

RESEARCH ARTICLE

Traditional knowledge regarding entomophagy in San Martín, Peruvian Amazon

Conocimientos tradicionales sobre entomofagia en San Martín, Amazonía Peruana

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Abstract

The consumption of insects is a widespread practice among indigenous or native peoples of the Amazon. To assess the knowledge of the diversity of resources for entomophagy from the perspective of these peoples, testimonies or references about knowledge and feeding traditions of 100 people were collected in 37 localities in seven provinces of the department of San Martín in the basin of the Huallaga River. One cumulative species curve and the probability function of new species were estimated, then the probability of not finding a new species (99.5 %) to n_{100} was determined. The specimens that were captured in the field (54 %) were compared with representative specimens and databases, and the information provided by the participants was analysed to approximate the preliminary taxonomic locations of the remaining part of the sample. We found 46 resources for entomophagy and reported for first time in the Peruvian Amazon, the feeding with *Chrysophora chrysochlora*, *Podalia* sp., *Lusura chera*, and Cymothoidae, among others. Entomophagy is a deeply rooted practice in the native and riverine populations of the Huallaga basin, where *Rhynchophorus palmarum*, *Rhinostomus barbirostris*, *Atta cephalotes* spp. and *Brassolis sophorae* were the most consumed for 78 % – 97 % of people. The least consumed species have the common characteristic of being scarce and they were part of the diet of the oldest segment in previous decades. At least 10 resources ceased to be consumed by the members of the sample. In addition to nutritional potential, the diversity of edible arthropod fauna represents complementary values for community health and cultural identity; however, most of these resources (87 %) are threatened and could disappear in brief time, as is the knowledge related to their use.

Keywords: edible insects, ethno-entomology, food safety, Huallaga, original towns.

Resumen

El consumo de insectos es una práctica extendida entre los pueblos indígenas u originarios de la Amazonia. Con el objetivo de aproximar el conocimiento de la diversidad de recursos para la entomofagia desde la perspectiva de estos pueblos, se recogieron testimonios o referencias sobre el conocimiento o tradiciones alimentarias de 100 personas en 37 localidades en siete provincias del departamento de San Martín en la cuenca del río Huallaga. Se estimaron una curva de acumulación de especies y la función de probabilidades para

How to cite this article:

Cerna, A., Vecco-Giove, D., Doria, M., Panduro, H., Rojas, J., García, P., Corazón-Guivin, M., Sangama, B., Macedo, J., Ubeda, M., & Maes, J.-M. (2021). Traditional knowledge regarding entomophagy in San Martín, Peruvian Amazon. *Peruvian Journal of Agronomy*, 5(2), 44–59. <https://doi.org/10.21704/pja.v5i2.1773>

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nuevas especies, luego se determinó la probabilidad de no encontrar nuevas especies (99,5 %) para n_{100} . Los especímenes que se lograron capturar en campo (54 %) fueron comparados con especímenes representativos y bases de datos, y se analizó la información proporcionada por los participantes para aproximar las ubicaciones taxonómicas preliminares de la parte restante de la muestra. Encontramos 46 recursos para la entomofagia e informamos por primera vez para la Amazonia Peruana, la alimentación con *Chrysophora chrysochlora*, *Podalia* sp., *Lusura chera* y Cymothoidae, entre otros. La entomofagia es una práctica profundamente arraigada entre la población nativa y ribereña de la cuenca del Huallaga, donde *Rhynchophorus palmarum*, *Rhinostomus barbistrois*, *Atta cephalotes* spp. y *Brassolis sophorae* fueron las especies más consumidas (78 % – 97 %). Las especies menos consumidas tienen en común ser escasas y haber constituido en décadas pasadas la dieta de los segmentos de mayor edad, y por lo menos 10 recursos dejaron de consumirse por los miembros de la muestra. Además de su potencial alimentario, esta diversidad representa valores complementarios para la salud comunitaria y la identidad cultural; sin embargo, la mayoría de estos recursos (87 %) se encuentran amenazados y podrían desaparecer en poco tiempo, y en el mismo sentido, el conocimiento relacionado con su utilización.

Palabras clave: *Insectos comestibles, etno-entomología, seguridad alimentaria, Huallaga, pueblos originarios.*

Introduction

Across the globe, there is a wide collection of shared and diverse knowledge when it comes to integrate insects into the human diet: approximately two billion people consume insects, covering a diversity of two thousand species (van Huis et al., 2013). Entomophagy (Jansson & Berggren, 2015) is a prehistoric practice older than civilization (Costa-Neto, 2002; Fleta, 2018) and that today continues to arouse the interest of societies, increasingly on the economic plane (Masclans, 2019).

Insects are a good source of protein (Gomez et al., 1961; Ramos-Elorduy et al., 1984), vitamins (Ramos-Elorduy et al., 1988) and are highly digestible (Ramos-Elorduy et al., 1981). The frequency of consumption today depends on the abundance, seasonality and the maintenance of

traditions related to food. In South American countries, eating insects is an ingrained custom (Paoletti, 2005). In Brazil, 135 edible insects have been reported (Costa-Neto & Ramos-Elorduy, 2006).

In Peru, at least 10 morphospecies were mentioned by Espejo (2016) in the Awajun communities of the Cenepa River (Marañón basin), Asangkay (2018) made some addition to the list on base a study in Imaza (Marañón) and Casas et al. (2018) adjusted the identity of 12 species consumed by Awajun people for both scopes: *Rhynchophorus palmarum*, *Rhinostomus barbistrois*, *Metamasius hemipterus* (Coleoptera: Dryophthoridae), *Strategus jugurtha* y *Megaceras crassum* (Coleoptera: Scarabaeidae) and one Elateridae (Coleoptera); *Cephalotes atratus*, *Crematogaster sordidula* y *Atta cephalotes* (Hymenoptera: Formicidae); *Agelaia pallipes* y *Mischocyttarus* spp. (Hymenoptera: Vespidae) and *Cyphomyia auriflamma* (Diptera: Stratiomyidae). Velasque (2017) reported eight insects consumed by the Ashaninka in Atalaya (upper Ucayali basin), some Coleoptera, presumably *Rhynchophorus palmarum* (“suri”), *Passalus* sp., *Oryctes* sp. [sic], *Stenocrates* sp. and *Tomarus* sp. (“papaso”), and other insects mentioned as “shiringa’s worm”, “awiwa”, and “bolaina’s worm”. Sadly, there are not good pictures or collections to check these registers.

