Final Report: PCBs in Utah Lake Sediment Study

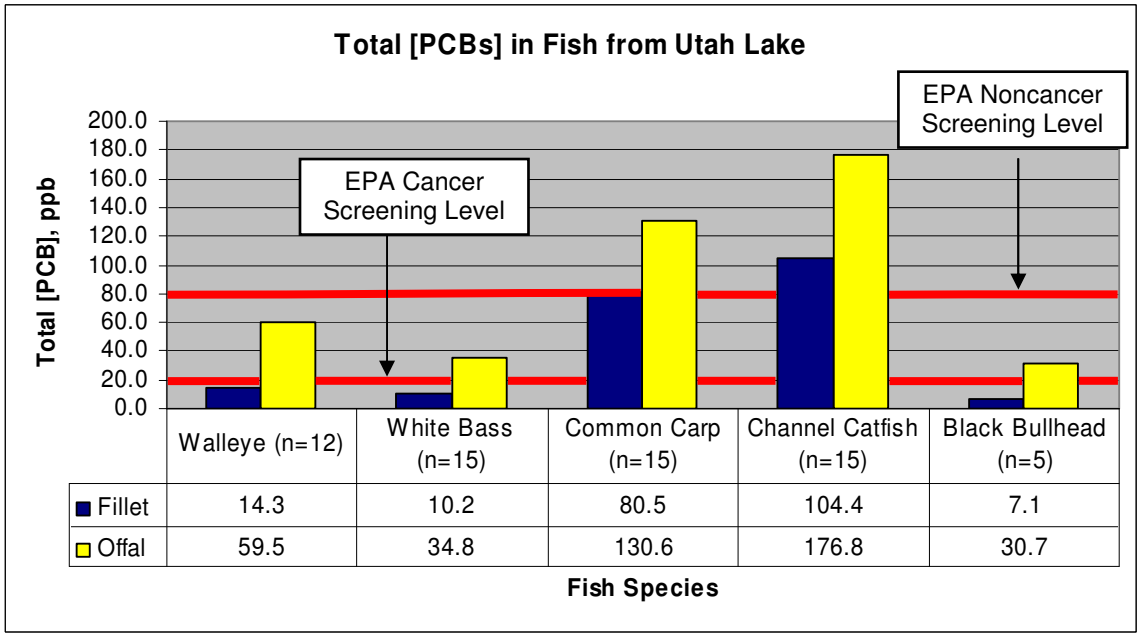
Sandy Wingert, DWQ
swingert@utah.gov

November 13, 2008

1.0 Background

In November 2005, 15 carp were collected from Utah Lake and analyzed for metals and PCBs; only total PCBs were found to be elevated. The concentrations for the fillet samples averaged 47.8 ppb for total PCBs and the offal samples were 139 ppb. The EPA cancer screening level is 20 ppb and the non-cancer screening level is 80 ppb (1). Since these samples exceeded EPA's cancer screening level, a health advisory was issued concerning consumption of carp in Utah Lake in May 2006. Following the first advisory, a more inclusive study of other fish species was completed in June 2006. A total of 65 fish, including white bass, common carp, channel catfish, walleye, and black bullhead, were sampled and analyzed for PCBs. The results indicated channel catfish and common carp exceeded EPA's cancer screening level. In October 2007 another fish consumption advisory was issued for PCBs in channel catfish in addition to common carp. See Figure 1 for PCB concentrations found in the second fish collection.

Figure 1. Mean Total PCB Concentration in Fish Collected from Utah Lake in June 2006.



Common carp are bottom-feeding omnivores that consume aquatic plants, insects, and other fish. Carp dominate the ecology of Utah Lake making up an estimated 90.9% of its total biomass (2). Their presence has lead to the decline of native fish species including the June Sucker, which was listed on the Endangered Species List in 1986. The June Sucker Recovery Implementation Program has been initiated to address its listing and to recover the species so that it no longer requires protection under the Endangered Species Act.

2.0 Sediment Sampling Plan

2.1 Objectives

Following the two health advisories and at the request of the June Sucker Recovery Implementation Program (JSRIP), DWQ conducted a follow-up study in June 2008 to investigate a potential source of PCBs in Utah Lake's bottom sediments. The overall objective was to minimize the ecological and human health risks associated with PCB contamination, in particular the potential of PCBs to bioaccumulate in the foodchain. It investigated not only the presence or absence of this organic pollutant in the sediments, but also surveyed the spatial distribution, magnitude, and historical deposition of contamination. Another objective was to determine the potential uptake of PCBs in the eggs of the endangered June Sucker.

