

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)

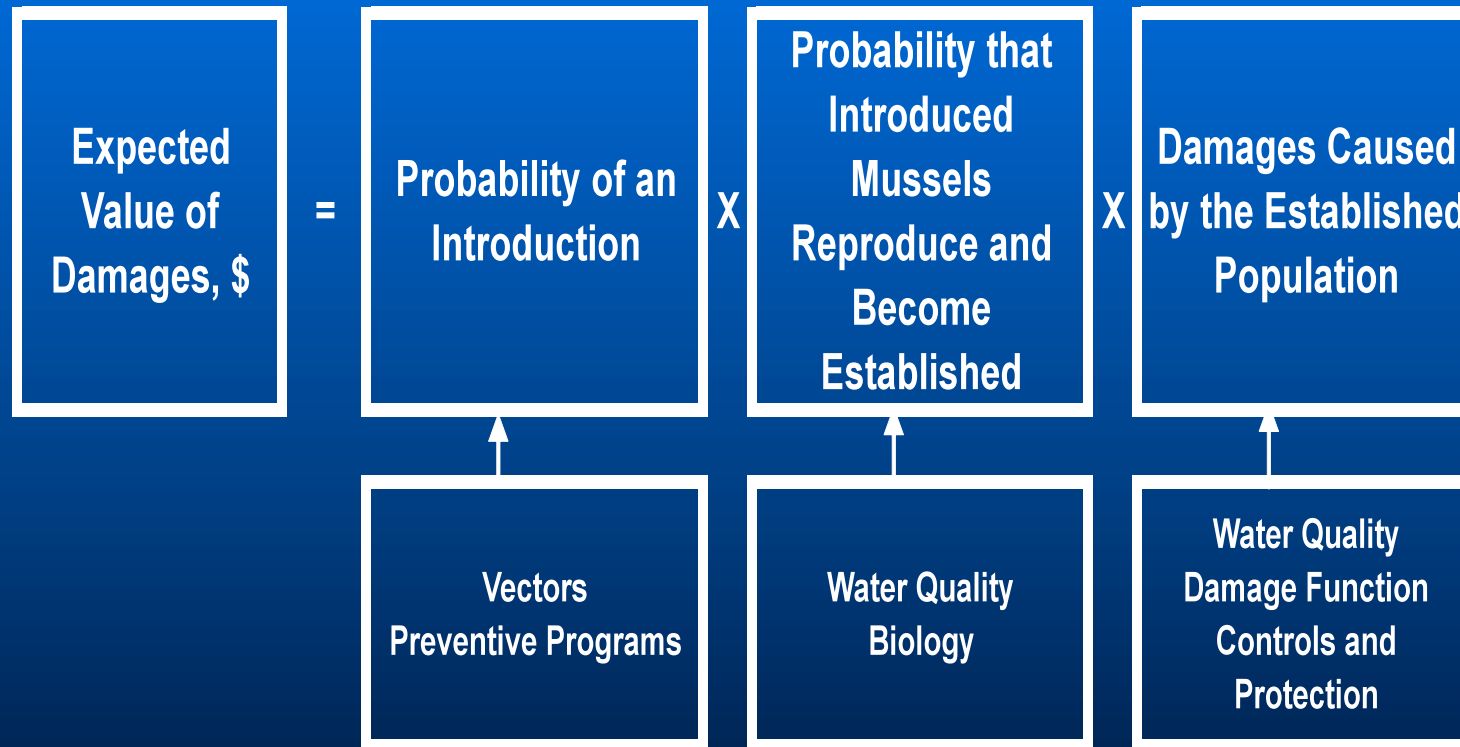
■ **Implications**

- 