Handbook of Research on Technological Developments for Cultural Heritage and eTourism Applications

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A volume in the Advances in Hospitality, Tourism, and the Services Industry (AHTSI) Book Series

IGI Global
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Published in the United States of America by
IGI Global
Business Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Rodrigues, Joao M. F., 1971-
Title: Handbook of research on technological developments for cultural heritage and eTourism applications / Joao M. F. Rodrigues, Celia M. Q. Ramos, Pedro J. S. Cardoso, and Claudia Henriques, Editors.
Description: Hershey PA : Business Science Reference, [2018]
Identifiers: LCCN 2017012413| ISBN 9781522529279 (hardcover) | ISBN 9781522529286 (ebook)
Subjects: LCSH: Tourism--Computer network resources. | Culture and tourism--Computer network resources. | Heritage tourism--Computer network resources.
Classification: LCC G156.5.I5 .T43 2018 | DDC 910.285--dc23 LC record available at https://lccn.loc.gov/2017012413

This book is published in the IGI Global book series Advances in Hospitality, Tourism, and the Services Industry (AHTSI) (ISSN: 2475-6547; eISSN: 2475-6555)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 16
Information Mycological Systems and Traditional Ecological Knowledge:
The Case of Mycological Tourism in Central Mexico

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ABSTRACT

Wild edible fungi are non-timber forest products that have great relevance for forest communities in central Mexico. Texcaltitlán is a rural community known for its traditional ecological knowledge on the use and identification of wild edible mushrooms. The aim of this work is to link Geographic Information Systems and Traditional Ecological Knowledge, in order to generate Mycological Information Systems. This is a qualitative, quantitative and exploratory research, which seeks to determine the usefulness of Geographic Information Systems (GIS) to systematize and locate mycological resources for use as a tourist attraction. The results show the existence of a wide variety of edible mushrooms in the region, along with a wide mycological traditional knowledge. Both aspects reflect the existence of unique natural and cultural features that can be the basis to build a unique tourism product in central Mexico. It is concluded that GIS are useful tools to build a multifunctional vision of mushrooms.

INTRODUCTION

This chapter is part of a basic scientific research entitled "Evaluation of the recreational dimension of wild edible mushrooms, their socioeconomic interest and their perspectives of rural development", supported by the National Council of Science and Technology of Mexico. This project contains three central components: (i) a participatory approach integrating local stakeholders as promoters of mycological tourism; (ii) generating mycological information systems based on traditional ecological knowledge

DOI: 10.4018/978-1-5225-2927-9.ch016

and scientific knowledge; and (iii) proposing a strategy for the tourism management of mycological resources in the central Mexican plateau.

Mycological tourism consists of experimenting with the natural and cultural dimensions of wild edible mushrooms, through an articulated offer of goods and services that allow a recreational experience to be lived. Its main activities are the identification, harvesting and tasting of the mushrooms in close contact with the nature and mushroom picking communities. This tourist modality is part of the new trends in rural tourism that are characterized by their high specialization, focused on a product anchored to the territory.

Mycological tourism is an example of the valorization of forests as a tourist resource in contemporary societies. The growing importance of forest spaces as tourist scenarios is associated with the specific characteristics of these ecosystems. This value can be increased by modifying forest management practices; For example, by maintaining the abundance of certain local resources of special interest (Bostedt & Mattsson, 1995). However, tourism exploitation of forests also generates environmental, social and cultural risks (Kuvan, 2005). Aspect by which planning is a central theme.

In the case of Geographic Information Systems, the interconnections between tourism and new technologies not only reveal the location of tourist attractions in a specific territory. Rather, they allow the mobilization of local resources, converted into cultural goods, as a distinctive sign of contemporary tourist leisure (Hannam, Butler & Morris, 2014).

The objective of this chapter is to analyze the relationship between mycological tourism and Geographic Information Systems as a tool for tourism planning in rural areas. All this from a participatory approach in which traditional ecological knowledge serves as a source of information and a point of reference to guide policies for economic restructuring of rural areas.

For this the text is divided into six parts. After this introductory section the relationship between Geographic Information Systems and Mycological Tourism is presented. Later, the use of GIS in the planning of mycological tourism is explored as a tool for generating data that can be analyzed from an integral and participatory perspective for the determination of the tourist potential of the territory and its adequate spatial projection. Later, the case study in a forest community in central Mexico is presented, where the characteristics of the observation unit and the methodological design of the research are discussed. Next, the application of the Mycological Information System is presented, through the evaluation of local mycological resources and a proposal of paths for mycological tourism. Finally, the conclusions and some considerations for the future of the research are presented.

