Characterization of Potential Adverse Health Effects Associated with Consuming Fish from the

Lavaca-Matagorda Bay Estuary

2013

Department of State Health Services
Division for Regulatory Services
Policy, Standards, and Quality Assurance Unit
Seafood and Aquatic Life Group
Austin, Texas

INTRODUCTION

This document summarizes the results of a survey of the Lavaca-Matagorda Bay Estuary conducted in the summer of 2012 by the Texas Department of State Health Service (DSHS) Seafood and Aquatic Life Group (SALG). The Texas Environmental Health Institute[1] (TEHI) provided project financial support. Over 1.1 million people participate in saltwater fishing activities in Texas annually.[2] Recreational saltwater fishing in Texas represents a $1.8 billion per year industry. In 1988, the Texas Department of Health (TDH), now the DSHS, issued Aquatic Life Order Number 1 (AL-1).[3] AL-1 prohibited the taking of finfish and crabs from a delineated area of Lavaca and Cox Bays due to mercury contamination. Mercury contamination in Lavaca Bay is attributed to wastewater discharge from a chloralkali plant that the Aluminum Company of America (ALCOA) Point Comfort Operation in Calhoun County, Texas, operated from 1965 to 1979. During 1999, additional fish and blue crab tissue monitoring in Cox Bay indicated that mercury concentrations decreased to acceptable levels. In 2000, TDH issued Aquatic Life Order Number 13 (AL-13; Figure 1).[4] AL-13 modified the prohibited area defined in AL-1 to exclude Cox Bay. Since the follow-up monitoring of Cox Bay in 1999, the DSHS has not conducted any seafood contaminant monitoring in the Lavaca-Matagorda Bay Estuary. This report will assess the current mercury-related human health risks associated with consumption of select seafood from the Lavaca-Matagorda Bay Estuary. This report also addresses the public health implications of consuming seafood from the Lavaca-Matagorda Bay Estuary and suggests actions to reduce potential adverse health outcomes.

Description of the Lavaca-Matagorda Bay Estuary

The Colorado-Lavaca Estuary, Lavaca-Matagorda Bay System, or Lavaca-Matagorda Bay Estuary (hereinafter referred to as Lavaca-Matagorda Bay Estuary) is located along the upper-mid coast of Texas.[5] It is the second largest estuary in Texas, with an area of 244,490 acres. The estuary is composed of two primary bays: Lavaca Bay and Matagorda Bay and several smaller bays including Carancahua Bay, Chocolate Bay, Cox Bay, Keller Bay, Powderhorn Lake, Tres Palacios Bay, and Turtle Bay. The estuary receives freshwater inflow from the Colorado River via a diversion channel, Lavaca River, Tres Palacios River, and several small surrounding coastal watersheds. The Matagorda Peninsula separates Matagorda Bay from the Gulf of Mexico. Two direct passes connect Matagorda Bay to the Gulf of Mexico: Pass Cavallo, a natural pass, and the entrance channel of the Matagorda Ship Channel. Other prominent characteristics include the Gulf Intracoastal Waterway, which transects Matagorda Bay from southeast to northeast.

Demographics of the Area Surrounding the Lavaca-Matagorda Bay Estuary

The United States Census Bureau (USCB) estimated the 2012 population of the four counties–Calhoun, Jackson, Matagorda, and Victoria–surrounding the Lavaca-Matagorda Bay Estuary at 161,680 people.[6] Thirty-nine percent of the four county area population resides within the Victoria, Texas, city limits.

Lavaca-Matagorda Bay Estuary Subsistence Fishing

The United States Environmental Protection Agency (USEPA) suggests that, along with ethnic characteristics and cultural practices of an area's population, the poverty rate could contribute to any determination of the rate of subsistence fishing in an area.[7] The DSHS finds, in concert with the USEPA, that it is important to consider the possible occurrence of subsistence fishing at a water body because subsistence fishers (as well as recreational anglers and certain tribal and ethnic groups) usually consume more locally caught fish than the general population. These groups sometimes harvest fish or shellfish from the same water body over many years to supplement caloric and protein intake. Should local water bodies contain chemically contaminated fish or shellfish, people who routinely eat fish from the water body or those who eat large quantities of fish from the same waters, could increase their risk of adverse health effects. The USEPA suggests that states assume that at least 10% of licensed fishers in any area are subsistence fishers. Subsistence fishing, while not explicitly documented by the DSHS, likely occurs. The DSHS assumes the rate of subsistence fishing to be similar to that estimated by the USEPA.

METHODS

Fish Sampling, Preparation, and Analysis

The DSHS SALG collects and analyzes edible fish from the state's public waters to evaluate potential risks to the health of people consuming contaminated fish or shellfish. Fish tissue sampling follows standard operating procedures from the DSHS *Seafood and Aquatic Life Group Survey Team Standard Operating Procedures and Quality Control/Assurance Manual.*[8] The SALG bases its sampling and analysis protocols, in part, on procedures recommended by the USEPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1.*[9] Advice and direction are also received from the legislatively mandated *State of Texas Toxic Substances Coordinating Committee (TSCC) Fish Sampling Advisory Subcommittee (FSAS).*[10] Samples usually represent species, trophic levels, and legal-sized specimens available for consumption from a water body. When practical, the DSHS collects samples from two or more sites within a water body to better characterize geographical distributions of contaminants.

Fish Sampling Methods and Description of the Lavaca-Matagorda Bay Estuary Sample Set

In May–October 2012, the SALG staff collected 657 seafood samples from the Lavaca-Matagorda Bay Estuary. The SALG risk assessors used these data to assess the potential for adverse human health outcomes from consuming mercury-contaminated seafood from the Lavaca-Matagorda Bay Estuary.

The SALG selected 17 sites or general areas as sample collection locations for seafood in the Lavaca-Matagorda Bay Estuary (Figure 2). The SALG collected oyster samples from known areas of commercial and recreational harvest and/or oyster resource production within the Lavaca-Matagorda Bay Estuary (Figure 2). Not all oyster collection locations coincide with the 17 sample collection locations. Oyster samples are listed by sample site (1–17) within the closest proximity to the actual oyster sample collection location. Species collected represent distinct

ecological groups (i.e. predators and bottom-dwellers) that have some potential to bio-accumulate chemical contaminants, have a wide geographic distribution, are of local recreational fishing value, and/or that fishers and their families commonly consume. The 657 seafood samples collected from the Lavaca-Matagorda Bay Estuary represent all species targeted for collection from this body of water (Table 1). Seafood samples collected for this project are listed in descending order by the number collected of each target species in parentheses: black drum (131), gafftopsail catfish (128), blue crab (83), eastern oyster (75), southern flounder (46), sheepshead (44), spotted seatrout (39), red drum (38), hardhead catfish (35), blacktip shark (10), sand trout (7), tripletail (6), alligator gar (5), bull shark (5), whiting (3), atlantic stingray (1), and bonnethead shark (1).

The SALG survey team set gill nets at the 17 sample sites (Figure 2). All gill nets were set in late afternoon, fished overnight, and retrieved early the following morning. The SALG gill nets were set at locations to maximize available cover and habitat within the general sample areas. During gill net retrieval and sample collection, to keep specimens from different sample sites separated, the survey team placed samples from each site into mesh bags labeled with the site number. The survey team immediately stored fish samples on wet ice in large insulated chests to ensure interim preservation. Survey team members returned to the bay any live fish culled from the catch and properly disposed of samples found dead in the gill nets. The SALG survey team deployed a boat-towed oyster dredge to collect oyster samples. The survey team immediately stored oyster samples on wet ice in large insulated chests to ensure interim preservation. Survey team members returned to the bay any oysters culled from the catch. The SALG staff also utilized hook-and-line sampling techniques to collect a small portion of the fish samples for this project. The SALG staff immediately stored caught fish, selected as samples, on wet ice in large insulated chests to ensure interim preservation. The SALG staff released any live fish culled from the catch or not selected as a fish sample for this project.

The SALG staff processed all fish samples either onsite at the bay or the SALG storage facility in Port Lavaca, Texas**.** The SALG staff weighed most fish samples to the nearest gram (g) on an electronic scale and measured total length (tip of nose to tip of tail fin) to the nearest millimeter (mm). After weighing and measuring each fish, staff used a cutting board covered with aluminum foil and a fillet knife to prepare one skin-off fillet from each fish. The skin-off fillet consisted of a minimum 50-gram dorsal epaxial muscle tissue with skin removed. The foil was changed and the knife cleaned with distilled water after each sample was processed. The SALG staff measured carapace width (CW; tip of lateral spine to tip of lateral spine) to the nearest mm for blue crab samples. Then the SALG staff removed the top shell from each blue crab to expose the internal body cavity, after which staff detached the feathery gills just proximal to the legs from the body cavity along with all loose viscera and mouthparts; the staff thoroughly rinsed the body cavity of each crab with distilled water. The SALG staff wrapped each fillet or eviscerated blue crab bodies in two layers of fresh aluminum foil, placed in an unused, clean, pre-labeled plastic freezer bag, and stored in the SALG Port Lavaca field office freezer for temporary storage. The SALG staff used oyster knives to shuck oyster samples directly into clean mason jars, placing the oyster-containing mason jars in the SALG Port Lavaca field office freezer for temporary storage. An oyster sample is a composite of approximately 10 oysters measuring at least three inches by greatest length of the shell. The SALG staff transported tissue samples on wet ice to their Austin, Texas, headquarters, where the samples were stored temporarily at -5°

Fahrenheit (-20° Celsius) in a locked freezer. The freezer key is accessible only to authorized SALG staff members to ensure the chain of custody while samples are in the possession of agency staff. The SALG delivered the frozen fish tissue samples to the Geochemical and Environmental Research Group (GERG) laboratory, Texas A&M University, College Station, Texas, for mercury analysis.

Analytical Laboratory Information

Upon arrival of the seafood tissue samples at the laboratory, the GERG laboratory personnel documented receipt of the 657 Lavaca-Matagorda Bay Estuary seafood samples and recorded the condition of each sample along with its DSHS identification number. Using established USEPA methods, the GERG laboratory analyzed 657 seafood tissue samples from the Lavaca-Matagorda Bay Estuary for mercury.[11]

Details of Mercury Analyses with Explanatory Notes

Nearly all mercury in upper trophic level fish three years of age or older is methylmercury.[12] Thus, the total mercury concentration in a fish of legal size for possession in Texas serves well as a surrogate for methylmercury concentration. Because methylmercury analyses are difficult to perform accurately and are more expensive than total mercury analyses, the USEPA recommends that states determine total mercury concentration in a fish and that – to protect human health – states conservatively assume that all reported mercury in fish or shellfish is methylmercury. The GERG laboratory thus analyzed fish tissues for total mercury. In its risk characterizations, the DSHS compares mercury concentrations in tissues to a comparison value derived from the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk level (MRL) for methylmercury.[13] (In these risk characterizations, the DSHS may interchangeably utilize the terms "mercury," "methylmercury," or "organic mercury" to refer to methylmercury in fish).

Derivation and Application of Health-Based Assessment Comparison Values for Systemic Effects (HAC_{nonca}) of Consumed Chemical Contaminants

The effects of exposure to any hazardous substance depend, among other factors, on the dose, the route of exposure, the duration of exposure, the manner in which the exposure occurs, the presence of other chemicals, and the genetic makeup, personal traits, or habits of the exposed.[14] People who regularly consume contaminated fish or shellfish conceivably experience repeated low-dose exposures to contaminants in fish or shellfish over extended periods (episodic exposures to low doses). Such exposures are unlikely to result in acute toxicity but may increase risk of subtle, chronic, and/or delayed adverse health effects that may include cancer, benign tumors, birth defects, infertility, blood disorders, brain damage, peripheral nerve damage, lung disease, and kidney disease.[14]

If diverse species of fish or shellfish are available, the SALG presumes that people eat a variety of species from a water body. Further, SALG risk assessors assume that most fish species are mobile. The SALG risk assessors may combine data from different fish species and/or sampling sites within a water body to evaluate mean contaminant concentrations of toxicants in all samples

as a whole. This approach intuitively reflects consumers' likely exposure over time to contaminants in fish or shellfish from any water body but may not reflect the reality of exposure at a specific water body or a single point in time. The DSHS reserves the right to project risks associated with ingestion of individual species of fish or shellfish from separate collection sites within a water body or at higher than average concentrations (e.g. the upper 95 percent confidence limit of the mean). The SALG derives confidence intervals by calculating the 95% upper confidence limit of the arithmetic mean (UCLAM) with Systat® statistical software, version 13.1 or from Monte Carlo simulations using software developed by a DSHS medical epidemiologist.[15] The SALG evaluates contaminants in fish or shellfish by comparing the mean or the 95% upper confidence limit of the mean concentration of a contaminant to its health-based assessment comparison (HAC) value for non-cancer or cancer endpoints.

In deriving HAC values for systemic (HAC_{nonca}) effects, the SALG assumes a standard adult weighs 70 kilograms (kg) and consumes 30 grams (g) of fish or shellfish per day (about one eight-ounce meal per week) and uses the USEPA's oral reference doses (RfDs)[16] or the ATSDR's chronic oral minimal risk levels (MRLs).[17] The USEPA defines an RfD as

An estimate of a daily oral exposure for a given duration to the human population (including susceptible subgroups) that is likely to be without an appreciable risk of adverse health effects over a lifetime.[18]

The USEPA also states that the RfD

… is derived from a BMDL (benchmark dose lower confidence limit)*, a NOAEL* (no observed adverse effect level)*, a LOAEL* (lowest observed adverse effect level)*, or another suitable point of departure, with uncertainty/variability factors applied to reflect limitations of the data used. [Durations include acute, short-term, subchronic, and chronic and are defined individually in this glossary]* and *RfDs are generally reserved for health effects thought to have a threshold or a low dose limit for producing effects.*[18]

The ATSDR uses a similar technique to derive its MRLs.[17] The DSHS divides the estimated daily dose derived from the measured concentration in fish tissue by the contaminant's RfD or MRL to derive a hazard quotient (HQ). The USEPA defines a HQ as

…the ratio of the estimated exposure dose of a contaminant (mg/kg/day) to the contaminant's RfD or MRL (mg/kg/day).[19]

Note that, according to the USEPA, a linear increase in the HQ for a toxicant does not imply a linear increase in the likelihood or severity of systemic adverse effects. Thus, a HQ of 4.0 does not mean the dose will be four times as toxic as that same substance would be if the HQ were equal to 1.0. A HQ of 4.0 also does not imply that the risk of adverse events is four times greater or will in fact occur four times as often as if the HQ for the substance in question were 1.0. Rather, the USEPA suggests that a HQ or a hazard index (HI) – defined as the sum of HQs for contaminants to which an individual is exposed simultaneously – that computes to less than 1.0 should be interpreted as "no cause for concern" whereas, a HQ or HI greater than 1.0 "should indicate some cause for concern."

The SALG does not utilize HQs to determine the likelihood of occurrence of adverse systemic health effects. Instead, in a manner similar to the USEPA's decision process, the SALG may utilize computed HQs as a qualitative measurement. Qualitatively, HQs less than 1.0 are unlikely to be an issue while HQs greater than 1.0 might suggest a regulatory action to ensure protection of public health. Similarly, risk assessors at the DSHS may utilize a HQ to determine the need for further study of a water body's fauna. Notwithstanding the above discussion, the oral RfD derived by the USEPA represents chronic consumption. Thus, regularly eating fish containing a toxic chemical, the HQ of which is less than 1.0, is unlikely to cause adverse systemic health effects, whereas routine consumption of fish or shellfish in which the HQ exceeds 1.0 represents a qualitatively unacceptable increase in the likelihood of systemic adverse health outcomes.

Although the DSHS utilizes chemical specific RfDs when possible, if an RfD is not available for a contaminant, the USEPA advises risk assessors to consider evaluating the contaminant by comparing it to the published RfD (or the MRL) of a contaminant of similar molecular structure or one with a similar mode or mechanism of action. For instance, Aroclor® 1260 has no RfD, so the DSHS uses the reference dose for Aroclor 1254 to assess the likelihood of systemic (noncarcinogenic) effects of Aroclor 1260.[17]

In developing oral RfDs and MRLs, federal scientists review the extant literature to devise NOAELs, LOAELs, or benchmark doses (BMDs) from experimental studies. Uncertainty factors are then utilized to minimize potential systemic adverse health effects in people who are exposed through consumption of contaminated materials by accounting for certain conditions that may be undetermined by the experimental data. These include extrapolation from animals to humans (interspecies variability), intra-human variability, and use of a subchronic study rather than a chronic study to determine the NOAEL, LOAEL, or BMD, and database insufficiencies.[16,18] Vulnerable groups such as women who are pregnant or lactating, women who may become pregnant, infants, children, people with chronic illnesses, those with compromised immune systems, the elderly, or those who consume exceptionally large servings are considered sensitive subpopulations by risk assessors and the USEPA and also receive special consideration in calculation of a RfD.[18]

Children's Health Considerations

The DSHS recognizes that fetuses, infants, and children may be uniquely susceptible to the effects of toxic chemicals and suggests that exceptional susceptibilities demand special attention.[20, 21] Windows of special vulnerability (known as "critical developmental periods") exist during development. Critical periods occur particularly during early gestation (weeks 0 through 8) but can occur at any time during development (pregnancy, infancy, childhood, or adolescence) at times when toxicants can impair or alter the structure or function of susceptible systems.[22] Unique early sensitivities may exist after birth because organs and body systems are structurally or functionally immature at birth, continuing to develop throughout infancy, childhood, and adolescence. Developmental variables may influence the mechanisms or rates of absorption, metabolism, storage, or excretion of toxicants. Any of these factors could alter the concentration of toxicant at the target organ(s) or could modulate target organ response to the toxicant. Children's exposures to toxicants may be more extensive than adults' exposures because children

consume more food and liquids in proportion to their body weights than adults consume. Infants can ingest toxicants through breast milk, an exposure pathway that often goes unrecognized. Nonetheless, the advantages of breastfeeding outweigh the probability of significant exposure to infants through breast milk and women are encouraged to continue breastfeeding and to limit exposure of their infants by limiting intake of the contaminated foodstuff. Children may experience effects at a lower exposure dose than might adults because children's organs may be more sensitive to the effects of toxicants. Stated differently, children's systems could respond more extensively or with greater severity to a given dose than would an adult organ exposed to an equivalent dose of a toxicant. Children could be more prone to developing certain cancers from chemical exposures than are adults.[23]

In any case, if a chemical or a class of chemicals is observed to be, or is thought to be, more toxic to fetuses, infants, or children, the constants (e.g., RfD, MRL, or cancer potency factors [CPFs]) are usually modified further to assure the immature systems' potentially greater susceptibilities are not perturbed.[16] Additionally, in accordance with the ATSDR's *Child Health Initiative*[24] and the USEPA's *National Agenda to Protect Children's Health from Environmental Threats,*[25] the DSHS further seeks to protect children from the possible negative effects of toxicants in fish by suggesting that this potentially sensitive subgroup consume smaller quantities of contaminated fish or shellfish than adults consume. Thus, the DSHS recommends that children weighing 35 kg or less and/or who are 12 years of age or younger limit exposure to contaminants in fish or shellfish by eating no more than four ounces per meal of the contaminated species. The DSHS also recommends that consumers spread these meals over time. For instance, if the DSHS issues consumption advice that recommends consumption of no more than two meals per month of a contaminated species, those children should eat no more than 24 meals of the contaminated fish or shellfish per year and should not eat such fish or shellfish more than twice per month.

