

Health Consultation

REVIEW OF 2002 EUNICE CITY LAKE FISH INVESTIGATION
EUNICE, LOUISIANA

JULY 27, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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

REVIEW OF 2002 EUNICE CITY LAKE FISH INVESTIGATION
EUNICE, LOUISIANA

Prepared by:

Louisiana Department of Health and Hospitals
Office of Public Health
Section of Environmental Epidemiology and Toxicology
Under a Cooperative Agreement With the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
COC	contaminant of concern
CSF	cancer slope factor
EPA	Environmental Protection Agency
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
LOAEL	lowest-observed-adverse-effects-level
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
MRL	minimal risk level
ng/kg	nanograms per kilogram
OPH	Office of Public Health
PCB	polychlorinated biphenyl
RBC	risk-based concentration
RECAP	Risk Evaluation/Corrective Action Program
SEET	Section of Environmental Epidemiology and Toxicology
TCDD	Tetrachlorodibenzo- <i>p</i> -dioxin
TEF	Toxicity Equivalency Factor
TEQ	Toxicity Equivalence Quotient
QA/QC	quality assurance/quality control
µg/kg/day	micrograms per kilogram per day

Summary and Statement of Issues

In May of 2000, a train carrying a variety of chemicals derailed northwest of Eunice, Louisiana. Concern arose about possible contamination that may have entered the Eunice City Lake during and following the derailment. Results of fish sampling showed that no advisory on fish consumption needed to be considered; however, it was suggested that follow-up sampling be performed to rule out the potential of bioaccumulation of contaminants from lake sediments or water into fish tissues. A second round of fish sampling was performed in May 2002. Due to continuing community concerns about the lake, the Louisiana Department of Health and Hospitals/Office of Public Health/Section of Environmental Epidemiology and Toxicology (LDHH/OPH/SEET) have performed a review of the 2002 data through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). SEET staff reviewed the contaminant concentrations found in fish tissue from Eunice City Lake to determine whether consumption of these fish would pose a threat to human health and to establish what further public health actions, if any, may be needed.

