HEALTH CONSULTATION

Lower Galveston Bay

Galveston County, Texas

June 18, 1999

Prepared by

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

BACKGROUND AND STATEMENT OF ISSUES

The Galveston Bay Estuary Program provided the Texas Department of Health (TDH) Seafood Safety Division (SSD) with a grant to evaluate potential health risks associated with consumption of fish and crabs taken from lower Galveston Bay. Currently, the upper portion of Galveston Bay and the Houston Ship Channel are under a fish consumption advisory, issued in 1990, due to contamination of catfish and crabs with dioxin. Samples collected for this evaluation were taken from the area below the current advisory area. Galveston Bay is Texas' largest estuarine source of seafood. Commercial and recreational fishing on Galveston Bay generates nearly one billion dollars per year in revenues. Approximately one third of the State's commercial fishing income comes from the Bay. Over one-half of the State's expenditures for recreational fishing are related to Galveston Bay. For every pound of finfish caught commercially in Galveston Bay, more than six pounds of finfish are caught by recreational anglers. For the nearly 300,000 licensed recreational anglers, Galveston Bay supports some two million hours of sport fishing annually. The economic benefits associated with sport fishing were estimated at $364 million in 1986.

More than three million people live in the five coastal counties bordering the Galveston Bay system. Twenty percent of that population lives within two miles of the Bay or its tidal tributaries. The upper Galveston Bay system is home to one of the nation's largest petrochemical and industrial complexes. The Bay is the final recipient of treated wastewater from more than 1,400 industrial and municipal point source discharges that amount to more than 60% of the wastewater (by volume) discharged in Texas. It also receives non-point source pollutants in storm water runoff generated by agricultural, urban, suburban and rural land users of the Bay.

Given the usage of Galveston Bay for recreational fishing and the intense industrial and human pressures on the area, questions may arise regarding the safety of seafood harvested from Galveston Bay. To answer such questions the TDH collected and analyzed a total of 130 fish and crab samples from five sites in the lower Galveston Bay: East Bay, Campbell's Bayou, Hannah's Reef, Snake Island, and the Dollar Point/Dickinson Bay shoreline (figure1). Sixty-five samples, consisting of six species of fish (nine red drum, two Atlantic croaker, twelve southern flounder, eight sheepshead, ten black drum, nine spotted seatrout) and fifteen composite crab samples, consisting of five crabs each, were analyzed for metals, volatile and semivolatile organic compounds, pesticides, and polychlorinated biphenyls (PCBs). Sixty-five additional samples consisting of eight red drum, two Atlantic croaker, thirteen southern flounder, seven sheepshead, eleven black drum, nine spotted trout and fifteen composite crab samples were sent to Wright State University for analysis of chlorinated dioxins and furans.