Data Analysis and Statistical Methods

The SALG risk assessors imported Excel© files into Systat® statistical software, version 13.1 installed on IBM-compatible microcomputers (Dell, Inc), using Systat® to generate descriptive statistics (mean, 95% confidence limits of the arithmetic mean, standard deviation, median, minimum, and maximum concentrations) for mercury.[26] In computing descriptive statistics, SALG risk assessors utilized ½ the reporting limit (RL) for mercury concentrations designated as not detected (ND) or estimated (J-values)[*]. The SALG risk assessors performed correlation and regression analyses to describe relationships between mercury concentration and total length (TL). When appropriate and as needed, the SALG risk assessors $\log_e$-transformed mercury concentrations to improve normality and best fit of the data. The SALG risk assessors used univariate analysis of variance (ANOVA) to consider differences in mercury concentrations in fish between the 17 sample sites and to consider differences in mercury concentrations in fish collected from the current Prohibited Area of Lavaca Bay by sampling event (i.e. 1998, 1989, 1990, 1991, 1993, 1994, 1996, and 2012). Statistical significance was determined at $p \leq 0.05$ for

[*] *"J-value" is standard laboratory nomenclature for analyte concentrations that are detected and reported below the reporting limit (<RL). The reported concentration is considered an estimate, quantitation of which may be suspect and may not be reproducible. The DSHS treats J-Values as "not detected" in its statistical analyses of a sample set.*

all statistical analyses. The SALG employed Microsoft Excel® spreadsheets to generate figures, to compute HAC_{nonca} values for mercury, and to calculate HQs and meal consumption limits for fish from the Lavaca-Matagorda Bay Estuary.[27]

RESULTS

The GERG laboratory completed analyses and electronically transmitted the results of the Lavaca-Matagorda Bay Estuary samples collected in May–October 2012 to the SALG in June–July 2013. The laboratory reported the analytical results for mercury.

For reference, Table 1 contains a list of fish and shellfish samples collected by sample site for this study. Tables 2a–2k present the results of the mercury analyses. Unless otherwise stated, table summaries present the number of samples containing a specific contaminant/number tested, the mean concentration ± 1 standard deviation (68% of samples should fall within one standard deviation of the arithmetic mean in a sample from a normally-distributed population), and, in parentheses under the mean and standard deviation, the minimum and the maximum detected concentrations. Those who prefer to use the range may derive this statistic by subtracting the minimum concentration of a given contaminant from its maximum concentration. In the tables, results may be reported as ND, below detection limit (BDL) for estimated concentrations, or as concentrations at or above the reporting limit (RL). According to the laboratory's quality control/quality assurance materials, estimated concentrations reported as BDL rely upon the laboratory's method detection limit (MDL) or its RL. The MDL is the minimum concentration of an analyte that can be reported with 99% confidence that the analyte concentration is greater than zero, while the RL is the concentration of an analyte reliably achieved within specified limits of precision and accuracy during routine analyses. Mercury concentrations reported below the RL are qualified as "J-values" in the laboratory data report.[28]

MERCURY

All 657 seafood tissue samples evaluated from the Lavaca-Matagorda Bay Estuary contained mercury (Tables 2a–2k). Across all species, mercury concentrations ranged from 0.008 (alligator gar) to 2.490 mg/kg (black drum). The mean mercury concentration for the 657 seafood tissue samples assayed was 0.314±0.408 mg/kg (Table 2i).

The SALG risk assessors performed ANOVA to test for differences in mercury concentration in fish collected from the Lavaca-Matagorda Bay Estuary. Blue crab and eastern oyster samples were not included in this analysis because of the low mercury concentrations, variability of sample sizes across all sample sites, or the absence of samples collected from some sample sites. Fish mercury concentrations differed significantly across the 17 samples sites (F [16, 482] = 20.888, $p < 0.0005$; Figure 3). Games-Howell post-hoc comparisons of fish mercury concentration indicate that the Site 2 (*Prohibited Area*) fish samples had significantly higher mercury concentrations than fish from most sample sites (Table 3).

The SALG risk assessors evaluated the 2012 mercury data by subdividing the Lavaca-Matagorda Bay Estuary into two composite sites: Composite Site 1 delineates the entire Lavaca-Matagorda

Bay Estuary *Outside the Prohibited Area* (Sites 1 and 3–17) and Composite Site 2 delineates the current *Prohibited Area* (Site 2) of Lavaca Bay (Tables 2a–2k).

OUTSIDE the PROHIBITED AREA

All 456 seafood tissue samples assayed from *Outside the Prohibited Area* contained mercury (Table 2j). Across all species, mercury concentrations ranged from 0.008 (alligator gar) to 1.423 mg/kg (gafftopsail catfish). The mean mercury concentration for the 456 seafood tissue samples evaluated was 0.168±0.188 mg/kg (Table 2j).

Alligator gar

Five alligator gar ranging from 38.3 to 51.8 inches TL ($\overline{X}$ – 45.3 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). Currently, there is no length limit for alligator gar in Texas waters.[34] Mercury concentrations ranged from BDL to 0.151 mg/kg with a mean of 0.068±0.053 and a median of 0.057 mg/kg (Table 2j).

Black drum

One-hundred black drum ranging from 14.4 to 41.9 inches TL ($\overline{X}$ – 21.3 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). Ninety percent of the black drum samples examined were of legal size (14 – 30 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.032 to 1.003 mg/kg with a mean of 0.150±0.154 and a median of 0.096 mg/kg (Table 2j). Mercury concentrations in black drum from *Outside the Prohibited Area* were positively related to TL ($r^2 = 0.322$, $n = 100$, $p < 0.0005$; Figure 4).

Blacktip shark

Eight blacktip shark ranging from 24.9 to 57.9 inches TL ($\overline{X}$ – 43.3 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the blacktip shark samples examined were of legal size (≥ 24 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.088 to 0.739 mg/kg with a mean of 0.348±0.217 and a median of 0.300 mg/kg (Table 2j). Mercury concentrations in blacktip shark from *Outside the Prohibited Area* were positively related to TL ($r^2 = 0.480$, $n = 8$, $p = 0.057$; Figure 5).

Blue crab

Seventy-two blue crab ranging from 5.0 to 7.1 inches CW ($\overline{X}$ – 5.8 inches CW) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the blue crab samples examined were of legal size (≥ 5 inches CW) for Texas waters.[34] Mercury concentrations ranged from 0.012 to 0.218 mg/kg with a mean of 0.067±0.040 and a median of 0.058 mg/kg (Table 2j). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and CW for blue crab *Outside the Prohibited Area*. There was no correlation between the two variables ($r = 0.113$, $n = 72$, $p = 0.345$).

Bull shark

Five bull shark ranging from 29.9 to 48.0 inches TL ($\overline{X}$ – 38.0 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the bull shark samples examined were of legal size (≥ 24 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.159 to 0.691 mg/kg with a mean of 0.438±0.205 and a median of 0.482 mg/kg (Table 2j).

Eastern Oyster

Fifty composite eastern oyster samples were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the composite eastern oyster samples were of legal size (single eastern oyster ≥ 3 inches as measured by the greatest length of the shell) for Texas waters.[34] Mercury concentrations ranged from 0.009 to 0.053 mg/kg with a mean of 0.022±0.013 and a median of 0.014 mg/kg (Table 2j).

Gafftopsail catfish

Sixty-five gafftopsail catfish ranging from 16.1 to 24.7 inches TL ($\overline{X}$ – 20.4 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the gafftopsail catfish samples examined were of legal size (≥ 14 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.152 to 1.423 mg/kg with a mean of 0.437±0.230 and a median of 0.392 mg/kg (Table 2j). Mercury concentrations in gafftopsail catfish from *Outside the Prohibited Area* were positively related to TL ($r^2 = 0.116$, $n = 65$, $p = 0.006$; Figure 6).

Hardhead catfish

Thirty hardhead catfish ranging from 12.0 to 18.2 inches TL ($\overline{X}$ – 14.7 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). Currently, there is no length limit for hardhead catfish in Texas waters.[34] Mercury concentrations ranged from 0.094 to 0.868 mg/kg with a mean of 0.283±0.199 and a median of 0.203 mg/kg (Table 2j). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL for hardhead catfish *Outside the Prohibited Area*. There was no correlation between the two variables ($r = 0.157$, $n = 30$, $p = 0.406$).

Red drum

Sixteen red drum ranging from 20.3 to 24.9 inches TL ($\overline{X}$ – 22.1 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the red drum samples examined were of legal size (20 – 28 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.060 to 0.234 mg/kg with a mean of 0.131±0.052 and a median of 0.132 mg/kg (Table 2j). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL for red drum *Outside the Prohibited Area*. There was no correlation between the two variables ($r = -0.288$, $n = 16$, $p = 0.280$).

Sand trout

Five sand trout ranging from 9.4 to 11.4 inches TL ($\overline{X}$ – 10.1 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). Currently, there is no length limit for sand trout in Texas waters.[34] Mercury concentrations ranged from 0.044 to 0.055 mg/kg with a mean of 0.049±0.004 mg/kg (Table 2j).

Sheepshead

Thirty-eight sheepshead ranging from 15.1 to 20.5 inches TL ($\overline{X}$ – 16.9 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the sheepshead samples examined were of legal size (≥ 15 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.010 to 0.306 mg/kg with a mean of 0.104±0.055 and a median of 0.098 mg/kg (Table 2j). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL for sheepshead *Outside the Prohibited Area*. There was no correlation between the two variables (r = 0.250, n = 38, p = 0.130).

Southern flounder

Twenty-three southern flounder ranging from 14.0 to 19.7 inches TL ($\overline{X}$ – 16.7 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the southern flounder samples examined were of legal size (≥ 14 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.036 to 0.181 mg/kg with a mean of 0.085±0.036 and a median of 0.083 mg/kg (Table 2j). Mercury concentrations in southern flounder from *Outside the Prohibited Area* were positively related to TL (r^2 = 0.175, n = 23, p = 0.047; Figure 7).

Southern kingfish "Whiting"

Three southern kingfish ranging from 11.9 to 14.0 inches TL ($\overline{X}$ – 13.0 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). Currently, there is no length limit for southern kingfish in Texas waters.[34] Mercury concentrations ranged from 0.056 to 0.405 mg/kg with a mean of 0.275±0.191 and a median of 0.363 mg/kg (Table 2j).

Spotted seatrout

Twenty-nine spotted seatrout ranging from 15.1 to 17.7 inches TL ($\overline{X}$ – 16.1 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the spotted seatrout samples examined were of legal size (15 – 25 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.058 to 0.298 mg/kg with a mean of 0.131±0.064 and a median of 0.117 mg/kg (Table 2j). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL for spotted seatrout *Outside the Prohibited Area*. There was no correlation between the two variables (r = 0.226, n = 29, p = 0.237).

Tripletail

Five tripletail ranging from 17.0 to 23.2 inches TL ($\overline{X}$ – 19.0 inches TL) were analyzed for mercury from *Outside the Prohibited Area* (Table 1). One-hundred percent of the tripletail samples examined were of legal size (≥ 17 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.029 to 0.097 mg/kg with a mean of 0.060±0.025 and a median of 0.054 mg/kg (Table 2j).

PROHIBITED AREA

All 201 seafood tissue samples assayed from the *Prohibited Area* contained mercury (Table 2k). Across all species, mercury concentrations ranged from 0.020 (southern flounder) to 2.490 mg/kg (black drum). The mean mercury concentration for the 201 seafood tissue samples evaluated was 0.646±0.553 mg/kg (Table 2k).

The SALG risk assessors performed ANOVA to test for differences in mercury concentration in fish collected from the Prohibited Area of Lavaca Bay by sampling event (i.e. 1988, 1989, 1990, 1991, 1993, 1994, 1996, and 2012). Games-Howell post-hoc comparisons of *Prohibited Area* fish mercury concentrations indicate that mercury concentrations do not statistically differ by sampling event (F [7, 402] = 2.667, p = 0.010; Figure 8; Table 4).

Black drum

Thirty-one black drum ranging from 14.6 to 39.2 inches TL ($\overline{X}$ – 21.9 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). Eighty-four percent of the black drum samples examined were of legal size (14 – 30 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.031 to 2.490 mg/kg with a mean of 0.882±0.593 and a median of 0.809 mg/kg (Table 2k). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL. There was no correlation between the two variables (r = 0.121, n = 31, p = 0.517).

Blacktip shark

Two blacktip shark ranging from 39.6 to 43.9 inches TL ($\overline{X}$ – 41.7 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the blacktip shark samples examined were of legal size (≥ 24 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.688 to 0.721 mg/kg with a mean of 0.704±0.023 mg/kg (Table 2k).

Blue crab

Eleven blue crab ranging from 5.2 to 6.5 inches CW ($\overline{X}$ – 6.0 inches CW) were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the blue crab samples examined were of legal size (≥ 5 inches CW) for Texas waters.[34] Mercury concentrations ranged from 0.057 to 0.327 mg/kg with a mean of 0.152±0.092 and a median of 0.123 mg/kg (Table 2k). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess

the relationship between mercury concentration and CW. There was no correlation between the two variables ($r = 0.349$, $n = 11$, $p = 0.292$).

Eastern Oyster

Twenty-five composite eastern oyster samples were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the composite eastern oyster samples were of legal size (single eastern oyster ≥ 3 inches as measured by the greatest length of the shell) for Texas waters.[34] Mercury concentrations ranged from 0.026 to 0.096 mg/kg with a mean of 0.052±0.020 and a median of 0.046 mg/kg (Table 2k).

Gafftopsail catfish

Sixty-three gafftopsail catfish ranging from 16.3 to 24.4 inches TL ($\overline{X}$ – 20.2 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the gafftopsail catfish samples examined were of legal size (≥ 14 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.263 to 2.261 mg/kg with a mean of 0.856±0.415 and a median of 0.856 mg/kg (Table 2k). Mercury concentrations in gafftopsail catfish exhibited a positive relationship to TL ($r^2 = 0.065$, $n = 63$, $p = 0.044$; Figure 9).

Hardhead catfish

Five hardhead catfish ranging from 12.6 to 16.6 inches TL ($\overline{X}$ – 13.7 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). Currently, there is no length limit for hardhead catfish in Texas waters.[34] Mercury concentrations ranged from 0.094 to 1.703 mg/kg with a mean of 0.608±0.649 and a median of 0.333 mg/kg (Table 2k).

Red drum

Twenty-two red drum ranging from 19.6 to 26.0 inches TL ($\overline{X}$ – 22.0 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). Ninety-five percent of the red drum samples examined were of legal size (20 – 28 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.482 to 2.159 mg/kg with a mean of 1.330±0.487 and a median of 1.317 mg/kg (Table 2k). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL. There was no correlation between the two variables ($r = -0.145$, $n = 22$, $p = 0.519$).

Sand trout

Two sand trout ranging from 9.9 to 11.7 inches TL ($\overline{X}$ – 10.8 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). Currently, there is no length limit for sand trout in Texas waters.[34] Mercury concentrations ranged from 0.116 to 0.207 mg/kg with a mean of 0.162±0.064 mg/kg (Table 2k).

Sheepshead

Six sheepshead ranging from 15.5 to 22.0 inches TL ($\overline{X}$ – 19.0 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the sheepshead samples examined were of legal size (≥ 15 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.060 to 1.020 mg/kg with a mean of 0.411±0.357 and a median of 0.269 mg/kg (Table 2k).

Southern flounder

Twenty-three southern flounder ranging from 14.0 to 20.8 inches TL ($\overline{X}$ – 16.4 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). One-hundred percent of the southern flounder samples examined were of legal size (≥ 14 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.020 to 0.466 mg/kg with a mean of 0.252±0.118 and a median of 0.238 mg/kg (Table 2k). The SALG risk assessors computed a Pearson product-moment correlation coefficient to assess the relationship between mercury concentration and TL. There was no correlation between the two variables (r = -0.224, n = 23, p = 0.303).

Spotted seatrout

Ten spotted seatrout ranging from 14.9 to 21.0 inches TL ($\overline{X}$ – 16.9 inches TL) were analyzed for mercury from the *Prohibited Area* (Table 1). Ninety percent of the spotted seatrout samples examined were of legal size (≥ 15 inches TL) for Texas waters.[34] Mercury concentrations ranged from 0.169 to 0.578 mg/kg with a mean of 0.314±0.117 and a median of 0.290 mg/kg (Table 2k). Mercury concentrations in spotted seatrout were positively related to TL (r^2 = 0.816, n = 10, p < 0.0005; Figure 10).

DISCUSSION

Risk Characterization

Because variability and uncertainty are inherent to quantitative assessment of risk, the calculated risks of adverse health outcomes from exposure to toxicants can be orders of magnitude above or below actual risks. Variability in calculated and in actual risk may depend upon factors such as the use of animal instead of human studies, use of subchronic rather than chronic studies, interspecies variability, intra-species variability, and database insufficiency. Since most factors used to calculate comparison values result from experimental studies conducted in the laboratory on nonhuman subjects, variability and uncertainty might arise from the study chosen as the "critical" one, the species/strain of animal used in the critical study, the target organ selected as the "critical organ," exposure periods, exposure route, doses, or uncontrolled variations in other conditions.[16] Despite such limitations, risk assessors must calculate parameters to represent potential toxicity to humans who consume contaminants in fish and other environmental media. The DSHS calculated risk parameters for systemic endpoints in those who would consume fish from the Lavaca-Matagorda Bay Estuary. Conclusions and recommendations predicated upon the stated goal of the DSHS to protect human health follow the discussion of the relevance of findings to risk.

Characterization of Systemic (Noncancerous) Health Effects from Consumption of Seafood from the Lavaca-Matagorda Bay Estuary

All 657 seafood samples collected from the Lavaca-Matagorda Bay Estuary in 2012 contained mercury (Tables 2a–2k). Sixteen percent of all samples (n = 657) analyzed contained mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury (0.700 mg/kg). Mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury were observed in one or more samples of the following species: black drum, blacktip shark, bull shark, gafftopsail catfish, hardhead catfish, red drum, and sheepshead.

In most cases, seafood samples examined from the Lavaca-Matagorda Bay Estuary exhibited little to no relationship between mercury concentration and TL or weak positive relationships, indicating that size is not a good predictor of mercury concentration and that other factors contribute to the bioaccumulation and subsequent biomagnification of mercury in seafood from the Lavaca-Matagorda Bay Estuary. These findings are atypical. Generally, in fish, the relationship between mercury concentration and size is a significant, strong positive relationship indicating that mercury concentrations increase as fish grow.

OUTSIDE the PROHIBITED AREA

All 456 seafood samples collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* in 2012 contained mercury (Tables 2j). Four percent of all *Outside the Prohibited Area* seafood samples (n = 456) analyzed contained mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury (0.700 mg/kg). Mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury were observed in one or more samples of the following species: black drum, blacktip shark, bull shark, gafftopsail catfish, and hardhead catfish. No mean mercury concentrations for all size classes assayed of any species of seafood equaled or exceeded the HAC_{nonca} for mercury.

Meal consumption calculations may be useful for decisions about consumption advice or regulatory actions. The SALG risk assessors calculated the number of eight-ounce meals of fish or shellfish from *Outside the Prohibited Area* that healthy adults could consume without significant risk of adverse systemic effects (Tables 5 and 6). Meal consumption rates were calculated by species utilizing the mean mercury concentration and 95% UCLAM. The SALG risk assessors estimated that healthy adults could consume at least one meal per week of any species of fish or shellfish containing mercury from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* (Table 6). The SALG risk assessors find that fish from *Outside the Prohibited Area* do not contain mercury at concentrations that may pose potential systemic human health risks.

PROHIBITED AREA

All 201 seafood samples collected from the Prohibited Area of Lavaca Bay in 2012 contained mercury (Tables 2k). Forty-two percent of all *Prohibited Area* seafood samples (n = 201) analyzed contained mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury (0.700 mg/kg). Mercury concentrations that equaled or exceeded the HAC_{nonca} for mercury were

observed in one or more samples of the following species: black drum, blacktip shark, gafftopsail catfish, hardhead catfish, red drum, and sheepshead. Mean mercury concentrations for all size classes assayed of black drum, blacktip shark, gafftopsail catfish, and red drum equaled or exceeded the HAC_{nonca} for mercury.

