



One health and social research in disease ecology: A social contextual study of vector-borne diseases in the Yucatan Peninsula, Mexico

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ABSTRACT

Although disease ecology recognizes the multiplicity of factors involved in the (re)emergence of vector-borne diseases (VBD), it is necessary to strengthen attention to the social context and the social determinants of health. It is essential to integrate a sociocultural approach to health into the biological analysis of VBD ecology. To implement a coherent One Health approach in the prevention and control of VBD, it is pivotal to first understand the social and ecological interactions of the local context. Between October 2021 and June 2022, a social contextual study was made through surveys, semi-structured interviews and participatory activities in 12 localities with diverse ecological, economic and socio-cultural contexts in the Yucatan Peninsula. Through the perceptions of the populations on health and VBD, specifically mosquitoes, we gained knowledge on socio-cultural dynamics that influence people's relationship with pathogens. Local knowledge, management, and control of vectors; interactions with domestic and wild animals; and health-landscape relationship, were identified as factors that determine health-disease processes. This study contributed to a better understanding of local contexts and therefore, to the design of socially pertinent strategies for the reduction of vector-borne diseases risk scenarios in the study sites with an integrated approach.

1. Introduction

In recent decades, in Latin America, the emergence and re-emergence of vector-borne diseases (VBD), continues to constitute a major health problem with social and economic consequences (Espinal et al., 2019; Gubler, 2002; Wilder-Smith et al., 2017). Human appropriation of territories and landscapes has been permeated by transformations in the market economy, the lack of control over land use and the exploitation of biodiversity exerted on nature (Barabas, 2014). Together with major territorial transformations that have led to emerging states of attention to the different environmental changes in the global biosphere, inequities in terms of health services and lack of

knowledge about diseases, result in scenarios in which vector-borne diseases (VBD) frequently develop (Hotez et al., 2015). Mainly in tropical and subtropical regions, the increase in incidence and prevalence of VBD transmitted by mosquitoes has generated a shift from a state of low endemicity to hyperendemicity (Espinal et al., 2019; San Martín et al., 2010).

This closely linked scenario requires systemic attention to address global health and health-disease processes in local contexts (Wolf, 2015). Disease ecology has explicitly focused on the ecological aspects of infectious disease transmission cycles (Arthur et al., 2017), often focusing on the landscape and the effects that alterations at the level of habitat fragmentation and loss of diversity have on transmission

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patterns and thus to potential infectious disease emergencies or re-emergencies (Suzan et al., 2008). The One Health approach recognizes, studies and addresses collaboratively the close relationship and interdependence between human, animal and ecosystem health with climate change, urbanization, agricultural intensification, habitat loss and fragmentation, and globalization (Zunino, 2018). In this *continuum* of interdisciplinary construction, we seek to integrate socio-anthropological sciences and biological sciences to carry out an exploration and analysis of the social factors that influence the exposure of human populations to pathogens.

The Yucatan Peninsula has been characterized by its identity and unity in language, culture and history (Bracamonte, 2014), elements that are reconfigured and settled in the contexts of ecological and cultural diversity today. This same diversity has pushed an important development in the demographic processes of the region and the dynamics of ecosystem use in the area. Baños (2000) describes these movements as an "[...] economic interconnection between capitals and people" (pp. 178) where external industrial investment in infrastructure and mobility, the development of electronic means of communication and the creation of mass tourism poles has generated a dynamic socio-economic change that is related to and expressed in its landscapes.

All this anthropogenic changes in the environment can create opportunities for vectors to spread by creating new habitats, increasing vector populations, and by the movement of people to areas where vectors are present (Suzan et al., 2008; Reyes-Novelo et al., 2022; Valdez et al., 2015). In 2015 and 2016, outbreaks of Chikungunya and Zika occurred. More recently, in 2023, Mexico's Health Department reported Yucatan as the entity with the highest number of confirmed cases of Dengue in the country (Secretaría de Salud de México [SS], 2023, p. 7).

Despite the efforts to control them, their incidence continues to increase (Angelotti and Peniche, 2017; Reyes-Novelo et al., 2011). The care processes, reduced to basic plans of entomological surveillance, limited diagnosis and treatment for reported cases, field operations for vector control, among others, are not sufficient for prevention (Valdez and Pinkus, 2021). We consider it key to integrate a social anthropological approach to health into the biological analysis of the ecology of VBD. This will allow us to understand perceptions and interpretations of health-disease and its relationship with the environment (Langdon and Braune, 2010), as well how these are expressed in states of health or disease (Álvarez-Castaño, 2009).

