Technology Innovation Project *Project Brief*

TIP 320: Modeling Mussels: Development of CE-QUAL-W2 Dreissena spp. mussel subcomponent

Context

Dreissena polymorpha and D. rostriformis bugensis (zebra and quagga mussels, respectively) are invasive freshwater mussels that foul hard substrates and clog pipes and screens. If they become established in the Columbia River Basin (CRB), management costs at hydropower facilities are expected to exceed $23 million per year (Phillips et al. 2005). Because of the potential impacts, vulnerability assessments are being completed for Federal Columbia River Power System (FCRPS) facilities that identify the structural components most at-risk for mussel colonization based on the flow velocity across the components, and other factors.

Description

Dreissena spp. do not thrive in all parts of a water body and hydro facility. Larval settlement and recruitment is reduced at low oxygen concentrations and high water velocities, as well as in areas with large amounts of sediment.

This project develops a *Dreissena* spp. model to predict where and when the various mussel life stages would thrive within a water body and facility, determine how facility operations affect colonization, aid cost/benefit analyses for control technologies, and guide application to maximize efficacy and reduce costs. This is accomplished by incorporating mussel growth and survival characteristics into the hydrodynamic and water quality model CE-QUAL-W2. The two dimensional model (longitudinal and vertical) describes and simulates temperature, velocities, dissolved oxygen-nutrients-sediment interactions, algae and zooplankton, selective withdrawal from stratified reservoirs, and flow over submerged hydraulic structures. It will allow the FCRPS and other water resource managers within the CRB and elsewhere to predict where and when the different mussel life stages would thrive within a water body given certain environmental parameters, determine how facility operations can affect colonization, aid cost/benefit analyses for various control technologies, and guide management to maximize effectiveness and reduce costs.

The zebra/quagga mussel (ZQM) subcomponent will be developed and calibrated using field collected data from already infested San Justo Reservoir in California. Additional field data will be collected from two water bodies within the CRB-- Lake Roosevelt and Brownlee Reservoir-- to calibrate the CE-QUAL-W2 model with the ZQM subcomponent and run simulations.

The ability of the CE-QUAL-W2 model to reproduce and predict system behavior is dependent on accurate input data. It is necessary to first determine the availability of existing geometric, kinetic, hydrodynamic and water quality data in order to identify the data to be field-collected. The development of the ZQM subcomponent will require extensive sampling of a *Dreissena* spp. population to determine the spawning periodicity and peak, larvae presence and depth distribution over time, as well as juvenile and adult mussel growth, survivorship, and distribution over depth and time.

Why It Matters

Dreissena spp. populations can drastically alter an ecosystem, quickly spreading via planktonic larvae and forming large, dense populations of sessile adult mussels that change the manner energy moves in an ecosystem. If they become established in the Columbia River Basin (CRB), management costs at hydropower facilities are expected to exceed $23 million per year

Developing the ZQM subcomponent for the CE-QUAL-W2 model will allow the computation of the hydrodynamic and water quality conditions and the resultant spatial and temporal distribution and abundance of *Dreissena* spp. within a water body.

This will help determine how facility operations affect colonization, aid cost/benefit analyses for control technologies, and guide application to maximize efficacy and reduce costs.

Goals and Objectives

The overall objective of this project is to develop technology to manage mussel invasions in FCRPS facilities.

Deliverables

The deliverables from the project will include: (1) Quality assurance project plans; (2) Database of water quality and biological variables for San Justo Reservoir; (3) Database of weather variables for San Justo Reservoir, database of water quality and biological variables for Brownlee Reservoir, and Lake Roosevelt; (4) Calibrated model for water budget, hydrodynamics, temperature, water quality, and *Dreissena* spp. population in San Justo Reservoir; (5) Model simulations of ZQM presence and location in Brownlee Reservoir, Lake Roosevelt, and San Justo Reservoir, and response to variable reservoir physical and chemical conditions; and (6) Interim and final reports.

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Project Start Date: October 1, 2014

Project End Date: September 30, 2016

Reports & References (Optional)

Links (Optional)

Funding

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BPA Share:	$379,223
External Share:	$379,509
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