Manno et al. (2018) mentioned as new registers of consumption for Ashaninka and Awajun people: *Callipogon* sp., *Macrodonia cervicornis*, *Acrocinus longimanus* (Coleoptera: Cerambycidae), *Dynastes hercules*, *Platycoelia lutescens* (Coleoptera: Scarabaeidae), ant *Atta sexdens*, *Brassolis sophorae* and *B. astyra* (Lepidoptera: Nymphalidae), *Castnia daedalus* and *Eupalamides cyparissias* (Lepidoptera: Castniidae). *Crematogaster stollii*, wasp *Polybia platycephala* and *P. furnaria* would be consumed only by Awajun, and *Premnotrypes* sp. (Coleoptera: Curculionidae), *Helicoverpa zea* and *Heliothis virescens* (Lepidoptera: Noctuidae), for the Quechua in Cusco. Whereas these authors confused origin of the people Quechua from Cusco and Kichwa of San Martín, they found a close relationship between food

traditions of these last and the other Amazonian people as Awajun and Ashaninka.

San Martín is a transitional region of high jungle and part of Amazon plain in the Huallaga River basin. This territory is characterized by wide and close valleys very humid in the South and dry seasonal in the central basin, between the foothills of the “Cordillera Oriental” to the West, and the last mountain chains to the East (“Cordillera Azul”) and North (“Cordillera Escalera” and “Campanquiz”) which limit and give way to Amazon plain in the low basin (Vecco, 2009). The region is the most deforested of the Country (Servicio Nacional Forestal y de Fauna Silvestre [Serfor], 2015): more than a half forest surface would have disappeared in the last 50 years, a fact that would have involved the sudden loss of biological diversity, and consequent decreasing of livelihoods of population, initially formed by convergence of pre-Columbian peoples, migrant and three current ethnic groups: Awajun (f. Jibaro), Shawi (f. Cahuapana), and

Kichwa (f. Kichwa). This last one seems bigger than the others in population and dispersion, with three variants (Sisa, Lamas and Chasuta) which were constituted in the “reductions” of the Colony (Maskrey et al., 1991) as from several ethnic groups of Amazonian origins (Sandoval et al., 2016).

The purpose of this work was to carry out an approach to the knowledge of the diversity of resources for entomophagy from the perspective of native and riverine peoples of San Martín.

Material and methods

The study was carried out in the scope of 37 localities of 26 districts in seven provinces (Rioja, Lamas, San Martín, Bellavista, Picota, El Dorado and Huallaga) of the department of San Martín (Figure 1). Between July 2019 - August 2020, and April 2021, we collected the testimonies or references of 100 people who asserted to practice entomophagy: 40 % women and 60 % over 50

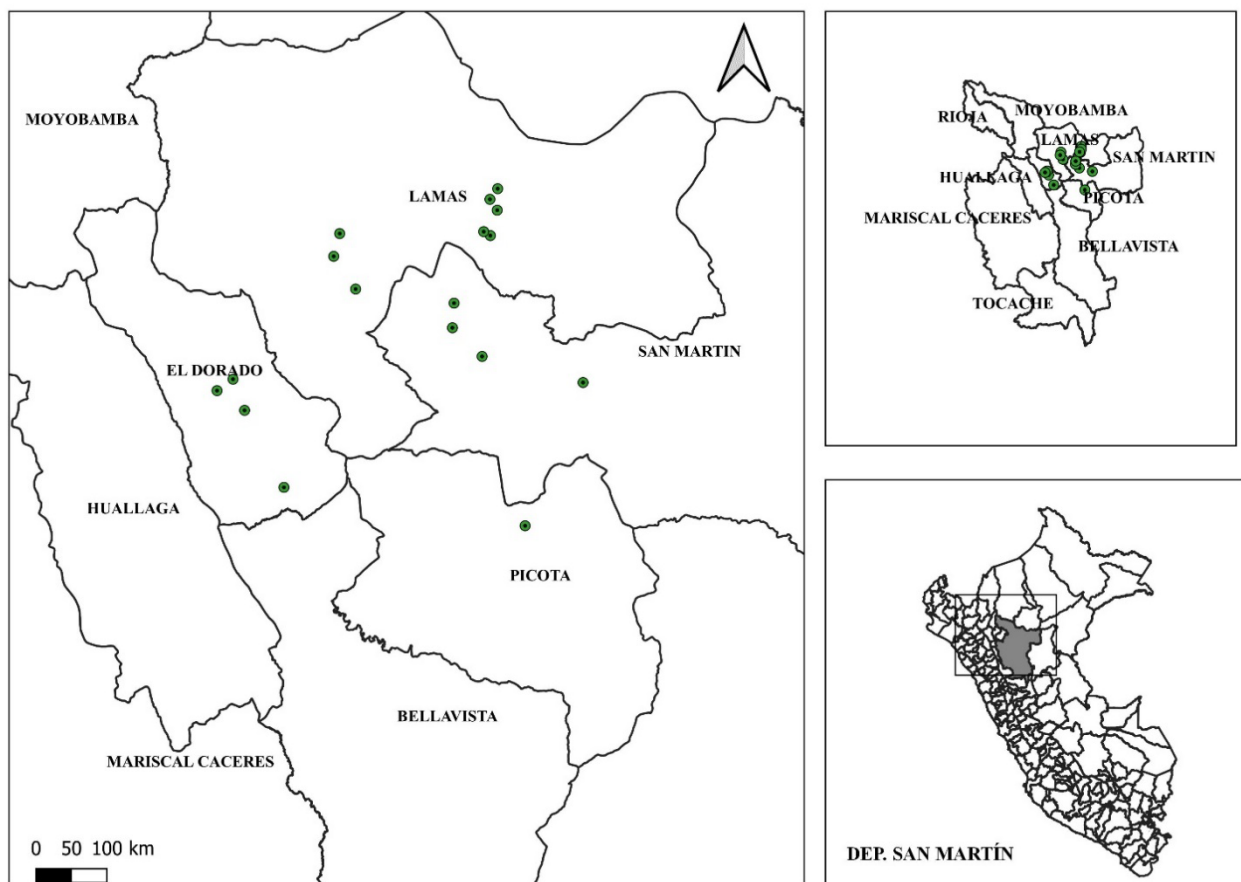


Figure 1. Study location, distribution in the Provinces of San Martín Region.



Figure 2. Images about people and process of the study.

years old. The interviews were conducted in the native languages Llakwash (Kichwa San Martin) and Awajun in seven Kichwa communities (Figure 2) and one Shuar - Awajun family, respectively. For others, communication was done in local Spanish. Information was collected on entomophagy knowledge and traditions: consumption histories, eating species, local names, hosts, habitat; availability, frequency, and cultural ways of consumption. A comparison of consumed species or resources in sceneries

“past” and “present” were done with the non-parametric statistic proof X^2 .

