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Keywords: EPIDEMIOLOGY, HEALTH, INDIGENOUS PEOPLE, VECTORS

**Occurrence records and metadata for sand flies (Diptera, Psychodidae, Phlebotominae) collected in the lands of indigenous people in the Brazilian Amazon**

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**Abstract**

In order to contribute to knowledge of the epidemiology of American cutaneous leishmaniasis (ACL) among indigenous people living in sylvatic regions, we studied the sand fly fauna collected in areas of disease transmission in the Brazilian Amazon. Our two datasets reported here are comprised of occurrence data for sand flies from the Suruwaha Indigenous Land in the state of Amazonas collected between 2012-1013, and the Wajãpi Indigenous Land in the state of Amapá collected between 2013-2014. Sand flies were collected using unbaited CDC-like light traps at various sites within each study area and were identified to species-level by taxonomists with expertise in Amazonian fauna. A total of 4,646 records are reported: 1,428 from the Suruwaha and 3,218 from the Wajãpi. These records will contribute to a better understanding of ACL transmission dynamics, as well as the distribution of insect vectors, in these areas.

Research areas: Animal and Plant Sciences, Biodiversity, Taxonomy

**Data description**

Leishmaniases are diseases caused by various species of the protozoan parasite genus *Leishmania*, which are transmitted between humans, and wild and domestic vertebrate animals, by the bites of blood-feeding female sand flies [1]. In Brazil, American cutaneous leishmaniasis (ACL) is an endemic disease, but little is known about its impact on indigenous human populations, especially those living in more remote areas with little contact with non-indigenous people living outside their territorial lands. In order to investigate the sand fly fauna present during outbreaks of ACL among the Suruwaha and the Wajãpi indigenous people that occurred between 2012-2014, we carried out fieldwork to collect these insects and identify potential vectors. Insects were identified by keys available in the literature [3,4] by experienced taxonomists.

Our datasets are comprised of sand fly occurrence data from: (i) the Suruwaha Indigenous Land (SIL) in the south of the state of Amazonas collected between 2012-1013; and (ii) the Wajãpi Indigenous Land (WIL) in the state of Amapá collected between 2013-2014. The data sets reported here are the metadata for each individual sand fly specimen collected during the fieldwork and include 41 Darwin Core Standard (DwC) terms [5] available for the Suruwaha dataset and 39 for the Wajãpi dataset. All mandatory fields are present and have gone through screening in the FIOCRUZ IPT, metadata fields are also available on the online pages.

Our dataset include fields describing for each individual sand fly specimen their: (i) taxonomy (kingdom, phylum, class, order, family, genus, specificEpithet, verbatimIdentification, infraspecificEpithet, scientificName, scientificNameAuthorship, taxonRank), (ii) collection details, including the collectors (recordedBy: Shimabukuro PHF; Stumpp RGAV; Medeiros MES.; Alves DRC; Moreno ES; Freire M P; Nascimento LOC), the collection date, trapping method, trap identification number, collection site description (verbatimEventDate, eventTime, habitat,

samplingProtocol), (iii) geolocation data (stateProvince, county, locality, locationRemarks, verbatimLatitude, verbatimLongitude, decimalLatitude, decimalLongitude, geodeticDatum), (iv) catalogue reference data (otherCatalogNumbers). Our data is available in the Sistema de Informação sobre a Biodiversidade Brasileira (SiBBr), an online platform that integrates data and information about biodiversity and ecosystems, and is the Brazilian Node of the Global Biodiversity Information Facility (GBIF), an internationally-recognized resource for collation of biological occurrence data [4], where our data set has been submitted, and is publically available for use by others (fiocruz_suruwaha_01: https://doi.org/10.15468/28xvr7 and fiocruz_wajapi_01: https://doi.org/10.15468/gt29ub).

**Context**

ACL is a serious public health problem in Brazil, with 203,406 cases were recorded between 2010 and 2020, with the administrative North Region of the country, which includes the Amazon biome, currently accounting for 42% of all cases recorded within Brazil [6].

Health and disease conditions among indigenous people in Brazil are poorly known. There is a huge gap in government databases on morbidity, mortality, disease notification, etc, which prevent the construction of the most basic socio-demographic and health indicators. However, the few studies on the public health of populations of indigenous people in Brazil show a situation of marginalization and vulnerability, which translate into low quality of life, difficulty in accessing services in general, and low health indicators [7].