2. Local knowledge and perceptions: guidelines for an anthropology of health

Local collective health systems in which populations participate socially and individually are often forgotten or excluded from the analysis of health services and from the decision-making on public prevention strategies and social programs (Blázquez Rodríguez, 2005; Franco-Giraldo, 2016; Iriart and Merhy, 2017). It is important to recognize the predominant narrative of the model being used to study the diseases (Comelles and Romaní, 2017; Paulo and Cruz, 2018; Menéndez, 2020) and take it into account. This recognition helps in understanding not only the complex relationships established between epidemiological, ecological, technological, and social processes and their effects on the emergence of zoonoses, but also the influence of broader environmental and socioeconomic drivers.

Given that transdisciplinary aims to "overcome the fragmentation of knowledge (Álvarez et al., 2021: pp 101) and that the field of health is subject to structural conditions and socio-technological determinants, we start from the anthropology of health as an approach that will help us conceptually and methodologically study health-disease processes. We propose this approach as a point of intersection between the social and biomedical sciences, which, understood within the framework of health studies, contribute to the understanding of health-disease by integrating territorial configurations, "economic, political, technical, cultural, ideological, and social transitions" (García and Stival, 2021: pp 2). From

sociocultural studies, the anthropology of health addresses the significance of disease and forms of health beyond biological bodies from an integrated and global perspective; focused not only on the individual but also on communities and their social living conditions (Álvarez et al., 2021).

Under this understanding, we will comprehend health and disease as multidimensional processes that acquire value and meaning based on the culture being studied. That is, they are not simply given but are constructed in everyday life and materialize through the relationships established between the physical, psychic, social, and biopolitical worlds. In turn, these local processes must be inscribed in the historiography, demography, economy, and global politics (Fassin, 2004). In other words, pathologies acquire meaning and are problematized through their identification and constitution within the framework of social relations. Health, therefore, is not just an objective or a point to reach, but a process that is configured throughout life itself.

The social construction of health allows us to give it meaning in the cultural context based on constructed experience and knowledge, as it is society itself that objectifies and interprets it within the framework of nature-culture relationships (Fassin, 2004). Pain, severity, well-being, safety, or danger are subject to the process of perception and the individual or collective experiences of people's lives (Arce, 2019). We speak of this subjectivation-objectivation of health as necessary and constantly dialoguing; both require an integrated study where the state of health, disease and care are understood within the framework of an understanding of reality narrated by those who live and reproduce it.

For this, it is essential to start from an analysis of the material conditions in which health-disease processes take place, with a subjective, sociocultural dimension contextualized in time-space (Álvarez et al., 2021). We consider that the anthropology of health should be involved in the field of health with a critical and transdisciplinary perspective that, in addition to contributing to the scientific field, seeks social transformation by working from the perceptions, conceptions and local knowledge of populations.

Gómez (1995) explains that local knowledge derives from three sources: accumulated historical experience transmitted across generations, social experiences shared within generations, and individual personal experiences. Local knowledge encompasses both "knowing" and "understandings", which are context-dependent, making it dynamic and adaptive over time. It constitutes a historical and sociocultural system transmitted orally and practically. In addition to relying on sensory perception, local knowledge is shaped by judgment, intelligence, and reflections on everyday reality (Martínez, 2020).

It is essential to know the local cultural processes that are from where the collective strategies of response and first attention to diseases arise (Menéndez, 2018). We consider that developing One Health research from a socio-anthropological approach plays a crucial role in understanding the perception and knowledge that populations have of diseases, the context of their dispersion, the local mechanisms for their prevention and cure, as well as the relationship they have with the landscape they inhabit.

Understanding perception as "the most intimate dimension of experience" (Ruiz et al., 2020, pp. 109), where lived experiences play a crucial role in understanding our environment, we inquired into perceptions of health and disease expressed in diverse knowledge about illness, symptoms, causes and origin of diseases (Flores-Guerrero, 2004). The stimuli generated from these experiences are organized and categorized, forming perceptual references through which individuals interpret the VBD world.

Part of the transdisciplinary discussion during the planning, proposal and development of this article focuses on developing a methodology that can be based on a common theoretical framework nourished by both biological and social sciences. This framework seeks to articulate the study criteria proposed by the disease ecology approach with tools that make sense in social research. This article first describes the methodological process for the social contextual study, followed by

presenting results of people's perceptions and knowledge of mosquitoes, as well as the recognition of the environment and its conservation through the presence and distribution of fauna over time and the ideas associated with the conservation and health of the landscape. The testimonies presented reflect the factors and scopes that determine health-disease processes associated with VBD of the study sites.

