

EDIBLE INSECTS AS PART OF THE TRADITIONAL FOOD SYSTEM OF THE POPOLOCA TOWN OF LOS REYES METZONTLA, MEXICO

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Edible insects are an integral part of the Traditional Food System of the Popoloca people of Los Reyes Metzontla in Mexico. Investigation of the knowledge associated with the gathering, preparation, consumption and classification (hot-cold) of edible insects shows that insect gathering is closely related with other activities such as subsistence agriculture, firewood collection and animal husbandry. These activities involve visits to the scrubland where, in addition, many wild foods are gathered depending upon their temporal availability. The people of Los Reyes Metzontla consume at least 17 species of insects. One of them, (Mormidea (Mormidea) notulata, Hemiptera: Pentatomidae), is a new record for the Edible Insects Database in Mexico and a new record for the state of Puebla.

Key words: *edible insects, Traditional Food Systems, Popoloca, Los Reyes Metzontla*

Los insectos comestibles son una parte integral del Sistema Tradicional de Alimentación (STA) de los Popolocas de Los Reyes Metzontla en México. El estudio de los conocimientos tradicionales asociados a la recolección, preparación, consumo y clasificación "frío-caliente" de los insectos comestibles muestra que la recolección de insectos está íntimamente relacionada con otras actividades como la agricultura de subsistencia, la recolección de leña y el pastoreo extensivo de chivos. Estas actividades implican visitas al monte, en donde además de la actividad principal los habitantes recolectan una serie de alimentos silvestres con base a su disponibilidad y abundancia temporal. Los habitantes de Los Reyes Metzontla consumen al menos 17 especies de insectos. Una de ellas, (Mormidea (Mormidea) notulata, Hemiptera: Pentatomidae) es un nuevo reporte de especie comestible para México, así como un nuevo registro (Estado de Puebla) para su distribución en México.

Introduction

Traditional Food Systems (TFS) encompass all the food available from local resources that are culturally accepted and include a remarkable diversity of plants, fungi, insects, amphibians, reptiles, birds, fish and mammals (Kuhnlein and Receveur 1996). These food resources are an important and integral part of the subsistence strategies of many indigenous peoples throughout the world (Dufour and Wilson 1994; Johns 1999) providing them with essential micronutrients (Kuhnlein 2003; Kuhnlein and Receveur 1996). TFS are associated with local knowledge, including ethnoecology, folk taxonomy, socio-cultural significance, and the techniques for acquisition, processing, and use of these wild foods

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(Hunn 1999; Kuhnlein and Receveur 1996; Paoletti and Dreon 2005; Toledo, 1991). Local knowledge associated with TFS represents many generations of observation and adjustment and it is essential to study, record and preserve this knowledge in order to understand how traditional foods contribute to the diets that support indigenous people (Hunn 1999; Kuhnlein and Receveur 1996; Paoletti and Dreon 2005; Wahlqvist and Lee 2007). This becomes more critical as socio-cultural (i.e., globalization) and ecological (i.e., global warming) factors threaten the already fragile condition of the Traditional Food Systems (Armelagos 1997; Kuhnlein and Johns 2003; Mintz and Du Bois 2002).

Insects constitute an important component of the diet of many cultures around the world and their consumption makes efficient use of available natural resources. Approximately 2000 species of edible insects have been identified (Bodenheimer 1951; Mitsuhashi 1984; Ramos-Elorduy 1997, 2005), and people consider them a delicacy as well as a healthy and valuable part of their diets (DeFoliart 1992; Morris 2004). In general, insects are a good source of protein, fats, unsaturated fatty acids, minerals, such as iron and zinc, and vitamins, such as thiamin and riboflavin (Bukkens 1997; Meyer-Rochow 1976; Ramos-Elorduy 2005; Ramos-Elorduy et al. 2006; Ramos-Elorduy et al. 1998). The consumption of leaf- and litter-feeding insects and other invertebrates by Amazonian Amerindians illustrates how entomophagy is integral to successful adaptations to the local environment. Leaves and litter are abundant in the rainforest, so this subsistence practice takes advantage of those food webs that have the highest energy flow to obtain animal protein (Paoletti et al. 2000). Some groups, such as the Jotís in Venezuelan Amazonia (Choo et al. 2009), even manipulate insect resources, in this case by cultivating palm weevil larvae (*Rhynchophorus palmarum* (L.) and *Rhinostomus barbirostris* (Fab.)). The rewarding use of insects as food involves a deep knowledge of the biology and ecology of species.

In Mexico, indigenous peoples have long used insects as food. Bernardino de Sahagún's Florentine Codex lists 96 species of edible insects regularly consumed in central Mexico before the Spanish conquest (Ramos-Elorduy and Pino-Moreno 1989; Sahagún 1979). Ramos-Elorduy and Pino-Moreno (1997) have identified 91 species of edible insects that were consumed in the Valley of Mexico in prehispanic times. Those insects provided an important source of protein, vitamins and minerals to a population where other sources of protein, like meat, were mainly reserved for the nobility and where there were few domesticated animals (Katz 1997).

Specific knowledge associated with entomophagy is handed down through generations by imitation, oral transmission and instruction, and conveys when and how to find, collect, and prepare certain species of insects (Costa-Neto and Ramos-Elorduy 2006; Ramos-Elorduy 2005; Ramos-Elorduy and Pino-Moreno 1997). Ramos-Elorduy et al. (2006) have registered around 535 species of edible insects currently used in central, southern and southeastern Mexico. In general, native people in Mexico gather edible insects for family consumption, selling the surplus locally. Some species, highly valued as delicacies, are in demand in markets and urban centers (Ramos-Elorduy 2006).

