This hard clam veliger was photographed using an electron microscope. The larval shell is laying flat on a piece of carbon tape and the straight-hinge where the shells connect, is on the left side of the photograph, which makes the shell resemble the letter D. The velum is the beard-like structure protruding from the margin of the shell in the upper right portion of the photo. The distance from the edge of the straight hinge to the velum is approximately 120 microns or less than 1/200 of an inch.

Marine invertebrates are fascinating creatures. Although terrestrial invertebrates far outnumber their ocean dwelling cousins in terms of number of species, the tremendous variety of body forms and lifestyles of marine invertebrates are unrivaled by any other group of organisms. However, the clams, barnacles, sea stars, and horseshoe crabs we observe at the shore represent merely one phase of complex lifecycles. The adult forms we see at the beach are the final phase in a series of wonderfully diverse developmental stages.

The term larvae is used to describe the various developmental or embryonic stages of invertebrates. Many marine invertebrates that spend their adult life attached to a rock or buried in the sand are transported as larvae by ocean currents for hundreds of miles along the coast. Larvae are much smaller than the adult stage and develop from a single fertilized egg cell. Although the egg may contain yolk material to provide energy for the developing embryonic organism, many larvae actively feed during this planktonic, or free floating stage.

Like many marine invertebrates, the hard clam, Mercenaria mercenaria, produces planktonic larvae. However, unlike most other marine invertebrates, the culturing and harvesting of hard clams supports an important commercial fishery. In 1992, the total U.S. hard clam fishery produced 12.3 million pounds of meat valued at 55.6 million dollars. The share of the fishery attributable to the aquaculture industry has been increasing over the last decade. Between 1983 and 1991, total U.S. aquaculture production more than doubled (from 1.7 to 3.8 million pounds) whereas total commercial landings increased 20% in that same period.

During commercial production, hard clams are induced to spawn by alternating increasing and decreasing water temperature. This temperature shock treatment causes the clams to release their gametes (females release eggs and males release sperm). Hard clam eggs are spherical with a diameter of approximately 70 microns or 1/364 of an inch. Sperm are significantly smaller and much more abundant. The gametes are suspended in water and allowed to mix. Fertilization takes place when a sperm cell penetrates an egg and the genetic material of two cells fuse to produce one fertilized egg cell or zygote. Aquaculture operators dilute the culture water so that the density of fertilized eggs is 30 per milliliter or more than 100,000 per gallon of culture water. A few drops of culture water may contain more than 100 fertilized egg cells. These cells rapidly begin to divide and develop into hard clam culture.

The most distinctive larval phase of mollusks (the group of organisms that hard clams and all other bivalves belong to) is the veliger. Hard clams develop into veligers 3 to 5 days after fertilization. Veligers form a larval shell around the soft tissue. The soft tissue includes a velum, which is a specialized larval structure used to capture food particles such as algal cells and other phytoplankton. Besides culturing clam larvae, aquaculture operators must also grow and maintain algae cultures to feed developing veligers.

In addition to feeding on algae, the larvae are also respiring (consuming oxygen and releasing carbon dioxide) and producing and releasing metabolic waste (nitrogen). Because of this activity it is necessary periodically to change the culture water in which the veligers are developing. This is accomplished by straining water from the culture tanks to retain the larvae and then supplying the tanks with new sea water. During this drain down process, the "runts of the litter" are allowed to pass through a sieve and are discarded. Only the largest or fastest growing are retained on the sieve. This procedure is intended to produce fast growing clams.

Increased growth rates equal greater production efficiency and yield by decreasing the amount of time clams take to reach marketable size. The goal of the drain down process, selecting the fastest growing larva to produce the fastest growing clams makes good economic sense. But do current aquaculture practices accomplish the goal? Do fast growing larvae produce fast growing adult clams? What if there is an adverse correlation between larval growth rate and clam growth rate? In other words, what if slow growing larvae produce the fastest growing clams and vice versa? If this is the case and there is negative correlation between larval and juvenile growth, then current practices are equivalent to "throwing the baby out with the bath water."

Through funding provided by NJ Sea Grant, we're conducting a research project (Enhancing Hard Clam Aquaculture Through Manipulation of Larval Culturing, R/E-95004) addressing this issue, at Villanova University. Working with Co-Investigator G. Flaim, of the NJ Sea Grant Marine Advisory Service, we're raising hard clam larvae, sieving veligers and sorting by size. Instead of discarding the smaller veligers, we're raising them in separate cultures from large larvae and following subsequent growth of the clams produced from the different larval size groups. This research will allow us to evaluate the effectiveness of the current aquaculture practice of larval size sorting during the drain down process. Results should be available by the summer of 1996, and will be applied in an commercial aquaculture facility. Information based on the laboratory and field results will then be used to publish and distribute a larval rearing manual that could prove to be a valuable resource for the aquaculture industry.