BACKGROUND

Geographic Information Systems Applied to Tourism

The use of local resources for tourism can produce the opportunity to generate processes of socio-economic transformation that help to improve the quality of life of rural inhabitants. However, the introduction of new non-agricultural rural activities such as tourism requires the development of systematized information platforms for the success of development strategies.

In the case of nature-based tourism, many of the resources in which the activity is focused can be documented through spatial information sources that indicate the quantity and characteristics of tourism resources, as well as the socio-economic impacts that can derive from their use as tourist capital.

Traditionally, the application of Geographic Information Systems (GIS) has focused on environmental issues and resource management (Robinson, 1992). Equally important are the works on rural space planning developed by Haines-Young, Bunce and Parr (1994). Both cases are important background on the use of GIS in the planning and management of tourism in rural areas.

The use of GIS can be a useful tool for tourism planning and management in rural areas where there is a clear lack of systematic information on local resources and where it is essential to avoid the negative impacts of tourism. This is of particular relevance in contexts where natural and cultural resources are vulnerable to anthropic, economic and political pressures related to tourism.

Having quality information is a key aspect of tourism spatial planning, to detect the multifunctional use of the territory, and to avoid the emergence of new social tensions among local actors linked to key resources. From a vision of the data that integrates socioeconomic and environmental variables, a set of negative effects and potential risks that tourism can generate in natural resources can be prevented. GIS can be an important tool to analyse the scenarios of the productive transformation of rural space.

According to the above, it is intended to detect the conflicts generated by tourism, to prevent negative impacts and to have elements for making decisions (Bahaire & Elliot-White, 1999), which is why GIS can play an important role in the planning, development and evaluation of the tourist activity.

There are several uses of GIS related to tourism, among which are: database design, map production, spatial analysis, spatial modelling and support for making decisions. In this way, it is possible to create multiple tourist applications such as resource inventories, tourism feasibility assessment, impact measurement, route design and the development of prospective tourism scenarios (Bahaire & Elliot-White, 1999).

There are pioneering works where GIS has been used as a tool for the analysis of resources related to tourism (Gunn, 1994). Through the overlapping of maps the tourism potential of the territory is identified through the selection of active and interpretive tourism zones, depending on the characteristics of the natural resources. In the same direction, Boyd and Butler (1996) use GIS to identify suitable spaces for the development of ecotourism through the association between natural resources and the specific characteristics of the landscape.

Some papers have explored the relationship between GIS and tourism planning in North America. In this regard, it is essential that local actors have key information about the location and availability of tourism resources, assessing the points of conflict and complementarity between tourism and other activities, and predicting the fragility of local resources (Williams, Paul & Hainsworth 1996).

GIS, Mycological Resources and Mycological Tourism

Spain is the pioneer in the management and use of mycological resources, through the use of GIS as a tool to generate data about wild edible mushrooms. With this objective, MICODATA was created, which is a system for the collection and management of data on wild edible mushrooms with socioeconomic importance in the province of Castilla y León. This system is based on soil and climate variables to generate useful information for the collectors and to provide advice for the management of mycological resources.

The objectives of MICODATA can be summarized as follows: (i) generate a mycological information system; (ii) have objective criteria for assessing the sustainable management and socio-economic impact of mycological resources; (iii) provide general information on the productivity, regulation and conditions of mushroom harvesting, through a web platform; and iv) contribute to the regulation and management of mycological resources (Martínez-Peña, et al., 2009).

From the MICODATA model, the need for a Mycological Information System with a participatory approach in central Mexico is proposed, for this it is necessary to integrate Geographic Information Systems, applied forest mycology, ethno-mycology and an approach from the tourist studies (Thomé-Ortiz, 2015).

The participatory approach proposed in this work is a tool for tourism planning based on the involvement of local mushroom pickers in the decision making process and the benefits of tourism. It seeks to integrate the vision of local pickers respect to tourism and the incorporation of other local actors such as traders, service providers and producers. The process includes a basic social consensus and the formation of new tourism-oriented capabilities (Dallen, 1999).

This is due to the fact that, in the case of Mexico, mycological resources are part of a common good from which apparently all people can enjoy except that knowledge about wild edible mushrooms is an access barrier that only allows the use of these resources by small groups where mycological knowledge is transmitted from generation to generation.

In this sense it is important to evaluate the recreational potential that wild edible mushrooms have as tourist attraction. This implies processes of productive innovation in rural areas, based on their territorial capacity to offer cultural services, aimed at urban societies in the context of globalization. The objective is also to promote multifunctional and sustainable management of forests that enhances and integrates the ecological, social and economic functions of wild edible mushrooms.