3. Methodology

This work is part of a larger project titled "Biological diversity, socio-ecosystems and emerging viral diseases in Mexico" which is part of the National Strategic Programs financed by the National Council of Humanities, Sciences, and Technologies. Its main objective is to characterize, from a disease ecology approach, the links between viruses, vectors and hosts and the relationship with the landscapes. Thus, the development, application and analysis of the methodology of the social study is constructed in correspondence with the theoretical framework that guides the biological research but with a primarily social focus. The sites in which the social study was developed, correspond to the localities surrounding twelve sampling sites selected as study areas for the main project to sample vertebrates and arthropods (mosquitoes). These 12 sampling sites present landscapes that range from urban to preserved. According to their degree of conservation and their land use, in each state (Campeche, Yucatan and Quintana Roo), four sampling sites were chosen, each one corresponding to the following landscape categories: a) urban: more than 60% urban settlements and high population density (more than 30,000 inhabitants); b) rural: more than 40% induced vegetation and low to moderate population density (up to 16,000 inhabitants); c) rural (diversified): 40% native vegetation and low population density (less than 800 inhabitants); d) preserved: more than 60% native vegetation and low population density (see Table 1).

Given the interdisciplinary nature of the project, social research is closely linked to other aspects and components of the biological study. Such is the case of the selection of the study sites. The gradient of landscapes is much more diverse than just referring to four types of landscape, however, the landscapes we worked with share certain aspects and conditions that allow us to discuss shared contexts.

Table 1

Locations where the study was conducted are categorized into three landscape types—urban, rural, and conserved—for organizational purposes. These locations should be viewed as part of a gradient rather than being strictly confined to these categories.

State	Municipality	Locality	Land Use Category
Campeche	San Francisco de Campeche	Minas (neighborhood)	Urban
Quintana Roo	Felipe Carrillo Puerto	Emiliano Zapata 1 (neighborhood) Jesús Martínez Rosas (neighborhood)	Urban
Yucatán	Mérida	Parque Arqueoecológico de Xoclán and Parque Ecológico del Poniente	Urban
Campeche	Calkiní	Calkiní	Rural
Campeche	Palizada	El Juncal	Rural (diversified)
Quintana Roo	Bacalar	Vallehermoso	Rural
Quintana Roo	Othón P. Blanco	Ejido Caoba	Rural (diversified)
Yucatán	Tizimín	San Pedro Juárez San Luis Tzuctuk	Rural
Yucatán	Tzucacab	Corral	Rural (diversified)
Campeche	Calakmul	Conhuas	Preserved
Quintana Roo	Othón P. Blanco	Ejido Tres Garantías	Preserved
Yucatán	Santa Elena	San Simón	Preserved

This is relevant because differences may arise in fieldwork designs between a biological-ecological study and a social study. Nevertheless, the research tools for social study were chosen according to the socio-anthropological approach, responding to the context of the localities where the research was carried out.

This study is based on a mixed research method (Cedeño-Viteri, 2012; Creswell, 2003; Núñez, 2017) where the target population was the residents of the selected localities. The sociocultural construction of health responds to multiple factors and fields of knowledge, so that its approach must contemplate the multi-actor approach to understand the diversity of visions and the complexities that integrate human, animal and ecological health issues. From the conceptualization and design of this study, we sought to integrate the participation of diverse actors belonging to multiple sectors of the localities to explore and learn a broader picture of the general health situation in the populations studied, as well as the socio-political conditions under which different factors interact and influence people's health.

Through this diversity of profiles, it is possible to know a collective vision of each locality from the set of experiences and reflections shared by people on the processes of health and disease that impact the subjects from multiple dimensions (personal experience, experience of third parties, collective experience as a community, beliefs, traditions). Among the diverse range of key people who participated in the study were: local authorities, traditional doctors (person whose specialized understanding of medicine integrates local knowledge and local practices linked to their cosmovision to care for the health processes of the community), nurses, medical personnel from hospitals and clinics, vector study teams, school personnel, area managers, cattle ranchers, farmers, participants in social-environmental projects, park guards, park rangers, among others.

Field work was conducted from October 2021 to June 2022 and lasted 3–4 days per site. In each locality, a reconnaissance tour of the study site and its boundaries was conducted, to later cover different areas of the total surface of the locality. An average of 30 surveys (total $n = 372$), 6 to 7 semi-structured interviews (total $n = 78$) with key actors and 1 workshop or closing activity were conducted per locality (for this article's purpose, workshops and closing activities were not included in the results). The sample sizes were determined by the available human resources, meaning the number of people able to carry out fieldwork and administer research tools, as well as the limited time allocated for fieldwork in each location. All the instruments were developed and applied by the researchers and first authors of this article. The instruments were applied in Spanish, which means that the participants speak or understand Spanish, although it is not necessarily their mother tongue.

