E Book ZOOLOGY Practical (Paper –III)

Sem III (ZO-233): and Sem IV (ZO-243): (2 Credits)

E Book Editor

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Adapted from Practical Handbook– S.Y.B.Sc. Practical Zoology – *Nirali Prakashan Original Authors – Dr. Kishor Pawar, Dr. Ashok Desai

E content (Study material) Credit to : - Prof. Mubeen Shaikh & Prof. Vikas Bhand as Reference

PRACTICAL E-SHEETS

Course Title: Zoology Practical Paper
Course Code: ZO – 233
Semester - III (2 credits – 60 Hours)

Animal Diversity - III

1. Museum study of Group Protochordata : *Balanoglossus, Herdmania, Petromyzon*. (D)
2. Museum study of Class Pisces: *Labeo, Scoliodon, Hippocampus*. (D)
3. Museum study of Class Amphibia :*Salamandra, Rana, Ichthyophis*. (D)
4. Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)
5. Study of types of tail fins in fishes: Homocercal, Heterocercal &Diphycercal. (D)

Sericulture –

1. Study of external morphology and life-cycle of *Bombyx mori*. (D)
2. Study of five equipments in Sericulture. (E) - Compulsory

Agricultural Pests and their control –

1. Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Jowar stem borer, b) Red cotton bug, c) Brinjal fruit borer, d) Mango stem borer.
3. Study of any two non-insect pests corresponding to theory course. (D)

S.Y.B.Sc. Zoology

SEMESTER III PRACTICAL E-SHEETS

Animal Diversity - III

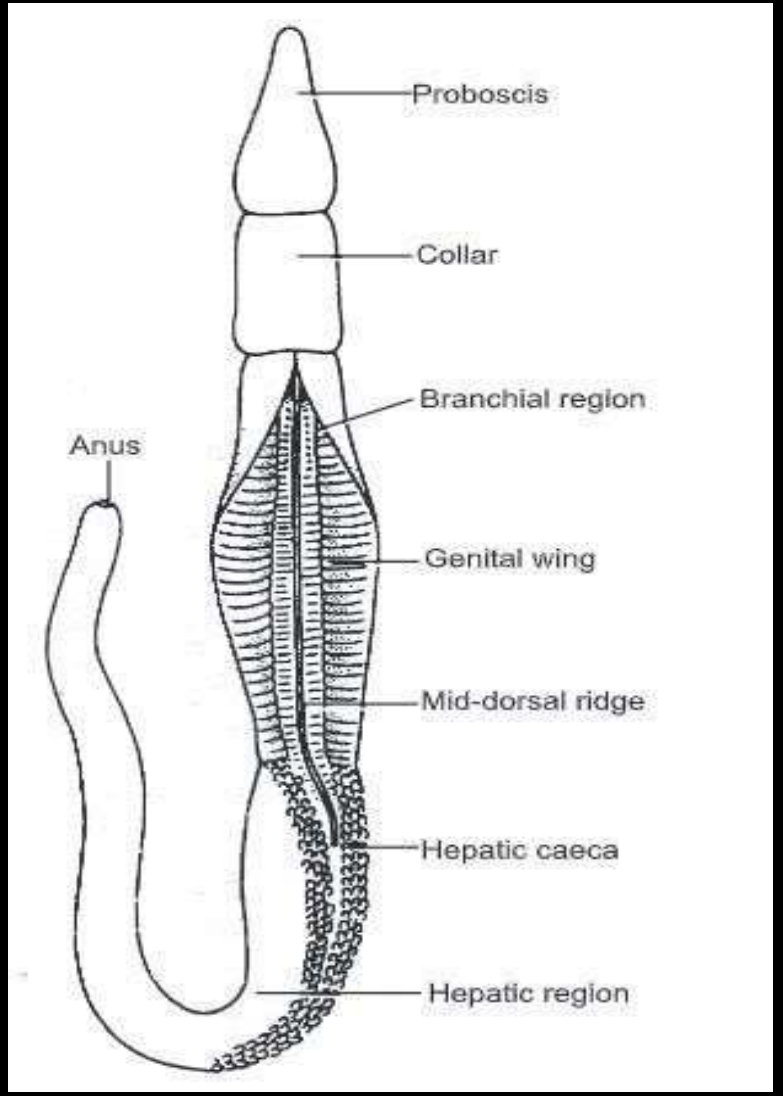
1. Museum study of Group Protochordata : *Balanoglossus, Herdmania, Petromyzon*. (D)
2. Museum study of Class Pisces: *Labeo, Scoliodon, Hippocampus*. (D)
3. Museum study of Class Amphibia :*Salamandra, Rana, Ichthyophis*. (D)
4. Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)
5. Study of types of tail fins in fishes: Homocercal, Heterocercal &Diphycercal. (D)

ANIMAL DIVERSITY III - PRACTICAL NO. 01
Museum Specimen of group Protochordata

1. Balanoglossus

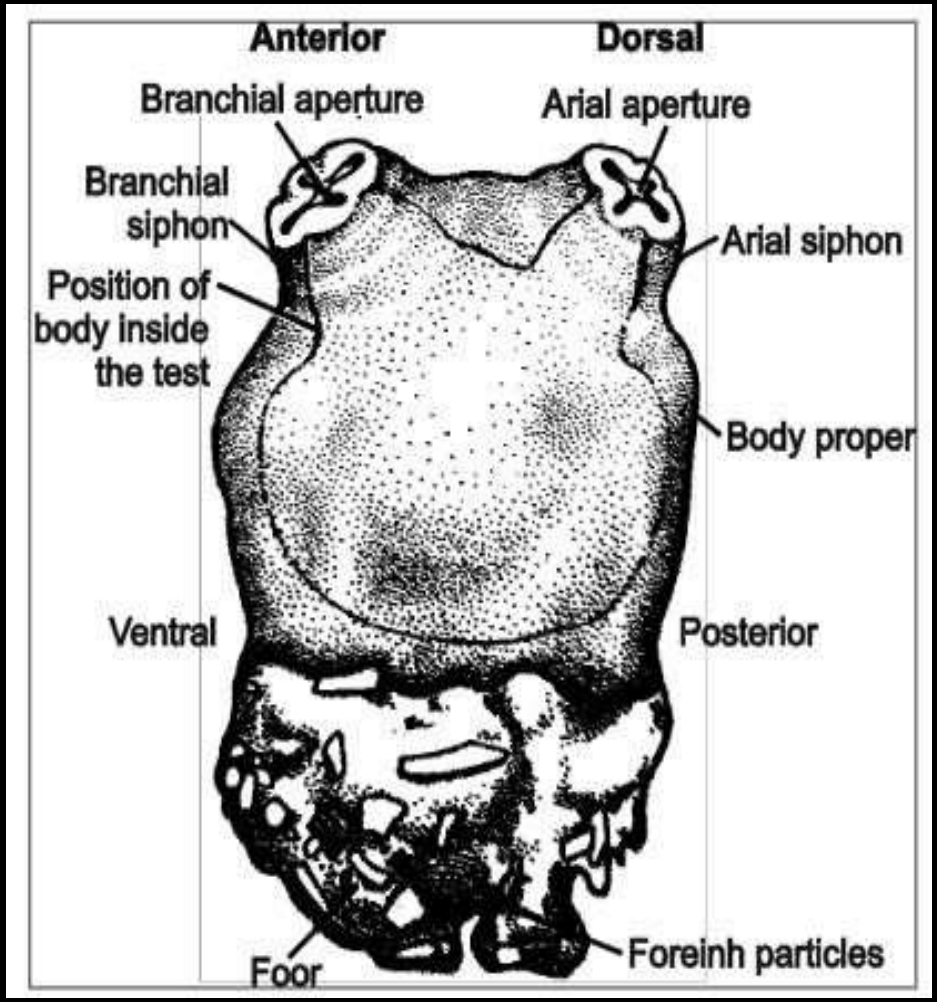
Classification:

Phylum	: ***Chordata***	–	Bilaterally symmetrical, triploblastic, coelomate animals; notochord, nerve cord and paired pharyngeal gill slits are present.
Group	: ***Protochordata***	–	Absence of cranium, vertebrae and paired limbs. Peribrachial cavity present, marine small animals.
Subphylum	: ***Hemichordata***	–	Body soft, worm-like, notochord short and restricted to anterior end, coelomate.
Class	: ***Enteropneusta***	–	Gut straight, presence of numerous paired pharyngeal gill slits, two rows of caeca.
Genus	: ***Balanoglossus.***		



ANIMAL DIVERSITY III - PRACTICAL NO. 01
Museum Specimen of group Protochordata

2. Herdmania



Phylum	:	**Chordata**	– Characters same as Balanoglossus.
Group	:	**Protochordata**	– Characters same as Balanoglossus.
Subphylum	:	**Urochordata**	– Adults solitary or colonial, free swimming or sessile, body enclosed in a tunic or test, notochord absent in the adult.
Class	:	**Ascidiacea**	– Test with scattered muscles, many pharyngeal gill slits, bottom-dwelling.
Order	:	**Ascidiae simplices**	– Solitary or fixed form, reproduction by budding rare, exhibit retrogressive metamorphosis.
Genus	:	**Herdmania.**	

ANIMAL DIVERSITY III - PRACTICAL NO. 01
Museum Specimen of group Protochordata

3. Petromyzon

Classification :

Phylum	–	**Chordata**	– Dorsal tubular nerve cord, paired gill slits.
Group	–	**Craniata**	– Definite head, cranium with brain and notochord present.
Subphylum	–	**Vertebrata**	– Notochord is replaced by vertebral column.
Superclass	–	**Agnatha**	– Jaws and appendages are absent.
Class	–	**Cyclostomata**	– Mouth circular, suctorial, without jaws.
Order	–	**Petromyzontia**	– Mouth with funnel, without tentacles, Gills 7 pairs, well developed branchial basket.
Genus	–	***Petromyzon***	
Species	–	***marine***	

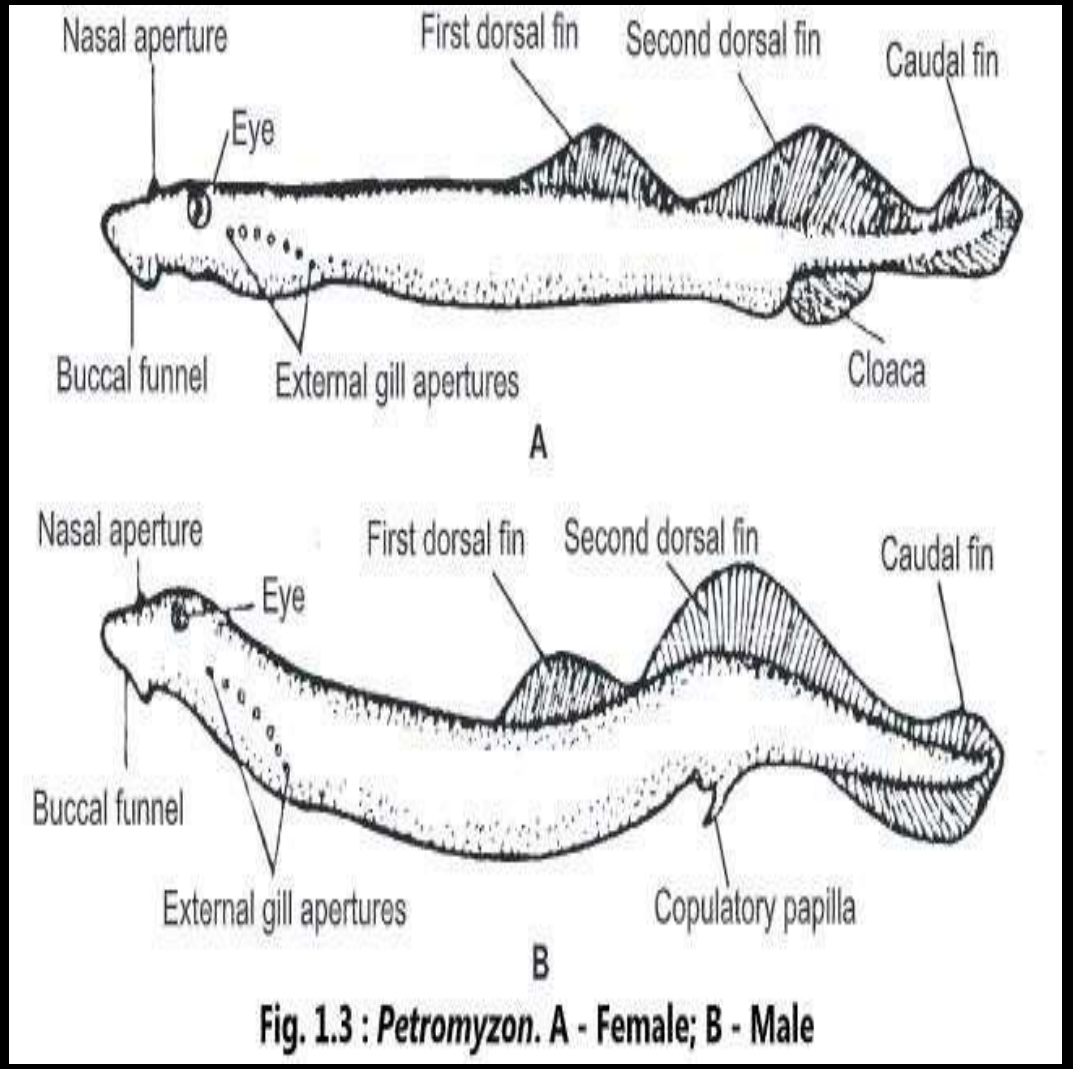
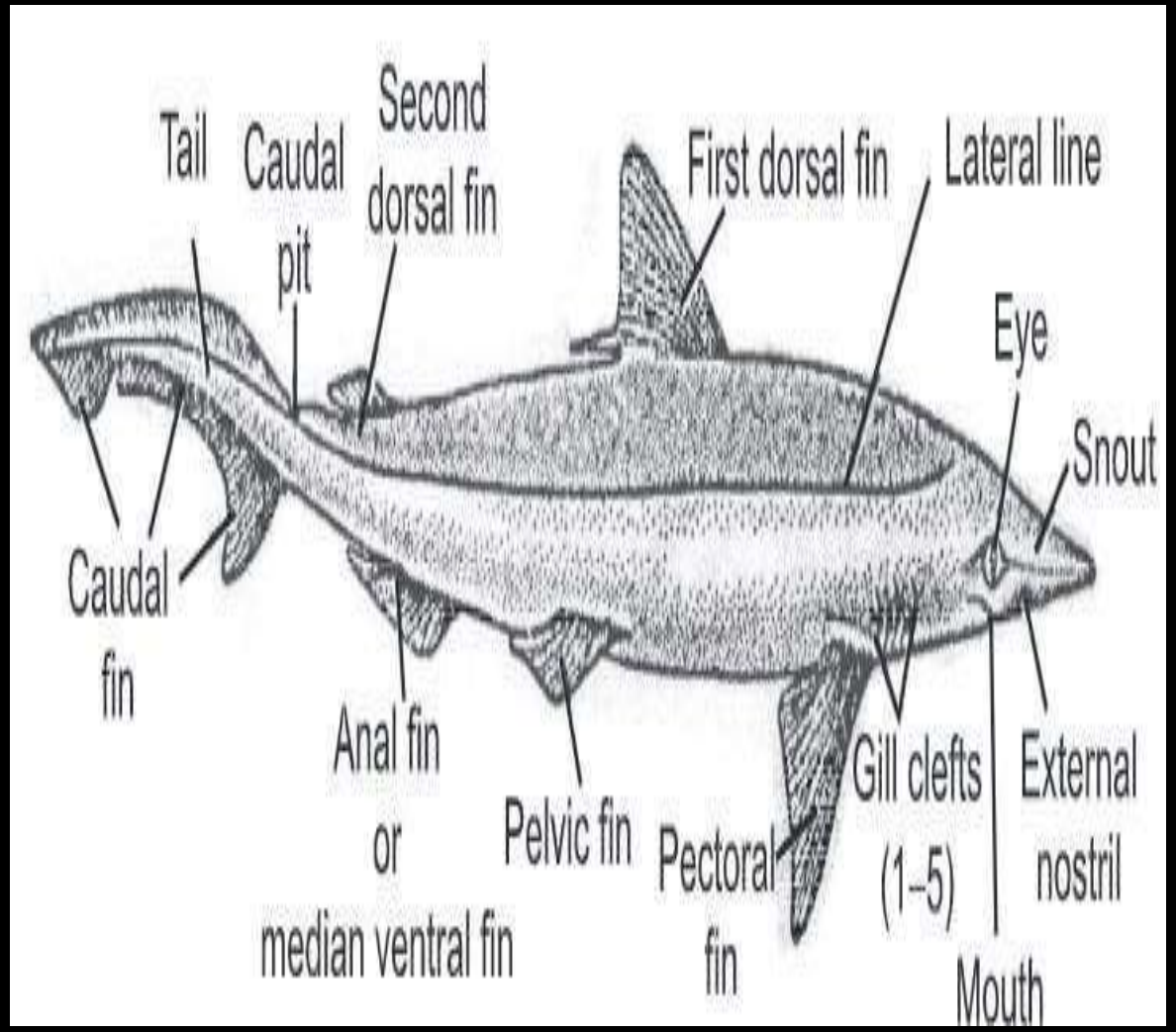


Fig. 1.3 : *Petromyzon*. A - Female; B - Male

ANIMAL DIVERSITY III - PRACTICAL NO. 02
Museum Specimen of group Pisces

1. Scoliodon



Classification :

Phylum	-	**Chordata**	-	Dorsal tubular nerve cord, notochord, and paired gill-slits are present.
Group	-	**Vertebrata**	-	Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present, blood red containing R.B.C.
Subphylum	-	**Gnathostomata**	-	Jaws and paired appendages are present.
Series	-	**Pisces**	-	Presence of paired or unpaired fins supported by soft or spiny rays and gill-slits.
Class	-	**Elasmobranchi**	-	Placoid scales in most of the species, endo-skeleton cartilaginous, gill-slits 5-7 on each side, operculum is absent, air-bladders absent, male with claspers, cloaca is present, marine.
Subclass	-	**Selachii**	-	Paired fins without a median axis, pectoral radials jointed, base of pectoral fin constricted.
Superorder	-	**Pleurotremata**	-	Gill-slits lateral, anterior margin of pectoral fin free, hyomandibular with branchial rays.
Order	-	**Lamniformes**	-	Two dorsal fins without spines, anal fin present, 5 gill-arches.
Genus	-	***Scoliodon***		

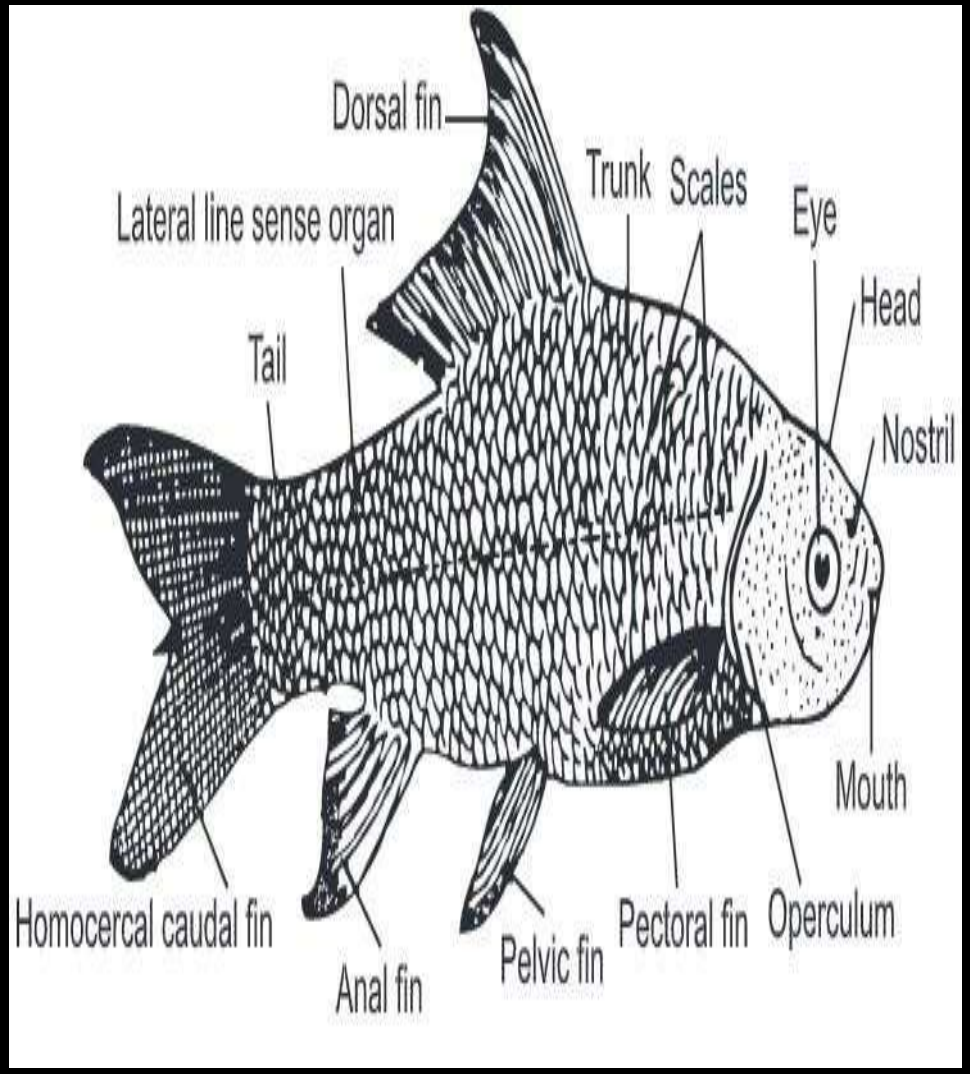
ANIMAL DIVERSITY III - PRACTICAL NO. 02
Museum Specimen of group Protochordata

2. Labeo

Classification :

