

Health Consultation

**AN EVALUATION OF MERCURY CONCENTRATIONS IN FISH
FROM RIVERS AND LAKES IN UTAH FOR YEARS 1990-2005**

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**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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HEALTH CONSULTATION

AN EVALUATION OF MERCURY CONCENTRATIONS IN FISH FROM RIVERS AND
LAKES IN UTAH FOR YEARS 1990-2005

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Background and Statement of Issues

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation report for Utah (U.S.DI 2003) estimates that approximately 517,000 people, ages 16 or older, fish in the state of Utah. The report also estimates 152,000 residents aged 6-15 years old fish in Utah. Recent public concern has been expressed about potential health risks associated with mercury levels in Utah fish. In response to these concerns, the Environmental Epidemiology Program (EEP) conducted a review of fish sampling data for mercury from fish sampled from Utah water bodies by various state and federal agencies. This Health Consultation is an evaluation of the data available on fish sampling for mercury conducted in Utah by various agencies covering the period of 1990 through 2005, and the potential public health risk associated with mercury contaminated fish in Utah.

Various agencies monitor chemical contaminant levels in fish from rivers and lakes in Utah. The U.S. Bureau of Reclamation (USBR) sampled Rainbow Trout from the Jordanelle Reservoir in 1995 and several fish species from East Canyon Reservoir in 1990. The U.S. Geological Survey (USGS) collected several fish species from several river sites in 1998 and 1999. The U.S. Fish and Wildlife Service (USFWS) collected three Bass species from sites in Lake Powell from 1991-1994, Carp from multiple sites in the Upper Colorado River basin during 1996 and 1997, and fish from Great Salt Lake wetlands in 1996-1997. The Utah Department of Environmental Quality (UDEQ) collected fish from 36 different sites during the years 2000-2003. Additional fish sampling by UDEQ was conducted in July 2005 to further characterize the mercury concentrations in fish from Gunlock Reservoir, Mill Creek, East Canyon Reservoir, and two locations in Lake Powell. Sampling sites are shown in Figures 1 - 7.

Results

Mercury Concentrations

All mercury concentrations are reported as a wet weight concentration in milligrams of mercury per kg fish tissue (mg/kg). The EPA screening value for mercury in fish is 0.3 mg/kg. Fish tissue was analyzed as fillets or whole body fish.

Rivers and Streams

Colorado, Yampa, White, Duchesne, and Price Rivers 1996 - 1997

Nine Carp collected from three different locations along the Colorado River in 1996 by the U.S. Fish and Wildlife Service had a high mercury concentration of 0.091 mg/kg (Table 1). Carp were sampled as an edible bottom-dwelling species of fish. The low of the dry weight mercury concentration was <0.177 mg/kg, therefore a low mercury wet weight concentration and average could not be calculated. Ten Carp were collected in 1997 from four different rivers at sites above their confluence with the Green River. The high mercury concentration for Carp from the

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Yampa, White, Duchesne, and Price Rivers was 0.085 mg/kg. The low of the dry weight concentration was <0.0925 mg/kg, therefore a low wet weight concentration and average could not be calculated. Mercury concentrations in fish sampled were below the 0.3 mg/kg level of concern. The sampling data provided did not describe if the samples from the Colorado, Yampa, White or Price rivers were analyzed as whole body or fillet.

Great Salt Lake Wetlands 1996 - 1997

Whole body fish from eleven different sites from Great Salt Lake wetlands were analyzed for mercury in 1996 and 1997 by the U.S. Fish and Wildlife Service (Table 2). The Great Salt Lake wetlands sites include areas along the eastern edge of the Great Salt Lake (Figure 1). Wet weight mercury levels in Carp ranged from non-detect to 0.015 mg/kg. No mercury was detected in one sample of White Bass collected. Mercury concentrations in fish sampled were below the 0.3 mg/kg level of concern.

Bear and Weber Rivers 1998

The U.S. Geological Survey sampled Carp from the Bear River near Corinne, Utah in 1998. The mercury level in a composite of five whole body Carp analyzed had a mercury level of 0.025 mg/kg, below the 0.3 mg/kg level of concern. Results are shown in Table 3.

Cub and Weber Rivers 1998 -1999

The US Bureau of Reclamation caught a total of five Mountain Whitefish from the Weber River near Coalville, Utah in 1998-1999. The fillets from these fish were analyzed for mercury resulting in a mean wet weight of 0.11 milligrams mercury per kg fish tissue (0.11 mg/kg) with mercury concentrations ranging from 0.073-0.141 mg/kg. The composite of fillets from two Largemouth Bass from the Cub River near Richmond, Utah had a mercury wet weight of 0.271 mg/kg. Results are shown in Table 4. The composite sample result is close to the EPA screening value of 0.3 mg/kg.

American Fork, North Fork 1999

As a part of a monitoring program to assess the potential impacts from abandoned mining operations in American Fork Canyon, personnel from the Uinta National Forest obtained fish (Cutthroat, Brown and Rainbow Trout) tissue samples from several areas of the North Fork of the American Fork River in 1999 (UDOH 2002).

Fillet samples of Brown Trout from below the Tibble Fork Reservoir had mercury levels ranging from 0.040-0.078 mg/kg for an average of 0.055 mg/kg. Brown Trout above the Tibble Fork Reservoir had mercury levels ranging from 0.050-0.068 mg/kg for an average of 0.059 mg/kg. Cutthroat Trout from the North Fork of the American Fork River above Major Evans Gulch had mercury levels of 0.029-0.062 mg/kg for an average of 0.043 mg/kg. Cutthroat and Rainbow Trout from below Pacific Mine ranged from 0.052-0.087 mg/kg mercury, average of 0.068

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mg/kg. Cutthroat, Rainbow and hybrid Trout from above Pacific Mine ranged from 0.031-0.064 mg/kg mercury with an average value of 0.045 mg/kg. Mercury concentrations in fish sampled were below the 0.3 mg/kg level of concern. Results from 1999 are shown in Table 5.

Silver Creek 2003

In the summer of 2003, fish were collected from the lower portion of Silver Creek by the U.S. Fish and Wildlife Service (USFWS) and analyzed for a spectrum of metals to assess the potential impacts from historic mining operations. Samples were submitted for analysis as fish fillets. Mercury concentrations in fish were determined as part of the study of metal concentrations in the fish of Silver Creek. Results are shown in Table 9.

One Rainbow Trout sample from Silver Creek in Summit County in 2003 had a mercury concentration of 0.027 mg/kg. Five Brown Trout averaged 0.06 mg/kg mercury with a range of 0.035-0.069 mg/kg. Thirteen Cutthroat Trout were caught from Silver Creek with an average mercury concentration of 0.08 mg/kg with a range of 0.046-0.105 mg/kg. Mercury concentrations in fish sampled were below the 0.3 mg/kg level of concern.

Environmental Monitoring and Assessment Program 2000 - 2003

The Utah Department of Environmental Quality (UDEQ) collected fish from 36 different sites during the years 2000-2003. This sampling was in cooperation with a study developed by the Environmental Protection Agency (EPA) called the (EMAP). The primary goal of EMAP is to generate state and regional assessments of the state of ecological resources in the United States. Part of this study involves assessing contaminant levels in fish; mercury is one of the many contaminants analyzed. Approximate locations of these sites studied under EMAP are shown on maps of Utah in Figures 2-5. EMAP fish samples are analyzed as whole fish. Results are shown in Tables 6 - 8.