2.2 Hydrology of Utah Lake

Utah Lake covers approximately 150 square miles of land, contains 870,000 acre-feet of water, and has an average depth of 9.2 ft. The sediment is primarily comprised of calcium carbonate followed by quartz and clay. Utah Lake's bottom sediment layer consists of an unconsolidated floc layer due to the constant resuspension of sediment caused by heavy wave action. The sedimentation rate has been calculated to be 1-2 mm/year (3). According to the Utah Lake Beneficial Use Assessment completed in February 2007, groundwater and springs account for 24% of the inflow, streams 51%, and precipitation 15%. The main surface water outflow is the Jordan River at an average annual flow of 428,000 acre-ft/year or roughly half of the total water volume. The other half leaves Utah Lake via evaporation leading to high TDS values in the lake (4).

2.3 Sampling Design

Given the bottom sediment sampling plan's objectives, sampling was conducted once to determine the present state of sediment contamination. Baseline sampling is meant to detect if any exceedances occur and determine if concentrations are higher in areas more likely to be affected by specific sources. If the sampling detected an exceedance of the PCB numeric criteria (Ecological Screening Level of 60 ppb), further sediment sampling and analysis would be conducted to characterize the spatial extent of the contamination.

A targeted sampling approach was used, concentrating on the eleven river/stream inflow's depositional zones. The depositional zone for the inflow sample sites were defined as being approximately 500 m from the mouth of the rivers. The industrial and municipal wastewater discharge sites targeted include Geneva Steel, Timpanogos Waste Water Treatment Plant (WWTP), and Saratoga Springs. There are three sampling sites near Geneva Steel's outfall into Utah Lake, one sample site near the Timpanogos WWTP outfall, and one near Saratoga Springs. On the western shores of Utah Lake, there is a CERCLA site for Ireco LLC, which was sampled as well. In addition, six in-lake sites were included, as well as the lake outlet near the Jordan River. In total, sediment cores were collected from 23 sites distributed throughout Utah Lake (Figure 2).

Figure 2. Overview of Sampling Sites on Utah Lake.

Note: Utah Lake UT-2 sampling site was not sampled. Spring Creek UT-17 included inflow from Hobble Creek.

2.4 Sediment Collection

At each sampling location, DWQ sampled Utah Lake's sediment at three different depths, at the surface, in the middle or floc layer, and at the maximum depth using a 45 cm long KB corer. The sediment sampling procedures used for Utah Lake mirrored the procedures and equipment used during EPA's Survey of the Nation's Lakes study (5). The surface sample was a composite sample at a depth of 0-2 cm below the sediment surface (bss). A majority of biological activity occurs in the upper 10 cm of sediment. Since the rate of sedimentation for Utah Lake is approximately 2 mm/year (4), sampling at a depth of 2 cm provided PCB data reflective of recent activity. The middle or floc layer was also collected. The floc layer is defined as the loosely aggregated sediment layer that is easily re-suspended back into the water column. This layer heavily influences the sequestration and release of both nutrients and contaminates to and from the water column. Horns (2005) stated that the bottom of Utah Lake is in a constant state of resuspension to a depth of 30 cm (12 in) due to heavy wave action, therefore a sample depth greater than 30 cm is needed to provide a detailed depth profile of PCB contamination.

Using a calibrated multi-parameter water quality meter, field measurements of dissolved oxygen, water temperature, specific conductivity, and pH were collected 0.5 m from the sediment surface at all sampling sites. The water depth and secchi depth were also measured. EPA Region 8 Laboratory analyzed all sediment samples for total PCBs.

3.0 Ecological Screening Levels

An ecological screening level (ESL) is a contaminant concentration that is set as a protective benchmark. The sampling plan for this study established that sampling locations with total PCB concentrations exceeding the ESL would be identified as areas needing additional analysis. ESLs are not to be used as a trigger for clean-up or remediation. EPA Region 8 has adopted Region 5's ESL for total PCBs in sediment of 59.8 ppb that the State of Utah used for total PCBs in Utah Lake's sediment.

The proposed ESL of 59.8 ppb for Utah Lake is more conservative than those set by other EPA Regions (EPA Region 4's ESL is 67 ppb) and other countries (Denmark's ESL is 67 ppb) and is thus more protective for the June Sucker and other biota of Utah Lake (6).

4.0 Results

The average depth for surface sediment samples was 2 cm, 10.8 cm in the floc layer, and 20.5 cm for the maximum depth. The total length of the cores ranged from 11 to 53 cm. EPA Region 8 Laboratory analyzed all sediment samples for total PCBs. All samples resulted in total PCB concentrations below the detection limit of 50 ppb.

Obtaining adequate samples of June sucker eggs for testing proved difficult. Elevated flows in the lower Provo River prevented access to spawning fish at the beginning of the spawning run. As flows receded, egg samples from three female June sucker were

obtained. The egg samples were damaged during shipping and testing for PCBs were not possible. Efforts to obtain adequate June sucker egg samples are planned for the future.