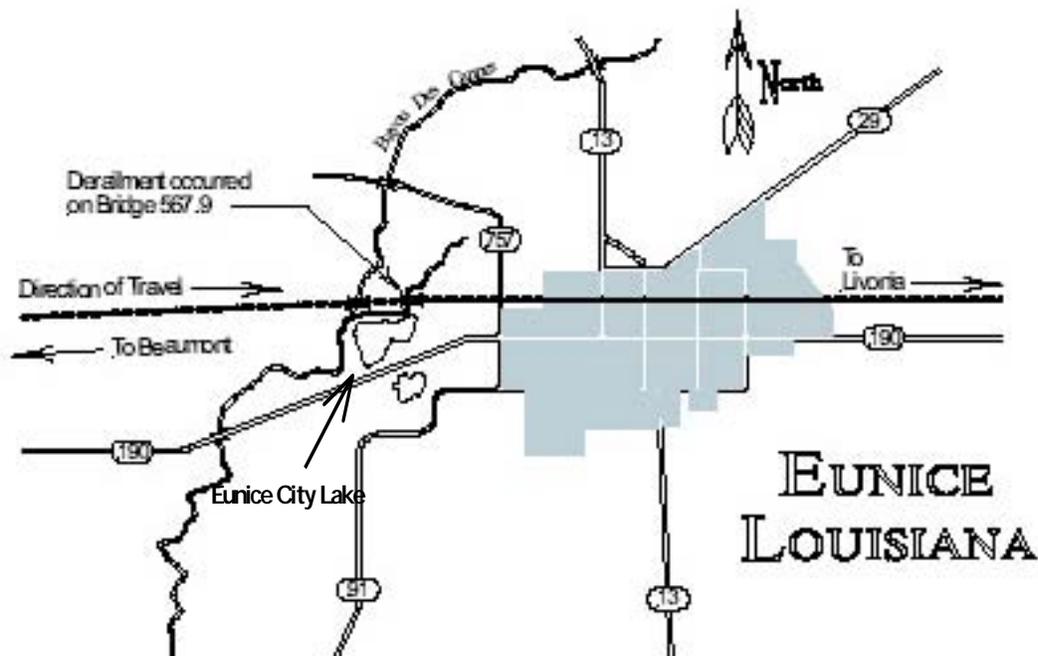
Background

Site Description and History

On Saturday, May 27, 2000, at approximately 11:48 a.m., 33 of the 113 cars making up an eastbound Union Pacific Railroad train derailed northwest of Eunice, Louisiana (see Figure 1). The derailment occurred on a bridge crossing an unnamed tributary to Bayou Des Cannes. Fifteen of the derailed cars contained a variety of hazardous materials including, but not limited to, acrylic acid, toluene diisocyanate, phenol, hexane, pentane, caprolactam, 1,2-dichloropropane, chloromethane, dicyclopentadiene, and alumina. An additional two rail cars contained hazardous material residue. The two rail cars carrying chloromethane exploded, potentially sending their contents into the surrounding area, including Eunice City Lake. No one was injured during the derailment of the train, but over 3,000 people were evacuated from the surrounding area. Over the following four days, emergency response crews used explosives to vent and burn additional tank cars to prevent additional explosions. At least one of these controlled explosions may have resulted in the rail car contents entering Eunice City Lake [1, 2]. The accident site does not drain directly into the lake, but contamination of the lake could potentially have occurred through transport by the force of the explosions, by aerosols, or in smoke blowing from the site. As a result, Eunice City Lake was closed to recreational activities, including fishing, until environmental and fish samples could be evaluated.

Directed by the Louisiana Department of Environmental Quality (LDEQ), Union Pacific removed contaminated soil, burned trees, and contaminated water from the site for suitable disposal [2]. LDEQ and Union Pacific consultants also performed investigations to determine whether fish tissue or environmental samples from Eunice City Lake were contaminated during the train derailment. Based on results from the sample analyses, no public health advisory was considered necessary for the lake, and the lake was reopened to recreational activities in

Figure 1. Location of Union Pacific Derailment outside Eunice, Louisiana



Adapted from: National Transportation Safety Board. Derailment of Union Pacific Railroad Train QFPLI-26 at Eunice, Louisiana, May 27, 2000. Railroad Accident Report: NTSB/RAR-02/03. Washington, DC: National Transportation Safety Board; 2003 April.

November 2001. A recommendation was made that an additional round of sampling be performed in the future to ensure that bioaccumulation of contaminants did not occur in Eunice City Lake's fish population [3]. The recommended sampling was performed in May 2002 by ARCADIS G & M, Inc. [1]. The community has recently expressed continuing concern about the water quality in the lake. SEET has therefore reviewed the ARCADIS data to determine whether consuming fish caught in Eunice City Lake would pose any human health risks.

Demographics

The city of Eunice straddles Acadia and Saint Landry Parishes in Louisiana. Census 2000 results recorded a population of 11,499. The largest ethnic group in the parish at that time was Caucasian (68.8%), followed by African-American (29.9%), Asian (0.2%), and Native American (0.1%). Twenty-nine point six percent (29.6%) of the population age 25 years or older in 2000 had earned at least a high school diploma. The median household income was \$21,372, with 31.4% of persons living below the poverty level. The largest employers were the educational, health and social services industry; the retail trade industry; the arts, entertainment, recreation, accommodation, and food services sector; construction; and the agriculture, forestry, fishing, and hunting industry [4].

Discussion

Data Used

The May 2002 Eunice City Lake fish investigation was performed by ARCADIS G & M, Inc. ARCADIS collected fish samples from the following three locations in the lake (see Figure 2):

1. LAKE-3, a sampling site immediately adjacent to the derailment site;
2. LAKE-7, a sampling site at the center of the lake; and
3. LAKE-6, a sampling site located in the southwestern portion of the lake, which was used as the background location at which fish should not have undergone exposure to contamination from the derailment.

