TZELTAL ETHNOMYCOLOGY: NAMING, CLASSIFICATION AND USE OF MUSHROOMS IN THE HIGHLANDS OF CHIAPAS, MEXICO

by

AARON MICHAEL LAMPMAN

(Under the Direction of Brent Berlin)

ABSTRACT

The Tzeltal Maya of Highland Chiapas have extensive knowledge of wild mushrooms in the local ecosystem. This dissertation examines the totality of Tzeltal ethnomycological knowledge through an analysis of patterns of nomenclature and classification, knowledge of mushroom ecology, and beliefs about mushroom nutritional, medicinal, and toxic properties. Research was conducted in communities in the municipalities of Oxchuc and Tenejapa. Methods included mycological collection, semi-structured interviews, pile sorts, triad tests, sentence substitution surveys and participant observation. The explanatory approach is ethnoecological, with a focus on the interaction between human cognition and domain features and how this interaction influences behavior.

A total of 72 species were identified and are described herein. Of these, 30 species are utilized for food and medicine. The mushroom domain is perceived as a third kingdom that is independent of the plant and animal kingdoms. The kingdom includes two life-forms that are further subdivided into 4 covert complexes, and 51 folk genera, 4 of which are polytypic and include between 2 and 5 folk species. These categories are based on morphological similarities and dissimilarities, supporting the universal principles of folk classification as proposed by Berlin (1992). However, unique features of the mushroom domain such as small size, morphological similarity and toxicity make the use of mushrooms potentially dangerous. The Tzeltal deal with these features through the recognition of two special purpose folk categories based on utility that overlap and interact with the general purpose system of folk classification.

Detailed ethnomycological knowledge is limited to species that are considered useful. Edible mushroom development is associated with the rainy season, a time when staple food supplies are low. Knowledge of the habitats, substrate preferences and tree associations of culturally important species is widespread. Linguistic designations are consistent only for useful species, and mushroom nomenclature is non-arbitrary, incorporating morphological features such as color, size, shape, and substrate preference. The strict separation of useful and useless species of mushrooms within the folk classification system provides guidelines for the safe use of macrofungi as biological resources, and influences the structure and substance of knowledge that is associated with each special purpose category.

INDEX WORDS: Biocultural diversity, Biodiversity, Chiapas, Classification, Cognitive anthropology, Ecological anthropology, Ecology, Ethnobiology, Ethnobotany, Ethnoecology, Ethnomycology, Folk biology, Folk classification, Fungi, Highlands, Human ecosystems, Indigenous knowledge, Macrofungi, Maya, Medical ethnobotany, Mexico, Mushroom, Mushroom diversity, Mushroom names, Mushroom use, Mycology, Nomenclature, Subsistence, Traditional ecological knowledge, Tseltal, Tzeltal

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Dedication

To my parents, Susan and Michael,

who made my footing more secure along this difficult path,

and

the people of Tenejapa and Oxchuc.

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A project such as this is the product of many minds and many voices. I am deeply grateful to my mentor, Brent Berlin, who introduced me to the world of the Tzeltal Maya and the wonders of human cognition. His dedication to the people and cultures of Chiapas is a shining example of the best that anthropology has to offer, and his continuing passion for research inspires everyone around you to work a little harder. Ethnobiology lives! I am also deeply grateful to Elois Ann Berlin, whose energy is constantly transferred to those around her, and whose meta-thoughts lead to inspired inquiry. She has always served as the glue for our fictive family in the labs of ethnobiology, and kept us healthy in the field. I am further indebted to another member of my dissertation committee, David Porter, who is one of the best teachers I have ever known. Many thanks for taking so much time out of your schedule to work closely with a "soft-scientist," and training me in the mystic arts of mycology. My heartfelt thanks to Ben Blount, a good friend and great mentor who helped me to shape so many of the ideas that are found throughout these pages, and Ted Gragson, who always managed to inspire me to make my research and analysis more rigorous.

More importantly, perhaps, are the people of Tenejapa and Oxchuc who not only made this research possible, but who welcomed me into their homes and lives. Due to complex politics in the Highlands, I would prefer to leave their names unspoken, but their contributions to shaping me, as a human and a researcher should not go unnoticed. Don

S. and his wonderful family fed and housed me, entertained me constantly, and continually supported me in my research efforts. I owe this family so much for unselfconsciously making me a welcome part of their community. In another part of the Highland region, another family cared for me and nourished my learning of language and tradition, and their children made life a true pleasure. For their support in integrating me with the community, and the many tortillas we shared together, I am grateful. In addition, I would like to extend my gratitude to my main collaborator, Jesus, who woke up each morning at 4:00 am, and worked with me all day every day. His collaboration was an extremely important part of this research, and he helped me in more ways than I can count – from introducing me to community elders, to guiding me through the complex maze of trails through the mountains. He helped teach me Tzeltal and was even willing entering our data into computers in his downtime. Many others in the Highlands contributed to this research, and all of the Maya researchers at ECOSUR deserve recognition. They are a generous and hardy group who make research in the Highlands a worthwhile endeavor.

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Chapter 1

Introduction

1.1 Dissertation outline

This dissertation focuses on a domain of traditional ecological knowledge that has, until now, received little attention: the domain of macrofungi[1]. More specifically, this research examines a number of factors that influence Tzeltal Maya perception and use of macrofungi as non-cultivated resources. Among the numerous factors that are discussed are specific domain features, such as the biological, behavioral and nutritional, hallucinogenic or toxic properties, that influence the ways in which the Tzeltal Maya name and classify macrofungal species. Also addressed are the cultural perceptions, values and needs that have an impact on the ways in which macrofungi are understood and utilized. The basic questions guiding this research include: (1) how biological and cultural features interact to affect the structure of ethnobiological knowledge, and (2) how the resulting structure of ethnobiological knowledge influences resource use strategies. The overall approach is essentially ethnoecological, and the goal is to examine how domain features interact with human cognition to influence behavior (Gragson and Blount 1999).

[1] The kingdom *Fungi* includes an incredible diversity of species with different morphological structures, reproductive structures, and means of obtaining food. The folk English term macrofungi is generally used in reference to species of fungi that produce a large, fleshy fruiting body called a mushroom. This term usually does not include groups such as molds, yeasts, mildews, algae, rusts, and smuts.

Chapter Two combines a discussion of the environmental and ethnographic contexts of the research location. Basic characteristics of the biophysical environment are discussed with the goal of contextualizing the natural world in which the Maya encounter and utilize resources such as wild mushrooms. Ethnographic and demographic data situate the Tzeltal Maya in time and space by providing some historical and cultural perspective on who they are, how they live, and what their needs and desires are at the current time.

Chapter Three develops the symbolic and sociocultural aspects of the ethnomycological knowledge of the Tzeltal Maya. My goal is to discuss how perceived ecological and morphological features of macrofungi interact with the overall system of ethnoecological and ethnobiological knowledge of the Tzeltal Maya. This chapter begins with a brief discussion of widely agreed upon, generalized knowledge, and how such knowledge is developed and spread. Following is a discussion of beliefs about the origins of macrofungi, and how mushrooms are related to other living things. I explore the ethnoecological knowledge of macrofungi in terms of their seasonal fruiting patterns, ecological preferences and requirements. I then describe the regular process by which the Maya identify and collect macrofungi, including which species are avoided and why. Finally I will briefly discuss Maya beliefs concerning mushrooms as food, poison and hallucinogens.

Chapter Four contains a description of the ethnomycological system of classification of the Tzeltal Maya. This chapter includes a discussion of the history of ethnobotanical theory, classification, nomenclature and variation in knowledge. This discussion is followed by the categories recognized by the Maya including the recognition of mushrooms at the kingdom, life-form, intermediate, genus, species and varietal ranks. Concluding the chapter, I provide a detailed discussion of the interaction of general purpose and special purpose categories.

Chapter Five provides the descriptive essence of the ethnomycological study. This chapter is organized according to Tzeltal perception of the macrofungal domain and includes a detailed description of morphology, habitat, substrate and seasonal growth. Also included are the Latin name(s) and cultural use of each species. The overall goal of this chapter is to document part of the mushroom diversity in the region and illuminate the ways in which the Tzeltal name, classify and utilize the macrofungi in their local environment.

The final chapter provides a summary of the conclusions of the study and explains the results in light of ethnoecological and ethnobiological theory. Potential avenues for future studies of macrofungal diversity, ethnoecological knowledge and applied research are explored.

1.2 Context and origins of the study

Although the biological kingdom *Fungi* is one of the largest and most diverse groups of organisms, the species that comprise it are conceivably the most under-studied biological and cultural resources in the world. Mushrooms, the fruiting bodies of macrofungi, not only make up a large part of the biodiversity of forest ecosystems, but also fill critical ecological roles as mycorrhizal symbionts that promote plant health, decomposers, recyclers and pathogens (Palm and Chapela 1997). Fungal species have been found in association with almost every ecological niche (Alexopoulos, Mims and

Blackwell 1996), and yet, despite estimates that 1.5 million species of fungi exist worldwide (Hawksworth 1991) only about 70,000 species have been described.

Given the diversity, abundance and ecological importance of fungi in nature, it is not surprising to find that they are also important in the dietary, symbolic and ethnomedical systems of traditional peoples in various regions around the world. Fungi play a critical role in many aspects of human activity, such as the making of bread, wine, beer and cheese (Benjamin 1995), the production of antibiotics such as penicillin, and the ritual use of hallucinogenic mushrooms for divination and curing (Wasson 1980). Species of macrofungi are highly important in the traditional medicine of China and Japan (Mizuno 1995). There is an established tradition of mushroom cultivation in these and other Asian countries that has spread to western nations. Fungi are also among the most important groups that parasitize and destroy economically important domesticated crops and managed forests. Despite these and numerous other important aspects of human-fungi interactions, the traditional mycological knowledge of indigenous groups has been little examined.

The paucity of research into the macrofungal domain by western ethnobiologists reflects the common perspective found in Britain and the United States that non-cultivated species of fungi are dangerous and relatively unimportant as biological resources (Benjamin 1995; Arora 1986). In the United States, for example, individuals who hunt and consume wild mushrooms are generally thought to be eccentric, or thrill seekers who are willing to trade the danger of being poisoned for the dubious reward of eating exotic foods. The common American perspective that wild mushrooms are generally dangerous comes from a long history of myths and stories that equate mushrooms with witchcraft, cemeteries, and toads, and the opinions of "experts" such as John Gerard who, in his Herball or Generall Historie of Plantes (1597), wrote:

> Few mushrooms are good to be eaten and most do suffocate and strangle the eater. Therefore I give my advice unto those that love such strange and new fangles meates to beware licking the honey among the thorns lest the sweeteness of the one do not countervaile the sharpness and pricking of the other.

The fear of wild mushrooms found in the United States and Britain is not reflected in other societies around the world, and in fact, many western and non-western cultures prize wild mushrooms as food and medicine. In Switzerland, for example, fifty-four species of mushroom are officially sanctioned for sale in open-air markets (Benjamin 1995:20-21). In Finland an estimated 72% of the population is thought to pick wild mushrooms for use in the home (Benjamin 1995:20-21). Mushroom hunting is a form of national recreation in Russia, and one of the many Russian proverbs concerning mushrooms neatly captures the dominant cultural attitude: "If you think you are a mushroom, jump into the basket." (ibid. 1995:21). China and Japan both have a long history of mushroom consumption, and the demand for wild mushrooms in these countries has recently led to the development of trans-continental trade of significant economic proportions (Redhead 1997).

The importance of wild mushrooms as resources in these and numerous other societies indicates a need for more extensive studies of the culinary, medicinal, and religious significance of mushrooms in small-scale societies. The growing economic impact of wild mushroom sales in international markets (de Geus and Berch 1997; Pilz and Molina 1997; Bandala et al. 1997), the burgeoning literature on the significant pharmacological features of mushroom species (Benjamin 1995), the expanding research into the ecological importance of wild mushrooms in forest management (Allen et al. 1997; Varela and Estrada-Torres 1997; Barreto and Evans 1997; Doroworth 1997), and the body of mythology surrounding mushrooms in many cultures (Wasson 1957; Singer 1958; Arora 1986; Schultes and Hoffman 1992; Compton 1995) suggests that the potential economical, medicinal, ecological and cultural value of fungi is vastly underestimated. As a group, fungal organisms are worthy of more study.

My own interest in exploring the knowledge and use of wild mushrooms by the Tzeltal Maya of highland Chiapas developed in a serendipitous way. I was involved in a small seminar discussion group focused on the study of traditional ethnobiological knowledge when I stumbled across the following quote in the pioneering work of Berlin, Breedlove and Raven: "With the exception of all fungi, lichens, algae and the like, the boundaries of the domain of plants as conceived by the Tzeltal corresponds almost perfectly to the standard plant division of Western systematic botany (1974:30)." This statement raised a number of questions for me, the most intriguing of which included whether or not, unlike western cultures, the Tzeltal conceptually include fungi within the domain of plants, whether mushrooms might be classified in ways that deviate significantly from the classification of plants, and how structural differences in classification might reflect unique biological features and culturally specific concerns.

Ethnobiological research focused specifically on the Tzeltal Maya of the Chiapas highlands has shown that these peoples possess extensive, empirically based knowledge of the plants and animals that exist in the biophysical environment surrounding their homes (Berlin, Breedlove and Raven 1974; Hunn 1977; Berlin and Berlin 1996; Stepp

2002; Casagrande 2002). The Tzeltal name and classify a significant proportion of the living things they encounter in the region, and utilize as much as sixty percent of these culturally recognized species for food, shelter, fuel, adornment, medicinal and ritual purposes (Berlin 1992). However, there had been little research into Tzeltal knowledge of macrofungi (Shepard and Arora 1992).

I conducted research into the ethnomycological knowledge of the Tzeltal Maya over a number of years, from 1998 to 2001. The Tzeltal families with whom I lived and worked regularly harvested and consumed as many as thirty species of macrofungi throughout the summer and fall seasons. Many of these species were collected and sold for small amounts of cash in the local markets, providing extra income for the household. Others were used to treat medical conditions such as cuts, burns, weakness, bedwetting, skin conditions, and gastrointestinal problems. In addition, there is a widespread belief that mushrooms provide essential nutrients that enhance strength, endurance and well being, and the unique flavor and texture of mushrooms is highly valued in the culinary tradition of the Tzeltal. It became clear that the domain of macrofungi is a highly salient and culturally important aspect of Tzeltal ethnobiological knowledge.

This ethnoecological knowledge, often learned by children at a young age, shapes the Maya worldview, allows for the construction of culturally meaningful categories of classification, and provides the skills necessary for making a living in a marginalized highland environment (Stross 1973; Alcorn 1984; Zarger and Stepp 2000; Zarger 2002). Although sometimes transformed by factors such as age, gender, expertise or community membership, much of this knowledge is widespread and shared across individuals and communities. By the age of adulthood, the “average” Tzeltal individual knows how and when to plant crops, where to seek out medicinal plants, and how to identify and gather herbs, small animals, insects and mushrooms in order to add variety and nutritional quality to their diet.

The value placed on mushrooms as non-cultivated resources was brought home to me in the spring of 2001. I was traversing the mountainous countryside of highland Chiapas in search of households with whom to sit and talk about mushrooms when I encountered a family that was busy weeding the small cornfield surrounding their home. Once the normal rituals of meeting and greeting were conducted and the subject of mushrooms raised, the entire family broke out in excited speech and laughter. The elderly head of the family leaped out of his chair, and without a word, raced into his cornfield and began looking under the numerous rocks that dotted the fields. He quickly found what he was looking for, and with a broad smile across his face, raised a morel[2] high up into the air like he was holding up a prized treasure (see Figure 1.1). In fact, in numerous cultures throughout the world the morel *is* a treasure, and in the United States this species brings in prices that reach $20 a pound. Our conversations were held over a dish of grilled morels that day and, much like many of the conversations I had throughout the course of research in the highlands, centered around the meaty texture and excellent flavor of morels and other mushrooms collected by the family.

The Tzeltal Maya, like many small-scale societies and indigenous cultures have developed an extensive body of ethnoecological knowledge through a long history of observation, experimentation and interaction with the environment (Berlin and Berlin 1996). Their perceptions of plants and animals are not only influenced by natural

[2] A species of the genus *Morchella* that is widely distributed throughout North America.

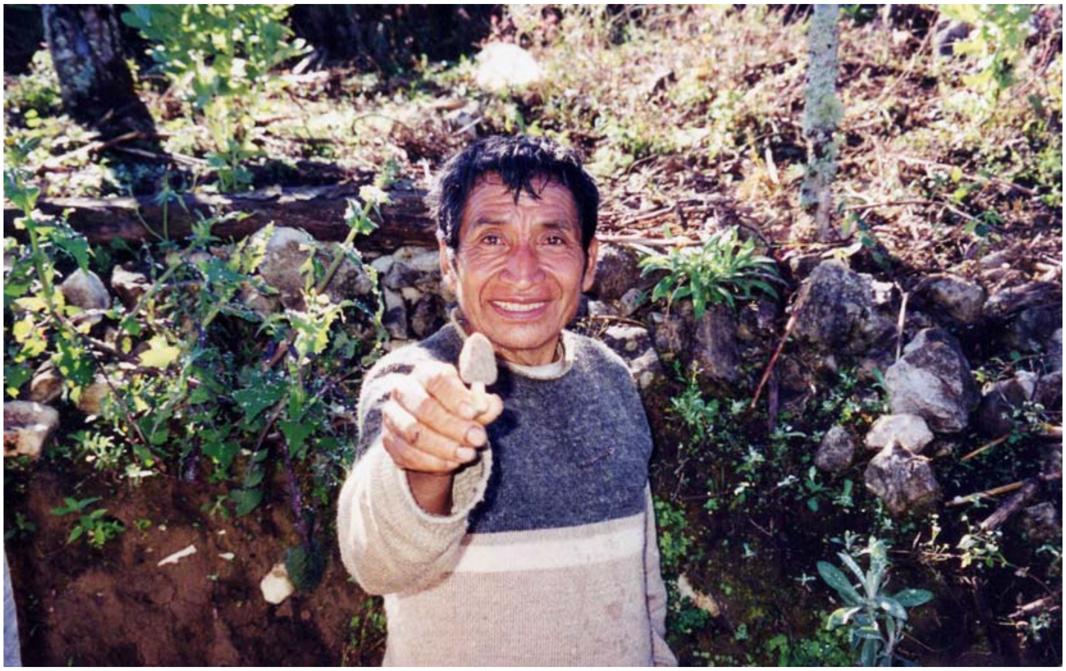

Figure 1.1. Prelude to a fine dinner of *Morchella*.

features such as morphology, distribution, behavior, and nutritional, hallucinogenic or toxic properties (Berlin, Breedlove and Raven1974; Berlin 1992; Casagrande 2002; Stepp 2002), but also by the inherent constraints of human cognition and communication (Atran 1990). Perception of the natural world is further constrained by the unique cultural worldview of the Maya (Laughlin and Breedlove 2000) and the subsistence strategies by which they have adapted to the environment (Berlin 1992). Ultimately, the Maya make decisions about which species to utilize based on the confluence of these various factors, and thus by examining how cultural needs, values and beliefs interact with cognitive perceptions of the natural world to influence human behavior, it is possible to gain a fuller understanding of the human-environment relationship.

Tzeltal Maya ethnomycological knowledge, however, is threatened by numerous changes that are occurring in the highland region. Population growth and a shift to wage-labor have led to a significant increase in out-migration. Development initiatives such as coffee farming, cattle and sheep production and logging are affecting local forest habitats (Castillo et al. 1998) and, as a result, mushroom biodiversity. This shift from local systems of production to systems that are incorporated with national and international markets is likely to lead to a loss of traditional ecological knowledge and, more specifically, a loss of appreciation of wild mushrooms (Bandala et al. 1997).

The potential impact of these changes on local ecosystems, local market systems, and ethnoecological domains of indigenous knowledge draw attention to the need to investigate and understand the role of macrofungi in rural communities in Chiapas. Thus, in addition to the goal of this research as contributing to current theories concerning the structural features of traditional nomenclatural and classification systems, this study is also meant to provide an understanding of how natural and cultural features associated with living things influence perception and ultimately human behavior. Finally, this dissertation aims to promote traditional ethnoecological knowledge and to contribute ecological and social data to ecologists that will allow for the development of models leading to the sustainable use of natural resources for the benefit of rural communities.

1.3 Research design: questions and findings

The overall objective of this research was to examine the totality of traditional mycological knowledge of the Tzeltal Maya of highland Chiapas (Ford 1978). In the broadest terms, I attempt to explain: (1) how the Tzeltal recognize, name and classify species of macrofungi, (2) how macrofungi are incorporated within the Tzeltal worldview, and (3) how the Tzeltal use species of macrofungi as non-cultivated resources. In order to explore these general questions, my research was guided by more specific questions related to the perception, naming, and classification of mushrooms as well as the cultural values, beliefs and uses associated with species of mushrooms. Many of these research questions were derived from the literature on ethnobiological knowledge, others from personal experience and observation of the beliefs and behaviors encountered in Chiapas.

The first set of research questions focus on the ways in which the Tzeltal name the mushrooms that exist in the local environment. Of the total domain of macrofungi, which species do the Tzeltal chose to name, and what kinds of names do the Tzeltal apply to mushrooms? These questions were addressed through linguistic analysis of mushroom names and frequency analysis of the cultural uses of mushroom species that were collected in the region. Consensus analysis was used to determine whether a given mushroom specimen had a "culturally correct" name, and whether a given mushroom specimen had culturally agreed upon uses. Frequency analysis of aggregated tables of name and use data for each mushroom specimen shows how many named mushrooms are considered "useful" (in diet and medicine) and how many are not considered "useful". In addition, translations of mushroom names were tabulated and frequencies of analyzable attributes were calculated to show what morphological, ecological or other characteristics are incorporated into mushroom names.

As with other domains of ethnobiology, the Tzeltal system of ethnomycological nomenclature focuses on only a small portion of the actual mushroom species found in the local environment. The following findings address which macrofungal species are recognized and named, why these species are selected, and how mushroom names are generally structured:

(1) The subset of named mushrooms is almost exclusively comprised of edible or otherwise useful species.

(2) Species that are widely agreed to be useful receive names that are consistent across informants within a municipality. Culturally useless species receive idiosyncratic names, or no name at all.

(3) Mushroom names, for the most part, are non-arbitrary and iconic. Salient biological characteristics such as morphology (i.e. color, shape, size) and the ecological growth requirements of mushrooms (i.e. growing in wood, grass, dung) are directly encoded in mushroom names.

The second set of research questions focused on modeling the ways in which the Tzeltal categorize or classify mushrooms in their local environment. Are macrofungi conceptually organized in a taxonomic hierarchy based on perceived similarities and dissimilarities? What is the structure of Tzeltal ethnomycological classification? In order to address these questions, pile sort data were compiled into a mushroom-by-mushroom similarity matrix. Each cell of this pile-sort similarity matrix contained the number of informants who placed a pair of mushrooms corresponding to the row and column into the same pile. Aggregated pile sort data provided a taxonomic model of Tzeltal perceptual groupings of mushroom species. Use data derived from sentence substitution frames was aggregated into species-by-attribute matrices. Each cell of this sentence-substitution matrix contained the number of informants who describe the species in a row as having the use in a column. Correlations of these matrices were used to compare informants' similarity judgments, use beliefs and morphological similarity. The results indicated whether informants based their pile sorting on morphological characteristics or on learned use characteristics.

Other evidence, such as comparisons of multidimensional scaling of similarity judgments, comparisons of explanations of decisions made in pile sorting tasks, and qualitative interpretation of responses to freelist questions, substitution survey interviews and qualitative interviews were used to support results. In addition, during elicitation interviews, every informant was asked whether each specimen "is a kind of _x_," with the blank being filled with the hypothesized unique classifier. Finally, linguistic analysis of mushroom names, qualitative analysis of semi-structured interviews, triads, pile sort and ranking interviews, and counting of taxa occurring in the ranks created during pile sort tasks were used to support conclusions.

As with other domains of ethnobiology, recognized mushroom taxa are grouped into ever more inclusive groups that form a shallow hierarchical taxonomy based on perceptual salience rather than degree or kind of usefulness. The following findings address how the macrofungal domain is cognitively separated from the domains of plants and animals, and how the classification system is internally structured.

> (1) Mushroom taxa of each rank are grouped together in a shallow hierarchy based on perceptual similarities and, in two cases, degree or kind of usefulness.
>
> (2) There is a single unique label that denotes the kingdom fungi and separates macrofungi from plants and animals.
>
> (3) Mushroom taxa of genus rank outnumber taxa of other ranks.
>
> (4) Because the culturally recognized domain of macrofungi is small in comparison with the domains of plants and animals, there are few taxa of the life-form, intermediate and species ranks.
>
> (5) Given that macrofungal species are not highly managed, taxa of the varietal rank are not recognized.

(6) There are two largely inclusive special purpose categories overlapping the general purpose system of ethnomycological classification. One category essentially includes all species that are edible or otherwise culturally important. The other category includes all species that are unknown, or thought to be toxic.

Another set of research questions focused Tzeltal knowledge of macrofungal life history, ecological requirements and seasonality and examined how such knowledge interacts with social and economic factors affect the use of mushrooms as a resource. These questions were evaluated through analysis of data derived from participant observation and elicitation interviews. Tabulation of elicitation data showed what time(s) of year mushroom species were harvested, which species were favored, how these mushrooms were being used, how much they were worth, in what quantities they were being harvest, where they were being harvested, by whom they were harvested, and whether and why the harvester was focusing on specific species of mushrooms. In addition, these data provided insight into Tzeltal knowledge of mushroom ecology, including knowledge of the specific substrates and habitats in which culturally important species of macrofungi develop.

The following findings address the fact that knowledge of mushroom ecology and seasonal availability is widespread and consistent, and that mushroom harvesting by households is determined by seasonal growth of mushrooms that happen to coincide with local hunger months:

(1) Knowledge of the seasonality of culturally recognized macrofungi is widespread and consistent across individuals and communities.

(2) Harvesting of macrofungi for food and sale coincides with the autumn season, a time when supplies of staple foods are low.

(3) Knowledge of the ecological requirements of macrofungi (habitat and substrate) of culturally recognized species is widespread and consistent across individuals and communities.

A fourth set of research questions focused on examining how knowledge about mushrooms is distributed throughout the Tzeltal population. Is knowledge consistent across factors such as age, gender, lineage, and occupation, or is there patterned variation in knowledge of the names and uses of macrofungi? These questions were examined through an analysis of pile sorts and freelist exercises. Patterns of consensus on mushroom names, uses and ecology emerged. Cultural consensus was used to develop the "ethnomycological competence" of all informants, ultimately indicating overall agreement on names, use and ecological information.

The following findings indicate that ethnomycological knowledge is highly shared and consistent across individuals and informants, and that patterns of variation in knowledge is related to lineage and family membership:

(1) The names and uses of most culturally relevant mushrooms are agreed upon and widely shared throughout the Tzeltal communities of the highlands.

(2) Despite the fact that women traditionally cook meals for the household, and harvest and sell wild foods in local markets, men and women appear to share equal knowledge about the names, uses and ecology of wild mushrooms.

(3) Individuals from different family groups name and use different mushrooms in different ways. Idiosyncratic experiences with mushrooms are shared and transmitted within family groups.

1.4 Secondary research goals

A number of secondary goals of this research were related to the need to initiate an inventory of the wild mushroom biodiversity in the Tzeltal and Tzotzil Mayan municipalities of Chiapas. The most recent estimate suggests that only 5-10% of fungi have been discovered and described worldwide (Hawksworth 1991), and in the Highlands of Chiapas, these numbers are certainly even lower. In fact, there have been no long-term studies of fungal composition and diversity in this region of Mexico. The data concerning fungal diversity and distribution collected for this dissertation contribute important information for research focused on conservation of biological diversity, diversification of local markets and promotion of food security, and the discovery of new pharmaceutical, agrochemical and biotechnological products.

In collaboration with Maya collaborators, mushroom species were collected, scientifically identified, and dried in an attempt to contribute to a comprehensive regional floristic survey of southern Mexico that is currently being developed by researchers working at El Colegio de La Frontera Sur (ECOSUR) in San Cristóbal de las Casas. These specimens have been deposited at the ECOSUR herbarium. The dietary and medicinal uses of these mushrooms were recorded in order to contribute to the ongoing efforts to document the natural products that can contribute to biodiversity conservation and economic development in the region. The harvesting and sale of wild mushrooms in local markets was studied in order to determine the potential of expanding and diversifying these markets to the national or international level. Finally, any data concerning Maya myths, stories, jokes and narratives about mushrooms were recorded in order to preserve the traditional knowledge for local communities.

1.5 Intellectual property and prior informed consent

The following paragraphs describe in detail how prior informed consent was obtained from the communities and individuals with whom I worked. These phases follow the preliminary process of obtaining permission for human subjects research from the University of Georgia and the government of Mexico. The process of gaining prior informed consent research in Tzeltal communities began in the summer months of 1998, and was repeated in every community in which I worked at the beginning of extended field research in 2000.

The first stage consisted of obtaining permission to live in Tzeltal communities, collecting biological specimens from within the boundaries of the township, and conducting interviews focused on gathering cultural knowledge from willing participants in the various communities. Obtaining permission to carry out these activities began at the level of the municipal governments in Oxchuc and Tenejapa. With the help of Tzeltal speakers who work at ECOSUR, an appointment was obtained for audience with the president and elected officers of these municipalities. The objectives and goals of the research were presented in both Spanish and Tzeltal (often with the help of interpreters), and the potential economic, social and cultural benefits of the project were outlined. Everyone present was invited to ask questions and make comments on the value of the project, and many leaders voiced thoughts and concerns. Once discussion subsided, a vote was taken, and in every case, I was given permission to conduct research within the boundaries of the municipality.

By traditional convention and law the Tzeltal Maya require researchers to obtain prior informed consent from the people of each individual community within which research is conducted. The second phase of obtaining permission for research thus consisted of approaching the leaders of each of the communities within which I hoped to conduct research, presenting my objectives, and waiting for a democratic vote on consent. Again, the process was formal, and the leaders of these communities called an open meeting that included every member of the community.

With the help of a local collaborator, a formal presentation was given in order to outline the purpose, methods and potential benefits of the project. What followed was a long, vocal discussion during which any adult, male or female, had the right to voice an opinion about the proposal. After this discussion, a vote was taken, and the elected leader of the *paraje* passed down the decision. In my own case, permission was often given with a caveat – I was asked to provide some form of up-front financial compensation that would benefit the community as a whole. This compensation varied from community to community and included providing paint for local schools or buying goods for a community festival. Once the terms were agreed upon the third phase of obtaining prior informed consent began.

The third phase of this process consisted of obtaining consent from every individual or household with whom I worked. While permission from the leaders of the municipality and individual community gives the researcher access to all the lands held in common, the researcher must obtain the explicit right to interview each and every individual. In general this consisted of sitting down and explaining the objectives of the research and the types of questions that would be asked. In order to compensate the individual for their time, payment was offered based on local wages and the amount of time involved. It is important to note that when an individual was not interested in participating, their wishes were respected. Over the course of a year and approximately 200 formal interviews, I encountered five individuals who either did not have the time or interest in participating. For the most part, people were interested in participating and entertained by our in-depth conversations concerning cultural beliefs about mushrooms.

1.6 Phases of field study

Table 1.1 Phases of field research.

Initial Stage **:**	**Obtained prior informed consent**
Phase 1 **:**	**Mycological Collection**
Phase 2 **:**	**Unstructured Interviews**
Phase 3 **:**	**Structured and Semi-Structured Interviews** a. Freelists b. Traveling herbarium elicitations c. Photograph elicitations d. Pile sorts e. Triads f. Quicksorts g. Sentence-substitution surveys h. Semi-structured qualitative interviews
Phase 4 **:**	**Market Surveys**

Phase I - Mycological collection

The first phase of my research focused on collection, identification and preservation of mushroom specimens in order to establish a base-line referent for mushroom diversity in the Tzeltal region. Only distinctive specimens in good condition were documented and collected. If available, several specimens of different ages and growth stages were collected. The collection number, season, date, and exact location of the mushroom were recorded on field collection sheets (see appendix A). The forest habitat-type and tree species surrounding the mushroom and the substrate in which it is growing (soil, grass, dung, wood, etc.) were described. This formal collection procedure was followed in order to ensure that adequate information on distribution, frequency, habitat and possible mycorrhizal association are available for future studies of mushroom biodiversity in the local region (Arora 1986; Villarreal and Gomez 1997).

In addition to habitat and location information, morphological data was recorded on collection sheets in the field in order to ensure that the distinctive features of the fresh specimen were accurately reported. This procedure was necessary due to the fragile nature of fungal specimens, which often change drastically as they dry out (Arora 1986). The shape, size, texture and color of the mushroom and the presence or absence of any other distinguishing characteristics were recorded. Color photographs of each new species of mushroom were taken for use in ethnographic elicitation and identification interviews.

It is important to note that after approximately two months of mycological collections, social and political debates concerning intellectual property rights made collection of biological specimens in the highland region a practical impossibility[3].

[3] This dissertation research was closely linked to a large bioprospecting project called the Maya International Cooperative Biodiversity Group (Maya ICBG), based in Chiapas, Mexico. The Maya ICBG focused on documenting the diversity of plants in Chiapas and developing pharmaceuticals from bioactive compounds found in local species. It was also developed in order to provide benefits to local communities in the form of community gardening, technical job training, preservation of local knowledge, distribution of pamphlets concerning herbal medicines, development of low-impact herbicides and pesticides for farming, and the creation of a fund that would provide grants for small businesses, community improvements and higher education. In the years 1999 and 2000, the Maya ICBG came under the close scrutiny of local, national and international NGOs including the Rural Advancement Foundation International, Global

Because of the volatility of these debates, I voluntarily discontinued mycological collections and focused my attention to the collection of cultural beliefs concerning macrofungi. In the end, I made approximately 250 collections, all of which are currently housed in the herbarium at El Colegio de La Frontera Sur (ECOSUR) in San Cristóbal de Las Casas, Chiapas, Mexico. Formal identifications of these specimens were made with the help of Lucia Robles, a masters student in mycology who was working in the herbarium at ECOSUR. All of this information was recorded in a field notebook and copied onto sheets that will be kept with herbarium specimens. These specimens contribute to a regional floristic database of southern Mexico, and are available for examination by local people, visiting scientists, and mushroom enthusiasts at the regional herbarium located at ECOSUR.

Phase II - Unstructured and semi-structured interviews

The second phase of my research was focused on a preliminary exploration of Tzeltal perceptions of mushrooms. This stage was conducted simultaneously with standard mycological collection, and involved having local collaborators accompany me during the survey in order to provide name, identification and use data concerning any

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Exchange, and OMIECH a group associated with the Traditional Healers Council of Chiapas. These organizations suggested that all bioprospecting projects are essentially "biopiracy" and threaten the rights of indigenous peoples to traditional knowledge and ownership of biological resources. What ensued was an intense international debate concerning prior informed consent and the recognition of local communities as the "…legitimate owners of the biological resources under their control…(Berlin and Berlin 2003:632)." During the course of the debate, all researchers involved with the Maya ICBG (myself included) voluntarily agreed to suspend the collection of biological specimens until a satisfactory solution could be resolved. This, despite the fact that 28 Maya communities had agreed to engage in the research, and were excited about the potential benefits of the project. As of March 2004, this important debate has yet to be resolved.

mushroom specimens encountered. The goal was to gather preliminary data that could be used to inform later, more structured phases of ethnographic research.

Throughout the mycological survey process, Tzeltal collaborators accompanied me as I scoured the mountains for mushrooms in order to provide ethnomycological data concerning the mushrooms being collected. At various times throughout this phase I was accompanied by one, two, or three Tzeltal men, all of who were over the age of 35. These men, chosen for their expertise concerning mushroom identification, examined the specimen in its natural context, and provided data concerning the name of the mushroom, where it typically fruits, what features were used to identify the specimen, and whether and how the species was used. Often, after field-collections were done, several men from the community would visit the home of my host, view the freshly collected mushrooms, and begin to actively debate and discuss the ecology, fruiting habits and uses of the species gathered. The data recorded included the Tzeltal names of the mushroom species, associated stories and folklore, and whether the specimen has any cultural use. It also included details concerning where the mushroom is typically sought and how the mushroom is identified and distinguished from similar mushrooms that might exist in the local environment. This research was essential to the development of an understanding of Maya perceptions and uses of mushrooms.

Phase III - Structured interviews

Once field collections were well underway, I began to conduct formal semi-structured and structured interviews with groups and individuals from different communities. A wide variety of qualitative and quantitative methods were employed in order to more fully explore how the Tzeltal Maya view the totality of the mushroom domain, and how they perceive and use various mushrooms in their everyday lives. Some of the methods used in data collection were highly systematic, others were opportunistic and much less formal, and the collection of cultural data often overlapped with biological field-collections.

Most participants were asked to respond to a standardized set of questions or visual stimuli, and most of these interviews lasted between one and two hours - for which a half-day wage was paid. My goal was to focus on generalized knowledge that is widely shared and distributed throughout the population, and I attempted to follow a stratified sampling strategy that consisted of gathering data from equal numbers of male and female participants of different ages. The realities of conducting fieldwork among people who work all day to make a living, however, did more to shape the final sampling strategy than epistemology. In short, when working with subsistence-level agriculturalists in the highlands of Chiapas, it is only possible to interview people who are at home after a day of working in the fields.

In the end, I conducted formal interviews with approximately equal numbers of men (N=113) and women (N=118). Approximately 13 interviews were conducted with individuals under the age of twenty, 44 interviews were conducted with individuals in their twenties, 54 interviews with individuals in their thirties, 50 interviews in their forties, 29 interviews with individuals in their fifties, and 41 interviews with individuals over the age of sixty. Due to cultural norms concerning social interactions in Tzeltal communities, far more informal conversations were held with men.

These interviews incorporated a number of methods designed to elicit data that can be reliably compared. The seven techniques used were the following:

Freelists: Approximately 109 participants from 8 different communities were asked to provide freelists. Essentially, the participants were asked, "*binti sbil jujuten* ***chejchewetik*** *ta balumilal*," or "What are the names of all the mushrooms that exist in the world?" This method was designed to elicit a basic outline of the total domain of mushrooms, as perceived by the individual and shared by the group (see data collection sheet in Appendix B). Lists ranged from as few as 5 mushrooms, to as many as 30 mushrooms, although one outlier listed about 40 different species.

Once a basic list was developed, the participant was asked to explain when the mushroom fruits, what substrate it prefers, what habitat it prefers, how it is used, what parts were used, and whether they could relate any stories or myths about the species. These participants were also provided with a detailed drawing of an "idealized" mushroom, depicting a cap, scales, stem, volva, mycelium, and an annulus, and asked to provide names for as many parts of the mushroom as possible. The goal of these methods was to compare basic knowledge across individuals and groups to explore whether knowledge of these aspects of the mushroom domain was consistent. Analysis and comparisons of these freelists provided basic data concerning the boundaries of the mushroom domain, prototypicality and salience of species, and ranking of mushroom taxa (Weller and Romney 1988; Borgatti 1992; Borgatti 1994).

Elicitation: Following the methodology used by Berlin and Berlin (1996), a "traveling herbarium" consisting of 30 mushroom specimens (representing 30 different species) was developed. Dried specimens were carried in boxes and paper bags to the houses of 15 individuals. These specimens were displayed on a tarp in front of the participant's house and one member of the household was asked to identify each specimen, and provide relevant cultural data such as use as food or medicine, use in ritual, or possible avoidance.

The traveling herbarium method ultimately proved limited in usefulness, as dried mushrooms tend to suffer loss of color and texture, and reduce greatly in size during the drying process due to the high water content (as much as 95%) of fresh fruiting bodies. In addition, fragile specimens were easily damaged or destroyed during transport, and valuable information was lost as the specimens were removed from the correct ecological context. As a result, the specimens utilized in the traveling herbarium proved difficult to identify and the method was discontinued in favor of the use of photographs that more accurately conveyed aspects of size, color, and ecological contexts.

Members of 30 households viewed 25 high-quality mounted photographs of the macrofungal species that were collected in the highlands. As with the traveling herbarium, informants were asked to provide a name and cultural use for the species depicted in each photograph, as well as data concerning knowledge of the ecology, abundance, habitat and harvesting methods.

<u>Triad Comparisons</u>: Using the balanced incomplete block design triad test (Burton and Nerlove 1976), 30 participants were presented with a randomized series of triads of photographs of mushroom species and asked to determine which two seem to go together best (see data collection sheet in Appendix C). Because 15 photographs were used, a *lambda* 2 balanced incomplete block design was used to reduce redundancy and ensure that each pair of photographs was viewed only twice for a total of 70 decisions (Burton

and Nerlove1976; Bernard 1995). Informants were asked to explain the criteria for each of the sorting decisions made during these triad tests. Analysis and comparison of triad tests isolated some of the salient components of the Maya ethnomycological system of classification, provided the outlines of basic groupings of mushroom taxa, and yielded data concerning intracultural variation in ethnomycological classification.

Pile Sorts: Approximately 30 participants were presented with dried specimens or photographs of mushroom species. They were asked sort these mushrooms into groups based on similarity. These pile sorts were unconstrained, and participants were asked to create groupings of any size based on whatever criteria that determined similarity from their own perspective. After the first sorting, participants were asked to repeat the exercise, subdividing the first groups into smaller groups based on similarity until they can no longer subdivide any groups. At each sorting level, participants were asked to explain the criteria for each of the sorting stages in order to gain an understanding of the criteria used in decision-making. Analysis and comparison of these sorting exercises generated taxonomic trees showing the underlying categories and relationships of the Maya system of ethnomycological classification.

Quicksorts: Another group of 20 participants were asked to conduct quicksorts (Weller and Romney 1988). Participants viewed a set of 25 photographs of mushroom species. One focal picture, chosen at random, was compared with each of the other photographs, and the non-focal photographs were ranked according to whether they was more or less like a "***batz'il chejchew***" or "true mushroom" than the focal picture. This process produced two piles; one that was considered “more” like a “true mushroom” than the focal picture and one pile that was considered “less” like a “true mushroom.” The process was repeated with each of the newly created piles until all the photographs had been sorted into a complete rank. The resulting data were useful for developing an understanding of the characteristics associated with “true mushrooms,” the prototypicality of certain species and features, the importance of morphology and utility in the mushroom domain, and how certain mushrooms were grouped along a scale.

Sentence-Substitution Surveys: The next step was to conduct sentence-substitution surveys (Bernard 1995). A sample of 20 participants were asked to respond to an identical set of 65 sentence-substitution questions meant to identify attributes associated with 15 different mushroom species. For example, a single mushroom photograph was presented to a participant, and 65 questions were asked concerning use, market value, habitat, etc. Informants simply responded in a true/false format when matching each mushroom with each statement. With every participant this process was repeated for each of 15 mushroom species. These responses were examined by creating aggregate similarity and profile matrices that could be compared across informants. The goal was to gain insight into the perceived attributes associated with each mushroom species (see data collection sheet in Appendix D).

Semi-Structured Interviews: The final step consisted of conducting semi-structured interviews with 15 participants who were asked to respond in an open way to 40 different questions (see Appendix E). Questions were developed in response to gaps in the data previously gathered, and focused on the process of learning and identification, as well as knowledge of nutrition, medicine, edibility, mythology, and ecological requirements. These data provided qualitative support for conclusions drawn from more quantitative methods.

Phase IV - Market surveys

Markets in the city of San Cristóbal, and the Tzeltal municipalities of Tenejapa and Oxchuc were visited at least twice per month in order to obtain data on the harvest and sale of mushrooms in the region (Martin 1992; Martin 1995). Systematic data collected in markets included: (1) information on the vendor (name, age, home town, and other personal details), (2) identification of the species being sold, (3) number of vendors selling the species and quantities being sold, (4) the origin of the product, (5) value of the product, as well as its use (medicine, food, etc.), (6) condition of the mushroom and how it is packaged, (7) seasonal availability of the mushroom, and (8) changes in demand and supply of the mushroom throughout the year(s). Although this approach was relatively unproductive due to the seasonal availability of wild mushrooms, the data collected provided some information about the diversity of mushrooms being harvested, abundance, availability and origins of commercially sold mushrooms, how they are being used, what price they bring, and who harvests, buys and sells mushrooms.

1.7 Orthographic conventions

The conventions used in this dissertation follow those of Berlin and Berlin (1996:xxix), Smith (1999), Laughlin and Breedlove (2000), and Casagrande (2002). The five vowels in Tzeltal (*a, e, i, o, u*) are pronounced much like vowels in Spanish. Consonants, with a few exceptions, are also pronounced as those in Spanish. For example, (*j*) is pronounced in English as (*h*). Two major exceptions are (*x*), which is pronounced in English as (*sh*), and (tz) which is pronounced as (ts). Other exceptions are the glottalized consonants (*ch', k', p', t'*, and *tz'*), which are pronounced through the use of a glottal stop. Laughlin describes the glottal stop as "… a "catch" in the voice, such as in uh-oh, or Hawai'i (2000:xi)." According to Smith, the proper pronunciation of these consonants can be achieved through the following process: "While the mouth is closed, the closed glottis is raised in such a way that when producing the consonant there is a small explosion of pressurized air (1999:4)." Glottal stops are indicated by an apostrophe [']. Tzeltal words and the Latin names of plant, animal and mushroom species are presented in italics. The Tzeltal names of plant, animal and mushroom species are presented in bold italics. In pronunciation, most Tzeltal words are stressed on the last syllable.

Chapter 2

The Research Setting

2.1 Choice of field site

In the large market of San Cristóbal de las Casas, a variety of species of wild mushrooms can be found piled high on the small wooden tables of Latino merchants throughout the months of the rainy season (see Figure 2.1). They are sold for as little as five pesos/kilo to upward of twenty-five pesos/kilo, and the trade for these species is brisk. Except for one species of *Agaricus*, mushrooms are not cultivated in the highlands, and the majority of wild mushrooms that are found in the markets make their way down to San Cristóbal from the surrounding mountains. They are brought to the city by Tzeltal and Tzotzil Maya individuals who hunt the forests of the highlands and harvest mushrooms for small amounts of cash to supplement household incomes.

Figure 2.1 Mushrooms for sale at roadside stand.

The species sold in the market represent only a small percentage of the mushrooms that are found in the highlands of Chiapas. Market mushrooms are the large, fleshy species that require more time and effort to find, and they are robust enough to survive the trip to San Cristóbal. They are also widely considered nutritional, meaty and tasty, and as a result, they are worth a relatively significant amount of money.

The Maya who reside in the outlying communities harvest and consume a much wider variety of mushroom species than are sold in the market. The majority of my research was conducted in these outlying communities, and I spent much of my time walking through the highland fields and forests in search of mushrooms, and talking with swidden agriculturalists about the unique cultural and ecological characteristics of these organisms.

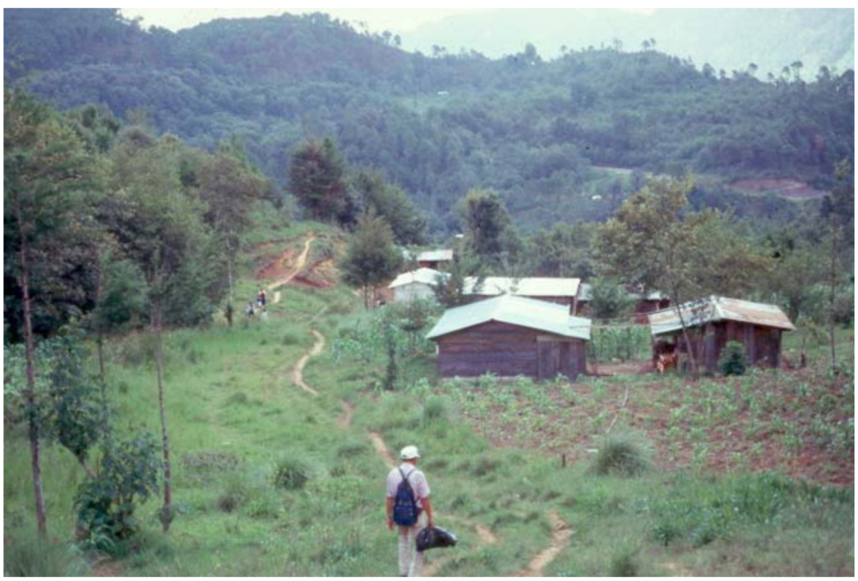


Figure 2.2 Trail leading through Nabil, Tenejapa (Courtesy of David Casagrande).

The first time I took a taxi ride along the long winding road to the Tzeltal Maya community of Tenejapa, I was struck by the difficulty of making a living in the rugged landscape. The road clung tenuously to the sides of the crumbling slopes, gradually climbing from the valley of San Cristóbal de Las Casas (see Figure 2.2). Eroding pastures grazed by flocks of sheep gave way to patches of forest interspersed with small, hand-worked milpas (cornfields) planted on steep hillsides. Men, women and children in brightly colored traditional clothing walked the highway with piles of firewood hanging from their backs on tumplines. Small houses made of wood or concrete lined the road, situated precariously on the tops of deep gorges. Dogs, chickens, and turkeys foraged in the dooryard gardens as families went about the daily business of cooking, working the fields, washing clothes, chopping firewood, and talking with passing neighbors.

The altitudinal variation, abundant precipitation, and patchy forests of pine, oak and liquidambar provides favorable conditions for the development of a wide variety of macrofungi, and the region is rich in mushroom diversity. In order to document the range of this diversity, and to explore variations in traditional knowledge about mushrooms in the highlands, I chose to conduct research in two politically independent, but linguistically related Tzeltal municipalities that spanned a wide range of altitudes, landscapes, and cultural differences. I specifically chose communities found at high elevation, *sikil k'inal* 'cold country', zones in order to limit range and scope of mycological collections and increase the accuracy and generalizability of my ethnomycological conclusions. In the end, I worked in numerous small hamlets located in the neighboring municipalities of Oxchuc and Tenejapa (see Map 2.2).

Although Oxchuc and Tenejapa exhibit a number of differences in patterns of speech, dress, and community participation, they are comparable in population size and density, settlement pattern, and ecological adaptation. There are other important similarities: The outlying communities in each of these municipalities are difficult to reach by truck, they have inadequate access to electricity and running water, and the majority of the residents rely on traditional swidden agriculture for subsistence. These communities also harbor patches of secondary forest within which the residents hunted and gathered wild plants and firewood. One of the most important cultural features shared by the Maya in these municipalities is sophisticated traditional knowledge and extensive utilization of wild species of macrofungi, providing ample opportunity for in-depth ethnographic study.

Specific communities within each municipality were selected on the basis of established relationships with community members, prior development of permission to conduct research, and exploratory research that indicated traditional use of macrofungi. Preliminary research was conducted in the municipality of Tenejapa over four months split between the summers of 1998 and 1999. This preliminary research was followed by 12 months of intensive research in 2000-2001. In the municipality of Oxchuc I worked in the *paraje* of Pak'bil na for approximately five months (July through November 2000). In order to broaden the geographic and cultural range of my research, I spent the remainder of my time (November 2000 through May 2001) in the municipality of Tenejapa, working in the neighboring *parajes* of Nabil and Chixaltontic.

I selected this region, and these specific communities, for six primary reasons: First, preliminary research conducted in the summer of 1998 indicated there was an established tradition of mushroom harvest and consumption in the region. Second, the mycoflora (composition and diversity of mushrooms) of the Central Plateau region of Chiapas had not yet been thoroughly examined and documented. Third, the extensive ethnobiological work conducted in this region by Berlin, Breedlove and Raven (1974), Hunn (1977), and Berlin (1992) provided an ideal framework for comparative research into indigenous classification systems. Fourth, Dr. Brent Berlin and Dr. Elois Ann Berlin have a well established relationship with El Colegio de La Frontera Sur (ECOSUR), a Mexican university located in San Cristóbal de Las Casas, Mexico. The generous collaboration of the Berlin's made this work possible, and I was provided with access to reference materials as well as human and technological support such as an herbarium, library, computers, and specialists in the fields of mycology, anthropology, and ecology. Fifth, through word of mouth I was able to make informal contacts with Tzeltal Maya individuals living in these *parajes* who were generously willing to allow me to live and work in their homes, and who agreed to help me gain permission to work within the boundaries of their communities.

The goal of the remainder of this chapter is to introduce the research settings in more detail, and to provide the ethnographic and ecological contexts within which the traditional ethnomycological knowledge of the Tzeltal Maya evolved. Numerous factors play a role in the development, transmission and adaptive functions of ethnomycological knowledge. Section 2.2 details the biocultural environment of the Chiapas Highlands with a focus on naturally occurring ecotypes and the impact of Maya management systems on floral and fungal communities. Section 2.3 introduces regional patterns of Maya culture, as well as modern trends that are affecting change. Sections 2.4 and 2.5

provide context for interpreting Tzeltal mushroom use through a discussion of the subsistence systems, household demographics, economic strategies and historical trends that characterize the communities within which I conducted research. The final section provides an historical perspective of the ways in which Mesoamerican cultures have perceived and interacted with macrofungal resources throughout time.

2.2 Ecology, subsistence strategy and ethnomycological knowledge

Mexico has been described as one of the world's six mega-biodiversity countries (Varela and Estrada-Torres 1997, Blanco et al. 1997) with the highest documented species richness in North and Central America, and a rate of endemism that approaches 52% for vascular plant species (Ramamoorthy et al. 1993; Rzedowski 1993; Stepp 2002). According to Moreno-Fuentes and Montoya (1999) more than 6,000 species of macroscopic fungi have been described in Mexico, at least 200 of which have documented cultural uses. There are many reasons for the high level of biodiversity in Mexico, including temperate to tropical latitudes, the location of the country between the two major biogeographic regions, irregular topography, past geological processes and climatic changes, and the evolutionary and migratory events of Mexico's flora and fauna.

Within this context, the state of Chiapas, which lies in the southernmost part of Mexico bordering Guatemala, is second only to the state of Oaxaca in terms of biodiversity (Toledo 1998). Its 73,887 km^2 of land give sanctuary to a rich array of biodiversity, with approximately 6,000 species of vascular plants and as many as 1150 species of vertebrates (Breedlove 1981; Rzedowski 1991; Berlin and Berlin 1996). Although the numbers of macrofungi have not been fully evaluated in Chiapas, more than

291 species had been documented by 1988, 18 of which are thought to be endemic (Villarreal and Perez-Moreno 1988). This backdrop provides ample potential for the exploration of cultural uses of macrofungi in the highlands.

The communities within which I conducted research are located in the Central Plateau (or Central Highlands) of Chiapas. This formation is approximately 220 km in length from its northwest intersection with the Northern Highlands to the southeast, where it meets the border of Guatemala (see Map 2.1). Throughout its length, the Central Plateau ranges from 50 to 100 km in width (Vogt 1969; Breedlove 1981).

Map 2.1 States of Mexico: Chiapas bordering Guatemala to the south (INEGI 2000).

The predominantly limestone substratum is irregularly interspersed with extrusive rock resulting from volcanic activity (Mulleried 1957; Villa Rojas 1969; Helbig 1976), and the landscape is continually broken by deep ravines, sink holes and caves. The highest summits drain into small basins (Villa Rojas 1969), forming small streams that quickly empty into a few permanent sinkholes and numerous underground caverns. Subsurface streams flow northeast, emerging from the ground to create rivers in the lowland valleys that eventually join the Grijalva River to enter the Gulf of Campeche. The shallow soil, derived from limestone and volcanic features, varies from rich brown clay loam found along fertile valley floors (Breedlove and Laughlin 2000) to an acidic and nutrient poor sand and clay loam (Stepp 2002) in the higher elevations.

The center of the municipality of Tenejapa is found at latitude 16º 50’ North, and longitude 92º 30’ West (Hunn 1977). The center of the municipality of Oxchuc is 16º 47’ North and longitude 92º 20’ West (INEGI 2000). Although these latitudes are situated in the American tropics, the climate is generally sub-humid temperate due to elevations that range from 900 m to 2900 m (Rzedowski 1993; Hunn 1977). The temperature is generally cool, and there is little variation throughout the year with lows that rarely drop to 12º C in January and highs that reach 25º C in the summer. At elevations below 1000 m, the temperature remains relatively warm throughout the year. At higher elevations, the full range of temperature variation can often be experienced during any given day in the dry winter months, with nearly freezing temperatures at night and hot temperatures in the midday sun. Precipitation varies greatly throughout the region, ranging from 1200 to 2000 mm depending on altitude and east-west location along the mountainous divide. As much as 90% of this precipitation occurs during a pronounced wet season, between the months of May and December (Vogt 1969). These seasonal conditions are good for wild mushroom production, as relative humidity increases decomposition rates of organic matter in the soil, stimulating the development of numerous varieties of macromycetes.

