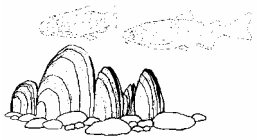
Proceedings for the 2nd Annual Freshwater Mussels of the Pacific Northwest Symposium

"Bridging the Gap Across the Continental Divide"

Organized and hosted by the:

Pacific Northwest Native Freshwater Mussel Workgroup



Jen Stone, Workgroup Coordinator
Al Smith, Workgroup Chair

April 20, 2004
Vancouver Water Resources Center
Vancouver, Washington

Sponsored by the:

U. S. Army Corps of Engineers

Oregon Chapter of the American Fisheries Society

Water Tenders, through the King County Water Quality Fund

Washington Department of Fish and Wildlife

U. S. Fish and Wildlife Service

Washington Trout

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About the Pacific Northwest Native Freshwater Mussel Workgroup

History

The status of the seven species of freshwater mussels native to the Pacific Northwest has received very little attention, despite the fact that freshwater mussels in general are considered the most endangered group of animals in North America. On February 19, 2003, a workshop on freshwater mussels was held in Vancouver, Washington that consisted of presented papers and a panel discussion. The purpose of the workshop was to initiate discussion on the regional population status of freshwater mussels. The workshop was attended by 91 participants of very diverse backgrounds. From this meeting, the Pacific Northwest Native Freshwater Mussel Workgroup was founded.

Purpose

The purpose of the Workgroup is to provide an open forum for discussions focusing on native freshwater mussels, dissemination of related information, and to provide guidance on integrated planning of mussel research, management, and education. The goal of the Workgroup is to ensure that freshwater mussel research, management, and educational activities are coordinated, prioritized, and are consistent with information needs identified.

Composition

Current representation includes: Portland State University, Confederated Tribes of the Umatilla Indian Reservation, University of California-Berkeley, Nevada Division of Wildlife, Washington Department of Fish and Wildlife, U. S. Forest Service (Utah), U. S. Fish and Wildlife Service (Washington and Alaska), Jamestown S'klallam Tribe, The Nature Conservancy, Washington Trout, Washington Department of Natural Resources, Deixis Consultants, Snohomish County, Bear Creek Water Tenders, Washington Department of Ecology, and retired biologists.

Process

Members of the Workgroup hold an annual freshwater mussel symposium, which may be attended by anyone, for the purpose of reviewing the state of mussel research, management, and education. The location of the annual symposium rotates throughout the Pacific Northwest.

Members of the Workgroup meet at least four times per year (either in person, via teleconference, or by proxy) to review projects, coordinate work, discuss research priorities, and conduct other associated activities. Workgroup meeting locations rotate throughout the Pacific Northwest.

Visit the Workgroup web site, hosted by the U. S. Fish and Wildlife Service, for more information at:
http://columbiariver.fws.gov/musselwg.htm

Pacific Northwest Native Freshwater Mussel Workgroup Members

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Symposium Introduction

The second annual Symposium was hosted on April 20th, 2004. Members of the Pacific Northwest Native Freshwater Mussel Workgroup solicited presentations by renowned mussel experts from the east coast and Midwest, as it is in these regions where mussel research has focused. Additionally, biologists from the Pacific Northwest presented the results of their local research.

Keynote Speakers

Tom Watters

I am a native of pastoral Beavercreek, Ohio. At an early age I became enthralled by seashells, and infused with a healthy dose of the Jacques Cousteau syndrome, I embarked on a career in malacology. This led me to the University of Miami for my BS and the University of Rhode Island for my MS. Through a peculiar set of circumstances I ended up back in Ohio for my PhD at THE Ohio State University. Noting a profound lack of oceans in the area, I switched to freshwater mollusks. I currently am the Curator of Molluscs at the Ohio State University Museum of Biological Diversity, which houses over 2 million freshwater mollusc specimens. I am also the president of the Freshwater Mollusk Conservation Society. In addition to mussels, my other interests include the phylogeny and zoogeography of Caribbean landsnails and GIS approaches to mollusc surveys and collections.

