For more information contact: Scott Breeding (573) 526-4325

Research Summary

Evaluating Sedimentation Impacts to Freshwater Mussels

Transportation system construction and maintenance can alter the local and regional hydraulics and water quality, notably by increasing suspended and redeposited solids in the adjacent water systems. This may adversely impact the aquatic flora and fauna, including freshwater mussels that belong to one of the most imperiled faunal groups in the world.

This project was to 1) evaluate the impacts of suspended solids on juvenile mussels, 2) assess the effects of sediment deposition on adult and subadult mussels, 3) develop a particle tracking model, and 4) evaluate the existing and potential mitigation approaches for mussel protection. The comprehensive research included a literature review, a Department of Transportation (DOT) survey and DOT interviews, laboratory studies, modelling development, interviews with Missouri DOT (MoDOT) personnel, and engineering assessments.

A state DOT survey and interviews were carried out to gather current knowledge regarding DOT practices for mitigating the potential impacts of transportation projects on freshwater mussels. The most frequently developed DOT resources for minimizing sedimentation impacts to freshwater mussels are BMP guidelines, survey protocols, and special provisions.

The potential effects of elevated suspended sediments on the survival and growth of juvenile freshwater mussels were examined by laboratory experiments. For three tested sediments, no clear effect of suspended solids on mussel survival was observed. Instead, the results showed a growth enhancement for juvenile mussels at lower levels of suspended solids in the presence of some types of sediments and soils. This suggests that suspended solids may not always be a stressor to juvenile mussels, although the mechanisms for this finding remain unclear.

"The most frequently developed DOT resources for minimizing sedimentation impacts to freshwater mussels are BMP guidelines, survey protocols, and special provisions…."

Responses of mussels to different sediment burial conditions were also assessed experimentally, using a flow-through design capable of controlling the vertical flow direction through the burial layer in mimic of the field hyporheic water flow conditions. Results indicated that failure to reemerge was lethal to mussels and mortality was positively related to the increased burial depth and decreased vertical water supply. Thus, for mussel protection, it is desirable to avoid sediment deposition, or at least to ensure the deposition layer on the mussel

bed/habitat be thin enough to allow mussels to quickly resurface. Otherwise, the impacted mussel bed should be relocated.

A Lagrangian particle tracking model was successfully developed as a quantitative tool to illustrate the spatial distribution of sediment transport. Results indicated that downstream distance affected by sediments was determined by factors including particle diameter, flow velocity, depth, and turbulence in the stream. However, more factors should be included in future research to develop a more realistic model. Specifically, a detailed computational fluid dynamics model is desirable when bathymetry data is available to provide more realistic simulations of hydraulics and sediment transport.

Engineering resources and practices are evaluated to develop revision recommendations to the MoDOT Engineering Policy Guide. The recommendations incorporate lessons learned from other state DOT and results from the mussel sediment impact experiments, the modeling exercises, and project site engineering perspectives. Conversations with state and federal agency personnel will be necessary to ensure that the policy recommendations are consistent with all other policies.

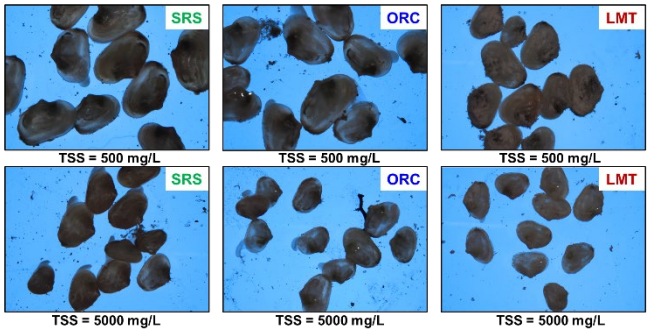

Figure 1. Images of Fatmucket juveniles after 28-d growth at different conditions. TSS = total suspended solids; SRS = Spring River sediment; ORC = Osage River bank soil; LMT = Columbia crushed limestone

Project Information

PROJECT NAME: TR202109—Evaluating Sedimentation Impacts to Freshwater Mussels

PROJECT START/END DATE: January 2021-August 2024

PROJECT COST: $600,000

LEAD CONTRACTOR: University of Missouri-Columbia

PRINCIPAL INVESTIGATOR: Deng Baolin

REPORT NAME: Evaluating Sedimentation Impacts to Freshwater Mussels

REPORT NUMBER: cmr 24-016

REPORT DATE: September 2024

Project Manager

CONTACT INFORMATION:

Scott Breeding
Senior Research Analyst
Missouri Dept. of Transportation
1617 Missouri Blvd.
Jefferson City, MO 65109
(573) 526-4325
Scott.Breeding@modot.mo.gov