The temperate climate and topographic diversity of the Central Plateau support a wide variety of vegetational associations, and the floral diversity has been estimated to approach 3000 vascular species (Stepp and Moerman 2001), although this number is a relatively high estimate. The Maya recognize vertical zones of vegetation and activity including tierra caliente (‘hot country’) below 900 m, tierra templada (‘temperate country’) extending from 900 to 1800 m, and tierra fría (‘cold country’) above 1800 m. Distinctive vegetational associations tend to follow these elevation patterns, with small patches of Evergreen Cloud Forests on the highest peaks, Pine-Oak and Pine-Oak-Liquidambar Forests at mid to high level elevations, and Seasonal Evergreen Forest and Tropical Deciduous Forests at lower elevations (Breedlove and Laughlin 2000). Second-Growth Successional Shrub and Forest associations are found throughout the region. My research was conducted only at mid to high elevations in Evergreen Cloud Forest, Pine-Oak Forests, Pine-Oak-Liquidambar Forests, and Secondary/Successional Associations.

Evergreen Cloud Forests are located only on the highest peaks and ridges in the highlands from 2000 to 2900 m (Berlin et al. 1974). The few patches that still exist are either protected or isolated from most human disturbance because they exist in incredibly rugged and steep areas that are practically impossible to access. The areas in which these patches are found are so steep and rugged the Maya cannot plant crops or graze domestic livestock. However the few remaining stands are rapidly disappearing as the Maya cut individual trees for firewood or construction materials.

Unlike other microhabitats in the highlands, Evergreen Cloud Forests receive precipitation throughout the year due to low hanging clouds and persistent fog that permeate through the canopy (see Figure 2.3). The trees, which reach 40 m in height, are closely spaced. Ferns and mosses are abundant (Berlin et al. 1974), and the underbrush is dense and difficult to traverse. Some of the dominant tree species, as reported by Breedlove and Laughlin (2000), include *Abies guatemalensis*, *Chiranthodenron pentadactylon*, *Clethra lanata*, *Drimys granadensis*, *Olmediella betschleriana*, *Oreopanax capitatus*, *Persea donnell-smithii*, *Photinia matudae*, *Pinus ayacahuite*, *Quercus benthamii*, *Weinmannia pinnata*, and *Wimmeria chiapensis*. During the time of my research, the only cloud forest I encountered was located in the *paraje* of Matzab in the municipality of Tenejapa, and, despite the rainy summer weather, few culturally important species of macrofungi were fruiting there.

Figure 2.3 Peaks of Matzab, Tenejapa covered in Evergreen Cloud Forest

Pine-Oak Forests, found between the elevations of 1200 to 2600 m, are currently among the most common woodland associations in the highlands. As reported by Berlin et al. (1974:14), Pine-Oak Forests are, for the most part, secondary formations that resulted from previous disturbance, and it is unclear whether these forests were common before human occupation. Composed of a wide variety of deciduous and semi-deciduous trees that grow 15 to 40 m in height, the Pine-Oak forests support a diversity of epiphytes, understory plants, and macrofungi. In some places there are stands of pure pine or pure oak, but more commonly these trees are found mixed together. As reported by Berlin et al. (1974), and Breedlove and Laughlin (2000) some of the most common tree species occurring in secondary stands of Pine-Oak Forest include *Abies guatemalensis*, *Pinus ayacahuite*, *Pinus michoacana*, *Pinus oaxacana*, *Pinus oocarpa*, *Pinus pseudostrobus*, *Quercus acatenangensis*, *Quercus corrugata*, *Quercus crassifolia*, *Quercus crispipilis*, *Quercus laurina*, *Quercus mexicana*, and *Quercus rugosa*. Stands of Pine-Oak Forest are found in small to large patches along ridges and in the valleys throughout the highlands, and they are consistently exploited for natural resources such as firewood, timber, hunting of small game, and gathering of medicinal plants and wild mushrooms.

Pine-Oak-Liquidambar Forests, occurring between 1000 and 1800 m, comprise another common woodland association in the highlands of Chiapas. This diverse forest is composed of numerous deciduous and semi-deciduous tree species, with abundant epiphytes and a variable understory of dense shrubs or grassy areas mixed with small shrubs. Pine-Oak-Liquidambar forests are thought to have once been one of the most important primary forest associations in the region, although today most stands are secondary. Some of the important tree species reported by Berlin et al. (1974) include *Brunellia mexicana*, *Carpinus caroliniana*, *Cornus disciflora*, *Erythrina chiapasana*, *Liquidambar styraciflua*, *Pinus chiapensis*, *Pinus monntezumae*, *Quercus candicans*, *Quercus oocarpa*, *Quercus polymorpha*, *Quercus sapotifolia*, *Quercus segoviensis*, *Quercus skinnerii*, and *Turpinia occidentalis* (for a more complete listing see Berlin et al. 1974:3-16; and Breedlove and Laughlin 2000:11-17). This forest community can be found in patches throughout the highlands, and provides a rich environment for important natural resources such as edible macrofungi.

As a result of disturbance by subsistence and economic strategies, the dominant vegetational associations in the highlands are composed of Second-Growth Successional Shrub and Forestlands. Throughout the region plots of land are cleared, burned, and farmed for 1-3 years. Once the soil is exhausted, these plots are left fallow for 4-15 years to rebuild nutrients through the natural process of succession. The ecological result is a complex patchwork of agricultural plots, successional shrubby lands, and secondary forest. These diverse associations, which are too variable to describe, are composed of remnants of species from the disturbed forest habitat and a dense assemblage of shrubs, vines, and herbaceous plants (see Figure 2.4).

Various common stages of succession are recognized as unique vegetational features by the highland Maya and are often referred to in discussions of the location and habitat of a particular species of macrofungi. The following description of linguistically recognized successional stages was originally discussed by Berlin et al. (1974:119-124), and is derived, with permission, from Casagrande (2002):

1. *pat na* – The highly disturbed areas found around houses with many weedy species and planted herbaceous species.
2. *ak'il* – Grasslands and pasture that are either used for livestock grazing, or allowed to develop successionally.
3. *k'altik* – Swidden agriculture fields of corn, beans and squash and the weedy species growing among them.
4. *k'ajbenal* – Recently abandoned corn field in the first year of fallow, characterized by dead corn stalks that are intermixed with weeds, herbaceous plants and saplings.

5. *wank’altik* – The second year of fallow with successional herbs, shrubs, and saplings reaching 1.5 m in height.
6. *unin k’inal* – Vegetation ranging from 3-7 years of age, young forest with dense understory growth and a canopy of 10 m.
7. *k’inal* – Trees and shrubs after 6-12 years of secondary growth, dense mixed forest up to 15 m in height and thick undergrowth.
8. *te’tikil* – Secondary woodland or forest of at least 10 years, with stands of pine and oak and a thinning understory.
9. *ja’mal* – Old growth forest or secondary forest of antiquity with pine, oak, liquidambar, and *Persea* spp. forming high canopies covered with epiphytes and humid herbaceous undergrowth.

Figure 2.4 Patchy landscape in various stages of succession

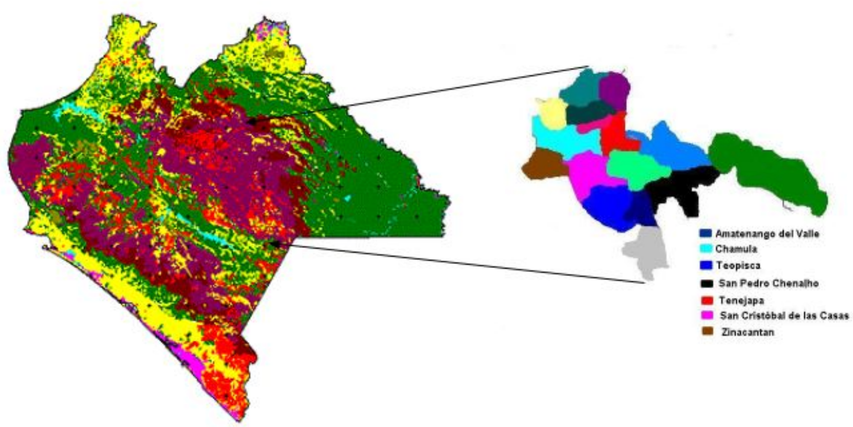
At the current time, secondary forest and successional shrub associations have replaced almost all of the old growth communities that once existed in the highlands. Unfortunately, despite recent evidence that disturbed habitats are rich in culturally important natural resources such as weedy and herbaceous plants that have medicinal qualities (Stepp 2002; Casagrande 2002), such habitats are not preferred by macrofungi. Ecozones such as *pat na*, *ak'il*, *k'altik*, *k'ajbenal*, *wank'altik*, and *unin k'inal* do not support the production of a large diversity of macrofungi, which generally require carbon-rich humid soils, shade and precipitation. Throughout the course of my research, milpas, pastures and early successional landscapes produced only saprophytic species such as *Daldinia* and *Schizophyllum* and parasitic species such as corn smut.

Despite the scarcity of primary forests in the region numerous patches of second-growth forests that include a mixture of old growth community trees are still somewhat prevalent throughout the municipalities of Tenejapa and Oxchuc. In many of these forests, trees reach heights of 35 m, suggesting they have grown undisturbed for 20 to 40 years. Studies of the fungal diversity in Deciduous Tropical Forests, Pine-Oak Forests, and Cloud Forests at similar elevations along the Neovolcanic Axis of Mexico have found more than 1,300 different species of macrofungi (Cifuentes et al. 1997). These numbers indicate that the primary and secondary forests of highland Chiapas provide good conditions for the growth of a large number of parasitic, saprophytic, and mycorrhizal macrofungi. Throughout the course of my research, for example, I collected numerous commercially important species including *Amanita caesarea*, *Boletus* spp, *Lactarius deliciosus*, *Russula brevipes*, and species of *Morchella*.

2.3 Regional patterns of traditional culture and culture change

Chiapas is a rugged, mountainous state located in the extreme south of Mexico on the border of Guatemala. Although Spanish is the official language, approximately 790,000 (23%) of the nearly 4 million inhabitants are native speakers (over the age of five) of an indigenous language (Instituto Nacional de Estadistica, Geografia e Informatica 'INEGI' 2000). An estimated 296,000 of these speak little or no Spanish (INEGI 2000). This places Chiapas fourth in total numbers of indigenous speakers in Mexico, with the states of Yucatan, Oaxaca and Quintana Roo first, second and third respectively. Five Mayan languages are spoken in Chiapas, including Tzeltal, Tzotzil, Tojolabal, Chol and Lacandon. One non-Mayan language, Zoque, is spoken in a few communities that border Oaxaca to the southwest (Kaufman 1964; Berlin et al. 1974). The majority of indigenous speakers in Chiapas, however, speak one of the eleven dialects of Tzeltal, with approximately 292,000 speakers, or Tzotzil, with approximately 285,000 speakers over the age of five (Kohler 2000; INEGI 2000).

Since at least the 17th century, Tzeltal and Tzotzil Maya have traditionally resided in the Central Highlands, or Central Plateau, of Chiapas (Adams 1961; Beltran 1973). This region is characterized by extreme altitudinal and ecological variations that, in conjunction with historical forces, resulted in cultural isolation and diversification. Throughout the past century small, marginalized communities formed by allied family groups sharing common dialects, lands, and cultural traditions have slowly gained political recognition and independent governance (Klein 1966; Collier 1976; Wasserstrom 1983). Each of these communities asserts its traditional identity through highly localized styles of clothing, and each community practices religious rituals and ceremonies to honor a specific set of patron saints. Specialized crafts, services and agricultural products are typically associated with specific communities, and interestingly, due to historical processes and the mountainous landscape, there are vast differences across these communities in access to modern services such as roads, utilities and healthcare. Despite these localized differences, Tzeltal and Tzotzil communities all exhibit social, political and religious characteristics common to the larger Mesoamerican culture, and at the household level, families engage in subsistence-level corn, bean and squash swidden agriculture (Kirchoff 1943; Laughlin 1969; Villa Rojas 1969; Collier 1975; Blanton and Feinman 1984; Blanton et al. 1993; Sharer 1994).



Map 2.2 State of Chiapas and municipalities surrounding San Cristóbal de Las Casas.

The largest distinct unit of political organization is the municipality (see Map 2.2), a geographically and culturally bounded area resembling a county that serves to tie numerous smaller communities together under indigenous leadership. Although the importance of the municipality for indigenous governance has been debated (Cancian 1992), most of the small outlying communities send delegates to municipal offices in order to voice specific needs. There is generally a single political and ceremonial center (the *cabecera* or 'head') that, today, is densely populated and hosts a large weekly market.

These *cabeceras*, at least in the highlands, once followed a modified form of the "vacant town" (Tax 1937; Wolf 1957) in which Ladinos and a few indigenous families fulfilling cargo duties resided in the *cabecera* throughout the year. Until recently, the majority of the indigenous population lived in the surrounding villages and traveled to the *cabecera* for markets, fiestas, and religious celebrations. Today, there has been a significant shift to permanent residency in the *cabaceras*, and these towns have become large, semi-urban central places. Many of the families that reside in the *cabaceras* today retain their rights to patrimonial lands in the outlying communities, and occasionally travel to these lands to visit with family and friends, or to work the fields.

The local indigenous government is a civil-religious institution, often called the cargo system, which is based in a large municipal building in the *cabecera* (Sharer 1994; Morely et al. 1983). The cargo system has been described as the "heart of the Mesoamerican village," (Wolf 1957; Wasserstrom 1983; Vogt 1976) and indeed this system has had a widespread influence on the customs, beliefs, economics and social relations of millions of peasants living in hamlets and villages throughout the various regions and cultures that, together, define "Mesoamerica" (Blanton and Feinman 1984). The civil side is the basis of political power, taxation and judicial rule (Collier 1976; Ouweneel 1995). Two men are typically elected on a yearly basis to serve as president and vice-president of the municipality. Various respected senior men are elected to positions as *alcades* 'mayors' and *gobernadores* 'governors' who assist in the administration of government in matters such as organizing fund collections. Also elected are *regidores* ‘rulers’, who serve as the heads of various subcommittees that make decisions about public service, social welfare and community works, and *mayores* ‘elders’, the minor level bureaucrats who police the towns, make judgments in local courts, make decisions for the town, collect taxes, and manage the treasury (Cancian 1965). Positions in the civil hierarchy last 1-3 years, and elected officials must reside in the *cabecera* throughout the duration of their term.

The religious side of the cargo consists of a hierarchy of men who are appointed to special religious positions designed to serve the various patron saints of the community (Carrasco 1961; Chance 1985a). Traditionally, the cargo is a hierarchical system, a ladder of prestige that men hope to climb throughout their lifetimes. With the financial support of the extended family, the men in these positions reside in the *cabecera* for exactly one year in order to organize and fund the religious ceremonies and fiestas. Due to the considerable costs involved, and the time spent away from the milpa and wage labor, the system could often be a considerable burden on cargo holders and their families and friends. On the other hand, holding a cargo position is highly prestigious, raising the status and influence of both the office holder and his extended family. Today, the cargo system appears to be changing dramatically.

The balance between individual wealth, social prestige, and the cargo system has been the focus of extended debate (Chance and Taylor 1985). Wolf (1957) thought the cargo system served to redistribute wealth and maintain a closed, egalitarian community with minimal social stratification. In a later analysis, Cancian (1965) claimed that the financial burdens associated with religious cargos leads to the monopoly control of high-prestige positions by a few wealthy families who generally reside in the *cabecera* permanently, resulting in obvious social stratification and a strengthening monopoly over cargo systems. In either case, the fate of the religious cargo system is uncertain due to modern trends that have increased the trend of accumulating wealth, and the institution is likely to continue to change in the future.

As Cancion (1965) suggests, increased market participation, new access to public services such as electricity and transportation, and the desire for modern products such as television, clothing, or household appliances have led to a rising need for cash income. Rising population densities and reduced productivity due, in large part, to erosion have led to land shortages and an inability to support a family through subsistence farming (Collier 1975). In response to these and other factors, large numbers of young men, who exclusively participate in the cargo system, are migrating out of the communities in search of wage-labor jobs (Burns 1993). In the near future, social prestige derived from community participation and cargo systems may soon be replaced by social prestige derived from material wealth.

The *cabecera* is surrounded by smaller *parajes* or 'communities' that radiate in an irregular pattern into the surrounding landscape. *Parajes* are not only distinct communities occupied by a number of closely allied families, they are also the smallest political units recognized by the system of indigenous government in Chiapas. The boundaries and organization of these hamlets are based on traditional lineage systems in which land is owned by families and inherited through the male line (Collier 1978). Although traditionally, *parajes* were geographically and religiously tied to a special cave or source of water (Villa Rojas 1969), today, because of local initiatives to develop water pipes near the roadways, they often surround the schools that have been built by the

Mexican government. Many *parajes* can be subdivided further into smaller named communities consisting of a number of families clustered together in groups of homes along high ridges or in small valleys. Although these smaller named communities are highly important for the purposes of social identification, they often lack representation in local governments.

Although Chiapas is rich in cultural diversity, biodiversity and natural resources, it remains one of the poorest states in Mexico. In general, indigenous populations in the state have grown rapidly (more than doubling in the past 30 years), while infrastructure, education, health care, and public utilities have not kept pace. These social problems are rooted in the difficulties of developing infrastructure in a mountainous region, the lengthy history of social, cultural and economic disparities between ladino and indigenous populations, and a lack of serious, funded government commitment to development in the region. Such trends are manifest in a number of key areas of socioeconomic life

More than half of the population of Chiapas lives in rural areas with little access to large towns and cities (INEGI 2000). Although the number of paved roads has increased dramatically during the past twenty years, numerous indigenous communities remain isolated from the outside world, linked to market centers only by radios, footpaths and eroding dirt roads. As a result, individuals in highland areas must either walk long distances, or pay a taxi or bus to reach the market to buy and sell even basic goods. In addition, those who travel to the lowlands to work find the trip expensive and arduous, and as a result, often spend weeks or months away from home.

One of the most alarming effects of the lack of roads is that health care workers have difficulty reaching the communities on a regular basis to administer vaccinations or to meet the health needs of the population. Although small clinics administered by the Instituto Mexicano del Seguro Social (IMSS) and Secretaría de Salud (SSA) are open two or three days a week in the *cabeceras*, there are no clinics or hospitals in the majority of indigenous *parajes*. In the year 2000, there were 42 hospitals in the entire state, serving a population of 4 million people (INEGI 2000). During that same year, there were only 88.2 physicians per 100,000 residents (INEGI 2000). Occasionally, when the support of government or private funding is available, health care workers and medical students from IMSS, Secretaria de Salud (SSA), or Instituto Nacional Indigena (INI) travel to the outlying *parajes* in order to diagnose illness, prescribe medications and administer vaccinations.

Pharmacies, although numerous in San Cristóbal, are scarce in the indigenous communities, and generally have few medicines available. In essence, health services are scarce and usually available only in big cities and municipal centers. Adding to these problems, many of the Maya distrust western trained doctors who are not only strangers, but can't communicate in indigenous languages, and prescriptions are often misused due to lack of cultural context and understanding. As a result, many of the Maya still rely on traditional herbal medicine for much of their health care (Berlin and Berlin 1996).

In contrast, one of the most successful government programs over the past forty years in Chiapas has been the construction of schools throughout the municipalities. Since the 1960s, schools have been built in almost every *paraje* in the highlands. In many cases the presence of a school affects settlement patterns; families that used to live in scattered houses throughout the mountains are now developing close-knit hamlets composed of homes built near the schools. Unfortunately, despite this explosion of school building there is little funding for textbooks, computers, teachers or other educational resources, and due to the lack of paved roads in many areas, educators who live outside the community often walk as many as ten miles to and from school each day. In 2000, approximately 522,600 (23%) of the people over the age of 15 in Chiapas were illiterate (INEGI 2000). Almost 16% of children between the ages of 6 and 14 were not attending school, and 50% of individuals over the age of 15 had not completed elementary school (INEGI 2000). These and other problems with the government funded education system are central themes of social unrest in Chiapas, and there is clearly much room for improvement.

The paucity of paved roads and highways is mirrored by a serious lack of electricity and phone services, which are reliably available only in the larger towns and *cabeceras*. Although government programs have slowly made progress in providing infrastructure in the highland communities over the past 20 years, the outlying *parajes* have access to the barest minimum of services. In the impoverished municipality of Oxchuc, for example, an estimated 45% of the population does *not* have access to electricity. More fortunate households throughout the region have a bare light bulb in each room in the house, including the separate kitchen structure, and, in some cases, outside the house as well.

Most of the families in the highlands have a small AM/FM radio that provides access to local and regional news and music stations. A few of the wealthier families have small televisions connected to antennas, and some even have direct-TV satellite dishes, although this is generally only true for the wealthiest families residing in the *cabeceras*. There are very few, if any, computers in outlying communities of the Tzeltal

Maya. Finally, there are few telephones in the *parajes*, and indeed, at the time of my research, there were only two or three working telephones in the political/ceremonial centers of Tenejapa and Oxchuc. These phone lines are expensive, they function irregularly, and they are difficult to access due to the number of people waiting to use them. Interestingly, although cell phones have become important sources of communication in many underdeveloped localities around the world, the majority of the Tzeltal and Tzotzil Maya have not adopted them. The most likely explanation for the lack of cells phones is a lack of money for infrastructural development and purchasing of phone plans.

Another ambitious project initiated over the past thirty years was the construction of a system of water pipes to every community in the highlands (Kohler 2000). Currently, although running water is generally available, most families in both the *cabecera* and the outlying *parajes* have access only to a single tap for the household. In some Tzeltal municipalities, however, as much as 75% of the population does not have running water (INI 2000). The system of water pipes, where it does exist, is small and fragile, composed of aboveground plastic pipes and rubber hoses between five and ten inches in diameter, and the reliability of this water is highly inconsistent throughout the year. Pipelines, which sometimes are raised on cement blocks, and sometimes simply running along the ground, are subject to days of cut-off due to breakdowns in the infrastructure, drought, or minor accidents such as the misplaced stroke of a machete, or the burning of the waterlines during the clearing of a milpa.

In locations without access to running water, some families have cement rainwater catchments, and in some communities there are large PVC rainwater storage tanks that provide access to water when there is enough precipitation. Indoor plumbing, latrines and sewage systems are practically unknown in the highlands, and indeed, as many as 66.9% of indigenous language speakers in Mexico have no access to a toilet (INEGI 2000). As for the families living in the *parajes* within which I did my research, most utilized the landscape directly adjacent to the house compound for this purpose.

The majority of homes are constructed of either concrete blocks with a flat cement roof or wooden planks with a corrugated roof. Although concrete floors are becoming more common in the highlands, as many as 89% of homes in some communities have dirt floors (INI 2000). Traditional wattle and daub homes with thatched grass and palm roofs can still be found, especially among the older generation (see Figure 2.5). Kitchens are almost always separate from the house, and are usually constructed of plank wood walls, corrugated iron roofs with large spaces along the crossbars for ventilation, and a simple fire-pit located in the middle of the floor. The kitchen serves as the center of social life, and the family spends much time cooking, talking and working around the fire.

Figure 2.5 Traditional style wooden plank homes with thatch roofs

Families tend to live in compounds, with two, three or four houses situated around a common open area. Sons, with their wives and children, usually settle down on the family plot in a patrilineal pattern (Villa Rojas 1969). These extended families often live, work and cook together. Meals are cooked either on a metal comal (a flat round metal sheet that resembles the traditional comal – a flat round ceramic sheet) or in metal and ceramic pots placed over an open fire. While the children are at school, the parents and elderly members of the family work in the fields, hunt, gather wood, and perform common household activities.

Traditional clothing is still an important marker of ethnicity and community membership, allowing observers to easily identify different groups at markets and fiestas. Men traditionally wear short pants (*wex*) and a long woven shirt tied at the waist with a cotton sash, as well as a palm hat (*pixol*) and leather sandals or boots (Villa Rojas 1969). In the higher elevations, the men also own a long shirt made of wool, which is worn when it is exceptionally cold or during ceremonial occasions. Although most men still own traditional garments, they tend to wear manufactured pants, cotton shirts, and sweaters throughout the average day. Women, however, have resisted such change, and generally go shoeless and wear traditional ankle-length woolen or woven blue skirts wrapped around the waist and tied with a sash (see Figure 2.6). They wear traditional blouses on ceremonial and festive occasions, although tee shirts, sweaters and long-sleeved half-turtle neck cotton shirts have become the norm when at home. Mothers of young children wear a cotton cloth around one should for carrying the child.

Although subsistence swidden agriculture of corn, beans, and squash is still the mainstay of the highland Maya lifestyle (see Figure 2.7), numerous other strategies are

Figure 2.6 Tzeltal women in traditional clothing in front of wood plank home

currently gaining in popularity. Both Tzotziles and Tzeltales have begun to intensify agricultural production of non-traditional crops through the use of hot houses, irrigation, fertilizers and pesticides. In Tenejapa coffee production developed as an important economic strategy, although, due to worldwide overproduction and the resulting severe drop in coffee prices in 1990 this approach is currently failing. In Chamula the production of various vegetables for markets has become important, and in Zinacantan flowers are produced in huge hothouses and shipped throughout Mexico.

The most interesting new economic strategy is the creation of a system of "Casas de Cultura" in the highland communities. Through various public and private initiatives,

Figure 2.7 Religious ceremony in thanks of water source that maintains the milpa.

Tzeltal and Tzotzil women have formed loose communal organizations engaged in the production of traditional weavings, clothing and crafts for sale in regional and international markets. Women who join these organizations have creative license with their artwork, and generally do the majority of their work in their spare time at home. The weavings and crafts produced are of the highest quality, and demand relatively high prices in comparison with typical wages in the region. Although these "Casas de Cultura" do not currently support entire communities, the advent of global tourism and access to the internet may well make them among the most profitable businesses in the region in the near future.

Men who remain within the communities participate in wage-labor timber harvesting, road building, transportation, and house construction. Due to the lack of opportunities in the highlands, however, many men spend part of the year away from the community, in lowland areas working agricultural plantations. Others travel farther for wage-earning opportunities in construction or oil production in coastal regions, or textile manufacturing on the U.S.-Mexico border (Burns 1993). Finally, emigration has become a popular strategy, with numerous Tzeltales and Tzotziles establishing colonies in the lowlands of the Selva Lacandon and other regions (Casagrande 2002).

These new economic strategies, and the movement of large numbers of Mayans out of the highlands, are related to increasing populations and the historical lack of indigenous control over the best agricultural lands, industries, or natural resources such as minerals and petroleum (Smith 1976). Most individuals work a few small plots of marginalized land, making barely enough to feed a family. Many rent additional plots in the lowlands to produce surplus for the household or the market. Those who migrate to the cities work two or three jobs and can barely pay rent; others work wage-paying jobs far from their homes, keeping families apart for months. In essence, the growing population of highland Maya will have to find new alternatives to support their families and to develop basic financial security in the future.

Unequal access to productive resources is mirrored by unequal access to basic government services, and an ingrained, unshakable racism directed toward people of indigenous descent. Until reform efforts began to gain momentum in the past three or four decades, those with wealth, education and European descent viewed the Maya as backward and lazy (Castellanos 1996). The entrenched ruling elite and newly emerging middle class used race as an explanation and rationalization for the plight of the Maya, and as support for continued political and academic obscuring of the real issues that face them (Gossen 1996). To this day the Maya lack basic access to education, health services, economic infrastructure such as roads, phone lines, sewage and electricity, and control over productive resources such as fertile land, minerals and oil. Without basic access to these social, political and economic resources, the Maya will continue to remain at the bottom of the socioeconomic hierarchy, and continue to face systematic discrimination.

Despite the rapid social, economic and political changes occurring in Chiapas, language differences, religious rituals, marriage systems, and clothing style continue to serve as traditional markers of ethnic identity. In addition, locally based traditional knowledge, beliefs and values continue to be maintained and passed on to younger generations. Among the many facets of Maya life that are important to the maintenance of this knowledge, the ones that stand out are language preservation, traditional ethnomedical practices in the maintenance of health (Berlin and Berlin 1996), and the continued importance of subsistence agriculture as the primary mode of production.

As the Maya become more involved in a global capitalist system, increasing wealth differences will create new cultural norms, beliefs, ideologies and economic strategies. As the population grows and places greater demands on the already over-cultivated lands, more people will migrate to other areas. Finally, as better access to medical care, communication, roads, and technology develops in the highlands, ethnic boundaries and socioeconomic differences will continue to change in new and hopefully positive ways.

2.4 The municipality of Tenejapa

The *cabecera* of the municipality of Tenejapa, alternately called *mero* Tenejapa ‘true Tenejapa’, Tenejapa *Centro* ‘Tenejapa center’, or *lum* ‘land’, is located in a group of mountains about 28 km to the northeast of the regional center of San Cristóbal de Las

Casas. Records indicate that this small valley has been inhabited since at least 1611 AD (Calnek 1961), although the Tzeltal Maya have lived in the region much longer. The elevation of this center is 2060 m above sea level, and the various outlying *parajes* range from 900 m in the northeast to 2800 m above sea level in the south (Hunn1977:5). The total population consists of 33,160 individuals over the age of five who reside within the boundaries of approximately 99 km^2 of land. The resulting population density of the municipality is approximately 335 persons/km^2 (INEGI 2001). These numbers show a significant increase from the population density of 56 persons/km^2 just 30 years ago, and contribute to a growing number of problems related to land ownership and subsistence in the region.

The *cabecera* is a growing maze of narrow brick streets lined with small storefronts and concrete and wood-plank houses. Although this center was occupied by large numbers of people of Spanish descent in the past, fewer than 200 remain today, and the majority of the permanent population consists of indigenous Maya. While electricity is readily available, there is limited access to phones, running water, and sewage. The outskirts of town are under continuous development as more and more of the Maya move down from the *parajes*, and as a result, there is little land left in the valley for further construction. A Catholic Church, casa de cultura, and municipal building line the central plaza on three sides. Three main thoroughfares wind through the town leading to more distant communities, and at the very edge of town, a small medical clinic operated by SSA offers the services of a doctor two or three days a week.

Although the *cabecera* of Tenejapa is densely populated, it is difficult to determine an exact number for the permanent residents for the town. The majority of the people on the streets are visitors who come to attend the weekly market, join in religious celebrations, visit the medical clinic, or work in short-term wage labor. Although *mero* Tenejapa gives the appearance of a thriving community, there few employment opportunities, and competition for residential or market space is fierce. Because the number of professional jobs is limited to service positions, buying and selling goods, education, transportation, and construction, over 99% of Tenejapanecos rely on swidden agriculture for their livelihood. In sum, Tenejapa Centro is a large and important gateway town in which social, mercantile, political and religious services are provided, and the town serves as an access point for people from distant *parajes* to find transportation for the forty-minute taxi ride to the large regional center of San Cristóbal de Las Casas.

<u>Nabil and Ch'ixaltontik</u>:

Approximately five km north along the paved road leading from Tenejapa *Centro* to San Juan Cancuc, a small dirt road winds its way up the steep mountain slopes to the *paraje* of Nabil. The latest census (IMSS 2000) estimates the population of Nabil at 360 individuals, many of whom have built new homes directly adjacent to the dirt road that was constructed in 1993. The small *paraje* of Ch'ixaltontik lies on the northern border of Nabil, and during the time of my fieldwork, could be reached only by way of footpaths that led from the end of the dirt road that marks the boundary of Nabil. IMSS (2000) estimates the population of Ch'ixaltontik at 173 individuals who live in a less nucleated pattern that is scattered across the landscape along the footpaths of the community. In 2001, the residents of Ch'ixaltontik were constructing a new dirt road that would link their community to Nabil and thus to the paved road that leads to San Cristóbal. Residents of these communities all speak the same dialect of Tzeltal, and as the climate, topography and social and cultural traditions of the neighboring *parajes* are generally similar, the following description pertains to both communities.

Elevations of these communities range between 2025 and 2250 m above sea level (Casagrande 2002:15). The average annual temperature is 14° Celsius, although highs often reach 25° Celsius in the heat of the day, and during the winter months of December to March, a freeze can be expected at night. Average annual rainfall for the highland region ranges from 1200 to 2000 mm, although the majority falls during the intense rainy season from late May to December, which is characterized by short thunderstorms in the early part of the season and day long drizzles beginning in August (Hunn 1977:5). From January to May there is little rainfall and only an occasional frost.

Figure 2.8 Musicians on hilltop in Nabil.

Nabil exhibits a linear pattern of household compounds spaced at irregular intervals along the road. This settlement pattern is relatively new, resulting from the construction of the road, and because family plots of land are widely scattered across the landscape, families walk as much as a half hour to tend their fields. Ch'ixaltontik, on the other hand, is arranged in a dispersed pattern of household compounds spaced along major footpaths and throughout the surrounding countryside. In contrast with Nabil, most of the houses of Ch'ixaltontik are found in locations close to the family-owned plots of land.

House construction ranges from cement block to wood plank to wattle and daub, with an average of 3-6 inhabitants living in one or two rooms. Each *paraje* has a small government school that serves as the focal point of the community. The school provides a location for education, sports, social gatherings and nightly community meetings that are announced daily over a tinny megaphone. Scattered throughout the communities, a few families operate tiny stores from a window in their homes. These merchants sell sodas, sugary or starchy snacks, eggs, and a few inexpensive utilitarian items. Running water is supplied by a small PVC pipe that runs above ground, and since 1994, most families have had access to enough electricity to burn a few light bulbs at night and listen to radio broadcasts.

Every single family in these communities engages in subsistence level swidden agriculture of corn, beans and squash. In small garden plots they raise herbs, greens and a few fruit trees such as peaches and plums. The agricultural cycle begins between January and March with the clearing of regrowth and corn stubble left from the previous year's harvest. During the dry months of March and April the fields are burned, and, just before the rains begin in May, corn and beans are planted in rows (Villa Rojas 1969). Weeding is the major focus of labor from June through August. In October most of the corn crop is bent near the middle of the stalk to prevent the grain from rotting. This is has the effect of lowering the corn ears toward the ground so the tough outer leaves allow rain to drip away from the grain. The main harvest occurs between November and January, and then the cycle begins anew (Cancian 1965).

Communities at high elevations experience long periods of cold dry weather, and the soils, which are low in nutrients, require long fallow periods of four to eight years to regenerate. As a result, corn is harvested only once during the year. At the household level the corn harvest provides just enough to feed the family, and there is rarely a surplus produced for market sale. Milpa production cannot be intensified through the planting of larger fields due to the lack of flat fertile land available for the steadily increasing population. The same climatic and soil limitations prohibit the production of cash crops such as coffee, avocados and other fruits, flowers, or vegetables.

In order to provide extra income for the household, some of the men cut timber in outlying regions of the *paraje*, and others work in construction or other wage-labor jobs in neighboring communities or the lowland *fincas* ‘plantations’. A number of women, and at least one elderly man who has difficulty walking long distances, in these hamlets produce intricate weavings for sale in San Cristóbal. Many families rent or own small plots of land in the nearby lowland ‘hot- country’ *parajes* of Tenejapa and raise coffee or corn for the market. Combined with an increasing population, the difficulty in producing enough food for the household and in finding alternative sources of income has resulted in fairly large-scale emigration and the establishment of a number of new colonies in lowland areas, such as the Selva Lacandona, that are anywhere from 25 to 150 miles away.

In addition to corn and a few other horticultural products, domesticated animals such as turkeys, chickens, and pigs are important sources of food and income (see Figure 2.9). Eggs are consumed on a regular basis, but the meat of domesticated animals is consumed only on special occasions, with a preference for selling these products in local markets for small amounts of cash. A few families own a cow or horse but ownership of these animals is rare in Nabil and Ch'ixaltontik, and cows are raised for market sale rather than for household meat or milk. In order to supplement the diet, everyone in the family gathers fresh plants, berries, insects, snails and mushrooms on a regular basis, and men often spend significant amounts of time hunting wild game such as squirrels, rabbits, birds, gophers and small rodents with a rifle.

Figure 2.9 Woman feeding chickens in Ch'ixaltontik.

Although both Nabil and Ch'ixaltontik are located only about an hour from Tenejapa Centro by foot, and Nabil only fifteen minutes by motor vehicle, they are among the most impoverished of *parajes* in an impoverished region. As swidden agriculture provides only enough staple food to allow for maintenance of the households, the highland Maya rely heavily on gathered wild foods to supplement their diet. Knowledge of wild mushrooms, which provide nutrition, flavor and texture to a meal, is extensive, and, during the long rainy season individuals and entire families travel the mountainsides in search of the most prized species. As these mushrooms are collected, mothers and fathers teach their children the names of the species, as well as which species are edible or medicinal and which are useless or dangerous. The same cultural and economic conditions that contribute to the maintenance and transmission of ethnomycological knowledge in Tenejapa are also found in the highland *paraje* of Pak'bil na in Oxchuc.

2.5 The municipality of Oxchuc:

The municipality of Oxchuc borders Tenejapa to the east, and the *cabecera* is located along the main highway, Carretera 190, approximately 48 km from San Cristóbal de las Casas. The topography of Oxchuc is similar to that of Tenejapa, consisting of high mountains and low valleys with a diversity of ecological zones and a temperate to semi-cold climate. The elevation of the center is roughly 2000 m above sea level (INEGI 2001), and the average elevation of the municipality is 2100 m above sea level. The *parajes* within which I worked were located high in the slopes, at elevations of at least 2200 m above sea level. With a population of 37,880 individuals over the age of 5

(INEGI 2000) located within 72 km^2 of land (INI 2002), the population density of the municipality is approximately 526 persons/km^2. These numbers make Oxchuc one of the most densely populated Tzeltal municipalities in the highlands.

The *cabecera* of Oxchuc consists of wide, open streets and sprawling stores and houses. The central plaza is bordered on all sides by streets, and is dominated by the municipal building and a large church that are located kitty corner to each other in the eastern section. Because the *cabecera* is located directly on the main highway that connects many of the municipalities in Chiapas, most of the taxis, buses and other vehicles that travel East and West through the state pass through the town. In response to this heavy volume of outside traffic, there is an incredible array of stores, service garages, restaurants and other services available. In the *cabecera* of Oxchuc, at least, there are many more opportunities to operate a small business or to find wage labor than exist in Tenejapa.

Figure 2.10 Family living on outskirts of Oxchuc *cabecera*.

The *cabecera* has electricity and running water, an impressive number of phones, and even photocopy machines in the local paper shops. Throughout the municipality, however, 89% of Oxchuceros live on dirt floors, 75% have no running water, 92% have no sewage, 45% live without electricity, and 87% have almost no access to regular health care (INI 2000). As in Tenejapa, the number of people of Spanish descent residing in the *cabecera* of Oxchuc is continually declining, and the majority of residents are Tzeltal Mayans. The town is growing at a rapid rate, and the outskirts are full of squatters from the outlying communities who live along muddy dirt roads in wood plank houses that contrast sharply with the solid concrete houses found in the center of town (see family living on outskirts of Oxchuc *cabecera*, Figure 2.10). Aside from the highway, there is only one main exit from town, a long, steep dirt road that leads directly into the mountains and the outlying communities.

Due to the presence of the highway, the *cabecera* of Oxchuc has completed the transition to a permanent village pattern in which people reside in the town year-round. I experienced the outcome of this relatively new settlement pattern first-hand when I was living and working in one of the highland communities. As I conducted interviews with individuals throughout the communities I was consistently told stories about an elderly man who was a well-known traditional healer and a specialist in mushroom knowledge. During my six months of research in Oxchuc, this herbalist never once made the thirty-minute trip from the *cabecera* to his *paraje* of origin, and I was able to talk with him only at his home in the *cabecera*. Despite the changing nature of the *cabecera*, however, the majority of Oxchuc residents live and work in the outlying communities.

Pak'bil na:

Heading north and east from the *cabecera* of Oxchuc is a rugged dirt road that runs deep into the territory of Oxchuc. Numerous small *parajes* nestled within small canyons and valleys or sprawled along high ridges are connected to this road by footpaths. Within this mountainous terrain, approximately 5 km up the road, a wooden sign heralds the presence of the *paraje* of Pak'bil na, and a small dirt drive leads to the concrete school that serves as its center. Pak'bil na has a population of fewer than 200 individuals who live scattered along trails winding through the base of a small valley. The dialect of Tzeltal spoken in this region differs from that of Tenejapa, but they are mutually intelligible. As the climate, topography and social and cultural traditions of Pak'bil na are similar to the *parajes* previously described, the following description will be brief.

Pak'bil na is located in a high elevation 'cold country' zone, ranging from 2100 to 2250 m above sea level. A number of limestone caverns dot the landscape, and a large spring located in the hillside drains into a small stream that winds through the valley. The average annual temperature is 22º C, and ranges from 15º C to 25º C, if not higher in the summer. Freezes are rare, although they may occur in December and January. Although I did not experience a frost during my stay, I was consistently told that frosts do occur on occasion. Average annual rainfall ranges from 1,200 to 1,500 mm; from May to August, dense fogs permeate the valley, and thunderstorms are a regular feature in the late afternoon. From September to December long, slow, cold rain can be expected throughout the day. The remainder of the year is relatively dry, with irregular precipitation.

The community of Pak'bil na is materially impoverished, and only a few families have access to electricity. There is little running water, no sewage system, and almost all of the houses are of wooden plank construction with dirt floors. Most of the homes in the region have installed large PVC water storage systems to collect rainwater, though there are often severe shortages during the dry season. As there is no sewage system, the fields or the undergrowth near the house are utilized for the disposal of human waste.

Houses are widely dispersed through the landscape and often are not visible to each other; a simple shout, however, can usually rouse the neighbors. Although house compounds are common, and land is inherited patrilineally, new families often build their homes away from the residence of the husband's parents, indicating that land is not yet scarce. The typical household, between 2 and 6 residents, consists of a husband, wife and their children. Milpas are located near the house, although some families own fields that are located as far as twenty minutes from the house by foot.

Figure 2.11 Eating field-rat with tortillas in typical kitchen, Pak'bil na, Oxchuc.

As with most communities in the highlands the school is the center of community life. After classes let out the men, women and children gather around the school buildings to play basketball, socialize, or discuss politics. Pak'bil na is a politically active community, and its leaders are constantly traveling to the *cabecera* of Oxchuc or San Cristóbal to actively give voice to the needs and concerns of the community. Despite the fact that there are no phones or computers, the residents pooled their money in 2000 to hire a technician to create a website that described the lack of infrastructure in the community and sought grants and donations to better the situation. This webpage ran briefly and disappeared because funding for maintenance was not available.

Pak'bil na does not support even a small market and the closest store, located along the main dirt road outside of the community, offers only sodas, snacks, and a few other small items. Like many of the small communities in the highlands, there is no clinic, and illnesses are treated with traditional medicine. Medicinal herbs are gathered throughout the landscape, and there is one large community garden, initiated and funded by the Maya ICBG project[1] in which the residents of Pak'bil na raise medicinal plants. Treatment of serious diseases or illnesses requires a thirty-minute trip to the clinic in the *cabecera* of Oxchuc or an hour and a half bus ride to San Cristóbal.

Everyone in Pak'bil na relies on subsistence level swidden agriculture of corn, beans and squash. Men sometimes travel to distant locations to work in lowland agriculture, manufacturing, or other wage-labor jobs. The only full-time business in the community is a wood working shop that produces lumber for construction. Because

[1] As mentioned in Chapter 1, the Maya ICBG project worked closely with many communities to develop community-level gardens focused on medicinal plants. Pak'bil na was one of the communities that got involved in the initial stages of these projects, and the garden is still maintained today.

Pak'bil na is located in 'cold country', milpas produce only one crop of corn per year in a cycle resembling that of Nabil and Ch'ixaltontik. Peach and plum trees are planted near each house, and different varieties fruit in succession throughout much of the year. Turkeys, chickens, and pigs provide important sources of meat and income for most families; a few cows are raised for the market; and at least one family owns a horse that is used for travel and for transporting goods. Despite an attempt to grow vegetables for sale in the market, the climate and topography are not suited to cash cropping of coffee, flowers, or wheat, resulting in little surplus production that can be used to provide extra income.

Overall, Pak'bil na is an isolated community with few productive resources and little modern infrastructure. The people there follow traditions that are centuries old, planting crops in small milpas, living on dirt floors, and cooking over open fires. The only links to the modern world include a dirt road to the highway, a few small radios, and a small government funded school. Despite the fact that these Maya are materially impoverished, they are incredibly generous with both their time and their resources, and they are taking steps to actively engage with the outside world to improve the infrastructure and services of their community.

As the community continues to change, many of the social and cultural traditions that serve as the cornerstone of Maya life and identity continue to be maintained. Knowledge of traditional herbs, medicinal plants, and non-cultivated foods (including mushrooms) is continually transmitted from generation to generation, within families, and between communities. This knowledge is not static, but results from close observation and study of the living things, and their habits, that are found in the surrounding mountains.

2.6 Mesoamerican ethnomycological traditions in perspective

The previous sections set the stage for examining mycological resource perception and traditional use of mushrooms in Mesoamerican societies. Much like other traditional cultures throughout the world, indigenous peoples of Mesoamerica have utilized the fruiting bodies of macrofungi for nutritional, medicinal and religious purposes throughout history (Schultes 1939 and 1940; Singer 1958; Wasson 1980). A more fully developed picture of the importance of mushrooms in Mesoamerican culture is only now beginning to emerge as more and more studies investigate the role of these biological resources in religion, economy, subsistence and ecosystem management. The remainder of this chapter provides an overview of Mesoamerican mushroom use with the goal of historically and culturally contextualizing the ethnomycological knowledge of the Tzeltal Maya.

One of the earliest published reports of mushroom use in Mesoamerica dates back more than 400 years to the writings of Sahagún, which were first published in 1829-1830. In his detailed discussion of indigenous cultures, Sahagún mentions "…small mushrooms called '*teonanácatl*' which grow in pastures and cause a kind of intoxication the same way as wine. (Sahagún 1829-1830:366)." Sahagún reports that these and other hallucinogenic mushrooms were used in Aztec rituals with the specific purpose to "…make one see visions". In addition, Sahagún wrote, "They [mushrooms] are medicinal for fevers and for rheumatism" (Schultes 1940). While debates exist over the mushroom species represented by the word *teonanácatl* (Singer 1958; Schultes 1939), the general conclusion is that *teonanácatl* (often translated as ‘flesh of the gods’) is a hallucinogenic species of *Paneolus, Stropharia, Conocybe,* or most likely, *Psilocybe*.

In addition to describing hallucinogenic mushrooms, chapter seven of the Florentine Codex, as translated by Sahagún, describes Aztec admonitions concerning the proper use of non-hallucinogenic edible mushrooms:

> “Mushrooms, mushrooms of the forest are not edible uncooked: they are to be well cooked. They are healthful. Those which are eaten uncooked, and not well cooked, cause one to vomit, to have diarrhea, to be thirsty. They are fatal. In order to be abated, in order to stop the diarrhea which the mushrooms cause, axin - boiled, softened - goes in the rectum.” (Sahagún 1829-1830:366).

Later in the text, the Codex provides an indigenous key to identification and use of six species of mushrooms, all of which are edible. This ancient identification key includes a description of the morphological characteristics and habitats of mushroom species, and indicates the importance of mushrooms as food, as opposed to strictly ritual implements, in Mesoamerican culture.

Supporting the writings of Sahagún are a number of Maya, Mixtec, and Nahuatl Códices that mention the use of sacred mushrooms in indigenous ceremonies (Singer 1958; Lowy 1972; Schultes and Hoffman 1982; Mayer 1978; Heim and Wasson 1958; Guzmán 1993), confirming that hallucinogenic mushrooms were an important aspect of ancient Mesoamerican religions. Various interpretations of the writings and paintings in the Códices suggest that mushroom admixtures were used by specialists to allow them to speak with the gods, heal illness, or perform divinations (Sahagún 1829-1830; Wasson 1974; Wasson 1980).

For example, a number of paintings in these Códices depict an individual making an offering of a mushroom-like object to a seated figure. The illustrations show a long slender stipe rising from the hand of a supplicant. At the top of the stipe, a large round head or cap is adorned with numerous bumps or warts. The mushroom-like object bears a striking resemblance to the warty-capped *Amanita muscaria* (which is distributed throughout Mesoamerica) in morphology (Lowy 1972). Other paintings have illustrations that resemble pairs of mushrooms on the crest of a hill or in the palm of the hand of a woman (Wasson 1980). Although the interpretations of these Códices are debatable, the research of Wasson (1962 and 1980), Lowy (1972), Schultes and Hofmann (1982), and Singer (1958), among others, provides ample ethnographic evidence that modern Mesoamerican religious and medicinal ceremonies utilizing hallucinogenic mushrooms have roots in ancient traditions.

Other manifestations of the antiquity of Mesoamerican use of hallucinogenic mushrooms derive from frescos in central Mexico and Maya stelae which have been interpreted as depicting mushrooms as well as from the "mushroom pottery" and "mushroom-stone" artifacts found distributed throughout the highlands of Guatemala, southern Mexico (including Chiapas), and El Salvador. The small stone carvings, dating from 1000 B.C. to 300 A.D. and ranging from 28-34 cm in height (Borhegyi 1961; Borhegyi 1963; Lowy 1971), are mushroom-shaped and often incorporate a human or animal figure squatting at the base.

The function and symbolism of these stones is unclear, and various interpretations suggest that they may have been utilitarian corn grinders, that they may represent a phallic cult, or that they served as boundary markers for land ownership (Borhegyi 1963).

The most widely supported hypothesis, however, is that the stones indicate a Mayan cult of ceremonial consumption of sacred mushrooms (Wasson 1957; Lowy 1971). Although the ritual and ceremonial importance of these artifacts is still uncertain, many of the stones were found in burials that included high status items such as jade and obsidian (Borhegyi 1961). At least one researcher has implied that the rise of civilization in regions of highland Guatemala that were otherwise scarce in resources could, in small part, be linked to long-distance trade in hallucinogenic mushrooms (Brown 1984).

The interpretation of these ancient texts and implements is hampered by the loss of traditional knowledge and folklore concerning mushroom use in most of the regions in which such evidence is found. This loss of knowledge may have resulted from the actions of the Spanish ‘conquistadores’, who attempted to stamp out indigenous religious beliefs and manifestations of idolatry, and to convert the native populace to Catholicism. As the new Spanish order was established and spread throughout Mesoamerica, priests such as Diego de Landa gathered and destroyed thousands of “idolatrous” artifacts and subjected the natives to the torturous methods of the Inquisition (De Landa 1966). The practice of traditional rituals and ceremonies went underground, disappeared, or merged with European beliefs as people were forced to adopt the teachings of Catholicism throughout the New World.

Despite the efforts of the Spaniards, a few communities scattered throughout Oaxaca, central Mexico and Guatemala maintained the tradition of hallucinogenic mushroom use, and these traditions were “rediscovered” by Western researchers in the early 1900s. The pioneering research of Schultes (1940) and Wasson (1957) introduced the Western world to a tradition of ritual consumption of hallucinogenic mushrooms by curanderos, mostly female, among the Mazatec, Zapotec and Mixtec of Oaxaca. During these ceremonies, mushrooms are consumed by large congregations of people in conjunction with the rhythmic chanting, clapping and singing of a priestess to call forth the voices of the gods. The purpose of these rituals, as described by Wasson (1957; Wasson et al. 1974), ranges from discovering the cause of illness and finding the correct cure, to finding the answer to some question of import or reaching the place where the gods live. These and other ethnographic studies provide some solid support for the interpretations of archaeological evidence discussed above.

More recent ethnomycological studies in Mesoamerica focus not merely on the use of hallucinogenic mushrooms but also examine other traditional uses of mushrooms as non-cultivated biological resources. Such studies are a response to a long history of ethnographic reports that ignored the importance of non-cultivated resources and overemphasized key aspects of subsistence and economy instead (Berlin and Berlin 1997). Among indigenous populations, non-cultivated resources provide important sources of fiber, fuel, building materials, and medicine, and constitute a much larger portion of the total diet than previously acknowledged (Laferriere et al. 1991). The following paragraphs outline a number of ethnomycological studies that acknowledge the importance of wild mushrooms as non-cultivated resources.

Ethnographic reports from North America indicate that puffballs were used by more than twenty-three Native American groups as food, or put into poultices to heal wounds, mend broken bones, and stop the flow of blood from cuts, or, in some cases, crafted into personal adornments (Burk 1983). Peoples of the Northwest Coast of the United States believed the tree-growing fungus *Fomitopsis officinalis* harbored supernatural powers and carved the thick woody sporophores into figurines that were placed as spiritual guardians on shaman graves (Blanchette at al 1992). Carved basidiocarps of *Haploporus odorus*, a fragrant, woody mushroom, have been found in medicine and shaman bundles, as well as strung on necklaces (Blanchette 1997). Other species found in North America were used as sources of dye, tinder, paint and medicine.

Aside from the studies of Wasson and others who are specifically interested in hallucinogens, abundant research has been published on contemporary wild mushroom use in Mesoamerica. Laferriere (1991) has reported that the Mountain Pima of Chihuahua and Sonora consume various species of *Agaricus*, *Coprinus*, *Panus*, *Ustilago*, and *Amanita*. Gonzalez-Elizondo (1991) published findings that the Southern Tepehuan of Durango consume species such as *Agaricus*, *Amanita*, *Hypomyces*, *Hygrophoropsis*, *Pleurotus*, *Ramaria*, and *Russula*, among others, during the rainy seasons. Martínez-Alfaro et al. (1983) described the use of at least 40 species of mushrooms that are consumed by the Nahua and Totonaca in the North Sierra region of Puebla. Finally, although the above-mentioned listing is not complete, it is worthy to mention that Guzmán (1993) published a comprehensive list of over 2,000 Mesoamerican names and uses for mushrooms that he garnished from over 500 published resources. These publications, and others like them, provide an invaluable service by documenting the traditional knowledge of indigenous groups that is severely threatened by modern changes and by contributing to our overall knowledge of global biodiversity.

Despite the abundance of ethnographic discussions of indigenous mushroom use, few researchers have focused on the adaptive role of wild mushroom use in traditional subsistence systems. Dietary studies suggest that mushrooms are important sources of food and nutrition during times of adversity such as droughts and other crop failures (Berlin and Berlin 1997; Laferriere et al. 1991; Dunnigan 1983). In Mesoamerica, for example, the mushroom season often coincides with the time just before the harvesting of crops, when the storage of staple resources is lowest (Berlin and Berlin 1997; Gonzalez-Elizondo 1991). Such studies provide an important starting point for understanding traditional mushroom use as an adaptive strategy and for determining how indigenous cultures perceive and manage their natural and social environments.

In addition to publications concerning utilization, some attention has been focused on indigenous perceptions of wild mushrooms as biological resources and living things. Mapes et al. (1981a, 1981b) not only examined the use of wild mushrooms among the Purépecha of Michoacán, but provided analysis of the Purépéhca system of ethnomycological classification. Shepard and Arora (1992) reported preliminary findings of the ethnomycological classification system of the Tzotzil and Tzeltal Maya, and created a video documentary of mushroom use in the highlands of Chiapas. Hunn et al. (unpublished paper 2003) is currently examining ethnomycological classification among the Zapotec of Oaxaca. These studies provide the beginnings of an understanding of indigenous non-cultivated resource perception and use, as well as a foundation for determining how human cultural strategies interact with natural and social environments.

Finally, during the past twenty years in ethnomycological studies a substantial amount of attention has been placed on the importance of wild mushroom harvesting as a complimentary source of income and ecosystem management on indigenous lands. Central to this new approach is the idea that humans are an integral part of nature, and that individuals are direct agents of environmental transformation (Gragson and Blount

1999; Kempf and Hopps 1993). Mushrooms constitute a significant part of global biodiversity (Bandala et al. 1997; Blanco et al. 1997; Varela and Estrada-Torres 1997) and are acknowledged as essential components of almost every terrestrial ecosystem (Benjamin 1995; Schaechter 1997). They can be used as bio-control agents and to restore and rehabilitate marginal and derelict land (Varela and Estrada-Torres 1997; Allen et al. 1997; Dorworth 1997). In addition, as potential non-timber forest products, long-term harvesting of wild mushrooms can be more valuable than a one-time harvest of trees (Pilz and Molina 1997).

