Arthropoda

** Classification of Arthropoda , Phylum arthropoda include :-

1. Class 1: Insecta (Hexapoda)
2. Class 2: Archnida
3. Class 3: Crustacea
4. Class 4: Diplopoda
5. Class 5: Chilopoda

- About 75% of all arthropoda are Insects.
- In this class (Insecta) there are 29 Orders , only 4 are Veterinary important :- This ; Flies (Diptera) , Fleas (Siphonaptera) , Lice (Phthiraptera) and some of (Hemiptera).

** Class : **Archnida** : There are only one group in this class which major veterinary importance , the subclass Acari containing Mites and Ticks , Other major subclass of Archnida include Scorpoins and Spiders.

Family : Ixodidae (hard ticks)

The Ixodidae is a family of ticks containing hard ticks , there are distinguish from the other main family of ticks,(the soft ticks Argasidae) by the response of ascutum or hard shield , in both the nymph and adult. They are obligate , blood – feeding ectoparasites of Vertebrates , Particulary Mammals and Birds.

Classification :- Ticks are archinds ,in the subclass Acari closely related to the mite , Order Ixodida , Family Ixodidae , this family contain 702 species in the 14 genera , some are of considerable economic importance as vector of diseases caused by bacteria such as *Rickettsia* and *Berrelia*.

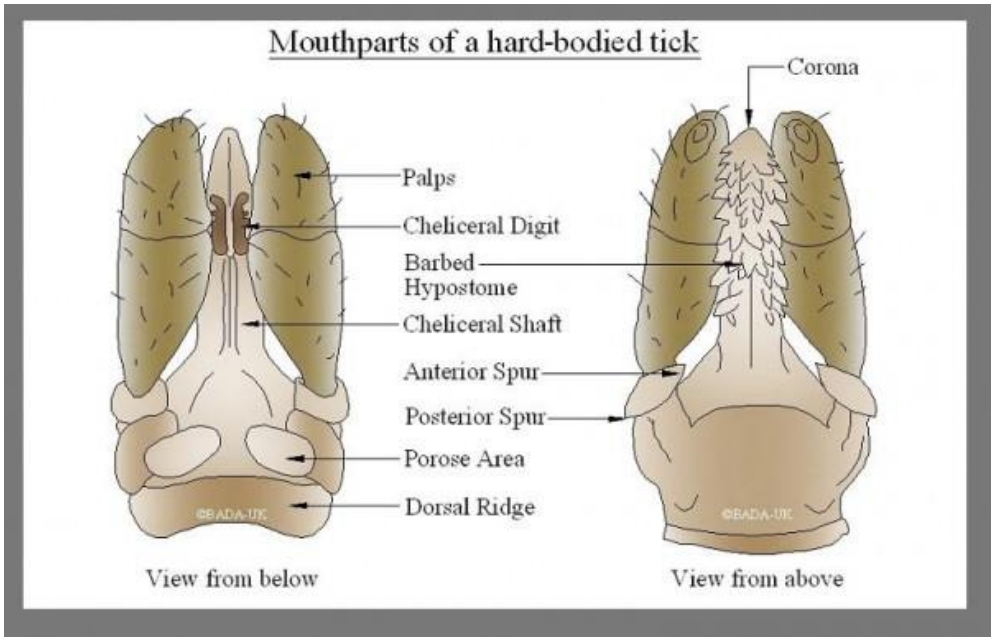
Morphology :- Ixodid Ticks are relatively large ranging between 2 to 20 mm. in length , flattened body divided in to only two sections, the anterior genathosoma (or Capitulum) and posterior idiosoma , which bears the

legs. The terminal gnathosoma is always visible when an ixodid ticks is viewed from above. The gnathosoma carrier a pair of four- segmented palps , which are simple sensory organs , its help the ticks to locate its host , the fourth segment of each palp is reduced and forming a pincer – like structure.

Mouth part of Ticks

- Four – segment palps.
- Cheli cerea sheeth.
- Basis capituli.
- Hypostome.

The region of the idiosoma which carriers legs is called podosoma and the region behind legs is opisthosoma. Male ixodid ticks are usually smaller then Female. Ixodid ticks posses asclerotised dorsal shield or plate on the idiosoma known as a Scutum , the scutum covers the entire dorsal surface , whereas Facilitate the size increase which occur during feeding.



