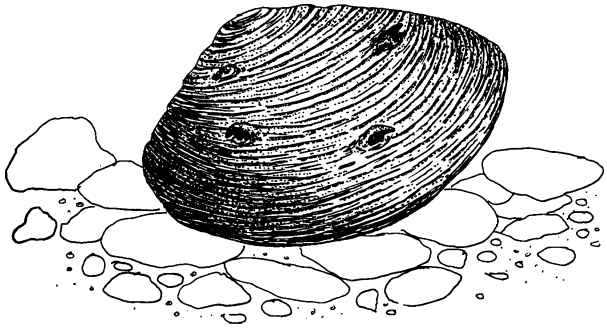
Mollusks: Freshwater Bivalves

An Overview of Freshwater Mussels



The freshwater mussel could be described as the "canary" of the aquatic world. As the canary in the underground mines of historical times was the early-warning system that notified miners of dangerous air pollution and lack of oxygen, so the status of a mussel population is an indicator of the water quality in the aquatic system that is its habitat. Because mussels require clean water to survive, the reduction and extirpation of these species in a lake or stream constitute a warning that water quality has been lowered and may be potentially hazardous for other species including humans.

Description: The freshwater bivalved mollusks have two valves (shells) joined together at the dorsal surface by a hinge ligament and by two strong internal muscles. The valves, which remain slightly open, are secreted by a thin layer of tissue called the mantle, which also forms **incurrent** and **excurrent** openings (siphons) at the posterior end of the animal. The anterior end is usually buried in the substrate.

All mussels are filter feeders. With its anterior buried in the bottom, the naiad draws oxygen-bearing water and food through the incurrent siphon, and passes deoxygenated waste-carrying water out the excurrent siphon. Food (mostly detritus, bacteria, one-celled algae, and small planktonic organisms) is filtered from the water by the gills. Through these filter-feeding activities, the mussels serve as a biological filter by removing organic and inorganic particles from the water, thus improving water quality downstream. This filtering activity also puts these species at risk from pollutants entering the streams.

The identification of freshwater mussel species relies primarily on shell characteristics. The most important diagnostic features are shape and dimensions of the shell, sculpture of the beak and surface, and coloration of the epidermis and nacre. Because of polymorphic shell characteristics in some species, it is difficult, even for experts, to determine differences between species, and sometimes between individuals in the same population. Therefore, only biologists with permits are allowed to complete surveys for these species. Illustrations are not included here, but the interested reader may consult a state maintained Web site for more information about these species (*http://www.wildlife.state.nc.us/nongame/mussel/*).

Life History: Naiad females extrude eggs through their oviducts and move them into the water tubes of the gills. During this period, the water tubes become more or less modified as gill pouches, forming a marsupium. Sperm shed by the males are drawn into the marsupial water tubes by ciliary action, and the fertilized eggs begin developing into unique larval forms known as **glochidia**. Depending on the genus, either all or only a portion of the gills may carry the developing embryos. A single female may produce hundreds of thousands of embryos. Short-term brooders spawn in spring and release glochidia in the summer while long-term brooders spawn in late summer, hold the glochidia through the winter, and release them in the spring and early summer.

The bivalved glochidium lacks most of the internal organs of the adult and is not capable of swimming or crawling. Almost all appear to be obligate parasites of fish. Most are parasitic on the gill filaments, skin, or fins of the fish. The infections are usually light and produce little harm. A major function of this parasitic relationship is to serve as a means of dispersal, transporting the juveniles some distance from their parental source. Specificity to particular host fishes limits the ability of the glochidia to reach maturity if that host is not available. Part of the plan for preserving threatened and endangered naiads, therefore, should be the preservation of native fish fauna and their natural migration and spawning patterns.

Of all the freshwater invertebrates, the freshwater mussels probably have the longest natural life span. Some thin-shelled pond species live only 4-10 years, but thicker shelled river species may survive several decades. While sexual maturity may require from 1-4 years, reproductive capability continues until the end of life.

While river naiads can be found as isolated specimens, they are most often found clustered in large groups called **beds**. These units are far more important reproductively than single individuals and are vital to perpetuating a population. Often, a single bed may be the source for an entire stream population, and destruction of such may result in extirpation of the species from the area.

Habitat: Some species of mussels are found in both streams

and lakes, while others are restricted to one habitat. Species specific to streams cannot survive in lakes, mostly because of the lack of proper glochidia fish hosts and /or because of the lack of currents that provide an adequate supply of food and oxygen. The preferred habitat varies with the species; but most riverine species do best in a cobble, gravel-sand substrate with good current and high water quality. Little movement occurs unless forced by environmental conditions. An individual rarely moves more than a few hundred yards in a lifetime. The range of any one species may be limited to a single river system.

Threats: The decline of mussels in North Carolina is caused by the degradation and destruction of instream habitat including altered natural fish communities. Detrimental to the aquatic environment are activities such as impoundment, channelization, and dredging, which cause deadly amounts of siltation as well as fragmentation of habitat. Riparian habitat is disturbed as a result of cutting and clearing of vegetation along stream banks, bank destabilization, and residential and road construction. These produce erosion, siltation, and sedimentation. Changes in water temperature, lowering of oxygen levels, and reduction of water quality results from wastewater discharges, toxic spills, pesticide and herbicide runoff, and the introduction of other pollutants. The smothering action of siltation seems to be the most detrimental factor.

Management Recommendations: Protection of water quality and existing habitat, and restoration of degraded habitat. Enforcement of protective laws so that potential threats to specific sites can be identified and preventive measures taken. Education of the public of the environmental threats to the mussels and the important role they play in aquatic ecosystems.

Sources: Terwilliger et al 1995, USFWS 1990.