

## SAND FLIES: A DANGEROUS INSECT ON A CHANGING PLANET

Tarcísio de Freitas Milagres<sup>†</sup> and Carla Maia<sup>\*\*</sup>

Global Health and Tropical Medicine, GHTM, Associate Laboratory in Translation and Innovation Towards Global Health, LA-REAL, Instituto de Higiene e Medicina Tropical, IHMT, Universidade NOVA de Lisboa, Lisboa, Portugal

### YOUNG REVIEWERS:



**EUGENE**

AGE: 14



**GRESHMA**

AGE: 13



**NAVINDER**

AGE: 13

Have you ever heard of sand flies? They are tiny but mysterious creatures, active at night, with fuzzy bodies with a mission of spreading trouble! They can transmit parasites that can cause serious illnesses for humans and other animals. Global changes are adding fuel to the fire. Increasing temperatures and other human-made changes to the environment are helping sand flies to spread and change their behavior, making this situation even more problematic and difficult to combat. What is the plan? Teamwork! We need cool collaborations and smart strategies to fight back. Initiatives like the CLIMOS project are preparing to take on the challenge of tackling sand flies and the diseases they transmit. But for this strategy to work, we need everyone to participate in this fight. Are you ready to help build a healthier world?

## WHAT ARE SAND FLIES AND WHAT DO THEY LOOK LIKE?

Sand flies are insects with a large number of hairs on their bodies, making them look fuzzy [1]. They have long legs, they are hunchbacked, and their wings are spear-shaped and always arched. These characteristics can be very difficult to see, since we are talking about a very small animal, measuring around 3 mm in length—smaller than the tip of your pencil! Sand flies are found on almost all continents, except Oceania.

Interestingly, sand flies cannot fly over long distances. Instead, they prefer to move around by making small hops. Sand flies are nocturnal, which means they are most active at night. Nighttime is when they carry out most of their activities, such as feeding and reproducing. Take a look at [Figure 1](#) to see where and how sand flies develop.

Sand flies have short, rigid mouthparts. Both males and females feed on sugary plant substances such as nectar and sap. However, females also feed on blood, as they need more energy to produce eggs. The sand fly bite can be painful and sometimes a small pool of blood forms at the site. And worse, you would not believe how much it itches! The female can feed on the blood of various animals, including humans, and this is why sand flies are dangerous—at the time of the bite, the female can transmit disease-causing **pathogens**, mainly a type of **parasite** called *Leishmania*, which is a **protozoan** ([Figure 1](#)).

## LEISHMANIA AND SAND FLIES: A DANGEROUS MATCH

Did you know that more than a thousand species of sand flies have been identified around the world? Of these, only ~100 have an important impact on human and animal health. This is because not all sand fly species can carry and transmit all parasite species, there must be a “match” [2]. Once *Leishmania* successfully multiplies within a sand fly, that fly can transmit that specific parasite to its next **host** during a bite.

*Leishmania* can be transmitted between animals and humans. It has been found in up to 70 different species of animals and is a major health problem in ~100 countries around the world. The disease *Leishmania* parasites cause is called **leishmaniasis**, and this disease kills the most people in the world after **Malaria**, so it is super serious.

## WHAT IS IT LIKE TO HAVE LEISHMANIASIS?

It is HORRIBLE to have leishmaniasis! This disease can show up in different ways, depending on factors such as the host’s immunity and the species of the parasite. Once *Leishmania* invades a person,

### PATHOGEN

A very small living thing, such as a virus, bacteria, or parasite, that can make a human or other living organism sick.

### PARASITE

An organism that lives in or on another organism to obtain food and survive.

### PROTOZOA

Microscopic, single-celled creatures that can be free-living or parasitic. Some make people sick, like those causing malaria and leishmaniasis.

