Phoronida

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The Phoronida, divided into two genera and 10 species, is a small marine group, which belongs to the phylum Lophophorata.

Basic Design

The Phoronida is an exclusively marine group with a sessile vermiform body enclosed in a tube (Figure 1) The body is composed of three distinct parts (prosome, mesosome and metasome), each containing its own coelomic cavity. The prosome forms the epistome, a fold overhanging the mouth dorsally. The mesosome bears the lophophore, with the mouth lying between its two rows of tentacles. The lophophore is a terminal, bilaterally symmetrical, tentacle crown, each tentacle having complex arrays of cilia for filter-feeding. Lophophore shape is a fairly constant feature within each species, and there is an increasing



Figure 1 Diagram of an adult *Phoronis* showing the main anatomical features.

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complexity of the lophophore from an oval to a helicoidal, through a horseshoe and spiral shape. This is related to an increase in the number of tentacles, which is proportional to the general body size.

The metasome (or trunk) is slender and cylindrical, with a bulb-like posterior end (or ampulla) that anchors the body in the rear end of the tube. It is separated from the rest of the body by the diaphragm, a thick transverse septum located behind the lophophore.

The digestive tract is U-shaped, bringing the anus close to the mouth. The descending branch is divided into a short oesophagus, followed by a long prestomach, then a stomach surrounded by a blood plexus. A muscular pylorus separates the stomach and intestine, the latter being a long, slender ascending tube, which ends in the anus on the anal papilla.

Phoronids have a closed circulatory system, containing red corpuscles with haemoglobin. In the trunk two longitudinal vessels communicate through the stomach blood plexus and the lophophoral vessel. The lophophoral vessel gives rise to a capillary in each tentacle where respiratory gas exchange takes place. The digestive products are taken up from the stomach and intestine into the blood plexus.

Two metanephridia, located on either side of the intestine, open into the trunk coelom by one or two funnels, and discharge to the exterior via a nephridiopore, located on the anal papilla. The morphological characteristics of the nephridia are of prime taxonomic importance in identifying a species.

The nervous system lies within the epithelial tissue. The main nerve centre or ganglion is located in the epistome and gives off a nerve ring at the level of the diaphragm. One or two giant nerves issue from the ganglion and extend along the body wall down to the ampulla.

The trunk wall includes strong longitudinal muscle bundles, arranged in four sections separated by the longitudinal mesenteries.

Phoronids are hermaphroditic or dioecious but can also reproduce asexually. The gonads are applied to the longitudinal lateral blood vessel. Gametes are released through the nephridia, which serve as gonoducts. Fertilization is internal and cross-fertilization takes place in hermaphrodite species. Egg cleavage is total, equal and typically radial. Three types of developmental patterns occur: species with small eggs which are shed directly into the seawater, and species with larger eggs brooded either within the lophophore or within the parental tube in *Phoronis ovalis*.

The embryonic development leads to a characteristic ciliated larva named the actinotroch, bearing an anterior preoral lobe on which is located the nervous ganglion (on the apical area), a tentacular ridge, a pair of protonephridia, and posteriorly a ciliated ring around the anus. The larvae undergo a planktotrophic development and settle after about 20 days. Metamorphosis is 'catastrophic', occurring in less than 30 minutes and leading to a slender young phoronid.

Diversity and Lifestyles

Two genera, *Phoronis* and *Phoronopsis*, are recognized, with respectively seven and three well-defined species. In the genus *Phoronopsis* an epidermal collar-fold occurs at the base of the lophophore.

Phoronids secrete rigid chitinous tubes to which sediment particles and debris adhere. Tube length varies from several millimetres to more than 450 mm and corresponds to the extended size of the vermiform body. Phoronids may occur vertically embedded in soft sediments (sand, mud or fine gravel) or form tangled masses of many individuals, buried in, or encrusting, rocks and shells. One species, *Phoronis australis*, is embedded into the tube of cerianthid anemones.

Phoronids are suspension feeders, capturing small particles (e.g. diatoms, flagellates, peridinians, small larvae, detritus) from the water by means of the lophophore. They orient their lophophores into the prevailing water current.

The lifespan is thought to be about one year. Phoronids generally breed from spring to autumn over a fairly long period. The actinotroch larva is a familiar component of the plankton (although there is a creeping larva in *Phoronis ovalis*). The predators of phoronids are not well known but they include fishes, gastropods and nematodes. The reaction of a phoronid to a predator is a very rapid retraction down into the tube. Furthermore, a damaged phoronid can rapidly regenerate a lost part.

Phoronids are found in all oceans (except the polar seas) and are not uncommon in favourable situations, sometimes up to some tens of thousands of individuals per square metre. All species have a wide geographical distribution. They occur at depths ranging from the intertidal zone to about 400 m.

Fossil History and Phylogeny

Several authors regard Phoronida as constituting a separate phylum; but others consider them to be a class within the phylum Lophophorata (called Tentaculata by some German authors), which also includes the Bryozoa and Brachiopoda. All three groups share a ciliated lophophore, which can be defined as 'a tentacular extension of the mesosome (and of its cavity, the mesocoelom) that embraces the mouth, but not the anus, its main functions being feeding, respiration and protection'. They also have many other morphological and embryological features in common. DNA analyses independently support the close relationships within the Lophophorata and their monophyletic origin.

There is a poor fossil record for soft-bodied phoronids: burrows and borings attributed to phoronids are known from the Devonian.

Further Reading

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