Five edible species of fish were collected as outlined in Table 1. Fish sampled were above legal size limits set by the Louisiana Department of Wildlife and Fisheries [5]. At each sampling site, all of the fish collected for a single species were filleted, and the fillets were blended into one representative tissue sample. Each of these samples was submitted for laboratory analysis. The analyses were performed by Gulf Coast Analytical Laboratories, Inc. (Baton Rouge, Louisiana) and Pace Analytical Services, Inc. (Minneapolis, Minnesota). Each tissue sample was analyzed for 138 constituents (the chemicals carried by the derailed cars and their combustible products) [1].

All sampling was performed in accordance with methodologies presented in an LDEQ-approved work plan. To be considered valid, analytical data had to meet the data quality assurance/quality control (QA/QC) requirements outlined by LDEQ's Risk Evaluation/Corrective Action Program (RECAP) and the US Environmental Protection Agency (EPA) [1].

Exposure Pathways

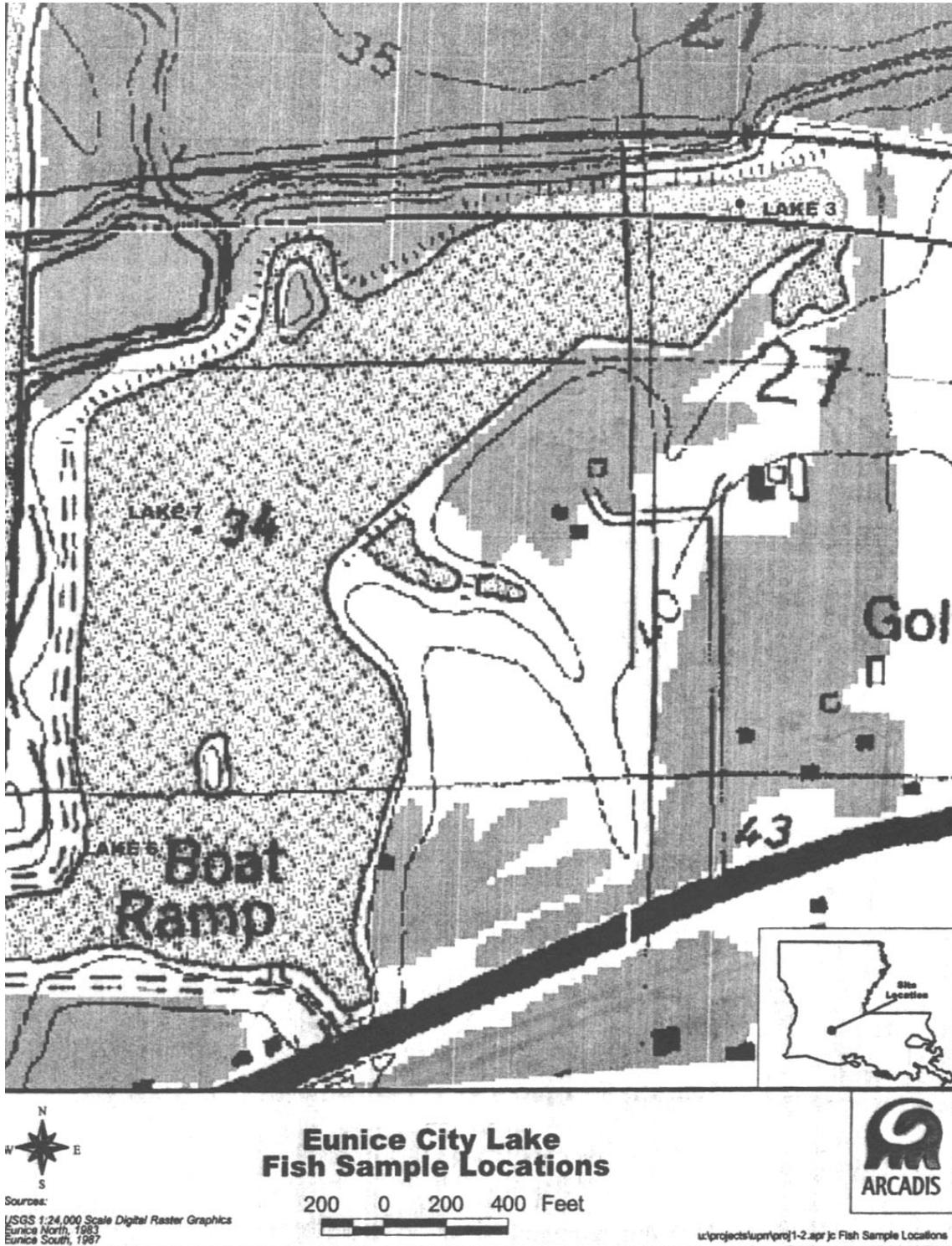
If contamination is present in Eunice City Lake, it can enter the lake's fish populations over time. Fish populations local to the site may absorb contaminants from the water or through consumption of contaminated sediment or smaller exposed organisms. People who consume fish from these local populations would also be at risk of consuming the contaminants that accumulate in the tissues of these fish.

