

Classification and morphology of mosquitoes

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Why mosquitoes are medically important ?

- Adult or larval stages of arthropodes can be injurious to Human.
- Mosquitoes act as vectors to transmit diseases.
- Vector- Is an invertebrate animal which transmits the parasite from one vertebrate host to another.

Arthropoda

Phylum

Classes

(5)

Insecta

Crustacea

Myriapoda

Arachnida

Orders

(4)

Diptera

(flies)

Siphnoaptera

(fleas)

Anoplura

(lice)

Hemiptera

(bugs)

Acarina

(ticks, mites)

Families

1. *Culicidae* - **Mosquitoes**
2. *Tabanidae* - (tabanid flies)
3. *Mucidae* – (house flies)
4. *Glossinidae* – (tsetse flies)
5. *Simulidae* – (sand flies)

1. *Cimicidae*
2. *Reduvidae*

- Three subfamilies are recognized among the Culicidae: Toxorhynchitinae, Anophelinae and Culicinae.
- Subfamily Toxorhynchitinae comprises a single genus, *Toxorhynchites*.
- There are about 76 species in this single genus. *Toxorhynchites* are not medically important.

ORDER DIPTERA (flies)



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graph TD; A[ORDER DIPTERA (flies)] --> B[FAMILY CULICIDAE (mosquitoes)]; B --> C[Subfamily Toxorhynchitinae<br/>(Non medically important)]; B --> D[Subfamily Anophelinae<br/>(malaria vectors)]; B --> E[Subfamily Culicinae<br/>(arbovirus vectors)]; C --> F[1 genus]; D --> G[3 genera]; D --> H[490+ species]; E --> I[40 genera]; E --> J[3100+ species];
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FAMILY CULICIDAE (mosquitoes)

Subfamily

Toxorhynchitinae

(Non medically important)

1 genus

Subfamily

Anophelinae

(malaria vectors)

3 genera

490+ species

Subfamily

Culicinae

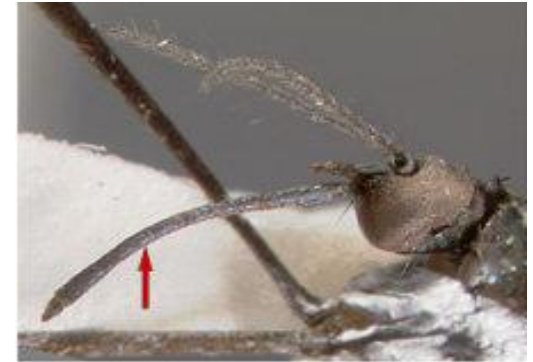
(arbovirus vectors)

40 genera

3100+ species

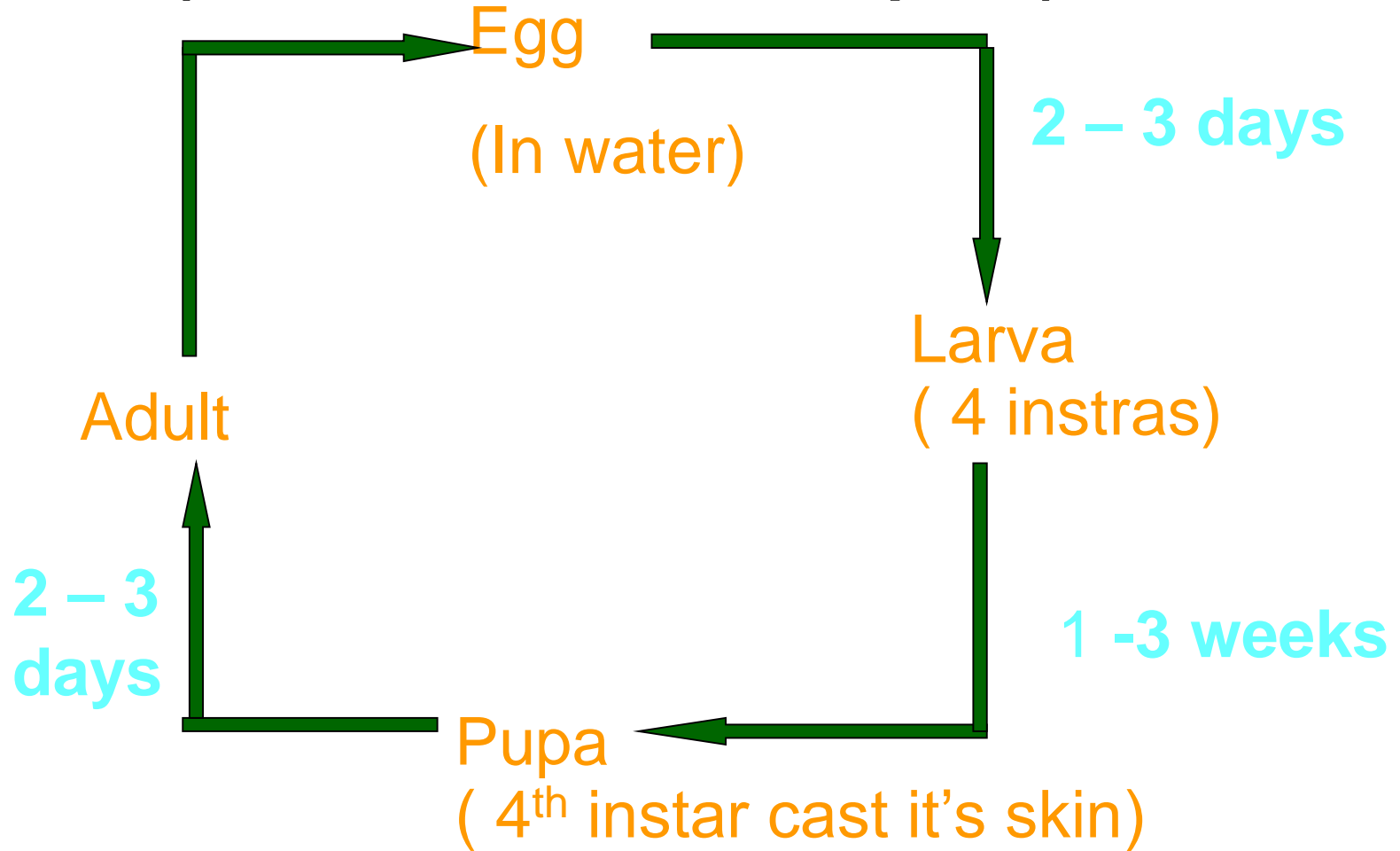
How to separate mosquitoes?

- Only one pair of true wings with characteristic wing venation.
- Adult female has a long proboscis modified for piercing or sucking.
- Body is covered with scales.



Life Cycle

(Holometabolic or complete)



Adult stage



Egg stage



Pupa stage



Larva stage

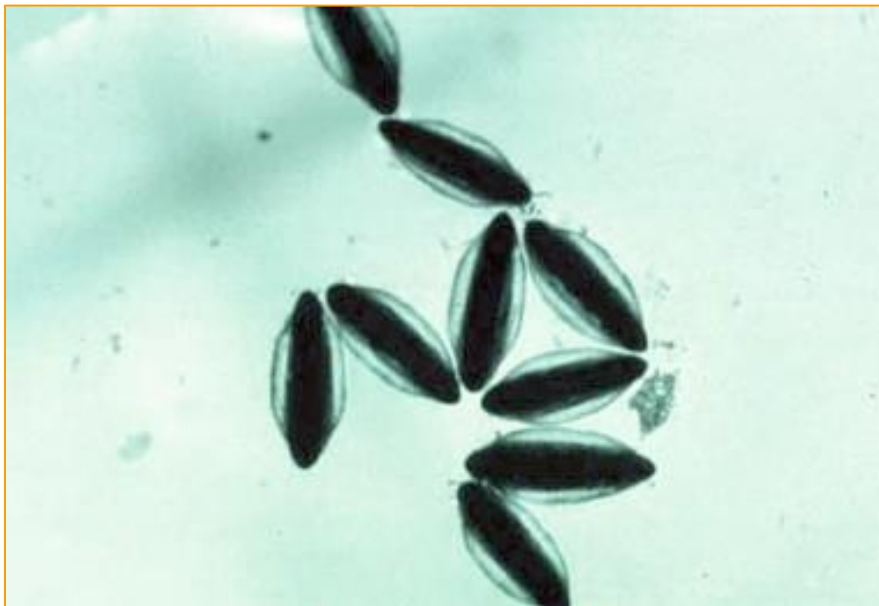


Life cycle

- Sperms pass by males in to “spermatheca” of females.
- One insemination is enough to fertilize all eggs produce by females during their life cycle.
- Females absorb blood to obtain nutrient for eggs development.
- Number of blood meals depends on several factors.

Eggs

- Depending on the species mosquitoes lay 50-500 eggs.
- Black or brown in colour.



Anopheline eggs

Larvae

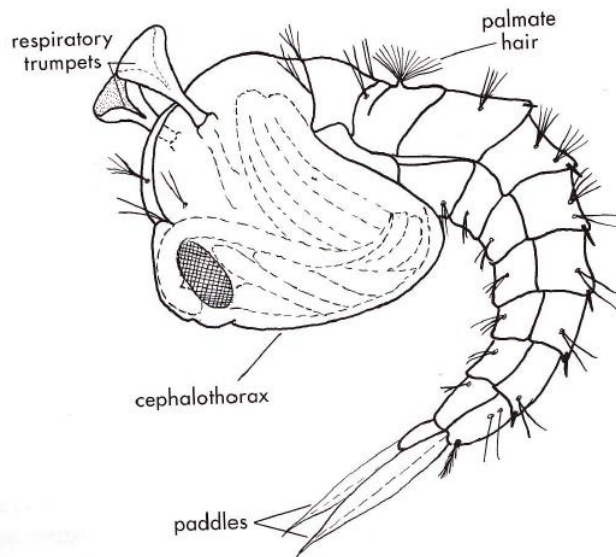
- Larval stage has a well defined head, thorax and abdomen.
- It also has a
 - pair of antennae
 - pair of eyes
 - pair of mouth brushes.

- Mosquito larvae distinguish from all other aquatic insect.
- Because they are legless and have wider thorax than both head and abdomen (Bulbous thorax).

