Lecture No.35 PARASITOLOGY DR. Raad H.H.

**Order Diptera (flies ; mosquitoes ; midges )**

**Introduction** :

1. About 120,000 described species
2. **1 pair wings on mesothorax**
3. **1 pair halteres (balance organs) on metathorax (derived from a reduced pair of wings)**
4. some species have lost wings secondarily
5. Some taxa (Simulidae, Tabanidae) display **compound eye sexual dimorphism. Females have eyes separated on the top of the head (dichoptic eyes) where the males have no separation (holoptic eyes)**
6. **three main groups (Nematocera, Tabanomorpha, Muscomorpha)**
	1. **suborder: Nematocera**
		1. **antennae with many segments; many filamentous**
		2. wings with many veins
		3. larvae active, with distinct head capsule
		4. **pupae often free-swimming, or develop in very moist soils**
		5. representative parasitic families
			1. Ceratopogonidae (biting midges)
			2. Culicidae (mosquitos)
			3. Psychodidae (sand flies and moth flies)
			4. Simulidae (blackflies)
	2. **suborder: Brachycera**
		1. **antennae with 3 segments; terminal segment often pointed**
		2. wing venation reduced
		3. larvae active and mostly predators; heads often vestigial, incomplete, or retractable
		4. **2 groups**
			1. **Infraorder: Tabanomorpha**
				1. face bulbous; larval head retractable
				2. includes the families Tabanidae (tabanids) and Rhagionidae (snipe flies)
			2. **Infraorder: Muscomorpha (=old suborder Cyclorrhapha)**
				1. antennae short, pendulous
				2. large compound eyes
				3. maggots without true head, with 2 posterior spiracles
				4. pupae a puparium, which is a surrounding encasement of hard larval tegumental material
				5. many species in some families may cause myiasis (infection by the maggots); especially in the Calliphoridae, Oestridae, and Sarcophagidae

facultative myiasis (normally free-living maggot can successfully establish parasitism by gaining access to the host accidentally

obligatory myiasis (necessary for completion of the life-cycle)

pseudomyiasis where eggs/larvae ingested and larvae may reside for a time enterically; most common family for this is the Fanniidae and Muscidae

different species may reside in different locations. Many species cutaneous, either ingesting necrotic or live tissues; others may be gastric, urogenital, nasopharyngeal, or ophthalmic

* + - * 1. many different families are parasitic; some representative families as below

Calliphoridae (blow flies and screwworms)

Chloropidae (eye gnats)

Fanniidae (latrine and lesser house flies)

Glossinidae (tsetses)

Hippoboscidae (louse flies)

Muscidae (house flies)

Nycteribiidae (bat spider flies)

Oestridae (head maggots, sheep bots, skin bots, heel flies, stomach bots; a number of previous families are now included as subfamilies in this taxon, although there are four main subfamilies)

Cuterebrinae (rodent or skin bots)

Gastrophilinae (stomach bots)

Hypodermatinae (warbles or heel flies)

Oestrinae (nose and pharyngeal bots)

Sarcophagidae (flesh flies)

Streblidae (bat flies)





**Order: Diptera; Suborder: Nematocera**

1. antennae with many segments; filamentous
2. many males have very elaborate (plumose) antennae to detect female pheromones; females tend to have simple antennae
3. wings have many veins, which is a fairly primative condition
4. larvae with well-developed head capsule
5. larvae often quite active and many free-swimming
6. most species have larvae and pupae that are aquatic or develop in wet soils
7. includes mosquitos, sand flies, midges, and black flies

