

**Animal Diversity- I
(Non-Chordates)**

Minor Phyla:

Phylum Bryozoa or Ectoprocta

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PHYLUM BRYOZOA OR ECTOPROCTA

In greek, **Bryon** means **moss**

Bryozoans are microscopic, sessile, colonial, unsegmented coelomate animals which remain, permanently attached on various substrata. They are commonly known as '**Sea-mats**' or '**Corallines**'. Superficially, they resemble the hydroid cnidarians. However, a close examination shows that it has a much higher type of organization. The bryozoan colony is called **zoarium**. Each colony is composed of several units or **zooids**. The zoarium is enclosed in an exoskeletal case called **zoecium** which opens to the exterior through an orifice. The zoecium may be gelatinous, horny or calcified. The interior of the body is occupied by coelom and an U-shaped digestive tract. Respiratory, circulatory and excretory systems are wanting in them. Majority of Bryozoans are marine, a few of them live in fresh water and brackish water. The bryozoans exhibit slight structural diversities. **Bugula** has been described here as a typical genus.

BUGULA

Habit and Habitat:

Bugula avicularia, the common **Birds Head Coralline** is a benthic animal found attached on any foreign object by its slender root filaments. It is brown or purple in color, 5 to 7 cm long. It is a ciliary feeder, feeds on micro-organisms, specially the diatoms.

Morphology:

The *Bugula* colony consists of a number of units called zooids. The colony is known as **Zoarium**. The zoarium is covered all along its length by a non-living exoskeletal case known as **zoecia** (Sing. Zoecium). The zooids are cylindrical in shape, five times as long as broad with a wide crescentic mouth at the terminal end. The zoecium opens to the exterior by an **orifice** situated at the free end (Fig. 1). The living parts of the zooids remain immovably attached to the inner side of the zoecia and consists of two parts: An anterior protrusible and movable **introvert** and a posterior **trunk** which is attached to the inner side of the zoecium. The trunk is the main body of the zooid and contains the coelom and other internal organs. The introvert at its anterior end bears a **lophophore** which can protrude out through an orifice. The lophophore bears a circlet of fourteen long, slender, filiform, hollow, ciliated **tentacles** surrounding the mouth. When retracted, the tentacles are enclosed in a **tentacular sheath**. The cilia of these tentacles vibrate, as a result of which they are capable of bending in many directions. These tentacles are tactile in function. They also help in feeding and respiration. The outer side of zoecium has some peculiar appendages called **avicularia** (Sing. avicularium) present on a very short stalk. It closely resembles a bird's head and are organs of defense. The avicularia is capable of rapid bending or pecking movements and serves to keep minute animals and foreign matter from settling on the body.

Body Wall: The body wall consists of an outer chitinous zoecium, an underlying epidermis and an inner peritoneal layer. Cuticle forms the covering of the zoecia (Fig. 1). The ventral side of the body wall has a very thin cuticle. Beneath the cuticle

lies a single layer of large, flattened epithelial cells constituting the epidermis. The cuticle and the underlying epidermis together constitute the frontal membrane. The epidermis secretes the overlying cuticle. Muscle layer is absent in this genus, however, it may be present in some. When present the muscles are present in two layers: an outer circular and an inner longitudinal.

Coelom: The coelom is quite extensive and is incompletely divided into two parts by an incomplete septum : **An anterior small ring coelom and a large posterior trunk coelom.** The two divisions are connected by a pore. The ring coelom is situated at the base of the lophophore and extends to the tentacles. The **trunk coelom** is large and occupies the space between the body wall and the alimentary canal. The trunk coelom is traversed by 20-40 pairs of muscle fibres which are regarded as the displaced muscles of the body wall. The trunk coelom contains *funicular cords* which suspend the alimentary canal. It is a large double strand that passes from the aboral end of the alimentary canal to the aboral wall of the zoecium. The coelomic fluid contains amoeboid phagocytes.