Art Bogan

I was born in Rhode Island and promptly moved to Enumclaw, Washington, where I grew up. My undergraduate training was in a Quaternary Studies Program at Washington State University. Here I found the interdisciplinary blend of archaeology, zoology, ecology and geology exciting and challenging. This set the direction for my graduate work. I was in a program in zooarchaeology; dead animal remains in an archaeological context. During my graduate school days at the University of Knoxville, Tennessee under Paul W. Parmalee, Neil Robison and I prevailed upon him to begin teaching a class on the identification of the freshwater mussels of North America. Thus began my descent down the slippery slope into unionids. I wrote *The Endangered Mollusks of Tennessee* (1983) while avoiding finishing my dissertation. I finished graduate school and took a job in the Malacology Department, Academy of Natural Sciences, Philadelphia. I spent 12 years working in one of the world's largest mollusk collections. Here I continued to focus on unionoid bivalves. During this time, Randy Hoeh came to New Jersey on his first post-doc and we spent a good amount of time mapping out a research plan on the Unionoida for the next 20 years. I left the Academy in 1992 and formed a consulting firm, Freshwater Molluscan Research, focusing on endangered freshwater mollusks. I was hired in late 1996 as the Curator of Aquatic Invertebrates at the North Carolina State Museum of Natural Sciences, Raleigh. I have given a number of workshops focusing on the identification of freshwater bivalves of Pennsylvania, Maryland and North Carolina, freshwater mollusks of the Northeastern United States and the freshwater gastropods of

the Southeastern United States. My interests focus on the taxonomy, systematics, zoogeography, evolution and phylogeny of the whole Order Unionoida.

Catherine Gatenby

I am the Hatchery Manager and Project Leader for White Sulphur Springs National Fish Hatchery, United States Fish and Wildlife Service, White Sulphur Springs, WV. My primary duties include developing a program aimed at the culture and conservation of imperiled species for the Fisheries Division of the USFWS. As well, my primary duties include managing a disease-free national brood stock hatchery for production of rainbow trout. We maintain and distribute 9000 adult rainbow trout, and produce and distribute 7 million eggs annually. We are building a mussel propagation facility and greenhouse dedicated to the culture of algae for feeding our imperiled species of mussels. We are preparing to rear three endangered freshwater mussels in 2004/2005 as well as one candidate species, and begin developing feeding protocols for maintaining adult brood stock. We also will serve as a temporary refugia for holding endangered species salvaged from various in-stream transportaion/navigation projects. Our top production goals will be to continuously feed 5000 adult freshwater mussels, and 50,000 growing juvenile mussels annually. We also develop outreach educational materials and events to enhance the public's recreational and learning experiences at the hatchery, and to make the public aware of the role the Fisheries Division plays conserving aquatic resources and providing recreational fishing opportunities.

Karen Mock

My undergraduate training was in microbiology and environmental toxicology at the University of Texas at Austin and Colorado State University. Oddly enough, my primary area of interest emerging from this background was in the genetics of natural populations, and in pursuit of this interest I completed a doctoral degree at Northern Arizona University in genetics. I am currently an assistant professor in the Forest, Range, and Wildlife Sciences Department at Utah State University, where my research program involves population and conservation genetics in a variety of terrestrial and aquatic species, including galliform birds, cyprinid fishes, mountain pine beetles, and unionid mussels. Recently, my lab has been involved in research on *Anodonta* population dynamics in the Bonneville Basin of Utah, a collaborative project with a real malacologist, Dr. Jayne Brim Box. Although the species in my research program vary widely, there are some common threads with respect to conservation and restoration, which I think are particularly applicable and unexplored in freshwater mussels.

Symposium Agenda

8:30am – 9:00am	Sign-in, refreshments provided
9:00am – 9:10 am	*"Welcome and Introduction to Workgroup"* Al Smith, chair of the Pacific Northwest Native Freshwater Mussel Workgroup, Hillsboro, Oregon
9:10am – 10:10am	"*Freshwater Mussels: From Living Rocks to Mean Mothers"* Tom Watters, THE Ohio State University, Columbus, Ohio
10:10am – 10:20am	Break, refreshments provided
10:20am – 11:20am	*"Freshwater Bivalves: Diversity and Distribution of the Unionoida"* Art Bogan, North Carolina Museum of Natural Sciences, Raleigh, North Carolina
11:20am – 11:30pm	Break, refreshments provided
11:30pm – 12:30pm	*"Cobbles with Gills and Guts: Conserving Freshwater Mussels and Water Quality"* Catherine Gatenby, U. S. Fish and Wildlife Service, White Sulphur Springs, West Virginia
12:30pm – 1:30pm	Raffle (must be present to win) Lunch
1:30pm – 2:00pm	*"Population Genetic Issues in the Management of Freshwater Mussels"* Karen Mock, Utah State University, Logan, Utah
2:00pm – 2:20pm	*"Beyond Biodiversity: the Conservation and Propagation of Native Mussel BioMASS for Ecosystem Services"* Danielle Kreeger, Academy of Natural Sciences, Philadelphia, Pennsylvania
2:20pm – 2:40pm	*"The Freshwater Mussel and a Tribal Culture"* David Wolf, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon
2:40pm – 3:00pm	*"Data Management for Invertebrates: Documenting and Sharing Knowledge"* Nancy Duncan, U. S. Bureau of Land Management, Roseburg, Oregon

