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Traditional knowledge about mushrooms in a Nahua community in the state of Tlaxcala, México

A. Montoya[1]
O. Hernández-Totomoch
A. Estrada-Torres
A. Kong

Centro de Investigaciones en Ciencias Biológicas, Universidad Autónoma de Tlaxcala Km 10.5 Autopista San Martín Texmelucan-Tlaxcala, Ixtacuixtla, Tlaxcala, C.P. 90120, México

J. Caballero

Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México Apartado Postal 70-614, México, D.F. 04510, México

Abstract: This paper describes the traditional mycological knowledge of the Nahua of San Isidro Buensuceso, on the slopes of La Malinche Volcano National Park, in the state of Tlaxcala, México. The results described in this paper were obtained through interviews with villagers selected at random; a free-listing technique was used to determine the cultural significance of the mushrooms of the region. A total of 48 species, which had 65 Náhuatl names and 40 in Spanish, were identified. Although San Isidro villagers consider mushrooms to be a natural resource mainly used for food, they also use them for medicine, insecticides and trade. This paper presents traditional information on the morphology, ecology, fenology and consistency of the mushrooms found around San Isidro. It proposes that, from a cultural perspective, *Gomphus flocossus*, *Ramaria* spp. and *Boletus* spp. are the most important species of the region.

Key words: Ethnomycology, La Malinche National Park, Nahua, traditional uses of fungi, wild mushrooms

INTRODUCTION

The Nahua are the most numerous and widely distributed ethnic group in central México. Nevertheless, few academic studies have focused on describing the group's traditional knowledge of mushrooms. Nahua used fungi during rituals, according to historic record. Nahua prehispanic poetry describes fungi consumption in religious ceremonies. The fungi used in those ceremonies commonly were known as ''xochinancatl'' or ''teonanacatl'' (Wasson 1983). *Psilocybe aztecorum* Heim, known as ''niños,'' ''niñitos'' or, in Náhuatl, ''apipiltzin,'' currently is used in religious rites in San Pedro Nexapa, on Volcan Popocátepetl. *Psilocybe muliercula* Sing. & Smith is a hallucinogenic mushroom used by the Nahua in Tenango del Valle, in the state of México (Guzmán 1983).

Although it is not known whether Nahua ceremonial use has endured elsewhere, other uses and aspects of the traditional knowledge have been studied. Dubovoy (1968) analyzed various indigenous codices and presented evidence that, in the past, the Nahua used mushrooms for food. Martín del Campo (1968) translated Náhuatl mushroom names registered by Herrera and Guzmán (1961), explained their meaning and offered synonyms and ecological information. Guzmán et al (1975) studied a specimen of *Ganoderma lobatum* (Schw.) Atk., which is displayed in a place of honor in a church in Chignahuapan, Puebla. Local people revere this particular mushroom, which was found in a local forest, believing that it has miraculous properties because of designs on its surface that suggest the face of Christ, the sun, the moon and the number 80. De Ávila et al (1980) analyzed the traditional Náhuatl nomenclature that residents of Hueyapan, Morelos, used for mushrooms, documenting how the mushrooms were used and how they were prepared for consumption. González (1982) carried out a study in Santa Catarina del Monte, Texcoco, obtaining information on the Náhuatl nomenclature of the local mushrooms, where they grew and how they were used. Martínez-Alfaro et al (1983) investigated the importance of mushrooms and the differences in the traditional knowledge of some communities in Puebla, gathering information on the origin of the mushrooms, their Náhuatl names, uses and importance. That paper concluded that the perception of mushrooms varies according to the viewer's age, sex, economic position and degree of cultural integration into the community. Gispert et al (1984) interviewed people of all ages in two Nahua communities in the state of México. They asked their subjects nine questions dealing with

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[1] Corresponding author. E-mail: ametnomicol@hotmail.com

mushroom nomenclature, classification, morphology, ecology and use. They also collected 24 mushroom species. They concluded that, in the village of Parres, mushroom trade is an important activity while, in the village of El Capulín, mushrooms are used only for home consumption.

In Tlaxcala, there is no documentaton on the current use of mushrooms by the Nahua, although there is some evidence that the ancient Nahua knew of their hallucinogenic and edible properties (Wasson 1983). The oldest reference is found in a paragraph in the book *Relación de Tlaxcala (Tlaxcala Connection),* written by Muñoz-Camargo (1586). This paragraph describes the use of a mushroom called ''nanacatl'', which the local aristocracy ate to predict the future. When these seers ate the mushroom, they were said to become drowsy, faint and have visions. Rojas-Garcidueñas (1935 in Wasson 1983) published an anthology of plays written toward the end of the 16th century, called *El Teatro de la Nueva España (The Theater of New Spain)*. One of the plays (it is not known whether it ever was performed in public) included in this work shows the opposition of the church to the use of hallucinogens. The play describes a baptism ceremony in which royalty ate such mushrooms. Wasson (1983) interpreted the words ''hongol,'' ''demon'' and ''idol'' in this play to mean ''teonaanacatl'' or ''xochinanacatl'' because of the way the word ''mushroom'' is translated into Spanish.

No one has determined the taxonomic identity of the mushrooms used for religious purposes by the ancient Tlaxcaltecan. However, such a register might include *Psilocybe aztecorum* or *Copelandia cyanescens*, two species with hallucinogenic properties that have been found in Tlaxcala (Guzmán 1983, Santiago-Martínez et al 1990). Additional historical references to these mushrooms can be found in ancient writings. One example is the name Antonio Xochinanácatl (''xochinanácatl = hongo flor = mushroom flower''), which appeared in a judicial proceeding in Tlaxcala long ago. The word ''Nanacamilpa'' means ''milpa de hongos'' (''nanacatl = hongo y milpa = mushroom and cornfield'') and is the name of a Tlaxcaltecan municipality founded in 1858. It is not known why this municipality was thus named (Wasson 1983). Residents of some communities on the slopes of Volcan La Malinche, Tlaxcala, still speak Náhuatl, with the village of San Isidro Buensuceso having the greatest number of inhabitants who speak it (79% of the population; INEGI 2000).

No studies have been conducted to measure the cultural significance of fungi, other than investigations into the roles fungi have played in the lives of Mesoamericans since pre-Hispanic days. For this reason this study was launched to describe the traditional mushroom knowledge of the people of San Isidro Buensuceso, including information on mushroom nomenclature, morphology, use and when and where mushrooms grow. The number of times mushroom names were mentioned in a free listing was used as an indicator of the cultural significance of those mushrooms to San Isidro residents. We do not know which factors they rely on when assessing the cultural importance of mushrooms; natural availability (abundance in the forest) and income derived sales could be two such factors. To test whether this is so, data from an ecological study were used to determine the relationship of the abundance of various mushrooms species in the forest and the cultural significance of such mushrooms to the community. Cultural significance also was compared to the price of each species.