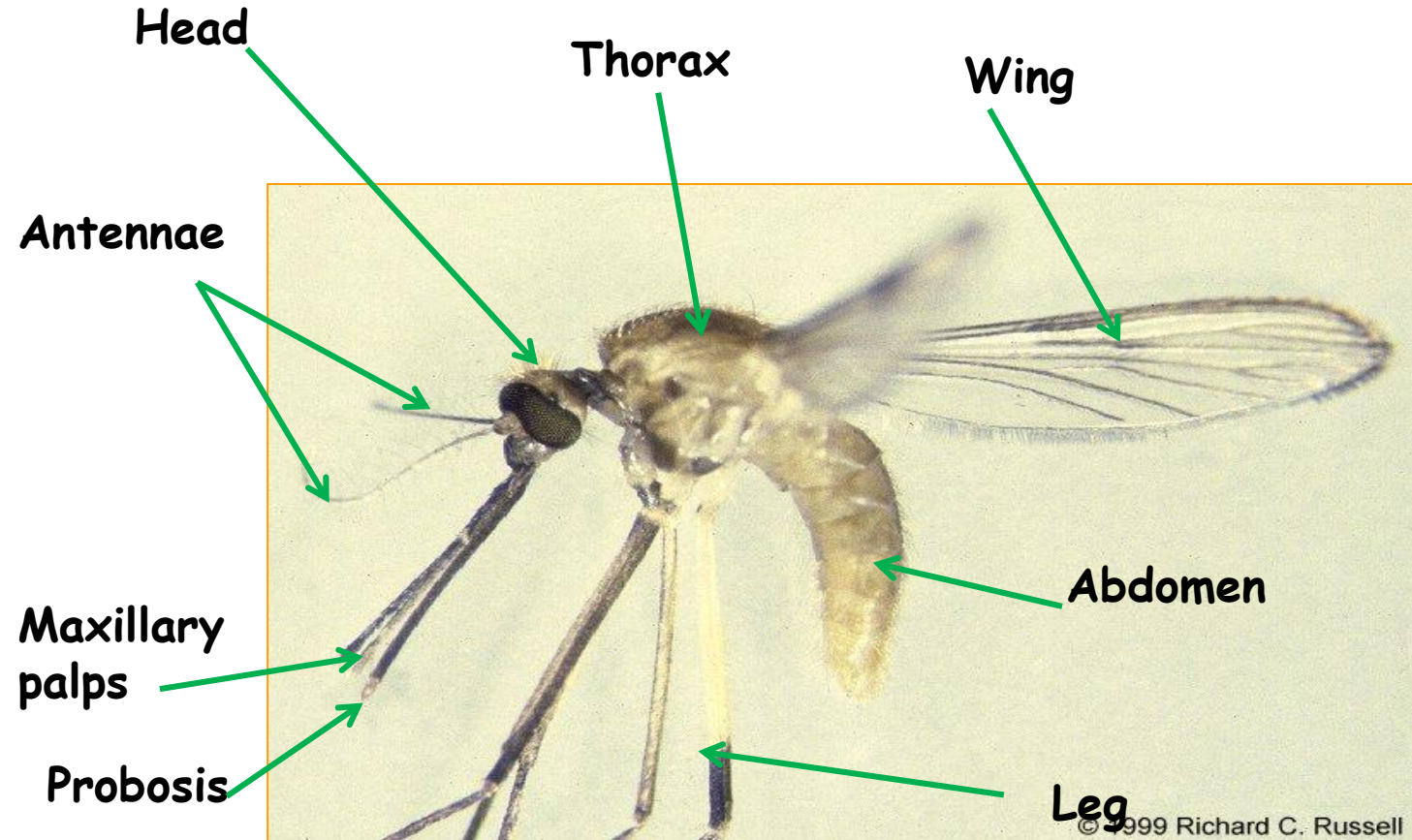


Pupa

- Mosquito pupae are comma-shaped.
- They hang just below the water surface.
- Head and thorax are combined to form the “cephalothorax”.
- Has a pair of breathing trumpet dorsally, which is used in respiration.



Adult mosquito



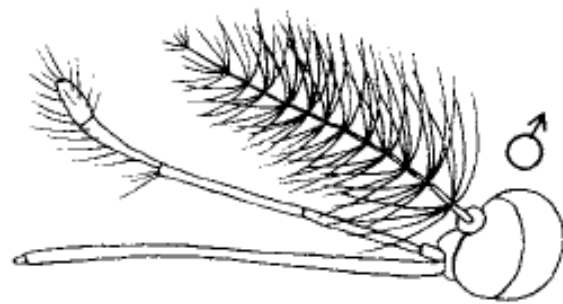
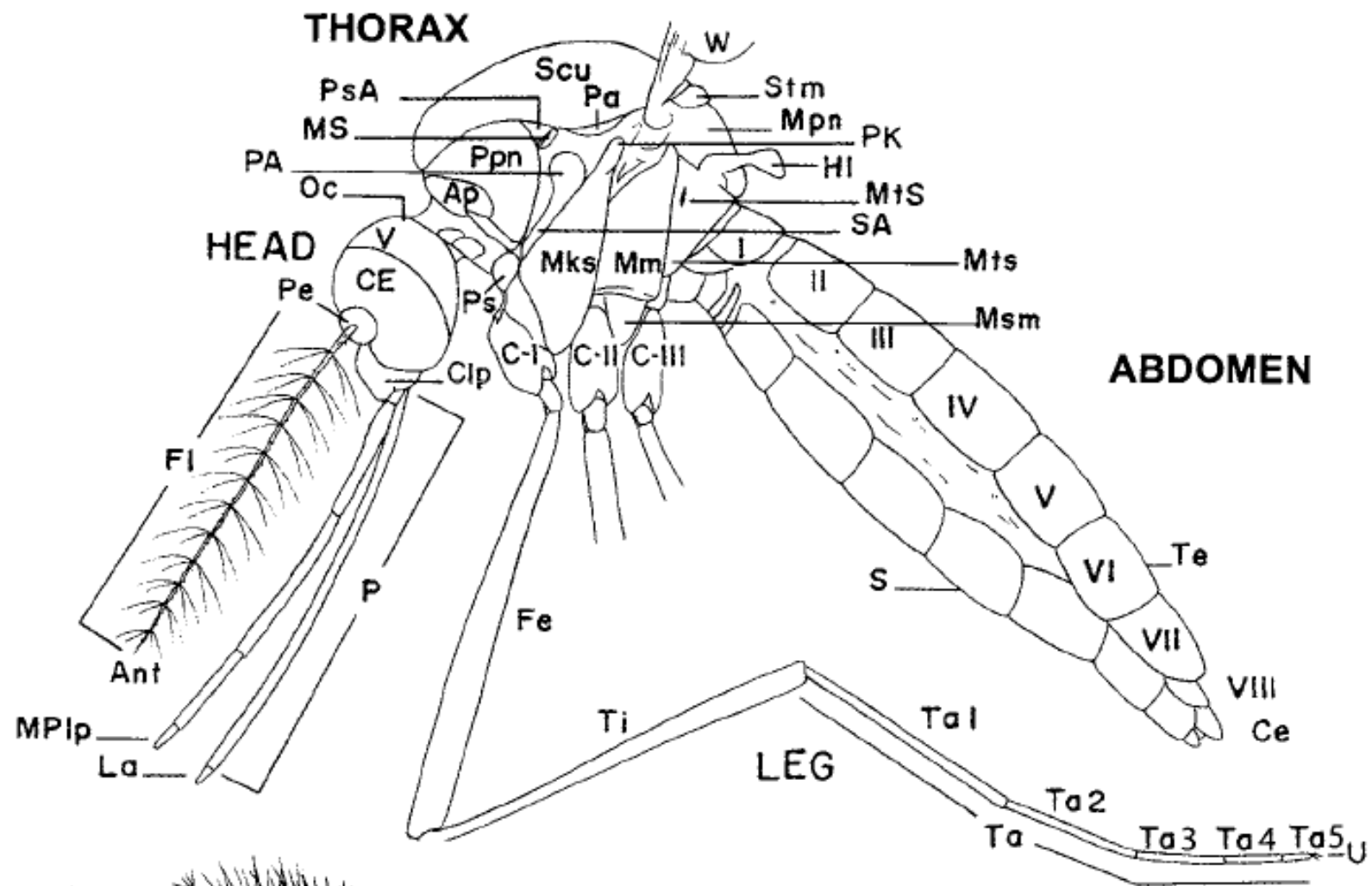
General Morphology

- Like other arthropods, bilateral in symmetry.
- The adult mosquito is covered with an exoskeleton.
- Its body is divided in to three principal regions.

Head

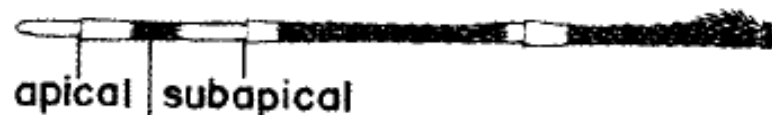
Thorax

Abdomen



HEAD

MAXILLARY PALPUS



Head

- Two large conspicuous kidney shaped compound eyes.
- Two long segmented filamentous antennae (differ in sexes).
- Two palps, each composed of 5 parts.
- Proboscis extends forward; the tip of the proboscis is called the labellum.





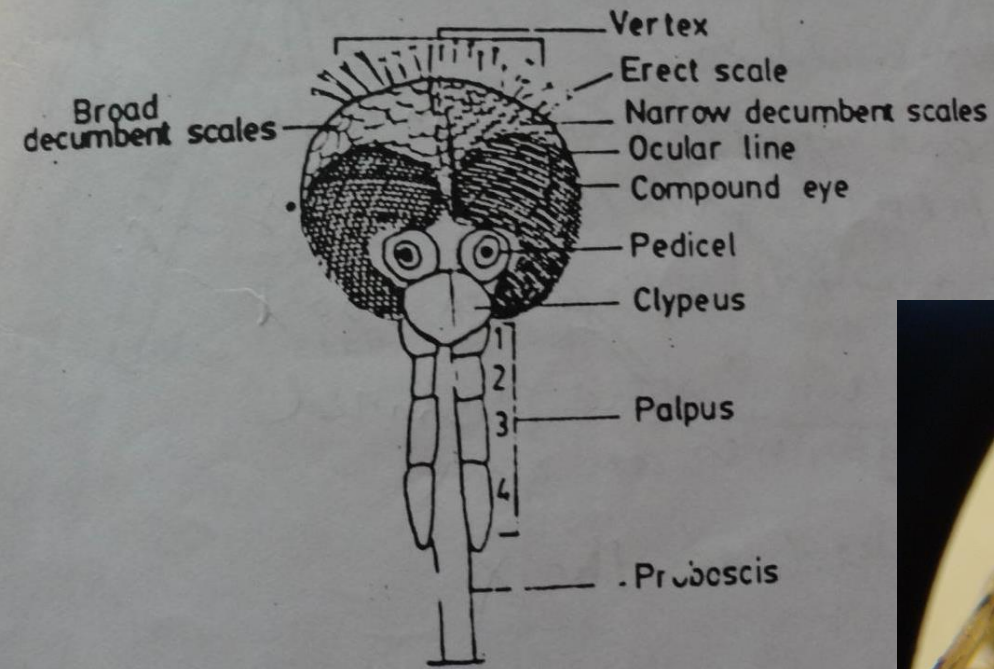
Proboscis (1)