Meal consumption calculations may be useful for decisions about consumption advice or regulatory actions. The SALG risk assessors calculated the number of eight-ounce meals of fish or shellfish from the *Prohibited Area* that healthy adults could consume without significant risk of adverse systemic effects (Tables 7 and 8). Meal consumption rates were calculated by species utilizing the mean mercury concentration and 95% UCLAM. The SALG risk assessors estimated that healthy adults could consume 0.7 (eight-ounce) meals per week of black drum, 0.9 meals per week of blacktip shark, 0.8 meals per week of gafftopsail catfish, or 0.5 meals per week of red drum containing mercury (Table 7). The SALG risk assessors find that fish from the *Prohibited Area,* adjacent to a point source of mercury, continue to contain mercury at concentrations that may pose potential systemic human health risks.

Characterization of Potential Exposure to Contaminants from Consumption of Seafood from Lavaca-Matagorda Bay Estuary

Notwithstanding, the 2012 Lavaca-Matagorda Bay Estuary meal consumption calculations, the SALG risk assessors deem it important to consider potential exposure when developing fish consumption advisories. Studies have shown that recoveries and yields from whole fish to skin-off fillets range from 17–58%.[29] The SALG risk assessors used an average of 38% recovery and yield from whole fish to skin-off fillets to estimate the number of eight-ounce meals for an average weight fish of each species from the Lavaca-Matagorda Bay Estuary in 2012 (Table 9). The recoveries and yields for an average fish of each species from the Lavaca-Matagorda Bay Estuary in 2012 ranged from 0.3–13.3 eight-ounce meals. Based on recoveries and yields ($\overline{X}$ – 38%) from whole fish to skin-off fillets for this project, the average Lavaca-Matagorda Bay Estuary fish yields 1.9 pounds of skin-off fillets or approximately 3.8 eight-ounce meals (Table 9). To illustrate the importance of potential exposure from large estuarine fish, let's consider the blacktip shark mean mercury concentration (0.348 mg/kg) from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area*. Based on a mean mercury concentration of 0.348 mg/kg, a person consuming nine eight-ounce meals per month would exceed the MRL. The maximum size blacktip shark (30.9 pounds) for this project yields 11.7 pounds of skin-off fillets, approximately 23 eight-ounce meals. Due to the potential exposure from large-sized fish, it is important for high volume fish consumers (persons who eat more than 2 eight-ounce meals per week) to understand that even though an average fish mercury concentration does not exceed the HAC_{nonca} for mercury a person may consume enough fish meals to exceed the MRL. For the reasons stated in the above discussion, the SALG risk assessors considered both standard meal consumption calculations and other potential exposure scenarios to develop fish consumption advice for seafood from the Lavaca-Matagorda Bay Estuary.

CONCLUSIONS

The SALG risk assessors prepare risk characterizations to determine public health hazards from consumption of fish and shellfish harvested from Texas water bodies by recreational or subsistence fishers. If necessary, the SALG may suggest strategies for reducing risk to the health of those who may eat contaminated fish or shellfish to risk managers at the DSHS, including the Texas Commissioner of Health.

This study addressed only the public health implications of consuming mercury-contaminated seafood from the Lavaca-Matagorda Bay Estuary. It does not consider the potential human health risks associated with other environmental contaminants. Risk assessors from the SALG conclude from the present characterization of potential adverse health effects from consuming fish from the Lavaca-Matagorda Bay Estuary that:

1. Fish and shellfish mean mercury concentrations from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* do not exceed DSHS guidelines for protection of human health. Therefore, consumption of fish and shellfish from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* containing mercury **poses no apparent risk to human health.**

2. Mercury concentrations in fish assayed from the *Prohibited Area* of Lavaca Bay continue to exceed the DSHS guidelines for protection of human health. Regular or long-term consumption of fish may result in adverse systemic health effects. Therefore, consumption of fish from the *Prohibited Area* of Lavaca Bay continues to **pose an apparent risk to human health**.

RECOMMENDATIONS

Risk managers at the DSHS have established criteria for issuing fish consumption advisories based on approaches suggested by the EPA.[9, 11, 30] Risk managers at the DSHS may decide to take some action to protect public health if a risk characterization confirms that people can eat four or fewer meals per month (adults: eight-ounces per meal; children: four ounces per meal) of fish or shellfish from a water body under investigation. Risk management recommendations may be in the form of consumption advice or a ban on possession of fish from the affected water body. Fish or shellfish possession bans are enforceable under subchapter D of the Texas Health and Safety Code, part 436.061(a).[31] Declarations of prohibited harvesting areas are enforceable under the Texas Health and Safety Code, Subchapter D, parts 436.091 and 436.101.[31] Consumption advice issued by the DSHS carries no penalty for noncompliance. Consumption advisories, instead, inform people of potential health hazards associated with consuming contaminated fish or shellfish from Texas waters. People may use this information to make informed decisions about whether and/or how much, contaminated fish or shellfish, they wish to consume.

The SALG concludes from this risk characterization that consuming fish from the *Prohibited Area* of Lavaca Bay continues to **pose an apparent hazard to public health.** Therefore, SALG risk assessors recommend that:

1. The DSHS should continue AL-13 issued January 13, 2000. AL-13 prohibits the harvest of fish and crab species from a small portion of Lavaca Bay known as the *Prohibited Area* of Lavaca Bay. Mercury concentrations of human health concern are limited to a small geographical portion of Lavaca Bay (extant *Prohibited Area* of Lavaca Bay). The SALG risk assessors are of the opinion that the appropriate risk management strategy is to continue to prohibit harvest of fish from the area of Lavaca Bay defined by AL-13. Albeit, the calculated meal consumption rates imply that recommending limited consumption of fish for adults may be appropriate for Lavaca Bay. The SALG risk assessors feel that the continuation of AL-13 is the best strategy to reduce the potential human health risks associated with consumption of seafood from the Lavaca-Matagorda Bay Estuary.

2. As resources become available, the DSHS should continue to monitor seafood from the Lavaca-Matagorda Bay Estuary for changes or trends in contaminants of concern or contaminant concentrations that would require a change in consumption advice.

PUBLIC HEALTH ACTION PLAN

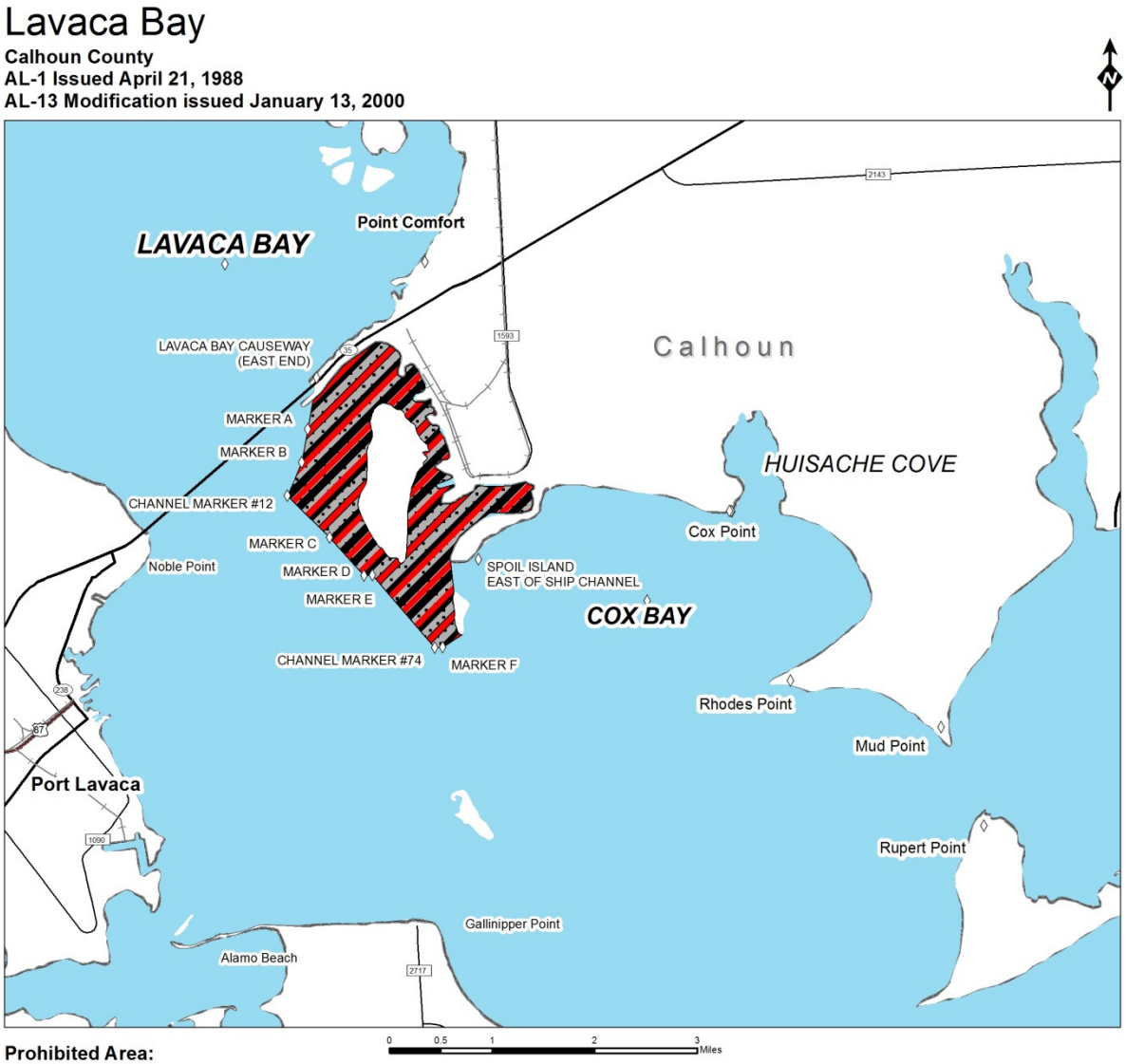
Communication to the public of new and continuing consumption advisories or possession bans, or the removal of either, is essential to effective management of risk from consuming contaminated seafood. In fulfillment of the responsibility for communication, the DSHS takes several steps.

- The agency publishes fish consumption advisories and bans in a booklet available to the public through the SALG. To receive the booklet and/or the data, please contact the SALG at 512-834-6757.[32]
- The SALG also posts the most current information about advisories, bans, and the removal of either on the internet at http://www.dshs.state.tx.us/seafood.[33] The SALG regularly updates this Web site.
- The DSHS also provides EPA (http://epa.gov/waterscience/fish/advisories/), the TCEQ (http://www.tceq.state.tx.us), and the TPWD (http://www.tpwd.state.tx.us) with information on all consumption advisories and possession bans. Each year, the TPWD informs the fishing and hunting public of consumption advisories and fishing bans on its Web site and in an official downloadable PDF file containing general hunting and fishing regulations available at http://www.tpwd.state.tx.us/publications/pwdpubs/media/cs_bk_k0700_284_2013_2014.pdf . A booklet containing this information is also available at all establishments selling Texas fishing licenses.[34]

Communication to the public of scientific information related to this risk characterization and information for environmental contaminants found in seafood is essential to effective risk management. To achieve this responsibility for communication, the DSHS provides contact information to ask specific questions and/or resources to obtain more information about environmental contaminants in seafood.

- Readers may direct questions about the scientific information or recommendations in this risk characterization to the SALG at 512-834-6757 or may find the information at the SALG's Web site (http://www.dshs.state.tx.us/seafood). Secondarily, one may address inquiries to the Environmental and Injury Epidemiology and Toxicology Unit of DSHS (800-588-1248).
- The EPA's IRIS Web site (http://www.epa.gov/iris/) contains information on environmental contaminants found in food and environmental media.
- The ATSDR, Division of Toxicology (888-42-ATSDR or 888-422-8737) or the ATSDR's Web site (http://www.atsdr.cdc.gov) supplies brief information via ToxFAQs.™ ToxFAQs™ are available on the ATSDR Web site in either English (http://www.atsdr.cdc.gov/toxfaq.html) or Spanish (http://www.atsdr.cdc.gov/es/toxfaqs/es _toxfaqs.html). The ATSDR also publishes more in-depth reviews of many toxic substances in its *Toxicological Profiles* (ToxProfiles™) http://www.atsdr.cdc.gov/toxprofiles/index.asp. To request a copy of the ToxProfiles™ CD-ROM, PHS, or ToxFAQs™ call 1-800-CDC-INFO (800-232-4636) or email a request to cdcinfo@cdc.gov.

Figure 1. Aquatic Life Order Number 13 (AL-13) Map



Prohibited Area:
That area of Lavaca Bay inshore of a line beginning at the last point of land at the northeastern approach of the Lavaca Bay Causeway, then in a southwest direction to Aquatic Life Marker A to Aquatic Life Marker B to Channel Marker #12, then in a southeastern direction to Aquatic Life Marker C to Aquatic Life Marker D to Aquatic Life Marker E to Channel Marker #74, then in a northeastern direction to Aquatic Life marker F to the outhernmost point of land on the spoil island east of the ship channel

Contaminant of Concern:
Mercury (Hg)

Restricted Species:
Persons are prohibited from possessing any species of fish or crabs from these waters.

Figure 2. The Lavaca-Matagorda Bay Estuary Sample Sites and Oyster Sample Locations

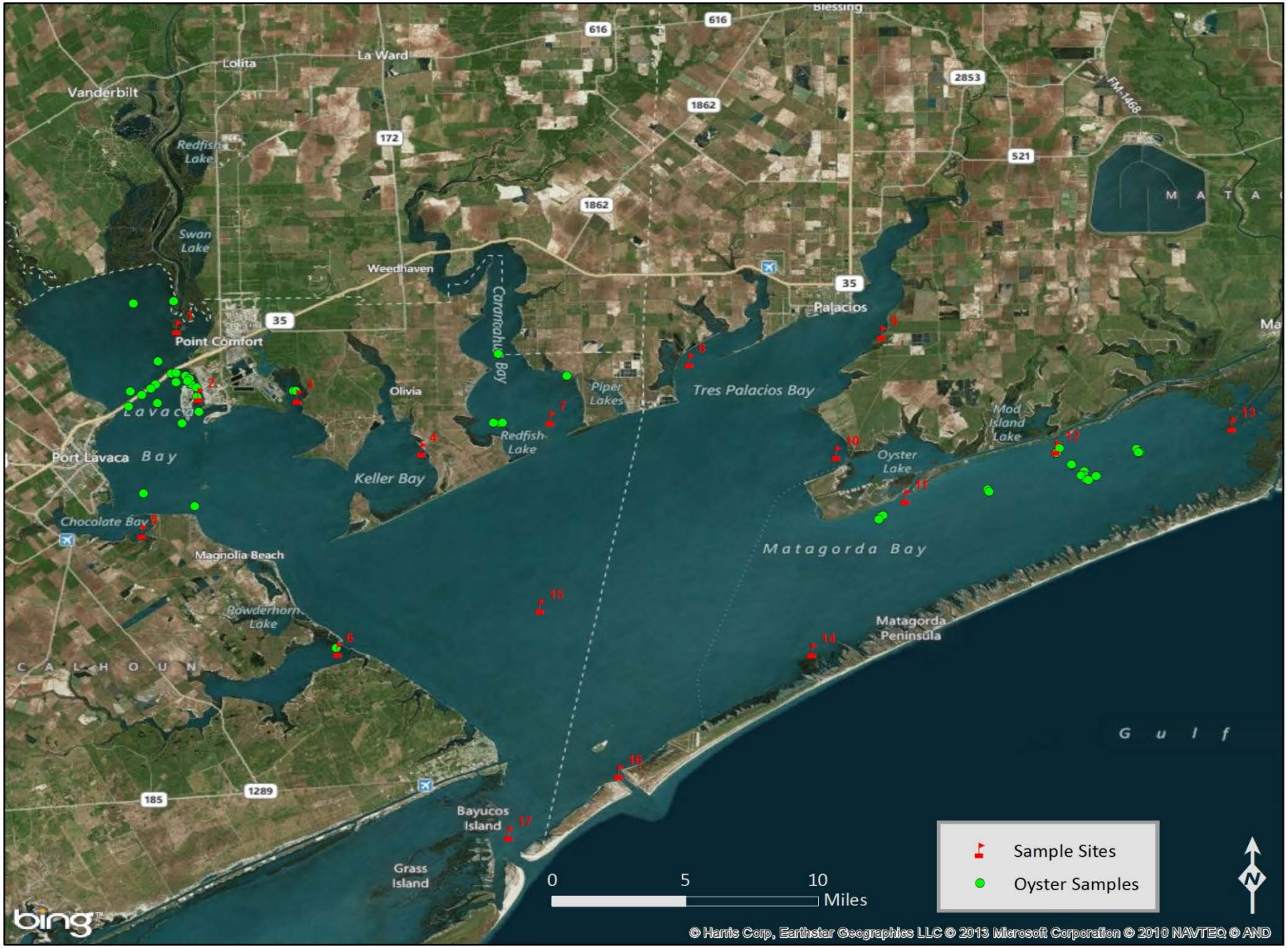


Figure 3. Means plot of mercury (mg/kg, wet wt.) in fish tissue by sample site collected from the Lavaca-Matagorda Bay Estuary, Texas 2012. The error bars denote the 95% confidence interval of the mean.

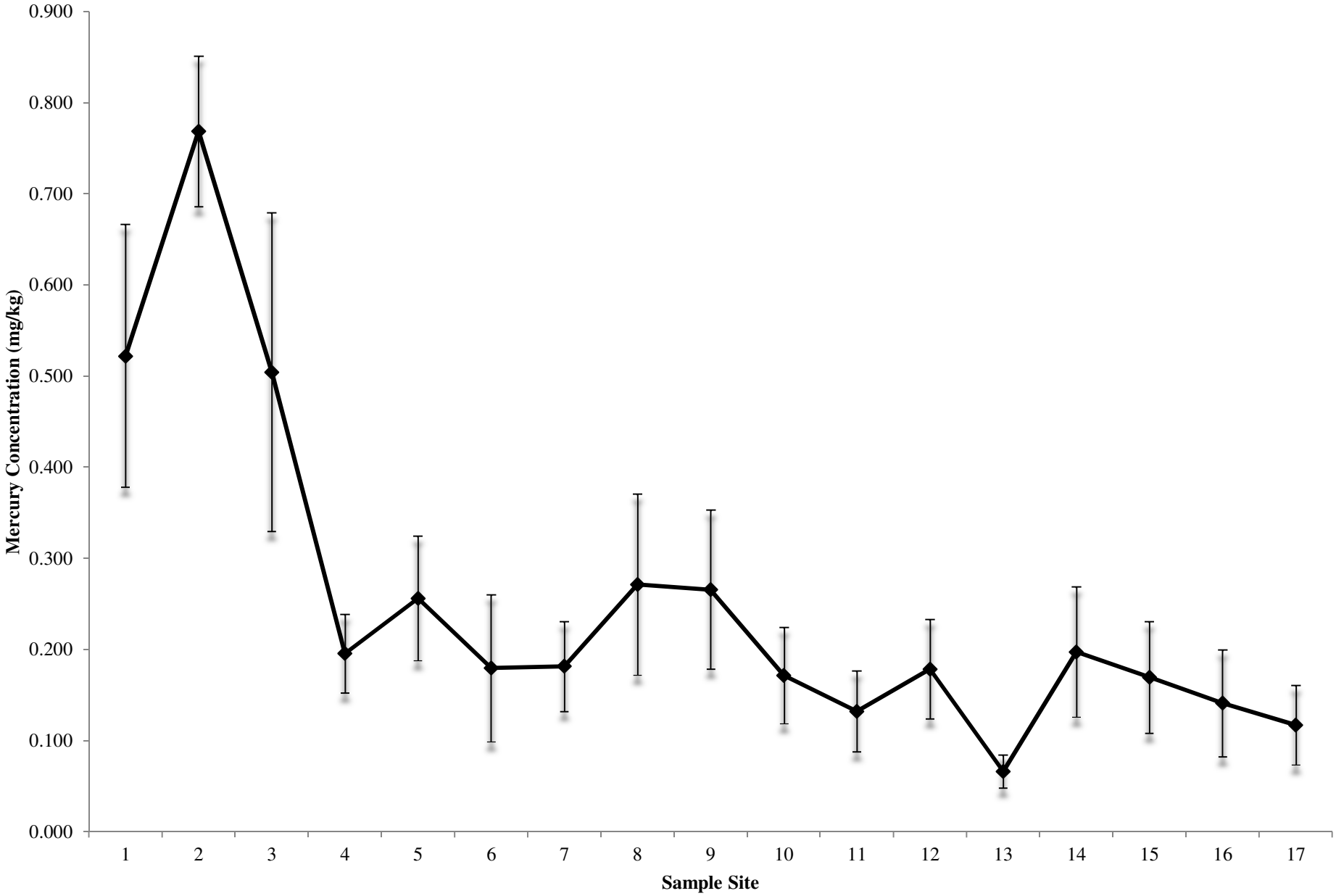


Figure 4. The relationship between mercury concentration and total length for black drum collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area*, Texas 2012.

