

Health Consultation

AN EVALUATION OF CONTAMINANT CONCENTRATIONS IN FISH
FROM STRAWBERRY RESERVOIR FOR 2002

STRAWBERRY RESERVOIR, WASATCH COUNTY, UTAH

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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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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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STRAWBERRY RESERVOIR, WASATCH COUNTY, UTAH

Prepared by:

Utah Department of Health
Office of Epidemiology
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Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Background and Statement of Issues

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 2004a). 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. The Division of Water Quality requested that the Environmental Epidemiology Program (EEP) review the fish sampling data from fish sampled from Utah lakes and reservoirs. Strawberry Reservoir was one of the reservoirs selected for sampling as part of this national study.

Strawberry Reservoir has a surface area of 17,200 acres. Strawberry Reservoir is located in Wasatch County, Utah and is easily accessible to both metropolitan areas of Salt Lake City and Provo. The reservoir has several camping and boating facilities and is one of the most heavily utilized fisheries in the state. Strawberry Reservoir is open for year-round fishing with the dominant species including: rainbow trout, cutthroat trout, and kokanee salmon.

Fish from Strawberry Reservoir have been collected and analyzed for chemical contaminants. Fish were analyzed for a few heavy metals, volatiles, semivolatiles, PCBs, dioxins, and furans. The sampling site is shown in Figure 1. This health consultation is an evaluation of chemical contaminants in fish from Strawberry Reservoir in Wasatch County, Utah covering the year 2002, the most current period of data collection for this site.

Results

All contaminant concentrations are reported as a wet weight concentration in milligrams of contaminant per kg fish tissue (mg/kg). Fish tissue was analyzed as a composite of multiple fish of one 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.

Five cutthroat trout from Strawberry Reservoir were filleted and analyzed as a composite. Mercury, n-hexadecane, eight pesticides, and one chemical from the dioxin/furan group were detected (Table 1). Alpha-BHC levels in cutthroat trout were 0.0084 mg/kg, above the cancer screening value of 0.0064 mg/kg. Three Utah sucker fish from Strawberry Reservoir were homogenized prior to chemical analysis. Mercury, four different pesticides, and three dioxin/furans were detected in Utah sucker fish (Table 2). Non-carcinogen and carcinogen screening values are found in Tables 3 and 4. Dioxin and dioxin-like toxicities are calculated in Table 5.

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 the exposure pathway 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]. Since alpha-BHC levels were elevated in cutthroat trout collected from Strawberry Reservoir, people consuming cutthroat trout from Strawberry Reservoir is considered a potential exposure pathway. Because of the limitations of the sample data, as discussed under limitations, the data is insufficient to eliminate or include the exposure point or exposure route elements. The source of the alpha-BHC is unknown.

While the levels of consumption for Utah sucker from Strawberry Reservoir are not known, the Utah Division of Wildlife Resources considers Utah sucker a species rarely eaten by man [UDWR 2005].

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 can trigger further investigation and/or consideration of fish advisories for the waterbodies and species where such concentrations occur [EPA 2000b].

Carcinogenic Effects

EPA classifies alpha-BHC as a probable human carcinogen (class B2). Long-term oral administration of alpha-BHC to laboratory rodents has been reported to result in liver cancer [ATSDR 2003]. Alpha-BHC, also known as alpha-hexachlorocyclohexane, exceeded the carcinogenic SV for cutthroat trout from Strawberry Reservoir. Alpha-BHC can accumulate in the fatty tissue of fish [ATSDR 2003]. Eating only the fillet portions of fish may reduce consumption of this contaminant.

Limitations

Although cutthroat trout exceeded the cancer SV for alpha-BHC, the fish sampling study design is insufficient to support a fish advisory. The sample size was small and limited to two species, and the quality assurance and quality control of the data is unknown. The preparation of the fish samples will affect the analysis. The analytical result for alpha-BHC was an estimated value. The target analyte alpha-BHC was reported above the method detection limit (MDL), but below the

minimum level (ML) of quantitation and, although the analyte was found using two different columns, the results reported on the two columns differed by a factor of more than two.

Although none of the detected chemicals exceeded the cancer and non-cancer SVs for Utah sucker, the same study design and sampling limitations apply to the contaminant analysis for Utah sucker fish.

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

Conclusions

Cutthroat trout from Strawberry Reservoir exceeded the screening value for alpha-BHC. There are limitations to the usefulness of the data because of the small sample size and the limitations of the quality of the data. Additional fish sampling is needed to determine if alpha-BHC concentrations in cutthroat trout from Strawberry Reservoir are at concentrations of potential public health concern. Due to the limitations of the data quality, consumption of fish from Strawberry Reservoir is considered an indeterminate health hazard.

Recommendations

The Utah Department of Health recommends that additional sampling of cutthroat trout be conducted to further characterize the extent of the concentrations of alpha-BHC in fish from Strawberry Reservoir. Sampling should follow a standard protocol that includes collection of at least five fish of the same species per site. Lab analysis should be standardized such that sample preparation, analysis and QA/QC meet EPA standards. Individual fish fillets should be analyzed instead of composite samples.