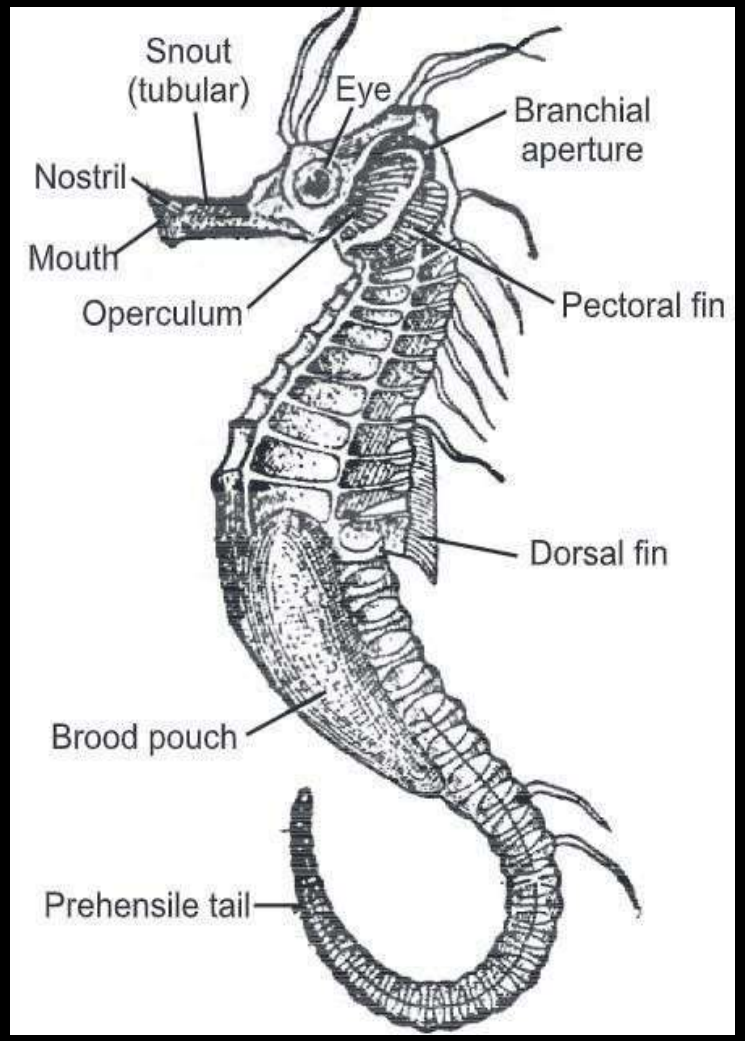
Phylum	:	**Chordata**	
Group	:	**Craniata (Vertebrata)**	
Subphylum	:	***Gnathostomata***	
Series	:	**Pisces**	
Class	:	**Osteichthyes (Teleostomi)**	– Endoskeleton chiefly bony, presence of both paired and unpaired fins supported by bony fins rays; tail homocercal, mouth terminal, cloaca and claspers are absent.
Order	:	***Cypriniformes***	– Ventral fin abdominal, pectoral fin usually with a spine, weberian apparatus connecting the ear with the air bladder, air bladder connected with the gut by a duct.
Division	:	***Cyprini***	– Body covered with scales or naked, scales cycloid type, third and fourth vertebrae not fused with each other.
Genus :		**Labeo**	

Same as Scoliodon



ANIMAL DIVERSITY III - PRACTICAL NO. 02
Museum Specimen of group Protochordata

3. Hippocampus



Classification :

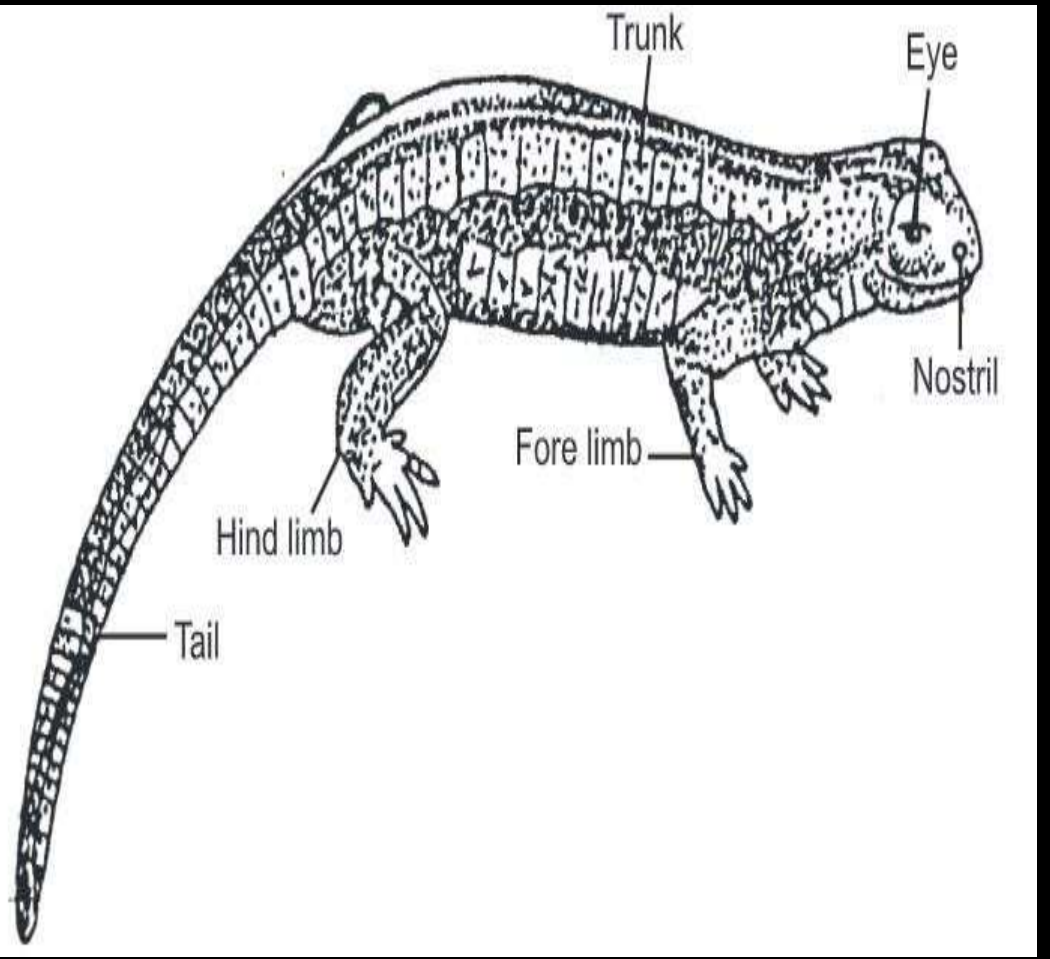
Phylum	-	**Chordata**	
Group	-	**Vertebrata**	
Subphylum	-	**Gnathostomata**	
Series	-	**Pisces**	**Same as Scoliodon**
Class	-	**Teleostomi**	
Subclass	-	**Actinopterygii**	
Order	-	**Syngnathiformes**	- Body covered with protective layer of scales or bony rings; mouth is terminal, snout tubiform; fin-rays of dorsal, anal and pectoral fins not branched; physoclistic.
Genus	-	***Hippocampus***	

ANIMAL DIVERSITY III - PRACTICAL NO. 03
Museum Specimen of group Amphibia

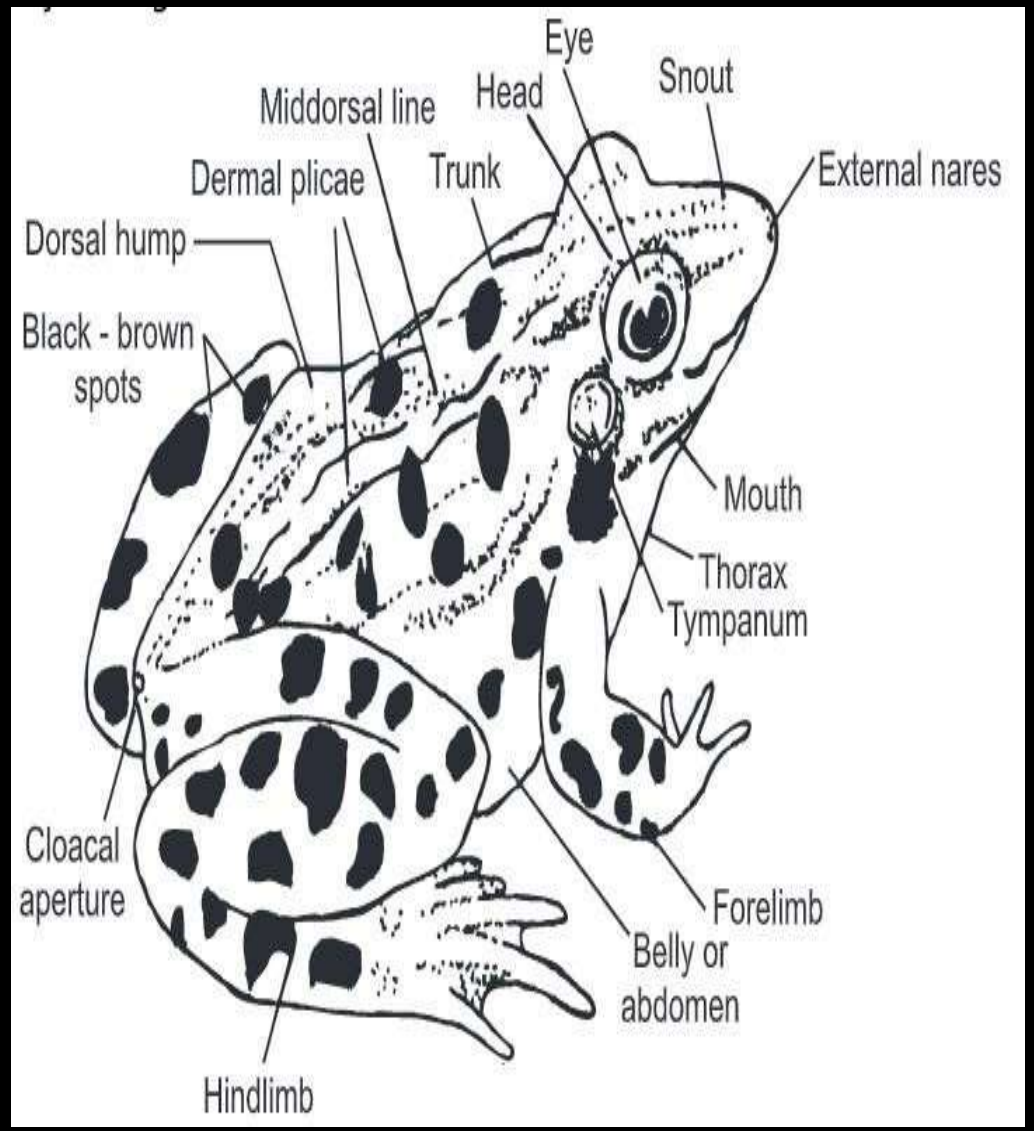
1. Salamandra

Classification :

Phylum	:	*Chordata*	– Characters are same as *Ichthyophis.*
Group	:	*Craniata*	– Characters are same as *Ichthyophis.*
Sub-phylum	:	*Gnathostomata*	– Characters are same as *Ichthyophis.*
Class	:	*Amphibia*	– Characters are same as *Ichthyophis.*
Order	:	Urodela (Caudata)	– Body elongated, lizard-like with distinct head, limbs poorly developed and almost of equal size, tail well developed, eyes small, lidless.
Genus	:	Salamandra	



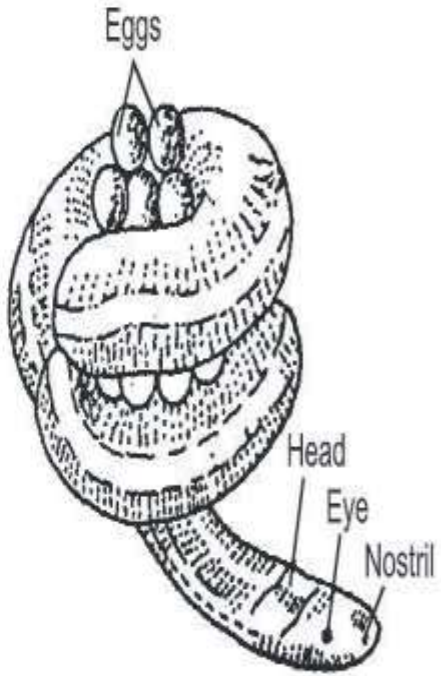
ANIMAL DIVERSITY III - PRACTICAL NO. 03 Museum specimens – amphibian ex Rana



Systematic Position :

Phylum	:	**Chordata**	–	Presence of distinct notochord in the embryonic stage.
Sub-phylum	:	**Craniata or Vertebrata**	–	Presence of skull and vertebral column in adult.
Section	:	**Gnathostomata**	–	The mouth is bounded by upper and lower jaws.
Superclass	:	**Tetrapoda**	–	Presence of four limbs.
Class	:	**Amphibia**	–	It can live in water as well as on land i.e. amphibious mode of life.
Order	:	**Anura**	–	It lacks tail, body is short and broad, and the legs are much longer than arms.
Suborder	:	**Diplasiocoela**	–	Sacral vertebra with convex centrum anteriorly and double convex posteriorly; 8th vertebra is biconcave.
Family	:	**Ranidae**	–	*R. tigrina* lacks cartilaginous discs between the centra of the vertebra and presence of teeth only in upper jaw.
Genus	:	***Rana***	–	Sternum is large body.
Species	:	***tigrina***	–	Upper surface of body is olive green, mottled with dark spots, under surface is white. A cutaneous fold borders the tympanum dorsally and 5th toe externally.

ANIMAL DIVERSITY III - PRACTICAL NO. 03 I) Museum Specimen of group Amphibia 3. Ichthyophis



Phylum	:	***Chordata***	– Characters are same as *Labeo*.
Group	:	***Craniato*** (Vertebrata)	– Characters are same as *Labeo*.
Subphylum	:	***Gnathostomata***	– Characters are same as *Labeo*.
Class	:	***Amphibia***	– Can live both in water and on land (i.e. amphi = both), cold-blooded, scaleless glandular skin, two occipital condyles, heart three chambered.
Order	:	***Apoda*** (Gymnophiona)	– Vermiform, without limb and limb girdles, burrowing.
Genus	:	***Ichthyophis***.	

ANIMAL DIVERSITY III - PRACTICAL NO. 04
Study of Types of Scales in Fishes

Aim :

Study of types of Scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale and Ganoid scale.

1. Placoid Scale :

1. The placoid scales are present on the skin of sharks (Elasmobranchs).
2. The placoid scales are arranged in regular oblique rows. They are dermal in origin and cover entire surface of body, forming dermal exoskeleton of the sharks.
3. Each scale is composed of a basal bony plate embedded in the dermis, from which a spine projects upwards and points posteriorily. It has small and pointed and triradiate denticles.
4. The placoid scale consists of a diamond shaped or rhomboidal basal plate having an opening of the pulp cavity and flat trident spine.
5. The basal plate is formed of a trabecular calcified tissue, the cement.
6. Spine is composed of dentine covered by a hard material called vitrodentine.
7. The pulp cavity contains the vascular connective tissue, pulp containing numerous odontoblasts, blood vessels, nerves and lymph channels.

Identification: Since, this scale has trident spines, hence it is placoid scale.

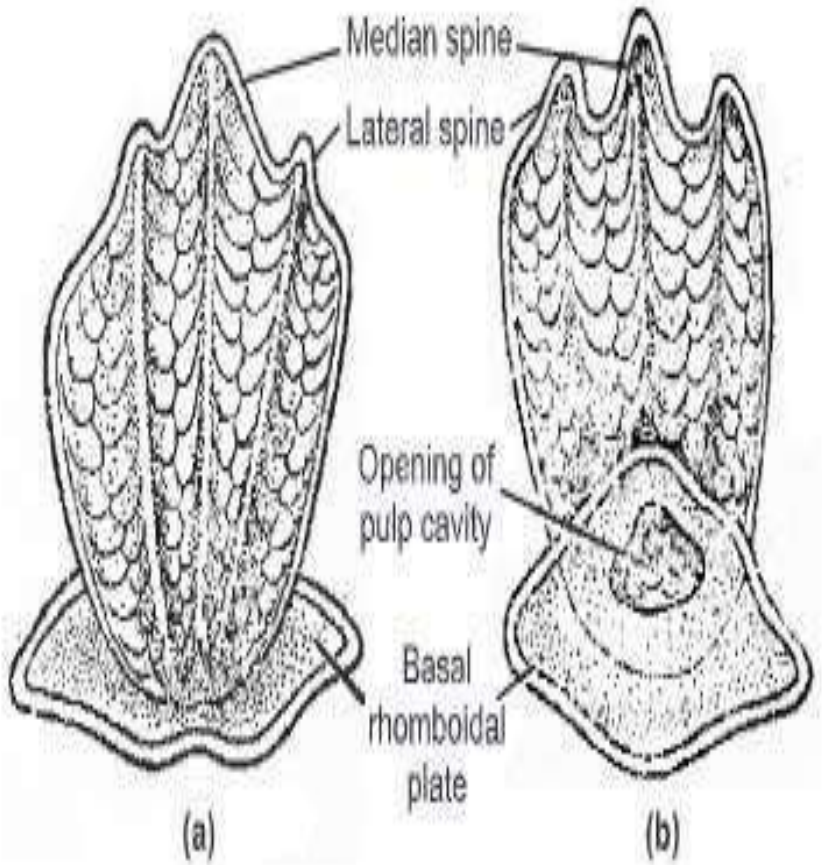


Fig. 1.10 : Placoid Scale of *Scoliodon*

ANIMAL DIVERSITY III - PRACTICAL NO. 04
Study of Types of Scales in Fishes

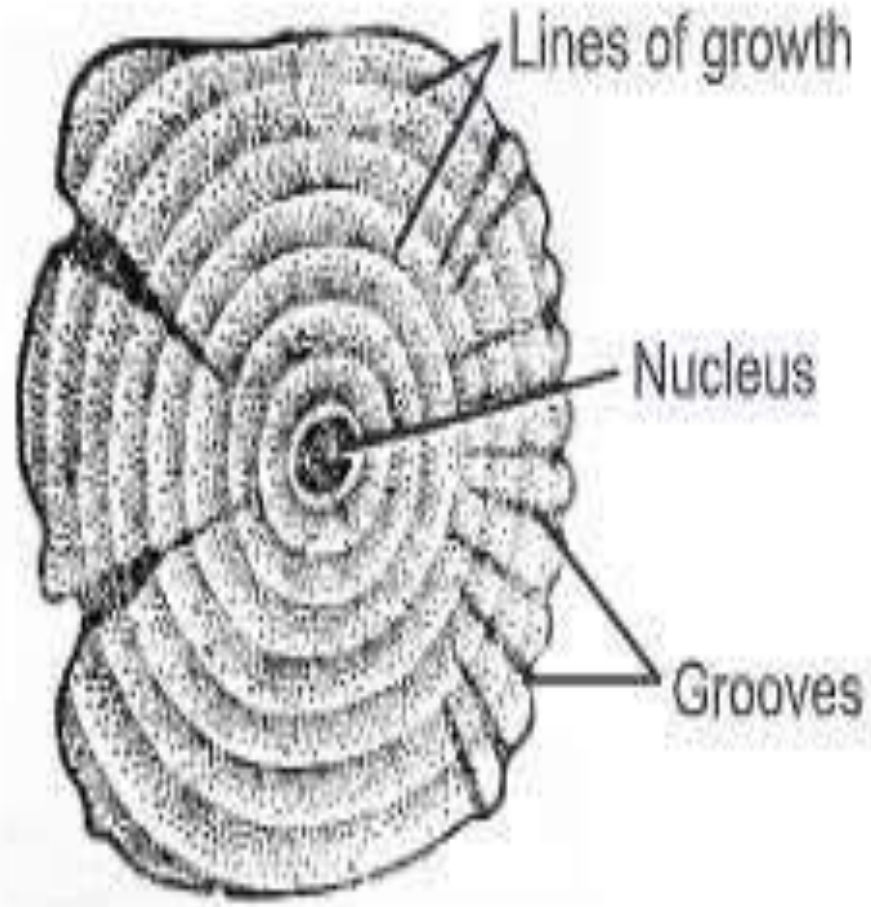
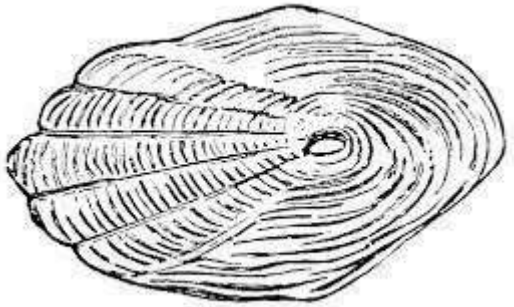


Fig. 1.11 : Cycloid scale

2. Cycloid Scale :

Comments :



1. Cycloid scales are found in carps (teleost fishes) and lung fishes (depnoi).
2. They are soft and located in dermal pockets and possess concentric lines of growth.
3. Each cycloid scale is roughly circular and flattened.
4. Each scale is composed of a central nucleus and numerous lines of growth.
5. The free or anterior border is more or less rounded and remains exposed.
6. The posterior part of the scale is having numerous longitudinal grooves for sucking the nourishment from the skin.
7. Scales are soft, arranged lengthwise in diagonal rows.
8. Cycloid scale is derived form of ganoid scales in which ganoin, cosmine and bone cells are lost.

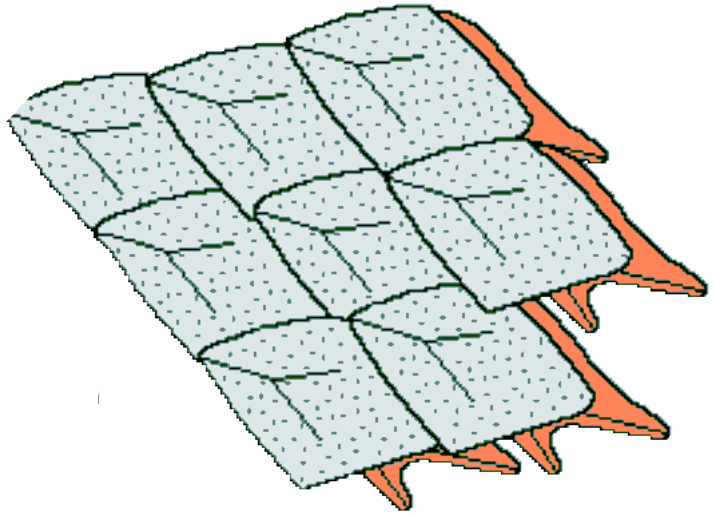
Identification : Since, the above scale contains concentric lines of growth, hence it is cycloid scale.

ANIMAL DIVERSITY III - PRACTICAL NO. 04
Study of Types of Scales in Fishes

3. Ctenoid Scale :

Comments :

1. Ctenoid scales are commonly found in teleosts and actinopterygian fishes.
2. They are thin, soft and dermal plates.
3. Each ctenoid scale is flat and somewhat oval in shape.
4. Each scale is composed of a central nucleus and numerous lines of growth.
5. The anterior free border bears numerous small teeth-like structures.
6. The posterior border remains embedded in the skin and slightly wavy.
7. Numerous longitudinal grooves are present on the posterior border and as such these grooves are used for sucking the nourishment from the skin.
8. Pulp cavity and dentine are entirely absent.
9. Ctenoid scales are derivatives of ganoid scales in which ganoin, cosmine layers and bone cells are lost.