Labellum

Maxillary palps (2)

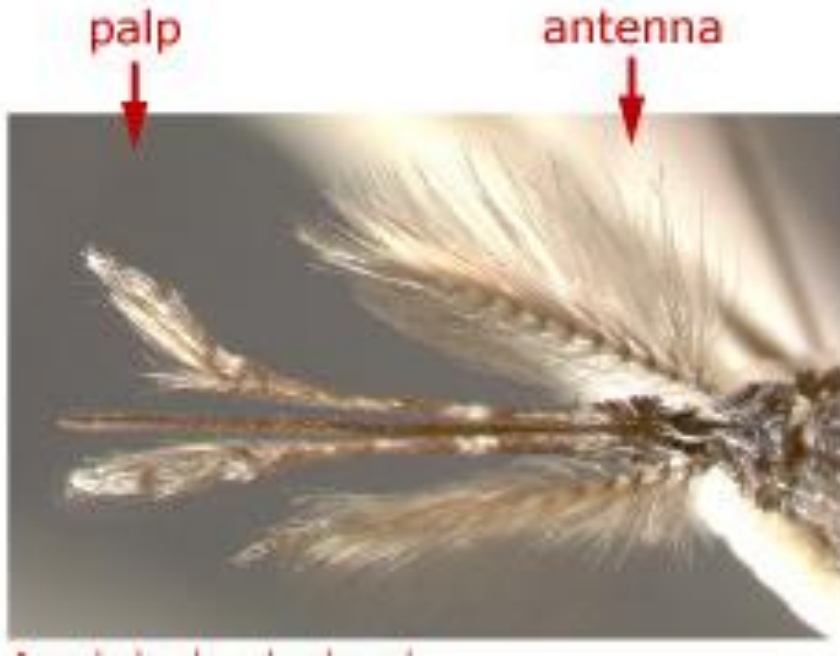
Antenna (2)

HEAD
ANTERIOR ASPECT



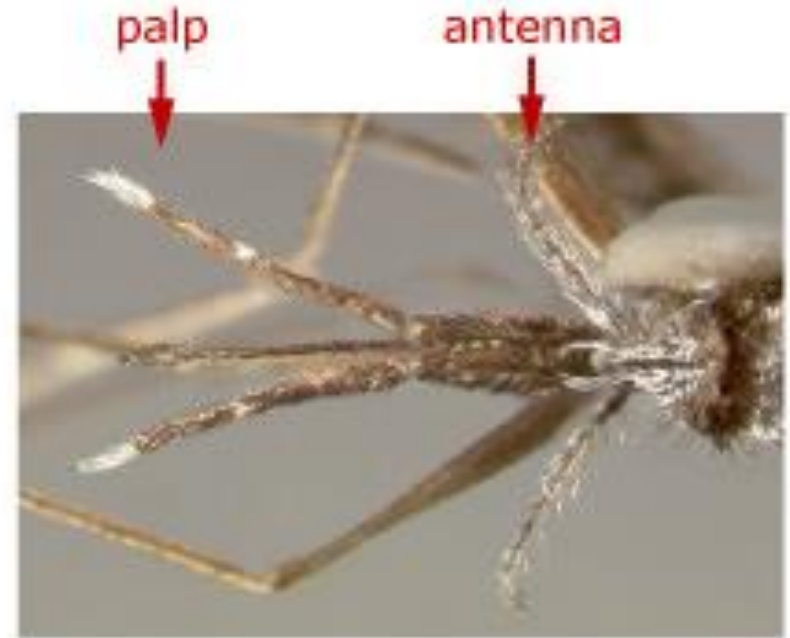
Male vs. Female Mosquitoes

Male



Many long hair
feathery (Plumose)

Female



Short hairs
(Pilose antennae)

- Both male and female mosquitoes have proboscis,
- Mandibles and maxillae are reduced in size or absent in male mosquitoes.



Thorax

- The body region between the head and abdomen.
- There are three segments.

Pro- thorax

Meso- thorax

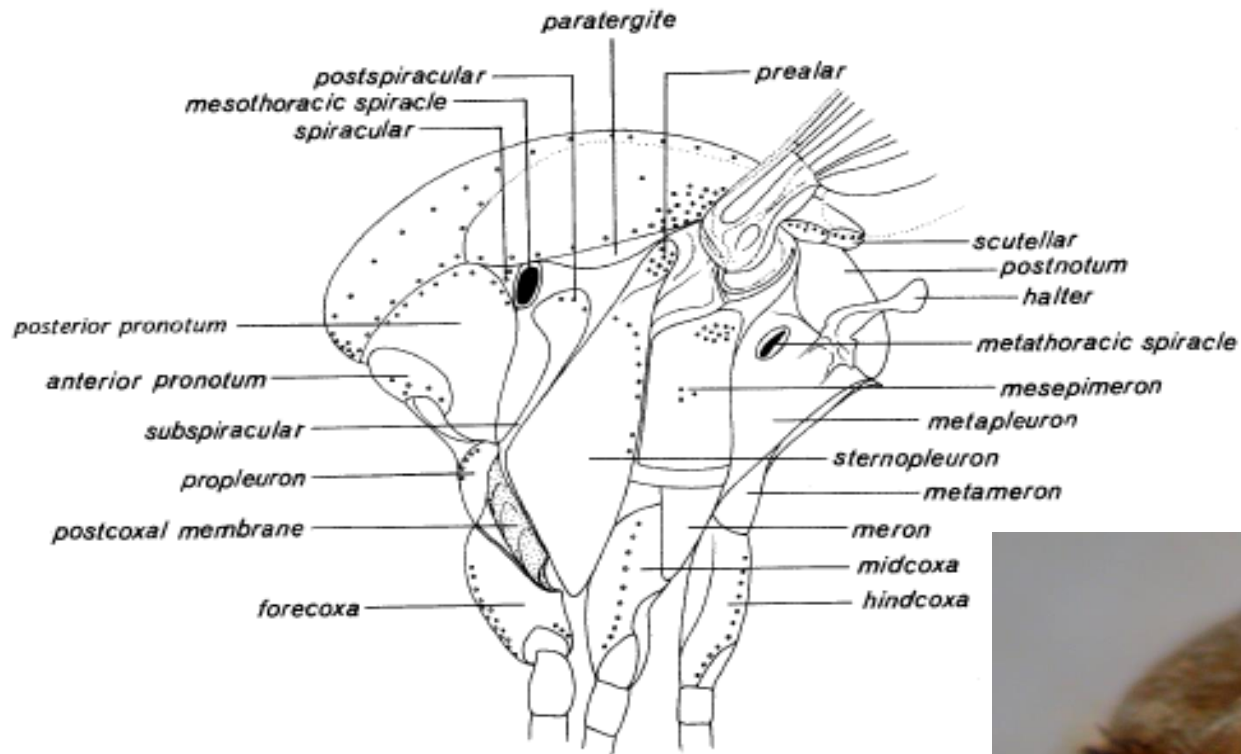
Meta- thorax

- A pair of wings and a pair of halteres on the upper surface.
- 3 pairs of legs on the lower or ventral surface.
- The wings have a specific venation system ; each vein is given a number and/or a name.
- Many anophelines have wings spotted with dark and pale areas which are used for species determination.
- Scutellum lies at the rear end of the upper surface of the thorax.

MORPHOLOGICAL FEATURES USED IN IDENTIFICATION

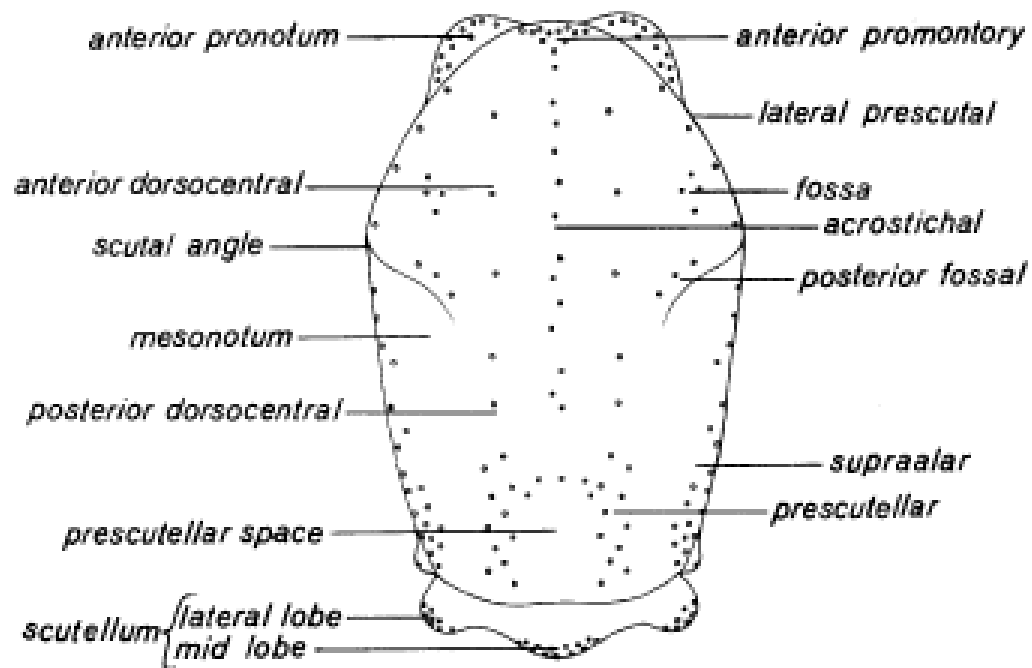
A. ADULT

F



THORAX - LATERAL





THORAX – DORSAL



Adult Female Mosquito: Thorax, dorsal view

- Scales can vary in color, patterns and shape.