Mycological tourism can be defined as a recreational activity focused on the conservation and protection of mycological resources to promote economic development and improve the living conditions of the population, which implies local mycological knowledge and may constitute a sustainable strategy for rural development (De Castro, 2009).

Although mycological tourism is practically unknown in Mexico, European experiences clearly show that it is a lucrative activity. According to data from the Micosylva + project, the average annual value generated by mycology in the province of Castilla y León is estimated at 65 million euros. Of this amount, 20 per cent is derived from the income generated by mushrooms collectors, 40 per cent is obtained from the added value generated by the collection and processing companies, and the remaining 40 per cent is generated by mycological tourism (Europa Press, 2014).

Mycological tourism is an activity that requires professional knowledge so it is necessary to have mycological information systems that promote correct practices of harvesting and management of mushrooms, in order to avoid any kind of risk derived from the consumption of toxic mushrooms, degradation of the environment and fragmentation of the social structure in the harvesting communities.

The development of Mycological Information Systems can also benefit tourists, since these systems can provide an interpretive framework for mycological resources. This requires that the information gathered is presented as mushroom picking guides and digital applications with information on seasonality, availability and location of fungi.

MAIN FOCUS OF THE CHAPTER

Geographic Information Systems as a Planning Tool for Mycological Tourism

The application of GIS in mycological tourism planning represents an important tool for the development of various tasks that are fundamental for the proper development of tourism activity, among which can

be highlighted: the generation of data, inventory of tourism resources, analysis of the data, zoning and a participatory approach.

The generation of data about mycological resources is a central aspect for their use for recreational purposes. Traditionally, forest management has focused on timber resources with the consequent oversight of the importance of non-timber forest resources for the ecological balance of forests and the economic well being of communities.

Certainly, wild edible mushrooms are resources of great socioeconomic importance for communities living in the forest. In Mexico, its use has been restricted to harvesting for their own consumption, exchange and sale, being a marginal activity that often does not reflect a fair return for the work and time invested.

This is why it is essential to explore some options, such as mycological tourism, that allow adding value to the use of mushrooms and retaining the income generated within the harvesting communities (De Frutos, Martínez & Esteban, 2012; Lázaro, 2008).

The recreational use of wild edible fungi requires accurate information systems to determine which are the most appropriate mechanisms for the management of these resources as tourist attractions. To do this it is necessary to develop the two dimensions of GIS. The first refers to a spatial perspective, focused on locating data at a specific point on Earth. While the second is related to the attributes of the data, qualitatively and quantitatively, they reflect the characteristics of a geo-referenced entity (Grimshaw, 1993). In this sense, it is possible to think of its usefulness both for the location of the mushrooms and for their detailed characterization.

From the point of view of the location it is important to detect in what type of forest fructify certain species of mushrooms. With this it is possible to establish the relationship between mycological resources and a certain type of vegetation, can also be associated with soil types and humidity. All of these are useful aspects for the location of mushrooms within pre-established mycological paths.

On the other hand, the attributes of the data usually provide more detailed information on the characteristics of the mushrooms. Among these characteristics are its shape and color, fruiting periods, availability, cultural importance and economic value. All of these data may be important elements for the planning of mycological tourism activities as will be discussed below.

In addition to the aspects related to wild edible mushrooms, the development of a mycological tourism project must have an inventory of tourism resources that can evaluate the existence of a set of goods and services that support the tourism experience. To obtain these data, a quantitative and qualitative approach is necessary to establish the levels of attraction, accessibility, presence of infrastructure and levels of degradation of resources (Priskin, 2001).

In the case of mycological tourism, the levels of attraction are directly related to the natural and cultural resources associated with mushrooms. This refers fundamentally to the specific characteristics of forests, their landscapes, ethno-mycological knowledge and mycogastronomy.

The conformation of interrelated data systems allows a comprehensive view of the management of wild edible mushrooms as a multifunctional resource. This provides an appropriate perspective on the possible complementarity or conflict between mycological tourism and other economic activities such as harvesting for self-consumption or harvesting for commercial purposes. In the same way it can help to understand the social tensions originated by the use of the common spaces for diverse purposes or the disputes between local and external actors for the use of the endogenous resources.