Uintah River 2000

Four species of fish were sampled from the Uintah River in Duchesne County in 2000. Mountain Sucker had an average mercury level of 0.16 mg/kg with a range from 0.136-0.193 mg/kg. Brown Trout had an average of 0.12, ranging from 0.097-0.151 mg/kg. One Rainbow Trout sample had a mercury level of 0.148 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Cottonwood Creek 2000

Five Cutthroat Trout from Cottonwood Creek in Garfield County had an average mercury level of 0.08 mg/kg in the year 2000. Mercury levels ranged from 0.064-0.096 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

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Panguitch Creek 2000

Five Brown Trout from Panguitch Creek in Garfield County had an average mercury level of 0.04 mg/kg in the year 2000. Mercury levels ranged from 0.027-0.063 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Hill Creek 2000

Four Brook Trout collected from Hill Creek in Grand County averaged 0.03 mg/kg mercury with a range of 0.022-0.031 mg/kg in the year 2000. One Mountain Sucker had a mercury level of 0.081 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Francis Canyon Creek 2000

Five Mountain Sucker from Francis Canyon Creek in Morgan County had an average mercury level of 0.02 mg/kg in the year 2000. Mercury levels ranged from 0.011-0.024 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Weber River 2000

Six Mountain Whitefish were collected from the Weber River in Morgan County that ranged in mercury concentration from 0.072-0.130 mg/kg with an average of 0.09 mg/kg. Utah Sucker samples averaged 0.05 mg/kg mercury ranging from 0.037-0.055 mg/kg. Brown Trout from the Weber River averaged 0.08 mg/kg mercury with a range of 0.052-0.098 mg/kg. Mountain Sucker samples averaged 0.10 mg/kg with range of 0.077-0.137 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Burnt Fork Creek 2000

Five Cutthroat Trout sampled from Burnt Fork Creek in Summit County in the year 2000 had an average mercury level of 0.09 mg/kg with a range from 0.048-0.172 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Weber River, Middle Fork 2000

Two Brook Trout from the year 2000 mercury levels ranged from 0.027-0.029 mg/kg with an average of 0.03 mg/kg. Cutthroat Trout mercury levels ranged from 0.022-0.035 mg/kg with an average of 0.03 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

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Logan River 2001

Three Brown Trout averaged 0.02 mg/kg of mercury with a range of 0.014-0.026 mg/kg from the Logan River in Cache County in 2001. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Gordon Creek 2001

Three Tiger Trout averaged 0.02 mg/kg of mercury with a range of 0.020-0.022 mg/kg from the Gordon Creek in Carbon County in 2001. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Colorado River 2001

Four Channel Catfish from the Colorado River in Grand County averaged 0.12 mg/kg of mercury with a range of 0.056-0.171 mg/kg in 2001. Three Yellow Bullheads averaged 0.04 mg/kg, ranging from 0.033-0.043 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Mill Creek, Moab 2001

Brown Trout from Mill Creek near the city of Moab in Grand County averaged 0.38 mg/kg of mercury with a range from 0.372-0.391 mg/kg in 2001. Both fish were above the EPA screening value of 0.3 mg/kg, the concentration in fish of public health concern. Fish samples were analyzed as whole body. Due to the small sample size, and since the whole body was analyzed instead of the fillet, the potential public health hazard is indeterminate. Additional sampling of Mill Creek is needed to determine the public health significance of mercury levels in fish from Mill Creek.

Sevier River, Mills 2001

One sample of Utah Sucker from the Sevier River near Mills in Juab County had a mercury concentration of 0.033 mg/kg in 2001, below the 0.3 mg/kg level of concern.. Fish samples were analyzed as whole body.

Sevier River 2001

Three Utah Suckers from the Sevier River in Millard County averaged 0.05 mg/kg mercury with mercury concentrations ranging from 0.043-0.066 mg/kg in 2001. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

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City Creek 2001

Three Brown Trout from the City Creek in Salt Lake County in 2001 averaged 0.04 mg/kg mercury with mercury concentrations ranging from 0.033-0.049 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Santa Clara River 2001

Two Desert Suckers from the Santa Clara River near the town of Santa Clara in Washington County had mercury concentrations of 0.107 mg/kg and 0.110 mg/kg for an average of 0.11 mg/kg in 2001, below the 0.3 mg/kg level of concern.. Fish samples were analyzed as whole body.

Range Creek 2002

Three Brown Trout sampled from Range Creek in Carbon County averaged 0.02 mg/kg of mercury with a range of 0.016-0.028 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Sheep Creek, North Fork 2002

Cutthroat Trout from the North Fork of Range Creek in Daggett County averaged 0.15 mg/kg of mercury with a range of 0.124-0.177 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Huntington Creek, Lower Fork 2002

Three Brown Trout from the Lower Fork of Huntington Creek in Emery County had a mercury concentration average of 0.06 mg/kg with values ranging from 0.050-0.062 mg/kg in 2002. Two Cutthroat Trout samples averaged 0.05 mg/kg with individual concentrations of 0.049 mg/kg and 0.054 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Huntington Creek, North 2002

Three Brown Trout from North Huntington Creek in Emery County had a mercury concentration average of 0.04 mg/kg with values ranging from 0.040-0.051 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Summit Creek 2002

Rainbow Trout from Summit Creek in Iron County averaged 0.10 mg/kg mercury with values ranging from 0.064-0.149 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

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East Canyon Creek 2002

Six Brown Trout from East Canyon Creek in Morgan County averaged 0.11 mg/kg mercury with values ranging from 0.081-0.142 mg/kg. Four Rainbow Trout samples had mercury values ranging from 0.088-0.225 mg/kg with an average of 0.12 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Sevier River 2002

One Mountain Sucker sample from the Sevier River in Sanpete County had a mercury level of 0.139 mg/kg in 2002, below the 0.3 mg/kg level of concern.. Fish samples were analyzed as whole body.

Fremont River 2002

Brown Trout from the Fremont River in Sevier County had mercury concentrations ranging from 0.027-0.041 mg/kg with an average of 0.04 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Smiths Fork, East Fork 2002

Three Brook Trout collected in 2002 from the East Fork of Smiths Fork in Summit County had an average mercury level of 0.06 mg/kg, ranging from 0.048-0.084 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Smiths Fork, West Fork 2002

Four Brook Trout from the West Fork of Smiths Fork in Summit County averaged 0.06 mg/kg with a mercury concentration range of 0.048-0.103 mg/kg. One Mountain Whitefish sample had a mercury concentration of 0.160 mg/kg in 2002. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Green River 2002

Three Channel Catfish from Desolation Canyon on the Green River in 2002 averaged 0.24 mg/kg mercury, ranging from 0.128-0.307 mg/kg. One Catfish exceeded the EPA screening value of 0.3 mg/kg mercury, the concentration in fish of public health concern. Smallmouth Bass averaged 0.14 mg/kg, ranging from 0.127-0.148 mg/kg. Three Common Carp had mercury values ranging from 0.110-0.114 mg/kg with an average of 0.11 mg/kg. Fish samples were analyzed as whole body.

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Strawberry River 2002

Three Brown Trout from the Strawberry River in Wasatch County had an average mercury concentration of 0.04 mg/kg in 2002. Mercury values ranged from 0.018-0.051 mg/kg, all below the 0.3 mg/kg level of concern.. Fish samples were analyzed as whole body.

Santa Clara River 2002

Three Brown Trout from the Santa Clara River near the town of Veyo in Washington County in 2002 had an average mercury concentration of 0.06 mg/kg with individual samples ranging from 0.026-0.074 mg/kg. Largemouth Bass had mercury values of 0.087 mg/kg and 0.151 mg/kg with an average of 0.12 mg/kg. Three Desert Sucker samples averaged 0.06 mg/kg with values ranging from 0.042-0.070 mg/kg. All values were below the 0.3 mg/kg level of concern. Fish samples were analyzed as whole body.

Lakes and Reservoirs

East Canyon Reservoir 1990

In studying metal concentrations in the aquatic life in East Canyon Reservoir, four species of fish were collected in 1990 by the U.S. Bureau of Reclamation. Mercury levels were analyzed from composites of either whole body fish or edible tissue (fillet) (Table 10). Mercury levels ranged from 0.174-0.224 mg/kg in two whole body Kokanee with an average of 0.20 mg/kg. Three Trout whole body mercury levels ranged from 0.100-0.910 mg/kg, average of 0.39 mg/kg. Only one of the three whole body trout fish samples exceeded the EPA screening value of 0.3 mg/kg mercury, the concentration in fish of public health concern. Levels of mercury in two Sucker whole body samples ranged from 0.019-0.265 mg/kg with an average of 0.14 mg/kg. One sample of edible tissue from a Kokanee had a mercury level of 0.162 mg/kg. Edible tissue (fillet) from four trout ranged from 0.132-0.410 mg/kg mercury with an average concentration of 0.23 mg/kg. Only one of the four edible tissue trout samples exceeded the EPA screening value of 0.3 mg/kg mercury. Since only one trout exceeded the SV of 0,3 mg/kg, eating trout from East Canyon is an indeterminate public health hazard. Additional sampling of East Canyon Reservoir is needed to assess the public health significance of mercury concentrations in trout from this reservoir.

