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Insect Consumption in Indigenous Communities of Central America

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Abstract Insect consumption, known as entomophagy, is an ancient practice that has recently garnered attention as a sustainable food alternative considering the global food crisis. A literature review was conducted on insect consumption among Indigenous communities in Central America, a region renowned for its biological and cultural diversity. The aim was to catalog, for the first time, the insect species consumed by these indigenous peoples. Various search engines, including Google Scholar, Mendeley, Scopus, and Web of Science, were used, focusing on articles in English and Spanish available until June 2024. The findings revealed a total of 15 edible species across five orders with a notable predominance of the order Hymenoptera. Consumption practices involve the harvesting of larvae and adults at different stages of development with larvae being particularly prized. Additionally, the review explores ongoing initiatives in Guatemala, Honduras, and Costa Rica that aim to implement trade in crickets and mealworms as an alternative food source. This study underscores the significance of preserving and valuing Indigenous knowledge regarding entomophagy, particularly in the context of food insecurity.

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Introduction

The region of Central America, located on the Caribbean plate, covers an area of 523,000 square kilometers, representing 1% of the Earth's surface (Serrano-Solares 2023). It consists of seven countries and is home to an estimated population of 52 million people (Figure 1), including around 65 Indigenous communities that occupy approximately 40% of Central American territory (Sistema de la Integración Centroamericana 2013, 2018). In countries like Guatemala, it is estimated that 40–45% of the population belongs to Indigenous communities (International Work Group for Indigenous Affairs 2024). These historically marginalized peoples face a range of common issues, including racism, limited access to education, land displacement, genocide, the sale and exploitation of natural resources, extreme poverty, and food insecurity (Camacho and Soto-Acosta 2015; Haas 2023).

Insects constitute the most diverse group of organisms on Earth, representing approximately 80% of all species worldwide (Chantawannakul 2020). These organisms coexist with us in daily life and provide essential services to other species, such as pollination, pest control, and seed dispersal (Eggleton 2020). The relationship between humans and insects is varied, as some insects are used for medicinal, economic, and nutritional purposes (Elizalde et al. 2020).

The practice of consuming insects is known as anthropo-entomophagy (Costa-Neto and Ramos-Elorduy 2006). This food culture is as old as humanity itself, with records of wings and other insect body parts found in fossilized human feces in caves in the United States and Mexico (Olivadese and Dindo 2023). Insect consumption is predominant in parts of Asia, Africa, and Latin America, supplementing the diet of at least 2 billion people (Deepak et al. 2022). It is estimated that around 2,111 insect species are traditionally consumed in at least 113 countries (Bermúdez-Serrano 2020). In Africa, insects are consumed in 48 countries across the continent, while in Asia, 52 countries incorporate insects into their diet. In the Americas, the number drops to 15

Figure 1 Borders and political division of Central America.

countries in the southern part of the continent (Omuse et al. 2024).

However, in the West, this practice has not been widely developed and could be considered to involve a certain phobia toward insect consumption by Western societies (DeFoliart 1999). Cultures such as those in Europe or the United States often view these activities as primitive or characteristic of marginal areas where significant agricultural development is lacking (Lesnik 2017). Despite this perception, thanks to globalization and the growing concern over the global food crisis and climate change, insect-based protein production has emerged as a highly viable option (Jaunikis and Michopoulou 2020).

The study of insect-based foods offers various benefits beyond their high protein levels and lower energy costs. These benefits include reduced land use for cultivation and the opportunity to produce in local farms to feed a population (Yen 2009). Additionally, insects can be utilized for the bioprospecting of new antibacterial components, as well as in functional, pharmaceutical, and industrial biotechnology (Verkerk et al. 2007).

Although this practice has been widely explored in the Latin American region (Abril et al. 2022; Bermúdez-Serrano 2020; Costa-Neto 2015; Granados-Echegoyen et al. 2024), the Central American isthmus has received less attention, despite being home to around 8% of the world's biological diversity (Sistema de la Integración Centroamericana 2020). In this region, new insect species are constantly being discovered (Hanson 2011). However, efforts in areas such as ethnobiology and ethnoecology remain scarce, especially in comparison to other regions. This study aims to conduct a review of the existing information on anthropo-entomophagic practices by Indigenous communities in the Central American region, to list for the first time for this region the edible insect species documented in each country, and the Indigenous peoples who carry out these practices.