### HOST

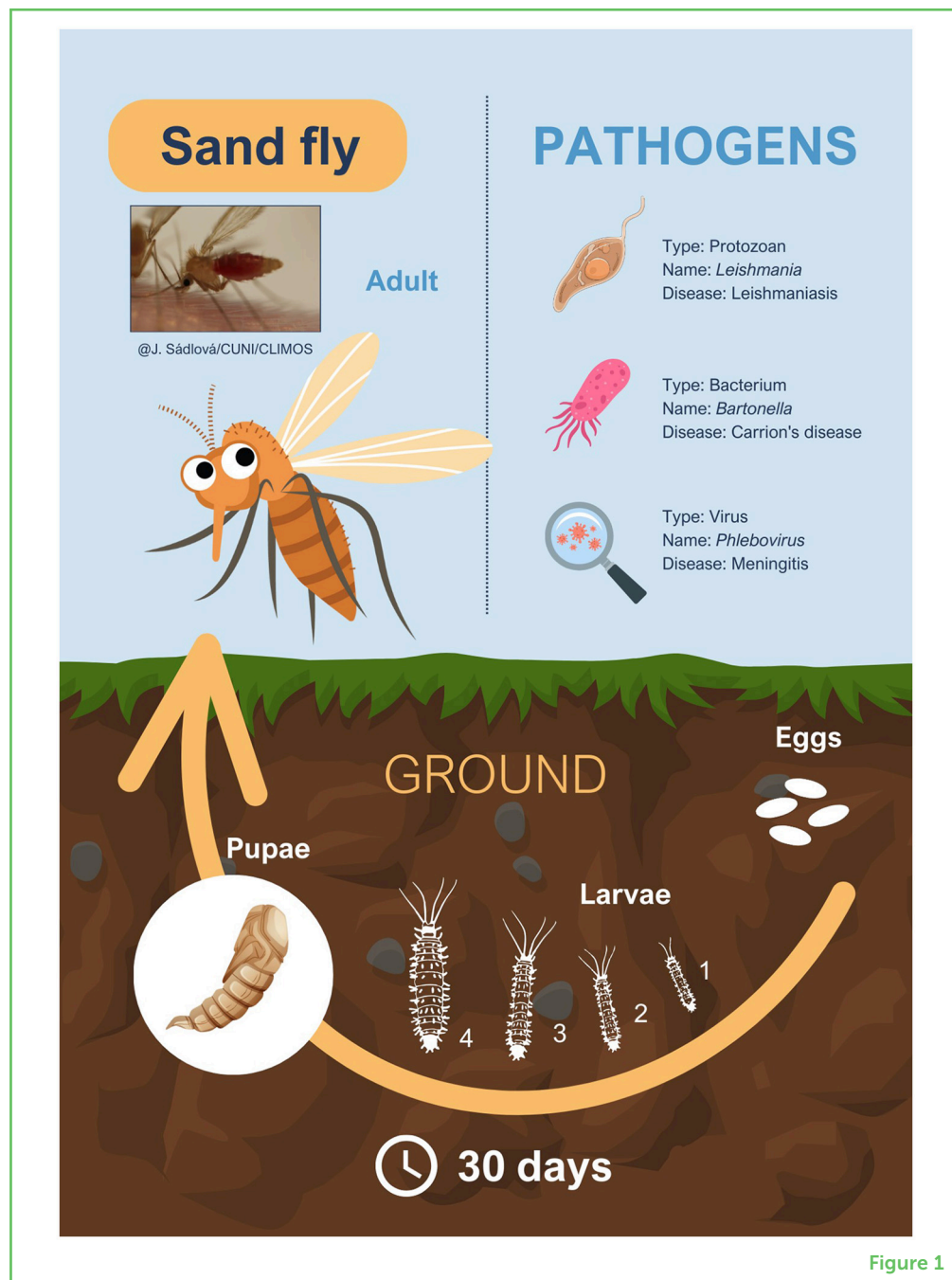
The organism that harbors the parasite. The parasite lives inside or on the host, often causing harm.

### LEISHMANIASIS

A disease caused by *Leishmania* parasites that affects humans and animals. It can cause different symptoms such as fever, sores on the skin or swelling of the belly.

