

## CHAPTER 29. Study of insect orders: Coleoptera

### 24. Order: Coleoptera

Synonym : Elytroptera

Etymology : Coleo - Sheath ; ptera-wing

Common names : Beetles, Weevils

**Characters:** They are minute to large sized insects. Antenna is usually 11 segmented. Mouthparts are chewing type. Mandibles are short with blunt teeth at the mesal face in phytophagous group. In predators the mandibles are long, sharply pointed with blade like inner ridge. In pollen feeders teeth are absent and the mandibles are covered with stiff hairs. Prothorax is large, distinct and mobile. Mesothorax and metathorax are fused with the first abdominal segment.

Forewings are heavily sclerotised, veinless and hardened. They are called elytra. Forewings do not overlap and meet mid-dorsally to form a mid-dorsal line. It is not used for flight. They serve as a pair of convex shields to cover the hind wings and delicate tergites of abdomen. Hind wings are membranous with few veins and are useful in flight. At rest they are folded transversely and kept beneath the elytra. In some weevils and ground beetles the forewings are fused and hind wings are atrophied. A small part of the mesothorax known as scutellum remains exposed as a little triangle between the bases of elytra. Cerci and a distinct ovipositor are absent. Metamorphosis is complete. Larvae are often called grubs. Pupae are usually exarate and rarely found in cocoons.

#### **Importance:**

It is the largest order. It includes predators, scavengers and many crop pests. They also damage stored products.

#### **Classification:**

This order is divided into two suborders, viz., **Adephaga** (devourers) and **Polyphaga** (eaters of many things). Adephaga includes Cicindelidae, Carabidae and Dytiscidae. Other families listed out below come under Polyphaga.

Families of predators

#### **1. Cicindelidae:** (Tiger beetles)

- 2. Carabidae:** (Ground beetles)
- 3. Dytiscidae:** (True water beetles, Predaceous diving beetles)
- 4. Gyrinidae:** (Whirligig beetles)
- 5. Coccinellidae:** (Lady bird beetles)
- 6. Lampyridae:** (Fireflies, Glow worms)

#### **Families of scavengers**

- 1. Scarabaeidae:** (Scarabs, Dung beetles)
- 2. Hydrophilidae:** (Water scavenger beetles)

#### **Families of stored product pests**

- 1. Anobiidae:** (Wood worms, Wood borers)
- 2. Bostrychidae:** (Grain borers)
- 3. Bruchidae:** (Pulse beetles, Seed beetles)
- 4. Tenebrionidae:** (Meal worms)

#### **Families of crop pests**

- 1. Apionidae:** (Ant like weevils)
- 2. Buprestidae:** (Jewel beetles, Metallic wood borers)
- 3. Cassididae:** (Tortoise beetles)
- 4. Cerambycidae:** (Longicorn beetles)
- 5. Curculionidae:** (Weevils, snout beetles)
- 6. Dynastidae:** (Unicorn beetles, Rhinoceros beetles)
- 7. Elateridae:** (Click beetles, Wire worms)
- 8. Galerucidae:** (Pumpkin beetles)
- 9. Meloidae:** (Blister beetles, Oil beetles)
- 10. Melolonthidae:** (Chafer beetles, June beetles, White grubs)

## CHAPTER 30. Study of insect orders: Neuroptera, Hymenoptera, Trichoptera

### 25. Order: Neuroptera

Etymology : Neuro-nerve; ptera - wings.

Common names : Lace wings, Ant lions, Mantispidflies, Owlflies.

**Characters:** They are soft bodied insects. Antenna is filiform, with or without a terminal club. Mouthparts are chewing type in adults. Wings are equal, membranous with many cross veins. They are held in a roof-like manner over the abdomen. They are weak fliers. Larva is campodeiform with mandibulosuctorial mouthparts. Pupa is exarate. Pupation takes place in a silken cocoon. Six out of eight Malpighian tubules are modified as silk glands. They spin the cocoons through anal spinnerets.