Methods

For the development of the review, search engines such as Google Scholar, Mendeley, Scopus, and Web of Science were used. The search was conducted using the keywords "entomophagy" AND "Central

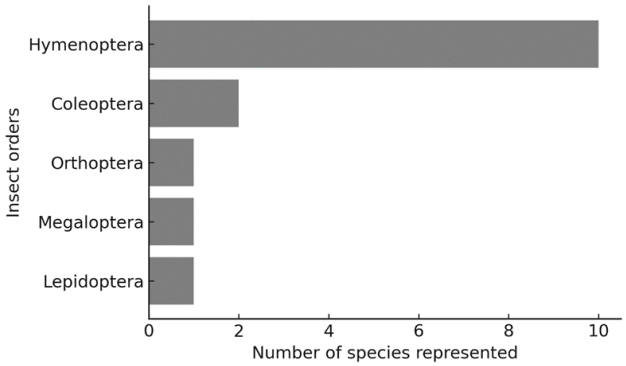

Figure 2 Number of edible insect species in Central America by Taxonomic Order.

America", "ethnoentomophagy" AND "Central America", "edible insects" AND "Central America", and "Ethnography AND Central America". The search was performed using the same keywords in both English and Spanish and included articles, book chapters, and opinion articles (letters to the editor, editorials and perspective articles). We considered peer-reviewed articles and not published ethnographic texts. The focus was on documents that mentioned one of the seven countries that make up the Central American isthmus or that referred to the region as a whole. Documents from 1932 until June 2024 were considered. However, local newspaper reports were excluded due to their inaccuracy and the inability to corroborate information.

Results and Discussion

A total of 15 different types of edible insects were reported, divided into five orders and eight families. Of these, only seven are identified at the genus and species level, while eight are identified at the genus level (Table 1). The order Hymenoptera is the most abundant with 10 organisms, followed by Coleoptera with two species (Figure 2). The diversity of edible insects in Central America recorded to date is presented in Table 1.

The number of edible insects by the Indigenous population in Central American region may be underestimated, as consumption by the Indigenous population is reported in only five of the seven countries that make up the region, leaving countries like Costa Rica and El Salvador without any bibliographic records of Indigenous insect consumption except for a Personal communication (founded in Pino et al. 2014) about the Guaymi people in the peninsula of Osa but without taxonomic data of consumed insects.

In the reported cases, consumption of insects at different growth stages is evident, with the larval stage being the most consumed, followed by processed insect products, while adult insects are the least consumed. The following is a brief discussion on insect consumption in Central America by Indigenous populations, with some specific examples of entomophagy.

Megaloptera

The larvae of *Corydalus* sp. are collected under rocks in rivers by the Mayan Chortí Indigenous people in the department of Copán in western Honduras and prepared on griddles with salt and chili to be consumed with corn tortillas. Consumption of larvae from the same genus is also recorded in Mexico (Montesinos and Ramos-Elorduy 2007).

Coleoptera

Evidence for beetle consumption exists in Honduras and Panama (Jongema 2017; Marineros et al. 2015), as well as among various Indigenous peoples of Latin America. The larvae are cooked on griddles or boiled and then consumed with various seasonings inside a corn tortilla. The consumption of *Rhynchophorus palmarum* is documented from Mexico (Viejo-Montesinos and Ramos-Elorduy 2007) to the Amazon (Costa-Neto and Ramos-Elorduy 2006; Sancho et al. 2015). Consumption of this species is also reported in the Caribbean islands, detailing the process by which Indigenous people cultivate the larvae on palm trees, where Bodenheimer (1951:302) translates Mérian's (1771:48) expedition account:

> The tree grows to the height of a man and is cut when it starts to become tender. It is cooked like cauliflower and tastes better than an artichoke. In the midst of these trees live countless quantities of larvae, which at first are as small as a worm in a nut but later grow to a very large size and feed on the tree's pith. These larvae are roasted over coals and are considered a very pleasant food.