When studying a group's TFS it is important to consider that both cultural and environmental factors determine what makes some species edible and

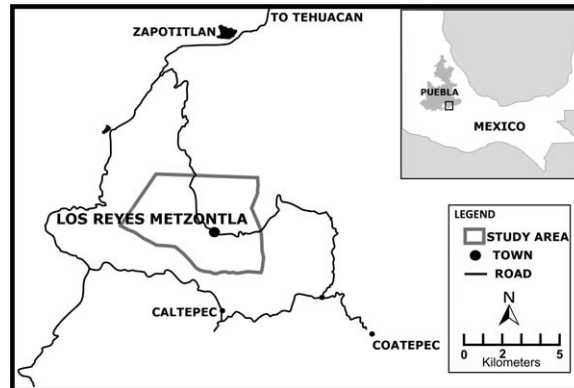


Figure 1. Territory of the Popoloca community of Los Reyes Metzontla, Mexico.

preferred over others. Weather, altitude, latitude, availability, religion and belief systems influence dietary choices (Contreras and García 2005; Harris 1974; Kuhnlein and Receveur 1996; Morris 2004). This study documents the traditional knowledge of the Popoloca people from Los Reyes Metzontla, Mexico about the collection, preparation, consumption and classification (hot-cold) of edible insects. We place entomophagy in its ecological context and describe its relationship to other economic activities to elucidate its role in their Traditional Food System.

Study Area and Methods

Los Reyes Metzontla, a municipality of Zapotitlán Salinas, Puebla, is part of the floristic province of the Tehuacán-Cuicatlán Valley. The valley, located in the southern part of the state of Puebla and northern Oaxaca, is part of the Mexican Xerophytic region (Rzedowski 1978). The Los Reyes Metzontla territory covers 3,648 ha and is located between $18^{\circ}12'00''$ and $18^{\circ}15'30''$ N and between $97^{\circ}27'00''$ and $97^{\circ}32'30''$ W, at an average altitude of 1850 m.a.s.l (Figure 1). The study area is considered a semi-arid region, with an annual mean temperature of 21°C and an annual mean precipitation of 400 mm (Dávila et al. 2002; Villaseñor et al. 1990). The vegetation is mainly xerophytic scrubland (Figure 2), characterized by cacti and other succulents such as *Myrtillocactus geometrizans* Mart., as well as *Prosopis laevigata* (Humb. & Bonpl. Ex Willd) M.C Johnston, *Dasyllirion serratifolium* Zucc., *Schinus molle* L., *Agave* spp. and *Yucca periculosa* Becker (Dávila et al. 2002; Villaseñor et al. 1990).

The town of Los Reyes Metzontla has 983 inhabitants (INEGI 2005). Although only the elderly speak the Popoloca language, the traditions, culture and practices of the general population are typically Popoloca, and most importantly, they identify themselves as part of this ethnic group. Pottery handcrafts and subsistence agriculture are the main economic activities of the town. The Popoloca are among the least known and least studied ethnic groups in Mexico. Since the colonial period, the Popolocas have inhabited three discontinuous areas located northwest, west and south of the city of Tehuacán,



Figure 2. A view from the scrubland of Los Reyes Metzontla. Photograph by A.M Acuña.

and they maintain economic and political relationships with nearby urban centers. People in these areas speak different variants of the Popoloca language (Gámez-Espinosa 2006; Jäcklein 1974) and are characterized by a high degree of marginalization and poverty, low access to health and education services, and a high rate of migration to urban centers and the USA (Gámez-Espinosa 2006; INEGI 2000).

To document the Popoloca's use of edible insects and the traditional knowledge associated with entomophagy, we compiled information from 59 randomly selected informants during insect gathering seasons. From February to October 2009, we conducted semi-structured interviews with informants aged from 8 to 83. We also interviewed four key informants, elderly people with extensive knowledge and experience in all aspects of TFS, and accompanied them on gathering trips for most species. Permission for this research was granted by the local authorities with verbal informed consent from all our sources. Most of our insect specimens were collected by our informants. Some specimens were identified by experts on the families: pentatomids by Guillermina Ortega León from the *Instituto de Biología* of Universidad Nacional Autónoma de México (UNAM) and bees by one of the authors (CHV). The rest of the specimens were identified using the *Colección Nacional de Insectos* of UNAM. Samples of adult stages were preserved dry while the immature stages of insects were kept in bottles containing 70% alcohol.

In order to understand the broader Popoloca TFS of Los Reyes Metzontla, we studied the non-cultivated plant foods that are a part of their gathering system, as well as the edible insects. Using the 82 species of edible plants reported by Paredes-Flores et al. (2007) for the region, we developed a questionnaire to record the number of edible plants that were actually consumed in Los Reyes Metzontla and the number that were gathered in the scrubland.

Traditional Food System of Los Reyes Metzontla

The TFS of Los Reyes Metzontla comprises a wide variety of cultivated and wild foods. The cultivated plants include the association of maize (*Zea mays* L.) and beans (*Phaseolus vulgaris* L.), which are the main crops of the *milpa* system and essential staples for the Popoloca, but other domesticated plant species are grown in home gardens. In this study, we focused only on wild edible species. We documented the consumption of 17 species of insects, 34 species of wild plants, 1 species of mushroom, and rabbits. Therefore, in addition to cultivated plants, the TFS of Los Reyes Metzontla is composed of at least 53 wild species, 32% of them insects.