**Figure 1**

Unlike mosquitoes, which breed in water, sand flies prefer places rich in decomposing organic matter, such as leftover leaves, animal feces, and rotted tree trunks. A sand fly egg develops into a larva, then a pupa, and finally reaches the winged adult stage. This entire process takes about a month to complete, and the adult sand fly lives for around 30 days—but this can vary greatly depending on environmental conditions. In addition to *Leishmania*, sand flies can transmit other types of pathogens, such as bacteria and even a group of viruses. In this figure, the sand fly picture was taken by Dr. Jovana Sádlová, Department of Parasitology, Faculty of Science, Charles University, Prague, Czech Republic and it is being used as a dissemination image in CLIMOS project.



it can attack vital organs leading to serious problems—even death! Unpleasant symptoms include fever, stomach pain, feeling weak, weight loss, and even a belly that swells like a balloon. Leishmaniasis can cause weird wounds on the skin, too.

Dogs, our furry friends, can also be greatly affected by this sneaky parasite, which spreads more intensely in this species, causing a very serious illness. Dogs may begin to develop non-healing sores on their noses, ears, joints, and tails, along with scaly skin and hair loss. And that is not all! Dogs may have other signs such as lack of energy, loss of appetite, and rapid weight loss. While there are medications to treat



leishmaniasis in dogs, some of them can have serious side effects. Vaccines are available for dogs, but unfortunately none are available for humans. There are several important ways to protect ourselves against leishmaniasis, however.

## GLOBAL CHANGES ARE AFFECTING SAND FLIES

### GLOBAL CHANGES

Major transformations affecting the entire world, spanning environmental, social, economic, and political aspects, shaping how we live and interact globally.

**Global changes** are already affecting how leishmaniasis spreads, as these changes affect where sand flies live and how they behave. Changes to the physical environment play a big role in this story. Things that humans do, such as cutting down forests [3], can change where sand flies live, bringing them in closer contact with people and dogs. This makes it easier for them to bite humans and dogs and to transmit parasites more easily.

Changes in Earth's climate can also make a difference (Figure 2) [4]. Warming temperatures make sand flies survive longer and cause them to have more offspring, increasing the number of sand flies in the environment. In the future, leishmaniasis will appear in places where it did not exist before. Warmer temperatures also increase the multiplication of parasites inside sand flies [5], so more *Leishmania* can enter the host at the time of the bite. If more parasites enter, the more serious the leishmaniasis will be.

There is also a very sad social aspect to leishmaniasis, since in a general sense it is strongly associated with poverty. Therefore, it can be considered a **neglected disease**. This happens because, in these areas of the world, the conditions are not so good—for example, people live in houses built with mud walls and earth floors, and keep domestic animals close to the main house, attracting sand flies and allowing them to breed and rest (Figure 3A) [6]. Furthermore, people in these communities often have difficulty accessing doctors, which delays the discovery of the disease and prevents them from receiving treatment early. This can make the disease more difficult to treat, and people become sicker. It is very important to ensure that everyone has access to the necessary healthcare—healthcare is a basic human right, and all humans should be treated fairly. This means that, beyond treating leishmaniasis, we should help communities that are in such difficult situations.

### NEGLECTED DISEASES

Diseases that mostly impact low-income regions (particularly tropical areas) where there are not enough resources for study, treatment, and control, leading to community problems and hindering economic growth.

### SUSTAINABILITY

Practices and strategies designed to meet present needs without harming future generations. Balances environmental and social aspects for long-term wellbeing.

## WHAT CAN WE DO TO FLIP THE SCRIPT?

How can we deal with the problems that sand flies cause? The search for new ways to reduce the impact of leishmaniasis needs to be based on **sustainability**. We must think about all the pieces of this huge puzzle. For example, we can no longer just focus on human health—we must also consider animals and the environment. Prioritizing prevention is essential to avoid the spread of sand flies



## Figure 2

(A) As temperatures rise, the *Leishmania* parasite reproduces more quickly inside the sand fly. (B) In a warmer climate, sand flies can produce more offspring. (C) At warmer temperatures, sand flies can live longer. (D) Also, as the climate warms, sand flies can spread to new places where the temperature is becoming more suitable for their survival.