Lepidoptera

Caterpillars are consumed in Honduras by Lenca people (Marineros et al. 2015), although their consumption is mentioned throughout Central America by Bodenheimer (1951:307), citing Daguin (1900), who describes the process of searching for and using the larvae of a lepidopteran called *maquara* by

the Mundraco people:

> Upon reaching a lake with its shores covered in reeds, these Indians began to shout joyfully, break the reeds, and extract from each knot large, white larvae, 8 to 10 cm long, called Maquara. They ate them greedily and soon fell down as if dead from drunkenness. These caterpillars are truly excellent, and to avoid intoxication, it is sufficient to remove their heads before consuming them.

However, there is no information provided by Daguin for the family or genus of these larvae, and there is limited additional evidence regarding the origin of the Mundraco people or the *maquara* larvae mentioned by the author in his expeditions.

Orthoptera

Orthoptera includes crickets, grasshoppers, and locusts, which have high nutritional values and are one of the groups of edible insects with high protein content with percentages of up to 61% (Liceaga 2022). They are one of the most consumed groups in North America (Costa-Neto and Dunkel 2016).

In Honduras, the consumption of *Neoconocephalus triops* is recorded among the Lenca Indigenous group (Marineros et al. 2015). The immature katydids are roasted on a griddle and consumed within a corn tortilla, accompanied by salt, spices, and chili.

Hymenoptera

Hymenoptera represents the most consumed group in Central America, with reports from Guatemala, Belize, Honduras, and Nicaragua (Bodenheimer 1951; Conzemius 1932; Costa-Neto and Ramos-Elorduy 2006; DeFoliart 2002; Marineros et al. 2015). The consumption of wasp larvae, adult ants and honey from stingless and stinging bee species has been recorded.

Evidence of the consumption of larvae of *Polistes* sp. is reported in Guatemala by the Chuh Indigenous

Table 1 Taxonomy of edible insects reported in Central America.

Order	Family	Species	Country	Edible Stage	Indigenous Group	Citation
Megaloptera	Corydalidae	*Corydalus* sp.	Honduras	Larvae	Mayan Chortí	Marineros et al. 2015
Coleoptera	Curculionidae	*Rhynchophorus palmarum*	Honduras	Larvae	Lenca	Marineros et al. 2015
	Hydrophilidae	*Tropisternus mexicanus*	Panamá	Larvae	No Data	Jongema 2017
Lepidoptera	Hepialidae	*Phassus.* sp.	Honduras	Larvae	Lenca	Marineros et al. 2015
Orthoptera	Tettigoniidae	*Neoconocephalus*	Honduras	Ninfae	Lenca	Marineros et al. 2015
Hymenoptera	Vespidae	*Polistes* sp.	Guatemala	Larvae	Chuh	DeFoliart 2002; Costa-Neto and Ramos-Elorduy 2006
		Polistes sp.	Honduras	Larvae	Mayan Chortí	DeFoliart 2002; Marineros et al. 2015
		Polybia sp.	Honduras	Larvae	Mayan Chortí and Lenca	Marineros et al. 2015
		Agelaia sp.	Honduras	Larvae	Mayan Chortí and Lenca	Marineros et al. 2015
		Synoeca sp.	Honduras	Larvae	Mayan Chortí and Lenca	Marineros et al. 2015
		Apoica sp.	Honduras	Honey	Mayan Chortí and Lenca	Marineros et al. 2015
	Apidae	*Melipona beechei*	Guatemala	Honey	Mayan Chortí	Bodenheimer 1951
			Honduras	Honey	Mayan Chortí	Bodenheimer 1951
		Trigona fulviventris	Belice	Honey	Maya-Yucateco	Bodenheimer 1951
		Apis mellifera	Honduras	Honey	Lenca	Marineros et al. 2015
	Formicidae	*Atta cephalotes*	Honduras	Adult	Miskitu	Conzemius 1932; DeFoliart 2002
			Nicaragua	Adult	Sumu	Conzemius 1932

group, who believe that the larvae's eyes confer reproductive abilities, allowing them to have children with large eyes (Costa-Neto and Ramos-Elorduy 2006; DeFoliart 2002). These larvae are also consumed by the Chortí Indigenous people in Honduras, along with species of *Polybia, Agelaia,* and *Synoeca* (Marineros et al. 2015). The methods for capturing these individuals vary, from flooding shelters to drive out the larvae, to manual capture using spines or sticks. Among the Chortí groups in Guatemala, the task of "honeycomber" for the bee *Melipona beechei* is common and is often done individually. In Belize, formerly known as British Honduras, the cultivation of the stingless bee *Trigona fulviventris* is as old as the colony itself, while in Honduras, honey collection was more common compared to beekeeping (Bodenheimer 1951). In Costa Rica, consumption of wasp larvae and honeycombs roasted by the Guaymi people is reported; unfortunately, there are no taxonomic records of the species consumed (Pino-Moreno et al. 2014).