Lake Powell 1991 - 1994

The U.S. Fish and Wildlife Service conducted a reconnaissance study of trace elements in sediment and biota of Lake Powell during 1991 through 1994 (USFWS 1996). One of the objectives of that study was to determine the trace element concentration in fish for comparison with human health thresholds. Mercury was one of the metals analyzed in that study. Mercury concentrations were determined from fish fillets. Locations of the sample sites on Lake Powell are presented in Figure 2. Results for 1991-1994 data from Lake Powell are shown in Table 11.

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Bullfrog Bay

Three Largemouth Bass were collected from Bullfrog Bay. Mercury levels in Largemouth Bass fillets ranged from 0.09-0.14 mg/kg with an average of 0.12 mg/kg; two Smallmouth Bass fillets averaged 0.13 mg/kg, ranging from 0.10-0.15 mg/kg; and three Striped Bass had an average mercury level of 0.14 mg/kg with a range from 0.06-0.26 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

Cha Canyon

One Largemouth Bass was collected from Cha Canyon with a mercury level of 0.20 mg/kg; one Smallmouth Bass fillet with 0.17 mg/kg mercury; and two Striped Bass had an average mercury level of 0.51 mg/kg with a range from 0.12-0.89 mg/kg. The high value of the Striped Bass is above the EPA screening value of 0.3 mg/kg, the concentration in fish of public health concern. Mercury concentrations were determined from fillets. Since only one fish sample exceeded the SV of 0.3 mg/kg, the public health hazard from eating fish from Cha Canyon is indeterminate. Additional sampling is needed to assess the public health significance of mercury concentrations in fish in Cha Canyon.

Colorado River

Two Striped Bass were collected from the Colorado River with an average mercury level of 0.24 mg/kg with range of 0.16-0.32 mg/kg. The high value is above the EPA screening value of 0.3 mg/kg. Mercury concentrations were determined from fillets. Since the mean concentration was below the SV of 0.3 mg/kg and one fish sample exceeded the SV, the public health hazard from eating fish from this area of the Colorado River is indeterminate. Additional sampling is needed to assess the public health significance of mercury concentrations in Striped Bass from the Colorado River.

Dangling Rope

One Largemouth Bass was collected from Dangling Rope with a mercury level of 0.14 mg/kg. One Striped Bass was collected with a mercury level of 0.32 mg/kg, slightly above the EPA screening value of 0.3 mg/kg. Mercury concentrations were determined from fillets. Since only one Striped bass was sampled and exceeded the SV of 0.3 mg/kg, eating Striped Bass from Dangling Rope is an indeterminate public health hazard. Additional sampling is needed to assess the public health significance of mercury concentrations in Striped Bass from the Dangling Rope area of Lake Powell.

Dirty Devil

Two Largemouth Bass were collected from Dirty Devil with an average mercury concentration of 0.14 mg/kg, ranging from 0.07-0.20 mg/kg. One Striped Bass was collected with a mercury level of 0.41 mg/kg, above the EPA screening value of 0.3 mg/kg. Mercury concentrations were

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determined from fillets. Since only one Striped bass was sampled and exceeded the SV of 0.3 mg/kg, the public health hazard from eating fish from Dirty Devil area of Lake Powell is indeterminate. Additional sampling is needed to assess the public health significance of mercury concentrations in Striped Bass from the Dirty Devil area of Lake Powell.

Escalante Arm

Two Largemouth Bass were collected from Escalante Arm with an average mercury concentration of 0.22 mg/kg, ranging from 0.11-0.32 mg/kg and two Striped Bass had an average mercury level of 0.53 mg/kg with a range of 0.33-0.73 mg/kg. The high value for Largemouth Bass, and both Striped Bass sampled were above the EPA screening value of 0.3 mg/kg. Mercury concentrations were determined from fillets. Due to the small sample size of Largemouth Bass and Striped Bass from the Escalante Arm, eating fish from the Escalante Arm of Lake Powell is an indeterminate public health hazard. Additional sampling is needed to assess the public health significance of mercury concentrations in fish from the Escalante Arm of Lake Powell.

Good Hope Bay

Two Smallmouth Bass were collected from Good Hope Bay with an average mercury concentration of 0.04 mg/kg, ranging from 0.02-0.06 mg/kg and two Striped Bass had an average mercury level of 0.06 mg/kg with both samples at 0.06 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

Hite Marina

One Smallmouth Bass was collected from Hite Marina with a mercury concentration of 0.07 mg/kg, and one Striped Bass had a mercury level of 0.04 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

Narrow Canyon

One Striped Bass was collected from Narrow Canyon with a mercury level of 0.27 mg/kg, below the 0.3 mg/kg level of concern.. Mercury concentrations were determined from fillets.

Navajo Canyon

Two Smallmouth Bass were collected from Navajo Canyon with an average mercury concentration of 0.14 mg/kg, ranging from 0.10-0.17 mg/kg and two Striped Bass had an average mercury level of 0.14 mg/kg with a range of 0.12 to 0.15 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

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North Wash

One Largemouth Bass was collected from North Wash with a mercury level of 0.12 mg/kg, below the 0.3 mg/kg level of concern.. Mercury concentrations were determined from fillets.

Oak Canyon

Two Largemouth Bass were collected from Oak Canyon with an average mercury concentration of 0.13 mg/kg, ranging from 0.10-0.15 mg/kg and one Striped Bass had a mercury level of 0.17 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

Wahweap

Two Smallmouth Bass were collected from Wahweap with an average mercury concentration of 0.22 mg/kg, ranging from 0.13-0.31 mg/kg and one Striped Bass had a mercury level of 0.07 mg/kg. The high value of the Smallmouth Bass is slightly above the EPA screening value of 0.3 mg/kg. Mercury concentrations were determined from fillets. Since only one Smallmouth Bass sampled exceeded the SV of 0.3 mg/kg, the public health hazard from eating Smallmouth Bass from Wahweap is indeterminate. Additional sampling is needed to assess the public health significance of mercury concentrations in Smallmouth Bass from the Wahweap area of Lake Powell.

Warm Creek

Two Smallmouth Bass were collected from Warm Creek with an average mercury concentration of 0.16 mg/kg, ranging from 0.14-0.17 mg/kg and two Striped Bass had an average mercury level of 0.12 mg/kg with a range of 0.10 to 0.13 mg/kg. All values were below the 0.3 mg/kg level of concern. Mercury concentrations were determined from fillets.

Zahn Bay

One Largemouth Bass was collected from Zahn Bay. Mercury levels in the Largemouth Bass fillet was 0.12 mg/kg; two Smallmouth Bass fillets averaged 0.20 mg/kg, ranging from 0.13-0.27 mg/kg; and three Striped Bass had an average mercury level of 0.39 mg/kg, above the SV of 0.3 mg/kg, with a range from 0.23-0.54 mg/kg. Mercury concentrations were determined from fillets. Since only one Striped Bass sampled exceeded the SV of 0.3 mg/kg, the public health hazard from eating Striped Bass from Zahn Bay is indeterminate. Additional sampling is needed to assess the public health significance of mercury concentrations in Striped Bass from the Zahn Bay area of Lake Powell.

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Jordanelle Reservoir 1995

During the spring of 1995, the U.S. Geological Survey collected Rainbow Trout from the Jordanelle Reservoir at several locations. Mercury levels were analyzed from composites of either whole body fish or eviscerated fish (Table 12). Samples were collected prior to the opening of the fishing season. Concentrations of mercury for whole body Rainbow Trout ranged from 0.076-0.247 mg/kg with an average mercury concentration of 0.16 mg/kg. Mercury levels in eviscerated fish ranged from 0.133-0.189 mg/kg for an average of 0.16 mg/kg. All values were below the 0.3 mg/kg level of concern.

