

PCBs in Tissue of Fish From the Spokane River, Washington, 1999

Several studies over the past 6 years have indicated that elevated concentrations of polychlorinated biphenyls (PCBs) in the Spokane River, Washington, are a potential hazard to human and aquatic health. To help address these concerns, fish were collected from the Spokane River in 1999 and analyzed for PCBs for a cooperative study by the U.S. Geological Survey (as part of the National Water-Quality Assessment Program) and the Washington State Department of Ecology. This Fact Sheet summarizes comparisons of PCB concentrations in fish tissue recommended by national criteria with concentrations in fish tissue analyzed for this 1999 cooperative study and for previous studies.

Introduction

A cooperative study between the U.S. Geological Survey (USGS) and the Washington State Department of Ecology (WDOE), completed in July 1999, documented elevated concentrations of polychlorinated biphenyls (PCBs) in sportfish (rainbow trout and whitefish) and large-scale suckers in the Spokane River, northeastern Washington. Concentrations of PCBs in fillets of sportfish collected from four sites on the Spokane River ranged from 0.07 to 1.61 parts per million (ppm—1 part PCB to 1 million parts of tissue). These concentrations exceed the human consumption criterion of 0.0053 ppm for edible fish tissue. Concentrations of total PCBs in most of the rainbow trout (whole body and fillets) and largescale sucker (whole body) samples exceed the criterion of 0.11 ppm for fish-eating wildlife. When these data are added to data from previous studies during 1993–94 and 1998–99, it is evident that concentrations of PCBs in fish have remained 10 times higher than the criteria for more than 6 years. The 1999

cooperative study, which focused on edible fish, provided information to help evaluate human health risk and resulted in a health advisory for Spokane River fish consumption, issued on March 7, 2001. The advisory is posted at the Washington Department of Health Web page at http://www.spokanecounty.org/health/EHS/Advisories/SR_Fish_PCBi.htm

What Are PCBs?

PCBs are a group of similar, manufactured, organochlorine chemicals. Their primary use was to insulate electrical equipment such as high-voltage transformers. They also were used in a wide variety of other materials, including heat-transfer fluids, hydraulic fluids, plasticizers, inks and dyes, oils, pesticide preparations, adhesives, wood preservatives, and fluorescent light fixtures. They were first manufactured in 1929. Peak production in the United States was 38,600 tons in 1970 (Smith and others, 1988).

PCBs are long-lived in the environment and bioaccumulate (increase in concentration) in fish and other animals where they can be toxic. They are considered human carcinogens (cancer-causing agents) and have been implicated in other serious human health effects (U.S. Environ-



Electrofishing on the Spokane River, Washington, 1999.
(Photograph by Ken Skinner, U.S. Geological Survey)



Spokane River near Post Falls, Idaho, 1999. (Photograph by Terry R. Maret, U.S. Geological Survey)

mental Protection Agency, 1998, online). Human exposure to PCBs is predominantly dietary, especially through consumption of fish (U.S. Environmental Protection Agency, 1999a). Manufacture of PCBs in the United States ended in 1977, but because of their environmental persistence, significant amounts of PCBs remain in the environment today.

Two hundred and nine different forms, or congeners, of PCBs exist. They differ in the number and location of chlorine atoms in the molecule. In the United States, PCBs were sold as mixtures of congeners under the trade name Aroclor¹. Aroclor mixtures are identified by their number; for example, Aroclor 1254 contains PCB congeners with 1 or 2 chlorine atoms and an average chlorine content of 54 percent by weight. Total PCBs were estimated by adding Aroclor 1248, 1254, and 1260.

Study Background

PCBs have been identified in previous studies as contaminants of potential ecological concern in the Spokane River. The origin of PCBs in the Spokane River is probably past industrial activities or other direct discharges along the river (Washington State Department of Ecology, 1995; Golding, 1996). Organochlorine compounds, including PCBs, were analyzed in whole-body fish from 16 sites throughout the Northern Rockies Intermontane Basins study area in eastern Washington, northern Idaho, and western Montana as part of the National Water-Quality Assessment (NAWQA) Program in 1998 and 1999 (fig. 1). Total PCBs were detected in tissue of fish from 15 of the 16 sites examined for contaminants. Concentrations of PCBs were highest in fish from the Spokane River and its tributaries downstream from Post Falls, Idaho. PCB concentrations detected in fish from the Spokane River during

that study exceeded the 0.11 ppm criterion set for the protection of fish-eating wildlife (Newell and others, 1987) and the 0.0053 ppm human consumption criterion for edible fish tissue (U.S. Environmental Protection Agency, 1999b). Previous studies by WDOE in 1993 and 1994 also have documented elevated concentrations of PCBs in the Spokane River.