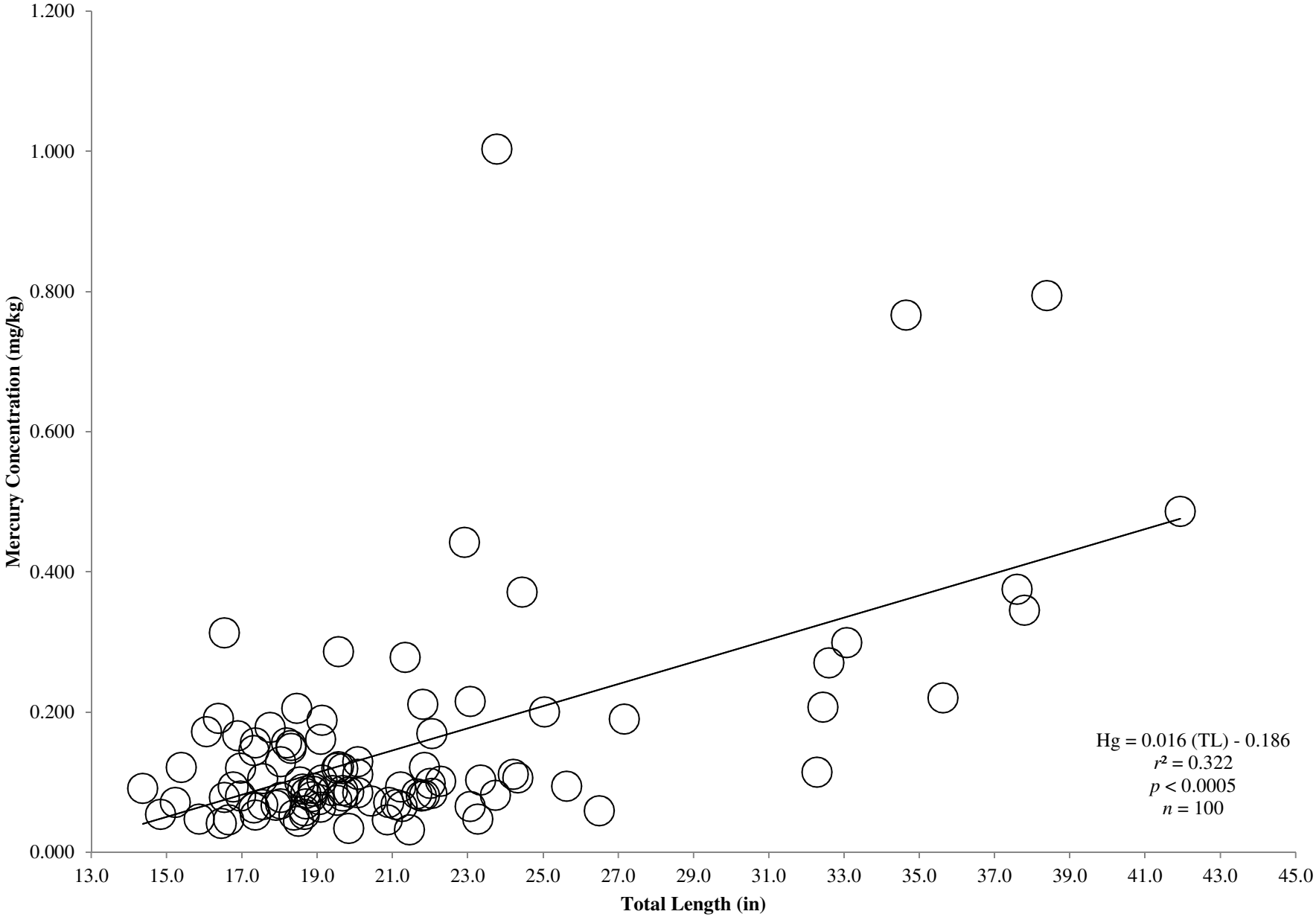


Figure 5. The relationship between mercury concentration and total length for blacktip shark collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area*, Texas 2012.

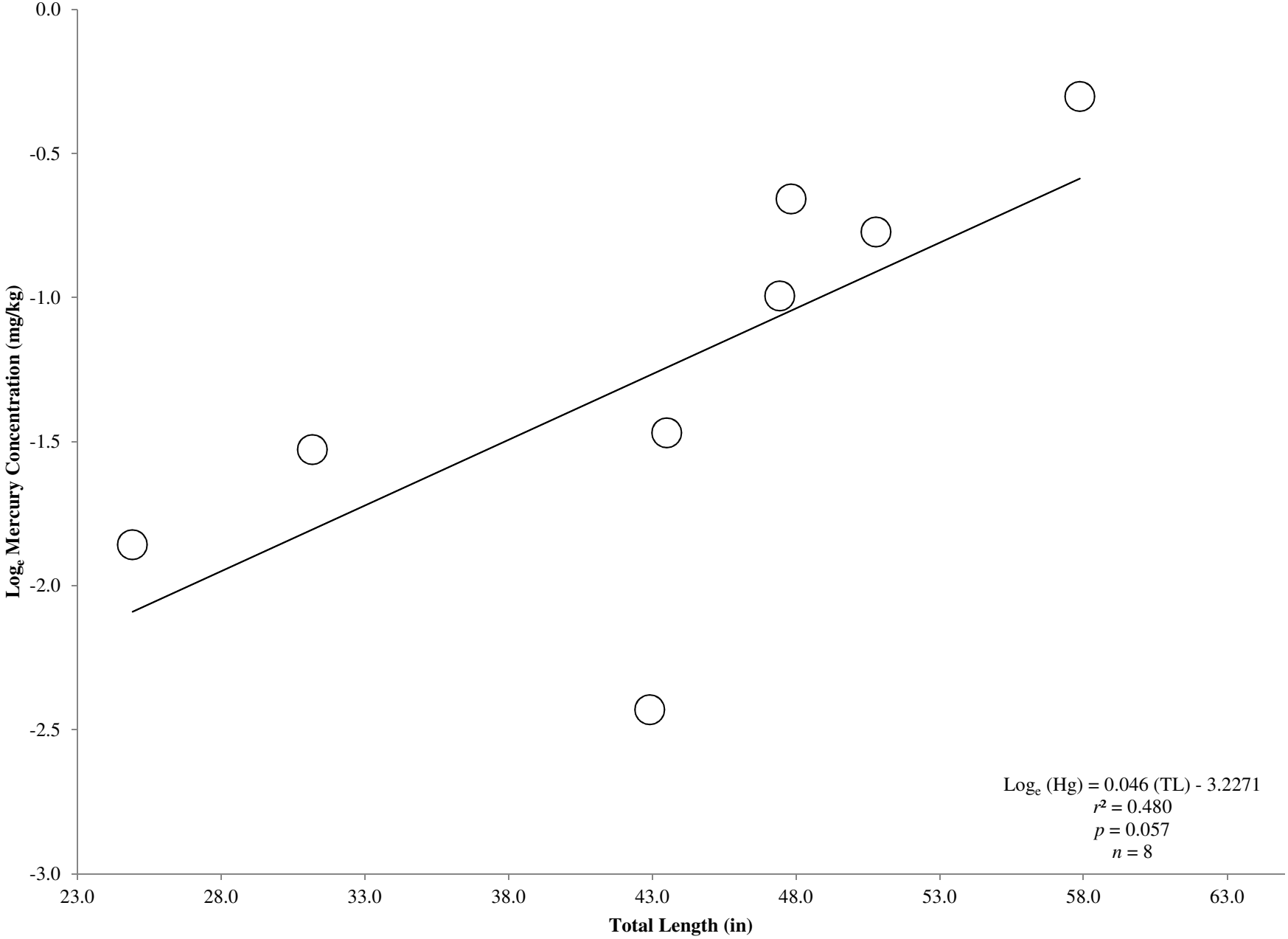


Figure 6. The relationship between mercury concentration and total length for gafftopsail catfish collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area*, Texas 2012.

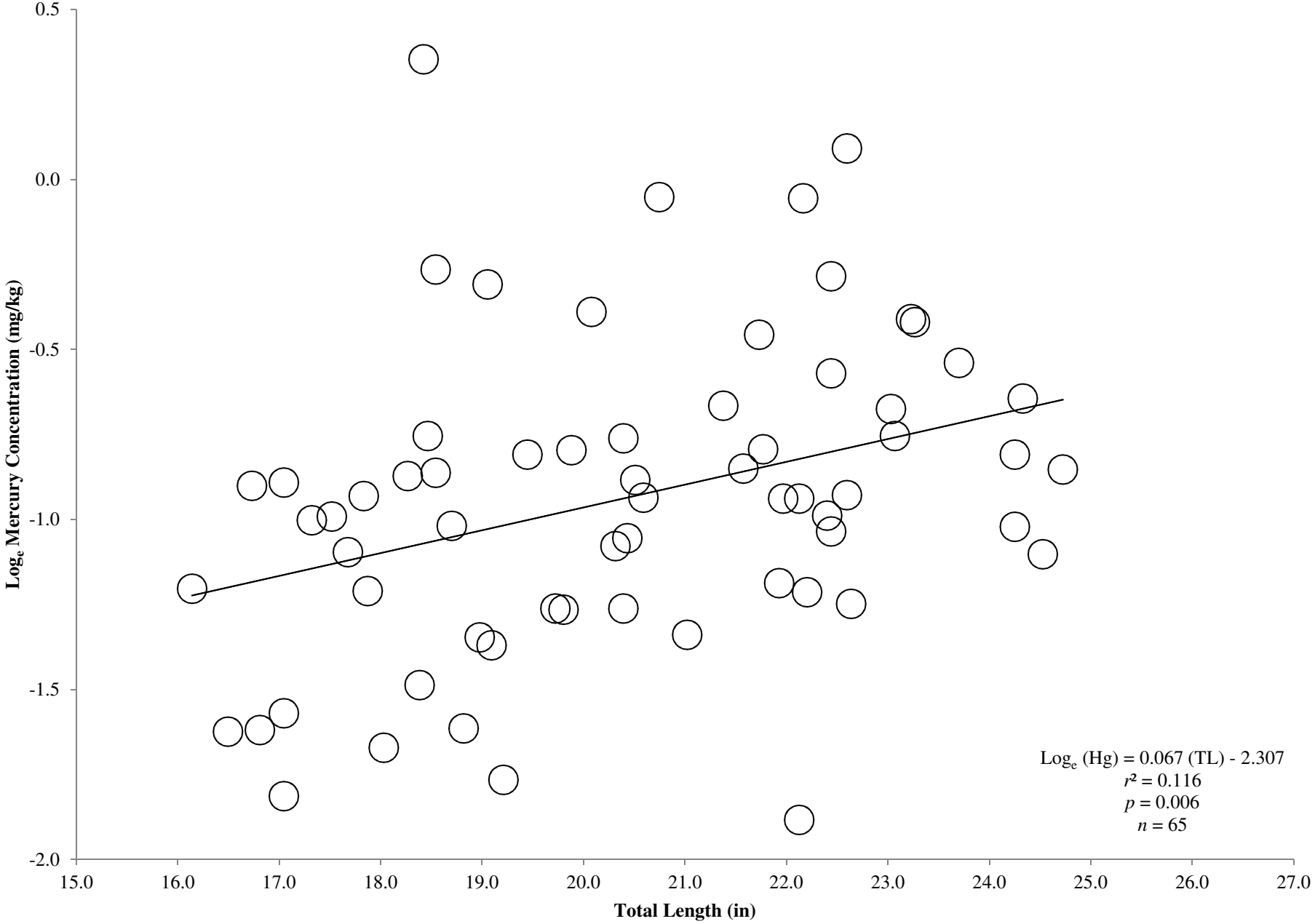


Figure 7. The relationship between mercury concentration and total length for southern flounder collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area*, Texas 2012.

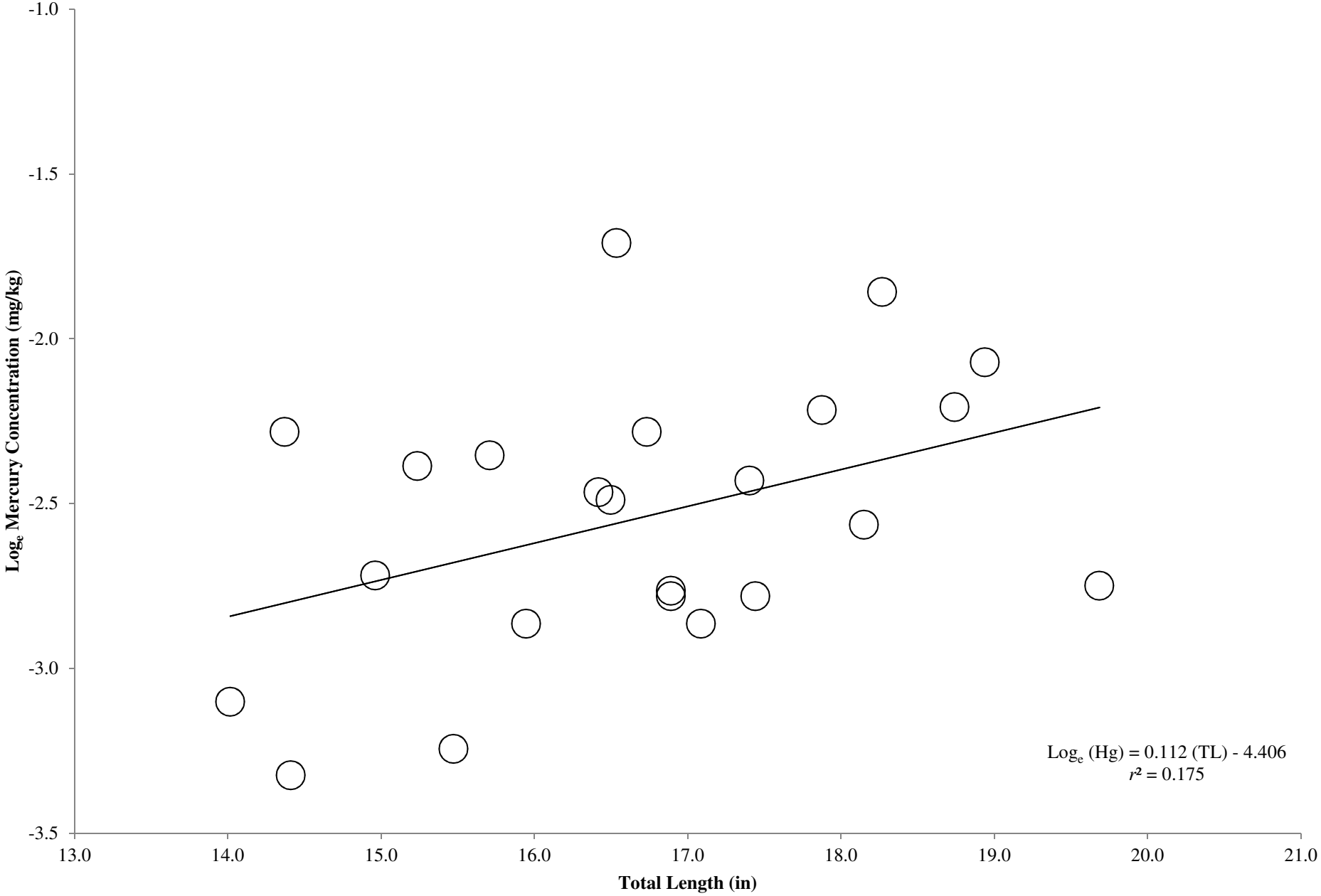


Figure 8. Means plot of mercury (mg/kg, wet wt.) in fish tissue by sampling event collected from the Lavaca-Matagorda Bay Estuary *Prohibited Area*, Texas 2012. The error bars denote the 95% confidence interval of the mean.

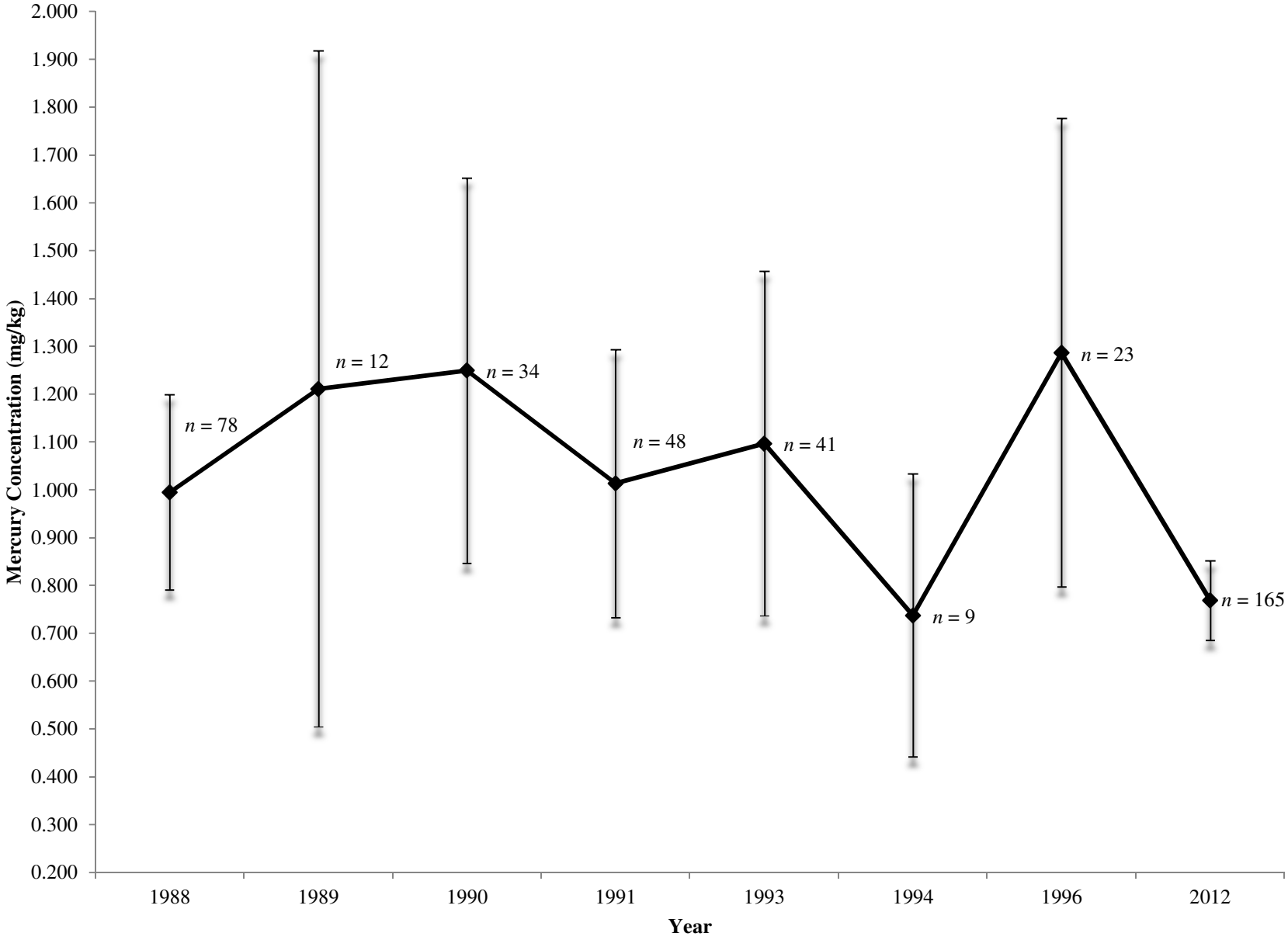


Figure 9. The relationship between mercury concentration and total length for gafftopsail catfish collected from the Lavaca-Matagorda Bay Estuary *Prohibited Area*, Texas 2012.