**FAMILY: Simulidae (black flies)**

1. over 1,720 named species and about 26 genera
2. small flies, generally dark although some species lighter in color
3. mainly temperate or subarctic; many exceptions however
4. most species with hump-back appearance
5. antennae with 11 segments, without hairs; ocelli absent
6. wings wide, and have well developed anterior veins but poor venation elsewhere in wing
7. females with serrated mandibles used to cut skin; females also feed on nectar; males with reduced mouthparts and feed solely on nectar
8. Large pair of compound eyes
	1. Females dichoptic (eyes separated on top of head)
	2. Males holoptic (eyes touch on top of head); males also with larger lenses on upper portion of eye
9. life-cycle of typical *Simulium* sp.
	1. females require blood meal for proper ovarian development
	2. females enter water and oviposit submerged; 150-800 eggs per oviposition
	3. eggs layed in flowing, well oxygenated waters
	4. larvae hatch 1-4 days; attach by a posterior disclike sucker ("anal sucker" or "posterior circlet") to a silken mat it produces and hangs downstream and filter feeds using fanlike projections around mouth
	5. 6-9 larval instars
	6. spins cocoon and transforms into pupa
	7. in a 2-6 days to several weeks, the adult emerges
	8. copulation in flight
10. some species are important pests of livestock and wildlife, and large numbers can kill their hosts
11. vectors of some *Onchocerca* spp. (i.e. *Onchocerca gutterosa* infecting bovids; *Onchocerca volvulus* infecting humans)
12. vectors of some *Leukocytozoon* spp. (i.e. *Leukocytozoon simondi* infecting anseriform birds is transmitted by *Simulium rugglesi*; *Leukocytozoon smithi* infecting turkeys is transmitted by several *Simulium* spp.)
13. representative genera include *Cnephia, Prosimulim, Simulium*
14. The primary pests are *Simulium meridionale*, *S. vittatum* (complex) and, to a lesser extent, *S. johannseni*.

**FAMILY: Culicidae (mosquitos)**

1. Over 3,500 described species
2. some host specific whereas others more generalists
3. slender wings with scales on the wings
4. elongate proboscis where labium encloses elongated mandibles, maxillae, hypopharynx, and labrum/epipharynx; inserted into dermis and used to imbibe blood; males feed on nectar and cannot suck blood
5. **antennae long, with 14-15 segments**
6. males have plumose antennae to detect pheromones; females have simple antennae
7. long slender legs
8. Presence of numerous appressed scales on thorax, legs, abdomen, and wing veins; fringe scales along posterior margin of wings
9. typical life-cycle
	1. mating occurs shortly after emergence from pupae
	2. females usually mate once, and store sperm in spermatheca
	3. females of most species require blood meal for maturation of eggs in ovary. Eggs develop over several-many hours
	4. female lays eggs (oviposition); may be laid in water in rafts, or individually or in small numbers in water or soil; depends upon species
	5. females may take 1-2 more blood meals, with egg maturation and oviposition after each feeding
	6. eggs hatch either soon or, in other species, following flooding or snow melt
	7. larvae are termed wigglers and occur in water
		1. some with a siphon (breathing tube at posterior end)
		2. well developed head
		3. compound eyes
		4. 4 larval instars; most filter feeders although some predators on other insects\
	8. pupate; pupae termed tumblers and periodically stick breathing tubes from thorax (trumpets) above water; tumble to bottom if detect disturbance
	9. after 2-3 days, adult emerges
	10. females typically live 1-2 weeks in tropical areas, and 3-4 weeks in temperate areas; males shorter lived
10. vectors of some important diseases
	1. *Plasmodium* spp. (malaria) transmitted by *Anopholes* spp.
	2. Some filarids transmitted by mosquitos
	3. Arboviruses like avian pox, yellow fever, dengue, various types of encephalitis
11. **Three subfamilies**
	1. **Subfamily: Toxorhynchitinae**
		1. One genus (*Toxorhynchites*) with about 75 spp. Although mainly tropical, a few species occur within North America
		2. Adults large, ca 2 cm long and colorful
		3. Proboscis curves backwards; incapable of piercing skin
		4. Larvae large and predatory; often dark reddish
	2. **Subfamily: Culicinae**
		1. Eggs usually elongate or ovoid; some have ends drawn out into terminal filament
		2. Larvae with siphon
		3. Larvae hang upside down at angle from water surface, with siphon touching water surface (except for two genera which insert siphon into aquatic plants for respiration
		4. Pupae with long, fairly cylindroid trumpets
		5. Adults rest with body parallel to substrate surface, and with proboscis not in line with rest of body
		6. Wing veins solid, brown or black in color
		7. Palps without pale rings
		8. Palps of females shorter than proboscis; palps of males about as long as proboscis
		9. Male palps not swollen anteriorly
		10. About 38 genera (depending upon the author) and 2,700 named spp.
		11. Genera :
			1. *Aedes* (ca 4 spp. in the U.S.)
			2. *Culex* (ca 29 spp. in the U.S.)
	3. **Subfamily: Anophelinae**
		1. Eggs typically laid singly on water surface; typically boat-shaped and with lateral floats
		2. Siphon absent; larvae lies parallel to water surface and feeds on surface
		3. Pupae with short, conical trumpets
		4. Adults of most species rest with bodies at angle to substrate, with proboscis and body in straight line
		5. Generally light and dark blots of scales on wing veins (i.e. spotted wings)
		6. Palps dark and often with pale rings
		7. Palps of both males and females about as long as proboscis
		8. Male palps expanded at ends
		9. Most species nocturnal, or feed in evening or early morning
		10. Molecular evidence suggests a South American origin to this subfamily, and that this group arose in the Mesozoic
		11. **Only three genera known**
			1. *Anopheles* with ca 440 spp. At least 22 spp.
			2. *Bironella* with ca 8 spp. (Australasian; does not occur in North America)
			3. *Chagasia* with ca 4 pp. (Neotropical; does not occur in North America)
* **Family Culicidae " Mosquitoes " vet. and med. Importance:**

