

# *Anopheles gambiae* s.l. : morphology, life-cycle, ecology



Worldwide, there are over **3,500** species of mosquitoes grouped into 41 genera.

**837** of those species are in Africa. Human malaria is transmitted only by females of the genus *Anopheles*. Of the approximately 430 *Anopheles* species, only 30-40 transmit malaria worldwide.

Target Malaria works specifically on 3 major malaria vectors that are distributed widely across Sub-Saharan Africa: *Anopheles gambiae*, *Anopheles coluzzii*, and *Anopheles arabiensis*, which look identical morphologically and belong to the species complex (group of related species) *Anopheles gambiae sensu lato*.

## Identification:

Mosquitoes are slender, long-legged insects that are easily recognised by their long proboscis (pointy piercing mouthparts) and the presence of scales on most parts of their body. Mosquitoes belong to the class of insects, hence are characterised by the presence of 3 pairs of legs, and to the order Diptera which is characterised by a single pair of wings (along with other flies).

## Morphology:

Adult anophelines have slender bodies with 3 sections: head, thorax and abdomen.

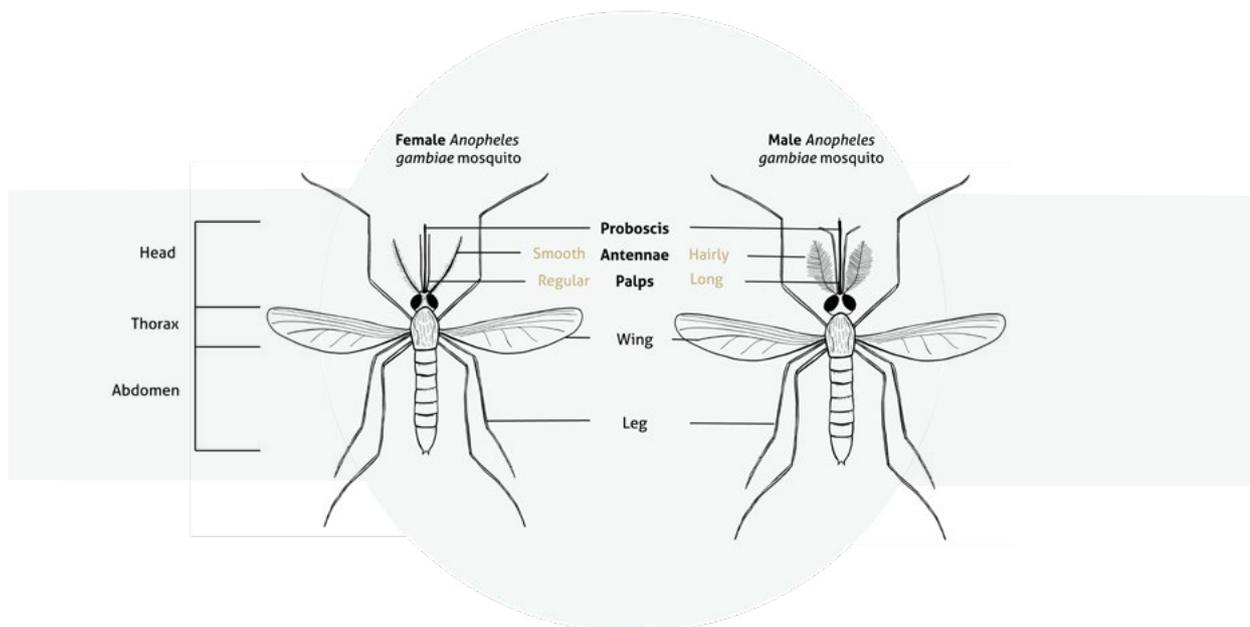
The head - is specialised for acquiring sensory information and for feeding. The head contains the eyes and a pair of long, many-segmented antennae. The antennae are important for detecting host odors as well as odors of breeding sites where females lay eggs. The head also has an elongate, forward-projecting proboscis used for feeding, and two sensory palps (organ near the mouthpart).

### What is the difference between male and female mosquitoes?

Male mosquitoes have more flagella or fine hairs on their antennae, so many so that it appears noticeably bushy to the naked eye. These flagella are important to a male mosquito's hearing, which comes in handy when the male is looking for female mosquitoes. A female mosquito's antennae are less bushy and contain several odor receptors that help her target blood sources so that she can feed and reproduce. **Only female mosquitoes bite and transmit malaria.**

- The thorax is specialised for locomotion. Three pairs of legs and a pair of wings are attached to the thorax.
- The abdomen is specialised for food digestion and egg development. This segmented body part expands considerably when a female takes a blood meal. The blood is digested over time serving as a source of protein for the production of eggs, which gradually fill the abdomen.

*Anopheles* mosquitoes can be distinguished from other mosquitoes by the palps (sensory organ near the mouthpart), which are as long as the proboscis, and by the presence of discrete blocks of black and white scales on the wings. Adult *Anopheles* can also be identified by their typical resting position: males and females rest with their abdomens sticking up in the air rather than parallel to the surface on which they are resting.



