D.N.R. COLLEGE (A), BHIMAVARAM

B.Sc., AQUACULTURE

PRACTICAL MANUALS

PAPER-4: Biology of Fin Fish & Shellfish

I B.Sc –II SEMESTER

PAPER-4: Biology of Fin Fish & Shellfish

Total hours- 30 Hours per week-02 Total credits-01

Practical Syllabus

1. Length-weight relationship of fishes
2. Gut content analysis in fishes and shrimp
3. Mouth parts and appendages of cultivable prawns, shrimps and other crustaceans
4. Study of eggs of fishes, shrimps, prawns and other crustaceans
5. Study of oyster eggs
6. Embryonic and larval development of fish
7. Study of gonadial maturity and fecundity in fishes and shellfish
8. Observation of crustacean larvae
9. Study of nest building and brooding of fishes

PAPER-4: Biology of Fin Fish & Shellfish

Practical Model Paper

Duration :3 hrs   Max.Marks:50

I. Write about gut content analysis of Fish — 15 Marks

II Explain about development of Fish — 15 Marks

III. Discuss about any two Crustacean larvae — 2x5= 10Marks

IV. Vivavoce — 05 Marks

V. Record — 05 Marks

1. Length-weight relationship of fishes

The relationship between length (L) and body weight (W) for nearly all species of fish can normally be represented by the "length-weight relationship" following equation:

$W = qLb$

Where W is the body weight of fish (in g), L is the length (in cm) and 'q' and 'b' are constants.

The parameter 'b' (also known as the allometry coefficient) has an important biological meaning, indicating the rate of weight gain relative to growth in length or the rate at which weight increases for a given increase in length.

The q and b constants could be estimated from linear functions.

However, many functional relationships observed in fishery biology such as length-weight relationship are not linear.

Fortunately, such curvilinear functions can often be transformed into linear functions by taking the logarithm or the natural logarithms of both sides:

$\ln W = \ln q + b.\ln L$

This equation is equivalent the regression equation: $y = a + b*x$ (2.2a)

This mean that; y is equivalent to ln W, a which represents the y-intercept (the point where the line crosses the y axis) of the regression line is equivalent to ln q, b is the slope of the line, and x is equivalent to ln L.

We are now in a position to carry out the estimation of a and b by linear regression analysis.

$a = \ln q$ Taking the antilog of a we can calculate q of the original length-weight relationship

$q = \exp a$

Note: exp is the inverse of ln, the base of the natural system of logarithms and equal to 2.718282.

For calculation of b -the slope of the line- see the example below.

Thus, the estimated relationship between W (in g) and L (in cm) which is equal to W = q.Lb could be easily determined.

2. Gut content analysis in fishes

Method of Gut Content or Food Analysis

Fish diets can be measured in a variety of ways.

Methods of gut contents analysis are broadly divisible into two, viz., qualitative and quantitative.

The qualitative analysis consists of a complete identification of the organisms in the gut contents. Only with extensive experience and with the aid of good references it is possible to identify them from digested, broken and finely comminuted materials.

Quantitative methods of analysis are three types, viz., numerical, gravimetric and volumetric.

Quantitative Method for Food Analysis

- Numerical Method
- Volumetric Method
- Gravimetric Method

Numerical methods

The numerical methods are based on the counts of constituent items in the gut contents. The numerical methods can be classified under four distinct heads

- a) Occurrence method
- b) Dominance method
- c) Number method
- d) Point (Numerical) method

A) Frequency of Occurrence: Stomach contents are examined and the individual food organisms sorted and identified. The number of stomachs (fishes) in which each item occurs is recorded and expressed as a percentage of the total number of stomachs (fishes) examined.

$$\text{Frequency of Occurrence, } O_i = \frac{J_i}{P}$$

• Where, Ji is number of fish containing prey i and P is the number of fish with food in their stomach.

b) Dominance method: Essentially the dominance method is a partial improvement of the occurrence method, viz., the lack of consideration of the quantities of the food items present in the stomach, sought to be remedied. The stomach contents comprising the main bulk of the food materials present, is determined and the number of fish in which each such dominant food material is present is expressed as a percentage of the total number of fishes examined.

c) Number method: The number of individual of each food type in stomach is counted and expressed as a percentage of the total number of food items in the sample studied, or as a percentage of the gut contents of each specimen examined, from which the total percentage composition is estimated. • It is suitable method for plankton feeder only. •

D) Points (Numerical) Method: Thepoints method is an improvement on the numerical method where consideration is given to the bulk of the food items. • The food items are seprated and counted and presence or absence of each food item in a stomach is recorded. Food items may be classified as very common, common, frequent, and rare based on rough count and judgment by eye.

Volumetric Method

The chief methods that are employed in assessing the volume of food items in the gut contents of fishes are:

a) Eye estimation method

b) Points (Volumetric) method

c) Displacement method

a) **Eye estimation method**: This is probably the simples and easiest means of determining the volume of food constituents. In this method the contents of each sample is considered as unity, the various items being expressed in terms of percentage by volume as estimated by inspection.

Points (Volumetric) method: This method is a variation of the eye estimation method. Here instead of directly assessing the volume by sight as in the previous method, each food item in the stomach is allotted a certain number of points based on its volume. The diet component with highest volume was given 16 points. Every other component was awarded 16, 8, 4, 2, 1 and 0 points depending on the volume relative to the component with the highest volume.

• In point (volumetric) method, percentage volumes within each subsample were calculated as:

$$\alpha = \frac{\text{Number of points allocated to component } \alpha}{\text{Total points allocated to sub sample}} \text{X100}$$

• Where α is the percentage volume of the prey (food item) component α

Displacement method: The displacement method is probably the most accurate one for assessing the volume. The volume of each food item is measured by displacement in a graduated container such as a cylinder with the smallest possible diameter for accuracy. This method is eminently suited in the estimation of the food of carnivorous fishes.

Gravimetric Method: The gravimetric method consists of the estimation of the weight of each of the food items, which is usually expressed as percentages of the weight of the total gut contents as in other quantitative methods.