The *monte*, common lands where the original vegetation, mainly xerophytic scrubland, is preserved in varying degrees and where their agricultural fields are located, is an important source of wild resources for the Popoloca. The people of Los Reyes Metzontla visit the scrubland almost every day to carry out three main subsistence activities: firewood gathering, agriculture and extensive goat grazing. In addition, they collect different kinds of wild plants and insects depending on their spatial and seasonal availability.

The Popoloca go to the scrubland once or twice a week to gather firewood mainly for pottery production and cooking. Every family cultivates several small plots widely distributed in the *monte* at a one to two hour walk from town. Subsistence agriculture requires visits to fields several times a week between May and December for plowing, sowing, weeding and harvesting. Animal husbandry is a main subsistence activity in the region and it is based on a system of extensive grazing. Goats are sold at regional markets although some of them are consumed on special occasions (Hernández et al. 2001). Goat herding is an everyday activity that involves all family members. One member of the family takes the goats (around 10–20 animals per family) and donkeys to the *monte* to graze daily from 10 am to 5 pm. The shepherd spends his time tending the animals and searching for different kinds of plants or insects depending on the season and availability, and may bring back a small load of firewood as well. Thus, the forays are multipurpose; many foods are collected. This simultaneous association of activities including the collection of edible insects maximizes energy efficiency and time spent during visits to the *monte*.

Collection and Uses of Edible Insects

Our study reveals that the people of Los Reyes Metzontla consume at least 17 species of insects (Table 1). Three species were determined only to order level because they were too scarce to be collected in 2009. One species, *Mormidea* (*Mormidea*) *notulata* (Herrich-Schäffer 1844) has not previously been reported in the State of Puebla, nor had it been identified as an edible species. Thus our information not only makes it a new edible species for the Edible Insects Database in Mexico, it also makes this a new species record for the state, broadening the insect's known distribution.

Table 1. Edible insects consumed by the Popolocas of Los Reyes Metzontla, Mexico.

Taxon	Spanish-Local Name	Popoloca Name	Stage Consumed	Season
HEMIPTERA				
Coreidae				
<i>Thasus gigas</i> (Klug,1835)	<i>Cocopache</i>	<i>Kudentiá</i>	Nymph	April
Pentatomidae				
<i>Mormidea</i> (<i>Mormidea</i>) <i>notulata</i> (Herrich-Schäffer, 1844)	<i>Chinche</i>		Adult	March–April–May
<i>Euschistus</i> sp.	<i>Chinche</i>		Adult	March–April–May
LEPIDOPTERA				
Saturniidae				
<i>Paradirphia fumosa</i> (R. Felder and Rogenhofer, 1874)	<i>Cuchamá</i>	<i>Cuchamá</i>	Larva	August–September
Undetermined	<i>Pochocuile</i>		Larva	June–July
Megathymyiidae				
<i>Aegiale hesperiaris</i> (Walker, 1856)	<i>Conducho, Gusano Blanco de Maguey</i>	<i>Kunduchó</i>	Larva	May–June–July
Cossidae				
<i>Comadia redtenbacheri</i> (Hammerschmidt, 1848)	<i>Gusano Rojo de Maguey</i>		Larva	
Undetermined	<i>Gusano del Pirul</i>	<i>Kundánu</i>	Larva	August
COLEOPTERA				
Undetermined	<i>Gusano del Cazahuate</i>		Larva	Year-round
HYMENOPTERA				
Vespidae				
<i>Brachygastra mellifica</i> (Say, 1837)	<i>Panal Miniagua</i>	<i>Cuchii</i>	Honey and Larva	Year-round
<i>Brachygastra</i> sp.	<i>Panal Culoamarillo</i>	<i>Cuchii</i>	Honey and Larva	Year-round
<i>Polybia occidentalis nigratella</i> Du Buysson, 1905	<i>Panal Cojon de Toro Blanco</i>	<i>Cuchii</i>	Honey and Larva	Year-round
<i>Polybia occidentalis bohemani</i> Holmgren, 1868	<i>Panal Cojon de Toro Negro</i>	<i>Cuchii</i>	Honey and Larva	Year-round
<i>Mischocyttarus</i> sp.	<i>Panal Cundaruta</i>	<i>Cuchii</i>	Honey and Larva	Year-round
Apidae				
<i>Plebeia mexica</i> Ayala, 1999	<i>Colmena negrita</i>		Honey	Once a year March–April–May
<i>Apis mellifera</i> Linnaeus,1758	<i>Enjambre</i>		Honey	Year-round
Formicidae				
<i>Atta mexicana</i> Smith, 1858	<i>Chicatanas, Cuatalatas or Arrieras</i>	<i>Kuchu iá</i>	Adult	May

C1



Figure 3. *Cocopaches* collected by hand from mesquite trees. Photograph by A.M. Acuña.

***Thasus gigas* (cocopache/giant mesquite bug)**

The *cocopaches*, or giant mesquite bugs, are found mostly on mesquite trees *Prosopis laevigata* (Humb. and Bonpl. ex Willd.) M.C. Johnst (Figure 3). Only the nymphs or immature stages are consumed. They are gathered by hand, typically in April, and after the legs are removed, they are roasted and mixed with *salsa* and *tortillas*. They are collected solely for family consumption and not for sale. Plant foods gathered in April include the fruits of several species of cacti including *Stenocereus pruinosus* (Otto) F. Buxb and the inflorescences of *Agave kerchovei* Lemaire and *Agave triangularis* Jacobi.