3.1. Surveys

Sample surveys were the first exercise carried out from house to house to local adult volunteer inhabitants. The collected data was systematized and analyzed qualitatively through a database by the first authors. This tool is a useful technique for collecting and analyzing data in a standardized way that allows contrasting responses between different sites (Corbetta, 2007). Due to its fluidity and duration, the survey allowed us to present the project and explore particularities that would be of interest to develop in the interviews with the people who were referred to as key actors. The objective of the surveys for this study was to determine the relationship of sociocultural aspects in the presence and transmission of VBD.

The questionnaire consisted of 7 sections: sociodemographic data, access to health, perception of health and disease, diseases, vector (mosquito), animals and environment. Through these items, the obtained data describe and enumerate the physical setting and perceptions of health and disease; what knowledge is held about vector-borne diseases; how populations are exposed to the vectors of pathogens; and finally, how they perceive the impact of their activities on the

distribution patterns of other hosts and vectors.

3.2. Semi-structured interviews

We developed semi-structured interviews (Ardévol et al., 2003) in which we elaborated a script that explores sociocultural dynamics contemplating human, animal and environmental health. In this study, the key actors were the people who, given their main activities, knowledge or participation in health-related topics, were referents for their communities. Local authorities were the ones with whom the first contact was established and from them, through a "snowball" process, other actors were identified who led the semi-structured interviews to a diversity of profiles involved in the topic under study.

The interview sought to "access the universe of meanings of the actors" by delving into themes that deal more intensively with the history and conformation of the sites (Guber, 2005), the characteristics and activities carried out, the transformations that have occurred over time, their vision of health and disease, as well as local alternatives for their prevention and treatment, the general perception of the local people with respect to their landscape and conservation. The domains and themes that make up the interview guide can be found in Table 2.

The interviews were collected through audio recording after obtaining the approval of the adult participants through letters of consent. These were hand-transcribed and systematized into a matrix by categories of interest: information access, feeding, occupation and working place, landscape composition and changes, conservation, covid-19, institutional description, age, diseases, prevention, history, locality, traditional medicine, environment, locality origin, social programs, proposes, health, vector, vulnerability.

4. Results

4.1. Perception, knowledge and treatment of VBD

Through perceptions of health and illness we can understand that factors such as mobility and the possibility of carrying out daily activities, both domestic work and other occupations, are most important when a person is ill. The moment when these aspects are affected by an illness or disease, is when people conceive themselves to be sicker. Also, when the illness impacts on the state of mind, leaving people without any physical or emotional strength to move, is when they feel sick. In all cases, the most commonly recognized VBDs are dengue and chikungunya, while other VBD like malaria and leishmaniasis were only mentioned in Quintana Roo and in the southern locality of Campeche where the prevalences of these diseases are higher. Knowledge of these diseases is directly related to individual or collective experience, as well as from media and health institutions' preventive campaigns (Arellano et al., 2015). People, based on their symptoms, would refer to having suffered from a VBD, regardless of whether they had a medical diagnosis or not.

In this sense, it is only in the face of people's previous experiences of

Table 2
Domains and themes resulting during the semi-structured interviews.

Domains	Themes
Profile and biography	Main activities
Characteristics of the locality	Local activities and collective organization
Memory and local history	Change in the locality, transformations in the landscape, consequences and effects.
Transformation of the environment over time	Conservation, environment and community
Health and disease	Meanings, common illnesses, perceptions of health and illness.
Local health services and alternatives	Health care, information and services
Prevention and treatment	Experiences and organization
Present-future considerations	Health-disease panorama

their own or others they know, that the mosquito can represent a threat when an epidemic outbreak has already occurred or when the disease has been very seriously passed. Otherwise, the mosquito becomes one more element of the inhabited environment, with which they coexist and build a dynamic around it to ensure a more harmonious or less conflictive coexistence. As referred by Suárez et al. (2009), being healthy or sick corresponds to past experiences, but also to the complex biological, cultural and social health disruptions that give meaning to health itself and to other related aspects. An example is the case of the Chikungunya virus whose outbreak in the peninsula in 2015 remains in people's memory given the diffusion and impact it had.