In addition, the different transmission patterns of ACL make the disease difficult to control, and understand, especially in the Brazilian Amazon, which has the greatest diversity of the species of parasites of the genus *Leishmania*, their insect vectors and vertebrate hosts, in the Neotropical region [1].

Our two datasets are comprised of sand fly occurrence data from fieldwork undertaken by the authors during the ACL outbreaks in) the SIL and WIL.

**Suruwaha dataset**

Transmission of ACL south of the Amazon River system is poorly understood [8,9]. Although it has often been stated that human *Leishmania* infection is either rare or absent south of the Negro and Amazon Rivers [8,10], the incidence of leishmaniasis in humans in some of these areas is equivalent to the incidence at north of the Negro and Amazon Rivers [9,11]. Guerra et al. (2011) [12] described the epidemiology of mucosal leishmaniasis (ML) south of the Amazon River, and not only found a high prevalence of this form of the disease, but also a distribution of *Leishmania* species similar to the distribution found north of the Amazon River. However, the etiologic agent of cutaneous leishmaniasis (CL) has not been identified, and the source of sylvatic infection and the vectors involved in transmission are not known south of the Amazon River system [8,13].

The Suruwaha are comprised of a population of approximately 170 people [14] whose only contact with non-indigenous people is through health workers and members of FUNAI (the Fundação Nacional do Índio; the Brazilian government agency responsible for protecting indigenous people). The Suruwaha live in a very remote location, far from urban areas and they manufacture of utensils, being agriculture and hunting the main activities of this people.

Entomological research within the SIL was carried out by us in order to contribute to the understanding of the transmission dynamics of ACL as there was an increase in the number of cases of ACL recorded among the Suruwaha between 2010 and 2012. Our investigation found that this increase was likely related to the distribution to the entire community of flashlights in late 2010, as requested by the Suruwaha themselves. This seems to be the main cause of the increase in ACL, as it led to changes in the hunting habits of the Suruwaha from

strictly diurnal to nocturnal, and coincides with the generally crepuscular and nocturnal biting activity of the blood-feeding female sand flies that transmit ACL.

The SIL is very remote and our entomological survey was performed by different teams to take advantage of routine operations by FUNAI. A total of 1,428 sand fly specimens were identified to either genus or species-level. Ten genera and 33 species were collected, of which the genera *Trichophoromyia* was predominant (57%), followed by *Psychodopygus* (20%) and *Nyssomyia* (5%). Among the most abundant species were *T. ubiquitalis* (25%), *T. octavioi* (9%) and *Ps. davisi* (8%).

**Wajãpi dataset**

The Wajãpi are a group of about 1,200 people [15], distributed in 80 small villages scattered throughout their territory. All families subsist by agriculture, fishing, hunting and gathering, periodically changing the location of their villages to allow the ecological recovery of the areas they have occupied. Access to the villages can be via the road, rivers and streams that cross their territory, as well as open trails through the forest. The resumption of the traditional model of Wajãpi occupation and dispersal for territorial exploitation, which maintains the quality of life of the people and, at the same time, guarantees territorial surveillance was essential to guarantee the pattern of abundance that the Wajãpi consider adequate [16]. In the last 10 years, the activity of large mining companies, and the building of hydroelectric plants, in the environment surrounding the WIL threatens the quality of life of the Wajãpi, through forest degradation, environmental contamination, and the insertion of the community in a context of great social vulnerability, which coincides with the increased incidence of pests in crops and endemic diseases, such as malaria and leishmaniasis.

Our dataset is comprised of sand fly records that resulted from the activities of a project aimed to evaluate the main risk factors for the disease, using an interdisciplinary

approach. In 2012, there was an outbreak of leishmaniasis in the WIL affecting more than 20 people in 7 different villages [17]. This outbreak triggered a broader investigation that was conducted between 2012-2015 in order to understand the causal processes related to the local epidemiological context, to propose measures to prevent and control the disease among the Wajãpi. The investigation unfolded in a multi-institutional project with the partnership of institutions related to health services, such as: Distrito Sanitário Especial Indígena (DSEI) Amapá e Norte do Pará, Secretaria Municipal de Saúde de Pedra Branca do Amapari, Coordenadoria de Vigilância em Saúde do Amapá, Laboratório Central de Saúde Pública do Amapá, Instituto René Rachou (Fiocruz-MG), Universidade Federal do Amapá, Universidade de São Paulo, and Universidade Federal do Oeste do Pará. Teams with different expertise were formed: entomologists, biologists, veterinarians, laboratory technicians, anthropologists, epidemiologists, nurses, etc.