***Mormidea* (*Mormidea*) *notulata* and *Euschistus* sp. (chinche/stink bugs)**

Chinche refers to two species that look alike and share the same habitat and host plant. These species are found only near the summit of Yiltepec hill (2,200 m) between the dead leaves of *cucharilla* (*Dasyllirion acrotriche* (Schiede ex. Shultes) Otto). They are collected early in the morning, just after sunrise when they are inactive, using a large wooden stick to shake the dried leaves of the host plant, forcing the insects to fall down onto a piece of plastic from which they cannot crawl out (Figure 4). To separate the live insects from the debris, the gatherings are put into a type of mosquito net bag; the bugs instinctively crawl up to the top of the bag and then are removed, leaving the detritus at the bottom. *Chinches* are boiled with water and salt and eaten with *salsa* and *tortillas*. Some local gatherers sell *chinches* to the town's elderly people or to those that do not want to do the difficult, early morning, journey to the collecting place. Selling the *chinches* for MEX\$10 (10 pesos: US\$0.80, 2009 exchange rate) for one *medida*, these collectors make extra money. Edible plant parts that can be collected at the same time as *chinches*, are *palmito* (*Yucca periculosa* Becker) flowers, *matzitz* (the inflorescence of *Dasyllirion serratifolium*), and edible flowers called *cacayas* from several *Agave* species.



Figure 4. *Chinchas* collected from the dry leaves of *Dasyllirion acrotriche*. Photographs by A.M. Acuña.

Paradhirphia fumosa (*cuchamá*/moth caterpillar)

The *cuchamá* or moth caterpillar is considered a delicacy that is highly appreciated by the Popoloca. The *cuchamá* eats the leaves of the *manteco* tree (*Cercidium praecox* (Ruiz & Pav.) Harms). Adults are gathered and consumed during March, April and May. The Popoloca knock or scrape the caterpillars from the tree with small wooden sticks, because the caterpillars are covered with stinging hairs. *Cuchamá* are purged in water for one night, boiled inside clay pots with salt and then left to dry under direct sun for two to three days. Then they can be stored up to three years. The Popoloca eat fried *cuchamás* with *salsa* or with lemon juice and chili (Figure 5). Some informants stated that these insects have aphrodisiac properties.

Cercidium praecox trees are rare in the common lands or *ejido* of Los Reyes Metzontla, but this tree is abundant in the Zapotitlán Valley where gatherers collect *cuchamá* caterpillars and sell them in the neighboring communities and regional markets at MEX\$60–\$80 (US\$4.50–\$6.00) per liter or MEX\$10 (US\$0.80)



Figure 5. Boiled and dried *cuchamás* ready to be enjoyed. Photograph by A. M. Acuña.



Figure 6. A *conducho* removed from an agave leaf with a small stick. Photograph by A.M. Acuña.

per *medida* (around 15 worms). *Pipichas* (*Porophyllum tagetoides* DC), fruits of *Bunchosia biocellata* Schldtl., and seeds of *Cnidocolus tehuacanensis* Breckon are some of the edible foods that can be collected in the same season as *cuchamás*.

***Pochocuile* (moth caterpillar)**

Although some people of Los Reyes Metzontla gather and consume *pochocuiles*, these moth caterpillars are not very popular because many think they strongly resemble snakes. *Pochocuiles* are collected from the *pochote* tree (*Ceiba parvifolia* Rose) using a wooden stick onto which the caterpillar crawls. The caterpillars are purged in water for one night, then boiled in salty water and eaten with *salsa* and *tortillas*. People from neighboring communities, where the host tree is more abundant, come to Los Reyes Metzontla to sell the *pochocuiles* at MEX\$5 (US\$0.40) a dozen.

***Aegiale hesperiaris* (conducho/white agave worm)**

The *conducho* or white agave worm is the most valued species in the community, considered a delicious delicacy because of its buttery flavor. This larva lives inside the base of the *maguey potrero* leaves (*Agave scaposa* Gentry). One agave plant will have no more than two or three leaves containing larvae and one to three larvae per leaf. Agave leaves are cut out with a machete and the larvae are taken out using small wooden sticks (Figure 6). A small hole at the base of the leaf signals the presence of a larva. The Popolocas stated that they could tell if the larva is mature enough to eat by looking at the frass that comes out of the small hole. White-colored frass indicates the larva is still immature and they do not cut off the agave leaf; black frass indicates a mature (in terms of size) larva, which they collect. Our informants agreed that *conduchos* are scarcer now than 40 or 50 years ago. Elderly people recalled that when they were young they could gather as many as 200–300 larvae every time they went collecting in the scrubland. Nowadays, people gather no more than 30–40 larvae per collecting visit and they have to go farther to find them.

The Popolocas eat *conduchos* boiled or fried with *salsa* and *tortillas*. Informants mentioned that, although there are no formally established community rules to

regulate the gathering of *conduchos*, some people leave a few larvae inside the agave leaves so they can complete their life cycle to “become a butterfly” and reproduce, providing more larvae for the next season. This species is collected for both family consumption and sale. Some local gatherers sell the larvae in the town or neighboring communities at MEX\$3 to \$5 (US\$0.25–\$0.40) each. Gathering *conduchos* is associated with collecting the highly valued *chende* fruit from the cactus *Polaskia chende* (Gosselin) A.C.Gibson & K.E.Horak, as well as fruits from *Neobuxbaumia tetetzo* (F.A.C. Weber) Backeb, *Opuntia depressa* Rose and *Pilosocereus chrysacanthus* (F.A.C. Weber) Byles & G.D. Rowley, among other species.

***Comadia redtenbacheri* (gusano rojo de maguey/red agave worm)**

The collection of the *gusano rojo de maguey* or red agave worm is associated with transplanting offsets of *Agave salmiana* (Otto ex Salm-Dyck) to the borders of agricultural plots. The larvae are considered a pest, because they weaken and eventually kill the plant. When a plant is yellowish, they know it is infected. So the whole plant is pulled up and the larvae collected. The larvae are boiled or fried, then ground and mixed with *salsa* or eaten whole with hot peppers and *tortillas*. They are collected opportunistically and only for family consumption.