I was five months pregnant with this boy when I got the chikungunya. There was dengue before and then the chikungunya disease started. Here it hit almost all of us and it came back, it was not enough just to hit us, in fact many people were left in bad shape because, for example, my brother's knees were swollen, it lasted about a year. To me, maybe because of the pregnancy, you see that during pregnancy they give you vitamins and so on, I did not feel so bad, but my brother did. He did feel very bad and so did many people. You come and take paracetamol, there was none ... you looked for other options and since they are new diseases you don't even know what [to take]. For example, you see when that hemorrhagic dengue came out, many people were used to it, it has temperature [fever], an aspirin and with that you managed to get through it. So, many died and many told about it [survived] (Female resident, Conhuas, Campeche, 2022 – Preserved).

Given the non-specific symptoms of VBD and the fact that these diseases can present in different clinical pictures, we wanted to know if people had a particular way of identifying certain symptoms for certain diseases. The symptom most commonly associated with VBD is fever, which is interesting since fever is also considered as the most common disease by a high percentage of the study participants. Even though we weren't able to relate specific symptoms to a specific disease, we learned that there are certain symptoms that people identify and recognize as more severe. Fever, headache, bone pain, and body pain are shared symptoms between VBD, but other symptoms such as: rash, red spots on the skin, vomiting, hemorrhages and bleeding of various kinds, immobility, respiratory symptoms, or diarrhea can be determinant in the way people act in response to it. Similarly, in the study made in Colombia, Suarez et al. (2009) mention that non-specific symptoms such as fever and headaches are not recognized as dangerous until bleeding appears, only until then these are categorized as a disease. In the following testimony, a woman tells us how the bleeding was reason enough to go to the city hospital two and a half hours away to see the doctor.

I was going to the center [local medical center] and the girl told me that I had nothing and that I had nothing. Then I came and I went to check myself, right? because I felt down and down [energy wise] and so I checked myself in the mirror and I saw the drops of blood. It was around one o'clock and at that time I went to Chetumal to see the doctor. And I had already taken [sic] a bottle of noni [fruit with medicinal properties] and the doctor said that it cut my reaction. Thank God –he said– it didn't go any further, because from hemorrhagic dengue, not everyone gets free and dies from it –he said (Health Committee, Vallehermoso, Quintana Roo, 2022 - Diversified rural).

A great importance in health-disease dynamics relies on the traditional doctors as they are an alternative form of care to the frequently restricted access to the institutionalized health system. Beyond the inaccuracies that local knowledge about symptoms may have, the most important thing is that the disease is understood as a complex social process that integrates dynamics, practices and social knowledge (Suárez et al., 2009) that can effectively reduce risks and promote prevention and care (Arellano et al., 2015). In the following testimony, one of the traditional doctors of one of the localities with a good range of

preserved native vegetation shared with us his opinion on malaria, demonstrating an integral understanding of the disease where we can find social, environmental, epidemiological, and medical knowledge.

Malaria is a mosquito that is produced a lot in puddles, where there are water greenhouses, where there are tires, where there are bottles, where people sometimes do not clean their property. There is a puddle of rotten water, there it reproduces, but for every thousand mosquitoes there can be one [infected], for every thousand, so you have to be very careful because malaria injects a virus and that virus attacks the immune system, nervous system, and begins to have a problem of cerebral shock, then begins to emit fever, high fever, a tremor, a cold that is deadly [...] (Traditional doctor, Tres Garantías, Quintana Roo 2022 - Preserved).

In general, people treat their VBD symptoms through biomedical treatment, however, in some localities, particularly in the less urbanized, people also refer to treatments through herbal and home remedies. “And there are ladies who know [traditional herbal medicine], and whatever [is needed], they support us. And there are people who have few resources, so they go and give them support (Villager, Conhuas, 2022).” The decision on the chosen type of treatment is subject to various factors such as the possibility (availability, costs, infrastructure, doctor-patient relationship), the perception of the disease, and the beliefs and preferences of each subject (Hoyler et al., 2016).

There are people who have come to me, for example, who say that their bones hurt a lot. But the only thing that sometimes I send them, as I say, they are from traditions to traditions on how to learn. And so I tell them, I can give you a remedy, a tea or an herb that I know, but I am not guaranteeing that the patent medicine [biomedical medicine] cannot cure you, you have to go to the doctor (Traditional doctor, Tres Garantías, Quintana Roo 2022 - Preserved).

Equally, traditional doctors believe in a mixed form of attention that mutually complements traditional and biomedical knowledge. Traditional medicine is known to be effective but also recognized as limited to other health issues, however we can see how it is part of the first attention that people resort to, and how people with further knowledge are available to help others.