National Fish Tissue Study 2000 - 2003

The Utah Department of Environmental Quality (UDEQ) is cooperating with the Environmental Protection Agency (EPA) in the *National Study of Chemical Residues in Lake Fish Tissue*. The National Fish Tissue Study is a survey of contamination in freshwater fish to estimate the national distribution of selected persistent, bioaccumulative and toxic chemicals in fish tissue from lakes and reservoirs of the contiguous United States (EPA 2004). The objectives of the study are to provide a national estimate of mean concentration of 268 chemicals in lake fish, define a national baseline to track progress of pollution control activities, and identify where contaminant levels are high enough to warrant further investigation. Fish were collected from 500 lakes and reservoirs randomly selected from the estimated 270,000 lakes and reservoirs in the lower 48 states. Gunlock Reservoir, Strawberry Reservoir, Utah Lake, Yuba Reservoir, and Cutler Reservoir were selected for sampling as part of this national study.

Gunlock Reservoir

Three Channel Catfish caught from Gunlock Reservoir in 2000 were homogenized (whole body, non-eviscerated) and analyzed as a composite. Mercury levels were 0.284 mg/kg for Channel Catfish. Five Largemouth Bass were collected from Gunlock Reservoir, filleted, and analyzed as a composite. Mercury was 0.324 mg/kg for Largemouth Bass, above the 0.3 mg/kg screening value established by EPA. The contaminant concentration is for the analyzed composite, not individual fish; therefore, the reported value is an average concentration of the contaminant concentrations of all fish in the composite. Since the composite sample of five Largemouth Bass exceeded the SV of 0.3 mg/kg, the level of mercury in Largemouth Bass from Gunlock Reservoir is at levels of public health concern. Additional sampling is needed to further characterize the public health significance of mercury concentrations in Largemouth Bass in this reservoir. Results are found in Table 13.

Strawberry Reservoir

Five Cutthroat Trout from Strawberry Reservoir in 2002 were filleted and analyzed as a composite. Mercury levels in Cutthroat Trout were 0.127 mg/kg. Three Utah Sucker fish from Strawberry Reservoir were homogenized (whole body, non-eviscerated) prior to chemical analysis. The mercury concentration in Utah Sucker was 0.041. The contaminant concentration is

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for the analyzed composite, not individual fish; therefore, the reported value is an average concentration of the contaminant concentrations of all fish in the composite. All values were below the 0.3 mg/kg level of concern. Results are found in Table 13.

Utah Lake

Five White Bass and five Black Bullhead fish were collected from Utah Lake in 2002. White Bass were filleted and Black Bullheads were homogenized prior to composite analysis. Mercury was 0.0696 mg/kg in White Bass; 0.013 mg/kg in Black Bullhead fish. The contaminant concentration is for the analyzed composite, not individual fish; therefore, the reported value is an average concentration of the contaminant concentrations of all fish in the composite. All values were below the 0.3 mg/kg level of concern. Results are found in Table 13.

Yuba Reservoir

Walleye from Yuba Reservoir had an average mercury level of 0.117 mg/kg in 2003. Common Carp samples had an average 0.185 mg/kg. Fish tissue from Yuba Reservoir was analyzed as a composite of multiple fish of each species. Contaminant concentrations are for the analyzed composite, not individual fish, therefore, the reported values are average concentrations of the contaminant concentrations of all fish in the composite. All values were below the 0.3 mg/kg level of concern. Results are found in Table 13.

Cutler Reservoir

Walleye from Cutler Reservoir had an average mercury level of 0.113 mg/kg in 2003. Channel Catfish samples had an average of 0.127 mg/kg. Fish tissue from Cutler Reservoir was analyzed as a composite of multiple fish of each species. Contaminant concentrations are for the analyzed composite, not individual fish, therefore, the reported values are average concentrations of the contaminant concentrations of all fish in the composite. All values were below the 0.3 mg/kg level of concern. Results are found in Table 13.

2005 Confirmation Sampling

Data from 1990-2003 suggested that several sites (Mill Creek, Moab; Lake Powell; East Canyon Reservoir; and Gunlock Reservoir) might have fish with elevated mercury concentrations. Sites that had fish with mercury concentrations above 0.3 mg/kg were reevaluated in 2005. Mercury analysis for fish caught and analyzed in 2005 was performed on individual fish fillets, not composites. The Division of Water Quality collected the fish samples in 2005. Results are shown in Table 14.

Mill Creek, Moab

Five Brown Trout from Mill Creek in Grand County near Moab, Utah were collected and individual fish fillets were analyzed for mercury. The Brown Trout averaged 0.33 mg/kg

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mercury with a range of 0.09-0.63 mg/kg. The mean concentration was slightly above the EPA screening value of 0.3 mg/kg. Concentrations of mercury in Brown Trout from Mill Creek are above levels of public health concern.

Rock Canyon, Lake Powell

Five Striped Bass were collected from Rock Canyon, Lake Powell in Kane County. Fish fillets averaged 0.32 mg/kg with a range of 0.10-0.57 mg/kg. The mean concentration was slightly above the EPA screening value of 0.3 mg/kg. Concentrations of mercury in Striped Bass from Rock Canyon are above levels of public health concern. Location of the sampling sites is shown in Figure 6.

Navajo Canyon, Lake Powell

Five Striped Bass were caught from Navajo Canyon, Lake Powell in Coconino County, Arizona. Fish fillets averaged 0.22 mg/kg with a range of 0.13-0.36 mg/kg. The mean value was below the screening value of 0.3 mg/kg, however the high value exceeded the SV. These results are slightly higher than the 1991-1994 sampling data where two Striped Bass had an average mercury level of 0.14 mg/kg with a range of 0.12 to 0.15 mg/kg. Since one value exceeded the SV of 0.3 mg/kg, the level of public health concern, eating Striped Bass from Navajo Canyon is an indeterminate public health hazard. Additional sampling at this site is needed to adequately characterize the potential public health hazard from eating fish from this area of Lake Powell. Location of the sampling site is shown in Figure 6.

East Canyon Reservoir

Eleven Rainbow Trout were caught from East Canyon Reservoir in Morgan County. Fish fillet mercury concentrations averaged 0.08 mg/kg with a range of 0.02-0.16 mg/kg. None of the samples exceeded the EPA screening value and therefore the concentrations of mercury in Rainbow Trout from East Canyon Reservoir are not at levels of public health concern.

Gunlock Reservoir

Three Bluegill and eight Largemouth Bass were collected from Gunlock Reservoir. Mercury analysis for fish collected from Gunlock Reservoir was performed on individual fish fillets. Bluegill from Gunlock Reservoir in Washington County had an average mercury concentration of 0.20 mg/kg with a range of 0.11-0.26 mg/kg. The Largemouth Bass averaged 0.47 mg/kg with a range of 0.22-0.95 mg/kg. None of the Bluegill exceeded the screening value. The mean concentration in Largemouth Bass exceeded the EPA screening value of 0.3 mg/kg. The concentrations of mercury in Largemouth Bass from Gunlock Reservoir are at levels of public health concern.

Discussion

To determine whether people are exposed to contaminants related to a site, ATSDR evaluates the environmental and human components that lead to human exposure. This exposure pathways analysis consists of five elements and can be completed or potential. The five exposure elements include: (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. In a completed exposure pathway, all five elements exist and indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. Potential exposure pathways require that one of the five elements is missing, but may exist, and indicate that exposure to a contaminant may have occurred in the past, may be occurring, or may occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present [ATSDR 2005].

People consuming Brown Trout from Mill Creek, Striped Bass from Lake Powell, and Largemouth Bass from Gunlock Reservoir are considered completed exposure pathways as all five elements exist and exposures are occurring. Other areas sampled have a completed exposure pathway, but, as the mercury levels do not exceed the screening level, fish from these areas are not considered to pose a public health risk.

Toxicological Effects of Mercury

In fish tissue, the majority of mercury is methylmercury. The amount of mercury in fish tissue tends to increase with the age and size of the fish. Fish-eating species of fish also accumulate higher concentrations of mercury than non-piscivorous fish [EPA 2000]. Methylmercury is rapidly absorbed from the gastrointestinal tract. The body absorbs about 90 to 100 percent of ingested methylmercury. Methylmercury can be changed by your body to inorganic mercury. Because inorganic mercury does not readily cross the blood brain barrier, conversion of the methylmercury to inorganic mercury in the brain results in the mercury being “trapped” in the brain for a long period of time. When methylmercury does leave your body after you have been exposed, it leaves slowly over a period of several months, mostly as inorganic mercury in the feces. The biological half-life of methylmercury in humans is roughly 50 to 65 days. The half-life is a measure of rate for the time required to eliminate one half of a quantity of a chemical from the body. Some of the methylmercury in a nursing woman's body will pass into her breast milk [ATSDR 1999].