Since the 100 references (n) it was determined the average of species by sample ($s. = S * n^{-1}$) which was considered as the first data to estimate the accumulation species curve, where following data was defined by 100 permutations of n_i , with software R – Vegan (Oksanen, 2020). The probability function for number of non-registered species S_i and each new testimony

n_i was estimated by $p_i = S_i / s$. on an Excel data sheet. To test the representativity of number of species S for sample n , the non-linear polynomic regression between logarithmical value of n_i and p_i was done, then the probability of finding a new species and the opposite it ($1 - p_i$) was determined.

Collecting activities of the food resources mentioned by the participants were carried out in the field from beginning of study until April 2021. The specimens captured (54 % of total of registers, Table 1) were compared with the representative specimens in the collections of the Entomological Museum of *Estudios Amazonicos* and the *Universidad Nacional de San Martín*, the *Museo Entomológico de León* – Nicaragua, and databases. The remaining part of the sample (48 %) was analysed with the information provided by the participants and secondary references to approximate preliminary taxonomic locations.

Results

The consumption of 46 food resources was recorded (Table 1); all they were insects, with exception of a Cymothoidae (Arthropoda: Crustacea: Isopoda) which parasitizes Loricariidae fish. The accumulation species function fitted with logarithmical model [$S_i = 9.5828 \ln(n_i) + 3.1452$] ($R^2 = 99$ %, Figure 3A). Probability's function [$\log p_i = -0.4075 (\log n_i)^3 + 0.932 (\log n_i)^2 - 1.3591 (\log n_i) - 0.0004$], depended on number of testimonies or references about entomophagy on a meaningful way ($R^2 \approx 100$ %, Figure 3B). The final probability of not find more species for $n=100$ was 99.5 %.

Despite this important food diversification, only five resources were the most consumed with frequency between 58 % and 97 % of the testimonies (Figures 4 and 5). The least consumed species have the common characteristic of being scarce and were part of the diet of the oldest segment in previous decades. Intergenerational loss of habits of entomophagy has mainly affected the Kichwa or native populations of El Dorado (-62 %), Lamas (-58 %), and San Martín (-47 %) ($PX^2 = 0,00\%$, Table 2) and at least 10 resources

ceased to be consumed by the members of the sample (Figure 4).

The beetles *Rhynchophorus palmarum* and *Rhinostomus barbirostris* are the most consumed, their larvae are known by Kichwa as “suri” or “shampuru” (Spanish [Sp.] “shamburo”) and adults as “mulutuwa” (Sp. “molotoa”). The females generally deposit their eggs on the lodged or standing trunks with the affected stipe of natural and cultivated palms, which determines a strong economic pressure on native palms and the host species *Jacaratia digitata* (Caricaceae), since these resources are often in great demand (prices of \$ 0.14 – 0.28 per unit) and are regularly found in the local markets of Tarapoto and Yurimaguas.

The reproductive queens of called “mamaku” or “sikisapakuru” (*Atta cephalotes*) are consumed by 95 % of those surveyed. They are seasonal in general (October - November), and usually are collected after light rains.

Two types of behaviour are distinguished by people: populations whose nuptial flight occurs during the day, mainly in the afternoon, and those that emerge at night or at dawn. Ants showing this last behaviour are known as “tutakuru” (literal from Kichwa “night or early morning ants”) and captured with lighters, whose light attracts these insects. Like other seasonal species whose abundance occurs for short periods, simple storage techniques are used in pots, clay jars, and plastic containers.

Colonies of these formicides, known in their usual form as “kuruwinsi” (Sp. “curhuinse”) are considered important pests for a wide variety of crops. However, they are usually sold at high price (\$ 36 kg⁻¹) in local markets. Seasonal harvests of this ant are traditional for several peoples, such as Yantaló (Moyobamba), where the “Festival of Mamaku” is celebrated each year.

The larvae of the *Brassolis sophorae* butterfly (Lepidoptera: Nymphalidae), known as “awiwa” present a widespread non-commercial consumption (95 % of sample), although they are not part of the food tradition of the Awajun communities. Seasonally available, they are usually found in plantations and urban areas;

Table 1. Resources for entomophagy in San Martín Region

№	Resource for entomophagy		M*	Consumption			Ecological association
	Taxonomic approximation	Local names		%	Object	Form	
1	<i>Rhynchophorus palmarum</i> (Coleoptera: Dryophthoridae)	Suri, shampuru /shamburo/, mulutuwa /molotoa/.	E, L, P, A	97%	Nutritional, complementary medicinal, ritual.	Larvae raw, roasted, fried, wrapped in leaves, or cooked. Oil.	Wild and cultivated palm trees, <i>Jacaratia digitata</i> .
2	<i>Atta cephalotes</i> spp. (Hymenoptera: Formicidae).	Sikisapa-kuru, mamaku (queens), washu (males); kuruwinsi (workers and military).	A	96%	Food.	Raw or toasted winged males and queens.	Several species and crops.
3	<i>Brassolis sophorae</i> and other <i>Brassolis</i> spp. (Lepidoptera: Nymphalidae).	Awiwa.	E, L, P, A	96%	Food.	Cooked, leaf-roasted, fried, or battered larvae.	Foliage of natural and cultivated palm trees, <i>Gynerium sagittatum</i> , and banana.
4	<i>Rhinostomus barbirostris</i> (Coleoptera: Dryophthoridae).	Yurak suri, suri blanco, shampuru /shamburo/, mulutuwa /molotoa/.	L, P, A	79%	Food.	Larvae raw, roasted, fried, wrapped in leaves, or cooked. Oil.	Wild and cultivated palm trees, <i>J. digitata</i> .
5	Chrysomelidae: Bruchinae	Shampurillu /shamburillo/, suricillo.	-	58%	Food, such as fishing bait.	Larvae raw, roasted, fried, wrapped in leaves, or cooked. Oil.	Inside the seed of palm fruits <i>Attalea</i> spp. (“shapaja” and “shebón”), <i>Aphalandra natalia</i> and <i>Astrocaryum murumuru</i> .
6	<i>Podischnus</i> sp. (Coleoptera: Scarabaeidae).	Suri, papasi, torito, molope.	L, A	34%	Food.	Roasted adults; grilled, leaf-wrapped, or cooked larvae.	Pineapple, <i>G. sagittatum</i> , and other Poaceae.
7	Group (Hemiptera: Cicadidae).	Chicharra, kakapana.	N, A	30%	Food.	Roasted nymphs and adults.	<i>Simarouba amara</i> , <i>Sickingia williamsii</i> , <i>Attalea</i> spp., <i>Matisia cordata</i> , <i>Tachigali vasquezii</i> .
8	<i>Diatraea</i> spp. (Lepidoptera: Crambidae).	Suri, cañero, simu /simo/.	L	27%	Food, in disuse.	Larvae roasted, seared in leaves, or cooked.	Inside the stem of sugarcane, corn.