4.2. Vector (mosquito) recognition and control

The knowledge that people have about mosquito-borne diseases and the mosquito is vast and sufficient to take precautionary and vector control measures. However, other social and landscape dynamics intervene and shape people’s practices, so vector control must also adjust to other people’s needs. Together with the social dynamics that characterize smaller towns where people’s houses are always open, climate and high temperatures experienced on the peninsula, make measures such as isolating the inside of houses from the outside to prevent mosquitoes from entering, is practically impossible. Culturally, there are ways that are stronger and incompatible with vector control as people are expected to perform it. Nonetheless, there is knowledge about the vector that allows people to differentiate the different behaviors of mosquitoes or other insects, which leads them to take specific control measures during times of increased exposure.

Resultant of the geographic and social particularities of each study site, dengue endemicity and a historical entanglement with the mosquito (Nading, 2012) makes the VBD become part of the people’s daily lives, making its perception and therefore coexistence with the vector less dramatic. As shown in the following testimony, people in Palizada where the climate is extremely humid and several forms of water bodies surround the area, mosquitos are perceived as one of the many elements of their ecosystem with which they must live and which may not necessarily be perceived as a menace (Suárez et al., 2009).

Well, the truth is, well, just the so-called dengue, but they are rare. Not here, there is almost none of that [dengue]. Mostly I say that in the other towns they say there are a lot of mosquitoes and here I hardly feel that much. Only here, it is [at] the beginning of the night, from then on, there are no more [mosquitos]. [...] In other places I see that there are quite a lot all the time. [...] Well, I feel that it is because of the river, I mean, the water of the river that is closer, I suppose that is what it is, but here almost none, it is not very common. Not a lot of mosquitoes, no (Alternate Delegate, El Juncal, Palizada, Campeche, 2022 - Diversified rural).

In all types of landscapes, the spaces where people identify the greatest number and activity of mosquitoes within their home are: behind, under or between furniture and other corners, where clothes or other items accumulate, in domestic spaces such as patios, gardens, lots or other outdoor spaces peripheral to the house where there is usually vegetation, puddles and other forms of water accumulation, as well as other spaces surrounding their homes such as vacant lots and bodies of water.

In exploring people’s daily activities and the way they organize their living spaces or homes, we can understand how knowledge about schedules, behavior and mosquito locations integrates with family dynamics. We will see that the socio-physical environment, including the house and the people living in or around it, acquires values and symbolism based on social representations of this inhabited space (Londoño y Chaparro, 2011). People are used to identifying mosquitoes in different environments, and even if they don’t recognize the types of mosquitoes by species, they differentiate mosquitoes by characteristic aspects such as size, color, bite, behavior and activity. “The one who stands with his back very straight, as if it were very elegant” referring to *Aedes aegypti*, to whom people also commonly refer to for its striped legs that resemble a tiger. The relationship that populations establish with mosquitoes is also associated with occupational and personal profiles that result in different expertise (Nading, 2012). “Egomorphism”, as discussed by Nading (2012), is reflected in the next quote of a Vector Control Department worker who talks about the mosquitoes as if they shared features with humans such as being well educated or having a schedule for eating.

Millions of mosquitoes are born every three days; however, we are not going to end it, not even with all the insecticide, not even with airplanes, we are not going to be able to do it [...] If there are mosquitoes, then [you use] your pavilion, close your doors and windows before 6 in the evening because that mosquito is more educated than the dengue mosquito. It is more educated in what sense? It has a schedule for biting. The dengue mosquito has no schedule, as long as it is hungry it bites ... night, day, it bites. This mosquito has a schedule, at night, from 6 to 7 p.m. when it is already dark, at that time it goes out to eat, when it says 9 p.m. it stops biting, it bites again at dawn, at 4 a.m. and before the sun arrives, it stops biting (Vector worker, Felipe Carrillo Puerto, Quintana Roo, 2022 - Urban).

In this study, people use mostly spray insecticides, physical barriers such as mosquito nets and pavilions, and the smoke of burning egg cartons to repel mosquitoes. The methods used to control the vector are similar to other studies where chemical methods are the most common (Harris and Carter, 2019; Torres-López et al., 2012). Other control measures are rather practices that remain constant in the daily dynamics, for example: avoiding the accumulation of water, weeding or avoiding “weeds”, burning organic and inorganic garbage, and cleanliness understood as hygiene and order (Harris and Carter, 2019). Vector control methods, while having a purpose related to people’s socioeconomic contexts and access to them, also stem from knowledge about their effectiveness and the perceived safety of their application as a mosquito control method. As Cañamares (2015) explains “perceptual access to the intrinsic properties [of the element] is determined by our

sensorimotor knowledge” (pp.207) which arises from practical understanding and knowledge of “how”. In this testimony, a health worker talks to us about how he describes a healthy environment which involves flora and fauna, but deals with a shared notion that a space with no weeds is known to be a clean and healthy space for avoiding mosquito-borne diseases.

