# Section 3: Life Cycle and Reproduction

Bryozoans exhibit a **combination of asexual and sexual reproduction**, allowing them to efficiently **expand their colonies and disperse to new habitats**. Their reproductive strategies are **highly specialized**, involving both **budding-based colony growth** and **larval dispersal**. Freshwater species possess a unique adaptation—**statoblasts**, which allow colonies to survive extreme environmental conditions.

**Asexual Reproduction and Colony Growth**

Asexual reproduction in bryozoans occurs primarily through **budding**, a process where **new zooids develop from existing ones**, increasing the colony’s size. This allows bryozoans to **expand rapidly** and colonize new surfaces.

1. **Budding and Colony Expansion**
	* Each new zooid **originates from an existing cystid**, ensuring genetic continuity within the colony.
	* Budding follows **a modular growth pattern**, meaning the colony expands in a **regular, repeating structure** based on species-specific organization.
	* The direction and shape of **colony growth** vary:
		+ **Encrusting species** spread laterally across surfaces.
		+ **Arborescent species** grow outward into the water column.
		+ **Erect bryozoans** form **branching or fan-like structures** to maximize feeding efficiency.
2. **Fragmentation and Regeneration**
	* Some species **can regenerate** from detached fragments of a colony, allowing them to **recolonize new areas**.
	* This is especially common in **marine bryozoans** that experience **high-energy wave action**, which may break off pieces of a colony that later reattach and grow into a new structure.
3. **Statoblasts: Dormant Survival Structures (Freshwater Bryozoans Only)**
In freshwater bryozoans (**Phylactolaemata**), **asexual reproduction occurs through statoblasts**, which are **dormant, encapsulated propagules** that allow colonies to survive environmental extremes.
	* **Statoblasts (statos, "standing" + blastos, "bud")** are **tiny, resilient structures** that develop inside zooids and are released when conditions become unfavorable.
	* These structures are highly **resistant to desiccation, freezing, and anoxia**, allowing bryozoans to persist in **temporary or seasonal freshwater habitats**.
	* When environmental conditions improve, **statoblasts hatch**, producing a **new founder zooid**, which then buds to create a **new colony**.

Statoblasts play a critical role in the **dispersal and survival** of freshwater bryozoans, ensuring that they can **repopulate lakes, ponds, and rivers** each season.

**Sexual Reproduction and Larval Development**

Bryozoans are **simultaneous hermaphrodites**, meaning that **each colony contains both male and female reproductive structures**. However, individual zooids within a colony **may specialize in sperm or egg production**.

1. **Gamete Production and Fertilization**
	* Sperm is released into the surrounding water, where it is captured by the **lophophore of a neighboring zooid** and transported to the eggs.
	* Fertilization is **internal** in most species, with embryos developing **within brooding zooids** before being released as larvae.
	* Some bryozoans **lack brooding capabilities** and release their eggs directly into the water, where fertilization occurs externally.
2. **Brooding and Larval Stages**
	* Many bryozoans **brood their embryos** inside specialized **brooding chambers**, which offer **protection and nourishment** until the larvae are ready for release.
	* Brooding is particularly common in **marine species**, where larvae must be **fully developed before dispersal** to maximize survival.
3. **Types of Larvae and Dispersal Strategies**
Bryozoans have two primary larval types, depending on whether they rely on **long-distance dispersal** or **rapid settlement**:
	* **Cyphonautes Larvae** (planktotrophic, feeding larvae)
		+ **Common in marine species**, these larvae have **triangular, shelled bodies** and can **feed on plankton** during their time in the water column.
		+ They **remain planktonic for days to weeks**, allowing them to **disperse over long distances** before settling.
		+ Once a suitable substrate is found, the larva **undergoes metamorphosis**, attaching itself and developing into the **first zooid of a new colony (ancestrula)**.
	* **Coronate Larvae** (lecithotrophic, non-feeding larvae)
		+ These larvae do **not feed** and instead rely on **yolk reserves** for nourishment.
		+ They have a **shorter planktonic phase** and typically **settle quickly**, ensuring that colonies form **close to the parent colony**.
4. **Colony Formation and Metamorphosis**
	* Once the larva settles, it **undergoes metamorphosis**, transforming into the **first zooid of the colony (ancestrula)**.
	* The ancestrula then **begins budding**, forming additional zooids and expanding the colony.
	* This rapid **colony establishment** ensures that bryozoans can **secure space on substrates**before competitors take over.

**Colony Longevity and Regeneration**

Bryozoan colonies exhibit a **unique life cycle**, where individual zooids may **senesce and be replaced**, but the colony itself can **persist for years**.

* **Zooidal Turnover**
	+ Individual **zooids have a limited lifespan**, often degenerating after **a few weeks or months**.
	+ Old zooids are replaced by new ones through **continuous budding**, ensuring the colony remains **active and functional**.
* **Regeneration and Colony Repair**
	+ Bryozoans possess **remarkable regenerative abilities**, allowing them to recover from **injury or partial damage**.
	+ If part of a colony is broken off, surviving zooids can **bud new individuals**, restoring the lost section.
* **Seasonal Dormancy**
	+ Some species enter a **dormant state during unfavorable seasons**, particularly in **cold or nutrient-poor environments**.
	+ In these cases, the colony may **cease budding**, with only a few active zooids maintaining basic functions until conditions improve.

### Species Profile: Solitary Bryozoan (Monobryozoon ambulans)

Unlike most bryozoans that form colonies, Monobryozoon ambulans is unique in being a solitary organism. Measuring just about 1 millimeter in length, it is one of the smallest known bryozoans. Its rarity and solitary nature make it a subject of fascination among scientists.

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