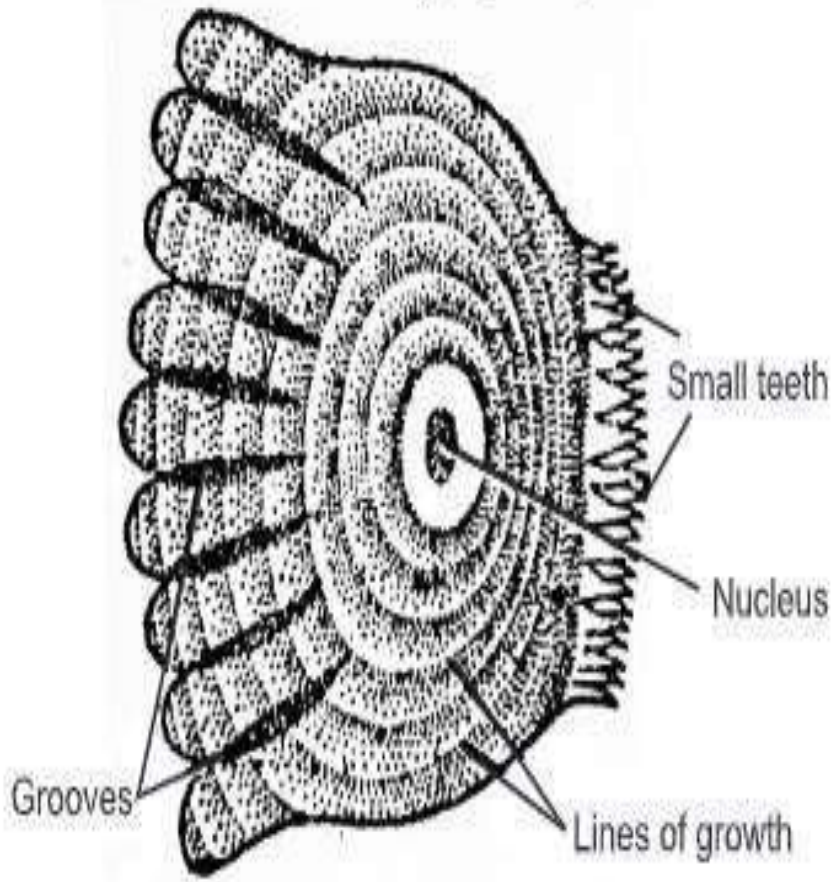


Fig. 1.12 : Ctenoid Scale

ANIMAL DIVERSITY III - PRACTICAL NO. 04
Study of Types of Scales in Fishes

4. Ganoid Scale :

Comments :

1. **Ganoid scales** are found in primitive ray-finned fishes such as polypterus and gar pike.
2. Scales are covered with a hard, shiny and translucent material of mesodermal origin called as ganoin.
3. Ganoid scales fit together like tiles and are arranged in diagonal rows.
4. Scales are dermal in origin.
5. Each scale consists of a bony base, coated by shining substance called ganoin.

Identification: Since the above scale is overlapping and fitted like tiles, hence it is ganoid scale.

Fig. 1.13 : Ganoid scales

ANIMAL DIVERSITY III - PRACTICAL NO. 05
Study of Tail Fins in Fishes

Aim :

Study of types of tail fins in fishes (D).

Fins are the organs of locomotions in fishes, which are thin, broad folds of integument internally supported by fin rays, which may be bony, cartilaginous, fibrous or horny. Fins are broadly divided into two types, *paired fins* and *unpaired fins*.

(1) Paired fins : Paired fins include anterior pectoral fins and posterior pelvic fins.

(2) Unpaired fins : These includes dorsal fins, ventral fins and caudal fins.

Tail or Caudal Fins :

The caudal fins are well developed in most fishes because it is important in direction and forward propulsion during swimming. Tail fins have variable shapes in different fishes, correlated with their habits. There are three main types of tail fins.

5.1 THE PROTOCERCAL (FIRST TAIL)

It is also called '*diphycercal*' and is primitive type. In this, the hind end of the notochord or vertebral column is straight and divides the caudal fin into two equal lobes, the dorsal *epichordal* and the ventral *hypochordal* lobe; hence termed diphycercal.

Diphycercal caudal fin occurs in modern cyclostomes, primitive sharks, holocephali (*chimaera*), living *dipnoi* (Lung fishes), and living crossopterygi (*Latimeria*), many larval teleost and deep sea fishes. In *chimaera*, the caudal fin is called *isocercal* because it is elongated and symmetrical.

Examples : *Latimeria* and *Neoceratodus*.

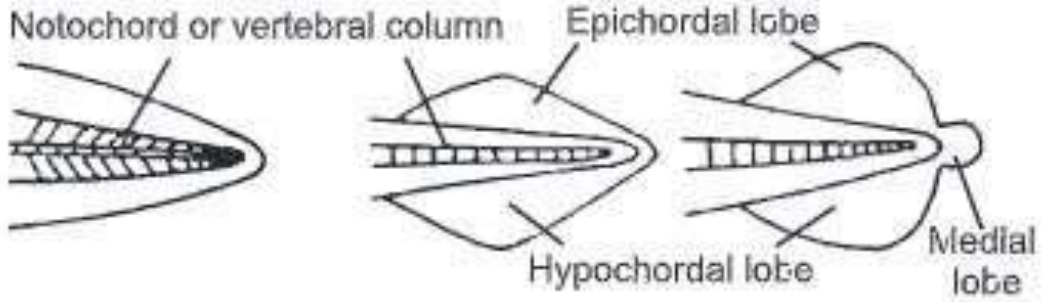


Fig. 1.14 : *Protocercal* **Fig. 1.15 : *Modified diphycercal***

ANIMAL DIVERSITY III - PRACTICAL NO. 05
Study of Tail Fins in Fishes

5.2 HETEROCERCAL FIN

In this, hind end of the notochord is bent upwards and continuous up to the tip of the caudal fin. The ventral hypochordal lobe is much larger than the dorsal epichordal lobe, so that the caudal fin is asymmetrical both externally and internally. This fin is the characteristic

of chondrichthyes and some primitive bony fishes, and bottom feeders as the stroke of larger dorsal lobe in swimming serve to direct fish towards bottom.

Examples : *Pristis, Sphyrna, Acipenser, Scoliodon, Exocoetus.*

Fig. 1.16 : Heterocercal

Fig. 1.17 : Hypocercal

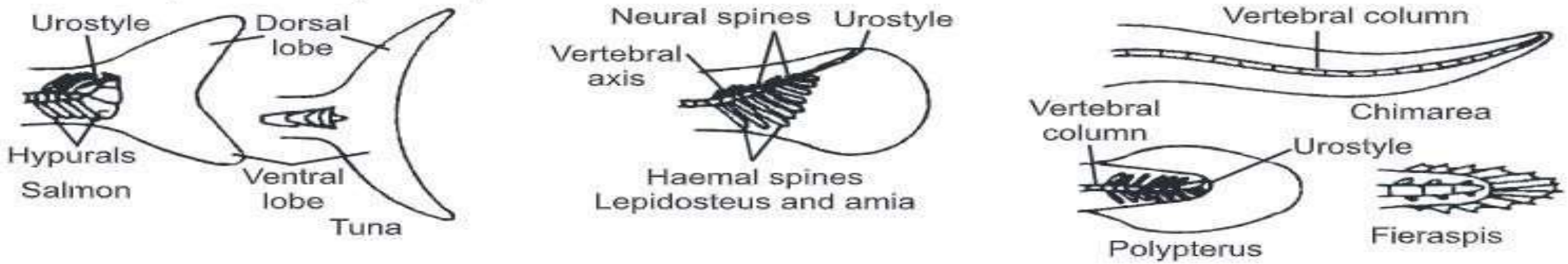
ANIMAL DIVERSITY III - PRACTICAL NO. 05
Study of Tail Fins in Fishes

5.3 THE HOMOCERCAL FIN

It is symmetrical externally consisting equal sized epichordal and hypochordal lobes. But internally the tail is asymmetrical i.e. the hinder end of the vertebral column is turned upward and greatly shortened. The end of the vertebral column cannot reach the posterior limit of the fin. Actually, the epichordal lobe is smaller than in the heterocercal tail. Homocercal fin is occurred in the living primitive teleost like *Amia*, *Lepidosteus* and *Polypterus*.

Homocercal type has several variations. In *Cod* and *tuna*, the upturned urostyle of vertebral column is reduced or absent. In *Fieraspis*, vertebral column and fin itself become reduced and vestigial to form a *Gephyrocercal* tail.

Examples : *Amia, Labeo, Cod and Tuna.*



(a) Homocercal (b) Abbreviated Homocercal (c) Gephyrocercal

Fig. 1.18 : Types of Homocercal Fins

Practicals : Applied Zoology I

Sericulture –

1. Study of external morphology and life-cycle of *Bombyx mori*. (D)
2. Study of five equipments in Sericulture. (E) - Compulsory

SERICULTURE - PRACTICAL NO. 01
Study of External Morphology & Life Cycle of Bombyx mori

Aim :

Study of External Morphology and Life-cycle of *Bombyx mori* (D).

Sericulture or the silk industry is a very important branch of applied zoology. It deals with production of silk yarn by artificially rearing silkworms. The five main sericulture producer and consumer countries of the world are Japan, China, South Korea, U.S.S.R. and India. The silk-fibre is a protein produced from the silk glands of silkworms. There are two main types of silks, *mulberry silk* and *non-mulberry silk*. Mulberry silk produced by silkworms which feed on mulberry leaves while the non-mulberry silkworms which feed on plant leaves other than mulberry. There are three types of non-mulberry silk, namely Tassar (Kosa) silk, Muga silk and Eri silk.

Following description is pertaining to Mulberry silk.

Systematic Position :

Phylum	–	Arthropoda
Sub-phylum	–	Mandibulata
Class	–	Insecta
Sub-class	–	Pterygota
Division	–	Endopterygota
Order	–	Lepidoptera
Family	–	Bombycidae
Genus	–	*Bombyx*
Species	–	*mori*

External Morphology :

The adult moth of *Bombyx mori* is seldom creamy white in colour and wooly fat bodied. It is about 25 mm long with a wing-span of 40-50 mm from side to side. The body is divided into head, thorax and abdomen. The *head* possess a pair of compound eyes, a pair of bushy antennae and the mouth parts with long proboscis.

The *thorax* is three segmented (pro, meso and metathoracic-segments) and bears three pairs of legs and two pairs of wings. The *abdomen* of male is 8 segmented and female has 7 segments. Female has fat and larger abdomen.

At the caudal end, the male moth has a pair of hooks (Harpes) whereas the female moth has a knob-like projection with sensory hair. The female is less active than male.

The silkmoth is *dioecious* i.e. the sexes are separate. Fertilization is internal, preceded by copulation. Silk moths pass through a complete metamorphosis (Holometabolous) from egg to adult stage through two intermediate stages, larva (caterpillar) and pupa (cocoon).

The life cycle of *B. mori* consists of four stages, namely, egg, larva, pupa and adult.

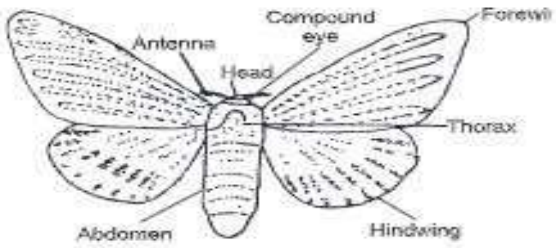


Fig. 2.1 : Moth (*B. mori*)

SERICULTURE - PRACTICAL NO. 01
Study of External Morphology & Life Cycle of Bombyx mori

Life Cycle of *Bombyx mori* :

Egg : During sericulture, the female moth is made to lay eggs on sheets of paper. Each female can lay 300-400 small, smooth, subspherical eggs. They measure 1 to 1.3 mm in length and 0.9 to 1.2 mm in width. The eggs are kept in cold storage for about six weeks. They are then washed in water and dried indoors.

Fig. 2.2 : Eggs on leaf of *B. mori*

There are two types of eggs, namely,

(a) **Hibernating eggs :** Deposited in spring, which undergo diapause and hatch out only in next spring.

(b) **Non-hibernating eggs :** Derived from successive generations without any pause in a year.

SERICULTURE - PRACTICAL NO. 01
Study of External Morphology & Life Cycle of *Bombyx mori*

Larvae : Eggs when fresh are bright yellow in colour and under suitable temperature, embryonic development takes place and colour changes from yellow to brown, then to gray and on 10th day they hatch into black coloured polypod catepillar. It has large head, the skin is rough, wrinkled and densely covered with bristles. It measures about 4-6 mm in length.

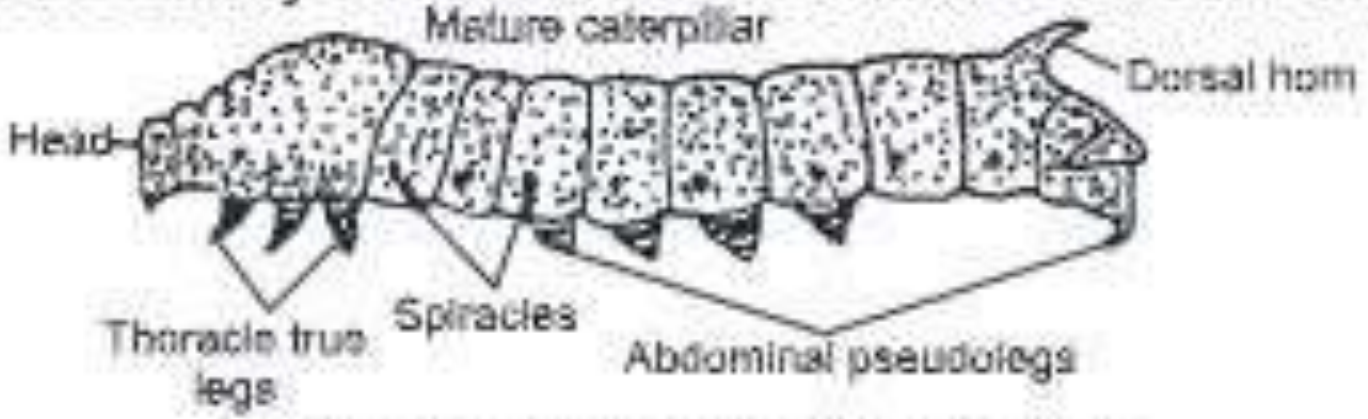


Fig. 2.3 : Silk moth (*Bombyx mori*) Larva

A full grown larva is 6-8 cm in length. The body of larva is divisible into head, thorax and abdomen. The head bears a pair of short antennae, two eye spots, mouth parts and a spinnerret (silk spinning apparatus). Larva moults four times within 30-40 days and reaches to fifth instar. The fifth instar larva becomes transparent and waxy in appearance.

SERICULTURE - PRACTICAL NO. 01
Study of External Morphology & Life Cycle of *Bombyx mori*

Pupa : Full grown larvae stops feeding and become restless and inactive. If suitable place given i.e. dried plants or bamboo mountage (chandrika), they soon begin to spin their cocoons in 3 days of constant motions of the head from side to side at the rate of 65 per minute. The cocoon is formed from a secretion of two large silk glands as a clear viscous fluid. On contact with air, this secretion becomes harden to form silk fibre. Each silk gland extrudes a fine filament of pulp material called *brin* or *fibroin* and two such brins are struck together by *sericin* or silk gum in the spinneret to form a single continuous fibre known as the *seric* bane of about 500 m long and 0.02 mm wide.

The cocoons are oval and vary in colour from white to a beautiful golden yellow. The cocoon provides protection for the developing pupa inside.

The pupal stage is generally resting, inactive stage. It is incapable of feeding and appears quiescent. During the pupal stage, internal organs undergo a complete change and assume the new form of the adult moth.

The prominent morphological parts visible on pupa are a pair of large compound eyes, a pair of large antennae, fore and hindwings and the legs. Ten abdominal segments seen on the ventral side and only nine on dorsal side. 7-pairs of spiracles are also seen on abdomen.

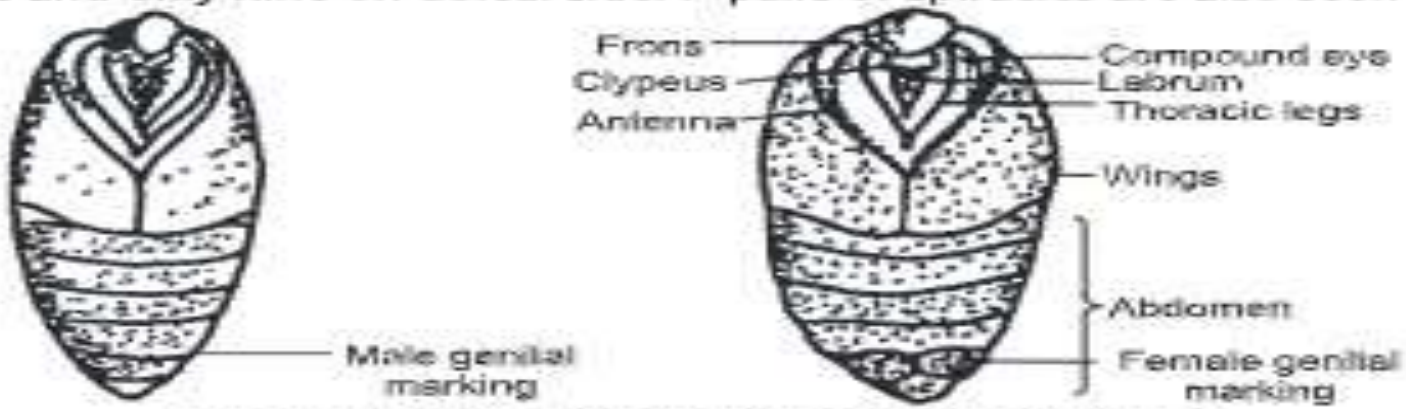


Fig. 2.4 : Male and Female pupa. *Bombyx mori*

SERICULTURE - PRACTICAL NO. 01
Study of External Morphology & Life Cycle of *Bombyx mori*

Adult : Within the cocoon, the pupa shrinks in length and in about 10-15 days a full-fledged moth emerges through an opening in the end of cocoon. The cocoons from which the moth emerges are called pierced cocoons. They are of low value because they cannot be reeled.

The ashy white moth has a fat body and wing expanse of about 5 cm. It takes no food and rarely attempts to fly but has high capacity for reproduction. The external features are described in external morphology of moth earlier.

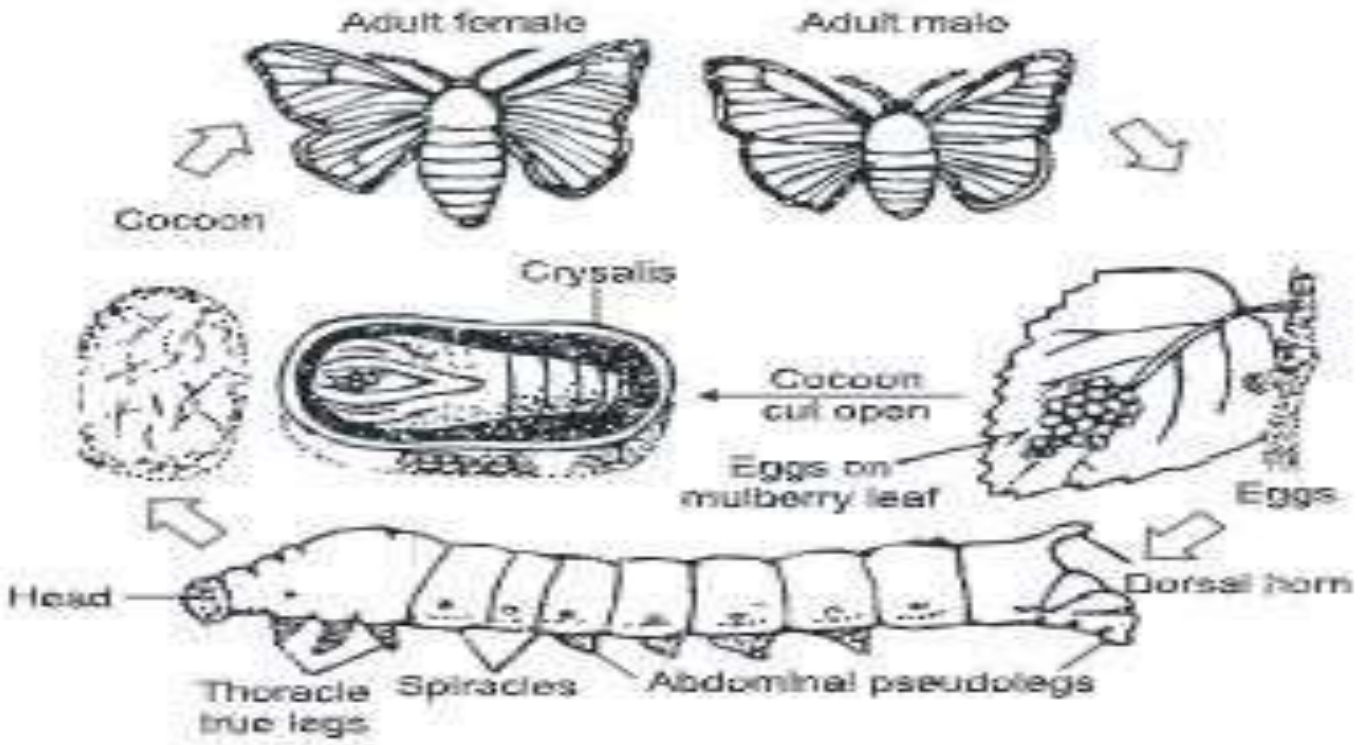


Fig. 2.5 : *Bombyx mori*. Life cycle

SERICULTURE - PRACTICAL NO. 02
Study of 05 Equipment in Sericulture

To study any five equipments in Sericulture. (E) Compulsory.

Following rearing equipments are required for the proper rearing of silkworms, without which the rearing would be a partial success.

(a) Rearing stands : Rearing stands are made of wood or bamboo and are portable for transportation. A rearing stand may be constructed and have dimensions like 2.5 m high × 1.5 m long × 1 m wide and should have 10 shelves with a space of 20 cm between each shelf. The trays are arranged on the shelves and each stand can accommodate 10 rearing trays. Six stands are enough for each rearing room.

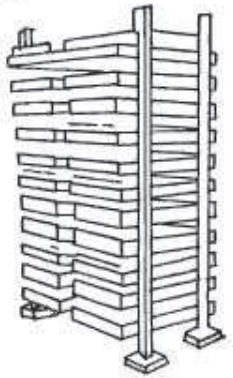
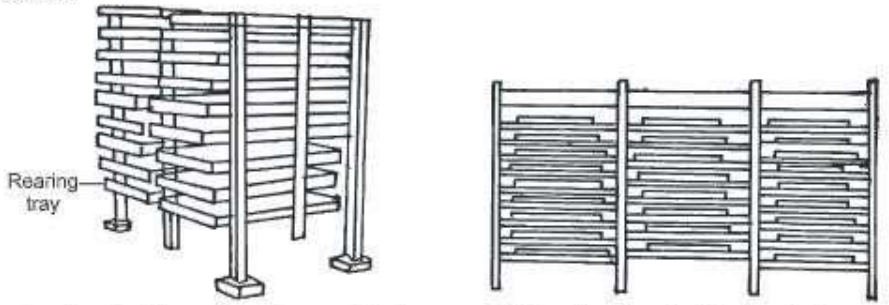


Fig. 2.6 : Rearing stand with Ant wells

(b) Ant wells : Ants are a serious menace to silkworms. To protect them, the legs of the rearing stand are kept in rectangular or circular enamel or concrete bowls containing water mixed with insecticide. The ant wells may be made of concrete or stone blocks 20 cm square and 7.5 cm high with a deep groove of 2.5 cm running all round the top (Fig. 2.6).

(c) Rearing trays : These are used to rear silkworms and are usually made up of locally available cheap material like bamboo so that they are light (in weight) and easy to handle. They are either circular (1.2 – 1.4 m diameter and 7.5 cm depth) or rectangular (0.7 – 0.9 m × 0.9 – 1.2 m). Sometimes, box type wooden trays are employed to rear early instars (I and II instar larvae).



(a) Rearing stand with rectangular wooden trays (b) Rearing stand with circular trays

Fig. 2.7

(d) Paraffin paper : Thick craft paper sheets coated with paraffin wax (M.P. 55°C) are required to cover the rearing trays to maintain the humidity in rearing beds and prevent withering of chopped leaves. It is used for rearing early stage silkworms.