So I think that in terms of vegetation, keeping it clean, as clean as possible, and also adopt other measures against *cacharros* [garbage], water puddles or plastic objects, to be aware of the cleaning campaign damaging as little as possible the fauna and flora. At the same time leaving the flora and reducing the amount of mosquitoes that are also circulating (Health personnel, Calkiní, Campeche, 2022 - Rural).

4.3. Landscape, conservation and health

By investigating the relationship that people establish with their landscape, through the perception they have of it and its conservation and interspecies relations, we were able to learn more about the transformations the landscape has undergone. These transformations go hand in hand with the history of each locality, the origin and founding of the *ejidos* (term for communal land ownership and use), the changes in land use, the various activities that have been carried out, as well as the social and cultural changes that the inhabitants have been experiencing. The notion of the pressure and impact that the environment receives due to anthropogenic activities is recognized and, on many occasions, people express their disagreement with it.

Our land is ... I'm telling you, if there were water here, these lands would already be ready, but cattle ranching is what ruins the land, not here. At least for me, as a beekeeper, I have already devastated [cleared] about 40 ha in my plot, but I do not plan to devastate any more. Since 2013, I have not devastated any forest, but I do have all that area surrounded by bees. And what I want are forests, I go, I have bees in the extension, over there because over there are mountains, jungles ... for the bees (Villager, Conhuas, Campeche 2022 - Preserved).

People mention that conservation is important because of the ecosystems' quality of sustaining, providing and generating a balance, which directly and indirectly affects their health. A frequent example is forest's capacity to provide fresh air, shade and heat reduction, as well as its function of attracting rain and protecting from hurricanes. In places considered more urbanized, green areas mean a space for leisure, where health is promoted through exercise, and the tranquility and peace that these spaces provide. In all the sites, the importance of forest conservation is recognized because it is the shelter of animals and different types of plants. However, in sites considered less urbanized and with extensive areas of preserved vegetation, they mention the importance and relationship that the forest has for their health due to the type of livelihood activities they carry out in the forest, such as planting and cultivation of cornfields, livestock activities and beekeeping.

People's relationship with their landscape is closely linked to interspecies relationships that are established either in the domestic dynamics, by the activities and jobs they perform, and by self-sustaining practices. By investigating the changes that have occurred in animal populations, we can track wildlife over time and understand how human activities are altering spaces and might be increasing the chances of contact with wild species, thereby raising the risk of exposure to zoonotic pathogens. Mostly people from less urbanized localities would refer to a decrease of wildlife in the forests due to: hunting and capture of animals, either for local consumption or for sale as meat or as ornamental species; loss of habitat due to practices such as clearing or deforestation and burning; urbanization due to the growth of towns and areas inhabited by people; human activities; hurricanes and floods; migration of fauna due to lack of food, climate change, among others.

There was a lot of the traditional *pijje*, *patillo* [wild duck]. Before, there was a lot and the people did not commercialize it because they took it to eat, that is right, to eat, not killing, in broad terms only what was necessary. [...] So what is it due to? I want to believe that, a lot of logging, a lot of things, because there were mountains that were cleared and all that, that affected a lot (Female inhabitant, El Juncal, Campeche, 2022 - Diversified rural).

Interestingly we could also learn how interspecies relationships are associated with health and disease processes. Animal keeping in the peridomestic area is a popular practice, especially in rural areas. And even if dogs and cats are the animals that most people own in urban landscapes, in general, people recognize the importance of responsible domestic and companion animal ownership (even if they don't practice it). Here again, hygiene is identified as a health aspect in that if the spaces inhabited by the animals are not clean, they acquire a connotation of contaminated spaces, considered as a health risk.

Leticia Durand (2008) explains that environmental perception is a social process of “assigning meanings” to the natural environment, which can be expressed through transformation or deterioration. This attribution of meanings is constructed based on culture over the course of populations' lives. We found that people's environmental perceptions are very diverse, not only because of the type of landscape, but also because of their individual understandings of the world they inhabit. Both health and landscape have aspects that permeate virtually all areas of people's lives. Landscape, understood as the environment in which life unfolds, and life as the dynamic manifestation of health. This final testimony reflects the experience of a man who's engaged in traditional medicine and whose interaction with the environment, both physical and spiritual, has generated a vast knowledge and a sense of service for his community.