Evaluation Process

Chemicals that had been detected in at least one fish tissue sample were identified as contaminants of concern (COCs) for the 2002 fish investigation risk assessment. The following polychlorinated biphenyl (PCB) congeners were the COCs for Eunice City Lake fish tissues:

- 2,3,3',4,4'-Pentachlorinated biphenyl;
- 2,3,4,4',5-Pentachlorinated biphenyl;
- 2',3,4,4',5-Pentachlorinated biphenyl;

Figure 2. Eunice City Lake Fish Sample Locations



Adapted from: ARCADIS G & M, Inc. May 2002 Fish Investigation: Eunice City Lake, Eunice Trail Derailment, May 27, 2000. Agency Interest No. 85276. 9 April 2003.

Table 1. Fish Species Collected and Sites Sampled from Eunice City Lake

Fish Species	LAKE-3	LAKE-6	LAKE-7	TOTAL
Catfish (<i>Ictalurus</i> species)				8
Yellow bullhead catfish (<i>Ictalurus natalis</i>)	2	2	2	
Channel catfish (<i>Ictalurus punctatus</i>)		2		
Crappie (<i>Pomoxis</i> species)	18	12	13	43
White crappie (<i>Pomoxis annularis</i>)				
Black crappie (<i>Pomoxis nigromaculatus</i>)				
Largemouth bass (<i>Micropterus salmoides</i>)	7	5	7	19
Sunfish (<i>Lepomis</i> species)	34	30	69	133
Bluegill sunfish (<i>Lepomis macrochirus</i>)				
Warmouth sunfish (<i>Lepomis gulosus</i>)				
Redear sunfish (<i>Lepomis microlophus</i>)				
Spotted gar (<i>Lepisosteus oculatus</i>)	8	6	6	20

Adapted from: ARCADIS G & M, Inc. May 2002 Fish Investigation: Eunice City Lake, Eunice Train Derailment, May 27, 2000. Agency Interest No. 85276. 9 April 2003

- 2,3,3',4,4',5-Hexachlorinated biphenyl;
- 2,3,3',4,4',5'-Hexachlorinated biphenyl; and
- 2,3',4,4',5,5'-Hexachlorinated biphenyl.

Table 2 lists detected concentrations of these contaminants and the species within which they were measured. PCBs were only sampled for at the sampling site immediately adjacent to the derailment site (LAKE-3). Though not part of the train's cargo, PCBs were sampled for as possible products of combustion that might have entered the lake upon explosion of the rail cars (D. Bradford, Louisiana Department of Environmental Quality, personal communication, 2005).