MATERIALS AND METHODS

Field of study.—The village of San Isidro Buensuceso, which lies on the southern slope of Volcan La Malinche, at 2600 m (FIG. 1), belongs to the municipality of San Pablo del Monte, in the southeastern part of the state of Tlaxcala. The community was founded near the end of the 19th century and has 6253 inhabitants (INEGI 2000). It has a temperate, subtropical climate, with plenty of summer rain and with average winter rain of less than 5 mm a month. The annual temperature varies between 12 C and 18 C. March, June, July and August are the warmest months, with temperatures between 14 C and 15 C, while the coldest months are December, January and February, with temperatures between 11 C and 12 C (Garcia 1986).

The residents of San Isidro Buensuceso collect mushrooms in local forests, as well as in areas surrounding the town and in cultivated fields. The vegetation of the forests includes: *Abies religiosa* (HBK.) Chamb. & Schl., *Pinus hartwegii* Lindl. and *Pinus montezumae* Lamb. Some forest patches with steep slopes, and a few areas near the crater Hueytlaocan have a mixture of *Alnus jorullensis* H.B. & K., *Salix* spp., *Cupressus* sp., *Quercus* spp. and *Abies religiosa.* The main types of shrubbery include secondary elements such as *Baccharis conferta* HBK. and *Senecio* spp. Grasslands have filled in the open areas; they consist of *Muhlenbergia macroura* (H.B.K.) Hitch., *Stipa ichu* (Ruiz & Pavón) Kunth. and *Eragostris bartieri* Dar.

Fieldwork involved 26 visits to San Isidro Buensuceso, in which 226 semistructured interviews were conducted. For these interviews, participants of both sexes and of different ages (5–90 yr) were selected randomly following Bernard (1988). The random selection was done as follows: 100 numbered dots were placed around the edge of a local map. Pairs of numbers were chosen randomly from a plastic bag, and lines were drawn between those numbers on the map. After 50 lines were drawn, the sampling was begun. The uneven areas created by the lines were numbered, and some of those plots were chosen randomly until 22 had been selected. Ten or 11 households in the designated area were visited, again at random.

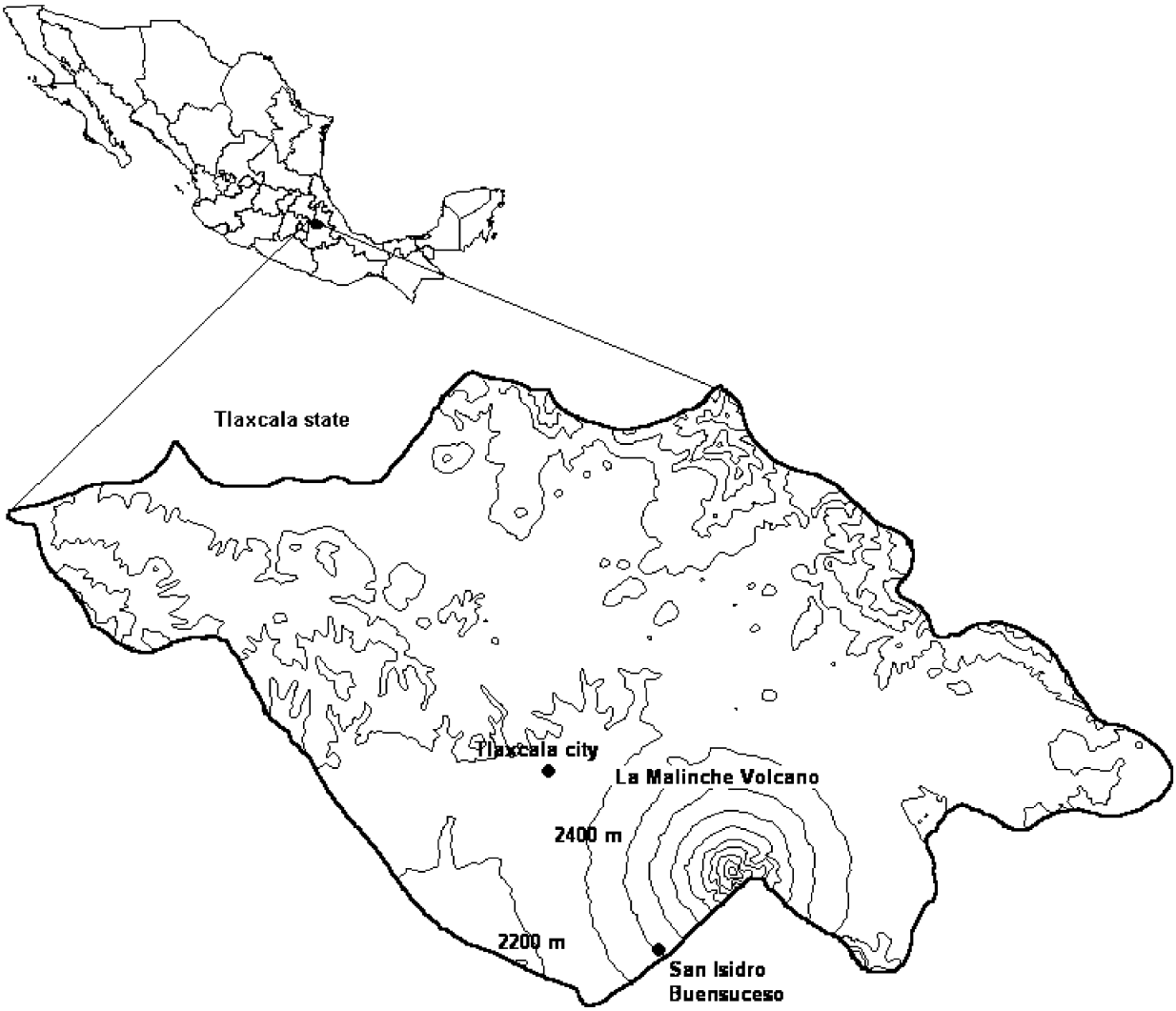

FIG. 1. Location of San Isidro Buensuceso and Malinche National Park.

In each interview, direct questions were used and, on several occasions, fresh or dry mushrooms and field guides were shown as stimuli. The interviews covered these aspects: common names of mushrooms, ideas about the origin of mushrooms, elements required for their development, classification according to the ''cold-hot'' system (described later), words used to name the different parts of the mushrooms, mushroom uses, methods of cooking, criteria used to distinguish edible from poisonous mushrooms, the months mushrooms are found, the locations where they are found and the prices at which they are sold in the community.