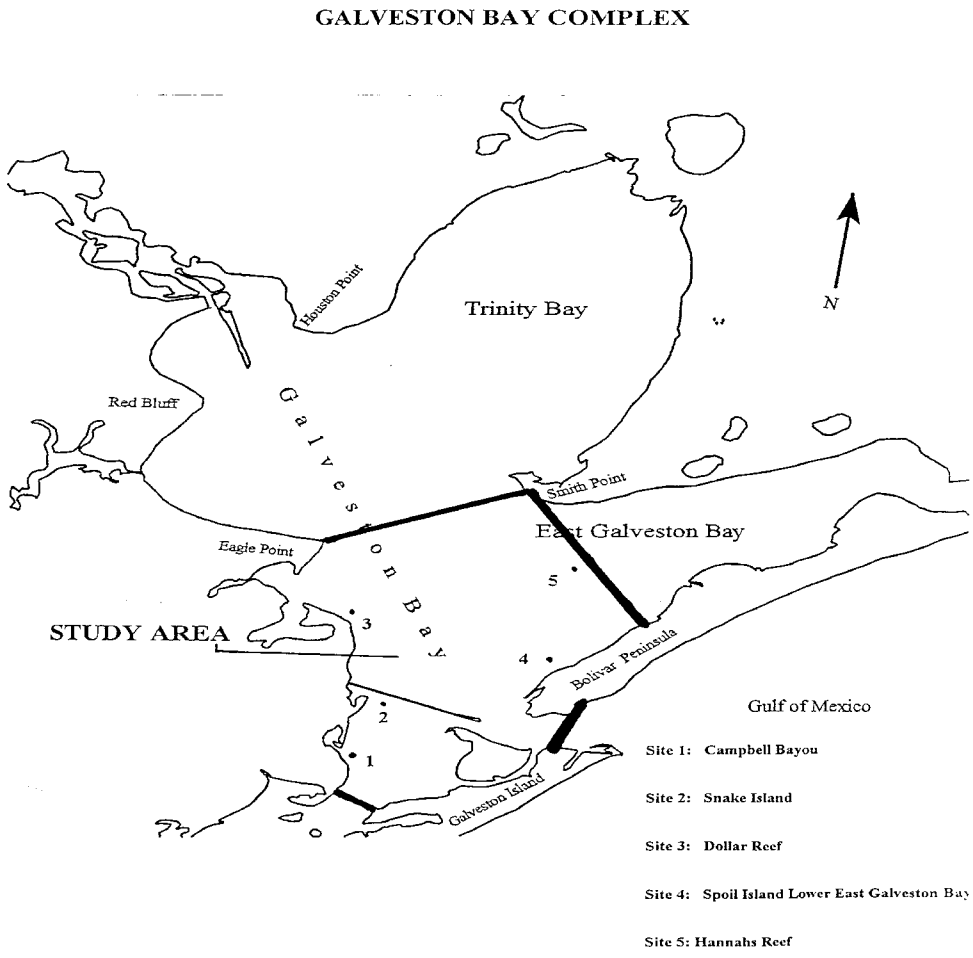
GALVESTON BAY COMPLEX
Houston Point
Trinity Bay
N
Red Bluff
Galveston Bay
Smith Point
East Galveston Bay
Eagle Point
5
STUDY AREA
3
4
Bolivar Peninsula
Gulf of Mexico
2
1
Galveston Island
Site 1: Campbell Bayou
Site 2: Snake Island
Site 3: Dollar Reef
Site 4: Spoil Island Lower East Galveston Bay
Site 5: Hannahs Reef

Figure 1.

DISCUSSION

Health Based Comparison Values

To assess the potential for carcinogenic and noncarcinogenic health effects associated with consumption of chemical contaminants in fish from lower Galveston Bay, TDH compared contaminant concentrations with health-based assessment comparison values (HACs). Non-cancer comparison values are based on the U.S. Environmental Protection Agency's (EPA's) reference doses (RfDs), the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk levels (MRLs), or other non-carcinogenic health based comparison values. RfDs and MRLs are estimates of daily exposures to a contaminant that are unlikely to cause adverse health effects unrelated to cancer if exposure should occur over a lifetime [1]. Cancer risk comparison values utilized in this assessment are based on EPA's chemical-specific cancer slope factors and an estimated lifetime risk of one excess cancer in ten thousand people exposed to the contaminant (1×10^{-4}) [1].

To evaluate potential non-carcinogenic health effects, we compared the average concentration of each contaminant to the associated HAC value. A body weight of 70 kg and an average consumption of 30 grams per day, or approximately one eight-ounce meal per week, was used to derive the HAC value. The non-cancer HAC values were not exceeded for any of the chemicals detected in fish and crabs from Galveston Bay.

Inorganic lead was present at levels near the detection limit in 32 of 65 samples (average concentration = 0.0109 mg/kg; Table 1). Because there are no health-based comparison values for inorganic lead, TDH used EPA's Integrated Exposure Uptake Biokinetic Model [2] (IEUBK) for lead to estimate the potential impact that chronic ingestion of fish containing lead would have on blood lead in children (the sensitive population). Assuming that fish or seafood accounts for 50% of the total daily meat consumption (a conservative estimate), this model predicts that daily ingestion of fish containing lead at the concentration detected in these samples would result in an increase of less than 0.3 ug/dL in the geometric mean blood lead level for children zero to seven years of age. Based on this information, the fact that finfish do not significantly bioaccumulate inorganic lead, and assuming that blood lead levels are well below 10 ug/dL prior to ingestion of

fish containing this concentration, TDH concluded that consuming fish containing small quantities of lead from the lower Galveston Bay estuary does not pose a threat to human health.