3:00pm – 3:20pm	Raffle (must be present to win) Break, refreshments provided
3:20pm – 3:40pm	*"Zebra Mussels and the Pacific Northwest"* Steve Wells, Portland State University, Portland, Oregon
3:40pm – 4:00pm	*"Factors Affecting the Shoreline Distribution of Asiatic Clams, Corbicula fluminea (Müller), in the Hanford Reach, Columbia River"* Gerald Turner, Pacific Northwest National Laboratories, Richland, Washington
4:00pm – 4:20pm	*"Bear Creek Mussel Studies 2003"* Micah Wait, Washington Trout, Duvall, Washington
4:20pm – 4:50pm	*"Tying It All Together --A Western Perspective"* Jayne Brim Box, U. S. Forest Service, Logan, Utah
4:50pm-- 5:00pm	*"Closing Remarks"* Al Smith, chair of the Pacific Northwest Native Freshwater Mussel Workgroup, Hillsboro, Oregon

Presentation Abstracts

"Freshwater Mussels: From Living Rocks to Mean Mothers"
Tom Watters, THE Ohio State University, Columbus, Ohio

n/a

"Freshwater Bivalves: Diversity and Distribution of the Unionoida"
Art Bogan, North Carolina Museum of Natural Sciences, Raleigh, North Carolina

The term freshwater bivalve is very inclusive and not very informative. There are representatives of about 19 families that have at least one representative living in freshwater. At least nine families have small to large radiations in the freshwater environment: Corbiculidae, Sphaeriidae, Dreissenidae, Hyriidae, Margaritiferidae, Unionidae, Etheriidae, Iridinidae, and Mycetopodidae. The last six families comprise the Order Unionoida that contains at least 160 genera and 1000 species. This order is characterized by the unique parasitic larval stage on the gills or fins of particular host fish. The Hyriidae, Margaritiferidae, and Unionidae are all characterized by having glochidial larvae. The Margaritiferidae and Unionidae have no mantle fusion resulting in incurrent and excurrent apertures while the other four families have some degree of fusion resulting in at least a fused, complete excurrent siphon and often a completely fused incurrent siphon. The Margaritiferidae contains three genera and is distributed across the Holarctic, with a single representative in Morocco, North Africa. The Unionidae containing about 120 genera is found in North America (49+ 1 in press),

Europe (5), Africa (11) including extreme northwest Madagascar, and Asia (48). The Hyriidae contains 18 genera and has a distribution including South America (9 genera) and, Australia, New Zealand and New Guinea (9 genera). The Etheriidae, represented by a single genus and species, is a cemented freshwater oyster living in Africa and extreme northwest Madagascar. The larval stage of the Etheriidae is unknown. The Mycetopodidae have a lasidial larval stage [lasidium] that apparently attaches to the sides of host fish. This family contains 11 genera and is restricted to South America and extends up the west-side of Central America to west Central Mexico. The Iridinidae have a haustorial larval [haustorium] stage that attaches to the sides of fishes. They are restricted to the Nile River basin and sub-Saharan Africa with six genera. This order of freshwater bivalves is suffering a very high rate of extinction, with about 37 species considered probably extinct in North America alone. The level of endangerment and extinction facing these animals is primarily the result of habitat destruction or modification.

"Cobbles with Gills and Guts: Conserving Freshwater Mussels and Water Quality"
Catherine Gatenby, U. S. Fish and Wildlife Service, White Sulphur Springs, West Virginia