(e) Foam rubber strips : Pieces (2.5 × 2.5 cm) of foam rubber soaked in water are kept all round silkworm rearing beds to maintain humidity during the first two instars. Newspaper folded strips moistened with water could be a convenient substitute.

(f) Chopsticks : Chopsticks are tapering bamboo rods meant to pick up younger stages of larvae to ensure their hygienic handling and preventing from injuries. These are made of bamboo approximately 17.5 cm to 20 cm long and tapering to one end.

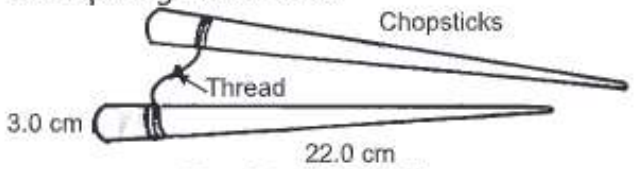


Fig. 2.8 : Chopsticks

(g) Feathers : Bird feathers, preferably white, are important items of silkworm rearing room. They are used for brushing the delicate newly hatched larvae (worms) onto the rearing bed to prevent injuries.

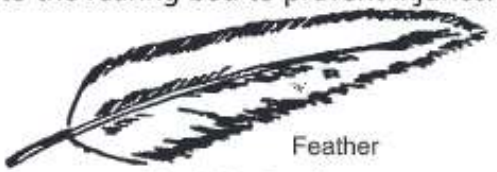


Fig. 2.9 : Feather

(h) Leaf chamber : Mulberry leaves harvested from the field are stored and preserved fresh for feeding the worms at set intervals during the day.

The leaves can be stored in cool rooms or in the rooms covered with cloth or polythene sheets. They can be also stored in leaf chambers (1.5 m long, 0.9 m wide and 0.8 m deep) of wooden strips fixed some distance apart of some porous board. The chamber with leaves is covered all over with gunny bag cloth kept moist during the summer months and dry days.

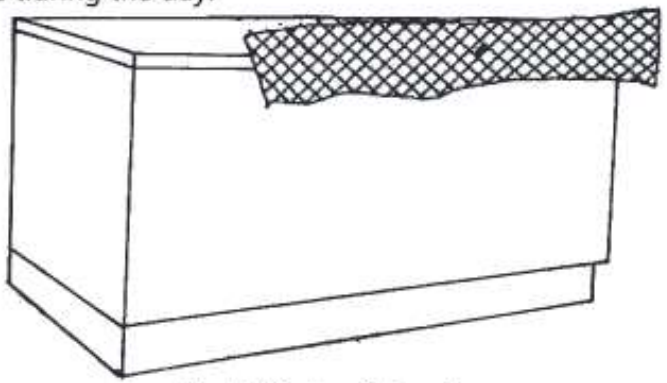


Fig. 2.10 : Leaf chamber

Agricultural Pests and their control –

1. Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)

   a) Jowar stem borer, b) Red cotton bug, c) Brinjal fruit borer, d) Mango stem borer.

3. Study of any two non-insect pests corresponding to theory course. (D)

AGRICULTURAL PESTS & THEIR CONTROL - PRACTICAL NO. 01

Study of Following Insects Pests with respect to marks of identification, nature of damage, economic importance and control measures

(a) Jowar Stem Borer :

Class	–	Insecta
Order	–	Lepidoptera
Family	–	Pyralidae
Genus	–	*Chilo*
Species	–	*zonellus* = *partellus* (Swinhoe)

Jowar is the most important staple food crop of the Maharashtra state. Besides being staple food crop of the people, it also supplies very good fodder for the cattle. It is cultivated in Kharif, Rabi and also in hot weather. Jowar stem borer is one of the major pests of jowar.

Distribution:

It occurs throughout India. The jowar stem borer is commonly called as *spotted stalk borer* or *pink borer*.

Identification Marks:

The adult moth is a medium sized insect with 3 cm wing span. Its forewings are straw or light brown in colour with numerous shining brown spots on the margin and hindwings are white and papery. The caterpillars (Larvae) are dirty white in colour with dark brown head with mandibulate type of mouth parts. Many dark spots are appeared on the body. Mature caterpillars are measured about 12-20 mm in length and shows four broad and patchy strips on the body.

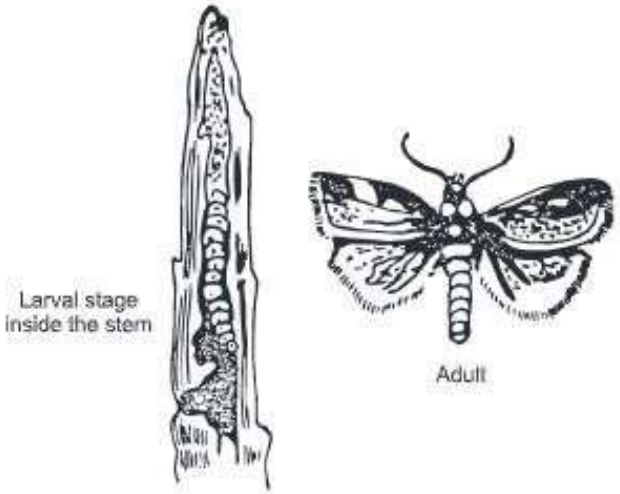


Fig. 3.1: Jowar Stem Borer

Host Plants:

This is the major pest of jowar and maize but also recorded on bajra, ragi and other grasses.

Life Cycle:

A female lays about 50-300 eggs in clusters arranged in two rows on the under surface of the leaves during April-May. Eggs are creamy white in colour. They hatch into the young caterpillar in about six days of incubation period. The young caterpillar feeds on tender leaves for a day or two and bores into the central shoot. The larval stage last for about 3-4 weeks and have normally five moults. Pupation takes place inside the stem and it last for about 7-10 days. The adult lives for 2-4 days. The pest is generally active from June to November and about four generations are completed in a year. The pest hibernates in the larval stage in stubbles during unfavourable period.

Nature of Damage:

Newly hatched caterpillars initially feed on the leaves causing numerous small holes in the leaf lamina and attack all parts of jowar plant except the roots. The larvae on entering the leaf, whorl and cut the leaves, which on emergence manifest characteristic pin holes, shoot holes and longitudinal streaks. At times the growing point is cut which results in drying of the central shoot and subsequently formation of dead-heart. The larvae after entering the stem, feed on the tissues (pith) and tunnels or galleries are formed.

Control Measures:

Cultural Method:

(i) Hand picking or light trapping of adult moths and collection of their eggs for destruction.

(ii) Burning of stubbles and trash which harbour borers and act as source of infestation for the next crop.

(iii) Growing resistant varieties of jowar like CHS-7, CHS-8, Indian sorghum types

Agricultural pests & their control - practical no. 01

Study of Following Insects Pests with respect to marks of identification, nature of damage, economic importance and control measures

Control Measures:

Cultural Method:

(i) Hand picking or light trapping of adult moths and collection of their eggs for destruction.

(ii) Burning of stubbles and trash which harbour borers and act as source of infestation for the next crop.

(iii) Growing resistant varieties of jowar like CHS-7, CHS-8, Indian sorghum types IS-5566, 5285 and 5613.

Chemical Method:

(i) For the *Chilo* on jowar a spray of 0.05% lindane or 0.1% endosulfan on 15 days old plants has been found effective. This may be followed after another fortnight with a second application of 1.0% lindane or 4% endo sulfan granules. A third application with 0.2% carbaryl spray may be carried out, if found necessary.

(ii) If the crop infestation is noticed, dusting of crop in the early stage with 10% BHC at the rate of 25 kg per hectare or spraying the crop with 350-400 ml of aldrin or dieldrin in 200 litres of water helps to control the pest.

Biological Method:

(i) The hymenopteran, *Trichogramma minutum* is employed as egg parasite.

(ii) *Apanteles flavipes* and *Bracon brevicornis* as larval parasites.

(iii) *Sexmaculata* has been recorded predating on early stages of the larvae of this pest.

Agricultural pests & their control - practical no. 01

Study of Following Insects Pests with respect to marks of identification, nature of damage, economic importance and control measures

(b) Red Cotton Bug :

Class – Insecta
Order – Hemiptera
Family – Pyrrhocoridae
Genus – *Dysdercus*
Species – *cingulatus* = *koenigii* (Fab.)

The red cotton bug has wide distribution; it is a minor pest in cotton growing region of northern India particularly Punjab and Uttar Pradesh. This pest also occurs throughout the Maharashtra state but is minor importance. It is commonly known as a "*cotton stainer*".

Host Plants:

Cotton, bhendi, ambadi, hollyhock and several other malvaceous plants.

Identification Marks:

The adult bug measures about 12-15 mm in length. The females are longer (15 mm) than the males (12 mm). It is blood red in colour except eyes, scutellum, and antennae which are black coloured. Besides, there is a black spot on each of the membranous forewings. A series of white transverse bands are present on the ventral side of the abdomen. Mouth parts are adapted for piercing and sucking. They form a straight beak or rostrum. The nymphs are smaller than adults and are wingless.

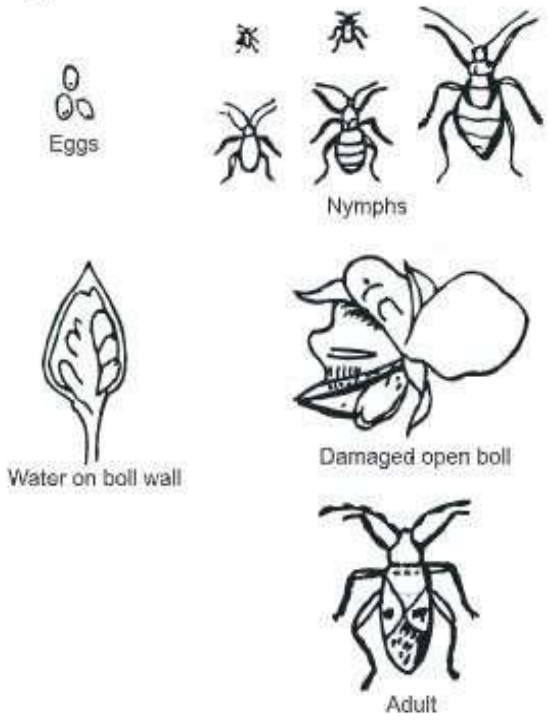


Fig. 3.2: Red Cotton Bug

Life Cycle:

The mature female lays eggs during spring in clusters of 70-80 eggs each under the moist soil surface; fallen leaves and in crevices. The eggs are spherical, yellowish-white about 1.2 mm in length. After 7 days of incubation period and moist weather, eggs are hatched into active 1 mm long red coloured nymphs which are resemble the adult except size and absence of wings. The nymphs feed gregariously on the cotton bolls. The nymphs undergo 5-moults within 49-89 days to reach adult stage. In winter, the life of the adult is about three months but in summer it is varied. Pest breeds on cotton from August-November; takes shelter under leaves or debris from December-middle of March and feeds on bhendi from April-July. The life cycle of bug is completed within six to eight weeks.

Nature of Damage:

Both nymphs and adults suck the cell sap from the leaves and tender shoots and impair the vitality of the plant. If the attack is severe, bolls open badly and the lint is of poor quality. In addition they also feed on the seeds and lower their oil content and low percentage of germination; such seeds are unfit for sowing. The lint is stained by the excreta of bugs or by their body juice as they are crushed in the ginning factories.

Control Measures:

1. Cotton field should be ploughed to expose eggs to sunlight.
2. Insects should be hand picked and killed in kerosinised water.
3. The crops of bhendi should be sown as trap crop and pests collected there, should be destroyed.
4. Moistened cotton seeds should be hunged up at different places in the field where bugs congregate, they may get killed in the kerosene mix water.

AGRICULTURAL PESTS & THEIR CONTROL - PRACTICAL NO. 01

Study of Following Insects Pests with respect to marks of identification, nature of damage, economic importance and control measures

(c) Brinjal Fruit Borer :

Class – Insecta
Order – Lepidoptera
Family – Pyralidae / Pyraustidae
Genus – *Leucinodes*
Species – *orbonalis* (Guenee)

Common Name:

Brinjal shoot and fruit borer.

Host Plants:

Brinjal (main) and other solanaceous plants and peas (alternative).

L. orbonalis is the most important and destructive pest of brinjal and has a countrywide distribution.

Identification Marks:

The moths are medium sized of about 20 mm across the spread wings. The head and thorax are blackish brown. The wings are white and provided with small hairs along the apical and anal margins. A number of black, pale and light brown spots are found on the fore and hindwings of the moth. The caterpillars are pale white and about 12 mm long when fully grown.

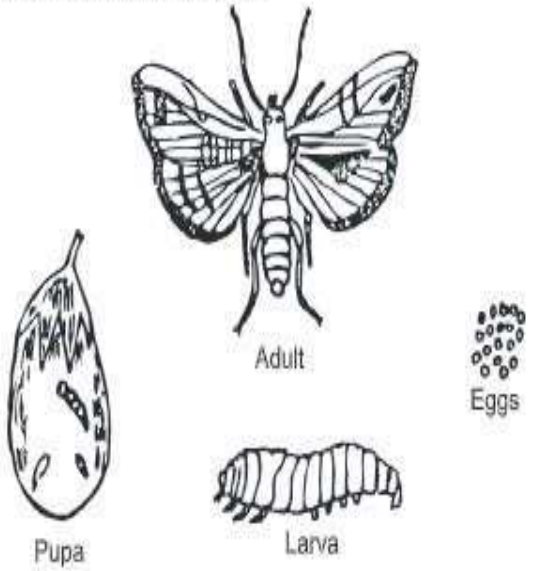


Fig. 3.3: Life history of *Leucinodes orbonalis*

Life Cycle:

The moth lays elongated eggs singly or in small batches, on the leaf surface, shoots and fruits. They hatch in 3-5 days. On hatching the caterpillars start boring into the shoot, leaf midrib, petiole and fruits and feeds on the internal tissues. The larva undergoes 5-moults in 10-15 days. The fifth instar larva is stout pink and measures about 1.6 cm in length. Pupation takes place in a cocoon on the plant and lasts for 6-8 days. Moth lives 2-5 days and the female lays upto 250 eggs. The larva is parasitized by *Pristomerus testaceus* Morl, *Cremastus flauoorbitalis* and Bracon species.

Nature of Damage:

The larval stage is the only destructive stage. In the early stages, the larvae bore into tender shoot as a result the infested shoots droop down and ultimately dry up. The larvae also bore into flower buds and developing fruits under the calyx leaving no visible signs of infestation. The attacked fruits show holes on them plugged with excreta. In case of severe, infestation in the initial stages, there may be no fruiting at all. The pinkish larvae make zig-zag tunnels in the fruits and fruits are holed; such infested fruits are rendered totally unfit for human consumption. Upto 70% loss of crop is caused by this pest.

Control Measures:

1. The affected fruits and drooping shoots, containing caterpillars inside, should be clipped off and destroyed.
2. The crop should be sprayed with suspension/emulsion of any of the following insecticides.

Insecticide	Concentration (%)	Quantity per litre of water
Carbaryl (Sevin) 50 w/p	0.2	4.0 g
Malathion 50 EC	0.1	2.0 ml
Endosulfan (Thiodan) 35 EC	0.1	3.0 ml
Phosalone (Zolone) 35 EC	0.075	2.1 ml

3. The biological agencies like, Braconid wasps (*Bracon chinensis, shirakia schoenobi*) and Inchenumonid wasps (Trathela flavoorbitais) parasitize the larvae of this pest.

Agricultural pests & their control - practical no. 01

Study of Following Insects Pests with respect to marks of identification, nature of damage, economic importance and control measures

(d) Mango Stem Borer :

Class	–	Insecta
Order	–	Coleoptera
Family	–	Cerambycidae
Genus	–	*Batocera*
Species	–	*rubus* (Linn)

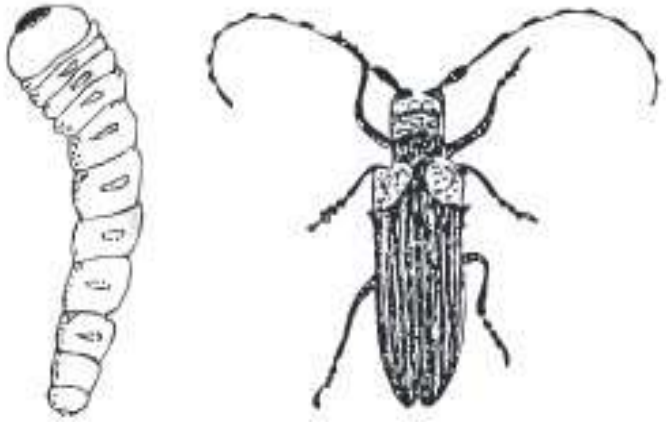
The mango, the king of fruits in India suffers from many serious pests. Among them mango stem borer is the most important. It is very common in Maharashtra and Uttar Pradesh.

Host Plants:

This pest is found on the planted plants like mango, fig, rubber and jack.

Identification Marks:

The adult beetles are well built, large sized, measuring about 5 cm long in length and brownish yellow/grey coloured. It has orange yellow spots on thorax and has hard forewings (elytra); lateral spines on the prothorax and long antennae and legs. The grubs are large, yellowish white in colour, fleshy in appearance and measures about 100 × 18 mm with black head bearing strong mandibles.



(a) Larva (b) Adult

Fig. 3.4: Mango Stem Borer

Life Cycle:

The female beetle lays single egg under the loose bark or in a diseased part of trunk or in the crevices of stems. After the incubation period of 14 to 17 days the egg hatches out. The grubs on hatching penetrate into the stem or even the roots feeding on the woody tissue and make tunnels. The larval stage last for 3 to 6 months; then they pupate in the stem and remain in the pupal stage for 3 to 6 months over winter and the adults generally emerge during the monsoon. Duration of life cycle may extend from 1-2 years.

Nature of Damage:

The grubs make zig-zag galleries beneath the bark and tunnel into the trunks or main stems. As a result of feeding on the internal tissues, the attacked branches and stem die and wither away. Sometimes, frass and masses of refuse exude may be seen on the opening of the bored holes. In severe cases of attack, the branches may collapse and the tree may die.

Control Measures:

1. The population of grubs and pupae of stem borer can be reduced by cutting and destroying the infested branches.
2. The best way to control the grubs is to just inject borer solution (i.e. two parts of carbon disulphide + one part of chloroform and cresole) in the holes after which it should be closed by mud.
3. Pest population can also be effectively reduced by injecting 0.05% spray fluid of the following into the borer holes.

Insecticide	Quantity (ml)/litre of water
DDVP (Dichlorvos) 76 EC	0.7
Endosulfan (Thiodan) 35 EC	1.5
Chlorpyriphos (Durshan) 20 EC	2.5

Immediately after insecticidal treatment the holes must be sealed with mud.

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Agricultural pests & their control - practical no. 02

Study of any teo non- Insects Pests corresponding to theory syllabus

1. CRABS

The crabs have been reported to cause heavy losses to paddy crop in Ratnagiri (Konkan), Thana and Kolaba districts of Maharashtra state.

Three species of crabs are known to damage in our country locally referred as *Khekada, Chimburi* and *Muthya*. All these crabs are polyphagous. They cut the young paddy plants near the ground level and carry them to their burrows for feeding. They are active during night; as they are nocturnal. Besides their crop damaging activity, they prepare a series of burrow in the paddy fields due to which water is not retained in the field. Thus, crab is major crustacean pest of paddy crop, it requires intensive control.

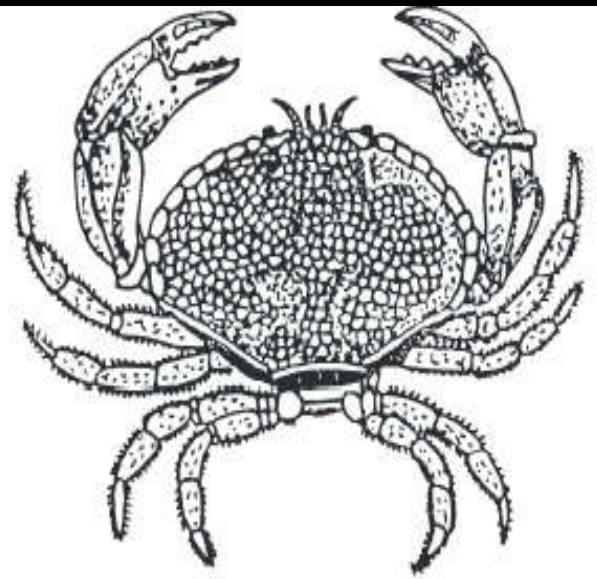


Fig. 3.11 : Crab

Control Measures :

(i) Crab burrows fumigated with the cyanogas dust.

(ii) Poison baiting of 5% DDT + 1% dieldrin or 0.08% endrin with rice syrup or 0.5% endrin or parathion at the rate of 80-100 ml per burrow is quite effective in controlling the crabs.

2. SNAILS & SLUGS

These are non-insect invertebrate *pests* and are herbivorous in habit. The land snails and slugs damage gardens, orchards, green houses and mushroom beds as they feed on sacculent parts of seedlings and mature plants. *Helix spp.* feed on living vegetable matter like leaves and fruits during night, *Pila* suppose to damage paddy fields, and African snail *Achatina fulica* is serious pest of fruits, vegetables and ornamental plants in coastal areas of Orissa, W.B., Assam, Tamil Nadu and Kerala.

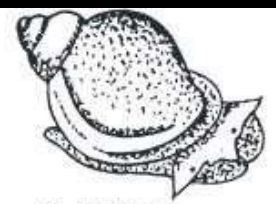


Fig. 3.12 : *Lymnaea*

Snails can cause damage to crops, particularly at the early stages and thus be agricultural pests. Besides this it may be vectors of diseases such as *Schistosomiasis* from veterinary and medical point of view.

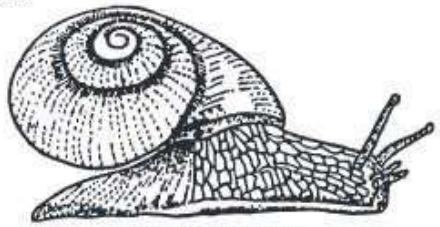


Fig. 3.13 : *Helix*

Control Measures :

The best known chemical control of snails is the use of poison bait with metaldehyde, a polymer of acetaldehyde.

It is toxic to snails by contact as well as ingestion. The chemical immobilises snails and copious slime is exuded out of the body of snails and they die of dehydration. It is applied as bait mixed with bran and the dosage is very low. About 400 gm of metaldehyde mixed with 30 kg of bran is sufficient per hectare will control slugs. Metaldehyde have low mammalian toxicity.

DNOC or dinitro-o-cyclo-hexyphenol reported to be very effective against snails when used as herbicide. Copper sulphate and N-trityl morpholine (frescon) have been found very useful against snails when they are spread on meadows harbouring these animals.

