Bryozoans

87 W 2030 Culture, 6-8 colonies
87 W 2035 MAGNAculture, 20 colonies
87 W 2040 Statoblasts, Jar/50

INTRODUCTION

Bryozoans are among the most common animals that grow on submerged objects in freshwater and marine habitats. The odd name, meaning "moss animals," refers to the appearance of certain freshwater species—inert brown crusts and spindly tendrils that are easily mistaken for dead moss. Other species are gelatinous blobs that sometimes reach football size.

Regardless of their size or form, all bryozoans are composed of multiple, tiny subunits, called zooids. These perform all major biological functions: capturing and digesting food, reproducing sexually and asexually, and exchanging gases with the surrounding water. Each zooid has its own muscular and nervous systems, and responds independently to stimuli. There are no nerve links between zooids.

The bryozoan colony, however, is more than a collection of zooids. Thin layers of muscles in the outer body wall operate without any central control. There is also a common coelom through which fluid circulates, propelled by scattered tracts of cilia belonging to no zooid in particular.

Such modular body organization is found also in other sessile invertebrate groups. Corals, hydroids, sponges, and certain protozoans are typical examples, all with repeating subunits that comprise the whole. Since colony growth involves simply adding new modules, there is none of the slowdown in growth that occurs when noncolonial animals increase in volume. This gives modular organisms a great advantage when competing with other encrusting organisms for space on a solid substrate. Most modular living organisms are difficult to examine under the microscope. They tend to be too bulky, too small, too shy, or too finicky in their living requirements. Freshwater bryozoans, however, lend themselves well to classroom study.

LOPHOPODELLA CARTERI

The freshwater bryozoan, *Lophopodella carteri* (Hyatt, 1860), is the best known of six species in the family Lophopodidae. The pea-sized colonies are globular, with a transparent body wall that allows a clear view of the interior (Figure 1). The species is easily maintained in continuous laboratory culture, and the hardy colonies tolerate much prodding and poking.

The known range of *Lophopodella carteri* includes most of Europe, southern Africa, southern Asia, Japan, and eastern North America. It occurs infrequently, but can be locally abundant, blanketing submerged logs, rocks, and aquatic vegetation in calm or flowing water. The species is believed to have entered North America in the early 1930s on the leaves of imported aquatic plants. It has now been reported from New Jersey west to as far as Illinois, north to Quebec, and south to Tennessee. It is especially abundant in late summer.

In *Lophopodella carteri* new zooids are constantly being formed along the colony margins. From there they gradually migrate toward the center. Old zooids contract into yellowish balls, detach from the colony wall, and slowly disintegrate inside the coelomic cavity. Presumably their body nutrients are recycled to new zooids.

