HEALTH CONSULTATION

TRINITY RIVER

Dallas County and Tarrant County, Texas

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Prepared by
Texas Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

The Texas Natural Resource Conservation Commission (TNRCC), in mid-1998, requested that the Texas Department of Health (TDH) evaluate potential health risks from consuming fish from the Trinity River between Fort Worth, Texas in Tarrant County and Dallas, Texas in Dallas County. This stretch of the Trinity River has been closed to the taking of fish since January 1990 when TDH issued a closure order prohibiting possession of fish from that segment of the river between the Seventh Street bridge in Fort Worth and the Highway 20 bridge in Dallas due to the presence of chlordane in fish [1]. Chlordane, an organochlorine pesticide banned by the U.S. Environmental Protection Agency (EPA) in 1988, degrades very slowly in the environment and may be detected for many years after its use has been discontinued. Although chlordane was identified in fish from the length of the surveyed area, the most severely-contaminated fish were collected from sites in the immediate vicinity of the Dallas-Fort Worth metropolitan area. In October 1990, fish from this stretch of the Trinity River were reevaluated. The 1990 samples showed continuing chlordane contamination, although concentrations were generally lower and not all samples contained measurable levels of chlordane (18 of 27 samples contained no reportable quantities of chlordane).

The Trinity River is a major naturally-occurring drainage channel for Tarrant and Dallas counties, where it is fed by Lake Worth (northwest of Fort Worth), Benbrook Lake (southwest of Fort Worth), Sycamore Creek (south of Fort Worth), Mountain Creek (in Grand Prairie), Elm Fork of the Trinity River (west of Dallas), and White Rock Creek (east of Dallas). Major influences on water quality along this stretch of the 550 mile-long Trinity River include treated municipal wastewater discharges, nonpoint-source runoff from the Dallas-Fort Worth metropolitan area and agricultural runoff. Although parks and bridges provide some public access to the river, approaches are otherwise limited in both counties because the steep, high banks of the river discourage public use. Despite these limitations, both recreational and subsistence fishing have been observed.

In November 1998, TDH's Seafood Safety Division collected one largemouth bass, four longnose gar, one spotted gar, two flathead catfish, nine smallmouth buffalo, eight common carp, two blue catfish, one channel catfish, and two freshwater drum (thirty fish) from three sites along the Trinity River between Dallas and Fort Worth, Texas. Samples were obtained from sites near the Riverside bridge, Belt Line Road bridge, and the Mockingbird Street bridge (maps available at TDH). The TDH laboratory analyzed edible fillets (skin removed) of samples for metals, pesticides, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). A grant from the TNRCC provided funding for this project.

Compounds detected in fish from this length of the Trinity River are summarized in Table 1. Organochlorine pesticides including chlordane, DDE, and dieldrin were found in many samples. Aroclor 1260, a mixture of PCBs containing approximately 60 percent chlorine, was identified in thirteen of the samples.

DISCUSSION

Deriving Health-Based Assessment Comparison Values

TDH evaluated chemical contaminants in fish from the Trinity River in the Dallas-Fort Worth area by comparing average contaminant concentrations with health-based assessment comparison (HAC) values for noncancer and cancer endpoints. We used the U.S. Environmental Protection Agency's (EPA) reference doses (RfDs) or the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk levels (MRLs) to derive the noncancer HAC values. RfDs and MRLs are estimates of daily exposures to contaminants that are unlikely to cause adverse noncancer health effects even if exposure occurs over a lifetime. The cancer risk comparison values that we used in this health consultation are based on the EPA's chemical-specific cancer slope factors, an estimated excess lifetime risk of one cancer in ten thousand people (1×10^{-4}) exposed, and an exposure period of 30 years. We used standard assumptions for body weight (70 kilograms, adult; 35 kilograms, child) and fish consumption (30 grams per day, adult; 15 grams per day, child) to calculate the HAC values [2]. Many of the constants we use to calculate HAC values have "safety" margins built in; thus, adverse health effects will not necessarily occur simply because concentrations of toxicants in seafood exceed HAC values.

Assessing the Potential for Cumulative Effects

When multiple chemicals affect the same target organ or when several chemicals present in fish tissue are thought to be carcinogens, we assume that adverse health effects are cumulative. To evaluate the potential public health impact of additive noncancer effects, we calculate the number of meals per week needed to exceed a hazard index (HI) of one (1.0). The HI is the sum of the ratios of the estimated exposure doses for each contaminant divided by the respective RfD (or MRL) for each contaminant. A hazard index of less than one suggests that exposure to the combined contaminants, at the specified exposure levels, is unlikely to cause adverse noncancer health effects, even if exposure continues for many years. On the other hand, while a hazard index that is greater than one does not necessarily mean that exposure to the contaminants will result in adverse health effects, it does suggest that some public health intervention may be considered. To estimate the potential excess lifetime cancer risks associated with simultaneous exposure to multiple carcinogens, we calculate a cumulative risk by adding the estimated risks for each of the individual contaminants. The Texas Department of Health recommends that consumption of fish contaminated with carcinogenic chemicals be limited to amounts that result in an estimated excess theoretical lifetime cancer risk of no more than one in 10,000 persons exposed to contaminants in seafood.