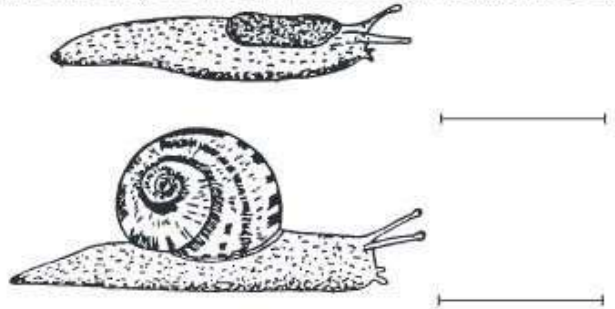


Fig. 3.14 : Miscellaneous Non-insect Group

Course Title: Zoology Practical Paper
Course Code: ZO – 243
Semester - IV (2 credits – 60 Hours)

Animal Diversity - IV

1. Museum study of Class Reptilia: Venomous & Non-venomous snake – Two each. (D)
2. Identification of Venomous & Non-venomous snakes with the help of pictorial taxonomic keys. – (D) -Compulsory
3. Museum study of Class Aves: Crow, Kingfisher& Duck. (D)
4. Study of types of beaks &feets in birds – Any two each. (D)
5. Museum study of Class Mammalia: Rat, Shrew & Bat. (D)

Apiculture –

1. Study of external morphology, life cycle and polymorphism in Honey Bee. (D)
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker, Bee-veil, queen excluder. (D)- Compulsory

Fisheries –

1. Identification, Classification and study of habit, habitat and economic importance of a) Rohu (Labeo rohita), b) Catla (Catla catla), c) Mrigal (Cirrhinus mrigala). (D)
2. Identification, Classification and study of habit, habitat and economic importance of a) Prawn, b) Crab, c) Lobster, d) Pearl Oyster. (D)

S.Y .B. Sc.Zoology PRACTICAL E-SHEETS (2 Credits)

SEMESTER IV (ZO-243)

Animal Diversity - IV

1. Museum study of Class Reptilia: Venomous & Non-venomous snake – Two each. (D)
2. Identification of Venomous & Non-venomous snakes with the help of pictorial taxonomic keys. – (D) -Compulsory
3. Museum study of Class Aves: Crow, Kingfisher& Duck. (D)
4. Study of types of beaks &feets in birds – Any two each. (D)
5. Museum study of Class Mammalia: Rat, Shrew & Bat. (D)

ANIMAL DIVERSITY IV - PRACTICAL NO. 01

Museum Study of Class Reptilia: Venomous & Non-Venomous Snkaes (Two Each)

A. VENOMOUS SNAKES

1. KRAIT OR BUNGARUS

Classification :

Phylum :	**Chordata**	– Dorsal tubular nerve cord, notochord and paired gill-slits are present.
Group :	**Vertebrata**	– Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present; blood red containing R.B.C.
Subphylum :	**Gnathostomata**	– Jaws and paired appendages are present,
Class :	**Reptilia**	– Cold blooded, terrestrial or aquatic vertebrates; single occipital condyle; vertebrae gastrocentrous; respiration by lungs; heart with two auricles and incompletely divided ventricle; right and left aortic arches complete and functional, cranial nerves 12 pairs and embryo with amnion and allantois.
Subclass :	**Diapsida**	– Two temporal vacuities on each side; post-orbital and squamosal usually meet between temporal vacuities.
Superorder :	**Lepidosauria**	– Two temporal vacuities present; anterior orbital vacuities absent; post temporal fenestrae usually present; humerus with two foramina.
Order :	**Squamata**	– Body covered with horny epidermal scales; single supra-temporal vacuity in lizards and none in snakes; teeth pleurodont; quadrate movable; quadrato-jugal absent; vertebrae procoelous; limbs present or absent; cloacal opening transverse ; male possesses a pair of irreversible copulatory organs.
Suborder :	**Ophidia**	– Terrestrial or aquatic, arboreal or burrowing; temporal vacuities entirely absent; limbs absent; rami of mandibles united by a ligament, sternum absent; eyelids immovable; tympanum absent; tongue bifid and protrusible, zygosphene and zygantra present in the vertebraa.

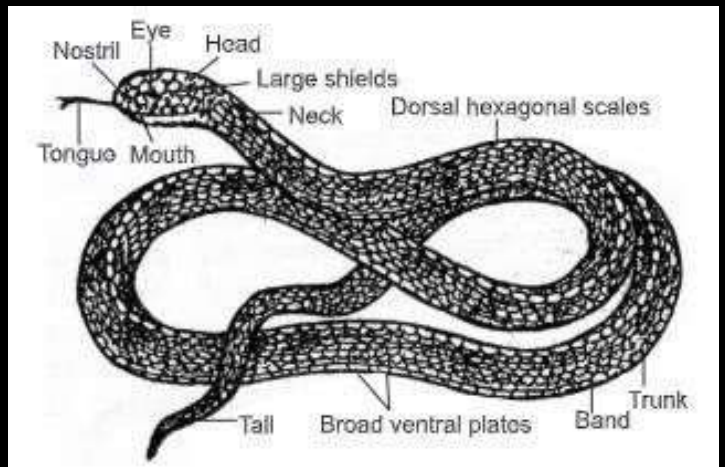


Fig. 4.1: *Bungarus*

Characters:

1. *Bungarus* is commonly called **krait**.
2. Body is elongated and slender, measuring about 1 metre in length.
3. The colour of the body is steel-blue with narrow cross bars or white specks dorsally and the under parts are uniform white.
4. Head with normal shields and is not differentiated from neck.
5. Loreals are absent. Two post-oculars, one pre-ocular and seven supra-labials are present.
6. Third and fourth supra-labials are touching the eye.
7. Eyes are of moderate size with narrow pupils.
8. The scales are smooth and form 13-17 rows. Ventrals are 194-234 and 42-52 caudals.
9. An enlarged chain of dorsal hexagonal scales is present on the dorsal side and ventral scales beyond the anal region are in a single row.
10. Oviparious.
11. Carnivorous, feeding on rats, lizards and snakes.

ANIMAL DIVERSITY IV - PRACTICAL NO. 01

Museum Study of Class Reptilia: Venomous & Non-Venomous Snkaes (Two Each)

A. VENOMOUS SNAKES

2. COBRA (NAJA)

Classification :

Phylum	– Chordata	Characters same as those of *Bungarus*
Group	– Vertebrata	
Sub-phylum	– Gnathostomata	
Class	– Reptilia	
Subclass	– Diapsida	
Superorder	– Lepidosauria	
Order	– Squamata	
Suborder	– Ophidia	
Family	– Elapidae	
Genus	– *Naja*	
Species	– *naja*	

Characters :

1. *Naja naja* is commonly called **Indian cobra** or **nag**.
2. Body is elongated measuring one and a half to two metres in length.
3. The colour of the body is brown or blackish.
4. Body is covered with smooth oblique scales without pits and are arranged in 15-25 rows. The subcaudals form only two rows.
5. Head is not differentiated from the neck. Neck is dilatable and the cervical ribs are elongated. The expansion of the neck and cervical ribs form the **hood**.
6. The upper surface of the hood bears a **binocellate mark** to which people call a mark of **spectacle** or the figure of ten.
7. The lower surface of the hood bears two dark round spots running to four scales surrounded by white lateral pupils.
8. Eyes are very small and with round pupils.
9. Each nostril lies between two nasals and the inter-nasal.
10. Loreal is absent. Frontal shield is truncated. Three postocular scales are present.
11. Third supra-labial is large and touches the eye and the nasal.
12. Poison fangs are followed by 1-3 small teeth.
13. Tail is cylindrical and tapering posteriorly.
14. Oviparious.
15. Carnivorous, feeding on frogs, lizards, rats and other snakes.
16. *Cobra* is **deadly poisonous** and its venom is **neurotoxic** and fatal. When it bites there is light pain and swelling, irritation and death due to respiratory failure.

Geographical distribution : *Naja* is widely distributed from Transcaspia to China and Malay islands. *Naja naja* is found all over India.

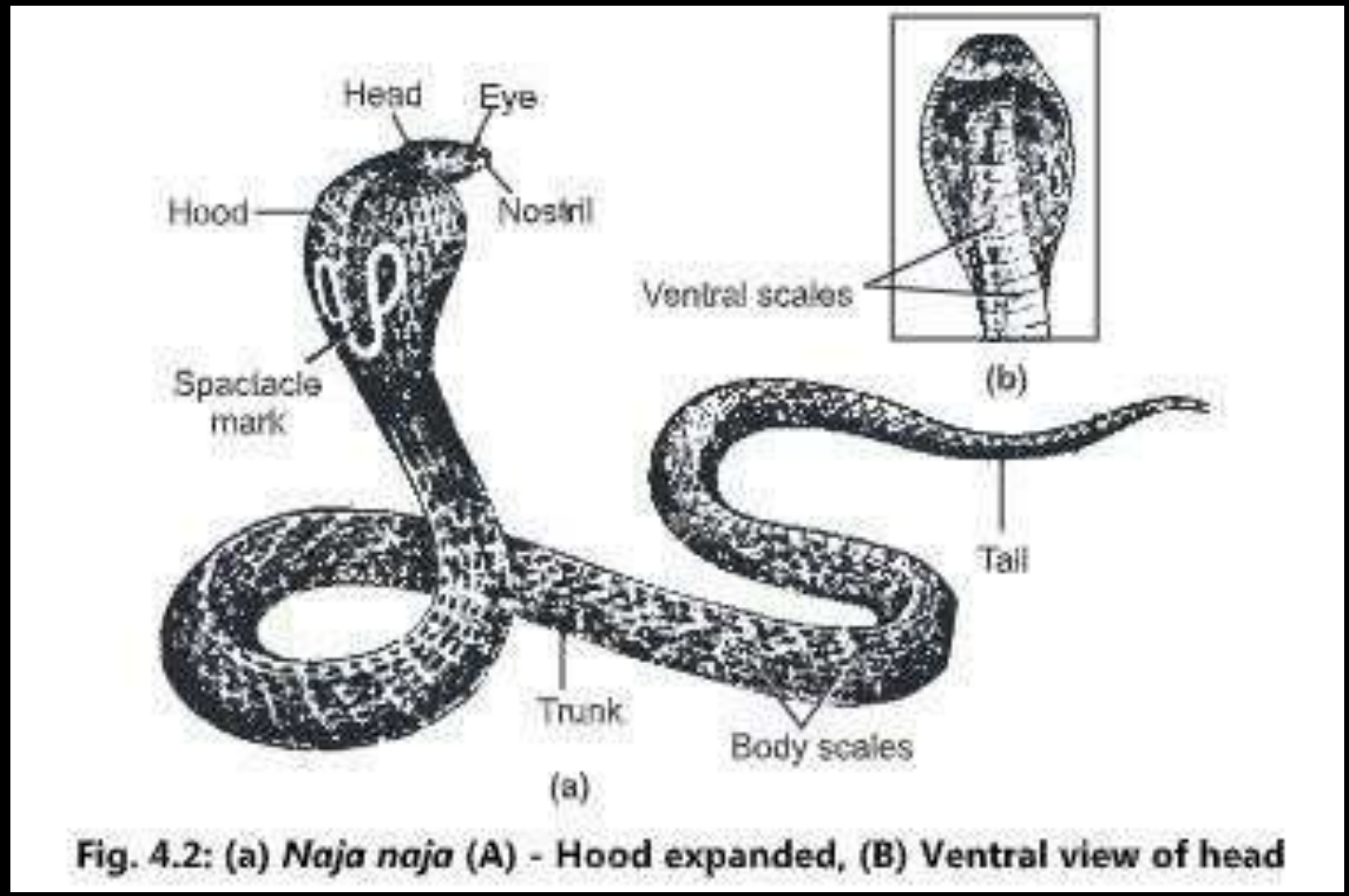


Fig. 4.2: (a) *Naja naja* (A) - Hood expanded, (B) Ventral view of head

ANIMAL DIVERSITY IV - PRACTICAL NO. 01

Museum Study of Class Reptilia: Venomous & Non-Venomous Snkaes (Two Each)

B. NON - VENOMOUS SNAKES

1. Python

Phylum	–	Chordata
Group	–	Vertebrata
Sub-phylum	–	Gnathostomata
Class	–	Reptilia
Subclass	–	Diapsida
Superorder	–	Lepidosauria
Order	–	Squamata
Suborder	–	Ophidia
Family	–	Boidae
Genus	–	*Python*
Species	–	*molurus*

Characters same as those of *Bungarus*

Characters :

1. *Python molurus* is commonly called **Indian python** or **Ajgar**.
2. It is a large, massive and **non-poisonous** snake.
3. It may reach the maximum length of 10 metres and is the biggest and thickest snake of India.
4. It weighs to a maximum of 125 kg.
5. The colour is brown above with rhomboid dark-grey edged spots on the body and ventral side is greyish with yellow-brown spots.
6. The scales are in 60 to 75 smooth rows, the ventrals are distinctly smaller.
7. Head is distinct from the neck and is covered with symmetrical shields or small scales.
8. Presence of a lancet-shaped brown mark on the head.

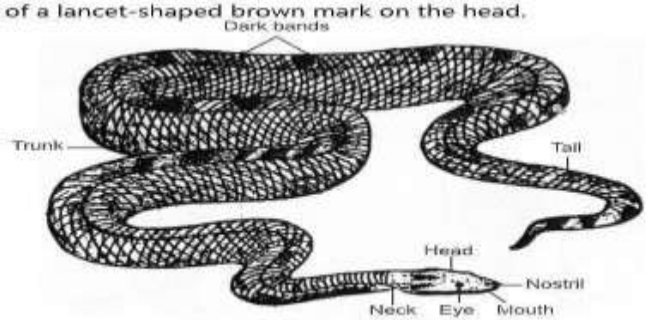


Fig. 4.5: *Python molurus*

2. Rat - Snake

Phylum	–	Chordata
Group	–	Vertebrata
Sub-phylum	–	Gnathostomata
Class	–	Reptilia
Subclass	–	Diapsida
Superorder	–	Lepidosauria
Order	–	Squamata
Suborder	–	Ophidia
Family	–	Colubridae
Series	–	Aglypha
Genus	–	*namenis (Ptyas)*
Species	–	*mucosus*

Characters same as those of *Bungarus*

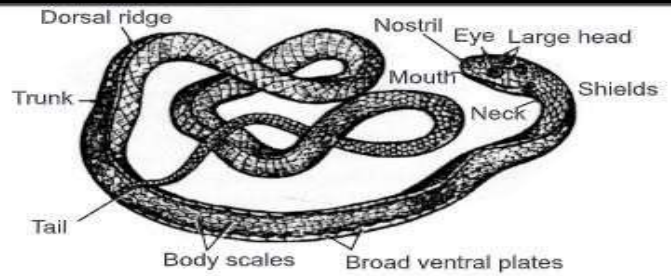


Fig. 4.4 : *Zamenis mucosus*

Characters :

1. *Zamenis mucosus* is commonly called **dhaman** or **rat-snake of India**.
2. It grows to a length of more than two metres.
3. It is brown above often with black cross bands on the posterior part of the body and tail and underparts are yellowish.
4. The scales on the body form 16-17 rows.
5. Presence of a prominent **dorsal ridge** of the back bone along the mid-dorsal line.
6. Head is distinct from the neck.
7. The eyes are large with round pupil.
8. Fourth and fifth supra-labials are touching the eye,

ANIMAL DIVERSITY IV - PRACTICAL NO. 02

Identification of Poisonous & Non- Poisonous Snakes

Aim :

Identification of Poisonous and Non-poisonous Snakes with the help of identification key with two examples of each [D].

Introduction :

The snakes are elongated and limbless reptiles with body covered by scales. A majority of the snakes are non-poisonous and they are beneficial to man since they destroy harmful insects and destructive rodents. There are very few snakes which are deadly poisonous and cause death from snake bite. According to the estimate of World Health Organisation (W.H.O.) every year 1000 to 1200 people die in our country due to snake bite. Majority of people die because of sheer fright about snakes and some due to ignorance and unscientific methods of treatment. Therefore, it is necessary to have the knowledge about snakes, their importance and identification of poisonous snakes from non-poisonous snakes, which can reduce high mortality from snake bite.

Some of the common poisonous snakes of India are Cobra, King Cobra, Krait, Pit viper, Indian Viper, Rattle snakes, Russell's Viper, Coral snakes and Sea snakes. The common non-poisonous snakes are Python, Rat snake, Trinket; Earth snake (Sand boa), Blind snakes. There are also semi-poisonous snakes like Golden Tree snake or flying snake, Green Tree snake, Dog faced water snake.

Poisonous snakes can be identified from non-poisonous snakes by using the following key :

(1) If the snake is a marine with laterally compressed tail, it is poisonous e.g. **sea-snake**.

(2) The terrestrial snake show rounded or cylindrical and not laterally compressed tail. Examine its ventral scales.

(i) If all the ventral scales are small or somewhat broad, then it is non-poisonous snake.

(ii) If the ventral scales are large transverse plates extending fully across the ventral side or belly, the snake may be poisonous or non-poisonous. Then examine the dorsal surface of the head.

(a) If all the dorsal scales of the head are small and uniform it is poisonous and it may be a **viper**.

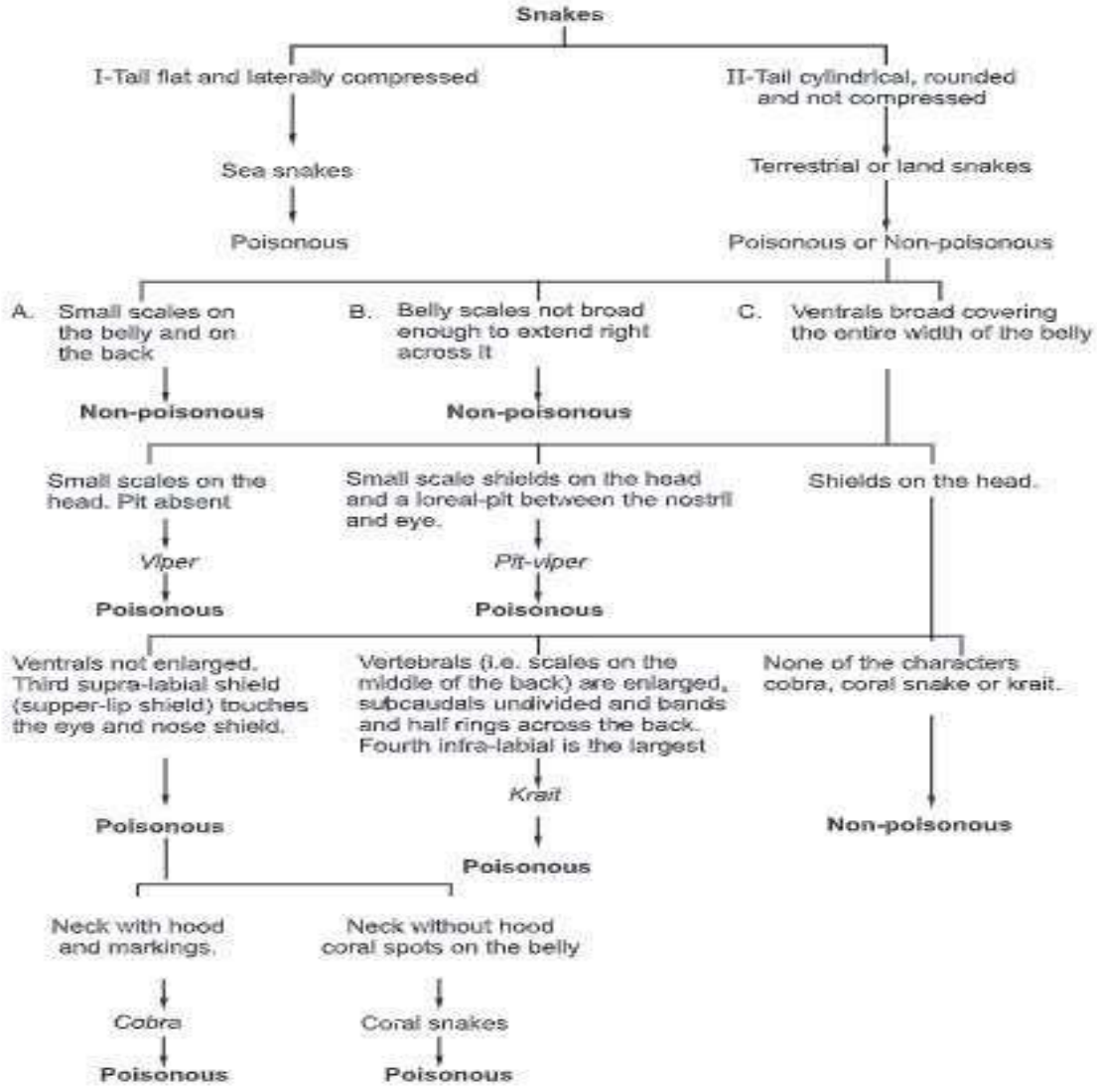
(b) If there is a **loreal** pit between the nostril and the eye, then it is a **pit viper**.

(c) If the subcaudals are double and there is a loreal pit, then it is **Russel's viper**.

(d) If dorsal side of the head has both small scales and large shields, the snake may or may not be poisonous, then examine the lateral side of the head.

(3) If the third supra-labial shield touches the nostril and eye, then it is a poisonous snake, may be **Cobra**, **King cobra** or **Caral snake**.

Key to Identification of Poisonous and Non-poisonous Snakes



ANIMAL DIVERSITY IV - PRACTICAL NO. 02

Identification of Poisonous & Non- Poisonous Snakes

(4) If the dorsal side of the head has both small scales and large shields but there is no loreal pit, and the third supra-labial shield does not touch the eye, examine the back of the snake and ventral side of the lower jaw.

(i) The middle row of scales on the back called vertebral may be larger than other.