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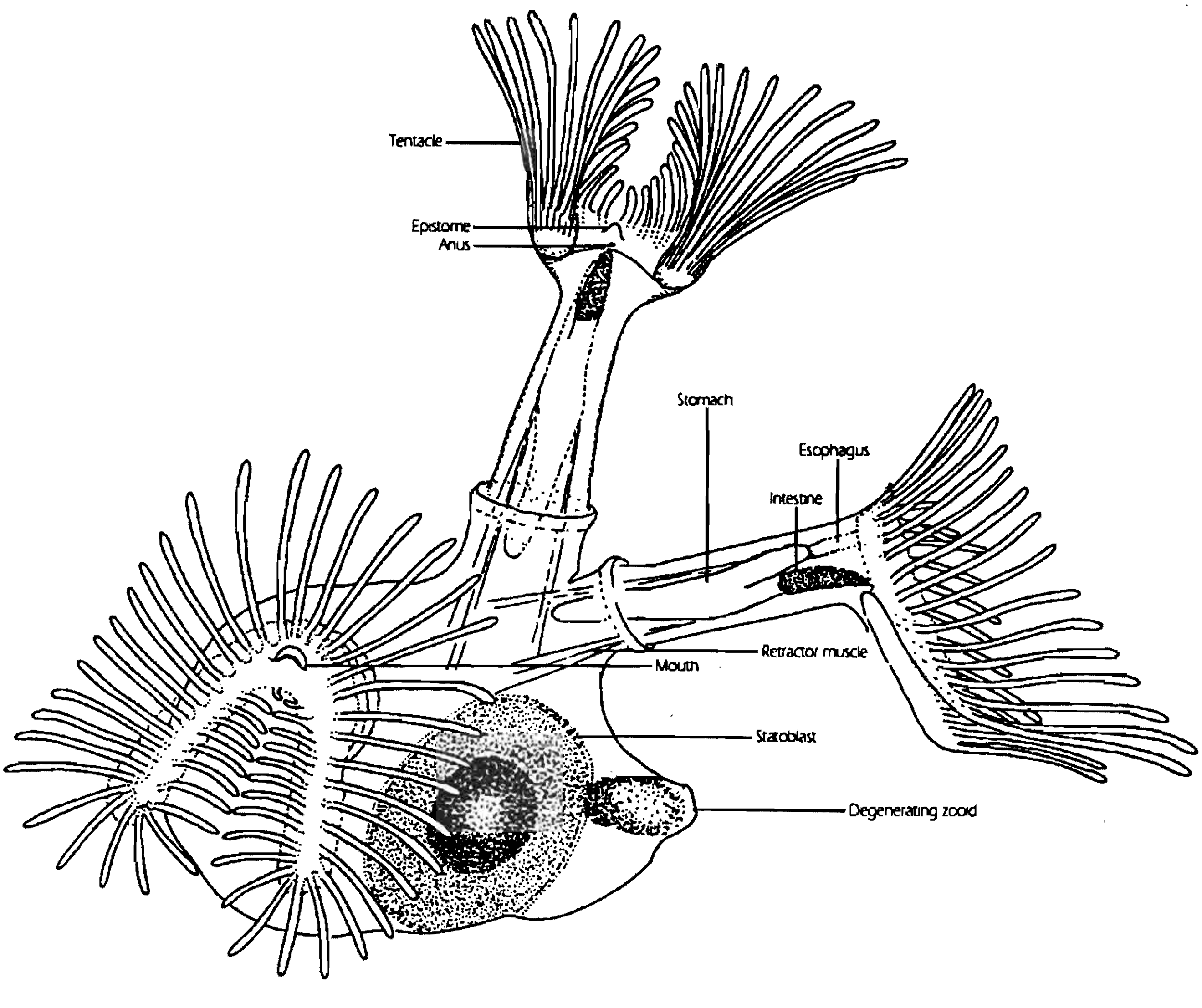
Colonies are capable of moving slowly over the substrate, although the mechanism for this movement is not known. Propulsion force may be generated by the combined effects of ciliated lophophores oriented in a similar manner. Occasionally a large colony will pull itself apart into two smaller colonies, each moving slowly in different directions.

At some point in colony development, zooids begin the asexual production of dark, seed-like structures called statoblasts. These are flat, disc-shaped capsules containing embryonic tissue and yolky food reserves. In Lophopodella each statoblast is released through a slit near the base of the lophophore. It sinks immediately to the bottom sediments, where it may remain viable for several years. After an obligatory dormant period, the statoblast germinates when exposed to favorable conditions. A single zooid emerges and starts a whole new colony.

Little is known about sexual reproduction in Lophopodella. Inert male gametes circulate with coelomic fluid to all parts of the colony. Eggs appear in a tiny, grape-like cluster on the inner colony wall. Indirect evidence suggests an exchange of gametes occurs between colonies, but the mechanism is unknown. Fertilization has never been observed, but fertilized eggs have been examined as they develop into ciliated "larvae." These are actually two or three zooids surrounded by a ciliated mantle. When fully grown the larva swims away like a miniature blimp. Within hours it attaches to a suitable substrate, withdraws the ciliated covering, extends its lophophores, and begins feeding as a new colony.

Figure 1. Small Colony of *Lophopodella carteri*



EXAMINATION OF THE COLONY

A colony of *Lophopodella carteri* is most easily examined with a dissecting microscope. Transmitted rather than reflected light is better for revealing major parts of the anatomy. You should first identify individual **zooids**, each with a **lophophore** of tentacles for capturing food particles. Constantly beating **cilia** are easily visible on the tentacles. The **mouth** is located between the two rows of tentacles at the base of the lophophore, best seen when you are looking directly down into the lophophore. Partially obscuring the mouth is a lobe-shaped **epistome**, which appears to sort or screen incoming particles. Ingested food collects briefly in a short **pharynx**, and is then "swallowed" through the **esophagus** to the Y-shaped **stomach**. Most of the stomach is a long sac in which food is mixed by rhythmic peristaltic contractions. At regular intervals, a small portion of stomach contents passes through a sphincter and into a short **intestine**. Here it is consolidated into a soft pellet, surrounded with mucus, and expelled through the **anus**. By packaging the gut contents in this way, the zooid assures that recently processed food is not immediately ingested by a neighboring zooid.