***Gusano del pirul* (pirul worm)**

This species was so scarce that it could not be collected in 2009 for identification. Informants described that the larvae are gathered from the *pirul* tree (*Schinus molle* L.). A long wooden stick is used to shake the branches causing the larvae to fall to the ground. *Pirul* worms are purged in water for one day, then boiled in water with salt and eaten with *salsa* and *tortillas* or with lemon juice and salt. This species is collected only for family consumption.

***Gusano del cazahuate* (cazahuate worm)**

This larva is found inside the rotten trunks of *cazahuate* tree (*Ipomoea pauciflora* Mart.& Gal.). They are collected opportunistically when people find a rotten trunk during their visits to the scrubland. These larvae are boiled and then eaten, as most of the other insects, with *salsa* and *tortillas*.

Wasp nests

The nests of five wasp species are collected by the people of Los Reyes Metzontla: *Brachygastra mellifica* (Mexican honey wasp), *Brachygastra* sp., *Polybia occidentalis nigratella*, *Polybia occidentalis bohemani* and *Mischocyttarus* sp. Most are found in the scrubland where they build their nests on various trees, columnar cacti, agaves and rock walls. Some other species like *Mischocyttarus* sp. and *Polybia occidentalis nigratella* nest in the town, over roofs and windows. The Popolocas collect nests only when the moon is between its last quarter and waning gibbous, the time when the nests are full of larvae and honey according to traditional knowledge and experience. At other times the larvae are in the last larval stage or have already become pupae, so the honey is scarce. When a nest is found, its location is recorded so that it can be collected when the moon is at its proper phase.

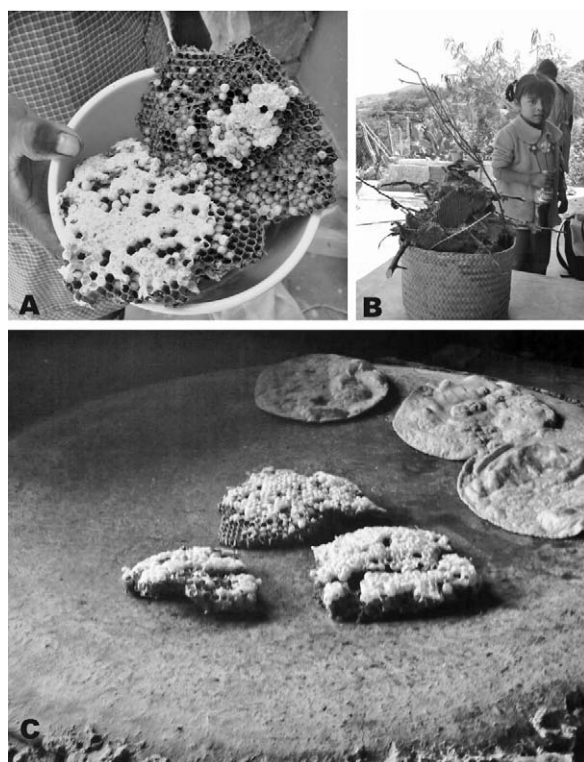


Figure 7. (A) Honeycomb containing larvae; (B) empty nest of *Brachygastra mellifica* stored for the “warming up” ritual; (C) honeycomb toasting on a traditional *comal*. Photographs by A.M. Acuña.

To collect a nest, people use long sticks to shake it or throw rocks at it to make the adult wasps fly away. Then, with the same stick the nest is pulled down. The nest is torn apart, the honey collected, and the comb containing the larvae is toasted on both sides. Fully cooked larvae are pulled out and eaten with *salsa* and *tortillas* (Figure 7). Ritual uses of empty wasp nests are discussed below.

Plebeia mexicana (*colmena negrita*/stingless bee)

This stingless bee is highly appreciated for the delicate and tasty honey it produces. Nests are rare, hard to find and can only be harvested once a year, making the honey even more valuable. This species builds its nests underground, so the gatherer, in order to obtain the honey, must dig carefully to avoid overly harming or destroying the nest. The best season to collect the honey is in spring, March to May.

Apis mellifera (*enjambre*/honey bee)

Until around 40 years ago the people of Los Reyes Metzontla kept honey bees; many people had between 6 and 8 wooden hives at their home gardens. After the Africanized honey bee invasion in the late 1980s and attacks on livestock, dogs and donkeys, people became afraid of the honey bees. Beekeepers

abandoned the hives, and the honey bees became feral. Most people are afraid to collect honey from the feral colonies but some people do collect it, although this activity is not widespread. Feral honey bee colonies are mostly found on rock walls and cliffs.

Atta mexicana (chicatanas/leaf-cutting ant)

The Popolocas only eat the winged adults (mostly females) of *chicatanas*. According to our informants, *chicatanas* emerge from their nest immediately after the first rain of the year. Then they fly throughout the town and are collected wherever they settle, mostly by children. When caught, their wings and heads are removed, and they are roasted and eaten mixed with *salsa* or hot peppers. In addition, *chicatanas* produce "abono," the refuse that the ants deposit outside their nests. This refuse is collected and used as a natural fertilizer in their home gardens for radishes, squash and coriander.

