushroom sold in supermarkets and as well quite favourite specie to enrich the taste of food, was the third-most common term.

Other words that came to the respondents' minds were "woods," "moist," "tree," "soil," "mold," and "nature," all of which represent the environment or habitat in which mushrooms are found. These words reflect the natural setting where mushrooms are commonly seen growing, such as in damp and wooded areas. The fact that mushrooms are associated with the environment where they grow is clear, and many authors have addressed this topic in the existing literature, e.g., Camarasa et al. 1993; Bingham et al.

1995; Ehrlich et al. 2005; de Frutos et al. 2009; Boedecker et al. 2013; Shumsky et al. 2014; Bringye et al. 2021.

Additionally, respondents also associated mushrooms with certain activities or hobbies. For example, words like "joy," "hobby," "passion," "walk," "society," and "life" were mentioned, indicating that respondents considered mushroom hunting to be a recreational activity or hobby. It is worth mentioning here that recreational activities, or hobbies, are highly associated with mushrooms in the existing literature, for example by the following authors Kalač et al. 2013; Capretz 2019; Houška et al. 2020; Bringye et al. 2021.

Lastly, the respondents also filled in words related to the consumption of mushrooms. Words like "soup," "sauce," "fry," "food," "edible," and "dishes" were mentioned, suggesting that respondents associate mushrooms with food and culinary uses. The perception of mushrooms as a source of food is associated with mushrooms in the existing literature by authors such as Heywood 1999; Boa et al. 2004; Stryamets et al. 2015; Matabaro et al. 2016; Iqbal et al. 2019; Fongzossie et al. 2020; Bringye et al. 2021.

Overall, the study showed that mushrooms are primarily associated with their natural environment, recreational activities, and culinary uses, as reflected in the respondents' answers.

Classification of mushroom collectors

The four groups were identified as part of PCA; (1) Medicinal Properties, (2) Taste of the Mushroom, (3) Dietary substitute, and (4) Traditional Family Hobby. All of them were in line with research done in Hungary (Bringye et al. 2021), but unlike that research, the group with negative opinions toward mushrooms is absent from this work because less than 2% of respondents reported they don't use/consume mushrooms.

The majority of mushroom collectors, 43%, said they collect mushrooms for their taste, according to the survey results. This is not surprising as many mushroom species have unique and delicious flavours that can enhance a wide range of dishes. The concept of mushrooms as a form of food is discussed in the current literature by authors such as Heywood 1999; Boa et al. 2004; Stryamets et al. 2015; Matabaro et al. 2016; Iqbal et al. 2019; Fongzossie et al. 2020; Bringye et al. 2021.

In addition, 31% of respondents said that they collect mushrooms as a traditional family hobby. This is a long family tradition, particularly in the Bohemian region of the Czech Republic. For many families, mushroom collecting is a cherished tradition passed down from generation to generation (Kalač et al. 2013; Houška et al. 2020).

Around 17% of respondents said they collect mushrooms for their medicinal properties. Mushrooms have been used in traditional medicine for centuries to treat a variety of illnesses as confirmed by several studies (Oei 2003; Chang et al. 2012; Bringye et al. 2021).

Finally, 9% of foragers said they collect mushrooms as a food substitute. This could be due to dietary restrictions, such as following a vegetarian or vegan diet, or simply as a way of reducing their meat consumption. Mushrooms are a good source of protein, and other nutrients, making them a healthy and satisfying substitute for meat in many dishes (Boin et al. 2018; Fongnzossie et al. 2020; Bringye et al. 2021).

The order of representation of each category differs from the study in Hungary, where the most represented group was "Supplementary food" which can be considered as our group "Dietary substitute", which ranked last in our scale (Bringye et al. 2021).

Factors affecting willingness to pay fee for mushroom collection

Since nowadays there is a discussion in the Czech Republic about the protection of the forest environment and the related charging of entry to the forest for the purpose of mushroom collection. This should lead to a more environmentally friendly and controlled use of forests and NTFPs. However, this debate has not yet been explored in any depth and the discussion on this topic is more in the mass media. Opinions on this issue vary, many people think that this is a great approach and a good step to improve the situation in over-exploited and often damaged and polluted Czech forests. However, the situation is now such that it is currently impossible to introduce such a policy and it cannot be controlled. Gender, marital status, and frequency of mushroom consumption are influencing willingness to pay for mushroom collection. It seemed to us that this paper could explore this question further and we focused on what factors would influence respondents' willingness to pay mushroom collection fees.

According to our results, we concluded that females are more willing to pay fee for mushroom collection, this may be due to the fact that women are more ecologically and protective-minded than men (Zhao et al. 2021).