5.0 Conclusions

It was agreed prior to sampling that locations exceeding the ESL of 59.8 ppb would be identified as needing additional analysis. However, since all sediment samples are below this ESL value, additional sediment analysis is not warranted at this time. When comparing the PCB concentrations of Utah Lake's fish and sediment to other PCB contaminated sites, Utah Lake is at least an order of magnitude lower (Figures 3 and 4).

Figure 3 compares the PCB concentrations in carp and catfish from Utah Lake to fish collected in the Great Lakes, Hudson River, Delaware Bay, and salmon sold in the market. PCB concentrations in fish from Utah Lake are comparable to those sold in the market. Utah Lake's fish are well below the Food and Drug Administration's (FDA) safe level of 2000 ppb. The FDA considers PCB concentrations greater than 2000 ppb in fish fillets to be a health risk. Additionally, PCBs found in Utah Lake are at least one order of magnitude below other contaminated sites including the Great Lakes, Hudson River, and Delaware Bay.

Figure 4 compares the PCB concentration in Utah Lake sediment to what was measured in the Great Lakes and Hudson River. Great Lake (Raisin River) sediment data collected from 2001-2002 showed [PCB] in deep sediment to be 90,000 ppb after the 1997 contaminated sediment removal project (8). General Electric discharged PCBs directly into the Hudson River from the latter 1940s to 1977. Utah Lake sediment is at least 3 orders of magnitude lower as well as below the ESL. Baker (2001) states that the desired remediation level for PCB contaminated sediment for Commencement Bay, WA is 450 ppb, for Housatonic River is 1000 ppb, Sheboygan Harbor, WI is 500 ppb, and Fox River, WI is 250 ppb. Utah Lake's sediment has PCB concentrations are below 50 ppb, thus well below the targeted clean-up level.