Over the past 20 years the economic value of wild edible mushrooms (including *Tricholoma magnivelare* 'matsutake', *Morchella* spp. 'morels', *Cantharellus cibarius* 'chanterelles', *Boletus* spp. 'Boletes', *Leucangium* (*Picoa*) *carthusiana* 'truffle', and *Hydnum repandum* 'hedgehog') has increased dramatically, resulting in the rapid expansion of a commercial wild mushroom industry in both the U.S. Pacific Northwest and Central Mexico (Hoekstra 1991; Arnolds 1994; Zamora-Martinez and Pascual-Pola 1994; Bandala et al. 1997; Blanco et al. 1997; McLain and Jones 1997). This lucrative commercial industry has developed in response to the rising demand for gourmet wild mushrooms around the world, especially in Japan (Redhead 1997; de Gues and Berch 1997; Pilz and Molina 1997). Wild mushroom productivity, however, is slowly declining on a global scale due to habitat destruction and over-harvesting (Redhead 1997; de Gues and Berch 1997; Pilz and Molina 1997). The greater demand in the global market for *T. magnivelare* and other wild edible mushrooms has led to increased interest in the commercial harvesting of mushrooms in Mexico, and a diverse array of stakeholders are beginning to explore the long-term benefits and threats of the commercial harvesting of these products.

Given the importance of wild mushrooms in forest ecosystems and their rapidly increasing value in global markets, the development of sustainable mushroom harvesting should be regarded with a sense of urgency. Essential to this goal is defining who will influence and control the natural resources in a given area and who will benefit from resource management and resource allocation decisions. Recent approaches in ecosystem management emphasize local community participation in natural resource decision-making, with the goal of developing economic benefits that enhance ecosystem stewardship (Kempf and Hopps 1993; McLain and Jones 1997; Bandala et al. 1997). While such an approach has significant potential for sustainable development of non-timber forest resources, several problems arise in the case of wild mushroom harvesting.

First, wild mushroom growth is unpredictable and varies in productivity and distribution through both time and space. Second, global demand for wild mushrooms is unpredictable, suggesting that basing local economies on wild mushroom harvest should be approached with caution. Third, defining the local community can be problematic when large numbers of both localized and migratory groups compete for the use of a common resource (McLain and Jones 1997). Finally, the diverse cultural values and meanings attached to natural resources by different ethnic groups may be overlooked in community-based management programs (Richards and Creasy 1996). These complex circumstances, which characterize wild mushroom harvesting in Mexico, represent one area in which an understanding of forest resources and changing socioeconomic conditions can contribute to biodiversity conservation and sustainable ecosystem management in the near future.

In summary, wild mushrooms have been used extensively in traditional systems of health and subsistence throughout the history of Mesoamerica. Numerous species have spiritual and ceremonial significance in the religious belief systems of Mesoamerican cultures. Economically, mushroom harvesting can contribute to the diversification of Mexican markets and can provide alternative sources of income for impoverished indigenous communities as commercial products. Finally, wild mushrooms perform ecological functions that are integral to the health of forests, and can be used to enhance the sustainable management of natural environments that will, in the end, improve human welfare.

This review of the history of Mesoamerican ethnomycology sets the stage for an exploration of mycological resource perception and use by the Tzeltal Maya of highland Chiapas. Among the many factors that will be discussed in the following pages are the traditional folk-system of classification and nomenclature; mushroom harvesting and consumption; the perception of the morphological, biological, ecological, and nutritional, hallucinogenic or toxic characteristics of mushrooms; the integration of wild mushrooms with traditional subsistence and economic strategies; and the use of mushrooms as food and medicine. It is hoped that by understanding these features of Tzeltal Maya culture, we will better understand the context of ethnobiological management systems and the adaptive functions of traditional ethnoecological knowledge.

Chapter 3

Ethnomycological Knowledge

3.1 Goals and objectives

This chapter examines how the Tzeltal Maya think of macrofungi as biological resources, and how they decide to use these resources in the activities of their everyday lives. The goal of presenting these data is to set the stage for understanding the folk taxonomy developed in later chapters. The folk taxonomy can be thought of as a widely shared and generally consistent cognitive model of how macrofungi relate to each other (and the rest of the natural world) biologically, ecologically, and behaviorally (Hunn 1977; Berlin 1992). The folk taxonomic system reflects, in some sense, the larger worldview and beliefs of the cultural group that are presented in this chapter. In other words, culturally specific beliefs about what macrofungi are, how they are related to one another, and how they are nutritionally, medicinally, spiritually and artistically useful are consciously or unconsciously built into the structure of the folk taxonomy.

Cultural beliefs that are embedded within the structure of folk taxonomies are reduplicated again and again through processes of enculturation and socialization. The beliefs incorporated within the ethnomycological system serve to guide both cognition and behavior by limiting the number of groups within which a mushroom can be categorized, and constraining the appropriate cultural uses to which a species can be put. A shared system of classification does not, however, influence behavior in isolation.

Folk taxonomic knowledge interacts with environmental and social contexts, individual life experience, and other forms of shared cultural knowledge in a way that influences every instance of utilization of species of wild mushrooms.

In other words, wild mushrooms are not just categorized, they are incorporated within a larger world-view or framework that influences how they are understood as cultural and biological resources. This larger ethnomycological framework can be thought of as a complex and flexible model of resource use that includes knowledge of the ecological characteristics of macrofungi such as developmental stages, habitat, and seasonality, cultural beliefs concerning edibility, nutrition, toxicity, and the origins of macrofungi, and a recognition of the social contexts within which the fungal species is to be used (Alcorn 1984). These, and other morphological ecological and cultural features interact to influence when, where and how the Maya utilize species of wild macrofungi.

This chapter deals with the various ways in which the Tzeltal Maya incorporate macrofungi within their broader worldview, and how the widely shared and highly detailed body of ethnomycological knowledge influences mushroom use. The chapter begins with an exploration of culturally specific beliefs about macrofungi, notably how mushrooms perceptually relate to other living things, and how mushrooms originated in the beginning of time. This is followed by an examination of the ethnoecological knowledge of wild mushrooms including aspects such as how they develop, when they appear, where they develop, and what substrates they prefer. The final sections explore various aspects of the how macrofungi are used in Tzeltal Maya society, with a detailed focus on learning, identification, collection, avoidance, and use as food or medicine. The overall goal of this chapter is to illuminate how the Maya understand macrofungi as biological and cultural resources.

3.2 Patterns of knowledge

As research with the Tzeltal progressed it became increasingly apparent that there is a widely shared body of ethnoecological knowledge of the mushroom domain. Although participant responses varied in small detail at the individual, family, or community levels of analysis, a number of striking patterns emerge from the interviews and collected discourse concerning beliefs about macrofungi. As with the folk taxonomy developed in Chapter 3, the most striking and pronounced pattern is the cultural division of the mushroom domain into two distinctive groups based upon perceived cultural utility. The association of a particular mushroom species with one or the other of these culturally defined categories profoundly affects the sophistication, uniformity and consistency of the patterns of knowledge concerning the morphological, ecological, and cultural features associated with the species. In other words, the culturally determined structural features of the special purpose folk taxonomy (as opposed to the general purpose taxonomic structure) essentially serve to reflect, constrain, and reinforce patterns of knowledge about biological characteristics and cultural uses of linguistically recognized mushroom species.

Another striking pattern observed was that lexically recognized details concerning morphological features, ecological characteristics, and uses of a core group of culturally important mushroom taxa were extremely rich and specific. Every individual over the age of 18 with whom I spoke was able to identify and name between 20 and 30 of the most widely agreed upon culturally important mushrooms, and provide details concerning the seasonality, growth habit, substrate, and habitat in which those species fruit. There were high levels of agreement concerning the salient morphological features used in identifying culturally important species, how mushrooms are collected, and the limited ways in which the species could be prepared. Collaborators generally agreed on characteristics such as what a mushroom tastes like, how it is cooked and eaten, what illness it can cure, and what nutritional benefits it provides. And finally, almost anyone in the highlands can tell one of a number of stories, similar in content and detail, concerning the dangers of eating poisonous mushrooms. This shared cultural knowledge of detailed features of the mushroom domain is relatively stable across factors such as gender, family membership, community membership and generation. When differences do appear they are either idiosyncratic, or show a marked pattern according to community membership.

The fact that so many details about culturally important species are so widely shared could, theoretically, relate to a number of perceptual characteristics of the mushroom domain. First, the size of the *culturally recognized* mushroom domain is highly limited in relation to the size of the entire domain of mushrooms fruiting in the region. Second, those species that are culturally recognized are generally large in size, widely distributed, and fruit in relative abundance throughout the region, and thus are "easy to observe" (Berlin 1992:263). Third, mushrooms that are utilized must be carefully identified through the use of distinctive features in order to avoid the dangers of poisoning. Finally, the ways in which such knowledge is generated and spread leads to consistency in this knowledge throughout the communities within which I worked.

These factors, which serve to limit the shared cultural knowledge of mushrooms to a relatively small number of species, also serve to increase the richness of the ethnoecological features that are culturally recognized as defining and characterizing mushrooms as a group. Each of these factors will be discussed in more detail below.

For example, although there are literally hundreds of species of macrofungi found in the highlands of Chiapas, the widely shared body of cultural knowledge is restricted to a small core group of about 30 species. These species tend to embody one of a few common threads: (1) they are either edible or otherwise useful (*Amanita caesarea, Morchella elata, Daldinia concentrica, Lactarius deliciosus*), (2) they are morphologically distinct in ways that would be difficult not to recognize (*Amanita flavoconia, Ganoderma lucidum, Naematoloma fasciculare, Strobilomyces floccopus*), (3) they are extremely abundant (*Entoloma* spp., *Peziza* spp.), or (4) they are considered poisonous (*Amanita muscaria, A. verna*). In general, those species that are inedible, unused, and morphologically indistinct or about which toxicity is unknown are lumped together into a large group of "useless" species. These species are either idiosyncratically named or receive no linguistic designation, they are never harvested, and they are generally ignored.

As mentioned above, the relatively large and highly diverse mushroom domain is reduced to a cognitively and culturally adaptive size by focusing only on those species that are useful or highly toxic and potentially dangerous. The "total" domain of mushrooms (with at least 250 currently identified species) is divided into two smaller groups: One group that consists of a small number (30 – 70 species) of useful, morphologically distinct, or potentially toxic species about which the Maya have a large amount of cultural and ethnoecological knowledge, and a second group that consists of a large number (all remaining species) of useless or indistinct species that are lumped together, and about which there is almost no shared knowledge. Because the domain of useful, distinct or highly dangerous species is relatively small, the cultural knowledge tied to these species is sophisticated and fairly homogenous across families and communities. Examples of this detailed and shared knowledge will be presented extensively throughout the latter portion of this chapter.

The fact that the Maya share detailed knowledge about a small group of macrofungi may also be related to the relative frequency and abundance of the recognized species. The macrofungi that receive linguistic designations are invariably species that are widely distributed and relatively abundant throughout the region. In fact, although more than 250 species of macrofungi have been reported for the highlands of Chiapas, my own collections made over the course of 2 years have high numbers of repeats of the same species. Table 3.1 shows a sample of species that were collected repeatedly in the months of July, August and September 2001.

Not surprisingly, these species are among the most well known mushrooms in the region. Most of these species fruit seasonally, and the Tzeltal regularly encounter the same kinds of mushrooms at the same times of year. These species are also found in local markets, reinforcing their visibility and utility, and allowing people to exchange knowledge concerning naming and use. The regularity with which the people of the highlands encounter these species serves to strengthen the shared aspects of knowledge about the mushroom domain, and contributes to the homogeneity of ethnomycological knowledge.

Table 3.1 Macrofungal frequency by number of times collected.

Scientific Name	Tzeltal Name	# Times Collected
Amanita virosa	***sakil balumilal***	12
Boletus spp.	***tonkos chejchew***	11
Lycoperdon spp.	***wuswus lu', tsis chauk***	10
Laccaria laccata	***slu'il samjijte'***	9
Daldinia concentrica	***t'ot'***	8
Lactarius deliciosus	***k'an chay***	8
Entoloma sp.	***yaxal chejchew***	7
Hygrocybe subminata	***slu'il wolnax***	6
Laccaria amethystina	***yaxal chejchewul muk'ul te'***	6
Russula emetica	***tsajal kaxlan k'an chay***	6
Clavicorona sp.	***tsijtsim***	5
Naematoloma fasciculare	***k'anal chejchew***	5
Peziza sp.	***sakil k'oj chikin***	5
Ganoderma lucidum	***muk'ul chikin jijte'***	4
Armillaria mellea	***chejchewil sánto***	3
Lentinus crinitus	***tzotzil lu'***	3
Paneolus solidipes	***ijk'al lu'***	3
Polyporus arcularius	***tsu chikin chejchew***	3
Polyporus badius	***tzotzil lu'***	3
Amanita caesarea	***k'an tsu***	2
Hypomyces lactiflorum	***tsajal ti'bal***	2
Lactarius indigo	***yaxal chejchew***	2
Schizophyllum commune	***sulte'***	2

The body of knowledge that must be acquired by individuals may also be limited by dangers involved in collecting mushrooms for consumption. Although an overwhelming majority of macrofungi do not cause violent physical or psychological reactions or illness, there are a few widely distributed species that, when consumed, cause hallucinations, stomach irritation, vomiting, and in a few rare cases, rapid death[1] (*Amanita muscaria, A. virosa, Russula emetica, Paneolus solidipes, Inocybe lanuginosa*).

[1] Although the species *Amanita muscaria* and *Inocybe lanuginosa* weren't collected during fieldwork, these species have been collected in the highland region by other authors (Perez-Moreno and Villarreal 1988; Shepard and Arora 1992; Robles Porras 2000).

In contrast, edible species are generally flavorful (*A. caesarea*, *Morchella esculenta*), nutritious (*Lactarius deliciosus*), meaty in texture and considered filling (*Boletus* spp., *Armillaria mellea*), or in some cases medicinal (*Lycoperdon* spp.). These conflicting nutritional, psychoactive and toxic characteristics are managed by restricting the domain of mushrooms that are collected to a highly limited number of species. In turn, by limiting the species that are culturally recognized, the ethnomycological system incorporates high numbers of salient identifying characteristics, a richly detailed body of knowledge.

Finally, the homogeneity of knowledge about the culturally recognized group of mushrooms may be related to how such knowledge is generated and spread. A number of processes contribute to the spread of knowledge about mushrooms across generations and communities. The most important of these processes include enculturation, the sharing of stories and myths, and contact with people from other communities at large events, local markets, or festivals.

3.3 The learning process

Children in the highlands of Chiapas begin to learn about culturally important mushrooms as soon as they are aware. Mushrooms are a highly prized food, and they are harvested, carried home, and prepared whenever they are encountered. As soon as they can eat solid food, children are encouraged to eat mushrooms, and it is not unusual to see very young children carrying edible species around the house-yard, or participating in the preparation of mushrooms by placing them on hot coals. This process begins before children are capable of identifying and harvesting mushrooms on their own.

As they begin to reach an age between 7 and 10, children begin to actively harvest a few species of mushrooms themselves (See figure 4.1). By this age, children are often able to name as many as 85% of the culturally important plants found near their homes (Zarger 2002). Yet when compared with plants, Tzeltal children know far fewer species of mushrooms (generally between 5 and 10) at this age, possibly because mushrooms are most often harvested in forests found long distances from the home.

Figure 3.1 Children ages 1 and 11 eating wild mushrooms.

At first children may harvest species that are unknown or inedible, but through a process of trial and error they begin to learn to identify those species that are known by their parents. This learning process is strengthened through active teaching of the relevant identifying characteristics by the parents. Eventually, children learn to ignore a large number of the macrofungi they encounter in the fields and forest, and begin to focus their attention on culturally important species. By the time an adolescent reaches the age of 18, regardless of gender or community membership, he or she is generally capable of identifying between 10 and 30 species of culturally important mushrooms.

The process of enculturation, however, is not a passive one, and children are taught by their parents to recognize culturally important species. Every individual with whom I worked made it clear that their parents specifically taught them which species were edible, and which species to avoid. These individuals pointedly noted that that they are continuing this process by imparting the same knowledge to their children. Significantly, not one individual claimed to obtain knowledge about mushrooms through personal observation or experimentation. The following sample of quotes indicate the key role parents and grandparents play in passing on this knowledge from generation to generation:

> *Our parents taught us what [species of mushroom] are edible. Their parents taught them. Far, far into the past. All this knowledge is passed from generation to generation. Petrona Guzmán Girón*

> *As I grew, I went with my parents many times and began to learn which [mushrooms] are edible and which not. I learned from my parents. My parents learned from their parents. Now I am teaching them to my children. Augustina Intsín Guzmán*

> *Our parents taught us, their parents taught them. They told us which were edible and poisonous. They tried these mushrooms and told each other. We are teaching our children as well. Francisco Guzmán Jiménez*

As these quotes indicate, the majority of learning about mushrooms occurs within the household through the careful transmission of knowledge from parents to children at an early age. The knowledge acquired during childhood appears to remain relatively stable throughout the life cycle, and there are few significant outside influences that might contribute to changes in naming or use of macrofungi. Perhaps the most significant changes occur after marriage, when women move to live with the families of their husbands in a patrilocal residence pattern, and begin to learn the uses of a few new species of mushrooms from their in-laws.

There is also little variation in knowledge among different families who reside in the same paraje. The culturally agreed upon names and uses of macrofungi found in the region are highly consistent among members of the same community. This is, perhaps, because members of parajes share the rights of access to communal lands, and their experience derives from interaction with the ecosystems and habitats found within the boundaries of those communally held lands. The set of macrofungal species that develop in response to the variations in habitat or other environmental factors found in the paraje will in large part limit and shape the total body of knowledge held by community members. Thus microhabitat, in addition to historical and cultural trends, results in shared knowledge within communities, and only a few obvious differences in knowledge between communities (see Table 3.2).

The process of acquiring knowledge about the mushroom domain is additionally supported by shared myths and stories. Stories told in the homes and schools provide cultural meaning by explaining the origins of mushrooms at the beginning of the world, and explaining how they develop and grow. This process serves to transfer knowledge about which species are edible, and which ones are dangerous or deadly. There are, for example, numerous stories, all of them similar in theme and detail, which relate the dangers of consuming poisonous species. In essence, the myths and stories told serve to transfer the experience and knowledge of previous generations, and serve as a general warning to be careful when experimenting with unknown species.

Table 3.2. Variation in naming among Tzeltal municipios.

Scientific Genus	Name in Oxchuc	Name in Tenejapa	Use
Boletus & Suillus	***bonkos***	***tonkos***	Eaten by some families and not others
Lycoperdon & Bovista	***wuswus lu'***	***tsis chauk***	Cure for warts and bedwetting
Agaricus	***sakil chejchew***	***konkiw***	Not used
Clavicorona & Ramaria	***tsijtsim lu'***	***akuxa ti'bal***	Eaten (usually grilled)
Schizophyllum	***chikin te'***	***sulte'***	Eaten (usually molido)
Lactarius	***k'an chay***	***tsajal ti'bal***	Eaten (usually grilled)

Variation is additionally smoothed over through visits to markets, events and festivals. When mushrooms are eaten or sold during these occasions, individuals learn more about species that were ignored or considered useless within their own families, and species that are not regularly found in their communities. Through these various processes of knowledge exchange, individuals throughout the highlands learn a shared body of widely distributed cultural knowledge concerning the small number of culturally recognized mushroom species.

The remainder of this chapter will be devoted to exploring the body of knowledge concerning the mushroom domain that is widely shared and relatively homogenous across the Tzeltal communities of highland Chiapas. The themes that are addressed herein are important to the Maya themselves, and they are rich in scope and breadth. There is, for example, a well-developed understanding of ecological requirements such as habitat and substrate, and seasonal variations in mushroom growth. Specific morphological features of the growth habit of a species including the size, shape, color and texture of features such as the cap, stipe, volva and annulus are important to the identification of various species. Knowledge of harvesting and preparation of mushrooms for use as food or medicine is widely shared, and recognition of a few species that are highly dangerous to consume is highly consistent across informants.

This body of shared knowledge serves to inform the Tzeltal how to act sensibly when dealing with mushroom species, and allows them to harvest those species that are useful. The following sections present a detailed analysis of various themes that were addressed again and again throughout semi-structured and structured interviews.

3.4 In the beginning - the origins of macrofungi

When the Spaniards arrived in the Highlands of Chiapas, one of their primary missions was to convert the native population to Christianity. They went about this task in a wide variety of startling and cruel ways including forced relocation, forced labor and taxation, enslavement, and torture (Díaz 1927; Sahagún 1950; Wasserstrom 1983a and 1983b). One of the key methods used in the process of religious conversion was the attempted extermination of all traces of ancient local religious beliefs. In this endeavor, the conquistadors were not entirely successful. Although the Maya of the Highlands of Chiapas are, by and large, Catholic or Protestant, their religious beliefs are truly a jumble of Christian dogma and indigenous mythology (Bricker 1981; Laughlin 1988; Carrasco 1990; Gossen 1999). This blending of native and foreign religious beliefs in some ways shape the worldview of the Maya people, including the ways in which they think about living things.

Figure 3.2 Syncretic blending of indigenous and old world icons.

The Maya share a number of creation myths describing the origins of humankind, the invention of corn and other crops, and the creation of plants and animals (Bricker 1981; Laughlin 1988; Gossen 1999; Breedlove and Laughlin 2000). These creation myths are often syncretic, blending stories from the bible with Mayan beliefs in ways that maintain culturally contextualized meaning. According to Glen Shepard and David Arora (1992), the Tzotzil Maya, neighbors to the west of the Tzeltal Maya, tell such a myth explaining the origins of mushrooms. The following is a brief version of the myth as related by Shepard and Arora:

> God sent a messenger bird to warn Noah, Job, Adam, Eve, Ali Baba, and all the town elders about the flood he was about to send to destroy the Third Creation of the World. Noah, Job, Adam, and the rest built an ark and filled it with their domestic animals and possessions. Then it rained for 13 days and 13 nights. Once the floodwaters subsided, Our Lord's first act was to make the edible mushrooms sprout up. Mushrooms are thus 'the grace of the flood' (*yutzil pulimal*), God's first gift to the humans and animals who suffered through the long days of rain.
>
> Soon thereafter, however, Adam and Eve betrayed their Lord. The Serpent-Demon tempted them with poisonous, intoxicating mushrooms. They ate the poisonous mushrooms and went 'stupid in the head' (*ya xbolub jolol*). Thus mankind fell from the Grace of Our Lord, and from the grace of the flood. From then on the forests and fields have been populated by poisonous mushrooms, the venomous and deadly sisters and brothers to Our Lord's original gift of edible mushrooms. Mushroom hunters since that time have had to carefully learn from their parents and grandparents, which mushrooms are consecrated with the grace of God, and which are the venomous progeny of the Serpent.

This creation myth makes apparent the cultural importance of mushrooms as biological resources. Mushrooms were "God's first gift to the humans and animals who suffered through the long days of rain," and thus were "the grace of the flood." The myth also indicates the importance of the culturally recognized dichotomy between edible and poisonous mushrooms. After temptation by the "Serpent-Demon," those who ate poisonous mushrooms went "stupid in the head," causing the fall from "the Grace of Our Lord." This admonition is a strong recommendation to steer clear of poisonous and intoxicating mushrooms.

The myth is also striking in its reference to the appearance of mushrooms immediately following the long days of rains. There is an explicit recognition of the widespread ethnoecological knowledge of the association of mushroom fruiting with long days of rain. Finally, the myth explicitly recognizes the importance of cultural transmission of knowledge from generation to generation, as well as the care that should be taken when learning which species are edible “gifts” from God, and which are “the venomous progeny of the Serpent.”

Despite my efforts to elicit a creation myth over a total of 15 months of interviews, I never encountered such a myth that coherently explained the origins of macrofungi. In fact, the Tzeltal do not appear to share a similar concrete, holistic explanation for how mushrooms were created. Explanations for the origins of mushrooms were highly varied and idiosyncratic, but consistently focused on a number of themes that are found in the myth discussed above. The main themes derived from interviews include: (1) God created mushrooms for human use, (2) Maya ancestors discovered the uses of mushrooms long ago, and have passed this knowledge down from generation to generation, (3) mushrooms originated locally; they are a natural part of the highland environment, and (4) mushrooms have always been found in the highlands, since the beginning of time. The following quotes[2] exemplify these themes:

> *They [mushrooms] were always here; they were here when I was a little child. God gave to us those that we eat. Petrona Guzmán Girón*
>
> *Only the ancestors know how they appeared. Pedro Pérez Intsín*
>
> *I don’t know where they come from. God began to grow them to provide food for us. Pedro López Ramírez*
>
> *Mushrooms come from the same time as when all the plants in the world began to grow. More than 2 thousand years ago, a long, long time ago. A story about the origins of humans claims that when the first humans arrived, the mushrooms where already here. They asked amongst themselves whether they could eat the*

[2] All interviews were conducted and recorded in Tzeltal. Due to the concerns of time and money, the majority of interviews were transcribed directly into Spanish by bilingual Mayan collaborators working at ECOSUR. These transcriptions were later translated into English by the author. Any questions concerning these translations should be directed to the author of this dissertation. It is hoped that in the near future, direct transcriptions in Tzeltal will be produced.

mushrooms. Nobody knew the answer. They tried a few to see if it would cause harm, but they tasted good. So they knew they could eat mushrooms. Augustina Intsín Guzmán

Parallels between these idiosyncratic explanations and the myth recorded by Shepard and Arora (1992) indicate that mushrooms are thought of as a highly prized resource that originated as a gift from God. There is a common belief that Mayan ancestors experimented with mushroom species a long time ago, and have passed on their accumulated knowledge from generation to generation. That I did not encounter a fully developed creation myth is unsurprising, as mushrooms are not highly managed or cultivated resources, and do not make up a significant proportion of the everyday diet and nutrition of the highland Maya. Those patterns that do emerge from the data indicate that the Tzeltal have a long history of regular mushroom use, and as will become clear later, place high importance on learning which species are edible, and which are venomous.

3.5 Tzeltal understanding of macrofungi

One key to exploring how the Maya think about macrofungi is to determine how they understand the relationship between mushrooms and other living things. In other words, *what are mushrooms* in the Maya worldview? The answer to this question should provide insight into why the Maya identify, name, classify and use mushrooms in the ways in which they do. It could strengthen our understanding of how the Maya perceive the natural world, or alternatively how they construct it, as well as how they distinguish among the various ‘kinds’ of the domain of living things.

Through the course of initial interviews, it quickly became apparent that the question presented above was far too vague and ambiguous, and practically meaningless without some supporting context. The question was modified to better indicate an interest in understanding mushrooms as living things, as creatures that are either a part of, or separate from the domains of plants and animals. In its final form, the question asked was: "*Are mushrooms plants or animals, or are they something totally different?*" Even this question was too vague, probably because people have not thought about what mushrooms are, or how they are situated within the larger domain of living things. As the following sample of quotes illuminate, mushrooms are, for the vast majority of my collaborators (70%), thought of them "simply" as mushrooms:

> *They [mushrooms] are neither animals nor plants, only mushrooms. They are totally different. Petrona Guzmán Girón*
>
> *They are simply mushrooms, not animals or plants, just mushrooms. Nicholas Pérez Guzmán*
>
> *Mushrooms are very different than plants or animals. Very different, there are no similarities. Manuel Encínos Gómez*
>
> *Mushrooms are different. They are not part of animals or plants. Francisco Gómez Sántiz*
>
> *They are not animals or plants, simply mushrooms. Francisco Guzmán Jiménez*
>
> *Mushrooms are not like animals or plants. They are totally different class of life. Vicente Sántiz Gómez*
>
> *Mushrooms don't compare with animals and plants. They are not either, they are totally different. Pedro Ramírez Méndez*
>
> *They are simply mushrooms. I don't specifically know why, it is just a mushroom. Antonia Guzmán Jiménez*

As mentioned in Chapter 1, I conducted more than 100 freelists with equal numbers of men and women ranging in age from 18 to 80 in order to further support this general pattern of responses. The question I asked was "*binti sbil jujuten chejchewetik ta balumilal*," or "what are all the kinds of mushrooms in the world." Every individual interviewed was able to respond by naming at least 5 mushrooms, and some individuals were able to generate a list of as many as 40 species. Significantly, in every case these lists included only species of macrofungi (see Table 4.1 in following chapter). In other words, collaborators had little trouble interpreting the question, and animals and plants were never mistakenly included on freelists. These results support the conclusion that mushrooms make up a single, agreed upon domain that is separate from the domains of plants and animals.

For the majority of the Tzeltal Maya interviewed throughout this research, mushrooms are neither plant nor animal, and belong to an entirely different category of living things. This response, however, does not entirely explain *how* or *why* the Tzeltal think about mushrooms as a separate, cohesive category. In order to more fully understand how the Tzeltal situate mushrooms within the domain of living things, more is needed concerning w*hat it is about mushrooms makes them different from plants, animals, or other living things*.

The answer to this related question is complex and varied. When asked to explore the reasons that mushrooms are "different," my collaborators tended to compare and contrast a variety of mushroom features with those that define plants and animals. The problem, related to observation and experience, is that mushrooms exhibit a confusing mixture of morphological, ecological, nutritional, hallucinogenic and toxic, or other culturally useful features that are shared with *both* plants and animals, and they present marked differences as well. As a result, the relationship of mushrooms with other living things is often ambiguously described.

Throughout the course of interviews a relatively limited number of themes emerged in answer to the question *what makes mushrooms different*. These themes focus on a suite of features that serve to define mushrooms and set them apart within the Tzeltal worldview. When comparing and contrasting mushrooms with plants and animals, the Tzeltal most often focus on locomotion, life history, taste and texture. In the following sections, interview responses are presented with the goal of providing insight into these morphological, ecological, and cultural features that are important to understanding how the Maya situate mushrooms within the domain of living things, as well as how they decide to utilize mushrooms.

Locomotion and life history:

Locomotion and life history are related features that, for the Tzeltal interviewed, contribute to the cognitive division of the domain of living things. Many of these features are so obvious they do not require explanation. For example, animals are not tied to the earth, movement is a defining characteristic, and once an animal dies, it never comes back to life. Plants, on the other hand, grow in the earth and often live for long periods of time in one stationary location; and plants often regenerate or grow back after they appear to be dead. Mushrooms, however, provide a unique perceptual set of locomotive and life history features that combine aspects of both plants and animals in varying degrees. My collaborators focused on these related features when they attempted to define and categorize mushrooms, but the results, as will become apparent throughout this analysis, are ambiguous.

For example, substrate preference and locomotion were often used to determine the relationship between mushrooms and plants. The key features that allied mushrooms to plants include the fact that they grow in the earth, and are usually stationary throughout their life history:

> *They [mushrooms] grow in the earth like plants. So they seem more like plants. And in fact, they don't have differences from plants. They are a type of plant. David Encínos Gómez*
>
> *They [mushrooms] don't move, so they are, in part, like a plant. Maria Intsín Guzmán*
>
> *They [mushrooms] are rooted to one spot like plants. Augustina Intsín Guzmán*

In contrast to the beliefs presented above, numerous collaborators (27%) who were asked to compare mushrooms with plants (probably for the first time in their lives) concluded that locomotion and life history features serve to separate mushrooms from the plant domain. The key features that were consistently mentioned included: (1) unlike plants, mushrooms have a short life-span lasting from 2 to 15 days, (2) unlike plants, mushrooms do *not* redevelop in the same spot once they have been harvested (or once they die), and (3) unlike plants, many species of mushrooms grow in the woody substrate of plants. The following quotes support these themes:

> *Mushrooms seem more like plants than animals, because they grow in the ground like plants. But really they aren't plants or animals, they are different. They die, fall and disappear much faster than plants or animals. Catalina Encínos Gómez*

Mushrooms grow for 1-2 days only. Plants grow for a long time. Rebecca Guzmán Mésa

Mushrooms only show up for 2-3 days, then they die, plants live very long. Lucia Mésa López

They are totally different from plants and animals. They grow very different from animals or plants that live a long time. Mushrooms only live a very short time; they come back each year around the same time. Sometimes there are kinds that grow in the same spots, others don't, and they grow all over. Antonio López Intsín

Totally different [from plants or animals], mushrooms are like earth because they grow from the earth and whey they die, they return to the earth. Mario Guzmán Girón

Mushrooms die; when they die they become part of the earth. If you cut plants they return, but if you cut mushrooms they don't return until next year. Pablo Girón Méndez

Neither [animals or plants], they are only mushrooms. Because mushrooms can grow in wood, unlike plants. Alonso Guzmán Girón

The relationship between mushrooms and animals is often defined in similar terms, with a focus on life-history features. Despite noting that, unlike animals, mushrooms are stationary, there are ways in which mushrooms do compare to animals. For example, when animals and plants die they do not regenerate. A second feature mentioned concerned the similar habitat preferences of mushrooms and animals. Specifically, importance was attached to the fact that mushrooms live in the mountains and forests, underneath plants, much like animals do:

In life they seem more like animals, because animals die if you kill them (like mushrooms). When you kill a plant, it grows back. Thus mushrooms are a type of animal. Miguel López Gómez

They [mushrooms] are like animals in that they live in the mountains they grow under plants in the mountains. Pasquala Gómez Díaz

The Tzeltal often refer to these unusual locomotive and life-history features when they discuss *what mushrooms are,* and these features result in a lot of ambiguity in relating mushrooms to other living things. Based on the data presented above, however, it is apparent that mushrooms make up their own unique domain of living things due to the differences in locomotive and life history features they exhibit. Table 3.3 provides a summary of the differences noted by the Tzeltal.

Table 3.3. Comparison of locomotion and life-history features.

	Locomotion	**Life History**	**Growth Habit**	**Death & Regeneration**
Plants	Stationary, rooted in spot	Long-Lived	Grow in Earth	Regenerate after cut
Animals	Constantly in motion	Relatively long-lived	Grow free of substrate	Return to earth after death
Macrofungi	Stationary, rooted in spot	Short life-span, seasonal	Grow in earth or wood	Return to earth after death

<u>*Taste and texture*</u>:

Other culturally important features that consistently appeared in discourse comparing mushrooms with plants and animals include taste and texture. In fact, when asked *what it is about mushrooms that make them different*, 56 percent of respondents mentioned taste. Of these responses, 32 percent claimed that mushrooms taste different from plants and animals. For the majority of individuals who responded this way, the unique flavor of macrofungi indicated that they are a different ‘kind’ of living thing. The following quotes provide some insight into the relationship between taste and classification as a living thing:

Mushrooms are very different. The taste and texture is not like animals or plants. Juan Gómez Sántiz

No, they [mushrooms] seem totally different than both plants and animals. They have a different taste. Pedro Sántiz Gómez

Mushrooms are not animals or plants because they have a very different taste and texture. They are totally different kinds of living things. Vicente Gómez Morales

They [mushrooms] are totally different because they have a different taste than plants or animals. José Encínos Méndez

It [the mushroom] is very different from animals; it tastes different from animal meat, and different from plants. They are different. Anita Sántiz Gómez

[Mushrooms are] totally different because the taste is different from plants and animals. Maria Elena Gómez Sántiz

[Mushrooms are] neither [plants or animals], they have a different taste, and are a different kind of living thing. Javier Girón Guzmán

However, 22 percent of Mayan respondents said that mushrooms are animals because they *taste like meat*:

They [mushrooms] are a little like animals because they taste more like meat. Pedro Intsín Girón

They [mushrooms] seem more like animals because they look and taste like chicken meat. Mariano Sántiz López

They [mushrooms] seem more like animals than plants because they taste and feel like meat. Caliksto Encínos Gómez

They are simply mushrooms. But they seem more like animals because they have meat like animals, and they taste like meat. Pedro López Ramírez

Mushrooms are animals because their flesh is like meat, and some taste like meat. Rebeca López Gómez

They are animals. They have meat. The reason we buy mushrooms like ***k'an tsu*** *[Amanita caesarea] is because they have better meat than chicken. Marcos Sántiz López*

Only 3 percent of respondents claimed that mushrooms are plants because they *taste like vegetables*.

> *Mushrooms are vegetables. They seem to taste like vegetables. Augustine Hernández Guzmán*
>
> *Mushrooms seem a little like plants. They taste a little like vegetables; on the other hand, they don't taste much like meats, so they seem like plants. Marcos López Gómez*

Texture also appears to be a key feature used by the Maya to situate mushrooms within the domain of living things. The texture of the body or "flesh" of the mushroom was most often compared with the texture of meat, and approximately 19 percent of respondents declared that mushrooms are, as a result, closely related to animals. The following quotes provide examples of how texture is used by the Maya in positioning mushrooms:

> *They seem to have meat. Maybe they are more like animals. Most mushrooms seem like meat. They have texture like meat. More or less they taste like meat. David Girón Guzmán*
>
> *Mushrooms are a type of animal because they have meat. Augustina Intsín Guzmán*
>
> *They grow like meat, so they seem like animals. Petrona Guzmán Intsín*
>
> *Some mushrooms seem like meat, the meat of an animal. Maria Guzmán López*
>
> *Mushrooms are animals. Because they grow like meat. They also have a little taste like meat. They are not plants. José Girón Guzmán*

This focus on flavor and texture is not unique to the Maya. In many traditional societies, mushrooms are closely associated with meat (Benjamin 1995: 23). For example, the Chewa of Malawi, conceptually group edible mushrooms as *nyama*, a linguistic designation also used to refer to both meat and wild animals (Morris 1984:54; Morris 1987). The Yanomamo of northern Brazil linguistically distinguish between eating meat and mushrooms, and eating other things (Prance 1984:131). It is also not unusual to find that in industrialized societies like the United States individuals tend to associate the taste and texture of mushrooms closely with meat. Portabella sandwiches, which have become the rage in trendy restaurants, are described as “meaty,” and amateur mycologists often compare the flesh of morels with the texture of cow intestines and the flavor of liver.

The close association between the texture and flavor mushrooms, and that of meat, is further strengthened linguistically. The Tzeltal Maya verb *ti’bal*, literally meaning ‘to eat meat’ is metaphorically extended to the act of consuming mushrooms. When asked point blank if mushrooms have meat, the majority (94%) of informants responded that they do, and yet they are quick to point out that this meat has a different flavor and different nutrients from animal meat. When asked a follow up question concerning whether having meat made them a kind of animal, however, most collaborators would shake their heads and patiently explain that mushrooms are neither plants nor animals, but are simply ***chejchewetik***. The following quotes, taken from discourse collected with various informants provide an example of the complexity of this domain:

> *Mushrooms are pure meat without bones. Francisco Guzmán Jiménez*
>
> *Mushrooms are plants with meat!! We eat them with tortillas and they taste like meat. Augustina Guzmán Girón*

The flesh of mushrooms seems like meat in texture, but very different in flavor. Petrona Guzmán Girón

Mushrooms have meat! But they don't taste like meat. Manuel Guzmán Intsín

Finally, a number of respondents focused on the intersection of taste and locomotion/life history when attempting to elaborate on the relationship of mushrooms with plants and animals. In these cases, the ambiguity of the positioning of mushrooms within the domain of living things becomes apparent:

They seem like both animals and plants. They taste and feel like animals, they have color like both plants and animals, David Encínos Gómez

Mushrooms are animals!! They grow in the earth and they have meat like animals. Benjamin Encínos Gómez

[They are] only mushrooms. They grow like a plant, but taste like meat. Miguel López Jiménez

3.6 Ethnoecological knowledge

As with any ubiquitous aspect of the natural or cultural environment, the Tzeltal have developed an extensive body of knowledge of the key ecological features associated with culturally important macrofungi, and utilize these features to inform their collection and use of mushrooms. Mushrooms are a prevalent and obvious aspect of the environment, and hundreds of species appear on a seasonal cycle, year after year, scattered throughout the forests, fields and pathways. The sophistication of Maya ethnoecological knowledge, then, is related to a long history of observation and utilization of mushrooms in the local environment. The following sections are an exploration of Tzeltal understanding of mushroom fruiting and development, seasonality, lifespan, habitat preferences, and substrate preferences.

Fruiting and development:

Despite the fact that the both ECOSUR and the Secretaria de Pueblos Indios (SEPI) have initiated numerous small-scale mushroom cultivation projects in the lowland 'hot-country' regions of the Tzeltal municipalities, ethnoecological explanations of wild mushroom reproduction and development are limited in scope. Cultural models of mushroom development are built upon the life-stages that are readily observable at a macro-level, and these explanations do not allow for active reproductive manipulation or cultivation of wild species. A number of differing models of mushroom fruiting were elicited throughout the course of research, and among the commonalities discovered was the belief that mushrooms produce and disseminate tiny seeds, much like those of plants, from which they develop:

> *I believe that they have seeds where they grow. I think they have seeds that you can't see. Like small, small plant seeds. Francisco Guzmán Jiménez*
>
> *I think they do have a seed because they grow up and out of the earth. But I've never seen a seed. But there is probably a seed underneath a large mushroom. Augustina Intsín Guzmán*

The belief that mushrooms have seeds, however, was limited to only a few individuals. The more common belief (held by 88%, N=16 of collaborators) was that mushrooms have no observable seeds. A frequently elicited comment can be summarized as, "we cannot plant them because they do not have seeds," a much lamented fact among those with whom I worked. The lack of explicit knowledge concerning macrofungal reproduction is not overly puzzling, as macrofungi reproduce through the dissemination of minute reproductive cells called spores. These spores are so small they are not readily observable to the naked eye. As evidenced in the following quotes, the fact that the Tzeltal note the absence of seed production highlights the relative confusion that surrounds mushroom reproduction:

> *There are no seeds, they only appear from the earth. We don't ever know where they will appear. Augustina Guzmán Girón*
>
> *They don't have seeds. But there are kinds we cultivate. These have seeds, but not the wild ones. They just appear when it rains, they live in the topsoil all year and when it rains a lot they begin to appear. Petrona Guzmán Girón*
>
> *They don't have seeds. They just begin to grow. They don't have roots. I know that God made the mushrooms and that they grow without seeds or roots. Juana Guzmán Jiménez*
>
> *They don't have seeds, they just grow. Some grow in the ground, and some in wood, some in the earth. They never grow in any wood, just rotting wood. They just grow without roots or seeds. Nicholas Pérez Guzmán*
>
> *They don't have seeds. They just begin to grow. They don't have roots. I know that God made the mushrooms and that they grow without seeds or roots. Juan Guzmán Jiménez*

These claims that mushrooms "just grow," however, belie the fact that the Tzeltal recognize many of the key aspects of mushroom development. Based on naturalistic observation, the Tzeltal note the obvious: macrofungi do not bear their young, they do not lay eggs, and they do not produce observable seeds. Instead, a shared cultural model explaining mushroom development is grounded in the observation of various stages in the lifecycle of certain macrofungi. The mushroom is thought to begin as a small ball-like mass underneath the substrate, and this ball expands in size until it breaks through the substrate. Once the ball has broken free from the substrate, it rapidly develops into a fully formed body. The following quotes explore the ways in which the Tzeltal explain mushroom development:

> *They grow from a tiny granule into a ball and then they grow large into mushrooms. The same is true for wood growers. They do no grow from seeds, only from these granules. They grow small balls, and then into mushrooms. They also grow in the trees, [first] small balls and then mushrooms. José Girón Guzmán*

> *There is no seed. They appear under the ground, without seed, and push out. David Girón Guzmán*

> *They only live for a week or two. They grow very small. God made them and they start small under the earth and then they break out of the earth and grow. Augustina Intsín Guzmán*

> *They begin as a small ball in the earth and begin to break through and grow. Others grow out from dry and rotting wood. There are no seeds. They just grow when there is rain. Juan Guzmán López*

> *Little tiny balls of the mushroom begin to appear. After 3-4 days they grow large and then they dry out and rot. Pedro Pérez Intsín*

In addition to explaining the initial development and rapid growth of macrofungi, many collaborators observed that the approximate lifespan of mushrooms is short in relation to that of most plants and animals. The Tzeltal report that macrofungi live, on average, for one to three days, although occasionally some species may last as long as two weeks. The most common explanation is focused on the lack of *yip*, or ‘strength’, of mushroom species. In some cases, limited strength of mushrooms is attributed to a lack of big thick roots that might convey *yip* to the fungus. In the majority of cases, as will be shown in the following quotes, the short lifespan of mushrooms is left unexplained:

> *Mushrooms die quickly because they are not strong; they have no strength. They only live for a short time, unlike plants, which have big thick roots to give them strength. Maria Guzmán Girón*

Plants live for a long time, always, they are strong. In contrast, mushrooms only live 2-3 days.   I don't know why mushrooms live so short, but I can see that they live only 2-3 days or 1 week. Augustina Guzmán Girón

Mushrooms only come and grow for 1-2 days, never more. Plants grow longer. Antonia Guzmán Jiménez

While this explanation of mushroom reproduction and development may appear limited, it becomes more comprehensive when combined with the belief that many species of mushrooms grow from *yisim*, 'roots', or *xch'in yisim*, 'little roots'. The widespread belief that mushrooms have roots stems from the observation of tiny but visible threads of mycelium, called rhizomorphs by western scientists, which are sometimes visible at the base of the mushroom. Threads of mycelium can be thick and root-like in appearance, and they often appear to emanate from the fruiting body of a mushroom. In fact, the word rhizomorph is a Greek construction that can be broken down into *rhizo* = root + *morphe* = shape, and is an obvious reference in Western science to these similarities.

Western scientists report that threads of mycelium are made up of collective strands of hyphae, the somatic filaments that make up the body of the mushroom (Alexopoulos et al. 1996). Bundles of mycelium superficially resemble roots because they are long, thin and spread out in the substrate (see Figure 3.3 below). In some sense mycelium act like roots as well, in that they sequester nutrients. Mycelium, however, differ from the roots of plants in that they mass together to form the fruiting body of the species, they absorb and digest carbon sources, and they form the reproductive structures of the mushroom. These differences, however, are not observable to the naked eye, and

Figure 3.3 Rhizomorphs, or threads of mycelium at the base of a stem of *Suillus* sp.

as the following quotes indicate, the Tzeltal believe these structures are the roots of the mushroom:

> *There are tiny roots in the earth from which they grow. They also grow tiny roots in the trees. José Girón Guzmán*

> *Always I take note when something grows in earth or trees, which ones grow where. I don't know if there are seeds, because when some grow a lot in one place, they return year after year. Where they grow there are tiny roots. We cut them carefully and leave the roots so they can grow again. I'm not sure if they leave seeds or grow from roots, but they return each year. Augustine Hernández Guzmán*

> *They do have roots, but if you cut them, they won't grow back again from the same roots. Martha Hernández Girón*

> *They grow roots when they die and rot. Another one does not grow there; instead they grow in different places. Antonia López Luna*

In summary, although the Tzeltal often claimed to have no knowledge of macrofungal development, there does appear to be a shared cultural model of the various life-stages of macrofungi. This model is based on readily observable processes, and is limited in its explanation of mushroom reproduction. A few individuals claimed that mushrooms develop from minute seeds; the majority agreed that mushrooms simply form in dry wood or on the earth, and rapidly develop in various life-stages. These stages include the development of a small ball underneath the substrate, the eventual break of this ball through the surface, and the rapid formation of a mature mushroom. But Tzeltal understanding of mushroom development deepens with an understanding of the relationship between rainfall, seasonality and mushroom development. The next section explores Tzeltal knowledge of mushroom seasonality in detail.

Seasonality:

In the highlands of Chiapas, the mushroom season advances in late June or early July, and extends as late as February. These months parallel the times of heavy rain and light frost or ice in the region. On average, the highlands receive from 100 – 200 mm of rain per month throughout the rainy season, producing conditions that are highly favorable to mushroom fruiting. Throughout this season literally hundreds of different macrofungi appear in various microhabitats and ecological niches throughout the highlands.

The Tzeltal recognize a relationship between season, abundance of rainfall and periods of mushroom abundance and diversity. They also believe that seasonal patterns of mushroom development differ dramatically between species. Much like amateur mushroom hunters from throughout the world, the Tzeltal know the specific range of months in which their favorite species develop, and utilize this knowledge to inform their mushroom hunting strategies. A general model of seasonality is shared across Tzeltal communities, and although modified by each individual through idiosyncratic observations, the model is fairly accurate and consistent across the highlands. The most important components of seasonal knowledge include: (1) edible mushrooms appear almost exclusively when there is plenty of rain, (2) every species of mushroom fruits within a short range of months, its “time to grow,” and will not reappear until the same months in the following year, and (3) a few species fruit throughout the year, and for the most part, these species are inedible or useless.

More than 90% of my collaborators noted that the majority of mushrooms exclusively appear during the rainy season, from the months of June to December. This widespread understanding of mushroom seasonality is further supported by the explicit belief that few, if any macrofungi fruit during the dry months from late January to early May. If this knowledge can be considered an ethnoecological model of seasonality, then rain is thought to be the key contributor, a necessary component, to the process of mushroom formation. This explanation mirrors the belief of much of the Western world that mushrooms appear after a good rainfall. When asked why mushrooms fruit after a rain, the common response was, “that is just the way it is,” or “*ya sk’an ja’al*,” “they [the mushrooms] like the rain.” The following quotes provide examples of how the Maya link mushroom development with rain.

> *I don’t know how they grow. I don’t know if they have seeds. I only know that in their time (each has a time) if there is rain, they grow. I think it is because of the rain that they grow. Antonia López Luna.*

When it rains for 2 weeks, they invade the dry sticks and trunks and small ones begin to appear and grow. They grow at a specific time each year. You don't find them all year, only at certain times. Because it is the time of rain. Now it's dry, and no mushrooms grow. David Girón Guzmán

They need rain to grow. After rains pass, they dry up and die. Francisco Guzmán Jiménez

December, January, February, or at times when there is lots of rain. When there is pure sun, no mushrooms grow. David Encínos Girón

When there is no water or no rains, there are no mushrooms. [They] only grow when there is rain. Juan Gómez Sántiz

Whenever there is a lot of rain, there are truly a lot of mushrooms. Vicente Gómez López

In addition to the general acknowledgement that most species of mushroom fruit during the rainy season, respondents claimed that each species fruits at a special time, consisting of only a few weeks or months, during the year. The most common explanations for the seasonal and monthly preferences of different mushroom species include the beliefs that "it is just their time," and that "God made it that way." The belief that each species has a unique seasonal pattern of development reveals, to my mind, an implicit understanding of the specialized temperature, moisture, and habitat requirements of macrofungal species, as well as a recognition of life-cycle patterns. The following quotes explore common explanations for the development of different species in different times.

Each mushroom has its own season, a month or two when it grows. Then it stops and doesn't reappear for a year. Anita Sántiz Gómez

There is a season for each mushroom. They like to grow during a short month, and then they disappear until next year. The reason is that it is just their time given by God. They grow in this time each year. Manuel Guzmán Intsín

They [mushrooms] each grow at different times of year. The time arrives, they only grow in their time, and only if it rains. If it rains but is not time, they don't grow. God said they grow in different times, and so they come in different times so that humans can have different mushrooms at different times of year. Pedro López Ramírez

They [mushrooms] grow in certain times, June, July or December. They don't grow in the same time, each grows in different times. Each has its own time to grow. It's just their time to grow. They need rain to grow. After rains pass, they dry up and die. Francisco Guzmán Jiménez

They [mushrooms] all grow at different months. They start and stop in the same month, and then they go away until the next year. Rosa Gómez Sántiz

Mushrooms all grow in different times. They arrive each month, depending on the time that they grow. Antonia López Luna

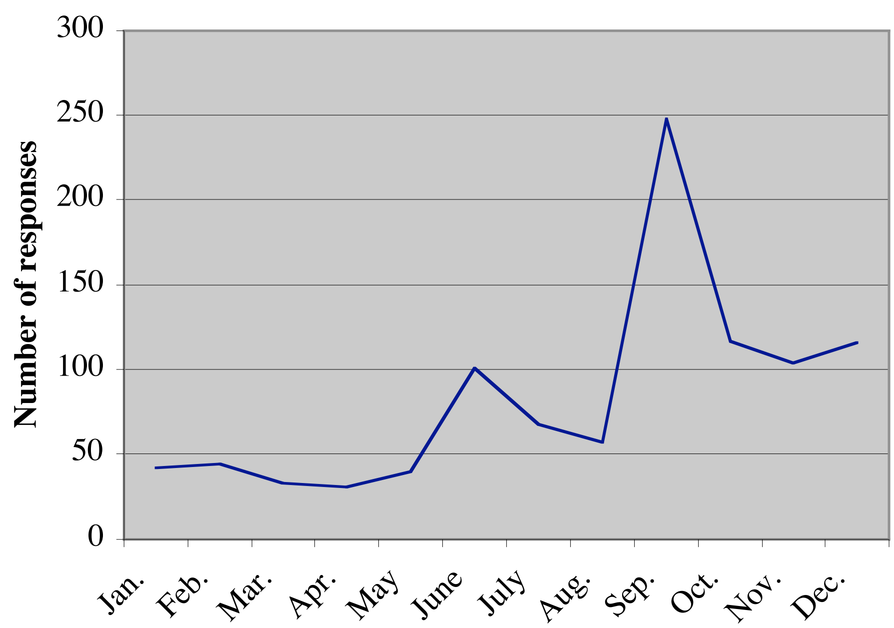
Knowledge of the specific fruiting season of macrofungal species is detailed and sophisticated. In fact, almost every Tzeltal informant voluntarily described the range of months in which prized mushrooms develop throughout the year. This knowledge, however, is generally restricted to culturally important species. Table 3.4 shows the seasonal ranges of a select group of macrofungi as agreed upon by approximately 100 informants.

Chart 3.1 represents the perceived seasonal abundance of macrofungi as measured by the number of informants who recalled that a given species fruits during a specific month. One of the most interesting features of this chart is that it shows a significant increase in mushroom abundance during the rainy season, from June through December. These seasonal growth trends are similar to those found in north America, and are likely to be supported by long term collections of macrofungi in the future.

Table 3.4. Reported seasonal fruiting patterns of selected macrofungi.

Tzeltal Name	Scientific Name	Reported Seasonality
woron kotz/tsukum ti'bal	*Morchella* spp.	January - February
akuxa ti'bal/tsijtsim lu'	Coral fungi	May - August
sak itaj	*Pleurotus* sp.	June - July
k'an chay	*Lactarius deliciosus*	June - September
k'an tsu	*Amanita caesarea*	June - November
batz'il chejchew	*Armillaria mellea*	June - December
yaxal k'an chay	*Lactarious indigo*	August - October
t'ot'	*Daldinia concentrica*	August - November
tonkos/bonkos	*Boletus* spp.	August - December
tsajal ti'bal	*Hypomyces lactifluorum*	August - December
ixim lu'	*Ustilago maydis*	September
k'o' chikin	*Auricularia auricula*	September - October
sulte'/chikin te'	*Schizophyllum commune*	September - November
wxix chejchew	*Naematoloma fasciculare*	November - December
tsis chauk/wuswus lu'	*Lycoperdon* sp.	All year

Chart 3.1. Monthly abundance of macrofungi in Tzeltal region as measured by recall.



Knowledge concerning the seasonality of species in the “useless” category was inconsistent, vague and incomplete, and it is clear that the people of the highlands do not keep track of when “useless” species develop. A few collaborators suggested that “useless” mushrooms grow throughout the year, or that perhaps they have specific seasons of growth that are unknown. There was not, however, a rich and detailed body of knowledge of the specific months in which these culturally useless species develop. This pattern supports the notion that ethnoecological knowledge associated with the culturally useful mushrooms is much more detailed than knowledge associated with “useless” species. The following quotes indicate the general level of knowledge concerning the seasonality of “useful” and “useless” species:

> *September is the high time. It is a good time for young edible mushrooms. Other kinds that I don’t know or eat grow all year long. Antonia Sántiz Gómez*

> *There is a season for those types you cannot eat. I don’t know why. Those that we can eat grow only in very specific times. But not at the same times. Those that we eat grow in the time of the rains. Juana Guzmán Jiménez*

> ***k’an chay** grows more in September and October, because of rain; the other mushrooms grow at different times all year long. Rosa Encínos Gómez*

In summary, the Tzeltal have a complex and shared understanding of the seasonality of macrofungi in general. This knowledge is more finely detailed, however, for those species that are culturally important and collected on a regular basis. The Tzeltal not only believe that the majority of mushroom species appear during the rainy months, but are capable of describing the specific months in which their favorite species develop. Given this focus on the seasonal fruiting habits of culturally important species, it should be clear that the Tzeltal have a highly sophisticated and shared body of knowledge about culturally important mushrooms. In contrast, they have very little detailed knowledge about those species that are lumped together as “useless.” In the following sections other aspects of Tzeltal knowledge of mushroom ecology will be explored with the goal of furthering our understanding of ethnoecological knowledge associated with culturally useful macrofungi.