A complementarity should be sought between new activities (tourism) and traditional activities (mushroom harvesting). In accordance with the above, the following criteria should be observed for the sustainable management of mycological tourism (Garau, 2015):

1. Protection of natural and cultural resources:
    a. Environmental sustainability (preservation of ecosystems, use of environmental management systems, protection of the productive vocation of the territory).
    b. Economic sustainability (development of landscape quality, development of nearby markets for products and services, innovation in environmental management).
    c. Social sustainability (generate a social awareness about the importance of mushrooms, develop participatory approaches and improve the network of relationships between stakeholders).
2. Development of sustainable mycological tourism:
    a. Local economic development (creation of local businesses, generation of employment, alliances between public and private sectors)
    b. Sustainable environmental development (small-scale tourism, protection of natural and cultural heritage, certification of tourist practices).
    c. Social development (integration between different productive sectors, development of a place-based perspective, detection of the opportunities of the exclusive resources of the territory).

The data obtained through GIS technology are an important reference for zoning in mycological tourism. The generation of mycological paths is more efficient through the use of accurate and georeferenced data to establish the fruiting areas of mushrooms and those places where the integrity of local resources is not compromised.

In the case of the Spanish province of Castilla y León, the existence of mycological information systems has allowed the development of 100 mycological paths, whose journey lasts between four and five hours. These paths contain elements to recognize the beginning and end of the trail, information on the natural environment in which they are located, instructions for the safe mushroom harvesting and criteria for identifying the species collected (De Frutos, Martínez & Esteban, 2012). In the same direction, it is important to determine the commercial areas, spaces for the development of sports activities and the spaces where housing and food infrastructures can be located.

One of the advantages of using GIS in mycological tourism planning is that it encourages community participation in tourism planning and decision-making (Hughes & Shirmer, 1994). In the case of wild edible mushrooms, the information generated comes from local informants and includes aspects such as location, identification, temporality and use of mushrooms, which is part of the traditional ecological knowledge about these resources (Jímenez, Thomé -Ortiz & Burrola, 2016).

On the other hand, the information generated through GIS has to be validated through processes of feedback and permanent consultation to the community. This implies a high level of involvement of the social actors and the collective appropriation of the tourism strategy. According to Harris, Weiner, Warner and Levin (1996), a participatory GIS allows the integration of local knowledge with the technical expertise of external actors, taking advantage of spatial representation of local knowledge.

Case Study of a Mushroom-Harvesting Community in Central Mexico

Study Area

The village called Ejido Venta Morales (La Laguna) is located in the municipality of Texcaltitlán, State of Mexico at an altitude of 2860 meters (figure 1). It is within the Natural Protection Area of Nevado de Toluca Volcano, in the GPS coordinates Length (dec) -99.895000 and Latitude (dec) 18.983333.

The community has electricity, potable water, radio signal and television signal, but only a small percentage has telephone service and no home has Internet signal. The average schooling of the population is 6.88 years. It has approximately 373 inhabitants, distributed in 110 houses, of which 179 are men and 194 are women, with a fertility rate of 2.95 children per couple.

Its predominant climate is temperate humid with rains in summer and has an average annual temperature of 19 C. Its territory is divided into communal and ejido lands and sits on pinus spp and abies religiosa forests, among which there are streams and waterfalls from the melting of the Nevado de Toluca volcano. Its population is mestizo and was evangelized by catholic missionaries, who founded the village church in the eighteenth century (INEGI, 2017).

This village is renowned in the region for its vocation as mushroom pickers, whose products are sold at the roadside or in the nearby markets. The mushrooms harvesting is an activity that brings important benefits to the economy of rural families since it generates additional income and contributes a food of self-consumption during the rainy season.

The learning process on the identification and harvesting of fungi starts from childhood. The first times children go out alone and collect everything they find, when they get home their mother teaches them which mushrooms are edible. The operation is repeated until the children show a satisfactory ability to identify good mushrooms to eat. Each picker family knows specific places where, according to altitude and vegetative dominance, certain species of mushrooms fructify. Harvesting should begin at an early hour to prevent others from finding edible mushrooms in accessible places (Mariaca, Silva & Castaños, 2001).