## Anopheles life-stages:

**Life Stages:** Like all mosquitoes, anophelines go through two phases. The first is aquatic and lasts 5-14 days depending on the species and the ambient temperature, and comprises the egg, larval and pupa stages. The second is aerial and involves the adult. The adult females can live up to a month (or more in a laboratory setting) but the majority live 2 weeks or less in nature. The adult stage is when the female *Anopheles* mosquito acts as a malaria vector.

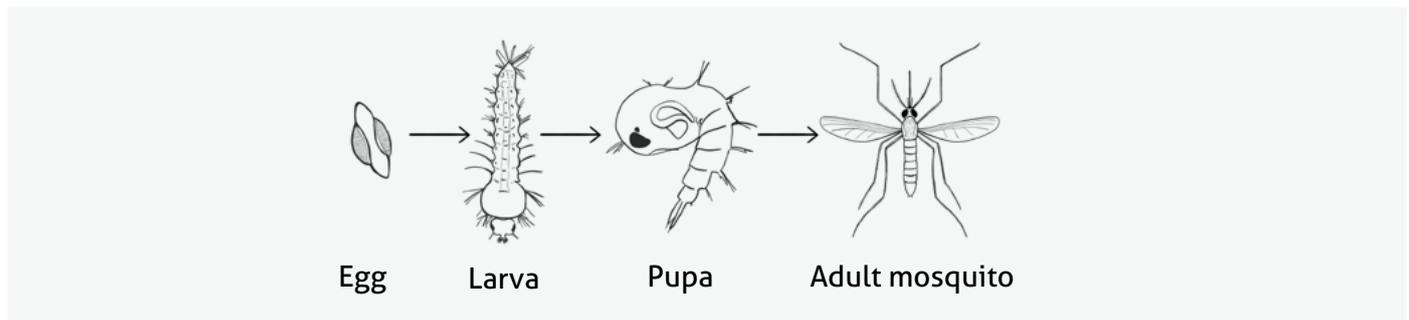
**Eggs:** One or two days after blood-feeding, adult females lay 50 to 300 eggs per oviposition and can lay between 800 and 1000 eggs during their life. Eggs are laid singly directly on water and are unique in having floats on either side. Eggs are not resistant to drying and hatch within 2-3 days.

**Larva:** A larva emerges from each egg and floats parallel to the surface of the water to breathe.

It feeds on particles present in the water. Measuring just 1mm, the larva undergoes three moults to reach 5mm in the fourth stage. Larvae occur in a wide range of habitats but most species prefer clean, unpolluted water. Larvae of *Anopheles* mosquitoes have been found in fresh or salt-water marshes, mangrove swamps, rice fields, grassy ponds, tree trenches, canals, ditches, the edges of streams and rivers, and small temporary rain pools. After the 4<sup>th</sup> stage, the larva turns into an intermediate stage between larva and adult, the pupa.

**Pupa:** The pupa is comma-shaped when viewed from the side. As with the larvae, pupae must come to the surface frequently to breathe, which they do through respiratory trumpets present on their cephalothorax. After a few days the adult mosquito emerges from the pupa. The complete cycle from egg to adult typically takes between 9 and 20 days for *An. gambiae s. l.*

## *Anopheles gambiae* development life cycle



### Adult behaviour

Adult mosquitoes usually mate within a few days after emerging from the pupal stage. The males form swarms around dusk often nearby huts within villages, and the females fly into the swarms to mate. *An. gambiae* females usually only mate once in their lifespan. Males and females feed on nectar and other plant exudates. Only females feed on blood - males do not have the right mouthparts to do this.

In the best tropical conditions, the average lifespan of *Anopheles* is about 2 weeks, depending on the climatic factors of nature. Adult *Anopheles* mosquitoes are thought to typically disperse a few hundred meters within villages, though exceptionally mosquitoes can fly longer distances (~3-4 km).

### Egg production cycle

Females feed on sugar sources for energy but require a blood meal for the development of eggs. They mostly bite between sunset and sunrise (6 pm to 6 am). After obtaining a full blood meal, the female will rest 2 to 3 days while the blood is digested and eggs are developed. Once the eggs are fully developed, the female lays them. The cycle repeats itself until the female dies. Females can survive up to a month (or longer in a laboratory). Their chances of survival depend on temperature and humidity, but also on their ability to successfully obtain a blood meal while avoiding host defenses.

**Preferred sources for blood meals:** One important behavioral factor for malaria transmission is the degree to which an *Anopheles* species prefers to feed on human or animals, such as cattle. *Anopheles* species that prefer human blood are more likely to transmit the malaria parasites from one person to another. Most *Anopheles* mosquitoes do not exclusively have a preference between human or animals as a food source. However, the primary malaria vectors in Africa strongly prefer human blood and, consequently, are the most efficient malaria vectors. *Anopheles gambiae* feeds at night either indoors (endophagic) or outdoors (exophagic). After blood feeding, it prefers to rest indoors but some can rest outdoors in suitable resting places, such as holes, animal sheds, and dense vegetation.

#### Selected references:

- A. N. Clements (1992) *The Biology of Mosquitoes. Volume 1: Development, Nutrition and Reproduction*, Chapman & Hall.
- A. N. Clements (1999) *The Biology of Mosquitoes: Sensory reception and behaviour*, Chapman & Hall.

