QUANTITATIVE RISK CHARACTERIZATION

Mountain Creek Lake

Tarrant County, TX

September 30, 2003

Texas Department of Health
Division of Seafood Safety
Division of Environmental Epidemiology and Toxicology

INTRODUCTION

Background and Statement of the Issues

The Commissioner of Health for the State of Texas issued an order on April 25, 1996 banning possession of fish taken from Mountain Creek Lake in Dallas County, Texas [1]. The order does not prohibit catch-and-release fishing from the lake. This order is enforceable under Texas law and remains in effect. This action was taken because edible fish collected from Mountain Creek Lake in July 1995 contained polychlorinated biphenyls (PCBs), chlordane, heptachlor epoxide, dieldrin, DDD, DDE, and DDT at concentrations that exceeded guidelines utilized by the Texas Department of Health (TDH) to protect the public from deleterious effects of eating fish or shellfish contaminated with environmental pollutants. In August 2002, based upon two small datasets of fish from Mountain Creek Lake collected in 2001 and 2002, the Texas Department of Health (TDH) determined that a full-scale reevaluation of fish from this reservoir was necessary to decide whether consumption of fish from Mountain Creek Lake continues to pose a risk to public health. The present study, funded by the U.S. Navy, evaluated a more complete sample from Mountain Creek Lake to determine the likelihood that consumption of fish from this reservoir continue to pose a hazard to public health. A 1994 survey by the United States Geological Survey (USGS), contracted by the US Navy (USN), showed that people regularly fish Mountain Creek Lake and that fishers were likely to consume channel catfish, common carp, and largemouth bass from the lake [2]. The USGS also examined several composite samples of fish from Mountain Creek Lake in1994. That preliminary examination revealed contaminants at concentrations of concern to TDH, TNRCC (now the Texas Commission on Environmental Quality; TCEQ), and the U.S. Environmental Protection Agency (EPA). In July 1995, after consulting with TDH, TNRCC, EPA, the USN, and other interested parties, the USGS conducted a comprehensive survey of contaminants in largemouth bass, common carp, and channel catfish from Mountain Creek Lake. This investigation showed widespread contamination of fish from Mountain Creek Lake [3], leading to TDH's 1996 ban on possession of fish from the reservoir.

Mountain Creek Lake, a 2,710-acre reservoir impounded in 1937 by damming Mountain Creek, a tributary of the West Fork Trinity River, borders the cities of Grand Prairie and Dallas, Texas near Interstate Highway 20. TXU is the controlling authority for this reservoir, which drains a 46,000-acre watershed also drained by Joe Pool Lake, another reservoir created by damming Mountain Creek. Mountain Creek Lake is turbid and shallow, with an average depth of eight feet and a sparsely vegetated shoreline. The reservoir serves the primary function of supplying cooling water to power-generating plants, but is also a popular destination for fishers and boaters. The public accesses Mountain Creek Lake by way of parks and a boat-launch facility. Extensive development west of the lake has occurred since 1985; runoff to the lake from these areas is primarily of a suburban nature. The Texas Utilities (TXU) power plant, a decommissioned naval air station (NAS), and a naval weapons industrial reserve plant (NWIRP) border the reservoir.

METHODS

Fish Tissue Collection and Analysis

The Texas Department of Health (TDH) collects and analyzes edible fish and shellfish tissues from the state's public waters to evaluate potential health risks to recreational and subsistence fishers and others who consume environmentally contaminated fish or shellfish. These samples usually represent species, trophic levels, and legal-sized specimens available for consumption from the waterbody under investigation. When practical, TDH collects samples from two or more sites within a water body to characterize the geographical distribution of contaminants. The TDH laboratory utilizes established methodology to analyze edible fillets (skin off) of fish and edible meats of shellfish (crab and oyster) for seven metals – arsenic, cadmium, copper, lead, total mercury[1], selenium, and zinc – and for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs- analyzed as Aroclors 1016, 1221, 1224, 1232, 1248, 1254, and 1260).

Description of the Mountain Creek Lake 2003 Sample Set

On April 15, 2003, SSD personnel collected thirty (30) fish from five sites around Mountain Creek Lake (map in Appendix): eleven (11) largemouth bass; eight (8) channel catfish; five (5) common carp; two (2) flathead catfish; two (2) freshwater drum; and two (2) smallmouth buffalo. Sample numbers from different collection sites ranged from two (2) fish at Site 3 to twelve (12) at Site 1. Not all species were collected from all sites. All fish collected for this study conformed to Texas Parks and Wildlife (TPWD) guidelines for legal possession [4].