A study by Maret and Dutton (1999) documented the presence of PCBs in the Spokane River and summarized information on synthetic organic compounds in the Northern Rockies Intermontane Basins. These investigators reported PCB concentrations in Spokane River bottom sediment that exceeded Washington's freshwater sediment-screening guideline of 0.021 ppm for total PCBs. Johnson (2000) also reported elevated concentrations of PCBs in bottom sediment at sampling sites immediately upstream from Upriver Dam, which suggests that sediment is a possible source of PCBs available for ingestion by fish. PCBs in sediment are not discussed in this Fact Sheet, but additional information can be found in WDOE reports (Washington State Department of Ecology, 1995; Golding, 1996) and at the USGS Web site <http://idaho.usgs.gov/projects/spokane/index.html>

Other contaminants such as zinc and other metals are elevated in the Spokane River sediment and tissue as well (Maret and Skinner, 2000). An ecological risk assessment of elevated metal concentrations in the Spokane River prepared for WDOE indicated that zinc in aquatic tissue can intensify the effects of PCBs in fish and other aquatic organisms (Kadlec, 2000).

Table 1. Summary of samples collected for three studies at four sites on the Spokane River, Washington

[WDOE, Washington State Department of Ecology; USGS, U.S. Geological Survey; NAWQA, National Water-Quality Assessment Program]

Study	Sample description	Fish species
WDOE, 1993–94	3–5 composites of 5–8 fillets	Rainbow trout, mountain whitefish
	1–2 composites of 5 whole fish	Largescale sucker
USGS NAWQA, 1998–99	1 composite of 8 whole fish	Largescale sucker
USGS/WDOE, 1999	5–8 fillets analyzed individually 1 composite of 5 whole fish	Rainbow trout, mountain whitefish
	1–2 composites of 5 whole fish	Largescale sucker

