

L.N.T. COLLEGE, MUZAFFARPUR, BIHAR

DEPARTMENT OF ZOOLOGY

General study of *Balanoglossus* (Toung worm)

Phylum	Chordata
Subphylum	Hemichordata
Class	Enteropezostea
Family	Ptychoderidae
Genus	<i>Balanoglossus</i>

(a) Habit And Habitat

Balanoglossus is a marine, tubicolous or burrowing hemichordate inhabiting shallow coastal waters of intertidal zone, but a few occur in deeper water.

Clavigerus lives inside a U-shaped tube or burrow with the two vertical limbs 50-75 cm deep and two opening 10-30 cm apart.

The anterior opening of burrow is funnel shaped and posterior end is rounded and concealed below the spirally coiled faecal matter of the animal.

Balanoglossus is an ocean-dwelling acorn worm (Enteropneusta) genus of great zoological interest because, being a Hemichordate, it is an "evolutionary link" between invertebrates and vertebrates.

Balanoglossus is a deuterostome, and resembles the Ascidiaceans or sea squirts, in that it possesses branchial openings, or "gill slits".

It has notochord in the upper part of the body and has no nerve chord, this notochord is well defined as stomochord. It does have a stomochord, however, which is gut chord within the collar.

Their heads may be as small as 2.5 mm (1/10 in) or as large as 5 mm (1/5 in).

(b) morphology of *Balanoglossus*

Balanoglossus is worm-like animal with soft, elongated cylindrical body.

They range in length from 3 cm to as much as 2.5 m (*B. gigas*).

They are bilaterally symmetrical animals.

The body surface is uniformly ciliated and is uniformly covered with mucus.

The body is divided into three parts: (1) proboscis (protosome), (2) collar (mesosome), and (3) trunk (metasome).

(1) Proboscis

It is the anterior-most part of the body and is conical in form, tapering anteriorly.

Posteriorly, it continues into a narrow proboscis stalk which is mostly concealed under the collar and is continuous with the inner surface of the dorsal wall of collar.

Below the stalk base the proboscis bears a "U" shaped ciliated depression called the preoral ciliary organ which is a chemoreceptors.

Proboscis encloses coelom of proboscis. Which opens out through the proboscis

pore situated mid-dorsally near its base

(2) Collar

It is middle, short and thick belt-like part of body, lying behind the proboscis.

Its surface is often marked with circular grooves or elevations.

The anterior funnel-like part of collar that encircles the proboscis stalk is called collarette.

Ventrally, below the proboscis stalk, the collarette encloses a wide aperture, the mouth.

The collar is well demarcated from the trunk behind by a circular constriction.

The collar has thick musculature and encloses the collar coelom.

Sometimes the collar coelom is divided into left and right parts by dorsal and ventral mesenteries.

The collar coelom opens by a pair of collar pores into the first pair of branchial sacs.

(3) Trunk

It is the posterior and largest part of the body. It is somewhat flattened and usually shows superficial annulations.

It is also marked by mid-dorsal and mid-ventral longitudinal ridges and is differentiated into three regions: the anterior branchio-genital region, middle hepatic region and posterior abdominal region, The branchio-genital region is distinguished by the presence of a longitudinal row of gill- pores on either side of mid-dorsal ridge.

Each row of gill- pores is mounted on a prominent ridge-like elevation.

The sides of branchio-genital region are thin and leaf-like and are referred to as genital wings, containing the gonads.

The gonads open out through gonopores which are microscopic apertures. The genital wings are usually curved and folded as the dorsal side coming close together in the median line thereby concealing the gill pores.