* Sample (M): it indicates if specimens were observed: egg (E), larvae (L) or nymph (N), pupae (P) and adult (A), or not (-), in field during the study.

May - August 2021

№	Resource for entomophagy		M*	Consumption			Ecological association
	Taxonomic approximation	Local names		%	Object	Form	
9	<i>Metamasius hemipterus</i> (Coleoptera: Curculionidae).	Suri, shampurillu / shamburillo/, mulutuwa / molotoa/; broca del plátano.	L, A	25%	Food, such as fishing bait.	Raw, fried, roasted, leaf-wrapped, or cooked larvae.	Banana, some Poaceae.
10	<i>Strategus</i> sp. (Coleoptera: Scarabaeidae).	Papasi del coco, suri del coco.	A	18%	Food.	Cooked adults and larvae.	Coconut tree.
11	<i>Crematogaster</i> spp. (Hymenoptera: Formicidae).	Buttery ant.	-	16%	Food, in disuse.	Adults and immatures toasted and wrapped in leaves of <i>Calathea</i> cf. <i>lutea</i> .	-
12	<i>Chrysophora chrysochlora</i> (Coleoptera: Scarabidae)	Sun-sún.	A	13%	Food (disuse for scarcity).	Adults cooked in brine, then roasted with a little oil.	“Retama” (<i>Senna reticulata</i>) for adults.
13	<i>Castniomera</i> sp. (Lepidoptera: Castniidae).	Gusano tornillo, suri de plátano, puñuy-siki (pupa).	L	13%	Food.	Raw, roasted, and cooked larvae and pupae.	Rhizome of banana, heliconia and achira (<i>Canna edulis</i>).
14	<i>Arsenura armida</i> (Lepidoptera: Saturniidae).	Bolayna-awiwa, bolasho, devil worm, kissing worm.	L, P, A	11%	Food.	Cooked or dressed larvae.	Foliage of <i>Guazuma crinita</i> , <i>G. ulmifolia</i> and Bombacaceae.
15	<i>Polistes</i> spp., <i>Polybia</i> spp. and other wasp (Hymenoptera: Vespidae).	Wayranka (huayranga) (<i>Polistes</i> spp.); shiro-shiro (<i>Polybia</i> spp.).	A	11%	Food and ritual (human and dogs).	Immatures raw or fire-fired (scorched).	Natural and secondary forests, urban areas.
16	Lepidoptera	Kinilla-kuru, shitaktak.	-	9%	Food.	Cooked or dressed larvae.	Foliage of <i>Manilkara bidentata</i> and cassava.
17	<i>Heliothis</i> spp. (Lepidoptera: Noctuidae).	Poroto-kuru.	-	8%	Eventual consumption with beans, lima beans, and other legumes.	Cooked larvae with grains.	Cultivated Fabaceae seeds.
18	<i>Lusura chera</i> (Lepidoptera: Notodontidae)	Awiwa of huaba.	E, L, P, A	8%	Food.	Cooked, steamed, or dressed larvae, wrapped in leaves.	Foliage of <i>Inga</i> spp.

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	Taxonomic approximation	Local names		%	Object	Form	
19	Hymenoptera: Apidae: Meliponini.	Ramichi, puynami, “chinito”, colmena and other.	E, L, P, A	8%	Food, medicinal.	Kichwa: fresh immature mixed with honey and pollen. Macerated in alcoholic drink.	Natural and secondary forests, urban areas.
20	Coleoptera: Passalidae	Suri of ojé.	-	7%	Food.	Roasted or cooked larvae.	Oje tree timber, (<i>Ficus</i> spp.).
21	<i>Cerconota anonella</i> (Lepidoptera: Depressariidae).	Worm of annona.	-	7%	Food, eventual consumption with the fruit.	Raw, fried, roasted, leaf-wrapped, or cooked larvae.	Annonaceae fruits.
22	Cymothoidae (Arthropoda: Crustacea: Isopoda).	Chicharra del shitari.	-	7%	Food.	Raw, leaf-seared, and cooked nymphs.	Parasite of Loricariidae fishes (rumi - shitari, barbusha).
23	Coleoptera	Simu /simo/.	-	5%	Food.	Cooked larvae.	Decomposed wood and organic matter.
24	<i>Helicoverpa zea</i> (Lepidoptera: Noctuidae).	Sara-kuru.	-	5%	Eventual consumption with corn.	Cooked larvae in corn.	Fresh corn cob.
25	Lepidoptera	Awiwa of chopé and sachamango	-	5%	Food.	Cooked or dressed larvae.	Foliage of chopé (<i>Gustavia</i> spp.) and sachamango (<i>Gryas</i> sp.).
26	Coleoptera: Cerambycidae.	Suri, llanchama-kuru.	-	4%	Food.	Roasted larvae.	Wood of llanchama tree (<i>Poulsenia armata</i>).
27	Lepidoptera.	Awiwa of mashonaste.	-	4%	Food, in disuse.	Cooked larvae.	Foliage of <i>Clarisia racemosa</i> .
28	Group (Lepidoptera: Sphingidae).	Cornegacho (larvae), puñuy-siki (pupae).	-	4%	Food.	Raw larvae and pupae, leaf-roasted, roasted or fried.	Edible plants (cassava and tomato).
29	Lepidoptera	Setico-kuru, shitaktak.	-	4%	Food.	Prepupae and pupae soaked in steamed leaves.	Foliage of <i>Cecropia</i> spp.
30	<i>Periplaneta americana</i> (Blattodea: Blattidae).	Cucaracha, sabandija.	N, A	4%	Medicinal (bronchial issues).	Kichwa: nymphs and toasted adults. Awajun people only drink water in contact with the insect.	Urban areas and rural establishments.
31	<i>Panchlora</i> sp. (Blattodea: Blaberidae).	Kustadu kuru, wira-cucaracha.	N, A	4%	Medicinal (fever, bronchial issues, pneumonia).	Kichwa: nymphs and adults mixed with tender shoots of vegetables, aromatic herbs, child’s urine, and alcoholic drink.	Natural and secondary forests, urban areas.