To evaluate carcinogenic health effects, we used the same assumptions, and an exposure period of 30 years to determine the theoretical excess lifetime cancer risk for each compound. Four of the chemicals found in seafood from Galveston Bay (DDE, dioxin, 2-(diethylhexyl)phthlate, and methylene chloride) are classified as probable human carcinogens, based on increased incidence of hepatic carcinoma in laboratory animals. Only those contaminants which are considered probable or known human carcinogens were considered in this evaluation. The combined (additive) risk of inducing one excess cancer was well below one in 10,000 persons at approximately six in 1,000,000 persons for persons consuming one eight-ounce meal per week (Table 2). Recreational fishers may eat fish as a regular part of their diet and may therefore be exposed to greater levels of fish contaminants. We assumed that recreational fishers in Galveston Bay may be consuming up to 3-4 meals per week to calculate a combined risk of approximately two in 100,000 persons, which is still well below one in 10,000 persons. Qualitatively, the risk from consuming 3-4 meals per week of fish from Galveston Bay is interpreted as insignificant or no increased risk for cancer.

ATSDR's Child Health Initiative

The TDH has prepared this consultation under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). TDH has included the following information in accordance with ATSDR's Child Health Initiative.

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children who consume seafood containing chemical contaminants are at greater risk for toxic effects than are adults who consume contaminated fish. Infants may be exposed by breast milk while fetuses may be exposed through transfer across the placenta. Children are also smaller, resulting in higher exposure doses per kilogram of body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most important, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. TDH evaluated the upper limits of fish consumption that would result in no significant risk to the fetus or to young children exposed after birth. TDH has determined that regular consumption of fish from Lower Galveston Bay poses no excess health risk to infants or children.

Table 1. Comparison of Contaminant Concentrations in Fish From the Lower Galveston Bay with Health Based Comparison Values*

Chemical	Number Affected	Average Conc.	Range	Comparison Value**	Basis	HAC Exceeded
Pesticides (mg/kg)						
DDE	6/65	0.0063	0 - 11	1.6	EPA slope factor 0.34 $(mg/kg\ day)^{-1}$	no
Semivolatile Organic Compounds (mg/kg)						
Di (2-ethylhexyl) phthalate	5/65	0.00025	0 - 8.4	38.8 46.7	EPA slope factor 0.014 $(mg/kg\ day)^{-1}$ EPA chronic oral RfD 0.02mg/kg/day	no
Volatile Organic Compounds (mg/kg)						
Methylene chloride	8/65	0.014	0 - 0.3	72 140 467	EPA slope factor 0.0075 $(mg/kg/day)^{-1}$ EPA chronic oral RfD 0.06 mg/kg/day ATSDR chronic oral MRL 0.2 mg/kg/day	no
Methyl- ethyl ketone	2/65	0.0042	0 - 0.15	1400	EPA chronic oral RfD 0.6 mg/kg/day	no
Dioxins & Furans (ng/kg, parts per trillion)						
Toxicity Weighted Concentration	29/65	0.185	0 - 7.39	3.4 ng/kg	EPA slope factor 1.56×10^{5} $(mg/kg/day)^{-1}$ ATSDR's chronic oral MRL $1x10^{-9}$ mg/kg/day	no
Metals (mg/kg)						
Cadmium	30/65	0.0297	0 - 0.353	0.47	ATSDR's chronic oral MRL 0.0002 mg/kg/day	no
Copper	16/65	2.15	0 - 13.1	--------	None Available	----------
Lead	32/65	0.0109	0 - 0.092	--------	IEUBK‡	----------
Mercury	14/65	0.0305	0 - 0.245	0.7	ATSDR's Chronic Oral MRL 0.0003 mg/kg/day	no
Selenium	65/65	0.584	0.306 - 1.2	12	Chronic oral MRL/RfD 0 .005 mg/kg/day	no
Zinc	65/65	12.4	2.9 - 57	700	Chronic oral MRL/RfD 0.3 mg/kg/day	no