The TDH laboratory analyzed thirty (30) tissue samples from Mountain Creek Lake for metals, a variety of pesticides, PCBs, and semivolatile organic compounds (SVOCs). The laboratory also analyzed ten (10) of the samples for volatile organic compounds (VOCs). The laboratory performed all requested tests.

Data Analysis

TDH used SPSS statistical software [5] on IBM-compatible microcomputers to generate descriptive statistics (mean, standard deviation, median, range, and minimum and maximum concentrations, geometric mean) for each reported contaminant in each species at each sampling site. TDH used SPSS software for hypothesis testing when appropriate [5]. TDH utilized Microsoft Excel [6] spreadsheets to generate health-based assessment comparison values (HAC values) and to calculate hazard quotients, hazard indices, cancer risk values, and allowable meal consumption for fish from Mountain Creek Lake. All samples were included in the statistical analyses and comparison matrices.

---

[1]Nearly all mercury in upper trophic-level fish over three years of age is methylmercury [17]. Total mercury is a surrogate for methylmercury concentration in fish and shellfish. Because of the cost of methylmercury analyses, USEPA recommends that states determine total mercury concentrations in fish and that – to protect human health – states assume that all mercury in fish or shellfish is methylmercury. TDH analyzes fish and shellfish tissues for total mercury. In its risk characterizations, TDH compares total mercury concentrations in tissues to a comparison value derived from the ATSDR's minimal risk level for methylmercury [18]. TDH may utilize the terms "mercury" and "methylmercury" interchangeably to refer to methylmercury in fish.

Derivation of Health-Based Assessment Comparison Values (HACs)

People regularly consuming environmentally contaminated fish or shellfish generally eat low concentrations of contaminants over an extended time. This exposure pattern seldom results in acute toxicity but may increase the risk of subtle, chronic, or delayed adverse health effects. Presuming that people eat a variety of fish or shellfish, TDH routinely evaluates mean contaminant concentrations across species and locations within a specific water body because this approach best reflects the likely exposure pattern of consumers over time. However, the agency also may examine the risks associated with ingestion of individual species of fish or shellfish from individual collection sites at higher concentrations (e.g., 95^{th} percentile on mean concentrations), should the need arise.

TDH evaluates chemical contaminants in fish by comparing contaminant concentrations with health-based assessment comparison (HAC) values (in mg contaminant per kg edible tissue or mg/kg) for non-cancer and cancer endpoints. To calculate HAC values for either carcinogenic or systemic effects, TDH assumes that a standard adult weighs 70 kilograms and that adults consume 30 grams of fish per day (about one eight-ounce meal per week). TDH uses the U.S. Environmental Protection Agency's (USEPA) oral reference doses (RfDs) [7] or the Agency for Toxic Substances and Disease Registry's (ATSDR) chronic oral minimal risk levels (MRLs) to derive HAC values for evaluating systemic (noncancerous) adverse health effects (HAC_{nonca}) [8]. The USEPA defines a reference dose (RfD) as an "*estimate of long-term daily exposures that is not likely to cause adverse noncancerous (systemic) health effects even if exposure occurs over a lifetime* [9]." TDH compares the measured concentration of each contaminant to its RfD or MRL, producing a Hazard Quotient for the individual contaminant in the samples. A hazard quotient (HQ) is the ratio of the estimated exposure dose of a contaminant to its RfD or MRL [10]. TDH assumes that health effects are unlikely from consumption of fish for which the toxicant – to – RfD ratio is less than 1.0. The cancer risk comparison values (HAC_{ca}) used at TDH to assess carcinogenic potential from consumption of fish containing carcinogenic chemicals are calculated from the USEPA's chemical-specific cancer slope factors (SFs) [7, 11], using standard weights and consumption rates, acceptable lifetime risk levels (ARL) of 1×10^{-4} persons equally exposed to the toxicant, and an exposure period of 30 years.

Most constants employed to calculate noncancer HAC values contain built-in margins of safety (uncertainty factors). Uncertainty factors are chosen to minimize the potential for systemic adverse health effects in those people – including sensitive subpopulations such as women of childbearing age, pregnant or lactating women, infants, children, the elderly, people who have chronic illnesses, those who consume exceptionally large quantities of fish or shellfish – who eat environmentally contaminated fish and shellfish [7]. Although comparison values used for assessing the probability of cancer do not contain "uncertainty" factors as such, conclusions drawn from those probability determinations do have substantial safety margins. Therefore, adverse health effects, either systemic or carcinogenic, are very unlikely to occur at concentrations approaching, or even greater than, comparison values. Moreover, health-based assessment comparison values (HACs) for systemic or carcinogenic effects do not represent a sharp dividing line between safe and unsafe exposures. The strict demarcation between acceptable and unacceptable exposures or risks is primarily a tool used to make management decisions that assure protection of public health. TDH finds it unacceptable when consumption of four or fewer meals per month would result in exposures to any contaminant or contaminants that exceed a HAC value or other measure of risk. TDH further advises people who wish to minimize their exposure to environmental contaminants in fish or shellfish to eat a variety of fish and shellfish and to limit consumption of those species that are most likely to contain environmental toxicants.