The success of conservation efforts to restore dwindling freshwater mussel populations through culture and propagation requires an understanding of their feeding physiology and requirements for food quantity and food quality. Because freshwater mussel feeding requirements are virtually unknown, the greatest challenge for hatcheries and other captive care facilities is to reliably maintain condition of freshwater mussels for periods longer than one year (Gatenby et al. 2000). Mussels are usually fed a green algal diet of unknown nutritional value, or in outdoor settings and allowed to feed upon the natural assemblage of suspended organic material. When freshwater mussels fail to thrive in captivity, however, the hatchery personnel rarely know what aspect of the care (handling stress, holding environment, diet, etc.) deleteriously affected mussel condition and survival of the mussels (Cope et al. 2003). We hypothesize that sub-optimal nutrition is the primary culture parameter currently restraining survival and condition in captive freshwater mussels. It is well documented that the nutritional requirements of marine bivalves varies seasonally with changing reproductive condition and changes in the quality and quantity of food (Hawkins and Bayne, 1985; Kreeger et al., 1995). Kreeger (1993) showed that growth and condition of marine mussels could be limited by dietary protein content at certain times of the year, whereas at other times, mussels were limited by energy (as carbohydrate). Thus, to successfully culture freshwater mussels, we must first develop a comprehensive understanding of the seasonal nutritional demands of healthy mussels living in nature, in order to formulate diets that balance changing nutritional demands for key biochemical constituents. Freshwater mussels employ significantly different reproductive strategies from their marine counterparts, and within the fauna as a whole. These differences must also be considered when developing diets and feeding protocols for a suite of mussels.

The overall goal of my research has been to quantify key feeding parameters for the culture of freshwater mussels, determine the seasonal nutritional requirements of

freshwater mussels, and identify suitable diets for the care of mussels in captivity. More specifically, I aimed to collect information on food particle size preferences, food ration requirements, and identify a diet that could maintain the physiological condition of mussels in captivity. Holding environment is known to affect the feeding activity of any captive animal, and filter-feeding bivalves are no exception to this "rule".

Today, I will present an overview of captive care technology and presumed feeding requirements of freshwater mussels. I will discuss why we care about these suspension-feeding bivalves, what we know about their declines, what we know about their biology, what we can do, and what do we need to know. I will discuss management challenges with respect to propagation and reintroduction of endangered species. As well I will discuss future opportunities for restoration and recovery of endangered species. Finally, I will provide information on information on a suitable diet regime (ration, diet, nutrition) for maintaining mussels from different subfamilies.

"Population Genetic Issues in the Management of Freshwater Mussels"
Karen Mock, Utah State University, Logan, Utah

The conservation and restoration of freshwater mussels in western North America is becoming a critical issue for a variety of state, federal, and non-governmental agencies. Unfortunately, although the conservation needs are pressing, our understanding of the systematics, population genetics, and ecological issues in western freshwater mussels is extremely limited. My focus today is on population genetic issues in freshwater mussel conservation. I will provide a brief primer of population genetics: how it is different from systematics and the utility and limitation of molecular markers. I will also summarize our findings from a recent study of *Anodonta* in the Utah's Bonneville Basin, which suggest that isolation and hybridization are shaping the distribution of genetic diversity in this landscape. Additionally, I will discuss general population genetic issues that should be considered in the conservation and restoration of freshwater mussels.

"Beyond Biodiversity: the Conservation and Propagation of Native Mussel BioMASS for Ecosystem Services"
Danielle Kreeger, Academy of Natural Sciences, Philadelphia, Pennsylvania

Native freshwater mussels (Mollusca: Unionacea) are the most imperiled fauna in the United States, and resources are being increasingly mobilized to protect and restore their biodiversity. Comparatively less effort has been directed at documenting and remedying declines in their population biomass, and the ecological consequences of losing these animals are unknown. Our objective was to preliminarily assess whether mussels (*Elliptio complanata*) remain sufficiently abundant in the lower Brandywine River in southeast Pennsylvania to affect key functional processes. Our approach was to quantify physiological rate functions (e.g., allometric rates of consumption, excretion, biodeposition) of adult mussels under simulated natural conditions. These processing rates were then related to both the population biomass of mussels in a six mile stretch of river and to the volume and flow of water. Within this reach, mussel density averaged only 1.7 m^{-2}, which was low compared to other streams where healthy mussel beds still

exist. Nevertheless, the combined population of more than 500,000 *E. complanata* in that section of the river was estimated to remove more than 25 metric tons of suspended particulates per year during base flow conditions, which represented more than 7% of upstream inputs. We also observed that particle concentrations in bottom waters became depleted by up to 80% as water passed small pocket beds of mussels. Sediment organic content within and below mussel groups was also enriched by up to 50% compared to areas immediately upstream where no mussels were found. These findings suggest that the relatively low population biomass of *E. complanata* in the lower Brandywine River is still sufficient to have a substantial impact on biogeochemical and energetic cycling in the river. The benefits of protecting and restoring native mussel populati□ns therefore extend beyond the conservation of biodiversity. Where abundant, native mussels provide important ecosystem services and a powerful management tool for maintaining and reclaiming water quality.