¹Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

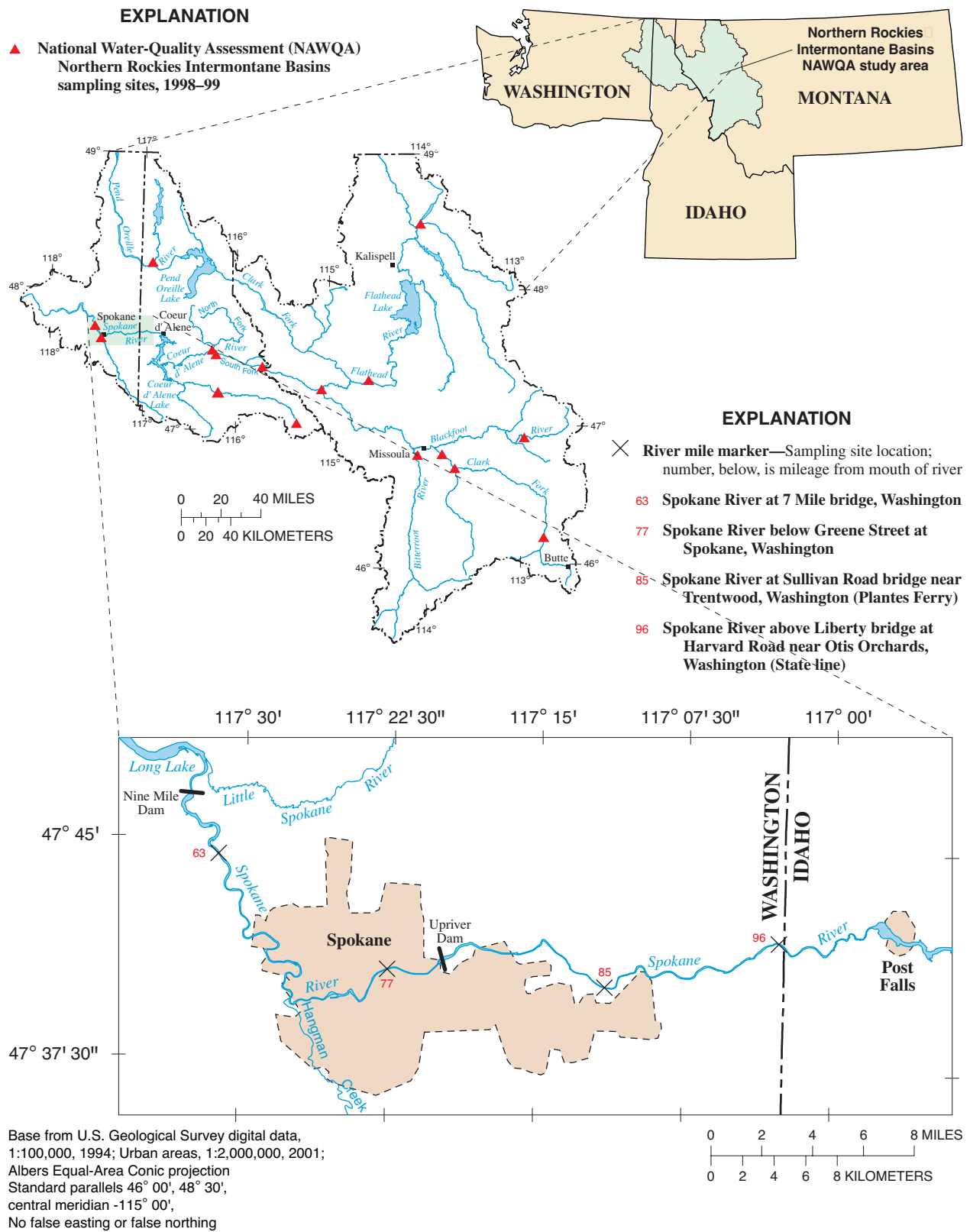


Figure 1. Location of cooperative U.S. Geological Survey/Washington State Department of Ecology 1999 study area and river mile sampling site locations, Spokane River, Washington, within the National Water-Quality Assessment (NAWQA) Northern Rockies Intermontane Basins study area.

Sampling Methods and Analysis

In July 1999, the USGS collected fish from four sites on the Spokane River (indicated by river mile marker in fig. 1). Fish were collected using EPA methods (U.S. Environmental Protection Agency, 2000), and tissue samples were analyzed by WDOE for PCB Aroclors and some PCB congeners.

Whole-body composites (five fish combined for one analysis) and individual fillet samples were collected. Three species of fish—rainbow trout, mountain whitefish, and largescale sucker—were collected to obtain information on individual species bioaccumulation of PCBs for ecological risk assessment and human health evaluations (Johnson, 1999). Specific protocol for fish tissue analysis can be found in the WDOE Quality Assurance Project Plan (Johnson, 1999). A summary of samples collected for the 1993–94 WDOE study, the 1998–99 USGS NAWQA Program study, and the 1999 USGS/WDOE cooperative study is given in table 1. These three studies had different objec-