The nervous system is very sensitive to all forms of mercury. In poisoning incidents that occurred in other countries, some people who ate fish contaminated with large amounts of methylmercury or seed grains treated with methylmercury or other organic mercury compounds developed permanent damage to the brain and kidneys. Animals exposed orally to long-term, high levels of methylmercury or phenylmercury in laboratory studies experienced damage to the kidneys, stomach, and large intestine; changes in blood pressure and heart rate; adverse effects on the developing fetus, sperm, and male reproductive organs; and increases in abortions and stillbirths [ATSDR 1999].

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Mercury in fish is highly associated with the muscle tissue, therefore trimming and skinning the fish does not reduce the mercury content of the fillet portion (as with PCBs, dioxins, and pesticides) [ATSDR 1999].

Screening Value for Mercury

Screening Values (SVs) were developed by the U.S. Environmental Protection Agency (EPA) and are used as standards by which levels of contamination can be compared. Screening values are defined as the concentrations of target analytes in fish tissue that are of potential public health concern. Screening values are used to establish the concentration in fish that can trigger further investigation and/or consideration of fish advisories for the waterbodies and species where such concentrations occur [EPA 2000]. Based on an adult body weight of 70 kg and a fish consumption rate of 0.0175 kg fish/day, EPA has calculated a fish tissue residue criterion for mercury to be 0.3 mg methylmercury/kg fish [EPA 2001]. UDOH is unaware of any subsistence fishing populations in the state of Utah.

SVs for mercury were only calculated for non-carcinogenic effects. Mercury and methylmercury are not considered carcinogens. EPA lists mercury as "Not classifiable as to human carcinogenicity" and methylmercury as "Possible human carcinogen (no human, limited animal studies)". Both the National Toxicology Program (NTP) and the International Agency for Research on Cancer list mercury as "not classified" with respect to carcinogenicity. NTP also lists methylmercury as "not classified".

Based on the confirmation sampling of fish filets conducted in July 2005, average concentrations of mercury exceed the SV value of 0.3 mg/kg at three sites: 0.33 mg/kg in Brown Trout from Mill Creek near Moab, 0.47 mg/kg in Largemouth Bass from Gunlock Reservoir and 0.32 mg/kg in Striped Bass from Rock Canyon, Lake Powell.

Several other sites in Lake Powell had average concentrations and individual fish with concentrations above the EPA screening value of 0.3 mg/kg based on analytical results from 1991-1994. Those sites included: Striped Bass from Cha Canyon, Striped Bass from the Colorado River, Striped Bass from Dangling Rope, Striped Bass from Dirty Devil, Striped Bass and Largemouth Bass from the Escalante Arm, Striped Bass from Narrow Canyon, Smallmouth Bass from Wahweep, and Striped Bass from Zahn Bay. For these sites the sample size was small (two or three fish), which limits the conclusions that can be made from the data. This sampling identifies areas in Lake Powell where mercury contaminant levels in Striped Bass are high enough to warrant further investigation.

Limitations

Although individual fish from multiple waterbodies in Utah exceed the SV for mercury, the fish sampling study design for data prior to 2005 was considered insufficient to support fish advisories. In some cases sample size was too small and limited to one or two species per site;

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samples were not consistently analyzed as fillets (and in some cases, the method is unknown); and the quality assurance and quality control of the data is unknown. For one study, a complete set of wet weight mercury values could not be calculated. These issues have been addressed for fish sampled in 2005.

Consumption Limits

When SVs are exceeded, consumption limits can be estimated to determine how many meals of fish can be safely consumed each month [EPA 2000]. Consumption limits do not apply to levels that do not exceed the SV. Calculations are based on an adult body weight of 70 kg with a meal size of 227 g fish and a child body weight of 16 kg with a meal size of 113 g fish (Appendix A).

Mill Creek

Based on an average mercury concentration of 0.33 mg/kg in Brown Trout, adults can safely eat 3 eight ounce meals per month, and pregnant women, women that may become pregnant or are breast feeding and young children can eat 1 four ounce meal per month of Brown Trout from Mill Creek near Moab, Utah.

Gunlock Reservoir

Based on an average mercury concentration of 0.47 mg/kg in Largemouth Bass, adults can safely eat 2 eight-ounce meals per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 four-ounce meal per month of Largemouth Bass from Gunlock Reservoir.

National Fish Advisory

The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to only eat fish and shellfish that are lower in mercury [EPA 2004]. The types of fish to avoid include Shark, Swordfish, King Mackerel or Tilefish because they contain high levels of mercury. Up to 12 ounces (2 average meals) a week of a variety of fish and shellfish can be eaten that are lower in mercury. The most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock and Catfish. Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. Up to 6 ounces (one average meal) of albacore tuna can be eaten per week.

Children's Health Considerations

The Agency of Toxic Substances and Disease Registry recognizes the unique vulnerabilities of infants and children to environmental contaminants. Children are less developed and may have developmental harm from exposure that would not be experienced by a completely developed adult. The developing body systems of children can sustain permanent damage if toxic exposures

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occur during critical growth stages. Children's health was considered as a part of this health consultation.

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also pass to a nursing infant through breast milk. However, the benefits of breast-feeding may be greater than the possible adverse effects of mercury in breast milk. Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage [ATSDR 1999].

Methylmercury that is in the blood of a pregnant woman will easily move into the blood of the developing child and then into the child's brain and other tissues. Like metallic mercury, methylmercury can be changed by the body to inorganic mercury. Inorganic mercury can remain in the body for a long time. Short-term, high-level exposure of laboratory animals to inorganic mercury has been shown to affect the developing fetus and may cause termination of the pregnancy [ATSDR 1999]. Due to the possible health effects from mercury on the fetus, pregnant women should follow the consumption limits assigned to children.

Conclusions

Mean mercury concentrations in fish exceeded the EPA screening value of 0.3 mg/kg in Brown Trout from Mill Creek, Striped Bass from Lake Powell, Trout from East Canyon Reservoir, and Largemouth Bass from Gunlock Reservoir. However, confirmation sampling in 2005 for East Canyon Reservoir showed that none of the eleven Rainbow Trout sampled had mercury concentrations above the EPA screening value.

Consumption of Largemouth Bass and Brown Trout from Gunlock Reservoir, and Mill Creek respectively, above the consumption advisory limits is considered a public health hazard based on concentrations of mercury in these species of fish. Concentrations of mercury in these fish are at levels that may result in a risk of increased adverse health effects if consumed above the consumption limit. Based on higher fish consumption rates, the potential for adverse health effects is higher for those consuming fish at a subsistence level. The EEP is not aware of people using these sites for subsistence fishing. Based on the nature of the contaminant, it is highly likely that exposure has occurred, continues to occur, and will exist in the future for those people that catch and consume fish from these waterbodies. The route of exposure is through ingestion of contaminated fish.

Based on the average mercury concentration of 0.33 mg/kg, consumption of Brown Trout from Mill Creek near Moab should be limited to 3 eight-ounce meals per month for adults and to 1 four-ounce meal per month for pregnant women, women that may become pregnant or are breast feeding and young children.

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Based on the average mercury concentration of 0.47 mg/kg, consumption of Largemouth Bass from Gunlock Reservoir should be limited to 2 eight-ounce meals per month for adults and 1 four-ounce meal per month for pregnant women, women that may become pregnant or are breast feeding and young children.

The public health hazard for consuming Striped Bass from Lake Powell is indeterminate at this time. UDEQ plans on further sampling in various areas of Lake Powell in 2006 with the intent of determining which regions of the lake may pose a hazard due to mercury contamination.

Other than Mill Creek, Gunlock Reservoir, and Lake Powell, the fish from other lakes and streams sampled in this report pose no public health hazard with respect to mercury contamination. A summary of sites, fish species sampled, and health hazard category is found in Table 15.

Recommendations

EEP has recommended fish advisories for Brown Trout from Mill Creek and Largemouth Bass from Gunlock Reservoir. Consumption of Brown Trout from Mill Creek should be limited to three 8-ounce meals per month for adults and one 4-ounce meal per month for children and pregnant women. Consumption of Largemouth Bass from Gunlock Reservoir should be limited to two 8-ounce meals per month for adults and one 4-ounce meal per month for children and pregnant women.