Table 2: Contaminant of Concern Concentrations in Eunice City Lake Fish Tissue*

COC [†]	Spotted Gar (ng/kg [‡])	Channel Catfish (ng/kg)
2,3,3',4,4'-Pentachlorinated biphenyl	708	66.1
2,3,4,4',5-Pentachlorinated biphenyl	3720	ND [§]
2',3,4,4',5-Pentachlorinated biphenyl	60	ND
2,3,3',4,4',5-Hexachlorinated biphenyl	323	ND
2,3,3',4,4',5'-Hexachlorinated biphenyl	108	ND
2,3',4,4',5,5'-Hexachlorinated biphenyl	234	ND

*Data retrieved from ARCADIS G & M, Inc. May 2002 Fish Investigation: Eunice City Lake, Eunice Train Derailment, May 27, 2000. Agency Interest No. 85276. 9 April 2003.

[†]COC=Contaminant of Concern

[‡]ng/kg=nanograms per kilogram

[§]ND=not detected

PCB concentrations for each fish species were assessed for noncancer health effects in terms of dioxin-like toxicity (see Appendix A). The lifetime cancer risks for consumption of PCBs in fish tissue from Eunice City Lake were also calculated in terms of dioxin-like toxicity (see Appendix A) [6, 7].

Polychlorinated Biphenyls

PCBs are a group of synthetic organic chemicals that were manufactured in the United States from 1929 to 1977. PCBs are colorless to light yellow oily liquids or solids with no known smell or taste. Due to their insulating properties, PCBs were formerly used as insulating materials, coolants, and lubricants in electrical equipment such as transformers and old appliance capacitors. [6].

PCBs enter the environment as mixtures of different chlorinated biphenyls, known as congeners, and impurities. Once in the environment, they do not readily break down. PCBs that enter water bodies are taken up by small aquatic organisms and can accumulate up the aquatic food chain [6]. This can pose a concern because EPA classifies PCBs as probable human carcinogens [8].

Table 3: Doses of PCBs in Eunice City Lake Fish Samples (in terms of dioxin-like toxicity)

Fish	Child's dose* in mg/kg/day [†] (3-ounce serving)	Child's dose in mg/kg/day (4-ounce serving)	Adult's dose in mg/kg/day (6-ounce serving)	Adult's dose in mg/kg/day (8-ounce serving)
Spotted Gar	2.62E-09	3.48E-09	7.47E-10	9.98E-10
Channel Catfish	8.00E-12	1.06E-11	2.29E-12	3.05E-12

* Child=6 years and under

[†] mg/kg/day=milligrams per kilogram per day

Health Effects Evaluation

Estimated doses of PCBs that would be absorbed by persons regularly eating spotted gar or channel catfish from Eunice City Lake are listed in Table 3. These doses were more than 15 times lower than the lowest-observed-adverse-effects level, or the lowest dose observed to cause noncancer health effects in terms of dioxin-like toxicity (see Appendix A) [6]. There are no adverse noncancer health risks involved with consuming fish from Eunice City Lake.

Cancer Health Effects Evaluation

The estimated lifetime cancer risks for consumption of channel catfish from Eunice City Lake do not exceed EPA's upper limit of acceptable cancer risk levels of 1 excess cancer per 10,000 people exposed for a lifetime (1.00×10^{-4}). The estimated lifetime cancer risks for consumption of Eunice City Lake's spotted gar are 1.12×10^{-4} to 1.50×10^{-4} for meal sizes of 0.170 kg to 0.227 kg (6-8 ounces). In other words, consumption of one 6-8 ounce meal per week of Eunice City Lake's spotted gar over a lifetime would expose a population to cancer risk levels of 1.12 to 1.50 excess cancers per 10,000 people. In comparison, the year 2000's dioxin-like TEQ sum of $1.81\text{E-}06$ mg/kg for spotted gar yields a cancer risk of 9.39×10^{-5} to 1.25×10^{-4} for meal sizes of 0.170 kg to 0.227 kg (6 - 8 ounces), or 0.94 to 1.25 excess cancers per 10,000 people exposed for a lifetime.