Cumulative Effects

When multiple chemicals that affect the same organ or that have the same mechanism of action (systemic or carcinogenic) exist together in one or more samples from a water body, a standard assumption is that potential adverse health effects are cumulative [9]. Therefore, TDH conservatively assumes that each time people eat fish or shellfish from an affected waterbody, those individuals are exposed to all of the chemicals present in any of the samples and, further, that the potential for cumulative adverse systemic or carcinogenic effects will be additive rather than multiplicative (synergistic).

Cumulative Systemic (Noncancerous) Effects

To evaluate the importance of possible cumulative systemic (noncancerous) health effects from consumption of contaminants with similar toxicity profiles, TDH calculates a hazard index (HI) by summing hazard quotients (HQ) initially calculated for each contaminant. A HI of less than 1.0 may suggest that no significant hazard is present for the observed combination of contaminants at the observed concentrations. While a HI that exceeds 1.0 may indicate some level of hazard, it does not imply that exposure to the contaminants at observed concentrations will result in adverse health effects. Nonetheless, finding an HI that exceeds 1.0 may prompt the agency to consider public health intervention strategies.

Cumulative Carcinogenic Effects

To estimate the potential additive effects of multiple carcinogens on excess lifetime cancer risk, TDH sums the risks calculated for each carcinogenic contaminant observed in a sample set. TDH recommends limiting consumption of fish or shellfish containing multiple carcinogenic chemicals to quantities that would result in an estimated combined theoretical excess lifetime cancer risk of not more than 1 extra cancer in 10,000 persons so exposed.

Children's Health Considerations

TDH recognizes that fetuses, infants, and children may be uniquely susceptible to the effects of toxic chemicals and that any such vulnerabilities demand special attention. Windows of vulnerability (i.e., critical periods) exist during development. These critical periods are particularly evident during early gestation, but may also appear throughout pregnancy, infancy, childhood, and adolescence – indeed, at any time during development, when toxicants can permanently impair or alter the structure or function of vulnerable systems [11]. Unique childhood vulnerabilities may result from the fact that, at birth, most organs and body systems have not achieved structural or functional maturity; rather, these organs continue to develop throughout childhood and adolescence. Because of these structural and functional differences, children may differ from adults in absorption, metabolism, storage, and excretion of toxicants, any one of which factors could increase the concentration of biologically effective toxicant at the target organ(s). Children's exposures to toxicants may be more extensive than adult's exposures because children consume more food and liquids in proportion to their body weight than do adults [11], a factor that also may increase the concentration of toxicant at the target. Children can ingest toxicants through breast milk – often unrecognized as an exposure pathway. They may also experience toxic effects at a lower exposure dose than adults due to differences in target organ sensitivity. Stated differently, children could respond more severely than would adults to an equivalent exposure dose [11]. Children may also be more prone to developing certain cancers from chemical exposures than are adults. If a chemical – or a class of chemicals – is more toxic to children than to adults, the RfD or MRL will be commensurately lower to reflect children's potentially greater susceptibility. Additionally, in accordance with ATSDR's *Child Health Initiative* [12] and USEPA's *National Agenda to Protect Children's Health from Environmental Threats* [11], TDH seeks to further protect children from the potential effects of toxicants in fish and shellfish by suggesting that this sensitive group consume smaller quantities of environmentally contaminated fish or shellfish than adults. Therefore, TDH routinely recommends that children who weigh 35 kg or less and/or who are eleven years of age or younger eat no more than four ounces of chemically contaminated fish or shellfish per meal. TDH also recommends that consumers spread these meals out over time. For instance, if the consumption advice recommends eating no more than two meals per month, children consuming fish or shellfish from the affected water body should consume no more than twenty-four meals per year. Ideally, children should not eat such fish or shellfish more than twice per month.

RESULTS

Analytical and Statistical Results

<u>Inorganic or Metalloid Contaminants</u>

The TDH laboratory reported inorganic contaminants in fish from Mountain Creek Lake: arsenic, cadmium, mercury, selenium, and zinc (Table 1). Two samples contained cadmium. Seven contained copper; ten had measurable levels of mercury (0.060±0.012). All samples contained selenium (0.218±0.071) and zinc (4.26±1.68). Three samples contained arsenic, measured as total arsenic (mean = 0.004 mg/kg ±0.014 mg/kg); however, the literature states that most arsenic in fish (±95%) is organic arsenic (i.e., arsenobetaine), a form of arsenic considered by most authorities to be virtually nontoxic to humans [13].