Generally the wet weigh of the food after removing superfluous water buy pressing it dry between filter papers is taken for this purpose

3. Prawn appendages:

Cephalic appendages

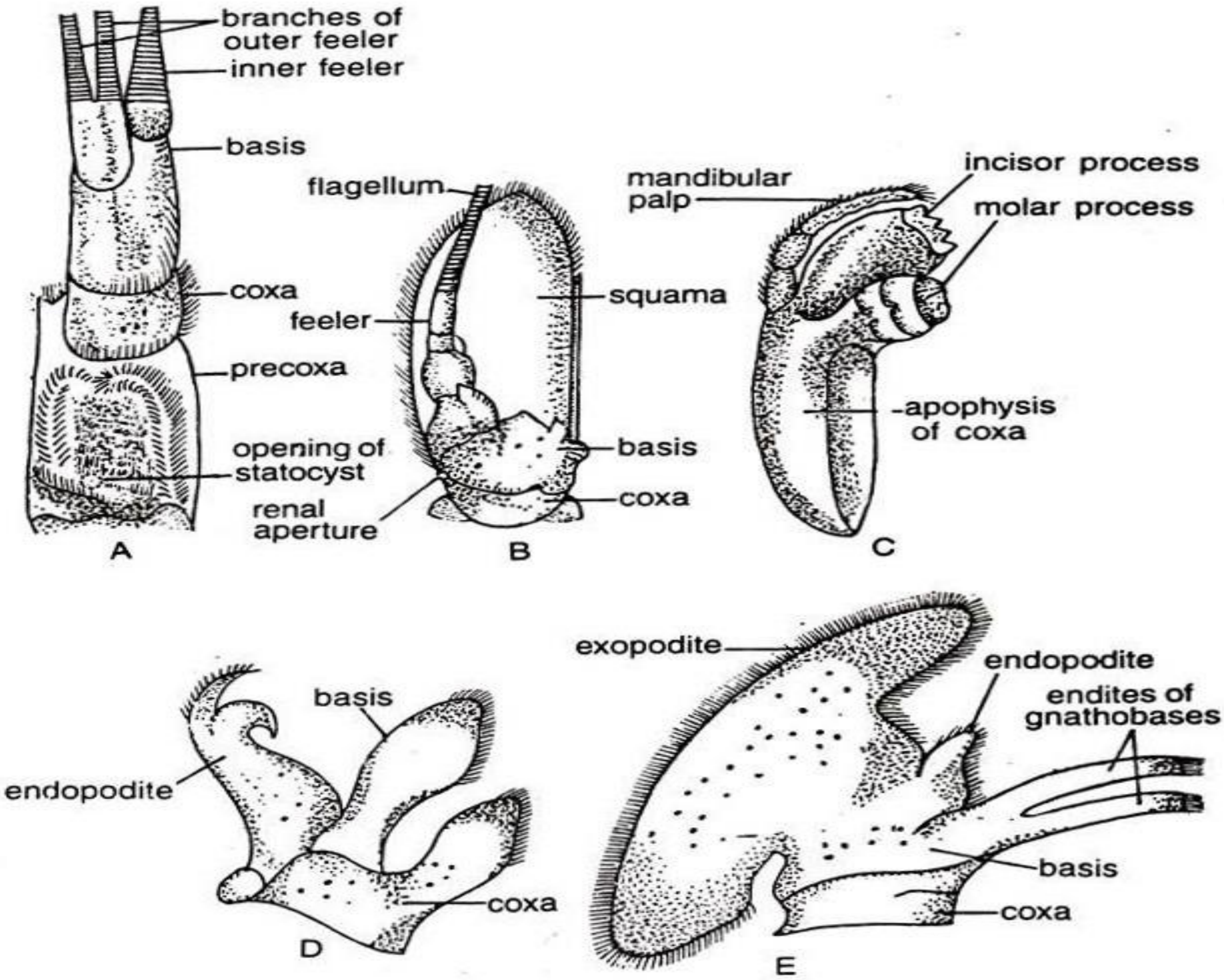


Fig. 25.2. Macrobrachium sp.
Cephalic appendages (five pairs). A. Antennule. B. Antenna. C. Mandible. D. Maxillula E. Maxilla

1. Antennules:

Each consists of a three- jointed protopodite bearing three many, jointed flagella at the distal end and a statocyst at the base.

Functions:

Sensory and tactile.

2. Antennae:

Each consists of a two- jointed protopodite bearing a flat squama and a many-jointed flagellum.

Functions:

Tactile and balance.

3. Mandibles:

The body is unjoin ted, bears teeth and masticatory lobes known as molar processes and a jointed mandibular palp on the outer surface.

Functions:

Cutting and crushing of the food.

4. 1st maxillae (maxillulae):

Leaf-like, with two inner lobes acting as gnathobases and an outer lobe.

Functions:

Tearing and passing the food to the mouth.

5. 2nd maxillae:

Leaf-like, with a flattened scaphognathite.

Functions:

Masticatory and respiratory

Thoracic Appendages:

6. 1st maxillipeds:

Leaf-like protopodite with a whip-like exopodite and a slender endopodite.

Functions:

Respiratory, masticatory and sending the food to the mouth.

7. 2nd maxillipeds:

The protopodite with an epipodite bears a five-jointed endopodite, a whip-like un-jointed exopodite and a gill.

Function:

Respiratory.

8. 3rd maxillipeds:

The protopodite bears a three-jointed leg-like endopodite and a slender un-jointed exopodite. A small epipodite is present.

Functions:

Locomotory and respiratory.

9. Pereopods (walking legs):

Five pairs; each leg consists of seven podomeres or segments.

The first two legs end in chela and the second is the largest. The two basal segments represent the coxopodite and basipodite and the remaining five are ischium, merus, carpus, propodus and dactylus, respectively, in order of succession.

Functions: Holding the prey and walking in first two, and only walking in the last three.