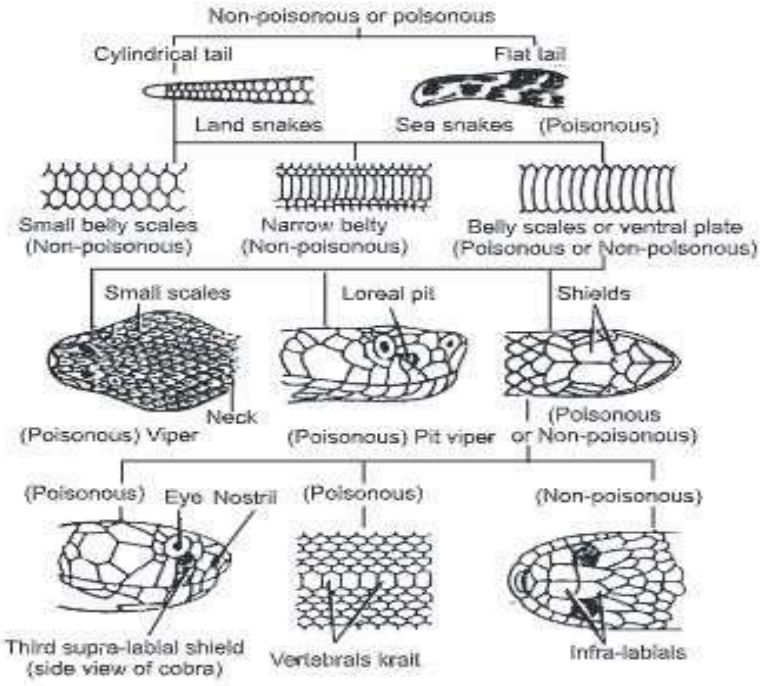
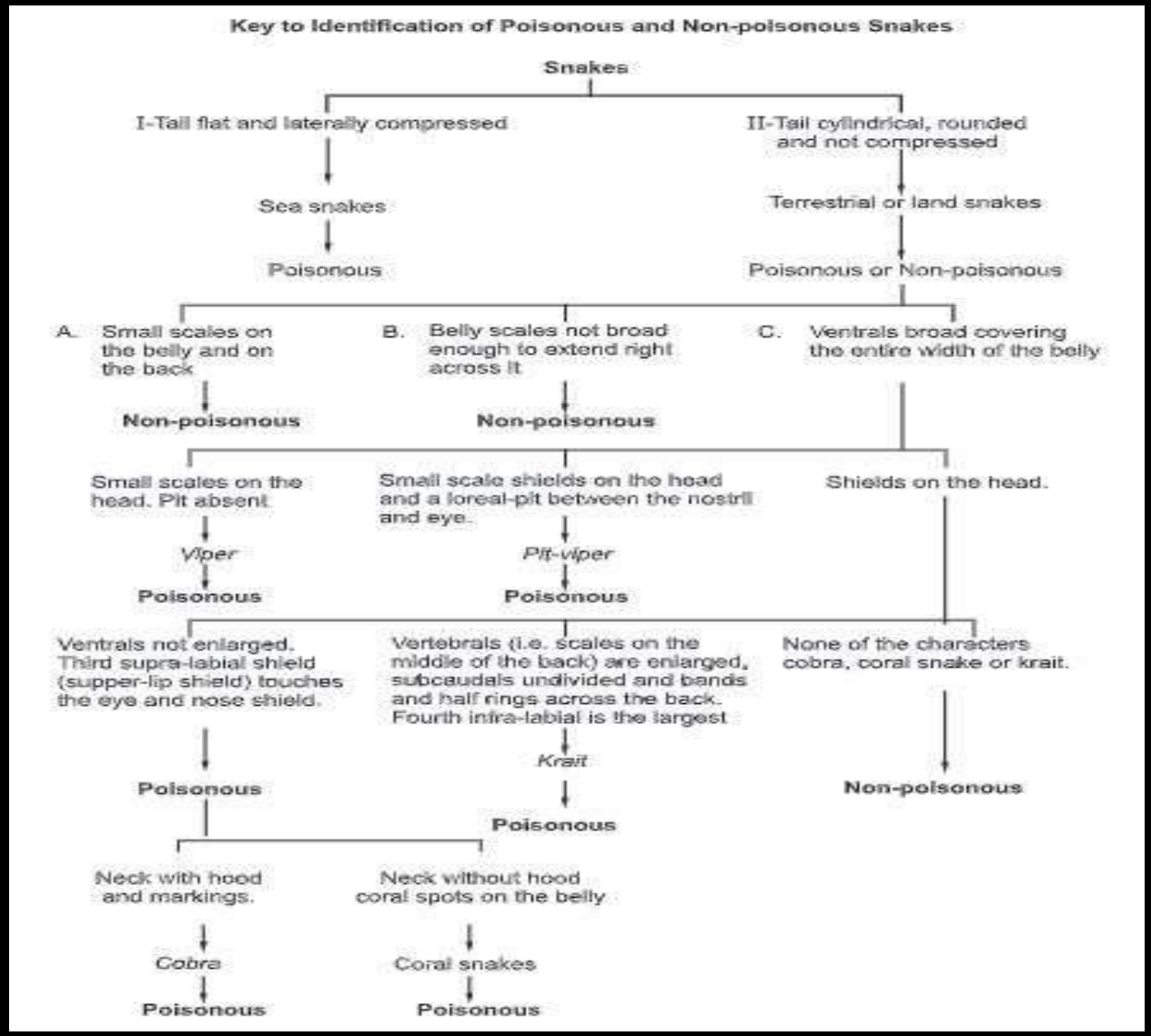


Fig. 4.6 : Key to identification of poisonous and non-poisonous snakes

(ii) On the ventral side of the lower jaw has fourth infra-labial shield larger than the others. If both characters are exhibited by snake, then it is krait.

(5) If the head of snake shows small scales and large shields then it is non-poisonous snake.



ANIMAL DIVERSITY IV - PRACTICAL NO. 03

Museum Study of Crow, Kingfisher & Duck

Aim :

Museum Study of Class Aves : Crow, Kingfisher and Duck.

Classification :

Phylum –	**Chordata**	– Dorsal tubular nerve cord, notochord and paired gill-slits are present
Group –	**Vertebrata**	– Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present; blood red containing R.B.C.
Subphylum –	**Gnathostomata**	– Jaws and paired appendages are present.
Class –	**Aves**	– Warm blooded with an exoskeleton of feathers; forelimbs modified into wings; hind-limbs for walking, perching or swimming; skull monocondylic, modern birds without teeth, a horny beak present; heart four chambered; oviparous; embryo with amnion, allantois and yolk-sac.
Subclass –	**Neornithes**	– Tail short ends in a pygostyle; rectrices are arranged in a semicircle around the pygostyle, teeth absent; metacarpals fused with distal carpals to form carpometacarpus; claws absent in fore-limbs; sternum well developed with a keel; vertebrae heterocoelous.
Superorder –	**Neognathae**	– Skull neognathus; teeth entirely absent; feathers having interlocking mechanism; wings well-developed; sternum with a well developed keel; tail vertebrae are 5 or 6; fore-limbs with metacarpals joined with fingers included in the wings.

1. Crow

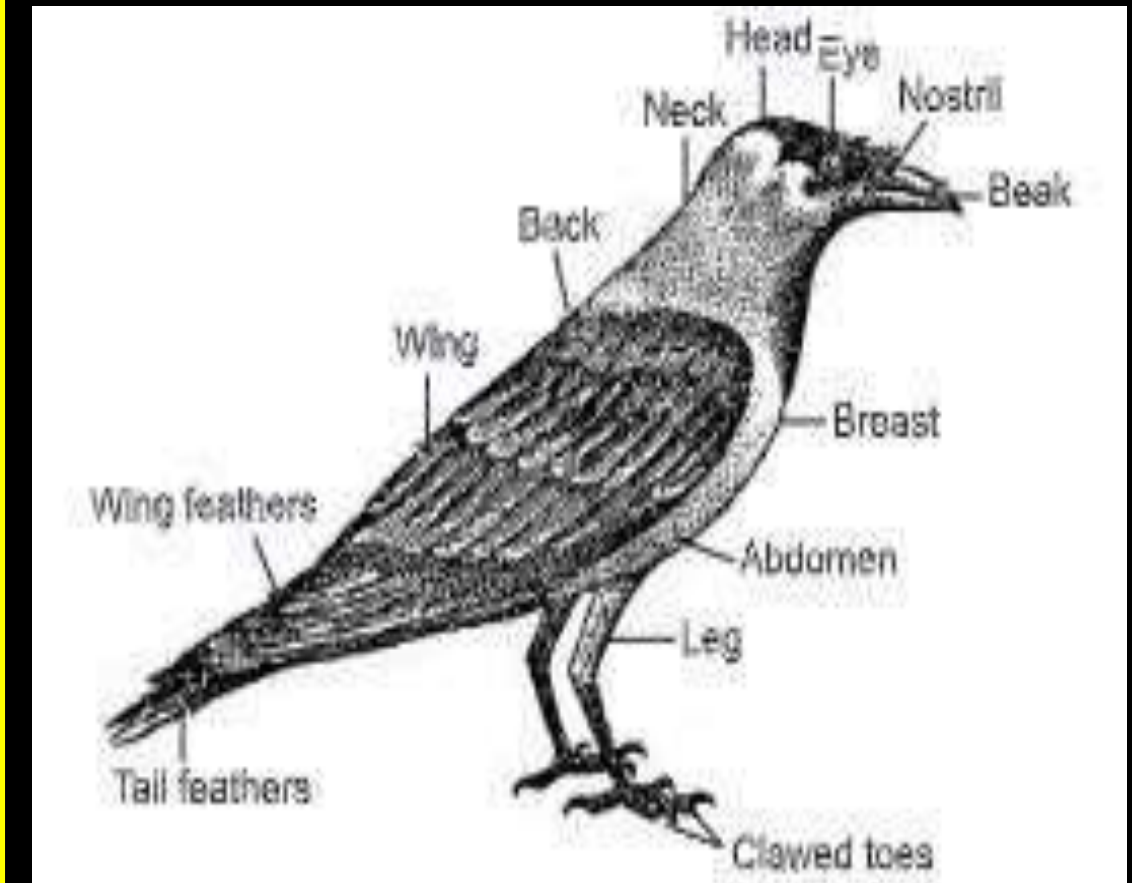


Fig. 4.7 : *Corvus* (Crow)

ANIMAL DIVERSITY IV - PRACTICAL NO. 03

Museum Study of Crow, Kingfisher & Duck

2. Kingfisher

Fig. 4.8: Kingfisher

Classification :

Phylum :	**Chordata**	– Dorsal tubular nerve cord, notochord and paired gill-slits are present
Group :	**Vertebrata**	– Notochord is replaced by vertebral column; two pairs of appendages; closed circulatory system; hepatic portal system present; blood red containing R.B.C.
Subphylum :	**Gnathostomata**	– Jaws and paired appendages are present,
Class :	**Aves**	– Warm blooded with an exoskeleton of feathers; forelimbs modified into wings.
Order :	**Coraciformes**	– Beak is strong, third and fourth toes are fused at the base.
Genus :	***Alcedo***	
Species :	***atthis***	

ANIMAL DIVERSITY IV - PRACTICAL NO. 03

Museum Study of Crow, Kingfisher & Duck

3. Duck

Phylum :	**Chordata**	– Dorsal tubular nerve cord, notochord and paired gill-slits are present
Group :	**Vertebrata**	– Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present; blood red containing R.B.C.
Subphylum :	**Gnathostomata**	– Jaws and paired appendages are present,
Class :	**Aves**	– Warm blooded with an exoskeleton of feathers; forelimbs modified into wings.
Order :	**Anseriformes**	– Beak is broad, covered with soft cornified epidermis. Margins of beak containing many transverse horny ridges (lamellae).
Genus :	***Anas***	
Species :	***Platyrhynchos***	

Fig. 4.9 : Duck

ANIMAL DIVERSITY IV - PRACTICAL NO. 04

Study of types of beaks & feets in birds – Any Two Each

Aim :

Study of Modifications of Beaks and Feet in Birds (Museum Specimen) (D).

Beaks:

1. Water and Mud Probing:

The aquatic birds like **herons**, **king-fishers** have long, powerful and sharply pointed beaks to capture fish, frogs, toads and aquatic animals. In case of cormorants, the beak is long and narrow with the edges armed with sharp backwardly directed teeth like processes for fish capturing whereas in Indian darter or snake bird these saw-like teeth form fine needle like points.

(a) Beak of Cormorant (b) Beak of King-fisher

Fig. 4.10: Water Probing Beaks

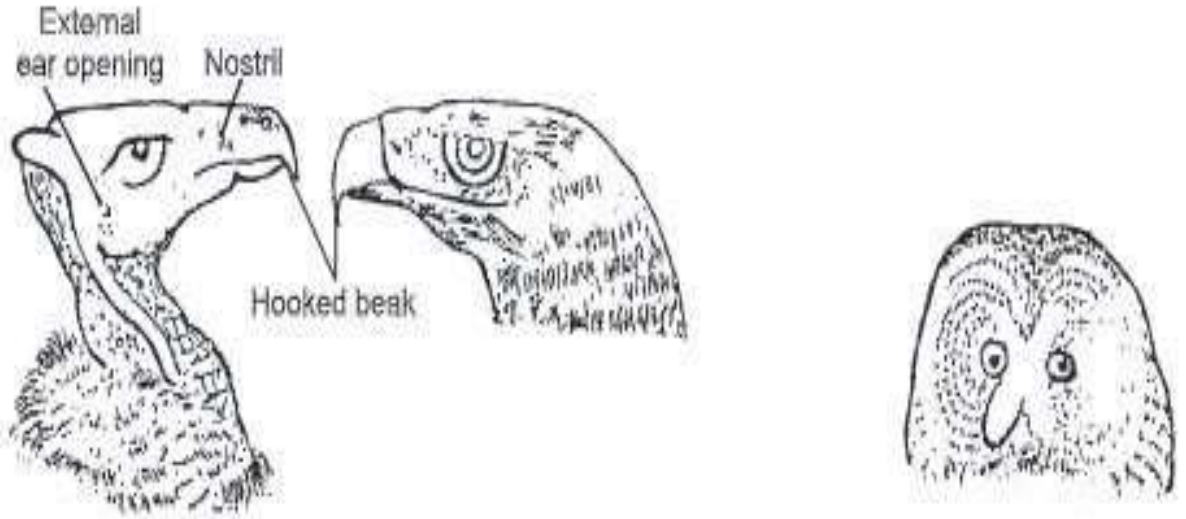
There are several birds which collect their food from the mud. Their beaks are extremely long and slender and slightly curved. These beaks are used as probes for thrusting in the mud for searching the food like aquatic worms, insects and larvae. Mud probing type beaks are found in **stilts**, **sandpipers**, **jacanas**, **lapwings**.

(a) Beak of stilt (b) Beak of Yellow Leg

Fig. 4.11: Mud probing beak

2. Tearing and Piercing:

The carnivorous birds which feed on carrion and flesh. Therefore, they have short, pointed, sharp edged, powerful hooked beaks for tearing flesh. This type of beak is operated by well developed mandibular muscles. Eagle, vulture, owls, kites; hawks are the examples of this type of beaks.



(a) Vulture (b) Eagle (c) Owl

Fig. 4.12: Tearing and piercing type beaks

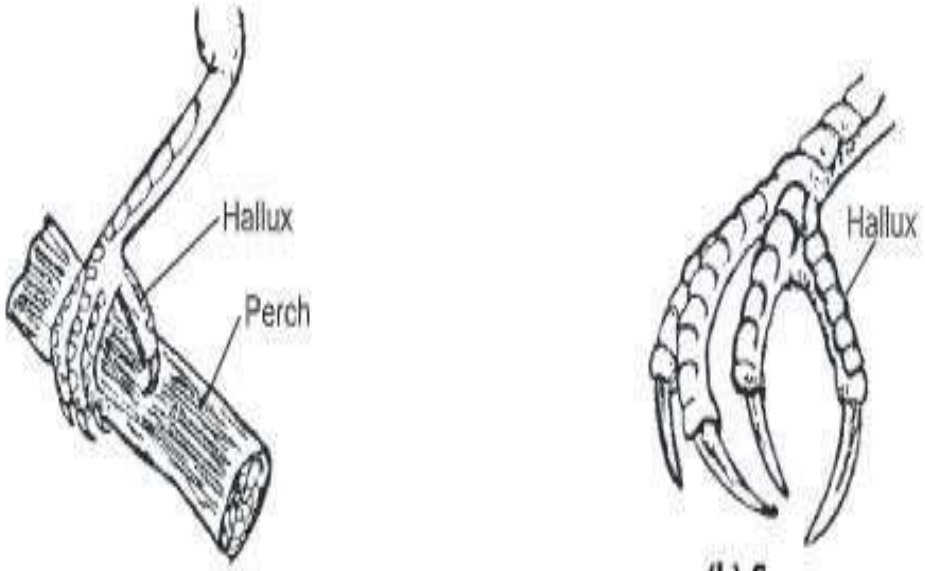
ANIMAL DIVERSITY IV - PRACTICAL NO. 03

Study of types of beaks & feets in birds – Any Two Each

Feet :

1. Perching Feet:

Majority of the birds show perching type of feet. In this type, three toes are directed forward and they are slender. While one toe or hallux is posterior which is strongly opposable so that they can securely fasten the foot to a branch or a berch? The feet possess long and powerful ankle bones, digits and sharp, oval and curved claws i.e. crow and sparrow.

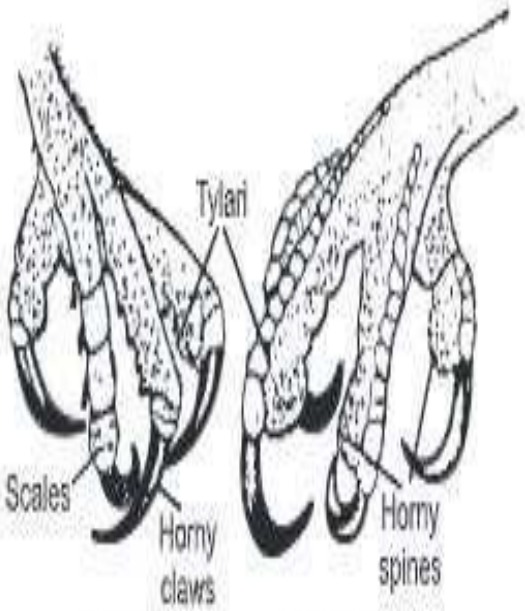


(a) Jungle Crow (b) Sparrow

Fig. 4.15: Perching Type of Feet

2. Raptorial Feet:

These feet are the peculiarity of the carnivorous, predatory birds like **kite**, **eagle**, **owls** etc. These birds bear such type of feet for striking and grasping their prey. The toes are armed with strong, sharp and curved claws. All the four toes are present and the hallux is strongly developed. The underside of toes show presence of large and fleshy bulbs called tylari. They are found in **sparrow** and **hawks**. In **osprey** instead of tylari, horny spines are present. These spines are useful in gripping slippery preys such as fish and frog. This type of feet is modified for grasping and holding the prey.



(a) Owl (b) Osprey

Fig. 4.16: Raptorial Feet

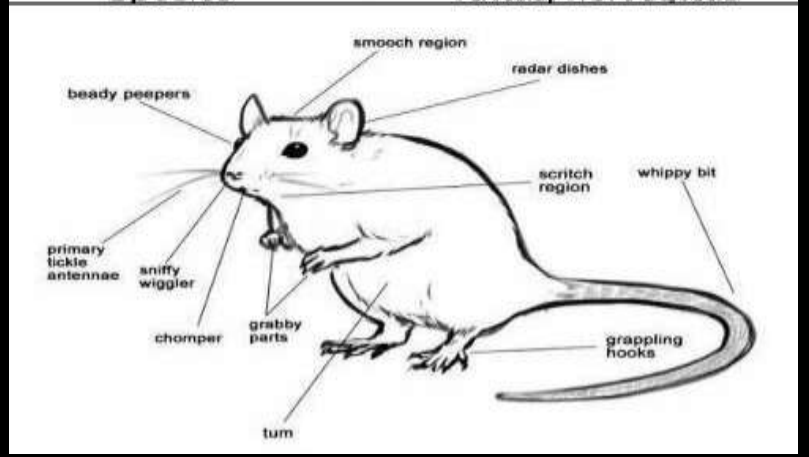
ANIMAL DIVERSITY IV - PRACTICAL NO. 03

Museum Study of Class Mammalia: Rat, Shrew and Bat

1. Rat

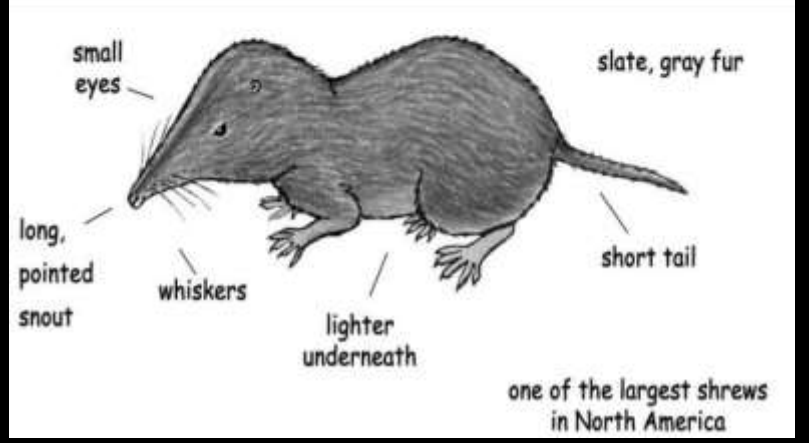
Systematic Position :

Phylum	-	Chordata
Sub-phylum	-	Vertebrata
Branch	-	Gnathostomata
Grade	-	Tetrapoda
Sub-grade	-	Amniota
Class	-	Mammalia
Sub-class	-	Placentalia
Older	-	Rodentia
Genus	-	*Rattus*
Species	-	*rattus, norvegicus*



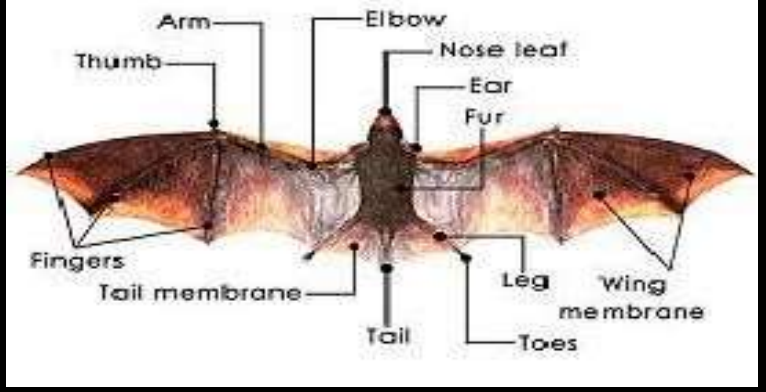
2. Shrew

Phylum	–	Chordata
Group	–	Vertebrata
Subphylum	–	Gnathostomata
Class	–	Mammalia
Subclass	–	Theria
Infraclass	–	Eutheria
Order	–	Insectivora
Genus	–	*Sore*
Species	–	*araneus*



3. Bat

Phylum	–	Chordata
Group	–	Vertebrata
Subphylum	–	Gnathostomata
Class	–	Mammalia
Subclass	–	Theria
Infraclass	–	Eutheria
Suborder	–	Microchiroptera



Apiculture –

1. Study of external morphology, life cycle and polymorphism in Honey Bee. (D)
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker, Bee-veil, queen excluder. (D)- Compulsory

APICULTURE - PRACTICAL NO. 01

Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

Aim :

(a) To study external morphology, life cycle and polymorphism in Honey Bees (D).

Aim :

(a) To study external morphology, life cycle and polymorphism in Honey Bees (D).

