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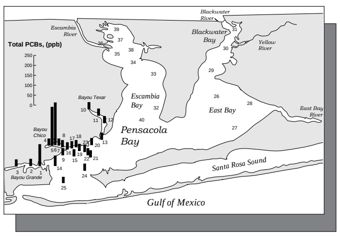
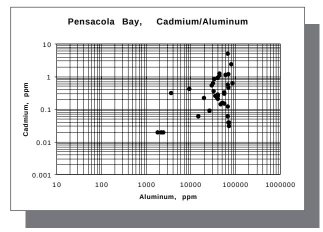
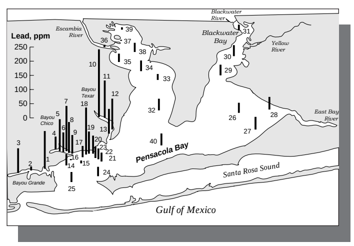
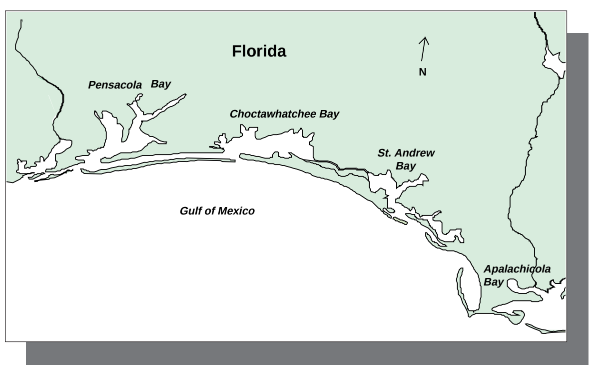
National Status and Trends Program
for Marine Environmental Quality

Magnitude and Extent of Sediment Toxicity in Four Bays of the Florida Panhandle: Pensacola, Choctawhatchee, St. Andrew and Apalachicola.









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Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Ocean Service

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Notice

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Magnitude and Extent of Sediment Toxicity in Four Bays of the Florida Panhandle: Pensacola, Choctawhatchee, St. Andrew and Apalachicola.

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ABSTRACT

The toxicity of sediments in Pensacola, Choctawhatchee, St. Andrew and Apalachicola Bays was determined as part of bioeffects assessments performed by NOAA's National Status and Trends Program**.** The objectives of the survey were to determine: (1) the spatial patterns in toxicity throughout each bay, (2) the spatial extent of toxicity throughout and among the bays, (3) the severity or degree of toxicity, and (4) the relationships between chemical contamination and toxicity. The survey was conducted over two years: Pensacola Bay and St. Andrew Bay were sampled in 1993; and Choctawhatchee Bay, Apalachicola Bay and Bayou Chico (a sub-basin of Pensacola Bay) were sampled during 1994.

Surficial sediment samples were collected from 123 randomly-chosen locations throughout the five areas. Multiple toxicity tests were conducted on all samples, and chemical analyses were performed on 102 of the 123 samples.

Toxicological tests were conducted to determine survival, reproductive success, morphological development, metabolic activity, and genotoxicity; all bays showed toxicity in at least some of the samples. Toxicity was most severe in Bayou Chico, an industrialized basin adjoining Pensacola Bay. Other developed bayous adjoining Pensacola Bay and the other bays also showed relatively severe toxicity. The main basins of the bays generally showed lower toxicity than the adjoining bayous. The different toxicity tests, however, indicated differences in severity, incidence, spatial patterns, and spatial extent in toxicity. The most sensitive test, a bioassay of metabolic activity of a bioluminescent bacteria, indicated toxicity was pervasive throughout the entire study area. The least sensitive test, an acute bioassay performed with a benthic amphipod, indicated toxicity was restricted to a very small portion of the area.

Causes of toxicity were not determined in the survey. However, mixtures of potentially toxic substances, including pesticides, petroleum constituents, trace metals, and ammonia, were associated statistically with the measures of toxicity. The concentrations of many substances were highest in Bayou Chico, where the most severe toxicity was observed. At these toxic sites, some of the substances had considerably elevated concentrations, often exceeding numerical guidelines or known toxicity thresholds. The relationships between toxicity and chemical concentrations differed among the bays and toxicity tests.

EXECUTIVE SUMMARY

The National Status and Trends (NS&T) Program, administered by the National Oceanic and Atmospheric Administration (NOAA), conducts a nationwide program of monitoring and bioeffects assessments. As a part of this program, regional surveys are conducted to determine the toxicity of sediments in estuarine and marine environments.

Toxicity in this survey of four western Florida Bays was determined using a suite of four laboratory tests done on all samples: (1) percent survival of marine amphipods (*Ampelisca abdita*) in 10-day tests of solid-phase (bulk) sediments; (2) changes in bioluminescent activity of a marine bacterium, *Photobacterium phosphoreum*, in 5-minute Microtox™ bioassays of organic extracts; (3) fertilization success of the sea urchin *Arbacia punctulata* in one hour tests of the sediment porewater; and (4) normal embryological development of *A. punctulata* in 48-hour tests of the porewater. In addition, the Mutatox™ variant of the microbial bioluminescence tests were performed on samples collected during the second year from Bayou Chico Bay, Choctawhatchee Bay and Apalachicola Bay. The concentrations of trace metals, pesticides, other chlorinated compounds, polynuclear aromatic hydrocarbons, and sedimentological features of the sediments were determined on 102 of the 123 total samples.

