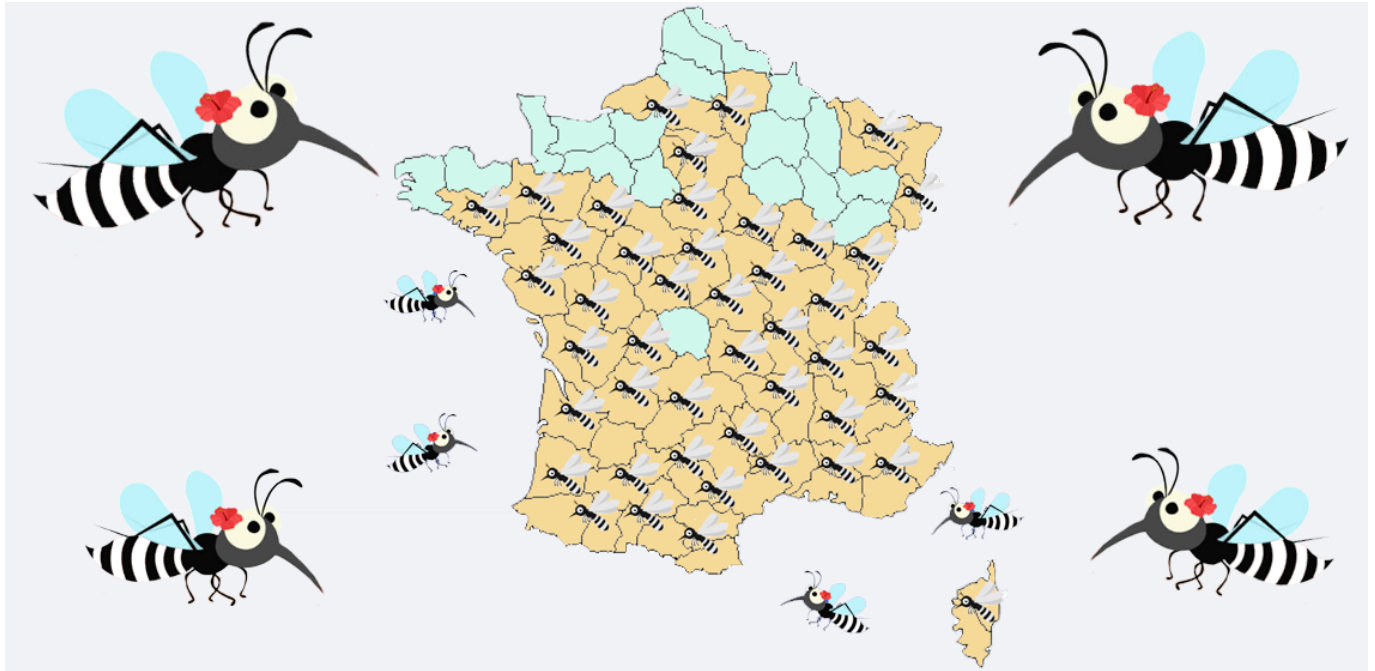




THE TIGER MOSQUITO: A DANGEROUS INVADER...

Didier Fontenille

MIVEGEC, Institut de Recherche pour le Développement, Montpellier, France

MICROORGANISM (MICROBE). An organism invisible to the naked eye.

VIRUS. A very small microorganism that can only multiply inside a cell.

ZIKA A word from the Zika forest in Uganda, Africa, where the Zika virus was first found in a monkey in 1947.

CHIKUNGUNYA. A word from the Kimakonde language, spoken in East Africa. It means "to deform" because the disease due to the chikungunya virus causes pain in the joints.

DENGUE FEVER. A word in the Swahili language of Zanzibar, East Africa. It means "muscle pain" because the disease due to the dengue virus causes great muscle fatigue.