During the rainy seasons of 1998–2000, fieldtrips were undertaken with key informants from the village, with the intention of collecting the mushrooms known and used by the locals and to corroborate the information obtained about times and places of growth. All mushroom species were collected in La Malinche National Park. The collections were taken to the Centro de Investigaciones en Ciencias Biologicas of the Universidad Autonoma de Tlaxcala (UAT) (Research Center of Biological Sciences) with the aim of identifying and drying them, as suggested by Cifuentes et al (1986). Different taxonomic keys were used to identify mushrooms, depending on the genus involved; those keys were supplied mainly by Abott and Currah (1988), Bon (1987), Jenkins (1986), Moser (1983), Romagnesi (1967) and Singer (1975). The specimens then were deposited in TLXM (Holmgren and Holmgren 1995). The initials used for collectors are: AK (Alejandro Kong), E-T (A. Estrada-Torres), OHT (O. Hernández-Totomoch) and AM (A. Montoya). The classification used was based on that proposed by Hawksworth et al (1995). Náhuatl names were written as pronounced by the San Isidro villagers and later translated into Spanish, using the Simeon (1977) and Sullivan (1992) dictionaries. The names then were compared with the information published by De Ávila et al (1980).

To determine the cultural significance of the mushrooms studied, structured interviews were conducted with 46 participants (24 females and 22 males, most of them married couples). One of the households of each area previously selected in the semistructured interviews was chosen for this purpose. Structured interviews made use of free listings, in

TABLE I. Mushroom species and traditional names used in San Isidro Buensuceso

Scientific name voucher specimens and	Náhuatl name	Spanish name
1. *Agaricus campestris* L. *AM 1644*	*ayotzin, ayutzin* (*ayotl* or *ayutl* = turtle; *ayohtli* = pumpkin; *tzin* = diminutive reverential; little turtle or little pumpkin)	Champiñón
2. *Amanita caesarea* (Scop.) Pers. *AM 1598*	*ayoxóchitl* (*ayotl* = zucchini; *xochitl* = blossoms; zucchini blossom mushroom) *cuazitlal* = ? *aquiyoxóchitl* (*quiyotl* or *quiotl* = vástago o retoño; *xochitl* = flower).	flor de calabaza = zucchini blossoms amarillos = yellow mushrooms
2. *Amanita tuza* Guzmán *AM 1747*	*cuatlamanil, cuatlal* (*quaitl* = head; *tlamanil* = ?) *iztacnanácatl* (*iztac* = white; *nanacatl* = mushroom; white mushroom)	—
3. *Armillaria mellea* (Vahl) P. Kumm. *AM 1742*	*tetecuitl* (*tecuitlatl* = slime or *cuitla*, excrement; probably means stone excrement) *xotlalist* = ? *xocuitlas* = ?	—
4. *Boletus atkinsonii* Peck *AM 1595*	*xotoma, xotomame, xotomate, xotomatzi* (icxi = paw, *tomahuac* = fat, fat paw mushroom; or *xitomatl* = red tomato, mushroom like tomato) *tlapalxotoma* (*tlapalli* = color), *tlatlauxotoma* = ?, *tlacuaxotoma* = ? *pantenanácatl* (pan = bread; mushroom like bread) *tlaxcaxotoma* (tlaxcalli = tortilla; tortilla mushroom) *zacaxotoma* (*zacatl* = grass) *ocoxaltoma* (*ocoxal* = pine cone litter) *oyamelxotoma* (*oyametl* = fir)	panza grande = big belly pante = ? cemita = meat sandwich pata gorda = fat paw
5. *Boletus pinophilus* Pilát & Dermek *OHT 05, 22*	*xotoma, xotomame, xotomate, xotomatz xitomatl* = looks like red tomato, mushroom like tomato; *tlapalxotoma, tlatlauxotoma, tlacuaxotoma, pantenanácatl, tlaxcaxotoma, zacaxotoma, ocoxaltoma, oyamelxotoma* See *B. atkinsonii*	*panza grande = big belly* *pante = ?* *cemita = meat sandwich* *pata gorda = fat paw*
6. *Cantharellus cibarius* Fr. *OHT 25*	tecosa, tecusa, tecutzal (*cuztic* = yellow; there is a yellow wild flower called *teguza*)	amarillitos = little yellow mushrooms
7. *Chroogomphus jamaicensis* (Murrill) O.K. Mill. *OHT 21*	*tlapaltecosa tlapaltecosauitl* (*tlapalli* = color or painting; it refers to a purple *tecosa*) *xilpatzutl* = ?	hongo morado = purple mushroom
8. *Clitocybe giba* (Pers.) P. Kumm. *OHT 44*	*izquilo* (*izquitl* = perfumed flower; the name refers to the mushroom's sweet smell) *totomoch* (*totomachtle* = the corn husk; its color resembles the color of cornhusks)	hongo de campana = bell mushroom campanilla = little bell
9. *Clitocybe* cf. *squamulosa* (Pers.) Fr. *OHT 24*	*izquilo, totomoch* See *C. gibba*	hongo de campana = bell mushroom campanilla = little bell
10. *Gomphus floccosus* (Schwein.) Singer *AM 1609*	*tlapitzal* (*tlapitzalli* = trumpet; mushroom with the trumpet shape) *oyamelnanácatl* (*oyametl* = fir; *nanacatl* = mushroom; fir mushroom)	corneta = trumpet cornetilla = little trumpet
11. *Hebeloma* cf. *mesophaeum* Fr. *AM 1713*	*ocoxalnanácatl* (*ocoxalli* = pine cone litter, it refers to pine needles; mushroom which grow in pine needles) *rastrojonanácatl* (rastrojo in Spanish means stubble; it refers to a mushroom growing in pine cone litter which looks like stubble)	hongo de ocote = pine cone mushroom