Single respondents are more willing to pay fee for mushroom collection, possibly due to having more free resources (DePaulo et al. 2005).

Higher their consumption of mushrooms is the more likely respondents are willing to pay fee for mushroom collection, they may place a higher value on the quality and taste of mushrooms and may be more willing to pay for mushrooms that are freshly picked and of high quality (Štursová et al. 2019).

Recommendations

The future research could use these findings as a basis for more detailed research with multiple respondents. Future studies could compare the condition in every region of Czechia and could look in more detail at the subject of willingness to pay fee for mushrooms, leading to the discovery of more data that could then be shared with decision-makers, who would, for instance, know what is socially acceptable and what would not work based on public opinion. The data and findings of this work could also be used to analyse the current situation of mushroom collection for an article in the media or for mushroom collecting enthusiasts. Future studies could also investigate the role of forests and the environment in relation to pollution from the mushroom collection. Further studies could look at the dietary habits of the respondents regarding mushrooms and the use of mushrooms as a substitute for meat (Bringye et al. 2021).

Limitations

The limitation of the work is quite a small number of respondents and the method of data collection, which could be more advanced, as mentioned above, it would be interesting to collect data across all regions in the Czech Republic. Income was not included in the questionnaire to protect personal information (recommended by workers in CMS), but it would be interesting to see if it has an influence on the willingness to pay for mushroom collection.

7. Conclusion

This thesis presents current insights on the knowledge, collection, and utilization of mushrooms in Bohemia.

With the aim of discovering the initial thoughts of participants upon hearing the term "mushroom". The most common word "forest" was the one that people most frequently reported. We might therefore conclude that the environment where mushrooms are found is the most noticeable. Next, „Boletus“, a species of mushroom, is one of the most well-known in the Czech Republic and is the second most frequently used term.

Binary logistic regression was used to investigate the factors that affect collectors' attitudes towards their willingness to pay for mushroom collection. Three variables influence the willingness to pay fee for mushroom collection: gender, marital status, and frequency of mushroom consumption. Females are more willing to pay fee for mushroom collection. Single respondents are more willing to pay fee for mushroom collection. The higher their consumption of mushrooms is the more likely they will be willing to pay fee for mushroom collection.

Mushroom consumption and the phenomenon of the popular activity of mushroom collection in the Czech Republic could be considered a national sport as well as in other eastern countries. Factors describing mushroom consumption were organised into four main groups. Based on the respondent's answers, it is clear that each group has a presence in the Bohemia region. The majority of participants (43%) indicated that they collect mushrooms primarily for their flavour, while 31% of respondents collect mushrooms as a longstanding family hobby. Approximately 17% of mushroom collectors reported collecting mushrooms for their medicinal properties, and 9% collect mushrooms as a dietary substitute.

Several differences were observed in the perception of forest and mushroom collection between Prague and non-Prague respondents. Collectors in urban areas reported fewer visits to forests, while collectors from areas outside of Prague reported more frequent forest visits. Residing in urban areas reported fewer visits to forests per month and year, while collectors from areas outside of Prague reported more frequent forest visits. An interesting contrast between collectors from Prague and those outside Prague is that a

higher proportion of non-Prague respondents collect mushrooms for medicinal purposes. Another noteworthy finding is that Prague collectors have a higher tendency than rural respondents to use mushrooms as a meat substitute.

In conclusion, this study confirms a strong tendency towards mushroom collection and use in Bohemians and knowledge of their use in several ways. Moreover, mushroom collecting has a long-standing family tradition and is associated with various types of ecosystems and their services, particularly forests.

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Appendices

List of the Appendices: a) Questionnaire for study

Appendix 1: Questionnaire for finding contemporary knowledge, collection and use of mushrooms in Bohemia

1) What is the first word association that comes to mind when you hear the word "mushroom"? Write a maximum of 3 words:

2) List up to 10 species of mushrooms that you have consumed (used) in the past year, regardless of their origin or method of acquisition (collection, purchase, gift):

3) The number of mushroom species you regularly collect is higher compared to the past (2000)?

(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

4) The number of mushroom species is smaller compared to the past (2000)?

(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

5) Are you able to name all the mushrooms you collect?

(no; I don't know the exact name of most of them; roughly half; majority yes; definitely yes)

6) In which places do you collect mushrooms?

(meadow; garden; park; forest; I cultivate)

7) In what form do you store mushrooms?

(dried; pickled; frozen)

8) Do you pick enough mushrooms for your own use over the year?