- **Branchio-genital region**

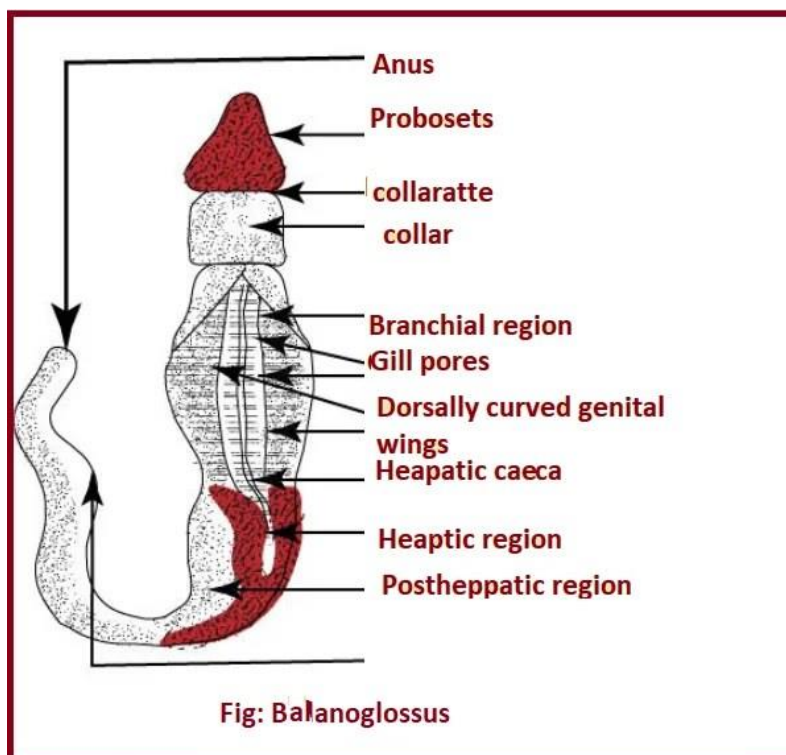
The anterior or branchio-genital region of trunk is marked by a pair of lateral, thin, flat and longitudinal flaps, the genital wings, which contains the gonads.

- **Hepatic Region**

The hepatic region is marked by numerous small, paired, transverse folds, the hepatic caeca, on the dorsal side. It is dark brownish or greenish in colour.

The post-hepatic region or abdominal region gradually tapers behind and bears a terminal anus.

The post-hepatic region it is the posterior most and the longest part of the trunk and is also called the abdomen or the caudal region.



(c) Anatomy of *Balanoglossus*

1. Body wall

The body wall is composed of epidermis, musculature and peritoneum.

Epidermis is outermost layer or and consists of a single layer of mostly tall, slender, columnar and ciliated cells.

Dermis is absent. The muscles are smooth, weak and mostly longitudinal.

In the trunk region, only longitudinal muscle fibres are present.

The coelom is lined by the parietal coelomic epithelium or peritoneum which covers the inner surface of the body wall musculature.

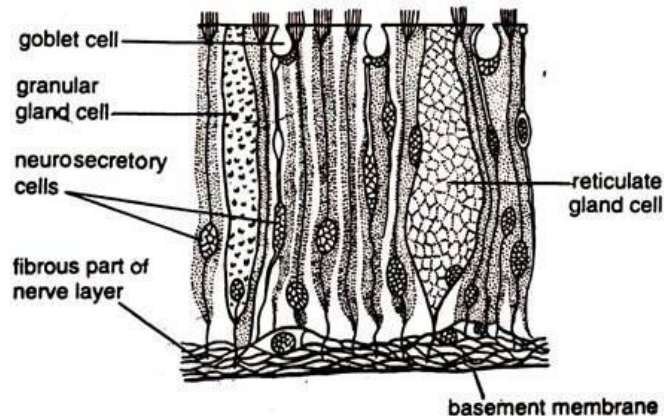


Fig. 28.A. *Balanoglossus* sp. Cross section of body wall

2. Coelom

Early developmental stages of *Balanoglossus* possess a spacious coelom lined with peritoneum. It is enterocoelous in origin.

As the adult condition is attained, the coelomic epithelium gives rise to the connective tissue and muscle fibres. Hence the coelomic cavity is obliterated. The coelom as a whole is divided into three parts.

- **Proboscic coelom (Protocoel)**

In the proboscis, the coelom is a small, unpaired cavity into which several structures like buccal diverticulum, central sinus, heart vesicle, glomerulus etc. project from the base of the proboscis.

The proboscis coelom opens out through a dorsal pore at the base of proboscis.

- **Collar coelom (Mesocoel)**

In the collar, the coelom consists of two separate sac-like cavities on left and right side due to the presence of dorsal and ventral mesenteries.

They communicate with the first pair of gill- sac by a pair of collar pores.