TABLE I. Continued

Scientific name voucher specimens and	Náhuatl name	Spanish name
12. *Helvella crispa* (Scop.) Fr. *OHT 19; AM 1602*	*pantalonanácatl* (pantalón in Spanish means trousers, *nanácatl* = mushroom)	*gachupi* blanco (blanco = white, *gachupi* = colloquial Mexican Spanish for Spaniards)
	huihuixocatzi (*uiuixqui* = weak; *xocatzi;* = ?, weak mushroom ?)	orejas = ears
	gachupitzetze = ?	güerito = little blond mushroom
	soldadosnanácatl (*soldados* in Spanish means soldiers, the soldiers mushroom)	orejas de ratón = mouse ears
	huevisnanácatl (huevo in Spanish means egg; egg mushroom)	tamborcito = little drum
13. *Helvella lacunosa* Afzel. *OHT 20, 38*	*charrononácatl* (charro in Spanish means horseman; horseman mushroom)	negrito = little black
	cuatlil (*quaitl* = head; *tlilli* = black; black head)	mushroom *gachupi negro* = black gachupi
14. *Hygrophorus chrysodon* (Bastch.) Fr. *AK 2831*	*xilonanánácatl* (*xilotl* = corncob; *nanacatl* = mushroom)	señoritas = young ladies
	xilonaltzitzi (*tzitzi* = ?)	blanquitos = little white mushrooms
	xixilonanácatl	
15. *Lactarius indigo* (Schwein.) Fr. *OHT 32*	*cacaxnanácatl* (*cacaxtli* = it refers a kind of bird and its blue color)	hongo azul = blue mushroom
16. *Lactarius salmonicolor* R. Heim *et* Leclair *OHT 30*	*chilnanácatl* (*chilli* = chilipepper; *nanácatl* = mushroom; referring to its bright red color or to the peppery flavor some informants claimed it has)	cajetitos rojos = red cajetitos (something shaped like a dish),
	chilabuelita (abuelita in Spanish means grandma), *chimelnanácatl, chilnanatzi, chichilnácatl, oyamelchilnanácatl*	trompa de cochino = pig
17. *Laccaria bicolor* (Maire) Orton *OHT 18*	*xocoyoli, xuxocoyoli, xoxocoyoli, xoxocoyolnanácatl, xocoyolnanácatl* (*xogoyolli* = the last child in the family, *xogoyolti* is the plural form, *xocoyoles* the Spanishized plural. The name is given because it is one of the smallest edible mushrooms)	clavito = little nail
18. *Lycoperdon perlatum* Pers. *AM 1615*, *OHT 14*	*xiteburo, xitenanácatl, xitetl* (*xiuitl* = red herb; *tetl* = egg; *buro* = simplification of the Spanish word, *burro* = donkey; donkey egg mushroom)	huevitos = little eggs
	cefamil = ?	
19. *Lycoperdon* sp. *AM 1605*	*xiteburo, xitenanácatl, xitetl cefamil*	huevitos = little eggs
	See *L. perlatum*	
20. *Lyophyllum decastes* (Fr.) Singer *AM 1741*	*xoletl, xuletl (xoletl* = It must be very delicate, *xolectle* is one easily hurt, *xoleme* is the plural)	clavitos = little nails
	tlacualxoletl, (*tlacuahuac* = oak)	hongo de mata = tuft mushroom
	ocolxoletl (*ocotl* = conepines) *cuaxuaxoletl* = ?	
21. *Morchella elata* Fr. *OHT 31*	*olonanácatl* (*olotl* = corncob, they are like corncobs. The name applies to various species of *Morchella*)	olotes = corncobs
22. *Morchella esculenta* (L.) Pers. *AM 857*	*olonanácatl*	olotes = corncobs
	See *M. elata.*	
23. *Pleurotus opuntiae* (Durieu & Lév.) Sacc. *AM 974*	*menanácatl* (*metl* = maguey, *nanácatl* = mushroom)	hongo de maguey = maguey mushroom
	mesonanácatl (megotl = dry maguey, mushroom of dry maguey)	
	huexonanácatl (*huexotl* = willow, willow mushroom)	
24. *Ramaria bonii* Estrada *AM 1599*	*xelhuas* (*xelguaztle* = brush or broom, mushroom broom)	escobeta = broom
25. *Ramaria cystidiophora* (Kauffman) Corner *AM 1715D*	*xelhuas* (See *R. bonii*)	escobeta = broom
26. *Ramaria rubripermanens* Marr & D.E. Stuntz *AM 1715C, 1747A*	*xelhuas* (See *R. bonii*)	escobeta morada = purple broom
	cuamanox = ?	
	xelhuastzitzi (tzitzi = ?)	

TABLE I. Continued

Scientific name voucher specimens and	Náhuatl name	Spanish name
27. *Ramaria sanguinea* (Pers.) Quél. *AM 1747B*	*xelhuas* (See *R. bonii*)	escobeta = broom
28. *Ramaria versatilis* Quél. *AM 1766*	*xelhuas* (See *R. bonii*).	escobeta = broom
29. *Russula delica* Fr. *OHT 15*	*cuatecax* (*cuatlil* = head, *tecaxitl* = stone dish; mushroom with a cap like a stone dish, because it has the shape of the stone dish, or metate used to mash vegetables to make sauces) *cualtzitzi* (*cuatlil* = head, *tzitzi* = ?) *iztacnanácatl* (*iztac* = white, *nanácatl* = mushroom)	charritos = little horsemen tecajete = Spanicized word from *tecaxitl*
30. *Suillus pseudobrevipes* A.H. Smith *et* Thiers *AM 1596*	*poposo, pupuso* (*poposonallot* = foam; foam mushroom. Referring to the hymenium appearance)	panza = belly pancita chica = little belly
31. *Ustilago maydis* (DC.) Corda *AM 973*	*cuitlacoche* (*cuitla* = excrement; *cochi* = the pig; pig's excrement)	hongo de maíz = corn mushroom cochinito = little pig

which respondents were asked to name 20 mushrooms that they were familiar with (the question in Náhuatl was: (''r nechunili tlanitoca nanacatl'' = ''Tell me the names of 20 mushrooms you know'') (Weller and Romney 1988, Bernard 1988). Each interview was carried out independently of the others. The surveys were conducted during the dry season (January–April), ensuring that all mushroom species had the same probability of being mentioned.

Free-listing compilations leads to several conclusions. First, some items on the list are better known, more important or more familiar to respondents than other items. Such items usually are placed high on an individual list. Second, there is usually a wide range in terms of where residents will place each item in their lists. The free-listing technique, therefore, lets us find the most important items with minimal effort. The list will not be definitive. However, as the number of respondents increases, the list will becomes more stable and the order of items will tend not to change even when a few new items are added by new respondents (Weller and Romney 1988). This approach suggests that the names of the mushrooms referred to most often by respondents are those that have the greatest cultural importance in the community studied.

The hypothesis of this paper is that the importance of a mushroom species bears a relationship to its abundance in the forest and/or to its price. To prove this, a three-year ecological study was undertaken in an area of 1600 m^2 in a nearby forest. Fruiting bodies of edible fungi were collected from four *Abies religiosa-Pinus* and four *Pinus-Alnus* transect lines along an altitude gradient in La Malinche National Park. In this area, it was possible to determine how many mushrooms grew in each of four sectors located at the same altitude as the village collection zones. Mushroom abundance was calculated by counting the fruit bodies of each species found in the area under study. The details of the methodology and the results of that ecological study will be published in a subsequent paper. A Spearman index was calculated with a statistics program (StatSoft Inc. 1995) to determine the correlation between frequency of mention and mushroom abundance or frequency of mention and prices.

RESULTS

In total, 48 species were identified, which had 105 common names (65 Náhuatl and 40 Spanish) (TABLES I and II). The mushrooms identified were classified as Ascomycetes or Basidiomycetes. Among the first group, there were three main families: Helvellaceae, with two species; Hypocreaceae, with one species; and Morchellaceae, with two species. The second group contained: Russulaceae and Ramariaceae, with nine species; Boletaceae, with six; Tricholomataceae, with five; Amanitaceae, with four; Lycoperdaceae, with two; and Agaricaceae, Chantharellaceae, Cortinariaceae, Gomphaceae, Gomphidiaceae, Hygrophoraceae, Pleurotaceae, Strobylomycetaceae, Ustilaginaceae and Xerocomaceae with one species each.