Abdomen

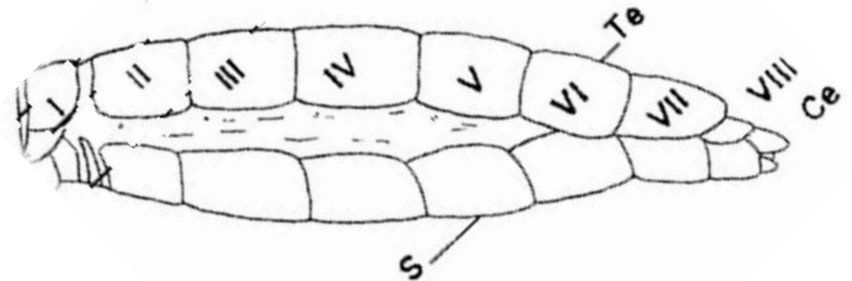
- There are eight (8) visible body segments.
- Last two segments are specialized for reproduction and excretion.

i-viii- Abdominal segments

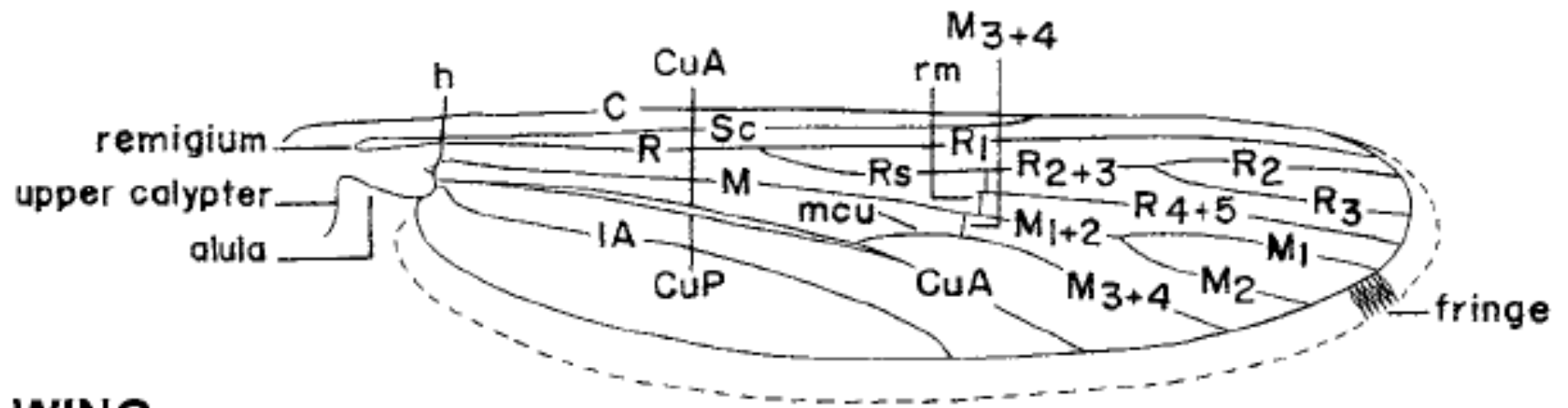
Te- Tergites

S- Stemites

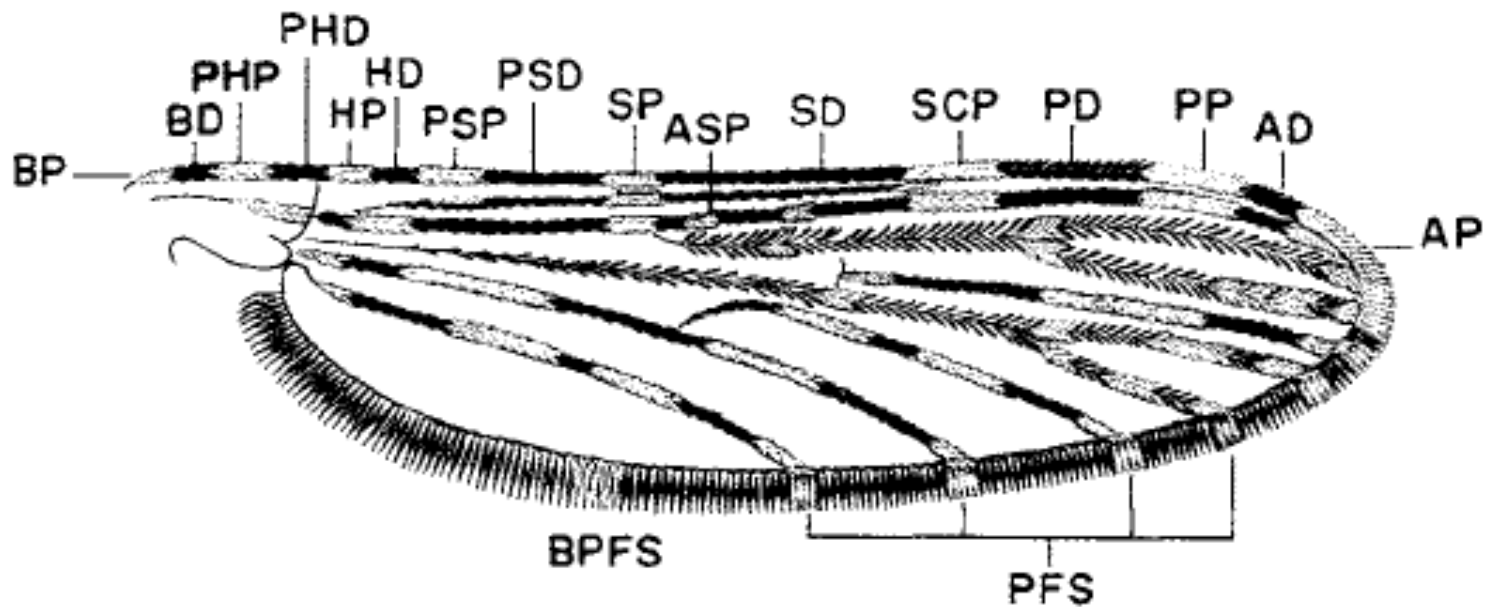
Ce- Cercus



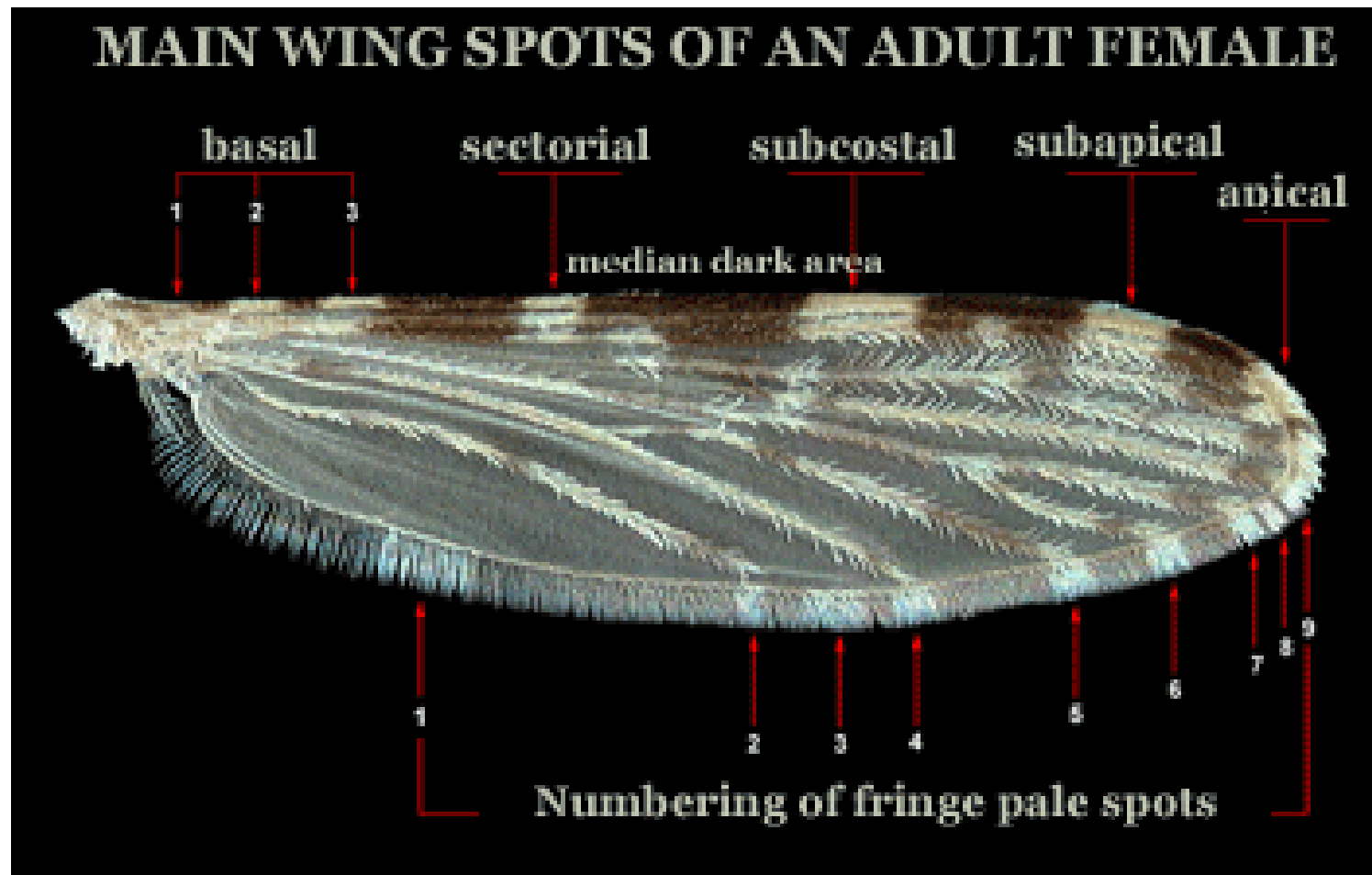
Wing



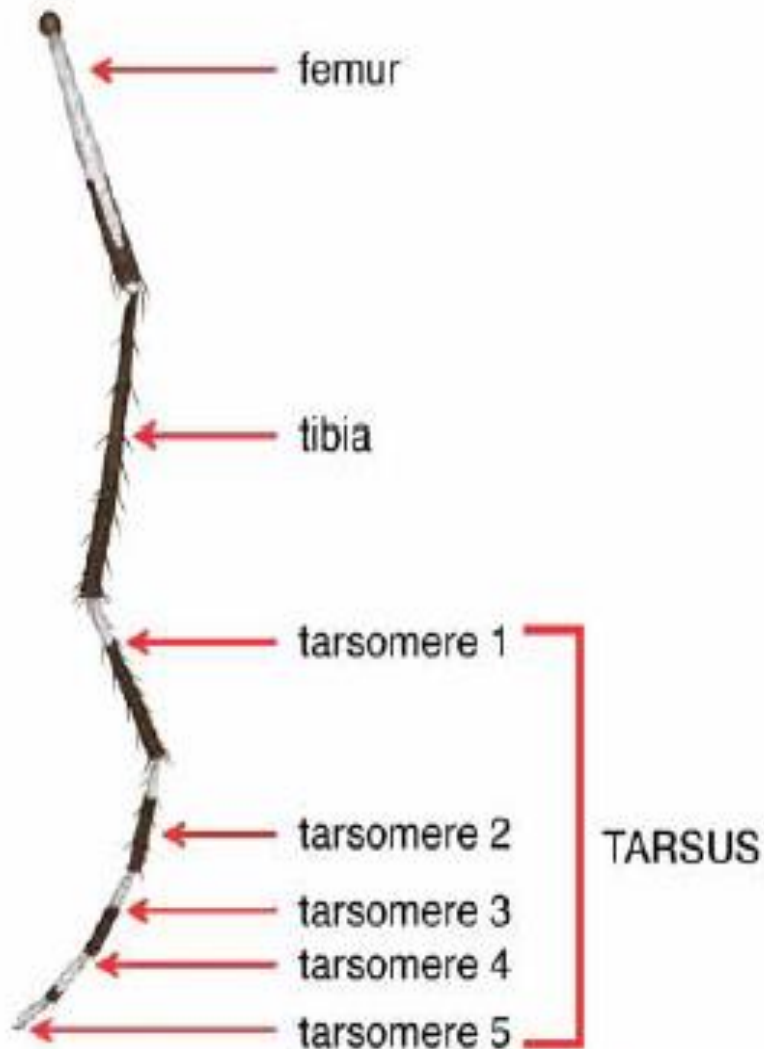
WING



- 1st, 3rd and 6th veins are unbranched.



