US Army Corps
of Engineers
Waterways Experiment
Station

Zebra Mussel Research Technical Notes

August 1993

Estimation of Filtration Rate of Zebra Mussels

Background and purpose

Zebra mussels, like all bivalve molluscs, are filter-feeders. They take in water, circulate it over their gills, and remove and ingest suitably sized particles. Particles that are not ingested are rejected as pseudofeces before reaching the mouth. By removing particles, large numbers of zebra mussels can alter clarity and quality. Production of pseudofeces affects chemical and physical conditions of substrate. In addition, removal of nutritious particles could negatively affect food availability for young, commercially valuable fishes. This technical note describes a method for determining the filtering rate of a population of zebra mussels consisting of multiple size classes.

Additional information

This technical note was prepared by Mr. Jin Lei, U.S. Army Engineer Waterways Experiment Station (WES). For more information, contact Mr. Lei, (601) 634-3224, or Dr. Barry S. Payne, (601) 634-3837. Dr. Ed A. Theriot, WES, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Estimating filtration rates

Laboratory studies have indicated that filtration rates vary exponentially with shell length (Figure 1). The equation that describes the relation illustrated in Figure 1 can be used to estimation the filtration rate of a zebra mussel population consisting of various sizes of individuals. For example, a zebra mussel with a shell length of 20 mm would filter about 60 ml of water per hour. Although mussels do not filter continuously, it is likely that a single zebra mussel could filter 1 L of water per day. Griffiths and others (1991) calculated the following filtration rates: for a population consisting only of juveniles, 262 L/hr/kg; for a population consisting of equal numbers of adults and juveniles, 201 L/hr/kg; and for a population with many adults, 78 L/hr/kg. The filtering rate for a population consisting of multiple size classes was estimated at 180 L/hr/kg. (In other words, 180 L of water will be filtered by 1 kg of zebra mussels per hour.) All particles in the water will be removed when water passes through the mussel. The filtration rate based on zebra mussel population volume can be converted to mass based on information in a previous technical note (Miller and Lei 1993).

Prepared and published by the Zebra Mussel Research Program, U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

All particles with diameter greater than 1.54 μm will be removed when water passes through the mussel. Retention time is less efficient when particle diameter is less than 1.5 μm (Figure 2). Water temperature also affects filtration rates. The filtration rates of zebra mussels (cold- and warm-acclimated) declined as temperature of water deviated from the optimum of 20 °C (Figure 3). If the particle concentration is less than 27 mg/L, most particles will be ingested. Conversely, if particle concentration is above 27 mg/L, excess material will be rejected as pseudofeces.

References

Griffiths, R. W., Schloesser, D. W., Leach, J. H., and Kovalak, W. P. 1991. "Distribution and Dispersal of the Zebra Mussel in the Great Lakes Region," *Canadian Journal of Fisheries and Aquatic Sciences,* Vol 48, pp 1381-1388.

Miller, A. C., and Lei, Jin. 1993. "A Method for Calculating the Total Mass of Zebra Mussels," Technical Note ZMR-4-02, Zebra Mussel Research Program, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

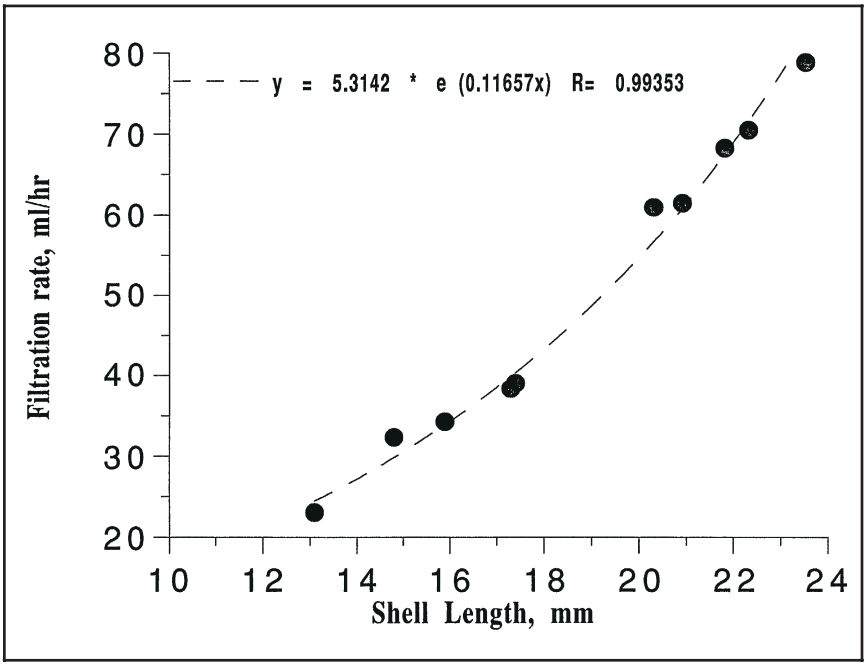

Figure 1. Relationship between shell length and water filtration rate of zebra mussel