Collection of mushrooms.—Those who spend their time gathering and selling mushrooms are known as ''hongeros'', i.e., ''mushroomers'' or ''those who gather mushrooms.'' Gatherers walk 10 km or more, spending 8–10 h in the process. Usually, at least two people, often of the same family or close neighbors, work together. Both men and women gather mushrooms, with the only difference being that men go farther afield. For example, the men search distant canyons to find bigger and better mushrooms. On occasion, they investigate almost inaccessible loca-

TABLE II. Species and traditional names used to describe poisonous fungi

Scientific name and voucher specimens	Náhuatl name	Spanish name
1. *Amanita muscaria* (L.) Hook. *OHT 13*	*pizutnanácatl* (*pitzotl* = pig, *nanácatl* = mushroom; mushroom of the pig, referring to the bad mushroom) *zitlalnanácatl* (*zitlalli* or *citlalin* = star; mushroom of the star, referring to the scales, because they looks like stars)	hongo malo o venenoso
2. *Amanita cf smithiana* Bas *AM 1594*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
3. *Boletus miniatopallescens* A. H. Sm. & Hesler *AM 1607*	*xotomarabia* (*xitomatl* = looks like red tomato, mushroom like tomato; *rabia* = rabies, means that the mushroom is poisonous)	hongo malo
4. *Chalciporus piperatus* (Bull.) Bataille *OHT 04*	*poposorabia, poposo, pupuso* (*poposonallot* = foam, poisonous foam mushroom, referring to the hymenium appearance)	hongo malo
5. *Lactarius chelidoniun* var. *quelidonioides* (A. H. Sm.) Hesler & A. H. Sm. *OHT 11*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
6. *Lactarius luculentus* Burl. *OHT 09*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
7. *Lactarius mexicanus* Kong & Estrada *OHT 07*	*pizutnanácatl* (See *A. muscaria*) *cuatecax* de veneno (*cuatlil* = head; *tecaxitl* = dish stone; poisonous mushroom with a head like a stone dish)	hongo malo
8. *Lactarius* cf. villosus Clem. *OHT 10*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
9. *Ramaria abietina* (Pers.) Quél. *AM 1600*	*Xelhuas* del veneno (*xelhuas* = broom, a poisonous broom)	hongo malo
10. *Leccinum aurantiacum* (Bull.) Gray *AM 1606*	*tepexotoma* (*tepetomatl* = madroño tree. Is a *xotoma* growing around madroños (*Arbutus* spp.)	hongo malo
11. *Ramaria abietina* (Pers.) Quél. *AM 1600*	*xelhuas* del veneno (*xelhuas* = broom, a poisonous broom)	
12. *Ramaria apiculata* (Fr.) Donk *E-T 2304*	*xelhuas* del veneno (See *R. abietina*)	hongo malo
13. *Ramaria concolor* (Corner) R. H. Petersen *AM 1601*	*xelhuas* del veneno (See *R. abietina*)	hongo malo
14. *Russula* cf. *fragilis* Vittad. *AK 2924*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
15. *Russula grisceacens* (Bon & Gaugué) Marti *AK 2939*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
16. *Russula murrilli* Burl. *AM 1613*	*pizutnanácatl* (See *A. muscaria*)	hongo malo
17. *Xerocomus truncatus* (Singer, Snell & E. A. Dick) *OHT 03*	*xotomarabia* (It is a poisonous *xotoma*)	hongo malo

tions to find more mushrooms. The men return and give the mushrooms to the women, who have been collecting in the more accessible places. Women then take charge of all mushrooms and carry them back to the village.

While gatherers are on forays, they exchange information about their finds. For example, they talk about the difficult access in certain locations, the form and color of different mushrooms, and the size and presence and absence of certain structures. FIGURE 2 shows gatherers from San Isidro with mushrooms collected in the forest of La Malinche.

Morphology.—San Isidro residents can name most parts of a mushroom: the cap, the veil, the cap context, the gills, the scales, the ring and the sac. FIGURE 3 shows the Náhuatl names that the San Isidro villagers have given to each part.

Categories of mushroom use.—There are four main categories of mushroom use in San Isidro: food, trade, insecticide and medicine.

Food. Edible mushrooms are called ''cualinanácatl,'' which means ''good mushroom.'' San Isidro villagers know approximately 58 mushroom names in

FIG. 2. Nahua from San Isidro collecting wild edible mushrooms in to the forest.

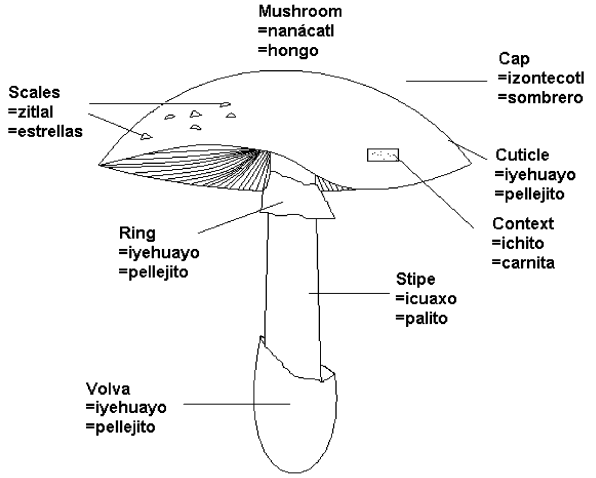

FIG. 3. Náhuatl terms for mushroom structures.

Náhuatl and 39 in Spanish, which correspond to 31 edible species. The mushrooms preferred because of their taste are *Gomphus floccossus* (''tlapitzal''), *Ramaria* spp. (''xelhuasnanácatl'') and *Boletus* spp. (''xotoma''). Each family has its own special way of preparing and eating mushrooms. Mushrooms might be stewed, put in quesadillas, scrambled with eggs, served in a mole or cooked with chile.

Commerce. Of the 220 interviewed, 21% sell the mushrooms they find. Wild mushrooms are sold ''for the ranch'' and ''for the market''. ''For the ranch'' is the most common sale and involves going to nearby villages and peddling door to door. Vendors have certain customers who buy their mushrooms every year; vendors tend to go directly to those houses first.

''For the market'' sales take place at a local market, where mushrooms are put in small piles in vendors' stalls. This activity takes place mainly in San Pablo del Monte's municipal marketplace. The mushrooms are sold by the kilo, by a portion halved by hand or by the piece, depending on the species. Only large mushrooms, such as *Amanita caesarea* (''ayocóchitl''), *Boletus atkinsonii*, *B. pinophilus* (''*xotoma*'') and *Gomphus floccosus* (''tlapitzal''), are sold individually.

Insecticide. The only species used as an insecticide is *Amanita muscaria.* The flesh of the mushroom cap is mixed with sugar and put in dish in a high place in the room. The mixture is supposed to attract and kill flies. This use was mentioned by 1.4% of the respondents.

Medicine. Only *Ustilago maydis* serves a medicinal purpose for 37% of those interviewed. One use is to spread the spores of the dried mushroom on a wound. It also can be used to moisturize dry lips, heal wounds, dry the navels of newborns, to heal baby rashes (in powder form), to stop hemorrhages and to help heal animal bites. The mushroom also is prepared as a tea to alleviate dehydration caused by the consumption of too much alcohol.