Life history :- the life cycle of ixodid ticks involve four instars :- egg , six – legged larva , eight – legged nymph and eight legged adult. During the passage through these stages ticks take a number of large blood meals, the time spent on the host may occupy as little as 10% of the life of ticks, each female may produce several thousand eggs. An example : the Rocky Mountain wood tick *Dermacentor andersoni.*

Pathology :- ticks are primarily parasites of wild animals and only about 10% of species feed on domestic animals (sheep and cattle). The effect of ticks on host species can be divided in to :-

1. Cutaneous effects
    - Inflammation.
    - Infection.
2. Systematic effects
    - Transmission of micro-organisms from another host.
    - Paralysis of host.
    - Bacteriaemia resulting from introduction of micro-organisms.

Cutaneous effects :- at the site of tick bite focal dermal necrosis and hemorrhage occur , followed by an inflammatory response , often involving eosinophils. Tick bite wounds can become infected with *staphylococcus bacteria* , causing local cautaneous abscesses or pyaemia. Heavy tick infestation can result in significant blood less ,reduced productivity, reduced weight and cause restlessness. Ticks – bite lesion may also predispose animals to myiasis.

** Argassidae :- are family of ticks containing the soft ticks ,they lack the hard scutum present in hard ticks (Ixodidae).

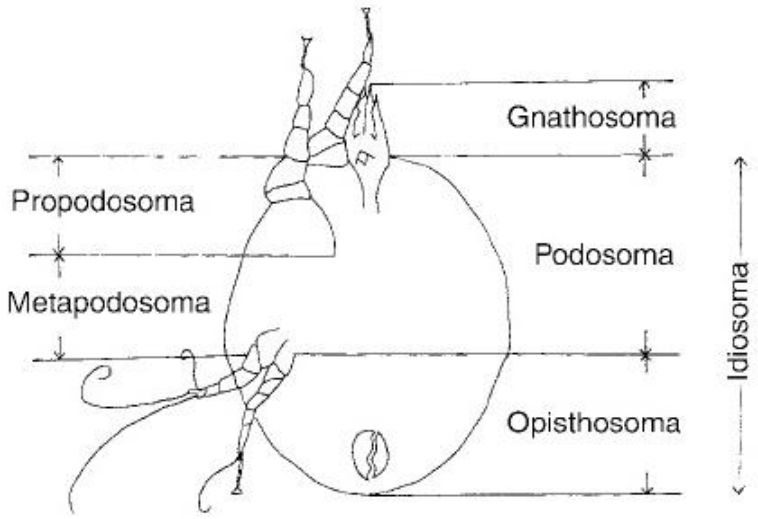
Family : Sarcoptidae (Mites)

The Sarcoptidae is a family of mites , members of family Sarcoptidae are parasitic throughout their lives. Mites, along with ticks, are

small arthropods , usually less than 1 mm. in length , belonging to the subclass Acari (also known as Acarina) and the class Arachnida. In soil ecosystems, mites are favored by high organic matter content and by moist conditions.

Diversity and Ecology : Mites are among the most diverse and successful of all the invertebrate groups. They have exploited an incredible array of habitats, and because of their small size (most are microscopic), go largely unnoticed. Many live freely in the soil or water, but there are also a large number of species that live as parasites on plants, animals, and some that feed on mold. It is estimated that 48,200 species of mites have been described.

Morphology : the body of mites shows no segmentation although it can have various sutures and grooves. The typical mite body can be divided into two sections, the anterior gnathosoma (or capitulum) and a posterior idiosoma . The gnathosoma is composed of the mouthparts .The brain and all other organs are in the idiosoma.



Divisions of the body of a generalized mite

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Life history :- Female mites produce relatively large eggs (oviparous) ,(a few species are ovoviviparous) ,from which small ,six- legged larva hatches ,the larva moults to become an eight-legged nymph .There may be between one or three nymphal instars ,the last one of these nymphal instars then moults to become an eight –legged adult , the life cycle may be completed in less than 4 weeks and in some species may be as short as 8 days, this mites are capable of living in wide range of habitats .

Pathology :- Mange is a class of skin diseases caused by parasitic mites. Since mites also infect plants, birds, and reptiles, and domestic animals (cats and dogs), in livestock (such as sheep scab), and in wild animals.