Based upon the chemistry data acquired as a part of this survey, concentrations of many trace metals, pesticides, and polynuclear aromatic hydrocarbons (PAHs) were considerably higher in the urbanized bayous of Pensacola, Choctawhatchee, and St. Andrew Bays than in the main basins of those systems or in Apalachicola Bay. Trace metals concentrations exceeded background levels as predicted by geochemical normalization using metal-to-aluminum ratios, suggesting problematic metals loadings from upland sources. Concentrations of zinc, numerous high and low molecular weight PAHs, dieldrin, and DDT isomers were particularly high in Bayou Chico. To a lesser degree, bulk chemistry results showed elevated values of several contaminants in Watsons Bayou, Bayou Texar, Garnier Bayou, Boggy Bayou, and Massalino Bayou. Therefore, these data suggested that toxicity would be most probable and most severe in Bayou Chico, somewhat less likely in the other urban bayous, and least likely in the main basins of all four bays.

Some of the tests showed agreement and concordance among test results, while others failed to show significant concordance. Therefore, different toxicity tests identified overlapping but generally different patterns in toxicity. The amphipod test data showed a general lack of toxicity. Only three stations throughout all four bays were significantly toxic in the amphipod test; one in Apalachicola Bay, one in Choctawhatchee Bay, and one in Bayou Chico Bay in the Pensacola Bay estuary. Amphipod survival was less than 80% of controls in only one sample, which was collected from Bayou Chico.

The data from the Microtox™ tests indicated that the majority of the samples from the four bays were toxic; 114 of 123 samples were significantly different from controls. Toxicity in this test was pervasive, extending throughout most or all of each bay. Mean test results often were less than 10% of reference response levels. All of the samples from Choctawhatchee Bay, St. Andrew Bay, and Bayou Chico were significantly different from controls. All except one sample from Apalachicola Bay were toxic and all except eight samples from Pensacola Bay were toxic. Nontoxic samples came from an upstream station in the Apalachicola River, several stations near the mouth of and scattered throughout Pensacola Bay.

Results of the Mutatox™ tests conducted in Year 2 revealed that 22 of 52 samples produced a strong genotoxic response (G category). An additional 11 stations produced suspect results. All stations tested in Bayou Chico provided a genotoxic response. In contrast, only one of the nine samples from Apalachicola Bay showed a genotoxic response and five of the samples showed no genotoxicity.

The sea urchin fertilization tests showed relatively high toxicity in several bayous of Choctawhatchee Bay, Watsons Bayou in St. Andrew Bay, and Bayou Chico of Pensacola Bay, as compared to the remainder of the study area. There was relatively low toxicity in most of the main basins of Pensacola and St. Andrew Bays. Most of the 1994 samples from Bayou Chico were highly toxic in all porewater concentrations, whereas none collected in 1993 was toxic in any porewater concentrations. Two samples each in the lower Apalachicola River and lower Apalachicola Bay were toxic in 100% porewater. Among the 123 samples tested, 38 (31%) were significantly toxic in tests of 100% porewater.

In the urchin embryo development tests, there was a relatively high incidence of toxicity in Choctawhatchee Bay, Apalachicola Bay and Bayou Chico as compared to other areas in the study area, and a low incidence of toxicity in St. Andrew Bay. Stations exhibiting toxicity in the embryo development tests were largely associated with urbanized tributaries to the bays in all systems, except in Apalachicola Bay. Toxicity was especially apparent in Bayou Chico, Watson Bayou, and Pensacola Harbor in Pensacola Bay, Destin Harbor, portions of Garnier Bayou, and part of Choctawhatchee Bay. Among the 123 samples tested, a total of 46 (37%) were toxic in at least 100% porewater, a slightly higher proportion than observed in the fertilization tests. Results of the embryo development tests agreed relatively well with those from the urchin fertilization tests.

Overall, the highest incidence of toxicity occurred among the Bayou Chico samples, followed by Choctawhatchee Bay, Apalachicola Bay, St. Andrew Bay, and Pensacola Bay. All of the Bayou Chico samples were toxic in the sea urchin development, Microtox™, and Mutatox™ tests performed in 1994; all were highly toxic in the urchin development and Mutatox™ tests; and all except one sample were highly toxic in the urchin fertilization tests. In addition, the only sample that was highly toxic in the amphipod survival tests was collected in Bayou Chico. In

Choctawhatchee Bay, all samples were toxic in Microtox™ tests, most were toxic in Mutatox™ tests, 57% were toxic in urchin fertilization tests, 49% were toxic in urchin development tests, and one sample was toxic in the amphipod tests. The incidence of toxicity in Pensacola Bay and St. Andrew Bay was relatively similar: zero and one sample toxic in amphipod tests (respectively), 10% and 13% toxic in urchin fertilization tests, 27% and 23% toxic in urchin development tests, and 80% and 100% toxic in Microtox™ tests.

These data suggest that amphipod survival was affected in a tiny portion (0.005%) of the entire study area and microbial bioluminescence was affected in nearly all (98.9%) of the area. Both sea urchin fertilization and embryo development were affected in nearly one-half of Choctawhatchee Bay, and small portions of St. Andrew and Pensacola bays. In Apalachicola Bay, the majority of the area was affected in sea urchin development tests, whereas about one-third was affected in the fertilization tests. Usually, small portions of each bay were affected in both tests of 50% and 25% porewater. Throughout the entire study area, 23% of the area was toxic in urchin fertilization tests and 34% was toxic in the urchin development tests. Usually, small portions of each bay were affected in both tests of 50% and 25% porewater.

The relationships between toxicity measured in the four bioassays and solid-phase (bulk) sediment chemistry were explored in a multistep approach. Microtox™ test results were highly correlated with the concentrations of chlorinated compounds, including DDTs, PCBs, and total pesticides. To a lesser degree, Microtox™ test results were significantly correlated with the concentrations of some trace metals and PAHs. Urchin fertilization was highly correlated with the concentrations of PAHs, numerous trace metals, and DDT. Urchin embryo development was primarily correlated with the concentrations of unionized ammonia, and to a lesser degree, PAHs, three trace metals, and the pesticide dieldrin. The results of the Microtox™ and urchin fertilization tests were significantly correlated with the sum of the 25 chemical concentrations normalized to (i.e., divided by) effects-based numerical guidelines, since these quotients account for the contribution of 25 different substances to toxicity. The correlations strongly suggest that mixtures of toxicants, co-varying with each other, contributed significantly to the observed toxicity. This association, on the other hand, was not observed in the embryo development tests, in which ammonia was a major contributor to toxicity. The relationships between measures of toxicity and chemical concentrations differed considerably among the bioassays and among the four bays.