Classification criteria.—Texture and consistency are important selection criterions for mushrooms merchants. Mushrooms are classified either as ''plain'' or ''of higher quality''. ''Plain'' mushrooms are brittle, fragile, small and easily damaged during transport. Because they need care, they are placed in the upper part of the collection basket or in a separate container. Examples of such mushrooms are *Clitocybe gibba* and *C. squamulosa* (''izquilo''), *Ramaria* spp. (''xelhuas''), *Hebeloma* cf. *mesophaeum* (''ocoshal''), *Amanita tuza* (''cuatlamanil''), *Laccaria bicolor* (''xocoyule'') and *Hygrophorus chrysodon* (''xilonananácatl'').

Mushrooms considered to be of the best quality are those that have a firmer and more enduring texture, are large and are not affected by transportation. Examples include *Gomphus floccosus* (''tlapitzal''), *Amanita caesarea* (''xochilnanácatl''), *Boletus pinophilus* (''xotoma''), *B. atkinsonii* (''tlacuahuacxotoma'') and *Lyophyllum* spp. (''xuletl''). San Isidro villagers like to collect solid mushrooms because these are generally of good quality and only a few are discarded. Nevertheless, they collect all the mushrooms they can find so that they will have more to sell and eat. Mushrooms are carried in baskets, boxes and plastic bags.

Hot-cold classification.—Classification of food and other elements of the universe as ''cold'' or ''hot'' is an important element of the Latin-American cultures (for a detailed explanation see Foster 1979 and Montoya et al 2002). According to this classification, mushrooms in several parts of México are considered to be cold. In San Isidro, they are considered ''cold'' by 69% of those interviewed and hot by 3%. The first

TABLE III. Criteria used to distinguish between a poisonous and an edible mushroom

Poisonous fungi	Edible fungi
* When you cut the mushroom it turns either green or purple	* When you cut the mushroom it does not stain green or purple
* When you taste a piece of the mushroom, it burns/stings the tongue	* When you taste a piece of the mushroom, it does not burn/sting the tongue
* Bad odor	* Pleasant odor
* Tastes bitter	* Sweet taste
* There is no presence of worms	* Presence of worms
* Presence of scales on the cap	* Without scales on the cap

criterion (cold) is associated with a minor stomach ache that some experience after eating a lot of mushrooms. Respondents think that mushrooms are cold because they grow in the forest where it tends to be cold. Some (3.1%) answered that mushrooms are ''hot'' because they need the heat of the sun to fruit or because they upset the stomach.

Classification by use.—San Isidro residents put mushrooms into two categories: good mushrooms (''cualinanatl'' = hongo bueno = good mushroom) and inedible mushrooms (''pitzunanácatl''). The most important are the edible mushrooms. This is evidenced by the many names they have been given, the knowledge of where and when they grow, the time spent looking for them, price and the fact that they choose to eat these species more than any others.

Seventeen poisonous species, which had seven Náhuatl names (TABLE II), were collected. In Spanish, they are called ''hongos malos'' or ''hongos venenosos'' while, in Náhuatl, the terms are ''pitzunanácatl'' (= hongo de puerco = mushroom of the pig) and ''zitlalnanácatl'' (= estrella-hongo = star mushroom). The latter refers to the white scales on the cap of *Amanita muscaria*, a fungus widely known in the San Isidro area and considered poisonous by most respondents.

Some add the word ''rabies'' to fungi considered poisonous, such as *Xerocomus truncatus*, which is named ''xotomarabia''. Poisonous fungi have no use whatsoever and are considered harmful, with the exception of *Amanita muscaria*, used as an insecticide. Many San Isdidro residents believe that all edible mushrooms have a poisonous double. For example, the double for *Amanita caesarea*, known as ''ayoxóchitl,'' is *Amanita muscaria* (''citlalnanácatl'' or ''ayoxóchitl de veneno'').

TABLE III lists the criteria the villagers use to identify edible and poisonous mushrooms. To be certain that they have collected an edible species, gatherers always pay particular attention to the morphological structures of each mushroom gathered.

The growing season.—In the case of San Isidro Buensuceso, mushroom season begins in March and ends in September, with June, July and August producing the most mushrooms. Mushrooms can be divided into several categories according to when they fruit. The first group includes those that need only a little humidity. These appear from March to June and include *Agaricus campestris*, *Amanita tuza*, *Hebeloma* cf. *mesophaeum*, *Lyophyllum decastes* and *Russula delica*. Some San Isidro residents believe that ''xoletl'' (*Lyophyllum decastes)* is edible only if it is collected before June 24; they believe it is poisonous after that date.

The second group includes mushrooms that need a lot of moisture to fruit. These appear from July until September and include: *Amanita caesarea*, *Armillaria mellea*, *Boletus atkinsonii*, *Laccaria bicolor* and *Suillus pseudobrevipes*. Species that emerge at the end of rainy season (the third group) include: *Cantharellus cibarius*, *Clitocybe gibba*, *Gomphus floccosus*, *Helvella crispa*, *Helvella lacunosa*, *Hygrophorus chrysodon*, *Lactarius salmonicolor*, *Morchella* spp. and *Ramaria* spp.

Data on where mushrooms grow.—San Isidro gatherers know exactly where to look for each type of mushroom. TABLE IV presents this information.

Frequency of mention.—The free-listing technique, described earlier, yielded a total of 52 traditional and common names for 29 mushroom species. TABLE V shows how often each species was mentioned.

According to the study findings, more than 90% of those interviewed mentioned these mushrooms: *Gomphus floccosus*, *Ramaria* spp., and *Boletus pinophilus*. Other mushrooms also appreciated and mentioned by more than 50% of the participants were: *Amanita caesarea*, *Cantharellus cibarius*, *Clitocybe* spp., *Laccaria bicolor*, *Lyophyllum decastes*, *Morchella* spp. and *Russula delica*. The mushrooms mentioned by more than 20% of the interviewees but fewer than 50% were: *Hebeloma* cf. *mesopheum*, *Armillaria mellea*, *Hygrophorus chrysodon*, *Suillus pseudobrevipes*, *Chroogomphus jamaiscensis*, *Helvella crispa*, *Lactarius indigo*,