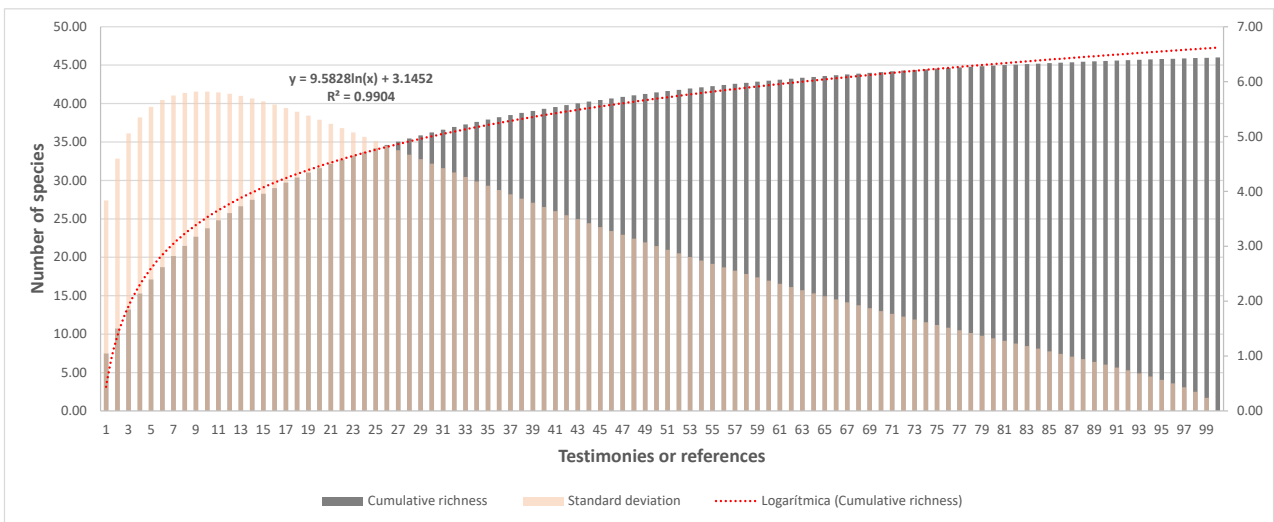
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	Taxonomic approximation	Local names		%	Object	Form	
32	<i>Euchroma gigantea</i> (Coleoptera: Buprestidae).	Intimaman.	A	3%	Food, ritual and sumptuary.	Cooked larvae and adults.	<i>Simarouba amara</i> , <i>Ochroma pyramidale</i> , Bombacaceae, Moraceae and <i>G. sagittatum</i> .
33	<i>Pyrophorus</i> sp. (Coleoptera: Elateridae).	Suri (larva), ninakuru (adult).	L	3%	Food.	Cooked larvae.	“Lupuna-tree” <i>Ceiba</i> spp. and other Bombacaceae.
34	Hymenoptera: Formicidae	Piña-añallu	A	3%	Food and ritual.	Immatures are steamed roast, wrapped in leaves.	-
35	Group (Diptera: Tephritidae).	Shawintukuru.	-	3%	Food, eventual consumption with the fruit.	Raw larvae in the fruit.	<i>Psidium</i> spp. and Myrtaceae and Anacardiaceae fruits.
36	<i>Apis mellifera</i> (Hymenoptera: Apidae)	African honeybee, honeybee.	E, L, P, A	3%	Food, medicinal.	Fresh immature mixed with honey, pollen and “bee bread”.	Natural and secondary forests, urban areas.
37	Coleoptera.	Chanka chakan.	-	2%	Food, in disuse.	Roasted or cooked adults.	Anona flower (<i>Annona</i> spp.).
38	<i>Mocis latipes</i> (Lepidoptera: Noctuidae).	Vareador.	-	2%	Food, in disuse.	Cooked larvae.	Corn, sugar cane, rice, and sorghum.
39	<i>Podalia</i> sp. (Lepidoptera: Megalopygidae).	Utku-bayuca.	L	2%	Food, in disuse.	Larvae placed on the embers to burn the stinging hairs; then roasted in steamed leaves.	Various wild and cultivated plants.
40	Lepidoptera	Awiwa de la topa.	-	2%	Food.	Cooked, steamed, or dressed larvae.	Foliage of <i>Ochroma pyramidale</i> .
41	<i>Schistocerca</i> spp. (Orthoptera: Acrididae).	Maru, langosta.	-	2%	Food (anecdotal).	Cooked larvae and adult.	Polyphage.
42	<i>Sarcophaga</i> sp. (Diptera: Sarcophagidae).	Shinku / shingo/.	-	2%	Food, in disuse.	Larvae obtained by falling from meat flaps or collected live, washed, and roasted in <i>C. lutea</i> (“bijao”) leaves.	Meat, corpses, hunt remains.
43	<i>Pseudomyrmex</i> sp. (Hymenoptera: Formicidae).	Tangarana.	E, L	1%	Medicinal.	Immatures are cooked wrapped in leaves.	“Tangarana-tree” (<i>Triplaris</i> spp.).

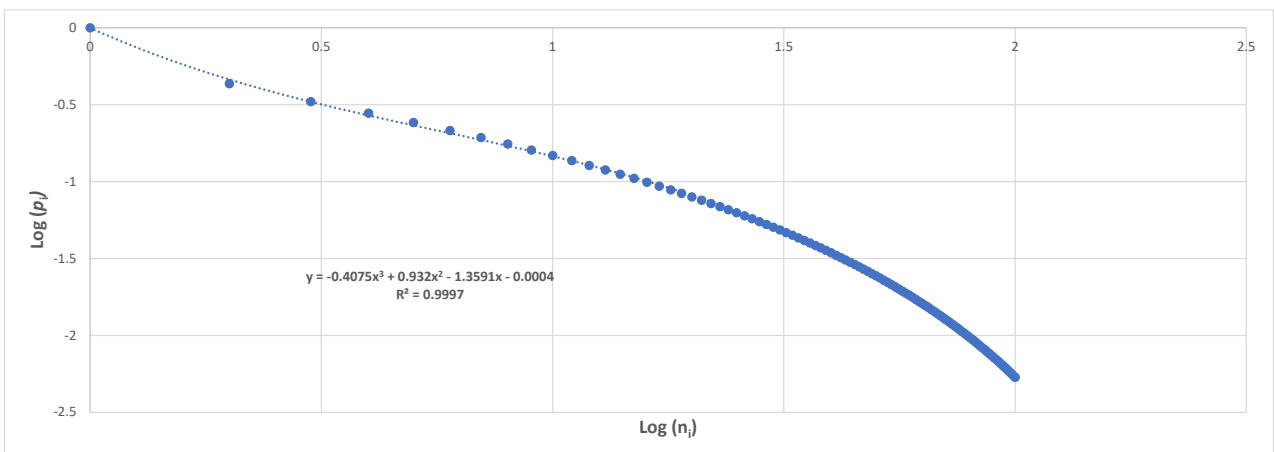
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№	Resource for entomophagy			Consumption		Ecological association	
	Taxonomic approximation	Local names	M*	%	Object		Form
44	<i>Paraponera clavata</i> (Hymenoptera: Formicidae).	Isula.	A	1%	Medicinal.	Adults are macerated in alcoholic drink. Immatures are steamed roast, wrapped in leaves.	-
45	<i>Pachylia cf. ficus</i> (Lepidoptera: Sphingidae).	Renako awiwa.	L, P, A	1%	Food.	Raw larvae and pupae, leaf-roasted, roasted or fried.	Renaco (<i>Ficus</i> spp.).
46	<i>Cyphomya</i> sp. (Diptera: Stratiomyidae)	Pinchuche.	-	1%	Food.	Raw larvae and pupae, leaf-roasted, roasted or fried.	Palms together with Dryophthoridae larvae.