HEMATOPHAGOUS: which feeds on blood

The 3700 species of mosquitoes known in the world are important organisms for biodiversity and interaction networks between living beings. These insects have an aquatic larval phase and an aerial phase for both male and female adults. Only the females bite and feed on the blood of various animals, including humans for some species such as the tiger mosquito. Some mosquitoes live in forests, others in cities or in temperate or tropical regions. Mosquitoes are not only unpleasant because of their bites, but they can also transmit microorganisms to humans, which are responsible for diseases such as malaria or dengue fever. These insects that can transmit microorganisms are called vectors. This is the case of the tiger mosquito (*Aedes albopictus*), the vector of the [Zika](#), [chikungunya](#) and [dengue fever viruses](#). The tiger mosquito is a species of Asian origin that is invading the whole world, France in particular, taking advantage of the climate, social, economic and ecological changes our planet is undergoing.

Who hasn't been bitten by a mosquito? Wherever you are in the world, except at the poles, at the tops of high mountains, on a few isolated islands, or off the coast, there are mosquitoes.

These mosquitoes all share common characteristics [1]. They are insects (with 6 legs), whose females, after a bite providing them with a blood meal (they are said to be [hematophagous](#)), develop and then lay between 50 and 100 eggs at the edge or surface of the water. The eggs laid hatch in the water and give birth to aquatic larvae, next

metamorphosed into aquatic nymphs and then into aerial winged male and female adults (Figure 1). The males of mosquitoes do not bite. Instead, they feed on plant nectar. Females will bite regularly throughout their lives, every 2 to 4 days on average. The life of a mosquito, from egg to death, generally lasts a few weeks: 6 to 12 days for the aquatic stages, 15 to 30 days for the aerial stages, depending on the season and the species of mosquito.

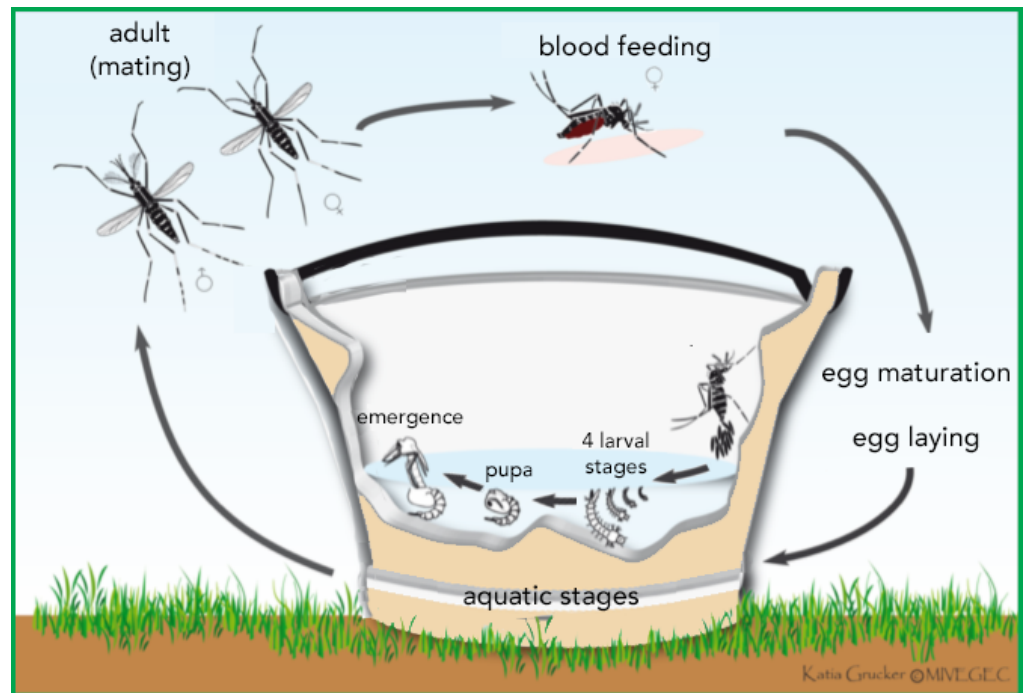


Figure 1. Life cycle of an *Aedes* mosquito, with larvae and nymphs in water, and adults in the air. *Aedes* larvae require little water to develop (shown here at the bottom of a cup).