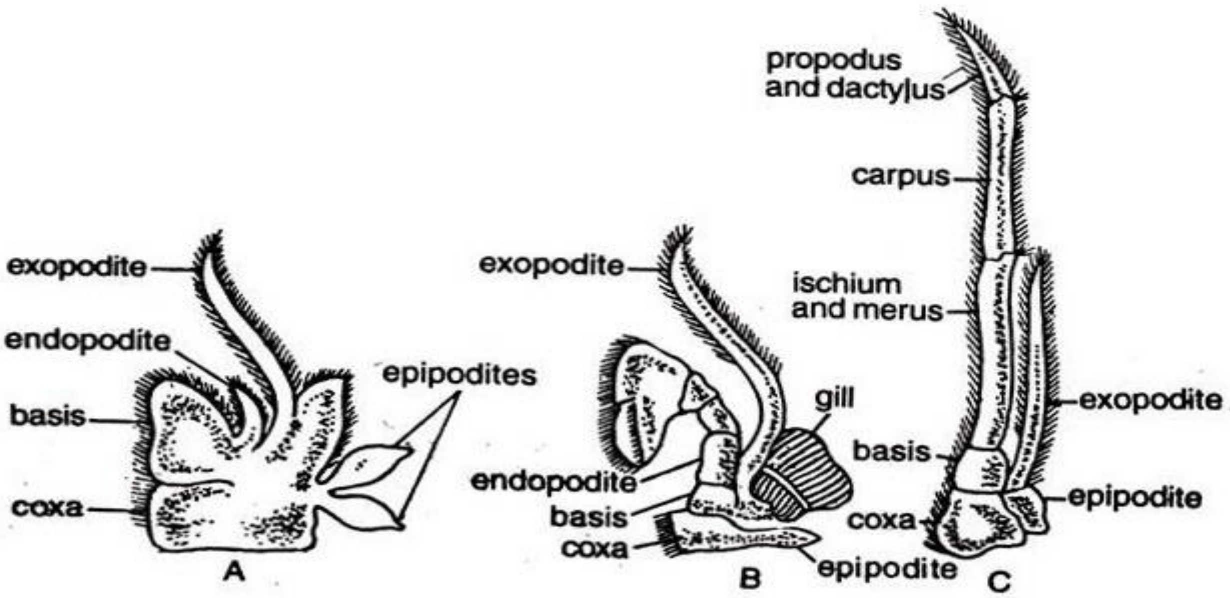


Fig. 25.3. Macrobrachium sp.
Thoracic appendages. A. First maxilliped. B. Second maxillipeds. C. Third maxilliped.

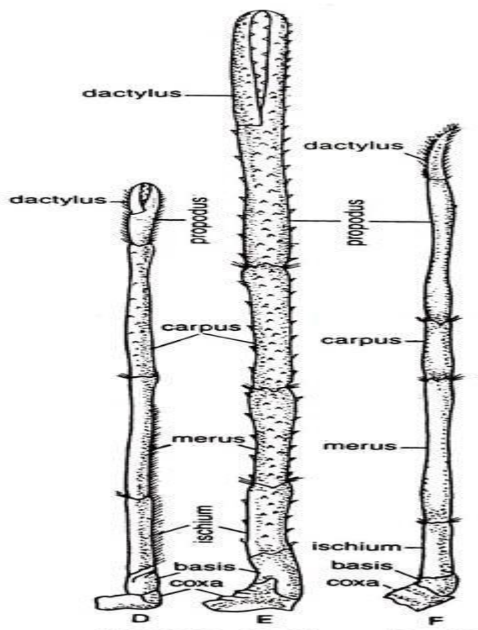


Fig. 25.3. Macrobrachium sp. (Contd.). Pereopods (thoracic appendages) D. First walking leg. E. Second walking leg. F. Third walking leg (Third to fifth lack pincer)

Abdominal Appendages (Fig. 25.4) of Prawn:

Six pairs; each pleopod consists of a two-jointed protopodite bearing expodite and endopodite. In the second pleopod of male, an appendix masculine, concerned with reproduction is found. In the second to fifth pleopods, appendix internae are present.

Function: Swimming.

Appendix masculine help in mating. Appendix internae form a basket in female to carry eggs.

Uropod:

Protopodite small, the exo-and endopodite are broad and oval. With the telson it forms the powerful tail fin.

Functions: Balance and back swimming with a jerk.

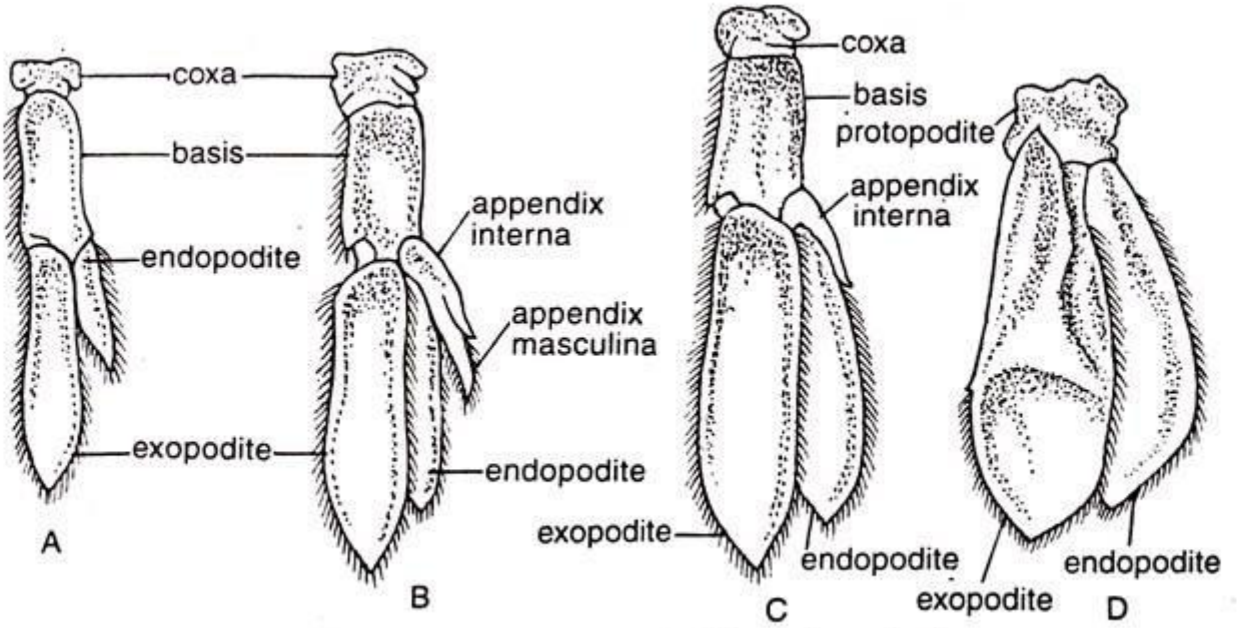


Fig. 25.4. Macrobrachium sp. Pleopods (abdominal appendages)
A. First swimmerete. B. Second swimmerete. C. Third swimmerete.. D. Uroped (last swimmerete)

4. Different types of eggs:

A) Fish eggs

Pelagic eggs Isolated eggs (mostly) - The spawned eggs are isolated, not forming any mass.