Additional sampling of fish for mercury in those waterbodies with fish samples that exceeded 0.3 mg/kg mercury should be conducted to delineate the extent of the mercury contamination in the fish. Sampling should include multiple species of game fish. Fillets from individual fish from sites in Lake Powell, and Green River (Desolation Canyon) also had elevated levels of mercury, however, the average concentration of mercury in fish sampled from these locations was below the EPA screening value of 0.3 mg/kg. Additional sampling of fish from these sites is needed to characterize the mercury concentration in fish from these areas.

Since the average mercury concentration of 0.32 mg/kg in Striped Bass sampled in July 2005 from Rock Canyon in Lake Powell exceeded the EPA screening value of 0.3 mg/kg, additional fish sampling should be conducted throughout Lake Powell to adequately characterize the mercury levels in Striped Bass. The mean mercury concentration in Striped Bass collected in 2005 from Navajo Canyon in Lake Powell was only 0.22 mg/kg, and the mean concentration of mercury in Striped Bass collected from Lake Powell during 1991-1994 was 0.18 mg/kg, below the screening value.

Priority sites for confirmation sampling in Striped Bass in Lake Powell should be those areas where the mercury in fish exceeded the EPA screening value of 0.3 mg/kg. Those sites include: Cha Canyon, Colorado River, Dangling Rope, Dirty Devil, Escalante Arm, Wahweap, and Zahn Bay.

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Additional sampling for mercury levels in fish from lakes, rivers, and streams in Utah not previously sampled should be conducted to assess the extent of mercury levels in Utah fish. A high priority should be given to those areas that are most heavily fished.

Public Health Action Plan

The Environmental Epidemiology Program of the Utah Department of Health will continue to work with the Utah Department of Environmental Quality, the Utah Division of Wildlife Resources and local health departments on the development of fish sampling and monitoring plans for Utah. A press release and fact sheet will be prepared to inform the public of the fish consumption advisories. A copy of this Health Consultation and fish advisories will be posted on the EEP web site.

The EEP will continue to work with all applicable agencies to perform additional research on mercury and other chemical contaminants in fish in Utah. The EEP will adjust recommendations as new information becomes available.

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Certification

This Health Consultation, An Evaluation of Mercury Concentrations in Fish From Rivers and Lakes in Utah for Years 1990-2005, was prepared by the Utah Department of Health, Environmental Epidemiology Program under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health consultation was initiated.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

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Figures and Tables

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Figure 1. Location of fish sampling sites from 1990-1999.



- | | | |
|--------------------------|----------------------|-------------------------------|
| 1: Cub River | 8: Lake Powell | 14: Price River |
| 2: Weber River | 9,10: Colorado River | 15: Great Salt Lake wetlands |
| 3,4,5: Bear River | 11: Yampa River | 16: American Fork, North Fork |
| 6: Jordanelle Reservoir | 12: White River | |
| 7: East Canyon Reservoir | 13: Duchesne River | |

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Figure 2. Location of Lake Powell fish sampling sites from 1991-1994.



- | | |
|-------------------|-------------------|
| 1: Bullfrog Bay | 8: Hite Marina |
| 2: Cha Canyon | 9: Narrow Canyon |
| 3: Colorado River | 10: Navajo Canyon |
| 4: Dangling Rope | 11: North Wash |
| 5: Dirty Devil | 12: Oak Canyon |
| 6: Escalante Arm | 13: Wahweap |
| 7: Good Hope Bay | 14: Warm Creek |
| | 15: Zahn Bay |

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Figure 3. Location of fish sampling sites from 2000.



- 1: Uintah River, Duchesne County
- 2: Cottonwood Creek, Garfield County
- 3: Panguitch Creek, Garfield County
- 4: Hill Creek, Grand County

- 5: Francis Canyon Creek, Morgan County
- 6: Weber River, Morgan County
- 7: Burnt Fork Creek, Summit County
- 8: Weber River, Middle Fork, Summit County

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Figure 4. Location of fish sampling sites from 2001.



- | | |
|------------------------------------|--|
| 1: Logan River, Cache County | 5: Sevier River (Mills), Juab County |
| 2: Gordon Creek, Carbon County | 6: Sevier River (Leamington), Millard County |
| 3: Colorado River, Grand County | 7: City Creek, Salt Lake County |
| 4: Mill Creek (Moab), Grand County | 8: Santa Clara River, Washington County |

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Figure 5. Location of fish sampling sites from 2002-2003.



- | | |
|--|--|
| 1: Range Creek, Carbon County | 8: Fremont River, Sevier County |
| 2: Sheep Creek, North Fork, Daggett County | 9: Smiths Fork, East Fork, Summit County |
| 3: Huntington Creek, Lower Fork, Emery County | 10: Smiths Fork, West Fork, Summit County |
| 4: Huntington Creek, North, Emery County | 11: Green River, Desolation Canyon, Uinta County |
| 5: Summit Creek, Iron County | 12: Strawberry River, Wasatch County |
| 6: East Canyon Creek, Morgan County | 13: Santa Clara River, Washington County |
| 7: Sevier River, west of Gunnison, San Pete County | 14: Silver Creek, Summit County |

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Figure 6. Location of fish sampling sites from lakes from 2000-2003.



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Figure 7. Location of fish sampling sites from Lake Powell from 2005.



1: Navajo Canyon, Coconino County, Arizona

2: Rock Canyon, Kane County

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Table 1. Sampling data for fish from the Colorado River and rivers that feed into the Green River, Utah (1996-1997).

Sites	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
<i>Sites along the Colorado River</i>					
Dewey Bridge	Carp	3	0.082	0.057	0.068
Negro Bill Canyon	Carp	3	0.091	0.059	0.080
Atlas - Moab	Carp	3	0.075	ND [†]	NA
<i>Sites above the confluence with the Green River</i>					
Yampa River [†]	Carp	3	0.085	ND [‡]	NA
White River	Carp	2	0.073	0.019	0.046
Duchesne River	Carp	3	0.074	ND [§]	NA
Price River	Carp	2	0.030	0.019	0.024

Fish samples collected by U.S. Fish and Wildlife Service.

* Wet weight concentration.

[†] ND = mercury dry weight was <0.177 ppm, mercury wet weight was not calculated.

[‡] ND = mercury dry weight was <0.0916 ppm, mercury wet weight was not calculated.

[§] ND = mercury dry weight was <0.0925 ppm, mercury wet weight was not calculated.

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Table 2. Sampling data for whole body fish from Great Salt Lake wetlands, Utah (1996-1997).

Sites	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
C7 Ditch	Carp	5	0.085	ND	NA
C7 Ditch	White Bass	1	ND	ND	NA
Goggin Drain	Carp	3	0.046	0.031	0.04
Airport Mitigation	Carp	3	0.080	ND	NA
Oil Drain	Carp	2	0.020	0.015	0.02
Bountiful Pond	Carp	3	ND	ND	NA
State Canal	Carp	3	0.025	0.019	0.02
Crystal Unit	Carp	3	0.060	0.045	0.05
Unit 1 Farm. Bay	Carp	3	ND	ND	NA
Kays Creek	Carp	1	0.035	NA	NA
Howard Slough	Carp	3	ND	ND	NA
Ogden Bay South	Carp	4	0.101	ND	NA

* Wet weight concentration.

ND = mercury dry weight was <0.200 ppm, mercury wet weight was not calculated.
Fish samples collected by U.S. Fish and Wildlife Service.

Table 3. Sampling data for whole body fish from the Bear and Weber rivers, Utah (1998).

Sites	Species	# fish	Mean Mercury Concentration (mg/kg)*
Bear River near Corinne, UT	Carp	5	0.025

* Wet weight concentration.

Fish samples collected by U.S. Geological Survey.

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Table 4. Sampling data for fish filets from the Cub and Weber Rivers, Utah.

Site	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Weber River near Coalville, UT	Mountain Whitefish	5	0.141	0.073	0.11
Cub River near Richmond, UT	Largemouth Bass	2	0.271	NA	NA

Fish samples collected by U.S. Bureau of Reclamation.

* Wet weight concentration.

Table 5. Sampling data for fish from American Fork, North Fork, Utah County (1999).

