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Preliminary Results on Studies of Mussel Shell Gape Under Different Environmental Conditions

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EXTENDED ABSTRACT

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PRELIMINARY RESULTS ON STUDIES OF MUSSEL SHELL GAPE UNDER DIFFERENT ENVIRONMENTAL CONDITIONS.—Freshwater mussels are perhaps the most endangered of North American animals. Populations have been in steady decline throughout the 1900s, and that trend is likely to continue into the 21st century. Mississippi's rivers and streams support a diverse range of aquatic habitats with approximately 80 species of freshwater mussels. Currently, only about half of these species are considered free of the threat of extinction. By far the largest threats to freshwater mussels in Mississippi result from anthropogenic activities such as dam building, dredging, and poor agricultural practices in riparian zones. As the human population continues to expand in the state, these activities will also increase. Commercial harvests to supply the cultured pearl industry have exerted pressure on many populations of unionid mussels in the United States. Large, thick-shelled mussels such as *Amblema plicata* and *Megalonaias nervosa* are found in large numbers in some Mississippi rivers; however, commercial harvests are not legal in the state.

At the beginning of this century, when the button industry depleted the supply of available mussels, aquaculture was explored as a means of preserving or extending mussel resources. Considering today's wide range of threats to our mussel populations, the development and implementation of successful aquaculture methods should be given high priority. Long-term maintenance of mussels in an artificial habitat and breeding of mussels in captivity are advances in aquaculture that can benefit conservation efforts as well contribute to the cultured pearl industry. The Center for Water and Wetlands Research at the University of Mississippi Field Station has tremendous potential for the study of freshwater mussel aquaculture practices. The facility has more than 200 experimental ponds as well as numerous stream mesocosms in which most aspects of water quality can be manipulated.

Bivalves must gape the shell valves in order to circulate water through the mantle cavity. Much basic research remains to be completed to assess the relationships between degree of shell gape and physiological parameters such as rates of filtration, clearance, and oxygen uptake (to name a few). Even in the absence of those data, some researchers have been using shell gape behavior as an indicator of water quality.

We have used a shell-gape monitoring device that produces a continuous record of shell aperture in various applications, two of which will be discussed. The device employs induction-type sensors whose voltage output is digitized and recorded on disk while simultaneously providing a waveform display on a monitor. Amplitude of the wave is proportional to degree of shell opening. Output for each mussel is calibrated in units of percentage of maximum shell gape for that individual. Figure 1 illustrates typical valve activity of one mussel for 1 hr. Comparison of experimental treatment effects can be made by evaluating time spent open, area under the curve, maxima and minima, recovery periods, etc.

In the first study, we used the shell-gape monitor to measure the response of *A. plicata* to brief changes in water velocity caused by passage of navigation vessels in the upper Mississippi River. Divers placed mussels and sensors in the channel. Multiple passages over mussels by recreational craft and work boats were recorded. Only 6 of 42 events, caused by passage of a work boat or a 6.5-m-long skiff, caused a measurable response in mussel shell gape. In associated laboratory trials, eight *A. plicata* collected from the Sunflower River in Mississippi were virtually unaffected by exposure every 2 hr to 5-min pulses of high-velocity water (45 cm/sec). Because mussels were not uniformly or greatly affected by water velocity changes, this technique may be less useful for investigating navigation effects than for detecting water quality.

In the second study, we evaluated shell-gape behavioral response of *A. plicata* to different water conditions. Thirty-two mussels were monitored for 10 days. After the first 5 d in aerated, dechlorinated tap water, the water was siphoned off and replaced with one of four water treatments. The treatments were 1) a suspension of live algae in a growth medium, 2) the same as treatment 1 but with the algae filtered out, 3) river water, and 4) filtered river water. Total time spent open and average magnitude of shell gape were significantly greater for mussels in the second 5 d of the study for treatments 1 and 3. We monitored a similar group of eight mussels for 5 d in a nearby lake.

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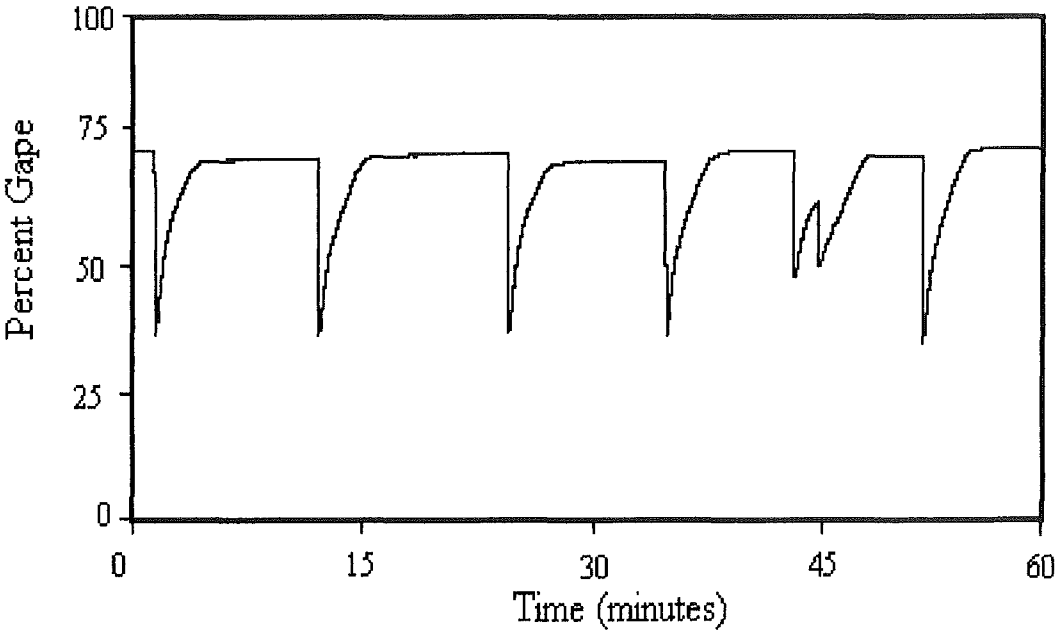

Fig. 1. Shell-gape activity of a single *Amblema plicata*. See text for desciption of percentage of gape.

These mussels exhibited far longer periods with the valves gaping and much higher average gapes than the mussels in any of the laboratory groups, suggesting that some influence of the laboratory environment may not have been accounted for.

Our research, and the research of others using similar techniques, demonstrates that shell-gape behavior studies can be a useful research tool, both in the field and in the laboratory. Potential uses of shell-gape monitoring devices are wide ranging and could include assessing the condition of mussels in transplant experiments, in holding tanks, under different nutrient regimes, or a variety of other stressors. The relationship between valve movement and mussel physiology needs to be explored. For many mussels, little is known of periodicity of activities like filtration or reproductive displays. Monitoring devices could also be used to evaluate the effects of relaxing agents or to monitor valve movement after implantation of nuclei.

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