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Zebra Mussel Research Technical Notes

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Upper Temperature Limits of Zebra Mussels as Indicated by Respiration Rates

Background and purpose

Respiration rates can be measured to indicate physiologically stressful conditions. Typically, "cold-blooded" aquatic animals show a more or less steady increase in respiration rate as water temperature increases — to a point. As temperature is raised beyond the upper thermal limit of an animal, respiratory rates plummet as physiological dysfunction occurs. Like other physiological processes, upper thermal limits are expected to vary with the temperature acclimation status. For example, winter versus summer collected mussels often show different respiration rates at a common test temperature.

The purpose of this note is to summarize information from a respiration rate study of upper thermal limits of zebra mussels acclimated to different temperature conditions.

Additional information

This technical note was written by Dr. Barry S. Payne, U.S. Army Engineer Waterways Experiment Station (WES), based on studies conducted by Drs. James Alexander and Robert F. McMahon, Center for Biological Macrofouling Studies, University of Texas at Arlington. For additional information, contact Dr. Payne, (601) 634-3837. Dr. Ed Theriot, WES, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Approach

Respiration rates of zebra mussels acclimated to 5°, 15°, and 25° C were measured at temperatures ranging from 5° to 45° C. Oxygen consumption of 12 mussels was measured at each acclimation-test temperature combination. The tissue dry mass of each mussel used was determined, and respiration rates were expressed in terms of microliters of oxygen uptake in one hour per milligram dry tissue mass.

Results

A sudden decline in respiration was noted between 30° and 35° C in all three temperature acclimation groups (Figure 1). Within this temperature range, the temperature at the onset of the sudden respiratory decline varied directly with acclimation temperature. The crash in respiration occurred as temperature was raised from 30° to 35° C for mussels acclimated to 5° C and as temperature was raised from 35° to 40° C for mussels acclimated to 25° C.

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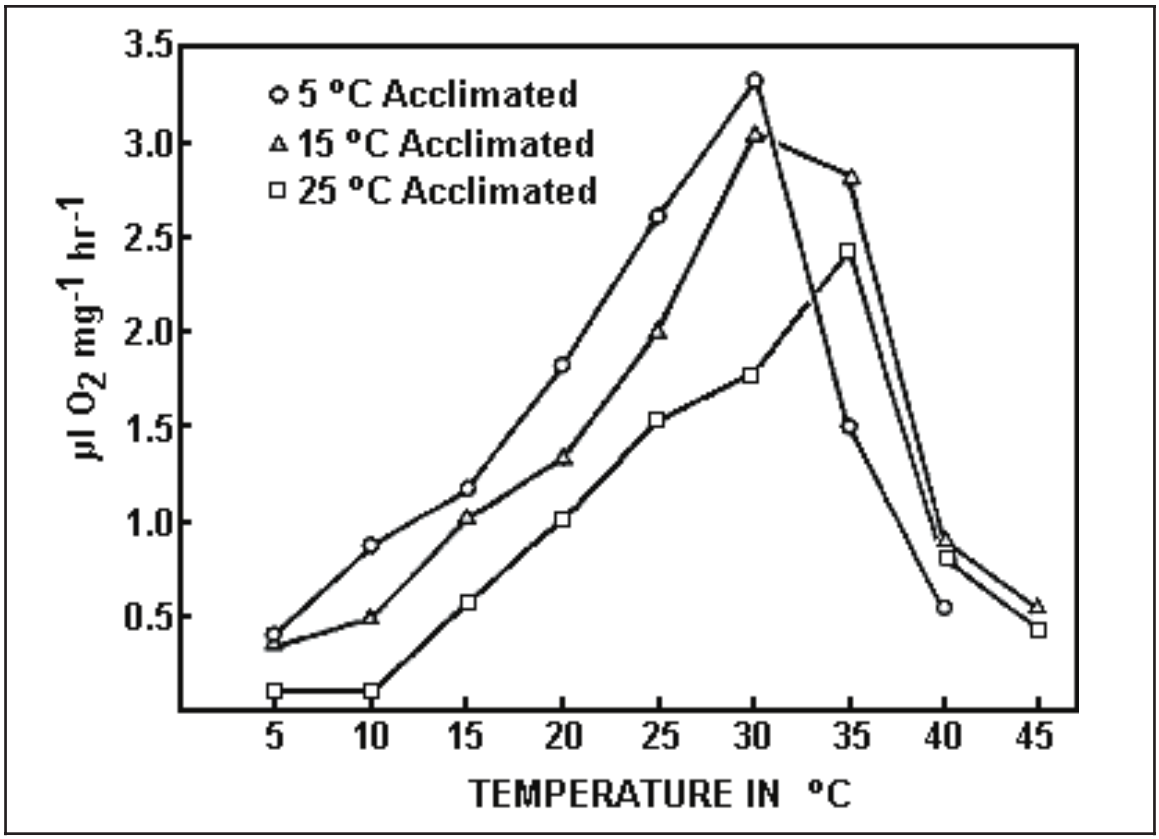

Figure 1. Respiration of zebra mussels acclimated to different temperatues exposed to various temperatures

Implications for control

In some instances, thermal methods of killing zebra mussels offer an alternative to chemical control. The results summarized herein show that higher water temperatures will be required to kill zebra mussels in summer than in winter. Water heated to 40° C (104° F) and 35° C (95° F) in summer and winter, respectively, should be effective at killing mussels.