Edible Insects as Part of the TFS

Both men and women collect insects, although men travel to the scrubland and collect insects found there more often. Women exclusively prepare and cook them. Gathering techniques are quite simple: most of the insects are collected by hand or with the help of wooden sticks of different sizes, rocks and machetes. Insects are eaten at various stages, (larvae, nymphs and adults), and other insect products, such as honey, are also used. Insects are highly appreciated as food by the Popolocas, but they do not cultivate them or promote their growth. The people of Los Reyes Metzontla value many of them for their flavor and taste and because they are "good to eat." Insects are not considered as emergency food for times of dearth. They are regarded as a luxury or delicacy. Our data demonstrate that the species with the highest cultural value and considered to be delicacies among all age and gender groups are *Aegiale hesperiaris*, *Mormidea* (*Mormidea*) *notulata* and *Euschistus* sp., *Paradirphia fumosa* and *Thasus gigas* (Figure 8).

The Popolocas of Los Reyes Metzontla have two different strategies for gathering and consuming insects: planned and opportunistic. At times people go to the scrubland specifically to find and collect them, in particular species considered delicacies such as *Thasus gigas*, *Mormidea* (*Mormidea*) *notulata*, *Euschistus* sp., *Aegiale hesperiaris*, *Paradirphia fumosa* and *pirul* worm. Although the primary objective is to collect these insects, the Popoloca also gather available fruits and other plant parts. People also opportunistically gather and consume the insects when they go to the scrubland for various activities and happen to find edible insects. *Comadia redtenbacheri*, *cazahuate* worm, the nests of *Brachygastra mellifica*, *Brachygastra* sp., *Polybia occidentalis nigratella*, *Polybia occidentalis bohemani*, *Mischocyttarus* sp., *Atta mexicana* and honey from *Plebeia mexicana* and feral *Apis mellifera* are generally collected in this manner.

Most of the edible insects are available from February to September (Table 1, Figure 9); 58.8% of the species are seasonal and abundant only for a short time of the year, while 41.2% are consumed year round (e.g., wasp nests). Edible wild plants are seasonal, available primarily during the rainy season, from April to October, before the harvest of the maize and beans (Figure 9). People gather the

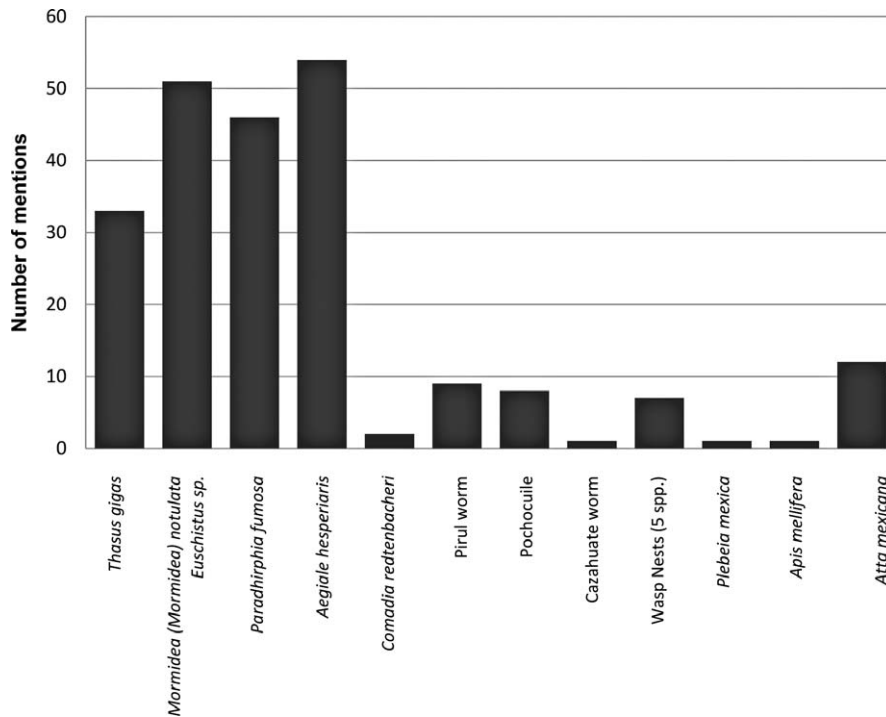


Figure 8. Relative importance of edible insects based on the number of times mentioned by the informants.

available wild foods during the rainy season as they go to work their agricultural plots. For example, in May several cacti fruits such as *chende* (*Polaskia chende*), *chichipe* (*Polaskia chichipe* (Rol.-Goss.) Backeb), *xoconostle* (*Stenocereus stellatus* (Pfeiffer) Riccob), *pitaya* (*Stenocereus pruinosis*) and *nopal de monte* (*Opuntia*

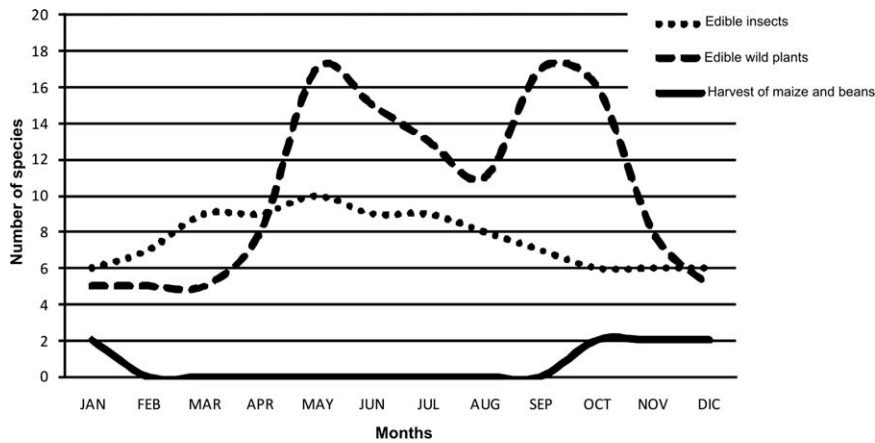


Figure 9. Temporal availability of edible insects, wild plants and the subsistence crops: maize (*Zea mays* L.) and beans (*Phaseolus vulgaris* L.).