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 the Wasatch County Health Department to notify the public of the findings of this health consultation. A copy of this health consultation will be posted on the Environmental Epidemiology Program web site.

The Environmental Epidemiology Program will continue to work with all applicable agencies to perform additional research on alpha-BHC, mercury, PCBs, and other chemical contaminants in

fish in Utah. The Environmental Epidemiology Program will adjust recommendations as new information becomes available.

The Environmental Epidemiology Program will work with the Utah Department of Environmental Quality, Utah Division of Wildlife Resources and the Wasatch County Health Department to monitor fishing at Strawberry Reservoir to identify potential subsistence fisher populations affected by contaminants in fish from Strawberry Reservoir.

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Certification

This Health Consultation, An Evaluation of Contaminant Concentrations in Fish from Strawberry Reservoir for 2002, 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 begun. Editorial review was completed by the Cooperative Agreement partner.

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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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References

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological profile for hexachlorocyclohexanes (HCH). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Public Health Assessment Guidance Manual (Update). January 2005.

Environmental Protection Agency. 2000a. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1. Fish Sampling and Analysis; 3rd ed. Washington. Publication No. EPA 823-B-00-007.

Environmental Protection Agency. 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits; 3rd ed. Washington. Publication No. EPA 823-B-00-008.

Environmental Protection Agency. 2004a. Fact Sheet: 2004 Update. The National Study of Chemical Residues in Lake Fish Tissue. Publication No. EPA-823-F-04-021.
www.epa.gov/waterscience/fishstudy/

Utah Division of Wildlife Resources. 2005. Online.
<http://dwrcdc.nr.utah.gov/rsgis2/Search/Display.asp?FINm=catoarde>

Figures and Tables

Figure 1. Location of sampling site on map of Utah.



Table 1. Sampling data for chemicals detected in cutthroat trout fillet composite samples from Strawberry Reservoir, Utah (2002).

Analyte	Concentration Wet Weight (mg/kg)	Non-Cancer Screening Value (mg/kg)	Cancer Screening Value (mg/kg)	SCC Code [†]
4,-4'-DDE*	0.0020	2.0	0.117	J
alpha-BHC	0.0084	32	0.0064	J, RNF2
beta-BHC	0.0082	2.4	0.022	NA
Dicofol	0.69	1.6	2.5	NCNF
Endosulfan I	0.0024	24	NA	J
Mercury+	0.13	0.3	NA	NA
n-Hexadecane	0.12	NA	NA	J
Pentachloronitrobenzene	0.0017	12	NA	J
Permethrin I	0.028	200	NA	J, RNF2
Total PCBs‡	0.0049	0.08	0.02	J
Trifluralin	0.0066	30	5.2	J, RNF2
2,3,7,8-TCDF	2E-07 (2E-08 TEQ)	4E-06 TEQ	2.56E-07 TEQ	N/A

[†] J = Estimated value; NCNF = Estimated value; the result was not confirmed (either no elution or co-elution on a second column); RNF2 = Estimated value, the results reported on two columns differed by a factor of more than two.

+Based on the chronic oral RfD for methylmercury.

*Based on the RfD for total DDT isomers of DDT, DDE, and DDD [EPA 2000a].

‡ Total PCBs based on the RfD for aroclor 1254.

TEQ = toxic equivalency concentration. There are no EPA Oral Slope Factor values for the following detected chemicals: dicofol, endosulfan I, ethalfluralin, mercury, n-hexadecane, permethrin I, pentachloronitrobenzene, and TEQs.

Table 2. Sampling data for chemicals detected in Utah sucker homogenized composite samples from Strawberry Reservoir, Utah (2002).

Analyte	Concentration Wet Weight (mg/kg)	Non-Cancer Screening Value (mg/kg)	Cancer Screening Value (mg/kg)	SCC Code [†]
4,-4'-DDE*	0.0033	2.0	0.117	NA
Ethalfuralin	0.0066	160	N/A	LOPR, RNF2
Mercury+	0.041	0.3	N/A	NA
Pentachloronitrobenzene	0.0025	12	N/A	NA
Total PCBs‡	0.0073	0.08	0.02	B, J
Trifluralin	0.0060	30	5.2	J, RNF2
1,2,3,4,6,7,8-HPCDD	4E-08 (4E-10 TEQ)	4E-06 TEQ	2.56E-07 TEQ	J
2,3,7,8-TCDD	8E-08 (8E-08 TEQ)	4E-06 TEQ	2.56E-07 TEQ	J
2,3,7,8-TCDF	1E-07 (1E-08 TEQ)	4E-06 TEQ	2.56E-07 TEQ	N/A
TOTAL TEQ	9E-08	4E-06 TEQ	2.56E-07 TEQ	N/A

[†] J = Estimated value; LOPR = Potential low bias, low analyte recovery observed with the OPR sample associated with this result. RNF2 = Estimated value, the results reported on two columns differed by a factor of more than two.

*Based on the RfD for total DDT isomers of DDT, DDE, and DDD [EPA 2000a].

‡ Total PCBs based on the RfD for aroclor 1254.