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

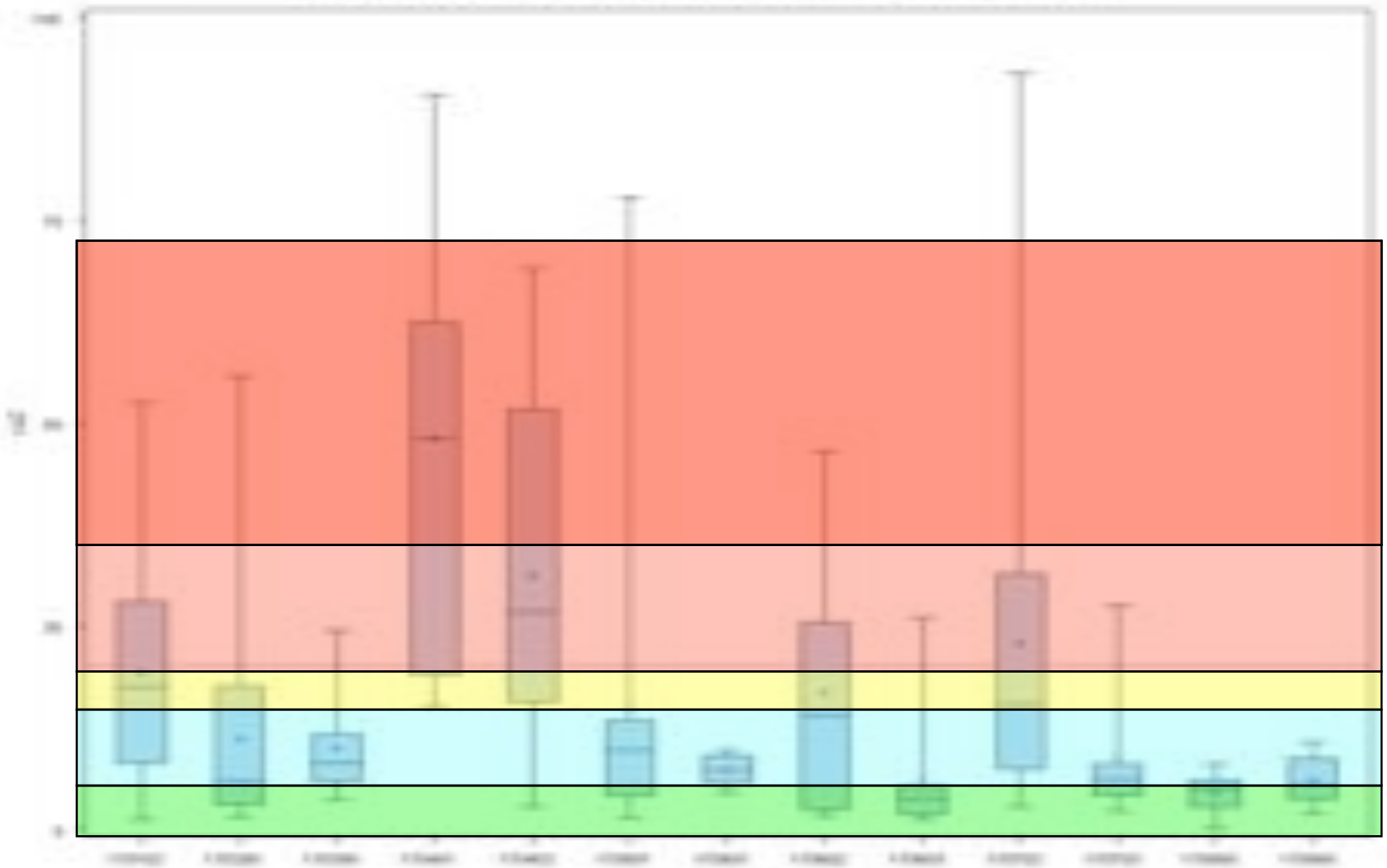
Flow Diagram for Expected Value of Damages from an Introduction Site