Since fillets from eight gar were blended into a single sample for testing, the PCB concentrations in this sample could be due to a small number of gar that happened to contain higher PCB levels because of advanced age and longer historical exposures. Without background samples, it is also difficult to determine whether these contaminant concentrations are combustion products from the May 2000 derailment or if they reflect concentrations commonly found in spotted gar from this area. Background samples, which are taken from similar areas lacking the source of contamination, would show what levels of PCBs are normally present in fish living in these conditions in Louisiana.

According to the Louisiana Department of Wildlife and Fisheries, gar fishing is not a common practice at Eunice City Lake. Gar fishing requires special gear, and gar habitat usually consists of backwater lakes and bayous. Recreational fishing for other freshwater species is a more common pastime at the lake (J. David, Louisiana Department of Wildlife and Fisheries, personal communication, 2005). The cancer risk estimated by SEET assumes consumption of one meal per week of gar caught in Eunice City Lake throughout a lifetime of exposure. Since gar would not be consumed from this source this often, there is no excess cancer risk associated with eating fish caught in Eunice City Lake.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

Children can be exposed to PCBs through ingestion of contaminated fish. Infants may also be exposed if drinking breast milk from a mother that has consumed fish containing PCBs or during the mother's pregnancy. The concentrations of PCBs found in fish caught from Eunice City Lake are not high enough to cause adverse health effects in small children. The estimated increases in cancer risk do not apply to children because these risks are averaged over an adult lifespan.

Conclusions

There are no health risks involved in eating fish caught in Eunice City Lake. Spotted gar tissues from the lake show increases in PCB content, and a slight increase in cancer risk has been estimated for residents eating one 6-8 ounce meal per week of spotted gar from the lake. However, since spotted gar are not commonly fished for at the lake, gar consumption at this rate from this source is unlikely. There is no public health hazard associated with consuming fish caught in Eunice City Lake.

Only one composite sample of spotted gar was analyzed, and background measures of PCB levels in spotted gar in similar locations are not available for comparison. It is therefore unclear whether the PCBs measured in Eunice City Lake's spotted gar in May 2002 were due specifically to combustion products from the May 2000 train derailment. These contaminants, which were not present in the train's cargo, may have historically entered the lake through some other source such as nearby roadways.

Recommendations

Resampling has been planned for Eunice City Lake to determine if contaminants or degradates from the May 27, 2000 train derailment remain in the lake. The resampling and analysis should involve more than one sample per species in each sampling area to make sure that the data is representative of the organisms in that area.

Public Health Action Plan

The information produced within this health consultation should be disseminated to the community members within the city of Eunice, Louisiana.

Preparers of this Report

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7. Van den Berg et al., 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environmental Health Perspectives*, 106 (12), 775-792.
8. U.S. Environmental Protection Agency. Integrated risk information system (for polychlorinated biphenyls). Accessed 15 Mar 2005 at URL: <http://www.epa.gov/iris/subst/0294.htm>

Certification

This Review of 2002 Eunice City Lake Fish Investigation health consultation was prepared by the Louisiana Department of Health and Hospitals under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures at the time the health consultation was begun. The editorial review was conducted by the Cooperative Agreement Partner.