+Based on the chronic oral RfD for methylmercury.

TEQ = toxic equivalency concentration. There are no EPA Oral Slope Factor values for the following detected chemicals: ethalfuralin, mercury, pentachloronitrobenzene, and TEQs.

Table 3. Non-carcinogen screening value calculations for chemicals detected.

Analyte	MRL/RfD (mg/kg/day)	Source	Screening Value (mg/kg)
alpha-BHC	0.008	Chronic Oral MRL	32
beta-BHC	0.0006	Intermediate Oral MRL	2.4
Dicofol	0.0004	EPA RfD	1.6
Endosulfan I	0.006	EPA RfD	24
Ethalfuralin	0.04	EPA RfD	160
Mercury*	0.0001	EPA RfD	0.3
Pentachloronitrobenzene	0.003	EPA RfD	12
Permethrin I	0.05	Intermediate Oral MRL	200
Trifluralin	0.0075	EPA RfD	30
Total DDTs†	0.0005	EPA RfD	2.0
Total PCBs‡	0.00002	EPA RfD	0.08
Total TEQs	1E-09	Chronic Oral MRL	4E-06

MRL = Minimal Risk Level, RfD = Reference Dose

Health guidelines are not available for n-hexadecane.

SVs based on body weights and fish consumption rates as described in Appendix A.

* Based on the chronic oral RfD for methylmercury.

† Based on the RfD for total DDT isomers of DDT, DDE, and DDD [EPA 2000a].

‡ Total PCBs based on the RfD for aroclor 1254.

Table 4. Carcinogen screening value calculations for chemicals detected.

Analyte	Oral Slope Factor (mg/kg/day)⁻¹	Screening Value (mg/kg)
alpha-BHC	6.3	0.0064
beta-BHC	1.8	0.022
Dicofol	NA	2.5
Trifluralin	0.0077	5.2
Total DDTs	0.34	0.117
Total PCBs	2	0.02
Total TEQs	156000	2.56E-07

SVs based on body weights and fish consumption rates as described in Appendix A.

There are no EPA Oral Slope Factor values for the following detected chemicals: dicofol, endosulfan I, ethalfluralin, mercury, n-hexadecane, pentachloronitrobenzene, permethrin I, and TEQs.

Table 5. Dioxin and dioxin-like compound toxicities

Trout				
			TEF[‡]	TEQ[‡] (mg/kg)
2,3,7,8-TCDF	2E-07	NA	0.1	2E-08
Total TEQ =				2E-08

Sucker			TEF[‡]	TEQ[‡] (mg/kg)
1,2,3,4,6,7,8-HPCDD	4E-08	J	0.01	4E-10
2,3,7,8-TCDD	8E-08	J	1	8E-08
2,3,7,8-TCDF	1E-07	NA	0.1	1E-08
Total TEQ =				9E-08

[‡] TEF = toxicity equivalency factor; TEQ = toxic equivalency concentration

TEF = toxicity equivalency factor

TEQ = toxic equivalency concentration

TEFs have been assigned to dioxins and dioxin-like compounds in order to compare the relative toxicity of each compound to that of TCDD. Toxicity equivalents (TEQs) are then calculated to assess the risk of exposure to a mixture of dioxin-like compounds. A TEQ is defined as the product of the concentration (C) of an individual compound and the corresponding TCDD toxicity equivalency factor (TEF):

$$\text{TEQ} = (C) * (\text{TEF})$$

The total TEQs is the sum of all TEQs for each of the congeners in a given mixture [ATSDR 1998]. In this health consultation, the total TEQs are used to determine an SV for all dioxins and dioxin-like compounds detected.

Appendix A

Screening Value and Consumption Limit Calculations

For Noncarcinogenic Health Effects

$$SV = [(MRL)(BW)]/CR$$

- SV = Screening value for a contaminant (in mg/kg or ppm)
MRL = Minimal risk level (in mg/kg/day)
BW = Mean body weight of the general population or subpopulation of concern (kg)
CR = Mean daily consumption rate of the species of interest by the general population or by the subpopulation of concern averaged over a 70-yr lifetime (in kg/day)

For Carcinogenic Health Effects

$$SV_c = [(RL/SF)*BW]/CR$$

- SV_c = Screening value for a carcinogen (in mg/kg or ppm)
RL = Maximum acceptable risk level (1/100,000 dimensionless)
SF = Oral slope factor (mg/kg/d)⁻¹
BW = Mean body weight of the general population or subpopulation of concern (kg)
CR = Mean daily consumption rate of the species of interest by the general population or by the subpopulation of concern averaged over a 70-yr lifetime (in kg/day)

Consumption Rate Calculations for Carcinogenic Health Effects

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

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

Where:

- CR_{lim} = maximum allowable fish consumption rate (kg/day)
ARL = maximum acceptable risk level (dimensionless) = 1/100,000
BW = mean body weight of the general population or sub-population of concern (kg)
CSF = oral slope factor (mg/kg/d)⁻¹
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 of fish per meal.

An average child weighs 16 kg and eats 113 g of fish per meal.