Ant consumption is restricted to the genus *Atta*. This consumption has been documented among the Miskitu and Sumu Indigenous groups of the Honduran and Nicaraguan Mosquitia. Although their diet is primarily based on other foods and animal husbandry, it has been recorded that the winged adults of the leaf-cutter ant *Atta cephalotes*, known as wiwi, are eaten by the Indigenous people. Their abdomen is roasted and eaten by both tribes (Conzemius 1932; DeFoliart 2002; Pino-Moreno et al. 2014).

Modern Drive for Insect Consumption in Central America

Recent years have seen a growing interest in insects as human food and animal feed (Baiano 2020). Central America is no exception and different companies and campaigns have been found promoting the cultivation, consumption and utilization of insect-based meals, as well as social projects to improve malnutrition rates (Bermúdez-Serrano et al. 2021; Hernández-De la Roca et al. 2018; Pino-Moreno et al. 2014; Quirós 2022).

In the municipality of Patulul, Guatemala, one of the regions with the highest malnutrition rates in the country, a feeding program was launched for children aged 4 to 6 years, incorporating yogurt made from flour derived from *Acheta domesticus*. This initiative aims to evaluate the effectiveness of insect-based yogurt in promoting weight gain, height increase, and overall growth among preschool-aged children (Hernández-De la Roca et al. 2018). According to the study, children who consumed yogurt showed greater acceptance of the product, as well as improvements in weight, height, and growth rates when compared to a control group. However, the study concluded that for the program to be sustainable, the production costs need to be reduced to meet the budget constraints of school nutrition programs.

In Honduras, the Entomology Museum at the Universidad Nacional Autónoma de Honduras organizes an invertebrate fair aimed at educating the university community about alternative sources of animal protein. Held once or twice annually, the event is organized by biology students, who prepare various dishes featuring insects, primarily crickets, *Tenebrio* larvae commonly named *gusano de la harina* in Spanish or yellow mealworm in English, and ants (Canahuati 2023). However, there is no available scientific literature or comprehensive list detailing the specific insect species offered during these exhibitions.

Meanwhile, in Costa Rica, there has been growing interest in developing an edible insect industry. National legislation now includes provisions for the industrial production of three species of edible insects: *Acheta domesticus*, *Tenebrio molitor*, and *Zophobas morio* (Promotora de Comercio Exterior de Costa Rica 2021). Reports indicate that there is potential for producing edible insects for export, further boosting the country's efforts to establish this industry (Bermúdez-Serrano et al. 2023). Currently, seven companies in Costa Rica are involved in the breeding, marketing, and promotion of insect consumption. These include Costa Rica Come Insectos, Insectario Orgánico, Juicy Ant, Gricket House, KTL Pro, Costa Rican Insect Company, Grillos en Costa Rica, and Gusanos de Harina & Grillos-Costa Rica (Pino-Moreno et al. 2014; Quirós 2022).

Additionally, the insect museum at the Universidad de Costa Rica contributes to this effort by cultivating various species of cockroaches, crickets, and mealworms. The university also organizes activities in collaboration with students and national media to raise awareness and disseminate information about the benefits of insect consumption (O'Neal Coto 2019).

Conclusion

Entomophagy practices in the Central American region, although not widely recognized by the general population, are still prevalent in most countries of the isthmus. Despite the taboos surrounding insect consumption in Western society, it represents a viable alternative in countries facing high rates of malnutrition, particularly among Indigenous populations (Spitzer 2023). Due to the growing demand for food, concerns about climate change, changes in land use, and excessive water resource use (Van Huis 2020; Van Huis et al. 2013), entomophagy emerges as a potential solution for the future.

The revaluation of this food practice is increasingly important, especially considering the growing interest of new generations in alternative food sources (Kamenidou 2023). In addition, its implementation promotes the recognition and appreciation of the knowledge and customs inherent to the Indigenous heritage of Central America.

Declarations

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