AN AMAZING BIODIVERSITY: MOSQUITOES IN CITIES, FIELDS, SWAMPS AND FORESTS

Each species of mosquito has a two-part name: the genus and the species. This is the way scientists call all living beings, plants and animals. You, a young human, belong to the species *Homo* (the genus) *sapiens* (the species), your cat is *Felix catus*, the plant in your living room may be *Ficus benjamina*. In France, the mosquitoes that will bite you most often are probably *Aedes albopictus* (black in color, with a white stripe on the back and black and white legs) (Figure 2), and *Culex pipiens* (brown in color). More than 3700 different species of mosquitoes have been described on Earth, as many as mammal species (but 3 times less than bird species). In mainland France, 65 species of mosquitoes are known, but this number highly increases if we count the French overseas territories, South America, the Caribbean, and the Indian and Pacific Oceans [1].

Each species of mosquito is adapted to a particular environment. This is what is known as its **ecological niche**, which is characterized by the living

ECOLOGICAL NICHE. The environment particularly appropriate for the life of an organism.

beings (plants, animals) and the physical and chemical components (soil, temperature, humidity, sunlight, etc.) with which this mosquito interacts. The aquatic larvae of some species develop in lakes or rivers, others in swamps or in flooded fields such as rice paddies, some in the shade of the forest, others in full sun, such as in the oases of the Sahara. Some species, such as the tiger mosquito (*Aedes albopictus*) lay their eggs in small volumes of water of natural origin (left by rain in the hollows of trees or rocks) or of human origin (outdoor flower vases in cemeteries, canisters, leaky water collectors, poorly cleaned gutters, etc.) or inside homes (saucers under flower pots).

Adult mosquitoes behave very differently depending on the species. Some are active and bite during the day, others are nocturnal. Female mosquitoes feed on a wide variety of animals, depending on the species of mosquito and where they live. Each species has its own preferences: amphibians (such as frogs), lizards, turtles, snakes, birds, rodents, antelopes, carnivore primates (monkeys or humans). Most of the time these preferences are not very strict: during its life the same mosquito can bite a bird, a human, a dog, or a horse, depending on what it finds on its way.

MOSQUITOES: OUR ENEMIES OR PART OF INSECT BIODIVERSITY?

Mosquitoes, like all other insects, are components of biodiversity. The vast majority of species are integrated into interaction networks with other living beings: prey, predators, competitors, and even pollinators. Importantly mosquitoes, male mosquitoes in particular (but also females) feed on flower nectar, like bees. However, some mosquito species are invasive species, which have colonized new regions through human transportation and travel. This is the case of the tiger mosquito in Europe. Controlling or even eliminating an invasive species, and only this one, has no consequence on the ecological balance.

The reason we humans have such a grudge against mosquitoes is, of course, because their bites are unpleasant, both during the day, when they prevent us from playing outside, and at night, when they prevent us from sleeping and we try, often unsuccessfully, to crush them on the wall of the bedroom.

What makes mosquitoes even more of our enemies is that they are what we call **vectors**. They then represent a danger to the health of humans and animals. Indeed, by feeding on an animal, sometimes a human, the female mosquito can absorb a micro-organism that this animal has in its blood, and then inoculate it into another person (or another animal). That's why they are called vectors. Mosquitoes can transmit many infectious agents to humans that are responsible for more than 30 diseases, some of which are very serious. These diseases are mainly tropical, but also occur in temperate regions. This is the case with

VECTOR: Insect or tick that transmits an infectious agent (a microorganism) from one human or animal to another

PARASITE. Animal or plant organism that lives at the expense of another organism of a different species.

ANTICOAGULANT. A chemical that prevents blood from solidifying.

QUIESCENCE. Temporary interruption of the development of certain insects due to unfavorable external conditions (e.g. too cold temperature, drought).

DIAPAUSE. Temporary interruption in the development and activity of certain animals caused, for example, by the change in the photoperiod (respective durations of day and night).

malaria, caused by the *Plasmodium* **parasite**, which kills 600,000 people every year, mainly children in Africa. This is the case for dengue fever (30,000 deaths, and more than 100 million human cases a year worldwide), Zika or chikungunya fevers, or West Nile virus fever (more than 1000 human cases annually in Europe).