Mites infestation can result in :

- Direct epidermal damage leading to inflammation ; this results in skin erythema , pruritus, scale formation , lichenfication (thikenin) and crust (inflammatory exudate)formation .
- The production of cutaneous hypersensitivity (especially type I hypersensitivity).
- Loss of blood or other tissue fluids.
- Mechanical or biological transmission of pathogens.

Order : Diptera

Diptera : are the true flies , is one of the largest orders in the class insecta , with over than 120,000 described species . the larvae (maggots) are completely different is structure and behavior to the winged adults , as larvae or adults , but they are rarely parasites in both life- cycle stage.

Adult flies of veterinary importance may feed on blood ,sweat , skin secretions, tears , saliva, urine or feces of the domestic animals to which they are attracted . They may do this either by puncturing the skin directly , in which case they are known as biting flies , or by scavenging at the

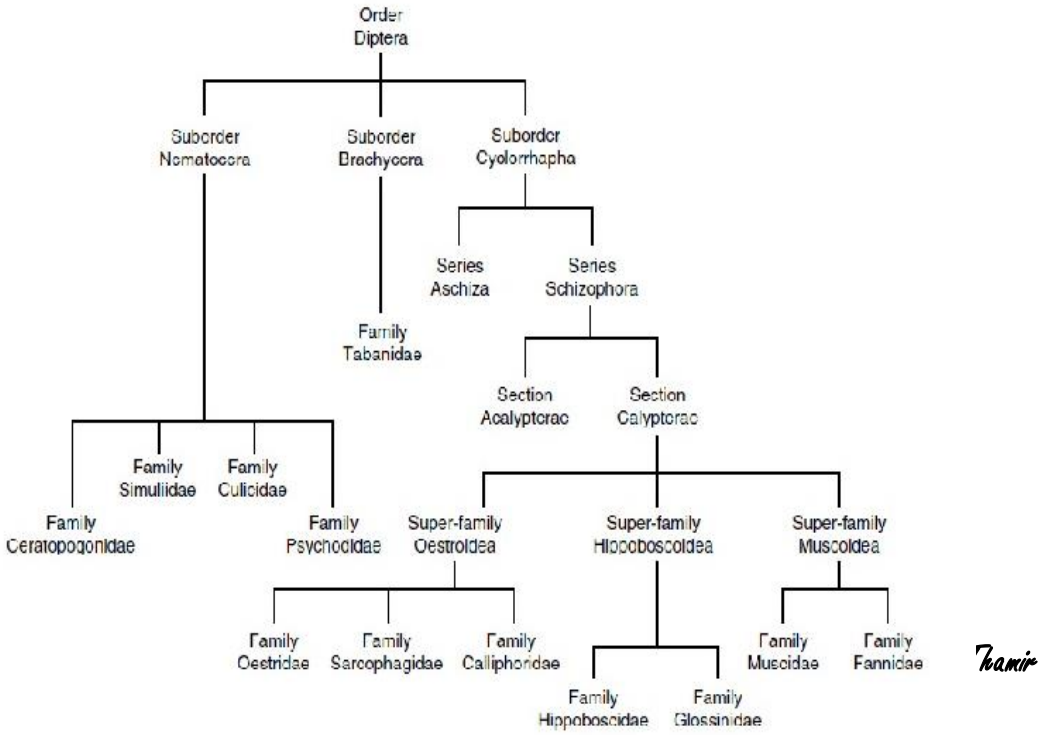
surface of the skin , wounds or body orifices, in which case they may be classified as Non biting flies.

What is Diptera :-

The insects grouped in to the order are two winged (di=two ; ptera = wings). The wing could be used as a classify factor, all these insect are characterized by having only one pair of wings ; the hind pair has degenerated , therefore , all that remains is a pair of drumstick- like organs, called Halters used for balance in flight.

Classification of Diptera :-

Historically dipteral was divided into three suborders :- Nematocera , Brachycera, and Cyclorrhapha. However, Major recent work combine the last two and make Cyclorrhapha an infra order Muscomorpha. Taxonomic Characters must used in Diptera are differences in mouth parts , head sutures ocielli , antennae , wings venations , tarsi, and placement of bristles (Chaetotaxy). Male genitalia offer useful taxonomic characters of the genus and species levels.