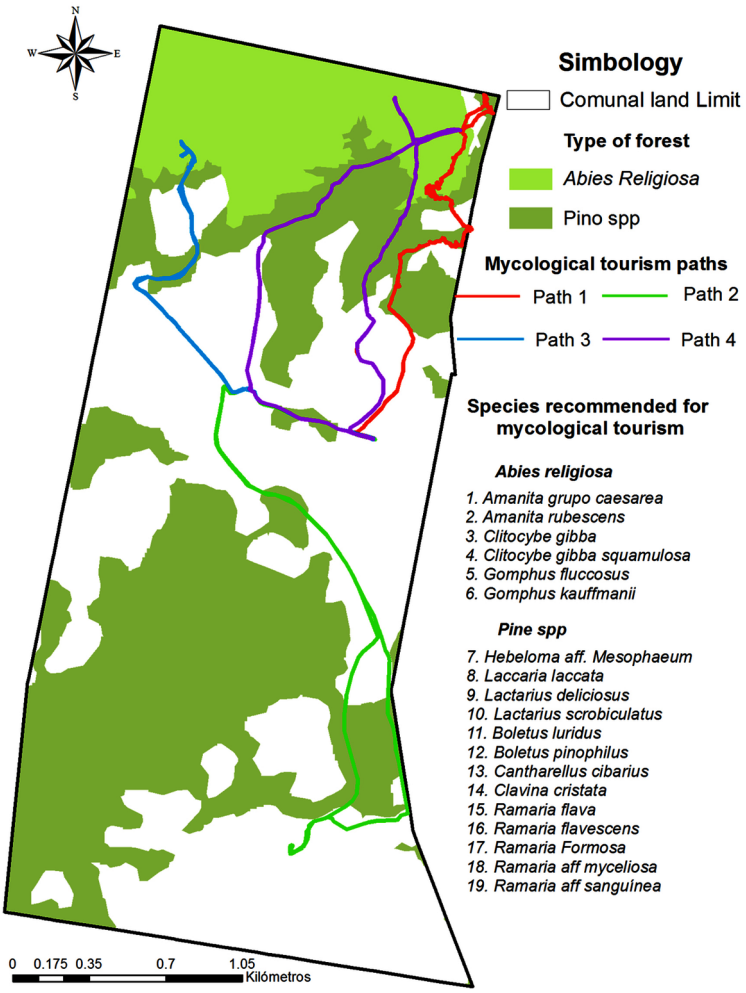
Mushrooms harvesting has a positive impact on the family economy. Through this practice families ensure mushrooms consumption between one and three times a week during the rainy season and can purchase basic food for at least three months. They usually exchange mushrooms in local markets for products such as oil, sugar, coffee, tomatoes, onions, salt, soap, candles and other necessities (Mariaca, Silva & Castaños, 2001).

Despite the socioeconomic importance of the mushrooms, it can be seen that the work of pickers does not have a fair payment as it only reaches the average of 5 dollars per day. In this regard, some studies indicate that mycological tourism has the capacity to produce between 7 and 9 times the income that the exclusive harvesting and sale of mushrooms generates (Lázaro, 2008).

Information Mycological System Based on Ethno-Knowledge

During the rainy season of 2015, a case study was carried out in Ejido Venta Morales village. The case study approach was relevant because from this it is possible to make theoretical constructs on emerging phenomena, based on predominantly qualitative analysis (Yin, 2009), but at the same time allows the flexibility to use mixed methods (Stake, 1994).

Figure 1. Map: Location of Texcaltitlán, Estado de México
Source: INEGI, 2012.



The fieldwork was developed during the mushroom season, which, according to the villagers, occurs between June and December. Two harvests were carried out per month. This led to an inventory of the main mushrooms with socioeconomic relevance in the study area.

In order to determine the species of edible mushrooms existing in the region, fourteen harvests were carried out, which were guided by local pickers who, from their traditional ecological knowledge, provided relevant data on the relation of fungi to certain tree species, soil type and weather. To collect field data a GPS (Global Positioning System), Garmin brand, model Map 64S with an accuracy of +/- 10 meters was used. The routes were made using the automatic route plotting function of the GPS equipment and in addition, the points were marked where the mycological species of interest were found. At each point the species, the scientific name, the availability and the approximate location were referenced.

Subsequently, a group of collectors was selected, who helped determine the index of cultural importance of each species and the index of economic importance. The selection of informants was based on the following criteria: (i) that they were locally recognized actors because of their knowledge about

mushrooms; (ii) that among its daily productive activities there will be the mushrooms harvesting; and (iii) that they had received their knowledge about mushrooms in an intergenerational manner. The sample included eleven informants and was determined using the non-probabilistic snowball sampling technique (Goodman, 1960).

The index of cultural importance (Signorini, 2009) corresponds to the percentage value of the number of times the specific uses of the taxon are mentioned by the number of informants and was calculated by the following formula:

$$CI_S = \sum_{u=u1}^{U_{NC}} \sum_{1=1_1}^{1_N} UR_{U1} \Big/ N$$

where u is the use category, NC is the total number of different use categories (of each "i" species), UR is the total number of uses reported by each of the species (corresponding in the study to the " Citations ") and N is the total number of informants in the study.

To calculate the NC, it was defined as the total number of uses-category (for each species the different number of secondary uses as NC was considered, taking into account that is more detailed and uses numerous than-category). Once obtained the index of each species were grouped under the criteria: high, medium and low.