However, the mosquito is not a flying syringe. It is not enough for him to bite a human suffering from dengue fever, for example, for it to immediately transmit the virus to another human. The virus absorbed with the blood in the mosquito's stomach first multiplies in the mosquito's body and then reaches its salivary glands, located at the base of the head. When the mosquito bites you, it injects you a little anesthetic and **anticoagulant** saliva with its proboscis, before taking your blood. The microorganism is thus injected to you with the mosquito's saliva. It can take 5 to 15 days for the microorganism to grow in the mosquito. The fact that mosquitoes are vectors means that we need to protect ourselves from them, and there are several possible strategies, as we will see at the end of this article.



Figure 2. Photo of an adult female tiger mosquito.

Among the 3700 species of mosquitoes on earth, there is one that has been in the news a lot over the last 15 years [2]. It's *Aedes albopictus*, the tiger mosquito (**Figure 2**). Its name alone, due to its color and its black and white stripes, is scary. The story of this mosquito is extraordinary. It has only been present in mainland France since 2004. This mosquito is an invader. His ancestors lived in Asia in the forests of Cambodia, Vietnam and Laos. The females laid their eggs in holes in trees, which retained rainwater allowing the larvae to develop. A remarkable feature of this small mosquito is the ability of its eggs to survive for several dry months when the water has evaporated. In this way, the mosquito spent the bad season, dry and/or cold, as an egg, in a slowed-down life which is known as **quiescence** or **diapause**, depending on the original mechanisms. Little by little (from generation to generation) this mosquito adapted to villages on the edge of the forest, where it found stagnant water, especially canisters and large

water storage vases. Right next to these breeding sites, it also found an abundance of human blood to feed on. Then it gradually adapted to larger cities.

So, scientists believe that the mosquito was transported from urbanized areas in tropical Southeast Asia in the form of eggs to cities with temperate climates in Asia, particularly Japan. It settled and developed in these cities, and then in 1985, companies from the United States of America that bought tires from Japan accidentally imported quiescent eggs of the tiger mosquito laid in these tires to Texas. The tiger mosquito then settled in American cities, finding a new ecological niche similar to that of Japan. The global spread of the tiger mosquito then took off. Thanks to the sale of American tires, containing mosquito eggs, our invader colonized countries in South America, Africa and Europe, where it was found first in Albania, then in Italy. From Italy it arrived on the French Riviera in 2004, and since then, taking advantage of road transport, it has been progressing year after year towards the north of France. In 2023, 71 French departments had reported the presence of the tiger mosquito (Figure 3).