Infestation Severity

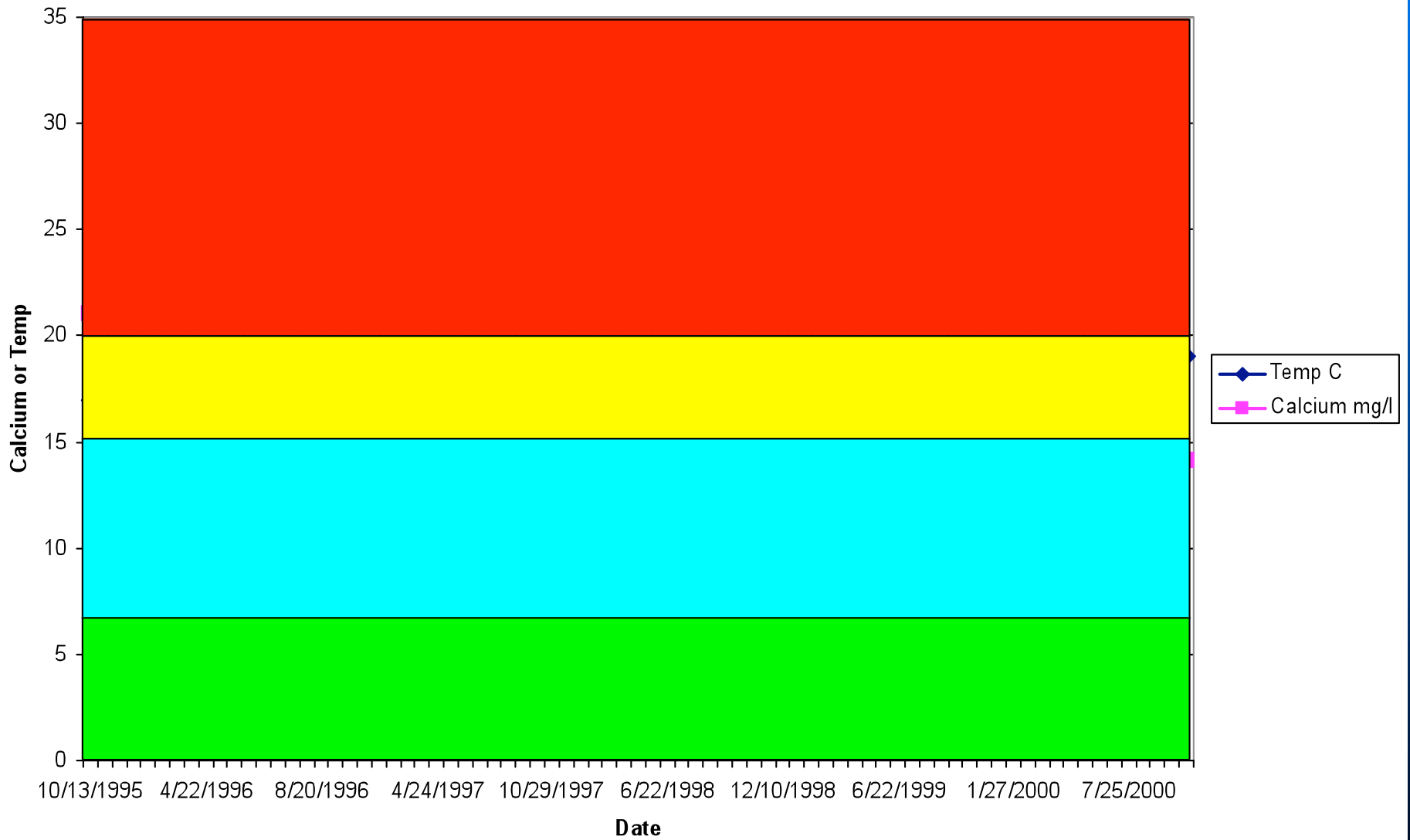
- If introduced, how bad could it get?
- Information required for economics
- Chance of colonization and reproduction, likely growth rates and density, by location
 - Calcium appears to be a key factor
 - Other factors include temperature, diet, pH, velocity
- Research is on-going and dynamic

Columbia Basin Calcium concentrations in Major Sub-basins (6-digit HUCs) with >5 sites
 (2007-2008 data only 2000 - 2008 for the Willamette, Columbia, or Snake River sites)