* Sample (M): it indicates if specimens were observed: egg (E), larvae (L) or nymph (N), pupae (P) and adult (A), or not (-), in field during the study.



3A



3B

Figure 3. Basis to test representativity of sample to estimate the cumulative richness of edible entomofauna. A) Cumulative species and standard deviation estimated by permutations of 100 data. B) Probability function of new species according to size-sample (logarithmic data).

considered pests of industrial crops of oil palm and coconut, among others. For other species that present phenomena of seasonal population massive irruption, there are several cicadas, the “bolayna awiwa” (*Arsenura armida*), the

“awiwa of huaba” (*Lusura chera*), the “sun-sun” (*Chrysophora chrysochlora*), and lobsters stand out. The cicadas (Hemiptera), known locally as “kakapana” constitute a group of species of edible adults and nymphs associated with forest or monospecific communities, such as the case of the “black-ukshakiru’s cicada”, related to *Tachigali vasquezii*. The traditional consumption of cicadas in Suchiche and other neighbourhoods of Tarapoto justified the nickname of “chicharreros” for this people. The Kichwa still show the traditional consumption of these insects that in the past were hunted with waves or blowpipes baited with *Achira* sp. seeds, as a proof of skill and competence.

Table 2. Intergenerational loss in the number of species consumed in seven provinces of San Martín

Provinces	Number of resources consumed		Loss of consumption	%
	Before	Today (<50 y.o.)		
Bellavista	20	11	9	45
El Dorado	26	10	16	62
Huallaga	9	6	3	33
Lamas	38	16	22	58
Picota	10	5	5	50
Rioja	5	5	0	0
San Martín	30	16	14	47

The larvae of *Arsenura armida* (Lepidoptera: Saturniidae) are known as “bolayna awiwa”, “bolasho”, “devil worm” or “kissing worm” because of characteristic noise that they produce. These are resources that are still present in the valleys of Sisa (San Pablo, February 2021), Caynarachi (Barranquita, July-August 2020), and

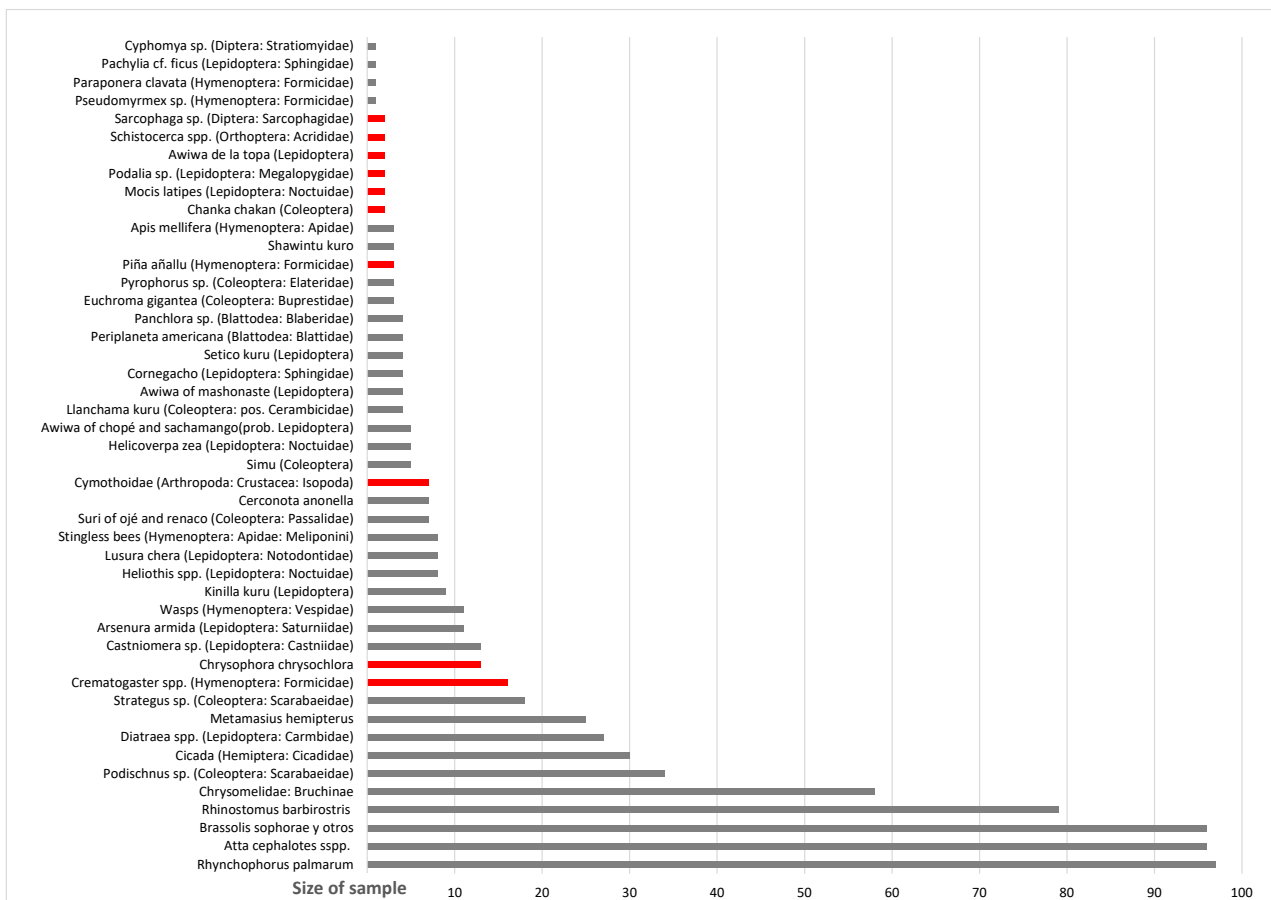


Figure 4. Absolute frequency of entomophagy for 46 registered resources. Red bars indicate the resources which consumption has been discontinued at the present.

