# Clonal creatures of pond and stream

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Clones and cloning were words from science fiction to most of us until quite recently, so it may seem surprising that a fisherman in a trout stream or a swimmer in a lake or reservoir has invaded a habitat where clonal organisms thrive. In nature, clonal reproduction is nothing futuristic at all. Plants and animals have been reproducing that way for hundreds of millions of years, and clones of many kinds can be found in both terrestrial and aquatic environments.

Biologically, cloning is simply asexual (one parent) reproduction, a form of reproduction in which the new individual is a genetically identical copy, or clone, of its parent. This is in contrast to sexual (two parent) reproduction in which special cells (e.g., eggs and sperm) from the two parents come together and the genes they contain are recombined to produce a new individual which is genetically similar, but not identical, to either parent.

Clonal plants and animals are composed of genetically identical modular units budded asexually from an original founder individual. Modules may remain physically linked in a colony, or they may fragment to produce several separate clones. Plant biologists have studied the lives of clonal plants for many years. They include many useful plants (like strawberries) and some of the worst agricultural pests (like kudzu). Animal biologists are just beginning to appreciate how much the ecology of clonal invertebrates resembles that of clonal plants, and how different clonal and colonial animals are from solitary animals like ourselves. In fact, compared to our own life cycle, their lives do sound like tales from science fiction. Humans are produced by two-parent reproduction. We go through a long juvenile period of growth in size, but cease growing as we become sexually mature adults. We then produce our offspring, enjoy our maximum economic and reproductive power in our prime, become old, and die. Even when young, we have relatively poor powers of regeneration – if an arm gets cut off, we can't grow another to replace it. But most clonal animals have enormous powers of regeneration, making them very difficult to kill off. They don't suffer from senescence, the debilities of old age, and they can continue to grow throughout their lives. In their populations, the largest, oldest individuals may control the most territory and enjoy the greatest amount of sexual reproduction.

Hydra are among the most delightful freshwater creatures. The amazing regenerative powers of these little polyps have made them popular subjects in laboratories and science classrooms for over 200 years. If their tentacle arms are cut off, or even if their bodies are cut in half, they can regenerate the missing pieces within a few days. Under good food and temperature conditions hydra reproduce asexually. A polyp produces one or two buds along its stalk. The buds develop into complete new animals which pinch off the parent stalk, and, within a few days, start producing buds themselves. For this reason, hydra populations in any particular body of water consist of many physical individuals, but they are all clones of a very few genetic individuals. Only when conditions in the stream or lake start to deteriorate do hydra reproduce sexually. Hydra then produce ovaries or testes in place of buds. Fertilized eggs are surrounded by a shell (theca) and may undergo a resting stage that lasts for days or months before they develop into new polyps.

Sponges and bryozoans are two other common freshwater animal groups that al-

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**Fig. 1**: Tan bryozoan colonies and green freshwater sponge on a submerged stick.

ternate periods of active growth and dormancy and utilize both asexual and sexual reproduction during their life cycles.

Sponges are simple invertebrate animals whose cells are organized only into tissues and whose bodies have no organs like mouths or stomachs. Thanks to the complex architecture of their tissues and supporting skeletons of spongin (a kind of collagen) and glassy spicules, however, they manage to feed themselves quite efficiently. Food-bearing water flows into the sponge through the small holes (ostia) in its mound-like body and out through a larger hole (osculum). Inside the sponge body, specialized cells along water channels create currents and engulf food particles. Sponges also have great powers of regeneration from injury or predation. Some species even reproduce asexually by fragmentation or breaking apart each fragment developing into a new sponge clone. There are only about two dozen different species of freshwater sponges in North America, but they can be both large and abundant in some ponds and lakes. *Spongilla lacustris* colonies measuring more than a cubic meter in size have been reported. They can also play an important part in keeping the water in which they live clean. For example, biologist T.M. Frost found that, at its peak density, the sponge population in one New Hampshire pond could filter the entire volume of the pond in about a week.

**Fig. 2**: Virginia Museum of Natural History volunteer Megan Greytak pulls up colonies of *Pectinatella magnifica* growing on a waterlogged tree branch in Philpott Lake, Virginia.

Under deteriorating conditions (such as falling temperatures in autumn) sponges reproduce asexually. Areas of the colony fill up with clumps of gemmules, thick-shelled resting buds, that can hatch out after a period of dormancy (such as over the winter). During active summer growth sponges can also reproduce sexually. The fertilized eggs develop into free-swimming larvae which settle and metamorphose into new genetic individuals.

Like sponges, freshwater bryozoans have few species, but they may be very common and play an important role in freshwater ecosystems. Bryozoans use ciliated tentacles to filter suspended particles. Colonies may form tan branching networks or brown fuzzy masses on rocks, submerged wood (e.g., Fig. 1, 2), or pond weeds. One species, *Pectinatella magnifica*, can be really noticeable. In late summer when water levels fall, its massive gelatinous colonies encrust sunken tree branches, stumps, and pilings as in Figure 2.