Based upon these analyses, it appeared that the concentrations of zinc, high molecular weight PAHs, two DDD/DDT isomers, total DDT, and dieldrin were most closely associated with toxicity in Pensacola Bay. To a lesser extent, cadmium, copper, lead, low molecular weight PAHs, and in the case of urchin embryo development, unionized ammonia, were moderately associated with toxicity in Pensacola Bay. Spearman-rank correlations failed to show significant correlations between toxicity and chemical concentrations in samples from Bayou Chico and Apalachicola Bay. However, there were numerous obvious associations between elevated chemical levels and toxicity. Of note, samples from Bayou Chico had considerably higher chemical concentrations than those from Apalachicola Bay.

The associations between toxicity and concentrations of potentially toxic substances in Choctawhatchee Bay were strongest for the urchin fertilization tests in which a large gradient in response was observed. Most notable among these were the concentrations of DDT isomers, total DDT, silver, the sum of PAHs, and dieldrin.

The four toxicity endpoints measured in St. Andrew Bay appeared to co-vary with different substances in the samples. Despite significant correlations between amphipod survival and the concentrations of copper and DDT, none of the bioassay results were significantly different from controls. Sea urchin development was significantly correlated only with unionized ammonia in the porewater tests, and zero percent normal development occurred in some samples with relatively high ammonia concentrations. Urchin fertilization was correlated with a number of trace metals, DDT, and ammonia. Concentrations of some metals and DDT exceeded effects-based numerical guideline values. Microtox™ test results were highly correlated with complex mixtures of substances, including many trace metals and organic compounds. Additionally, Microtox™ test results showed a strong association with the cumulative ERM quotients, again suggesting that microbial bioluminescence responded to complex mixtures of substances in the organic solvent extracts.

The data from this survey indicated that sediments in some regions of the area were contaminated relative to background conditions and effects-based numerical guidelines, that toxicity occurred throughout the entire region as measured in the most sensitive tests, that the most severe toxic responses and the highest incidences of toxicity occurred in Bayou Chico, that the toxicity test results generally paralleled the concentrations of potentially toxic substances in the samples, and that different mixtures of toxicants were associated with toxicity.

INTRODUCTION

Toxic chemicals can enter the marine environment through numerous routes: stormwater runoff, industrial point source discharges, municipal wastewater discharges, atmospheric deposition, accidental spills, illegal dumping, pesticide applications and agricultural practices. Once they enter a receiving system, toxicants can become bound to suspended particles and increase in density sufficiently to sink to the bottom. Sediments are one of the major repositories of contaminants in aquatic environments. Furthermore, if they become sufficiently contaminated, sediments can act as sources of toxicants to important biota. Sediment quality data are direct indicators of the health of coastal aquatic habitats.

Sediment quality investigations conducted by the National Oceanic and Atmospheric Administration (NOAA) and the Florida Department of Environmental Protection (FDEP) have indicated that toxic chemicals are found in the sediments and biota of Florida estuaries, including those of the western Florida panhandle (NOAA, 1992; Seal et al., 1994). This report documents the toxicity of sediments collected within four large bays of the western Florida panhandle: Pensacola, St. Andrew, Choctawhatchee, and Apalachicola (Figure 1).

As a component of its National Status and Trends (NS&T) Program, NOAA monitors toxicant concentrations in selected locations throughout the nation and surveys the biological significance of toxicant accumulations in selected regions. In the monitoring component of the program, mollusks and demersal fishes are captured annually for chemical analyses of their tissues. Sediments are collected and analyzed for a suite of metals and organic parameters. Spatial patterns and temporal trends in chemical concentrations are determined from the data (O'Connor and Ehler, 1991; O'Connor, 1991). Chemical analyses of sediments collected at each sampling site were performed at many of the sites the first year that each site was sampled. Nationwide, NS&T monitoring activities were initiated in 1983 and have continued each year to the present.

Thus far, sediment toxicity surveys have been performed by NOAA in San Francisco Bay (Long and Markel, 1992), Tampa Bay (Long et al., 1994), Long Island Sound (Wolfe et al., 1994), Hudson-Raritan estuary (Long et al., 1995), Boston Harbor (Long et al., 1996), Los Angeles/Long Beach Harbor (Sapudar et al., 1994), San Diego Bay (Fairey et al., 1996), and in several other areas in which the surveys are still underway.

Each year, numerous sites (50-70) have been sampled along the Gulf of Mexico, including the bays of the western Florida panhandle (Sericano et al., 1990). During the first years of the program, sediments and oysters collected at sites in Choctawhatchee Bay and St. Andrew Bay contained extremely high concentrations of DDTs, PCBs, and non-DDT pesticides (Sericano et al., 1990), exceeding the concentrations of those substances in all other Gulf coast sites.

NS&T Program data from estuaries nationwide for the period 1984 through 1989 were summarized by NOAA (1991). These data revealed that the concentrations of a number of chemicals were significantly elevated in sediments, warranting further in-depth investigation. In ranking estuaries nationwide with respect to sediment contamination, the NS&T Program ranked Choctawhatchee Bay 1st (highest) in the nation for total chlorinated pesticides, 3rd highest for total DDT, 6th highest in lead, 6th highest for total PAHs, and 4th highest for arsenic. St. Andrew Bay ranked 19th highest in the nation with respect to total chlorinated pesticides, 9th highest for total DDTs, 2nd highest for total PCB's, 3rd highest for total PAHs, and 6th for TOC.