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

Cooperative Agreement Team Leader, DHAC, ATSDR

Appendix A: Evaluation Process

Noncancer Health Effects

The health risks presented by PCBs in Eunice City Lake fish tissues were evaluated by comparing the toxicity of the PCB congeners to that of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). A toxicity equivalency factor (TEF) was used to weight each PCB's relative dioxin-like toxicity as compared to the toxicity of TCDD, one of the most toxic and most studied of the dioxins. Multiplying the actual concentration of each PCB congener by its TEF produced a toxicity equivalence quotient (TEQ) (see Table A-1)^{†‡}. The following equation was then used to calculate exposure doses from the summed TEQs for PCBs in fish tissue:

$$\text{Exposure Dose} = \frac{(\text{Contaminant Conc.}) \times (\text{Meal Size}) \times \text{FI} \times (\text{Meal Frequency}) \times (\text{Exposure Duration})}{(\text{Consumer's Weight}) \times (\text{Averaging Time})}$$

The variables for this equation are presented in Table A-2.

The exposure dose calculated from the sum of PCB TEQs for each fish species was compared to the *minimal risk level* (MRL) for TCDD, which is **1E-09 mg/kg/day**. An MRL is an estimated daily human exposure to a hazardous substance that is not likely to cause adverse noncancer health effects over a specified duration of exposure. Developed by the ATSDR, MRLs are not intended to be used as predictors of adverse health effects but only as a screening step to determine whether further assessment is required. MRLs may be found at <http://www.atsdr.cdc.gov/mrls.html>.

Because the PCB TEQ sum for garfish was greater than the MRL for TCDD, the TEQ sum was compared to the *lowest-observed-adverse-effects level* (LOAEL) for TCDD. The LOAEL is the lowest level of continuous exposure to a contaminant that has been observed to cause adverse health effects. The lowest LOAEL for TCDD is 1.2E-04 µg/kg/day, or **1.2E-07 mg/kg/day**[†].

Calculation of Carcinogenic Risk

To examine the carcinogenic risk involved in eating fish from Eunice City Lake, the sum of PCB TEQs for each fish species was compared to the EPA Region III *risk-based concentration* (RBC) for the carcinogenic effects of TCDD in fish tissue. The RBC for TCDD in fish tissue is

[†] Agency for Toxic Substances and Disease Registry. Toxicological profile for polychlorinated biphenyls. Atlanta: US Department of Health and Human Services; 2000 Nov.

[‡] Van den Berg et al., 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environmental Health Perspectives*, 106 (12), 775-792

Table A-1: Toxicity Equivalence Quotients (TEQs) for Polychlorinated Biphenyls in Spotted Gar from Eunice City Lake in 2002

Contaminant of Concern	Spotted Gar PCBs (mg/kg)*	TEF ^{†‡}	TEQ (mg/kg)	Channel Catfish PCBs (mg/kg)	TEF	TEQ (mg/kg)
2,3,3',4,4'-Pentachlorinated biphenyl	7.08E-04	0.0001	7.08E-08	6.61E-05	0.0001	6.61E-09
2,3,4,4',5-Pentachlorinated biphenyl	3.72E-03	0.0005	1.86E-06	ND [§]	--	--
2',3,4,4',5-Pentachlorinated biphenyl	6.00E-05	0.0001	6.00E-09	ND	--	--
2,3,3',4,4',5-Hexachlorinated biphenyl	1.08E-04	0.0005	5.40E-08	ND	--	--
2,3,3',4,4',5'-Hexachlorinated biphenyl	3.23E-04	0.0005	1.62E-07	ND	--	--
2,3',4,4',5,5'-Hexachlorinated biphenyl	2.34E-04	0.00001	2.34E-09	ND	--	--
		TOTAL TEQ	2.16E-06		TOTAL TEQ	6.61E-09

* mg/kg=milligrams per kilogram

† TEF=Toxicity Equivalency Factors.

‡ Van den Berg et al., 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environmental Health Perspectives*, 106 (12), 775-792

§ ND=Not detected

2.10E-08 mg/kg. This is the concentration at or below which the contaminant is unlikely to cause carcinogenic health effects. The sum of PCB TEQs for channel catfish (6.61E-09) was lower than this RBC and therefore not likely to cause carcinogenic health effects. The concentrations of PCBs in spotted gar tissues yielded a higher TEQ sum (2.16E-06 mg/kg) and therefore needed further evaluation. A total dioxin-like TEQ sum was calculated for spotted gar sampled in 2000 for further comparison (1.8.E-06 mg/kg; see Table A-3).