The Diptera Veterinary Importance

Diptera and Human :-

Dipterans are important to humans for a variety reasons , many flies are pests , in addition , many serve as either mechanical or biological vectors of infections agents . Tse tse fly transmits the agent causing African sleeping sickness; mosquito transmits malaria, lymphatic filariasis ,and hundreds of viruses ; biting midges transmit filarioid nematodes and viruses such as blue tongue virus ; tabanids transmit tularemia . Many flies are parasitic as larvae ; they can be serious medical and economic problems like species of Calliphoridae.

Dipterans Food :-

Dipterans are only able to take fluid food , which in the case of bloodsucking flies is obtained by injecting the piercing mouthparts (proboscis) into living tissue . In other flies , food is liquidized externally by budding it with spongy mouth parts.

Dipterans Life Cycle :-

All Diptera go through a complete metamorphosis in their life cycle , developing from the egg through a number of larval stages to the pupa from which the adult emerges . The larva which is feeding and growing stage is

typically found in a completely different environment from adult, although the adult will be associated the larval environment when mating and laying eggs.

Control of Diptera :-

Sanitation is the most effective and important step in controlling Diptera . Dry and wrap organic waste before placing it in garbage can, seal garbage cans with tight fitting lids . Windows and doors to keep pests out .Use indoor fly traps or sticky traps to control it inside the house. Filling swamps or covered with oil ,and use the chemical pesticides when

Necessary .finally the biological control is more safe method of control for human health.

Sub order : Nematocera

Antennae of species in this group have many segments and are filamentous . They may be plumose especially in males ,but it is longer than the head .the wing have many veins ,larvae are active ,with a well – developed head capsule and pupae often are free swimming .most larval and pupal stages are aquatic .

Familly Culicidae :

Kingdom :Animilia

Phylum :Arthropoda

Class :Insecta

Order :Diptera

Suborder :Nematocera

Family :culicidae

Genus *:Culex ,Ades*

Mosquitos : are the most important insect as a vector of human disease , and the most common blood sucking arthropods .they feed on amphibians ,reptiles ,birds ,mammals .More than million people die every year from malaria . Approximately 3500 species have been described ,at least 150 of these in north America .Mosquitoes having slender thin body ,long legs ,long needle shaped mouthparts specialized to piercing sucking , hypopharynx is more important part because it is pumping blood in the food channel .Mosquito undergo complete metamorphosis, with egg, larval , pupa and adult stages , larval and pupa stages can develop only in water.

Subfamily Culicinae :-

This subfamily has more than 30 genera and about 3000 species , most of which are in genera ***Culex*** and ***Aedes.***

Genus *Culex* :-

Females have rounded tips on their abdomens and their palps are less than half as long as the proboscis . They have on thoracic spiracles or post spiracles bristles. Larvae have along slender, air tube bearing many hair.

Culex pipiens :- the house mosquito is nearly worldwide in distribution . It is a plain ,brown insect that breeds freely around human habitation , laying egg rafts in tin cans ,tires ,cisterns ,clogged , rain gutters and any other receptacle of water. It is enter houses readily and is a night feeder, causing consternation in many bedrooms. Members of this genus are important not only for their annoyance factor but also because they are major Urban vectors of SLE (Systematic Lupus Erythematosus) and virus and the filarial worms ***Wuchereria bancrofti*** and ***Dirofilaria immitis*** also transmits bird malaria and avian pox.

Genus *Aedes* :-

The posterior end of female abdomen is rather pointed and post spiracles bristles are present on the thorax. Larvae have siphon bearing only one pair of post roventral hair tufts . Most species are diurnal activities, they lay their eggs singly on water , mud or soil in places likely to be flooded.

Many species of *Aedes aegypti* is a mosquito that can spread the dengue fever (Yellow Fever) , only female bites for blood which it needs to mature their eggs, to fined a host , *Aedes aegypti* are attached to chemical compounds that are ammonia ,carbon dioxide ,lactic acid and actenol. Also Dengue or (Break Bone Fever) , other disease transmitted by *A.aegypti* , it is tropical disease caused by Dengue Virus , symptoms include fear. Headache , Muscle and Joint pains.

Subfamily : Anophelinae

Adult anophelines have ascutellum that is rounded or straight, but never tri-lobed in dorsal view. Abdominal largely , lack scales. Palpi of both sex are almost as proboscis. Larvae lack an air tube , and their dorsal surface bears branching hairs.