Addressing the Unique Vulnerabilities of Children

We recognize that the unique vulnerabilities of infants and children demand special attention. Windows of vulnerability (critical periods) exist during development, particularly during early gestation, but also throughout pregnancy, infancy, childhood and adolescence-periods when toxicants may permanently impair or alter structure or function [3]. Unique childhood

vulnerabilities may be present because, at birth, many organs and body systems-including the lungs, immune, endocrine, reproductive, and nervous system-have not achieved structural or functional maturity; these organ-systems continue to develop throughout childhood and into adolescence. Children may exhibit differences in absorption, metabolism, storage, and excretion of toxicants, resulting in higher biologically-effective doses to target tissues. They may also be more highly exposed than adults because they consume proportionately more food and liquids than adults [3]. Thus, children may suffer adverse health effects not experienced by adults; they may experience toxic effects at a lower exposure level or they may react more severely to an equivalent exposure dose [3]. Children may also be more prone to developing certain cancers from chemical exposures than adults. Therefore, in accordance with ATSDR's *Child Health Initiative* [3] and EPA's *National Agenda to Protect Children's Health from Environmental Threats* [4], we evaluated the potential public health hazards to children who eat fish from the Trinity River between the cities of Fort Worth and Dallas, Texas.

Characterizing the Risk

Assessing Noncancer Health Effects

In the present fish samples, only Aroclor 1260 exceeded its noncancer HAC value (Table 1). We derived the noncancer HAC value for Aroclor 1260 from the EPA's RfD for Aroclor 1254, a mixture of structurally-similar polychlorinated biphenyls. The RfD for Aroclor 1254 is based on immune system dysfunctions in rhesus monkeys dosed with the toxicant for many months [5]. The RfD for Aroclor 1254 was calculated by dividing the lowest observed adverse effects level (LOAEL) of 0.005 milligrams per kilogram per day (mg/kg/day) identified in that experiment by an uncertainty factor of 300 (10 for use of a LOAEL, 10 for human variability, and 3 for extrapolation from animals to humans). Average concentrations of PCBs in fish tissue from the Trinity River near the Metroplex are approximately five times higher than the noncancer HAC value. Based on the RfD for Aroclor 1254, we calculated that a person who regularly consumes more than 0.2 meals per week (1.5 ounces per week for an adult and 0.75 ounces per week for a child) would exceed the RfD for immunological effects. Nevertheless, the daily dose of PCBs that produced adverse effects on the immune systems of rhesus monkeys is much higher than that dose to which people eating one meal per week of fish from this sector of the Trinity River would likely be exposed.

Although the RfD does not represent a sharp dividing line between "safe" and "unsafe" exposures, in practice, we view it as "unacceptable" when consumption of less than one meal per week results in exposures that exceed the RfD. The strict demarcation between "acceptable" and "unacceptable" levels of exposure or risk is, thus, a management a tool used to ensure protection of public health. Therefore, consuming more of a contaminant or contaminants than that recommended for management of risk does not necessarily mean that adverse health effects will occur.

In addition to Aroclor 1260, three chlorinated hydrocarbon pesticides (chlordane, DDE, and dieldrin) detected in samples from this portion of the Trinity River have adverse noncancerous effects on the livers of experimental animals [6]. Although concentrations of these pesticides did

not exceed their respective noncancer HAC values, similar toxicological profiles suggest that hepatic effects may be cumulative. We evaluated these chemicals for potential additive effects by calculating a hazard index (HI). The calculated HI was less than 1.0 (0.2) for these three compounds, suggesting that simultaneous exposure to all three compounds is unlikely to increase the risk of adverse hepatic effects in persons exposed through consumption of fish from this section of the Trinity River.

Assessing Cancer Health Effects

All contaminants in fish from the Trinity River between Fort Worth and Dallas were observed at average concentrations below their respective cancer HAC values (Table 1). Four of the chemicals (Aroclor 1260, chlordane, DDE, and dieldrin) in these samples are classified by the EPA as Group B2 (probable human) carcinogens based on an increase in the incidence of tumors in laboratory animals [6]. People who eat fish from the river may be exposed to several of these chemicals at the same time. Using EPA's chemical-specific cancer slope factors and the average concentration for each compound, we calculated that adults eating one eight-ounce meal per week of fish from the river for 30 years could theoretically increase their excess cancer risk by approximately 1.03 per 10,000 persons exposed to the combined toxicants (Table 2). It is quite plausible that the actual risks are lower than those cited in this health consultation. However, although higher risks are not likely, they cannot be completely ruled out. For seafood consumption, TDH has set an acceptable risk level of one excess cancer in 10,000 persons exposed. The estimated risk associated with consumption of one meal per week of fish from the Trinity River slightly exceeds TDH's acceptable risk level. Qualitatively, we interpret the present findings as a low increase in the risk for development of cancer.

