Monitoring Asiatic Clams for Uptake of Hanford Site Materials Along the Hanford Reach of the Columbia River

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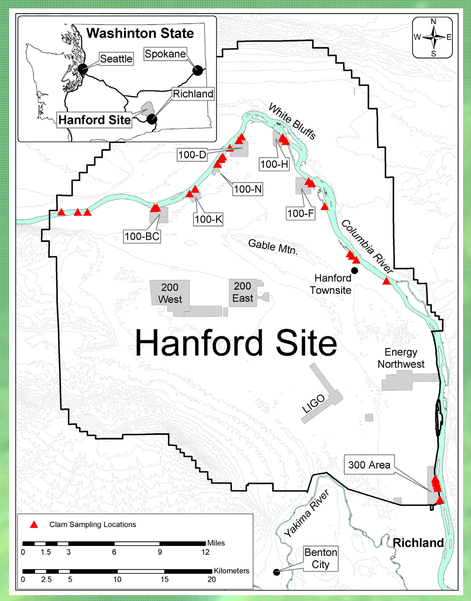
ABSTRACT

Contaminants in fish and wildlife that inhabit the Columbia River and Hanford Site are monitored by the U.S. Department of Energy's (DOE) Public Safety and Resources Protection Program (PSRPP) to help fulfill DOE Order 450.1 objectives. Wildlife have access to areas of the site containing radioactive or chemical contamination. Aquatic organisms can be exposed to contaminants entering the Columbia River along the Hanford Reach shoreline by seepage of contaminated groundwater.

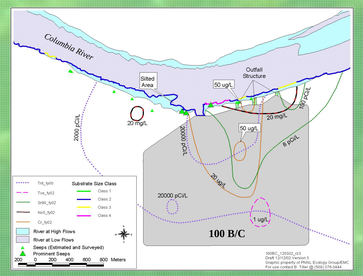
Historically, fish and some wildlife species were selected for monitoring by the PSRPP based upon their likelihood of being harvested by people for food and potentially contributing to offsite public exposure. As cleanup has progressed on the Hanford Site, considerations for sampling wildlife species have changed to include factors such as an organism's likelihood to accumulate contaminants in its tissues (e.g. mobility and uptake pathway), its likelihood of being found at Hanford waste sites, the ability to relate contaminant levels in abiotic media (e.g. water, soil, air) to concentrations found in tissues of organisms, the ability to collect samples that provide consistent results, and the organism's ecological guild (e.g., herbivores, predators, primary producers, etc…).

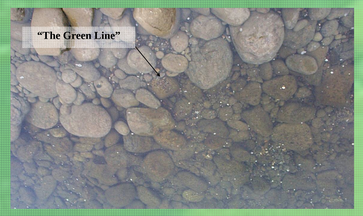
For these reasons, the Asiatic clam (*Corbicula fluminea*) was one of the species selected for PSRPP environmental monitoring and results from clams collected and analyzed between 2001 and 2003 have shown that this organism can help DOE describe the degree (relative levels of exposure) and the extent (where elevated levels of Hanford materials are found) of contaminants in the riverine environments in the Hanford Reach.

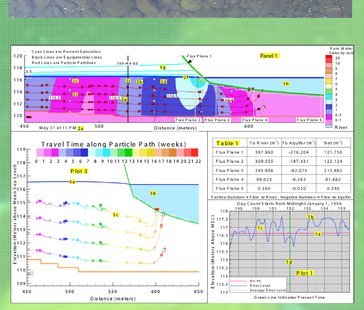
Bivalve Sampling Sites Along the Hanford Reach of The Columbia River 2001—2003



METHODS







Sampling sites along the Hanford Reach were selected in areas known or suspected to have metals and radiological materials present in shallow groundwater. Samples were also collected from reference sites upstream of the Hanford Site in areas with similar substrate types.

Sample sites were standardized to the low-water mark identified by persistent periphyton growth on substrate. The edge of the periphyton growth is referred to as "The Green Line."