TABLE IV. Places where mushrooms grow

Outside of the forest	
Plains and meadows	*Agaricus campestris* (ayutzi)
	Lycoperdon perlatum (xiteburo)
On *Agave* spp. (maguey)	*Pleurotus opuntiae* (mesonanácatl)
Around agricultural fields (*Zea mays*) on oak trunks (*Quercus* sp.)	*Armillaria mellea* (''tehtecui'')
	Amanita tuza (''cuatlamanil'')
Road sides	
In the forest	
In fir forest (*Abies religiosa*) (''oyametl'')	*Clitocybe gibba* (''izquilo'')
	Gomphus floccossus (''tlapitzal'')
	Helvella crispa (''gachupi'')
	Helvella lacunosa (''charronanácatl'')
	Hygrophorus chrysodon (''xilona'')
	Lactarius salmonicolor (''chilnanácatl'')
	Morchella esculenta, M. elata (''olonanácatl'')
	Ramaria spp. (''xelhuas'')
In pine forest (*Pinus* spp.) (''ocotl'')	Associated to grass (*Agrostis* sp. and *Mulhenbergia* sp.)
	Boletus pinophilus, B. atkinsonii (''xotoma'')
	Suillus granulatus, S. pseudobrevipes (''poposo'')
	Amanita caesarea (''ayoxóxitl'')
	Cantharellus cibarius (''tecosa'')
	Chroogompus jamaiscensis (''tlapaltecosa'')
	Hebeloma cf. *mesophaeum* (''ocoxal'')
	Laccaria bicolor (''xoxocoyule'')
	Lyophyllum decastes (''xuletl'')
In oak forest (*Quercus* spp.) (''tlacuauatl'')	*Armilaria mellea* (''tehtecui'')
	Lactarius indigo (''cacaxnanácatl'')
	Hypomyces lactifluorum (''chilnanácatl de ocotl'')
	Boletus sp. (''xotoma'')

Agraricus campestris and ''*totoltenanácatl*'' (a species not gathered by San Isidro villagers).

TABLE VI lists how many of each of 17 species were found in the local forest. These figures are compared with data on the frequency of mention and prices. Mushroom names were ranked from most significant to least significant, according to the number of people who named them. The table presents abundance information only for the species mentioned in the free listing and for which prices were available. The Spearman correlation index between frequency of mention and abundance had a value of −0.51, while that between frequency of mention and price had a value of 0.39. The most abundant species in the study area were *Laccaria bicolor*, *Morchella* spp., *Clitocybe* spp., and *Helvella lacunosa*. *Amanita caesarea*, *Gomphus floccosus*, *Ramaria* spp., *Boletus pinophilus*, *Laccaria bicolor* and *Helvella crispa* fetched the highest prices.

DISCUSSION

San Isidro Buensuceso is an important community, from a cultural point of view, given that its residents retain many of their indigenous traditions, maintain a set of typical social and family values, still use forest products for their subsistence and communicate in their indigenous (Náhuatl) language.

This study obtained detailed information about several aspects of traditional mushroom knowledge. According to the information gleaned from the older residents, we hypothesize that mushrooms have played a role in the daily lives of this community for a very long time. Unfortunately, no previous studies confirm this information.

Based on the number of mushroom species (33) used by the people of San Isidro, the number of names in use (115) and the information about when and where each species grows each season, one can say that the traditional mushroom knowledge in San Isidro Buensuceso is similar to that of other Nahua communities, such as Hueyapan, Morelos (De Ávila et al 1980), Santa Catarina del Monte, in the Valley of México (González 1982), Parres, D.F. and El Capulín (Gispert et al 1984). A comparison of the few ethnomycological Nahua studies to date shows that each has had its own focus, but there is a commonality as well; they all addressed traditional nomenclature, where and when mushrooms grow, how mush-

TABLE V. Frequency of mushroom mention using free listing

Scientific name	Traditional name	Women	Men	Total
Gomphus flocossus	*tlapitzal,* cornetas	22	21	42
Ramaria spp.	*xelhuasnanácatl*	19	23	42
Boletus pinophilus	*xotoma*	21	20	41
Cantharellus cibarius	*tecosananácatl*	19	16	35
Russula delica	*cuatecax* (*nanácatl*), *iztacnanácatl*	18	16	34
Amanita caesarea	*ayoxochitl*	13	7	30
Laccaria bicolor	*xoxocoyuli*	16	19	30
Lyophyllum decastes	*xuletl, xuletlnanácatl*	16	16	28
Clitocybe gibba, C. squamulosa	*izquilo, izquilonanácatl, izquilon, totomoch*	15	11	26
Morchella elata, M. conica	*olonanácatl* olotitos, suéter	14	10	24
Hebeloma cf. *mesophaeum*	ocoxalnanácatl (sh), *ocoxoletl, xuletl* de *ocoxal*	12	9	21
Armillaria mellea	*tehtecui*	12	7	19
Hygrphorus chrysodon	*xilonananácatl*	8	9	17
Suillus pseudobrevipes	*poposo*	8	7	15
Chrogoomphus jamaiscencis	*tecosa cafecita, t.* de toro, *tlapaltecusa, tecosan morado*	9	5	14
Helvella lacunosa	*gachupinanácatl, gachupi, g. blanco*	6	6	12
Lactarius indigo	*cacaxnanácatl, cuatecax azul,* h. azul	7	5	12
Lycoperdon perlatum	*xiteburo, xitetl*	2	1	3
Agaricus campestris	*ayutzi*	8	2	10
	totoltenanácatl	3	7	10
	cefamile	4	4	8
Lactarius salmonicolor	*chilnanácatl*	3	5	8
Amanita tuza	*cuatlamanil*	3	5	8
Pleurotus opuntiae	*menanácatl,* hongo de maguey	4	3	7
Amanita muscaria	*citlalnanácatl*	2	4	6
Lyophyllum sp.	*tlacuahuacxuletl*	4	1	5
Lactarius salmonicolor	*chilnanácatl de oyametl, oyamechilnanácatl*	3	1	4
Helvella lacunosa	*gachupin* negro, charro	1	2	3
	cuatlillzi	1	2	3
	solnanácatl	2	1	3
Boletus atkinsonii	*tlapalxotoma*	0	2	2

rooms are rated according to the ''hot-cold'' system and how certain species are cooked.

Descriptions of Nahua knowledge show that, until today, in different places in México, this indigenous group uses mushrooms both for food and for commercial purposes. Of course, we do not really know how important mushroom commerce is. For example, it appears to be very important in some places, such as Santa Catarina del Monte, and not so important for San Isidro residents. On the other hand, the knowledge of this resource is detailed, probably because mushroom collection and commerce began deep in the past (Martín del Campo 1968).

From the total known species in San Isidro, the villagers eat 67% of them and various recipes are used to prepare and cook each one. Mushrooms help provide a nutritional complement to an otherwise monotonous diet (Montoya et al 2000). For example, mushrooms provide protein in a diet that normally consists of beans, tortillas and sauce. To that end, it is important that species are selected that can be cooked together in one dish, with consideration for taste and texture.

The activity of collecting is equally important, because it permits Nahua to preserve their traditional mushroom knowledge, which is passed onto their children during forays or when mushrooms are sorted for sale or when they are prepared for meals at home. Similarly, they pass on information concerning how to distinguish edible mushrooms from those considered poisonous. This has helped reduce incidences of mushroom poisonings.

A primary means of identifying mushrooms is the morphology of the fruit bodies. San Isidro villagers recognize and can name all the parts of mushrooms in the Agaricales order (gilled mushrooms). Estrada-Torres (1989) concluded that this knowledge might be determined by the influence of a species, or group of species, that had a major cultural value in a region. The results of the current study indicate that this does not appear to be the case in San Isidro, where the most important mushrooms are not Agarics.