Within the colony it is possible to detect the circulation of coelomic fluid from the movement of suspended cells and other particles. Also visible are the long strands of **retractor muscles** capable of quickly withdrawing the lophophore when necessary. The slow relaxation of these muscles, combined with an internal coelomic pressure, enables the zooid to extend its lophophore back into the water.

In *Lophopodella carteri* the statoblasts are flattened oval shapes about 0.5mm long. The color is white in the early stages of formation, gradually changing to a dark brown when the outer chitin is secreted. Under close scrutiny, you can see that the statoblast has a central iridescent area, which is the exposed portion of a large interior **capsule**. Surrounding that is a **periblast** of tiny chambers. When the statoblast is dried or frozen, the chambers fill with air, enabling the statoblast to float. At the time of its release, the statoblast is enclosed in a membranous envelope. This envelope soon disintegrates, exposing hooked spines at each end of the statoblast, which are distinctive for this species.

A germinating statoblast opens like a clam shell. A crack appears at the equatorial **suture**, the two **valves** separate, and an **adhesive pad** protrudes slightly. Later, the valves gape wider and a tiny lophophore emerges from the newly developed zooid. This entire process normally takes about three days at room temperature.

CARE AND MAINTENANCE

Lophopodella carteri is a hardy animal that cultures easily and tolerates neglect. A colony can be transferred from one container to another with a large bore dropping pipet. You can make one by snipping off the narrow tip of a plastic pipet to leave an opening about 4mm diameter. Gently dislodge the colony under water with the tip of the pipet and draw it up inside with some water.

Colonies can be placed in a petri dish of aged water for examination under a dissecting microscope. However, they tend to drift out of the field unless they are attached to the bottom of the dish. Colonies normally adhere to a clean substrate when left undisturbed for 24 hours or less.

Colonies kept for more than a few days should be held in a position that prevents fecal pellets from accumulating. You can stand the petri dish on edge or invert it inside a larger container or aquarium.

Finding the proper water and food is important. Bryozoan colonies usually thrive in fresh water collected from a productive lake or pond. Unfiltered water from an established aquarium also works well. For reasons we have yet to understand, the presence of fish seems to be beneficial.

Statoblasts can be kept dormant by storing them in a totally dark and cool environment. Their container should be loosely capped to allow gas exchange. To germinate, place statoblasts in a covered petri dish of aged water with normal classroom lighting and temperature. Germination is enhanced by using very soft water or even tap water mixed with an equal volume of distilled water and aerated in advance for 24 hours. Germination should begin within two to seven days, depending on statoblast age and temperature. Most zooids adhere nicely to the bottom of the dish, although there are always a few that fail to stick. Germinated zooids have sufficient internal food reserves for about a week. The granular yolky material and retained statoblast valves largely obscure internal structures.

SUGGESTED ACTIVITIES

1. Count the number of "swallowing" movements per minute in individual zooids. Is the swallowing rate the same for all zooids? Is it influenced by either the nature or concentration of particles in the water? Is the rate of food intake linked to the contraction rate of the stomach?

2. Tear apart a fecal pellet and examine it with a compound microscope. Identify the type and condition of digested food, and compare with the particles available in the water. Is there evidence of particle selection? What can you conclude about the rigor of the digestive process? (This works best with fresh water from a lake or pond containing plankton.)

3. Examine a functioning lophophore and note the direction of water movement around it. How does the zooid respond to different types of particles? How are certain particles rejected? Can the cilia beat be reversed? Does it ever stop?

4. Examine zooid sensitivity to various stimuli. Where is it most sensitive to touch? What other stimuli cause it to withdraw?

5. Focus on the colony interior and note the particles circulating in the coelom. Describe the appearance of various particles. Is there a particular circulatory pattern, or does coelomic fluid move randomly? Look for the internal cilia that propel the fluid.

6. Look for developing new zooids and disintegrating old ones. Where are these located in the colony? For a longer term study, determine the average longevity of a single zooid. How long does it take for an old zooid to disintegrate?

7. Record the migration of a colony over several days. Is the direction of migration random or directed? Is it affected by the type of substrate? The orientation of the substrate with respect to gravity? Water currents?

8. Study the process of statoblast germination. How long does it take? Record a chronology of all the changes that occur. When are the first small movements detected? When does the lophophore become functional?

9. Study the growing zooid after it germinates from a statoblast. How does it differ from the mature zooid in an established colony? How long does it take to reach full size? Are new tentacles added as the size increases?

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