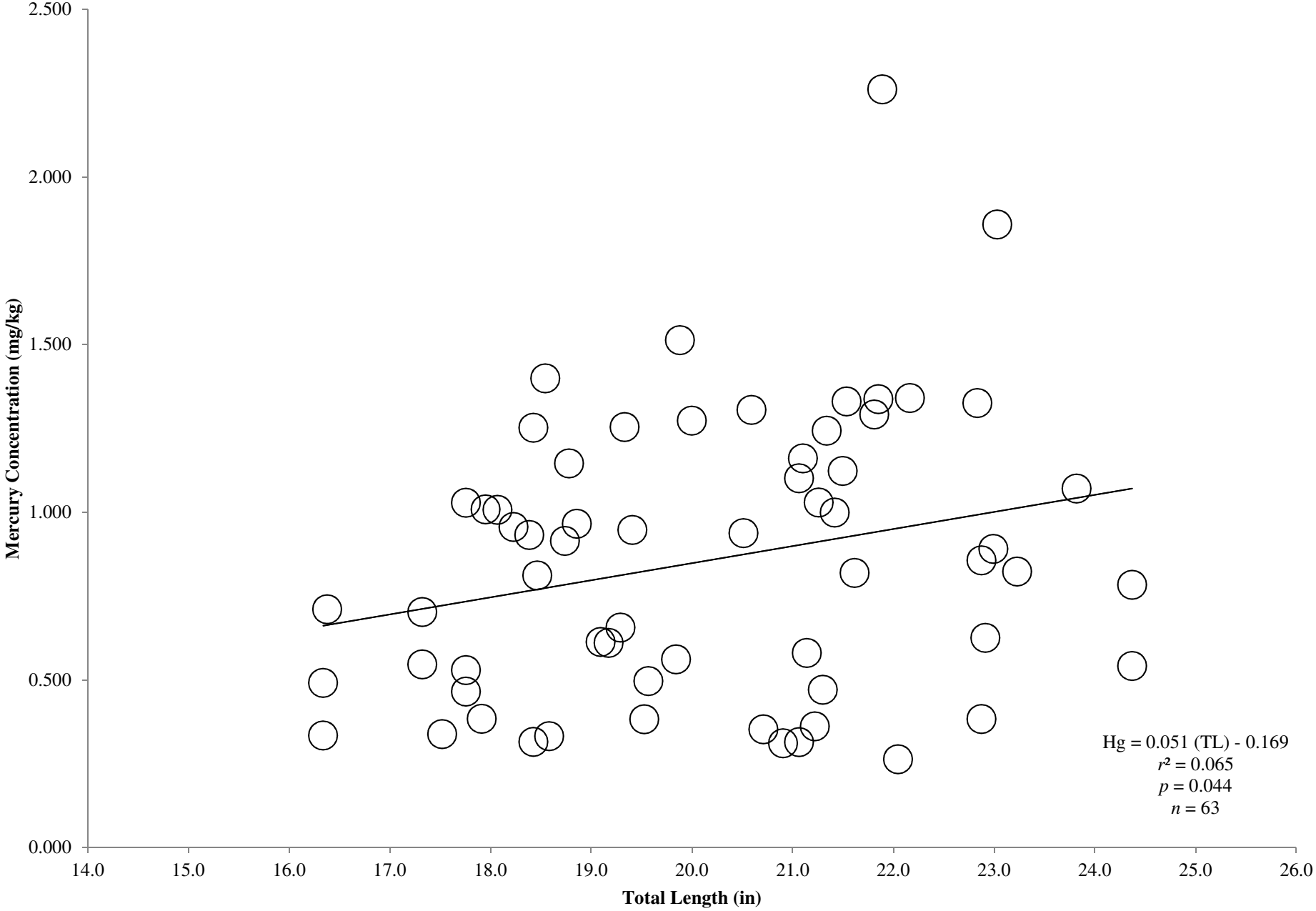
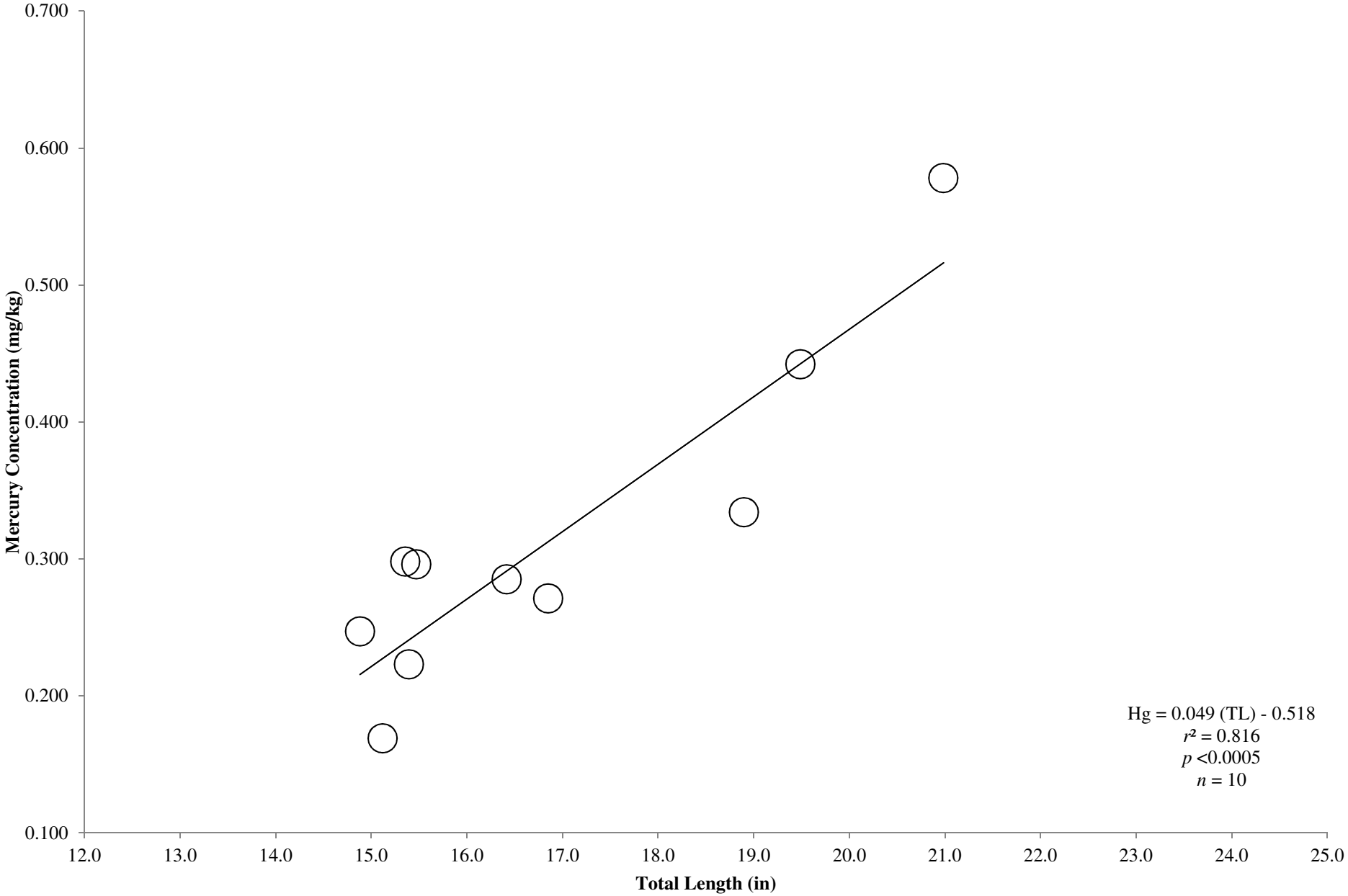


Figure 10. The relationship between mercury concentration and total length for spotted seatrout collected from the Lavaca-Matagorda Bay Estuary *Prohibited Area*, Texas 2012.



TABLES

Table 1. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 1 Lavaca Bay near the mouth of the Lavaca River			
LAV174	Bull shark	1040	N/A
LAV175	Bull shark	770	N/A
LAV176	Bull shark	1030	N/A
LAV177	Bull shark	760	N/A
LAV178	Gafftopsail catfish	519	1257
LAV179	Gafftopsail catfish	469	763
LAV180	Gafftopsail catfish	510	1273
LAV181	Gafftopsail catfish	590	1962
LAV182	Gafftopsail catfish	471	1043
LAV183	Gafftopsail catfish	562	1470
LAV184	Gafftopsail catfish	527	1427
LAV185	Gafftopsail catfish	574	1553
LAV186	Gafftopsail catfish	575	1643
LAV187	Gafftopsail catfish	454	833
LAV188	Gafftopsail catfish	468	882
LAV189	Gafftopsail catfish	534	1193
LAV190	Gafftopsail catfish	563	1570
LAV191	Gafftopsail catfish	557	1335
LAV192	Hardhead catfish	405	737
LAV193	Black drum	497	1661
LAV194	Spotted seatrout	391	577
LAV195	Red drum	555	1526
LAV196	Southern flounder	420	1000
LAV197	Southern flounder	481	1333
LAV198	Blue crab	159	N/A
LAV199	Blue crab	151	N/A
LAV200	Blue crab	139	N/A
LAV201	Blue crab	133	N/A
LAV202	Blue crab	136	N/A
LAV203	Blue crab	128	N/A
LAV204	Blue crab	127	N/A
LAV205	Blue crab	163	N/A
LAV480	Eastern oyster	N/A	N/A
LAV481	Eastern oyster	N/A	N/A
LAV482	Eastern oyster	N/A	N/A
LAV483	Eastern oyster	N/A	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 1 Lavaca Bay near the mouth of the Lavaca River (cont.)			
LAV484	Eastern oyster	N/A	N/A
LAV485	Eastern oyster	N/A	N/A
LAV486	Eastern oyster	N/A	N/A
LAV487	Eastern oyster	N/A	N/A
Site 2 Lavaca Bay at the Prohibited Area			
LAV1	Blacktip shark	1115	8156
LAV2	Black drum	981	14950
LAV3	Black drum	422	943
LAV4	Black drum	370	662
LAV5	Black drum	541	2187
LAV6	Black drum	568	2596
LAV7	Black drum	416	995
LAV8	Black drum	423	933
LAV9	Black drum	955	17404
LAV10	Black drum	977	15140
LAV11	Black drum	431	1023
LAV12	Black drum	380	672
LAV13	Spotted seatrout	390	618
LAV14	Spotted seatrout	384	552
LAV15	Spotted seatrout	428	763
LAV16	Sheepshead	475	2171
LAV17	Sheepshead	559	3404
LAV18	Sheepshead	555	3479
LAV19	Gafftopsail catfish	526	1493
LAV20	Gafftopsail catfish	549	1626
LAV21	Gafftopsail catfish	581	1886
LAV22	Gafftopsail catfish	546	1679
LAV23	Southern flounder	384	665
LAV24	Southern flounder	365	613
LAV25	Southern flounder	391	544
LAV26	Gafftopsail catfish	581	2062
LAV27	Gafftopsail catfish	556	1338
LAV28	Gafftopsail catfish	605	1686
LAV29	Gafftopsail catfish	521	1333
LAV30	Gafftopsail catfish	416	640
LAV31	Blacktip shark	1005	6002
LAV32	Black drum	574	2713

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 2 Lavaca Bay at the Prohibited Area (cont.)			
LAV33	Black drum	470	1320
LAV34	Black drum	484	1476
LAV35	Black drum	451	1277
LAV36	Southern flounder	419	999
LAV37	Southern flounder	356	547
LAV38	Southern flounder	435	1102
LAV39	Southern flounder	356	654
LAV40	Southern flounder	441	1138
LAV41	Tripletail	394	1416
LAV42	Spotted seatrout	480	1065
LAV43	Spotted seatrout	393	546
LAV44	Blue crab[c3]	148	N/A
LAV45	Sheepshead	394	1032
LAV46	Black drum	413	893
LAV47	Black drum	375	606
LAV48	Black drum	485	1422
LAV49	Southern flounder	365	587
LAV50	Gafftopsail catfish	535	1450
LAV51	Gafftopsail catfish	493	1236
LAV52	Gafftopsail catfish	580	1705
LAV53	Gafftopsail catfish	451	910
LAV54	Gafftopsail catfish	451	748
LAV55	Gafftopsail catfish	440	946
LAV56	Gafftopsail catfish	497	1129
LAV57	Gafftopsail catfish	455	725
LAV58	Gafftopsail catfish	544	1375
LAV59	Gafftopsail catfish	504	1085
LAV60	Gafftopsail catfish	554	1680
LAV61	Gafftopsail catfish	415	630
LAV62	Gafftopsail catfish	508	1075
LAV63	Gafftopsail catfish	555	1580
LAV64	Gafftopsail catfish	468	926
LAV65	Gafftopsail catfish	440	738
LAV66	Gafftopsail catfish	445	705
LAV67	Gafftopsail catfish	540	1475
LAV68	Gafftopsail catfish	468	909
LAV69	Gafftopsail catfish	563	1506

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 2 Lavaca Bay at the Prohibited Area (cont.)			
LAV70	Gafftopsail catfish	487	1253
LAV71	Gafftopsail catfish	471	879
LAV72	Gafftopsail catfish	477	970
LAV73	Gafftopsail catfish	479	1077
LAV74	Gafftopsail catfish	537	1315
LAV75	Gafftopsail catfish	582	1704
LAV76	Gafftopsail catfish	463	830
LAV77	Gafftopsail catfish	619	2275
LAV78	Gafftopsail catfish	523	1230
LAV79	Gafftopsail catfish	496	1090
LAV80	Gafftopsail catfish	451	840
LAV81	Gafftopsail catfish	585	1977
LAV82	Gafftopsail catfish	505	1163
LAV83	Gafftopsail catfish	547	1519
LAV84	Gafftopsail catfish	459	920
LAV85	Gafftopsail catfish	415	535
LAV86	Gafftopsail catfish	476	974
LAV87	Gafftopsail catfish	467	1025
LAV88	Gafftopsail catfish	536	1340
LAV89	Gafftopsail catfish	472	930
LAV90	Gafftopsail catfish	535	1290
LAV91	Red drum	544	1720
LAV92	Spotted seatrout	495	1007
LAV93	Black drum	445	1510
LAV94	Black drum	514	2000
LAV95	Red drum	642	3115
LAV96	Spotted seatrout	417	942
LAV97	Spotted seatrout	391	892
LAV98	Spotted seatrout	378	745
LAV99	Sheepshead	426	1300
LAV100	Gafftopsail catfish	584	1890
LAV101	Gafftopsail catfish	590	2085
LAV102	Gafftopsail catfish	541	1405
LAV103	Gafftopsail catfish	560	1669
LAV104	Gafftopsail catfish	539	1340
LAV105	Gafftopsail catfish	531	1133
LAV106	Gafftopsail catfish	619	2235
LAV107	Hardhead catfish	320	275

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 2 Lavaca Bay at the Prohibited Area (cont.)			
LAV108	Hardhead catfish	330	309
LAV109	Hardhead catfish	350	485
LAV110	Hardhead catfish	422	877
LAV111	Blue crab	155	N/A
LAV112	Blue crab	131	N/A
LAV113	Blue crab	160	N/A
LAV114	Blue crab	151	N/A
LAV476	Eastern oyster	N/A	N/A
LAV477	Eastern oyster	N/A	N/A
LAV478	Eastern oyster	N/A	N/A
LAV479	Eastern oyster	N/A	N/A
LAV490	Eastern oyster	N/A	N/A
LAV491	Eastern oyster	N/A	N/A
LAV492	Eastern oyster	N/A	N/A
LAV493	Eastern oyster	N/A	N/A
LAV494	Eastern oyster	N/A	N/A
LAV495	Eastern oyster	N/A	N/A
LAV498	Eastern oyster	N/A	N/A
LAV499	Eastern oyster	N/A	N/A
LAV500	Eastern oyster	N/A	N/A
LAV501	Eastern oyster	N/A	N/A
LAV502	Eastern oyster	N/A	N/A
LAV503	Eastern oyster	N/A	N/A
LAV504	Eastern oyster	N/A	N/A
LAV505	Eastern oyster	N/A	N/A
LAV506	Eastern oyster	N/A	N/A
LAV507	Eastern oyster	N/A	N/A
LAV508	Eastern oyster	N/A	N/A
LAV509	Eastern oyster	N/A	N/A
LAV510	Eastern oyster	N/A	N/A
LAV511	Eastern oyster	N/A	N/A
LAV512	Eastern oyster	N/A	N/A
LAV528	Red drum	599	2100
LAV529	Red drum	623	2700
LAV530	Red drum	577	1900
LAV531	Red drum	539	1300
LAV532	Red drum	520	1400
LAV533	Red drum	499	1300
LAV534	Black drum	444	1200
LAV535	Black drum	455	1200

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 2 Lavaca Bay at the Prohibited Area (cont.)			
LAV536	Blue crab	150	N/A
LAV537	Blue crab	151	N/A
LAV538	Blue crab	163	N/A
LAV539	Blue crab	155	N/A
LAV540	Red drum	549	1500
LAV541	Red drum	554	1400
LAV542	Black drum	995	N/A
LAV543	Black drum	840	8400
LAV544	Black drum	600	3400
LAV545	Black drum	521	1900
LAV546	Black drum	461	1500
LAV547	Black drum	519	2000
LAV548	Gafftopsail catfish	542	1900
LAV549	Gafftopsail catfish	485	1700
LAV550	Gafftopsail catfish	469	1200
LAV551	Gafftopsail catfish	491	2100
LAV552	Gafftopsail catfish	456	800
LAV553	Gafftopsail catfish	490	900
LAV554	Southern flounder	529	1800
LAV555	Southern flounder	414	1000
LAV556	Southern flounder	412	1000
LAV557	Southern flounder	410	1000
LAV558	Southern flounder	435	1100
LAV598	Red drum	520	1387
LAV599	Red drum	519	1277
LAV600	Red drum	536	1358
LAV601	Red drum	637	2602
LAV602	Red drum	660	2824
LAV603	Red drum	510	1221
LAV604	Red drum	511	1293
LAV605	Red drum	530	1460
LAV606	Red drum	531	1485
LAV607	Red drum	578	1832
LAV608	Sand trout	252	166
LAV609	Sand trout	296	246
LAV610	Spotted seatrout	533	1410
LAV611	Red drum	552	1701
LAV612	Red drum	539	1536
LAV613	Sheepshead	479	1920
LAV614	Blue crab	165	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 2 Lavaca Bay at the Prohibited Area (cont.)			
LAV615	Blue crab	156	N/A
LAV617	Southern flounder	385	798
LAV618	Southern flounder	407	858
LAV619	Southern flounder	449	1119
LAV620	Southern flounder	481	1420
LAV621	Southern flounder	470	1334
LAV622	Southern flounder	422	877
LAV623	Southern flounder	419	1057
LAV624	Southern flounder	421	953
LAV625	Southern flounder	401	1005
LAV629	Black drum	565	2357
LAV630	Black drum	560	2429
LAV636	Black drum	599	2856
LAV637	Hardhead catfish	320	342
Site 3 Cox Bay			
LAV375	Black drum	604	2814
LAV376	Black drum	420	1048
LAV377	Black drum	582	2820
LAV378	Black drum	975	14000
LAV379	Black drum	880	12500
LAV380	Black drum	451	1382
LAV381	Black drum	462	1423
LAV382	Sheepshead	484	2108
LAV383	Southern flounder	464	639
LAV384	Gafftopsail catfish	484	1024
LAV385	Hardhead catfish	336	350
LAV386	Hardhead catfish	309	261
LAV387	Hardhead catfish	324	313
LAV388	Blue crab	130	N/A
LAV389	Blue crab	145	N/A
LAV496	Eastern oyster	N/A	N/A
LAV497	Eastern oyster	N/A	N/A
Site 4 Keller Bay			
LAV390	Red drum	583	1943
LAV391	Black drum	416	1031
LAV392	Black drum	391	774
LAV393	Black drum	429	1040