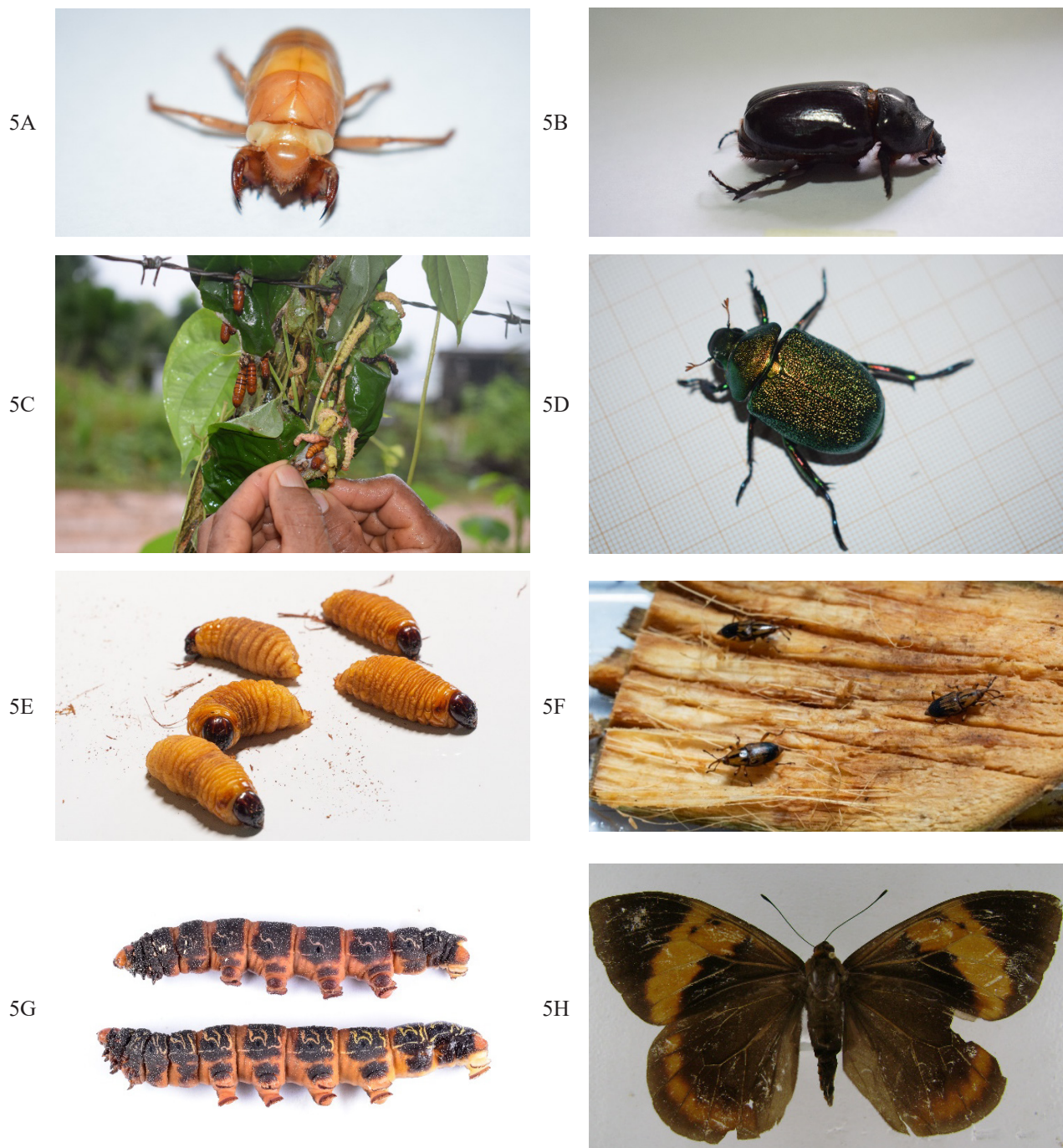


Figure 5. Pictures of some identified resources: A) cicada nymph; B) *Strategus* sp., female; C) *Lusura chera*; D) *Chrysophora chrysochlora*; E) *Rhynchophorus palmarum* larvae; F) *Metamismus hemipterus*; G) *Arsenura armida* larvae; H) *Brassolis sophorae ardens*.

Low Mayo (Rumisapa, April 2021), although the habit of consumption in these two last localities is virtually lost. The larvae of *Lusura chera* (Lepidoptera: Notodontidae), “awiwa of huaba” (*Inga* spp.) are little consumed in the valley of Caynarachi, where were found in March 2021. Also, larvae of *Pachylia* cf. *ficus* was found in La Banda de Shilcaya (March 2021).

The use of some entomophagy resources has been discontinued (22 % of the sample), either in relation to the disappearance of their populations, as such is the case of the “sun-sún” (*Chrysophora chrysochlora*) and the “shitari’s cicadas” (Isopoda: Cymothoidae) in the Pongo de Caynarachi and Low Huallaga River, as well as with the passing of the people who kept these

traditions. A little population of “sun-sún”, that according Remberto Salas (66) was the first after 40 years, was recorded in March 2021 (rainy season) on riverside of the Caynarachi (Pongo de Caynarachi).

Immatures of a wide diversity of stingless bees are ate yet with honey, pollen and “bee bread”, but this practice has been extended to immatures of exotic *Apis mellifera* in Valley of Sisa. By the similar sense, the locust *Schistocerca* spp. (Orthoptera: Acrididae) were eventually consumed during a famine that devastated the peoples of Central Huallaga in 1947, when a great drought and the massive proliferation of these insects coincided (reference by Samuel Del Águila †).

The ancient Kichwa habit of consuming the “chanka chakan” (Coleoptera) was revitalized by Benicio Amasifuén (†) in Chasuta in the sixties but today is not practiced. The “buttery ant” (*Crematogaster* sp.) that people used to eat in Pongo de Caynarachi (Isabel Vela † and Germán Salas †) are no longer consumed in this place or any town in San Martín. The same case occurs with the consumption of larvae of “shinku” (*Sarcophaga* sp.) (Eleadoro Sangama †), recovered in the carcasses of hunt remains (shells of *Dasytus* spp., for example) in Chasuta and cattle in the Biavo valley (Bellavista).

The oldest population consulted agrees that the current scarcity of edible insects is due to deforestation and disappearance of primary forest communities. In the past, the “kinilla-kuru” (Lepidoptera) was object of active exchanging between the nearby towns to the forest of *Manilkara bidentata* (kinilla) and the farthest ones of the Ponasa River Valley (Lidia Amasifuen Chistama), but today the species became to scarce for the gradual loss of those forest communities. In the same sense, the “llanchama-kuru” is less consumed because the drastic reduction of “llanchama tree” populations (*Poulsenia armata*) in the humid forest.