"The Freshwater Mussel and a Tribal Culture"
David Wolf, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon

n/a

"Data Management for Invertebrates: Documenting and Sharing Knowledge"
Nancy Duncan, U. S. Bureau of Land Management, Roseburg, Oregon

Data on sensitive species is used by federal and state agencies to document trends in population distribution and threats to persistence. In order for data to be effective for regional decision making, it must be centrally available and accurate, both in location and species identification. The "historic condition" or "baseline" from which to assess trends is not documented for most mussel species, and data from region-wide, long-term monitoring plots will be necessary in order to provide this information. Taxonomic uncertainty, inherent in invertebrate work, demands that voucher specimens accompany location data. This will allow current species identifications to be modified by future refinements in taxonomy. Federal regional databases currently used to capture sensitive species information include the Interagency Species Management System (ISMS) and the Natural Resources Information System (NRIS). California BLM, Oregon/Washington (OR/WA) BLM, and FS, R-6 will continue to input this data into the Interagency Species Management System (ISMS) until NRIS accommodates the information on these species. Other databases may be more appropriate for aquatic organisms, such as the Aquatic Resources Inventory Management System (**ARIMS)** and the **StreamNet** database (formerly WRIS), both directly linked to stream reaches or river segments for which habitat information is available. **Nature Serve,** the Natural Heritage Database, also contains regional and global "elemental occurrence" information as point or polygon data. The mussel working group may want to consider which of these database structures works best for the types of data collected for these species, but should emphasize the need to standardize which system is used, so that all data can be put on the table when species are being evaluated for listing or other protection.

"Zebra Mussels and the Pacific Northwest"
Steve Wells, Portland State University, Portland, Oregon

n/a

"Factors Affecting the Shoreline Distribution of Asiatic Clams, Corbicula fluminea (Müller), in the Hanford Reach, Columbia River"
Gerald Turner* and Brett Tiller, Pacific Northwest National Laboratories, Richland, Washington and Dr. Allan T. Scholz, Eastern Washington University, Cheney, Washington

A study designed to evaluate the effects of river fluctuations on the shoreline distribution of Asiatic clams, *Corbicula fluminea*, was conducted in the Hanford Reach of the Columbia River. A flow model was used to create a spatial GIS map that showed the amount of time the shoreline was submerged on an annual basis along existing bathymetry transects. The amount of time the shoreline was submerged significant affected the distribution of clams (X^2>101.56; d.f. = 10; $p<0.05$). Clams were not found in shoreline areas submerged less than 50 percent of the time. At shoreline areas submerged greater than 90 percent of the time, Asiatic clams were found for all observations within gravel–cobble substrates. Clams capable of maintaining buoyancy due to a mucous thread mobility mechanism were found in shoreline areas sporadically submerged by high flows. Larger clams (>22 mm in shell length) became scarce as the amount of time the shoreline was dewatered increased. Frequent dewatering stressed Asiatic clam populations. Further aquatic studies performed on Asiatic clams that explore other potential environmental stressors should be standardized at the annual low-water mark to avoid false-positive results.

"Bear Creek Mussel Studies 2003"
Micah Wait, Washington Trout, Duvall, Washington

Western pearlshell freshwater mussels (*Margaritifera falcata*) inhabit Bear Creek in King County, Washington. In 2002 Washington Trout determined *M. falcata* bed size, density, and population age structure at a sub-sample of ten known freshwater mussel beds on Bear Creek. In 2003 five of the ten beds were resampled in order to elucidate changes in mussel bed density and population age structure. The results of this study provide the beginnings of a documented population trajectory for the Bear Creek mussel population. In order to make certain that population age structure estimates were accurate, Washington Trout also undertook a detailed search for juvenile mussels using a methodology designed explicitly for the location of smaller individuals. In addition to the mussel bed demographic studies, Washington Trout began investigating predation of mussel beds using an infrared trail monitor linked to a camera.