Digestive System: The alimentary canal is a U-shaped tube. The mouth is a crescentic aperture situated at the centre of the lophophore. The mouth leads into a wide pharynx, lined internally by cilia. Pharynx opens into the oesophagus. Oesophagus in turn opens into the stomach (Fig. 1). A constriction separates the oesophagus from the stomach. The anterior part of the stomach, called the **cardia**, is separated from the oesophagus by a valve. The stomach gives off a long, conical caecum which passes towards the aboral end of zoecium. The caecum is attached with the body wall by **funiculus**. A valvular constriction separates the posterior part of the stomach called the pylorus from the intestine. The intestine terminates in an anal opening situated near the mouth on the dorsal side of the tentacular sheath outside the lophophore.. The entire alimentary canal is lined by ciliated epithelium except in a portion of the stomach.

Bugula feeds on zooplanktons. During feeding, lophophore is pushed outward through the mouth causing the tentacular sheath to evert. The eversion of the tentacles is achieved by hydrostatic pressure resulting from the reduction of coelomic space brought about by the contraction of the muscles. The tentacles then expand forming a funnel. When the lophophore is protruded, the lateral ciliary tracts on the tentacles create a current and the food along with the water current is driven into the funnel. Ingestion is further facilitated by the ciliation of the pharyngeal lining and the rapid dilation of the lower part of the pharynx. Large particles may be rejected by the closure of the mouth or the funnel or by the flicking of the tentacle. Food passes through the stomach by peristaltic contractions. Digestion is both extracellular and intracellular within the stomach. Caecum is the principal site for intracellular digestion.

Circulatory System: Circulatory system is wanting.

Excretory System: Definite excretory organs are lacking. The excretion is apparently being carried by the coelomocytes, funicular tissues, tentacles and caecum of the alimentary canal.

Nervous System: The nervous system consists of a nerve ring around the pharynx and small ganglion situated in the ring coelom between the mouth and anus. The ganglion is continuous with the nerve ring. Nerves are given to the various parts of the body from the nerve ring and the ganglion. The nerve ring gives two ganglionated motor and sensory nerve fibres to each tentacle.

Special sense organs are absent.

Reproductive System: Asexual reproduction by budding is occasionally found in *Bugula*. Sexual reproduction is of most common occurrence. It is **hermaphrodite**. Ovary and testis occur together on the same zooid and are formed from specially modified cells of the parenchyma, either of the funiculus or of the body wall. Gonoducts are absent. The ovary is an aggregation of oocytes and remains enveloped by a thin peritoneal wall in the middle of the zooid. Only one ovum matures at a time. The testis develops from the cells of funicular tissue and is located at the proximal end of the body. It may be divided into three or four bunches. Cells of the testis undergoes spermatogenesis and form long tailed motile sperms. The ova and sperms rupture into the coelom. Sperms move about freely in the coelom. Fertilization probably takes place in the coelom. The fertilized ovum then passes into a rounded outgrowth of the **zoecium** called **ooecium** or **ovicell (Fig. 1)** which forms a brood chamber where further development takes place.

Development: Self-fertilization has been observed in *Bugula*. The fertilized egg undergoes radial and holoblastic cleavage. The coeloblastula is formed which eventually transforms into a gastrula by the process of delamination. The developing embryo derives nutrition from the maternal zooid through placenta-like connections to the ovicell. Development is indirect through a larva called **Cyphonaules**. The larva so formed then escapes from the brood chamber. The *cyphonaules* larva is oval in shape, devoid of a shell and an alimentary canal. The larva cannot feed because of the absence of the alimentary canal. The larva possesses a locomotor ciliated girdle or corona, an anterior tuft of long cilia and a posterior adhesive sac. They have a very brief larval existence after which it settles down. The adhesive sac everts suddenly by muscular contraction and fastens to the substratum by means of secretions of the pyriform organ. The attached larval structures then undergo histolysis and develop into an adult. The first zooid is called **ancestrula**. The ancestrula gives rise to other zooids by budding. The colony then gradually increases in size by budding.

Phylogenetic relationship

Affinities with Phorinida: Caldwell (1888) emphasized the relationship between Phorinida and Ectoprocta on the basis of some similarities.

Similarities between Phorinida and Bryozoa (Ectoprocta):

1. Presence of horse-shoe shaped lophophore.
2. Presence of an epistome and a U-shaped alimentary canal.
3. Similar disposition of coelom and the presence of a septum separating the mesocoel and metacoel.

4. Presence of the nerve centre in the mesocoel. Nerve centre is supraenteric.
5. However, there are many structural and embryological differences between the two.