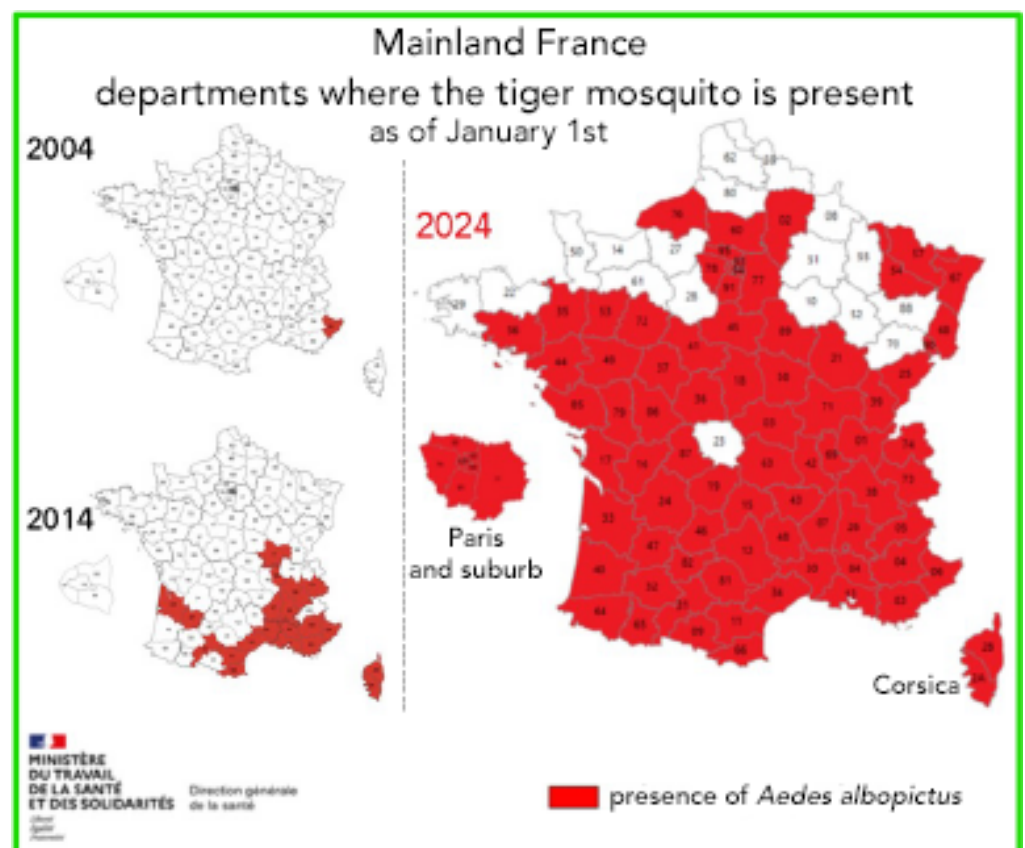


Figure 3. Distribution of the tiger mosquito in mainland France from 2004 to 2024. Based on maps from the Ministry of Solidarity and Health - Directorate-General for Health. Paris and its region are shown enlarged on the left of the map of France.

It has become a real nuisance in cities where it is abundant, biting from May to November, especially in the late afternoon, when you want to enjoy your terrace, garden and outdoor games. Unfortunately, it doesn't

EPIDEMIC. Rapid increase of a disease in a given place over a given time.

NATIVE. Native to the area where it lives (as opposed to invasive).

Bti. Preparation from a bacterium, *Bacillus thuringiensis israelensis*, that makes a substance that kills mosquito larvae

just make for unpleasant snack times; it can also transmit three viruses to humans that can cause serious illness: dengue fever, Zika virus fever and chikungunya virus fever. The dengue virus was introduced into mainland France by travelers from tropical regions where there are dengue **epidemics**. Once in mainland France, these travelers carrying the virus in their blood were bitten by local tiger mosquitoes. After a few days, these local mosquitoes transmitted the virus to people who had never travelled. These are called **native** dengue cases. In 2022 and 2023, 65 and 45 native cases of dengue fever were reported in mainland France. Given the increase in the presence of the tiger mosquito, widespread intercontinental travel and numerous epidemics around the world, researchers predict an increase in cases of dengue fever, but also of Zika and chikungunya in the coming years, especially if the proliferation of the tiger mosquito is not limited.

WHAT TO DO?

There are many ways of reducing mosquito bites, but none of them are perfect. It is often the use of several methods at the same time that gives lasting results. This is called integrated pest management. Eliminating mosquitoes from the surface of the Earth is not only unfeasible, but above all it is not recommended. As we have seen, mosquitoes are insects that form part of ecosystems, food chains and interaction networks between living beings. We therefore need to adopt strategies that target only those species that are dangerous to humans, while respecting the environment as much as possible.

To decrease the number of a given species of mosquito, the tiger mosquito for example, you can reduce the water reserves where it lays its eggs. To do this, empty all unnecessary tanks, for example saucers under flower pots and outdoor containers. If they cannot be emptied, these containers can be covered, like rainwater harvesters. If the surface or depth is greater, you can put small fishes that will eat the mosquito larvae (guppies or gambusias). You can also use an insecticide of biological origin, such as **Bti** (*Bacillus thuringiensis israelensis*).

An additional strategy is to kill the adult female mosquitoes that bite us. It is not advisable to use insecticide sprays, which are toxic, polluting and ultimately ineffective. You can still use mosquito swatters, possibly electric if you are quick and agile. You can also use commercial mosquito traps. They are still expensive, and, like the other methods, will only capture a fraction of the mosquitoes.

