US Army Corps
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Waterways Experiment
Station

Zebra Mussel Research Technical Notes

August 1993

Acclimation Response of Zebra Mussels to Laboratory Testing

Background and purpose

Laboratory studies of zebra mussels and their control sometimes require field collection of individuals that are subsequently kept in the laboratory. Zebra mussels are poikilothermic or cold-blooded (that is, their physiological rates are dependent on water temperature). Thus, an especially important aspect of field-to-laboratory transfer and subsequent studies of zebra mussels is their acclimation to water temperature. For example, mussels might be collected in warm water during the summer, kept at low temperatures during laboratory holding (to reduce condition decline and minimize mortality during laboratory holding), and transferred at a later date to a warm temperature for a particular study. The purpose of this technical note is to summarize temperature acclimation patterns of zebra mussels.

Additional information

This technical note was written by Dr. Barry S. Payne, U.S. Army Engineer Waterways Experiment Station (WES), and Dr. David Aldridge, North Carolina A&T State University, based on studies conducted by Dr. Aldridge. Contact Dr. Payne, (601) 634-3837, for additional information. Dr. Ed A. Theriot, WES, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Approach

Mussels were collected from the Niagara River at Buffalo, NY, in late spring and were shipped to Dr. Aldridge's laboratory in North Carolina. Here, mussels were acclimated for 25 days to either 8 °C (cold acclimated) or 18 °C (warm acclimated). A group of mussels from each acclimation group were then transferred to the higher or lower temperatures.

The rate of acclimation to a warmer temperature, or the warm-acclimation response, was assessed by comparing respiration rates (an indicator of physiological condition) of mussels remaining at 8 °C to rates of mussels transferred from 8 to 18 °C. The cold-acclimation response was assessed by comparing respiration rates of mussels kept at 8 °C to those of mussels held at 18 °C to those of mussels moved from 18 to 8 °C.

Results

Acclimation to a warmer temperature involved rapid respiration rate reduction (Figure 1). Prior to transfer (day 0 in Figure 1), mussels that had been acclimated to 8 °C had a respiration rate at 18 °C that was 1.7 times higher than rates at 18 °C of mussels that has been acclimated to 18 °C. From day 3 through day 12, the transferred mussels reduced their rate of oxygen consump-

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tion to a level equal to that of warm-acclimated mussels. Cold acclimation involved a delayed but then rapid increase in respiration rates (Figure 2). Prior to transfer (day 0 in Figure 2), mussels that had been acclimated to 18 °C had a respiration rate at 8 °C that was 35 percent of the rate of mussels tested at and acclimated to 8 °C. Respiration rates of mussels transferred from 18 to 8 °C did not begin to increase until 10 to 15 days after transfer. By day 21, the respiration rates of transferred mussels equaled those of mussels kept at 18 °C.

Discussion These studies indicate that warm acclimation is rapid compared to cold acclimation, and that complete acclimation occurs regardless of direction of the temperature shift. Cold-acclimated mussels that are abruptly shifted to warm temperatures could be especially susceptible to control during the first few days when their physiological rates at a higher temperature are elevated because of their cold-acclimation status. These patterns of temperature acclimation (as shown in Figures 1 and 2) must be considered in the design and analysis of laboratory studies of zebra mussel physiology and control.

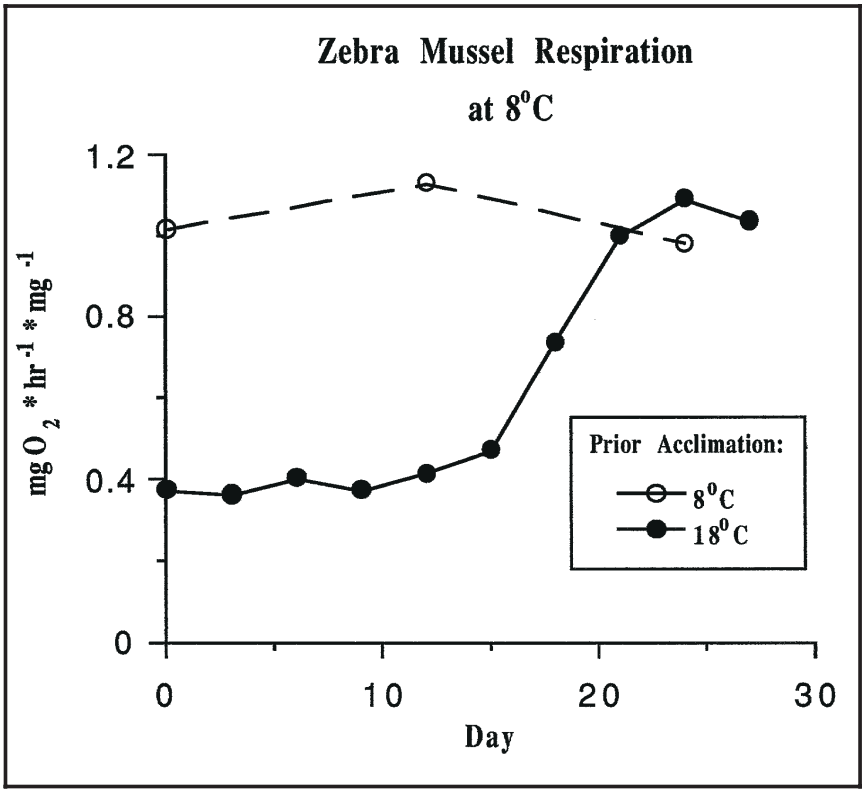

Figure 1. Warm-acclimation response of zebra mussels

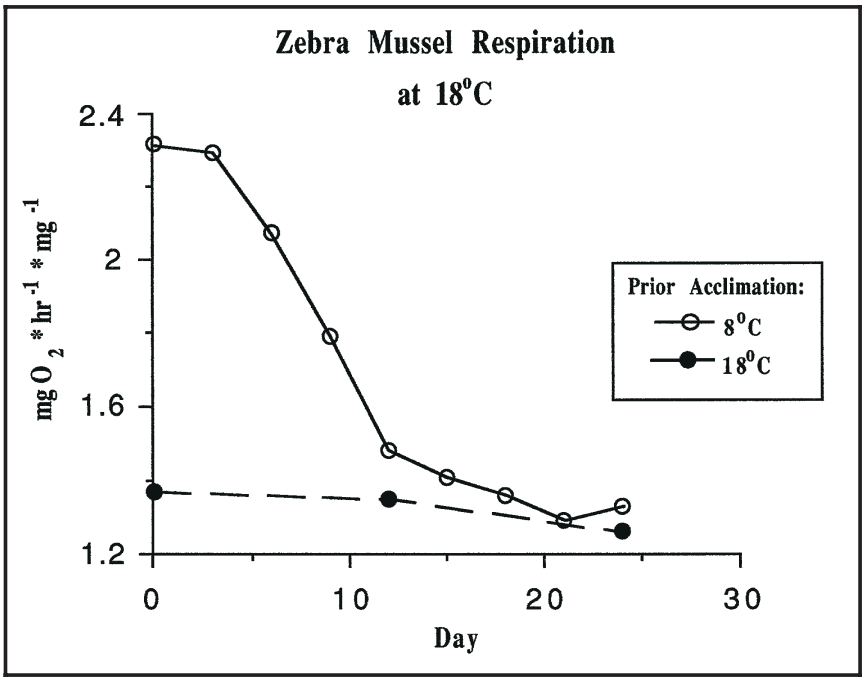

Figure 2. Cold-acclimation response of zebra mussels