Site	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Below Tibble Fork Reservoir	Brown Trout	4	0.078	0.040	0.055
Above Tibble Fork Reservoir	Brown Trout	4	0.068	0.050	0.059
Above Major Evans Gulch	Cutthroat Trout	4	0.062	0.029	0.043
Below Pacific Mine	Cutthroat and Rainbow Trout	4	0.087	0.052	0.068
Above Pacific Mine	Cutthroat, Rainbow, and hybrid Trout	4	0.064	0.031	0.045

* Wet weight concentration.

Fish samples collected by personnel from the Uinta National Forest. It is not known if samples are whole fish or filets.

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Table 6. Sampling data for fish from 2000.

Species	# fish	Mercury Concentration (mg/kg)*		
		high	low	mean
<i>Uintah River, Duchesne County</i>				
Mountain Sucker	2	0.193	0.136	0.16
Brown Trout	2	0.151	0.097	0.12
Rainbow Trout	1	0.148	NA	NA
<i>Cottonwood Creek, Garfield County</i>				
Cutthroat Trout	5	0.096	0.064	0.08
<i>Panguitch Creek, Garfield County</i>				
Brown Trout	5	0.063	0.027	0.04
<i>Hill Creek, Grand County</i>				
Brook Trout	4	0.031	0.022	0.03
Mountain Sucker	1	0.081	NA	NA
<i>Francis Canyon Creek, Morgan</i>				
Mountain Sucker	5	0.024	0.011	0.02
<i>Weber River, Morgan County</i>				
Mountain Whitefish	6	0.130	0.072	0.09
Utah Sucker	2	0.055	0.037	0.05
Brown Trout	7	0.098	0.052	0.08
Mountain Sucker	3	0.137	0.077	0.10
<i>Burnt Fork Creek, Summit County</i>				
Cutthroat Trout	5	0.172	0.048	0.09
<i>Weber River, Middle Fork, Summit County</i>				
Brook Trout	2	0.029	0.027	0.03
Cutthroat Trout	3	0.035	0.022	0.03

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality. It is not known if samples were whole fish or fillets.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 7. Sampling data for fish from 2001.

Species	# fish	Mercury Concentration (mg/kg)*		
		high	low	mean
<i>Logan River, Cache County</i>				
Brown Trout	3	0.026	0.014	0.02
<i>Gordon Creek, Carbon County</i>				
Tiger Trout	3	0.022	0.020	0.02
<i>Colorado River, Grand County</i>				
Channel Catfish	4	0.171	0.056	0.12
Yellow Bullhead	3	0.043	0.033	0.04
<i>Mill Creek, Grand County</i>				
Brown Trout	2	0.391	0.372	0.38
<i>Sevier River, Juab County</i>				
Utah Sucker	1	0.033	NA	NA
<i>Sevier River, Millard County</i>				
Utah Sucker	3	0.066	0.043	0.05
<i>City Creek, Salt Lake County</i>				
Brown Trout	3	0.049	0.033	0.04
<i>Santa Clara River, Washington County</i>				
Desert Sucker	2	0.110	0.107	0.11

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality. It is not known if samples were whole fish or fillets.

Results in bold exceed SV for mercury.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 8. Sampling data for fish from 2002.

Species	# fish	Mercury Concentration (mg/kg)*		
		high	low	mean
<i>Range Creek, Carbon County</i>				
Brown Trout	3	0.028	0.016	0.02
<i>Sheep Creek, North Fork, Daggett County</i>				
Cutthroat Trout	3	0.177	0.124	0.15
<i>Huntington Creek, Lower Fork, Emery County</i>				
Brown Trout	3	0.062	0.050	0.06
Cutthroat Trout	2	0.054	0.049	0.05
<i>Huntington Creek, North, Emery County</i>				
Brown Trout	3	0.051	0.040	0.04
<i>Summit Creek, Iron County</i>				
Rainbow Trout	3	0.149	0.064	0.10
<i>East Canyon Creek, Morgan County</i>				
Brown Trout	6	0.142	0.081	0.11
Rainbow Trout	4	0.225	0.088	0.12
<i>Sevier River, San Pete County</i>				
Mountain Sucker	1	0.139	NA	NA
<i>Fremont River, Sevier County</i>				
Brown Trout	3	0.041	0.027	0.04
<i>Smiths Fork, East Fork, Summit County</i>				
Brook Trout	3	0.084	0.048	0.06
<i>Smiths Fork, West Fork, Summit County</i>				
Brook Trout	4	0.103	0.048	0.06
Mountain Whitefish	1	0.160	NA	NA
<i>Green River, Desolation Canyon, Uintah County</i>				
Channel Catfish	3	0.307	0.128	0.24
Smallmouth Bass	3	0.148	0.127	0.14
Common Carp	3	0.114	0.110	0.11
<i>Strawberry River, Wasatch County</i>				
Brown Trout	3	0.051	0.018	0.04
<i>Santa Clara River, Washington County</i>				
Brown Trout	3	0.074	0.026	0.06
Largemouth Bass	2	0.151	0.087	0.12
Desert Sucker	3	0.070	0.042	0.06

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality. It is not known if samples were whole fish or fillets.

Results in bold exceed SV for mercury

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 9. Sampling data for fish from 2003.

Site	County	Species	# fish	Mercury Concentration (mg/kg)*		
				high	low	mean
Silver Creek	Summit	Brown Trout	5	0.069	0.035	0.06
Silver Creek	Summit	Cutthroat Trout	13	0.105	0.046	0.08
Silver Creek	Summit	Rainbow Trout	1	0.027	NA	NA

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality fillets were submitted for analysis.

Table 10. Sampling data for fish from the East Canyon Reservoir, Utah (1990).

Species	Body Part	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Kokanee	Whole body	2	0.224	0.174	0.20
Trout	Whole body	3	0.910	0.100	0.39
Sucker	Whole body	2	0.265	0.019	0.14
Kokanee	Edible tissue	1	0.162	NA	NA
Trout	Edible tissue	4	0.410	0.132	0.23

* Wet weight concentration.

Fish samples collected by U.S. Bureau of Reclamation.

Results in bold exceed SV for mercury.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 11. Sampling data for fish fillets from Lake Powell, Utah (1991-1994).

Sites	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Bullfrog Bay	Largemouth Bass	3	0.14	0.09	0.12
Cha Canyon	Largemouth Bass	1	0.20	NA	NA
Dangling Rope	Largemouth Bass	1	0.14	NA	NA
Dirty Devil	Largemouth Bass	2	0.20	0.07	0.14
Escalante Arm	Largemouth Bass	2	0.32	0.11	0.22
North Wash	Largemouth Bass	1	0.12	NA	NA
Oak Canyon	Largemouth Bass	2	0.15	0.10	0.13
Zahn Bay	Largemouth Bass	1	0.12	NA	NA
Bullfrog Bay	Smallmouth Bass	2	0.15	0.10	0.13
Cha Canyon	Smallmouth Bass	1	0.17	NA	NA
Good Hope Bay	Smallmouth Bass	2	0.06	0.02	0.04
Hite Marina	Smallmouth Bass	1	0.07	NA	NA
Navajo Canyon	Smallmouth Bass	2	0.17	0.10	0.14
Wahweap	Smallmouth Bass	2	0.31	0.13	0.22
Warm Creek	Smallmouth Bass	2	0.17	0.14	0.16
Zahn Bay	Smallmouth Bass	2	0.27	0.13	0.20
Bullfrog Bay	Striped Bass	3	0.26	0.06	0.14
Cha Canyon	Striped Bass	2	0.89	0.12	0.51
Colorado River	Striped Bass	2	0.32	0.16	0.24
Dangling Rope	Striped Bass	1	0.32	NA	NA
Dirty Devil	Striped Bass	1	0.41	NA	NA
Escalante Arm	Striped Bass	2	0.73	0.33	0.53
Good Hope Bay	Striped Bass	2	0.06	0.06	0.06
Hite Marina	Striped Bass	1	0.04	NA	NA
Narrow Canyon	Striped Bass	1	0.27	NA	NA
Navajo Canyon	Striped Bass	2	0.15	0.12	0.14
Oak Canyon	Striped Bass	1	0.17	NA	NA
Wahweap	Striped Bass	1	0.07	NA	NA
Warm Creek	Striped Bass	2	0.13	0.10	0.12
Zahn Bay	Striped Bass	3	0.54	0.23	0.39

* Wet weight concentration.