And so we work with many plants. I know more than 1500, 2000 plants, viral, regenerative, antibiotic, anti-inflammatory, depurative. Thousands of plants, the knowledge of botanical plants, those of us who cure or help people have a very pleasant sense of nature. We go to the jungle and I know the plant, I subtract it for that [particular illness], before cutting the plant, I pray to God, I make a prayer, I say –Lord thank you for this plant that you gave us, with the virtues of your powerful hands– so it is nice that knowledge that we have and the way we help people is that when they need to be healed they come and they are healed. (Traditional Doctor, Tres Garantías, 2022).

5. Discussion

Although the health-disease and care processes between different VBD may vary between different landscapes and regions, the “tropical neglected diseases” share a common context in Latin America. To a lesser or greater degree, conditions of limited access to health, limited access to basic services and adequate housing and infrastructure conditions are common to various Latin American contexts (Arellano et al., 2015; Harris and Carter, 2019; Suárez et al., 2009; Torres-López et al., 2006; Valdez et al., 2016; Valdez and Pinkus, 2021). The landscape, its historical construction, as well as the more immediate structural conditioning factors that exert pressures on it, largely define the dynamics that generate and that are generated by the presence of diseases such as dengue and other VBD.

The One Health approach has proved to be a good initiative to set an interinstitutional conversation, but failed to engage in the social conditions that generate health and disease emergencies. Cultural production and transformation allow perceptual references to be reformulated according to historical-social transitions within a space-time framework (Vargas, 1994). Nowadays, social factors such as limited access to health care, the lack of comprehensive information provided on VBD, and the perception of the vector as just another component of the landscape and

its elements, build realities around VBD. Taking this logic into account, we understand that each population constructs a system of local knowledge based on the experiences (Figueroa-Ibérico, 2020; Villagómez and Rivadeneira, 2020) not only of suffering from the disease, but also of the dynamics underlying these conditions.

Given that, the definition that populations have for VBD does not necessarily coincide with the definition from the biomedical field (Torres-López et al., 2006), it is important to recognize works that study the sociocultural factors and the interpretations of populations regarding their world. Thus, they allow a comprehensive understanding of the factors that generate the conditions in which populations increase their exposure and risk to VBD. Current public health systems seek prevention based on larval and vector control while ignoring local knowledge and perceptions. Therefore, biasing the comprehension of the VBD domain without recognizing the activities that shape the populations' response to diseases and that are fundamental for community engagement when promoting health and disease prevention.

6. Conclusions

Aiming for a broader expression of One Health approach, the results of this study expand our understanding of the reality of VBD and its transmission cycles in twelve localities of the Yucatan Peninsula.

We recognize that anthropological social research demands different timescales than quantitative research, nevertheless, both are fundamental to integrating knowledge. By adopting this One Health approach to disease ecology, we integrated sociocultural aspects that allowed us to understand the study area from a broader perspective that goes beyond the interaction between hosts and vectors. By considering sociocultural aspects and analyzing social dynamics within the framework of the VBD ecology, health care and health education strategies can be developed based on the perspective and perception of the populations, seeking more effective risk prevention. Likewise, it is crucial to promote and convene the participation of actors and representatives from different spheres and with diverse roles in order to have a broad and integrated vision of the issue during the fieldwork process and subsequent data analysis.

Disciplinary integration within the One Health field continues to be a challenge, but as we better understand the particularities of localities and their populations across time and space, we will be able to explain the generalities and thus more successfully have local influence. This paper represents a first step in understanding the social dynamics of twelve localities and its populations within the One Health framework. It is hoped that this will be one of the bases for future research as well as a first presentation that can trigger social analysis in the identification of priority aspects related to the health and risk scenarios of each of the localities.

CRedit authorship contribution statement

Mitsuri Pacheco-Zapata: Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Fernanda Pérez-Lombardini:** Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Benjamin Roche:** Writing – review & editing, Supervision, Funding acquisition. **Audrey Arnal:** Writing – review & editing, Supervision. **Erika Marcé:** Writing – review & editing, Supervision. **Gerardo Suzán:** Writing – review & editing, Supervision, Funding acquisition.

7. Statement EA not required

For this study we addressed the ethical management of the collected data by using consent letters for all the conducted interviews. The respondents of the survey were all voluntary participants that gave their verbal approval. The digitalized signed consent letters are available upon request. Also, this project has been designed and developed in

accordance with the Ethical Principles of Professional Responsibility of the American Anthropological Association and the Mexican Ethics Code of the Colegio de Etnólogos y Antropólogos Sociales, A.C.

Declaration of interest

There is no financial/personal interest or belief that could affect our objectivity.

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Data availability

Data will be made available on request.

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