You can also avoid being bitten by using mosquito repellent products. Some can be applied to the skin or clothing, others are in the form of tablets or bottles that are plugged into electrical outlets, or, for outdoor use, as "twists" that burn slowly. Finally, as African children know all too

ENTOMOLOGIST. A person who studies insects.

well, the best thing to avoid nocturnal mosquito bites is to sleep under a mosquito bed net.

While there is still no good medicine against the viruses transmitted by the tiger mosquito, there are excellent medicines against malaria. Unfortunately, they are still underused in Africa due to the lack of access to medical services and costs. But in recent years, pharmaceutical companies and research centers have been developing vaccines against malaria, dengue fever and chikungunya. They are not yet perfect, but if used widely, they will reduce the number of deaths from these diseases, especially among children.

CONCLUSION

Economic (increase in international trade), societal (increasing urbanization), ecological (loss of biodiversity), and climatic changes increase the risk of new mosquito-borne diseases. Other species of invading mosquitoes have already been spotted: *Anopheles stephensi*, native to Asia, is invading Africa and *Aedes japonicus*, also coming from Asia, has been reported in France.

But we are not powerless. **Entomologists**, and those with a curious eye, are capable of detecting them and solutions, while not perfect, do exist to limit the impact of these small insects. Each of us can take action at his own level. Keep an eye on the small water tanks, empty or cover them, talk to your friends and adults about the right things to do! In short, make life difficult for the mosquitoes but accept that you have to live with them. They were on Earth long before *Homo sapiens*!

LEARN MORE

<https://www.quae-open.com/produit/205/9782759235988/le-moustique-ennemi-public-n-1>. Illustrated with numerous examples, a document summarizing knowledge on mosquitoes and current control methods.

<https://multimedia.ird.fr/IRD/media/71233>. From a humorous but scientifically accurate angle, this film informs you about the biology of the tiger mosquito and gives you recommendations to protect yourself from it.

REFERENCES

1. Lecollinet S, Fontenille D, Pages N, Failloux AB. 2022. The Mosquito, Public Enemy No. 1?: Edition QUAE, 168 pages.
2. C. Paupy, H. Delatte, L. Bagny, V. Corbel, D. Fontenille, 2008. "Aedes albopictus, an arbovirus vector: From the darkness to the light", *Micro-organisms Infect.* 11 (2009), pp. 1177-1185.

ENGLISH VERSION

TRANSLATION: Lushi Aumeer, SickKids, Toronto, Canada

EDITION: Catherine Braun-Breton, Association Jeunes Francophones et la Science.

SCIENTIFIC MENTOR: Catherine Braun-Breton, Association Jeunes Francophones et la Science.

CITATION: Fontenille (2025). The tiger mosquito: a dangerous invader. <https://www.jeunesfrancophonesetlascience.fr/>.

CONFLICT OF INTEREST

The author states that the research was conducted in the absence of any commercial or financial relationship that could be interpreted as a potential conflict of interest.

COPYRIGHT

Copyright © 2025 Fontenille.

This article is freely accessible and licensed under a Creative Commons Attribution (CC BY) license. Its use, distribution, or reproduction is permitted, provided that the original authors and copyright holders are credited and that the original publication is cited in accordance with current academic practice. Any use, distribution or reproduction not in accordance with these conditions is prohibited.

YOUNG REVIEWERS

CYRIL, AGE:10

Hi, I am Cyril! I am highly interested by sciences, enjoy Legos, Star Wars and Jurassic world movies and love to play Mine Craft and soccer.

ANAÏS, AGE:14

Hello, I'm Anaïs. I grew up loving rocks, horses, and all other animals. I ride at least 2-3 times a week and love spending time at the barn. I don't enjoy talking to people that much and prefer the company of animals. I have written a novel, started to write a new one and have completed short stories.

AUTHOR

DIDIER FONTENILLE

I am a medical entomologist by training and Emeritus Research Director at the Research Institute for Development (IRD) in Montpellier, France. Most of my research, for which I lived abroad for 22 years (Madagascar, Senegal, Cameroon, Canada, Cambodia), has focused on the systematics, biology, behavior, genetics, and control of vectors (mosquitoes, ticks, sandflies, etc.) of infectious diseases such as malaria, arboviruses, plague...