From the beginning, researchers were faced with a complex environmental and intercultural context, in which the simple intensification of standard measures recommended by health services proved to be insufficient or even antagonistic in relation to the health principles and concepts of the indigenous group. Difficult access to villages made it difficult to map and record possible transmission sites. The long incubation period of the ACL, the complex mobility profile through their territory of the Wajãpi and the limitations of the health services, i.e. lack of trained personnel, lack of proper funding and infrastructure, made the search for transmission foci, according to the surveillance standards recommended by the Ministry of Health – based on the search for individual risk factors, an unpromising task.

The need for a broader and more sensitive assessment from the ecological, cultural and ethnic point of view of this epidemiological context unfolded in a review not only of the objectives and methods of providing services in indigenous health and of epidemiological research and conduct, but also of an epistemological reconstruction of the process of

understanding causality in health-disease and its inseparable relationship with social and ecological processes, their different scales and dimensions of perception. Therefore, data on ACL vectors' occurrence was paramount.

A total of 3,218 specimens were identified to either genus or species-level. The most abundant genera were *Trichophoromyia* (20%), *Nyssomyia* (13%) and *Psathyromyia* (11%). And the most abundant species were *T. brachipyga* (14%), followed by *Pa. dreisbachi* (9%) and *Nyssomyia pajoti* (6%).

## Methods

Specimens were georeferenced with the aid of a Garmin® 62sGPS.

## Study area

### Suruwaha Indigenous Land (SIL)

The municipality of Tapauá is located on the banks of the Purus River and has a population of 16,876 inhabitants and a total area of 84,946 km2 [11]. The main economic activity is agriculture (cassava, jute and beans) and extractivism (nuts, rubber, wood, copaiba oil and andiroba), livestock has become the main product in the last 10 years.

The Middle Purus region is located in the southern region of the Amazon rainforest and includes several conservation units, in addition to various indigenous lands, several of which are already officially recognized by the federal government while others are currently in the process of formal legal demarcation.

According to the SIASI (Sistema de Informação da Atenção à Saúde Indígena), operated by the Secretaria Especial de Saúde Indígena (SESAI), the indigenous population of the Middle Purus is estimated at around 8,117 inhabitants, divided into 13 ethnic groups and distributed

in 24 demarcated indigenous lands and another 6 non-demarcated (unidentified and/or delimited), the total territorial extension of the demarcated indigenous areas corresponds to 189,870.964 ha.

The Suruwaha Indigenous Land (SIL) is located in the municipality of Tapauá. The SIL area comprises a total of 239,070 hectares and is located between the Riozinho River and the Coxodoá stream, both tributaries of the Cuniuá River, which in turn is a tributary of the Tapauá River that flows into the Purus River [18]. The SIL is surrounded to the west by the Deni Indigenous Land and to the east by the Hi-Merimã Indigenous Land, of isolated indigenous peoples. The population consists of 171 people who were living in isolation and were contacted in the 1980s by missionaries [14]. The productive activities of the Suruwaha include agriculture, hunting, fishing, gathering and tool making [19]. Hunting is the most prestigious activity, and a good hunter not only kills many animals but must also have killed many tapirs, the most coveted game because of its size that can feed many people [19].

**Wajãpi Indigenous Land (WIL)**

The Wajãpi Indigenous Land (WIL) extends between the basins of the Jari (to the west), Amapari (to the east) and Oiapoque (to the north) rivers. Official recognition by the Brazilian government occurred in 1996, with a territorial extension of 6,070 $km^2$. The area is of dense tropical forest and in rugged relief, integrating the Tumucumaque Mountains complex. Currently, the Wajãpi number about 1,221 people, distributed in more than 80 villages [15].

The Wajãpi organize themselves into autonomous local groups, called "iwanã-ko", which are represented by a local group that has its origin in a specific region, where there are several villages. But not all the people of an “iwanã-ko” live in the same region, because when marriages between people from different groups take place, one of the spouses starts living in the other's region [20], which may represent only a temporary physical settlement. The different groups occupy three spatial categories: the places of concentration – rural villages /

dwellings; intermittent dispersal/settlements (mainly during the dry season – hunting, fishing and gathering camps) and "koo kwerã" sites which are wildlife reserves and are left undisturbed for wild animals to use and therefore, be hunted. This combination of social, political and ecological factors that determine the movements of concentration and dispersion of the Wajãpi in its territory seems to accompany the patterns of disease distribution in the TIW, so that the tendency to concentrate families close to the Perimetral Norte highway, which reaches TIW, seems to be related to the increased incidence of infectious diseases [16,21].