The concentrations of total polynuclear aromatic compounds (PAHs), total DDTs, and lead in fine-grained sediments collected at each of the ten historic NS&T Program monitoring sites in western Florida are compared in Figures 2-4. These samples accompanied collections of either fish or oysters and were intended to represent "average" conditions within major basins of each bay. They were not selected to represent highly contaminated areas within each bay. They may or may not represent conditions throughout each bay.

Stations PCMP and SAWB in St. Andrew Bay had the highest PAH concentrations. PAH concentrations were relatively low at three stations sampled in Apalachicola Bay, two locations in Pensacola Bay, station CBSR in Choctawhatchee Bay, and station PCLO in St. Andrew Bay. The concentrations of total DDTs showed a pattern very different from that of total PAHs (Figure 3). Elevated concentrations were found only at one location; station

CBPP in Choctawhatchee Bay. Another pattern in concentrations was evident with lead (Figure 4). Lead concentrations were elevated at station CBPP, intermediate at two locations in St. Andrew Bay (stations PCMP and SAWB), and moderate to relatively low in several other locations. The concentrations of total PAHs, total DDTs, and lead were uniformly relatively low in the Apalachicola Bay stations.

Concentrations of major classes of organic compounds and each trace element are compared among the NS&T Program stations collected during 1991 in Figures 5-8. In Pensacola Bay, concentrations of PAHs, chromium, copper, lead, nickel, and zinc were relatively high at station PEN as compared to station PBIB (Figure 5). In Choctawhatchee Bay, PAH, DDT, and lead (Pb) concentrations were higher at station CBPP than at station CBSR (Figure 6). Among the three locations sampled in St. Andrew Bay, stations PCMP and SAWB had relatively high concentrations of several classes of organic compounds, chromium, copper, lead, and zinc (Figure 7). In Apalachicola Bay, the concentrations of both high molecular weight PAHs and total PAHs were relatively high at station APDB compared to the others (Figure 8). All other organic compounds occurred at relatively low concentrations. Among the trace elements, chromium and zinc occurred in relatively high concentrations at all three stations (Figure 8). The concentrations of each trace metal were similar among the three stations.

The Florida Department of Environmental Protection investigated coastal sediment quality from 1982 through 1991 throughout the state (Seal et al., 1994). The objectives of their investigations were several: to provide a statewide (spatial) perspective on the presence of contaminants in coastal systems, to investigate areas of special interest (ports projects) and to determine ways to interpret sediment quality data.

The FDEP produced an atlas that summarized sediment chemistry data from both the FDEP and NOAA NS&T Program investigations in bay systems throughout the state (Seal et al., 1994). Elevated levels of both metals and organic contaminants were detected in samples collected statewide, including those from the four estuaries in northwest Florida. Metals contamination within the studied estuaries was usually within a factor of 5 times the expected background level, based on normalization to aluminum (Seal et. al., 1994, Schropp and Windom, 1988). PAHs were the most frequently detected organic contaminant, which followed a statewide trend (Seal et al, 1994). Other organic contaminants of concern included pesticides and PCBs. Brief synopses of conditions within each of the four bays are provided in the following discussion.

Pensacola Bay. Four major water bodies make up the Pensacola Bay estuarine system: Escambia Bay, Pensacola Bay, Blackwater Bay and East Bay (Figure 9). Together these waterbodies form one of the largest estuarine systems of Florida, encompassing over 152 square miles of estuarine surface water area (Seal et al., 1994). The estimated drainage basin covers 3,480 square miles of Florida and Alabama. Average water depth of the estuary is 19 feet (NOAA, 1985). Principle tributaries of the estuary include the Escambia, Blackwater, Yellow and East Bay Rivers.

The western portion of the Pensacola Bay estuary is predominantly urban, whereas the eastern portion is relatively undeveloped. The urban center of the city of Pensacola contains extensive industrial, commercial and residential development. Industrial facilities are located along Bayou Chico, the Escambia River, and near Escambia Bay. Other land uses within the watershed include urban development, military holdings, silviculture, agriculture, conservation and recreation (Seal et al., 1994, Paulic et al. 1994).

The Pensacola Bay estuary is included in the Surface Water Improvement and Management (SWIM) program of the State of Florida, overseen by the Florida Department of Environmental Protection and administered by the Northwest Florida Water Management. The SWIM plan prepared for the Pensacola Bay estuary reported that there has been an extensive loss of aquatic grass beds and widespread fluctuations in fish and shellfish harvests in both Escambia Bay and East Bay (Northwest Florida WMD, 1990).

FDEP sediment studies detected PAHs and PCBs in most stations located throughout the bay, and in NOAA NS&T Program stations in Pensacola Bay and Indian Bayou showed elevated PAH concentrations. Sediments in the western portion of the estuary exceeded natural background levels of metals, especially in Bayou Chico and Bayou Grande (Seal et. al., 1994).

Choctawhatchee Bay. The Choctawhatchee Bay estuary has a surface area of 123 sq. miles with an estimated drainage area of 2259 square miles of Florida and Alabama (Seal et al., 1994) (Figure 10). Average depth of the estuary is about 22 feet (NOAA, 1985), however the bay is deepest to the west, and shallows to the east. The

Choctawhatchee River entering the bay on the far eastern shore is the most significant freshwater tributary. Several small tributary streams enter the Bay along the north shore (Seal et al., 1994).

Development in the basin along the north and west has been sparse. Eglin Air Force Base occupies most of the immediate northern drainage basin. The city of Fort Walton Beach is on the eastern shore, and the town of Destin is situated at East Pass, the mouth of the bay. Much of the peninsula that forms the southern boundary of the bay has been developed for single-family dwellings, hotels, and condominiums (Paulic et al., 1994). This coastal peninsula was severely impacted by Hurricane Opal in October of 1995.