Differences between Phorinida and Bryozoa (Ectoprocta):

1. The origin of coelom is different.
2. Region between the mouth and anus is ventral in Bryozoa while it is dorsal in Phorinida.
3. Excretory and circulatory system are wanting in Bryozoa whereas in Phorinida both are present.

Thus, because of these differences a definite relationship cannot be established between Bryozoa and Phorinida.

Affinities with Brachiopoda:

Similarities between Brachiopoda and Bryozoa (Ectoprocta):

1. Both have similar body plan.
2. Bivalved shell of *cyphonautes* larva of Bryozoa is comparable to the shell of Brachiopoda.
3. Presence of coelomic septa between the mesocoel and metacoel.
4. Presence of a U-shaped alimentary canal.

Differences between Brachiopoda and Ectoprocta:

1. The Brachiopod shell cannot be compared to the exoskeleton of Bryozoa. The shell is laterally placed in Bryozoa, while in Brachiopoda it is dorsoventrally placed.
2. Chitinous setae are present in Brachiopoda but absent in Bryozoa.
3. Nervous system is supraenteric in Bryozoa but is subenteric in Brachiopoda.

Affinities with Endoprocta:

Similarities between Endoprocta and Ectoprocta:

1. Both have a looped alimentary canal.
2. Both have a crown of ciliated tentacles.
3. The two have a marked similarity in the larval stages.

Nitsche (1869) placed the Ectoprocta and Endoprocta as two classes under the phylum Bryozoa because of these similarities between the two.

Differences between Endoprocta and Ectoprocta:

1. The ectoprocta possesses a true coelom, whereas it is wanting in Endoprocta.
2. A crown of tentacles surrounds the mouth and the anus in Endoprocta, whereas it surrounds only the mouth in Ectoprocta.
3. Both the nephridia and gonoducts are present in Endoprocta but are absent in Ectoprocta.

Thus, it is convenient to place Ectoprocta under a separate phylum having phylogenetic relationship with the other lophophorate coelomates.

CLASSIFICATION

Class: Phylactolaemata

Freshwater bryozoans that contains only 50 species. The cylindrical zooid possesses a horseshoe-shaped lophophore (except in *Fredericella*). Colonies are non-polymorphic and have an epistome. They have a non-calcified muscular body wall. Coelom is continuous between zooids.

Examples: *Plumatella*, *Cristatella*, *Fredericella*, *Pectinatella*

Class: Stenolaemata

Marine bryozoans. Tubular zooids with calcified walls which are fused with adjacent zooids. Coelom of adjacent zooids not continuous, though sometimes communicating through pores. Circular lophophore, without a epistome. Body wall is non muscular.

Order: Cyclostomata

They contain some living and many fossil species. Colonies with tubular calcareous zooids having circular orifices. Avicularia absent.

Examples: *Crisia*, *Lichenopora*, *Stomatopora*, *Tubulipora*.

Class: Gymnolaemata

Primarily marine bryozoans with polymorphic colonies. Zooids are either flattened or cylindrical. The members of this class are characterized by having a circular lophophore and the absence of epistome. Non-muscular body- wall, sometimes calcified. Coelom of adjacent zooids not continuous, though interzooidal continuity is maintained through pores. This class includes a great majority of marine and fossil species.

Order: Ctenostomata

Compact colonies in which the zooecia are membranous, chitinous, or gelatinous, never calcareous. Ovicells, avicularia and vibracula are absent. The terminal orifice lacks an operculum.

Examples: *Amathia*, *Bowerbankia*, *Alcyonidium*

Order: Cheilostomata

Boxlike zooids that are adjacent but have separate calcareous walls. Orifice is provided with an operculum (except in *Bugula*). Avicularia, vibracula or both may be present. Development of embryo in special brood chambers called ovicells.