Habitat and substrate:

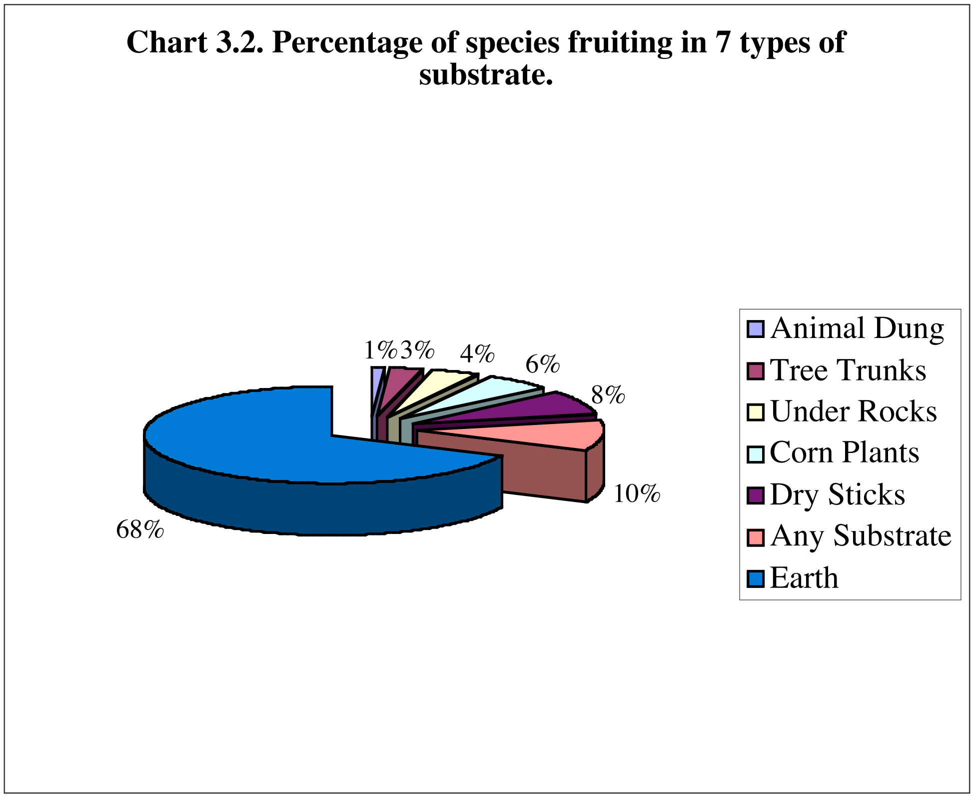
Macrofungi develop in almost every type of habitat and substrate on the planet. In the highlands of Chiapas, a few species fruit in the few remaining old growth forests, the majority develop in the secondary forests of the mountains, others in lowland ‘hot-country’ areas, and a very few form in human-disturbed habitats (see Figure 3.5). As for substrate, macrofungi develop in almost any carbon-rich substrate including soil, dung, living and rotting wood, and sand. An awareness of the habitat and substrate in which particular species develop not only provides a useful context for identifying mushrooms, it also serves to inform the Tzeltal of where to search for particular species when harvesting.

Figure 3.5 Variety of habitats found in the human landscape of the highlands of Chiapas.

The Tzeltal are thoroughly acquainted with the types of habitats and substrates in which different species of macrofungi fruit. When hunting for puffballs to heal wounds or cure young children of bedwetting, they search in the earth of newly fallow milpas, open fields and pastures. They claim that ***k'an chay*** and ***yaxal ti'bal***, each a species of *Lactarius*, only fruit in the earth of mid- to secondary-growth pine forests. They seek out ***k'an tsu***, a prized species of *Amanita*, in the mountains under mixed-oak forests. And they recognize that a few poisonous or hallucinogenic species of macrofungi grow in pastures in the dung of cows and horses.

Mushrooms are usually characterized as fruiting in one of a number of substrates, the most important groupings of which include earth or humus (usually with reference to the species of tree that the macrofungus most commonly fruits near), dry or rotting sticks or tree trunks, underneath rocks, in corn plants, or in animal dung. If a species tends to grow in areas that have recently been burned, this fact is also often mentioned. Although by no means required by convention, the names of mushrooms often code for these categories, and of approximately 139 linguistic designations collected for 70 macrofungal species, approximately 21 percent included a term referencing substrate. During freelists, approximately 100 collaborators were asked to list the substrates within which each species mentioned was found. Chart 3.2 represents the percentages of species believed to fruit in the substrates that were most often mentioned.

Although the Tzeltal are well aware that macrofungi develop in a wide variety of substrates, they essentially lump all mushrooms into two categories: those that grow in dry or rotting wood, and those that grow in the earth. Those species of mushrooms that grow in wood are generally considered a kind of ***chikin te'***, which can be glossed as 'tree



ear'. This grouping includes any macrofungus that grows in sticks, logs, rotting tree trunks, living trees, roots, and even human made artifacts of wood.

Those species that grow on the earth are generally considered a kind of ***chejchew***, which loosely translates as 'any mushroom', but can also be used to refer specifically to ground-dwelling macrofungi. This grouping also includes species that develop in pine straw, green or dry soil, dung, and rotting leaves. The following quotes give some indication of the primacy of these two categories:

> *Some grow in the wood, some in the earth. They are all still family, still the same mushroom. Like **batz'il chejchew** which grows big in the earth, and small in wood. I don't know why some grow in the wood and some in the earth. They are equal in all ways except where they grow. Antonia López Luna*

> *Some mushrooms are of the earth and others are of the trees. They are simply different types. They grow in the ground and in dry sticks and tree trunks. Augustina Guzmán Girón*

> *Different types grow in the earth and in the trees. David Girón Guzmán*

Many grow in dry trunks and sticks, and many grow in the earth. But only when there are rains. I don't know why some like wood or earth. Those in the wood only like wood, they like the humidity of green wood. Petrona Guzmán Girón

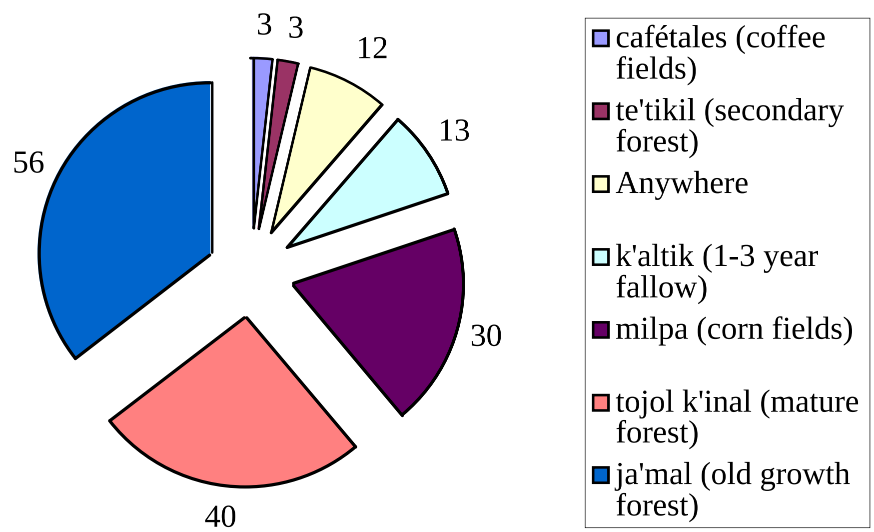
They just like to grow in the earth. They don't want to grow anywhere else. Those of the wood just want to grow in wood. Pedro Pérez Intsín

I only know that many grow in the ground, and many in wood. Augustine Hernández Guzmán

In addition to knowledge of the substrate preferences of macrofungi, respondents had a well-developed understanding of the biological communities, or habitats, within which particular mushroom species develop (see section 2.2 in Chapter 2 for a lengthy discussion of biological communities). These habitat categorizations consistently appeared in discourse concerning the habitats in which mushrooms develop, and in fact, of approximately 139 linguistic designations collected for 70 species of macrofungi, approximately 12 percent included a term referencing habitat.

One of the most prominent beliefs that emerged from discussions about habitat is that culturally useful mushrooms tend to fruit in stages of mature or old growth forest such as *tojol k'inal* and *ja'mal* (see Chart 3.3). This belief, which is supported by literature concerning the same species in North America, indicates that the Tzeltal are aware of significant restrictions on growth patterns of macrofungi. It also implicitly suggests that loss of mature forests will lead to lower production and abundance of culturally important species. This knowledge informs harvesting strategies, and when the rainy season arrives, the Tzeltal make special trips to the more remote locations of the mountains in which mature forest is found in order to seek out abundant and diverse species that are highly prized.

Chart 3.3. Number of species reported in 7 types of habitat (N=70).



However, a significant number of edible species, especially those that fruit in rotting wood and corn, can be found in milpa or any of the successive stages of fallow milpa. These latter species were generally less highly prized, and collected opportunistically. The detailed nature of knowledge concerning the specific habitats in which macrofungi are likely to be found are illuminated through the following quotes:

> ***sulte’*** *[Schizophyllum commune] grows in milpas on dead logs. Most mushrooms grow in ja’mal and te’tikil. Antonia Sántiz Gómez*
>
> *They grow in the mountains, high up in k’inal, or ja’mal, near pines. We also collect them when we pass them on the path. Maria Sanchez Gómez*
>
> *[They grow] in ja’mal and milpas and te’tikil. David Encínos Gómez*

They grow in the ja'mal and te'tikil. They don't grow in the milpa. I don't collect in the canyon because there are not enough that grow down here in the milpas.
José Encínos Gómez

Tzeltal knowledge of mushroom ecology parallels that of western mycology in other, curious ways. For example, western mycologists make several distinctions concerning the ecological role of macrofungi. Some mushrooms are considered to be saprophytic on wood, breaking down and recycling the nutrients in wood. Others are parasitic, living on plants and causing them harm.

Another important ecological category consists of the mycorrhizal fungi that form a symbiotic or mutually beneficial relationship with the roots of plants and trees. The mycelium of the fungus forms a sheath around the roots of the tree and the two species exchange nutrients. Tree roots provide the fungus with a carbon source, and in return, the fungus provides the roots with increased access to phosphorus, nitrogen and various minerals. Although my collaborators did not recognize the role of macrofungi as decomposers, they did view species that grow in corn as annoying parasites, and more importantly, they recognize that many species of mushrooms prefer to grow near specific types of trees, a belief that mirrors western understanding of mycorrhizal relationships.

Respondents did not explicitly recognize the existence of a symbiotic relationship between species of trees and macrofungi, and in fact deny that any necessary and mutually beneficial relationship exists. They did, however, quite clearly recognize that some species of mushrooms consistently fruit near certain species of trees or plants. Species of *Amanita*, for example are known to grow exclusively in stands of oak trees, whereas species of *Lactarius* are thought to grow exclusively near pine trees. This knowledge is widespread and shared across communities in the highlands, and the common explanation for this association is that mushrooms prefer the shade, humidity, and moist earth provided by their host tree. Again, this body of knowledge is an inherent recognition that macrofungi have a narrow range of requirements in terms of substrate, humidity, pH, and exposure to the sun. The following sample of quotes explores the depth of this ethnoecological knowledge:

> *There are many mushrooms that grow near certain trees. They grow very close, but not on the trees. They like to grow near the tree for the shade. They also like the green earth near the trees, which is hot and humid earth. They just like the shade. José Girón Guzmán*

> *Many grow near trees.* ***tsajal ti'bal*** *[Lactarius deliciosus] grows near* ***taj*** *[pine], they like* ***tajetik*** *[pine forests]. The mushroom likes the tree, they like the shade from the tree. The ones that grow near trees like the "green" earth underneath the trees. Augustina Guzmán Girón*

> *All mushrooms grow near trees. Some, like* ***tsajal ti'bal****, grow under pines because they like the dry leaves. They just like these leaves. Also,* ***k'an tsu*** *[Amanita caesarea] likes oaks. They like shade and humid earth as well. Juana Guzmán López*

> *Some types grow near trees. Like* ***k'an tsu*** *grows under oaks.* ***tsajal ti'bal*** *grows in pine forests. They reason they grow here is that they like the earth under trees. The trees offer green humid earth and the shade. They only grow in the old forest with many trees and green earth. Antonia López Luna*

Knowledge of the association between trees and macrofungi is not only the implicit recognition of an important relationship between these species it also serves the Tzeltal well when they search for particular species of prized macrofungi. Rather than searching blindly for mushrooms, or harvesting opportunistically, the Tzeltal often travel directly to habitats within which these tree species exist. But this knowledge appears to have a more profound purpose as well, serving in some sense as an ecological indicator. Many of the older Maya spoke at length about how deforestation, whether by natural or human causes, has led to detrimental effects on the macrofungal population. As the following quote indicates, the elders lament the loss of old-growth forest, and note the concomitant loss of prized mushrooms.

> *Before, when there where many trees, many mushrooms appeared. In my lifetime, there have been fewer and fewer trees, and thus fewer mushrooms. Manuel Guzmán Intsín*

> *When I grew up, there were mushrooms here. Before, long in the past, there were many, many, mushrooms growing here. Then there was a volcano "chicholnal" and it blew and the ash fell, and now there are fewer mushrooms. Not many grow now. Nicholas Pérez Guzmán*

The Tzeltal also believe that, like any living species, mushrooms sequester nutrition from some environmental source. There is a clear understanding that unlike plants, macrofungi do not benefit from sunlight, and numerous collaborators noted that exposure to the sun leads to the death of the fruiting body. Instead, the nutritional requirements of mushrooms are closely linked to substrate preference and ecological niche. In fact, there is a widespread belief that different species of mushrooms sequester nutrients from specific types of soil that are linked to the types of trees under which they fruit. This concept indirectly parallels the Western concept of mycorrhizal symbiosis discussed above. The following quotes explore the Mayan way of thinking about mushroom nutritional requirements:

> *Yes, some grow under trees. The reason is that the mushroom wants the shade and the dry leaves for nutrition. And the moist or humid green earth under the trees. Those that like specific trees live there because they like the nutrition from the naturally decaying leaves of that tree. Augustina Intsín Guzmán*

> *There are ones that grow with specific trees like* ***yaxal lumilal*** *[Entoloma* sp.*]. They like the hot or humid earth. They also need to grow in the substrate of the dry leaves of the tree. They don't actually provide any benefits to the tree; they just like to live near them. Augustine Hernández Guzmán*

> *Some kinds only grow near certain trees;* ***k'an tsu*** *[Amanita caesarea] only grows near oaks. They like to live near these trees. The earth near these trees is very good, it is green, moist, and humid and they like the shade. So they don't die from the sun. They like the dried leaves. They get nutrition from the leaves of the trees. Martha Hernández Girón*

> *Some will only grow under certain trees.* ***k'an tsu*** *[Amanita caesarea] likes to grow near large trunks of oaks. They like the dry leaves of the oak. They get nutrition. They also like the shade; they will die without the shade.* ***k'an tsu*** *would die without oaks. The mushroom likes the soil and the nutrition given by the oak. Manuel Guzmán Intsín*

The Tzeltal have an impressive understanding of many of the ecological requirements of macrofungi. This knowledge is highly important to the process of making decisions about the use of mushrooms as a resource. Knowledge of seasonality, substrate and habitat is widespread and relatively uniform, and is often highly detailed for culturally important species of mushrooms. The awareness of macrofungal habitats and substrates serves a number of cultural and cognitive functions, aiding in identification and harvesting strategy, and serving as a key feature of classification. The following section deals with the ways in which the Maya use this ecological knowledge, along with other important features, in identification.

3.7 Ethnomycological knowledge and identification:

One of the claims I make throughout this dissertation is that macrofungi present somewhat of a unique domain to the human observer. Any mushroom harvester can tell you that mushrooms are ubiquitous in time and space, they are not like plants or animals, and that they can be dangerous to consume. In order to utilize a mushroom as a dietary, nutritional, medicinal or ethnogenic resource, an individual must have some kind of cognitive model for safely identifying, collecting, and utilizing the specimen. Few people, including the majority of the Tzeltal Maya, are willing to experiment with new species of mushrooms unless they have access to solid information concerning the species under consideration. As a result, the Maya are highly restricted in their use of macrofungi, and rely on basic, obvious morphological and ecological cues to determine which species are to be used, and how these species are to be used.

Mushroom harvesters everywhere rely on a long list of distinctive morphological and ecological characteristics in order to identify macrofungal species. Most would agree, however, that the best mushroom hunters develop a gestalt idea of the "essential" form of a well-known mushroom genus or species. Such individuals are often capable of correctly identifying mushrooms growing on the roadside from a speeding car based on a cognitive abstraction of the unique features of the species. In a similar fashion, the Tzeltal usually identify well-known macrofungal species immediately, without close or careful examination.

The ease with which species of mushrooms were identified throughout the course of interviews suggests that most Tzeltal adults develop a mental model, or gestalt, of the overall “configurational quality” of the organism based on the confluence of several characteristics (Bruner et al. 1956:46). This gestalt serves as a cognitive shortcut, allowing the identification of well-known species without reference to a laundry list of defining features. It is a holistic picture or pattern that develops inductively, without an explicit recognition of the set of features or rules that have been learned through observation and experimentation (Hunn 1977:47). Because the group of highland species that is harvested and consumed on a regular basis consists of about thirty distinctive species, there is rarely a problem with misidentification based on a gestalt.

Implicit to the concept of a gestalt, however, is the fact that cognitively abstracted features represent a series of concrete facts that can be identified, defined and discussed when the context demands. The Tzeltal interviewed had little difficulty making explicit the unique characteristics that together, served to define various species of macrofungi. The total list of features utilized is large, numbering in the hundreds. However, only a few defining attributes, including habitat, substrate and the presence or absences of gills, pores, or teeth, emerged from the majority of interviews. In addition, the size, shape, color, texture, positioning, and thickness of key macrofeatures such as the cap, stipe, annulus, and volva proved to be important cues for identification. Finally, the growth habit of the species, such as whether it grows solitary, scattered or clustered, appeared to contribute to the process of mushroom identification.

Interestingly, most, if not all of these macro-features are subject to high degrees of variability due to the influence of factors such as weather, climate, season, age, nutrient load, pH, altitude, or exposure to sunlight (Alexopoulos et al. 1996: 28). Misidentification based on variability in these macro-features, if the mushroom is consumed, could potentially lead to severe results including cramping, diarrhea, vomiting, unwanted hallucinations, or even death. When in doubt about the identification of a particular specimen, Tzeltal collaborators examine the independent morphological features of the species in much closer detail, taking careful note of variable attributes that contributed to the ultimate identification. Species that could not be securely identified after close scrutiny were invariably avoided, as the Tzeltal are highly aware of the dangers of consuming the wrong mushroom and tell many stories of people who have suffered the consequences. The following discussion will focus on those morphological features that are most often utilized by the Maya when identifying macrofungi.

Size and thickness:

Size plays an important role in Tzeltal identification of macrofungi, and approximately 14% of the linguistic designations applied to the 70 species included in this dissertation include a reference to this characteristic. Specimens of the same species that are grossly different in size are often marked with the labels *ch'in* 'small', *muk'ul* 'large', *bajkal* 'fat or thick', *pimil* 'thick', or *ch'ujch'ul* 'small or secondary'. Other size modifiers that appear in conversations include *bik'it* 'small', *jayal* 'thin or skinny', *natil* 'deep or long', and *niwak* 'large or primary'.

When these size-terms are applied to the linguistic designation of a macrofungal specimen, they are usually not obligatory. Instead, they appear to be included with the label when the informant is making a deductive determination of the size of the fungus, indicating that size was an important determining feature. When determining whether a species is edible, the Maya often claim that one is too small to eat, and thus is merely the "brother" of the "true" species. For obvious reasons, large specimens are much preferred, and more easily identified. The notion of size is also frequently applied to various other features of the macrofungus itself, including features such as the cap, stipe, and volva.

Color:

Western mycologists often downplay the importance of cap color in identifying macrofungi because it is a highly variable characteristic. The color of the cap often varies from one extreme to another among different specimens of the same species, and colors displayed by a single specimen can change throughout the day due to exposure to sunlight, wind, rain and humidity. In addition, cap color can be influenced by habitat, substrate and differing nutrients in the soil. As a result, Western mycologists prefer to focus on more reliable characteristics for identification, many of which are microscopic, although most do rely on spore color as an important aid in identification. Despite the importance of spore color in Western mycology, I found no evidence that the Tzeltal focus on spore color in identifying macrofungi.

Among the Tzeltal, color is a key component of the identification process, and approximately 53% of the linguistic designations applied to 70 species discussed in this dissertation including a color in the name. As with plants, the most common color terms included with linguistic designations are *k'anal* 'yellow', *tsajal* 'red', *ijk'al* 'black', *sakil* 'white', and *yaxal* 'green or blue'. Often, several species of a polytypic genus are labeled with different color designations (e.g. ***tsajal k'an chay*** 'red yellow fish' refers to *Lactarius deliciosus*, whereas ***yaxal k'an chay*** 'blue yellow fish' refers to *Lactarius indigo*). In some cases, however, different color terms paired with the same basic label may indicate an entirely different genus (e.g. ***ijk'al lu'*** 'black genitalia' refers to a number of species of *Coprinus*, whereas ***tsajal lu'*** 'red genitalia' refers to a number of species of *Russula*).

Often, the assignment of a particular color term to a species may appear arbitrary to the western observer, but in a small number of cases, the linguistic marking of this feature may be used as an indicator of whether a certain species of macrofungi is edible or deadly (e.g. ***k'an tsu*** 'yellow cup-like' refers to *Amanita caesarea*, an edible species, whereas ***ijk'al k'an tsu*** 'black yellow cup-like' refers to *Amanita fulva*, a species that is not consumed). If the color is faded or indeterminable, the Maya might be willing to make a tentative identification, but are unlikely to eat the specimen. Finally, although it is an important identifying feature among Western mycologists, I could find no evidence that the Maya focus on chemical color changes from bruising or cutting of a mushroom in the process of identification.

Annulus:

An obvious morphological feature providing clues to the identity of a mushroom species is the annulus. An annulus is the left over ring of specialized veil tissue, usually found on the upper portion of a stalk and often appearing like a necklace on the mushroom (see Figure 3.6 below). Not every species of macrofungi retains the annulus into maturity, and these rings can be drastically different in color, texture and robustness among and between different species. Despite these potential variations, however, the Tzeltal often explain that the presence or absence of an annulus is an important indicator of edibility.

A number of the most culturally prized macrofungi in the Highlands retain an annulus into maturity. The folk genus *Amanita* is one of the largest and most visually salient groups and includes at least four folk species that retain an annulus. This group

Figure 3.6 Amanita sp. with obvious annulus.

includes both edible members, such as the highly prized *Amanita caesarea*, and deadly ones such as *Amanita virosa* (see photograph above). The presence of an annulus is also used to distinguish between the edible mushroom ***batz'il chejchew*** "true mushroom" (*Armillaria mellea*), which retains an annulus, and an inedible look-alike, ***xwix chejchew*** "sister mushroom" (*Naematoloma fasciculare*), which does not retain an annulus.

Many collaborators claimed that the absence of an annulus signifies that a mushroom is inedible, despite the fact that they themselves consume species that lack an annulus. This common cultural narrative, however, may be important in distinguishing among species of the genus *Amanita*, or among species from different genera that look highly similar. The most common names applied to the annulus by the Tzeltal are *stsek* 'its skirt', *xwex* 'necklace', and *stsakabil* 'its knee'.

Veil tissue:

The veil is a thin layer of tissue that often covers the entire mushroom like a tight-fitting eggshell before it emerges from the substrate and matures. As the mushroom grows larger and larger, this tissue tends to stretch and break, often disappearing altogether. A number of macrofungi, however, retain remnants of veil tissue into maturity, and these remnants can become manifest in a number of ways.

The volva is present as a sack at the base of the stalk, or rings or scales found on the lower portion of the stalk. For the Tzeltal, presence of a specific form of volva (e.g. a cup-like-like structure at the very base of the stalk) is an immediate clue to the identity of a species. Another component of veil tissue important to identification is the presence or absence of scales or "warts" that are the shredded leftovers from the veil that remain stuck to the cap or cap margins (see Figure 3.7 for photo of veil remnants and volva). In species that normally possess any of these features, the absence of veil remnants can

Figure 3.7 *Amanita* sp. with veil remnants on cap and volva at base.

easily obscure the identity of the species. Retention of veil remnants, as either a volva or as scales on the cap is a common feature of the genus *Amanita*, and among the Tzeltal, the presence or absence of veil tissue is often noted during identification. The most common names applied to the volva are *yok* 'branch', and *yakan* 'foot'. The most common name applied to the warts and scales among the Tzeltal are *stirunel* (unanalyzed) *sburumal* 'its paint', and *xluchul* 'decorations'.

<u>*Gills, pores and teeth*</u>:

Among the most obvious and useful features used in identification of macrofungi is the presence of gills or pores. Gills and pores are the spore-bearing surfaces of the macrofungi, usually found on the undersurface of the cap. Gills are essentially thin blades of tissue that radiate from the center stalk underneath the cap (see Figure 3.8). Pores are minute to large holes found in large numbers on an otherwise smooth surface underneath the cap. Teeth are short spiny projections that often extend downwards from the underside of the cap. The presence of one or the other feature provides a morphological basis for the immediate elimination of a large number of potential alternatives, and provides a clue as to the true identity of the species.

Gills come in many sizes, shapes and textures. They can be waxy or dull, soft or brittle, numerous or sparse, notched or smooth, variously colored, connected to the stalk or free, and the convergence of any of these features can provide identification clues to the observer. Interestingly, however, although the Tzeltal had no difficulty recognizing the presence or absence of gills, my collaborators rarely examined the gills closely, or mentioned these features in discourse. More than likely, the presence of gills is so obvious it doesn't require comment. The most common names applied to gills include *srayail* 'its rays', *stsek* 'its skirt', *sulil* 'its [fish] scales', *sbelal* 'its paths', *xchial* 'tendons', and *stsibal* 'its little rays'.

Figure 3.8 Gills under the cap of an unknown species of macrofungus.

In conjunction with substrate preference and other identifying features, the presence of pores or teeth is usually enough to limit the potential identification of a macrofungus to one of a few genera. Pores and teeth are often brightly colored, and vary highly in size and shape. The Tzeltal clue into these important features almost immediately when making a determination. The two largest groupings of pore-bearing macrofungi in the Highlands include the pore-bearing earth-growing bolete group, and the wood-growing polypores. The only tooth bearing macrofungus identified in the highlands was *Dentinum repandum* (*Hydnum repandum*). The label most commonly applied to pores by the Tzeltal is *sbak'etal* 'its seeds', and the only label applied to teeth is *xch'in ste'el* 'its little sticks'.

The stipe:

The size, shape, texture and ornamentation of the stalk are highly important features for identification among the Tzeltal. Respondents, for example, often noted that the stalks of *Russula* and *Lactarius* are brittle rather than soft, or mentioned that various species of the folk life-form category ***chikin te'*** lack a stalk altogether. Other stalk characteristics noted included the relative size of the stalk, whether it is long or short, fat or thin, whether it is leathery, fleshy or tough, and whether is had an annulus, volva, scales or warts. Interestingly, although the length and width of the stalk are not considered truly useful features among western mycologists, these features are frequently noted as a key determinant of species identity among the Tzeltal. The most common names applied to the stalk include *yakan* 'its leg', *ste'el* 'its branch', or *snuk'* 'its neck'.

Texture:

The texture of the flesh provides a key feature to the Tzeltal in identifying macrofungi. The Tzeltal love to handle a specimen when they are trying to determine its name, and they make note of whether the flesh of the cap is tough, leathery, brittle, woody, hairy, soft, or fleshy. Texture may provide important clues as to the edibility of the mushroom, although the Maya eat a wide range of fungi including some that are incredibly woody (*Daldinia concentrica*), others that are brittle (*Lactarius deliciosus*), and many that are meaty or fleshy (*Boletus* spp., *Amanita* spp., *Armillaria mellea*). As noted before, the texture of macrofungi is often compared with that of meat in the highlands, an association that more than likely contributes to widespread beliefs that a few of the fleshy species are highly nutritious. A few of the terms used to refer to the texture of macrofungi include *tulan* 'tough', *ti'bal* 'meat or flesh', *bak'el* 'soft or fleshy portion', *k'oj* 'snail-like, jelly-like', *nujkul* 'leathery', *tzotz* 'hairy', and *ch'ulul* 'smooth'.

Pileus:

Various aspects of size, shape, texture, color and ornamentation of the cap all provide useful clues to the identity of the macrofungal specimen. Mushroom caps come in many shapes, and may be cylindrical, conical, bell-shaped, convex, planar, depressed, or even funnel shaped. The surface can be smooth, pitted, shaggy, scaly, hairy, warty, hygrophanous (seemingly wet), or viscid (seemingly sticky). The outer edge, or margin of the cap, can be straight, smooth, wavy, cracked, upturned, down turned, or laden with veil remnants. When these features are distinctive and typical of the growth pattern of a species, the Tzeltal pointedly note them, often in the linguistic designation of the species. Such features are also used to point out differences between specimens of the same species that are highly different in morphology. The number of possible variations in pileus size, shape and ornamentation are incredibly high, and the most common terms applied to these variations (such as hairy, thick, smooth, etc.) are covered in the other sections of this chapter.

Mycelium:

Finally, as noted in a previous section of this chapter, the Tzeltal pay close attention to the mycelium, or thicker strands of threadlike cells called rhizomorphs that develop in the substrate at the base of the mushroom (see Figure 3.3). These strands, which are usually invisible to the naked eye, can sometimes appear in masses that resemble roots at the base of a fruiting body. According to many of the Tzeltal, these features *are* the roots of the mushroom, and their presence can be an identifying feature. The most common term applied to this feature is *yisim*, or 'its roots'.

3.8 Harvesting strategies

During the rains in the fall season, the Tzeltal collect large quantities and numerous varieties of wild edible mushrooms. Beginning in early June and lasting through December, families collect *Lactarius*, *Armillaria*, *Amanita*, *Pleurotus*, *Boletus*, *Suillus* and numerous varieties of coral fungi for the cookpot at home. From January to February they search for species of *Morchella*. A few species are available throughout the entire year, most notably the edible species *Schizophyllum commune* and *Daldinia concentrica*, and the medicinal puffballs of the genus *Lycoperdon*. Most of these species are collected only when they are found in large enough quantities to complete a meal, or when a specific remedy or medicine is required due to illness.

The Tzeltal are particularly active in their search for prized fungi as the fall advances, during the time in which they begin to plant corn. There is a convergence of factors that help to make this the best time of year to hunt mushrooms. Not only is this the highest season of mushroom abundance, but the Maya are continually walking through the woods, forests, fields and mountains on their way back and forth to the milpas. These walks provide opportunities to keep a sharp eye out for wild macrofungi, and the children often make short excursions through the underbrush in search of wild foods or firewood as they follow their parents along the pathways.

A more important aspect of this harvesting strategy, perhaps, is that the fall season is the time of year during which stored staple food resources begin to deplete (Berlin 1998). The harvest of corn and beans occurs during the months of November to January, and by August households sometimes begin to run low on basic food supplies. The harvesting of wild foods such as mushrooms likely serves as a buttress for the family's sustenance by providing a filling side dish with much needed nutrition, texture, and flavor.

In fact, a number of studies have suggested that macrofungi and other non-cultivated resources provide essential minerals and nutrients to foraging and horticultural societies during periods of general resource scarcity (Dunnigan 1983; Laferriere et al. 1991). Benjamin notes that in rural Zambia, "They [mushrooms] are most widely eaten during the "hunger" months, from late November through early April...they were second only to insects (mainly caterpillars) as a food source during the rainy period" (1995:15). In an earlier study in the highlands of Chiapas, Shepard and Arora suggested that the Tzeltal harvest mushrooms as dietary supplement during the rainy season (1992). The indigenous groups of Durango and Tlaxcala, Mexico are reported to consume mushrooms during the rainy season (Gonzalez Elizondo 1991; Esquivel 1998). Morris reports that the people of Malawi regularly gather mushrooms at favorable times, "as the rainy season is apt to be a lean time for relish and food" (1984:51), and Sather states that the Iban of

Sarawak commonly collect mushrooms "during the rainy season and the early stages of farming, particularly when families are staying temporarily in field huts near their farms (1978:96)." These, and other studies suggest that many indigenous peoples place a high value on macrofungi as important nutritional resources during times when staple food stocks are low. More research is needed on the importance of this strategy for the seasonal maintenance of health in horticultural societies.

Most Tzeltal families collect wild edible mushrooms exclusively for consumption at the household level. Collecting wild mushrooms for the market appears to be an opportunistic strategy, initiated only when large groups of valuable species are encountered by chance. Given the abundance of mushrooms in the San Cristóbal market on a weekly basis during the rainy season, however, there may be a few individuals or families who specialize in wild mushroom harvesting as cash based strategy.

Harvesting is largely a collective endeavor, with no evidence of a gendered or generational division of labor. During household activities everyone in the family, including children, keeps an eye out for edible species. Men bring home mushrooms encountered on hunting trips or expeditions to the milpas, and women gather baskets of mushrooms as they collect firewood or work in the fields. By the age of eight, children begin to collect mushrooms as they play in the forests and fields near the home. The following quotes illuminate the communal aspects of mushroom harvesting and ethnomycological knowledge in general.

> *Men and women know the same mushrooms. Everyone collects mushrooms in the forests, in the milpa, wherever they grow. We collect them especially for food. Some people even sell them. José Girón Guzmán*

Men and women here know the same mushrooms. Sometimes we all collect them. Children, husband, wife, sometimes we search especially for them. Augustine Hernández Guzmán

Men and women know the same mushrooms. But older people know more than the rest of us. All of us collect mushrooms, we only collect them when working or passing by them. Antonia López Luna

In many respects, Tzeltal harvesting methods are focused on knowledge of macrofungal life cycles and human health. Whether during a chance encounter or on a special trip to the field, the Tzeltal collect any edible specimen that appears to be in good fresh condition. As with most mycologists, the Tzeltal avoid dry, rotting or putrid specimens, and believe that these specimens can cause gastrointestinal discomfort or illness. As a result, the Tzeltal often mention that the best time to search for macrofungi is during the morning hours, before the hot afternoon causes them to dry or rot.

Tzeltal harvesting strategies also indicate a belief that human activities affect the structure and functioning of the local ecosystem. Several of my collaborators pointedly harvested only the top half of the fungus, leaving the lower stipe in the ground in an effort to encourage the “roots” to continue growing in the substrate so that they might return in the following year. This strategy mirrors the conservation strategies of chanterelle harvesters the Northeast of the United States and Europe, where studies are showing that the indiscriminate collection of wild mushrooms has the potential to lower mushroom abundance and diversity (McLain and Jones 1997).

3.9 Wild food resources and nutrition

Although the debate is still ongoing, evidence from Western science supports the idea that at least a few select species of mushrooms have significant nutritional value when they develop under the right conditions. The nutritional properties of macrofungi, however, are highly affected by genetic make-up, specific environmental conditions, and variation in metabolism during post-harvest life among other factors (Buswell and Change 1993:27). As a result, generalizations concerning protein, amino acid, carbohydrate and mineral content are difficult to make. The following brief discussion of the range of nutrients that have been discovered in macrofungi is meant to provide a baseline referent for meaningful nutritional comparisons with other foods.

Current studies show that the protein content of macrofungi from genera such as *Agaricus*, *Boletus*, *Pleurotus*, and *Volvariella* generally falls between 19 and 35 % of dry weight (Buswell and Chang 1993 27). Chang and Miles indicate that these percentages compare favorably with foods such as rice, wheat, milk, cabbage, oranges and apples, though they are considerably lower than the protein content of animal meat (1989:29). Buswell and Chang further claim that, “the proteins of commonly cultivated mushrooms contain all nine amino acids essential for man” (1993:29). Levels of these essential amino acids compare favorably with eggs, corn and potatoes, although depending on the conditions in which the fungal body develops, these levels can fall well below reported averages.

Species of *Pleurotus* have been shown to be a good source of carbohydrates, ranging from 47% - 80% in dry weight (Buswell and Chang 1993:33), and minerals such as potassium, phosphorus, calcium and magnesium have been found in numerous genera of macrofungi (ibid., 34). Although current reports show that macrofungi are generally low in fiber and fat content, the research of Crisan and Sands suggests that macrofungi contain relatively significant contents of vitamin B1, vitamin B2, and vitamin C (1978). The relatively high nutritional value of mushrooms, however, is offset by the low weight of the individual mushroom body, the high water content (90%) of fresh specimens, and relatively sparse distribution of wild species that makes them difficult to harvest in large quantities. These factors help to explain why mushrooms are not major subsistence crops in any society, but rather are used as culinary and dietary supplements, especially during periods of low resource availability and high mushroom availability.

Among the Tzeltal of the highlands, there is little consensus concerning the nutritional value of mushrooms. Knowledge about nutritional content ranges from the belief that all mushrooms are highly nutritious, to the idea that macrofungi possess little of nutritional worth. A number of Tzeltal informants claimed to eat mushrooms only for flavor and taste; others mentioned that specific mushrooms are important sources of nourishment; and yet others claimed that mushrooms are high in protein content. A commonly held belief, however, is that certain species of mushrooms possess *yip*, or 'strength for the body' when a person is tired or weak. The following quotes exemplify the idiosyncratic nature of beliefs concerning mushroom nutrition:

> *There is nutrition and yip in the mushrooms. And they taste good. José Girón Guzmán*

> *They [mushrooms] don't have yip, nutrition, or vitamins. Martha Hernández Girón*

> *We eat them [mushrooms] for our bodies, and they give much strength and nourishment to our body and are good food. Pedro López Ramírez*

Some [mushrooms] have nourishment that is good for the body. The Maya, we eat what grows in the mountains because we know they have nourishment and strength and are natural not artificial. Like mushrooms. Whatever types of fat and oil they sell in the markets are not good for our bodies. Like the oil and fat from pigs. These are very cold and don't have nourishment and aren't good for our bodies. Francisco Guzmán Jiménez

k'an chay *[Lactarius deliciosus] has nourishment that is good for yip. If you boil it in water and then drink it, you feel much stronger. The same goes for* ***batz'il chejchew*** *[Armillaria mellea]. The other mushrooms, I don't know if they have nourishment. Thomas Encínos Gómez*

3.10 Integration with the humoral system

As with many indigenous cultures in Latin America, the Maya rely on a 'hot' and 'cold' classification system for classifying and curing illness, and preparing medicine or food (Foster 1994). This system, known as a humoral system, is grounded in the cultural belief that traditional medicines, foods, and human health are all regulated by a balance of opposing 'hot' and 'cold' qualities (Etkin 1988; Foster 1994; Berlin and Berlin 1996). Beliefs about the humoral qualities of macrofungi influence and explain how they are prepared as food, and more significantly, how they are thought to affect human health. The 'hot' and 'cold' classification system also serves to constrain the kinds of spices and herbs that can be cooked together with mushrooms.

Although there is a widespread recognition among the Tzeltal that all mushrooms have either 'hot' or 'cold' qualities, there is little agreement concerning the humoral status of unknown, culturally useless, and inedible mushrooms. The humoral status of culturally important species of macrofungi, however, shows a high degree of agreement across informants (see Table 3.5). A small number of species are conceptually grouped with other 'hot' foods such as meat, beans and chili peppers. Without exception, these are among the most well known species in the highlands and place within the top ten names mentioned on aggregated freelists. All other culturally recognized species of macrofungi, if eaten, are thought to be cold. The following quotes represent a sample of the range of beliefs concerning the humoral status of macrofungi:

> *Some mushrooms are hot, like* ***tsajal ti'bal*** *[Lactarius deliciosus] and* ***k'an chay*** *[Amanita caesarea]. There are very hot when cooked with epasote. These are hot because God said so. When it is very hot, it has nourishment for strength for our body. Pedro López Ramírez*
>
> *All mushrooms are hot because we eat them with epasote. And they give strength and heat. They are hot because they have a lot of 'yip' [strength or power]. Maria Intsín Girón*
>
> *For example,* ***sulte'*** *[Schizophyllum commune] is hot, it is very hot and works with chili. The woman is cold and* ***sulte'*** *heats her. There are kinds that are hot and some that are cold.* ***tsajal ti'bal*** *[Lactarius deliciosus] and* ***sulte'*** *are hot,* ***batz'il chejchew*** *[Armillaria mellea] is cold. Mushrooms are hot because they have nourishment. Augustine Hernández Guzmán*
>
> *Mushrooms are hot. They are naturally hot, as our ancestors told us. This heat is like it is for meat. You boil hot foods with epasote. Augustina Intsín Guzmán*
>
> *Those that grow in wood are hot; those growing on the ground are cold or warm. Those types that are cold can cause indigestion; those that are hot don't cause indigestion. Manuel Guzmán Intsín*

Species that are widely believed to provide strength and nutrition to the human body are generally classified as 'hot'. These species are thought to contain nourishment, and provide relief for conditions such as chills, indigestion, weakness, tiredness or exhaustion. Only two culturally salient species, ***t'ot'*** (*Daldinia concentrica)* and ***batz'il chejchew*** (*Armillaria mellea)*, were classified by collaborators as 'cold'. Whereas ***t'ot'*** is consumed as a snack, and not generally thought to provide nutrition, approximately 65 percent of collaborators believed that ***batz'il chejchew*** is an important source of nourishment. Neither of these 'cold' species is used to cure any medical condition.

Table 3.5. Humoral and nutritional beliefs about a sample of macrofungal species.

Scientific Name	**Humoral Status** **(agreement ≥ 70%)**	**Provides Nourishment to the Body** **(agreement > 85%)**
Schizophyllum commune	Hot	Yes
Lactarius deliciosus	Hot	Yes
Morchella spp.	Hot	Yes
Amanita caesarea	Hot	Yes
Ramaria spp.	Hot*	Yes**
Armillaria mellea	Cold	Yes***
Daldinia spp.	Cold	No

*Approximately 55% of informants agreed.
**Approximately 60% of informants agreed.
***Approximately 65% of informants agreed.

The belief that 'hot' species of macrofungi provide strength and nutrition is the only confirmed association between humoral and medicinal qualities. Other well known medicinals such as *Lycoperdon* and *Bovista*, which are widely used in the highlands to cure warts, cuts, bruises and other external skin conditions, do not appear to have any humoral status. A full 100 percent (N=20) of collaborators claimed that puffballs are neither 'hot' nor 'cold', apparently because these species are not consumed. Beliefs about medicinal properties associated with macrofungi, therefore, are not always dependent on humoral status.

Regardless of the assumed 'hot' or 'cold' status of a mushroom species, the method by which culturally important wild mushrooms were prepared as food a topic that was highly agreed upon by informants in the highlands (see Table 3.6). Some species are exclusively boiled, some are exclusively grilled, some are eaten raw, others fried, and some species are prepared by any of these methods. Additionally, although ‘hot’ species of macrofungi are generally cooked with herbs and spices such as epasote and chili, beliefs about humoral status do not appear to significantly affect the method by which a species is prepared as food (see Figure 3.6). Instead, texture and cultural tradition are likely to determine how each species is prepared.

Table 3.6. Method of preparation of edible species.

Species or group	**Humoral Status**	**Method of Preparation***
Boletus spp.	Alternately 'hot' or 'cold'	grilled
Lactarius indigo	Alternately 'hot' or 'cold'	grilled or boiled
Naematoloma fasciculare	cold	grilled, boiled or fried
Morchella spp.	hot	grilled, boiled, fried, or mashed
Daldinia concentrica	cold	grilled
Schizophyllum commune	hot	boiled
Coral fungi	hot	boiled, sometimes grilled
Amanita caesarea	hot	grilled, boiled, fried, or mashed
Lactarius deliciosus	hot	grilled, boiled, fried, or mashed
Armillaria mellea	cold	boiled, grilled, fried

*Ordered by preferred method of preparation.

3.11 Medicinal properties

Reference to mushrooms as medicine is found in the mythology and literature of many traditional societies. The Japanese and Chinese use many species of wood growing mushrooms, such as *Ganoderma lucidum* and *Ganoderma tsugae*, in teas meant to cure

Figure 3.9 Tzeltal woman preparing *Armillaria* sp. for dinner.

colds, coughs, and cancer, or to provide overall balance to the immune system (Mizuno et al. 1995). Medicinal uses of mushrooms in Western cultures included the use of *Fomitopsis officinalis* as a purgative and a cure for night sweats associated with tuberculosis (Benjamin 1995:45). *Boletus* spp. were also used to treat conditions such as hemorrhoids, warts, and sore eyes (ibid., 45). Various peoples from North America, Central America, and West Siberia commonly used puffballs to dry and clean wounds or cure various skin conditions, as well as to stop blood flow from open cuts (Saar 1991; Benjamin1995). On the Northwest Coast of the United States, indigenous groups believed *Fomitopsis officinalis* to contain supernatural powers of protection (Blanchette

1997), and among the Khanty of West Siberia *Fomitopsis fomentarius* was used to protect against disease and death (Saar 1991).

As mentioned in Chapter Two, Mesoamerica has an ancient tradition of mushroom use in religion and medicine (Schultes 1939; Singer 1958; Wasson 1980). The Aztecs and the Maya are both thought to have used hallucinogenic mushrooms to facilitate divinations, healing illness, or speaking with the gods. Sahagún (1829) suggests that at least one species was used to cure fevers and rheumatism, and another species was utilized like an enema to cure diarrhea. Wasson et al. (1974) found modern use of hallucinogenic mushrooms for purposes similar to those described for the Aztecs and Maya among the Mixtec of Oaxaca.

Scientific evidence of the medicinal value of mushrooms suggest that a number of species may have antitumor, antiviral and anti antimicrobial activity. Virus-like particles found in *Lentinula edodes* and other mushrooms, for example, have been shown to suppress tumors in mice (Chang and Miles 1989:36; Benjamin 1995: 83). *Lentinula edodes* was also shown to have antiviral influenzal activity in mice. Other species of edible mushroom have been shown to contain proteins that have hematological effects (Chang and Miles 1989:36). Species of *Ganoderma* have been shown to contain substances that affect blood pressure, cholesterol levels, and blood sugar levels, as well as substances that have anti-tumor properties (Mizuno et al. 1995). To date, many of the important antibiotics used in western biomedicine are derived originally from species of microfungi. (Schultes and Hofmann 1992:19).

Although the Tzeltal utilize wild mushrooms to cure a relatively limited number of illnesses, the importance of these species in the maintenance of health – and their potential for biomedical research – should not be overlooked. As mentioned before, a number of species are thought to provide nourishment and strength when one is weak, exhausted or tired. For most of the collaborators with whom I spoke, the curing of weakness was not simply a by-product of eating food, but was an important medicinal effect associated with species of macrofungi such as *Amanita caesarea*, *Armillaria mellea*, *Schizophyllum commune* and *Daldinia concentrica*. Interestingly, this use parallels the use of *Amanita muscaria* by the Khanty of West Siberia to combat the effects of psychophysical fatigue (Saar 1991).

The most commonly known medicinals in the highlands are species of puffballs (*Lycoperdon* and *Bovista*) which are used to cure cuts, burns, boils, sores, warts, goiter, ***cha'lam tzotz*** (two-hair disease), and to reduce unusual swelling and itching in the penis of young children. Many of these uses parallel those of both European (Benjamin 1995) and indigenous North American groups (Esquivel 1998), as well as the Khanty of West Siberia (Saar 1991). Literally hundreds of idiosyncratic uses of various species of macrofungi were documented during the course of research. Numerous collaborators utilized *Schizophyllum commune* in soups to cure obesity, stomach pains, diarrhea, inflammation, and to increase the production of breast milk in women with young infants. Various species of *Daldinia* were used to cure warts, to provide strength, and as a decongestant for colds. *Ustilago maydis* was reported to heal stomach pains and diarrheas, species of *Amanita* and various coral fungi to cure headaches, and a few species of *Boletus* and *Auricularia* were used to cure sadness or anxiety and fear. Interestingly, despite research into ancient Maya uses of hallucinogenics to cure disease, I found no evidence of the use of hallucinogens for these purposes among the modern day Tzeltal.

The evidence suggests that macrofungi are important medicinal resources that are utilized to cure a wide variety of illnesses. They are not as important as plant medicines, however. Numerous informants reported that they did not know any medicinal uses for macrofungi, and a number of the cures that were documented were entirely idiosyncratic, and could not be supported by statements from other informants. The list of illnesses that wild mushrooms are thought to cure, however, is fairly limited; suggesting that general knowledge of the medicinal properties of macrofungi is widespread throughout the highlands. Table 3.7 provides a full listing of documented medicinal uses of macrofungi by the Tzeltal.

3.12 Conclusion

The data presented in this chapter illuminate Tzeltal Maya beliefs about macrofungal ecology, behavior, and chemistry with the goal of exploring how these beliefs affect mushroom use. These beliefs derive from the accumulated knowledge of macrofungal identification and use passed down from generations past, and despite the introduction of Spanish-language schools in the highlands, ethnomycological knowledge continues to be transmitted from parent to child in traditional ways. This process ensures that the unique ways in which the Maya view the macrofungi of the highlands remain intact.

Table 3.7. Medicinal uses of macrofungi.

Scientific Name	Tzeltal Name	Medical Condition	Preparation
Schizophyllum commune	***sulte'/***	Indigestion and gas	
	chikin te'	Diarrhea	
		Weakness	
		Obesity	Boiled in a soup, or crushed in posol.
		Inflammation	
		Headaches	
		Rheumatism	
		Pain in the body	
		Low production of mother's milk	
Ramaria sp., *Clavulina* sp.,	***tsijtsim lu'/***	Indigestion	
Tremellodendropsis sp.,	***akuxa ti'bal***	Headaches	Boiled in a soup
and *Clavicorona* sp.		Weakness	
		Pain in the body	
		Inflammation or pain in the legs	Poultice applied externally
		cha'lam tzotz (two-hair disease)	
Lycoperdon sp., and	***tsis chauk/***	Warts	
Bovista sp.	***wuswus lu'***	Burns	
		Cuts and bleeding wounds	Spores puffed onto affected area
		Goiter	
		Bedwetting	
		Swollen/itchy penis in infants	
Lactarius deliciousus	***k'an chay***	Intestinal pain	
		Fever	Boiled in a soup
		Pain in the body	
Daldinia sp.	***t'ot'***	Warts	Interior rubbed on area
		Back pain	Boiled in a soup
		Phlegm, mucus from a cold	

Scientific Name	Tzeltal Name	Medical Condition	Preparation
Ustilago maydis	***slu'il ixim***	Indigestion Diarrhea	Boiled in a soup, or crushed in posol
Mycena sp.	***k'anal chejchew***	Headache Pain in the body	Boiled in a soup
Pleurotus sp.	***sak itaj***	Headache Sadness	Boiled in a soup, or crushed in posol
Entoloma sp.	***balumilal lu'***	Headache	Boiled in a soup
Boletus sp., and *Suillus* sp.	***bonkos/ tonkos***	Sadness	Boiled in a soup
Auricularia auricula	***k'o' chikin***	Anxiety or fear	Raw, or boiled in soup
Hypomyces lactiflorum	***tsajal ti'bal***	Headaches	Boiled or grilled
Lentinus crinitus	***tzetz chikin te'***	Strength after giving birth	Boiled in a soup
Amanita caesarea	***k'an tsu***	Inflammation	Boiled or grilled
Unknown sp.	***yok wakax***	Indigestion Losing too much weight Pain in joints Sadness	Boiled in a soup
Unknown sp.	***taxux***	Headache	Boiled in a soup
Unknown sp.	***wox ijk' lu'***	Worms, parasites	Boiled in a soup

Tzeltal ethnoecological knowledge associated with macrofungi is essentially limited to species that are either culturally important, or highly abundant and morphologically distinct. The body of knowledge associated with culturally important species is specific and detailed, and includes an in-depth understanding of life cycles, seasonality, habitat and substrate preferences, generalized morphological patterns, and nutritional, hallucinogenic or toxic properties. Knowledge associated with unknown or indistinct species is limited in scope and highly idiosyncratic, and there is little interest among the Tzeltal in discussing where, when, how or why such species develop.

The detailed nature of this ethnoecological and ethnomycological knowledge serves to inform the use of macrofungi by the Tzeltal. If a species is unknown, it is ignored. For those species that are known and utilized, a detailed understanding of seasonality, and habitat and substrate preference allow the Tzeltal to seek out specific types of macrofungi at appropriate locations and times. Extensive knowledge of the morphology of culturally recognized species facilitates quick and accurate identification, and once a species has been identified, the Tzeltal have well-developed cultural models of edibility, preparation and use.

Chapter 4

The Mushroom Domain and Folk Ethnomycological Classification

4.1 Ethnobiological classification

The fundamental question motivating this research concerns how traditional cultures conceptualize the natural world. Although ethnobiology as a discipline has its roots in utilitarian research and economic botany, intellectualist research into cognition and perception of the natural world have served as the foundation of ethnobiological research and cognition studies since the late 1800's. (Harshburger 1896; Castetter 1944; Harrington 1947; Conklin 1954). An understanding of how people conceptualize living things provides a basis for explaining how people adapt to their local environments, how they determine which species are worthy of recognition, which species are useful, and how they manage biological resources occurring in the landscape. Research into the conceptualization of the natural world provides opportunities for an exploration of generalities in human patterns of thought, and provides a framework for the development of theories that explain how cultural and historical forces lead to differences in these general patterns.

The primary vehicle for examining general patterns of thought in ethnobiological and cognitive research is categorization (Kay 1971; Rosch 1978; Atran 1990; Berlin 1992; D'Andrade 1995). Categorization is thought to be a basic human quality, deriving from experience with the world, and allowing for structured order within which people can describe and interpret reality. Just a few of the numerous hypothesized functions of categorization include: (1) defining and expressing relationships between and among things, (2) aiding in learning and communicating ideas, (3) serving as cognitive and semantic devices for storing and retrieving information, (4) aiding in identification of things, (5) reflecting evolutionary relationships (Berlin 1992), (6) illuminating what is important to specific groups of people (Ellen 1979; Hunn 1982; Ellen 1993), and (7) providing a basis for inductive generalizations about the world (Coley et al. 1997). This cognitive ability is a fundamental component of human survival in the natural world.

The importance of classification to human adaptation explains, perhaps, the proliferation of ethnobiological studies since the pioneering work of Conklin (1954), which advanced the notion that an examination of traditional systems of classification can provide insight into how people perceive and interact with the natural world. Within years of Conklin's work, ethnobiologists moved away from economic and utilitarian concerns, and a wave of debate concerning the nature of human systems of classification dominated the ethnobiological literature through the 1990's. The crux of these debates centers around the universality of human patterns of thought.

Led by the work of Berlin, Breedlove and Raven (1974) and Berlin (1992), the universalists (or intellectualists) assert that "…human beings everywhere are constrained in essentially the same ways – by nature's basic plan – in their conceptual recognition of the biological diversity of their natural environments (1992; 8)." According to this position, the natural continuities and discontinuities arising from patterns of evolutionary divergence are, for all practical purposes, inescapable to the mind of the human observer. Taking this argument a step further, Atran (1990) argues that the human mind, which presumably develops in a similar way throughout the world, adds additional constraints to the ways in which nature is recognized and classified. Traditional systems of classification, then, develop from a basic human tendency to recognize "information chunks," or groupings of living things, that are imposed by nature. Cross-cultural studies tend to support the universalist position, consistently showing that folk categorization follows highly similar patterns in different cultures, and that in most cases folk genera and folk species correspond with those of western science (Berlin et al. 1974; Hunn 1977).

Reaction to the universalist paradigm has been prolific and vocal, and many ethnobiologists rejected cross-cultural comparison in favor of relativist descriptions of individual cultural systems of classification. Variably known as relativists or utilitarianists, the major proponents of alternative positions assert "nature is ultimately a continuity made discontinuous by taxonomic science on the basis of certain selected criteria (Ellen 1979:154)." The essence of these approaches is the idea that the human mind constructs reality, essentially imposing an arbitrarily defined order on the natural world (Ellen 1979; Hunn 1982; Ellen 1993). Systems of folk classification, rather than objective recognition of natural patterns, are thought to develop from the unique history and culturally defined beliefs, behaviors and preferences of a particular group. In addition, folk categories are viewed as unstable and shifting; subject to idiosyncratic variation; and patterned according to variables such as gender, age, or social context. Support for the relativist position derives from studies of variability in folk categories within specific cultures, and cross-cultural studies pointing to "special cases" of folk categories that deviate from the idealized universalist model (Hunn 1977; Ellen 1979).