Leg



long legs which made up of
a short coxa (joined to the body)
a short trochanter
a long femur,
a long tibia,
and long tarsus (5 parts)

At the end of the leg is a pair of claws.

The legs are also covered with scales
which may be of different colours

**Who are medically important
mosquitoes ??**

1. *Culex* :

- Filariasis [W.b } and Arboviruses



2. *Aedes* :

- Yellow fever, dengue, encephalitis, filariasis [W.b and B.m]



3. *Anopheles* :

- Malaria

4. *Mansonia* :

- Filariasis [B.m, W.b] and Arboviruses



Disease transmitting mechanisms by mosquitoes

Mosquitoes carry infectious agents internally.

1. Vertical transmission
2. Horizontal transmission

Culex mosquito identification

1. Eggs

Adults lay eggs as nests, which are called as egg rafts.

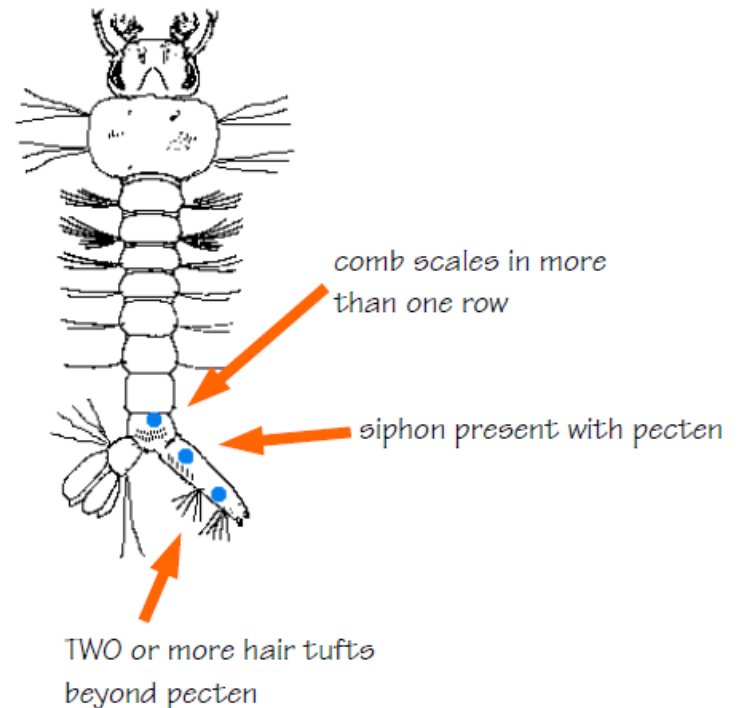
Culicine



- In rafts, No floats.

2. Larvae

- Larvae hang from the water surface, feed from the bottom.
- Breathe air through a “siphon tube”.
- Siphon tube is long and slender.



3. Pupa

The breathing trumpet culicine pupa is long and slender with a narrow opening.



4. Adults

- Stay parallel to the resting surface.
- Palps are shorter than the proboscis.
- No scales in wings.
- Dusty color appearance.



Short palps

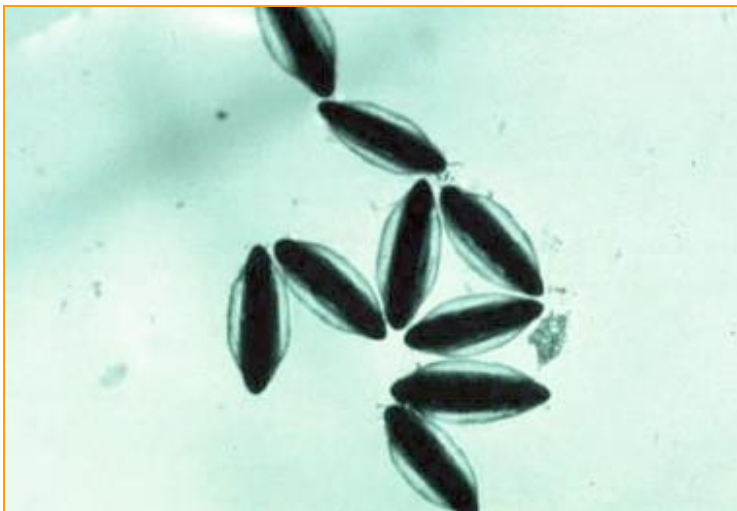


- *Culex quinquefasciatus*. - Main Filaria vector
- *Culex gelidus*. - JE vector
- *Culex tritaeniorhynchus* - JE vector

Anopheles Identification

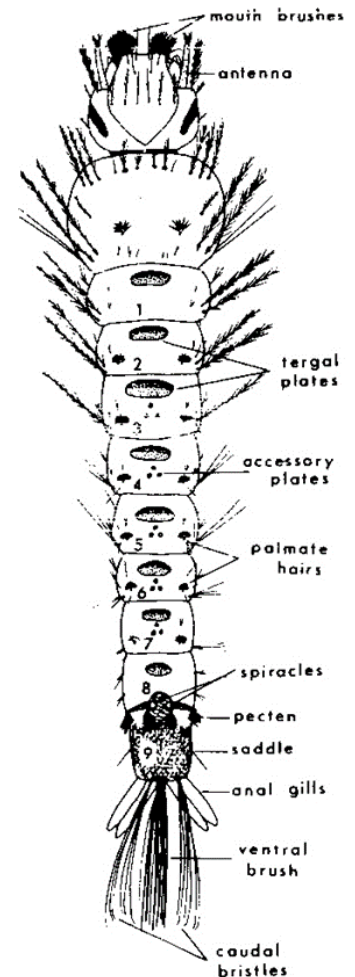
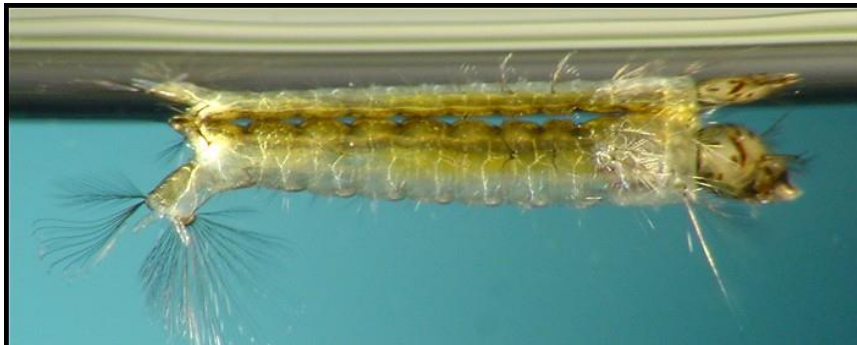
1. Eggs

- Depending on the species anopheline mosquitoes lay 50-500 eggs.
- Black or brown in colour.
- Eggs are boat shaped with lateral floatings.



2. Larvae

- Float parallel to the water surface.
- Siphon tube is absent. (breathe air through a special breathing tube called spiracles).



Palmate Hair



- Abdominal setae 1 palmate, at least on abdominal segments III-VII.



Palmate Hairs



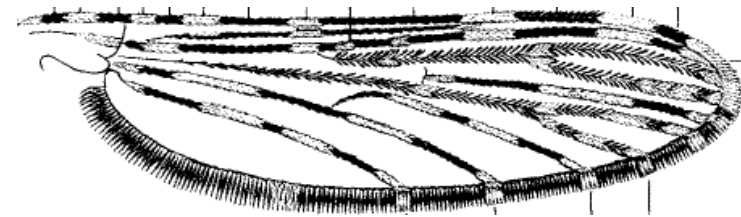
3. Pupa

- The breathing trumpet of the anopheline pupa is short and has a wide opening.

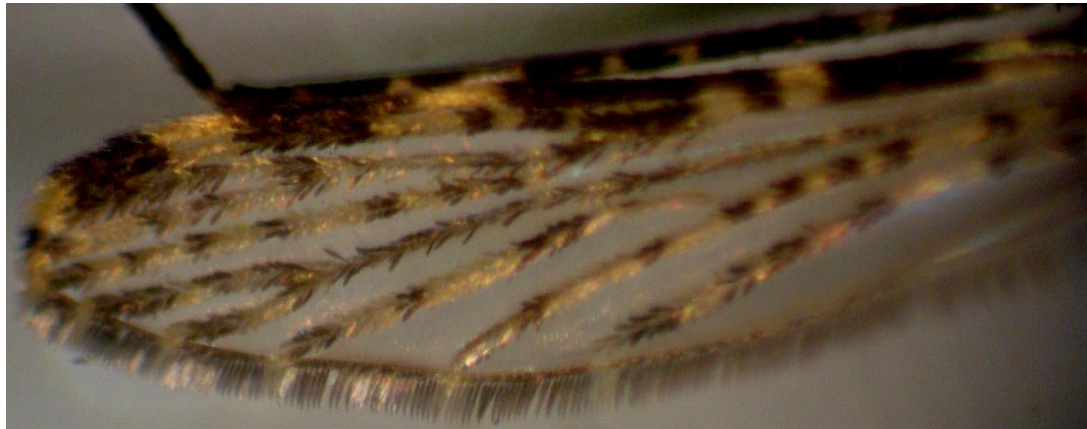
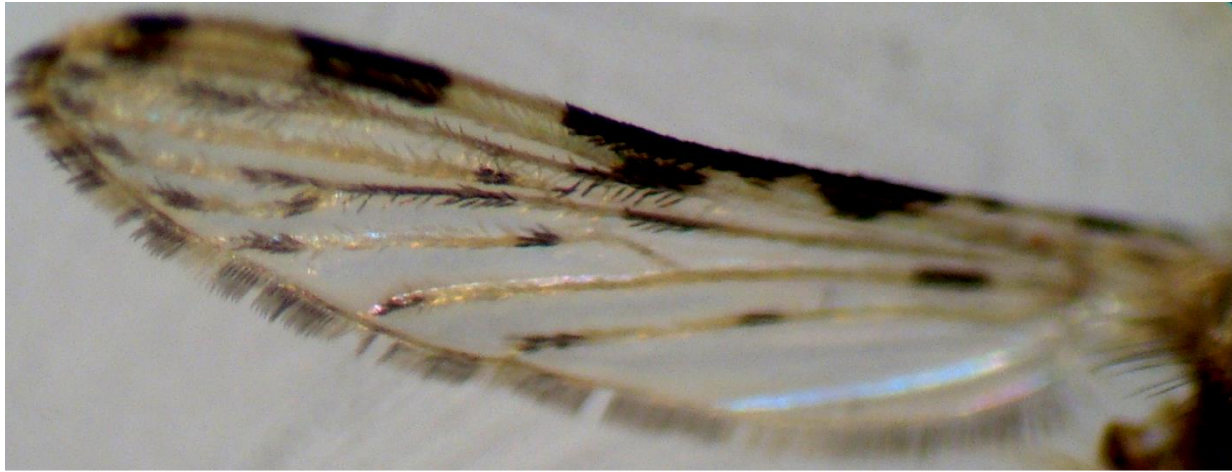