**Classification:** This order is subdivided into two suborders viz., Megaloptera and Planipennia.

#### Sub order : Planipennia:

1. **Chrysopidae:** (Green lacewings, Goldeneyes, Stinkflies, Aphid lions)
2. **Mantispidae:** (Mantispidflies).
3. **Myrmeleontidae:** (Ant lions)
4. **Ascalaphidae:** (Owlflies)

### 26. Order: Hymenoptera

Etymology : Hymen - membrane; ptera - wings.

Hymeno - god of marriage; ptera - wings,

(Marriage / union of fore and hind wings by hamuli)

Common names : Ichneumonflies, Ants, Bees, Wasps, Parasitoids.

**Characters :** Mouthparts are primarily adapted for chewing. Mandibles are very well developed. In bees both labium and maxillae are integrated to form the **lapping tongue**. Thorax is modified for efficient flight. Pronotum is collar like. Mesothorax is enlarged. Metathorax is small. Both prothorax and metathorax are fused with mesothorax. Wings are stiff and membranous. Forewings are larger than hindwings. Wing venation is reduced. Both forewings and hindwings are coupled by a row of hooklets (**hamuli**) present on the leading edge of the hindwing.

Abdomen is basally constricted. The first abdominal segment is called **propodeum**. It is fused with metathorax. The first pair of abdominal spiracles is located in the propodeum. The second segment is known as **pedicel** which connects the thorax and abdomen. Abdomen beyond the pedicel is called **gaster** or **metasoma**. Ovipositor is always present in females. It is variously modified for oviposition or stinging or sawing or piercing plant tissue.

Metamorphosis is complete. Often the grub is apodous and eucephalous. Larva is rarely eruciform. Pupa is exarate and frequently enclosed in a silken cocoon secreted from labial glands. Sex is determined by the fertilization of the eggs. Fertilized eggs develop into females and males are produced from unfertilized eggs. Males are haploid and females diploid.

**Classification:** This order is subdivided into two suborders.

### **Symphyta Apocrita**

1. Abdomen is broadly joined to the thorax. Abdomen is petiolated.
2. Larva is a caterpillar and Larva is a grub and it belongs  
belongs to eruciform type to apodous eucephalous type
3. Stemmata are present Stemmata are absent.
4. Both thoracic and abdominal Legs are absent
5. Ovipositor is saw like and Ovipositor is not saw like and suited for piercing the plant is  
suited for piercing in para-tissue sitic groups or for stinging in other groups.
6. Behavioural sophistication is Behavioural sophistication is less more.
7. They are phytophagous They are generally parasitic

### **Suborder : Symphyta**

#### **1. Tenthredinidae : (Sawflies)**

### **II. Suborder: Apocrita**

#### **1. Ichneumonidae: (Ichneumonflies)**

#### **2. Braconidae : (Braconid wasps)**

#### **4. Bethylidae: (Bethylid wasps)**

#### **5. Chalcididae: (Chalcid wasps)**

#### **6. Eulophidae: (Pupal parasitoids)**

#### **7. Trichogrammatidae: (Egg parasitoids)**

#### **8. Evaniidae: (Ensign wasps)**

#### **9. Agaonidae: (Fig wasps)**

#### **10. Vespidae: (Yellow jackets, Hornets)**

#### **11. Sphecidae: ( Thread waisted wasp, Digger wasp, Mud dauber)**

#### **12. Formicidae: (Ants)**

#### **13. Apidae : (Honey bees)**

#### **14) Megachilidae: (Leaf cutter bees)**

#### **15. Xylocopidae: (Carpenter bees)**

**27. Order: Trichoptera (Caddisflies)**

- a) Slender, elongate moth like insects
- b) Antennae long and thread like usually as long as longer than the body
- c) Two pairs of wings held roof like at repose
- d) Mandibles vestigial or absent
- e) Legs long, slender, tarsi segmented
- f) Larvae eruciform, aquatic – respire through tracheal gills, live in cases made of leaves, shoot, sand grains, debris and silken web. Pupae exarate.

e.g. *Rhacophila naviculata*

## CHAPTER 31. Study of insect orders: Lepidoptera, Siphonoptera

### 28. Order: Lepidoptera

Synonym : Glossata

Etymology : Lepido - scale; ptera - wings.