In addition to food applications, testimonies were recorded on the complementary consumption of insects for medicinal and ritual purposes (Table 1), the oil of “suri” has been

used frequently to treat a disease known as “pulsario”, infectious processes, bronchitis and as an effective purgative. With these insect alcoholic macerates are prepared that according to the version of the riverside inhabitants have the property of alleviating rheumatic afflictions. In communities of Kichwa - Shawi descent from Pongo de Caynarachi and Yumbatos, elders report that people used to tied alive adults of *R. palmarum* to the forearms of young people, to test their courage and with the assumption of transferring skills so that these become winners in the not unusual fights.

This belief in the “transfer of attributes” from consumed insects to people is also evidenced in the consumption of “piña-añallu”, a small ant that secretes formic acid and has a painful bite of short duration. The men used to expose their fists on the colonies, for the purpose of intimidating rival groups in Pongo de Caynarachi. In the communities of the Sisa valley, the elytra of the buprestid *Euchroma gigantea* are still extracted to make bracelets that are placed on new-borns with the purpose of modelling a lively and rebellious character. Since a local approach, ingestion of immatures wasp (Vespidae) in infancy it would be cause of the future changes in character (bellicosity) in people, and domestic animals such as dogs. The name “kustadu-kuru” of the cockroaches of the *Panchlora* genus, used for medical purposes like *Periplaneta americana*, alludes to their behaviour of inflating the flanks to breathe, with a parallel with the cases of respiratory problems in humans.

Discussion

The present study states the coincidences in entomophagy between the people of the Huallaga Valley and other peoples of the Peruvian Amazon such as the Awajun and the Ashaninka (Espejo, 2016; Velasque, 2017; Asangkay, 2018; Casas et al., 2018; Manno et al., 2018), but at the same time it shows the large diversity of arthropod which has been overlooked as resource for alimentation. The future works should clarify the taxonomy of edible insects, given the difficulties posed to quantify it (DeFoliart, 1997).

In this paper we report for first time the feeding with *Chrysophora chrysochlora*, *Podalia* sp., *Lusura chera*, and Cymothoidae in the Peruvian Amazon. By other hand, Paoletti and Dufour (1987, 2005) and Kim et al. (2019) have informed people eating beetles and larvae of *Podischnus agenor*, and *Erinnyis* sp. in Colombia. Choo (2008) has reported three Bruchinae (Chrysomelidae) take out from *Attalea* seeds and consumed by the Matsigenka from Peru, among other groups in South America. DeFoliart (1997, 2012) cited consumption of *Schistocerca* spp., *Euchroma gigantea*, and *Mocis repanda* in Colombia. Mitsuhashi (2017) referred larvae of *Pachylia ficus* as food in Chiapas, Mexico. Costa-Neto and Ramos-Elorduy (2006) based in previous authors referred that the cockroaches as *Periplaneta americana* were preferred by indigenous in Brazil and cited a wide range of edible insect in general taxa.

In the past, insects were numerous in population and species diversity, representing a range of possibilities for food. Agricultural systems were able to facilitate the emergence of edible phytophagous, but deforestation and climate change have irreversibly affected the distribution of many key floristic species (Botero, 2015) and have modified the distribution and behaviour patterns of these insects. The expansion of African palm and other intensive crops, for example, would have promoted an increase in the populations of *B. sophorae*, *R. palmarum*, *R. barbirostris*, *Strategus* sp. and *A. cephalotes*, without implying the revitalization of entomophagy; due to a greater dependence of rural society on industrialized food and the use of insecticidal chemicals promoted from the business and academic sectors.

Although deforestation - defaunation processes interact with intergenerational change and subjective phenomena that reflect the power relations that determine the loss of local knowledge, it should be considered that the persistence of certain uses will respond to the adaptability of the entomofauna. In this regard, it is worth highlighting what is indicated by Dufour (1987), who explains the food importance of insects due to their potential contributions of energy and protein to a society, depending on

their size, predictability of aggregation and periodicity of access. Such is the case of the five species with the highest consumption in this study, with respect to other species in which populations that were smaller, dispersed, and unusual or undetectable during field trips.

The concept of “nutraceutical entomofauna” by Costa-Neto and Ramos-Elorduy (2006) is implicit in subjectivity of those who still consume insects in the Huallaga basin and relate them to health. The consumption of insects for medicinal purposes is not an isolated habit and there is evidence of extensive use of certain species for similar purposes. Cockroaches, for example, have been mentioned as therapeutic resources for native peoples in Brazil by Costa-Neto (2002) and Schaden (1938, cited by Lenko & Papavero, 1996). The potential of *P. americana* to treat health problems and emergent diseases such as cancer has been well documented by Zeng et al. (2019), in close similarity with the traditional knowledge found in the present study.

Ritual uses and beliefs related to the local consumption of insects, rather than interpreting as simple remnants of the animist conception of Amazonian cultures, must be understood as an ethical element arising from the human-nature relationship (Kapfhammer, 2012), whose essence today is as fundamental to our survival as it was to the original civilizations.

Conclusions

In this paper we found 46 resources for entomophagy and report for first time in the Peruvian Amazon, the feeding with *Chrysophora chrysochlora*, *Podalia* sp., *Lusura chera*, and Cymothoidae, among others. Entomophagy is a deeply rooted practice in the native and riverine populations of the Huallaga basin in San Martín, where *Rhynchophorus palmarum*, *Rhinostomus barbirostris*, *Atta cephalotes* spp. and *Brassolis sophorae* were the most consumed for 78 % – 97 % of people. In addition to nutritional potential, the diversity of edible arthropod fauna represents complementary values for community health and cultural identity; however, most of these resources (87 %) are threatened and could

disappear in brief time, as is the knowledge related to their use.

Acknowledgements

In memoriam to Hilda Ishuiza Ishuiza. Thanks to the Research and Development Institute (IID) of the Universidad Nacional de San Martín. To the wise people of the communities of Kawana Sisa, Ishichiwi, Kopal Sacha, Pongo de Caynarachi and Yumbatos: Víctor Acho Paima, Edovigia Pashanasi Ishuiza, Remberto Salas Vela, Alfredo Tangoa Romero, Floresmila Huansi Peña, José Jesús Lumba Salas, Asunción Amasifuen Tuanama, Encarnación Tuanama Salas, Roberto Tuanama Salas and Yanua Atamain. To Daniel Ushiñahua, Liz Quiñones, Roberto Palomo and Kareli Herrera. Acknowledgment to Carlos Etsá Vecco for technical support and Andrew Clark for translating this article into English.

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