4. Adults

- Stay 45 degrees angularly to the resting surface.
- Palps about as long as the proboscis.
- Many of the anophelines have dark and pale scales on wing veins arranged in specific areas (wing spots).



Wings of *Anopheles*





Identification can begin in the field

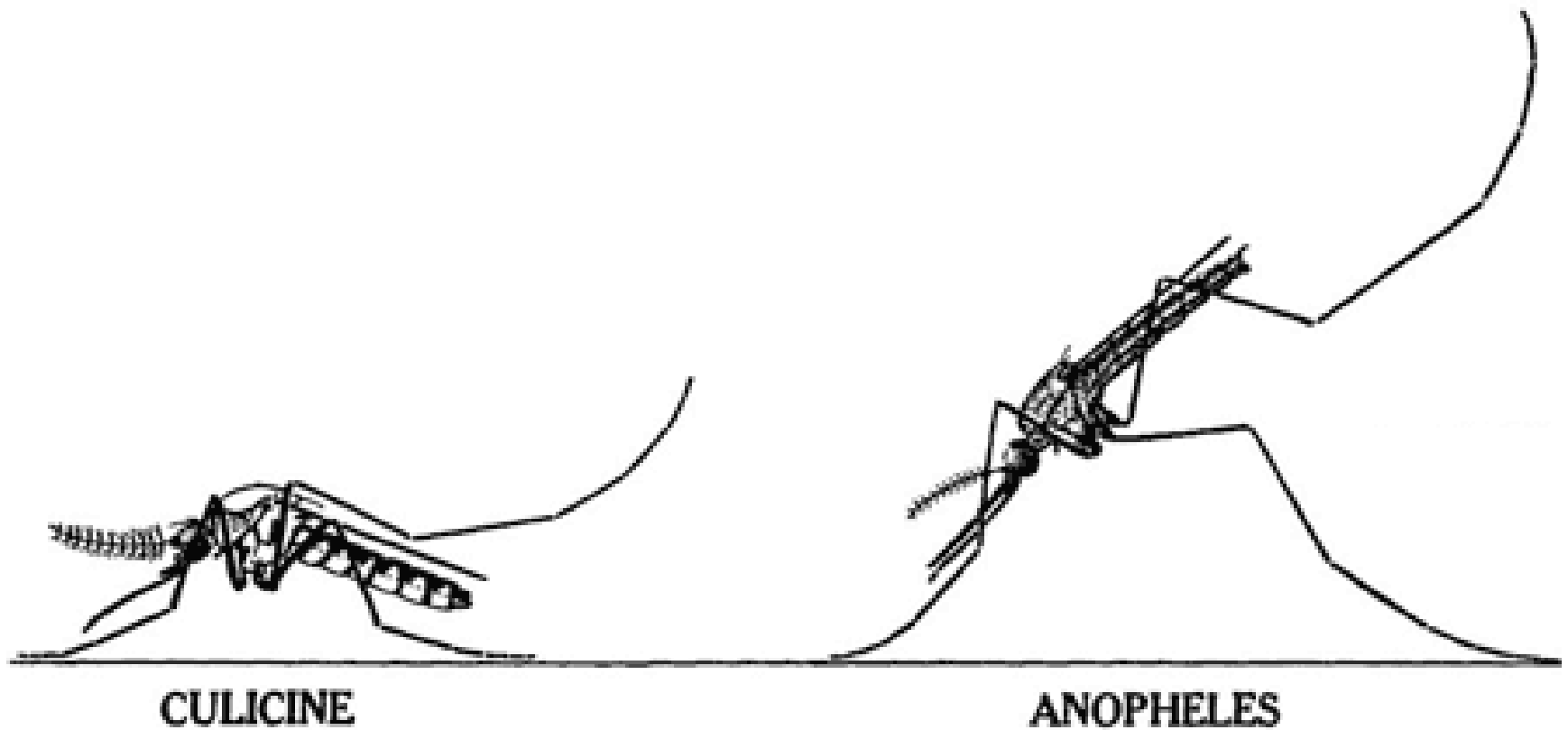
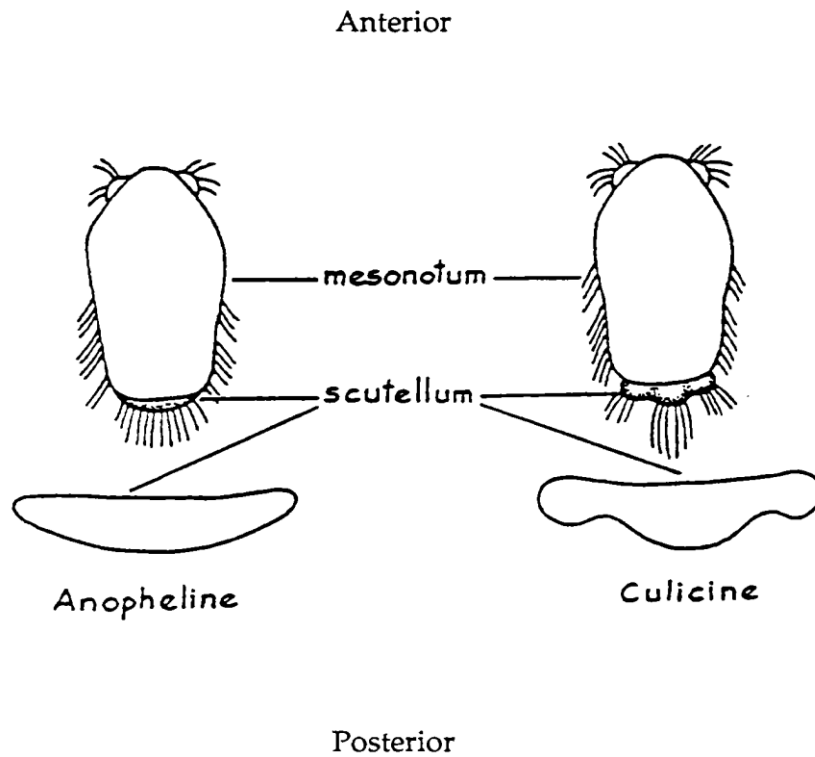


FIG. 24. Differences in the usual shape and resting attitude of Anopheline and Culicine adults.
(From Hodgkin)

Scutellum is rounded in anopheline



Malaria Vectors

Main vector

- *An. culicifacies*

Subsidiary vectors

- *An. subpictus*
- *An. vagus*
- *An. annularis*
- *An. tessellatus*

***Aedes* Identification**

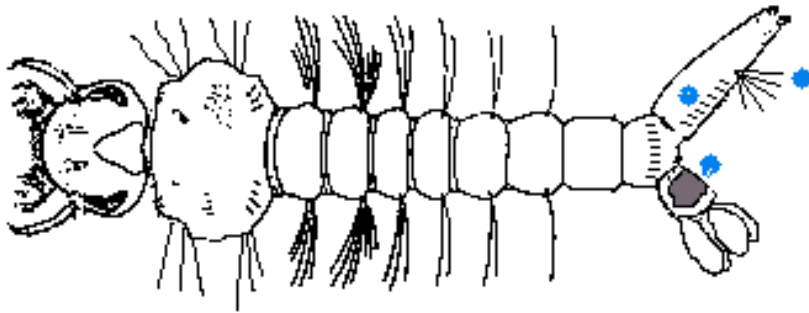
1. Eggs

- Elongated (slender)
- Stick eggs immediately above the water surface
- No!!! Floating.
- Resistance to desiccation.



2. Larvae

- Siphon tube is short and barrel shaped with one pair of hair sub-ventral rufts.
- Stay vertically.



3. Pupa

- Breathing trumpet is long, cylindrical with a narrow opening.



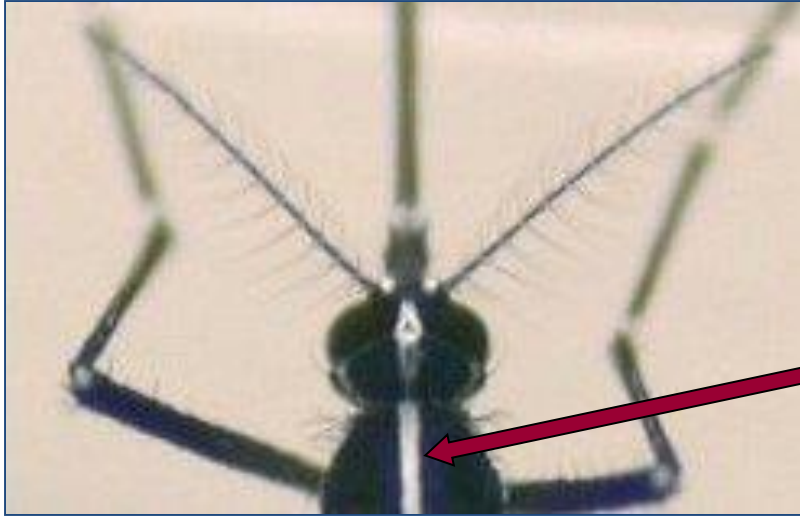
4. Adults

- Dark black in color.
- Abdomen is banded with black and white margins.
- Legs are banded with black and white.



basal bands on
abdomen





Thorax has a straight
white colour line

Aedes albopictus

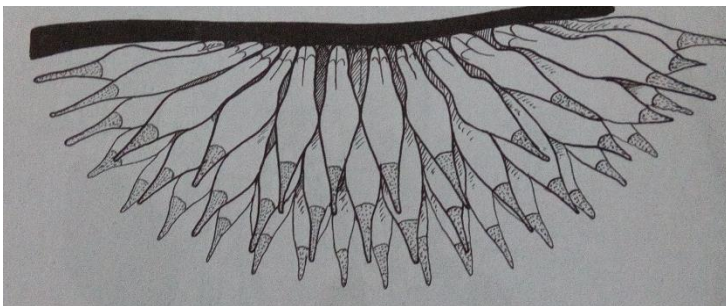


Aedes aegypti

Identification of genus *Mansonia*

Eggs

- Dark brown-black.
- Cylindrical but have a tube-like extension apically.
- Eggs are arranged as a rosette.
- Eggs are glued to the undersurface of plants and hatch within few days.