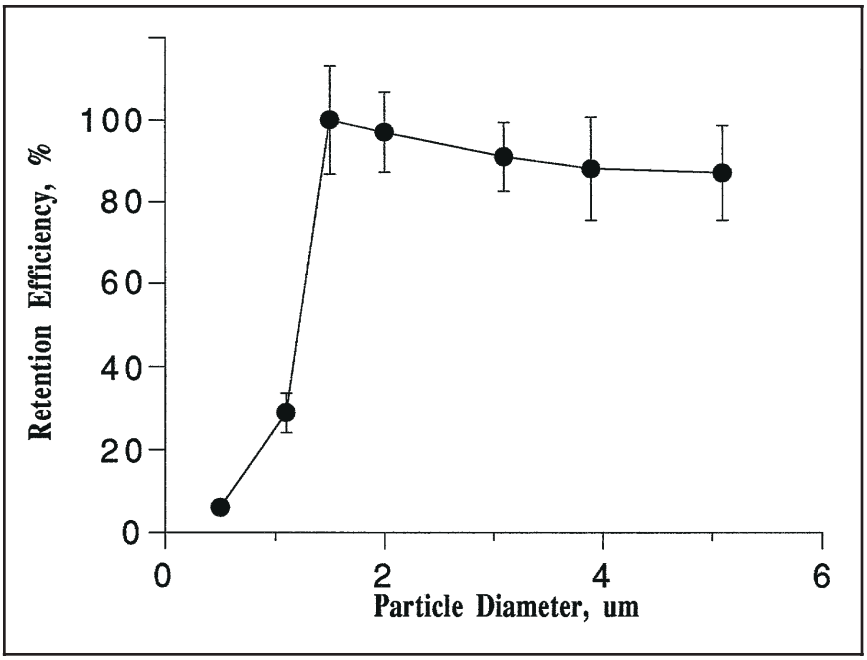

Figure 2. Effect of particle size on retention efficiency

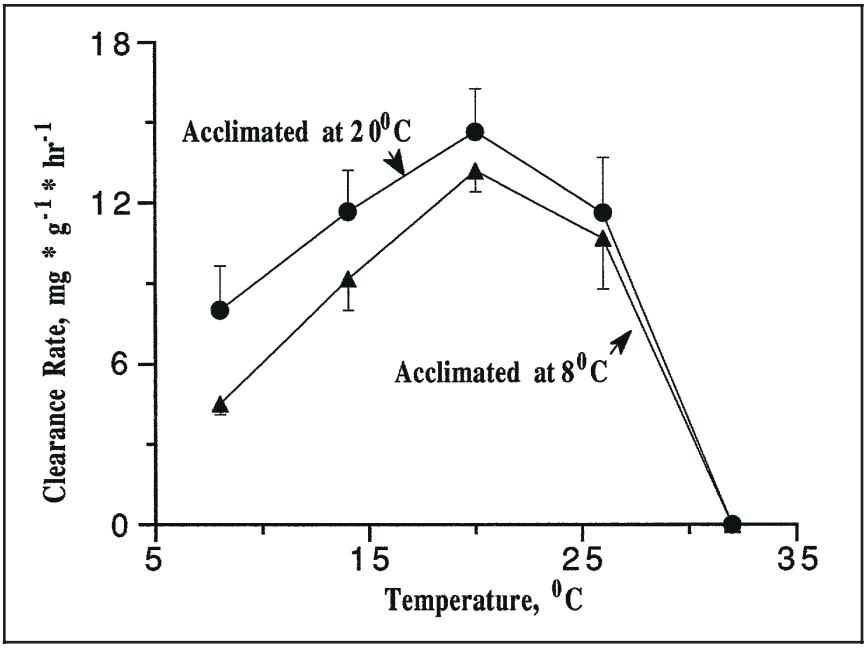

Figure 3. Effect of temperature on filtration