Systematic Position :

Kingdom	–	Animalia
Group	–	Invertebrata
Phylum	–	Arthropoda
Class	–	Insecta/Hexapoda
Sub-class	–	Pterygota
Division	–	Endopterygota
Order	–	Hymenoptera
Family	–	Apidae
Genus	–	*Apis*
Species	–	(i) *mellifera*
		(ii) *indica*
		(iii) *florea*
		(iv) *dorsata*

(a) External Morphology of Worker bee :

The worker bee is smallest member of the colony. It is black brown in colour and entire body is densely covered with hairs. The body of worker bee is divided into three regions, *Head, Thorax and Abdomen.*

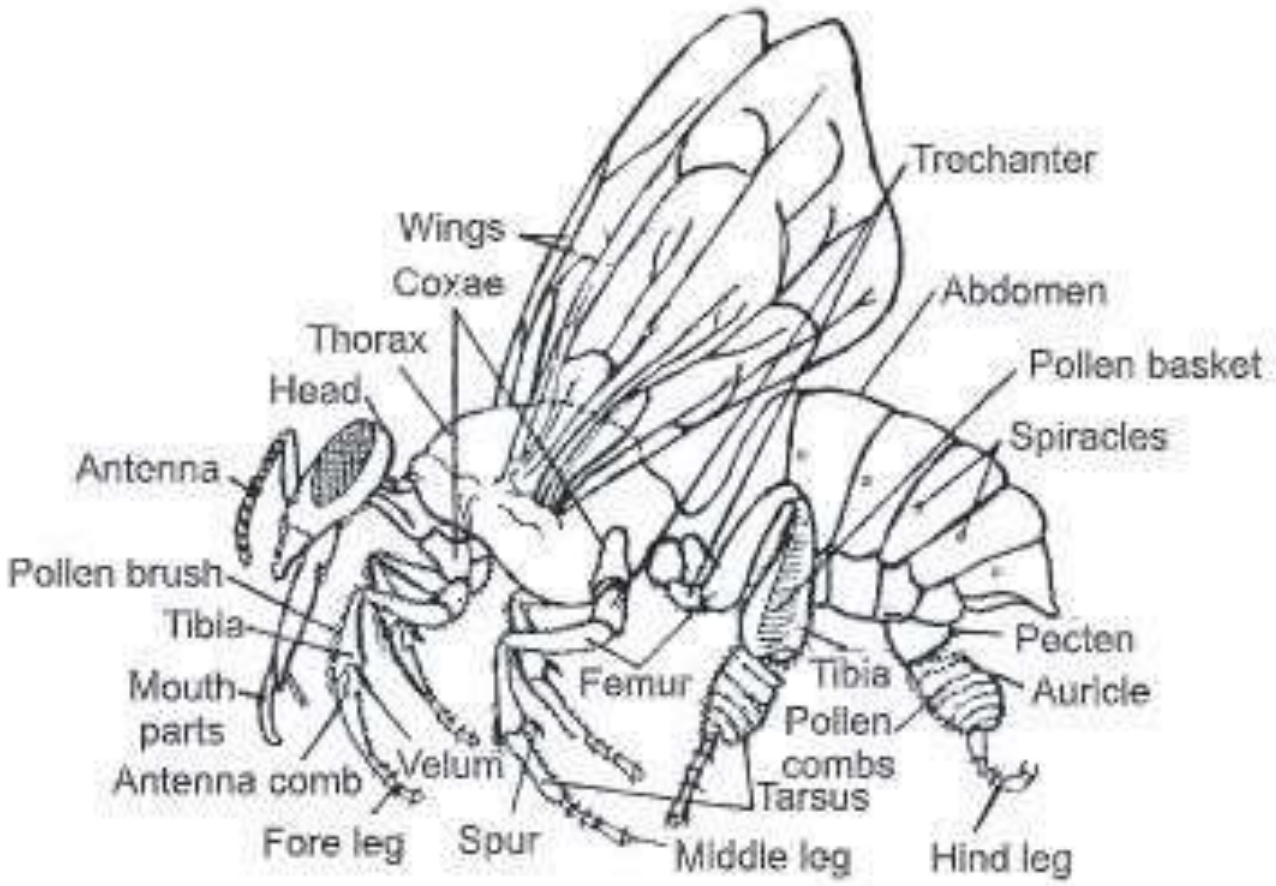


Fig. 5.1 : *Apis sp.* External morphology, lateral view

APICULTURE- PRACTICAL NO. 01

Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

Head :

The head is triangular, flattened, broader on dorsal side and narrow ventrally. The head bears dorsoventrally large compound eyes and three ocelli in the middle of face. A pair of freely movable antennae is arising in the middle of the head. Each antenna is jointed, having three segments, scape, pedicel and flagellum with olfactory pits for sense of smell. Below the bases of antennae there is large plate called clypeus to this labrum is attached to lower margin. Behind the labrum are two mandibles, below this two maxillae and medium labium is seen. On the back side of head shows a central opening called occipital foramen.

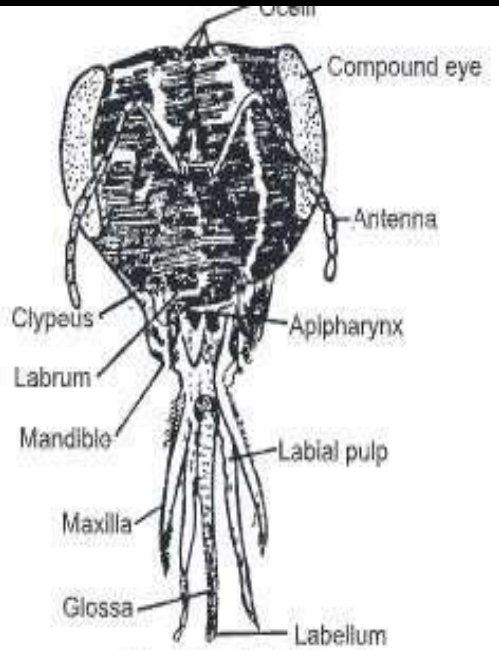


Fig. 5.2 : *Apis*. Head

Mouth Parts :

These are attached to the lower part of head. The mouth parts are *biting* and *sucking* type. It consists of labrum, epipharynx, mandibles, maxillae and labium.

(a) Labrum : Large plate like attached to lower margin of clypeus.

(b) Epipharynx : It lies below the labrum. Fleshy in appearance. Epipharynx is an organ of taste.

(c) Mandibles : These are two in number and lies on the sides of labrum. The mandibles of worker are spoon shaped, thick at the base and narrowed through the middle. At the base of mandibles, mandibular glands open. Mandibles are equipped with abductor and adductor muscles which work sidewise. Mandibles are useful to gather pollen and mould the wax.

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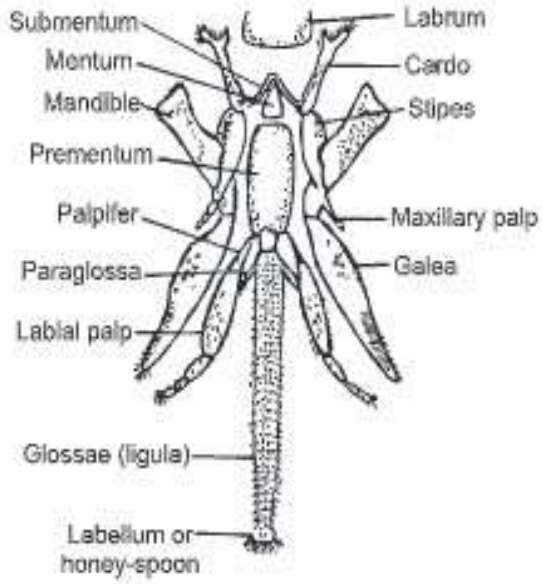
(c) Mandibles : These are two in number and lies on the sides of labrum. The mandibles of worker are spoon shaped, thick at the base and narrowed through the middle. At the base of mandibles, mandibular glands open. Mandibles are equipped with abductor and adductor muscles which work sidewise. Mandibles are useful to gather pollen and mould the wax.

Maxillae : It lies beneath mandibles. The lacinia is absent in maxillae while the maxillary palps are vestigial and the galea is elongated and blade-like.

Labium : The labium shows strongly reduced paraglossae but the glossae are very much elongated. They are united, hairy and form a honey-spoon called *labellum* at the terminal part. The labial palps are well developed and help to make the ligula up. The apparatus is well surrounded by the galeae of maxillae.

At the time of nectar feeding, the labium and maxillae come together to form



APICULTURE- PRACTICAL NO. 01

Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

Thorax : The thorax is large and strong. It is composed of four segments, namely : prothorax, mesothorax, metathorax and propodeum. Each segment has three sclerities i.e. turgum (dorsal plate), sternum (ventral plate) and pleuron (side plates).

Thorax bears two pairs of wings and three pairs of legs.

Wings : The wings are small, narrow, membraneous and transparent. They lie flat over the back at rest. Wings show modified and reduced wing veination. The fore and hind wings are interlocked by hooks (*hamuli*) so as to work together during flight.

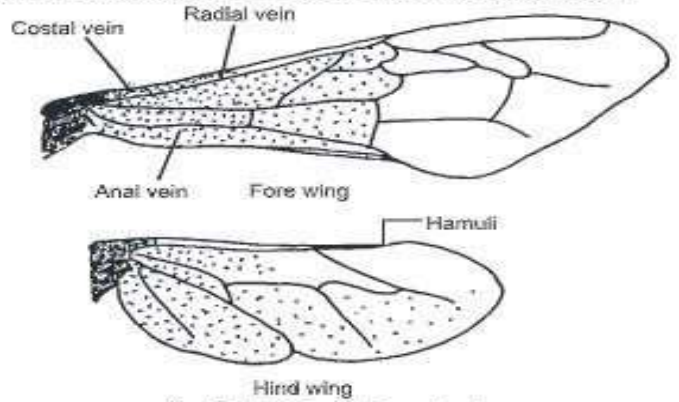


Fig. 5.4 : Wings of worker bee

Legs : There are three pairs of legs, i.e. prothoracic, mesothoracic and metathoracic shows progressive increase in length from 1st to 3rd pair. Legs are densely covered with hairs. Each leg consists of five parts viz. *coxa, trochanter, femur, tibia* and *tarsus*. The tarsus is five joined and ends into the *claws* and pulvillus.

Abdomen :

The abdomen of worker bee is oval and posterior most region of the body. It has six visible segments i.e. II to VII because the first segment (propodeum) transferred to thorax and remaining is reduced. Each visible segment has large dorsal tergum, and smaller ventral sternum. The successive terga and sterna are connected by intersegmental membrane. The posterior part of abdomen is modified into sting apparatus and wax gland on ventral surface of abdomen.

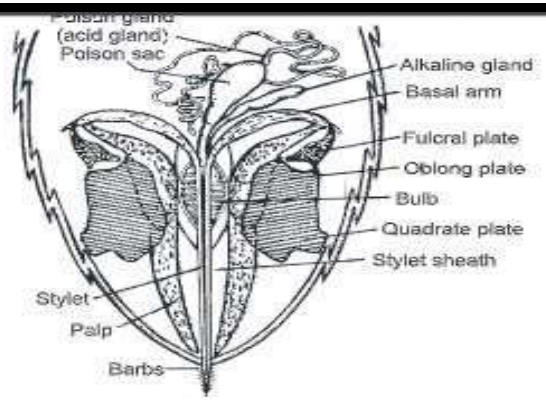


Fig. 5.8 : *Apis sp.* Poison apparatus

(a) Prothoracic leg : Number of stiff bristles are present on the anterior face of tibia distally, which forms *pollen brush*. On the posterior face of tibia have movable plate-like process called *velum*, which fits over a circular notch in the upper part of the first tarsal segment. The velum and antena-comb together serve as antenna cleaners.

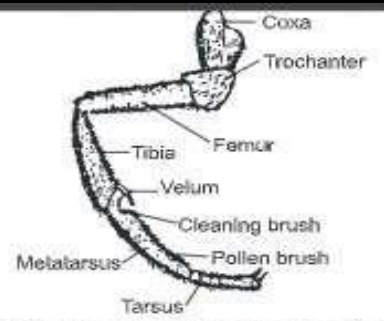


Fig. 5.5 : Honey bee legs. Prothoracic leg

Eye brush is present on the anterior surface of first tarsal segment which is used for removing pollen and other particles from the surface of compound eyes.

(b) Mesothoracic leg : The mid leg shows usual segments. The tibial segment bears a brush on its inner surface and a spine-like *pollen-spur* on its distal end. The spurs are used to remove pollen from the pollen baskets of hind-legs and to dislodge wax from wax pockets on the ventral surface of the abdomen.

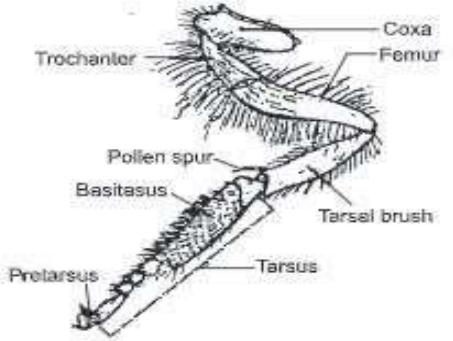


Fig. 5.6 : The mesothoracic leg

(c) Metathoracic leg : Each metathoracic leg has a large tibia with a cavity with bristles forming a *pollen basket* i.e. a depression on the outer surface of tibia, used for storing pollens during collection. At the distal end the tibia has a row of stiff bristles called *pectins* below which has a flat plate, known as *auricle*. The pectin and auricle form a *pollen packer* to convey packed pollens into the pollen basket.

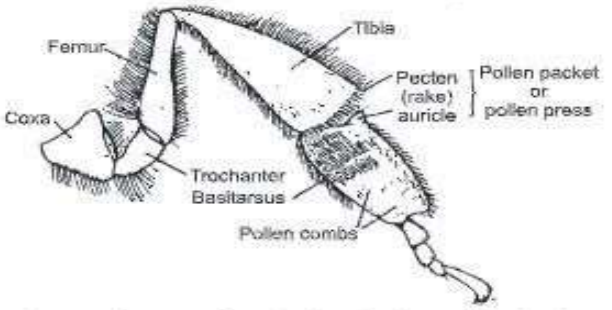


Fig. 5.7 : The metathoracic leg showing pollen basket

APICULTURE- PRACTICAL NO. 01

Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

(b) To study the life cycle of Honey bee *Bombyx mori* (D).

The honey bee shows complete metamorphosis and thus termed as holometabolous insect. The queen is functional female. The life cycle consists of egg, larva, pupa and adult.

Nuptial flight :

A virgin queen takes her first aerial flight followed by a swarm of drones on warm, sunny days and mates with queen during which she receives spermatophores from the drone and stored in spermatheca to fertilize her eggs as long as she lives. The queen after mating returns to the hive. The drone is always killed in the act of copulation, since he can eject the sperm by generating great pressure in his abdomen with the help of muscles and fluid pressure of blood.

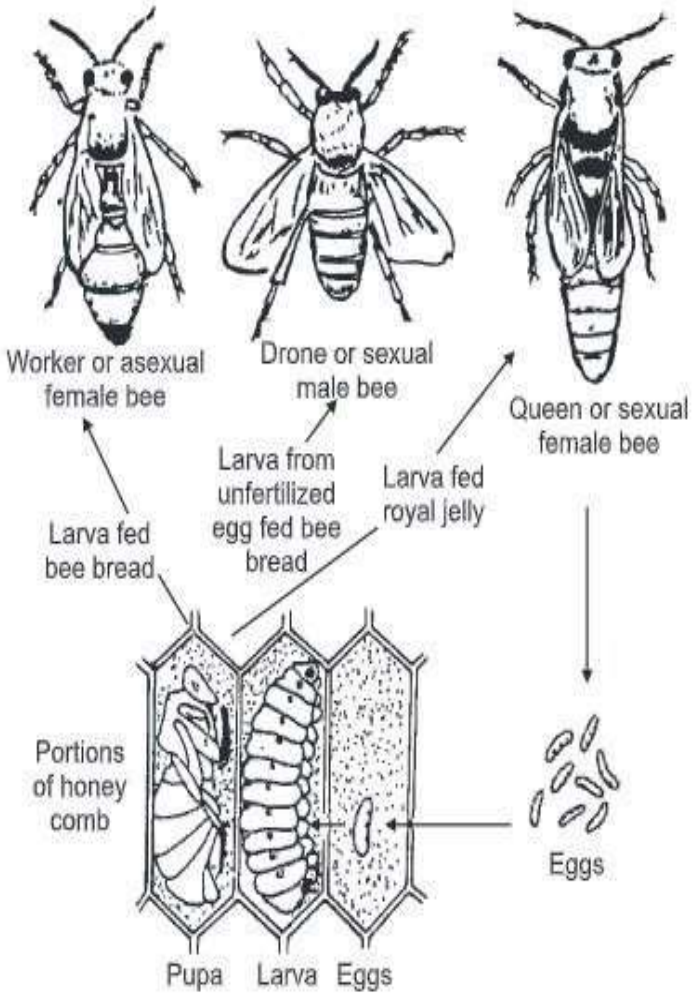


Fig. 5.9 : *Apis.* Life Cycle

Egg :

Egg laying starts after 3 days of copulation. The eggs are pinkish, elongated, cylindrical and generally attached at the bottom of the cell at the junctions of any two walls. The eggs are of two types – fertilized eggs develop into queen and workers and unfertilized egg develop into drones. Queen lays about 1500 egg per day. The egg hatch in 3 days into white, legless grubs from the fertilized as well as unfertilized eggs.

Grub :

The larvae are minute, white, apodous (legless) and with no eyes. For the first 3 days all larvae are fed on *'royal jelly'* which is produced by pharyngeal glands of young workers. After 3 days, worker and drone bees larvae are fed on a mixture of honey and pollen called *'bee bread'* but the larvae of queen are continuously fed on royal jelly. Type of food supply determines the caste. The grub grows and moults several times, then cells are sealed with a wax cap.

Pupa :

Grub transformed into a pupa in the sealed chamber. The wax lid is porous and allows exchange of air for respiration. The pupa spins a thin silken cocoon around itself and pupates completely. Pupa undergoes metamorphosis i.e. change of legless, wingless and eyeless worm like form into a winged insect with legs and eyes. The pupa is exarate type (i.e. the legs are free not adhered to the body). The worker, drone and queen pupae can be distinguished by examining the distance between eyes. In case of drone, eyes meet over the head and in worker and queen the eyes are far apart. After the pupal period is over the sealed pupae becomes tan and finally light brown in colour and the lid of cell is cut-off by the young bee, with jaws. After few hours later the pupal cuticle breaks and the adult bee emerges out.

Apiculture- practical no. 01

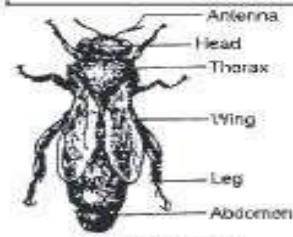
Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

Adult :

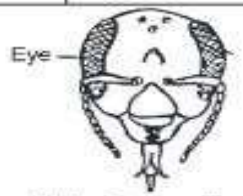
The emerged adult chew away the cell cap and crawls out to join the other bees as a member of the hive. The morphological features are described in tabular form (Table 5.1). Emergence of the young ones takes place after 3 weeks and they get busy in the indoor duties for about 2-3 weeks. Later on they are sent for the outdoor duties.

Table 5.1 : Morphological feature of three caste of a honey bee

	Drone	Worker	Queen
1.	Eyes meet over head.	Eyes far apart.	Eyes far apart.
2.	Abdomen black, rectangular, blunt and without sting.	Abdomen stripped, triangular with barbed sting.	Golden (*A. florea*) or black (*A. indica*) triangular but more elongated.

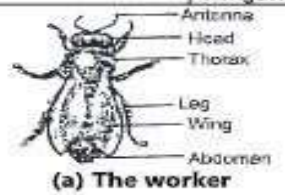


(a) The Queen

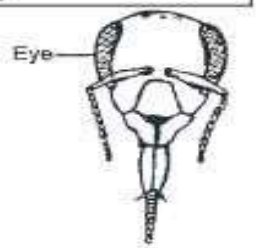


(b) Front view of head of the queen

Fig. 5.10

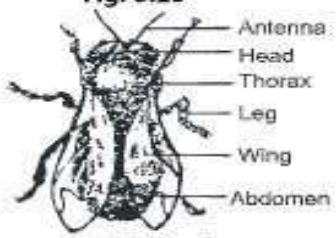


(a) The worker



(b) The front view of head of worker

Fig. 5.11



(a) The Drone

(b) Front view of head of drone

Fig. 5.12

Table 5.2 : Periods of development of different castes of honey bees

	Duration in days			
Caste	**Egg**	**Larva**	**Pupa**	**Total**
Queen	3	5	7-8	15-16
Worker	3	4-5	11-12	18-20
Drone	3	5-7	13-14	21-24

Apiculture- practical no. 01

Study of External Morphology, Life Cycle & Polymorphism in Honey Bees

(c) Study of Caste System (Polymorphism) in honey bee (D).

A highly organized system of division of labour is found in colony of bees. The colony is highly polymorphic, comprising three castes – queen, workers and drones. In a normal colony, there is one queen (functional female), 25,000 to 35,000 workers (sterile female) and 300-500 drones.

(a) The queen : The queen is only perfectly developed fertile female. She is true mother of colony with well developed ovaries. The queen is 15-20 mm in length and can be easily identified by her long tapering abdomen, short legs and weak wings. She is unable to produce wax or honey and gather pollen and nectar. Egg laying is the sole function of the queen and lay about 1500 eggs in a day. She feeds on Royal jelly. She lives for about 3-3$^1/_2$ years and lays about 15,00,000 eggs during her life span. Queen lays fertile and unfertile eggs.

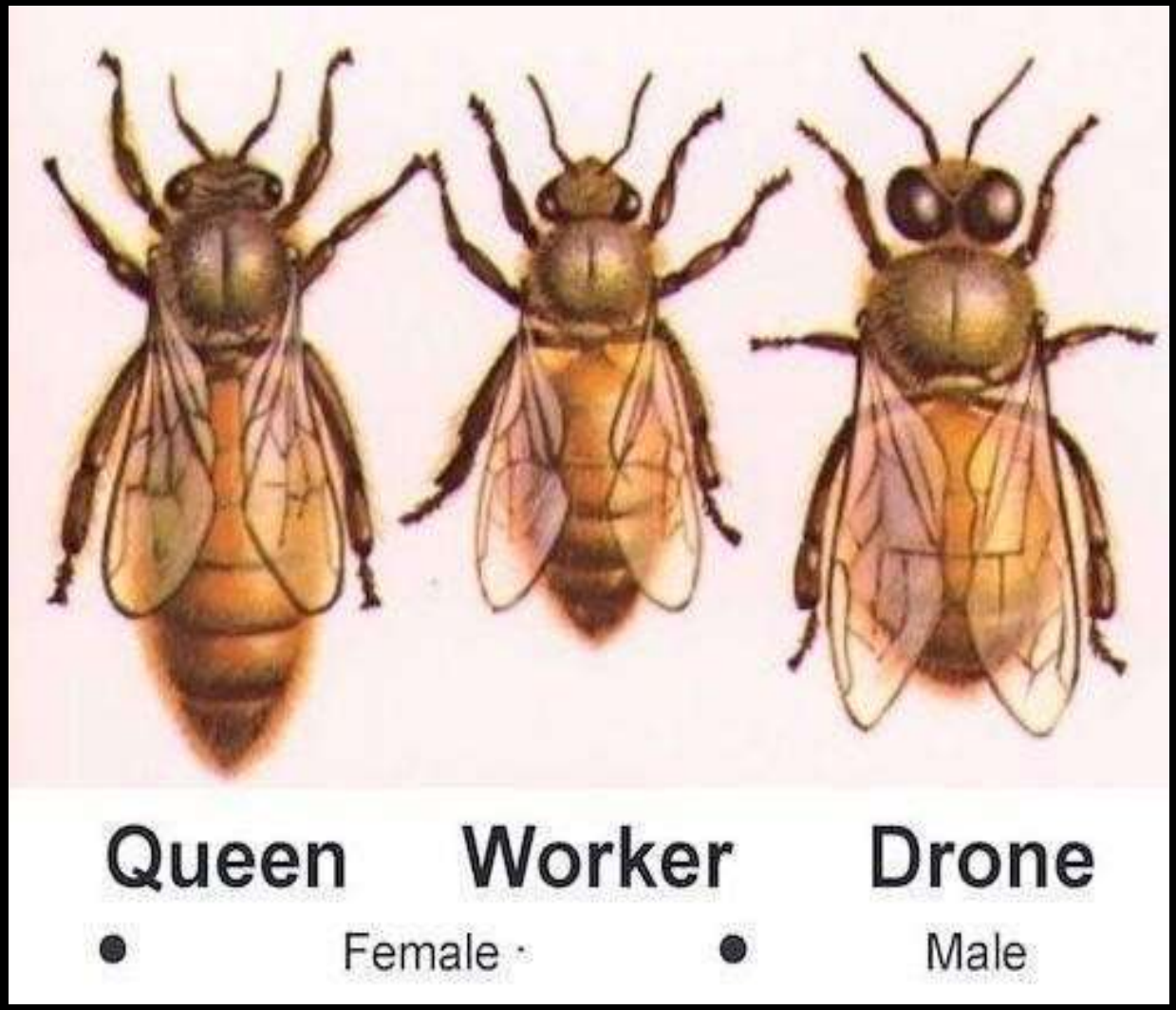
Queen secretes 'Queen substance' which is most important in the maintenance of a colony and its social organization.