*Assumes 70 kg adult ingesting 30 grams of fish and crabs per day (one eight-ounce meal per week) and, for carcinogenicity risk, an acceptable risk level of 1×10^{-4} for a lifetime of exposure

**mg/kg unless otherwise specified.

‡ Integrated Exposure Uptake Biokinetic Model, EPA

Table 2. Potential Carcinogens in Lower Galveston Bay Fish and Crabs and associated theoretical excess lifetime cancer risk			
Compound	**Estimated Excess Theoretical Cancer Risk***		
	One meal per week	**Three meals per week**	**Four meals per week**
DDE	3.9×10^{-7}	1.2×10^{-6}	1.6×10^{-6}
2-(diethylhexyl)phthalate	6.4×10^{-10}	2×10^{-9}	2.7×10^{-9}
Methylene Chloride	1.9×10^{-8}	6.2×10^{-8}	8.2×10^{-8}
Chlorinated Dioxins & Furans	5.3×10^{-6}	1.7×10^{-5}	2.2×10^{-5}
OVERALL RISK	**5.7×10^{-6}**	**1.8×10^{-5}**	**2.4×10^{-5}**

*Assumes a body weight of 70 kg, and an exposure period of 30 years

CONCLUSIONS

1. Health based comparison values for chronic consumption of one eight-ounce meal per week were not exceeded for any of the compounds detected in fish and crabs from lower Galveston Bay. Thus, adverse non-carcinogenic health effects are not likely.

2. Inorganic lead in these fish does not pose a risk to young children.

3. For carcinogenic chemicals, the Texas Department of Health recommends that consumption be limited to amounts that result in an estimated excess theoretical lifetime cancer risk of less than one in ten thousand persons. Based on the data evaluated for this health consultation, the overall theoretical excess cancer risk for 70 kg adults consuming one eight-ounce meal per week for thirty years is estimated to be approximately 6 in 1,000,000 people. Qualitatively, this is interpreted as insignificant or no increased risk for cancer.

4. Eating fish and crabs from this area poses no apparent public health hazard.

RECOMMENDATIONS/PUBLIC HEALTH ACTION

The TDH Seafood Safety Division has established criteria for issuing fish consumption advisories. For non-carcinogens, these criteria state that, in the absence of site-specific consumption information, TDH assumes that recreational fishers eat approximately thirty grams of fish per day (about one eight-ounce meal per week) [1]. If analysis shows that it is unsafe to eat one, or fewer, eight-ounce meals each week, the Seafood Safety Division recommends that the Commissioner of Health issue an advisory.

The data analyzed for this health consultation indicate that consuming fish and crabs from Galveston Bay poses no apparent public health hazard. No public health action is

necessary at this time for the Lower Galveston Bay estuary.

REFERENCES

1. Environmental Protection Agency 1995. Guidance for assessing chemical contaminant data for use in fish advisories. Volume II. Fish Sampling and Analysis, Second Edition. Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC.

2. IRIS, 1998. Integrated Risk Information System. # 271: Lead. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. Cincinnati, Ohio.

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CERTIFICATION

This Health Consultation was prepared by the Texas Department of Health under the 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.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

ERRATA

HEALTH CONSULTATION

Lower Galveston Bay
Galveston, Galveston County, Texas

dated September 29, 1999

Entered 15 February 2000

1. Page 5, Table 1. Comparison of Contaminant Concentrations in . . . DDE Range reads 0 - 11. Correction **from** 0 - **11 to** 0 - **0.011**

5. Original Data Tables: PESTICIDES IN FISH AND CRAB TISSUE (GALVESTON BAY) MAY/JUNE, 1998, SNAKE ISLAND: Sample **GAL92A-52**: **DDE** concentration reads 583. Correction: from 583 to **5.83**

PLEASE NOTE: The DDE CONCENTRATION OF SAMPLE GAL92A-52 in the datafile named F:\SSD\SEAFOOD\GAL98.GRT *HAS BEEN CHANGED* TO REFLECT THE CORRECTION OUTLINED IN ERRATUM #2, THIS PAGE