Table 2. Approximate amounts of insects consumed by the Popoloca people of Los Reyes Metzontla based on their monthly availability. The *medida* generally corresponds to an individual's consumption and the *litro* is shared among family members.

Month	Insect and Insect Products	Approximate amount of consumption
YEAR-ROUND	Cazahuate worm	From ¼ to ½ liter two or three times a year per family
	Wasp nest (five species)	From 1 to 4 nests a year per family
	<i>Apis mellifera</i> honey	No data available
JAN	Year-round insects	—
FEB	<i>Comadia redtenbacheri</i>	Around 1 liter once or twice a year per family
MAR	<i>Mormidea (Mormidea) notulata</i> and <i>Euschistus</i> sp.	From 1 to 2 liters once or twice a year per family
	<i>Comadia redtenbacheri</i>	Around 1 liter once or twice a year per family
	<i>Plebeia mexica</i> honey	Collected once a year during spring
APR	<i>Mormidea (Mormidea) notulata</i> and <i>Euschistus</i> sp.	From 1 to 2 liters once or twice a year per family
	<i>Thasus gigas</i>	From ¼ to 2 liters one to three times a year per family
	<i>Plebeia mexica</i> honey	Collected once a year during spring
MAY	<i>Mormidea (Mormidea) notulata</i> and <i>Euschistus</i> sp.	From 1 to 2 liters once or twice a year per family
	<i>Plebeia mexica</i> honey	Collected once a year during spring
	<i>Aegiale hesperiaris</i>	Around 50 larvae each season per family
	<i>Atta mexicana</i>	From ¼ to 1 liter once a year per family
JUN	<i>Aegiale hesperiaris</i>	Around 50 larvae each season per family
	<i>Pochocuile</i>	Around one or two "medidas" (12 larvae) once a year per person
JUL	<i>Aegiale hesperiaris</i>	Around 50 larvae each season per family
	<i>Pochocuile</i>	Around one or two "medidas" (12 larvae) once a year per person
AUG	<i>Paradirphia fumosa</i>	From a couple of "medidas" (15 larvae) per person to 3 liters per family once a year
	<i>Gusano del pirul</i>	From ¼ to 1 liter two or three times a year per family
SEP	<i>Paradirphia fumosa</i>	From a couple of "medidas" (15 larvae) per person to 3 liters per family once a year
OCT	Year-round insects	—
NOV	Year-round insects	—
DEC	Year-round insects	—

depressa) can be harvested along with insects such as *chinchas*, *conduchos* and *chicatanas*. Therefore wild foods provide important supplements to the diet of the Popoloca, particularly when the maize and beans reserves become scarce.

The quantity of insects consumed by the Popoloca of Los Reyes Metzontla in a year depends on several factors. First, according to our informants the abundance of certain seasonal species varies from year to year, as climatic conditions affect the insects' availability. Second, individual preferences influence the type and quantity of insects eaten, and third, even chance could be considered a determining factor, especially for those species used opportunistically. The data our informants gave us regarding the quantity of insects eaten seasonally provide a rough calculation of consumption for each species (Table 2).

The units of measure related to insect consumption and most commonly utilized by the inhabitants of the community are the *litro* (liter) and the *medida* (measure). The former is the quantity of insects that a liter (33.81 oz) container holds, while the "medida" is either a specific number of insects (i.e., a *medida* of *cuchamás* is 15 worms) or the quantity of insects that a 220 g (8 oz.) *chile* container holds. A *medida* is a typical portion size for one person while a *litro* is shared and

consumed by a family (5 to 10 members). Table 2 shows the availability of edible insects throughout the year and gives a general approximation of the quantity of insects consumed by local people. The fact that some species are collected opportunistically makes their use highly variable and their numbers difficult to determine precisely.

This traditional practice is firmly linked to the cultural heritage of the Popoloca people, and it is associated with extensive knowledge about the environment and the species of insects consumed. Traditional knowledge includes the gathering and preparation techniques that are rooted in past practices and passed from one generation to the next. Our research found that children start learning this traditional knowledge at an average age of 9, and they get it mainly from their parents. The people of Los Reyes Metzontla know how, when and where to find and collect the insects, and are equally knowledgeable regarding the processes associated with their consumption and in some cases, with their preservation for later consumption.

Hot-Cold Classification of Edible Insects

Many cultures have beliefs, values, practices, categories and rules that seek balance and equilibrium of their cosmos, social world and health (Douglas 1966; Meyer-Rochow 2009). The principle that ensures a constant preservation and restoration of balance is often expressed in pairs of metaphorical qualities. In Mesoamerica, the "hot-cold" classification system applies to all living and supernatural beings, and is based on this equilibrium model. Health depends on the maintenance of balance between "hot" and "cold." In this context, "hot" and "cold" refer to inherent qualities of plants, animals and the environment and their effect on the body, not necessarily to temperature or spiciness. An excess of "hot" or "cold" elements leads to illness, which must be treated with remedies or foods of the opposite quality (Boster and Weller 1990; Foster 1987; López Austin 1984a, 1984b; Pool 1987).