Common names : Moths, Butterflies, Skippers

**Characters:** Body, wings, appendages, are densely clothed with overlapping scales, which give colour, rigidity and strength. They insulate the body and smoothen air flow over the body. Mouthparts in adults are of **siphoning** type. Mandibles are absent. The galeae of maxillae are greatly elongated and are held together by interlocking hooks and spines. The suctorial proboscis is coiled up like a watch spring and kept beneath the head when not in use.

Wings are membranous and are covered with overlapping pigmented scales. Forewings are larger than hind wings. Cross veins are few. Wings are coupled by either **frenate** or **amplexiform** type of wing coupling.

Larvae are **polypod-eruciform** type. Mouthparts are adapted for chewing with strong mandibles. A group of lateral ocelli is found on either side of the head. The antenna is short and three segmented. There are three pairs of five segmented thoracic legs ending in claws. Two to five pairs of fleshy unsegmented **prolegs** are found in the abdomen. At the bottom of the proleg, **crochets** are present. Pupa is generally **obtect**. It is either naked or enclosed in a cocoon made out of soil, frass, silk or larval hairs.

**Classification:** Majority of Lepidopteran insects (97%) are grouped under the suborder **Ditrysia** in which the female insects have two pores. The copulatory pore is located in eighth abdominal sternite and the egg pore in ninth abdominal sternite. Remaining insects are grouped under the suborder **Monotrysia** in which the female insects have one pore.

#### Butterfly families

1. **Nymphalidae:** (Brush footed or four footed butterflies)
2. **Lycaenidae:** (Blues, Coppers, Hair streaks)
3. **Papilionidae:** (Swallow tails)
4. **Pieridae:** (whites and Sulphurs)
5. **Satyridae:** (Browns, Meadow - browns)

#### MOTH FAMILIES

6. **Arctiida :** (Tiger moths)
7. **Bombycidae:** (Silk worm moths)
8. **Cochlididae:** (Slug caterpillar)
- 9) **Crambidae :** (Grass moths)
10. **Gelechiidae:** (Paddymoth)
- 11) **Geometridae:** (Loopers)

**12. Lymantridae:** (Tussock moths)

**13. Noctuidae:** (Noctua moths)

**15. Pyraustidae:** (Grass borers)

**16. Saturniidae:** (Moon months, giant silk worm moths)

**17. Sphingidae :** (Hawk moths, Sphinx moths, Horn worms)

**Skipper family**

**18. Hesperidae** (Skipper)

**29. Order: Siphonoptera (Fleas)**

Fleas are small, wingless, holometabolous insects. With rare exception, the adults depend for nourishment on the blood of warm-blooded vertebrates. However, the larvae are relatively free-living and feed on organic material in the larval habitat. The bodies of adult fleas tend to be laterally compressed and usually have caudally directed setae and spines that expedite forward progress through the vestiture of the host while resisting the backward movements frequently associated with the grooming activities of the host. Adults have shiny, hairy bodies and range from light, yellowish brown to almost black.

#### **Identification characteristics**

- a) Small, wingless, laterally flattened insects with backwardly directed spine like setae
- b) Mouth parts adopted for piercing and sucking, laciniae of maxillae forming the suctorial apparatus
- c) Legs long with coxae greatly enlarged, have tremendous capacity to jump
- d) Antennae short, lie in grooves in the head
- e) Both sexes suck blood from mammals and birds, some are vectors of deadly pathogens

e.g. *Pulex irritans* – Human flea; *Xenopsylla cheopsi* – Rat flea

## CHAPTER 32. Mecoptera, Strepsiptera, Diptera

### 30. Order: Mecoptera (Scorpionflies)

Scorpionflies and hangingflies are medium-sized (about 9-25 mm long), slender-bodied insects with the head prolonged below the eyes as a beak, or rostrum. The rostrum is formed primarily by elongation of the clypeus. Its posterior surface consists partly of the lengthened maxillae and labium, but the mandibles are not unusually elongate and are at the lower end of the rostrum. Most Mecoptera have four long, narrow membranous wings. The front and hind wings are similar in size and shape and have similar venation.