Agglutinated eggs (Lophiidae) - The spawned eggs are embedded in a gelatinous ribbon/ballon, or agglutinated to each other forming a mass

Pelagic eggs: The pelagic eggs of most species are small in size, measuring about 0.7 mm to 1.5 mm in diameter. A few species have larger eggs between 1.6 mm and 2.6 mm in diameter. All pelagic eggs are transparent and are practically spherical, except for those of anchovies which are oblong (longer than broad). Occasionally eggs are found to be slightly ovoid.

Pelagic eggs are floating type, smaller in size compared to demersal eggs. These eggs do not have adhesive membrane. They are buoyant; the buoyancy is maintained by single oil globule. If the oil globule is not there, high percentage of water is present which helps in floating. During floating stage, dispersion of eggs takes place. The pelagic eggs are subjected to high mortality mainly due to two factors. i. Predation, ii. Eggs are exposed (carrying) to unfavourable conditions. But this is compensated by increased fecundity and protracted spawning season.

Demersal eggs

Adhesive eggs (Exocoetidae, Gobiidae) - The spawned eggs adhesive to substratum with adhesive egg membrane or filaments

Non –adhesive eggs (Salmonidae)

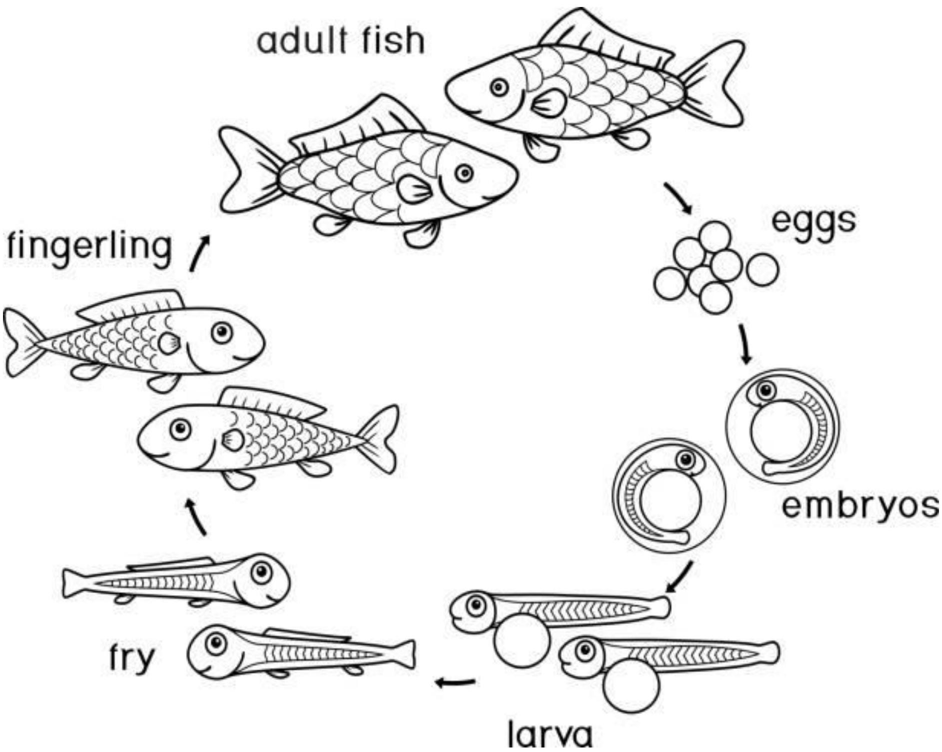
The demersal eggs are generally larger than pelagic eggs which may be laid in masses or singly. These eggs are heavy or dense. Since they are heavy, they link to the bottom. The eggs are provided with adhesive membrane. They stick on to other objects with filamentous structure. Normally there is no relation between habitat and type of eggs produced. i.e. pelagic fishes can produce demersal eggs and demersal fishes can produce pelagic eggs. (Generally most common pelagic food fish have pelagic eggs)

The pelagic sardine produces pelagic eggs, whereas herring is a pelagic fish but the eggs are demersal. Similarly angler fish which is a demersal fish but produce pelagic eggs. Deep sea wolf herring is a demersal fish and produces demersal eggs.

B) Prawn Eggs : Fertilized eggs hatch in less than 24 hours, and larvae spend time floating in the sea, maturing through several stages as they move shoreward to shallow, hypersaline (very salty) waters. They are known as 'postlarvae' when they reach these shallow waters and are ready to settle on the bottom, where they will develop into young prawns. They can stay in the nursery zones for up to six months until reaching a size (near maturity) that requires them to return to oceanic waters to mate and spawn, finishing their life cycle.

C) Shrimp eggs: Brine Shrimp produce two different types of eggs; thin-shelled summer eggs and thick-shelled winter eggs. The thin shelled eggs develop steadily and then hatch; while the development of the embryo within the thick shelled eggs halts when it reaches a particular stage. The eggs, and the embryos within them, are then able to survive for months or even years until changes in the environmental conditions trigger the embryos to develop further and hatch. Brine Shrimp eggs hatch into larvae called nauplii.