In the fall of 2003, Washington Trout, in partnership with Applied Biomonitoring and Bear Creek Water Tenders, initiated a caged mussel study in Bear Creek. The purpose of this study was to determine the spatial distribution, in the upper Bear Creek Watershed, of chemicals that are bioaccumulated by the freshwater mussel *Margaritifera falcata*. The

M. falcata population of Bear Creek has declined greatly over the last 40 years; it is unknown what proportion of this decline is due to exposure to toxic chemicals from anthropogenic sources. As filter feeders, freshwater mussels have a great deal of direct contact between their body tissues and any chemicals dissolved or suspended in the water. By placing caged mussels in strategic locations throughout the Bear Creek watershed, we will be able to determine the spatial distribution of the chemicals which are being bioaccumulated by *M. falcata*. Cage locations were chosen to specifically examine the relationship between upstream landuse and accumulated chemicals.

"Tying It All Together --A Western Perspective"
Jayne Brim Box, U. S. Forest Service, Logan, Utah

n/a

Poster Abstracts

"Survey of Western Pearlshell Mussel (Margaritifera falcata) Populations, Church Creek, WA"
Sacha Johnson, Surface Water Management, Public Works, Snohomish County/College of Forest Resources, University of Washington, Seattle

n/a

"Filtration Effects of Western Pearlshells on Water Quality"
Clancy O'Connor, Cody Wheeler, Astoria High School, Astoria, Oregon

n/a

"Monitoring Endocrine Disruption Using Caged Bivalves"
Mike Salazar and Sandra Salazar, Applied BioMonitoring, Kirkland, Washington

Collectively, the results from the caged mussel studies using *Elliptio complanata* on the St. Lawrence River in Montreal and the Kennebec River in Maine, show that the vitellin (Vn) biomarker is a sensitive effects endpoint, suggesting endocrine disruption (ED) and effects on reproduction. Furthermore, specific estrogenic effects (increased vitellin and feminization) appear to be related to unidentified chemicals in both municipal and pulp and paper mill effluents. Similar studies with *Mya arenaria* (a marine clam) show androgenic effects (decreased vitellin and masculinization) may be related to TBT exposure. Although relatively little is known about the endocrine system in invertebrates, synthesis of vitellin, the major protein found in oocytes of invertebrates synthesized from vitellogenin, has been shown to be regulated by estrogens in freshwater and marine bivalves. This process appears to be susceptible to endocrine disruption in a manner similar to that of fish. Increased levels of these vitellin proteins have been reported in the marine clams, mussels, and oysters. Feminization and masculinization have been shown in several of these species, depending on the chemicals of exposure. Results from a 1-year benthic cage study suggest that prolonged exposure to these chemicals can results in sex reversal. Due to their high filtration rate, an ability to accumulate and bioconcentrate

chemicals, and their sedentary life style, bivalves may be at particular risk to ED chemicals. This increases their utility as sentinels for monitoring purposes. The caged bivalve methodology provides the advantage of knowing the bivalves' chemical, biochemical, and biological properties at the beginning of the test as well as conducting field experiments at locations of interest, even though they may not normally be found at those locations. Results also suggest that ED chemicals can be added to the list of potential stressors on native unionid populations by affecting reproduction and the sex ratios of existing populations.

"Monitoring Sentinels for Uptake of Hanford Site Materials Along the Hanford Reach of the Columbia River"

Brett Tiller* and Gerald Turner, Pacific Northwest National Laboratories, Richland, Washington

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, and aquatic organisms can be exposed to contamination entering the river along the shoreline.

Historically, fish and some wildlife species were selected for monitoring by the PSRPP based upon the likelihood of animals being harvested for food, potentially contributing to offsite public exposure. As cleanup has progressed on the Hanford Site, considerations for sampling wildlife species have changed and have included factors such as the organism's likelihood to accumulate contaminants in their tissue (e.g. mobility and uptake pathway), their likelihood of being found at Hanford waste sites, the ability to relate ambient levels in abiotic media (e.g. water, soil, air) to the concentration found in the tissues of the individuals, ability to collect samples from the field that provide consistent results and are relatively clean of cross-contamination, their ecological guild (e.g., herbivores, predators, primary producers, etc…), and more.

The Asiatic clam (*Corbicula fluminea)* was one of the species selected for the PSRPP environmental monitoring objectives and results collected between 2001 and 2003 have shown the ability of this organism to help U.S. DOE describe the degree (relative levels of exposure) and the extent (where elevated levels of Hanford materials are found) in the riverine environments on the Hanford Site. This poster illustrates metals and radiological concentrations reported in A. clams collected at various locations along the Hanford Reach. The poster also illustrates relative levels of selected metals (uranium and chromium) in clams compared to results reported in water and in other species from higher-order guilds collected from the same sites.

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