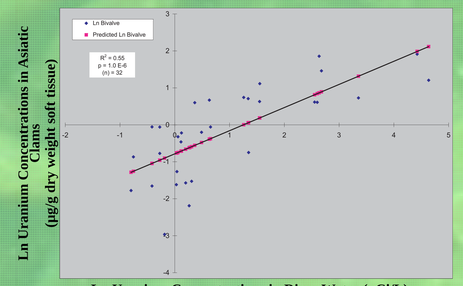
Samples were collected along transects beginning at the green line (0.0 meter water depth) and extending into the river perpendicular to shoreline at water depths (0.0, 0.25, 0.5, 1.0, and 1.5 meters). These locations include potential areas of groundwater infiltration and upwelling.

Asiatic clam samples were collected during periods of low river-flow at 28 sites (includes 5 upstream reference sites).

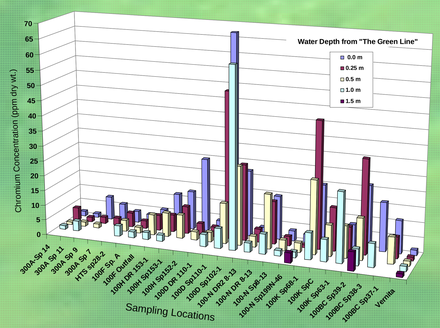
Clam samples were flash-steamed (15 to 30 seconds). Soft tissues were separated from the shells tissue, rinsed in de-ionized water, and submitted to a laboratory for selected trace metals analyses. Shells were submitted for analysis of selected radionuclides. Sample mass requirements were 2.0 g for metals

RESULTS

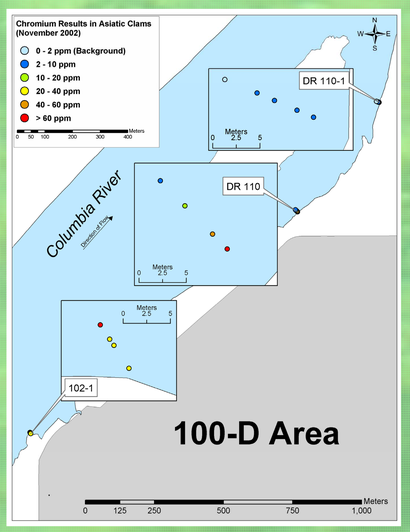
- **Elevated levels of chromium, uranium, strontium-90, and technetium-99 were identified in clam tissues at several sites near Hanford Site operations.**
- **Results generally support the premise that the highest concentrations of trace metals and radionuclides are found near the low-water mark and decrease as water depth increases. However, the opposite was true at some sites where the topographical relief of the river bottom was high.**
- **A regression analysis showed the concentrations of uranium measured in Asiatic clams corresponded (R^2=0.55, p<0.001) to concentrations measured in water sampled from same regions near the 300 Area.**
- **Concentrations of trace metals in tissues of Columbia River Asiatic Clams indicated their relative degree of exposure to metals in groundwater entering the river along the Hanford Reach.**



Uranium Levels Measured in Columbia River Asiatic Clams vs. Uranium Levels in Columbia River Water, August 2001



Total Chromium Concentrations (ppm dry wt.) in samples of Asiatic Clam Soft Tissues Collected from the Hanford Reach of the Columbia River, 2001 - 2003



GIS-based Illustration of Chromium Levels in Asiatic Clams Collected In the Columbia River near the 100-D Area, November 2002

CONCLUSIONS

These results indicated that sampling Asiatic clams for metals and radiological constituents using standardized methods described for this study helped identify the extent and degree of biotic exposure from Hanford Site operations in the aquatic environments. These study results indicated that clams may be an effective sentinel organism for monitoring both radiological contaminants and metals entering the Columbia River along the Hanford Reach shoreline. Monitoring the uptake of metals and radionuclides by Asiatic clams may help describe long-term trends in contaminant levels in Hanford Reach shoreline effluents, evaluate the effectiveness of Site clean-up operations, and provide regulatory agencies the information they need to evaluate the potential ecological impacts of Hanford Site contaminants entering the Columbia River via shoreline groundwater seeps.

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