6. Life Cycle of a Fish:



1. The Egg – Stage 1

In this stage, the tiny embryo develops inside the hard shelled egg. During this process, the embryo develops different organs of its body. Many eggs do not survive this stage. Fishes which live in warmer regions hatch their eggs faster, compared to fishes living in colder regions.

2. The Larvae – Stage 2

After the egg hatches, the larvae emerge from the eggs that have a yolk sac attached to their bodies. This attached yolk sac provides nutrition to the growing larvae. The larvae survive for about 4 days on the nutrition provided by this yolk sac. The eyes and mouth parts of the larvae develop in this stage. When the yolk sac is completely absorbed, the young larvae are called fry.

3. The Fry – Stage 3

Unlike the fish larvae that depended on the yolk sac for food source, the fry has the ability to feed on its own. In the first few months a young fish is called fry. In this stage, the fry undergo many developmental stages.

4. The Juvenile – Stage 4

In this stage, the fish develops more adult-like characteristics like fins, color and other body parts. This is the stage where a fish transforms from a fry to an adult fish. Time period of this stage varies from species to species. Most species do not survive this stage due to inevitable predators.

5. The Adult – Stage 5

Here, the fish is fully grown with all body parts and is sexually mature. The adult fish is capable of mating and reproducing. Sexual maturity depends on the lifespan of the fish. Species with shorter lifespan mature faster compared to species with longer lifespan.

6. The Spawning – Stage 6

Spawns are the eggs and sperm released or deposited by fishes and other aquatic animals. The female fish releases eggs into the water and the male fish releases milt (semen from male fish) to fertilize the eggs. Not all eggs are fertilized. Spawning in fishes varies, depending on the species. While some fish spawn in intervals, some spawn annually and there are some fishes which spawn once in a while.

7. Study of Fecundity in Fishes:

Fecundity can be defined as "the number of ova that are likely to be laid by a fish during the spawning season". The number of eggs produced by a fish differs in different species, and depends on the size and age of the fish. It may also differ in different races of the same species. Thus, fecundity is a measure of the reproductive capacity of a female fish, and is an adaptation to various conditions of the environment. It can be estimated by any of the following methods:

1. In the volumetric method, the total volume of the ovary is measured. Small pieces of the ovary are taken in random samples from the anterior middle and posterior parts of the ovary, and the number of ova in each sample is counted along with the volume of the sample. The total number of ova in the total volume of the ovary is then calculated.
2. In the gravimetric method, the formalin preserved ovaries are used. After determining the weight of the ovary, three small samples of 100 mg each are taken at random from the anterior middle and posterior part. The number of ova in each sample is counted under a binocular microscope. Total number of ova are then calculated as below:

$$F = \frac{S \times OW}{100}$$

Here, F = Fecundity
S = Average number of ova obtained from three samples of 100 mg each
OW = Total weight of the ovary

The fecundity of a number of species has been studied by several investigators.

Fecundity of *Cirrhina mrigala* varies from 75,900 to 11, 23,200 when the length ranges from 349 – 810mm in length.

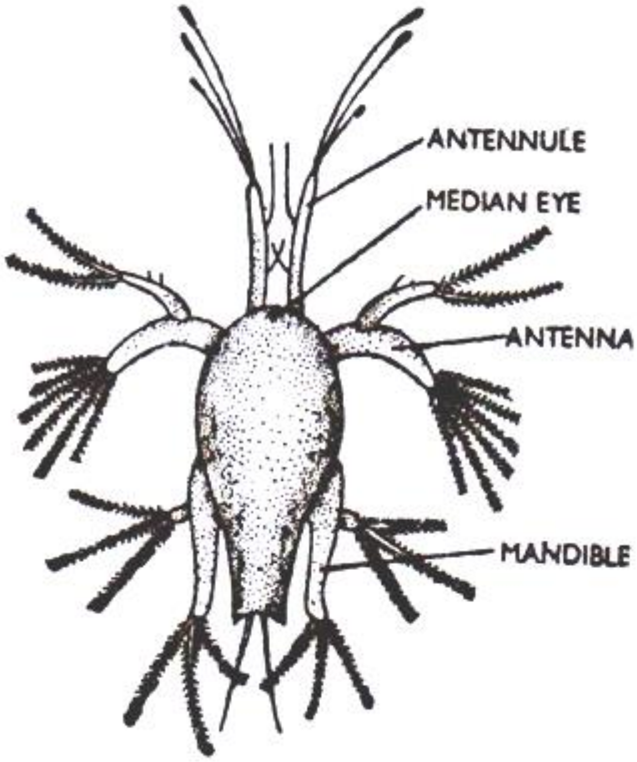
In *Labeo gonius* ranging between 270 – 490mm, the fecundity varies from 47,168 to 3,80,714 , but according to Chondar the values are 2,73,955 to 5,39,168 in the fish ranging from 270 – 490mm in length. The differences in the values are possibly due to the collection from different habitats.

Fecundity of the fish is closely related to the fish length and weight. A straight line relationship has been observed between the fecundity and the fish length, and the fecundity and fish weight in a number of species.

Knowledge of the fecundity of fish is useful in fishery management and the information regarding the possible number of eggs and fry likely to be produced can be used for selecting the fish of high productivity for fish culture.

8. Crustacean Larvae:

Nauplius Larva :