The dichotomous nature of this debate resulted, in part, from the lack of comprehensive explanations for the exceptions that appear in the "fabric" of folk classification systems. Just a few examples will suffice to illuminate the potential problems raised by these exceptions. The original conceptualization of classification, for example, focused on shared attributes, or criteria, as the basis for category inclusion (Goodenough 1957; Lounsbury 1964; Frake 1972). The structure of folk taxonomies, however, has proven not to be neat or clean, and category inclusion based on readily perceived, shared definitional attributes is an incomplete model. The research of Berlin and Kay (1969), Berlin et al. (1974) and Hunn (1977), among others, demonstrated that category boundaries are often "fuzzy," and that some taxa are "unaffiliated," "overlapping," or "residual." The conclusion was that categories are often graded, that no single well-defined set of definitional criteria determined category, and, as Berlin and Kay (1969) showed in their work, categories consist of focal members with basic ranges that represent prototypes.

Prototype theory (Rosch 1978) developed from these studies, and refined and explained these notions by proposing that some taxa possess more definitional attributes than others, and that the attributes of these "prototypical" taxa serve as referents against which the attributes of other taxa are judged for category inclusion. Prototypes are thought to reflect more closely psychological reality than earlier models, and have been proposed as a mechanism for the development of expectations, theories, and beliefs about the world (Rosch and Lloyd 1978; Gelman 1988; Wierzbicka 1990; D'Andrade 1995; Medin et al. 1997), as well as serving as a basis for learning and early category development in children (Gelman et al. 1994; Keil 1994).

Another interesting set of problems arises, in part, from the ways in which domesticated plants and other human artifacts are categorized in folk classification systems. Berlin (1992), and Atran (1987), for example, claim that some taxa, most notably those that are culturally important (i.e. domesticated), cease to be “natural things” and enter a new realm in which some other, potentially culturally defined criteria, play a role in determining how they are categorized. Aberrant cases such as these contributed to a growing body of literature concerning alternative or special purpose taxonomies that develop in response to utilitarian goals. These arguments have been closely examined and broadly extended to suggest that ethnobiological classification is, in some cases, partly dependent on proximate needs (Rosch 1978; Barsalou 1991), social or cultural contexts (Ellen 1979; Hunn 1982; Ellen 1993), or some unique perceptual qualities of the domain under consideration (Wierzbicka 1984; Atran 1987; Boster and Johnson 1989).

The current chapter examines a number of questions related to the approaches mentioned above. My objectives include: (1) confirming the cognitive recognition of macrofungi as a domain that is separate and independent from the domains of plants and animals, (2) modeling the outlines of Tzeltal ethnomycological classification, (3) describing and explaining asymmetries in Tzeltal ethnomycological classification, (4) examining how special purpose, utilitarian categories interact with the basic structure of ethnomycological classification, and (5) investigating how morphological, ecological and nutritional, hallucinogenic or toxic properties influence the size and substance of the semantically recognized macrofungal domain.

I originally hypothesized that *function* played the dominant role in determining the internal recognition and classification of the macrofungal domain. The reasoning for this original approach was based on a few simple observations: (1) past studies of the macrofungal domain in the highlands of Chiapas have discovered relatively few species in comparison with domains of plants and animals, thus the currently known diversity of macrofungi was low[1] (2) a large number of these taxa are "little brown mushrooms," meaning they are morphologically indistinct, (3) in comparison with plants and animals, mushroom taxa are small, ephemeral, and seasonal, and thus are difficult to observe on a regular basis, (4) a significant number of species are edible and highly prized as food, and (5) a few species are poisonous and dangerous to consume. As a result, I hypothesized, when people are faced with deciding which species to recognize from the bewildering array of indistinct and potentially dangerous species the motivating factor in classification would be functional rather than observational.

The reality of the situation, of course, is much more complex than my original hypotheses suggested, and the following pages attempt to demonstrate that, whereas functional concerns *influence* the size and boundaries of the semantically recognized macrofungal domain, the internal structure of ethnomycological classification is based on the recognition of biological continuities and discontinuities. In the end, it became clear that in order to classify macrofungi in special purpose utilitarian categories, the Tzeltal must first observe a specimen and, based on morphological characteristics, know what the mushroom is.

[1] Although *known* diversity of macrofungi in the highlands of Chiapas is low (approximately 250 species), the likely diversity of macrofungi in the highlands is quite high. If, as quoted in Chapter 2, there are close to 3,000 vascular plants in the highlands (Stepp and Moerman 2001), the number of macrofungi is likely to reach several hundred or more based on a 3:1 plant to fungus ratio (Hawksworth 1991)

4.2 The boundaries of the macrofungal domain

A domain is a well-defined conceptual realm consisting of related members that conform to guidelines of form, function or behavior (Weller and Romney 1988:9). The consistent use of specific lexemes by large numbers of individuals belonging to a single cultural group to describe a domain indicates the existence of a single, coherent and shared "reality" for the cultural group. Thus by examining the ways in which mushroom names organized in nomenclatural and classification systems we gain insight into the beliefs that people have about them (D'Andrade 1995). The first step in examining Tzeltal ethnomycological knowledge was to confirm that macrofungi form a group of related members with consistent cognitive reality.

Perhaps the earliest indicator that macrofungi form an independent cognitive domain recognized by the Tzeltal was the ease with which my collaborators and I could communicate about mushrooms as a group. Throughout the course of approximately 200 conversations and interviews, the term ***chejchewetik*** 'mushrooms' was used to refer exclusively to species or groups of species that are recognized as fungi in the western scientific system. And despite the diversity of morphotypes that together, form the mushroom domain, Tzeltal collaborators unambiguously included them all as kinds of ***chejchew***.

Similar findings concerning the separate status of the macrofungal domain have been reported among other groups in Mexico (and other locations), including the Purépecha (Mapes et al. 1981), Huastec (Brown 1972), Tzotzil (Laughlin 1975), Matlazinca (Escalante 1974), Mazateco (Wasson and Wasson 1957), Southern Tepehuan (Elizondo 1991), groups from Tlaxcala (Esquivel 1998), Mixtec Zapotec (Hunn et al., unpublished paper 2001), Iban of Sarawak (Sather 1978), and the Chewa of Malawai (Morris 1984). Research conducted with these groups suggests that the existence of single lexeme referring specifically to fungi is common among different cultures. The existence of a widespread overarching term helped to confirm the relevance of the domain for the Tzeltal and eased the process of engaging them in informal and semi-formal discussions about the characteristics and uses of macrofungi.

Additional evidence confirming the existence of a single, coherent domain comes from the use of freelists. Freelisting is an exploratory method for eliciting the words or concepts that define the boundaries of a cultural domain (Weller and Romney 1988; Bernard 1995). This relatively simple, yet powerful technique consists of asking a collaborator to "list all of the kinds of X that exist in the world." If large numbers of collaborators answer this question without confusion, and if the terms and concepts generated by these lists are related, it is safe to assume that there is wide agreement about the substance and structure of the domain.

Deeper analysis of freelists can also provide the beginnings of a framework within which to conduct further investigations by indicating which members of the domain are the most salient, and which collaborators possess the greatest knowledge of the domain. Salience, for example, can be indicated by frequency of appearance and relative position of a label across the full sample of freelists. Level of knowledge is indicated by the agreement of an individual's list with a measure of the average of the summed lists.

During the early, exploratory phase of my research I collected freelists with approximately one hundred (N=109) Tzeltal collaborators. My goal was to discover whether knowledge about macrofungi was widely shared across Tzeltal communities, and alternatively, whether distinctive patterns of variation in knowledge might exist across different social groups. In pursuit of this goal, I attempted to stratify my sample by sex, age, and community membership under the assumption that these variables would account for a significant proportion of any variation that might be discovered. In the end, I worked with fifty-one women and fifty-eight men. These individuals lived in nine different barrios ‘neighborhoods’ belonging to three different communities that were distributed across two different municipalities throughout the highland region. Collaborators ranged in age from sixteen to seventy, with an average of forty-four years of age.

Each collaborator was asked the same question, “*binti sbil jujuten* ***chejchewetik*** *ta balumilal*,” which can be roughly glossed as ‘what are the names of all the mushrooms that exist in the world?’ Answers to this question were extremely consistent, and as will be shown below, the lists exhibit a high degree of similarity. More often than not, as my collaborators began the process of recall, they would go into long monologues about the edibility, morphology or habitat features of the species, and the number of smiles and fond stories that accompanied this process indicated that mushrooms are a highly prized resource. These descriptive notes and colorful stories served as a basis for formulating the later stages of my research by indicating the most salient features associated with the domain.

Responses were recorded in Tzeltal, in the order mentioned, and analyzed using the ANTHROPAC software package (Borgatti 1994). Due to the limitations imposed by ANTHROPAC (which can only run fifty freelists at a time), a random sample of forty-eight freelists was chosen for analysis. Table 4.1 provides a summary of the mushroom names recalled by two or more individuals, as well as frequency of recall, average placement across lists, and culturally agreed upon use. Smith's measure of salience, computed by ANTHROPAC, is composite measurement of the frequency and average placement (rank of a name on a list) of a mushroom name across all of the lists, and represents: (1) which mushrooms are most often recalled, (2) which species are most likely to be true members of the domain, and (3) which species represent the best, or most prototypical, members of the category.

As can be seen in Table 4.1, these freelists produced 25 items that were mentioned by two or more collaborators. The average size of an individual freelist was 11.5 items, with a range from 7 to 16 items. The mushroom species that appear in the table represent the most salient, or well-known, species in the highlands *as measured by recall*, rather than an exhaustive summary of the knowledge of macrofungal species in the region. Perhaps the most interesting feature of this list is that, with the exception of ***xwix k'an tsu***, which is variably described as edible or inedible by the different informants, every member of this list is considered edible or medicinal. Another striking feature of the results in Table 4.1 is that, with the exception of ***wuswus lu'*** and ***tsis chauk***, which are synonyms for a polytypic group of puffballs, and ***tsajal ti'bal*** and ***k'an chay***, which are synonyms for *Lactarius deliciosus*, every name on this sample of freelists represents a unique species of macrofungi.

Although not represented in the table, this sample generated more than 40 items that were mentioned idiosyncratically. A separate analysis of all 109 freelists produces more than 150 different names used by the Tzeltal to label the mushroom domain, although at least 50 of these are probably descriptive variations of the most widely agreed upon names. Variations in lexemes aside, collaborators who were presented with photographs of mushrooms collected in the region could identify 30 or more species without difficulty. By combining freelists and photo identification interviews, I determined the total domain of ethnomycological knowledge, distributed across informants, includes more than 70 distinct species, and with more long-term field collections this number is likely to be higher.

Table 4.1 Summary of mushroom freelists from Tenejapa ranked by frequency.

Tzeltal Name	Species	Use	Frequency (N=48)	Average Rank On Lists	Smith's Measure of Salience
tsajal ti'bal	*Hypomyces lactiflorum*	Edible	48	3.312	0.800747
t'ot'	*Daldinia concentrica*	Edible	47	6.148	0.541561
chejchew	Unknown sp.	Edible	45	2.555	0.815007
slu'il ixim	*Ustilago maydis*	Edible	43	8.906	0.302245
tonkos	*Boletus* spp.	Edible	43	6.093	0.509715
k'an tsu	*Amanita caesarea*	Edible	41	5.878	0.511908
akuxa ti'bal	Coral fungi	Edible	39	7.564	0.3767
chikin te'	Tree growing spp.	Edible	34	5.941	0.428542
tsukum ti'bal	*Morchella* spp.	Edible	33	8	0.274157
k'an chay	*Lactarius deliciosus*	Edible	30	6.3	0.356849
tsis chauk	*Lycoperdon* spp.	Medicinal	26	10.038	0.138785
sak itaj	*Pleurotus* sp.	Edible	22	8.363	0.202581
sulte'	*Schizophyllum commune*	Edible	20	7	0.204209
woron kotz	*Morchella* spp.	Edible	13	7.615	0.115106
xwix chejchew	*Armillaria mellea*	Edible	13	6.923	0.145984
k'o' chikin	*Auricularia auricula*	Edible	8	8.5	0.05879
pat najk	Unknown sp.	Edible	8	7.25	0.091636
konkiw	*Agaricus californicus*	Edible	8	6.125	0.09481
taxux	*Coprinus* sp.	Edible	6	10.333	0.040956
hongo	*Agaricus* sp.	Edible	4	10.25	0.024673
usamte'	*Schizophyllum commune*	Edible	4	5.5	0.051592
tan mut	*Trametes* spp.	Edible	3	10.666	0.016445
xwix k'an tsu	*Amanita flavoconia*	Unclear	3	9.666	0.020833
chi' lu'	Unknown sp.	Edible	3	8.666	0.030222
wuswus lu'	*Lycoperdon* spp.	Medicinal	2	6.5	0.021465

In comparison with other indigenous groups that have been studied, the number of species recognized and labeled by the Tzeltal is impressive. Hunn, for example, found that 18-20 species are consistently recognized among the Zapotec-Mixtec of Oaxaca (unpublished paper 2001), Esquivel found 71 species in Tlaxcala, Elizondo found 14 species in Durango (1991), and Mapes et al. (1981) discovered eleven stable groups of macrofungi at the genus rank recognized by the Purépecha of Michoacán, with an unknown number of distinctions at the species rank. Morris, on the other hand, found 70 species of edible mushrooms recognized by the Chewa of Malawai (1984). The relatively low numbers of macrofungi identified in these studies should be explained: Do these numbers reflect incomplete inventories of macrofungi in the study regions? Do ecological and reproductive characteristics of macrofungi lead to cultural limitations of the size of the cognitively recognized domain? Could the size of the domain be related to utilitarian concerns and the avoidance of potentially toxic species? These and other questions will be addressed throughout the remainder of the chapter.

In order to test the degree of agreement among the freelists, and determine whether these species are salient in a statistical sense, a respondent-by-item matrix was derived from collaborator responses and submitted to consensus analysis in ANTHROPAC (Borgatti 1994). Responses were coded as either 1 or 0 depending on whether a collaborator mentioned a mushroom name or not, and the matrix was analyzed to determine the general distribution of knowledge about the items that belong in the domain. Results, displayed in Table 4.2, show that the ratio of the first to second eigen value (which typically should be 3:1 or higher in order to indicate that one pattern of responses is occurring) indicate that mushrooms make up a coherent, culturally recognized domain. There is also a high degree of agreement about which mushrooms actually belong within the boundaries of the domain, as the first two eigen values account for 98.7% of the variability in the sample (Borgatti 1994; Romney et al. 1986).

Table 4.2 Eigenvalues from consensus analysis of mushroom freelists.

FACTOR	VALUE	PERCENT	CUM %	RATIO
1	29.59	85.1	85.1	9.196
2	3.218	9.2	94.3	1.626
3	1.979	5.7	100	
	34.786	100	100	

Pseudo-Reliability = 0.987

To briefly summarize my findings, the boundaries of the macrofungal domain in Tzeltal classification are consistent and well defined, and mushrooms form an obvious, separate group of living things with unique characteristics. For the Tzeltal mushrooms are a group of living things that are neither plants nor animals. This finding is, perhaps, unsurprising, as fungi form a separate and unique kingdom in the western system of classification, and are generally recognized as distinct in the English folk taxonomy. In addition, my findings show that there is little variation in knowledge of mushroom species and mushroom use according to age (discounting the fact that I rarely worked with children) or gender. Whereas freelists show that there are variations in the names applied to certain species according to community membership, the taxa that tend to receive names are highly consistent throughout the Tzeltal region. The following sections outline the entire system of Tzeltal ethnomycological classification.

4.3 Taxa of the genus and species ranks

Berlin's general principles of ethnobiological classification (1992), built on the earlier work of Conklin (1954), Bulmer (1970), Brunel (1974), Berlin et al. (1974), Hunn (1977), Brown (1984, 1986) and many others, suggest that traditional societies classify living things in a shallow hierarchy composed of four to six exclusive ethnobiological ranks, potentially including the ranks of kingdom, life-form, intermediate, genus, species and variety. The genus rank makes up the core of any given folk taxonomy, and includes by far the majority of recognized taxa found in local environments. Taxa at the genus rank are thought to be more perceptually salient than taxa at other ranks in the sense that they represent the most obvious natural discontinuities in nature and motivate perceptual and linguistic distinction in folk taxonomies. In other words, folk genera are natural groupings that can be recognized almost without effort. The notion that genera have primacy in folk taxonomic systems is not only supported by the fact that they exist in greater numbers than taxa of other ranks, but also by ethnographic evidence suggesting that children in traditional horticultural societies generally learn folk genus names before they learn the names of species (Stross 1970, 1973; Zarger and Stepp 2000).

In some folk taxonomic systems a small proportion (generally 20% or less) of taxa at the genus rank are divided more finely into subgroups of taxa at the species rank, and very rarely, specific taxa are further subdivided into groups at the varietal rank (Berlin 1992:34). These subdivisions form contrast sets that appear to be based, in most cases, on the close examination of a few perceptually recognized features that allow the observer to distinguish between two or more taxa. The most common characteristics used in making such distinctions include features such as color, size, shape or habit (Berlin 1992:107).

This theoretical model provides a starting point for a discussion of Tzeltal ethnomycological classification. As is the case with most ethnobiological classification systems, taxa of the genus rank make up the core of the Tzeltal ethnomycological taxonomy. Mushroom genera represent morphologically and behaviorally distinctive discontinuities that are readily observed, and often typified by a single, central member. Based on the collections made for this dissertation, the Tzeltal ethnomycological taxonomy includes at least 51 monotypic taxa at the genus rank, and at least 3 polytypic taxa of the genus rank that immediately include two or more members at the species rank (see Chapter 5). There appear to be no taxa at the varietal rank, a fact that is not surprising as the Tzeltal Maya cultivate only one or two species of mushrooms in the region.

One interesting feature of this domain is that the number of folk genera that are recognized and named within the mushroom domain appears to be relatively low in comparison with the domains of plants and animals. This structural feature likely arises from some unique feature of the macrofungal domain itself. For example, although the number of fungal species existing in the region is likely to compare well with the numbers of plants and animals, the number of readily observable macrofungi is likely be much lower[2]. In other words, there are simply fewer mushroom species and folk genera to classify. Other features of the macrofungal domain, including unusual morphological

[2] Based on a 3:1 plant to macrofungi ratio (Hawksworth 1991), with approximately 3,000 vascular plants (Stepp and Moerman 2001) the number of macrofungal species in the highlands could range from 300 – 1,000, and the number of fungi in the region is likely even higher.

and behavioral characteristics, may also contribute to differences in ethnomycological classification. For example, gross morphology, size, prevalence, life history, or morphological diversity of macrofungal species found in the local environment could all have such effects (Hunn 1977; Berlin 1992). This structural difference could also be the result of utilitarian factors such as the avoidance of poisonous species. These questions will be specifically addressed in more detail in the final section of this chapter concerning the subset of mushroom species that are recognized and named.

On the other hand, the fact that the Tzeltal name relatively few of the macrofungi that exist in the region may be the result of the fact that I have an incomplete inventory of the totality of the species that make up the macrofungal domain in the highlands of Chiapas. As mentioned before, due to complex social and political issues related to intellectual property and indigenous rights, field-collections of macrofungal specimens were conducted for only two months. Impressively, these field-collections yielded over 250 specimens, approximately 72 of which have been identified as distinct species. Given the short duration of this stage of research, however, it must be assumed that the 72 species identified represent only a small portion of the total number of species existing in the local environment. As a result, the unusual structural features noted above could be the result of a statistical effect such as the over-representation of a few species or genera in my collections. These structural features may also be the result of under differentiation at the genus rank, with the Tzeltal lumping more than one scientific species into one genus.

More detailed collections made over the span of several years in the Tzeltal region will likely uncover other macrofungal taxa recognized at the genus rank. In fact, other mycologists and ethnomycologists working the highlands of Chiapas have reported a number of species that were not encountered in the course of this research, and a full listing of the macrofungi known to exist in the region currently includes just over 250 species (Villarreal and Guzman 1985a, 1985b; Villarreal 1987; Perez-Moreno and Villarreal 1988; Villarreal and Gomez 1997; Guzman 1993, 1998; Robles Porras 2000; Shepard and Arora 1992; Breedlove and Laughlin 2000). Expanding our knowledge of the total mushroom domain is likely to have some effect on an analysis of the unusual aspects of the domain as outlined in this dissertation, although it does appear that the Tzeltal consistently under differentiate by lumping more than one scientifically recognized species at the genus level.

These concerns aside, the primacy of genera is predictable, having been found in hundreds of folk taxonomic systems throughout the world, and the finer division of a small proportion of taxa at the genus rank into two or more taxa at the species rank follows a pattern that is not unusual in indigenous cultures. The centrality of these categories at the genus rank, and the existence of subgenus categories in the ethnomycological system of classification lend additional support to the general principles of folk classification as outlined by Berlin (1992).

4.4 Taxa of intermediate and life-form ranks

Moving upward in a folk taxonomic system, taxa of the genus rank are sometimes grouped into categories at an intermediate rank, often affiliated with one of a few categories at the life-form rank, and almost always lumped together as members of one of the two often unnamed (and thus covert) categories of plant or animal at the kingdom rank. This section is devoted specifically to a discussion of taxa of intermediate and life-form ranks, and the following section will discuss the potential recognition of a kingdom by the Tzeltal Maya of the highlands. As this section will show, there is some ambiguity as to the recognition of intermediate taxa (be they covert or loosely named), whereas there are two or three consistent groupings of taxa at the genus rank that appear to fit the general definition of life-forms.

As suggested by Berlin, taxa of intermediate rank unite a few perceptually affiliated genera at a structural position between life-form and genus ranks (1992:139). While the majority of intermediate categories appear to be formed by groupings of taxa of genus rank from the same biological family, in some cases these categories include genera and species from a few different families. Much like categories of folk genera, the underlying basis of intermediate categories is thought to be shared morphological and behavioral characteristics that appear to form a "natural grouping" with perceptual salience (Bulmer 1979).

Despite the fact that intermediate categories are often based on the recognition of natural groupings, there is great range of cross-cultural variability in the number of intermediate taxa found folk classification systems, as well as the kinds of taxa that are included in these categories. The variability found among intermediate taxa may indicate these groupings are less perceptually salient than taxa of genus rank, or it might indicate that criteria such as cultural beliefs sometimes play a role in determining category membership at this rank. In general, however, intermediate taxa are thought to be "formed on the basis of readily perceived morphological similarities among the contrasting genera of which they are composed (Berlin 1992:148)," while the status of utilitarian categories as true components of folk taxonomic systems is debated.

Intermediate taxa are typically centered around one prototypical member whose characteristics serve as the criteria against which other members are included (Berlin 1992:149). An example in folk English might be "water birds" with ducks serving as a prototypical member and an extended range including wood ducks, mallards, geese and even coots. In many cases, the name of this prototypical genus member is polysemous, also serving as the name for the intermediate category. In other cases, taxa of intermediate rank lack consistent, agreed-upon labels, leading investigators to refer to them as "covert taxa of intermediate rank," (Berlin 1992) or "covert complexes" (Hunn 1977).

The Tzeltal system of ethnomycological classification appears to include at least four covert groupings that could be argued to be intermediate categories. These covert groupings of folk genera are clearly based on obvious similarities overall morphology, and tend to include groupings based on shape, habit, texture, size, life history and substrate preference. Each covert category includes between two and five monotypic folk genera, many of which share an obligatory label. Although the importance of these categories for the structure of the overall classification system is debatable, these covert groupings appear to be highly salient in that if an exact identification of at the folk genus is dubious, collaborators will revert to calling a specimen a "kind of" the presumed covert category. At least two Tzeltal intermediate categories resemble intermediate taxa of the folk English mycological system, as the covert complex ***tsijtsim lu' – akuxa ti'bal*** corresponds closely with the folk taxon 'coral fungi', and the covert complex ***bonkos –***

tonkos corresponds closely with the folk taxon ‘bolete’. The other two intermediate categories, ***k’an chay*** and ***tsa’ wakax*** appear to be based on gross morphology or substrate preference, and do not appear to have correlates in the folk English ethnomycological system.

Life-forms, on the other hand, are large, broadly inclusive categories that “…incorporate the majority of the taxa of lesser rank (Berlin 1992:24).” Taxa of the life-form rank form contrast sets at a structural position that immediately, and often completely, partitions the ethnobiological kingdom. Life-form taxa are made up of groupings of a large number of morphologically diverse folk genera from different biological families. These genera are perceptually grouped together at the life-form rank on the basis of a small number of shared morphological features that cause them to be perceptually similar in a somewhat abstract sense. Because they are based on only a few features, and because they tend to cut across natural, biological boundaries, life-forms sometimes appear to be a less “natural” grouping of folk biological taxa. Yet life-form categories rarely have a utilitarian basis, suggesting that they do indeed represent abstract perceptual similarities.

The Tzeltal system of ethnomycological classification appears to contain two contrasting life-form taxa loosely grouped on the basis of substrate preference and morphology (see Chapter 5). These two categories are salient and widely agreed upon across the highlands, whereas the other potential categories are relatively unstable, and have less consistent agreement across collaborators. The first of these well-defined life-form categories, is polysemously labeled ***chikin te’*** ‘tree ear’, and generally includes all of those macrofungi that grow on trees, sticks, logs or roots[3]. A second salient category, which either lacks a linguistic designation, or quite often is polysemously labeled ***chejchew***, generally includes all of those macrofungi that grow in the earth. Like the taxa of life-form rank in other ethnobiological domains, these life-form categories include folk genera from a broad range of biological families, cutting across "natural" boundaries.

Interestingly, the membership and boundaries of these two proposed life-form categories are only stable in a general sense. The majority of my collaborators would consistently claim that all tree-growing mushrooms were a type of ***chikin te'***, and earth growing mushrooms were a type of ***chejchew***. However, when examined more closely, membership in these two groups appears to vary to a considerable degree. Aside from the polysemously labeled prototypical genera that serve as the central members of these categories, Tzeltal collaborators often disagreed about which folk genera belong to one or the other of these categories respectively, and a few folk genera are included in *more than one category*. In other words, the boundaries of these life-form categories are, to some extent, fluid and porous.

For example, throughout the course of sixty interviews, collaborators consistently made "mistakes" when placing mushroom taxa together in the life-form categories that I claim are based loosely on substrate preference. These "mistakes" are exemplified by Tzeltal treatment of the species *Naematoloma fasciculare*, which despite the fact that it grows in rotting tree trunks, was labeled ***xwix chejchew*** 'sister of the true mushroom', and consistently grouped with 'earth-growers' rather than 'tree-ears'. The reason for this classificatory paradox was obvious; ***xwix chejchew*** is a large, fleshy species that grows in

[3] Interestingly, one of the most prevalent folk English terms for tree growing species is also tree ear.

large clusters and closely resembles the prototypical earth-growing species ***chejchew*** in morphology, though not substrate preference. In essence, ***xwix chejchew*** with its long stem, conical cap and clustered habit, simply does not look like a typical flat-capped, stem-less ‘tree-ear’. The key point is that, rather than making “mistakes,” my collaborators were relying on *a combination of* key morphological features and substrate growth patterns to make determinations of category membership, and in some cases had to choose between conflicting features. As often as not, collaborators choose overall morphological appearance rather than substrate preference in making this choice.

An interesting parallel can be found in western folk mycological field guides in which morphological features such as an absent or off-center stipe, or an absent or ill-formed cap, are frequently used as indicators for a “natural grouping” of various biological families of wood-growers typically referred to as ‘Polypores’. Alternatively, features such as a large, well-developed cap and stipe, obvious gills, and development in the earth are indicators of a “natural grouping” of biological families generally referred to as ‘Agarics’. Numerous examples of intermediate groupings including Boletes, Coral Fungi, Tooth Fungi, Truffles, and many others, can be found in western field guides. Unlike western scientific classification, which is increasingly based on evolutionary relationships, folk English groupings are based on the co-occurrence of highly salient features such as substrate and morphology, suggesting that these taxa form easily observable natural groupings. Interestingly, the terms Polypore, Bolete, Agaric, etc., derive from the most prevalent, or most prototypical families included in these categories. It is not unusual, then, for mycologists to develop some sort of gestalt idea of intermediate mushroom groups based on the co-occurrence of ecological and morphological features exemplified by one or more central members.

My point is that the formation of higher-order mushroom categories in both folk English and folk Tzeltal systems relies on the development of a set of expectations concerning the morphological features that accompany substrate preference, and vice-versa. These expectations become "guiding principles" that are structurally, and sometimes linguistically built into the folk taxonomy. Throughout the course of interviews and discussion, collaborators used these guiding principles to make sweeping generalizations such as "all the mushrooms that grow in wood are kinds of ***chikin te'***." The dilemma, however, is that while the expectations linking substrate and morphology hold true in general, there are numerous exceptions that lead to overlapping and inconsistently agreed upon categories. As the ***xwix chejchew*** example suggests, rather than treating the life-form category ***chikin te'*** as a group that includes 'all of the species that grow in wood', it is better to think of this category as 'all those species that grow in wood, lack a consistent, central stipe, and have an irregularly formed, planar cap'. This restricted definition more closely reflects the reality of the taxonomic structure suggested by aberrant taxa such as *N. fasciculare*. And consistent with life-form categories found in other ethnobiological systems, such a definition allows for the inclusion of numerous different biological families, and simultaneously reduces the "kinds of" taxa that form a category to those that share a specific set of substrate and morphological characteristics.

Another significant feature of life-form categories in the Tzeltal ethnomycological system is the relative paucity of folk genera that are included in each category. Compared with the life-form taxa such as 'tree' or 'bird' found respectively in plant and animal systems of classification, the number of folk genera included in life-form categories is extremely low, with approximately 26 members of the ‘tree-ear’ category, and fewer than 46 members of the ‘earth-grower’ category. In some sense, these groupings are simply too small, and their boundaries too unclear, to be treated as categories of equal perceptual status with the large polytypic groupings found at the life-form rank in the other kingdoms. On the other hand, the proposed life-form categories clearly form labeled groupings of perceptually related folk genera that immediately, and perhaps exhaustively partition the kingdom rank. And although these categories appear to stretch the notion of life-form taxa a bit, it is possible that the small size and relatively low diversity of the macrofungal domain, as well as cultural considerations, could lead to structural differences such as those noted here.

A case can be made for at least one additional category that occurs at the same level as taxa of intermediate or life-form rank, although the recognition of this category is highly variable across collaborators, and its boundaries are, in some ways, poorly defined. This category receives the consistent linguistic designation ***lu’***, and appears to be a large grouping of what in folk English might be called “toadstools.” This group appears to include all of those macrofungi that are morphologically undistinguished or considered inedible. As this definition indicates, the criteria used to form the category is variable: the category ***lu’*** is used as a dumping ground for all those mushroom taxa that are indistinct, considered poisonous, and about which nothing is known. As a result, this grouping is similar in size to the other ethnobiological life-forms, and includes a much wider diversity of biological families.

The boundaries of the category ***lu'*** are difficult to define because they are based in large part on cultural considerations. For example, what appears to be an indistinct little brown mushroom to one individual might be a well-known mushroom to another. Additionally, a number of mushrooms that are consumed in one paraje are often considered inedible in another paraje. Membership in the category ***lu'*** thus appears to be loosely based on crosscutting dimensions of substrate, habitat, morphology, and more importantly, utility. As a result, I would either include the ***lu'*** as a third life-form that immediately partitions the macrofungal kingdom, or due to the primacy of cultural considerations in determining membership (i.e. avoidance), think of it as a cross-cutting special purpose category that overlaps the basic taxonomic system. The latter possibility will be discussed in more detail in a following section of this chapter.

In summary, the recognition of linked morphological and ecological characteristics is a consistent feature of Tzeltal ethnomycological classification, and seemingly leads to the formation of cognitively salient higher order groupings of folk genera based on natural and obvious affinities. In some sense, the boundaries of these groupings are amorphous and poorly defined, a number of genera either morph between groups, or fall outside them altogether. In addition, these groupings characteristically include taxa from a variety of different biological families. Despite these irregularities, the categories I have discussed are highly salient groupings of folk genera that are generally widely agreed upon across collaborators. And although they are less inclusive in terms of species diversity than typical examples of life-form taxa such as 'trees', 'vines', 'grasses', or 'birds', it is best to treat the categories ***chejchew*** and ***chikin te'*** as taxa of the life-form rank.

4.5 The kingdom

Taxa of the rank of kingdom, though often covert, occur at the highest (or most abstract level), and incorporate all of the taxa of lesser rank. Although generally unlabeled in folk systems of classification, many traditional cultural groups are thought to indirectly acknowledge the existence of at least two categories at the kingdom rank: one corresponding to Plantae, and one corresponding to Animalia. Interestingly, there has been little discussion concerning the recognition of other kingdoms in ethnobiological systems. The problem, however, is that macrofungi do not appear to "fit" with either of the two previously described kingdoms.

Because they have historically been understudied, it is important to question whether or not the mushroom domain forms a third, independent kingdom that exists as cognitively separate from the kingdoms of plants and animals. This question remained essentially unanswered until Glenn Shepard and David Arora conducted research into mushroom classification and use in 1992. Despite the somewhat ambiguous nature of the linguistic evidence they collected, Shepard and Arora concluded that the Maya recognize the mushroom domain as a third, separate and independent kingdom. This conclusion is anything but shocking, as the Western system of classification recognizes the entire group of fungi as a separate biological kingdom and given the morphological, behavioral, and nutritional, hallucinogenic or toxic features of fungi it might be more bizarre to find that traditional cultural groups did *not* recognize them as a different class of living things. The goal of the remainder of this section is to examine the linguistic and behavioral evidence that supports the claim that the macrofungi are recognized as a third kingdom in the highlands of Chiapas.

The most unambiguous evidence for the recognition of macrofungi at the rank of kingdom was presented earlier in this chapter during the discussion of the mushroom domain. In brief, macrofungal taxa at the genus rank are definitely *not* included with any of the life-form categories ***te'*** "tree', ***ak'*** 'vine', ***ak*** 'grass', or ***wamal*** 'herb' found in the Tzeltal ethnobotanical system (Berlin et al. 1974), nor are they included with the life-form categories ***mut*** 'bird' or ***chanbalam*** 'mammal' found in the Tzeltal ethnozoological system (Hunn 1977). This claim is easy to confirm: ask any Tzeltal speaker whether mushrooms are a kind of ***te'*** or ***wamal*** or ***chanbalam***, etc., and he/she will inevitably answer that no, mushrooms are simply a kind of ***chejchew***, or 'mushroom'.

In fact, the various taxa of the mushroom domain recognized by the Tzeltal Maya all appear, at first glance, to be grouped under the single, higher-order term, ***chejchew***. This label is an unanalyzable primary lexeme, and given that it includes a wide array of diverse morphotypes it might best be glossed as 'all of the fleshy mushrooms'. As suggested by Berlin, the existence of a single, agreed upon label designating the highest level grouping of taxa is somewhat unique in traditional systems of ethnobiological classification, as they generally "…lack habitual linguistic designation (1992:190)." The Tzeltal Maya, however, have loose labels that apply to the kingdom rank for ***te'ak'*** 'plants' and ***chanbalam*** 'animals', and as a result, the mushroom domain is not treated in a way that is qualitatively different from these other two domains.

There is, however, ambiguity in the use of the term ***chejchew***. One of the most interesting problems with the term ***chejchew*** is that, despite the fact the label can be used to refer to 'all the small to large fleshy fungi' in normal conversation, the label *cannot* be applied to all species of macrofungi. For example, when asked whether species of macrofungi that are culturally useless, poisonous, or undistinguished in appearance are a type of ***chejchew***, many of my Tzeltal collaborators claimed that these species are not a type of ***chejchew***, but rather a type of ***lu'***. There is, then, a key distinction between ***chejchew*** and ***lu'***, and this distinction is complex and difficult to parse out, and appears to based on a number of factors including cultural utility and morphological salience.

These linguistic dilemmas raise the question of whether all of the lesser-ranked taxa of the macrofungal domain are incorporated within a single, labeled category at the highest level. However, the fact that all macrofungi, regardless of morphology or use, are cognitively and linguistically separated from the plant and animal kingdoms supports the notion of recognition of macrofungi at the kingdom rank. Additionally, when asked to list "all the kinds of ***chejchew*** that exist in the world," almost every collaborator included species that were later classified as types of ***lu'***. My best guess is that this confusion arises from the fact that the term ***chejchew*** is polysemous and is used as the linguistic designation for mushroom taxa at the kingdom, life-form and genus ranks. The term ***lu'***, as a result, is either a linguistic designation for an odd grouping of biologically and perceptually unrelated taxa at the life-form level, or can be thought of as a special purpose category that serves as a dumping ground for species that are unknown. These possibilities will be discussed in more detail in following sections of this chapter.

As Berlin asserts (1992:190-191), additional support for the existence of a kingdom category comes from linguistic evidence such as specialized vocabulary and descriptive phrases. For example, numerous folk taxonomic systems (Tzeltal, Huambisa, Aguaruna, Hanunóo, Ndumba and others) have extensive morphological vocabularies used exclusively for the description of folk taxa of plant or animal kingdoms (ibid.). The

Tzeltal utilize such a well-developed vocabulary in describing the mushroom domain, with more than 150 terms describing features of mushroom morphology such as size, shape, color, texture, taste, habitat, and growth habit (see table 4.3 for a sample of these terms). While many of these terms are simply descriptive (as with color terms), and others are shared with the domains of plants and animals (such as the term *yakan* ‘stem/trunk’), this vocabulary is large and sophisticated, resembling the specialized terminology of western mycologists in specifying unique features of mushroom morphology, ecology, habitat, and habit (see a listing in Table 4.3).

The existence of this detailed vocabulary suggests that the Tzeltal have a long history of interacting with and exploiting mushrooms found in the local environment. It also suggests that mushrooms have special status as a unique domain. When combined with interview data showing that the Tzeltal consistently separate mushrooms from plants and animals, and evidence that the macrofungal domain has a linguistic designation that can generally be used to refer to all of the fleshy macrofungi, there is a plethora of evidence supporting the notion of a third, independent kingdom of macrofungi. Other forms of linguistic evidence, however, indicate a more paradoxical treatment of the mushroom domain by the Tzeltal.

Linguistic evidence pointing to an intermediate or aberrant conceptualization of the macrofungal domain comes from other sources. Numeral classifiers, for example, are obligatory grammatical forms found in Mayan languages that specify, classify or describe things that are being counted. Although there is little or no data concerning Tzeltal use of numeral classifiers in association with the macrofungal domain, Shepard and Arora (1992) report that the Tzotzil Maya from the neighboring region regularly use the terms *kojt* ‘animal’, *wojt*’ ‘flower’, and *lejch* ‘leaf’ to classify mushrooms while counting. In other words, the Tzotzil do not use a unique numeral classifier in association with the mushroom domain, and in fact, those numeral classifiers that are used indicate the somewhat paradoxical treatment of macrofungi as alternatively plants or animals.

Another form of linguistic evidence indicating the paradoxical nature of the mushroom domain comes from the use of the transitive verb *ti’* which literally means ‘to eat meat’. Although in general, this verb occurs only in association with the flesh of animals, it is also consistently used to express the act of consuming mushrooms. The use of this verb may be a reference to the texture and flavor of mushrooms, which in many ways resembles the texture and flavor of animal meat. This kind of association of mushroom flesh with meat is found in the languages of numerous cultures, including for example, folk English. Other examples include the Chewa of Malawi who conceptually group mushrooms with *nyama*, a term referring to both meat and animals (Morris 1984:54), and the Aztecs of Mexico, who wrote of a divine, hallucinogenic mushroom called *teonanácatl* which can be glossed as ‘flesh of the gods’ (Schultes 1939 and 1940;Wasson 1957 and 1980; Singer 1958). In most, if not all of these cultures, the macrofungi are classified as a separate and independent kingdom. The fact that the domains of animals and macrofungi share the verb *ti’* in the highlands of Chiapas, then, does not indicate that they are thought of as similar kinds of living things, but rather that they share some features of texture and flavor[4].

[4] However, it is interesting that the numeral classifiers *kojt, wojt’, and lech* are used in interchangeably in counting macrofungi, suggesting that mushrooms share features with the domains of both plants and animals.

Table 4.3 Selected vocabulary for the Tzeltal mushroom domain.

Tzeltal Term	English Gloss	Tzeltal Term	English Gloss
Terms for Cap		Terms for veil remnants	
s-jol	'its head'	*s-tsijtsimal*	'its little hairs'
x-pixol	'the hat'	*s-ch'inul*	'grains'/'warts'
s-wolwolwil s-jol	'ball of the head'	*s-burumal*	'its paint'
yabenal	'leaf'	*sit*	'fruit'
Terms for Gills		Terms for Stipe	
s-rayil yutil	'its rays underneath'	*y-akan*	'leg/stem'
stsi'mal y-akan	'rays of the foot'	*s-te'el*	'stem/trunk'
x-ch'in s-te'el	'its little sticks'	*s-k'ab*	'its arm'
s-majkil	'its splits/internodes'	*s-ts'akabil*	'its knee'
s-belal	'its pathways'		
s-k'ab	'its arms'		
Terms for Annulus		Terms for Volva	
x-ch'ujt	'stomach'	*yuxub*	'navel'
s-ts'akabil y-akan	'knee of the leg'	*s-bobil*	'area at base of stem'
s-chokowil s-nuk	'ring of the neck'	*ye'tal yisim*	'tuber root'
s-nukulel	'its neck'	*s-tep*	'its shoe'
ts'akabil	'joint/node'	*ch'in yakan*	'little foot'
Terms for Describing Color		Terms for Mycelium	
yaxal	'blue/green'	*yisim*	'roots'
tsajal	'red'	*yalal isim*	'round/early roots'
sakil	'white'	*x-ch'in yisim*	'little roots'
ijk'al	'black'		
k'anal	'red/yellow'		
Terms for Habitat		Other Descriptive terms	
chikin te' *	'tree ear'	*k'o' chikin* *	'snail/slug ear'
balumilal lu' *	'earth vagina'		

*Note: None of the terms used to describe mushrooms are exclusive to the domain. The only exception: Terms marked with a * are specific mushroom names.

In summary, despite the somewhat ambiguous nature of these different forms of linguistic data, mushroom taxa are consistently separated from plants and animals, they are generally grouped under a single linguistic designation, and there is a large, consistent vocabulary used to describe their features. To my mind these data, when combined with the way in which the Tzeltal Maya treat mushrooms in conversation and everyday use, suggest that the mushroom domain forms a third, independent group of taxa at the kingdom rank. The ambiguous application of plant and animal descriptors as numeral classifiers, and the sharing of the verb *ti'* with the animal kingdom, on the other hand, suggest that the diverse taxa of the macrofungal kingdom share key morphological and cultural features with a wide variety of living things including, potentially, humans. The sharing of these features, when combined with some of the truly unique morphological and cultural features of the mushroom domain, may ultimately result in the unique differences in the shape and structure of the ethnomycological system that have been described above.

4.6 Integrating special purpose categories

Critics of hierarchical taxonomic models based on natural continuities and discontinuities claim that taxonomic models are "divorced from the situational considerations of ethnography, of the context in which folk classifying takes place (Ellen 1986:86)." In large part these critics object to the etic[5] nature of theoretical taxonomic models, claiming that traditional ethnobiological knowledge is portrayed as overly

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[5] The etic perspective is the objective or 'outsider' perspective that generally refers to the search for general principles that can be applied to more than one case.

systematic, rational from a Western perspective, and composed of neat categories with consistent boundaries. There are, however, numerous "messy" taxonomic properties in folk systems of classification, including: (1) prototypicality and fuzzy boundaries, (2) asymmetries of rank and level, (3) uneven distribution of knowledge within a population, and (4) the influence of cultural concerns on taxa of both intermediate and subgenus rank. Whereas the outline of any given folk taxonomy is predictably based on inescapable observations of natural patterns, the specific structural details are anything but neat and clean, and, as with any human system of knowledge, subject to historical and cultural influences.

Other criticisms of taxonomic approaches focus on methodological techniques that constrain informants in their answers and essentially determine the outcome of the investigation (Gardner 1976; Ellen 1986). Literally hundreds of ethnobotanical studies, conducted with all manner of ethnographic approaches have shown that traditional peoples recognize relationships among living things on the basis of natural resemblances. This cross-cultural pattern, however, does not necessarily preclude the formation of overlapping or independent categories based on cultural beliefs and adaptive concerns. Methods aimed at discovering deductive categories certainly exist, and contribute greatly to an understanding of the total knowledge associated with any given ethnobiological domain. Combining various methodological approaches, then, should be the goal if we are to understand ethnobiological knowledge in its totality, and answer questions concerning currently misunderstood taxonomic anomalies.

Also relevant to the current discussion is the criticism that formal taxonomic models inherently treat classification as separate and isolated from other, social or utilitarian realms of ethnobiological knowledge. Rather than assuming that folk taxonomies are isolated and independent of other forms of ethnobiological knowledge, however, it may be possible to show that they are fundamentally integrated with social and cultural concerns in a myriad of complex and flexible ways. By beginning with a conceptual model of how people classify living things, the groundwork is laid for understanding how crosscutting adaptive needs, worldviews, ideologies, and norms of behavior interact with, or are influenced by, natural patterns and vice versa. In other words, by exploring the integration of inductive and deductive forms of knowledge, an understanding of how and why people manage local ecosystems in the ways in which they do can be approached. Overall, I believe folk taxonomies provide a framework based on obvious natural patterns upon which overlapping cultural models developed in social and cultural contexts are placed, much like a weaving is interlaced with the flexible strings of a loom.

The concept of overlapping perceptual and utilitarian models has often been couched in terms of general and special purpose taxonomies. General purpose taxonomies, specific to the domain of living things, are thought to result from inductive thinking, and produce categories that reflect objective biological diversity (Hunn 1977). Special purpose taxonomies, on the other hand, result from deductive processes, and develop in response to proximate utilitarian needs, extreme variation in biological reality, or different cultural strategies and beliefs (Berlin et al. 1966; Bulmer 1970; Hunn 1977; Hays 1982). Because general purpose taxonomies result from constant interaction with the world and recognition of natural patterns, they are thought to be generally comparable throughout the world (Berlin 1992). Special purpose taxonomies, which categorize restricted domains such as human artifacts and social or cultural concepts, are subject to a bewildering array of cultural beliefs, goals and preferences, and as a result, such taxonomies exhibit extreme variation and flexibility. These alternative systems of classification exist and operate simultaneously in our minds, forming a fairly coherent body of ethnobiological knowledge that encompasses features of morphology, ecology, biology, and cultural beliefs about living things.

The explicit recognition that humans categorize nature in various ways provides a baseline for describing and explaining the structural differences that are described in folk taxonomies within and between cultures. I prefer to think of special purpose taxonomies as classificatory "grids," or "cultural models," which overlay the essentially universal infrastructure of perceptual classification when the cognitive situation demands. Thus special purpose categories could be idiosyncratic and result from individual experience, such as a taxonomy that results from an allergic reaction to certain types of plant pollen; or they could arise from cultural convention, such as categories of plants that are appropriate for the ceremonies associated with the transition from childhood to adulthood. These special purpose categories could be relatively long-term, widespread and stable, as in the case of fine taxonomic divisions of domesticated crops (Boster 1980), or they could be somewhat ephemeral, as might be true of a goal-derived category (Barsalou 1991; Casagrande 2002) such as "plant to be used as a club during a fight." The important point is that special purpose taxonomies reflect and express relationships among the taxa of restricted domains based on learning, socialization and experience. As a result, special purpose taxonomies are unpredictable, and change according to bioregion, culture, and context.

One of the main goals of this dissertation was to examine the role of special purpose categories in ethnomycological classification. This goal reflects one of the most intriguing aspects of Tzeltal ethnomycological knowledge discovered in the course of preliminary research in the highlands of Chiapas: an obvious and undeniable focus on edible species. Any conversation concerning mushrooms is invariably accompanied by a discussion of edibility, method of preparation, flavor, texture and nutritional content. In fact, the term ***chejchew*** seems to indicate a grouping of taxa that are not only perceptually related, but edible as well. The importance of edibility is exemplified by the fact that all of the species mentioned by two or more collaborators on the sample of freelists in Table 4.1, with one ambiguous exception, were mushrooms that are edible or otherwise useful. At the conclusion of these freelist exercises, I often asked my collaborators whether they knew the names of any inedible species, and the common response was: *ay bayel* ***[chejchewetik]*** *ma stak' ti'el pero ja'nax ma jna'be sbai*, which roughly translates as 'there are many mushrooms that you cannot eat, but I do not know them.' These comments suggested, to me, that utilitarian concerns are deeply integrated with the basic perceptual taxonomic model for the mushroom domain.

In fact, the common focus on edibility is so prevalent in discussions concerning macrofungi; it appears at first glance to govern the structure and substance of the ethnomycological system of classification. Two large special purpose categories that immediately include all mushroom taxa are readily discernable; one that includes all mushrooms that are edible, and one that includes all mushrooms that are inedible, poisonous, or unknown to the collaborator. Agreement about whether these categories have linguistic designations varies between collaborators, as 10 of 16 interviewees

(62.5%) claimed that all inedible mushrooms are called ***lu'***, whereas all edible mushrooms are ***chejchew***. Paradoxically, the very same collaborators provided numerous exceptions to this rule, applying labels such as ***balumilal lu'*** (unknown Agaric sp.), ***t'ot' lu'*** (*Daldinia* spp.), ***tonkos lu'*** (*Boletus* spp.), and ***slu'il ixim*** (*Ustilago maydis*) to edible taxa, and ***xwix chejchew*** (*Naematoloma fasciculare*) to a species thought to be inedible. The remaining six interviewees all claimed that inedible mushrooms, in general, have no names at all. One collaborator, however, had an interesting perspective, claiming that there are types of ***chejchew*** that can be eaten, and types that cannot; types of ***chikin te'*** that can be eaten, and types that cannot; and finally there are ***lu'***, of which none can be eaten. In light of the ambiguity of the labels ***chejchew*** and ***lu'***, and the functional concerns that seem to morph with perceptual criteria in determining category membership, I prefer to treat the groupings of edible and inedible taxa as covert special purpose categories that overlap the basic taxonomic system.

Interestingly, the internal linguistic and structural dimensions of these two functionally determined categories are very different. The category of edible (or otherwise useful) mushrooms is small in terms of species diversity (including approximately 40 species), and aside from idiosyncratic variations, knowledge of the names and uses of edible taxa is consistent and widely shared across the highlands. The category of inedible mushrooms is quite large in terms of species diversity (including *all* mushrooms not found in the edible category), and recognition and labeling of these taxa is inconsistent and highly variable across collaborators. Although when pressed, collaborators can produce descriptive labels for almost any mushroom species they encountered, the common form of response to questions about inedible taxa is *ma' jna'be* *bi sbil stukel te'y e*, 'I don't know its name' or *ma'yuk sbil ma stak' ti'el* 'it doesn't have a name, it is inedible'. The fact that these two domains, based on utilitarian concerns, receive different cognitive and linguistic treatment suggests that utility does not provide a solid taxonomic foundation upon which people can unambiguously determine category membership. Utilitarian categories, then, play a unique and independent role in ethnomycological classification.

During pile sort exercises, almost every collaborator created piles based on edibility at some stage during the exercise suggesting that function is a salient feature of ethnomycological knowledge and perhaps taxonomy. However, given the ambiguity of the results found, I believe that functional categories are separate and overlapping, rather than an integral part of the classificatory system. These categories are not intermediate, as they are not in any way based on perceptual similarities, and, rather than contrasting with the life-form categories such as ***chikin te'***, and ***chejchew***, these large special purpose categories *include* taxa from those life-form categories. As a result, although functional concerns seem to contribute the structure and substance of ethnomycological classification systems in important ways, I am not led to conclude that the basic structure of the ethnomycological system is determined by utilitarian concerns. In other words, I do not believe that the macrofungal domain is treated in significantly different ways than other domains of living things.

In summary, my contention is that covert edible and inedible categories form a special purpose taxonomy that is imperfectly integrated with the general-purpose taxonomy based on morphology. On the other hand, edibility might play an important role in determining *which* species, from the total domain of macrofungi, are labeled, and to some extent functionality also might explain *why* these species are chosen. The fact is, the Tzeltal, like many other indigenous groups (see Sather 1978; Mapes et al. 1981; Morris 1984 and 1987; Prance 1984; Elizondo 1991; Esquivel 1998) simply chose not to bother with thinking about or labeling inedible species on a regular basis, preferring to place them in a large residual category indicating the species is unknown and worthless. Categories based on edibility seem to overlap categories based on morphology, and operate as a secondary system of knowledge that is attached to specific taxa in certain contexts. If, however, unlike other ethnobiological domains, functional criteria play a role in determining which mushroom species are recognized and labeled, the next question is why this role is so crucial to the macrofungal domain. The answer lies, perhaps, in the morphological, ecological and toxic or hallucinogenic characteristics that make the macrofungal domain unique in the first place.

4.7 Domain features and the small subset of named macrofungi

Traditional societies classify only a small subset of the vast numbers of living things existing in local environments. Berlin claims, “This subset is comprised of the most salient plant and animal species in that local habitat, where salience can be understood as a function of biological distinctiveness.” (1992:21). Berlin’s contention arises, in part, from the observation that approximately 40% of the named genera and species in “typical” ethnobiological classification systems have no direct utilitarian value (Shepard and Arora 1992:5). The recognition of such a high proportion of presumably “worthless” taxa may seem surprising, but as Hunn (1977:72-75) and Berlin (1992:263) suggest, perceptual features such as gross morphology, biodiversity, size, prevalence, and ease of observation are inescapable, and play a major role in determining which taxa within any domain are recognized and named. In other words, large, ubiquitous and morphologically salient taxa, regardless of utility, are rarely ignored in ethnobiological systems of classification.

In order to adequately measure the role of biological distinctiveness in determining which macrofungal species are recognized and named, it would be necessary to start with a complete inventory of mushroom diversity, along with accurate measures of the size, color, shape, and nutritional, hallucinogenic or toxic features of each species. Unfortunately, such an inventory does not yet exist. This does not preclude, however, an exploration of unique domain features that might affect the size and substance of the semantically recognized ethnomycological domain. The remainder of this section explores the role of domain features in more detail.

Throughout the course of my research, I was struck by the convergence of a few key features that, to my mind, are likely to influence the ways in which the Tzeltal cognitively and semantically deal with the macrofungal domain: (1) the domain of macrofungi, in terms of currently known species diversity, is relatively small in comparison with the domains of plants and animals (although as stated before, the number of macrofungi species that actually exist in the region is likely to rival or exceed numbers of plant species), (2) the number of morphologically salient species is far outweighed by the number of indistinct species, (3) almost all macrofungi can be considered small in size and stature (4) mushrooms are seasonal and highly constrained by environmental conditions, and as a result, are fairly difficult to observe on a regular basis, (5) due to nutritional, hallucinogenic or toxic features, it is dangerous to experiment with unknown species, and (6) the Tzeltal highly prize those species that are edible. I believe this convergence of domain features and cultural considerations leads the Tzeltal to split the macrofungal domain into two large special purpose groups – those species that are known, named and utilized, and those species that are unknown, thought to be inedible or poisonous, and ignored. There are a number of exceptions, and approximately 35% of the inedible mushrooms collected are given consistently agreed upon common labels, but these exceptions, in general, consist of species such as *Strobilomyces floccopus* and *Amanita muscaria* that are large, brightly colored, common and widespread, or very poisonous.

It is important to note at this stage, the subtle distinction between claiming that special purpose considerations influence the substance of the semantically recognized ethnomycological domain, and the claim that utility affects classification. As discussed extensively above, it is clear that the Tzeltal recognize the morphological similarities and dissimilarities that form natural groupings of mushroom taxa. The key point is that my collaborators simply chose, in general, not to expend time and energy naming or learning about useless species. A more detailed exploration of the "biological distinctiveness" of the macrofungal domain might, paradoxically, provide some clues that explain why "worthless" taxa are practically ignored in the Tzeltal system of ethnomycology.

To begin with, in comparison with plants and animals, the domain of macrofungi in the highlands of Chiapas has relatively low species diversity. For example, approximately 3,000 species of vascular plants and 500 distinct taxa of animals have been reported in the highlands of the central Plateau of Chiapas (Stepp and Moerman 2001; Hunn 1977). In contrast, the last complete report of macrofungal diversity in Chiapas listed approximately 250 species (Villarreal and Perez-Moreno 1988), and since that time, scattered reports have documented only a few new species at best (Shepard and Arora 1992). Whereas it is safe to assume that the dearth of mycological studies conducted in the region contributes to this low number of documented species, it appears the Tzeltal have less exposure to mushrooms than they do to plants, and possibly animals as well.