Investigations of sediment quality throughout Choctawhatchee Bay have shown minimal enrichment by metals bay wide (Seal et al, 1994), however concentrations of several metals were elevated in Destin Harbor, and concentrations of lead were elevated near Boggy Point at the confluence of Boggy Bayou and the main basin of the Bay. Organic contaminants were elevated at several locations, including: PAH's in Destin Harbor (Seal et al, 1994); and PAH's, PCB's, and total DDT at the some of highest levels in the nation at both the Santa Rosa and Boggy Point NS&T Program locations (NOAA, 1991).

St. Andrew Bay. The St. Andrew Bay estuarine system has a surface area of 98 square miles. The drainage basin of 1130 square miles is entirely within Florida. The average depth of the bay is 27 feet. Several embayments distinguish the St. Andrew Bay estuarine system (Figure 11): West Bay, North Bay, East Bay and the main basin of St. Andrew Bay. The drainage area includes the urban centers of Panama City, Lynn Haven, and Panama City Beach, however, the majority of the watershed is forested and in silviculture (Paulic et. al., 1994).

Elevated concentrations of metals and organic contaminants have been documented in the bay (FDEP, 1994; U.S. FWS, 1995; NOAA, 1991). The main source of elevated trace metals appears to be stormwater runoff from urbanized areas in and around Panama City (Seal, 1994). PAH's, PCB's and pesticides were detected at all NS&T Program sites (NOAA, 1994).

An evaluation of dredged material from five stations in St. Andrew Bay, prepared by Battelle Ocean Sciences (1993) for the Army Corps of Engineers, showed that, in general, sediments from stations located in the bay had higher concentrations of the majority of contaminants of concern relative to reference sediments. Metals data were plotted using the FDEP metals normalization procedure, and were rarely found to be elevated above natural background levels. Sediments from most sites were nontoxic in multiple biological assays; sediments from only one station were toxic to the amphipod *Rhepoxynius abronius.* However, significant bioaccumulation of PAHs, pesticides and PCBs was measured in clams (*Macoma nasuta*) relative to reference sediment concentrations (Mayhew et.al, 1993), indicating that toxicants were bioavailable.

Apalachicola Bay. The Apalachicola Basin encompasses nearly 200 square miles of estuary, including St. Vincent Sound, East Bay, Apalachicola Bay and St. George Sound (Figure 12). The major freshwater inflow to the bay is the Apalachicola River, which originates at Lake Seminole, the impounded confluence of the Chattahoochee and Flint Rivers, formed by the Jim Woodruff dam at Chattahoochee, Florida. Headwaters for this alluvial river system originate in the Blue Ridge physiographic province. Annual flow into the bay is 25,000 cfs, varying seasonally from less than 15,000 to greater than 100,00 cfs. The estuary is highly productive, providing over 90% of the Florida oyster harvest, as well as supporting commercial fin fishing and other shellfish industries (Seal et al, 1994).

The Apalachicola estuary is unusual in that this system is composed of a river delta developing behind a sequence of barrier islands. This geomorphic situation will eventually eliminate the estuary by sediment infilling (Donoghue 1988). Finer grained materials are associated with higher burdens of contaminants; it follows that there exists good potential for contaminants to become trapped in the system in the finer grained depositional areas.

No metals enrichment had been detected by the DEP in the estuary, and only one sample out of three from NOAA's NS&T Program surveys indicated slight enrichment with mercury. PAH's, PCB's and pesticides were detected in Apalachicola Bay, but they occurred in relatively low concentrations.

Current Survey Rationale. Several factors lead to the decision to conduct a survey of sediment bioeffects in this area. First, very high concentrations of organic compounds (DDT, PCB) had been found by the NOAA NS&T Program in sediments and biota of Choctawhatchee and St. Andrew bays, bringing attention to the area from a nationwide perspective. Second, the state of Florida wanted to further explore the potential for biological effects in the marine environment and field-validate recently drafted statewide sediment quality guidelines. Previously collected data were compared to effects-based numerical guidelines (Long and Morgan,1990; MacDonald, 1993, 1994). Sufficient numbers of sediment samples equaled or exceeded these values to warrant concern that sediments may pose a toxicological risk to resident biota. Third, the bays of the western Florida panhandle support abundant populations of living marine resources that could be at risk from toxicant contamination. Collectively, these factors lead to the decision to determine if contamination of the sediments in the western Florida panhandle was sufficiently high to warrant concern for resident biota.

This document reports the results of a survey of sediment toxicity in four selected bays of the western Florida panhandle. Sediments were collected throughout each of the bays over a two-year period to determine if there was an effect on biota based on the use of a battery of laboratory toxicity tests.
The objectives of the survey were to:
(1) determine the presence and severity of toxic responses,
(2) estimate the spatial extent of toxicity,
(3) identify spatial patterns of toxicity in each system, and
(4) characterize the relationships between toxicity and potential toxicants.

Sampling and testing methods used in previous surveys performed elsewhere in the USA were employed in this survey. A wide variety of candidate measures of toxicant effects were evaluated and compared to determine which would be most useful in NOAA's surveys (Wolfe, 1992; Long and Buchman, 1989). Batteries of assays performed with sediments, bivalve mollusks, and demersal fishes in selected regions have been used to form a weight of evidence with regard to the presence and incidence of toxicant-associated bioeffects. Analyses of sediment toxicity have been included in these regional assessments to provide an estimate of potential effects of sediment contaminants on resident benthic populations. Batteries of toxicity tests appropriate for analyzing sediment toxicity were selected following evaluations of a number of candidates (Long and Buchman, 1989).