TABLE VI. Comparison between frequency of mention, abundance values and selling prices of 17 species of wild mushrooms

Scientific name	Mention frequency (Number of persons who mention each species)	Abundance values (Number of fruit bodies in 1600 m²)	Selling prices (2000)	
			Pesos per kilogram	US Dollars per kilogram
Gomphus floccosus	42	9	$30.00	3.19
Ramaria spp.	42	0	$30.00	3.19
Boletus pinophilus	41	2	$30.00	3.19
Cantharellus cibarius	35	2	$8.00-10.00	0.85–1.06
Russula delica	34	10	$25.00	2.66
Lyophyllum decastes	33	12	$15.00	1.6
Amanita caesarea	30	0	$70.00	7.45
Laccaria bicolor	30	225	$30.00	3.19
Clitocybe giba	26	152	$8.00-10.00	0.85–1.06
Morchella spp.	24	161	$8.00-10.00	0.85–1.06
Hebeloma cf. *mesopheum*	21	36	—	—
Hygrophorus chrysodon	17	50	$8.00-10.00	0.85–1.06
Chroogomphus jamaisensis	14	2	$8.00-10.00	0.85–1.06
Helvella crispa	12	80	$30.00	3.19
Lactarius salmonicolor	4	13	$25.00	2.66
Helvella lacunosa	3	122	$25.00	2.66
Lycoperdon perlatum	3	18	$8.00-10.00	0.85–1.06

In addition to their use as food at home, edible mushrooms are sold in neighboring communities. Although this activity does not seem that important in this region (considering how few people— 21%—are engaged in it), it does produce additional income. Only a few use mushrooms as medicine or insecticide (37% and 1.4%, respectively). Nevertheless, Nahua have some knowledge of such uses, which increases their potential pharmaceutical resources. There has been no evidence that San Isidro Buensuceso residents use hallucinogenic mushrooms for ceremonial or medicinal purposes, despite what historical records of Tlaxcala say about their use by the ancient Nahua.

Based on the study's findings, it seems that San Isidro villagers take a utilitarian approach when classifying their mushrooms, because they always refer first to the edible ones, which they use in great numbers. They put ''citlalnanácatl'' (*Amanita muscaria*) or ''pitzunanácatl'', the poisonous ones, in second place and use only a few of them.

San Isidro villagers gather the most and most diverse number of edible mushrooms in the area they call ''the mountain''. Based on the number of species found, forests with *Pinus* and *Abies* provide the type of vegetation that promotes the greatest diversity of mushrooms and produces the species that are most valued from a commercial point of view. Forests of *Abies* are especially important because that is where *Gomphus floccosus*, the most sought after mushroom in the area, thrives. Several hunters rely on *Sarcodon* sp. to indicate the presence of that species. They believe that, if *Sarcodon* sp. is present, they are certain to find several fruit bodies of *Gomphus*. This is odd because *Sarcodon* is dark and difficult to see, whereas *Gomphus* is bright orange. Perhaps because both species grow at the end of the rainy season, gatherers make the connection.

Away from the mountain, oak forests are important because of the species that grow there. Nevertheless, San Isidro residents believe that mountain mushrooms are superior and have a much better flavor because they grow where there are many trees. Our findings on where and when mushrooms grow agree with those published by González (1982) and Gispert et al (1984).

The results on the cultural importance of the mushrooms used by the San Isidro villagers, as indicated by the free listing, suggest that *Gomphus floccosus*, *Ramaria* spp. and *Boletus pinophilus* are the most important mushrooms to this community. The efforts spent on their collection and the fact that only few are found are the determinants of price. They are the ones most sought after, although they fruit in remote places. Those most valued in this community are not the gilled mushrooms, as was suggested by Estrada-Torres (1989) for other communities in the country.

The mushrooms mentioned earlier are the ones most valued, and almost everyone in San Isidro is familiar with them. At the very least, they cook *Gomphus floccosus* in various ways. The sale of these mush-

rooms produces a higher income than the sale of the more fragile and smaller species, which also require more energy to collect.

Although Lincoff (1977) concluded that *Gomphus floccosus* can upset the stomach, this does not seem to be the case in México. Moreover, it is surprising to see how popular this mushroom has become in San Isidro. Nevertheless, because it is bitter, a knowledge of the mushroom is needed to cook it properly. The cleaning process involves removing the scales on the cap and the veins of the hymenophore. San Isidro residents, in addition, recommend boiling the mushroom before cooking it with other ingredients; this mushroom generally is eaten in a mole or in tamales.

The Spearman correlation indices for frequency of mention in the free listing and number of mushrooms found and for frequency of mention and selling prices were low (−0.51 and 0.39, respectively). The reason for this is that a high frequency of mention does not always correspond with abundance or price. It was a surprise to discover that the correlation between abundance and frequency of mention was not positive, indicating that, most of the time, a mushroom found only rarely is mentioned frequently. This means that the most abundant resources are not always the most appreciated, and because a great deal of time and effort are spent looking for the rarer but particularly popular species, prices are higher. Thus, the abundance of mushrooms and prices are factors that contribute to the attribution of cultural significance of at least some species. But, because other factors also could affect how important each species is considered to be, our findings only partially support the hypothesis posed earlier. In the following paragraphs, we show some of the instances where at least one of the predictions of this study (correlation between frequency of mention and abundance or price) is satisfied.

Gomphus floccosus, *Ramaria* spp., *Boletus pinophilus*, *Russula delica* and *Lyophyllum decastes* were mentioned most frequently and brought in the highest prices, but their numbers in the forest were among the lowest. Although *Cantharellus cibarius* are scarce and culturally important, neither fact is reflected in its price.

Amanita caesarea fetches the highest price ($7.44/kg) of all the mushrooms that are sold by San Isidro villagers and is found rarely in the areas studied, but these facts are not reflected in this mushroom's cultural value, which was lower than those mentioned above. The scarcity of this species must be due the fact that it develops in very specific micro-environments, which were not included in our sample areas. *Laccaria bicolor* is the most abundant species and fetches a relatively good price, even though it is generally mixed with other marketed species. Even though it is not the most popular species, one can conclude that, for 68% of those interviewed, it has a relatively high cultural value.

On the other hand, *Clitocybe gibba* and *Morchella* spp. were mentioned by more than half of those interviewed and are among the most abundant species, yet their prices are among the lowest. *Helvella crispa* and *Helvella lacunosa* both are abundant and expensive, yet they received the least mention in the free listings. *Chroogomphus jamaicensis*, *Hygrophorus chrysodon* and *Lycoperdon perlatum* were mentioned by less than half of those interviewed, and their abundance, as well as their prices, were low.

Although the frequency with which a species was mentioned is a good indicator of its cultural significance, it is necessary to confirm this conclusion with other studies that consider additional variables, such as abundance, selling prices, knowledge of where mushrooms grow, the fruiting season, information on morphology, recipes used, eating preferences and consistency of fruiting bodies. These variables should be factors in determining more precisely the cultural value of mushrooms in this and other Mexican communities.

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