To calculate the economic value (Reyes-Garcia, Huanca, Vadez, Leonard & Wilkie, 2006) of mushrooms was used as reference the local price of species, from its sales value in the markets, roadside and into the community.

For those species of mushrooms that did not present a market value, analogies has to be made about their exchange value for other products and investigating the relationship between the time invested in their harvest and the value of time reflected in income from other paid activities. The following formula was used:

$$EV_e = Me_e * Pe_e$$

where EV_e is the economic value of species e. Me_e is the number of species mentioned and Pe_e is the price of species e. After obtaining the economic value of each species were grouped under the criteria high, medium and low.

The points and routes obtained in the field were related to the availability of mycological resources, their index of importance and economic value. These data were exported from the file in GPX format (GPS format) to ArcGis 10.2.2 software. Subsequently, the information obtained in the field was overlapped with the vegetation type layers of the V series, in .shp format, at scale 1: 250,000 of INEGI (National Institute of Statistics and Geography, for its acronym in Spanish). With this overlap, it was possible to identify the type of forest and the mycological species of the study region suitable for mycological tourism.

Evaluation of the Wild Edible Mushrooms of Texcaltitlán

36 species of wild edible mushrooms were detected (Table 1). Most of these species are distributed in different parts of the forest, associated with forests of pinus spp and abies religiosa. A small percentage

Table 1. Wild edible fungi of Texcaltitlán, State of Mexico

Local Name	Scientific Name	Location	Availability	Cultural Significance	Economic Value
1. Chicale	*Amanita grupo caesarea*	Abies Religiosa Forest	Medium	Low	Low
2. Mosco	*Amanita rubescens*	Abies Religiosa Forest	High	Low	Low
3. Zorrita	*Hebeloma aff. Mesophaeum*	Pinus Spp. Forest	High	Low	Low
4. Jocoyol	*Laccaria laccata*	Pinus Spp. Forest	High	Low	Low
5. Tejamanilero	*Clitocybe gibba*	Abies Religiosa Forest	High	Medium	Low
6. Tejaminilero	*Clitocybe squamulosa*	Abies Religiosa Forest	High	Medium	Low
7. Clavito o Jarero	*Lyophyllum aff. Connatum*	Pinus Montezumae Forest	High	High	Low
8. Blanco	*Russula brevipes*	Abies Religiosa Forest	High	Medium	Low
9. Enchilado azul	*Lactarius deliciosus*	Pinus Spp. Forest	High	Low	Low
10. Enchilado blanco	*Lactarius scrobiculatus*	Pinus Spp. Forest	Low	Low	Low
11. Cema	*Boletus appendiculatus*	Pinus Montezumae and Abies Religiosa Forest	Low	High	Low
12. Pancita	*Boletus barrousii*	Quercus Ilex Forest	Low	Medium	Low
13. Pancita	*Boletus edulis*	Quercus Ilex Forest	Low	Medium	Low
14. Pancita	*Boletus edulis var. Clavipes*	Quercus Ilex Forest	Low	Medium	Low
15. Galambo	*Boletus luridus*	Pinus Spp. Forest	Low	Low	Low
16. Cema	*Boletus pinophilus*	Pinus Spp. Forest	Low	Medium	Low
17. Naranjo	*Cantharellus cibarius*	Pinus Spp. Forest	Low	Low	Low
18. Corneta roja	*Gomphus fluccosus*	Abies Religiosa Forest	High	Low	Low
19. Corneta blanca	*Gomphus kauffmanii*	Abies Religiosa Forest	Low	Low	Low
20. Pata de pajaro	*Clavulina cristata*	Pinus Spp. Forest	Low	Low	Low
21. Pata de pájaro	*Ramaria flava*	Pinus Spp. Forest	Low	Low	Low
22. Pata de pájaro	*Ramaria flavescens*	Pinus Spp. Forest	Low	Low	Low
23. Escobeta	*Ramaria Formosa*	Pinus Spp. Forest	Low	Low	Low
24. Escobeta	*Ramaria aff myceliosa*	Pinus Spp. Forest	Low	Low	Low
25. Escobeta	*Ramaria aff sanguinea*	Pinus Spp. Forest	Low	Low	Low
26. Gachupín	*Helvella crispa*	Abies Religiosa Forest	Low	Medium	Medium
27. Gachupín	*Helvella fusca*	Abies Religiosa Forest	Low	Medium	Medium
28. Gachupín	*Helvella lacuosa*	Abies Religiosa Forest	Low	Medium	Medium
29. Gachupín	*Champiñon pithiophyla*	Abies Religiosa Forest	Low	Medium	Medium
30. Olote	*Morchella elata*	Quercus Ilex Forest	Low	High	High
31. Olote	*Morchella esculenta*	Quercus Ilex Forest	Low	High	High
32. Olote	*Morchella conica*	Quercus Ilex Forest	Low	High	High
33. Matas	Unidentified scientific name	All kinds of forest	Low	High	Medium
34. Coyote	Unidentified scientific name	All kinds of forest	Low	Low	Low
35. Juanito (Champiñón)	Unidentified scientific name	Plains	Low	Low	Low
36. Hongo de ocote	*Trocholoma magnivelare*	Pinus Montezumae Forest	Low	High	High