<u>Organic Contaminants</u>

Fish from Mountain Creek Lake contained polychlorinated biphenyls along with the chlorinated organic pesticides chlordane; p,p'-DDD and p,p'-DDE (Table 2). A single sample also contained diazinon at a concentration equal to the laboratory's reporting limit (0.01 mg/kg). Chlordane was found in thirteen (13) of thirty (30) samples; p,p'-DDD in two (2) of thirty (30); p,p'-DDE in ten (10) of thirty (30) samples. Fifteen (15) of thirty (30) samples contained PCBs. All detected PCBs were consistent with the original presence of Aroclor 1260 (Table 3). All species tested – largemouth bass, channel catfish common carp, flathead catfish, freshwater drum, and smallmouth buffalo – contained PCBs, although not all samples of each species contained these contaminants. For instance, one (1) of eleven (11) largemouth bass contained PCBs. It is, however, unusual for TDH to have observed PCBs in largemouth bass. Three (3) of five (5) common carp, one (1) of two (2) flathead catfish, six (6) of eight (8) channel catfish, two (2) of two (2) freshwater drum, and two (2) of two (2) smallmouth buffalo contained PCBs. Average concentrations of PCBs increased in the species as follows: largemouth bass< common carp<flathead catfish<channel catfish<freshwater drum<smallmouth buffalo (Table 2).

DISCUSSION

Risk Characterization

Systemic (Noncancerous) Health Effects from Consumption of Individual Contaminants in Mountain Creek Lake Fish

Inorganic or Metalloid Contaminants

TDH compared average concentration of the metalloid contaminants – copper, cadmium, mercury, selenium, and zinc – in fish from Mountain Creek Lake to the respective HAC_{nonca} value for each of the contaminants. None exceeded its respective HAC_{nonca} value and none exceeded a hazard quotient of 1.0. Thus, consumption of fish containing any one of these metalloid components is unlikely to have any effect on human health. Additionally, copper, selenium, and zinc are essential trace elements that are present in all vertebrates and are necessary for optimum health in humans and other animals.

Organic Contaminants

Fish from Mountain Creek Lake contained p,p'-DDD, p,p'-DDE, chlordane, and PCBs. The hazard quotients for chlordane (0.024), p,p'-DDD (0.004), and p,p'-DDE (0.007) were negligible (Table 3). Therefore, consumption of fish from Mountain Creek Lake that contain chlordane, DDD, or DDE at levels near those observed in samples from this reservoir is not expected to adversely impact human health.

The PCBs identified in fish from Mountain Creek Lake were consistent with the original presence of Aroclor 1260. No reference dose (RfD) is available for Aroclor 1260. Therefore, TDH compared levels of Aroclor 1260 in fish from the reservoir with the HAC_{nonca} derived from the reference dose for Aroclor 1254 – a recognized technique for approximating hazards associated with contaminants for which no RfD exists. Aroclor 1260 is a complex mixture of compounds many of which overlap with the PCB congeners comprising Aroclor 1254. The hazard quotient for PCBs in the thirty fish collected from Mountain Creek Lake in 2003 was 2.57. A hazard quotient that is greater than 1.0 indicates a potential hazard from consuming fish containing PCBs or other contaminants.

Cancer Risk from Consumption of Individual Contaminants in Mountain Creek Lake Fish

Inorganic or Metalloid Contaminants

Some channel catfish and flathead catfish collected in 2003 from Mountain Creek Lake contained arsenic (mean concentration, all samples = 0.0044 mg/kg). The arsenic in these fish was, in all likelihood, organic or "fish arsenic," a form of arsenic considered virtually nontoxic to humans [13]. Although arsenic in fish from Mountain Creek Lake should pose no hazard to human health, TDH computed the excess risk of cancer from consumption of arsenic-containing fish from Mountain Creek Lake because the USEPA and other cancer research organizations classify inorganic arsenic as a human carcinogen (Group A) [7]. Assuming the arsenic in fish from Mountain Creek Lake to be inorganic (an unlikely scenario) and using the average concentration of arsenic in all fish (0.0044 mg/kg), the excess risk of cancer would be about 1 in 824,000 equally exposed persons, an insignificant increase in the lifetime risk of cancer. Using the highest concentration observed (0.05 mg/kg), excess cancers might approach 1 in 72,000 equally exposed persons – a risk qualitatively interpreted as no apparent increase in lifetime cancer risk. Because of these low risk quantifications and because arsenic in fish is – for all intents and purposes, organic arsenic – exposure to arsenic in fish from Mountain Creek Lake is unlikely to increase the rate of cancer. TDH also calculated the excess risk of cancer from eating fish containing cadmium to be 1 in 196,409 equally exposed people. Qualitatively, TDH interprets this as no apparent increase in the lifetime risk of cancer. Cancer potency factors (slope factors) are not available for copper (Group (D), mercury (Group C), selenium (Group D), or zinc (Group D) [7]. Thus, TDH was unable to determine the probability of excess cancers from consuming fish from Mountain Creek Lake that contain copper, mercury, selenium, or zinc. It is also important to note that copper, selenium, and zinc are essential trace elements, necessary for good health.