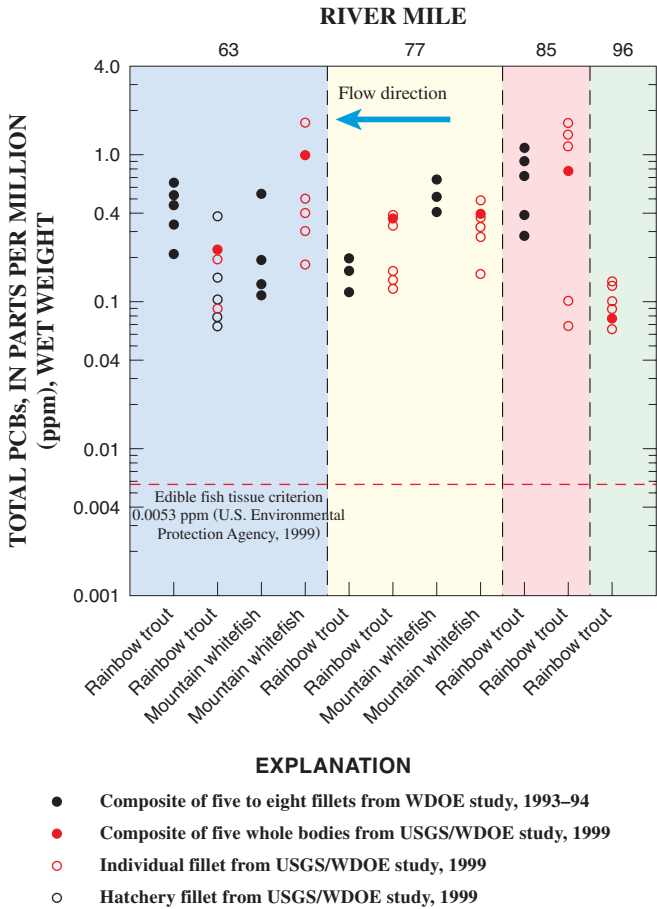


Figure 2. PCBs in tissue of sportfish from four sites on the Spokane River, Washington, 1993–94 and 1999. [River mile markers shown on figure 1; data from Washington State Department of Ecology (WDOE) study, 1993–94 (Washington State Department of Ecology, 1995); and cooperative U.S. Geological Survey (USGS)/WDOE study, 1999 (U.S. Geological Survey, 1999)]

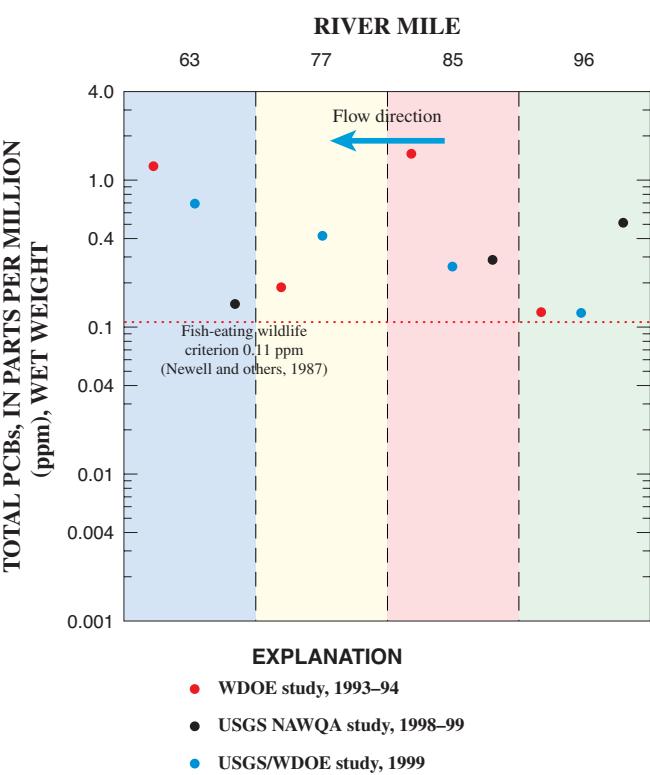


Figure 3. PCBs in tissue of whole-body largescale sucker from four sites on the Spokane River, Washington, 1993–94 and 1998–99. [River mile markers shown on figure 1; data from Washington State Department of Ecology (WDOE) study, 1993–94 (Washington State Department of Ecology, 1995); U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) study, 1998–99; and cooperative USGS/WDOE study, 1999 (U.S. Geological Survey, 1999)]

tives, and the samples were analyzed and the data summarized differently. Therefore, only a general comparison among the three studies is made in this Fact Sheet.

Summary of Findings

Total PCB concentrations in tissue samples of sportfish collected from four sites on the Spokane River during the 1993–94 and 1999 studies are summarized in figure 2. Concentrations in all fish fillets and whole-body sportfish exceeded the edible fish tissue criterion of 0.0053 ppm. In fact, the concentrations of PCBs in fish tissue were 10 times higher than the criterion and have been at this level for the past 6 years. Concentrations were highest in rainbow trout fillets collected in 1999 behind Upriver Dam at river mile 85. The PCB concentrations in Spokane River fish were about 100 times higher than those in more pristine streams in Washington (Serdar, 1999).