**Sand fly collection and processing**

Sand flies were collected with unbaited CDC-like light traps operated between 5:00 pm and 6:00 am. The traps were placed in areas used by the indigenous people, such as swiddens, forest areas, hunting grounds, access trails and homes.

The insects were stored in microtubes containing 70% alcohol and sorted from the other insects collected either in the field or under a dissecting microscope in the laboratory. The insects were clarified and mounted on a slide to identify the species, using the identification key of Galati (2003) [2]. A subsample of the insects will be deposited in the Coleção de Flebotomíneos of the Instituto René Rachou/FIOCRUZ-Minas (COLFLEB/FIOCRUZ).

The collection licenses and permits for our studies were as follows: in the SIL, SISBIO collecting license, issue by the Sistema de Autorização e Informação em Biodiversidade (IBAMA) (39337-1) and FUNAI (08620.040969/2013-51); and in the WIL, SISBIO collecting license (37935-4), FUNAI (08620.030843/2014-59), Ethics Committee approval (CONEP - CAAE: 20188213.9.0000.5091), and IPHAN access to associated traditional knowledge for scientific research purposes (01450.008806/2014-14).

## DATA VALIDATION AND QUALITY CONTROL

Insects were identified by keys available in the literature [2,3] by experienced taxonomists. The dataset is in Darwin Core format 41 terms are available for the Suruwaha dataset and 39 for the Wajãpí dataset. All mandatory fields are present and have gone through screening in the FIOCRUZ IPT, metadata fields are also available on the online pages.

## RE-USE POTENTIAL

The data are of importance because they describe the distribution of sand flies collected at different sites in two indigenous lands located in the Brazilian Amazon. The data can be used by different sectors of academia, government, civil society, NGOs. However, the data can be of particular importance to balance scientific knowledge and indigenous knowledge so that health surveillance activities are improved and adapted to different eco-social contexts with the participation of indigenous people, who better know their territories.

These data can be used to address challenges in leishmaniases control and to a better understanding of the epidemiology of this disease. Since control measures in Brazil are based on disease surveillance and monitoring in territorial units, which include biological and environmental characteristics, our dataset can contribute to a broader knowledge. Our data provide occurrence records from previously unknown which would not normally be surveyed by the public health system ACL control programmes from the Brazilian government. These data can be used for modelling of both vector and disease distribution in space and time as well as provide clues on priority areas for ACL surveillance and control in these areas.

Our data are an expert-validated and list of sand fly species in which names are up to date and can be a valuable source of high-quality data on sand flies from remote areas in the Brazilian Amazon.

## DATA AVAILABILITY STATEMENT

### Declarations (https://gigabytejournal.com/data-release-description)

**Data published through**

http://ipt.fiocruz.br/ipt/resource?r=fiocruz_suruwaha_01

GBIF UUID d9f6d2bf-20d7-4b87-99ac-e902b34364e4

Occurrence dataset https://doi.org/10.15468/28xvr7

http://ipt.fiocruz.br/ipt/resource?r=fiocruz_wajapi_01

GBIF UUID 7140a42f-8ad6-43cd-b252-b5a791c8de4a

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## COMPETING INTERESTS

The author(s) declare that they have no competing interests.

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**AUTHORS' CONTRIBUTIONS**

PHFS: provision of resources, funding acquisition, conceptualization of the research, supervision, preparation of manuscript; DRCA: fieldwork, provision of resources, data collection; ESM: provision of resources, funding acquisition, conceptualization of the research; JACB: sample preparation; MPF: fieldwork, conceptualization of the research, data collection; MEMS: fieldwork, provision of resources, data collection; MDGGA: sample preparation; SFM: sample preparation; TSC: sample preparation; VRA: sample preparation and identification; LAB: data curation, revision of manuscript.