CONCLUSIONS AND PUBLIC HEALTH IMPLICATIONS

The TDH concludes that regular consumption of one meal per week of fish from the Trinity River could result in doses of PCBs that exceed risk management guidelines. While the estimated doses of PCBs are not likely to result in overt signs and symptoms of disease or toxicity, the possibility of subtle neurobehavioral or immunological effects from long-term low-level exposure to PCBs cannot be easily dismissed. Because of this concern and because the estimated PCB doses exceed TDH risk-management guidelines, ingestion of fish from the Trinity River poses a public health hazard. In isolation, chlordane in fish from the Trinity River in the Dallas-Fort Worth area no longer poses a risk to public health. However, it does contribute to the calculated theoretical cancer risk from consumption of fish from this water body.

RECOMMENDATIONS AND PUBLIC HEALTH PLAN

In 1990, the Texas Department of Health closed the Trinity River from the 7th Street bridge in Fort Worth to the Interstate 20 bridge in Dallas County to the taking of fish because chlordane in tissue samples exceeded public health guidelines in use at that time. Although chlordane in fish from the area is presently of less concern, in part due to decreases in concentrations of this pesticide in fish tissue and, in part, to changes in knowledge of the toxicology of chlordane, Aroclor 1260 concentrations in fish tissue exceed TDH health-based guidelines. TDH has established criteria for issuing fish consumption advisories based on consumption guidelines from the EPA [2]. EPA estimates that the 50th percentile of recreational fishers consume 30 grams of fish per day (approximately one eight-ounce meal per week). When the data show that eating less than one eight-ounce meal per week results in exposures that exceed health-based assessment guidelines, the Seafood Safety Division and the Environmental Epidemiology and Toxicology Division generally recommend that the Commissioner of Health issue a consumption advisory.

Based on the findings of this health consultation, the Seafood Safety and Environmental Epidemiology and Toxicology Divisions of the Texas Department of Health recommend the following actions:

1. We advise issuing a fish consumption advisory for the Trinity River near the Metroplex or continuing the existing ban on possession of fish from this portion of the River due to the presence of PCBs in concentrations that exceed health-based guidelines.

2. We advise continued monitoring of samples from the Trinity River near the Metroplex as these data become available.

Table 1. Organic contaminants detected in fish from the Trinity River between Fort Worth and Dallas (mg/kg)				
Contaminant	**# Detected/ # Sampled (Reporting Limit)**	**Average Concentration (Range)**	**Health-based Comparison Value[1]**	**Basis for Comparison Value**
Aroclor 1260	13/30 (0.04)	0.205 (nd[2]-2.7)	**0.047**	EPA chronic oral RfD for Aroclor 1254: 0.00002 mg/kg/day
			0.272	EPA slope factor for PCBs: 2.0 $(mg/kg\ day)^{-1}$
chlordane	22/30 (0.01)	0.136 (nd-0.84)	1.2	EPA chronic oral RfD: 0.0005 mg/kg/day
			1.6	EPA slope factor: 0.35 $(mg/kg/day)^{-1}$
p,p'-DDE	29/30 (0.005)	0.041 (nd-0.32)	1.6	EPA slope factor: 0.34 $(mg/kg/day)^{-1}$
dieldrin	8/30 (0.006)	0.006 (nd-0.04)	0.12	EPA chronic oral RfD: 0.00005 mg/kg/day
			0.03	EPA slope factor: 16 $(mg/kg/day)^{-1}$

[1] derived from the MRL or RfD for noncarcinogens or the EPA slope factor for carcinogens; assumes a body weight of 70 kg, and a consumption rate of 30 grams per day, and assumes a 30-year exposure period for carcinogens and an excess lifetime cancer risk of 1x10-4

[2] nd-not detected

Table 2. Theoretical lifetime cancer risks from consumption of fish from the Trinity River near the Dallas-Fort Worth Metroplex	
Contaminant	**Cancer Risk**
Aroclor 1260	**7.53×10^{-5}**
chlordane	**8.81×10^{-6}**
p,p'-DDE	**2.58×10^{-6}**
dieldrin	**1.62×10^{-5}**
CUMULATIVE RISK	**1.03×10^{-4}**

REFERENCES

1. Texas Department of Health (TDH). Order of Closure, January 4, 1990. Fish Advisories and Bans 2001, Texas Department of Health, Seafood Safety Division, March 2001.

2. U.S. Environmental Protection Agency (USEPA). Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2. Risk Assessment and Fish Consumption Limits, 3rd Edition, Draft, August 1999.

3. U.S. Environmental Protection Agency (USEPA). Strategy for Research on Environmental Risks to Children, section 1.2. USEPA, Office of Research and Development, Washington D.C., EPA/600/R-00/068, August 2000.

4. Agency for Toxic Substances and Disease Registry, Office of Children's Health. Child Health Initiative, 1995.

5. Agency for Toxic Substances and Disease Registry. Toxicological profile for polychlorinated biphenyls, Atlanta: ATSDR, September 1997.

6. IRIS. Integrated Risk Information System. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. www.epa.gov/ngispgm3/iris/. February 2001.

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CERTIFICATION

This Trinity River Health Consultation was prepared by the Texas Department of Health 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 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.

Chief, State Programs Section, SSAB, DHAC, ATSDR