Genus : *Anopheles*

Female Anopheles spp. Lay up to a thousand eggs depositing them singly on water . The eggs have useful taxonomic characters , such as presence or absence the lateral floats ,,eggs must remain in contact with water to survival. Usually they hatch within two or six days and develop to four larval instars in about two weeks followed by three –days pupal stages . Development from egg to adult take from three weeks to one month. Development of mosquitoes ,like that of virtually all insects ,however, is temperature dependent.

Anopheles is a genus about 484 recognized species , over 100 can transmit Human Malaria , but 30 – 40 commonly transmit parasites of the genus Plasmodium that cause Malaria, Anopheles gambianae is one of best

known , because of its predominant role in the transmission of the deadly species Plasmodium falciparum.

Family : Psychodidae

Subfamily : Phlebatominae (sand flies)

Phylum : Arthropoda

Class : Insecta

Order : Diptera

Suborder : Nematocera

Family : Psychodidae

Subfamily : Phlebatominae (sand flies)

Genus : *Phebotomus*

The large family Psychodidae contains over 600 species widely distributed in the tropics , subtropics and around the Mediterranean. In the subfamily Psychodidae, the true sand flies there is a single genus of veterinary important in the old world , *Phlebotomus* this genus may act as vector of *Leishmania*.

Morphology : sand flies are narrow bodies up to 5mm. in length , they are hairy in appearance with large black eyes and long legs , the wings are narrow, long , hairy . The antennae are long 16 segments ,filamentous and covered in fine setae , there is no sexual dimorphism in the antennae. The mouth parts are moderately long and the palps are five segments.

Life Cycle : females lay 50 to 100 eggs per egg batch in small cracks or holes in damp ground , in leaf litter and round the roots of forest trees . The gray , segmented Larvae pass through four stadia before pupa ration , the larvae feed on organic debris , such as feces and decaying plant material ,

the larvae and pupa are very sensitive to desiccation . Only Female have functional mouth parts and are blood feeders. The rate of life cycle development is usually slow taking at least 7 to 10 weeks , and having only two generations per year.

Pathology : Sand flies are good and important vector of disease , They transmit Leishmaniases , Bartonellosis, Sand fly fever.

- Leishmaniases : affect over 12 million people distributed in 88 countries , every year , new cases amount to more than 2 million . The intermediate host and vector of Leishmaniases are sand flies , when these flies such the blood of an infected animal they ingest amastigotes, The parasites pass to the midgut or hindgut then replicate by binary fission , by fourth or fifth day after feeding , promastigotes move forward to the esophagus and pharynx, attaching to the lining and forming plaques , by the eighth day, the flagellates begin metamorphosing into slender , active , metacyclic promastigotes which are injected with the next blood meal.
- Bartonellosis : the bacterium *Bartonella bacilliforms* cases a disease known as carrion's disease , or oroya fever , it is found in northwestern of south America , transmission by contamination of mouth parts of fly.
- Sand fly fever : Also known as papatasi fever and three-day fever it occur in Mediterranean region , center Asia , Southern China and India . Sand fly fever is a nonfatal , Febrile , Viral disease.

Types of *Leishmania* : There are three type of ***Leishmania*** caused disease :-

1. *Leishmania tropica* or cutaneous Leishmaniasis also the common name is Baghdad sore or oriental sore .

2. *Leishmania donovani* or visceral Leishmanisis also the common name is Kala Azar .
3. *Leishmania braziliensis* or mucocotanous Leishmanisis also the common name is Uta.

Control :- the control of sand fly is problematic because their Larvae develop in largely unknown terrestrial habitats making them impervious to available control measures , so we used insecticides like DDT in several countries.

Family : Oesteidae

Subfamily 1) Oestrinae

2) Gasterophilinae

3) Hypodermatinae

The family Oestridae contain flies commonly known as bots and warbles , all are obligate parasite and most show a high degree of host

specificity, all larvae are develop exclusively in the nasopharyngel cavities or skin boils (warbles) of mammals , the adult have primitive , usually non functional mouthparts and are short lived.

Morphology :- Mature larvae in the nasal passage are white , becoming slightly yellow or brown as they mature , the ventral surface of each segment bears arrow of small spines. Adult are grey flies , about 10 – 12 mm. in length with small black spots on the abdomen and a covering of short brown hairs .