1. It is the slide of Nauplius larva, which is the earliest free swimming stage in the development of crustaceans.

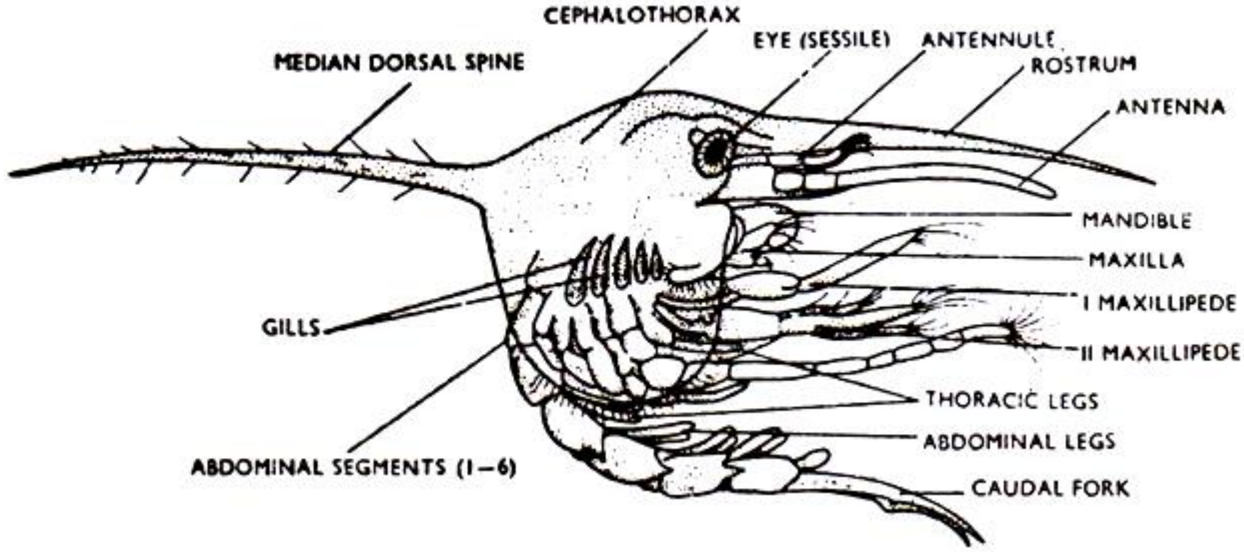
2. Body is somewhat fusiform or pear shaped and is without segmentation.

3. The head bears paired mitanous antennae and biramous antennule and mandibles and a median sessile eye.

4. All appendages bear setae.

5. This larva possesses only alimentary canal and no other organ. After spending free swimming life it metamorphoses into metanauplius.

Zoea Larva :



1. It is the slide of Zoea larva, which is the fourth stage in the life cycle of crustaceans.

2. This larva develops from Protozoa.

3. The body is divisible into cephalothorax and a long segmented abdomen.

4. The cephalothorax is covered over by carapace and bears paired compound eyes and paired appendages e.g., antennules, antennae, mandibles, maxillae and maxillepedes and five pairs of gills.

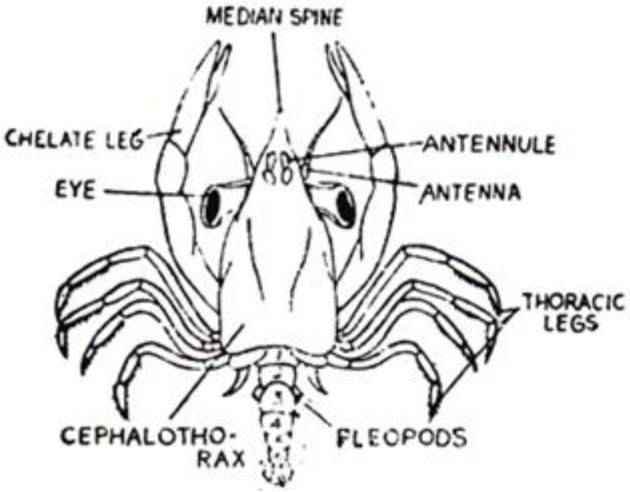
5. The carapace is produced into a long and pointed rostrum and a long median dorsal spine with many small bristles.

6. The cephalothorax also bears buds for 6 pairs of thoracic appendages.

7. The abdomen has six segments with paired rudiments of abdominal apeandages and a pair of caudal forks.

8. It metamorphoses into Metazoea and ultimately into Megalopa.

Megalopa Larva:



1. It is the slide of Meglaopa larva of crustaceans.

2. It develops from Zoea larva through Metazoea stage.

3. The body is divisible into a large anterior cephalothorax and a long posterior abdomen.

4. The cephalothorax bears paired antennules, antennae, mandibles, stalked compound eyes and five pairs of thoracic legs and is covered over by a carapace.

5. The carapace is produced in front into a median rostral spine.

6. Of the thoracic legs the first paired is chelate and the rest non-chelate.

7. The abdomen bears six segments and five pairs of plumose pleopods.

8. It metamorphoses into the adult crustacean.

9. Different types of nests building in Fishes:

Some fishes prepare crude nests for egg laying. At first a suitable place for preparing the nest is selected and some species may defend the place till death.

They are following types

(a) Basin-like nests:

(i) Male of Darter (Etheostoma congregata), during the spawning season, selects a suitable place called domain, which it defends repelling with vigour any attempt by rival males. Any female Darter entering its domain is allowed to remain.

The female Darter then makes a basin-like depression, sinks into it and deposits the eggs. The eggs are immediately fertilized by the male who covers the fertilized egg by a sticky secretion, secreted from its kidneys. These sticky eggs remain attached to the stone till hatching.

(ii) Fresh water sunfishes build a nest by scooping out a shallow basin-like nest at the bottom of the impoundment by carefully removing pebbles and leaving behind large stones (Fig. 5.42). A layer of fine sand remains attached with the eggs. Male sunfish guard the eggs till they hatch.

Fig. 5.42 : Basin-like nest of sunfish

(b) **Circular nest** : (i) The male Bowfin (*Amia calva*) prepares a crude pit-like circular nest (Fig. 5.43A) among aquatic vegetation.

(iii) Cichlid fishes (Haplochromis burtoni) build basin-like nest which is guarded by both the parents.

(iv) In some North American catfishes both the male and female prepare a crude nest in the mud to lay eggs.

(b) Circular nest:

(i) The male Bowfin (Amia calva) prepares a crude pit-like circular nest (Fig. 5.43A) among aquatic vegetation. The male then invites a female. She spawns and the male fertilizes the eggs. The fertilized eggs are then protected by the male who keeps guard over the nest till the young ones are hatched. The young ones are allowed to leave the nest in a boa/ under the protection of the father (Fig. 5.43B).