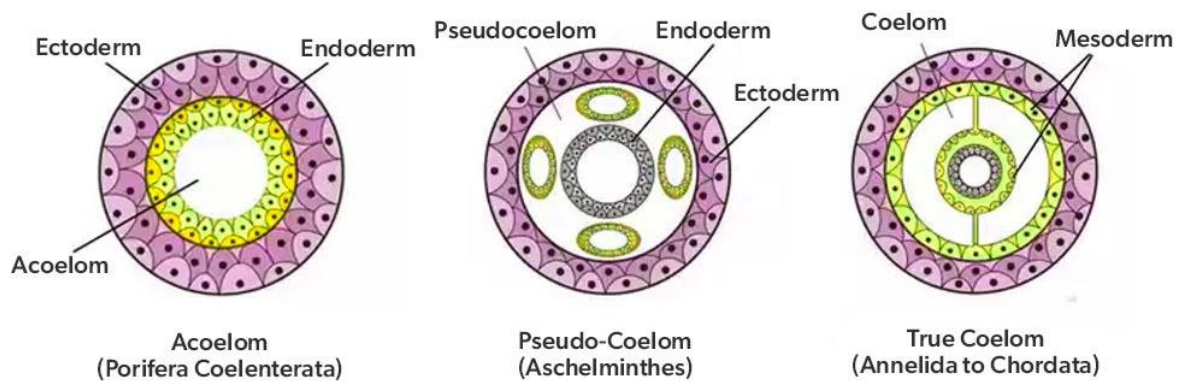
- **Trunk coelom (Metacoel)**

In the trunk the coelom consists of a pair of cavities which are separated by incomplete mid-dorsal and complete ventral mesenteries.

The trunk coelom is filled with coelomic fluid containing amoeboid corpuscles, the coelomocytes. They originated from coelomic epithelium.

According to Spengel (1893), the coelomocytes secrete a membrane around any foreign particle which invades the animal thus behaving like leucocytes.

Coelom



3. Endoskeleton

A definite Endo-skeletal system is absent in Balanoglossus but the basement membrane becomes extraordinary thickened and lamellated to perform the function of skeleton.

Following are the skeletal elements:

- **Buccal diverticulum**

It is short, hollow and stiff tube-like projection extending forward through the proboscis stalk into the proboscis coelom.

It doesn't bear a notochord it has stomochord which is endodermal in origin. Hyman preferred to call it as the buccal diverticulum.

Its wall is composed of single layer of tall, slender, vacuolated endodermal cells.

Silen (1950) has assumed it as an extension of the preoral-region of the digestive tract.

- **Proboscis skeleton**

It is a 'Y' shaped structure, partly secreted by the epithelium and partly by coelomic tissue.

It resembles to a hyoid apparatus in general appearance. It consists of a median plate in the proboscis stalk and continues behind into two narrow horns which extend into the roof of buccal cavity.

The median plate is produced ventrally into keel. The median plate lies below the buccal diverticulum.

- **Branchial skeleton**

It is formed by the thickening of the basement membrane. it consists of numerous M – shaped chitinous skeletal rods that lie in the wall of the pharynx and support the U-shaped gill slits that perforate it

- **Pygochord**

In the post- hepatic region of the trunk, mid-ventrally between the intestine and body wall, developed a rod-like thickening called phygochord. Its cells are vacuolated.

4. Digestive system

It consists of the following parts :-

- **Mouth**

At the base of proboscis stalk a wide circular opening, mouth is situated ventrally and is covered by collarette. It has two sets of muscle fibers, the radial fibers to open it and the concentric fibers to close it. Mouth leads into buccal cavity.

- **Buccal cavity**

It lies in collar region and its epithelial wall contains glandular goblet cells. Anteriorly it forms hollow buccal diverticulum and posteriorly extends up to the collar trunk septum and leads into the pharynx.

- **Pharynx**

It lies in the branchial region of the trunk. Its wall has lateral constrictions projecting into its lumen as ridges called parabranial ridges. These ridges incompletely divide the pharynx into a dorsal respiratory or branchial portion and a ventral digestive portion. Ventral digestive portion lined with ciliated epithelium with gland cell & helps in food concentration.

- **Oesophagus**

Behind the last pair of gill slits the pharynx continues into the short oesophagus. The dorsal part of the oesophagus is called post branchial canal which possesses thick folded and glandular epithelium. Posterior part of oesophagus reduces in diameter and has deeply furrowed epithelium.

- **Intestine**

It occupies hepatic and post hepatic region of trunk. Intestine also extends intestinal caecum corresponding to the hepatic caeca of this region. Post hepatic region of intestine is connected with the ventral body wall by the pygochord

- **Anus**

Intestine opens to the exterior by a terminal circular aperture, the anus at the tip of the trunk. It is often surrounded by a sphincter muscle.