Organic Contaminants

Fish from Mountain Creek Lake contained organic contaminants considered by the USEPA to be probable human carcinogens (p,p'-DDD, p,p'-DDE, chlordane, and PCBs). Therefore, TDH addressed the probability of cancer from consuming fish from this waterbody containing any one of the observed organic contaminants. The risk of increased numbers of cancers from consumption of fish from the lake containing PCBs was about 1 in 22,700 equally-exposed persons (Table 3), qualitatively interpreted as a low increase in the lifetime risk of cancer. Risk of cancer from eating fish containing p,p'-DDD or p,p'-DDE was less than 1 excess cancer in 1,000,000 people (insignificant risk), while that for chlordane was about 1 in 500,000 equally exposed individuals, interpreted as no apparent increase in the lifetime risk of cancer. The risks calculated for each of these contaminants did not exceed TDH guidelines for protection of public health (1 excess cancer in 10,000 equally-exposed persons).

Cumulative Systemic Adverse Health Effects and Cumulative Cancer Risk from Consumption of Mountain Creek Lake Fish

Metalloid Contaminants

Fish from Mountain Creek Lake contained no metalloid contaminants with the same mechanism of action or that attack the same target organ. Thus, consumption of fish from this reservoir that contain metalloid contaminants is not expected to result in cumulative systemic adverse effects. Cadmium and inorganic arsenic (arsenic in fish is, in all likelihood, organic arsenic) are carcinogens. Therefore, TDH considered likelihood of cancer from the presence of both inorganic contaminants as additive. The cumulative risk of cancer from consuming fish containing cadmium and arsenic did not exceed TDH guidelines for protection of public health (1 excess cancer in 10,000 equally-exposed individuals).

Organic Contaminants

The hazard index for chlordane, p,p'-DDD, p,p'-DDE, chlordane, and PCBs in fish from Mountain Creek Lake, based upon systemic effects observed in experimental animals or human epidemiologic studies, was 2.6, the major portion of which was due to polychlorinated biphenyls (Table 3). Thus, consumption of fish from Mountain Creek Lake could potentially result in an increased risk of systemic adverse health effects in humans.

The cumulative (additive) carcinogenic effects of consuming fish from Mountain Creek Lake that contain chlordane, DDD, DDE, and polychlorinated biphenyls was determined by adding the risks for the individual contaminants. Perusal of Table 3 shows that potential adverse health effects from eating fish containing all observed organic contaminants at concentrations around those observed in fish from Mountain Creek Lake are not much greater than those calculated for fish that contained only polychlorinated biphenyls. The calculated excess risk of cancer from consuming fish from Mountain Creek Lake containing all four contaminants at average concentrations approximating those observed in the 2003 samples is calculated to be approximately 1 in 21,480 equally-exposed individuals (Table 3), a risk that does not exceed TDH's guidelines for public health (1 excess cancer in 10,000 equally-exposed persons). Although risk may be greater than that calculated, TDH interprets these findings to mean that consumption of fish from Mountain Creek Lake should not result in a discernable increase in the lifetime risk of cancer.

Conclusions

TDH toxicologists prepare quantitative risk characterizations to determine public health hazards from consumption of fish and shellfish harvested from Texas waterbodies by recreational or subsistence fishers, and, if indicated, may suggest risk management strategies to TDH risk managers who include the Texas Commissioner of Health.

TDH concludes from the results of the present quantitative risk characterization that fish from Mountain Creek Lake contain PCBs at levels that could result in systemic adverse health outcomes for people who consume those fish regularly or over an extended time. The presence of chlordane, p,p'-DDD, p,p'-DDE or inorganic contaminants is unlikely to contribute significantly to risks from consuming fish from this reservoir.

Public Health Implications

Consumption of fish from Mountain Creek Lake **poses a hazard to human health** due to the continuing presence of polychlorinated biphenyls (PCBs) in multiple fish species collected in 2003 from this reservoir.