Based upon sediment chemistry data from previous studies, toxicity was most probable in portions of Pensacola Bay (especially in the adjoining urban/industrial bayous), St. Andrew Bay, and Choctawhatchee Bay. Toxicity was least probable in Apalachicola Bay.

METHODS

Sampling Design. The four estuaries were investigated during 1993 and 1994; Pensacola and St. Andrew bays were sampled during 1993, and Choctawhatchee and Apalachicola bays were sampled in 1994. Samples were collected in Bayou Chico, an embayment contiguous to Pensacola Bay, during both years.

The study area included saltwater portions of these four coastal bays. Stratified, random sampling designs patterned after those of the EMAP-Estuaries surveys (Schimmel et al., 1994) were used in each bay during the selection of sampling stations. Each bay was subdivided into irregular-shaped strata. Large strata were established in the open waters of the bays where toxicant concentrations were expected to be uniformly low. This approach provided the least intense sampling effort in areas known or suspected to be relatively homogenous in sediment type and water depth, and relatively distant from contaminant sources. In contrast, relatively small strata were established in urban harbors and bayous nearer suspected sources in which conditions were expected to be heterogeneous or transitional. Sampling effort was more intense in the small strata than in the large strata. The large strata were roughly equivalent in size as were the small strata.

This approach combines the strengths of a stratified design with the random-probabilistic selection of sampling locations. Data generated within each stratum can be attributed to the dimensions of the stratum. Therefore, these data can be used to estimate the spatial extent of toxicity with a quantifiable degree of confidence (Heimbuch, et al., 1995). Strata boundaries were established to coincide with the dimensions of major basins, bayous, waterways, etc. in which hydrographic, bathymetric and sedimentological conditions were expected to be relatively homogeneous.

The locations of individual sampling stations within each strata were chosen randomly using the EMAP computer software and hardware (Dr. Kevin Summers, U.S. EPA, Environmental Research Laboratory, Gulf Breeze, FL). One to three samples were collected within each stratum. Usually, four alternate locations were provided for each station in a numbered sequence. The coordinates for each alternate were provided in tables and were plotted on the appropriate navigation chart. In a few cases the coordinates provided were inaccessible. They were rejected and the vessel was moved to the next alternate.

Sample Collection. At each station the sampling vessel was piloted to the first alternate location for the sample collection. If the station was inaccessible or if the material at the location was only coarse sand with no mud component, that alternate location was abandoned and the second (third, or fourth, if needed) alternate was sampled. In almost all cases the first or second alternates were acceptable and were sampled.

Vessel positioning and navigation were aided with a Trimble NavGraphic XL Global Positioning System (GPS) unit and a compensated LORAN C unit. Both systems generally agreed very well with each other when both were operational. Both were calibrated and their accuracy verified each morning at a known location within the study area.

Samples were collected with a Kynar-lined 0.1m^2 modified van Veen grab sampler (also known as a Young grab) deployed with an electric windless aboard the state of Florida R/V *Raja*. The grab sampler and sampling utensils were acid washed with 10% HCl at the beginning of each survey, and thoroughly cleaned with site water and acetone before each sample collection. Usually 3 or 4 deployments of the sampler were required to provide a sufficient volume of material for the toxicity tests and chemical analyses. The upper 2-3 cm. of the sediment were sampled to ensure the collection of recently arrived materials. Sediments were removed with a plastic scoop and accumulated in a stainless steel pot. The pot was covered with a Teflon plate between deployments of the sampler to minimize sample oxidation and exposure to shipboard contamination. The material was carefully homogenized in the field with a stainless steel spoon before it was distributed to prepared containers for each analysis.

Samples were shipped in ice chests packed with water ice or blue ice to the testing laboratories by overnight courier. Samples were accompanied by chain of custody forms which included the date and time of the sample collection, and station designation.

Locations of the individual sampling stations for each bay are illustrated in Figures 13-17, and coordinates for each are listed in Table 1. Forty samples were collected in 1993 throughout all the major basins of Pensacola Bay and in Bayou Grande, Bayou Texar, Bayou Chico and the mouth of the Escambia River (Figure 13). Twelve samples were collected in 1993/94 in Bayou Chico where toxicity was most probable (Figure 14). Samples (n=36) were collected throughout Choctawhatchee Bay, a very large system, and many adjoining bayous (Figure 15). Thirty-one samples were collected throughout St. Andrew Bay, near Panama City (Figure 16). In Apalachicola Bay, nine samples were collected throughout the bay and up the Apalachicola River (Figure 17). Field log notes containing information on depth and sediment characteristics at each station are listed in Appendix A.

Multiple toxicity tests were performed on all sediment samples. Chemical analyses were performed on a subset of samples from each bay system for trace metals, butyl tins, polynuclear aromatic hydrocarbons, chlorinated pesticides and PCBs following a review and evaluation of the toxicity test results. Because the study encompassed two years, different contract laboratories performed chemistry analyses and amphipod toxicity tests.

Amphipod Survival Test. The amphipod tests are the most widely and frequently used assays in sediment evaluations performed in North America. They are performed with adult crustaceans exposed to relatively unaltered, bulk sediments. *Ampelisca abdita* has shown relatively little sensitivity to nuisance factors such as grain size, ammonia, and organic carbon in previous surveys. In previous surveys, the NS&T Program has observed wide ranges in responses among samples, strong statistical associations with toxicants, and small within-sample variability (Long et al., 1994; Wolfe et al., 1994; Long et al., 1995).

Ampelisca abdita is a euryhaline benthic amphipod that ranges from Newfoundland to south-central Florida, and along the eastern Gulf of Mexico. The amphipod test with *A. abdita* has been routinely used for sediment toxicity tests in support of numerous EPA programs, including EMAP in the Virginian, Louisianian, and Carolinian provinces (Schimmel et al., 1994). Amphipod toxicity tests followed ASTM protocols (ASTM, 1990, 1992). In the first year, amphipod tests of samples from Pensacola Bay and St. Andrew Bay were conducted by the National Biological Service (NBS, now USGS) laboratory in Port Aransas, Texas. In the second year, amphipod assays were conducted by Science Applications International Corporation, (SAIC) in Narragansett, R.I.