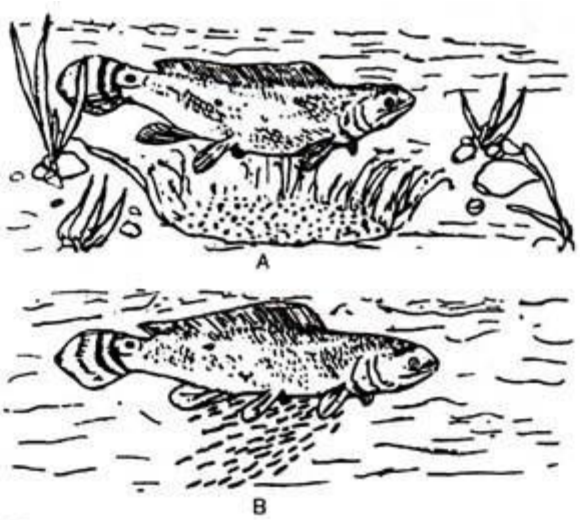


Fig. 5.43 : A. Male Bowfin prepares a circular nest. B. The hatchlings swims in a group under the protection of the father

(ii) Both the male and the female of some cat fishes (Arius) of North America prepare a crude circular nest in the mud, at the bed of the river. The diameter of the nest is about 50 cm and is sometimes provided with a protective cover of logs, stones etc. The fertilized eggs are left uncared.

(c) Hole/Burrow nest:

(i) The African lung fish (Protopterus) prepares a simple nest in the form of a deep hole in swampy places along the river bank. The male prepares the nest surrounded by long aquatic weeds and grasses and after spawning keeps guard over it, occasionally aerating the water by his slow body movement.

(ii) The South American lung fish (Lepidosiren) prepares a nest in the form of a burrow in swampy places, varying in length from 1 to 2 metres. The nest consists of a short vertical and a larger horizontal portion in which eggs are deposited. Males take care of the eggs. During this time they develop a long red filament from the pelvic fins which perform the function of aeration without coming out on to the surface to gulp air.

(d) Barrel-shaped nest:

Before the start of courtship the male stickleback (example: three-spined stickleback, Gasterosteus aculeatus and ten-spined stickleback, Pygosteus pungitius) builds a quite elaborate nest. The male at first selects suitable place in shallow water where the flow of water is continuous but not swift.

He then builds a nest by collecting plant fragments, rootlets, weeds and then binds them together with the help of a sticky secretion from its kidney. The various activities of males such as probing, boring, sucking and glueing result in the formation of a compact nest with tunnel to receive the eggs.

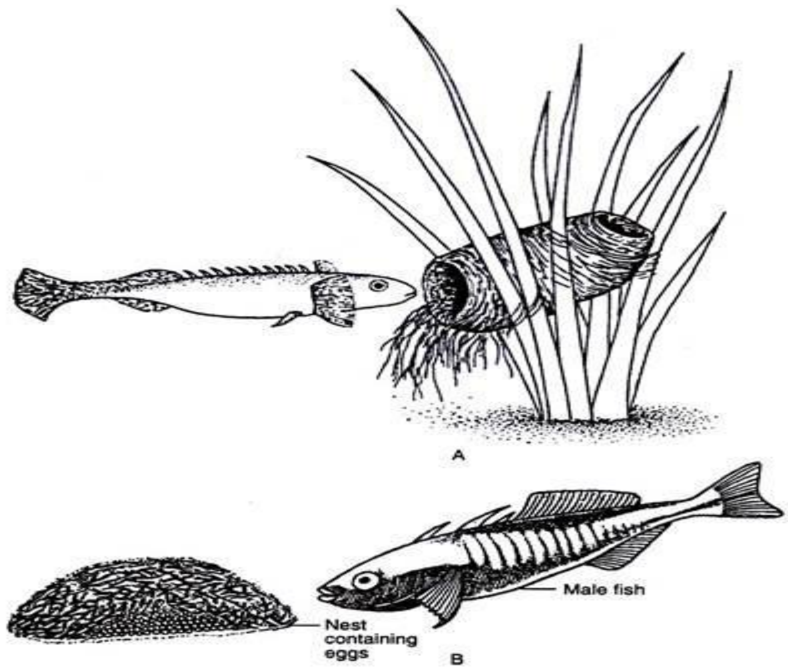


Fig. 5.44 : Barrel shaped nest of : A. Ten-spined stickleback and B. Three-spined stickleback

The male then goes out in search of a mate. The bulging abdomen of the female stimulates the male to perform a zigzag dance around her, displaying his red spot. If the female is ready to lay eggs she responds by curving her head and tail upwards. On reaching the nest the male opens the entrance of the nest with its snout. The female, after depositing two to three eggs within the nest, swims out of the nest through the opposite side of the entrance.

The male then enters the nest and fertilizes the eggs. He then comes out of the back entrance and moves out to seek another female. The same process is then repeated till sufficient eggs are deposited. The male then guards the nest and keeps the eggs aerated by fanning the nest with his fins and tail. Later, the male stops fanning and keeps close watch over the brood, not allowing any young one to go astray.

(e) Cup-shaped nest:

The male of Apelts quadracus builds an elaborate cup-shaped nest, attached to rooted plants close to the bottom. After a female lays a clutch of eggs, the male builds an extension of the nest up and over the eggs, with a concave upper surface in the extension. A second female lays another clutch of eggs on the new concave floor. This process is repeated several times, until the male has several clutches of eggs stacked vertically within a multi-tiered nest.

(f) Floating nest:

The male Mormyrids (Gymnarchus) constricts a floating nest with the help of aquatic vegetation. The wall of the nest remains projected several centimeters above the water surface.

(g) Foamy nest:

(i) The nest made by American catfishes contains eggs that are suspended in a mass of bubbles and mucus produced by the male.

(ii) The male fighting fish (Beta) builds a nest by blowing bubbles of air and sticky mucus that adhere together forming a floating mass of foam on the surface of water (Fig. 5.45). The fertilized eggs are collected by the male in his mouth, who gives them a coating of mucus and sticks them to the lower surface of the foamy nest. The male then stays on guard and fights till death to defend it.