Recommendations

TDH risk managers have established criteria for issuing fish consumption advisories based on approaches suggested by the USEPA [14]. When a risk characterization confirms that consumption of four or fewer meals per month (adults: eight ounces per meal; children: four ounces per meal) would result in exposures to toxicants that exceed TDH's health-based guidelines, risk managers may wish to recommend consumption advice for fish from the water body in question. Alternatively, the department may ban possession of fish from the affected water body. Possession bans are enforceable under subchapter D of the Texas Health and Safety Code, part 436.061(a) [15]. Consumption advisories are not enforceable by law and carry no penalties for noncompliance. Rather, TDH formulates consumption advisories to inform the public of health hazards from consuming environmentally contaminated fish or shellfish so that they can make informed decisions about eating environmentally contaminated fish or shellfish. Based on the information in the present risk characterization, the Seafood Safety Division (SSD) and the Environmental Epidemiology and Toxicology Division (EE&TD) of the Texas Department of Health (TDH), find that fish from Mountain Creek Lake contain PCBs and other toxicants that, if consumed, would pose a threat to public health. Therefore, these divisions recommend:

1. That TDH continues to prohibit possession of fish from Mountain Creek Lake because consumption of fish from this reservoir would pose an unacceptable risk of systemic adverse health effects due to contamination with polychlorinated biphenyls.

2. That, as resources allow, TDH continues to monitor fish from Mountain Creek Lake to determine whether and when PCBs levels decline in fish tissue to levels that would allow TDH to lift the ban on possession of fish from Mountain Creek Lake.

Communication of Health Risks from Consumption of Environmentally Contaminated Fish or Shellfish

TDH publishes fish consumption advisories and bans in a booklet available to the public through the Seafood Safety Division: (512-719-0215) [16]. The Seafood Safety Division (SSD) also posts this information on the Internet at URL: http://www.tdh.state.tx.us/bfds/ssd. The SSD regularly updates its web site. Some risk characterizations for water bodies surveyed by the Texas Department of Health may also be available from the Agency for Toxic Substances and Disease Registry (http://www.atsdr.cdc.gov/HAC/PHA/region6.html). The Texas Department of Health provides the U.S. Environmental Protection Agency (URL: http://fish.rti.org), the Texas

Commission on Environmental Quality (TCEQ; URL: http://www.tceq.state.tx.us), and the Texas Parks and Wildlife Department (TPWD; URL: http://www.tpwd.state.tx.us) with information on all consumption advisories and bans on possession. Each year, the TPWD informs the fishing and hunting public of fishing bans in an official hunting and fishing regulations booklet [4], available at some state parks and at establishments that sell fishing licenses.

Readers may direct questions about the scientific information or recommendations in this risk characterization to the Seafood Safety Division (512-719-0215) or the Environmental Epidemiology and Toxicology Division (512-458-7269) at the Texas Department of Health. Toxicological information on a variety of environmental contaminants found in seafood and other environmental media may also be obtained from the Agency for Toxic Substances and Disease Registry (ATSDR), Division of Toxicology, by telephoning that agency at the toll free number (800-447-1544) or from the ATSDR website (URL: http://www.atsdr.cdc.gov).

TABLES

Table 1. Inorganic Contaminants (mg/kg) in fish from Mountain Creek Lake collected in 2003 (N= 30).