In Year 1, test animals were purchased from Brezina and Associates of Dillon Beach, California. Amphipods were packed in native sediment with 8-10 liters of seawater in doubled plastic bags. Oxygen was injected into the bags and shipped via overnight courier to the testing lab at Port Aransas. Upon arrival, amphipods were acclimated and maintained at 20∞C for one day prior to the initiation of the test.

Control sediments for Year 1 testing included sediment collected from the natural habitat of the amphipods in California, and a reference sediment from Redfish Bay, Texas. The Redfish Bay sediments had been used in previous sediment quality assessment studies by SAIC and by the U.S. Fish & Wildlife Service (NBS, then USGS). Both reference sediments were handled in the same manner as the Pensacola Bay and St. Andrew Bay sediments.

For Year 2 testing, amphipods were collected by SAIC from tidal flats in the Pettaquamscutt (Narrow) River, a small estuary flowing into Narragansett Bay, Rhode Island. Animals were held in the laboratory in pre-sieved uncontaminated (“home”) sediments under static conditions. Fifty percent of the water in the holding containers was replaced every second day when the amphipods were fed. During holding, *A. abdita* were fed laboratory cultured diatoms (*Phaeodactylum tricornutum*).

Control sediments were collected by SAIC from the Central Long Island Sound (CLIS) reference station of the U.S Army Corps of Engineers, New England Division. These sediments have been tested repeatedly with the amphipod survival test and other assays and found to be nontoxic (amphipod survival has exceeded 90% in 85% of the tests) and uncontaminated (Wolfe et al., 1994; Long et al., 1995). Sub-samples of the CLIS sediments were tested along with each series of samples from Pensacola, Choctawhatchee and Apalachicola bays.

Amphipod testing performed by both laboratories followed the procedures detailed in the Standard Guide for conducting 10 day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods (ASTM, 1990, 1992). Briefly, amphipods were exposed to test and negative control sediments for 10 days with 5 replicates of 20 animals each under static conditions using filtered seawater. For the Year 1 (NBS) test, 250 milliliters (mls) of test or control sediments were delivered into 1-liter glass jars, and 700 mls of seawater were added to each jar. The Year 2 SAIC procedure differed somewhat: 200 mls of test or control sediments were placed in the bottom of the test chamber and covered with approximately 600 mls. of filtered seawater (28-30 ppt). For both sets of tests, air was provided by air pumps and delivered into the water column through a pipette to ensure acceptable oxygen concentrations, but suspended in a manner to ensure that the sediments would not be disturbed. Temperature was maintained at ~20∞C by either incubator (NBS) or water bath (SAIC). Lighting was continuous during the 10 day exposure period to inhibit the swimming behavior of the amphipods. Constant light inhibits emergence of the organisms from the sediment, thereby maximizing the amphipod’s exposure to the test sediments.

Twenty healthy, active animals were placed into each test chamber, and monitored to ensure they burrowed into sediments. Non-burrowing animals were replaced, and the test initiated. The jars were checked daily, and records kept for dead animals and animals on the water surface, emerged on the sediment surface, or in the water column. Those on the water surface were gently freed from the surface film to enable them to burrow, and dead amphipods were removed.

Tests were terminated after ten days. Contents of each of the test chambers were sieved through a 0.5 mm mesh screen. The animals and any other material retained on the screen were examined under a stereomicroscope for the presence of amphipods. Total amphipod mortality was recorded for each test replicate.

During Year 1 the NBS laboratory had to terminate the first test trial due to poor amphipod survival in the controls. Major storm events in the San Francisco Bay area may have led to poor viability of test animals. The tests were repeated within 20 days of collection of test sediments. Animal quality and survival improved for the repeated test, although they were not optimal. The second test batch was initiated within 10 days of receipt of field collected sediments.

A positive control, or reference toxicant test, was used to document the sensitivity of each batch of test organisms. The positive control consisted of 96 hr. water-only exposures to sodium dodecyl sulfate (SDS). LC50 values were calculated for each test run.

Sea Urchin Fertilization and Embryological Development Tests. Tests of sea urchin fertilization and embryo development have been used in assessments of ambient water and effluents and in previous NS&T Program surveys of sediment toxicity (Long et al., 1994). Test results have shown wide ranges in responses among test samples, excellent within-sample homogeneity, and strong associations with the concentrations of toxicants in the sediments. The tests, performed with the early life stages of sea urchins, have demonstrated high sensitivity.

In previous surveys, the tests of embryological development have shown higher sensitivity than tests of fertilization success and the two endpoints have shown relatively poor correlations with each other (Long, et al., 1990; Carr, 1993; NBS, 1994; Carr et al., in press). It appears that these two endpoints respond to different toxic substances in complex mixtures (Long, et al., 1990; Carr, 1993; NBS, 1994; Carr et al., in press).

Toxicity of sediment pore waters were conducted with the sea urchin *Arbacia punctulata.* These tests were performed during both years by the National Biological Service (NBS), National Fisheries Contaminant Research Center in Corpus Christi, Texas at their laboratory located in Port Aransas. Sea urchins used in this study were obtained either from jetties at Port Aransas, Texas, or from Gulf Specimen Company, Inc. (Panacea, Florida), and were acclimated to Port Aransas seawater before gametes were collected for testing.