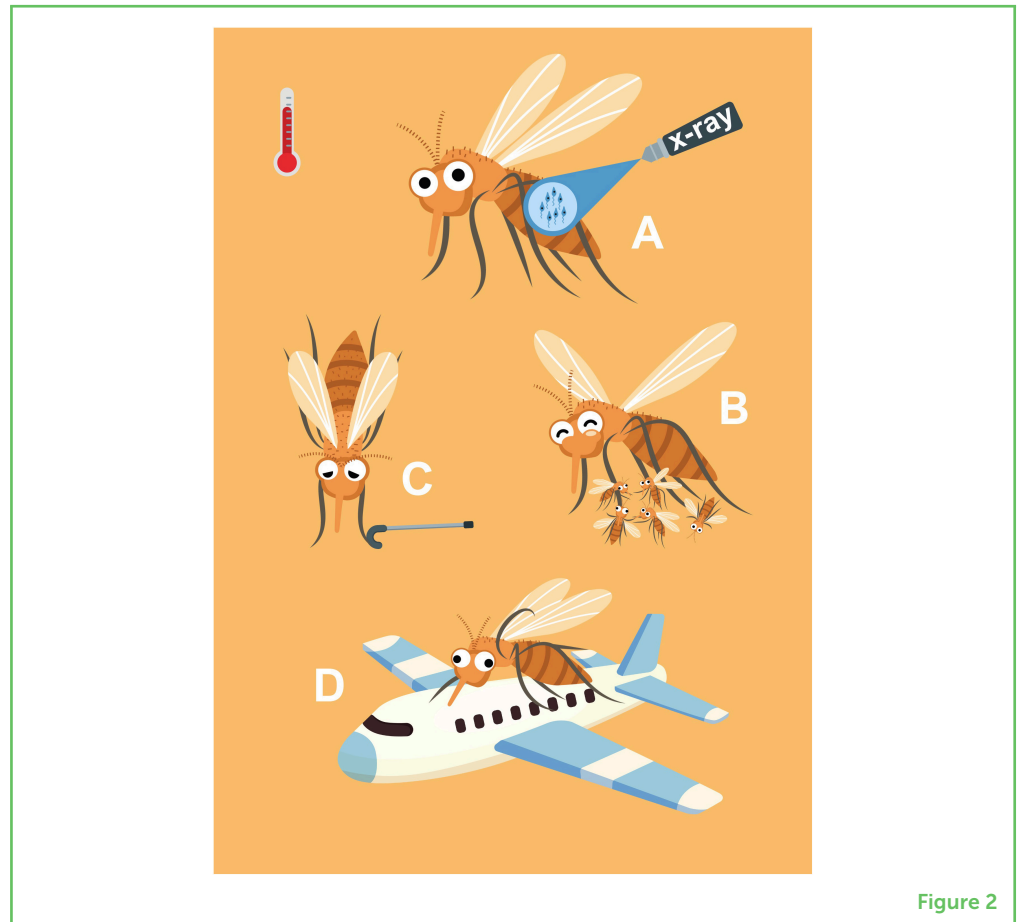


Figure 2

and thus the spread of leishmaniasis. For preventive measures to be functional and long lasting, they must take into account the characteristics of each place. For example, dogs should be protected against sand flies with collars or pipettes containing insecticides. In this way, we not only protect our pets from being bitten by sand flies, but humans too.

If the entire community actively participates in control actions, people can learn together and feel like they have more control over the situation. Everyone can contribute with ideas and opinions, helping to find better solutions! Empowering communities to actively participate in disease-control efforts fosters collective responsibility and ensures that disease-control programs work well and are successful now and in the future [7].