(a) Queen (b) Worker (c) Drone

Fig. 5.13 : *Apis spp.* Polymorphism

(b) Workers : Workers are imperfectly developed females. These are smallest in size but play very important role in the colony. They are raised in cells known as "worker cells". Workers are unable to reproduce; but possess all maternal instincts. They have powerful wings, wax glands on ventral side of the abdomen, a pollen basket on third legs, mandibles for work in hive and full-fledged sting. They are responsible for all the work necessary for the maintenance and welfare of the colony. The average life span of workers is 50 days during which period they perform different types of work. First half of her life she attends "*indoor duties*" such as secretion of "royal jelly" feeding of the brood, feeding the queen, secreting bees wax, building combs, cleaning, ventilating, cooling and guarding the hive, etc. During the second half of her life, she attends *outdoor duties* as collects the nectar, pollen, propolis and water which are received and stored properly by the house bees.

(c) The drones : The drones are the male members of the colony. These are raised in drone cells in 24 days. Their only function is to fertilize the queen during the nuptial flight when only one of them copulates with the queen and dies immediately thereafter. The drones are unable to gather food, but they eat in enjoying the sun and fresh air. Drones are driven out of the hive to die of starvation before monsoon and winter. Drones are dependent and begging honey from the workers. During the swarming period, the drone follows the queen, copulates and dies after copulation.



Apiculture- practical no. 02

Bee Keeping Equipment- Bee Box, Honey Extractor, Smoker, Bee-Veil, Queen Excluder

Bee Box

1.

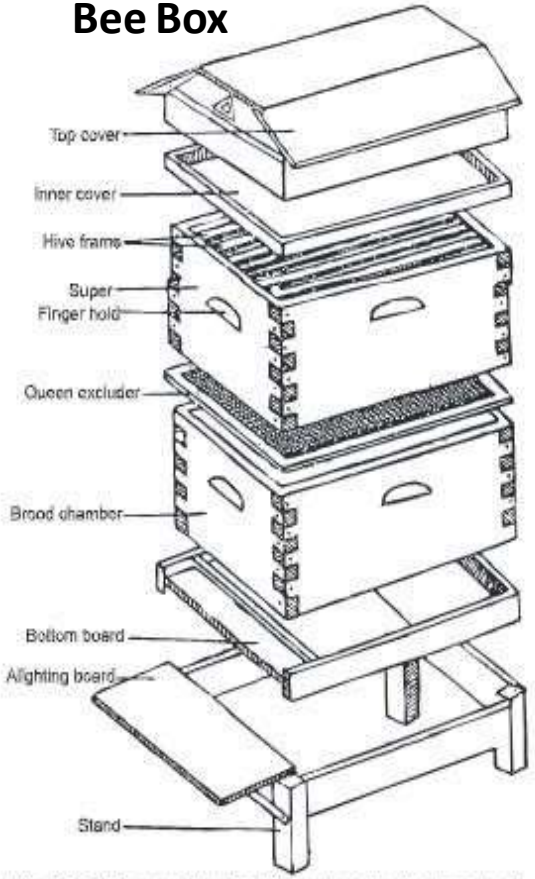


Fig. 5.15 : Diagram showing different parts of a Langstroth frame hive (see text for descriptions)

(iii) Bottom bar : Each is 17 – 5/8" long, 3/4" wide and 3/8" thick.

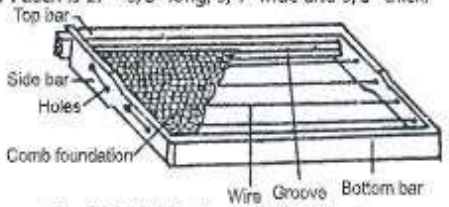


Fig. 5.16 : (a) Hoffman self-spacing type

The details of construction are as follows :

1. Stand : It is any, four legged structure (stand), 6-9 inches high, with dimensions to support the floor-board; on which the whole hive is constructed. The stands are adjusted to make slope for the hive, which drain off rain water. The main purpose of stand is to support the box and to prevent entry of ants and other insects.

2. Bottom Board : It is situated above the stand and forms the proper base for the hive having two gates in the front position. One gate is used as an entrance whiles the other as exit for bees. It can be constructed either by taking a piece of wood 22" long, 16"/4" broad and 7/8" thick or by joining two wooden boards together, nailing them in position with "wooden rods". Along each end of the longer side is nailed a 'wooden rod' 22" long, 7/8" broad and 7/8" thick and another "wooden rod" $14\frac{1"}{2} \times 7/8"$ is nailed at the back and this has an entrance 3" long and 3/8" deep in its middle.

Fig. 5.14 : A double walled Langstroth hive with supers

3. Brood Chamber : The bottom board carries the brood chamber which is the most important part of the bee hive. Brood chamber is a rectangular box without top and bottom. It is prepared of thick wood of 7/8" thick. Brood chamber is 20" from outside and $18\frac{1"}{4}$ from inside in length. Its breadth is $16\frac{1"}{2}$ on the outside and $14\frac{1"}{2}$ on the inside and its height is $9\frac{1"}{2}$. A rabbet (scooped shelf) 5/8" deep and 1/2" wide is cut along the entire of the box to receive the ends of the top bar of the hive frames. The number of brood boxes could be increased to 2 when the colony becomes strong. It is provided with 10 frames.

4. Standard Langstroth Frame : Each wooden frame composed of a top bar, two side bars and a bottom bar. There are two types of frames : (i) Hoffman type (ii) Staple type.

(a) Hoffman type (Self-spacing frame) :

(i) The top bar is 19" long, 1" wide and 7/8" thick. The ends of top bar extend beyond to rest on the rabbet scooped on the long sides of the brood box and under surface is grooved for fixing the edge of the comb foundation sheet.

(ii) Side bar : It is 9 – 1/8" long and made from 3/8" thick wood. Each is cut out from the middle portion at either end to accommodate the top and the bottom bars respectively. There are four holes in each side bar for wiring the frame.

(b) Staple Spacing Frame :

(i) Top bar : Top bar is 19" long, 1" wide and 7/8" thick. It has a groove as like Hoffman top bar. It is covered with metal spacing devices on each end of its opposite faces.

(ii) Side bar : Each is made of 3/8" thick wood. It is 3 – 3/4" long and 1" wide. There are 4-holes in each side bar for wiring the frame.

(iii) Bottom bar : It is 16 - 7/8" long, 1" wide and 3/8" thick.

Both the type of frames are spaced apart to leave the bee-space (0.96 cm or 3/8 inch) by the width of the upper third of the side bars (Hoffman type) or by nailing two staples on ends of the tops bar on opposite sides of the frames (staple spaced frames).

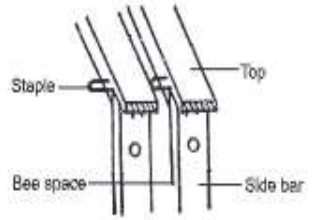


Fig. 5.17 : (b) Staple-spaced type

5. Super : The supers are like brood box without cover and the base. Super is provided with many frames containing comb foundation to provide additional space for the expansion of the hive. It is placed over the queen excluder.

6. Inner Cover : This is a wooden board to cover the brood chamber or the super. It is 20" long, $16\frac{1"}{4}$ broad and 3/8" thick wood. It has many holes for proper ventilation.

7. Top Cover : It is meant for protecting the colony from rains. It is fitted with zinc sheet. There are two types of top cover : (i) Sloping and (ii) Flat top cover.

Sloping top cover is wooden, broad, $20" \times 16\frac{1"}{4}$ in measurement from outside and 26" long slanting boards are nailed on top for the rain water to shed off the sides.

Flat top cover : It is made up of 3/8" thick wooden board, nailed to a rectangular frame 2" high, all covered with zinc sheet so as to make it impervious to rain water.

8. Queen Excluder : It is necessary to separate the brood chamber from the supers where honey is stored. This is made with the help of a zinc or wire gauze frame with 2.3 – 3.5 mm perforations to enable the workers to pass through but not the queen whose thoracic width, 4.3 – 4.5 mm, is more in size than perforations. The queen stays within the brood box and spares the super of the eggs and brood.

Apiculture- practical no. 02

Bee Keeping Equipment- Bee Box, Honey Extractor, Smoker, Bee-Veil, Queen Excluder

Honey Extractor

2. It is a machine with which honey is separated in its purest form from the honey comb. It is made from the metal or tin material. Honey extractors are available in variety of sizes with the frames arranged tangentially or radially and is operated manually or with electric power and functions on principle of centrifugal force. When combs are centrifuged by this device the pure honey is thrown out without any damage to the comb.

Fig. 5.19 : Honey extractor

3. **Smoker :** It is used to give smoke gently (and not blast; it infuriates them) to the bees for easy handling. It consists of a tin can provided with a spout for directing the smoke from the smouldering material inside it with the help of a bellows.

Fig. 5.21 : Smoker

4. **Hive tool :** It is a flat piece of steel sharpened at one end for inserting between hive boxes to separate them and the other end bent to separate the frames. It is also used to scrape off the bee glue and pieces of comb from various parts of the hive.

Fig. 5.22 : Hive Tool

5. **Bee veil :** It is made of frames covered on the four sides with small mesh wire gauge, black light material, silk, cotton and top and bottom with thick cloth. The bottom cloth is provided with rim (circular ring) with elastic to make it stick to the neck. Bee veil is worn over the face of the person handling bees, for the protection against stings.

Fig. 5.24 : Bee Veil

Fisheries –

1. Identification, Classification and study of habit, habitat and economic importance of
   a) Rohu (Labeo rohita), b) Catla (Catla catla), c) Mrigal (Cirrhinus mrigala). (D)
2. Identification, Classification and study of habit, habitat and economic importance of
   a) Prawn, b) Crab, c) Lobster, d) Pearl Oyster. (D)

Fisheries- practical no. 01

Identification, Classification and Study of Habit, Habitat and Economic Importance of *Rohu, Catla and Mrigal*

(a) *Rohu* :

Systematic Position:

Phylum	–	Chordata
Sub-phylum	–	Vertebrata
Class	–	Pisces
Sub-class	–	Teleostomi
Order	–	Cypriniformes
Family	–	Cyprinidae
Genus	–	*Labeo*
Species	–	*rohita*

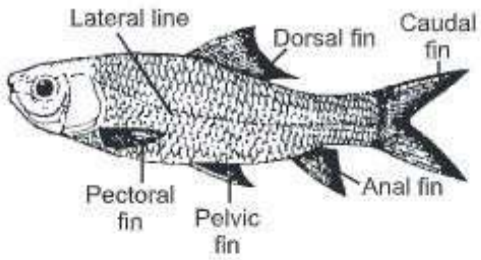


Fig. 6.1: *Labeo rohita*

Habit and Habitat:

Labeo rohita is commonly found in fresh water ponds, rivers, lakes and esturies. It is herbivorous and bottom feeder feeding on algae, aquatic plants. It frequently comes to water surface to take air into air bladder. *Labeo* is the major carp distributed in the plains of India except Southern part.

Identification Characters:

(1) *Labeo rohita* is commonly known as *rohu* in Hindi.
(2) Body is elongated, spindle shaped, with gray colour on back and silvery white on the two sides and belly.
(3) Adult ones are measures about 1 metre in length with 20 to 25 kg weight.
(4) Body is divisible into head, trunk and tail.
(5) Scales are large, orange to reddish in colour in the centre and are cycloid type.
(6) Head is prominent with blunt snout.
(7) Mouth is large transverse aperture bounded by thick and fleshy lips.
(8) Trunk is thick. Lateral line is present on either side of trunk and tail.
(9) Trunk bears single dorsal fin, pectoral fins and pelvic fins.
(10) Tail is laterally compressed and has homocercal caudal fin.
(11) Air bladder is large and divided into anterior and posterior fin.
(12) It is economically important due to its food value.

(b) *Catla* :

Systematic Position:

Phylum	–	Chordata
Sub-phylum	–	Vertebrata
Class	–	Pisces
Sub-class	–	Teleostomi
Order	–	Cypriniformes
Family	–	Cyprinidae
Genus	–	*Catla*
Species	–	*catla*

Habit and Habitat:

It is distributed throughout India, Pakistan, Bangladesh, Nepal and Thailand. It inhabits the surface layer of fresh water and found in Krishna river. *Catla* is a surface feeder feed on plankton, insects, vegetable debris, algae, crustaceans etc.

Identification Characters:

(1) *Catla catla* is largest Indian carp commonly known as *Katla* in Hindi.
(2) Body is deep, stout with broad snout. Mouth is large, provided with promient lower lip and large gill apparatus.
(3) The colour is greyish on the dorsal side while silver on the ventral side.
(4) Dorsal profile is more convex in comparison to the ventral one.
(5) Scales are pink in the centre of dorsal side and whitish below.
(6) Eyes are large situated in the anterior half of the head.
(7) Dorsal fin is quite large. Caudal fin is bilobed.
(8) Air bladder is large consists of two parts.
(9) It is grown in polyculture system.
(10) It is economically important as a food-fish.

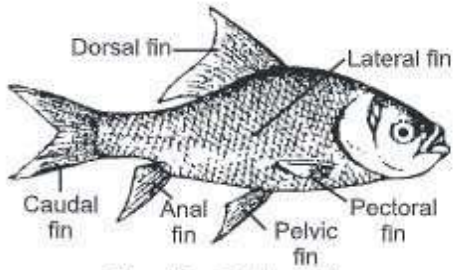


Fig. 6.2: *Catla catla*

Fisheries- practical no. 01

Identification, Classification and Study of Habit, Habitat and Economic Importance of *Rohu, Catla and Mrigal*

(c) *Mrigal* :

Systematic Position:

Phylum	-	Chordata
Sub-phylum	-	Vertebrata
Class	-	Pisces
Sub-class	-	Teleostomi
Order	-	Cypriniformes
Family	-	Cyprinidae
Genus	-	*Cirrhinus*
Species	-	*mrigala*

Habit and Habitat:

It is found in fresh water bodies like lakes and ponds, rivers. It is bottom feeder and feeds on green algae, decayed vegetable, mud and detritus. *Mrigala* is distributed in river systems of India, Pakistan, Bangladesh and Burma.

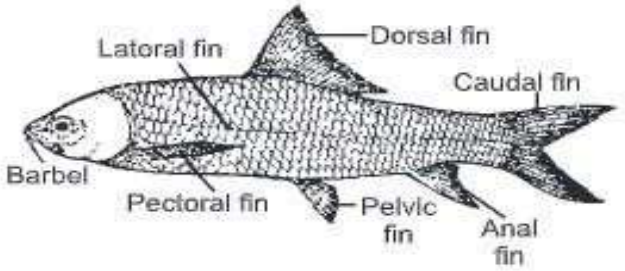


Fig. 6.3: *Cirrhinus mrigala*

Identification Characters :

(1) *C. mrigala* is commonly called *mrigal* and is a fresh water carp of India.

(2) The body is elongated and compressed and measure about 66 cm with 1.4 to 2.8 kg in weight.

(3) The body is silvery but dark grey along back. The body is covered by large cycloid scales but absent on head.

(4) The mouth is wide and lips are thin.

(5) Snout is rounded.

(6) 2-4 barbels are small in fold of lip.

(7) Pectoral, pelvic and anal fins are orange with black tips.

(8) Caudal fin is strongly forked.

(9) Lateral line is clear.

(10) Upper margin of the body is concave particularly in the posterior side.

(11) Economically very important as tasty and delicious fish.

Fisheries- practical no. 02

Identification, Classification and Study of Habit, Habitat and Eco Imp. of *Prawn, Crab, Lobster, Pearl Oyster*

Identification, Classification and Study of Habit, Habitat and Economic Importance of (a) Prawn, (b) Crab, (c) Lobster and (d) Pearl Oyster (D).

(a) Prawn :

Systematic Position:

Phylum	–	Arthropoda
Class	–	Crustacea
Order	–	Decapoda
Family	–	Palaemonidae
Genus	–	*Palaemon* or *Macrobranchium*
Species	–	*rosenbergii*

Habit and Habitat:

P. rosenbergii is freshwater inhibitant found in streams, rivers, ponds and lakes in Central and South India. It is benthic animal and omnivorous feeding algae, organic matter, insect larvae and small insects.

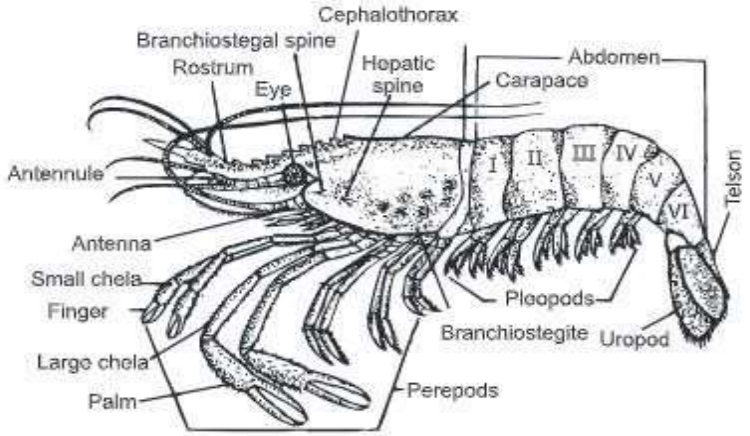


Fig. 6.4: Prawn (*Macrobrachium rosenbergii*)

Identification Characters:

(1) *Palaemon resenbergii* is commonly called as freshwater prawn.

(2) The body is elongated, spindle shaped and about 25-40 cm long.

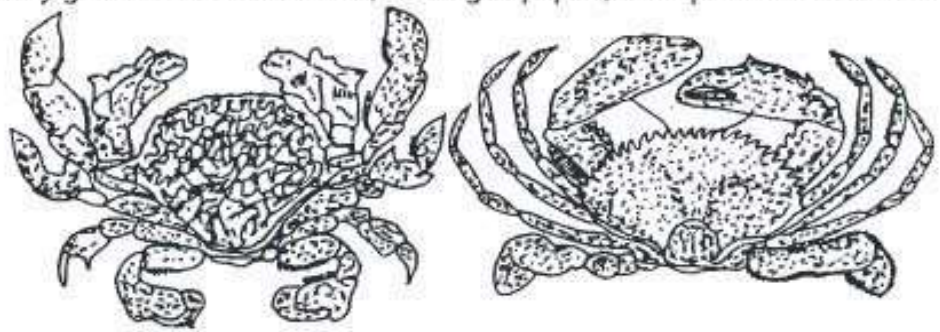
(b) Crab :

Systematic Position:

Phylum	–	Arthropoda
Class	–	Crustacea
Order	–	Decapoda
Sub-order	–	Brachyura
Family	–	Calippidae/Portunidae/Grapsidae
Type	–	Edible crabs

Habit and Habitats:

Crabs occur in freshwater, marine, brackish water habitats. They generally show aquatic respiration by gills. Crab is carnivorous, feeding copepod, shrimps and small fishes.



***(a) Matuta planipes* (Fabricius)** ***(b) Scylla serrata* (Forskal)**

Fig. 6.5: Marine Crabs

Identification Characters:

(1) Cephalothorax is large and covered by a hard chitinous partly calcified *carapace*.

(2) Cephalothorax has five pairs of head appendages and eight pairs of thoracic appendages. The last five pairs are the legs.

(3) First pair of legs is powerful called chelate, used for capturing food. They also serve as organs of offense and defence. The remaining organs are used for swimming and walking.

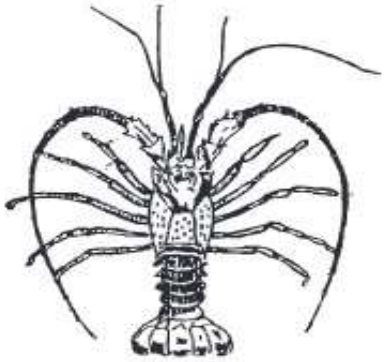
Fisheries- practical no. 02

Identification, Classification and Study of Habit, Habitat and Economic Importance of *Prawn, Crab, Lobster, Pearl Oyster*

(c) Lobster :

Systematic Position:

Phylum	–	Arthropoda
Class	–	Crustacea
Sub-class	–	Malacostraca
Order	–	Decapoda
Sub-order	–	Macrura
Family	–	Palinuridae
Genus	–	*Palinures*
Species	–	*polyphagues* (Herbst)



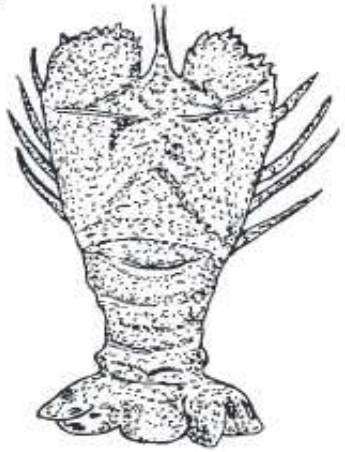


Fig. 6.6 (a): *Panulirus polyphagus* (Herbst) **Fig. 6.6 (b): *Thenus orientails* (Lund)**

Habit and Habitat:

The common lobster found in the Pacific and the Atlantic Oceans and spiny or rocky lobster found in Indian waters under rocks, coral reefs and muddy bottom of seas. Lobster are primarily scavengers feed on carrions but also feeds on polychaetes, molluscs, crustaceans.

Identification Characters:

(1) The body is divisible in cephalothorax and abdomen. Abdomen ends into a fan-like tail fin.

(2) Telson and uropods reddish-tinged; legs brownish red with cream coloured joints.

(d) Oyster :

Systematic Position:

Phylum	–	Mollusca
Class	–	Bivalvia
Order	–	Pseudolamellibanchiata
Family	–	Pteriidae
Genus	–	*Pinctada*
Species	–	*margaritifera* (Indian Pearl Oyster)

Habit and Habitat:

Common pearl oyster is distributed in Gulf of Kutch, Gulf of Mannar, the Pak Bay, and Indian Coast i.e. from Cape Comorin to Rameshwarm Island. They found on hard, rocky, sandy substratum in the bays and creek near coastal area. Oysters are ciliary feeder and feed on a variety of diatoms with detritus material.

***Pinctada margaritifera* (Linnaeus)**

***Pinctada chemnitizii* (Philippi)**

***Pinctada fucata* (Gould)**

Identification Characters:

(1) Shell valves may be equal or unequal and shell surface is coarse, irregular ruffled.

(2) Left shell valve is large, convex and permanently attached to rock. Right shell valve is smaller, thin and covers the viscera.

(3) Gills plated with vertical folds and ciliated.

(4) Only posterior single adductor muscle present, which is very large and strong.

(5) Body measures about 25 cm in length.

(6) Oysters are economically very important because they produce high quality pearls as gems.

❖ Acknowledgements

❖ Special Thanks to

❖ Dr. Kishor Pawar

❖ Dr. Ashok Desai

Prof. Mubeen Shaikh

Vikas Bhand