The carcinogenic risks for consumption of spotted gar in 2000 and 2002 were calculated by multiplying the adult exposure dose over a lifetime by the TCDD *cancer slope factor* (CSF) of **1.5E+05 (mg/kg/day)⁻¹**. The answers were compared to EPA's upper limit of acceptable

Table A-2: Variables for Exposure Dose Equation

Variable	Child's Value	Adult's Value
Contaminant Conc. = concentration of contaminant in fish tissue (in mg/kg [*])	varies by sample	varies by sample
Meal size (in kg)	0.085 kg-0.113 kg (3-4 ounces)	0.170 kg-0.227 kg (6-8 ounces)
FI = Fraction of contaminant ingested	1 (100% of contaminant absorbed)	1 (100% of contaminant absorbed)
Meal Frequency (in days/year)	52 (one meal per week)	52 (one meal per week)
Exposure duration (in years)	6 years	70 years
Consumer's Weight	10 kg	70 kg
Averaging Time	365 days/year x 6 years	365 days/year x 70 years

* mg/kg=milligrams per kilogram

cancer risk, which is set at 1 excess cancer per 10,000 people exposed for a lifetime (1.00×10^{-4}). This estimation of carcinogenic risk presents the worst-case maximum increase in the risk of developing cancer after exposure to a contaminant. This estimation is considered to be accurate within one order of magnitude. For example, a calculated cancer risk of $2.00\text{E}-04$ might actually be $2.00\text{E}-03$ or $2.00\text{E}-05$.

Because of the uncertainties involved in estimating carcinogenic risk, ATSDR also employs a weight-of-evidence approach in evaluating all relevant carcinogenic data, describing carcinogenic risk in words as well as in numeric terms.[§] To restate the previous example, a calculated cancer risk of 2 excess cancers per 10,000 people might actually be 2 excess cancers per 1,000 people or 2 excess cancers per 100,000 people.

[§] Agency for Toxic Substances and Disease Registry. Cancer policy framework. Atlanta: US Department of Health and Human Services; 1993.

Table A-3: Toxicity Equivalence Quotients (TEQs) for Polychlorinated Biphenyls in Spotted Gar from Eunice City Lake in 2000

Contaminant of Concern	Spotted Gar PCBs (mg/kg)*	TEF ^{†‡}	TEQ (mg/kg)
2,3,3',4,4'-Pentachlorinated biphenyl	5.20E-04	0.0001	5.20E-08
2,3,4,4',5-Pentachlorinated biphenyl	2.55E-03	0.0005	1.28E-06
2,3,3',4,4',5'-Hexachlorinated biphenyl	7.64E-05	0.0005	3.82E-08
2,3,3',4,4',5-Hexachlorinated biphenyl	2.14E-04	0.0005	1.07E-07
2,3',4,4',5,5'-Hexachlorinated biphenyl	1.53E-04	0.00001	1.53E-09
2,2',3,3',4,4',5-Heptachlorinated biphenyl	5.51E-04	0.0001	5.51E-08
2,2',3,4,4',5,5'-Heptachlorinated biphenyl	7.77E-04	0.0001	7.77E-08
2,3,7,8-TCDD toxicity equivalent	4.00E-09	1	4.00E-09
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	4.00E-06	0.0001	4.00E-10
Total Hexachlorodibenzofuran	2.00E-06	0.1	2.00E-07
		TOTAL TEQ	1.81E-06

* mg/kg=milligrams per kilogram

† TEF=Toxicity Equivalency Factors.

‡ Van den Berg et al., 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environmental Health Perspectives*, 106 (12), 775-792

§ND=Not detected