Contaminant	# Detected/ # Sampled	Average Concentration ± S.D. (Min-Max)*	Health-based Assessment Comparison Value (HAC)	Basis for Comparison Value†
Arsenic				
Channel catfish	2/8	0.011±0.02 (nd-0.05)	0.362	USEPA Oral Slope Factor: 1.5 per mg/kg – day
Flathead Catfish	1/2	0.023±0.032 (nd-0.045)		
All Species	3/30	0.0044±0.014 (nd-0.05)		
Cadmium				
Largemouth bass	2/11	0.002±0.005 (nd-0.0153)	0.47	ATSDR chronic MRL: 0.0002 mg/kg -day
Copper				
Channel catfish	1/8	0.032±0.089 (nd-0.253)	333	NAS UL: 0.143 mg/kg – day
Common carp	5/5	0.447±0.182 (0.302-0.759)		
Freshwater Drum	1/2	0.135±0.190 (nd-0.269)		
All Species	7/30	0.092±0.187 (nd-0.759)		
Mercury				
Channel catfish	1/8	0.015±0.043 (nd-0.122)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg –day
Common carp	1/5	0.025±0.057 (nd-0.127)		
Largemouth bass	8/11	0.141±0.166 (nd-0.583)		
All Species	10/30	0.0599±0.120 (nd-0.583)		
Selenium				
Channel catfish	8/8	0.152±0.057 (0.0926-0.261)	6	EPA chronic oral RfD: 0.005 mg/kg –day ATSDR chronic oral MRL: 0.005 mg/kg –day NAS UL: 0.400 mg/day (0.005 mg/kg –day)
Common carp	5/5	0.244±0.025 (0.206-0.274)		
Flathead catfish	2/2	0.160±0.018 (0.147-0.172)		
Freshwater Drum	2/2	0.258±0.039 (0.230-0.285)		
Largemouth bass	11/11	0.245±0.072 (0.156-0.434)		
Smallmouth buffalo	2/2	0.288±0.029 (0.267-0.308)		
All Species	30/30	0.218±0.071 (0.093-0.434)		
Zinc				
Channel catfish	8/8	4.36±0.89 (3.20-5.43)	700	EPA chronic oral RfD: 0.3 mg/kg–day ATSDR chronic oral MRL: 0.3 mg/kg–day
Common carp	5/5	6.87±2.53 (5.2-11.3)		
Flathead catfish	2/2	3.65±0.89 (3.02-4.28)		
Freshwater Drum	2/2	2.74±0.67) (2.26-3.21)		
Largemouth bass	11/11	3.63±0.44 (3.13-4.30)		
Smallmouth buffalo	2/2	2.92±0.50 (2.56-3.27)		
All Species	30/30	4.26±1.68 (2.26-11.30)		

†*See text for explanation of derivation of HAC values.*

Table 2. Organic Contaminants (mg/kg) in fish collected in 2003 from Mountain Creek Lake (N = 30).

Contaminant	# Detected/ # Sampled	Average Concentration ± S.D. (Min-Max)*	Health-based Assessment Comparison Value (HAC)	Basis for Comparison Value†
Polychlorinated Biphenyls				
Channel catfish	6/8	0.107±0.075 (nd-0.230)	0.047	EPA chronic oral RfD for Aroclor 1254: .00002 mg/kg-day
Common carp	3/5	0.063±0.043 (nd-0.084)		
Flathead catfish	1/2	0.070±0.071 (nd, .120)		
Freshwater Drum	2/2	0.215±0.092 (0.150, 0.280)		
Largemouth bass	1/11	0.023±0.009 (nd-0.050)		
Smallmouth buffalo	2/2	0.804±0.984 (0.108, 1.500)		
All Species	15/30	0.120±0.270 (nd-1.500)		
Chlordane				
Channel catfish	6/8	0.0276±0.027 (nd-0.077)	1.167	EPA chronic oral RfD for chlordane: 0.0005 mg/kg-day
Common carp	2/5	0.0088±0.013 (nd-0.030)		
Flathead catfish	1/2	0.0315±0.045 (nd, 0.063)		
Freshwater Drum	2/2	0.0755±0.025 (0.058, 0.093)		
Smallmouth buffalo	2/2	0.1765±0.104 (0.103, 0.250)		
All Species	13/30	0.0277±0.052 (nd-0.250)		
p,p’-DDD				
Freshwater Drum	1/2	0.0090±0.0127 (nd, 0.018)	1.167	EPA chronic oral RfD for p,p’-DDT: 0.0005 mg/kg-day
Smallmouth Buffalo	1/2	0.0550±0.0778 (nd, 0.110)		
All Species	2/30	0.0043±0.020 (nd-0.110)		
p,p’-DDE				
Channel Catfish	5/8	0.0082±0.0073 (nd-0.017)	1.167	EPA chronic oral RfD for p,p’-DDT: 0.0005 mg/kg-day
Flathead Catfish	1/2	0.004±0.0057 (nd, 0.0080)		
Freshwater Drum	2/2	0.024±0.0028 (0.0220, 0.0260)		
Smallmouth Buffalo	2/2	0.0687±0.0868 (0.0073, 0.130)		
All Species	10/30	0.0086±0.0241 (nd-0.130)		

Table 3. Theoretical risks from consuming fish collected in 2003 from Mountain Creek Lake (n=30) and the number of eight-ounce meals that a 70-kg person could consume each month without exceeding guidelines for health (a 35-kg child could consume the same number of 4-ounce meals each week).				
CONTAMINANT	**HAZARD QUOTIENT**	**Allowable Meals per Month**	**LIFETIME EXCESS CANCER RISK**	**Allowable Meals per Month**
Chlordane	0.024	169	1.8×10^{-6} (1 in 561,572)	226
p,p-DDD	0.004	1100	1.9×10^{-7} (1 in 5,312,690)	2134
p,p-DDE	0.007	544	5.4×10^{-7} (1 in 1,855,512)	745
Aroclor 1260	**2.569**	**1.6***	4.4×10^{-5} (1 in 22,710)	9
	HAZARD INDEX		**CUMULATIVE RISK**	
	2.592	**1.5***	4.7×10^{-5} (1 in 21,487)	9