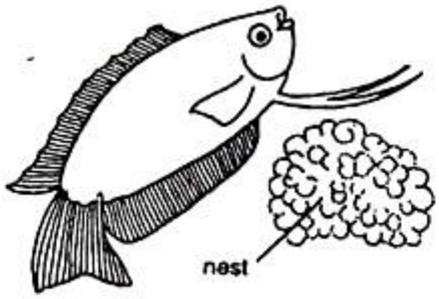


Fig. 5.45 : Male siamese fighting fish (*Beta splendens*) defending his foamy nest

(iii) The male paradise fish (Macropodus), also prepares a similar foamy nest. In this species the eggs are lighter and rises up to the nest without the active participation of the father.

10. Parental care in Fishes: Parental care as an association between parents and the offspring through which the chance of survival of young ones gets increased or any behaviour performed by parents that appears likely to improve the survival and reproduction of the young.

- **Deposition of eggs in sticking covering**
    - Carps are laid with special sticky coverings for attachment to each other or to stones, weeds, etc.
    - Yellow perch deposits eggs in a rope-like structure, and a long floating membrane works for eggs to hold together.
    - Flying fishes, garfishes, skippers, etc. secrete a sticky thread-like substance from the kidney by which eggs remain attached.
- **laying eggs at suitable places**
    - The anadromous fishes like Acipenser, Onchorynchus, etc. lay their eggs in suitable places for spawning. They lay their eggs in pits and cover them with gravel and desert them.
- **Depositions of eggs on dead shells of bivalves**
    - Fishes like the female of European bitterling (*Rhodeus amarus), and* females like the cyprinid family deposits their eggs in dead shells, water Mussels.
- **Scattering of eggs over aquatic plants**.
    - Examples of such parental care in fishes as such pikes, carp, the eggs are scattered and attached to aquatic plants.

Self-made nest for deposition of eggs:

Some species of fish prepare different types of nests for the deposition and protection of their eggs. These nests may be **Basin-like, Circular nest, Hole, burrow nest, Barrel shaped to nest, Cup-shaped nest, Floating nest, or Foamy nest**.

Examples of different types of nests made during parental care:

- **Female Darter makes basin-like depression** and deposits eggs in it. The eggs are fertilized by the male and covered by a sticky secretion from its kidney. These sticky eggs stay attached to the stone till hatching.
- **The Cichlid fishes build a basin-like** nest and it is guarded by both parents.
- **Male Bowfin (Amia calva)** makes a circular nest
- The male **African lungfish (Protopterus)** makes a nest in the form of a deep hole in swampy places along the river bank.
- The **male Mormyrids (Gymnachus)** make a floating nest in aquatic vegetation.
- The **male Betta fish (Fighting fish)** makes a nest by blowing bubbles of air and sticking mucus that adheres and forms a floating mass of foam on the water surface. The fertilized eggs are collected in the mouth of males. The male stays and guards the eggs and fights till death to protect them.

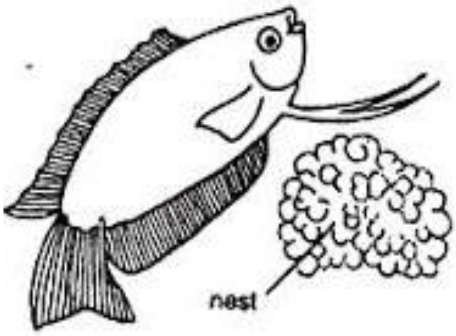
Concealing eggs and young inside or on their body:

Some fish species keep eggs and young in their body or mouth or brood pouches**.**

Example of Concealing eggs inside the body:

- In cichlids, the female keeps the fertilized eggs in their mouth.
- In Catfishes (Arius) and cardinal fishes, the male carries eggs and young ones in their mouth. During this period the male fish does not take food.
- The male Kurtus (nursery fish) of new guinea, carries eggs on the forehead, held in the cephalic hook.
- Some parents keep eggs in Brood pouches: like sea horses (Hippocampus). In sea horses, the fertilized eggs are transferred by the female into the brood pouch of the male. The brood pouch is found on the lower abdomen. For several weeks the male hippocampus provides nutrients and oxygen to the fertilized eggs.
- In male pipefishes (Syngnathus) a brood pouch is formed between two flaps of skin, on the underside of the body. The female lays eggs on these brood pouches.

Beta splendens fish



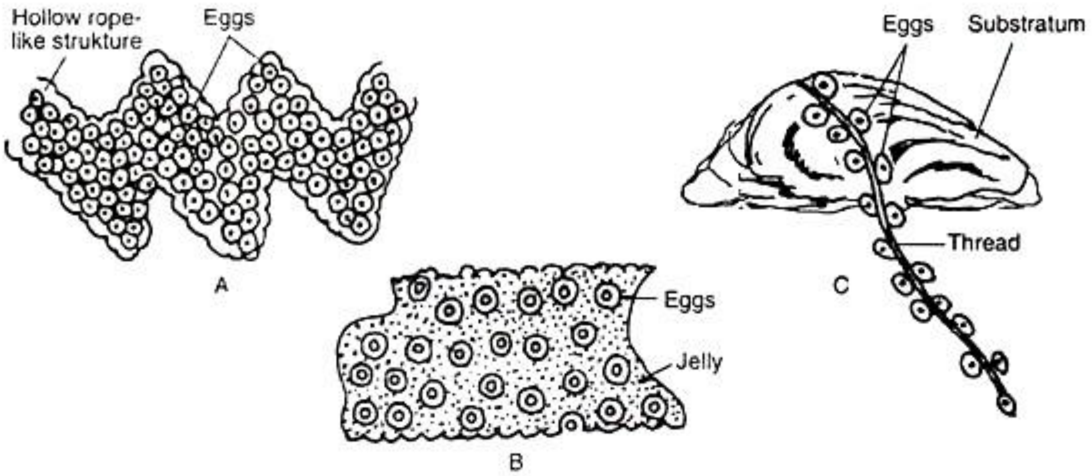


Fig. 5.40 : Deposition of eggs in sticky covering : A. Eggs deposited in a rope-like structure in yellow perch. B. Eggs deposited in a gelatinous outer coat in the case of Angler fish. C. Eggs deposited on a sticky thread secreted from the kidney of flying fishes, skippers, garfishes etc.

Hippocampus and Syngnathus fish