Economic Risk Associated with the Potential Establishment of Zebra and Quagga Mussels

Independent Economic Analysis Board of the Northwest Power and Conservation Council

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Description of Issue

- Invasive Zebra and Quagga mussels have not yet colonized the Columbia Basin
  - Potential types and costs of damages
  - How much should be spent on planning and prevention?
  - What information is needed to improve economics?
Summary

- Mussels can be extremely invasive when conditions are right
- NW prevention efforts growing and finding mussels, current prevention costs are much less than potential mussel costs
- Additional prevention justified in the short run by uncertainty about how bad infestations might be
Key Findings

- **Uncertainties**
  - Viability of mussels in Columbia River basin
  - Effectiveness of prevention

- **Vulnerabilities**
  - Bypass screens and ecosystem effects
  - Hydropower and water supply facilities (hatcheries, irrigation and M&I)

- **Implications**
  - Research
  - Cost-effectiveness of prevention
Highlights of Approach

- Build on existing vulnerability and cost studies
- Focus on FWP and FCRPS
- Work with natural resource scientists to develop infestation potential
- Identify and quantify high-cost damages
- Summarize additional information needs for economic assessment
Flow Diagram for Expected Value of Damages from an Introduction Site

\[
\text{Expected Value of Damages, } \$, \quad = \quad \text{Probability of an Introduction} \times \text{Probability that Introduced Mussels Reproduce and Become Established} \times \text{Damages Caused by the Established Population}
\]

- Vectors Preventive Programs
- Water Quality Biology
- Water Quality Damage Function Controls and Protection
Infestation Severity

- If introduced, how bad could it get?
- Information required for economics
- Chance of colonization and reproduction, likely growth rates and density, by location
  - Calcium appears to be a key factor
  - Other factors include temperature, diet, pH, velocity
- Research is on-going and dynamic
Columbia Basin Calcium concentrations in Major Sub-basins (6-digit HUCs) with >6 sites

Infestation Severity Summary

- Calcium concentrations exhibit much variability around the basin
- Seasonal in the mainstem rivers, and within the range known to be important
  - “Calcium oscillations are introducing a big unknown in terms of mussel survival.”
- Temperature affects reproduction timing, velocity affects colonization
- Diet, pH, other factors may be important
- Still much uncertainty about effects of water quality factors on mussels in the basin
## Potential Costs of Invasive Mussels in the Columbia River Basin; Hydropower, Water Supply, Non-fish Facilities

<table>
<thead>
<tr>
<th>Type of Cost</th>
<th>Million $ Annualized Cost Per Year</th>
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</thead>
<tbody>
<tr>
<td>Hydropower main cooling system, trashracks, intakes, other water supply</td>
<td>$16 M FCRPS plus $5 M others</td>
</tr>
<tr>
<td>Hydropower spillway gates, piers, apron, stilling basins</td>
<td>$3 M to $10 M, FCRPS</td>
</tr>
<tr>
<td>Hydropower other, see Athearn and Darland, RNT</td>
<td>Unknown</td>
</tr>
<tr>
<td>Hatchery water supply</td>
<td>$3 M for 20 facilities</td>
</tr>
<tr>
<td>Costs to other facilities/property, especially water supply, including</td>
<td>Potentially tens to hundreds of millions annually</td>
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<td>navigation, waterfront, boats and marinas</td>
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### Potential Costs of Invasive Mussels in the Columbia River Basin; Fish Passage Facilities and Ecosystem

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<th>Type of Cost</th>
<th>Million $ Annualized Cost Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish passage facilities, bypass screens, fish ladders, gatewells</td>
<td>$1.95 M Screens, $1.1 M Ladders, $1.0 M gatewells</td>
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<tr>
<td>Fish passage increased mortality, additional cleaning and control costs, and reduced power generation</td>
<td>Unknown, could be tens of millions to hundreds of millions in Snake River Basin</td>
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<tr>
<td>Fish passage other, See Kovalchuk and RNT</td>
<td>Unknown</td>
</tr>
<tr>
<td>Ecosystem impacts primarily from food web effects, displacement and loss of habitat</td>
<td>Potentially tens to hundreds of millions annually</td>
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Comparing Annual Prevention and Damage Costs

- PNW States are currently taking lead and are spending about $3 million/yr
- QZAP recommends PNW should be spending about $30 million/yr
- We estimate hydrosystem and passage direct costs at $10’s of millions/yr
- Total costs including fish and wildlife, irrigation, other water supply, property, recreation, hydropower, and other uses could be in the 100’s of millions/yr
Information Needs to Support Better Economic Analysis

- Factors affecting viability of mussels
  - Calcium levels and variability
  - Water quality and diet
- Vectors and locations of introduction
- Prevention strategies and effectiveness
- Colonization and growth on fish screens
- Potential for hatchery infestation
- Food web effects