Life Cycle :- Female are viviparous , depositing up to 25 live first – stage larvae at a time , in or on the nostrils of the host , during flight , the adults are active during hot, dry weather. The first – stages larvae are about (1) mm. long and crawl up the nasal cavity and attach to the mucus membranes. Here they feed on mucus and desquamated call, when mature at up to 20 mm. in length , the third – stage larvae re-enter the nasal cavities where they sneezed out . One reaching the ground the larvae puparat. Development can takes as little as 25 to 35 day and , its produced up to three generation per year.

Pathology :- as they deposit larvae , the activity of adult *Ostrus ovis* may annoy sheep , leading to a loss of grazing time , reduced weight gain in lambs. However, In general , infestation are relatively light with only an average between 2 and 20 larvae present in the frontal sinus of infested animals at any one time.

Clinical symptoms , nasal discharge , sneezing , nose rubbing or head shaking . Dead larvae in the sinuses can cause allergic and inflammatory responses, followed by bacterial infection and sometime death. Larvae may occasionally penetrate the olfactory mucosa and enter the brain , causing ataxia , circling and head pressing.

Family : Calliphoridae

Phylum :Arthropoda

Class :Insecta

Order : Diptera

Suborder : Cyclorrhapha

Fammily :Calliphoridae

Genus *: Calliphora , Chrysomya*

Calliphoridae : are medium to large flies , almost all of which have a metallic –blue or green color . There are over 1000 species divided between 150 genera . The majority of species in this family are saprophages ,living in decaying organic material .Most of the calliphorid agents of myiasis ,have similar life cycle ,all are oviparous ,eggs are laid in wounded infected vertebrate hosts .the larvae pass through three instars while feeding on host tissues , causing coetaneous myiasis .

Myiasis : Is the infection of organs or tissues of host animals by the larval stages of dipterous flies usually known as maggots .The fly larvae feed directly on hosts necrotic or living tissue , the hosts are usually mammals .Myiasis may be described as obligatory ,facultative or accidental ,obligatory ectoparasites must have a living host to complete their development and are unable to survive in the absence of host , facultative parasites can develop in both living and dead organic matter ,the final group of species to be described causes accidental myiasis ,that are accurse when fly eggs reached to elementary canal of human incidentally .

Suborder :- Brachycera

There is only single family of Brachycera of major veterinary , the Tabanidae , often Known as hors flies , or dear flies .

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Tabanidae :- all Tabanidae are large robust flies , up to 25mm. long , with large ,broad heads and bulging eyes , the body is generally dark in color (from dull brown to black or gray)

The mouth parts of Brachera combine the sponging mouthparts of Cyclorrhapha with the blood – sucking mouthparts of Nematoceran.

The mature larvae of tabanids are grayish- white and cylindrical, segmented . The pupae are usually brown and cylindrical.

Life Cycle :- in general , the larvae of tabanidae are found in wet mud at the side of rivers or lakes . Eggs are laid in large masses, containing from 100 up to 1000 eggs , on steams of aquatic plants . Four to seven days later they hatched by using a special spine to exit , Tabanidae larvae are aquatic , semi-aquatic or terrestrial , most larvae require several months to several years to complete development but in typical condition they require several weeks (2-4). In most species , male complete there puparation before Female , Adult are strong fliers and usually diurnal.

Pathology :- Tabanidae feed primarily on large mammals and occasionally birds , the flies stay on animals only long enough to feed , congregation around the abdomen , legs and neck on livestock. The bits of these flies are deep and painful and may case considerable disturbance , and sucking the blood , these leading to reduced weight and lower milk yields. Tabanidae may also be important mechanical vectors of anthrax, pasteurellosis , equine infections anemia , hog cholera, tularaemia , trypanosomiasis and anaplasmosis.

Phylum : Arthropoda

Class: Insecta

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Subclass: Pterygota

Order : 1) Phthiraptera 2) Mallophaga 3) Anoplura

Family: 1) Pesiculidae 2) Phthiriidae

Genus :- *Pediculus humanus*

Louse :- (Plural : Lice) is the common name of members of over 3000 species of wingless insects of the order Phthiraptera , they are obligate ectoparasite of mammalian and avian.

Biology :- most lice are scavengers, feeding on skin and other debris found on host's body , but some species feed on sebaceous secretions and blood. A louse color various from beige to dark gray , however , if feeding on blood it may become considerably darker . Female lice are usually more common than male . A louse's egg is commonly called nit, many lice attach their eggs to their host's hair with specialized saliva .