Freshwater bryozoans may spawn free-swimming sexually produced larvae during their active growing season. However, they also rely on specialized resting stages, called statoblasts, to get them through bad times such as winter (Fig. 3). Statoblasts are asexually-produced dormant buds with thick protective shells. Their structure and shape are unique for each phylactolaemate species. Some statoblasts sink to the mud as the parent colony breaks up and decays in winter; others float at the water surface, dispersing the clones far and wide, to hatch out later when and where conditions become favorable once again (Fig. 4).

Biologists think that asexual reproduction is the fastest and energetically cheapest way for an organism to make new members of its kind, members that are proven to be adapted to the same environment as the successful parent. It is easy to see how the clonal offspring of a large old *Pectinatella* colony, produced in one large batch at the end of the colony's life in autumn, could come to dominate a pond when they hatched out and produced new colonies the following season.

On the other hand, in sexually produced offspring the genetic material has undergone recombination, and the new individuals produced may have different strengths and weaknesses than their parents. This variation is vital in enabling a plant or animal species to spread into new habitats and geographic regions or even to maintain its populations in one habitat under shifting environmental conditions. This is essential in freshwater habitats where these conditions may change drastically, from hot to cold or from drought to flood in just one season. Clonal organisms with their varied and flexible life cycles are prepared for almost anything.

In 1997 the sudden and unexpected announcement of the successful cloning of a mammal, a Scottish sheep named Dolly, made headlines around the world. Mammal clones can occur naturally – identical twins are an example. But in mammals, natural cloning can occur only at a very early embryonic stage in fertilized egg cells. It cannot take place in regular adult body cells. The technological breakthroughs made by the Scottish research team were three-fold: 1) in regressing a body cell from an adult sheep to a potential embryonic condition, 2) in successfully transferring its genetic material to a sheep egg whose own genetic material had been destroyed, and 3) in then implanting the egg in a surrogate mother sheep. One reason the case of Dolly, the Scottish sheep, had such repercussions is that it caused people to realize human cloning might someday be possible and that the many ethical issues regarding such experiments had not been resolved. The techniques that produced Dolly have been developed since to produce clones of a number of other domesticated animals. Once we come to terms with them, they will no doubt find uses in human medicine, as well as in the conservation of endangered wildlife. Before there are clones among us, however, we still have a lot to learn biologically by studying life among the clones.

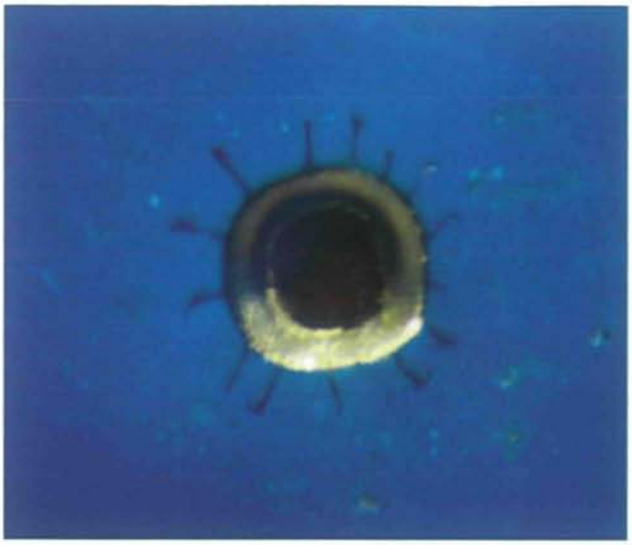

**Fig. 3**: Statoblast of *Pectinatella magnifica*.

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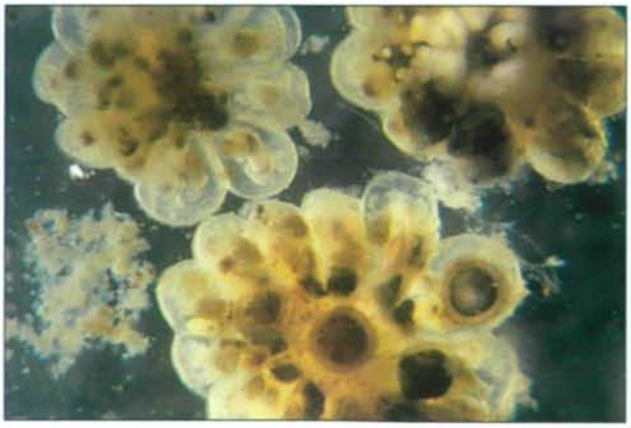

**Fig. 4**: Statoblasts inside a fragmenting colony of *Pectinatella*.