If lack of exposure to a domain affects the number of species that are named and recognized, then macrofungi are further disadvantaged by a number of life-history features related to prevalence. Unlike many species of plants, and a few animals, most macrofungi do not thrive in human disturbed habitats. Of the numerous species of mushrooms collected during my research, approximately 60% grow in association with the roots of mature trees, or rely on the rich humus and rotting compost found only in forest associations. Relatively few species (approximately 24% of species collected), whether edible or inedible, grow in the dung of domesticated animals, or the open areas created by cornfields, pastures and dooryards. Given the large percentage of land area caught up in human production in Chiapas, the Tzeltal have to venture relatively long distances to the few remaining patches of forest in order to encounter significant numbers of macrofungi.

Another significant life history feature that affects exposure to this domain is the distinct seasonality of mushroom species. The majority of macrofungi in Chiapas develop fruiting bodies only in the rainy season, from June to December in a typical year. During the dry months, from January to May, macrofungi are scarce. The relative low visibility of macrofungal species is compounded by the fact that the typical growth season for any given species is restricted to one or two months, after which the species disappears until the following season. Additionally, unlike many plants, when a mushroom is either harvested or left to rot, there are no guarantees that another one will develop in the same place at a later date. Finally, macrofungi are highly sensitive to environmental conditions such as temperature, humidity, precipitation and soil composition, and if these conditions are not right, a given species might not develop at all in a given year. The point is that macrofungi are ephemeral and difficult to observe on a daily basis, and as a result, people have little chance to observe and experiment with them. This could explain, in part, the ingrained tendency of the Tzeltal to focus on known edible species, as it would be inefficient to devote a lot of time or attention to learning about, or experimenting with, unknown species that appear on an irregular basis.

The perceptual features of the macrofungal domain may well differ from those of plants and animals in other significant ways. Bulmer (1974) and Berlin (1992) suggest that size may play an important role in determining which species are named and recognized in any ethnobiological system of classification. In other words, the largest species in any given environment are most likely to be recognized and named. If size predicts the relatively likelihood of a taxa to be recognized and named, this would help to explain, to some extent, why such a large proportion of macrofungi are not linguistically recognized by the Tzeltal. With the exception of a few well-known species, the majority of macrofungi found in the highlands of Chiapas are generally smaller than a clenched fist. In fact, most macrofungi are so small and indistinct, they might be considered “little brown mushrooms” in folk English, indicating that they are nearly impossible to identify on the basis of readily observable macro-features. When combined with the above-mentioned problems of prevalence, the small stature of macrofungal species forms a domain that is not only difficult to observe, but undistinguished in terms of size of taxa. It is no wonder so few species are recognized and named.

Alternatively, in terms of perceptual salience, the mushroom domain *as a whole* has proven highly distinctive. As shown above, macrofungi are most decidedly not animals or plants, and form a domain with cognitive recognition at the kingdom level (if not rank). Yet the internal perceptual salience of the taxa within the domain of macrofungi is more debatable. While measuring perceptual salience is a difficult proposition to say the least, a comprehensive list of biological families, genera, and species occurring in a local environment would allow one to hypothesize about which groups are most unusual, and thus most likely to be recognized. One approach, first suggested by Berlin (1992:263), is to examine closely those biological families that include only one or two taxa of genus rank. The idea is that these families, due to evolutionary divergence, will stand out from the rest.

Unfortunately, no list of the total diversity of mushroom species occurring in the highlands of Chiapas exists, and my data are ambiguous on the topic of internal phenotypic salience as measured by the number of monotypic biological families. What my data do show is that of the 33 biological families I collected, 48% (N=16) are monotypic (include only one species), indicating that roughly half of the biological families are likely to stand out from the rest. Of these monotypic biological families, 50% (N=8) are edible or medicinal species, and are consistently labeled by collaborators. The remaining 9 monotypic biological families consist of inedible folk genera, and the names of these species are inconsistent across informants, making it difficult to parse out the relative weight of edibility and morphological salience in this situation.

Aside from size, prevalence, seasonality and biological distinctiveness, the domain of macrofungi has one final important feature that likely affects its perception and classification: some mushroom species are poisonous. Interesting, perhaps, to members of "mycophobic" western cultures is that the number of toxic species is relatively low. Of the more than 10,000 macrofungi described in the world, only 400 have been reported by physicians as potentially causing adverse reactions, and as few as 20 common species are thought to cause the majority of mushroom poisonings around the world (Benjamin 1995:153). These benign numbers belie the fact that many more species, if eaten raw, will cause discomfort and symptoms running the spectrum from headaches, to abdominal pain, nausea, vomiting and diarrhea. Only a few species produce toxins that can cause irreversible damage to the liver or kidneys. A limited number of species are hallucinogenic, causing deep trances, muscle twitching, hallucinations, euphoria, exhilaration, confusion or delirium. Finally, in a few rare cases of consumption of toxic mushrooms, enough damage can be done to the liver, kidney, gastrointestinal system, or brain to be lethal. In light of these serious concerns, it is possible that in mycolphilic cultures where people regularly harvest and ingest macrofungi, the ethnomycological classification system will somehow reflect the need to avoid species that are poisonous.

Concerns about toxic species are well founded in the highlands of Chiapas. The most highly prized edible in the local environment is *Amanita caesarea*, a member of one the most dangerous macrofungal families in the world. In fact, the highlands provide fertile ground for the *Amanitas,* with at least ten species that fruit in the region. One of these species, *A. virosa*, is known to be highly toxic and cause liver damage and renal failure, sometimes leading to death. Another two species, *A. muscaria* and *A. pantherina* are widely thought to cause nausea, sleepiness, and a feeling of drunkenness. Other common groups found in the highlands that are thought to occasionally cause vomiting, diarrhea and headaches if consumed raw include at least three species of *Entoloma*, more than ten species of *Russula*, five species of *Boletus*, and a few species of *Ramaria*, *Agaricus*, and *Armillaria*. Finally, although the Maya do not appear to seek them out, a large number of potentially hallucinogenic species commonly occur in the highlands, including species of *Gymonpilus, Paneolus,* and *Psilocybe*. Interestingly these potentially toxic families are highly polytypic, common and widely distributed throughout the highlands of Chiapas. Given the relatively high potential for a severe reaction to toxic compounds, it is clear that the Maya must be careful when choosing which species they consume.

Without a well-developed "objective" measure, the idea that macrofungi possess unique characteristics is somewhat subjective, and in the end, it is practically impossible to measure the degree to which any given taxa or class of organisms is biologically or culturally distinct (although Hunn 1977 attempts to provide a more objective measure of biological salience). The goal of this final section was simply to present the morphological, ecological and toxic, hallucinogenic or nutritional features that, throughout the course of my research, I believed likely to affect ethnomycological classification and use in significant ways. Ultimately, I believe the perceptual and utilitarian properties of the macrofungal domain are unique, and that when combined these properties define a group of organisms that are relatively difficult to distinguish, difficult to observe, and alternately wonderful or dangerous to experiment with. My opinion is that the Tzeltal are forced to cognitively deal with this combination of properties by essentially limiting the number and kind of species that are semantically recognized to those that are useful, lethal, or truly morphologically distinct. Thus Tzeltal ethnomycological classification resembles that of other folk classification systems in that groups of taxa at different ranks are formed by natural patterns or evolutionary relationships, but the substance of the semantically recognized domain is limited by overriding adaptive demands.

4.8 Summary and conclusions

The structure of folk taxonomies is the result of a number of interacting factors with baseline morphotypes representing biological discontinuities in nature, and a web of overlapping restricted categories loosely reflecting cultural needs and beliefs. The resulting system of ethnobiological knowledge is flexible and responsive to human needs, and yet, given the inductive primacy of form and behavior in folk classification, we should theoretically be able to predict which species in a given environment will be lexically recognized and classified. This theoretical framework served as a crucial motivator for my own dissertation research. My goal was to examine the total ethnobiological knowledge of a relatively restricted domain of living things in a single region in order to discover (1) which species and groups of species are lexically recognized, (2) why these species are given recognition over others, (3) how the general purpose taxonomic system is organized and how it is similar or different from other ethnobiological systems of classification, and (4) how overlapping functional schemas interact with the basic system of folk classification to make up the total ethnobiological knowledge about the domain.

My data show that the domain of macrofungi is bounded and discreet, consisting of only those species that would be considered fungi in the western system of classification. Although the total size of the domain is unknown due to incomplete mycological collections, it is apparent that the Tzeltal Maya split the domain into two very different kinds of special purpose groupings. The larger of these groupings consist of all those species of macrofungi that are uncommon, perceptually indistinct, or culturally useless. In essence, the grouping can be considered a unique kind of special purpose category in that it is motivated largely on the basis of avoiding the consumption of toxic species. This category can be considered unique because it is, for the most part, a lumping together of species that are useless. In other words, although the category as a whole is labeled ***lu'***, by far the majority of the taxa that are included in the category are unlabeled and taxonomically undivided.

The second special purpose grouping of mushrooms is much smaller in terms of numbers of included species, and consists of all those species that are common, perceptually distinctive, or more importantly, culturally useful. Unlike the large special purpose category that essentially lumps together all of the useless species, this small second grouping undergoes several classificatory divisions based on the perception of natural resemblances, or biological continuities and discontinuities. The folk classification of the taxa within this second special purpose grouping resembles that of general purpose categories in that macrofungal taxa are more and more finely divided into groupings at the genus and species ranks.

For this second grouping, which is labeled ***chejchew***, the most salient taxa are the taxa of genus rank. Folk genera make up the majority of the recognized mushroom taxa in the highlands of Chiapas, and they are the most consistently named groupings across individuals and communities. Most, if not all of the folk genera appear to have a prototypical member that shares its name polysemously at the genus and species ranks, and sometimes even at the life-form rank.

In some cases, taxa of the genus rank are more finely divided at the specific rank. These divisions are interesting because, unlike specific taxa in other domains of ethnobiology, we can unequivocally state that they are *not* determined by the fact that they are cultivated or significantly managed. Instead, the recognition of specific taxa appears to be based on the diversity of biological species that are included in the folk genus, and in some cases by the need to distinguish between edible and inedible species. Thus in some sense, cultural concerns do motivate the recognition of specific mushroom taxa, although these concerns are different than they are for taxa of folk species rank in other ethnobiological domains. Finally, as would be expected due to the lack of cultivation of mushrooms in the region, there are no taxa recognized at the varietal rank.

At the higher order levels of the general purpose taxonomic system, there are two relatively well-defined life-form taxa. These life-forms, ***chejchew*** and ***chikin te'***, are smaller in terms of species diversity than the average life-form found in ethnobiological systems, although they appear to be motivated by similar perceptual features – namely broad morphological patterns of substrate preference and gross form. There is evidence for the existence of covert intermediate categories based on perceptual similarities, or perhaps as with other taxa of the ethnomycological domain, cultural concerns, although such categories may not be consistently shared by individuals across the region. Finally, there is an abundance of evidence to suggest that all lesser taxa are united under a single category, labeled ***chejchew***, at the kingdom rank. This latter finding, in conjunction with research from other cultural groups around the world, suggests that ethnobiological systems in general recognize three, rather than two taxa at the kingdom rank.

Overall, the picture that emerges from these data suggests that macrofungi are consistently recognized as a separate and unique domain. The structure of this domain resembles that of most other ethnobiological systems in that those species that are named and classified are consistently divided into finer and finer divisions based, for the most part, on perceptual similarities. The structure of this widely shared model diverges from that of other systems in that cultural concerns are highly integrated with morphological distinctiveness in determining which species are consistently recognized and named, and which are not. This divergence results in a highly lopsided system of classification, in which by far the majority of species that exist in the natural environment are, for all intents and purposes, ignored. My contention is that the unique morphological, behavioral, and nutritional, hallucinogenic or toxic features of the domain motivate this somewhat strange classificatory solution to cultural concerns. Once these cultural concerns have been addressed, however, the species of macrofungi that make the classificatory "cut," are more finely categorized on the basis of criteria that motivate categorization in all folk systems of ethnobiology.

Chapter 5

Ethnomycological Description

5.1 Introduction

This chapter presents an ethnomycological description of 72 species of macrofungi collected during the course of research in the municipalities of Oxchuc and Tenejapa of highland Chiapas, Mexico. These species are organized into major groupings as recognized by the Tzeltal Maya. Included are Tzeltal and scientific designations, morphological and ecological descriptions of the species, and a discussion of the cultural uses and beliefs about each species. Two tables organized by scientific name and Tzeltal name are included at the end of the chapter in order to facilitate rapid examination by individuals more interested in specific mushrooms.

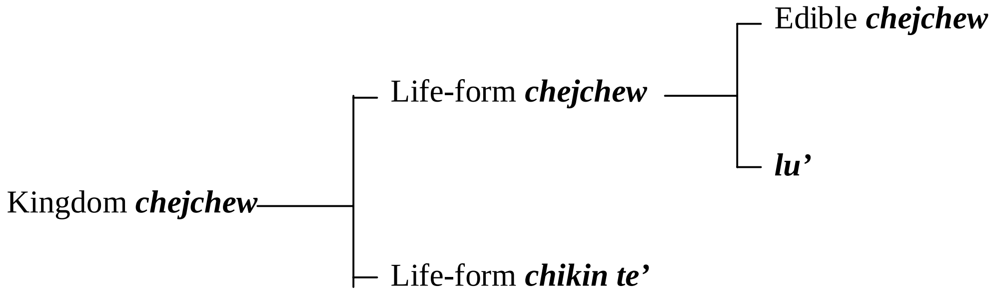
As is appropriate with studies of indigenous understanding of the natural world, this ethnomycological description is organized so as to reflect some of the ways in which the Tzeltal Maya conceptually group species of macrofungi. Throughout the course of research, the Tzeltal variously grouped macrofungi by overall morphological pattern, cultural use, color, shape, and substrate preference. The most widely agreed upon groupings, however, focused on the intersection of obvious natural patterns of morphology and cultural use. The presentation of the most widely recognized groupings should, as a result, illuminate the ways in which folk classification systems integrate with cultural knowledge to inform culturally appropriate human interaction with the natural world.

Although there is currently no single source that describes them all, more than 250 species of macrofungi have been reported in isolated studies of macrofungal diversity in the highlands of Chiapas (Perez-Moreno and Villarreal 1988). With only 72 species, this ethnomycological description is anything but exhaustive of the natural diversity of macrofungi of the region. For the same reason, this description cannot be said to fully explore Tzeltal knowledge of macrofungi. Although a more complete description of macrofungal diversity and Tzeltal beliefs would require several years of extensive research, the description presented herein includes the majority of the most widely known species in the highlands as measured by observations in the field and freelist recall methods. As a result, this ethnomycology should accurately reflect knowledge associated with the most culturally important species of macrofungi, and to a large extent, reflect the most important ways in which the macrofungi as a group are conceptually organized by the Tzeltal themselves.

The remainder of the chapter is organized as follows: Section 5.2 “Folk categories” explains and describes the major folk groupings (kingdom, life-forms, genera and complexes). Section 5.3 “Mushroom descriptions and cultural uses” is devoted to individual species, and includes pictures and descriptions of each mushroom identified in the field. These species are organized according to the major groupings within which they are found. Two quick-reference tables are found at the end of the chapter. The first is organized by the Latin name of each species described, and the second is roughly organized by Tzeltal name.

5.2 Folk categories

FOLK KINGDOM: *chejchew*



The taxon ***chejchew*** defines all of the species of macrofungi found in the highlands of Chiapas, whether or not a linguistic designation is applied. The name ***chejchew*** is linguistically unanalyzable, meaning that the term does not have any known Tzeltal roots, and that the name cannot be glossed in English as anything other than mushroom. The taxon is broad and inclusive of a variety of macrofungal taxa that bear only a vague resemblance to one another, and as a result, this category is difficult to accurately describe. Although it is unclear whether mosses, lichens, or molds are included within this category, no inanimate objects, or plant or animal organisms are ever included. In general, the taxon might be best defined as small organisms that are relatively short-lived, stationary, ephemeral in appearance, seasonal in fruiting pattern, fleshy in texture, and have some sort of cap-like structure emerging from a narrow base. In other words, this taxon is made up of mushrooms.

For the Tzeltal with whom I worked, the various species of mushrooms that collectively make up the kingdom ***chejchew*** form smaller groupings that are generally based on morphology. At least two life-forms are recognized (based on substrate preference and overall morphological appearance), one of which is further subdivided into two large special purpose groups based on utility. Life-forms and special purpose categories are subdivided into numerous smaller groupings that form polytypic folk genera and allied "complexes" of genera based on morphological similarity. Finally, the majority of mushrooms occurring in the highlands are recognized as isolated monotypic genera that are highly morphologically distinct and included directly at the life-form rank.

The resulting structure of the Tzeltal ethnomycological system of classification is somewhat confusing and difficult to follow. Adding to this confusion is the fact that the term ***chejchew*** is polysemously applied at a number of levels and ranks in the folk taxonomic hierarchy. The life-form taxon ***chejchew*** includes all mushrooms that grow in the earth. The special purpose category ***chejchew*** includes all mushrooms that are considered edible or otherwise useful, and the complex ***chejchew*** is a group of at least two species that are morphologically similar (although one species is considered edible and the other inedible). In order to address the problems of capturing the cognitive organization of mushroom categories in an accessible way, the following table (Table 5.1) mirrors the organization of the chapter.

Table 5.1 Organization of the Tzeltal system of ethnomycology

KINGDOM ***chejchew***

- LIFE-FORM ***chejchew***
  - EDIBLE CATEGORY ***chejchew***
    - Polytypic folk genus ***k'an tsu***
    - Polytypic folk genus ***tsijtsim lu'***
    - Complex ***k'an chay***
    - Complex ***chejchew***
    - Complex ***bonkos***
    - Folk genus ***wuswus lu'***
    - Isolates (monotypic folk genera) of edible category
  - INEDIBLE CATEGORY ***lu'***
    - Complex ***tsa' wakax***
    - Polytypic folk genus ***k'anal lu'***
    - Isolates (monotypic folk genera) of inedible category
- LIFE-FORM ***chikin te'***
  - Isolates (monotypic folk genera) of life-form category

FOLK LIFE-FORM *chejchew*

Life-form *chejchew*
- ***chejchew*** (edible group)
- ***lu'*** (inedible group)

The major life-form ***chejchew*** includes at least 28 folk genera that refer to more than 44 scientific species of macrofungi. Three of these folk genera are polytypic, and 25 are monotypic. Species included in this life-form all develop in substrates found on the ground, including soil, moss, humus, pine needles or the leaves of hardwoods. These taxa generally have a 'typical' form, including a stipe and cap, and although most have gills, although a few have pores or teeth underneath the cap.

The life-form is conceptually split into two named special purpose categories[1]. The special purpose category ***chejchew*** includes taxa that are either edible or medicinal. This category includes 2 polytypic folk genera of between 2-4 folk species, 1 under-differentiated folk genus, 3 covert complexes of 2 – 3 members, and 3 conceptual isolates (monotypic genera directly included in the life-form). In a few cases, inedible taxa are included with this category, reflecting the fuzzy nature of special purpose categories that are imperfectly integrated with general purpose folk classification systems.

The special purpose category ***lu'*** which can roughly be glossed as 'vagina', 'labia', or as utilized in this text, 'genitalia', includes only taxa that are inedible or considered poisonous. Occasionally the term ***lu'*** is applied to species that are widely considered edible, indicating that the term can also be used polysemously to discuss 'all mushrooms'. Thus the term can be somewhat confusing. This special purpose category includes 1 covert complex consisting of 2 monotypic folk genera, 1 polytypic folk genus with 2 folk species, and 12 conceptual isolates (each of which can be considered a monotypic genus).

The organization of the following description reflects these conceptual groupings, and presents the special purpose category ***chejchew*** first, and the special purpose category ***lu'*** afterwards. Within each of these special purpose categories, taxa are organized first by size of the polytypic genera and complexes recognized by the Tzeltal.

[1] A distinction must be made between general purpose categories which are motivated by cognitive perceptions of similarity and dissimilarity in the natural world, and special purpose categories (Berlin et al. 1966) which are categories or classification systems motivated by the recognition of functional or utilitarian beliefs or needs.

Those groupings with the highest number of species are presented first. Conceptual isolates are listed separately within each special purpose category.

EDIBLE CATEGORY *chejchew*

Polytypic folk genus *k'an tsu*:

k'an tsu	***batz'il k'an tsu***	*Amanita caesarea*
	k'an tsu lu'	*Amanita muscaria*
	ijk'al k'an tsu	*Amanita fulva – Amanita vaginata*
	xwix k'an tsu	*Amanita flavoconia*

The polytypic folk genus ***k'an tsu*** 'yellow cup-like' includes only members of the scientific genus *Amanita*, whether edible or inedible. Interestingly, the highly toxic species *Amanita virosa* is never included within this folk genus, and is always categorized within the ***lu'*** complex. This folk genus includes the most highly prized edible in the Tzeltal region, *Amanita caesarea*, as well as the mildly hallucinogenic species, *Amanita muscaria*. Also included are the scientific species *A. flavoconia*, *A. fulva*, and *A. vaginata*.

These species are all large and brightly colored, and have a well-formed cap, stipe and gills. Many of these species retain a distinct annulus into maturity, and they all have some form of volva, whether present as a sack-like structure or scales at the base of the stipe. A few species retain warts or patches on the top of the cap. These species generally grow solitary, or scattered in groups of twos and threes. They fruit almost exclusively near trees in mature forests.

EDIBLE CATEGORY *chejchew*

Polytypic folk genus ***tsijtsim lu' – akuxa ti'bal***:

tsijtsim lu' – akuxa ti'bal

k'anal tsijtsim lu'	*Ramaria* sp.
sakil tsijtsim lu'	*Tremellodendron schweinitzii* *Tremella reticulata*
tsajal tsijtsim lu'	*Clavicorona pyxidata*
tsijtsim lu'	*Clavulina cinerea*

The ***tsijtsim lu' – akuxa ti'bal*** is polytypic folk genus consisting of at least four folk species including ***k'anal tsijtsim lu'***, ***sakil tsijtsim lu'*** (which includes at least two scientific species), ***tsajal tsijtsim lu'***, and ***tsijtsim lu'***. The folk genus and indeed each of the folk species are labeled differently in the two dialects found in the municipalities of Oxchuc and Tenejapa. In Oxchuc, this folk genus is generally given the linguistic designation ***tsijtsim lu'*** 'whiskery genitalia'. In Tenejapa the folk genus is generally called ***akuxa ti'bal*** 'needle-like meat'. Both of these general designations appear to reflect the morphology of the taxa in these groups, the upright branches of which do resemble a wavy beard-like whiskers or group of needles or spines rising into the air. In folk English, this group of species is often called 'coral fungi' as they resemble the colorful corals that grow on underwater reefs.

The taxa of this folk genus are generally small to large with numerous upright branches or clubs rising from a single thin to fat base. The species are variously colored, although they are often whitish with tinges of yellow, orange, pink, red, purple or dingy tan. They are fleshy and often edible, and grow solitary or scattered.

EDIBLE CATEGORY *chejchew*

Complex *k'an chay*:

	ch'ujch'ul k'an chay	*Lactarius scrobiculatus*
***k'an chay* complex**	***tsajal k'an chay***	*Lactarius deliciosus*
	yaxal k'an chay	*Lactarius indigo*

The ***k'an chay*** complex is an unnamed grouping of three monotypic folk genera including ***ch'ujch'ul k'an chay***, ***tsajal k'an chay***, and ***yaxal k'an chay***. In Tenejapa, the latter two of these genera are generally labeled ***tsajal ti'bal*** and ***yaxal ti'bal***.

The taxa of the ***k'an chay*** complex are small to large macrofungi that grow in the shape of a horn or funnel. The funnel-shaped caps are often fused with a short stem, and have a large depression in the center, with wavy margins that rise up into the air. The gills are obvious and exposed outwards. Species are often brightly colored orange, yellow, blue, purple, or alternatively tan. The flesh is thick and brittle. They grow solitary to scattered in mature forests.

EDIBLE CATEGORY *chejchew*

Complex *chejchew*:

***chejchew* complex**	***k'anal chejchew***	*Naematoloma fasciculare*
	xwix chejchew	*Armillaria mellea*

The ***chejchew*** complex is an unnamed group that includes at least two monotypic folk genera, ***k'anal chejchew*** and ***xwix chejchew***. I suspect that ***xwix chejchew*** (*Armillaria mellea*) is the same species as ***batz'il chejchew***, and indeed, a number of informants called this species ***batz'il chejchew***. There is however, some ambiguity on the subject, as I never collected a species that was unambiguously labeled ***batz'il chejchew*** by every informant.

The taxa of the ***chejchew*** complex are generally yellowish-orange in color, with gills and a well-developed cap and stipe. These fleshy species grow in dense clusters with many individual stems emerging from a single point (caespitose) in the substrate. They variously grow in the rotting wood of tree trunks, on roots of dead trees, or seemingly spring from the earth near trees.

EDIBLE CATEGORY *chejchew*

Complex ***bonkos – tonkos***:

	bonkos lu’	*Boletus* spp.
***bonkos – tonkos* complex**		
	sakil bonkos	*Suillus* spp.

The ***bonkos – tonkos*** complex includes all species of the scientific genera *Boletus* and *Suillus* that fruit in the highlands of Chiapas. Numerous distinct species fruit in the region, but many of these could not be accurately identified in the herbarium at El Colegio de la Frontera Sur. It is my hope that the dried specimens that have been collected and preserved will be identified in the future. As presented here, the complex includes at least two monotypic folk genera, both of which probably include several scientific species. The taxa of this complex are labeled ***bonkos*** in the dialect of Oxchuc, and ***tonkos*** in the dialect found in Tenejapa.

The taxa of this complex tend to be medium to large in size. All of the taxa included have pores on an otherwise smooth surface underneath the cap. Often, these pores are brightly colored yellow, white, or orange, and a number of these pore surfaces bruise to a dark brown color when touched. These taxa have well developed caps and stipes, and often the cap is a dark or dingy brown color. They grow solitary to scattered in mature forests.

EDIBLE CATEGORY *chejchew*

Folk genus *wuswus lu' – tsis chauk* (puffballs):

Folk genus *wuswus lu'-tsis chauk*	——	*Lycoperdon foetidum* *Lycoperdon pulcherrimum* *Lycoperdon perlatum* *Lycoperdon pyriforme*

wuswus lu' – tsis chauk is an under-differentiated folk genus that includes all species of puffballs. The Tzeltal do not appear to partition this group of macrofungi as finely as scientific systems, and extend the range of the labels ***wuswus*** or ***tsis chauk*** to a number of species that are considered distinct in the western system of scientific classification. Each scientific species collected is included here.

The two dialects found in Oxchuc and Tenejapa tend to apply different labels to the taxa of this group. In Oxchuc, the folk genus is given the label ***wuswus lu'*** '***wuswus*** genitalia'. In Tenejapa the folk genus is given the label ***tsis chauk*** 'thunder fart', a label that is also applied to the plant species *Thalictrum guatemalense* an herbaceous perennial with small petals and long conspicuous stamens that hang down from the flower. Both terms could reflect the action of pores puffing up in clouds from a slit in the top of the mushroom.

This group includes small to medium sized macrofungi that grow in the shape of balls, usually without any obvious stipe. These balls are generally white and fleshy when young, sometimes with obvious spines or scales on top. As they mature, the flesh of these taxa tends to rot and become slimy, and eventually become a dry powdery mass of brownish colored spores. The exterior skin of the ball goes from firm and fleshy to papery and smooth. They grow solitary to scattered in fields, grasslands and forests.

EDIBLE CATEGORY *chejchew*

Isolates (monotypic folk genera) of the edible category:

chejchew **isolates**

konkiw	*Agaricus californicus*
tsajal ti'bal	*Hypomyces lactiflourum*
tsukum ti'bal	*Morchella elata*
	M. esculenta

These monotypic folk genera are all isolates, meaning they are directly included within the special purpose category ***chejchew***, and are not lumped with any other genera as a result of their distinct morphology.

INEDIBLE CATEGORY *lu'*

Complex *tsa' wakax*:

tsa' wakax **complex**

- ***chejchewil tsa' wakax*** — *Conocybe tenera*, *Coprinus atramentarius*, *Coprinus comatus*
- ***slu'il tsa' kaballo*** — *Coprinus plicatilis*

The ***tsa' wakax*** complex is an unnamed grouping of two monotypic folk genera. ***chejchewil tsa' wakax*** consists of a range of species that do not appear to be distinguished by the Tzeltal including *Conocybe tenera*, *Coprinus atrementarius*, and

Coprinus comatus. ***slu'il tsa' kaballo*** includes only *Coprinus plicatilis*. The Tzeltal appear to consistently lump a number of small, brown, inedible and relatively indistinguishable macrofungi together because they tend to grow in open pastures and grasslands in which domestic animals graze.

The taxa of this complex are small and fragile. They generally have gills, and a well-developed cap and stipe. Usually some shade of brown, white or tan, with smooth or scaly caps and sometimes small hairs or scales on the stipe. They grow solitary, or in large groups in grass of pastures. These taxa are extremely short-lived, and often shrivel up and die quickly in the sun, or in some cases, autodigest within the span of a few short days.

INEDIBLE CATEGORY *lu'*

Polytypic folk genus *k'anal lu'*:

k'anal lu'	***k'anal slu'il***	*Hygrocybe acutoconica* *Hygrocybe conica* *Hygrocybe flavescens*
	tsajal k'ank'anik slu'il najk	*Hygrocybe subminata*

The polytypic folk genus ***k'anal lu'*** includes at least two folk species, ***k'anal slu'il***, and ***tsajal k'ank'anik slu'il najk***. Although at least four species are included within this polytypic folk genus, the Tzeltal do not appear to distinguish between a number of them that look highly similar in size and shape.

The taxa of this complex are all species of the scientific genus *Hygrocybe*. They often exhibit extraordinary colors of yellow, red, orange and green. These taxa generally have white gills, and a well developed cap and stipe. The cap and stipe are often highly waxy in texture. They are small and fragile, and often many are found scattered throughout the substrate.

INEDIBLE CATEGORY *lu'*

Isolates (monotypic folk genera) of the inedible category:

lu' **isolates**

ijk'al lu'	*Paneolus solidipes*
sakil balumilal lu'	*Amanita virosa*
	Amanita verna
kaxlan ok'es lu'	*Dentinum repandum* (*Hydnum repandum*)
ijk'al chejchew	*Strobilomyces floccopus*
yaxal kaxlan k'an chay	*Laccaria amethystina*
slu'il samjijte'	*Laccaria laccata*
chejchewil tsa'	*Russula* sp. (*cremicolor*)
tsajal kaxlan k'an chay	*Russula emetica*
tsajal chejchew	*Russula rosacea*
yaxal lu'	*Russula virescens*
chejchew kaballo	*Gymnopilus spectabilis* group
yaxal balumilal lu'	*Entoloma* sp.

These monotypic folk genera are directly included in the special purpose category ***lu'***. They are generally distinct in morphology, and appear not to be lumped in polytypic genera or complexes.

FOLK LIFE-FORM *chikin te'*

Isolates (monotypic folk genera) of the life-form category:

Life-form *chikin te'*	
chikin te'ul k'an tulan	*Stereum ostrea* group
ijk'al tsijtel lu'	*Xylaria multiplex*
ijk'al chikin te'	*Phellodon niger*
ijk'al k'o' chikin	*Otidea* sp.
k'anal chejchewil meste'	*Phyllotopsis nidulans*
k'anal k'o' chikinul tsajal lum	*Peziza violaceae*
k'anal lukulmil slu'il te'	*Cordyceps militaris*
k'o' chikin	*Auricularia auricula*
k'o' chikin	*Fomitopsis scutella*
muk'ul chikin jijte'	*Ganoderma lucidum*
muk'ul chikin te' k'a'al taj	*Perenioria contraria*
muk'ul sulte'al meste'	*Phellinus* aff. *chinensis*
najkul chikin te'	*Polyporus badius*
pimil chejchew	*Lenzites betulina*
sakil k'o' chikin	*Peziza* sp.
sakil nujkul chikin lu'	*Helvella crispa*
slu'il ixim	*Ustilago maydis*
slu'il kap'nal jijte'	*Helvella macropus*
sulte'	*Schizophyllum commune*
tsu chikin chejchew	*Polyporus arcularius*
tzetz chikin te'	*Lentinus crinitus*
tzotzil lu'	*Inocybe lanuginosa*
t'ot'	*Daldinia concentrica*
	D. grandis
	D. vernicosa
yaxal balumilal slu'il yan jijte'	*Pluteus cervinus*
unnamed	*Heteroporus biennis*
unnamed	*Pholiota gregariiformis*

The major folk life-form ***chikin te'*** includes at least 26 monotypic folk genera, two of which are unlabeled. Almost all of the taxa included fruit in some form of wood, be it living trees, dead trees, rotting stumps, or dry or rotting sticks or twigs. I could find no evidence that any of these folk genera formed larger covert groupings, despite a number of similarities in linguistic designations.

5.3 Mushroom descriptions and cultural uses

FOLK LIFE-FORM *chejchew*

Life-form *chejchew*
- ***chejchew*** (edible group)
- ***lu'*** (inedible group)

EDIBLE CATEGORY *chejchew*

Polytypic folk genus *k'an tsu*:

k'an tsu

batz'il k'an tsu	*Amanita caesarea*
k'an tsu lu'	*Amanita muscaria*
ijk'al k'an tsu	*Amanita fulva – Amanita vaginata*
xwix k'an tsu	*Amanita flavoconia*

batz'il k'an tsu 'genuine yellow cup-like' *Amanita caesarea*

Fruiting Body: This big beautiful species is brightly colored orange and yellow on the cap, with a white stalk and a big cottony basket-shaped volva. **CAP**: Very large, disk like. 3 – 20 cm broad. Convex when young, becoming planar with a central umbo in age. Bright orange in the center, turning yellow at the margins. Margin distinctly striate. Surface smooth (without veil remnants), slightly viscid or slimy when wet. **FLESH**: Soft, firm and fleshy or meaty. White or yellow. **GILLS**: White or cream colored, or sometimes yellowish. Close, broad, many, adnate to free. **STALK**: 6 – 13 cm long, 1 – 3 cm thick. Equal or enlarging to base, smooth or with patchy scales, white to creamy yellow in color. **ANNULUS**: Distinct, persistent cottony yellow annulus forming a ring high up on the stalk. **VOLVA**: Thick, cottony, white to creamy yellow volva. Resembles a large sack or a bucket from which a large stalk emerges. **SPORE PRINT**: White

Habitat and Substrate: Soil, in the forests of pine and oak, or sometimes in open pastures. Solitary or scattered.

Season: June – October, possibly until December.

Cultural Use: Possibly the most highly prized edible in the highlands of Chiapas. Everyone loves the flavor and texture of this species, and they pick it whenever they encounter it. Sold in small quantities on roadsides and in markets for as much as 20 pesos per basket. This is grilled and eaten with salt and chili, or boiled and eaten in soup or simply in tortillas. These are so large; a few of them can make a good meal.

k'an tsu lu' 'yellow cup-like genitalia' *Amanita muscaria*

Fruiting Body: This highly visually salient species has a bright red cap, often covered with contrasting white veil remnants or warts, a long slender white stipe often with a cottony annulus and scaly volva, and white gills. **CAP**: Beginning as an oval-egg shaped in primordium, expanding to become convex, and then planar. 5 – 15cm broad, thin. Bright red, or fading to orange, yellow and white. Often with numerous white veil remnants (warts) covering the entire cap. Margin sometimes striate, other times smooth. **FLESH**: Thin, white, fragile, solid and fleshy. **GILLS**: Adnexed to free, white, close, many. **STALK**: Central, more or less equal, or enlarging to a bulb at the base. 10 – 15 cm tall, 0.5 –1 cm thick. White with yellowish coloring. Smooth or becoming somewhat scaly towards the base. **ANNULUS**: Distinct annulus below the cap, white, yellowish or even orange in color. **VOLVA**: Scaly volva ringing the base of the stalk. **SPORE PRINT**: White.

Habitat and Substrate: Solitary to scattered in earth of young forests with oak, pine and other hardwoods. Somewhat abundant, can be found in any forest throughout much of the year.

Season: June through December. Possibly found in spring as well.

Alternative Names: Also known as ***xwix k'an tsu***, or 'sister of ***k'an tsu***'.

Cultural Use: Not used. Avoided, thought to be poisonous.

Photo Credit: http://www.fishing-in-wales.com/wildlife/fungi/flyagarc.htm

ijk'al k'an tsu 'black yellow cup-like' *Amanita fulva*

Fruiting Body: This tall, slender species has an orange-brown cap, with highly striate margins, a well-developed stalk lacking an annulus but with a sack-like volva, and obvious white gills. **CAP**: Beginning as an oval egg-shaped "button", the cap expands rapidly to become convex, and eventually planar, possibly with a slight umbo. 2 – 10 cm broad, thin. Orange-brown in color. Distinctly striate. Lacking partial veil remnants or warts. **FLESH**: Soft, fleshy, fragile, yet firm. White, not changing color. **GILLS**: White, many, close, soft, blade-like, adnexed or free. **STALK**: Central, long, slender, smooth (without veil remnants), 2 – 10 cm long or longer. **ANNULUS**: Absent. **VOLVA**: Present as a cottony sack at the base of the stalk. White. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or scattered in the earth underneath oak and pinewoods. Fairly abundant in low-lying areas with a lot of water and hardwood oak trees.

Season: June through October.

Cultural Use: Not used.

ijk'al k'an tsu 'black yellow cup-like' *Amanita vaginata*

Fruiting Body: This species is tall, smooth and obvious on the forest floor with its gray cap with striate margins, long white stalk without an annulus, and saclike volva at the base. **CAP**: Beginning as an oval egg-shape when young, becoming convex to planar with an umbo. 4 – 8 cm broad, thin. The cap is often very smooth, with a striate margin, although sometimes white veil remnants can be found on the cap. **FLESH**: Fragile, easily split, fleshy, soft, white. **GILLS**: Free, white, blade-like, smooth, many, close. **STALK**: Central, equal to enlarging to base. 6 – 12 cm long, 0.5 – 1.5 cm thick. Usually smooth and white or grayish, sometimes covered with white or gray shaggy fibrils or scales. **ANNULUS**: Absent. **VOLVA**: Present and distinct as a sack-like cottony bucket-shape at the base of the stalk. Margin free at the top. **SPORE PRINT**: White.

Habitat and Substrate: Solitary to scattered. Found on the earth under oaks and pines. Fairly abundant throughout the highlands where mid-age forests are found.

Season: June – October or later in the fall.

Cultural Use: According to more than one informant, some individuals eat the cap of this species. I never confirmed this directly, and believe it is generally avoided. The species is eaten in North America and Europe.

xwix k’an tsu ‘sister of yellow cup-like’ *Amanita flavoconia*

Fruiting Body: This large, distinct species is bright orange-yellow with obvious patches of white veil forming warts on the cap. It has a cap, stipe and gills, as well as an annulus and scales at the base of the stalk. **CAP**: Convex and becoming planar in age. 4 – 6 cm broad, thin. Bright orange-yellow with more yellow at the margin. Surface covered with yellow or white patches of universal veil (warts). Slightly viscid. Not striate. Margin smooth. **FLESH**: White, thin, soft, fleshy. **GILLS**: Free, white, blade-like, close, many, and wavy. **STALK**: Yellowish-white, 7 – 9 cm long, 0.5 – 1.5 cm broad, smooth, not scaly. Fleshy and firm. Bulbous at the base. **ANNULUS**: Yellowish ring forming high on the stalk. **VOLVA**: Patchy scales at base of stalk, not a bucket-shape. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or scattered in the earth underneath oak trees. Not particularly abundant.

Season: June – September, or later.

Alternative Names: Also known as ***k’an tsu lu’*** ‘yellow cup-like genitalia’.

Cultural Use: Not consumed.

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Polytypic folk genus *tsijtsim lu’ – akuxa ti’bal*:

tsijtsim lu’ – akuxa ti’bal

- ***k’anal tsijtsim lu’*** — *Ramaria* sp.
- ***sakil tsijtsim lu’*** — *Tremellodendron schweinitzii*, *Tremella reticulata*
- ***tsajal tsijtsim lu’*** — *Clavicorona pyxidata*
- ***tsijtsim lu’*** — *Clavulina cinerea*

k'anal tsijtsim lu' 'yellow whiskery genitalia' in Oxchuc, or k'anal ***akuxa ti'bal*** 'yellow needle-like meat' in Tenejapa. *Ramaria* sp.

NO PHOTO INCLUDED.

Fruiting Body: This yellow-orange coral fungus with pink tinges is medium sized, fleshy, and highly branched. 5 - 7 cm tall, and 3 – 5 cm across the top. **BRANCHES**: Many large, erect branches emerge from the base and split 2 - 5 times until becoming thin tips. The tips are long and slender, and again, split into 3 - 5 points at the apex. **FLESH**: Thick, solid, fleshy, spongy and meaty. Exterior is yellow-orange with pinkish tinges; interior flesh is white when fresh. **GILLS**: No gills, spores born on branches. **STALK**: Single large central base that is highly branched. 2 - 4 cm thick across the base, tapering at the bottom **SPORE PRINT**: White.

Habitat and Substrate: Often clustered in groups of 3 - 4, these coral fungi grow in soil, often near the base of oak trees. Found in woods of oak, pine and other hardwoods.

Season: Late summer and early fall from July to October.

Cultural Use: All parts of this mushroom are eaten. Often grilled over the coals of an open fire, or boiled in a soup, this species is prized, and eaten throughout the highlands.

sakil tsijtsim lu' 'white whiskery genitalia' in Oxchuc. *Tremellodendron schweinitzii*

NO PHOTO INCLUDED.

Fruiting Body: Small, tough, wiry, firm and fleshy fruiting body developing from a single thin base that breaks into numerous branches ending in flattened clubs that are often wavy or frayed at the tip. 1 – 4.5 cm in height from base to tips. Resembles a coral fungi in shape. **BRANCHES**: Less than 0.5 cm wide, and between 1 and 3 cm long. Usually numerous, sometimes few, these finger-like branches are erect, fleshy or hollow, usually thin, and almost always flattening at the tip. The margins of the tip of these branches are wavy or frayed, but never form crowns or distinct "fingers." Color is white, with dingy yellow to tan or even brown coloring. Sometimes mottled red or rosy tones or blue tinges are apparent. **FLESH**: White to dingy yellow, tan or light brown in age. Tough, spongy firm flesh, or even wiry or rubbery. Thin but firm flesh. **GILLS**: None, spores born on branches. **STALK**: Single base is usually very thin and short (1 cm wide or less), more or less central. White or dingy tan or yellow. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or clustered in groups. Usually found in black soil, although sometimes found in leaf-litter. Found in woods composed of oak, pine and other hardwoods.

Season: This highly abundant species is found throughout the summer and fall from June to October. Probably develops earlier in the spring, and one of the most abundant species in the highlands.

Alternative Names: Also known as ***muk'ul k'anal tsijtsim lu'*** 'large yellow whiskery genitalia', ***stunimal kojkmalmut lu'*** 'cottony chicken breast genitalia', ***tsijtsimul***

tsa'amuch 'whiskery dung', ***sakil yisim tentsun*** 'white goat whiskers' or ***k'anal tsijtsim lu'*** 'yellow whiskery gentialia'.

Cultural Use: When the age and size of this species make collecting worthwhile, many people throughout the highlands eat this mushroom. If it is old, or small, it is often ignored. Typically coral fungi are grilled on a comal or the coals of an open fire and eaten with salt, chili and tortillas. It is almost never eaten boiled. One informant used this species as a medicine for bleeding wounds. The tips are cut off and mashed up, placed in the wound and wrapped with a bandage. This helps keep the wound from becoming infected.

sakil tsijtsim lu' 'white whiskery genitalia' in Oxchuc. *Tremella reticulata*

Fruiting Body: Medium to large fleshy fruiting body that resembles a coral fungi with few to numerous hollow branches rising irregularly from a single large, thick base. Fruiting body 7 – 15 cm tall or taller from base to tips. **BRANCHES**: Translucent white in color, hollow but firm, rubbery, slimy or gelatinous in texture, with a smooth exterior. Long (2 - 8 cm in length) and thick (1 - 3 cm thick). Branches are club-like, and sometimes fused together for much of their length. Often, 1/3 the distance from the tip, the original branch coming from the base splits to form a U-shaped saddle with 2 - 4 new branches. The tips of these branches are both blunt and thick, or have "tips" or small pointed "cones" at the margin. Sometimes with a brown color at very tip. **FLESH**: The flesh of this species is rubbery and gelatinous, slimy when wet. Translucent white in color, and the branches have a feel like cooked macaroni. **GILLS**: None, spores born on branches. **STALK**: Large, thick single base that branches a few times (and these branches split again to become more numerous). 6 – 9 cm thick at base, rising as much as 6 cm tall before branching (about 1/2 – 1/3 height of entire mushroom). **SPORE PRINT**: White.

Habitat and Substrate: Solitary, growing in soil and leaf litter of forests of oak, pine and other hardwoods. According to one informant, *spul sti'* ***k'an chayotik*** *ta te'eltik* 'it grows with ***k'an chay*** mushrooms in the forest'.

Season: This species is moderately abundant, and found in late summer and early fall from July to September or October.

Cultural Use: Often simply ignored, this species is sometimes grilled on the coals or the comal and eaten with salt and chili. Often only the branches are eaten, as the base is said to be sour.

tsajal tsijtsim lu' 'red whiskery genitalia' in Oxchuc, or ***tsajal akuxa ti'bal*** 'yellow needle-like meat' in Tenejapa. *Clavicorona pyxidata*

Fruiting Body: This dingy white to yellowish coral fungus often has rosy or orange tips that form tiny crownlets at the top of long, thin branches. These small to large fungi usually have a large, fat base that branches many times to become long, thin stems with tiny crownlets at the crest. Not as highly branched as Ramaria. These crownlets are like a small cup with 3 – 5 tips that rise like a crown around the depression. Size is 5 – 11 cm tall; the stems (not including the base) can be as long as 6 cm tall, but they are thin, usually less than 5 mm at the thickest point. The color is dingy white or tan, or dingy yellowish. The branches become dingy rose colored, to pink-tinged or sometimes a rosy-orange color towards the top. **FLESH**: Thick, firm, fleshy, spongy, solid, often soggy. **GILLS**: None, spores born on branches. **STALK**: Generally central to irregular. Quickly breaking up into numerous long stems that often branch again, and end in crownlets. Base is often fat, from 2 – 7 cm thick at the base. Smooth surface. **SPORE PRINT**: White.

Habitat and Substrate: Solitary, scattered, or sometimes even clustered in groups. Grows in the earth and humus of pine-oak forests, or cipixidated on wood. Fairly abundant.

Season: June – November.

Alternative Names: Also known as ***k'anal tsijtsim lu'*** 'yellow whiskery genitalia', ***k'anal tsijtsim tensun*** 'yellow goat whiskers' or ***k'anal akuxa ti'bal*** 'yellow needle meat'.

Cultural Use: Some individuals prize this mushroom as an additive to a soup for texture and flavor, to simply grilled over hot coals. Use of this species is highly variable, however, depending on the habitat in which it's found. More than one collaborator claimed that when found under oaks, this species is too sour to be edible. Others claimed it was too spicy. One collaborator claimed this species could be used as a medicine for growths on the neck (it was never determined whether this referred to warts, pimples, goiter, tumors, or some other growth). For this application, the branches are cut away from the base. The base is mashed into the leaf of a cactus and ground up with a rock. This paste is applied to the growth, and wrapped with a scarf for about 3 days. It is thought that the fats in the base of the fungus have healing properties.

tsijtsim lu' 'whiskery genitalia' in Oxchuc, or akuxa ***ti'bal*** 'needle-like meat' in Tenejapa. *Clavulina cinerea*

Fruiting Body: This whitish, gray, or purplish coral fungus is small to medium in size, often highly branched, think and fleshy at the base, and generally has blunted, wavy tips at the end of the branches. The slender stipe branches many times, becoming a wavy mass towards the top. Not as highly branched as Ramaria. The original branches often split and extend to become blunted tips without a crown or fringe at the top. The surface of these branches is smooth. Total size is 2 – 6 cm tall or taller, and 0.2 – 1 cm wide at the base. The branches are very thin (1 - 2mm). The color is highly variable, from dingy white, to yellowish, although usually some form of gray to purple-gray. **FLESH**: Dingy white to olive gray or gray, or with yellow tones. Fleshy, spongy, somewhat rubbery or wiry, firm, solid. **GILLS**: None, spores borne on branches. **STALK**: More or less central, although the wavy branches may extend horizontally in irregular shapes. Thin, from 0.9 – 6 cm tall, 0.2 - .5 cm wide. Firm, fleshy, wiry, and solid. Smooth, same color as fruiting body. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or scattered in the rich soil of the pine-oak forests. This species is fairly abundant, or not, depending on the seasons and conditions.

Season: July – November.

Alternative Names: Also known as ***tzot ak'an*** 'it wants to be hairy' or ***stunimal kojkmalmut lu'*** 'cottony chicken breast genitalia'.

Cultural Use: Some individuals eat this in soups, as an extra herb and to add texture. It is also mashed up and eaten alone as a pasty gruel, or mixed with corn gruel. Others grill this over open coals and eat it without additives.

Photo Credit: http://home.wanadoo.nl/abiemans/e_clav_ciner.html

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Complex *k'an chay*:

	ch'ujch'ul k'an chay	*Lactarius scrobiculatus*
***k'an chay* complex**	***tsajal k'an chay***	*Lactarius deliciosus*
	yaxal k'an chay	*Lactarius indigo*

ch'ujch'ul k'an chay 'small yellow fish' *Lactarius scrobiculatus*

Fruiting Body: This small to medium sized fungus has a cap and stem, large gills, and is a light yellow color. **CAP**: 4 cm broad, 0.6 cm thick. Planar with small central depression. Sticky and slimy, but only a bit viscid. Surface is bumpy, with lots of shallow pits. Margin inrolled and downcurved, not striate. Consistency is thin, fleshy, flaky and chalky. **FLESH**: White or stained yellow, thick, flaky, chalky and firm. When cut or bruised, a clear or yellowish latex fluid emerges. **GILLS**: Adnate. White with yellow stains. Thin, close, many. **STALK**: 1 cm broad at apex, 2 cm tall. Central, equal, and covered with wrinkly pits that are yellow or dark in color. Firm, fleshy and chalky. **SPORE PRINT**: White to yellowish.

Habitat and Substrate: Solitary under pine, and sometimes oak forest. In soil or leaf litter.

Season: Only found in August.

Cultural Use: Eaten grilled or in a soup, bottom half of stem is removed first.

Photo Credit: http://users.skynet.be/jjw.myco.mons/Lactarius_scrobiculatus_1.html

tsajal k'an chay 'red yellow fish' *Lactarius deliciosus*

Fruiting Body: This visually salient fungus has a cap and stem, large gills and is a bright orange color, often with green "splotches". **CAP**: 3 – 9.5 cm broad, thick (up to 0.8 cm thick), planar with an obvious central depression, or occasionally appearing to be funnel-shaped. Varies in color from a dull carrot orange to a bright pumpkin orange, often with shades of gray and an olive or green discoloring in patches or concentric zones. Margin often downturned or even slightly inrolled, can become wavy or even upturned in age. Surface is smooth and waxy, sometimes roughened or bumpy to the touch. Not viscid. **FLESH**: Thick, flaky, brittle, chalky and fragile. Fleshy or meaty in thickness. When cut, this flesh exudes an orange colored or clear latex fluid. **GILLS**: Bright orange, decurrent and extending partway down the stalk. Smooth, not forked or serrated. Thick, distant, and yet many. **STALK**: 2.5 – 6.5 cm tall, 0.9 – 1.2 cm wide. Central, equal or tapering, or sometimes enlarging to base. Orange with green/gray bruises. Chalky, solid, fleshy, and smooth, without ornamentation. **SPORE PRINT**: White or tan.

Habitat and Substrate: Found solitary or scattered in the earth and humus underneath pine trees. This species is abundant and common in the older stands of pine forest in both the mountains and valleys in Chiapas. The Tzeltal claim it is found exclusively in the forests of the mountains, and never in open areas.

Season: Available mostly in from mid-summer to early fall, the Tzeltal claim this most abundant in June, but can be found through September.

Alternative Names: Also known as ***tsajal ti'bal*** 'red meat' in Tenejapa.

Cultural Use: Edible and highly prized among the Tzeltal, this species can be boiled or grilled on the comal. Full and fleshy or even meaty, a small number of ***k'an chay*** can provide a meal. It is often thought by the Tzeltal to provide nourishment similar to the meat of chicken. When large numbers are found, they are sold by numerous individuals for 5 pesos for a half-pound.

Photo Credit: http://www.fishing-in-wales.com/wildlife/fungi/delmilk.htm

yaxal k'an chay 'blue yellow fish' *Lactarius indigo*

Fruiting Body: This medium to large mushroom is a funnel-shaped addition to the understory of pine-oak forests. It has a cap, stalk and obvious gills, and exudes indigo blue latex when squeezed. **CAP**: Convex to planar, usually with a central depression that can be so deep as to make the mushroom look funnel shaped. Margin is often inrolled, especially when young. 3 – 12 cm broad. Blue or purplish when young, fading to a light tan or brown in maturity, often with green stains. Surface smooth, somewhat viscid when wet. **FLESH**: Brittle, solid fleshy, blue or tan, staining green. **GILLS**: Adnate to decurrent, deep indigo blue, staining green when cut or bruised. **STALK**: 1 – 5 cm tall, 1 –2 cm thick. Straight, thick, short and smooth. Blue to brown with green stains. **SPORE PRINT**: Creamy white to yellow.

Habitat and Substrate: Solitary or scattered on the ground in pine-oak forests. Not particularly abundant during our collections, but apparently abundant in some years.

Season: June – October or later.

Alternative Names: Also known as ***yaxal ti'bal*** 'blue/green meat' in Tenejapa.

Cultural Use: Highly prized edible. My collaborators make special trips to well known forests to find this species. Grilled over an open fire and eaten with salt, chili and tortillas, or ground up and mixed with posol (after grilling), or boiled and eaten in a soup. I never saw this being sold in the markets.

Photo Credit: http://www.nybg.org/bsci/res/hall/indigo.html

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Complex *chejchew*:

***chejchew* complex**	***k'anal chejchew***	*Naematoloma fasciculare*
	xwix chejchew	*Armillaria mellea*

k'anal chejchew 'yellow mushroom' *Naematoloma fasciculare*

Fruiting Body: Small to medium sized mushrooms found in densely packed clusters on the decaying wood. Fleshy, soft, fragile and bright yellow, yellow-green, to dull yellowish-brown. Sometimes turning dark brown in age. **CAP**: 1 - 4.2 cm broad, conical to convex, or planar in age. Smooth, dry to wet and soggy in appearance, slightly waxy when dry, not viscid to only slightly viscid, margin straight to wavy. **FLESH**: Consistency soft, soggy, dry, and fragile. **GILLS**: Thin, close, numerous, attached. Straight, not forked, yellow or greenish-yellow, turning dark brown with age. **STALK**: 2 - 4.5 cm long, central, very thin, equal to tapering, greenish-yellow to brown, no volva or annulus, flesh thin, hollow, fragile and soft. **SPORE PRINT**: Purple-brown to purple-gray.

Habitat and Substrate: Densely packed clusters on dead, decaying tree trunks and roots. These mushrooms are highly gregarious, and highly visible due to their bright yellow or yellow-green color.

Season: This species has a long season extending from June to December.

Alternative Names: Also known as ***bajkal k'anal chejchew*** 'clustered yellow mushroom'

Cultural Use: Not Used.

xwix chejchew ‘sister of [genuine] mushroom’ *Armillaria mellea*

Fruiting Body: The large clusters of these mushrooms are highly conspicuous. They are yellow-orange, yellow-green to rusty brown in color, with distinctive caps, stipes, and gills, and usually an obvious annulus high on the stipe. **CAP**: Convex, becoming planar sometimes with a small umbo. 3–9 cm broad, and thin in age. Cap dry to hygrophanous, slightly viscid to very viscid. Often covered with minute brown to black hairs or scales. **FLESH**: White, thick, firm, solid, fleshy. **GILLS**: White or brownish, blade-like, smooth to notched. Adnate to somewhat decurrent. **STALK**: 10–15 cm long, white, yellow or brown in color. Firm, solid, filamentous, tough. **ANNULUS**: Present as a well-developed ring high on the stalk. Cottony. White or brown or orange. **SPORE PRINT**: White.