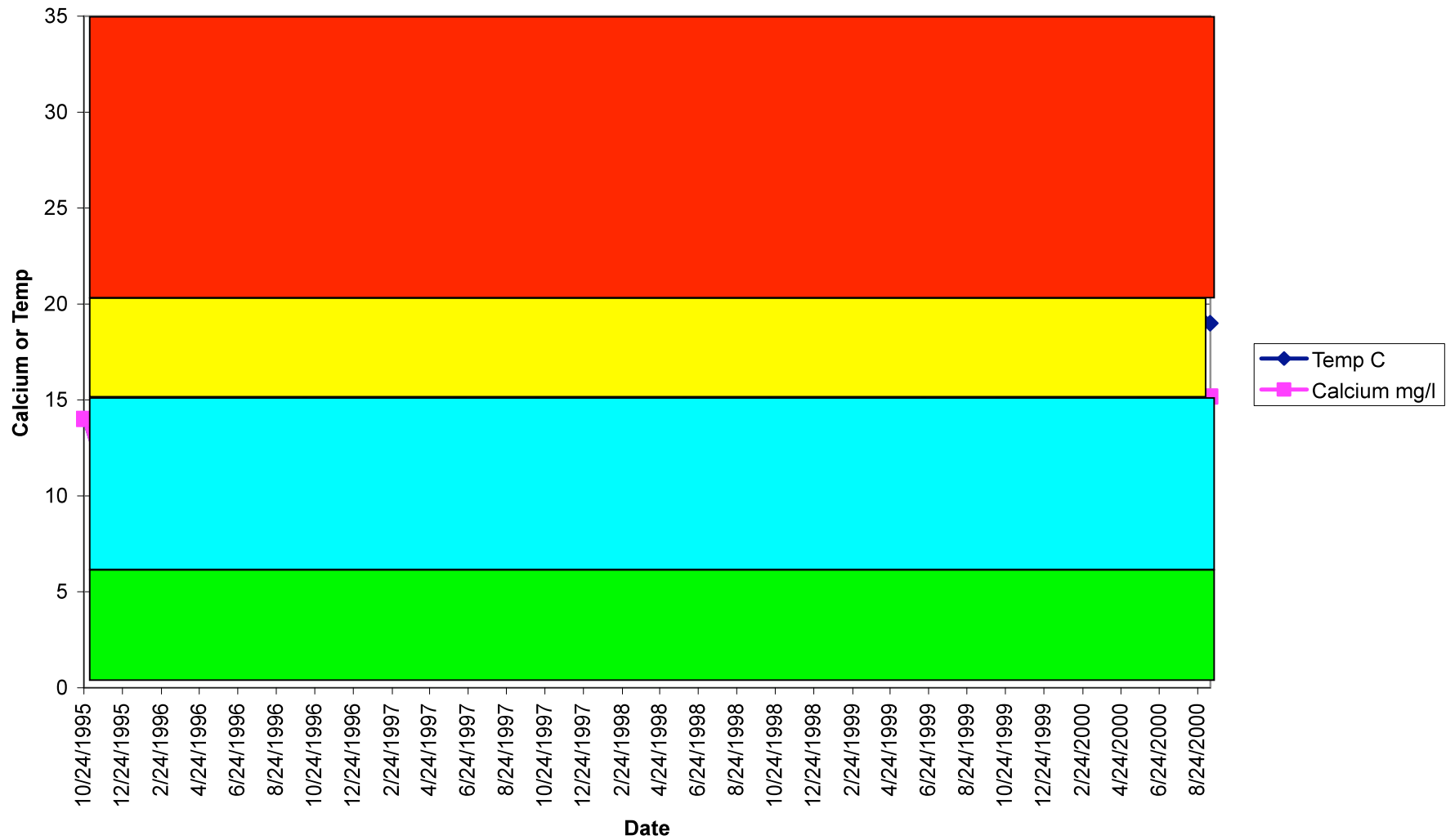


Pend Or/Upper CO/Yakima/Snake H./U. Snake/M. Snake/L. Snake/Salmon/Clearwater/John D./Deschutes/Lower C/Willamette

Figure 1. Snake River at Burbank, Below Ice Harbor



Calcium and Temperature, Quincy OR, Near Beaver Army Terminal, 1995 to 2000



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

Type of Cost	Million \$ Annualized Cost Per Year
Hydropower main cooling system, trashracks, intakes, other water supply	\$16 M FCRPS plus \$5 M others
Hydropower spillway gates, piers, apron, stilling basins	\$3 M to \$10 M, FCRPS
Hydropower other, see Athearn and Darland, RNT	Unknown
Hatchery water supply	\$3 M for 20 facilities
Costs to other facilities/property, especially water supply, including navigation, waterfront, boats and marinas	Potentially tens to hundreds of millions annually

Potential Costs of Invasive Mussels in the Columbia River Basin; Fish Passage Facilities and Ecosystem

Type of Cost

Million \$ Annualized Cost Per Year

Fish passage facilities, bypass screens, fish ladders, gatewells

\$1.95 M Screens, \$1.1 M Ladders, \$1.0 M gatewells

Fish passage increased mortality, additional cleaning and control costs, and reduced power generation

Unknown, could be tens of millions to hundreds of millions in Snake River Basin

Fish passage other, See Kovalchuk and RNT

Unknown

Ecosystem impacts primarily from food web effects, displacement and loss of habitat

Potentially tens to hundreds of millions annually

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