Source: Own elaboration based on fieldwork, 2015.

of the mushrooms are located in quercus ilex and pinus montezumae forests and in a lesser amount in the plains. According to data provided by the informants it is observed that in a good amount of species, it is increasingly difficult to determine their exact location, an aspect that is related to variables such as forest fragmentation, anthropic pressure and climate change.

Of the identified mushrooms, only 9 species with high availability and 27 with low availability were geo-referenced. Mushroom pickers describe that finding mushrooms has become more difficult, that the places where they habitually found them have changed drastically and that there is disappearance of some species.

18 species of low cultural importance were detected, 11 with medium cultural importance and 7 with high cultural importance. This aspect is related to those species with greater gastronomic value and those whose collection involves a high degree of difficulty. Species of high cultural importance often have a high economic value, and even some locally highly valued species are not sold and are exclusive to local consumption.

Regarding economic value, there are 27 low value species, 5 medium value species and 4 high value species. This is associated with the loss of value experienced by mushroom pickers, related to the intermediaries who sell the mushrooms to the final consumers. This justifies the development of strategies that help to retain and add value within the mushroom picking territories.

Design of Mycological Tourism Paths

Of the 36 species identified, it is only proposed to use 19 for mycological tourism (Table 2). Which are intended to respect the criteria of ecological, cultural and economic sustainability. Those species with very low availability, which are culturally significant for the population and those with high market price, are excluded from the recreational harvesting. With this, it is sought that mycological tourism does not generate new social tensions around mycological resources.

All species with tourism potential are found in the abies religiosa and pinus spp forest ecotones, which cover most of the study area and have been divided into four mycological paths with different degrees of difficulty and different scenic attractions (Figure 2). This allows articulating different recreational experiences that are halfway between nature and culture. For this purpose, it was important to take into account three fundamental considerations: (i) that the type of land tenure in which the proposal would be developed is communal, so it is important to respect the collective management of resources; (ii) harvesting areas accessible to a wide range of tourists; and (iii) that the interests of the local population would not be affected.

According to the results it was determined to select those paths that have better conditions for the development of mycological tourism. It was determined that the mycological paths were composed, 70%, by those rural roads used by the villagers to carry out other productive activities. This has the objective of not generating new paths that produce impacts such as noise pollution, soil compaction and ecosystem fragmentation. On the contrary it is intended to generate a strategy based on the multifunctional use of existing rural infrastructure.

This prevents tourists from entering the forest and only visiting specific areas that have a high concentration of mushrooms. On the other hand, due to the seasonality of the activity, there are no apparent conflicts due to the land use of forest and tourist use. It is important to emphasize that the use of communal roads, for tourism purposes, encourages the collective appropriation of tourism strategy and limits the participation of external actors.

Table 2. Recommended mushroom species for mycological tourism

Species	Fruiting Time	Keys for Localization
1. *Amanita grupo caesarea*	July – September	In sandy soils under large trees
2. *Amanita rubescens*	July – September	Within the forests, associated with the roots of the trees
3. *Hebeloma aff. Mesophaeum*	June – July	It is widely distributed in coniferous forests
4. *Laccaria laccata*	June – September	In wet soils under trees
5. *Clitocybe gibba*	October – December	Under shady trees in coniferous forests
6. *Clitocybe squamulosa*	October – Diciembre	Under shady trees in coniferous forests
7. *Lactarius deliciosus*	July – October	Under the pines
8. *Lactarius scrobiculatus*	June – September	Under the pines
9. *Boletus luridus*	September – October	In mossy areas
10. *Boletus pinophilus*	May – June	In pinus spp forests in areas rich in moss
11. *Cantharellus cibarius*	June – October	In coniferous forests, in areas rich in moss
12. *Gomphus fluccosus*	August	In abies religiosa forests in areas rich in moss
13. *Gomphus kauffmanii*	August	In coniferous forests in soils rich in organic material
14. *Clavulina cristata*	July – August	In coniferous forests, in moist areas, near rotten wood
15. *Ramaria flava*	July – December	Inside the forest in humid and dark areas
16. *Ramaria flavescens*	July – August	In litter in mixed forest areas
17. *Ramaria Formosa*	July – August	Grow under the trees
18. *Ramaria aff myceliosa*	July – August	It grows on land and rarely in moist logs
19. *Ramaria aff sanguinea*	July – August	Woody substrate, under the ground, in coniferous forests

Source: Own elaboration based on fieldwork (2015).