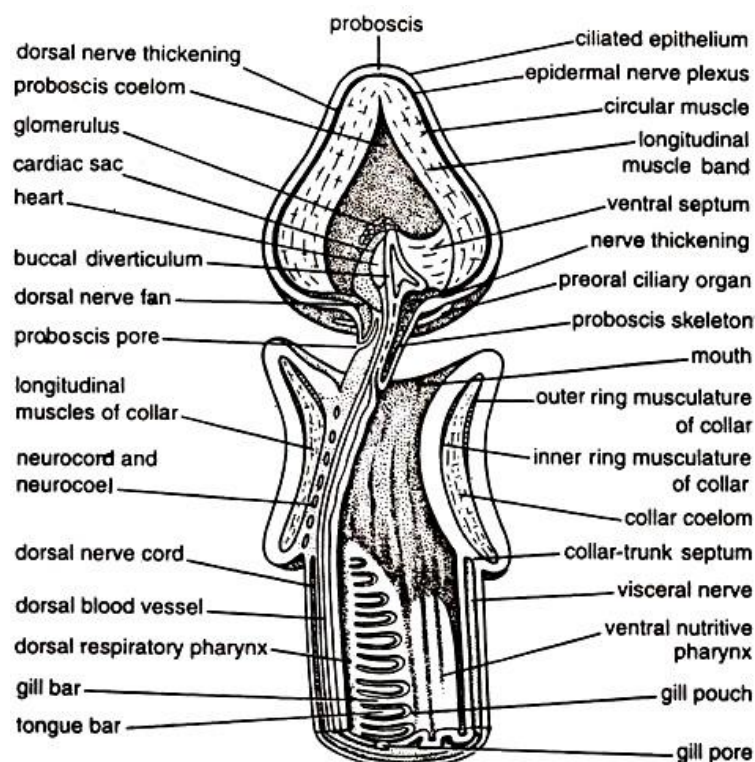


Fig. 28.3. *Balanoglossus* sp. Median sagittal section of the anterior end

5. Food, feeding and digestion:

Balanoglossus is a ciliary feeder. Its food comprises of microscopic organisms and organic particles present in water and the bottom sand in which it makes its burrows.

A respiratory cum food water current is set up by the lateral cilia of gill slits. It enters the mouth, passes through the buccal cavity, pharynx, gill slits and branchial sacs and leaves through the gill pores.

The food, present in the water current is collected by the mucus, secreted by the proboscis gland cells in the form of mucus string.

This mucus string is directed towards the pre-oral ciliary organ at the base of the proboscis by the cilia covering the proboscis.

Then it goes back to the mouth. U-shaped pre oral ciliary organ tests the quality of food and water entering the mouth.

Backward movement of food through the alimentary canal is maintained by the ciliated lining of its walls. Digestion takes place by enzymes secreted by gland cells of the pharynx, oesophagus and hepatic region of the intestine.

Exact process of digestion in Balanoglossus is not known. Undigested substances, along with sand and silt pass out through the anus as "castings".

6. Respiratory system

The respiratory apparatus of Balanoglossus comprises, The branchial sacs that open out through gill-pores and the branchial portion of pharynx bearing gill-slits.

- **Branchial pharynx**

Two lateral longitudinal para-branchial ridges divide the pharyngeal cavity into a ventral digestive portion and a dorsal respiratory or branchial portion.

Dorso-laterally, on each side, the branchial portion is perforated by a longitudinal series of numerous U-shaped opening, the gill-slits.

Their number varies and increases as the animal grows older. At the start of development, a gill-slit is a broad oval slit.

Later, a hollow projection of dorsal pharyngeal wall, called tongue bar, grows into the making it U-shaped.

A tongue bar is connected with adjacent gill septa by short transverse or horizontal connections, the synapticula.

The development and arrangement of gill-slits is identical with that found in Branchiostoma. The gill-slits are richly lined by cilia, called lateral cilia.