***Emboldened numbers suggest that consumption may be limited.** *A person (70-kg adult: 8 ounces per meal; 35-kg child: 4 ounces per meal) should be able to eat four or more meals each month of fish or shellfish from a waterbody. TDH considers it unacceptable, depending upon individual waterbody characteristics, if a person cannot consume a minimum of four fish or shellfish meals per month (one meal per week) from a given waterbody.*

SELECTED REFERENCES

1. [TDH] Texas Department of Health, Seafood Safety Division. Austin, Texas: Fish advisories and bans 2003. Information available at URL: http://www.tdh.state.tx.us/bfds/ssd.

2. [USGS] United States Geological Survey, Water Resources Division. Chemical quality of fish tissues (phase ii) in Mountain Creek Lake near naval air station Dallas and naval weapons industrial reserve plant, Dallas, Texas. Austin, Texas: 1996, March.

3. [TDH] Texas Department of Health, Environmental Epidemiology and Toxicology Program. Health consultation: Mountain Creek Lake fish tissue, Dallas, TX. 1996: April.

4. [TPWD] Texas Parks and Wildlife Department. 2002-2003 Outdoor Annual: hunting and fishing regulations. Ed. J. Jefferson. Texas Monthly Custom Publishing. 2002.

5. SPSS® Base 10.0 ©SPSS Inc, 1999. Information available at URL: http://www.spss.com

6. Microsoft Corporation. Microsoft Excel®2000. Copyright© Microsoft Corporation 1985-1999.

7. [IRIS] Integrated risk information system. U.S. Environmental Protection Agency. Office of Research and Development, National Center for Environmental Assessment. Information available at URL: http://www.epa.gov/iris.

8. [USEPA] U.S. Environmental Protection Agency. Guidelines for the health risk assessment of chemical mixtures. Office of Research and Development. Washington, D.C: 1986.

9. [USEPA] U.S. Environmental Protection Agency. Glossary of risk assessment-related terms. Washington, D.C.: 1999. Information available at URL: http://www.epa.gov/iris/gloss8.htm

10. [USEPA] U.S. Environmental Protection Agency. Technology Transfer Network. National Air Toxics Assessment. Glossary of Key Terms. Washington, D.C.: 2002. Information available at URL: http://www.epa.gov/ttn/atw/nata/gloss1.html.

11. [USEPA] U.S. Environmental Protection Agency. Office of Research and Development. Strategy for research on environmental risks to children, section 1.2. Washington D.C.: 2000.

12. [USDHHS] U.S. Department of Health & Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. Office of Children's Health. Child health initiative. Atlanta Ga.: 1995.

13. [ATSDR] Agency for Toxic Substances and Disease Registry. Case Studies in Environmental Medicine: Arsenic Toxicity. Information available at URL: http://www.atsdr.cdc.gov/HEC/CSEM/arsenic/exposure_pathways.html

14. USEPA] U.S. Environmental Protection Agency. Guidance for assessing chemical contaminant data for use in fish advisories. Vol. 2, Risk assessment and fish consumption limits, 3rd ed. Washington, D.C.: 2000.

15. Texas Statutes: Health and Safety, Chapter 436, Subchapter D, § 436.011, §436.061 and other.

16. [TDH] Texas Department of Health. Fish Consumption Advisories and Bans. Seafood Safety Division. Austin, Texas: 2003.

17. Clean Water Act. 33 USC 125 *et seq.* 40CFR part 131: Water Quality Standards.

18. [USDHHS] U.S. Department of Health & Human Services. Public Health Service. [ATSDR] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Mercury (update). Atlanta, GA.: March 1999.

REPORT PREPARED BY

Jerry Ann Ward, Ph.D.
Toxicologist
Seafood Safety Division
Bureau of Food and Drug Safety

Michael Tennant, B.S.
Environmental Specialist III
Seafood Safety Division
Bureau of Food and Drug Safety

Richard A. Beauchamp, M.D.
Senior Medical Toxicologist
Environmental Epidemiology and Toxicology Division
Bureau of Epidemiology

Lisa Williams, M.S.
Toxicologist
Environmental Epidemiology and Toxicology Division
Bureau of Epidemiology

G. Kirk Wiles, R.S.
Director
Seafood Safety Division
Bureau of Food and Drug Safety

Gary Heideman, B.S.
Assistant Director
Seafood Safety Division
Bureau of Food and Drug Safety

APPENDIX: Sampling Site Map, Mountain Creek Lake