Figure 3. PCB Concentration in Fish across the USA. **Note: Log Scale.**

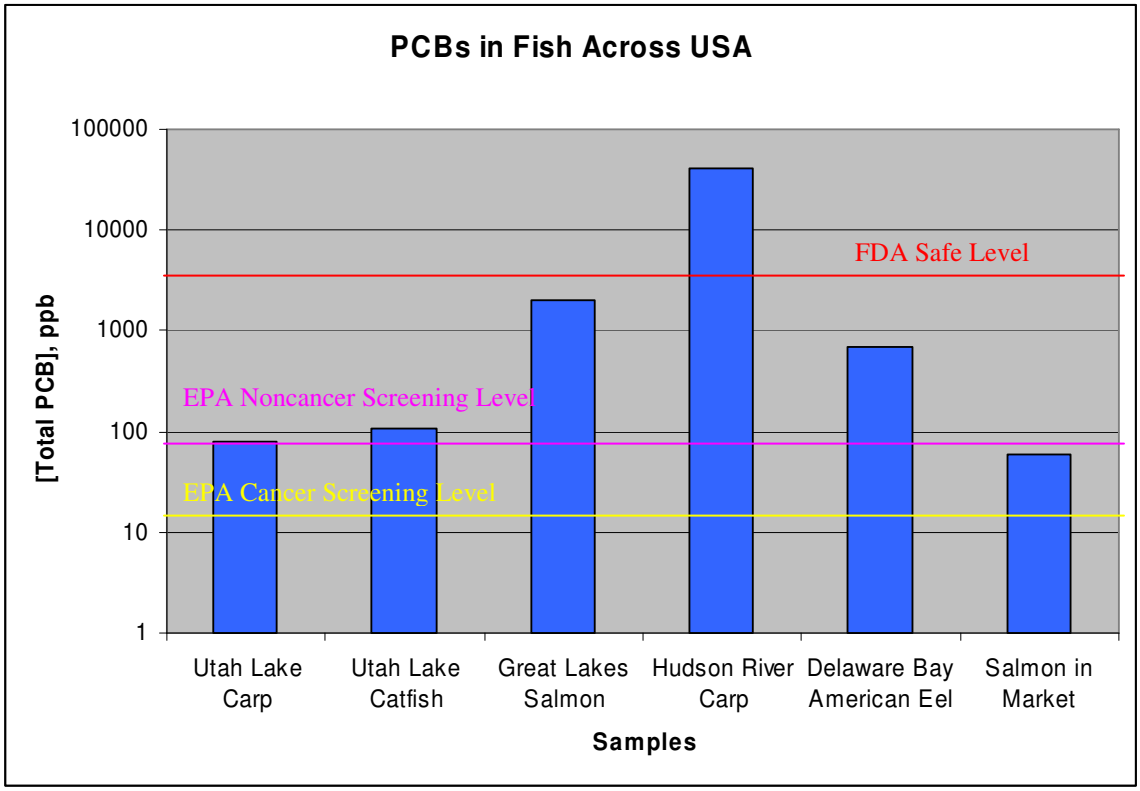
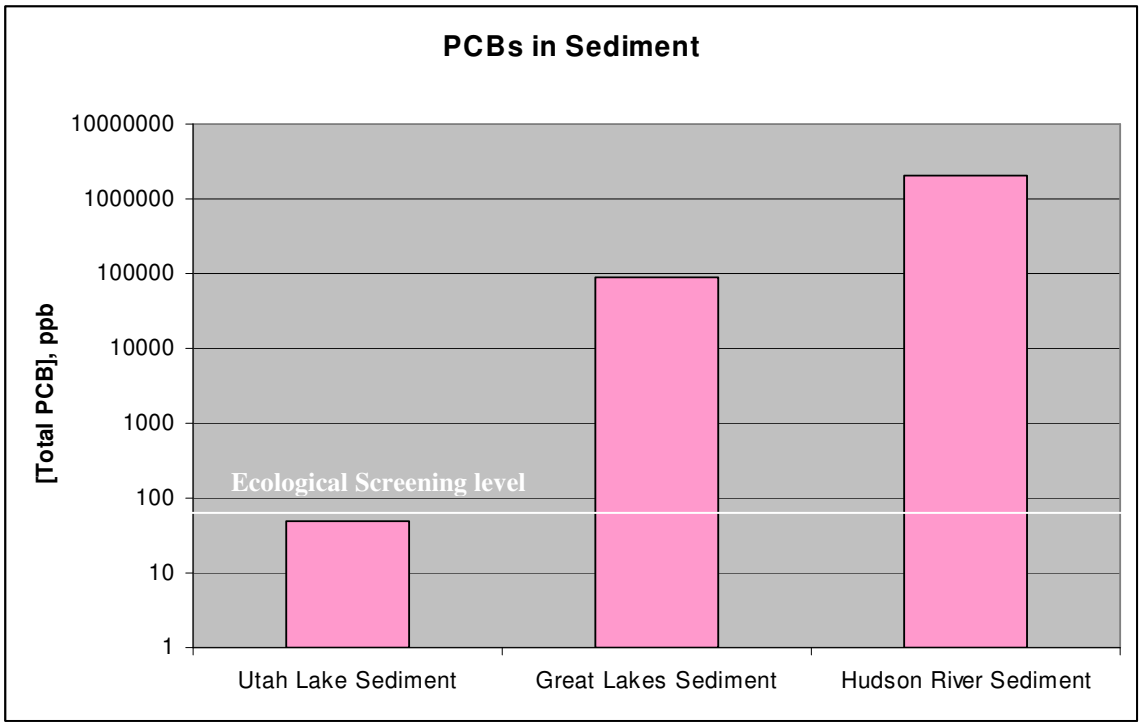


Figure 4. PCB Concentration in Sediment across the USA. **Note: Log Scale.**



Since the concentration of PCBs in Utah Lake's sediment is below the Ecological Screening level and the nation-wide targeted remediation concentrations, no further sediment collection or analysis is warranted at this time. The source of PCBs in fish is likely through bioaccumulation via the food chain and thus not readily controllable. The Division of Wildlife Resources and the JSRIP have indicated interest in continuing to collect and analyze fish from Utah Lake once every five years to assess long term trends in PCB concentrations and whether the consumption advisories are still necessary.

6.0 References

1. Utah Department of Health (2006)."An Evaluation of Contaminant Concentrations in Carp from Utah Lake for 2005".
2. June Sucker Recovery Program. http://www.junesuckerrecovery.org/achi-nonn.html
3. Horns, D (2005). "Utah Lake Comprehensive Management Plan Resource Document".
4. Brimhall, W.H., and Merritt, L.B (1981). "Geology of Utah Lake: Implementations for Resource Management. Great Basin Naturalist Memoirs Number 5, Utah Lake Monograph".Brigham Young University.
5. US EPA (2007). "Survey of Nation's Lakes Field Operations Manual".
6. EPA Region 5. http://www.epa.gov/region5/rcraca/edql.htm
7. Baker, JE *et al*. "PCBs in the Upper Hudson River: The Science Behind the Dredging Controversy." Hudson River Organization. October 25, 2001. www.hudsonriver.org/ls/reports/hrfpcb102901.pdf
8. EPA Great Lakes National Program (2003). "Post Remediation Sediment Sampling on the Raisin River near Monroe, Michigan Final Results from 2001-2002 Survey: PCB Chemistry, Caged Fish, and Bioaccumulation Results. http://www.epa.gov/glnpo/sediment/raisin/raisinrvrpt.pdf