Total PCB concentrations in whole-body samples of largescale suckers are summarized in figure 3. All concen-



Rainbow trout, *Oncorhynchus mykiss*, South Fork Coeur d'Alene River, Idaho, 2000. (Photograph by Dorene MacCoy, U.S. Geological Survey)

trations of PCBs in whole-body suckers exceeded the fish-eating wildlife criterion. As previously stated, PCBs can accumulate in tissue and biomagnify (increase incrementally) at each level of the food chain, which causes high risk to predatory wildlife such as eagles and river otters.

With the additional data collected for the 1999 USGS/WDOE study, a more thorough analysis of the risk to human health could be done. As a result, a health advisory has been issued by the Washington State Department of Health and the Washington State Department of Ecology. A summary of the advisory is given on the back of this Fact Sheet. Further investigation of the biological community structure and habitat is needed to fully understand the environmental risks of PCBs in the Spokane River.

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Additional information about the Northern Rockies Intermontane Basins NAWQA study is available at URL:

<http://montana.usgs.gov/nrok/nrokpage.htm>

This Fact Sheet can be viewed in PDF format at URL:

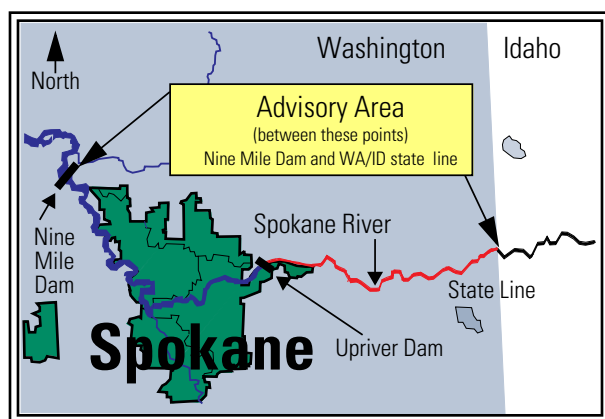
<http://idaho.usgs.gov/public/reports.html>

Health Advisory for Spokane River Fish Consumption

Update, March 2001

Background

The Spokane River has been impacted by many years of mining in the region and industrial discharge. Pollutants from these sources have been found in both sediment and fish. The Washington State Department of Health and the Spokane Regional Health District have found that some of these pollutants in fish are high enough to recommend consumption limits for the area indicated in the map below.



What are the contaminants and species of concern?

Lead and polychlorinated biphenyls (PCBs) were found at elevated levels in three fish species tested: **rainbow trout, mountain whitefish, and largescale suckers.**

What are the harmful effects of PCBs and lead? Who should be concerned?

Pregnant women and women considering pregnancy should carefully follow the meal limits given in table 1. The fetus is particularly susceptible to the harmful effects of lead and PCBs when the mother eats contaminated fish. Such effects can include learning problems that appear during childhood years. Negative effects on a child's behavior and ability to learn can also occur in children exposed to lead from birth through six years of age. **Because lead was found at higher levels in whole fish samples, it is especially important for children under age six to eat only fillets according to the meal limits in table 1.**

Animal studies have shown that PCBs affect the reproductive and immune systems, liver and thyroid. PCBs may cause cancer in humans. **All adults and children should observe the meal limits given in table 1.**

How much fish from the Spokane River should you eat?

No one should eat rainbow trout or mountain whitefish caught between Upriver Dam and the WA/ID state line. The advised fillet meal limits given in table 1 below are considered protective of all adults (including pregnant women) and children. **All meals should be prepared as fillets because whole fish have higher levels of lead and PCBs.**

Table 1. Suggested fillet meal limits

Fish Species	Recommendation
Above Upriver Dam to WA / ID state line	
Rainbow trout	None
Mountain whitefish	None
Largescale suckers	One meal per month
Below Upriver Dam to Nine Mile Dam	
Rainbow trout	One meal per month
Mountain whitefish	One meal every other month
Largescale suckers	One meal per month

Note: One meal equals 8 ounces of fish for the average adult. Meal sizes are assumed to be less for children.

For additional information

For additional information, please contact the Washington State Department of Health toll-free at 1-877-485-7316 or the Spokane Regional Health District at (509) 324-1560 ext 3. The complete advisory is available at: http://www.spokanecounty.org/health/EHS/Advisories/SR_Fish_PCBi.htm.