Fish samples collected by U.S. Fish and Wildlife Service and fillets were analyzed.

Results in bold exceed SV for mercury.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 12. Sampling data for fish from the Jordanelle Reservoir, Utah (1995).

Whole Body					
Sites	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Provo River arm, Drain tunnel, Ontario tunnel	Rainbow Trout	7	0.247	0.076	0.16
Eviscerated Fish					
Sites	Species	# fish	Mercury Concentration (mg/kg)*		
			high	low	mean
Provo River arm, Ross Creek, Tunnel Creek, Bone Hollow, Ontario tunnel	Rainbow Trout	19	0.189	0.133	0.16

* Wet weight concentration. Fish samples collected by U.S. Geological Survey.

Table 13. Sampling data for fish from Utah lakes 2000-2003.

Site	County	Year	Species	n	Mean Mercury Concentration (mg/kg)*
Cutler Reservoir	Cache	2003	Channel Catfish	4	0.127
Cutler Reservoir	Cache	2003	Walleye	3	0.113
Yuba Reservoir	San Pete	2003	Common Carp	5	0.185
Yuba Reservoir	San Pete	2003	Walleye	3	0.117
Utah Lake	Utah	2002	Black Bullhead	5 [†]	0.013
Utah Lake	Utah	2002	White Bass	5 [‡]	0.0696
Strawberry Reservoir	Wasatch	2002	Utah Sucker	3 [†]	0.041
Strawberry Reservoir	Wasatch	2002	Cutthroat Trout	5 [‡]	0.127
Gunlock Reservoir	Washington	2000	Channel Catfish	3 [†]	0.284
Gunlock Reservoir	Washington	2000	Largemouth Bass	5 [‡]	0.324

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality.
Results in bold exceed SV for mercury.

[†] Whole body fish were homogenized and analyzed as a composite.

[‡] Fish fillets were homogenized and analyzed as a composite.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 14. Sampling data for fish from Utah lakes and rivers 2005.

Site	County	Species	n	Mercury Concentration (mg/kg)*		
				high	low	mean
Mill Creek	Grand	Brown Trout	5	0.63	0.09	0.33
Rock Canyon, Lake Powell	Kane	Striped Bass	5	0.57	0.10	0.32
Navajo Canyon, Lake Powell	Coconino, AZ	Striped Bass	5	0.36	0.13	0.22
East Canyon Reservoir	Morgan	Rainbow Trout	11	0.16	0.02 [†]	0.08
Gunlock Reservoir	Washington	Bluegill	3	0.26	0.11	0.20
Gunlock Reservoir	Washington	Largemouth Bass	8	0.95	0.22	0.47

* Wet weight concentration.

Fish samples collected by the Utah Department of Environmental Quality. Individual fish filets were analyzed for mercury.

Results in bold exceed SV for mercury.

[†] Undetected, value is one-half the detection limit.

Mercury Concentrations in Fish
In Utah 1990 - 2005

Table 15. Summary of health hazards from sampled Utah rivers and lakes.

Site	Species	Health Hazard Category	Recommended Consumption Limits	
			Adults (8 oz meals/month)	Pregnant Women and Children (4 oz meals/month)
Gunlock Reservoir	Largemouth Bass	Public Health Hazard	2	1
Mill Creek	Brown Trout	Public Health Hazard	3	1
Lake Powell	Striped Bass	Indeterminate Health Hazard	NA	
Gunlock Reservoir	Channel Catfish	No Public Health Hazard	NA	
Lake Powell	Largemouth and Smallmouth Bass	No Public Health Hazard	NA	
Cutler Reservoir	Channel Catfish, Walleye	No Public Health Hazard	NA	
East Canyon Reservoir	Kokanee, Sucker, Rainbow Trout	No Public Health Hazard	NA	
Jordanelle Reservoir	Rainbow Trout	No Public Health Hazard	NA	
Strawberry Reservoir	Utah Sucker, Cutthroat Trout	No Public Health Hazard	NA	
Utah Lake	Black Bullhead, White Bass	No Public Health Hazard	NA	
Yuba Reservoir	Common Carp, Walleye	No Public Health Hazard	NA	
American Fork, North Fork	Brown, Cutthroat, and Rainbow Trout	No Public Health Hazard	NA	
Bear River	Carp	No Public Health Hazard	NA	
Burnt Fork Creek	Cutthroat Trout	No Public Health Hazard	NA	

Mercury Concentrations in Fish
In Utah 1990 - 2005

			Recommended Consumption Limits
City Creek	Brown Trout	No Public Health Hazard	NA
Colorado River	Carp, Channel Catfish, Yellow Bullhead	No Public Health Hazard	NA
Cottonwood Creek	Rainbow Trout	No Public Health Hazard	NA
Cub River	Largemouth Bass	No Public Health Hazard	NA
East Canyon Creek	Brown and Rainbow Trout	No Public Health Hazard	NA
Francis Canyon Creek	Mountain Sucker	No Public Health Hazard	NA
Fremont River	Brown Trout	No Public Health Hazard	NA
Gordon Creek	Tiger Trout	No Public Health Hazard	NA
Great Salt Lake Wetlands	Carp	No Public Health Hazard	NA
Green River, Desolation Canyon	Channel Catfish, Smallmouth Bass, Common Carp	No Public Health Hazard	NA
Hill Creek	Brook Trout, Mountain Sucker	No Public Health Hazard	NA
Huntington Creek, Lower Fork	Brown and Cutthroat Trout	No Public Health Hazard	NA
Huntington Creek, North	Brown Trout	No Public Health Hazard	NA
Logan River	Brown Trout	No Public Health Hazard	NA
Panguitch Creek	Brown Trout	No Public Health Hazard	NA
Range Creek	Brown Trout	No Public Health Hazard	NA
Santa Clara River	Desert Sucker, Brown Trout, Largemouth Bass	No Public Health Hazard	NA

Mercury Concentrations in Fish
In Utah 1990 - 2005

			Recommended Consumption Limits
Sevier River	Utah and Mountain Sucker	No Public Health Hazard	NA
Sheep Creek, North Fork	Cutthroat Trout	No Public Health Hazard	NA
Silver Creek	Brown, Cutthroat, and Rainbow Trout	No Public Health Hazard	NA
Smiths Fork, East Fork	Brook Trout	No Public Health Hazard	NA
Smiths Fork, West Fork	Brook Trout, Mountain Whitefish	No Public Health Hazard	NA
Strawberry River	Brown Trout	No Public Health Hazard	NA
Summit Creek	Rainbow Trout	No Public Health Hazard	NA
Uintah River	Mountain Sucker, Brown and Rainbow Trout	No Public Health Hazard	NA
Weber River	Mountain Whitefish, Utah Sucker, Brown Trout, Mountain Sucker	No Public Health Hazard	NA
Weber River, Middle Fork	Brook and Cutthroat Trout	No Public Health Hazard	NA
Yampa, White, Duchesne, Price Rivers	Carp	No Public Health Hazard	NA

Mercury Concentrations in Fish
In Utah 1990 - 2005

Appendix

Consumption Limit Calculations

Consumption Rate Calculations for Noncarcinogenic Health Effects

To calculate the maximum allowable fish consumption rate for a non-carcinogen:

$$CR_{lim} = [(RfD)(BW)]/C_m$$

Where:

CR_{lim} = maximum allowable fish consumption rate (kg/day)

RfD = 0.0001 mg/kg/day

BW = mean body weight of the general population or sub-population of concern (kg)

C_m = measured concentration of chemical contaminant in a given species of fish (mg/kg)

$$CR_{mm} = [(CR_{lim})(T_{ap})]/MS$$

Where:

CR_{mm} = maximum allowable fish consumption rate (meals/month)

CR_{lim} = as calculated above

T_{ap} = time averaging period (365.25 days/12 months = 30.44 days per month)

MS = meal size (0.227 kg fish/meal for adults, 0.113 kg fish/meal for children)

Assumptions for Consumption Rate Calculations are as follows:

An average adult weighs 70 kg and eats 227 g (8 ounces) of fish per meal.

An average child weighs 16 kg and eats 113 g (4 ounces) of fish per meal.