#### Identification characteristics

- a) Slender, moderate sized, carnivorous insects, usually with two pairs of subequal wings
- b) Head produced into a vertically deflected rostrum with biting mouthparts
- c) Abdominal tergum 1 fused with the thorax
- d) Male genitalia held like a scorpion sting at the end of the abdomen
- e) Larvae eruciform with compound eyes
- f) Pupae exarate

e.g. *Panorpa furcata*

### 31. Order: Strepsiptera – Twisted wing parasites

The strepsiptera are minute insects, all of which are parasitic on other insects. The two sexes are quite different; the males are free-living and winged, whereas the females are wingless and often legless, and in most species do not leave the host.

#### Identification characteristics

- a) Minute insects and are parasitic on other insects
- b) Males-free living & winged, whereas the females are wingless and often legless
- c) Front wings are reduced and hind wings are large and membranous, fanlike.
- d) Have chewing mouth parts and compound eyes.

Eg. *Neostylops shannoni*

## 32. Order: Diptera

Etymology : Di-two; ptera-wing

Common names : True flies, Mosquitoes, Gnats, Midges,

**Characters:** They are small to medium sized, soft bodied insects. The body regions are distinct. Head is often hemispherical and attached to the thorax by a slender neck. Mouthparts are of sucking type, but may be modified. All thoracic segments are fused together. The thoracic mass is largely made up of mesothorax. A small lobe of the mesonotum (scutellum) overhangs the base of the abdomen. They have a single pair of wings. Forewings are larger, membranous and used for flight. Hind wings are highly reduced, knobbed at the end and are called **halteres**. They are rapidly vibrated during flight. They function as organs of equilibrium. Flies are the swiftest among all insects. Metamorphosis is complete. Larvae of more common forms are known as maggots. They are **apodous** and **acephalous**. Mouthparts are represented as mouth hooks which are attached to internal sclerites. Pupa is generally with free appendages, often enclosed in the hardened last larval skin called **puparium**. Pupa belongs to the coarctate type.

**Classification** This order is sub divided in to three suborders.

**Nematocera (Thread-horn)** Antenna is long and many segmented in adult. Larval head is well developed. Larval mandibles act horizontally. Pupa is weakly obtect. Adult emergence is through a straight split in the thoracic region.

**Brachycera (Short-horn)** Antenna is short and few segmented in adult. Larval head is retractile into the thorax. Larval mandibles act vertically. Pupa is exarate. Adult emergence is through a straight split in the thoracic region.

**Cyclorrhapha: (Circular-crack)** Antenna is aristate in adult. Larval head is vestigial with mouth hooks. Larval mouth hooks act vertically. Pupa is coarctate. The coarctate pupa has a circular line of weakness along which the pupal case splits during the emergence of adult. The split results due to the pressure applied by an eversible bladder **ptilinum** in the head.

### i. Nematocera

1) **Culicidae:** (Mosquitoes)

2. **Cecidomyiidae :** (Gall midges)

### ii. Brachycera

3. **Asilidae:** (Robber flies)

4. **Tabanidae:** (Horse flies)

### iii. Cyclorrhapha

5. **Syrphidae:** (Hover flies, Flower flies)

6. **Tephritidae:** (Fruit flies)

7. **Drosophilidae:** (Vinegar gnats, Pomace flies)

8. **Tachinidae:** (Tachinid flies)

9. **Muscidae:** (House fly)

10. **Hippoboscidae:** (Dogfly)