The family has 3 genera of medically importance due to feed on human 's blood & transmit diseases agents such as Plasmodium causing "Malaria".

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| stage | Anopheles | Culex | Aedes |
| Egg | Single egg laying | Batch egg laying | Single egg laying |
| Larva | -Resting parallel to water surface.-Have spiracles for breathing. | -Inclined 45▫ on resting in water surface .-Have Siphon for breathing |  As in Culex |
| Adult  | -Inclined 45▫ on resting places | - standing parallel on resting places |  As in Culex |

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| Table: Difference between Culex and Anopheles |
| Culex | Anopheles |
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| Eggs |
| 1. Eggs are laid vertically in clusters.2. Rafts are formed.3. Egg cigar-shaped4. Egg without lateral air float.5. Usually 200-400 eggs in dirty water. |   | Egg are laid horizontally singly.Rafts are not formed.Egg boat-shaped.Egg with lateral air floats.usually 40-100 eggs are laid in fresh and clean water. |
| http://www.2classnotes.com/images/12/science/Zoology/Culex_Eggs.gif |   | http://www.2classnotes.com/images/12/science/Zoology/Anopheles_eggs.gif |
| Larva |
| 6. Bottom feeder.7. The head hangs downwards at an angle with the surface.8. Without paimate hairs.9. Long conical respiratory siphon. |   | Surface feeder.The head lies horizontally parallel to the surface of water.With palmate hairs on the abdomen.Respiratory siphon absent (= exceedingly short) |
| http://www.2classnotes.com/images/12/science/Zoology/Culex_Larva.gif |   | http://www.2classnotes.com/images/12/science/Zoology/Anopheles_Larva.gif |
| Pupa |
| 10. Pupa colorless11. Respiratory trumpet long.12. No palmate hairs. |   | Pupa green in colour.Respiratory trumpet short.With palmate hairs. |
| http://www.2classnotes.com/images/12/science/Zoology/Culex_Pupa.gif |   | http://www.2classnotes.com/images/12/science/Zoology/Anopheles%20_Pupa.gif |

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