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 4 Keller Bay (cont.)			
LAV394	Spotted seatrout	389	538
LAV395	Bonnethead shark	643	1160
LAV396	Southern flounder	454	1050
LAV397	Southern flounder	365	566
LAV398	Southern flounder	387	713
LAV399	Gafftopsail catfish	482	865
LAV400	Gafftopsail catfish	523	1308
LAV401	Gafftopsail catfish	449	765
LAV402	Black drum	469	1274
LAV403	Black drum	560	2690
LAV404	Spotted seatrout	449	835
LAV405	Spotted seatrout	387	531
LAV406	Hardhead catfish	324	317
LAV407	Blue crab	147	N/A
LAV408	Blue crab	130	N/A
LAV409	Red drum	516	1444
Site 5 Chocolate Bay			
LAV410	Red drum	549	1476
LAV411	Black drum	621	3364
LAV412	Black drum	486	1411
LAV413	Black drum	586	2628
LAV414	Black drum	636	3353
LAV415	Southern flounder	461	1176
LAV416	Southern flounder	425	877
LAV417	Southern flounder	399	766
LAV418	Gafftopsail catfish	425	691
LAV419	Gafftopsail catfish	471	754
LAV420	Gafftopsail catfish	410	532
LAV421	Gafftopsail catfish	440	641
LAV422	Gafftopsail catfish	494	986
LAV423	Hardhead catfish	353	421
LAV424	Hardhead catfish	390	473
LAV425	Blue crab	144	N/A
LAV426	Blue crab	135	N/A
LAV427	Blue crab	130	N/A
LAV428	Blue crab	132	N/A
LAV429	Blue crab	142	N/A
LAV430	Blue crab	140	N/A
LAV431	Atlantic stingray	505	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 6 Powderhorn Lake			
LAV432	Alligator gar	1155	9300
LAV433	Black drum	474	1319
LAV434	Black drum	550	2635
LAV435	Black drum	519	1895
LAV436	Black drum	586	3103
LAV437	Black drum	493	1620
LAV438	Black drum	673	4239
LAV439	Black drum	618	3107
LAV440	Black drum	536	2254
LAV441	Black drum	531	2239
LAV442	Sheepshead	516	2469
LAV443	Blue crab	150	N/A
LAV444	Blue crab	166	N/A
LAV445	Black drum	484	1493
LAV446	Blue crab	131	N/A
LAV447	Gafftopsail catfish	586	1743
LAV448	Gafftopsail catfish	518	1130
LAV449	Gafftopsail catfish	585	1568
LAV450	Gafftopsail catfish	433	603
LAV451	Hardhead catfish	349	352
LAV452	Hardhead catfish	306	226
LAV453	Whiting	303	310
LAV454	Blue crab	139	N/A
PWH1	Eastern oyster	N/A	N/A
PWH2	Eastern oyster	N/A	N/A
Site 7 Carancahua Bay			
LAV559	Alligator gar	1275	N/A
LAV560	Black drum	960	N/A
LAV561	Black drum	955	N/A
LAV562	Bull shark	1220	N/A
LAV563	Black drum	510	2300
LAV564	Black drum	615	3700
LAV565	Black drum	690	5700
LAV566	Black drum	440	1500
LAV567	Black drum	485	1600
LAV568	Black drum	465	1600
LAV569	Black drum	840	N/A
LAV570	Black drum	510	1900

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 7 Carancahua Bay (cont.)			
LAV571	Black drum	500	1900
LAV572	Black drum	480	1700
LAV573	Tripletail	460	2300
LAV574	Tripletail	490	3100
LAV575	Tripletail	432	1800
LAV576	Southern flounder	380	800
LAV577	Southern flounder	476	1600
LAV578	Southern flounder	500	1700
LAV579	Sheepshead	500	2600
LAV580	Sheepshead	420	1500
LAV581	Hardhead catfish	378	600
LAV582	Gafftopsail catfish	475	1000
LAV583	Gafftopsail catfish	570	2000
LAV584	Red drum	530	1700
LAV585	Red drum	630	3000
LAV586	Black drum	458	1500
LAV587	Black drum	554	2300
LAV588	Spotted seatrout	410	700
LAV589	Southern flounder	429	1300
LAV590	Gafftopsail catfish	570	2000
LAV591	Whiting	355	600
LAV592	Sheepshead	405	1200
LAV593	Blue crab	174	N/A
LAV594	Blue crab	175	N/A
LAV595	Blue crab	160	N/A
LAV596	Blue crab	180	N/A
LAV597	Blue crab	169	N/A
CAR1	Eastern oyster	N/A	N/A
CAR2	Eastern oyster	N/A	N/A
CAR3	Eastern oyster	N/A	N/A
CAR4	Eastern oyster	N/A	N/A
CAR5	Eastern oyster	N/A	N/A
CAR6	Eastern oyster	N/A	N/A
Site 8 Turtle Bay			
LAV341	Black drum	1065	N/A
LAV342	Black drum	559	2369
LAV343	Black drum	560	2520
LAV344	Black drum	504	1682

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 8 Turtle Bay (cont.)			
LAV345	Black drum	504	1704
LAV346	Sheepshead	473	1860
LAV347	Gafftopsail catfish	602	1957
LAV348	Gafftopsail catfish	505	857
LAV349	Gafftopsail catfish	570	1319
LAV350	Gafftopsail catfish	518	1382
LAV351	Gafftopsail catfish	569	1762
LAV352	Gafftopsail catfish	521	1188
LAV353	Gafftopsail catfish	501	1158
LAV354	Gafftopsail catfish	433	776
LAV355	Black drum	555	2498
LAV356	Spotted seatrout	444	929
LAV357	Hardhead catfish	353	466
LAV358	Gafftopsail catfish	458	806
LAV359	Blue crab	134	N/A
LAV360	Blue crab	157	N/A
LAV361	Blue crab	146	N/A
LAV362	Blue crab	147	N/A
LAV363	Blue crab	138	N/A
LAV364	Blue crab	145	N/A
LAV365	Blue crab	140	N/A
Site 9 Tres Palacios Bay			
LAV366	Black drum	824	10250
LAV367	Black drum	828	9700
LAV368	Black drum	820	8500
LAV369	Sheepshead	415	1263
LAV370	Hardhead catfish	390	654
LAV371	Gafftopsail catfish	516	1387
LAV372	Gafftopsail catfish	553	1322
LAV373	Gafftopsail catfish	485	1033
LAV374	Hardhead catfish	386	625
Site 10 Tres Palacios Bay at Oliver Point			
LAV263	Blacktip shark	1090	N/A
LAV265	Black drum	471	1450
LAV266	Black drum	475	1329
LAV267	Spotted seatrout	407	693
LAV268	Southern flounder	443	1193
LAV269	Gafftopsail catfish	574	1604

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 10 Tres Palacios Bay at Oliver Point (cont.)			
LAV270	Gafftopsail catfish	616	2166
LAV271	Gafftopsail catfish	623	2021
LAV272	Blacktip shark	633	1463
LAV273	Hardhead catfish	462	956
LAV274	Hardhead catfish	365	663
LAV275	Red drum	547	1966
LAV276	Spotted seatrout	408	630
LAV277	Spotted seatrout	394	575
LAV278	Spotted seatrout	414	627
LAV279	Sheepshead	403	1358
LAV280	Sheepshead	492	2282
LAV281	Sheepshead	442	1373
LAV282	Sheepshead	426	1280
LAV283	Sheepshead	457	1558
LAV284	Sheepshead	479	1877
LAV285	Sheepshead	388	1059
LAV286	Black drum	540	2232
LAV287	Black drum	387	819
LAV288	Black drum	446	1297
LAV289	Black drum	431	1060
LAV290	Black drum	465	1315
LAV291	Black drum	553	2318
LAV292	Gafftopsail catfish	552	1778
LAV293	Gafftopsail catfish	478	1013
LAV294	Gafftopsail catfish	427	915
LAV295	Gafftopsail catfish	488	1131
LAV296	Gafftopsail catfish	453	1350
LAV297	Gafftopsail catfish	591	2163
LAV298	Southern flounder	393	843
LAV299	Sheepshead	450	1823
LAV300	Spotted seatrout	401	765
LAV301	Spotted seatrout	414	665
LAV302	Spotted seatrout	420	727
LAV303	Blue crab	156	N/A
LAV304	Blue crab	163	N/A
LAV305	Blue crab	140	N/A
LAV306	Blue crab	151	N/A
LAV307	Blue crab	140	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 10 Tres Palacios Bay at Oliver Point (cont.)			
LAV308	Blue crab	144	N/A
LAV309	Blue crab	139	N/A
LAV310	Blue crab	150	N/A
LAV311	Blue crab	128	N/A
LAV312	Sand trout	239	151
LAV313	Sand trout	250	187
Site 11 Matagorda Bay near Oyster Lake			
LAV264	Alligator gar	1315	N/A
LAV314	Red drum	524	1670
LAV315	Red drum	541	1809
LAV316	Red drum	539	1804
LAV317	Spotted seatrout	395	575
LAV318	Spotted seatrout	441	865
LAV319	Spotted seatrout	414	701
LAV320	Spotted seatrout	385	546
LAV321	Spotted seatrout	387	565
LAV322	Black drum	441	1129
LAV323	Black drum	426	1033
LAV324	Black drum	408	866
LAV325	Black drum	365	703
LAV326	Black drum	496	1672
LAV327	Black drum	545	2006
LAV328	Black drum	542	981
LAV329	Sheepshead	410	1229
LAV330	Sheepshead	520	2476
LAV331	Southern flounder	419	932
LAV332	Southern flounder	434	1404
LAV333	Southern flounder	442	1515
LAV334	Gafftopsail catfish	543	1322
LAV335	Blue crab	148	N/A
LAV336	Blue crab	130	N/A
LAV337	Blue crab	160	N/A
LAV338	Blue crab	156	N/A
LAV339	Blue crab	157	N/A
LAV340	Blue crab	130	N/A
MAT1	Eastern oyster	N/A	N/A
MAT2	Eastern oyster	N/A	N/A
MAT3	Eastern oyster	N/A	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 11 Matagorda Bay near Oyster Lake (cont.)			
MAT21	Eastern oyster	N/A	N/A
MAT22	Eastern oyster	N/A	N/A
MAT23	Eastern oyster	N/A	N/A
Site 12 Matagorda Bay at Mad Island Reef			
LAV206	Black drum	510	1974
LAV207	Black drum	593	3153
LAV208	Black drum	497	1669
LAV209	Black drum	591	2715
LAV210	Black drum	651	3978
LAV211	Black drum	530	1799
LAV212	Black drum	566	2442
LAV213	Black drum	555	2230
LAV214	Black drum	539	2279
LAV215	Gafftopsail catfish	548	1562
LAV216	Gafftopsail catfish	503	1333
LAV217	Gafftopsail catfish	616	2146
LAV218	Gafftopsail catfish	618	1979
LAV219	Gafftopsail catfish	558	1574
LAV220	Gafftopsail catfish	564	1633
LAV221	Blacktip shark	792	3654
LAV222	Southern flounder	405	817
LAV223	Sheepshead	440	1480
LAV224	Sheepshead	412	1107
LAV225	Red drum	560	1761
LAV226	Black drum	905	12700
LAV227	Black drum	603	3268
LAV228	Gafftopsail catfish	628	2238
LAV229	Southern flounder	429	1132
LAV230	Hardhead catfish	387	545
LAV231	Hardhead catfish	406	764
LAV232	Spotted seatrout	384	526
LAV233	Spotted seatrout	426	675
LAV234	Blue crab	174	N/A
LAV235	Blue crab	169	N/A
LAV236	Blue crab	150	N/A
LAV237	Blue crab	128	N/A
LAV238	Blue crab	164	N/A
LAV239	Blue crab	153	N/A

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 12 Matagorda Bay at Mad Island Reef (cont.)			
LAV240	Blue crab	145	N/A
LAV241	Blue crab	132	N/A
LAV242	Blue crab	129	N/A
LAV243	Blue crab	160	N/A
LAV244	Blue crab	157	N/A
LAV245	Blue crab	145	N/A
MAT4	Eastern oyster	N/A	N/A
MAT5	Eastern oyster	N/A	N/A
MAT6	Eastern oyster	N/A	N/A
MAT7	Eastern oyster	N/A	N/A
MAT8	Eastern oyster	N/A	N/A
MAT9	Eastern oyster	N/A	N/A
MAT10	Eastern oyster	N/A	N/A
MAT11	Eastern oyster	N/A	N/A
MAT12	Eastern oyster	N/A	N/A
MAT13	Eastern oyster	N/A	N/A
MAT14	Eastern oyster	N/A	N/A
MAT15	Eastern oyster	N/A	N/A
MAT16	Eastern oyster	N/A	N/A
MAT17	Eastern oyster	N/A	N/A
MAT18	Eastern oyster	N/A	N/A
MAT19	Eastern oyster	N/A	N/A
MAT20	Eastern oyster	N/A	N/A
Site 13 Matagorda Bay near the mouth of the Colorado River			
LAV246	Alligator gar	973	5480
LAV247	Alligator gar	1035	6230
LAV248	Black drum	423	992
LAV249	Black drum	470	1764
LAV250	Black drum	418	945
LAV251	Red drum	632	2660
LAV252	Red drum	632	2557
LAV253	Gafftopsail catfish	562	1660
LAV254	Sheepshead	419	1312
LAV255	Sheepshead	456	1691
LAV256	Sheepshead	429	1371
LAV257	Sheepshead	409	1059
LAV258	Southern flounder	356	652
LAV259	Spotted seatrout	390	701

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 13 Matagorda Bay near the mouth of the Colorado River (cont.)			
LAV260	Hardhead catfish	405	603
LAV261	Hardhead catfish	361	435
LAV262	Blue crab	147	N/A
Site 14 Matagorda Bay at SLT 222			
LAV455	Blacktip shark	1205	11750
LAV456	Blacktip shark	1290	14000
LAV457	Blacktip shark	1215	11000
LAV458	Blacktip shark	1105	7500
LAV459	Spotted seatrout	414	672
LAV460	Spotted seatrout	384	495
LAV461	Spotted seatrout	412	664
LAV462	Black drum	431	997
LAV463	Black drum	377	565
LAV464	Gafftopsail catfish	467	840
LAV465	Gafftopsail catfish	445	546
LAV466	Hardhead catfish	370	484
LAV467	Hardhead catfish	408	649
LAV468	Hardhead catfish	410	775
LAV469	Hardhead catfish	350	490
LAV470	Whiting	330	368
LAV471	Red drum	539	1398
LAV472	Red drum	565	1393
LAV473	Blue crab	162	N/A
LAV474	Blue crab	131	N/A
LAV475	Blue crab	162	N/A
Site 15 Matagorda Bay at SLT 130			
LAV522	Tripletail	590	4500
LAV523	Spotted seatrout	440	700
LAV524	Spotted seatrout	431	700
LAV525	Spotted seatrout	400	500
LAV526	Spotted seatrout	421	700
LAV527	Gafftopsail catfish	419	500
Site 16 Matagorda Bay near the Port O'Connor jetties			
LAV153	Sheepshead	418	1182
LAV154	Sheepshead	397	1054
LAV155	Sheepshead	426	1285
LAV156	Sheepshead	403	1171
LAV157	Sheepshead	409	1145

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 16 Matagorda Bay near the Port O'Connor jetties (cont.)			
LAV158	Sheepshead	392	1022
LAV159	Sheepshead	395	965
LAV160	Sheepshead	394	996
LAV161	Sheepshead	384	964
LAV162	Sheepshead	404	1025
LAV163	Sheepshead	395	981
LAV164	Sheepshead	398	1057
LAV165	Southern flounder	417	873
LAV166	Blue crab	174	N/A
LAV167	Blue crab	135	N/A
LAV168	Blue crab	128	N/A
LAV169	Gafftopsail catfish	464	979
LAV170	Hardhead catfish	386	584
LAV171	Sand trout	289	270
LAV172	Sand trout	255	157
LAV173	Sand trout	253	151
Site 17 Matagorda Bay near Pass Cavallo			
LAV115	Blacktip shark	1470	N/A
LAV116	Black drum	480	1486
LAV117	Black drum	475	1403
LAV118	Black drum	455	1361
LAV119	Black drum	500	1725
LAV120	Black drum	500	1727
LAV121	Black drum	486	1482
LAV122	Black drum	441	1186
LAV123	Black drum	479	1396
LAV124	Black drum	440	1316
LAV125	Black drum	473	1361
LAV126	Black drum	458	1286
LAV127	Black drum	420	1049
LAV128	Black drum	446	1242
LAV129	Black drum	403	893
LAV130	Black drum	467	1329
LAV131	Black drum	485	1422
LAV132	Black drum	496	1650
LAV133	Black drum	474	1557
LAV134	Black drum	458	1327
LAV135	Sheepshead	405	1137

Table 1 cont. Fish samples collected from the Lavaca-Matagorda Bay Estuary in 2012. Sample number, species, total length, and weight recorded for each sample.