(yes; No, I only use what I collect myself; No, I'm contacting friends; No, I'm buying them)

9) If you buy mushrooms, in what form? (multiple answers possible)

(fresh; dried; pickled; frozen; I do not buy them)

10) If you buy mushrooms, where? (multiple answers possible)

(specialty stores supermarket; farmers' markets; street sales; from friends; I don't buy)

11) Where did you buy mushrooms in 2000?

(specialty stores supermarket; farmers' markets; street sales; from friends; I didn't buy)

- 12) Where do you get your information about mushrooms? (multiple answers possible)
(family; friends; newspaper; internet; scientific literature; radio; TV; social media)
- 13) From what did you get your information about mushrooms in the year 2000?
(family; friends; newspaper; internet; scientific literature; radio; TV)
- 14) What type of information about mushrooms are you looking for? (multiple answers possible)
(increase the number of species I collect; learn about new culinary techniques; learn about the medicinal benefits of mushrooms; growing mushrooms at home/on the property; new ways to process mushrooms)
- 15) I eat mushrooms regularly.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 16) I eat/use mushrooms because they have medicinal properties.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 17) I eat/use mushrooms because they contain important vitamins.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 18) I eat/use mushrooms because they contain minerals.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 19) I eat/use mushrooms because they lower blood pressure.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 20) I eat/use mushrooms because they lower cholesterol.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 21) I eat/use mushrooms because they support immunity.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 22) I eat/use mushrooms because they contain fiber.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

- 23) I eat/use mushrooms because they are my hobby and hobby
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 24) I eat/use mushrooms because they have a distinctive taste.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 25) I eat/use mushrooms because they have a characteristic aroma.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 26) I eat/use mushrooms because they enrich dishes due to their physical structure.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 27) I eat/use mushrooms because it replaces meat in my diet.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 28) I eat/use mushrooms because they are low in fat and calories.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 29) I eat/use mushrooms because it's a long-standing family tradition.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 30) I eat/use mushrooms because I can spend time together with family or friends.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 31) I consume/use mushrooms because I can use them to decorate my home (ornaments, etc.).
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 32) I consume/use mushrooms because they are good for making teas, infusions and decoctions (soothing, poultices, mood altering).
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 33) I eat/use mushrooms because they have hallucinogenic effects.
(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)
- 34) How long does it take you to get to the most visited forest?
(up to 30 minutes; up to an hour; more than an hour)

35) How do you primarily visit this forest to collect mushrooms (max two options)?

(by foot; by bike; by car; by bus; by train; by motorcycle)

36) Compared to the year 2000, do you visit the forest more often to collect mushrooms?

(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

37) What type of forest do you visit most often?

(coniferous; deciduous; mixed)

38) List the 3 most prevalent tree species in this forest:

39) In which months do you mostly go to the forest to collect mushrooms?

(January; February; March; April; May; June; July; August; September; October; November; December)

40) How often do you go into the forest to pick mushrooms during the picking season?

(daily; 2-3 times per week; 1x per week; 1x per month; 1-3 times per year)

41) You go to the forest to pick mushrooms mostly:

(individually; with family; with friends)

42) In addition to collecting mushrooms, you also perceive going to and staying in the forest as (multiple answers possible):

(recreation/relaxation; teaching children about nature; family tradition and reviving memories; spending time with a loved one; opportunity to collect other non-timber forest products; sporting activity; opportunity to discuss an important topic)

43) How satisfied are you with the amount of mushrooms in the forests?

(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

44) The environment in the forest is more polluted compared to the past (year 2000).

(Strongly Agree; Agree; Undecided; Disagree; Strongly Disagree)

45) What do you think is the biggest source of forest pollution?

(hikers; cyclists; recreationalists; mushroom hunters; industry; power plants; logging; motorcyclists)

46) Would you be willing to pay a fee for mushroom collection?

(yes; no)

47) If yes, how much? (Specify the amount and unit, e.g. CZK/kg, CZK/year, CZK/visit to the forest)

48) Are you a member of the Czech Mycological Society?

(yes; no)

49) I use the Czech Mycological Society for information/consultation on:

(unknown mushroom species (identification); effects/uses of mushrooms; mushroom conservation options; mushroom occurrence; mushroom cultivation; education and exhibitions; do not use)

50) What is your gender?

(Male; Female)

51) Please indicate the year of your birth and the name of the municipality of your first residence:

52) Please give the name of the municipality (or part of it) where you currently live for most of the year:

53) What is your highest level of education?

(Primary education; lower secondary education; upper secondary education; Higher vocational; University education)

54) What is your marital status?

(married; divorced; widowed; in a relationship)

55) What is your predominant (primary) employment status?

(privately employed; state employee; woman on parental/maternity leave; student with part-time job; student with regular job; unemployed; retired; other)