Habitat and Substrate: Growing in large caespitose clusters with 30 or many more distinct mushrooms coming from the same point of origin. Usually found on tree stumps, or dead trees, but occasionally on apparently healthy trees (hardwoods). Sometimes appears to be growing on the ground (although probably on roots). Very abundant.

Season: Throughout the summer and fall, from June to December.

Alternative Names: Also known as ***batz’il chejchew*** ‘true mushroom’ or ***chejchewil sánto*** ‘saint mushroom’.

Cultural Use: Eaten and highly prized. This species is abundant in the region, and often collected when encountered. Rarely sold in markets, people collect large masses of this while traveling or working and boil it for 20 minutes. Eaten alone, or with salt, chili and tortillas, or as an herb in a soup.

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Complex *bonkos – tonkos*:

- ***bonkos – tonkos* complex**
  - ***bonkos lu'*** — *Boletus* spp.
  - ***sakil bonkos*** — *Suillus* spp.

bonkos lu' ***'bonkos*** genitalia' in Oxchuc, or ***tonkos lu'*** ***'tonkos*** genitalia' in Tenejapa.

Boletus spp.

Fruiting Body: These highly visible species are yellow-brown to reddish-chestnut brown, large, abundant, and have a cap, stipe and bright yellow pores underneath. **CAP**: Convex to planar. 5 – 20 cm broad, very thick. Surface dry or viscid, sometimes pitted with scars or cracked. **FLESH**: Thick, soft, fleshy, meaty, white to yellow, bruising brown rather than blue. **PORES**: Yellow (bright to dingy), bruising brown. Round, close, many. **STALK**: Central, equal or enlarging to become bulbous at the base. Often reticulate. Firm, fleshy, solid, white or yellowish in areas. 6 – 15 cm long, 1 cm broad. **SPORE PRINT**: Brown to olive brown.

Habitat and Substrate: Growing solitary or scattered in the ground and humus underneath pine-oak forests. This is a highly abundant species, found everywhere in the highlands of Chiapas.

Season: August – November.

Alternative Names: Also known as ***muk'ul bonkos lu'*** 'large ***bonkos*** genitalia'.

Cultural Use: Use of this species is highly variable across families and individuals in the highlands. Some families consume young, fresh species. Others avoid them and believe that they cause indigestion and stomach pains. Most have heard that they are considered edible. The cap of this species is grilled over a comal or open coals, eaten with tortillas. Never boiled.

sakil bonkos 'white ***bonkos***' in Oxchuc, and ***k'anal tonkos*** 'yellow ***bonkos***' in Tenejapa. *Suillus sp.*

NO PHOTO INCLUDED.

Fruiting Body: This species has a brown-yellow to pumpkin or pumpkin-yellow colored cap, bright yellow pores, and a small stipe. **CAP**: Convex, becoming more planar in age. Lumpy, viscid or slimy, smooth, or more often covered with shaggy, cottony or grainy scales. 1.5 – 5 cm across, 0.5 – 1 cm thick/tall. Margin straight and smooth, or becoming slightly upturned in age. **FLESH**: Generally yellow to bright yellow. Can be whitish or pumpkin yellow. Soft, spongy, thick flesh with a texture like slimy meat. When cut, flesh can turn dark, brown, black or even bluish. **PORES**: Bright yellow to dingy yellow, or in some cases a pumpkin-yellow color. Fully attached to stalk, or even appearing slightly decurrent. Small and round, or elongated in most cases. Not bruising easily, but often slowly turning brown, blue, or black after being solidly pressed. Close, many. **STALK**: Central, equal to tapering, or sometimes enlarging slightly to base. 1 – 3 cm tall, .4 – 1 cm thick. Smooth, or covered with tiny brown shaggy or grainy scales. Brown or brown yellow, can bruise to a brown-black. Tough, solid, fleshy, and sometimes becoming hollow in the center in age. No veil or volva apparent on stalk (other than shaggy scales). **SPORE PRINT**: Brown.

Habitat and Substrate: Solitary to scattered or gregarious in the soil and humus of pine-oak forests. Highly abundant and found throughout the highlands of Chiapas.

Season: June – November, or possibly all year long.

Alternative Names: Also known as ***k'anal chejchew*** 'yellow mushroom', ***botom lu'*** '***botom*** genitalia', ***bonkos lu'*** '***bonkos*** genitalia', ***tonkos lu'*** '***tonkos*** genitalia', and ***sakil tonkos*** 'white ***tonkos***'.

Cultural Use: Generally, species of *Suillus* are not eaten, and are often thought to be poisonous.

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Folk genus *wuswus lu’ – tsis chauk* (puffballs):

Folk genus *wuswus lu’-tsis chauk*	——	*Lycoperdon foetidum* *Lycoperdon pulcherrimum* *Lycoperdon perlatum* *Lycoperdon pyriforme*

wuswus lu' '***wuswus*** genitalia' in Oxchuc, or ***tsis chauk*** 'thunder fart' in Tenejapa.

Lycoperdon perlatum, L. pulcherrimum, L. pyriforme, Lycoperdon foetidum.

Fruiting Body: Shaped like a light bulb or hot air balloon, the top of this mushroom is round or somewhat flattened, and attached to a large, thick and obvious base. 1 – 5 cm tall, 1 – 5 cm broad across the top, and 2 cm broad at mid-point. The most obvious feature of this species is the presence of large white or gray spines that are interspersed with smaller gray granules. When these warts fall off in age, they leave wrinkles or scars in the outer peridium. The outer peridium is closed and tough when young, eventually becoming papery and thin in age. As it matures, this species develops small tears or pores on the top and at the sides. **FLESH**: When young, the flesh is white, thick, soft, solid, firm and fleshy. As this species ages, the flesh becomes soft and slimy, yellow, greenish or even olive colored. Eventually becomes a dark brown, soft and powdery mass. **GILLS**: None, spores develop in dense mass within the peridium. **STALK**: This central stalk is really a sterile base. 1 – 3 cm long, equal to tapering. 2 – 2.2 cm thick at mid-point. Flesh of this base is white or gray-white, solid, thick, firm, fleshy and soft. Near the apex of this base, spikes, warts or granules cover the exterior portion. Bottom half is smooth. **SPORE PRINT**: Dark brown and powdery.

Habitat and Substrate: Solitary or scattered in soil or humus of pine-oak forests, generally in the mountains. Fairly abundant.

Season: Most abundant in August, this species can be found throughout the summer months of June and July and later in the fall season as well.

Alternative Names: Also known as ***ijk'al wuswus lu'*** 'black ***wuswus*** genitalia', and ***kaxlan wuswus lu'*** 'Spanish ***wuswus*** genitalia'.

Cultural Use: Not consumed, but used as a cure for warts. The wart is cut or scraped open, and the mature spores are puffed onto the wart. This action is repeated until the wart disappears. Also thought to cure bleeding wounds. The spores are puffed on open wound, thought to clean the wound, and speed up the process of healing. This species is also used to cure bedwetting. Mature spores are puffed into the bellybutton, or onto the testicles of the patient in an attempt to stop the bedwetting. Repeated until bedwetting ceases.

FOLK LIFE-FORM *chejchew*

EDIBLE CATEGORY *chejchew*

Isolates (monotypic folk genera) of the edible category:

chejchew **isolates**

konkiw	*Agaricus californicus*
tsajal ti'bal	*Hypomyces lactiflourum*
tsukum ti'bal	*Morchella elata*
	M. esculenta

konkiw ‘***konkiw***’ *Agaricus californicus*

Fruiting Body: This small to medium sized fleshy white mushroom has a distinct cap, stipe with a cottony annulus, and free, pink to purple gills. **CAP**: Convex or oval (egg-shaped), 3 – 6 cm broad, fairly thick. Surface smooth, or cracked in age. Sometimes with slight scales. White to gray. Margin incurved when young, smooth or wavy, sometimes fringed with veil remnants. **FLESH**: Thick, solid, firm, fleshy, white. **GILLS**: Free at maturity, and a bright pink or purple color. Smooth, close, many, becoming brown in age. **STALK**: Central, equal or enlarging to base, 5 – 7 cm long, 0.5 cm thick. White. **ANNULUS**: Skirt-like annulus cottony and white. Thick and felty. Forming on upper portion of stalk. **VOLVA**: None. **SPORE PRINT**: Brown.

Habitat and Substrate: Solitary to scattered in fields, pastures under trees, and along pathways, or sometimes in open stands of trees with plenty of light. Not abundant.

Season: Most abundant in summer and fall (May – October), may be found throughout the year.

Alternative Names: Also known as ***sakil chejchew*** ‘white mushroom’.

Cultural Use: Not used.

Photo Credit: Retrieved from the *MushroomExpert.Com* Web site: http://www.mykoweb.com/CAF/species/Agaricus_californicus.html

tsajal ti'bal 'red meat' *Hypomyces lactifluorum*

Fruiting Body: This bright pumpkin orange and yellowish mushroom is the result of parasitism of Lactarius by another fungus. It is found in pine-oak forests. It is distinctive in color, size and thick, meaty texture. Because it is a parasite on other species of fungi, it takes the shape of the host species. Usually, it has a cap and stalk, with blunt, poorly defined wrinkles that resemble widely spaced gills running underneath the "cap". Surface smooth, but pitted and pimpled. **FLESH**: Thick, heavy, tough and meaty, white, or the color of the host species. **GILLS**: None, although there are blunt wrinkles that resemble the gills of chanterelles that are widely spaced and running down the stalk. Spores borne in perithecia in the skin of the fungus (causing the bumpy or pimply surface). **STALK**: Size and shape of the host species.

Habitat and Substrate: Solitary or scattered, often appearing to develop on the ground in pine-oak forests, this species actually parasitizes the abundant species of *Russula* and *Lactarius*, growing as a layer over the host.

Season: Summer and fall, June through October or later.

Cultural Use: This meaty species, and its host, is grilled over an open fire and eaten with salt, chili and tortillas. Just a few can make a solid meal. It can also be cooked as a meat substitute in a soup. Large numbers are sold in local and regional markets for 10 pesos a bucket. Interestingly, consuming this mushroom is somewhat dangerous, as the host species could be a poisonous mushroom. Perhaps thorough cooking helps eliminate the danger, or perhaps this species only parasitizes edible mushrooms.

tsukum ti'bal 'stomach meat' *Morchella elata* and *Morchella esculenta*

Fruiting Body: These highly distinctive mushrooms have hollow, honeycombed heads with large pits. They highly resemble tripe, which explains why the Tzeltal of highland Chiapas call these mushrooms "stomach meat mushroom". The Tzeltal do not distinguish this species from *M. esculenta*, although this species is much darker in color. Overall, this species is 2 – 7 cm tall, and the fertile portion is elongated and often pointed/conical in shape. Resembles and "elf hat." Color a dark brown or almost black, or dark olive. Pits often elongated vertically, almost appearing in rows. Interior is hollow and creamy white. **FLESH**: Thin and rubbery, creamy colored, sometimes even brittle. **GILLS**: None, spores borne on asci lining the surface of the pits. **STALK**: 1 – 8 cm long, hollow, white or creamy, 1 – 2 cm thick, wrinkled or grooved.

Habitat and Substrate: Often found growing from the edges of rocks in milpa fields, this species can also be found in forests, bogs, swamps, and along trails.

Season: March or April through June.

Alternative Names: Also known as ***woron kotz*** 'turkey tail' or ***jol kotz*** 'turkey head'

Cultural Use: Prized edible, thought to taste like meat. This species is grilled or boiled.

FOLK LIFE-FORM *chejchew*

INEDIBLE CATEGORY *lu'*

COMPLEX *tsa' wakax*:

***tsa' wakax* complex**	***chejchewil tsa' wakax***	*Conocybe tenera* *Coprinus atramentarius* *Coprinus comatus*
	slu'il tsa' kaballo	*Coprinus plicatilis*

chejchewil tsa' wakax 'mushroom that grows in cow dung' *Conocybe tenera, Coprinus atramentarius,* and *Coprinus comatus* (*C. comatus* is pictured below).

Fruiting Body: These mushrooms, which really are not overly similar in appearance, all have a cap, stalk and gills, and tend to appear in grassy areas. The species of *Coprinus* tend to autodigest, rapidly turning into an inky mass. **CAP**: Generally highly conical, bullet –shaped or egg-shaped, possibly flattening a bit, with an umbo (bell-shaped). Light brown to dingy white, darker brown at the margin. *Conocybe tenera* and *Coprinus atramentarius* are both smooth, without ornamentation (although *C. atramentarius* can have long white hairs or obvious striations). *Coprinus comatus*, unlike the other species included, has distinct white shaggy scales on the cap. Margin wavy, wrinkled in age, and in the species of *Coprinus* the margin begins to lift up and deliquesce. Small, 2 – 3.5 cm across the cap, or larger from 5- 6 cm tall, and 2 – 3 cm wide, very thin. **FLESH**: Thin, fragile, yet fleshy. In species of *Coprinus,* becoming brown to black and finally a black inky mass. **GILLS**: Large and blade-like, generally free or lightly attached at center. Generally full gills interspersed with shorter gills that do not reach the center. White when young, brown to dark brown, purple and usually black in age. **STALK**: Central, thin, equal, without veil, annulus or volva. 3 - 8 cm tall, very thin (1 - 3 mm). Smooth or slightly grainy in texture. **SPORE PRINT**: Brown in *Conocybe,* black in *Coprinus*.

Habitat and Substrate: Solitary to scattered or gregarious in grassy areas such as milpa, scattered along paths, and especially cow pastures. All species are fairly abundant.

Season: June – October. Possibly appearing earlier and later.

Alternative Names: Also known as ***lu' chejchew*** 'genitalia mushroom'.

Cultural Use: Not used.

slu'il tsa' kaballo 'genitalia that grows in horse dung' *Coprinus plicatilis*

Fruiting Body: This tiny, translucent and fragile species has a cap, stem and gills, and tends to autodigest rapidly, turning into an inky black mass in mere minutes. **CAP**: Conical when young, becoming planar with a small umbo in age. 1.5 cm broad. Gray in color, turning a gooey black quickly in age or when touched. Surface with deep groove-striations (almost like pleats), not viscid. **FLESH**: Very, very thin, and very fragile. Deliquescent. **GILLS**: Thin, close, many, smooth. Gray in color, turning black when old or bruised. Appearing to be attached to stalk, but pulling free with ease. **STALK**: Central, equal, smooth, fragile, hollow. White. 6 cm tall, very thin. **SPORE PRINT**: Black.

Habitat and Substrate: Solitary or scattered on soil in pine-oak forests, or grassy areas of open pastures and fields.

Season: July – October.

Cultural Use: Not used (not really possible to use as it becomes an inky mass quickly).

Photo Credit: Retrieved from the *MushroomExpert.Com* Web site:

http://www.mykoweb.com/

FOLK LIFE-FORM *chejchew*

INEDIBLE CATEGORY *lu’*

Polytypic folk genus *k’anal lu’*:

k’anal lu’	***k’anal slu’il***	*Hygrocybe acutoconica* *Hygrocybe conica* *Hygrocybe flavescens*
	tsajal k’ank’anik slu’il najk	*Hygrocybe subminata*

k'anal slu'il 'yellow genitalia' *Hygrocybe flavescens, Hygrocybe conica, Hygrocybe acutoconica*

Fruiting Body: This small yellow waxy-cap differs from *Hygrocybe conica* in that it does not blacken, and from *H. acutoconica* in that it has a very viscid convex cap without an umbo. **CAP**: Convex. Tiny, 0.5 – 1.5 cm broad, 0.5 cm high. Bright waxy yellow in color (like a raincoat). Surface is highly viscid, smooth without any ornamentation. Long, translucent striations from center to margins. Margin slightly inrolled. **FLESH**: Thin, very soft, fragile. Bright yellow. **GILLS**: Adnate to free. Bright yellow. Not forked. Smooth, thick, distant, few. **STALK**: Central, equal to tapering. 4 cm tall, 0.4 cm wide. Bright yellow, smooth, waxy. Hollow, fragile.

SPORE PRINT: White.

Habitat and Substrate: Solitary or scattered in soggy, wet soil. Growing in shade of swampy underbrush.

Season: July and August. Possibly has a much longer season.

Cultural Use: Not used.

tsajal k’ank’anik slu’il najk ‘red yellowing genitalia of ***najk*** [*Alnus* spp.] forests’

Hygrocybe subminata

Fruiting Body: This tiny species adds bright color to the forest, with its red cap, very slender stem and well-developed gills. **CAP**: Conical to convex, often with a slight depression in the center. Bright waxy red, fire-engine red, blood colored or sometimes an orange-red, often becoming paler at the margin. 0.6 – 2.3 cm broad, 0.6 - 1 cm high. Surface waxy, smooth, or sometimes covered with fine velvety scales. Not viscid to slightly viscid, and sometimes hygrophanous when wet. Margins smooth and straight to wavy or lobed, or appearing serrated. Not striate. **FLESH**: Very thin, rubbery or fleshy, waxy, fragile. White, red, or yellow in color. **GILLS**: Decurrent or attached in a sinuate/notched pattern. Variably colored white to yellow, bright yellow, or bright red. Thick or thin, but always widely spaced, often with short gills interspersed with long gills. Few. **STALK**: Central, equal, tapering or even enlarging slightly at base, smooth to waxy, thin, rubbery, hollow. 2 – 8 cm long, 1 – 5 mm wide at apex. Variably colored bright red, red-orange, or sometimes turning yellow from base to midpoint. **SPORE PRINT**: White.

Habitat and Substrate: Abundant and found solitary, scattered or almost clustered in soil, humus, leaf-litter and moss in association with *Alnus* spp. or pine-oak forests.

Season: June – October.

Alternative Names: Also known as ***slu'il wolnax*** 'ball-like genitalia', ***tsajal slu'il tseto te'*** 'red genitalia of ***tseto*** tree', ***tsajal lu'*** 'red genitalia', and ***tsajal chejchew*** 'red mushroom'.

Cultural Use: Thought to be poisonous, and occasionally ground up and used as an insecticide to kill ants around the house.

Photo Credit: http://www.nybg.org/bsci/res/hall/hygrocyb.html

FOLK LIFE-FORM *chejchew*

INEDIBLE CATEGORY *lu'*

Isolates (monotypic folk genera) of the inedible category:

***lu'* isolates**	
ijk'al lu'	*Paneolus solidipes*
sakil balumilal lu'	*Amanita virosa*
	Amanita verna
kaxlan ok'es lu'	*Dentinum repandum*
	(*Hydnum repandum*)
ijk'al chejchew	*Strobilomyces floccopus*
yaxal kaxlan k'an chay	*Laccaria amethystina*
slu'il samjijte'	*Laccaria laccata*
chejchewil tsa'	*Russula* sp. (*cremicolor*)
tsajal kaxlan k'an chay	*Russula emetica*
tsajal chejchew	*Russula rosacea*
yaxal lu'	*Russula virescens*
chejchew kaballo	*Gymnopilus spectabilis* group
yaxal balumilal lu'	*Entoloma* sp.

ijk'al lu' 'black genitalia' *Paneolus solidipes*

Fruiting Body: These little creamy white mushrooms have a cap, stalk, and gills. They are distinct because they consistently grow in dung, and do not resemble other dung-growing species in the region. **CAP**: Convex. 3 – 7 cm broad, thick and high. White with a creamy yellowish color. Surface wrinkled near the center. Margins straight and smooth. Not viscid, not striate, but sometimes becoming cracked or scaly as it ages and dries out. **FLESH**: Thick, solid, fleshy, white to creamy. **GILLS**: Fully or partially attached, smoky gray, white or even black in color. Mottled in color with various colors on each gill. Edges somewhat serrated or toothed. **STALK**: Central, equal or enlarging to base, solid, fleshy, tough, striate. 5 – 12 cm tall, 0.4 - 0.7 cm thick. White or gray. **SPORE PRINT**: Black.

Habitat and Substrate: Solitary or in large numbers in cow and horse dung found on pathways and in fields and pastures. Fairly abundant during the rainy season.

Season: Found in June and July, possibly appearing year-round.

Cultural Use: Not used.

sakil balumilal lu' 'white earth genitalia' *Amanita virosa* and *Amanita verna*

Fruiting Body: These species are large, slender and beautiful bone white. **CAP**: 4.5 – 5.5 cm broad, conical when young, planar to convex in age, thin and soft. Surface smooth, or sometimes with small dry pits. Slight striations at the margin, slightly viscid or not. Margin occasionally with slightly frayed veil remnants. Bone white and not changing color. **FLESH**: Thin, soft, fleshy, white, not changing color. **GILLS**: White, thick, close and adnate to adnexed, or appearing free. Covered with white universal veil when young. **STALK**: White, 3 - 4 cm tall when young, 10 cm in age, 0.5 cm thick, firm and fleshy, equal or tapering from a bulbous base. **ANNULUS**: Large cottony, veil-like ring about 1/3 distance to top of stem. Originally covering gills, breaks free to become skirt-like or ring-like annulus. **VOLVA**: Large, white, thin cottony sack at base of stalk. Margins of volva completely free at top. **SPORE PRINT**: White

Habitat and Substrate: Found solitary or scattered in small groups growing in earth, and in leaf litter usually under hardwoods. Also found near dogwoods and pines. In this region it is commonly found in the late summer and throughout the fall season. The distinguishing features are the pure, unchanging whiteness of this species, and the large cottony ring near the top of the stipe and the huge cottony volva at the base. It is an attractive group of thin Amanitas, highly visible, and occurring frequently throughout the region.

Season: In this region it is commonly found in the late summer and throughout the fall season.

Alternative Names: Also known as ***sakil bajkal lu’*** ‘thick white genitalia’, ***sakil chejchew*** ‘white mushroom’, ***sakil balumilal lu’*** ‘white earth genitalia’, ***yaxal balumilal lu’*** ‘blue/green earth genitalia’, ***sakil k’an tsu*** ‘white yellow cup-like’ and ***bajkal balumilal lu’*** ‘earth genitalia’.

Cultural Use: Usually thought to be inedible or venomous, especially if the volva is eaten. A few individuals eat the cap only, and specify that it must be eaten in a soup, rather than grilled. One collaborator used the volva for a rat poison. The volva is cut from the stalk, grilled over a fire, ground-up and mixed with water, and then the mash is put in holes or other places to prevent rats from entering. Another collaborator followed the same procedure, cutting, grilling and grinding the volva. This mash is mixed with a mash of a species of coral fungus, and provides medicinal relief from gas pains in the stomach.

kaxlan ok'es lu' 'Spanish trumpet genitalia' *Dentinum repandum (Hydnum repandum)*

Fruiting Body: This medium to large fleshy fungi has a cap and a stipe, with spikes or teeth extending downward underneath the cap. **CAP**: Convex becoming planar to irregular with a central depression. 1.7 – 7 cm broad, and very thick. Orange, yellow-orange or dingy brown, with tinges of white. Smooth, not viscid, and in maturity covered with cracks or large flaky, orange-brown scales in the center and often extending to the margin. **FLESH**: Flesh of the cap is firm, soft, fleshy, meaty and thick. Spongy and pliable like the agarics. White to brown in color. **TEETH**: 1 – 5 mm in length, orange to flesh colored, white or peach colored. These teeth cover the underside of the cap, and extend down the stipe, sometimes to the base of the stipe, sometimes only covering part of the stipe. **STALK**: Central or off-centered. 2.5 – 6.5 cm long, .4 – 1.4 cm wide. Enlarging to thick and bulbous at the base, or tapering at base. Dingy white, tan or fleshy colored, or even orange. Flesh of stipe is full, tick, soft and filamentous. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or scattered in groups of 2 - 4, in the soil or humus of rotting wood, or at the base of a tree. Found in pine-oak and hardwood forests.

Season: Somewhat abundant, found from July – October.

Alternative Names: Also known as ***sk'anal slu'il bajchen*** 'yellow genitalia from the community of ***bajchen***' and ***k'anal slu'il muk'ul jijte'*** 'yellow genitalia of large oaks'.

Cultural Use: Although considered edible and even desirable in much of North America, this species is not used in the highlands of Chiapas, and in fact, is sometimes considered poisonous.

Photo Credit: http://www.fishing-in-wales.com/wildlife/fungi/grcoral.htm

ijk'al chejchew 'black mushroom' *Strobilomyces floccopus*

Fruiting Body: This extraordinary mushroom is covered with large black scales or warts from top to bottom. It has a distinct cap, stipe and pores. **CAP**: Generally convex, can become planar. 2.5 – 8 cm broad, thick and fat. White to gray or brown surface is covered with thick, fat, black scales or warts. Surface dry, not viscid or hygrophanous. Margin straight, hung with a few scales or veil remnants. **FLESH**: Thick, firm, fleshy. White or gray, staining brown to black when bruised or exposed. **PORES**: White, close, many, round. Staining black when touched lightly. Attached to stalk, or slightly decurrent. **STALK**: 5 – 11 cm long, 1 – 3 cm thick. Thick, fleshy, black, enlarging to a bulb at the base. Covered with large, black scales or warts. **SPORE PRINT**: Black.

Habitat and Substrate: Solitary or scattered in soil and leaf-litter of oaks. Not particularly abundant, but highly visible and obvious.

Season: June – September.

Cultural Use: Not used, considered poisonous.

yaxal kaxlan k'an chay 'blue Spanish yellow fish' *Laccaria amethystina*

Fruiting Body: This delicate, waxy species has a cap, stipe and large, distant gills that are obvious because they are pink to purple. **CAP**: 0.5 – 2.7 cm broad, very thin. Convex to planar with small central depression, or sometimes almost funnel shaped with highly uplifted margins. Margin sometimes uplifted, often downcurved or incurved, straight or wavy, with striations at the outer edge. Texture waxy and smooth, thin and fragile or rubbery. Not viscid. Entire cap has deep grooves resembling striations that follow the gills underneath. Surface usually covered with a fine, white, velvety down of hair. **FLESH**: A deep, dark purple or lavender color, sometimes with white or tan tinges. Very thin and rubbery, but not really fragile, rather pliable and difficult to tear. **GILLS**: Generally decurrent, although can be adnate. Very thick, deep, few widely spaced or distant. Very dark, deep purple in color. **STALK**: 2 - 10 cm long, 0.2 - .5 cm wide at apex. Central, equal to tapering, or sometimes enlarging slightly at base. Surface smooth or with striations along the length that can be slight, or deep and resembling ridges. Sometimes a fine down of white mycelium at base. Generally purple in color, although white and tan occasionally present. Consistency of stalk tough and wiry, and fleshy or filamentous. **SPORE PRINT**: White with slight lilac tinge.

Habitat and Substrate: Solitary, although more than one often found nearby. Occasionally clustered in groups. Growing in soil, often at the base of trees. Found most often in association with oak, sometimes near pine and other trees. Highly abundant throughout the forests of the highlands.

Season: This species is abundant in June, July and August, and can be found through November.

Alternative Names: Also known as ***bajkal chejchewul k'al te'etik*** 'clustered mushroom of secondary forests', ***slu'il xumential kajket jijte'*** 'genitalia ***xumential*** fever oaks', ***slu'il ka'al pat mail*** 'day genitalia of back of the armadillo', and ***yaxal chewchejwil muk'ul te'eti****k* 'blue/green mushroom of large forests'.

Cultural Use: Not used by the Maya of highland Chiapas, although the caps are eaten in other parts of North America.

slu'il samjijte' 'genitalia that grows near oak trees' *Laccaria laccata*

Fruiting Body: Large thin mushrooms with distinct waxy gills that are distant, and a stipe that is covered with scales. **CAP**: 2 - 12 cm broad, and very thin. Convex when young, becoming planar with a depression in the center in age. Wavy or lobed margins in age, often uplifted. Light to dark brown with rusty or lilac tinges. Large grooves resembling striations extend from center to margin, grooves consistent with gills underneath. Entire cap covered with a cracked, scurfy or fine down that is difficult to see without a lens. Not viscid. Waxy or smooth on surface. Thin, fragile, rubbery texture. **FLESH**: Brown with purple/lavender, lilac or pinkish tinges. Thin, rubbery, fragile, brittle and waxy. Flesh of the stalk is thin and tougher than that of the cap. **GILLS**: Thick, distant, large and deep, few in number. Waxy in texture, straight and smooth. Deep purple or lilac in color. Adnexed, or sometimes adnate. **STALK**: 9 - 20 cm long, 0.5 - 1.4 cm wide at apex, and 1.5 cm wide at base. Central, enlarging to base. Texture very tough and fibrous. Exterior and interior brown with white, tan, or pinkish tinges. Entire length of the stalk covered with thick, scurfy brown scales. **SPORE PRINT**: White, round, spiny.

Habitat and Substrate: Solitary or found in groups of 2 - 5 in the soil and leaf litter of forests. Found in association with pine, oak and many other trees. Highly abundant and common throughout the region.

Season: Highly abundant in August, can be found in July and through September.

Alternative Names: Also known as ***slu'il oncon*** 'genitalia ***oncon***', ***k'anal lu'*** 'yellow genitalia', ***bajkal slu'il tajaltik*** 'thick genitalia of pine forests', and ***muk'ul slu'il ka'al taj*** 'large genitalia of dry pine'.

Cultural Use: In general this species is not used by the Maya of highland Chiapas although it is considered edible in other regions of North America.

chejchewil tsa' 'mushroom of dung' *Russula* sp. (*cremoricolor)*

NO PHOTO INCLUDED.

Fruiting Body: This white to yellowish species is found in abundance, and in association with the other Russulas. It has a cap, stalk and gills, and is flaky, chalky, brittle. **CAP**: Convex to planar, or slightly depressed in age. Margin straight, but highly striate in age. 4 – 9 cm broad, thin. White to yellow in age. Not often viscid, but smooth and dry. **FLESH**: White, solid, fleshy, brittle, chalky or flaky. **GILLS**: White to yellow, adnate to almost free. Close, thick, many. **STALK**: Central, equal or enlarging slightly to base. 3 – 13 cm tall, 1.5 cm thick. White, solid, brittle or chalky, becoming mushy and hollow in age. No veil, annulus or volva, smooth surface. **SPORE PRINT**: White.

Habitat and Substrate: Solitary to scattered, often many found in a small vicinity. Found in earth and leaf-litter of pine-oak forests in association with *R. emetica* and *R. rosacea*. Fairly abundant throughout the region, and throughout much of the year.

Season: May – December.

Cultural Use: None.

tsajal kaxlan k'an chay 'red Spanish yellow fish' *Russula emetica*

Fruiting Body: This small to medium sized species is a beautiful and highly abundant mushroom of the forests of the highlands. It has a cap and stipe, with numerous gills, and a dark red top. **CAP**: 1.5 – 5 cm broad across the top, variably light pink or rosy red to dark red, often with several colors appearing in the same cap. Surface smooth to slightly viscid, sometimes hygrophanous in wet weather, and occasionally feeling slightly velvety. Convex when young, planar with a slight depression in age. Sometimes in age, the margin becomes slightly uplifted. Usually highly striate, especially near the margin, margins smooth to wavy or frayed in age. Consistency thick, brittle, flaky, chalky. No latex. **FLESH**: White, thick, flaky, brittle and chalky. **GILLS**: Adnate, sometimes adnexed, often easy to separate from stalk. White, close, thin, many. Smooth, straight, not forked. **STALK**: Central, equal or enlarging to bulbous, sometimes tapering. White. 2 – 4.5 cm long, .4 – 1.4 cm wide at apex (fairly thick). Fleshy or hollow, brittle and flaky. **SPORE PRINT**: White.

Habitat and Substrate: Highly abundant throughout the highlands, found in the soil underneath forests of pine and oak.

Season: Found throughout the fall and into early winter, from August through December.

Cultural Use: Generally considered poisonous by western cultures, and thought to induce vomiting if eaten raw, a few Mayan informants claimed to eat the cap after boiling in water.

tsajal chejchew ‘red mushroom’ *Russula rosacea*

Fruiting Body: This species, highly abundant in the pine-oak forests throughout the highlands of Chiapas has a bright to dark red cap, rosy colored stem, and creamy white gills. **CAP**: Beginning as convex, becoming planar or depressed. Surface smooth, margin not usually striate, but striations possible. 3 – 12 cm broad, thin. Bright red to dark blood red, fading to pink in age. **FLESH**: White, firm, solid, very brittle or chalky in texture. Mild odor and taste. **GILLS**: Creamy white or dingy white to slightly yellowish. Adnate to decurrent. **STALK**: Central, equal, white with rosy colors throughout. 3 – 8 cm tall, 0.5 – 2 cm thick. Firm, solid, chalky or brittle. No veil, annulus or volva. **SPORE PRINT**: White.

Habitat and Substrate: Solitary to scattered, often many found in the vicinity. Growing in earth and leaf-litter of pine-oak forests. Incredibly abundant, found everywhere in large numbers.

Season: May – December.

Cultural Use: Never eaten.

yaxal lu' 'green genitalia' *Russula virescens*

NO PHOTO INCLUDED.

Fruiting Body: This distinctive species of *Russula* has a green-gray and slightly velvety cap, white to creamy gills that are adnate to free, and a well-developed stipe. **CAP**: Convex, becoming planar, sometimes with a slight depression. 2 – 5 cm broad, thin. Margin wavy or lobbed, or straight when young. Not striate. Surface of the cap slightly velvety, dull green to green-gray in color. **FLESH**: White to creamy, possibly staining a dull bluish-green. Brittle, chalky, flaky, solid, fleshy. **GILLS**: White, close, many, adnate to free. Brittle, easily flaking. **STALK**: Central, equal, white, staining bluish-green. Short, 2 – 3 cm tall, 0.5 – 1 cm thick. Brittle and chalky in texture. **SPORE PRINT**: White.

Habitat and Substrate: Solitary, possibly scattered, although never found in abundance. Growing at the base of hardwoods, in the earth. Not abundant.

Season: June – November.

Cultural Use: Not used.

chejchew kaballo 'horse mushroom' *Gymnopilus spectabilis* group

Fruiting Body: This species occurs in dense clusters of very large, distinct mushrooms with pizza-sized, shaggy caps, scaly stalks with a well-developed annulus, and almost decurrent gills. **CAP**: Convex or even conical in young specimens, becoming planar when old. 10 – 20 cm broad. Fire orange, or bright yellow-orange in color with shades of rusty brown. Surface smooth, or more likely covered with light scales that are the same color as the cap. **FLESH**: Thick, solid, firm, fleshy, meaty. **GILLS**: Adnate, notched, or slightly decurrent. Orange, thick, blade-like, close or somewhat distant. **STALK**: Central, equal or narrowing, 5 – 15 cm long, 1 - 5 cm thick. Covered with thick scales. Orange to rusty brown. **ANNULUS**: Thick, obvious, distinct annulus high up on the stalk. 3 - 4 cm in width. Whitish, or orange or rusty brown. **VOLVA**: None. **SPORE PRINT**: Orange.

Habitat and Substrate: Many (10 – 30) clustered on or near rotting stumps or possibly the roots of live trees, in forest of oak. Given the very large size of these mushrooms, and clustered habit, one would assume people to know it well. This species is so rare, however, that most collaborators had never seen it, and knew no name or use for it. Interestingly, I found many groups clustered in one small area.

Season: June – September (or later).

Alternative Names: Also known as ***k'anal k'an chay*** 'yellow yellow fish', and ***k'anal chejchew*** 'yellow mushroom'.

Cultural Use: Not used, and thought to be slightly hallucinogenic in North America.

yaxal balumilal lu' 'blue earth genitalia' *Entoloma* sp.

NO PHOTO INCLUDED.

Fruiting Body: This small to large mushroom has a cap and a stipe with gills. **CAP**: Convex when young, the cap becomes planar and maintains an umbo in age. The margins are often straight, and otherwise uplifted and wavy. The color is mousy gray, gray-brown, or olive brown, often with a darker gray at the umbo. 1 – 7.5 cm broad, and thin. Not viscid, or only slightly so, usually smooth on top, and often hygrophanous. Sometimes feels a little waxy. The cap sometimes has striations, otherwise smooth. The consistency is thin, soft, fleshy, fragile, and sometimes rubbery or waxy. **FLESH**: White, but turning gray or brown or olive in age. Flesh is very thin, soft, fleshy and fragile, and sometimes a bit rubbery. Smells slightly radishy on occasion. **GILLS**: Generally adnate, sometimes sinuate (notched) or adnexed. White to fleshy-salmon colored. Thin, close, many. Edges either straight and smooth, or irregularly wavy to serrate. **STALK**: Central, equal to tapering (or occasionally enlarging). Color is bone white. 4.5 – 13.5 cm tall, 0.5 – 1.1 cm thick at apex. Consistency is thick, firm, solid flesh, filamentous, can feel brittle. Often has long, line grooves or ribs extending lengthwise down the stipe. **SPORE PRINT**: Pinkish

Habitat and Substrate: Solitary or scattered in groups of 2 - 7, growing in the soil or leaf-litter of pines and oaks. Found usually in pine-oak forests with other hardwoods.

Season: August – October.

Alternative Names: Also known as ***yaxal chejchew*** 'blue/green mushroom'.

Cultural Use: The cap is boiled and added to soups or greens. Never grilled. The stipe is never eaten.

FOLK LIFE-FORM *chikin te'*

Isolates (monotypic folk genera) of the life-form category:

Life-form *chikin te'*	
chikin te'ul k'an tulan	*Stereum ostrea* group
ijk'al tsijtel lu'	*Xylaria multiplex*
ijk'al chikin te'	*Phellodon niger*
ijk'al k'o' chikin	*Otidea* sp.
k'anal chejchewil meste'	*Phyllotopsis nidulans*
k'anal k'o' chikinul tsajal lum	*Peziza violaceae*
k'anal lukulmil slu'il te'	*Cordyceps militaris*
k'o' chikin	*Auricularia auricula*
k'o' chikin	*Fomitopsis scutella*
muk'ul chikin jijte'	*Ganoderma lucidum*
muk'ul chikin te' k'a'al taj	*Perenioria contraria*
muk'ul sulte'al meste'	*Phellinus* aff. *chinensis*
najkul chikin te'	*Polyporus badius*
pimil chejchew	*Lenzites betulina*
sakil k'o' chikin	*Peziza* sp.
sakil nujkul chikin lu'	*Helvella crispa*
slu'il ixim	*Ustilago maydis*
slu'il kap'nal jijte'	*Helvella macropus*
sulte'	*Schizophyllum commune*
tsu chikin chejchew	*Polyporus arcularius*
tzetz chikin te'	*Lentinus crinitus*
tzotzil lu'	*Inocybe lanuginosa*
t'ot'	*Daldinia concentrica*
	D. grandis
	D. vernicosa
yaxal balumilal slu'il yan jijte'	*Pluteus cervinus*
unnamed	*Heteroporus biennis*
unnamed	*Pholiota gregariiformis*

chikin te'ul k'an tulan 'ear of the ***k'an tulan*** tree [Tzotzil for *Quercus* spp.]' *Stereum ostrea group*

NO PHOTO INCLUDED.

Fruiting Body: This common species grows in dense layers or clusters on rotting hardwoods. It is a shelf fungus, growing without a true stipe. It is irregularly shaped, growing in concentric zones from a single center point, which is attached to the wood. It is rusty red-brown with black spirals and appears to grow in layers that resemble scales (although it is not scaly). The surface is flat and smooth, not striate, with concentric zones of color. Sometimes green alga is growing on top. Very thin, 0.8 – 5.5 cm broad. Tough, leathery, or bark-like in consistency. **FLESH**: White, or rusty red-brown to black. Very thin, very tough, leathery or bark-like. **PORES**: The underside of the "cap" is the fertile surface. This appears to be a smooth rusty red-brown to black or even yellow surface. **STALK**: No stalk, attachment off-center. **SPORE PRINT**: White.

Habitat and Substrate: Fairly abundant in forests and fields with abundant cut wood. Develops in *Quercus* and other hardwood sticks, logs, stumps, etc. Develops in dense layers or clusters.

Season: Found year round.

Alternative Names: Also known as ***pimil sulte'al te'*** 'thick scale/bark of tree'.

Cultural Use: Sometimes called "women's medicine", this species is used to relieve the bloating and stomach or body pains associated with menstruation. The entire mushroom is used, and is ground up in the corn grinder. The resulting paste is mixed with posol (corn gruel), cooked with pimiento and eaten.

ijk'al tsijtel lu' 'black ***tsijtel*** genitalia' ***Xylaria multiplex***

NO PHOTO INCLUDED.

Fruiting Body: These black clubs grow out of rotting wood in clusters. The clubs are a fused stipe with a slightly enlarged upper portion. 2 – 2.5 mm in height, very thin (< 0.5 mm wide). They develop straight and erect in a cylinder or club-like fashion, rarely or never branched. The upper portion is bumpy or roughened whereas the stipe is smooth.

FLESH: Brittle, tough, not fleshy (more brittle woody to the touch). **GILLS**: None.

STALK: Black, tough, woody, sterile lower portion of the club. Very short (1 mm).

SPORE PRINT: Black.

Habitat and Substrate: Rotting wood of logs, stumps, sticks in hardwood (oak) forest, or open fields that have been cut for cultivation.

Season: Year round.

Cultural Use: Not used.

ijk'al chikin te' 'black tree ear' *Phellodon niger*

Fruiting Body: This small to medium sized fungus has a cap and stipe, and has obvious white teeth hanging underneath the cap. **CAP**: Planar with cracked depression occasionally found in the center, or irregularly shaped in a rough rounded shape. 2 – 5 cm broad. Mild concentric zones of color, mostly black, brown, with a white ring at the margin. Surface smooth, dry and cracked. **FLESH**: Thick, tough, leathery, meaty and flexible. Not woody. Shiny charcoal black in color. TEETH: Short (< 1 mm), blunt white teeth or spines hanging from the cap. These do not extend down the stalk.

STALK: More or less central, thick at the apex, seeming to taper at bottom. Alternatively, base can be fused with stalk of another stalk, giving rise to more than one mushroom from a single point of origin. 4 – 5.5 cm tall, 1.5 cm thick at apex. Thick, tough, leathery, spongy, meaty. Black with white mycelium at base.

Habitat and Substrate: Found scattered or even clustered in groups of 2 – 10 mushrooms in black soil in pine-oak forests. Not highly abundant.

Season: August – September, possibly later in the fall and early winter.

Cultural Use: The cap is eaten. Ground into a paste and mixed with corn gruel

ijk'al k'o' chikin 'black snail-like ear' *Otidea* sp.

Fruiting Body: This small, essentially stalkless cuplike fungus really grows erect like a clam facing the sky, and consistently has a slit down one side. It is like a cup that has been folded, with very high margins. It is 1 – 3 cm across at the broadest point, and 2 - 3 cm tall from base to tip of the margin. The exterior and interior surfaces are tan to deep, dark brown. The exterior surface is smooth to slightly granulose. The interior portion is smooth. **FLESH**: Thin, rubber, not really brittle or fragile. Tan to dark brown. **GILLS**: None, spores born on the fertile inner surface of the cup, often coming off in puffs of brown spores when touched. **STALK**: Absent, or existing as an extension of the mushroom body, this attachment is central or slightly off-center. It can be as much as 1 cm long, and 0.7 cm wide at base. There is a fine covering of white mycelium at the base.

Habitat and Substrate: Usually clustered in gregarious groups, found in rotting wood, or humus in pine-oak forests.

Season: Not highly abundant, found in June, July, August.

Alternative Names: Also known as ***k'anal muk'ul chikin*** 'large yellow ear'.

Cultural Use: None.

Photo Credit: http://home.wanadoo.nl/abiemans/pict/otidea_alut_1.jpg

k'anal chejchewul mes te' 'yellow mushroom of ***mes te'*** [*Baccharis confertoides*]'

Phyllotopsis nidulans

Fruiting Body: This little mushroom is bright pumpkin orange, and highly abundant. It has a well-developed cap, no stalk, and obvious gills. Found throughout the highland forests. **CAP**: Broadly circular, fan-shaped or scallop shaped, a circle with a single attaching point. 0.5 – 5.5 cm broad, 1 – 2.8 cm from attachment to margin, 1 – 4 mm thick. Bright pumpkin orange, smooth, dry, not scaly or viscid. Not striate. Margin slightly inrolled, and slightly furry at margin. **FLESH**: Thick, soft, solid, fleshy. Bright pumpkin orange, no changes in color. **GILLS**: Thick, many, attached at tiny stalk. Bright pumpkin orange and not changing color. **STALK**: Essentially non-existent, or tiny stalk as point of attachment to substrate. Off-center. **SPORE PRINT**: Pale pink to brown.

Habitat and Substrate: Usually clustered in shelf-like groups or many scattered close. Grows in rotting sticks, logs and stumps of hardwoods, conifers, and *Baccharis* spp. Highly abundant in early fall.

Season: June – December.

Cultural Use: Thought to be poisonous, this species is ground up and mixed with posol and then left out as a rat poison.

Photo Credit: http://www.nybg.org/bsci/res/hall/nidulans.html

k'anal k'o' chikinul tsajal lum 'yellow snail-like ear red earth' *Peziza violaceae*

Fruiting Body: This small, stalkless cup fungi has a white to gray exterior, with a violet or purple coloring on the fertile upper surface of the cup. The height from base to margin is 0.7 - 0.9 cm tall, and the cup is 1 – 1.5 cm broad at the top. Taking the form of a disk or a cup, the margins are highly uplifted and inrolled, curled almost into a ball, and nearly covering the interior fertile surface. In age, the margins fall, becoming more of a cup or disk. The exterior is smooth and white or gray, and the interior is smooth or wrinkled, and purple. **FLESH**: Thin, rubbery and brittle, and very fragile, breaking up easily. **GILLS**: None, spores born on fertile upper surface of the cup. **STALK**: None, although attachment to soil is central. A fine, downy white mycelium is found at the base.

Habitat and Substrate: Solitary or sometimes scattered in pine-oak forests that have been previously burned.

Season: July and August

Cultural Use: Not used.

Photo Credit: Retrieved from the *MushroomExpert.Com* Web site: http://www.mykoweb.com/CAF/species/Peziza_violacea.html

k'anal lukulmil slu'il te' 'yellow worm-like tree genitalia' *Cordyceps militaris*

Fruiting Body: This bright pumpkin-orange fungus grows as a single, unbranched club (although often clustered) with a swollen "head" that is covered in warts, grains or pimples. 1.5 – 2.5 cm tall, 0.4 – 0.6 cm thick in the swollen "head" portion. Surface pimpled, or covered with orange-yellow granules or warts. **FLESH**: Yellow – orange. Thick, tough, spongy, solid in middle. **GILLS**: None, the warts on the swollen head are perithecia ("nests" of asci) that bear the spores. **STALK**: 1.5 cm long until swells to become the "head". 2 – 3 mm thick. Central, equal, thinner than upper portion. Solid, fleshy, more yellowish than upper portion, but still yellow-orange.

Habitat and Substrate: Numerous groups found growing in clusters of 3 – 5 in rotting hardwood or soil. Presumably the pupae of moths or butterflies found in this wood. Not highly abundant.

Season: Found in July. Extended season unknown.

Cultural Use: Not used, thought to be possibly poisonous.

Photo Credit: http://ocid.nacse.org/research/cordyceps/html/cmilitaris.html

k'o' chikin 'snail-like ear' *Auricularia auricula*

Fruiting Body: This wood-growing rubbery ear-shaped species is highly abundant and well used by the people in Chiapas. Gelatinous or rubbery, ear-shaped fungus. 3 – 6 cm broad, irregularly shaped, often longer than it is wide. Brown in color. Upper surface smooth or slightly wrinkled, silky underneath. **FLESH**: Thin, rubbery, tough or fragile. **GILLS**: None, spore borne on inner surface. **STALK**: Absent, or formed as the point of attachment to the substrate underneath the body of the fungus. **SPORE PRINT**: White.

Habitat and Substrate: Usually attached centrally to rotting wood of stumps, logs, or sticks of hardwoods. Abundant and found throughout the forests and fields of highland Chiapas.

Season: Found throughout the year.

Cultural Use: Eaten fresh for a quick snack in the fields, or boiled in a soup as an herb.

muk'ul k'o' chikin 'snail-like ear' *Fomitopsis scutellata*

NO PHOTO INCLUDED.

Fruiting Body: This medium to large sized conk or crust-shelf fungus is very tough and woody-leathery, and a deep dark purple to black color. The "cap" is irregularly shaped like a rounded shelf growing from the rotting wood substrate, or a fan. Often 5 – 10 cm across, and very thin. Surface is generally smooth and not viscid, and becomes wrinkled or bumpy in age. The margin is wavy, and minutely inrolled. **FLESH**: Extremely tough, the mushroom can be bent in half without breaking, leathery to woody and very thin. White. **PORES**: Tiny, really only visible with a lens, many, circular, close. White or grayish. **STALK**: If present, the stipe is off-center, short and equal. Black on the exterior, white interior, tough, spongy or woody. 0.5 cm long, and 0.5 cm in diameter. **SPORE PRINT**: White.

Habitat and Substrate: Common and widely found throughout the highlands. These conks develop in rotting wood, and sometimes live trees. Solitary, although sometimes found scattered together.

Season: Grows throughout the year.

Cultural Use: Boiled for a long time, and eventually softens enough to be eaten in a soup.

muk'ul chikin jijte' 'large ear of oak trees' *Ganoderma lucidum*

Fruiting Body: This woody species is often large and obvious with its shiny, glazed red and black surface, and growth from trees or stumps. It has a cap, and often has a stipe, and the undersurface is a layer of pores or tubes. **CAP**: 18 cm in width, 25 cm in length, 0.5-2 cm thick. The cap is roughly a half-circle in shape, dark-brown to reddish-brown to black in concentric circles of color, the surface has a lacquer-like finish, woody to very hard, and the surface is bumpy and lumpy. Not viscid. Margin is wavy. **FLESH**: Extremely woody and very hard throughout. Reddish-brown to dark brown to black. **PORES**: Pores are not visible, microscopic; the surface underneath the cap is smooth white with black bruises. **STALK**: There is often little to no stalk, although the cap does end in a node that could be considered a small stalk, and other times there is an obvious stalk. The stalk almost always off-center. **SPORE PRINT**: Brown.

Habitat and Substrate: Develops in the wood of both live and dead trees. Found in the forests and mountains, in oak, dogwood and other hardwoods.

Season: Available throughout the year, especially in the fall from August to December.

Alternative Names: Also known as ***tsajal sulte'al k'a'al te'*** 'red scale/bark of ***ka'al te'***'.

Cultural Use: Although not used regularly, at least one informant said that when young, this *Ganoderma* is less woody and more supple. At this young stage, it can be grilled over an open fire, ground up and put into a tea. This tea is thought to warm a very cold, shivering body.

muk'ul chikin te' k'a'al taj 'large tree ear of dry pine' *Perenniporia contraria*

NO PHOTO INCLUDED.

Fruiting Body: This species doesn't really have a cap or a stipe. Grows upward from the woody substrate in an irregular lumpy patter. It is medium to large, and an orange-brown to dark rusty brown color in concentric zones of color. The margin is white. The surface is rough and bumpy, highly pitted, and not striate. It is a rough, pitted, thick, tough and concentric ugly mushroom. If a cap is present, it is only because the margin is free of the substrate. **FLESH**: Tough and thick, like leather, not woody, but difficult to cut through. Thick, white to tan inside, staining darker tan when cut. 0.5 – 1 cm thick. **PORES**: White, shallow pores, roundish, but not developing in rows. Appear more like indentations in the thick white skin of the mushroom than pores. **STALK**: None, but a small ledge that is darker brown may be found growing under the rest of the body. This is very tough and leathery, though not woody.

Habitat and Substrate: Growing on rotting wood, almost resupinate (lying flat on the surface). Solitary.

Season: All year.

Cultural Use: Not used.

muk'ul sulte'al mes te' 'large tree skin/bark of ***mes te'*** [*Baccharis confertoides*]'

Phellinus aff. *chinensis*

NO PHOTO INCLUDED.

Fruiting Body: This hard woody species is a conk or shelf fungus that grows typically without a stipe. The "cap" is irregularly shaped in a half-circle from the point of attachment to the substrate in a fan-shape. It is small to medium in size, 3 - 4 cm broad, and 1.5 – 3 cm from attachment to margin. Color is dark red-brown to black, in concentric circles. The surface is dull, and roughly pitted with broad scars. The margin is irregularly wavy or lobed. The consistency is spongy, firm, solid, and even woody. **FLESH**: Brown to black, thick, solid, fleshy, spongy and woody. **PORES**: White, turning black with age. Many small, round or elongated pores, undersurface of the cap resembles a honeybee hive. Bruises black. **STALK**: None, attachment off-center. **SPORE PRINT**: Whitish.

Habitat and Substrate: Grows in rotting wood of stick, logs or stumps. Solitary or many clustered nearby on the same log.

Season: Year round.

Cultural Use: None

najkul chikin te' 'ear of *Alnus* spp.' *Polyporus badius*

Fruiting Body: This small, highly abundant species is found in fields that are cut, or successional stages occurring in early fallow. They have an obvious cap and small stipe, and pores underneath the cap. **CAP**: 2 – 5 cm broad and very thin. Develops in an irregular pattern, generally fan-shaped, round, planar with a depression. Not viscid, smooth on the surface, with light fine wrinkles in age. Margin is irregular and wavy, or even frayed in age, not striate. Tough, leathery consistency. Color is a dark, reddish brown. **FLESH**: Very thin, very tough, leathery, and brown-red in color. **PORES**: White, turning brown or black in age. Tiny, close, difficult to observe without a hand lens. The underside of the cap appears to be a smooth, white surface. **STALK**: 0.3 – 1 cm long, 0.2 - 0.4 cm wide. Dark red-brown to black, central or off-center, equal to tapering. Very tough, leathery and almost woody stipe can even appear to be lacquered. **SPORE PRINT**: White.

Habitat and Substrate: Grows in rotting wood of alder, and hardwoods, often in open fields that have recently been cut for milpa. Solitary, or scattered with many developing in a single log, sometimes clustered.

Season: Found in abundance throughout much of the year from May to December.

Alternative Names: Also known as ***tsajal sulte'al te'*** 'red scale/bark of tree'.

Cultural Use: The cap of this species is ground up into a paste and eaten with tortillas, or used as an herb in whatever sauce or soup is being prepared. It is thought to help with putting on weight for people who are too skinny. The stipe is always cut off and discarded before use.

pimil chejchew ‘thick mushroom’ *Lenzites betulina*

Fruiting Body: These hairy, concentrically zoned shelf fungi generally do not have a stalk, but has a well-defined “cap” and highly forked gills on the underside. **CAP**: Small to medium sized, scallop-shaped or fan-shaped cap. Irregular half-circle. 3 – 8 cm broad, 2.5 – 3.8 cm from point of attachment to margin. Concentrically zoned white with brown and darker colors. Covered with light green algae. Smooth, not striate or viscid. Tough and leathery. **FLESH**: Thin, tough, very leathery, white, and dingy. **GILLS**: White, dingy tan attached (adnate) to the non-existent stipe (where the mushroom attaches to the substrate). Deep, thick, many, distant. Gills highly forked. **STALK**: Off-center point of attachment. Essentially non-existent stipe. If present, short, thick, fat, tough, spongy, woody. White to brown in color.

SPORE PRINT: White.

Habitat and Substrate: Rotting wood of stumps, logs, sticks, etc. Fairly abundant.

Season: All year.

Cultural Use: Not used.

Photo Credit: Retrieved from the *MushroomExpert.Com* Web site:

http://www.mykoweb.com/photos/large/Lenzites_betulina(mgw-01).jpg

sakil k'o' chikin 'white snail-like ear' *Peziza* sp.

Fruiting Body: Small, stalkless cup fungi with a tan-brown, olive brown or dark brown exterior, and a dingy tan to brown, or lilac-tinged color on the fertile upper surface of the cup. This species tends to be almost round in youth, and open up in age becoming a deep cup or saucer shape at maturity. The margins can be smooth, wavy or even lobed. The height from base to margin is 0.8 – 2.5 cm tall, and the cup can be from 1 – 5 cm across. The exterior is either smooth, or slightly pitted, or in one case, granulose. The interior portion is smooth. Neither portion is viscid. **FLESH**: Thin and rubbery, tan to brown, fragile. **GILLS**: None, spores born on fertile upper surface of the cup. **STALK**: None, or in some cases a tiny stipe, attachment to substrate is central.

Habitat and Substrate: Solitary, but often many growing close together in soil or humus of pine-oak forests.

Season: June, July and August.

Alternative Names: Also known as ***k'anikal k'o' chikin*** 'yellowish snail-like ear'.

Cultural Use: This species is often added to soups or boiled greens, and can be grilled and eaten.