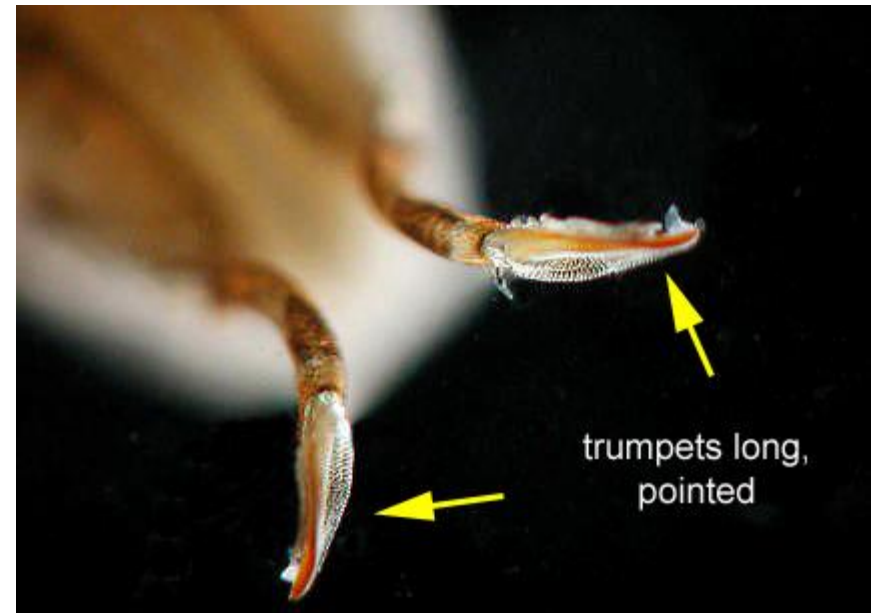
Larvae

- Can be easily recognized by the modified siphon tube (saw-tooth structure) adapted to piercing aquatic plants.

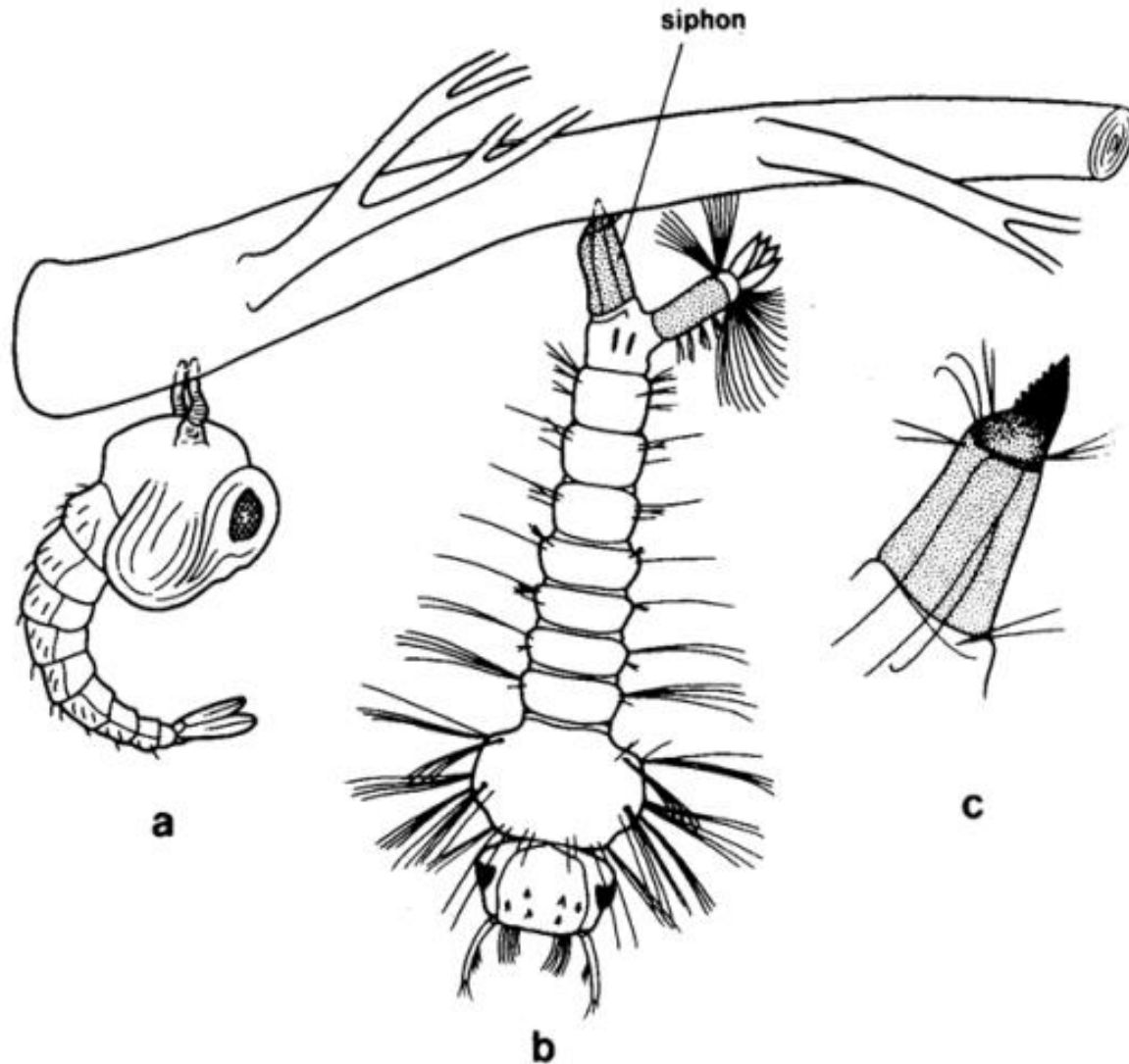


Pupae

- Breathing trumpet is long and pointed to pierce the aquatic vegetation in order to acquire oxygen.

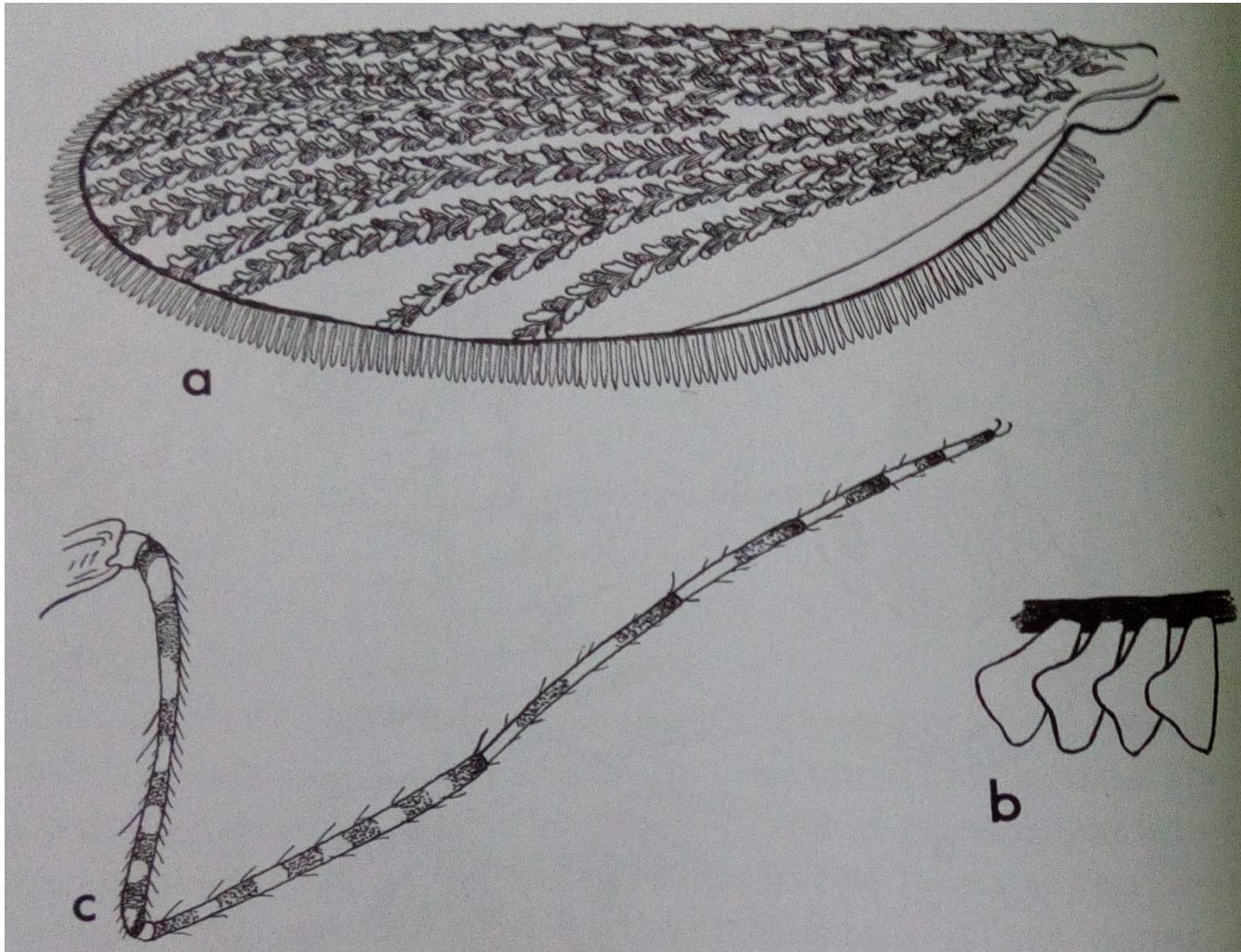


Immature stages of genus *Mansonia*



Adults

- Adults have the legs, palps, wings and body covered with a mixture of dark and pale scales, giving the mosquito a rather dusty appearance.
- The speckled pattern of dark and pale scales on wing veins gives the wings the appearance of having been sprinkled with salt and pepper.
- Closer examination shows that the scales on the wings are very broad and often asymmetric.