Examples: *Bugula*, *Aetea*, *Cellaria*

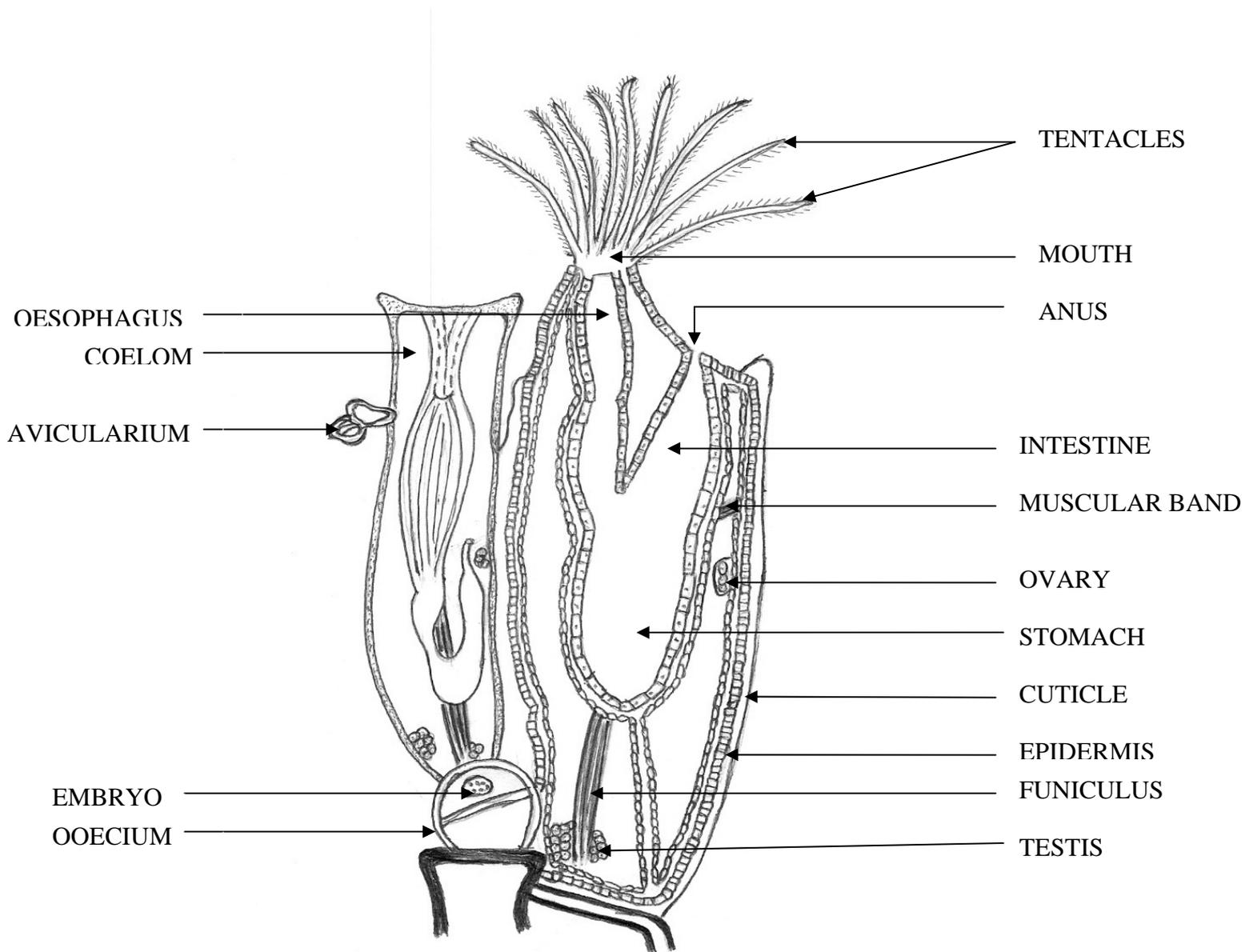


Figure 1. *Bugula* : Two zooids shown in longitudinal section

Suggested Reading :

1. Invertebrate Zoology , by Robert D. Barnes, Publisher: Saunders College International Edition (5th Edition)
2. Parker And Haswell Text Book Of Zoology, Invertebrates, Volume 1, Edited by Marshall And Williams (7th Edition) A.I.T.B.S. Publishers And Distributors
3. Biology Of The Invertebrates, by Jan A. Pechenik, Publisher: Mc Graw Hill Higher Education (4th Edition)
4. Biology Of Animals, by Ganguly, Sinha And Adhikari, Publisher: New Central Book Agency
5. Invertebrate Zoology, by E. L. Jordan And P. S. Verma, Publisher: S. Chand And Company