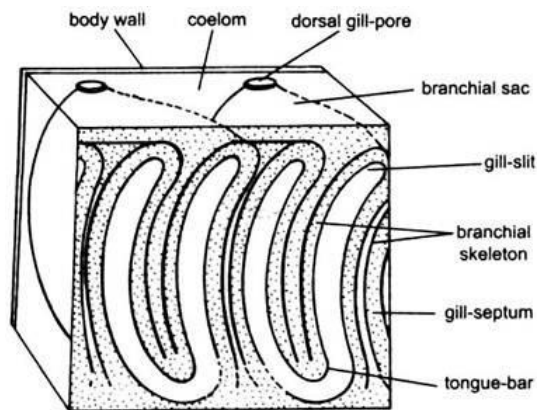


Fig. 2.14. *Balanoglossus*. Diagrammatic three-dimensional view of two gill-slits and two branchial sacs.

- **Mechanism of respiration**

The lateral cilia lining the gill-slits set up a food cum respiratory current of water. It enters the pharynx through mouth, then passes through gill-slits into the branchial sacs and finally leaves through the gill-pores.

The tongue bars are richly vascular and participate in gaseous exchange. The blood of their capillary networks takes up the oxygen dissolved in water and returns carbon dioxide to it.

7. Nervous system

The nervous system is of primitive type resembling that of coelenterates and echinoderms.

Nervous layer is thickened along definite strands to form two Main nerve cords, one mid-dorsal and other mid-ventral, which runs along the entire length of the trunk. Ventral cord extends upto collar-trunk septum where it connects with the dorsal cord by circular strands, called circumenteric nerve ring.

Dorsal cord extends anteriorly upto the base of proboscis where it is connects with other circular strands called anterior nerve ring. Dorsal cord leaves the epidermis and traverses the collar coelom as collar cord. The collar cord contains a cavity called neurocoele.

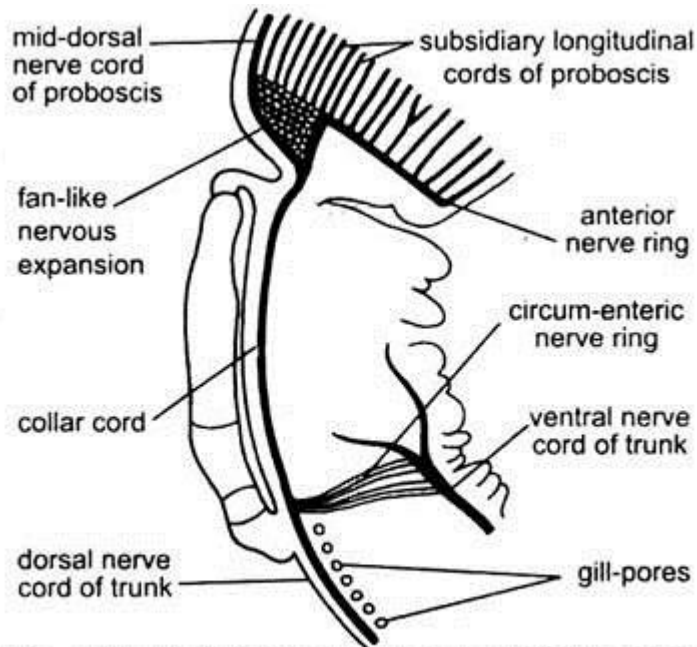


Fig. 2.18. *Balanoglossus*. Nerve cords in the anterior region of the body.

8. Reproductive System

Balanoglossus performs asexual and sexual reproduction. Gilchrist described asexual reproduction in *Balanoglossus capensis*. In the summer season its posterior end will divide into a number of bits. Each bit will develop into a new individual.

Sexes are separate, sexual dimorphism is absent. The gonads are simple. They are present in one or many rows in branchio-genital region, fertilized zygote undergo holoblastic cleavage. In *Balanoglossus kowaiowsley* the development is direct. No larval form is seen in its life history. In other species of *Balanoglossus* a larval form called 'Tonaria' is seen in the development. It will undergo metamorphosis and becomes adult.

9. Development

The fertilized egg contains some amount of yolk. It is mesoelecithal egg. It undergoes holoblastic cleavage. Because of cleavage it gives Morula, blastula stages. In Blastula stage a cavity is present called Blastocoel. The blastula is round in the beginning then it becomes flat. It undergoes invagination and gives two layered gastrula. This stage will show blastopore, which will slowly closer.

This stage will develop cilia. It will also develop apical tuft. It shows ectoderm and endoderm. It will develop enterocoelic coelom. At this stage the ciliated embryo will be liberated into water. It elongates and transforms into tornaria" larva.

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