Sample Number	Species	Length (mm)	Weight (g)
Site 17 Matagorda Bay near Pass Cavallo (cont.)			
LAV136	Sheepshead	404	1109
LAV137	Sheepshead	455	1592
LAV138	Red drum	543	1541
LAV139	Tripletail	439	1720
LAV140	Southern flounder	366	619
LAV141	Spotted seatrout	390	540
LAV142	Blue crab	140	N/A
LAV143	Blue crab	176	N/A
LAV144	Blue crab	159	N/A
LAV145	Blue crab	132	N/A
LAV146	Gafftopsail catfish	433	681
LAV147	Hardhead catfish	376	568
LAV148	Hardhead catfish	366	560
LAV149	Hardhead catfish	394	613
LAV150	Hardhead catfish	400	760
LAV151	Hardhead catfish	387	468
LAV152	Hardhead catfish	363	449
Site 18 Lavaca Bay at Gallinipper Reef			
LAV513	Eastern oyster	N/A	N/A
LAV514	Eastern oyster	N/A	N/A
LAV515	Eastern oyster	N/A	N/A
LAV516	Eastern oyster	N/A	N/A
LAV517	Eastern oyster	N/A	N/A
LAV518	Eastern oyster	N/A	N/A
LAV519	Eastern oyster	N/A	N/A
LAV520	Eastern oyster	N/A	N/A
LAV521	Eastern oyster	N/A	N/A

Table 2a. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 1 Lavaca Bay near the mouth of the Lavaca River				
Black drum	1/1	0.286	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blue crab	8/8	0.070±0.026 (0.031-0.113)		
Bull shark	4/4	0.413±0.228 (0.159-**0.691**)		
Eastern oyster	8/8	0.041±0.008 (0.032-0.053)		
Gafftopsail catfish	14/14	0.634±0.362 (0.262-**1.423**)		
Hardhead catfish	1/1	**0.868**		
Red drum	1/1	0.233		
Southern flounder	2/2	0.154±0.039 (0.126-0.181)		
Spotted seatrout	1/1	0.291		
All fish combined	24/24	0.522±0.340 (0.126-**1.423**)		
All species combined	40/40	0.335±0.349 (0.031-**1.423**)		
Site 2 Lavaca Bay at the Prohibited Area				
Black drum	31/31	**0.882**±0.593 (0.031-**2.490**)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	2/2	**0.704**±0.023 (**0.688-0.721**)		
Blue crab	11/11	0.152±0.092 (0.057-0.327)		
Eastern oyster	25/25	0.052±0.020 (0.026-0.096)		
Gafftopsail catfish	63/63	**0.856**±0.415 (0.263-**2.261**)		
Hardhead catfish	5/5	0.608±0.649 (0.094-**1.703**)		
Red drum	22/22	**1.330**±0.487 (0.482-**2.159**)		
Sand trout	2/2	0.162±0.064 (0.116-0.207)		
Sheepshead	6/6	0.411±0.357 (0.060-**1.020**)		
Southern flounder	23/23	0.252±0.118 (0.020-0.466)		
Spotted seatrout	10/10	0.314±0.117 (0.169-0.578)		
Tripletail	1/1	0.066		
All fish combined	165/165	**0.768**±0.536 (0.020-**2.490**)		
All species combined	201/201	0.646±0.553 (0.020-**2.490**)		

Table 2b. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 3 at Cox Bay				
Black drum	7/7	0.522±0.333 (0.156-**1.003**)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blue crab	2/2	0.146±0.103 (0.073-0.218)		
Eastern oyster	2/2	0.035±0.035 (0.030-0.039)		
Gafftopsail catfish	1/1	**0.734**		
Hardhead catfish	3/3	0.568±0.230 (0.303-**0.702**)		
Sheepshead	1/1	0.306		
Southern flounder	1/1	0.156		
All fish combined	13/13	0.504±0.289 (0.156-**1.003**)		
All species combined	17/17	0.407±0.311 (0.030-**1.003**)		
Site 4 at Keller Bay				
Black drum	5/5	0.170±0.032 (0.121-0.205)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blue crab	2/2	0.118±0.028 (0.098-0.138)		
Bonnethead shark	1/1	0.138		
Gafftopsail catfish	3/3	0.329±0.066 (0.260-0.392)		
Hardhead catfish	1/1	0.287		
Red drum	2/2	0.152±0.003 (0.150-0.154)		
Southern flounder	3/3	0.101±0.009 (0.092-0.109)		
Spotted seatrout	3/3	0.216±0.079 (0.140-0.298)		
All fish combined	18/18	0.196±0.086 (0.092-0.392)		
All species combined	20/20	0.188±0.085 (0.092-0.392)		

Table 2c. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 5 at Chocolate Bay				
Atlantic stingray	1/1	0.100	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Black drum	4/4	0.243±0.086 (0.188-0.371)		
Blue crab	6/6	0.098±0.055 (0.036-0.180)		
Gafftopsail catfish	5/5	0.388±0.057 (0.300-0.445)		
Hardhead catfish	2/2	0.287±0.118 (0.204-0.371)		
Red drum	1/1	0.234		
Southern flounder	3/3	0.091±0.013 (0.077-0.102)		
All fish combined	16/16	0.256±0.128 (0.077-0.445)		
All species combined	22/22	0.213±0.133 (0.036-0.445)		
Site 6 at Powderhorn Lake				
Alligator gar	1/1	0.151	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Black drum	10/10	0.074±0.015 (0.054-0.106)		
Blue crab	4/4	0.043±0.020 (0.019-0.063)		
Eastern oyster	2/2	0.036±0.001 (0.035-0.037)		
Gafftopsail catfish	4/4	0.464±0.041 (0.410-0.509)		
Hardhead catfish	2/2	0.118±0.034 (0.094-0.142)		
Sheepshead	1/1	0.064		
Whiting	1/1	0.363		
All fish combined	19/19	0.180±0.166 (0.054-0.509)		
All species combined	25/25	0.146±0.156 (0.019-0.509)		
Site 7 at Carancahua Bay				
Alligator gar	1/1	BDL	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Black drum	14/14	0.183±0.092 (0.091-0.375)		
Bull shark	1/1	0.539		

Table 2d. Mercury (mg/kg) in species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 7 at Carancahua Bay (cont.)				
Blue crab	5/5	0.071±0.048 (0.026-0.146)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Eastern oyster	6/6	0.014±0.002 (0.009-0.016		
Gafftopsail catfish	3/3	0.427±0.120 (0.355-0.565)		
Hardhead catfish	1/1	0.115		
Red drum	2/2	0.144±0.030 (0.122-0.165)		
Sheepshead	3/3	0.111±0.040 (0.086-0.157)		
Southern flounder	4/4	0.076±0.023 (0.063-0.110)		
Spotted seatrout	1/1	0.132		
Tripletail	3/3	0.068±0.025 (0.053-0.097)		
Whiting	1/1	0.405		
All fish combined	34/34	0.182±0.139 (0.008-0.565)		
All species combined	45/45	0.147±0.137 (0.008-0.565)		
Site 8 at Turtle Bay				
Black drum	6/6	0.152±0.166 (0.034-0.486)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blue crab	7/7	0.061±0.014 (0.045-0.087)		
Gafftopsail catfish	9/9	0.393±0.184 (0.188-**0.752**)		
Hardhead catfish	1/1	0.178		
Sheepshead	1/1	0.132		
Spotted seatrout	1/1	0.131		
All fish combined	18/18	0.271±0.199 (0.034-**0.752**)		
All species combined	25/25	0.212±0.193 (0.034-**0.752**)		
Site 9 at Tres Palacios Bay				
Black drum	3/3	0.197±0.078 (0.114-0.270)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Gafftopsail catfish	3/3	0.349±0.099 (0.254-0.452)		

Table 2e. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.

Species	# Detected/ # Sampled	Mean Concentration ± S.D. (Min-Max)	Health Assessment Comparison Value (mg/kg)	Basis for Comparison Value
Site 9 at Tres Palacios Bay (cont.)				
Hardhead catfish	2/2	0.327±0.015 (0.316-0.337)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Sheepshead	1/1	0.101		
All fish combined	9/9	0.266±0.113 (0.101-0.452)		
All species combined	9/9	0.266±0.113 (0.101-0.452)		
Site 10 at Tres Palacios Bay at Oliver Point				
Black drum	8/8	0.095±0.029 (0.065-0.148)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	2/2	0.122±0.048 (0.088-0.156)		
Blue crab	9/9	0.054±0.020 (0.028-0.090)		
Gafftopsail catfish	9/9	0.380±0.179 (0.171-**0.657**)		
Hardhead catfish	2/2	0.426±0.280 (0.228-0.624)		
Red drum	1/1	0.148		
Sand trout	2/2	0.047±0.004 (0.044-0.049)		
Sheepshead	8/8	0.095±0.069 (0.010-0.196)		
Southern flounder	2/2	0.051±0.016 (0.039-0.062)		
Spotted seatrout	7/7	0.093±0.028 (0.064-0.128)		
All fish combined	41/41	0.172±0.166 (0.010-**0.657**)		
All species combined	50/50	0.150±0.157 (0.010-**0.657**)		
Site 11 at Matagorda Bay near Oyster Lake				
Alligator gar	1/1	0.076	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Black drum	7/7	0.135±0.078 (0.032-0.278)		
Blue crab	6/6	0.078±0.048 (0.028-0.133)		
Eastern oyster	6/6	0.012±0.001 (0.010-0.014)		
Gafftopsail catfish	1/1	0.514		

Table 2f. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.

Species	# Detected/ # Sampled	Mean Concentration ± S.D. (Min-Max)	Health Assessment Comparison Value (mg/kg)	Basis for Comparison Value
Site 11 at Matagorda Bay near Oyster Lake (cont.)				
Red drum	3/3	0.100±0.040 (0.073-0.146)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Sheepshead	2/2	0.108±0.037 (0.082-0.134)		
Southern flounder	3/3	0.076±0.017 (0.057-0.088)		
Spotted seatrout	5/5	0.125±0.033 (0.086-0.168)		
All fish combined	22/22	0.132±0.100 (0.032-0.514)		
All species combined	34/34	0.101±0.094 (0.010-0.514)		
Site 12 at Matagorda Bay at Mad Island Reef				
Black drum	11/11	0.098±0.048 (0.028-0.133)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	1/1	0.217		
Blue crab	12/12	0.061±0.034 (0.020-0.130)		
Eastern oyster	17/17	0.012±0.001 (0.010-0.014)		
Gafftopsail catfish	7/7	0.387±0.084 (0.282-0.525)		
Hardhead catfish	2/2	0.207±0.107 (0.283-0.132)		
Red drum	1/1	0.207		
Sheepshead	2/2	0.099±0.074 (0.047-0.151)		
Southern flounder	2/2	0.059±0.004 (0.062-0.057)		
Spotted seatrout	2/2	0.081±0.003 (0.079-0.083)		
All fish combined	28/28	0.178±0.139 (0.046-0.525)		
All species combined	57/57	0.104±0.124 (0.010-0.525)		
Site 13 at Matagorda Bay near the mouth of the Colorado River				
Alligator gar	2/2	0.052±0.007 (0.047-0.057)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Black drum	3/3	0.044±0.003 (0.041-0.046)		
Blue crab	1/1	0.058		

Table 2g. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 13 at Matagorda Bay near the mouth of the Colorado River (cont.)				
Gafftopsail catfish	1/1	0.152	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Hardhead catfish	2/2	0.118±0.021 (0.103-0.133)		
Red drum	2/2	0.061±0.001 (0.060-0.062)		
Sheepshead	4/4	0.052±0.012 (0.036-0.064)		
Southern flounder	1/1	0.045		
Spotted seatrout	1/1	0.058		
All fish combined	16/16	0.066±0.034 (0.036-0.152)		
All species combined	17/17	0.066±0.033 (0.036-0.152)		
Site 14 at Matagorda Bay at SLT 222				
Black drum	2/2	0.067±0.018 (0.080-0.054)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	4/4	0.395±0.126 (0.230-0.518)		
Blue crab	3/3	0.036±0.016 (0.026-0.054)		
Gafftopsail catfish	2/2	0.298±0.103 (0.226-0.371)		
Hardhead catfish	4/4	0.165±0.042 (0.108-0.200)		
Red drum	2/2	0.127±0.021 (0.112-0.141)		
Spotted seatrout	3/3	0.090±0.017 (0.070-0.102)		
Whiting	1/1	0.056		
All fish combined	18/18	0.197±0.142 (0.054-0.518)		
All species combined	21/21	0.174±0.143 (0.026-0.518)		
Site 15 at Matagorda Bay at SLT 130				
Gafftopsail catfish	1/1	0.197	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Spotted seatrout	4/4	0.187±0.039 (0.147-0.226)		
Tripletail	1/1	0.069		
All fish combined	6/6	0.169±0.058 (0.069-0.226)		

Table 2h. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 15 at Matagorda Bay at SLT 130 (cont.)				
All species combined	6/6	0.169±0.058 (0.069-0.226)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Site 16 at Matagorda Bay near the Port O'Connor jetties				
Blue crab	3/3	0.038±0.032 (0.014-0.074)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Gafftopsail catfish	1/1	0.418		
Hardhead catfish	1/1	0.481		
Sand trout	3/3	0.050±0.004 (0.047-0.055)		
Sheepshead	12/12	0.117±0.025 (0.083-0.161)		
Southern flounder	1/1	0.085		
All fish combined	18/18	0.141±0.117 (0.047-0.481)		
All species combined	21/21	0.126±0.115 (0.014-0.481)		
Site 17 at Matagorda Bay at Pass Cavallo				
Black drum	19/19	0.073±0.015 (0.047-0.103)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	1/1	**0.739**		
Blue crab	4/4	0.053±0.043 (0.011-0.111)		
Gafftopsail catfish	1/1	0.163		
Hardhead catfish	6/6	0.202±0.033 (0.158-0.254)		
Red drum	1/1	0.105		
Sheepshead	3/3	0.075±0.044 (0.048-0.125)		
Southern flounder	1/1	0.036		
Spotted seatrout	1/1	0.086		
Tripletail	1/1	0.029		
All fish combined	34/34	0.117±0.124 (0.029-**0.739**)		
All species combined	38/38	0.110±0.119 (0.011-**0.739**)		

Table 2i. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Site 18 at Matagorda Bay at Gallinipper Reef				
Eastern oyster	9/9	0.032±0.004 (0.025-0.037)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
All species combined	9/9	0.032±0.004 (0.025-0.037)		
All Sampling Sites				
Alligator gar	5/5	0.068±0.053 (BDL-0.151)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Atlantic stingray	1/1	0.100		
Black drum	131/131	0.323±0.444 (0.031-**2.490**)		
Blacktip shark	10/10	0.419±0.244 (0.088-**0.739**)		
Blue crab	83/83	0.078±0.057 (0.011-0.327)		
Bonnethead shark	1/1	0.138		
Bull shark	5/5	0.438±0.205 (0.159-**0.691**)		
Eastern oyster	75/75	0.032±0.021 (0.009-0.096)		
Gafftopsail catfish	128/128	0.644±0394 (0.152-**2.261**)		
Hardhead catfish	35/35	0.329±0.311 (0.094-**1.703**)		
Red drum	38/38	**0.825**±0.704 (0.060-**2.159**)		
Sand trout	7/7	0.081±0.061 (0.044-0.207)		
Sheepshead	44/44	0.146±0.170 (0.010-**1.020**)		
Southern flounder	46/46	0.168±0.121 (0.020-0.466)		
Southern kingfish	3/3	0.275±0.191 (0.056-0.405)		
Spotted seatrout	39/39	0.178±0.113 (0.058-0.578)		
Tripletail	6/6	0.061±0.022 (0.029-0.097)		
All fish combined	499/499	0.396±0.436 (0.008-**2.490**)		
All species combined	657/657	0.314±0.408 (0.008-**2.490**)		

Table 2j. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Composite Area 1 Lavaca-Matagorda Bay Estuary (*Outside the Prohibited Area*)				
Alligator gar	5/5	0.068±0.053 (BDL-0.151)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Atlantic stingray	1/1	0.100		
Black drum	100/100	0.150±0.154 (0.032-**1.003**)		
Blacktip shark	8/8	0.348±0.217 (0.088-**0.739**)		
Blue crab	72/72	0.067±0.040 (0.012-0.218)		
Bonnethead shark	1/1	0.138		
Bull shark	5/5	0.438±0.205 (0.159-**0.691**)		
Eastern oyster	50/50	0.022±0.013 (0.009-0.053)		
Gafftopsail catfish	65/65	0.437±0.230 (0.152-**1.423**)		
Hardhead catfish	30/30	0.283±0.199 (0.094-**0.868**)		
Red drum	16/16	0.131±0.052 (0.060-0.234)		
Sand trout	5/5	0.049±0.004 (0.044-0.055)		
Sheepshead	38/38	0.104±0.055 (0.010-0.306)		
Southern flounder	23/23	0.085±0.036 (0.036-0.181)		
Southern kingfish	3/3	0.275±0.191 (0.056-0.405)		
Spotted seatrout	29/29	0.131±0.064 (0.058-0.298)		
Tripletail	5/5	0.060±0.025 (0.029-0.097)		
All fish combined	334/334	0.211±0.201 (0.008-**1.423**)		
All species combined	456/456	0.168±0.188 (0.008-**1.423**)		

Table 2k. Mercury (mg/kg) in all species collected from the Lavaca-Matagorda Bay Estuary, 2012.				
Species	**# Detected/ # Sampled**	**Mean Concentration ± S.D. (Min-Max)**	**Health Assessment Comparison Value (mg/kg)**	**Basis for Comparison Value**
Composite Area 2 Lavaca-Matagorda Bay Estuary (*Prohibited Area of Lavaca Bay*)				
Black drum	31/31	**0.882**±0.593 (0.031-**2.490**)	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg–day
Blacktip shark	2/2	**0.704**±0.023 (**0.688-0.721**)		
Blue crab	11/11	0.152±0.092 (0.057-0.327)		
Eastern oyster	25/25	0.052±0.020 (0.026-0.096)		
Gafftopsail catfish	63/63	**0.856**±0.415 (0.263-**2.261**)		
Hardhead catfish	5/5	0.608±0.649 (0.094-**1.703**)		
Red drum	22/22	**1.330**±0.487 (0.482-**2.159**)		
Sand trout	2/2	0.162±0.064 (0.116-0.207)		
Sheepshead	6/6	0.411±0.357 (0.060-**1.020**)		
Southern flounder	23/23	0.252±0.118 (0.020-0.466)		
Spotted seatrout	10/10	0.314±0.117 (0.169-0.578)		
Tripletail	1/1	0.066		
All fish combined	165/165	**0.768**±0.536 (0.020-**2.490**)		
All species combined	201/201	0.646±0.553 (0.020-**2.490**)		

Table 3. Games-Howell post hoc comparisons of sample site mercury concentrations from the Lavaca-Matagorda Bay Estuary in 2012.

Site Number	Site Number	Difference	p-Value	95% Confidence Interval	
				Lower	Upper
1	2	-0.247	0.209	-0.545	0.051
1	3	0.017	1.000	-0.384	0.419
1	4	0.326	0.010	0.051	0.601
1	5	0.265	0.094	-0.021	0.552
1	6	0.342	0.011	0.047	0.637
1	7	0.340	0.006	0.062	0.618
1	8	0.250	0.240	-0.060	0.561
1	9	0.256	0.154	-0.041	0.553
1	10	0.350	0.005	0.070	0.630
1	11	0.390	0.001	0.114	0.666
1	12	0.343	0.006	0.063	0.623
1	13	0.455	0.000	0.186	0.725
1	14	0.324	0.016	0.036	0.613
1	15	0.352	0.005	0.073	0.631
1	16	0.380	0.002	0.099	0.662
1	17	0.404	0.001	0.129	0.680
2	3	0.264	0.302	-0.092	0.621
2	4	0.573	0.000	0.413	0.733
2	5	0.512	0.000	0.325	0.700
2	6	0.589	0.000	0.386	0.791
2	7	0.587	0.000	0.421	0.753
2	8	0.497	0.000	0.269	0.726
2	9	0.503	0.000	0.295	0.711
2	10	0.597	0.000	0.427	0.767
2	11	0.636	0.000	0.475	0.798
2	12	0.590	0.000	0.419	0.761
2	13	0.702	0.000	0.555	0.850
2	14	0.571	0.000	0.381	0.762
2	15	0.599	0.000	0.427	0.772
2	16	0.627	0.000	0.450	0.804
2	17	0.651	0.000	0.490	0.813
3	4	0.309	0.100	-0.035	0.652
3	5	0.248	0.338	-0.102	0.598
3	6	0.324	0.093	-0.030	0.679
3	7	0.322	0.078	-0.023	0.668
3	8	0.233	0.526	-0.132	0.597
3	9	0.238	0.425	-0.118	0.594
3	10	0.333	0.066	-0.013	0.678
3	11	0.372	0.029	0.028	0.716
3	12	0.326	0.076	-0.020	0.672
3	13	0.438	0.008	0.097	0.780
3	14	0.307	0.122	-0.044	0.658
3	15	0.335	0.062	-0.011	0.681
3	16	0.363	0.036	0.016	0.710
3	17	0.387	0.021	0.043	0.731

Table 3 cont. Games-Howell post hoc comparisons of sample site mercury concentrations from the Lavaca-Matagorda Bay Estuary in 2012.