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**REFERENCES**

1. Rangel EF, Lainson R. Flebotomíneos do Brasil. In: Rangel EF, Lainson R, organizers. Flebotomíneos do Brazil. Rio de Janeiro: Editora Fiocruz, 2003. p.23-175.
2. Galati EAB. Classification of Phlebotominae. In: Rangel EF, Lainson R, organizers. Flebotomíneos do Brazil. Rio de Janeiro: Editora Fiocruz, 2003. p.23-175.
3. Young DG and Duncan MA. Guide to the identification and geographic distribution of Lutzomyia sandflies in Mexico, The West Indies, Central and South America (Diptera: Psychodidae). Mem Am Entomol Inst 1994;54: 1-881.
4. GBIF: The Global Biodiversity Information Facility (2022) What is GBIF?. Available from https://www.gbif.org/what-is-gbif/ . Accessed 27 Feb 2022.
5. Wieczorek J, Bloom D, Guralnick R, Blum S, Döring M, Giovanni R, et al. Darwin Core: An Evolving Community-Developed Biodiversity Data Standard. PLoS ONE. 2012;7(1): e29715. doi:10.1371/journal.pone.0029715.
6. Sistema de Informação de Agravos de Notificação, Ministério da Saúde, Brasil. https://www.gov.br/saude/pt-br/media/pdf/2021/novembro/17/lt-casos.pdf/ . Accessed 22 Feb 2022.
7. Coimbra Jr. CEA, Ventura SR. Saúde, minorias e desigualdade: algumas teias de inter-relações, com ênfase nos povos indígenas no Brasil. Ciênc. saúde coletiva. 2000;5(1):125.
8. Arias JA & Freitas RA. Sobre os vetores da leishmaniose cutânea na Amazônia Central do Brasil. 2. Incidência de Flagelados em flebótomos selváticos. Acta Amaz 1978;8:387.

9. Justiniano SCB, Chagas AC, Pessoa FA, Queiroz RG. Comparative biology of two populations of Lutzomyia umbratilis (Diptera: Psychodidae) of Central Amazonia, Brazil, under laboratory conditions. Braz J Biol 2004;64: 227.
10. Lainson R, Shaw JJ, Ready PD, Miles MA, Póvoa M. XVI. Isolation and identification of Leishmania species from sand flies, wild animals and man in north Pará State, with particular reference to L. b. guyanenesis causative agent of "pian-bois". Trans R Soc Trop Med Hyg 1981;75: 530.
11. Instituto Brasileiro de Geografia e Estatística. https://cidades.ibge.gov.br/ . Acessed 22 Feb 2022.
12. Guerra JA, Prestes SR, Silveira H, Coelho LI, Gama P, Moura A, Amato V, Barbosa Md, Ferreira LC. Mucosal Leishmaniasis caused by Leishmania (Viannia) braziliensis and Leishmania (Viannia) guyanensis in the Brazilian Amazon. PLoS Negl Trop Dis. 2011;8;5(3):e980. doi: 10.1371/journal.pntd.0000980.
13. Grimaldi G Jr, Momen H, Naiff RD, McMahon-Pratt D, Barrett TV. Characterization and classification of leishmanial parasites from humans, wild mammals, and sand flies in the Amazon region of Brazil. Am J Trop Med Hyg 1991;44(6):645.
14. Povos Indígenas do Brasil. https://pib.socioambiental.org/pt/Povo:Zuruah%C3%A3/ . Accessed 23 Feb 2022.
15. Povos Indígenas do Brasil. https://pib.socioambiental.org/pt/Povo:Waj%C3%A3pi/ . Accessed 23 Feb 2022.
16. Gallois DT. Terra Indígena Wajãpi: da demarcação às experiências de gestão territorial. São Paulo: Iepé; 2011.
17. Secretaria Especial de Saúde Indígena. SESAI 2012 – unpublished data.
18. Aparício M. A vida social e econômica dos Sorowaha. Cuiabá: OPAN - Operação Amazônia Nativa, CIMI - Conselho Indigenista Missionário, Prelazia de Lábrea. 1996.

19. Fank J & Porta, EM. A vida social e econômica dos Sorowaha. Cuiabá: OPAN - Operação Amazônia Nativa, CIMI - Conselho Indigenista Missionário, Prelazia de Lábrea. 1996.
20. Plano de Gestão Socioambiental | Terra Indígena Wajãpi como estamos organizados para continuar vivendo bem na nossa terra. © Apina, Awatac e Iepé, 2017. https://institutoiepe.org.br/wp-ontent/uploads/2020/07/plano_de_gestao_wajapi.pdf/ . Accessed 27 Feb 2022.
21. Gallois C. Wajãpi rena: roça, pátios e cassa. 2ª Ed. Rio de Janeiro: Museu do Índio/APINA/Iepé, 2009.

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