MANSONIA



apex of abdomen blunt,
cut-off

postspiracular
setae present



antennae have
white scales at
flagellomere joints



wing scales large, light
and dark, ends of scales
blunt, cut-off



hind legs have narrow
basal bands

Summary

PRINCIPAL CHARACTERS FOR IDENTIFYING THE THREE GENERA OF MEDICAL IMPORTANCE

ANOPHELES

AEDES

CULEX

EGGS



LAID SINGLY



HAS FLOATS



LAID SINGLY



NO FLOATS

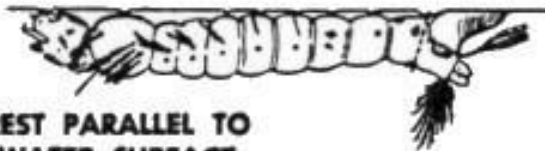


LAID IN RAFTS



NO FLOATS

LARVAE



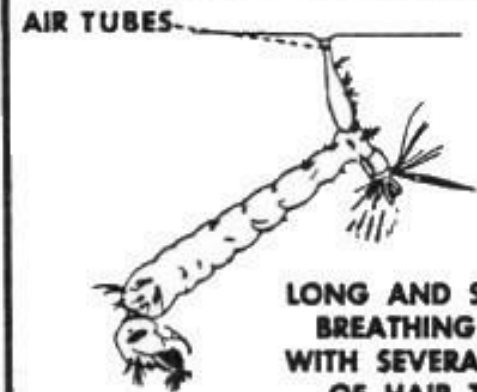
REST PARALLEL TO
WATER SURFACE

RUDIMENTARY BREATHING TUBE



REST AT
AN ANGLE

SHORT AND STOUT
BREATHING TUBE
WITH ONE PAIR OF
HAIR TUFTS



LONG AND SLENDER
BREATHING TUBE
WITH SEVERAL PAIRS
OF HAIR TUFTS

PUPAE



PUPAE DIFFER ONLY SLIGHTLY



Aedes

ADULTS

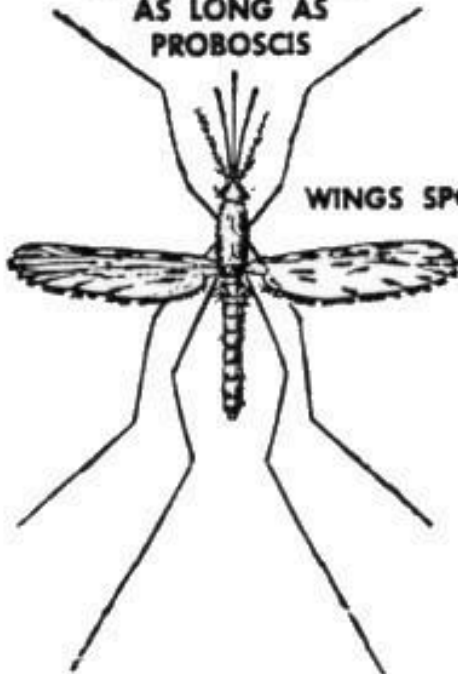
PROBOSCIS AND



BODY IN ONE AXIS

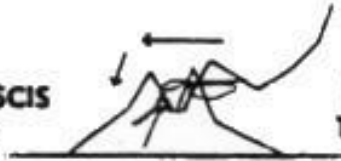


MAXILLARY PALPS AS LONG AS PROBOSCIS



WINGS SPOTTED

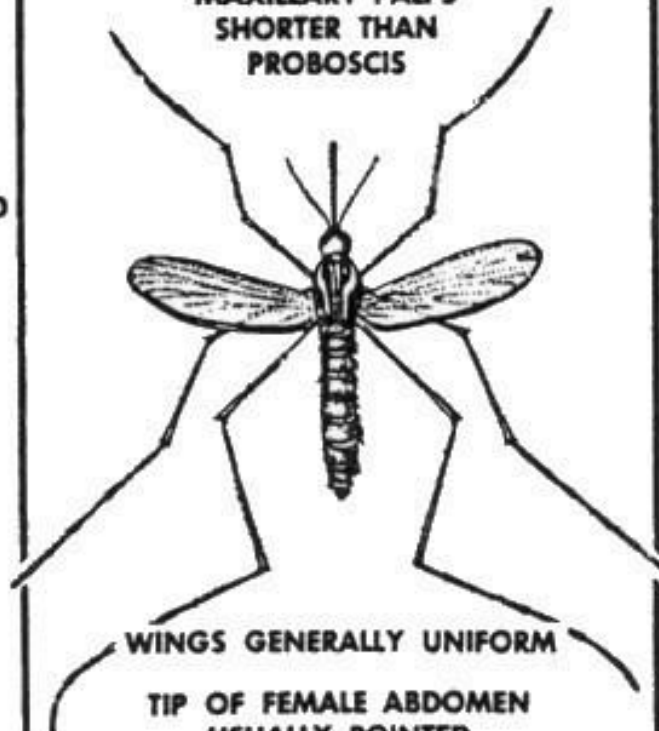
PROBOSCIS AND



BODY IN TWO AXIS



MAXILLARY PALPS SHORTER THAN PROBOSCIS



WINGS GENERALLY UNIFORM

TIP OF FEMALE ABDOMEN USUALLY POINTED

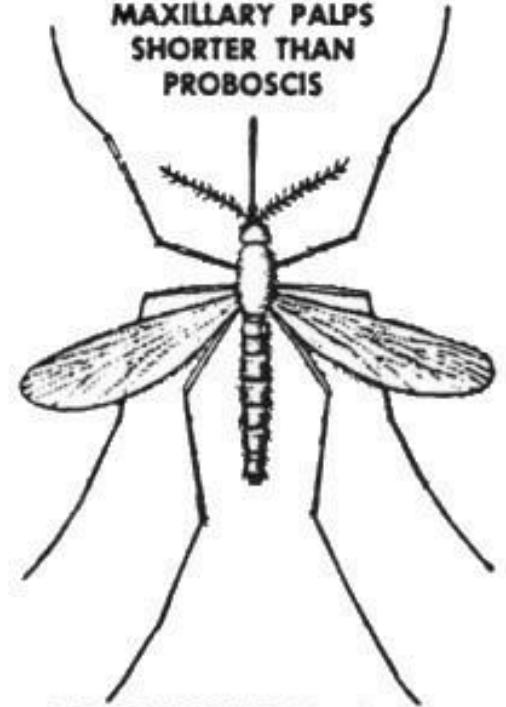
PROBOSCIS AND



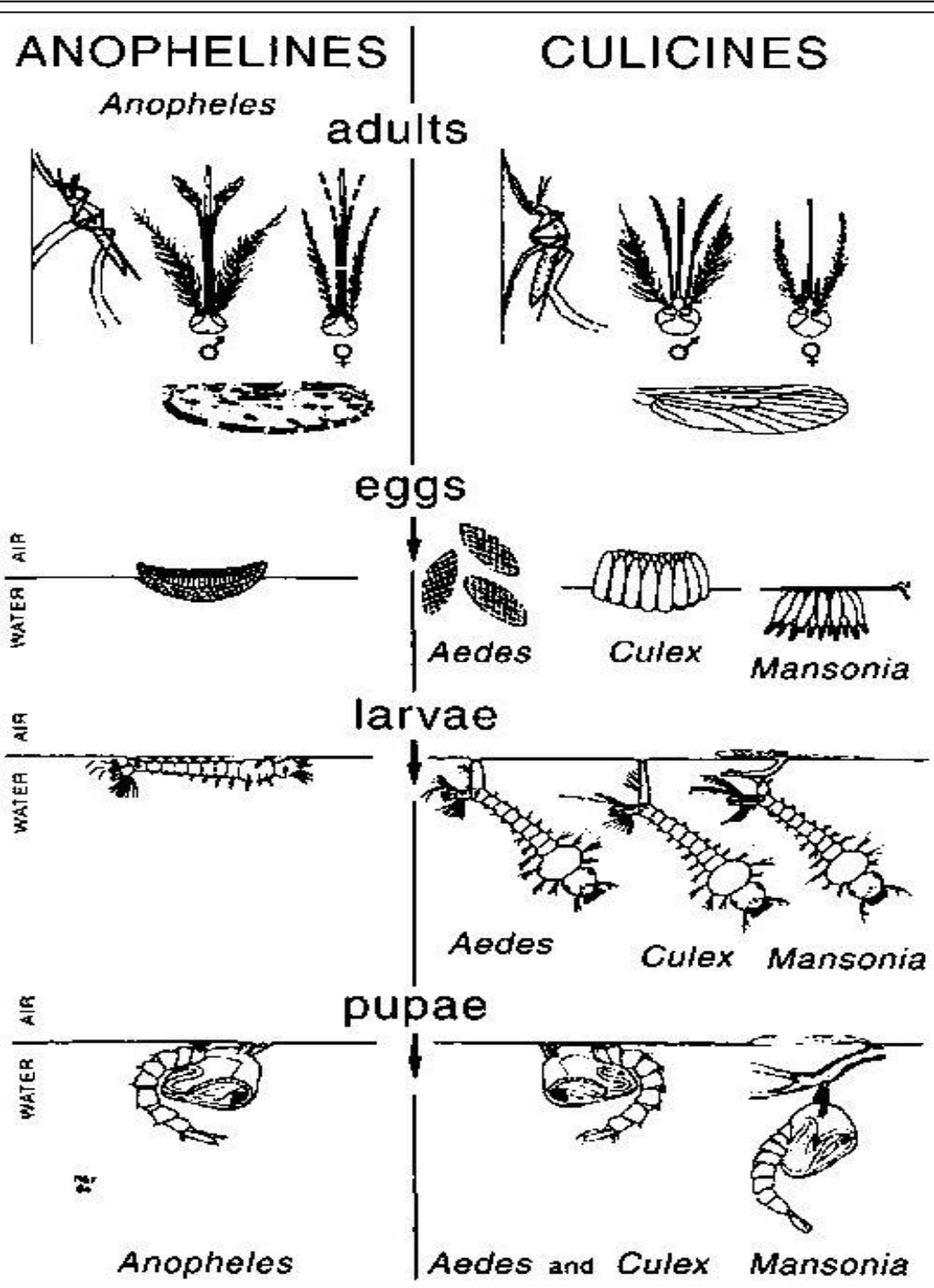
BODY IN TWO AXIS



MAXILLARY PALPS SHORTER THAN PROBOSCIS



TIP OF FEMALE ABDOMEN USUALLY BLUNT



Thank You