Site Number	Site Number	Difference	p-Value	95% Confidence Interval	
				Lower	Upper
4	5	-0.061	0.962	-0.205	0.084
4	6	0.016	1.000	-0.148	0.180
4	7	0.014	1.000	-0.100	0.128
4	8	-0.076	0.979	-0.273	0.122
4	9	-0.070	0.940	-0.250	0.109
4	10	0.024	1.000	-0.095	0.143
4	11	0.064	0.740	-0.045	0.172
4	12	0.017	1.000	-0.105	0.139
4	13	0.129	0.001	0.045	0.214
4	14	-0.002	1.000	-0.150	0.147
4	15	0.026	1.000	-0.104	0.156
4	16	0.054	0.967	-0.074	0.183
4	17	0.078	0.400	-0.029	0.186
5	6	0.076	0.975	-0.110	0.263
5	7	0.074	0.890	-0.075	0.224
5	8	-0.015	1.000	-0.230	0.199
5	9	-0.010	1.000	-0.205	0.186
5	10	0.085	0.804	-0.069	0.238
5	11	0.124	0.163	-0.022	0.270
5	12	0.078	0.887	-0.077	0.232
5	13	0.190	0.002	0.057	0.323
5	14	0.059	0.996	-0.115	0.232
5	15	0.087	0.718	-0.070	0.244
5	16	0.115	0.386	-0.044	0.274
5	17	0.139	0.071	-0.006	0.284
6	7	-0.002	1.000	-0.171	0.167
6	8	-0.092	0.978	-0.318	0.134
6	9	-0.086	0.959	-0.294	0.121
6	10	0.008	1.000	-0.164	0.180
6	11	0.048	0.999	-0.118	0.213
6	12	0.001	1.000	-0.172	0.174
6	13	0.114	0.311	-0.040	0.267
6	14	-0.018	1.000	-0.207	0.172
6	15	0.010	1.000	-0.163	0.184
6	16	0.038	1.000	-0.138	0.215
6	17	0.063	0.986	-0.102	0.227
7	8	-0.090	0.940	-0.291	0.111
7	9	-0.084	0.864	-0.266	0.098
7	10	0.010	1.000	-0.116	0.137
7	11	0.050	0.977	-0.067	0.166
7	12	0.003	1.000	-0.126	0.132
7	13	0.116	0.005	0.022	0.209
7	14	-0.016	1.000	-0.169	0.138
7	15	0.012	1.000	-0.121	0.146
7	16	0.040	0.999	-0.094	0.175
7	17	0.065	0.828	-0.050	0.180
8	9	0.006	1.000	-0.225	0.236

Table 3 cont. Games-Howell post hoc comparisons of sample site mercury concentrations from the Lavaca-Matagorda Bay Estuary in 2012.

Site Number	Site Number	Difference	p-Value	95% Confidence Interval	
				Lower	Upper
8	10	0.100	0.890	-0.104	0.303
8	11	0.139	0.405	-0.059	0.338
8	12	0.093	0.934	-0.111	0.297
8	13	0.205	0.027	0.016	0.395
8	14	0.074	0.996	-0.143	0.291
8	15	0.102	0.849	-0.102	0.306
8	16	0.130	0.596	-0.077	0.337
8	17	0.154	0.259	-0.044	0.352
9	10	0.094	0.786	-0.090	0.278
9	11	0.134	0.260	-0.046	0.314
9	12	0.087	0.861	-0.097	0.272
9	13	0.200	0.024	0.023	0.376
9	14	0.068	0.990	-0.129	0.266
9	15	0.097	0.720	-0.091	0.284
9	16	0.125	0.439	-0.063	0.312
9	17	0.149	0.156	-0.031	0.328
10	11	0.040	0.999	-0.082	0.161
10	12	-0.007	1.000	-0.140	0.126
10	13	0.105	0.029	0.006	0.205
10	14	-0.026	1.000	-0.183	0.131
10	15	0.002	1.000	-0.135	0.139
10	16	0.030	1.000	-0.109	0.169
10	17	0.054	0.967	-0.066	0.175
11	12	-0.046	0.993	-0.170	0.077
11	13	0.066	0.305	-0.021	0.153
11	14	-0.065	0.955	-0.215	0.084
11	15	-0.037	0.997	-0.168	0.094
11	16	-0.009	1.000	-0.139	0.121
11	17	0.015	1.000	-0.094	0.124
12	13	0.112	0.023	0.009	0.216
12	14	-0.019	1.000	-0.177	0.140
12	15	0.009	1.000	-0.130	0.148
12	16	0.037	1.000	-0.104	0.178
12	17	0.061	0.917	-0.061	0.184
13	14	-0.131	0.067	-0.268	0.005
13	15	-0.103	0.124	-0.230	0.024
13	16	-0.075	0.471	-0.188	0.038
13	17	-0.051	0.695	-0.135	0.033
14	15	0.028	1.000	-0.132	0.188
14	16	0.056	0.995	-0.106	0.219
14	17	0.080	0.817	-0.069	0.229
15	16	0.028	1.000	-0.116	0.172
15	17	0.052	0.943	-0.077	0.182
16	17	0.024	1.000	-0.105	0.153

Table 4. Games-Howell Test post hoc comparisons of mercury concentration by sampling event from the Lavaca-Matagorda Bay Estuary from 1988-2012.

Event	Event	Difference	p-Value	95% Confidence Interval	
				Lower	Upper
1988	1989	-0.216	0.997	-1.413	0.980
1988	1990	-0.255	0.943	-0.957	0.447
1988	1991	-0.019	1.000	-0.552	0.515
1988	1993	-0.102	1.000	-0.743	0.539
1988	1994	0.257	0.760	-0.292	0.807
1988	1996	-0.292	0.943	-1.126	0.542
1988	2012	0.226	0.452	-0.115	0.567
1989	1990	-0.039	1.000	-1.308	1.231
1989	1991	0.197	0.999	-1.019	1.414
1989	1993	0.114	1.000	-1.134	1.362
1989	1994	0.474	0.856	-0.741	1.688
1989	1996	-0.076	1.000	-1.400	1.249
1989	2012	0.442	0.855	-0.740	1.624
1990	1991	0.236	0.976	-0.520	0.993
1990	1993	0.153	0.999	-0.677	0.983
1990	1994	0.512	0.387	-0.241	1.266
1990	1996	-0.037	1.000	-1.011	0.937
1990	2012	0.481	0.280	-0.168	1.130
1991	1993	-0.083	1.000	-0.785	0.619
1991	1994	0.276	0.820	-0.337	0.889
1991	1996	-0.273	0.972	-1.150	0.604
1991	2012	0.245	0.694	-0.211	0.701
1993	1994	0.359	0.724	-0.341	1.060
1993	1996	-0.190	0.998	-1.127	0.747
1993	2012	0.328	0.626	-0.253	0.909
1994	1996	-0.549	0.469	-1.422	0.324
1994	2012	-0.031	1.000	-0.538	0.476
1996	2012	0.518	0.407	-0.276	1.312

Table 5. Hazard quotients (HQs) for mercury in seafood collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* in 2012 assuming exposure equivalent to the arithmetic mean mercury concentration. Table 5 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.[*]

Species	Number (N)	Mean (mg/kg)	Hazard Quotient	Meals per Week
Alligator gar	5	0.068	0.10	9.5
Atlantic stingray	1	0.100	0.14	6.5
Black drum	100	0.150	0.21	4.3
Blacktip shark	8	0.348	0.50	1.9
Blue crab	72	0.067	0.10	9.7
Bonnethead shark	1	0.138	0.20	4.7
Bull shark	5	0.438	0.63	1.5
Eastern oyster	50	0.022	0.03	29.4
Gafftopsail catfish	65	0.437	0.62	1.5
Hardhead catfish	30	0.283	0.40	2.3
Red drum	16	0.131	0.19	4.9
Sand trout	5	0.049	0.07	13.2
Sheepshead	38	0.104	0.15	6.2
Southern flounder	23	0.085	0.12	7.6
Southern kingfish	3	0.275	0.39	2.4
Spotted seatrout	29	0.131	0.19	4.9
Tripletail	5	0.060	0.09	10.8
All fish combined	334	0.211	0.30	3.1
All species combined	456	0.168	0.24	3.9

[*] *DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.*

Table 6. Hazard quotients (HQs) for mercury in seafood collected from the Lavaca-Matagorda Bay Estuary *Outside the Prohibited Area* in 2012 assuming exposure equivalent to the 95% UCLAM mercury concentration. Table 6 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.[*]

Species	Number (N)	95% UCLAM (mg/kg)	Hazard Quotient	Meals per Week
Alligator gar	5	0.133	0.19	4.9
Atlantic stingray	1	0.100	0.14	6.5
Black drum	100	0.180	0.26	3.6
Blacktip shark	8	0.529	0.76	1.2
Blue crab	72	0.076	0.11	8.5
Bonnethead shark	1	0.138	0.20	4.7
Bull shark	5	**0.693**	**0.99**[†]	**0.9**[‡]
Eastern oyster	50	0.026	0.04	24.9
Gafftopsail catfish	65	0.494	0.71	1.3
Hardhead catfish	30	0.357	0.51	1.8
Red drum	16	0.158	0.23	4.1
Sand trout	5	0.054	0.08	12.0
Sheepshead	38	0.122	0.17	5.3
Southern flounder	23	0.101	0.14	6.4
Southern kingfish	3	**0.748**	**1.07**	**0.9**
Spotted seatrout	29	0.156	0.22	4.2
Tripletail	5	0.091	0.13	7.1
All fish combined	334	0.233	0.33	2.8
All species combined	456	0.185	0.26	3.5

[*] *DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.*
[†] *Emboldened numbers denote that the HQ for mercury is ≥ 1.0.*
[‡] *Emboldened numbers denote that the calculated allowable meals for an adult are ≤ one meal per week.*

Table 7. Hazard quotients (HQs) for mercury in seafood collected from the *Prohibited Area* of Lavaca Bay in 2012 assuming exposure equivalent to the arithmetic mean mercury concentration. Table 7 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.[*]

Species	Number (N)	Mean (mg/kg)	Hazard Quotient	Meals per Week
Black drum	31	**0.882**	**1.26**[†]	**0.7**[‡]
Blacktip shark	2	**0.704**	**1.01**	**0.9**
Blue crab	11	0.152	0.22	4.3
Eastern oyster	25	0.052	0.07	12.5
Gafftopsail catfish	63	**0.856**	**1.22**	**0.8**
Hardhead catfish	5	0.608	0.87	1.1
Red drum	22	**1.330**	**1.90**	**0.5**
Sand trout	2	0.162	0.23	4.0
Sheepshead	6	0.411	0.59	1.6
Southern flounder	23	0.252	0.36	2.6
Spotted seatrout	10	0.314	0.45	2.1
Tripletail	1	0.066	0.09	9.8
All fish combined	165	**0.768**	**1.10**	**0.8**
All species combined	201	0.646	0.92	1.0

[*] *DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.*
[†] *Emboldened numbers denote that the HQ for mercury is ≥ 1.0.*
[‡] *Emboldened numbers denote that the calculated allowable meals for an adult are ≤ one meal per week.*

Table 8. Hazard quotients (HQs) for mercury in all species collected from the *Prohibited Area* of Lavaca Bay in 2012 assuming exposure equivalent to the 95% UCLAM mercury concentration. Table 8 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.[*]

Species	Number (N)	95% UCLAM (mg/kg)	Hazard Quotient	Meals per Week
Black drum	31	**1.100**	**1.57**[†]	**0.6**[‡]
Blacktip shark	2	**0.914**	**1.31**	**0.7**
Blue crab	11	0.214	0.31	3.0
Eastern oyster	25	0.060	0.09	10.8
Gafftopsail catfish	63	**0.961**	**1.37**	**0.7**
Hardhead catfish	5	**1.413**	**2.02**	**0.5**
Red drum	22	**1.545**	**2.21**	**0.4**
Sand trout	2	**0.740**	**1.06**	**0.9**
Sheepshead	6	**0.786**	**1.12**	**0.8**
Southern flounder	23	0.303	0.43	2.1
Spotted seatrout	10	0.398	0.57	1.6
Tripletail	1	0.066	0.09	9.8
All fish combined	165	**0.851**	**1.22**	**0.8**
All species combined	201	**0.723**	**1.03**	**0.9**

[*] *DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.*
[†] *Emboldened numbers denote that the HQ for mercury is ≥ 1.0.*
[‡] *Emboldened numbers denote that the calculated allowable meals for an adult are ≤ one meal per week.*

Table 9. The number of eight-ounce meals assuming 38% yield from whole fish to skin-off fillets for an average weight fish of each species from the Lavaca-Matagorda Bay Estuary.

Species	Number of Eight-Ounce Meals
Alligator gar	11.7
Black drum	4.4
Blacktip shark	13.3
Gafftopsail catfish	2.2
Hardhead catfish	0.9
Red drum	3.0
Sand trout	0.3
Sheepshead	2.6
Southern flounder	1.7
Spotted seatrout	1.2
Tripletail	4.1
Whiting	0.7
Lavaca-Matagorda Bay Estuary fish average	3.8

LITERATURE CITED

[1] Texas Environmental Health Institute (TEHI). 2013. Available: http://www.dshs.state.tx.us/epitox/tehi.shtm (October 7, 2013).

[2] Southwick Associates. 2007. Sportfishing in America: an economic engine and conservation powerhouse. Produced for the American Sportfishing Association with funding from the multistate conservation grant program.

[3] Texas Department Health (TDH). 1988. Aquatic life order number 1(AL-1) Lavaca Bay. Texas Department of Health, Seafood Safety Division, Austin, Texas.

[4] Texas Department Health (TDH). 1988. Aquatic life order number 13(AL-13) Lavaca Bay and Cox Bay. Texas Department of Health, Seafood Safety Division, Austin, Texas.

[5] Texas Water Development Board (TWDB). 2013. Coloardo-Lavaca Estuary. Available: http://www.twdb.state.tx.us/surfacewater/bays/major_estuaries/colorado_lavaca/index.asp (April 30, 2013).

[6] United States Census Bureau (USCB). 2012. 2012 census data. Available: http://www.census.gov/ (May 6, 2013).

[7] United States Environmental Protection Agency (USEPA). 2002. Economic and benefits analysis for the proposed section 316(b) phase II existing facilities rule Available: http://www.epa.gov/waterscience/316b/phase2/econbenefits/toc.pdf (July 14, 2010).

[8] Texas Department of State Health Services (DSHS). 2007. Standard operating procedures and quality assurance/quality control manual. Seafood and Aquatic Life Group Survey Team ,Austin, Texas.

[9] United States Environmental Protection Agency (USEPA). 2000. Guidance for assessing chemical contaminant data for use in fish advisories. vol. 1, fish sampling and analysis, 3rd ed. EPA-823-B-00-007. Office of Water, Washington, D.C.

[10] Toxic Substances Coordinating Committee (TSCC) Web site. Available: http://www.tscc.state.tx.us/dshs.htm (July 14, 2010).

[11] United States Environmental Protection Agency (USEPA). 2000. Guidance for assessing chemical contaminant data for use in fish advisories. vol. 2, risk assessment and fish consumption limits, 3rd ed. EPA-823-00-008. Office of Water, Washington, D.C.

[12] Clean Water Act (CWA). 33 USC 125 *et seq.* 40CFR part 131: Water Quality Standards.

[13] Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury (update). United States Department of Health & Human Services, Public Health Service. Atlanta, GA.

[14] Klaassen C.D., editor. 2001. Casarett and Doull's toxicology: the basic science of poisons, 6th ed. McGraw-Hill Medical Publishing Division, New York, NY.

[15] Beauchamp, R. 1999. Personal Communication: Monte carlo simulations in analysis of fish tissue contaminant concentrations and probability of toxicity. Department of State Health Services, Austin, TX.

[16] Integrated Risk Information System (IRIS). 1993. Reference dose (RfD): description and use in risk assessments. United States Environmental Protection Agency. Available: http://www.epa.gov/iris/rfd.htm (August 27, 2010).

[17] Agency for Toxic Substances and Disease Registry (ATSDR). 2009. Minimal risk levels for hazardous substances. United States Department of Health & Human Services. Public Health Service. Available: http://www.atsdr.cdc.gov/mrls/index.html (August 27, 2010).

[18] Integrated Risk Information System (IRIS). 2010. IRIS glossary/acronyms & abbreviations. United States Environmental Protection Agency. Available: http://www.epa.gov/NCEA/iris/help_gloss.htm (August 27, 2010).

[19] United States Environmental Protection Agency (USEPA). 1999. Glossary of key terms. Technology transfer network national-scale air toxics assessment. Available: http://www.epa.gov/ttn/atw/natamain/gloss1.html (August 27, 2010).

[20] Thompson, K.M. 2004. Changes in children's exposure as a function of age and the relevance of age definitions for exposure and health risk assessment. MedGenMed. 6(3), 2004. Available: http://www.medscape.com/viewarticle/480733. (February 24, 2009).

[21] University of Minnesota, Maternal and Child Health Program, School of Public Health. 2004. Children's special vulnerability to environmental health risks. Healthy Generations 4(3). Available: http://www.epi.umn.edu/mch/resources/hg/hg_enviro.pdf (August 27, 2010).

[22] Selevan, S.G., C.A. Kimmel, and P. Mendola. 2000. Identifying critical windows of exposure for children's health. Environmental Health Perspectives Volume 108, Supplement 3.

[23] Schmidt, C.W. 2003. Adjusting for youth: updated cancer risk guidelines. Environmental Health Perspectives. 111(13):A708-A710.

[24] Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Child health initiative. United States Department of Health & Human Services. Public Health Service. ATSDR Office of Children's Health. Atlanta, GA.

[25] United States Environmental Protection Agency (USEPA). 2000. Strategy for research on environmental risks to children, Section 1 and 2. Office of Research and Development (ORD)Washington, D.C.

[26] Systat 13 for Windows®. Version 13.1. Copyright© Systat Software, Inc., 2009 all rights reserved. Available: http://www.systat.com/ (September 18, 2013).

[27] Microsoft Corporation. Microsoft® Office Excel 2010. Copyright© 2010 Microsoft Corporation.

[28] Corl, E., R. Owen, A. Pollack, S. Braunig, and M. Holden. 2002. Detection and reporting limit issues related to risk assessments. United States Navy. Available: http://web.ead.anl.gov/ecorisk/issue/pdf/Final_Detection_04_02.pdf (August 27, 2010).

[29] University of Alaska Fairbanks, Alaska Sea Grant College Program. 2004. Recoveries and yields of pacific fish and shellfish.Marine Advisory Bulletin No. 37. University of Alaska, Fairbanks, AK

[30] United States Environmental Protection Agency (USEPA). 1996. Guidance for assessing chemical contaminant data for use in fish advisories. vol. 3, overview of risk management. EPA-823-B-96-006. Office of Water, Washington, D.C.

[31] Texas Statutes: Health and Safety Code, Chapter 436, Subchapter D, §436.061and § 436.091.

[32] Department of State Health Services (DSHS). 2009. Guide to eating Texas fish and crabs. Seafood and Aquatic Life Group. Austin, TX.

[33] Department of State Health Services (DSHS). 2013. Seafood and Aquatic Life Group web site. Austin, TX. Available: http://www.dshs.state.tx.us/seafood/ (September 18, 2013).

[34] Texas Parks and Wildlife Department (TPWD). 2013-2014 Outdoor annual: hunting and fishing regulations. Ed. J. Jefferson. Texas Monthly Custom Publishing, a division of Texas Monthly, Inc. 2013 (valid September 1, 2013 through August 31, 2014).