That is why projects like CLIMOS are so important. Picture this: for the first time ever, a bunch of researchers from across Europe, Türkiye, and Israel have come together to crack the code on how climate, environment, and social issues influence sand flies, and to try to predict where a lot of dangerous pathogens might spread (Figure 3B). CLIMOS is multidisciplinary, which means the project contains a cool mix of science, education, and health. CLIMOS uses both traditional and new methods to combat diseases. And they are not just leaving it to people

### Figure 3

(A) Some living conditions favor the appearance of leishmaniasis. Irregularly built houses make it easy for sand flies to enter, increasing their interactions with humans and dogs. Often, the environment around houses is not properly cleaned, and large amounts of decomposing organic matter can increase the available breeding sites for sand flies, causing them to multiply even more. Where there are more sand flies, the risk of *Leishmania* infection rises, too. (B) The CLIMOS project combines high-tech to analyse data from insect traps, climate, and environment, predicting where sand flies will attack next and combat diseases before they spread.



Figure 3

who wear lab coats—they want everyone in this mission. Yes, you too! The main objective is to provide important tools to help create new policies, involving both scientists and the community, so that everyone can better protect themselves and their pets. These tools must be easy to understand and apply, no matter where people are, so that the project can work in diverse regions of the world. This will help us prevent leishmaniasis from spreading to places where it does not yet exist, so we can keep everyone safer and healthier. Are you ready to join this fight?

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## YOUNG REVIEWERS



### **EUGENE, AGE: 14**

Our young reviewer is a vibrant 14-year-old with a passion for music and games. At nearly 3 years old, he was already exploring toy stores and gravitating toward musical instruments. Today, he plays nicely the violin, somehow of flute, zampoña, and piano. He is also an avid video gamer, especially enjoying Blox Fruits on Roblox. His curiosity and energy extend to sports as well; he plays volleyball at school and swims in the afternoons when his homework load allows.



### **GRESHMA, AGE: 13**

Hello! My name is Greshma, and I am in 8th grade. I love reading, playing tennis, traveling, and hanging out with my friends. I hope to be a forensic scientist someday!



### **NAVINDER, AGE: 13**

Hi, my name is Navinder. I am in 7th grade. My hobbies are baking, painting, and trying new things. My favorite subject is science because you try new things and I like to participate in argumentative discussions. I like to be outside and explore new places. When I grow up I want to be a lawyer someday.

## AUTHORS



### **TARCÍSIO DE FREITAS MILAGRES**

Tarcísio Milagres has a degree in biology, a master's degree in parasitology and an M. B. A. in innovation management. Currently, he is completing his Ph.D. in microbiology, carried out partly in Brazil and partly in Spain. Additionally, he is integrating the team of researchers of the CLIMOS project in Portugal, which assesses the impacts of global changes on sand flies. He stands out in the field of neglected diseases, relying on multidisciplinary approaches to find innovative solutions through an inclusive outlook. Tarcísio also loves doing outdoor activities, traveling with his husband, going to parties with friends, and reading good books.

†[orcid.org/0000-0002-7397-1612](https://orcid.org/0000-0002-7397-1612)



### **CARLA MAIA**

Carla Maia holds a veterinary medicine degree, an M. Sc. in medical parasitology, a Ph.D. and a habilitation title in biomedical sciences, with specialization in parasitology obtained from NOVA University of Lisbon. She is a veterinary parasitology specialist at the European Veterinary Parasitology College. She is as an assistant researcher at the Institute of Hygiene and Tropical Medicine. She is actively involved in One Health research projects, addressing vector-borne diseases

such as leishmaniasis and sand fly- tick- and mosquito-borne diseases, and climate change's impact and planetary health. Carla loves walking with her two dogs, Honey, a female beagle, and Cacao, a male teckel, traveling to watch wildlife, and going to the gym. \*[carlamaia@ihmt.unl.pt](mailto:carlamaia@ihmt.unl.pt)

†[orcid.org/0000-0002-2545-7686](https://orcid.org/0000-0002-2545-7686)