Photo Credit: http://www.in2.dk/fungi/imageframe1.htm

sakil nujkul chikin lu' 'white leathery/flexible ear genitalia' *Helvella crispa*

Fruiting Body: This small distinct species has a contorted and lobed "cap" sitting over a well-developed and chambered stalk. The fused upper portion of this species is 2 cm broad, 1 cm thick. Contorted or lobed in the shape of a saddle, almost planar. Margin free from stalk. Tan to gray, or olive colored. Smooth, not viscid or pitted. Consistency is rubbery, but brittle and fragile. **FLESH**: Tan to gray or olive, thin, rubbery and brittle. **STALK**: Central stalk is tan to olive colored. 1.5 – 3 cm tall, 0.6 cm broad. Highly ribbed, with folded chambers that extend from the base to the margins of the cup. Thin, tough, and leathery.

Habitat and Substrate: Not abundant. Soil or leaf litter of oak. Scattered in groups of 6 or 7.

Season: Unknown, found in late July.

Cultural Use: Not used, and thought to be very sour in flavor.

Photo Credit:
http://www.bluewillowpages.com/mushroomexpert/images/smith/smith_helvella_crispa.jpg

slu'il ixim 'genitalia of corn' *Ustilago maydis*

Fruiting Body: This parasitic fungus grows in small to large clusters on the ears of corn plants. The shape is highly variable, consisting of little clustered balls resembling lumps of coal, or long, finger-like clubs, to large irregularly shaped masses of fused balls. When young, the color can be whitish or gray, and in age, this species is generally lackluster black. These galls infest kernels of corn, and as they develop eventually fill with black powdery spores. **FLESH**: Firm and fleshy when young, white or grey throughout. Becoming papery and thin skinned in age, filling with soft powdery spores. **SPORE PRINT**: Black.

Habitat and Substrate: Develops in the ears of domesticated corn plants.

Season: August through December, the corn season in the highlands.

Alternative Names: Also known as ***lu' ixim*** 'genitalia of corn', and ***tsijstimul tsetojil ixim*** 'whiskery ***tsetojil*** of corn'.

Cultural Use: Although this species is a highly prized edible throughout much of Mexico, the informants with whom I worked rarely consume it. They are aware, however, that this mushroom is edible, and a number of collaborators said that specimens at immature stages are grilled in corn ears over the fire and eaten as a side dish.

Photo Credit:

http://vegetablemdonline.ppath.cornell.edu/PhotoPages/Impt_Diseases/Corn/Corn_Smut.htm

slu'il kap'nal jijte' 'genitalia ***kap'nal*** of oak trees' *Helvella macropus*

Fruiting Body: This is a small, shallow cup fungus with a "cap" and a long, thin stipe. The shallow cup is 2.2 cm across, very thin, and 6 cm tall. Both the exterior and the fertile interior surfaces are a mousy gray to brown color. The exterior surfaces, excluding the fertile surface, are covered with layer of fine or scaly gray hairs that extend from the outside margin to the base of the stipe. The fertile surface is a shallow cup with uplifted margins (though not forming a funnel), and is smooth, dull, mottled in color.

FLESH: Mousy gray to brown, very thin and rubbery, and somewhat brittle or fragile.

STALK: 6 cm tall, thin, central and enlarging to base. Not wrinkled or pitted, but round and somewhat flat. Hard and wiry in texture, and somewhat hollow. Covered in fine grey hairs.

Habitat and Substrate: Solitary or scattered on soil or rotting wood underneath hardwoods such as oak.

Season: Relatively scarce, found in July and August.

Cultural Use: None.

Photo Credit: http://website.lineone.net/~fungi.dells/mycology/helvella.macropus1.jpg

sulte' 'tree skin/bark' *Schizophyllum commune*

Fruiting Body: Small, tough and leathery, these mushrooms grow fan-like or in a half circle without a stalk, and resemble an ear in shape. **CAP**: 1 - 4 cm broad, usually white or dingy gray, the surface is densely covered with soft hairs that give it a furry feel, margin wavy and often in-rolled. **FLESH**: Thin, tough, leathery, soft but not fragile, white to gray. **GILLS**: Many radiating from base to margin, thin, tough, shallow, widely spaced, white. **STALK**: Absent, or appearing as a narrow base. **SPORE PRINT**: White.

Habitat and Substrate: Found all over the highlands, solitary or in groups and clusters on dead limbs, branches or logs of hardwoods. These can be found in milpas and pastures, in the forest, and often fruit on the hardwood posts that serve as fences in the highlands.

Season: All year long.

Alternative Names: Also known as ***chikin te'*** 'tree ear'.

Cultural Use: This little "tree ear" is one of the most commonly known and used mushrooms in the highlands. Although small, they are relatively abundant, and grow everywhere, including in town, on the fence posts. They are widely known, and utilized by everyone. These mushrooms are most often eaten boiled alone or with vegetables and herbs to make a soup. However, many people grind them up raw and mix them in with posol to add flavor, texture and nutrition. They are also sometimes boiled and served with beans. ***sulte'*** is considered a nutritious mushroom in the highlands, it is thought of as being “hot” and thus providing strength to individuals who are weak. It is also thought to sooth churning or painful stomachs, and relieves stomach cramps caused by gas.

tsu chikin chejchew ‘cup-like ear mushroom’ *Polyporus arcularius*

Fruiting Body: This little wood-growing mushroom has a cap with a fringe of hairs on the edges, obvious pores or tubes underneath, and a well-developed stipe. **CAP**: Round, convex to planar with a depression. 1 – 5 cm broad, very thin. Usually some shade of brown or tan. Margin highly hairy or fringed. Surface dry or somewhat scaly. **FLESH**: Very thin, tough, fleshy. **PORES**: Large shallow tubes or pores, not necessarily round, but angular or elongated. White, turning creamy or brown. Attached to stalk or slightly decurrent. **STALK**: Central, equal, thin and short, 1 – 5 cm long, 2 – 5 mm thick. Brown to tan, smooth or somewhat scaly or furry. Tough.

SPORE PRINT: White.

Habitat and Substrate: Solitary or scattered on rotting wood in forests and fields with stumps, logs or sticks. Fairly abundant and widely available.

Season: Year-round.

Alternative Names: Also known as ***chikin te’*** ‘tree ear’.

Cultural Use: Not used.

Photo Credit: http://www.anbg.gov.au/fungi/images-captions/polyporus-arcularius-0044.html

tzetz chikin te' 'shaggy tree ear' *Lentinus crinitus*

Fruiting Body: This little brown-yellow mushroom is fairly indistinct, except for the shaggy scales covering the cap and margin. It has a well-developed cap, small stipe and decurrent gills. **CAP**: 3 – 10 cm broad. Convex to planar with a deep central depression. Brown with yellow tones. Surface covered with large shaggy scales or fur that start in the central depression and extend to the margin. Margin highly inrolled. **FLESH**: Soft, fleshy, thin, white. **GILLS**: Dingy white, slightly decurrent, thin, many, close. **STALK**: Central, equal to tapering, solid, firm, fleshy. 2 cm long, 0.5 cm thick. No veil, annulus or volva, but covered with shaggy scales. White, creamy, becoming darker brown to the base. **SPORE PRINT**: White.

Habitat and Substrate: Solitary or scattered on rotting wood, stumps, logs or in algae/moss. Not particularly abundant.

Season: June – October. Rainy season.

Cultural Use: Not consumed (although not considered poisonous). Used as an adornment for the house. The stalk is cut off, and a string is pushed through the caps to create a long "necklace" that is hung from the roof, on a wall, or around a picture.

tzotzil lu' 'hairy genitalia' *Inocybe lanuginosa*

Fruiting Body: This small to medium mushroom is distinctive due to its shaggy, scaly or wooly cap and stipe. **CAP**: Convex to planar, sometimes with an uplifted margin that gives it a mildly depressed appearance. Margin inrolled or uplifted. 2 – 4 cm broad, thin. Brownish, dingy yellow or olive colored, sometimes with various zones of color in concentric circles. Cap covered with brownish scales or large, thick hairs. **FLESH**: Obvious odor of rotting fish. Thin, white to brown to olive in color. Soft, fragile, yet fleshy. **GILLS**: Adnate, thin, close, many, blade-like. **STALK**: Central, equal or enlarging to base. 2 – 4 mm broad, 3 – 4 cm tall. Covered with brownish scales or wholly hairs. Tough and fibrous. Probably remnants of the veil. **SPORE PRINT**: Brown.

Habitat and Substrate: Solitary or scattered, yet highly abundant throughout the forests and fields of Tenejapa. Found growing in rotting wood of stumps and logs in milpa, pine-oak forests, and any successional stage in between.

Season: June – October or possibly throughout the year.

Alternative Names: Also known as ***chejchew kaballo*** 'horse mushroom', ***tsu chikin*** 'cup-like ear', ***chikin te' lu'*** 'tree ear genitalia', ***chis chis lu'*** '***chis chis*** genitalia', ***tzotz ni' chejchew*** 'hairy nose mushroom', and ***bol lu'*** 'crazy mushroom'.

Cultural Use: Although generally thought to be mildly poisonous or even slightly hallucinogenic in North America, at least one collaborator claimed to eat this species after boiling in water. Most collaborators, however, agreed that this species is not eaten, and often had difficulty coming up with a name for the species.

Photo Credit: http://www.grzyby.pl/gatunki/Inocybe_lanuginosa.htm

t'ot' ***'t'ot''*** *Daldinia concentrica*

Fruiting Body: Hard, woody (or sometimes slightly spongy) sphere that is alternately smooth, lumpy, or pitted. Shaped like a lumpy ball, or a piece of coal. Charcoal-like in appearance and texture, usually dark, black or brown in color, sometimes shiny or lustrous. Small, usually 1 - 4 cm in diameter. **Cap**: None. **FLESH**: Interior flesh is dark brown to black or white, sometimes with concentric lines of white in radiating circles. Often woody, tough and sometimes spongy. **STALK**: Absent, sometimes present as a narrow, tapering base underneath the fertile portion. **SPORE PRINT**: Unknown.

Habitat and Substrate: Found all over the highlands of Chiapas, these little black fungi which resemble pieces of charcoal appear alone or scattered in groups on the dead sticks and twigs fallen from hardwood trees. They are most often found in the open areas of milpa and pasture where the trees have been cut.

Season: Found all year long.

Cultural Use: ***t'ot'*** is one of the most widely known and often mentioned species of macrofungi in the highlands. Although not highly relished (and indeed, not recognized as an edible in the U.S.) among the Maya, they are eaten quite often. Because they can be eaten raw, they are considered to be a quick snack for individuals working in the field. They can also be collected in large quantities and brought home and cooked on the comal, with salt, chili and even lime for a much tastier treat. They are not used as medicine, or any other purpose.

Notes: Although all of the specimens preserved are small, round, brown or black and woody, this highly abundant species vary in many ways. Some have no stalk; others have a narrow or tapering base. Some are smooth; others are pitted, lumpy, bumpy or smooth. Most have a shiny, lustrous appearance. The interior flesh can be dark brown, black, white, or vary concentrically with dark and white zones. In essence, there may be more than one species present, including *Daldinia grandis* and *D. vernicosa*.

yaxal balumilal slu'il yan jijte' 'purple earth genitalia of oak trees' *Pluteus cervinus*

Fruiting Body: This brown capped, wood-growing mushroom has an obvious stipe and numerous close, salmon or flesh colored gills. **CAP**: Convex to planar, or slightly umbonate. 5 – 8 cm broad. Color is some shade of brown to dark brown. Surface smooth, or slightly wrinkled, hygrophanous, or with longish fibrils. **FLESH**: Soft, thin to thick, fleshy, fragile, white, with a mild odor. **GILLS**: Free from the stalk. Many, close, soft, white to pink, salmon or flesh colored. **STALK**: White, firm, smooth. Sometimes with white or brown fibers running down length of stalk. 7 – 10 cm tall, 0.5 cm thick. No veil, annulus or volva. **SPORE PRINT**: Flesh colored or pink or brownish.

Habitat and Substrate: Solitary or in groups growing on rotting wood, humus or stumps and logs. Not abundant.

Season: Rainy season, from June to November.

Cultural Use: Although known as an edible in much of North America, this species is not eaten in the highlands. Possibly too many look-alikes are present in the region, making identification difficult.

Unnamed *Heteroporus biennis*

NO PHOTO INCLUDED.

Fruiting Body: This yellow-orange-rusty colored, tough leathery polypore has a short, blunt stalk, and an irregular cap, and the pores are highly irregular. **CAP**: Irregularly shaped in a funnel or half-circle, or overlapping shelves. Distorted shapes. Variably yellow-orange mixed with rusty colors, and pale pink or flesh tones. 2 – 5 cm broad. Surface smooth or covered with patches of white furry hairs, mottled colors, wrinkles. Dry, not viscid. Margin very irregular, wavy, uplifted, wrinkled. **FLESH**: Firm, very tough, leathery, solid, thin. Tan to white in color. **PORES**: White with reddish tones, bruising light tan to brown. Extending to stalk, but not down the stalk. Small, but highly irregular in shape, some elongated, others round. Scrambled and maze-like. **STALK**: More or less central, or off-center. Short, thick, extending underground. Equal. Thick, solid fleshy, spongy, tough, leathery. 1.2 – 4.5 cm tall, 1 – 1.8 cm wide. Dark brown-red. Some covering of scurfy, fine, thick minute hairs. **SPORE PRINT**: White.

Habitat and Substrate: On the ground, probably growing on roots or rotting wood.

Season: June - December

Cultural Use: None

Unnamed *Pholiota gregariiformis*

NO PHOTO INCLUDED.

Fruiting Body: This small to medium mushroom had a distinct cap, stipe and gills. The cap is distinct only in that it is highly viscid and covered with small brown scales in concentric rings on the cap. **CAP**: Convex to planar. Brown in the center, becoming lighter tan at the margin. 2 – 5 cm broad, .4 cm thick. Slimy, viscid, wet and glossy in appearance (possibly only when wet). Margin smooth, not striate, wavy. Surface covered with small brown scales scattered in concentric rings on the cap. **FLESH**: Brown to tan, full, thick, soft flesh. A bit slimy. **GILLS**: White, turning dark brown. Straight, not forked, many, thin, close. Adnate. **STALK**: Central, equal, 3 cm long, 0.4 cm wide. White near the top, brown towards the bottom. Wiry, filamentous, hollow. Covered with cottony brown scales or fibrils (strings). **SPORE PRINT**: Brown.

Habitat and Substrate: Solitary or scattered in rotting wood of stumps, logs, etc. Somewhat abundant.

Season: July – October or later.

Cultural Use: Not used.

Table 5.2. All species arranged alphabetically by Latin name.

Scientific Name	Tzeltal Name	English Gloss
Agaricus californicus	***konkiw***	***konkiw***
Amanita caesarea	***batz'il k'an tsu***	genuine yellow cup-like
Amanita flavoconia	***xwix k'an tsu***	sister of yellow cup-like
Amanita fulva	***ijk'al k'an tsu***	black yellow cup-like
Amanita muscaria	***k'an tsu' lu'***	yellow cup-like genitalia
Amanita vaginata	***ijk'al k'an tsu***	black yellow cup-like
Amanita verna	***sakil k'an tsu***	white yellow cup-like
Amanita virosa	***sakil balumilal lu'***	white earth genitalia
Armillariella mellea	***xwix chejchew***	sister of genuine mushroom
Auricularia auricula	***k'o' chikin***	snail-like ear
Boletus spp.	***bonkos lu'***	***bonkos*** genitalia
Clavulina cinerea	***tsijtsim lu'***	whiskery genitalia
Clavicorona pyxidata	***tsajal tsijtsim lu'***	red whiskery genitalia
Conocybe tenera	***chejchewil tsa' wakax***	mushroom that grows in cow dung
Coprinus atramentarius	***chejchewil tsa' wakax***	mushroom that grows in cow dung
Coprinus comatus	***chejchewil tsa' wakax***	mushroom that grows in cow dung
Coprinus plicatilis	***slu'il tsa' kaballo***	genitalia that grows in horse dung
Cordyceps militaris	***k'anal lukulmil slu'il te'***	yellow worm-like tree genitalia
Daldinia concentrica	***t'ot'***	***t'ot'***
Dentinum repandum	***kaxlan ok'es lu'***	spanish trumpet genitalia
Entloma sp.	***yaxal balumilal lu'***	blue/green earth genitalia
Fomitopsis scutellata	***k'o' chikin***	snail-like ear
Ganoderma lucidum	***muk'ul chikin jijte'***	large ear of oak tree
Gymnopilus spectabilus group	***chejchew kaballo***	horse mushroom
Helvella crispa	***sakil nukul chikin lu'***	white leathery/flexible ear genitalia
Helvella macropus	***slu'il kap'nal jijte'***	genitalia ***kap'nal*** of oak tree
Heteroporus biennis	***no name***	n/a
Hygrocybe autoconica	***bajkal k'anal chejchew***	clustered yellow mushroom
Hygrocybe conica	***k'anal slu'il tsitimaltik***	yellow genitalia of ***tsitim***
Hygrocybe flavescens	***k'anal slu'il***	yellow genitalia
Hygrocybe subminata	***tsajal k'ank'anik slu'il najk***	red yellowing genitalia of alder
Hypomyces lactiflorum	***tsajal ti'bal***	red meat
Inocybe lanuginosa	***tzotzil lu'***	hairy genitalia
Laccaria amethystina	***yaxal kaxlan k'an chay***	blue Spanish yellow fish
Laccaria laccata	***slu'il samjijte'***	genitalia growing near oaks
Lactarius deliciosus	***tsajal k'an chay***	red yellow fish
Lactarius indigo	***yaxal k'an chay***	blue/green mushroom

Scientific Name	Tzeltal Name	English Gloss
Lactarius scrobiculatus	***ch'ujch'ul k'an chay***	small yellow fish
Lentinus crinitus	***tzetz chikin te'***	shaggy tree ear
Lenzites betulina	***pimil chejchew***	thick mushroom
Lycoperdon foetidum	***tsis chauk***	thunder fart
Lycoperdon perlatum	***tsis chauk***	thunder fart
Lycoperdon pulcherrimum	***tsis chauk***	thunder fart
Lycoperdon pyriforme	***tsis chauk***	thunder fart
Morchella elata	***tsukum ti'bal***	stomach meat
Morchella esculenta	***tsukum ti'bal***	stomach meat
Naematoloma fasciculare	***k'anal chejchew***	yellow mushroom
Otidea sp.	***ijk'al k'o' chikin***	black snail-like ear
Paneolus solidipes	***ijk'al lu'***	black genitalia
Perenniporia contraria	***muk'ul chikin te' ka'al taj***	large tree ear of dry pine
Peziza sp.	***sakil k'o' chikin***	white snail-like ear
Peziza violaceae	***k'anal k'o' chikinul tsajal lum***	yellow snail-like ear red earth
Phellinus aff. *chinensis*	***muk'ul sulte'al meste'***	large tree skin/bark of *Baccharis confertoides*
Phellodon niger	***ijk'al chikin te'***	black tree ear
Pholiota gregariiformis	***no name***	n/a
Phyllotopsis nidulans	***k'anal chejchewul meste'***	yellow mushroom of *Baccharis confertoides*
Pluteus cervinus	***yaxal balumilal slu'il yan jijte'***	blue/green earth genitalia growing near oaks
Polyporus arcularius	***tsu chikin chejchew***	cup-like ear mushroom
Polyporus badius	***najkul chikin te'***	alder tree ear
Ramaria sp.	***k'anal tsijtsim lu'***	yellow whiskery genitalia
Russula cremicolor	***chejchewil tsa'***	mushroom of dung
Russula emetica	***tsajal kaxlan k'an chay***	red Spanish yellow fish
Russula rosacea	***tsajal chejchew***	red mushroom
Russula virescens	***yaxal lu'***	blue/green genitalia
Schizophyllum commune	***sulte'***	tree skin/bark
Stereum ostrea group	***chikin te'ul k'an tulan***	tough yellow tree ear
Strobilomyces floccopus	***ijk'al chejchew***	black mushroom
Suillus sp.	***sakil bonkos***	white ***bonkos***
Tremella reticulata	***sk'apalal sakil tsijtsim lu'***	it's baby's arms white whiskery genitalia
Tremellodendron schweinitsii	***sakil tsijtsim lu'***	white whiskery genitalia

Scientific Name	**Tzeltal Name**	**English Gloss**
Ustilago maydis	***slu'il ixim***	genitalia of corn
Xylaria multiplex	***ijk'al tsijtel lu'***	black ***tsijtel*** vagina

Table 5.3. All species arranged by Tzeltal name in roughly alphabetical order by the prototypical name.

Tzeltal Name	English Gloss	Scientific Name
sakil balumilal lu'	white earth genitalia	*Amanita virosa*
yaxal balumilal lu'	blue/green earth genitalia	*Entloma* sp.
yaxal balumilal slu'il yan jijte'	blue/green earth genitalia growing near oaks	*Pluteus cervinus*
bonkos lu'	***bonkos*** genitalia	*Boletus* spp.
sakil bonkos	white ***bonkos***	*Suillus* spp.
bajkal k'anal chejchew	clustered yellow mushroom	*Hygrocybe autoconica*
chejchew kaballo	horse mushroom	*Gymnopilus spectabilus group*
chejchewil tsa'	mushroom of dung	*Russula cremicolor*
chejchewil tsa' wakax	mushroom that grows in cow dung	*Conocybe tenera*
chejchewil tsa' wakax	mushroom that grows in cow dung	*Coprinus atramentarius*
chejchewil tsa' wakax	mushroom that grows in cow dung	*Coprinus comatus*
ijk'al chejchew	black mushroom	*Strobilomyces floccopus*
k'anal chejchew	yellow mushroom	*Naematoloma fasciculare*
k'anal chejchewul meste'	yellow mushroom of *Baccharis confertoides*	*Phyllotopsis nidulans*
pimil chejchew	thick mushroom	*Lenzites betulina*
tsajal chejchew	red mushroom	*Russula rosacea*
xwix chejchew	sister of genuine mushroom	*Armillariella mellea*
chikin te'ul k'an tulan	tough yellow tree ear	*Stereum ostrea group*
ijk'al chikin te'	black tree ear	*Phellodon niger*
muk'ul chikin jijte'	large ear of oak tree	*Ganoderma lucidum*
muk'ul chikin te' ka'al taj	large tree ear of dry pine	*Perenniporia contraria*
najkul chikin te'	alder tree ear	*Polyporus badius*
tsu chikin chejchew	cup-like ear mushroom	*Polyporus arcularius*
tzetz chikin te'	shaggy tree ear	*Lentinus crinitus*
ch'ujch'ul k'an chay	small yellow fish	*Lactarius scrobiculatus*
tsajal k'an chay	red yellow fish	*Lactarius deliciosus*
tsajal kaxlan k'an chay	red Spanish yellow fish	*Russula emetica*
yaxal k'an chay	blue/green mushroom	*Lactarius indigo*
yaxal kaxlan k'an chay	blue Spanish yellow fish	*Laccaria amethystina*

Tzeltal Name	English Gloss	Scientific Name
batz'il k'an tsu	genuine yellow cup-like	*Amanita caesarea*
ijk'al k'an tsu	black yellow cup-like	*Amanita fulva*
ijk'al k'an tsu	black yellow cup-like	*Amanita vaginata*
k'an tsu lu'	yellow cup-like genitalia	*Amanita muscaria*
sakil k'an tsu	white yellow cup-like	*Amanita verna*
xwix k'an tsu	sister of yellow cup-like	*Amanita flavoconia*
ijk'al k'o' chikin	black snail-like ear	*Otidea* sp.
k'anal k'o' chikinul tsajal lum	yellow snail-like ear red earth	*Peziza violaceae*
k'o' chikin	snail-like ear	*Auricularia auricula*
k'o' chikin	snail-like ear	*Fomitopsis scutellata*
sakil k'o' chikin	white snail-like ear	*Peziza* sp.
sakil nukul chikin lu'	white leathery/flexible ear genitalia	*Helvella crispa*
konkiw	***konkiw***	*Agaricus californicus*
ijk'al lu'	black genitalia	*Paneolus solidipes*
ijk'al tsijtel lu'	black ***tsijtel*** genitalia	*Xylaria multiplex*
k'anal lukulmil slu'il te'	yellow worm-like tree genitalia	*Cordyceps militaris*
k'anal slu'il	yellow genitalia	*Hygrocybe flavescens*
k'anal slu'il tsitimaltik	yellow genitalia of ***tsitim***	*Hygrocybe conica*
kaxlan ok'es lu'	spanish trumpet genitalia	*Dentinum repandum*
slu'il ixim	genitalia of corn	*Ustilago maydis*
slu'il kap'nal jijte'	genitalia ***kap'nal*** of oak tree	*Helvella macropus*
slu'il samjijte'	genitalia growing near oaks	*Laccaria laccata*
slu'il tsa' kaballo	genitalia that grows in horse dung	*Coprinus plicatilis*
tsajal k'ank'anik slu'il najk	red yellowing genitalia of alder	*Hygrocybe subminata*
tzotzil lu'	hairy genitalia	*Inocybe lanuginosa*
yaxal lu'	blue/green genitalia	*Russula virescens*
muk'ul sulte'al meste'	large tree skin/bark of *Baccharis confertoides*	*Phellinus* aff. *chinensis*
sulte'	tree skin/bark	*Schizophyllum commune*
t'ot'	***t'ot'***	*Daldinia concentrica*
tsajal ti'bal	red meat	*Hypomyces lactiflorum*

Tzeltal Name	English Gloss	Scientific Name
k'anal tsijtsim lu'	yellow whiskery genitalia	*Ramaria* sp.
sakil tsijtsim lu'	white whiskery genitalia	*Tremellodendron schweinitsii*
sk'apalal sakil tsijtsim lu'	it's baby's arms white whiskery genitalia	*Tremella reticulata*
tsajal tsijtsim lu'	red whiskery genitalia	*Clavicorona pyxidata*
tsijtsim lu'	whiskery genitalia	*Clavulina cinerea*
tsis chauk	thunder fart	*Lycoperdon foetidum*
tsis chauk	thunder fart	*Lycoperdon perlatum*
tsis chauk	thunder fart	*Lycoperdon pulcherrimum*
tsis chauk	thunder fart	*Lycoperdon pyriforme*
tsukum ti'bal	stomach meat	*Morchella elata*
tsukum ti'bal	stomach meat	*Morchella esculenta*
no name	n/a	*Heteroporus biennis*
no name	n/a	*Pholiota gregariiformis*

Chapter 6

Conclusions

6.1 Results

This research shows that the substance and structure of Tzeltal ethnomycological knowledge is constrained by cultural beliefs, adaptive needs and the unique perceptual features of the macrofungal domain. Through a long history of interaction, experimentation and management the Tzeltal have accumulated extensive knowledge concerning the nutritional, hallucinogenic, toxic and medicinal qualities of the macrofungi in the local ecosystem. This knowledge is directly reflected in oral history and a set of cultural beliefs that strictly distinguishes between culturally useful and culturally useless species of macrofungi. These distinctions are further embedded within the Tzeltal systems of ethnomycological nomenclature and classification, which clearly delineate the subset of macrofungi that are perceived as culturally useful, and serve as a set of guidelines for the safe use of macrofungi as biological resources.

The adaptive need to distinguish between edible and inedible species of macrofungi is particularly important in a society that consumes wild mushrooms on a regular basis. The Tzeltal could be considered ‘mycophiles’, or ‘mushroom lovers’, as they harvest and consume as many as 30 to 40 species of mushrooms during the rainy season from June to December. This season coincides with the ‘hunger months’ during which supplies of staple foods are running low due to the agricultural cycle of the highland region. Current studies of the use of non-cultivated resources suggest that the consumption of mushrooms may provide an important nutritional supplement to the diet of numerous indigenous groups during hunger months, and the Tzeltal themselves believe that many mushroom species provide strength and nourishment to the body. The importance of wild mushroom resources in times of hardship, and the need to avoid potentially toxic species, likely serves to reinforce the strict cultural distinction between edible and non-edible species of macrofungi.

Knowledge of the proper ways to identify, name, harvest and utilize macrofungi is transmitted from generation to generation through the processes of observation, active teaching, oral history and experience. By the age of four or five, children are taught that wild mushrooms are flavorful and nutritious, and they are encouraged to eat the various species that have been brought home from the field. Through both formal and informal means, Tzeltal parents teach their children that there are two distinct classes of macrofungi: those that are edible and those that are toxic or otherwise potentially dangerous to human health. This distinction results in an unequal approach to learning about macrofungi, and throughout their lives the Tzeltal focus their attention on the morphological characteristics, life history, ecological preferences, and cultural value of species that are considered useful.

As they mature, Tzeltal children begin to learn how to identify and name the small subset of well-known edible mushrooms of the highlands. At the same time, they learn to ignore all other species of macrofungi, and to lump any unknown species together into a large residual category of unnamed species that are perceived as culturally useless. Powerful cultural beliefs concerning the dangers of inedible mushrooms are

Figure 6.1 Young Tzeltal girl with fistful of *Armillaria*.

constantly reinforced through cultural narratives that tell of people who consumed unknown species and became drunk or went mad, or in some cases, died. By the time they become adults, Tzeltal individuals develop a deeply ingrained strategy of avoidance of previously unknown species of macrofungi, and they exhibit little interest in observing or experimenting with these unknown species.

The prevailing cultural beliefs surrounding edible and inedible mushrooms strongly influence patterns of mushroom nomenclature. Of the 72 species collected for this dissertation, approximately 40 received consistent Tzeltal linguistic designations that were widely known throughout the highlands. At least 75% of these linguistically recognized species were considered edible, medicinal or otherwise considered useful. I argue that the remaining 25% of linguistically recognized species are abundant in the landscape, large or otherwise morphologically salient, or highly toxic. These patterns indicate that although cultural beliefs account for a major part of the linguistically recognized domain, inescapable morphological, behavioral and nutritional, hallucinogenic, toxic and medicinal features also influence the cultural recognition of macrofungal species.

The majority of Tzeltal informants considered the remaining 32 species collected for this dissertation culturally useless. The linguistic designations applied to these species are usually highly descriptive and decidedly idiosyncratic, varying from informant to informant. In the majority of cases, culturally useless species received no name at all. A pattern of consistency emerged from the inconsistent application of names to culturally useless species: unknown mushrooms are lumped together into a large group that is generally labeled ***lu'***, which can be glossed as 'genitalia'. Membership in this group is clearly determined by cultural beliefs as the morphological, behavioral and nutritional, hallucinogenic, and toxic attributes of these species are as varied as the names they received.

As with other ethnobiological domains, a significant number of mushroom names (96%) are non-arbitrary and iconic. These names often directly encode salient morphological, ecological and culturally characteristics that are useful in identification. The most prevalent classifier associated with mushroom names is color, although attributes such as size, texture, shape, and habitat or substrate preference are utilized regularly. The frequent use of labels that encode salient features may be related to the fact that macrofungi are non-cultivated resources with which the Tzeltal have relatively little hands-on experience. Only the most prevalent and abundant species, such as ***chejchew*** (*Armillaria mellea*), ***bonkos*** (*Boletus* spp.) and ***t'ot'*** (*Daldinia concentrica*) receive unanalyzable linguistic designations.

The body of knowledge associated with culturally recognized species interacts with economic and subsistence strategies, individual preferences and cultural beliefs in a way that leads to highly consistent patterns of classification. Tzeltal ethnomycological classification focuses on natural patterns of similarity and dissimilarity, with at least 51 monotypic taxa at the genus rank and at least 3 polytypic genera that include more than one member of the specific rank. Moving upward in the taxonomic hierarchy, the Tzeltal appear to recognize and label at least two taxa at the rank of life-form. These life-forms, which include all taxa of lower rank, are formed on the basis of readily observable patterns of overall morphology and, perhaps more importantly, substrate preference. 46 species that grow in the earth are lumped together under the label ***chejchew***, and 26 species that grow in wood are grouped under the designation ***chikin te'***. The life-form category ***chejchew*** is further subdivided into at least three polytypic folk genera and four complexes based on the recognition of overall morphological similarity, whereas the life-form category ***chikin te'*** appears to include only monotypic folk genera. The Tzeltal distinguish between macrofungi and other kinds of living organisms, and lump all folk taxa within a single kingdom with the linguistic designation ***chejchew***.

Classification through recognition of natural patterns is not enough, however, to fully explain how the Tzeltal categorize and label the macrofungi in their local environment. The Tzeltal clearly place importance on the cultural utility of macrofungi, and consistently group edible or medicinal species together under the special purpose designation ***chejchew***. Culturally useless species of macrofungi are always grouped together under the special purpose designation ***lu'***. These two special purpose categories are well developed and highly consistent across Tzeltal informants. They are, however, very different in the numbers of species included: the special purpose category ***chejchew*** includes between 30 and 40 culturally useful species, whereas the category ***lu'*** includes all other species found in the highlands (a number which is likely to be a few hundred species). Another key difference is that all species lumped within the category ***chejchew*** receive consistent linguistic designations. As mentioned before, of the many species that the Tzeltal categorized as a type of ***lu'***, only 10 received consistent names. These 10 species are highly abundant and easy to observe, large and morphologically distinct, or considered by the Tzeltal to be highly toxic.

Knowledge of the life history and reproduction of macrofungi is highly generalized and relatively incomplete. The Tzeltal believe that macrofungi are stationary, ephemeral, seasonal, and die rapidly rather than regenerating. There is little specialized knowledge of macrofungal reproduction, even for species that are highly culturally salient. The general model that emerges from interviews indicates that the Tzeltal believe that mushrooms emerge from tiny roots that develop in the substrate. The young fruiting body develops as a ball in the substrate; this ball grows rapidly and pushes out of the substrate, becoming fully developed within a few hours. The mushroom is delicate and requires moisture to survive, and direct sunlight is thought to lead to rapid desiccation and death. Although various species are known to appear near specific trees, mushrooms are not thought to regenerate after death, nor are they believed to return to the exact same spots from season to season. Overall, the life cycle of an individual organism is considered short in comparison to other living things. Through reference to life history features including locomotion, growth patterns, and life stages my Tzeltal collaborators almost always claimed that mushrooms are neither plants nor animals, but a different kind of living thing.

Knowledge of taste, texture, seasonality, and habitat and substrate preferences is intimately associated with the ethnomycological systems of nomenclature, classification and use. For macrofungal species that are highly prized and consistently utilized across the highlands, the Tzeltal have intimate knowledge of the flavor and texture of the species, the specific months within which the species generally appears, which stages of ecological succession and kinds of forests within which to find the species, and which substrates the species prefers. Much of this knowledge parallels that of western science, and there is agreement that large, fleshy species of edible fungi are most likely to be found in mature forests during the rainy season. In fact, a few elder collaborators implied that the number of edible mushrooms is declining through time as human impact on the landscape has reduced the size of mature forests. The Tzeltal do not generally bother to generate this kind of ethnoecological knowledge for species that are unknown, unnamed, or considered useless, and often will profess ignorance of the subject.

Tzeltal adults generally identify familiar macrofungi immediately and without difficulty, suggesting they rely on a gestalt idea of the overall morphological form of the organism rather than a checklist of identifying features. Because they identify, harvest and consume only about 30 species on a seasonal basis, misidentifications are rare. When asked to discuss the features that make each species unique, however, the Tzeltal are capable of pointing out a long list of macroscopic characteristics. Defining attributes used in identification parallel those of professional and amateur mycologists throughout the world, and include habitat, substrate, size, shape, color, texture, thickness, and the presence or absence of gills, pores, teeth, a cap, stipe, annulus or volva, and growth habits such as solitary, scattered or clustered specimens. Any species that cannot be positively identified is invariably avoided.

Families often collect edible mushrooms together as a group by making special trips to late-stage second growth forests in which prized species are regularly found. The more abundant and generally less desirable species are often harvested opportunistically while the family is working in the milpa, or traveling along one of the numerous footpaths that wind through the mountains. The majority of collections are made for consumption at the household level, although a few individuals harvest valuable species for sale in local markets. Species that are thought to possess medicinal properties are generally sought out when medical conditions demand. In some sense, the Tzeltal employ conservation strategies when harvesting macrofungi, attempting to lessen the affects of their activity by leaving the lower half of the stipe, base and mycelium in the substrate.

The data gathered in this dissertation show that macrofungi are an important biological resource for the Tzeltal of highland Chiapas. As with other kinds of living things, the Tzeltal interact with and manage macrofungi through both direct means such as harvesting and indirect means such as landscape transformation. Through a long history of utilization, the Tzeltal have developed extensive knowledge of the morphological, ecological and nutritional, hallucinogenic, and toxic attributes of

Figure 6.2 Tzeltal woman collecting *Armillaria* in her door garden.

macrofungal species. Ethnomycological nomenclature and classification follows highly consistent patterns across individuals throughout the highlands, and the substance and structure of these folk cognitive systems serve adaptive functions. This knowledge is organized in systematic ways that both reflect the unique biological features of the macrofungal domain and facilitate safe cultural use of the domain.

6.2 Theoretical and practical implications

Changes in health care, education and infrastructure in the highlands of Chiapas have led to major shifts in demographics and human impact on the landscape during the past twenty years. Concurrent with these changes are political and economic initiatives such as the North American Free Trade Agreement (NAFTA), Plan Puebla Panama

(PPP), and the new immigration laws proposed in 2004 by president Bush of the United States and backed by president Fox of Mexico, all of which provide new incentives for emigration from the impoverished highlands. Conservationists worldwide are decrying the rapid advent worldwide development initiatives that result in the loss of both biodiversity and traditional ecological knowledge. In Chiapas, the effects of modernization, globalization, and more significantly, overpopulation are already becoming manifest in terms of deforestation, slope erosion, urbanization, a shift away from traditional clothing and language, and heavy out-migration of young Tzeltal men.

The question is not whether such changes are negative, but how the Tzeltal themselves will chose to adapt, and in what ways they will maintain traditional values, knowledge and beliefs as they adopt new worldviews and technologies. The potential exists for the extensive loss of traditional systems of knowledge, and a concurrent loss of Mayan identity. This dissertation is one among many that document the accumulated knowledge of centuries of Tzeltal interaction with, and understanding of the local environment. Not only are dried specimens of macrofungi collected in the region stored in the herbarium at ECOSUR in San Cristóbal de las Casas for perusal by scientists, enthusiasts and the Tzeltal themselves, but these data will be transformed into informative booklets that include Tzeltal names, photographs and documented uses for museums in the communities in which research was conducted. These may prove to be important educational resources for Tzeltal communities in the very near future.

The documentation of macrofungal diversity and use in the highlands has implications for the conservation of biological diversity as well. These data indicate that the majority of edible mushrooms are harvested in mature secondary forests that have been uncut for decades. Rapidly increasing populations and the demand for lumber and land for cultivation are all changes that could impact the distribution and availability of macrofungi in the highlands. At the same time, harvests of staple foods such as corn and beans are threatened by erosion and the introduction of cash crops such as coffee that are subject to worldwide fluctuations in prices. Paradoxically, as the reliance on wild food supplements to the diet is likely to become more important in the highlands, the availability of macrofungi is almost guaranteed to decrease.

Admittedly, a call for the preservation of macrofungi is unlikely to ever be an important part of the conservation debate in the highlands. This study does suggest, however, that macrofungi play an important role in Tzeltal diet during times of hardship, and as the highlands are affected more and more by human impacts, the importance of supplemental wild foods is difficult to overestimate. In addition, we simply have not evaluated the potential nutritional, economic, pharmacological and ecological value of macrofungi in the highlands. Studies in other parts of Mexico and north America indicate that mushrooms not only play crucial roles in ecosystem maintenance, but that sustainable harvesting of macrofungi for international markets can become a significant economic resource for local populations as worldwide demand for unique mushrooms increases. And despite the fact that fungi as a group have proven to contain numerous secondary compounds important in medicine, research into the potential pharmacological value of macrofungi has been minimal. Fungal species represent an important potential resource for indigenous populations in the future, and the call for the conservation of macrofungi is just another reason to preserve threatened ecosystems.

Figure 6.3 Wild mushrooms for sale on a roadside stand along the highway.

The potential impact of present and future changes on local ecosystems, local market systems, and ethnoecological domains of traditional knowledge draw attention to the need to investigate and understand the role of macrofungi in indigenous cultures. This study is not meant to examine Tzeltal ethnomycological knowledge in isolation. The data presented herein provide more evidence to support the work of Berlin et al. (1974) and Berlin (1992) that humans everywhere classify living things according to natural, observable patterns. These data also support the work of Berlin (1992), Ellen (1979; 1993) and many others who have shown that a history of human management, cultural beliefs and resource use contexts affect systems of ethnobiological classification. More importantly, perhaps, the data presented herein indicate that specific domain features such as the size of the domain, prevalence of organisms, and nutritional, hallucinogenic and toxic properties, significantly influence the substance and structure of traditional systems of nomenclature and classification in ways that could, through the development of a set of measurement criteria, be predicted.

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Appendix A

Macrofungal Collection Sheets

Agaricales:

Collection #__________________ Collector________________________
Common Name____
Determination____
Informant Name____________________________________ Age_____________ M F
Language(s)____
Alt._____________ GPSLat.___________ GPSLong._________ Waypoint_________
Municipio_________________ Paraje __________________ Barrio ______________

Substrate:____
Habit (Solitary/Clustered):____
Type of Vegetation: (unin k'inal, te'tikil, akil)_________________________________
Plant Associations:____

Mushroom Description:
BASIDIOCARP (COMPLETE MUSHROOM BODY)

Spore Color____
Size____ Type_____________________
Consistency (color, texture, thickness, feel)_____________________________________

PILEUS (CAP)

Size__________________________________ Shape________________________________
Color____
Surface Characteristics (viscid, glutinous, hygrophanous, smooth, scaly, granulous, fibrillose, warty, etc.)____
Ornamentation____
Margin (inrolled, incurved, straight, uplifted, striate, translucent-striate)_______________

Consistency________________________________ Latex (color)_____________________

GILLS

Color_____________________________ Pattern__________________________________
Attatchment to Stalk____
Spacing/Thickness____

FLESH

Color/changes____
Texture/Thickness____
Odor__________________________________ Taste_______________________________

STIPE

Size____________________________________ Position_____________________________
Color/changes___________________________ Shape_______________________________
Volva_________________________________ Annulus______________________________
Consistency___________________________ Ornamentation________________________

When most abundant?_____________________ Abundance: +++____ ++____ +____
How Used?____

Aphyllophorales and Polyporaceae:

Collection #_________________ Collector:________________________
Common Name____
Determination____
Informant Name___________________________________ Age____________ M F
Languages____
Alt.____________GPSLat.___________GPSLong.__________Waypoint___________
Municipio______________________ Paraje_________________ Barrio___________

Substrate:____
Habit (Solitary/Clustered):____
Type of Vegetation: (unin k'inal, te'tikil, akil)________________________________
Plant Associations:____

Mushroom Description:
BASIDIOCARP (COMPLETE MUSHROOM BODY)

Spore Color____
Size____ Type__________________
Consistency (color, texture, thickness, feel)___________________________________

PILEUS (CAP)

Size_________________________________ Shape_____________________________
Color________________________________ Ornamentation____________________
Surface Characteristics (viscid, glustinous, hygrophanous, smooth, scaly, granulous, fibrillose, warty, etc.)____
Margin (inrolled, incurved, straight, uplifted, striate, translucent-striate)____
Consistency___________________________ Latex_____________________________

GILLS

Color______________________________ Pattern_____________________________
Spacing/Thickness____
Other____

FLESH

Color/changes____
Texture/Thickness____
Size________________________ Odor__________________ Taste________________
Other____

STIPE

Size_________________________________ Position____________________________
Color/changes________________________ Shape______________________________
Consistency__________________________ Ornamentation______________________

When most abundant?_______________________ Abundance: +++___ ++___ +___
How Used?____

Macrofungi With Pores:

Collection #__________________ Collector________________________
Common Name____
Determination____
Informant Name__________________________________ Age_____________ M F
Language(s)____
Alt.____________ GPSLat.___________ GPSLong.__________ Waypoint_________
Municipio_________________ Paraje __________________ Barrio ______________

Substrate:____
Habit (Solitary/Clustered):____
Type of Vegetation: (unin k'inal, te'tikil, akil)_________________________
Plant Associations:____

Mushroom Description:
BASIDIOCARP (COMPLETE MUSHROOM BODY)

Spore Color____
Size____ Type____________________
Consistency (color, texture, thickness, feel)______________________________

PILEUS (CAP)

Size________________________________ Shape______________________________
Color____
Surface Characteristics (viscid, glutinous, hygrophanous, smooth, scaly, granulous, fibrillose, warty, etc.)____
Ornamentation____
Margin (inrolled, incurved, straight, uplifted, striate, translucent-striate)______________
____
Consistency______________________________ Latex (color)____________________

PORES

Color___________________________ Pattern_______________________________
Attatchment to Stalk____
Spacing/Thickness____
Other____

FLESH

Color/changes____
Texture/Thickness____
Odor_______________________________ Taste_____________________________

STIPE

Size_________________________________ Position__________________________
Color/changes_________________________ Shape____________________________
Volva______________________________ Annulus____________________________
Consistency__________________________ Ornamentation______________________

When most abundant?____________________ Abundance: +++____ ++____ +____
How Used?____

Other Groups:

Collection #__________________ Collector________________________
Common Name____
Determination____
Informant Name___________________________________ Age_____________ M F
Language(s)____
Alt.____________ GPSLat.___________ GPSLong._________ Waypoint_________
Municipio________________ Paraje _________________ Barrio ______________

Substrate:____
Habit (Solitary/Clustered):____
Type of Vegetation: (unin k'inal, te'tikil, akil)________________________________
Plant Associations:____

Mushroom Description:
BASIDIOCARP (COMPLETE MUSHROOM BODY)

Spore Color____
Basidiocarp Color____
Size____
Type____
Consistency (color, texture, thickness, feel)____________________________________
Shape____
Surface Characteristics (viscid, glutinous, hygrophanous, smooth, scaly, granulous, fibrillose, warty, etc.)____
Ornamentation____
Pores or Gills?:____
____

FLESH

Color/changes____
Texture/Thickness____
Odor______________________________ Taste______________________________
Other____

STIPE

Size________________________________ Position___________________________
Color/changes________________________ Shape____________________________
Volva______________________________ Annulus____________________________
Consistency_________________________ Ornamentation______________________

When most abundant?___________________ Abundance: +++____ ++____ +____
How Used?____

Questionnaire – Mushroom Uses

Collection #____________ Determination____________________________________
Common Name____
Informant_______________________________________ Age_______________ M F
Occupation (Specialization)____
Education________________________ Municipality___________________________
Paraje____________________________ Barrio_______________________________

Mushroom Use(s)

Edibility (Preparation, Taste, Nutrition)____________________________________

Poxil (Medicine, Type of Illness)____

Preparation (Mixed With Other Things)?____________________________________

How Often Taken?____
How Long Take to Work?____
How Does Medicine Work In Body?____

Poisonous?____
Effect (Death, Vomiting)____
Cure?____

Season__________________________________ Abundance +++____ ++____ +____
Habitat/Habit:____
Lookalikes?____
Relations (Brothers/Sisters)?____
Uses of Relations?____

Any Other Uses (Fuel, Ritual, Incense, Ornamentation)?________________________

Who Collects It (women, children, men)?_____________________________________
When/Why?____
Do you always pick this mushroom when you see it (why- why not)?_____________

Do people sell this mushroom? Y N
Where?____
How much is the mushroom worth?____
Who sells these mushrooms?____
Who collects them?____
How do they get them to the market?_______________________________________
Who buys these mushrooms?____
How are these mushrooms prepared for sale (dried, fresh, packaged)?____________
____
Does anyone cultivate this mushroom?____
Do any (outsiders) people come to pick this mushroom for commercial sale?_______
____

IDENTIFICATION CHARACTERISTICS:

How do you distinguish (know) this mushroom?________________________________
____

- **Cap Color____**
- **Cap Size____**
- **Cap Shape____**
- **Cap Texture____**
- **Stalk Color____**
- **Stalk Length, Width____**
- **Stalk Texture____**
- **Annulus____**
- **Volva____**
- **Gill Color____**
- **Gill Attachment____**
- **Habit____**
- **Habitat____**
- **Taste____**
- **Changes In Color____**
- **Season____**
- **Weather____**
- **Altitude____**
- **Other____**
- ____
- ____
- ____
- ____

Appendix B

Freelist Interview

Name: ____ Gender M F Age ______

Date: ________________________ Paraje, Municipio ______________________

Mushroom Name:	**Use:**	**Habit/Habitat:**	**Poxil/Vitam**
1)________________	______________	_____________	____________
2)________________	______________	_____________	____________
3)________________	______________	_____________	____________
4)________________	______________	_____________	____________
5)________________	______________	_____________	____________
6)________________	______________	_____________	____________
7)________________	______________	_____________	____________
8)________________	______________	_____________	____________
9)________________	______________	_____________	____________
10)_______________	______________	_____________	____________
11)_______________	______________	_____________	____________
12)_______________	______________	_____________	____________
13)_______________	______________	_____________	____________
14)_______________	______________	_____________	____________
15)_______________	______________	_____________	____________
16)_______________	______________	_____________	____________
17)_______________	______________	_____________	____________
18)_______________	______________	_____________	____________
19)_______________	______________	_____________	____________

Appendix C

Pile Sort and Triad Interviews

Pile Sort Questions:

This process repeated until all groups have been split as far as the informant desires.

1) ja'ini ja' slok'omba kich'obetal jo'tik te a la chejchewetike maj na' ay la wan ya na'besbaini tatik? Binti sbil li ja'ini y binti ya yich' utel?

These are photos of wild mushrooms. Can you tell us the name of each mushroom and how you utilize the organism?

2) te bi ya jk'an jo'tik tatik jai' jun grupo inito cheb grupo yaj k'an yax lok' jo'tik a jun grupo te ba pajal soke y jun grupo te ay kol jmajike?

We would like you to create two groups from the total number of photos. Create this groups based on which organisms are most similar.

3) ja' tsi' jun grupo ini pajalawan (o) bin ut'il yu'un yael tsi' la xat' lok'ele?

If this group is more similar, why?

Triads Test Design

RANDOM TRIADS TEST
MUSHROOMS OF THE HIGHLANDS
SPRING, 2001
NAVIL, TENEJAPA, CHIAPAS, MX

Name:____ Age:_______ Gender: M F

Date:____

Location:____

Balanced Block Design (N=15), Lambda 2
Begin Set: (3,6,9,10,21,25,31,33,35,38,40,42,45,48,49)

	ITEM I	**ITEM II**	**ITEM III**
1)	6	31	40
2)	10	38	31
3)	45	35	40
4)	31	3	38
5)	42	9	49
6)	48	42	10
7)	9	3	38
8)	6	3	49
9)	35	3	42
10)	48	49	45
11)	45	3	40
12)	6	31	48
13)	45	42	38
14)	33	42	25
15)	3	21	6
16)	6	38	25
17)	35	49	21
18)	35	31	40
19)	48	25	3
20)	33	48	49
21)	9	48	6
22)	21	10	33
23)	21	40	48
24)	48	35	9
25)	31	49	45
26)	45	9	6
27)	21	9	40

	ITEM I	**ITEM II**	**ITEM III**
28)	42	6	10
29)	38	35	33
30)	10	3	40
31)	21	6	25
32)	31	10	33
33)	35	10	21
34)	49	40	25
35)	38	40	10
36)	45	38	21
37)	31	25	48
38)	25	10	49
39)	3	33	9
40)	35	25	45
41)	42	49	21
42)	35	6	49
43)	38	40	49
44)	45	10	6
45)	33	38	25
46)	10	45	48
47)	33	35	6
48)	42	31	45
49)	33	9	45
50)	9	21	31
51)	38	35	48
52)	42	40	48
53)	3	48	33
54)	6	38	42
55)	25	31	21
56)	40	42	33
57)	10	25	9
58)	40	9	25
59)	10	35	9
60)	45	25	3
61)	21	33	45
62)	3	49	10
63)	42	9	31
64)	49	9	38
65)	40	6	33
66)	21	48	38
67)	42	25	35
68)	3	42	21
69)	31	33	49
70)	35	31	3

Appendix D

Qualitative Interview Questions

Informant:
Date:
Sex:
Age:
Location:

1) How did mushrooms originally get on earth? Is there a story?

2) How do you learn about mushroom names and which ones are edible?

3) How did the person who taught you learn about them?

4) Who was the first person to learn about them and how did they do it?

5) Do they grow from seeds? How do they grow?

6) Why do some mushrooms grow on the ground, and some on rotting wood?

7) Do mushrooms grow near certain kinds of trees? Which ones? Why?

8) What do mushrooms eat?

9) Why do they only grow at certain times of year?

10) Can someone grow mushrooms? How?

11) Why are some mushrooms poisonous?

12) How do you know if one is poisonous?

13) Why do some mushrooms make you crazy?

14) Is there a cure for the craziness?

15) Why are some mushrooms edible?

16) How do you know which ones are edible?

17) Why do you eat mushrooms?

18) Do mushrooms have vitamins or nutrition?

19) Do you ever eat mushrooms you don't know?

20) Are any mushrooms used as medicine?

21) Are mushrooms hot or cold?

23) Are mushrooms animals, plants, or something different?

24) What is the word (verb) used to describe eating mushrooms (ti'bal?). In other words, do you we'el a mushroom, kux a mushroom or ti'bal a mushroom? Why?

25) Do mushrooms have meat?

26) Is there a general term for mushrooms as a group?

27) Do mushrooms have families? Brothers, Sisters?

28) Do all edible mushrooms have names? Why?

29) Do non-edible mushrooms have names? Why?

30) What is the difference between a chejchew and a lu'?

31) What is the difference between a chejchew and a chikin te'?

32) What is the difference between a lu' and a chikin te'?

33) Why are some mushrooms called lu'?

34) Do people in other communities know the same mushrooms?

35) Do people in other communities know different mushrooms? Why?

36) Do men and women know different mushrooms? Why?

37) Who collects mushrooms? Why?

38) Religious Uses?

Appendix E

Mushroom Sentence Substitution Frame Survey

Name: ____ Gender M F Age ______

Date: _________________________ Paraje, Municipio ______________________

1) ____ is edible

2) ____ is poisonous

3) ____ can cause vomiting

4) ____ can cause death

5) ____ can cause diarrhea

6) ____ can make you drunk/crazy

7) ____ can cause stomach pains

8) ____ has vitamins/nutrition/yip

9) ____ has tulan yip (bad force)

10) ____ tastes like meat

11) ____ tastes like a vegetable

12) ____ tastes very good

13) ____ does not have much flavor

14) ____ is hot

15) ____ is cold

16) ____ only grows under oaks

17) ____ only grows under pines

18) ____ only grows in dry/rotting wood

Name:______________________________ Date:________ Location:____________

19) ____ grows on tree roots

20) ____ only grows in pastures

21) ____ only grows in manure

22) ____ grows in k’altik

23) ____ grows in kabenal

25) ____ grows in wan k’altik

26) ____ grows in unin k’inal

27) ____ grows in te'tikil

28) ____ grows in ja'mal

29) ____ can cure diarrhea

30) ____ can cure burns

31) ____ can cure vomiting

32) ______________________________________ cures itchy/swollen testicles

33) ____ can cure stomach ache/gas

34) ____ can cure warts

35) ____ cures tiredness/weakness

36) ____ can cure cuts of the skin

37) ____ can cure rashes

38) ________________________________ cures mothers who aren't giving milk

39) ____ cures bedwetting

Name:______________________________ Date:________ Location:____________

40) ____ can be boiled

41) ____ can be grilled

42) ____ can be fried

43) ____ is crushed and eaten molido

44) ____ can be eaten raw

45) ____________________________________ only grows during the rainy season

46) ____ grows all year round

47) ____ is a kind of chejchew

48) ____ is a kind of lu'

49) ____ has a sombrero (xpixol)

50) ____ has an annulus (stsek)

51) ____ has a short stem (kom yakan)

52) ____ has a long stem (najt yakan)

53) ____ has a fat stem (jujpen yakan)

54) ______________________________________ skinny stem (jichil, chin yakan)

55) ____ has a vovla (pujul yakan)

56) ____ has gills (sbelal)

57) ______________________________________ has pores (jujtatik, cho'chontik)

58) ____ has roots (yisim)

Name:______________________________ Date:________ Location:____________

59) ______________________________________ scales on the cap (xch’inul sjol)

60) ____ is fleshy/soft (k'un)

61) ____ is woody/tough (tulan)

62) ____ is round like a ball

64) ____ is sold in the market

65) ____________________ is smooth on the underside

66) ____________________ grows like coral (tsijtsim)