Figure 2. Map: mycological tourism paths in Texcaltitlán, State of Mexico
Source: Own elaboration based on field work, 2015.

FUTURE RESEARCH DIRECTIONS

The use of GIS as a planning, management and evaluation tool has been widely used in tourism studies. However, there are few examples of the use of these systems applied to rural tourism focused on local resources such as mycological tourism.

In this direction, the use of GIS as a tool for planning and management of mycological tourism should be conceived in the context of an integrated strategy for sustainable forest management. This is important because traditional ecological knowledge, linked to the use of mushrooms, should not only be a source of information, but must provide a perspective and a way of seeing the world that influences development policies and strategies for the rural space. This gives an ethical dimension to the application of GIS that has a positive impact on the actors affected by the way information is presented.

Accordingly, GIS is an important tool for tourism planning since in the rural space it is essential to generate information on endogenous resources that will help local actors to face the challenge of diversifying their productive activities towards tourism. This requires precise data on the set of goods and services that is useful to determine the tourist potential of the territory.

Nevertheless, some aspects to investigate are still pending, such as the perspective of the tourist demand, the carrying capacity and the mechanisms of regulation of this new activity in the territory.

CONCLUSION

One of the main advantages of the analysis conducted through GIS is that it allows a comprehensive perspective on the interrelations between the data collected, which allows an adequate spatial projection of the sustainable tourism strategy in the social, economic and environmental dimensions. For this, it is necessary that the data feeding and its subsequent interpretation be based on a participatory approach.

The results show that there are an important variety of wild edible mushrooms in the study area, whose use through commercialization and self-consumption provides marginal benefits for the mushroom pickers. In this regard it can be concluded that mycological tourism can diversify the traditional activities of the mushroom pickers and generate more lucrative benefits that positively impact on their quality of life.

Mycological tourism is not the panacea to solve the economic problems of the mushroom pickers but it is a complementary strategy that must strictly follow criteria to protect the species of threatened mushrooms and must work for the benefit of those who have been dedicated to the mushroom harvesting as an economic activity.

Mycological tourism in Texcaltitlán should be a small-scale activity, in accordance with the available accommodation infrastructure, which should be restricted to the use of the 19 species with tourist vocation and only four paths must be operated, which agree with the communal roads where the population develops other forestry activities.

This chapter is part of a basic science research aimed at exploring the tourist potential of wild edible mushrooms in the high mountain area of central Mexico. The data obtained in this research can be useful to generate mechanisms of control, management and territorial ordering around the mycological resources.

ACKNOWLEDGMENT

This work was funded by the National Council for Science and Technology of Mexico (CONACYT) through the SEP – Basic Science Joint Fund 2014; and by the Autonomous University of the State of Mexico through the Fund for Innovation and Development 2014.

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KEY TERMS AND DEFINITIONS

Altiplano: An elevated intermontane plateau, which is generally found between two or more mountain ranges.

Central Mexico: The central region of Mexico concentrates most of the economic, political and cultural activity of the country. It is made up of Mexico City and the states of Guanajuato, Hidalgo, Mexico, Morelos, Puebla, Querétaro and Tlaxcala. Its approximate extension is of 130,000 km2.

Communal Lands: Mode of land tenure that is jointly exploited by a social group and owned by the community.

Geographic Information Systems: An organized integration of hardware, software and geographic data to capture, store, manipulate, analyze and deploy geographically referenced information in order to solve complex planning and management problems.

Mycological Tourism: Tourism and leisure activity that combines cultural, nature and sports activities. It consists of the search and collection of wild edible mushrooms with the purpose of consuming them as a gastronomic product of high quality.

Participatory Approach: A set of methodologies and approaches based on the participation of the local population and used for the diagnosis, execution, monitoring and evaluation of development projects.

Rural Tourism: All forms of tourist activity carried out in rural areas are usually small-scale and developed within the family economy. It is based on the natural and cultural resources of the rural environment.

Territorial Specialization: The new economy of rural areas is based on the productive specialization of the countryside, linked to the particular characteristics of its natural and cultural capital.

Traditional Ecological Knowledge: A qualitative, intuitive, holistic, moral and spiritual knowledge, based on empirical observation and accumulation of facts through the daily use of natural resources.