The Popolocas classify a wide variety of foods as "hot" or "cold," depending on their qualities and the effects their intake are believed to have on the human body and on a person's health. Our study shows that insects are no exception (Table 3). Fifteen of the edible species are considered "hot" or "very hot" while two are "cold" or "hot" depending on the informant. In Mesoamerican culture the idea of equilibrium is different from the Chinese Ying-Yang concept, so the existence of "hot" insects does not imply the existence of "cold" insects that could balance the system. Most edible insects get their "hot-cold" quality from the host plant they live in or feed from (Table 3). For example, *Mormidea* (*Mormidea*) *notulata* and *Euschistus* sp. are considered "hot" because their host plant *Dasyllirion acrotriche* has a "hot" quality. Similarly the *pirul* worm is considered to be "very hot" because the *pirul* tree is "very hot" and is used to treat "cold" illnesses. To our knowledge, our finding that the hot-cold quality of edible insects reflects the quality of their host plant has not been previously reported in Mexico. Two species (*cazahuate worm* and *pochocuile*) did not clearly fall into either category, even though their host plants are "hot." Some of our informants considered them "cold" while others considered them "hot." This

Table 3. Hot-Cold classification of the edible insects and their host plants by the people of Los Reyes Metzontla.

Insect or Insect Product	Classification	Host Plant	Classification
<i>Thasus gigas</i>	Hot	<i>Prosopis laevisgata</i>	Hot
<i>Mormidea (Mormidea) notulata</i>	Hot	<i>Dasyllirion acrotriche</i>	Hot
<i>Euschistus</i> sp.	Hot	<i>Dasyllirion acrotriche</i>	Hot
<i>Paradirphia fumosa</i>	Very Hot	<i>Cercidium praecox</i>	Hot
<i>Pochocuile</i>	Cold/Hot	<i>Ceiba parvifolia</i>	Hot
<i>Aegiale hesperiaris</i>	Hot	<i>Agave scaposa</i>	Hot
<i>Comadia redtenbacheri</i>	Hot	<i>Agave salmiana</i>	Hot
<i>Gusano del Pirul</i>	Very Hot	<i>Schinus molle</i>	Hot
<i>Gusano del Cazahuate</i>	Cold/Hot	<i>Ipomoea pauciflora</i>	Hot
Wasp Nests (five species)	Hot	—	—
<i>Plebeia mexicana</i>	Hot	—	—
<i>Apis mellifera</i> honey	Hot	—	—
<i>Atta mexicana</i>	Hot	—	—

ambivalent classification seems related to the appearance of the larvae that to some people look like snakes, which are “cold” animals. This discrepancy is not rare, according to Lopez-Austin (1984a:22), since the hot-cold classification may vary between communities and even from one person to another.

In order to maintain a healthy inner balance, the Popolocas refrain from eating insects in excess. Since almost all of them are “hot,” eating too many could cause thirst, mouth sores and in extreme cases, diarrhea. Nursing mothers are advised not to eat many *cuchamá* caterpillars because they are considered to be “very hot” and will have an ill effect on the mother and child’s health. The informants of Los Reyes Metzontla stated that when they overeat “hot” or “very hot” insects and become ill, they try to regain balance by eating and drinking “cold” things.

Aside from their role in a healthy diet, insects and insect products serve as medicine and in rituals. Honey is considered “hot” and is useful for treating “cold” illnesses such as throat and lung diseases. Our informants describe how they use the empty wasp nests of *Brachygastra mellifica*, *Brachygastra* sp., and *Polybia occidentalis bohemani* for a ritual to “warm up” new or long abandoned houses that have a “cold” condition. They place the nest on a clay dish inside the house and burn it along with common rue (*Ruta graveolens* L), common myrtle (*Myrtus communis* L.), common basil (*Ocimum basilicum* L.) and garlic (*Allium sativum* L). The Popolocas believe that the smoke will expel the “air” or wind, which is considered to be a personification of an illness or evil spirit that causes the “coldness” of the house.

Conclusions

Entomophagy among indigenous people in Mexico has been extensively studied from a biological and entomological point of view, but not as a component of Traditional Food Systems. In this study we report that the Popoloca people of the village of Los Reyes Metzontla hold insects in high regard as food, considering them a true delicacy rather than merely a famine food. Edible insects are integral element of the Popoloca TFS, a complex interplay between *milpa* agriculture,

animal husbandry, firewood collection and wild food gathering. The gathering of wild resources, including edible insects, represents a fundamental part of their TFS since they consume at least 53 different species of wild plants and animals, of which 17 are insects. The insects recorded in our study were collected both deliberately and opportunistically, but nonetheless, provide a valuable resource that complements other foods from cultivated plants and livestock. Moreover, the insects are an invaluable source of proteins, vitamins, minerals and micronutrients, particularly during the months prior the harvest.

The TFS of the Popoloca of Los Reyes Metzontla, particularly insect consumption, is an important part of their cultural heritage and identity. The traditional knowledge of the Popoloca represents a profound understanding of local conditions and environment as well as a continuity and survival of their worldview. Older generations transmit their traditional wisdom of insect gathering and resource management through oral transmission, teaching by example and direct experimentation in the field. New generations thus learn the traditional ways of how and when to find certain species of insects, how to collect them and how to process and prepare them as food. The new generations also learn, in this manner, the ascription of edible insects to their plant hosts as a part of their "hot-cold" classification system, and the profound importance of this system for maintaining their internal balance (i.e., health and well-being). Our documentation of Popoloca TFS helps us understand the adaptations and relationships between indigenous people and their local environments and serves to assist them in the preservation of their natural and cultural heritage.

Note

¹ Voucher specimens of Pentatomidae are deposited at the *Colección Nacional de Insectos* at UNAM. Vouchers of all other taxa are deposited at the Laboratory of Entomology at UDLAP.

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C1. Indent (Schaffer, 1844) to align on the first letter of notulata.