Morphology :- the sucking lice (Anoplura) are usually small insects , adults are about 2 mm. long on average , its small head in relation to body size , the antennae have five segments , the eyes are reduced or absent, the anoplura have highly modified mouthparts , quite different to those of other insects , which are highly adapted for piercing the skin of their hosts , the mouth parts are usually retracted into the head when not in use.

The thoracic segments of Anoplura are fused together and are difficult to distinguish , the abdomen has nine visible segments , it have what appear to be crab-like claws on each leg . these are composed of a single claw projecting from the tarsus. This closes on to a projection from the tibia called tibial spur. This structure enables the lice to cling to hairs :-

Life History :-

The nymph which closely a smaller version of the adult , hatches from the egg within 1 to 2 weeks of oviposion . Over the caurs of between 1 and 3 weeks the nymph feed and moult through three to five stages. Mature female lice generally deposit one to two eggs per day when sexually mature, adults probably live for up to month, during that , they lay about 50 -100 eggs on the host.

Pathology :-

Heavy louse infestation is known as pediculosis. In medical entomology , lice are most well known as vector of important human diseases such as typhus and louse borne relapsing fever. The effect of lice is usually a function of their density , however, louse population can increase dramatically , reaching high densities .For Example, the number of the louse *Bovicola ovis* on sheep has been recorded as increasing from about 4000 in autumn to more than 400000 in spring , Transfer of lice from animal or from human to human is usually by direct physical contact.

Phylum : Arthropoda

Class : Insecta

Subclass : pterygota

Order : Siphonaptera ⟹ Fleas

The fleas (order : siphonaptera) are small , wingless, obligate , blood feeding insects, with mouth parts adapted for piercing skin and sucking blood. Over 95% of fleas species are ectoparasites of mammals ,while the other are ectoparasites of birds.

Adult fleas usually live in temporary association with their host ; many species of flea are able to parasite a range of hosts ,this combined with their mobility , which move easily between hosts , makes them parasites of great medical and veterinary importance and makes them difficult to control. Fleas feed daily or every other day , Female require significantly more blood than males , Blood feeding may have a range of damaging effects on the host animal causing inflammation , pruritus or anemia, fleas may also act as vectors of bacteria , protozoa , viruses and tap worms. In veterinary entomology fleas are probably of most importance as a cause of cautaneous hypersensitivity reaction.

Morphology :- the adult are highly modified for an ectoparasitic life and are structurally very different from most other insects. Adults are wingless , usually 1-6 mm. in length , Females being larger than males , the body color may vary from light to brown to black. The body is armed with spines, which are directed backward , the function of it is a question of some debate , they may serve simply to product the articular membranes at joints between tergites. With all insects , the body is divided in to head , thorax and abdomen, the head is high narrow and cuneate , the shape of it is highly variable and may be useful in species identification , its also vary between the sexes and individual of a species. Eyes are absent in some species , if present however , are usually simple and found on the head in

front of the antennae. Thorax is composed of three thoracic segments are (Pronotum, Mesonotum, and Metanotum), the posterior pair of legs of most species of flea is highly adapted to jumping , the flea abdomen is clearly divided in to segment , there are ten segments, eight of them visible and bears a pair of spiracles the shape of abdomen may used to distinguish the sex.

Life History :-

Fleas are holometabolous and go though four stages :- Egg, Larvae , Pupa and Adult . under ideal condition the entire cycle may take only 18 days to complete , although it can range from 6 to 12 months.

Under ideal condition , a Female flea can produce up to several hundred eggs in its life time , the eggs are usually large and may supply many of vitamins and sterols required for subsequent larval development eggs may be laid on the ground or on the host itself, generally hatch within a few days of oviposition may after 2-6 days.

The fleas embryo is equipped with a sharp spine on the head to help it to burst through the egg shell , flea's larvae are active and feed on proteinaceous organic debris, such as hair , feathers or adult fleas faeces , fleas larvae usually live in the host or bedding , they moult twice untile , when fully grown the third stage larva spins a thin cocoon of silk , after a number of days the cocooned larvae transforms into a pupa the duration of pupal stage is highly dependent on temperature. After emergence from the pupal cubical , both male and female are obligate blood feeders , female require a blood meal before they can being to mature their eggs.