Pore water was extracted from sediments with a pressurized squeeze extraction device (Carr and Chapman, 1992). Sediment samples were held refrigerated at 4° C until pore water was extracted. Pore water was extracted as soon as possible after receipt of the samples, but in no event were sediments held longer than 7 days from the time of collection before they were processed. After extraction, porewater samples were centrifuged in polycarbonate bottles (at 4200 g for 15 minutes in Year 1, and in Year 2, using a new centrifuge where1200 g for 15 minutes was adequate) to remove any particulate matter, and then frozen. Two days before the start of a toxicity test, samples were moved from a freezer to a refrigerator at 4° C, and one day prior to testing, thawed in a tepid water bath. Experiments performed by NBS have demonstrated no effects upon toxicity attributable to freezing of the pore water samples.

Sample temperatures were maintained at 20±1° C. Sample salinity was measured and adjusted to 30±1 ppt, if necessary, using ultrapure sterile water or concentrated brine. Other water quality measurements were made for dissolved oxygen, pH, sulfide and total ammonia. Temperature and dissolved oxygen were measured with YSI meters; salinity was measured with Reichert or American Optical refractometers; and pH, sulfide and total ammonia (expressed as total ammonia nitrogen, TAN) were measured with Orion meters and their respective probes. The concentrations of unionized ammonia (UAN) were calculated using respective TAN, salinity, temperature, and pH values.

Each of the porewater samples was tested in a dilution series of 100%, 50%, and 25% of the water quality adjusted sample with 5 replicates per treatment. Dilutions were made with clean, filtered (0.45 *u*m), Port Aransas laboratory seawater.

Tests followed the methods of Carr and Chapman (1992). Pore water from a reference area in Redfish Bay, Texas, an area located near the testing facility and in which sediment porewaters have been determined to be nontoxic in this test (e. g., Long et al., 1994), was included with each toxicity test as a negative (nontoxic) control. Adult male and female urchins were stimulated to spawn with a mild electric shock, and gametes collected separately.

For the sea urchin fertilization test, 50 *u*L of appropriately diluted sperm were added to each vial, and incubated at 20±2°C for 30 minutes. One ml of a well mixed dilute egg suspension was added to each vial, and incubated an additional 30 minutes at 20±2°C. Two mls of a 10% solution of buffered formalin solution was added to stop the test. Fertilization membranes were counted, and fertilization percentages calculated for each replicate test.

For the sea urchin embryological development test, a well mixed dilute egg solution was added to each vial. Then, 50 *u*L of appropriately diluted sperm were added to each vial, and vials were incubated at 20±1°C for 48 hours. At the end of 48 hours, 2 mls of 10% buffered formalin were added to each vial to stop the test. One hundred embryos were counted, and recorded as normal, or as unfertilized, embryological development arrested or otherwise abnormal. The percent of the embryos that were normal was reported for each replicate test.

<u>Microbial Bioluminescence Microtox™ Test</u>. This is a test of the relative toxicity of extracts of the sediments prepared with an organic solvent, and, therefore, it is immune to the effects of nuisance environmental factors, such as grain size, ammonia and organic carbon. Organic toxicants, and to a lesser degree trace metals, that may or may not be readily bioavailable were extracted with the organic solvent. Therefore, this test can be considered as a test of potential toxicity. In previous NS&T Program surveys, the results of Microtox™ tests have shown extremely high correlations with the concentrations of mixtures of organic compounds (Long et al., 1994; Long et al., 1995; Wolfe et al., 1994).

The Microtox™ assay was performed with dichloromethane (DCM) extracts of sediments following the basic procedures used in testing Puget Sound sediments (U.S. EPA, 1986, 1990, 1994) and San Francisco Bay sediments (Long and Markel, 1992). Organic extracts were prepared by ABC laboratories, Inc. of Columbia, Missouri. The extractions and transfers were conducted under a laminar flow hood to limit exposure of the sample to light. All sediment samples and extracts were stored in the dark at 4∞C. Prior to initial homogenization of the sediment samples, any excess water was decanted and large debris (shells, pebbles, etc.) was discarded. Each sediment sample was centrifuged for five minutes at 1000 x *g*. Water was removed by decanting with a Pasteur pipette. Moisture content of each sample was determined and recorded. Five g. of sediment were weighed, recorded, and placed into a DCM rinsed 50 mL centrifuge tube. Residue or spectral grade DCM (30 ml) was added and mixed. The mixture was shaken for 10 seconds, vented and tumbled overnight.

Each sample was centrifuged for 5 minutes at 1000 x *g*, and the extract poured into a Kuderna-Danish (KD) flask. Again, 30 ml DCM was added to each centrifuge tube. Each tube was shaken for 10 sec, vented, centrifuged for 5 min at 1000 x g, and the extract transferred to the K-D flask. This extraction procedure was repeated once more, and the extract combined in the flask.

A Snyder column was attached to the flask, and the DCM was concentrated with steam to a final volume of less than 2 mls. Acetone (approximately 5 mls) was added to the flask, and the volume concentrated to approximately 2 mls. This acetone procedure was repeated. The extract was quantitatively transferred to a 10 ml DCM rinsed flask, using acetone to rinse the Kuderna-Danish flask. The extract was concentrated with a gentle stream of nitrogen gas to a volume of approximately 1 ml. Dimethylsulfoxide (DMSO) was added to make a final volume of 10 ml.

A suspension of luminescent bacteria, *Photobacterium phosphoreum*, (Microbics Corporation, Inc.) was thawed and hydrated with toxicant-free distilled water, covered and stored in a 4°C well on the Microtox™ analyzer. To determine toxicity, each sample was diluted into four test concentrations. Percent decrease in luminescence of each cuvette relative to the reagent blank was calculated. Based upon these data, the sediment concentrations that caused a 50% decrease in light production (EC50's) were reported.

A negative control (extraction blank) was prepared using DMSO, the test carrier solvent. A positive control was prepared by adding phenol (50 mg/ml) to an extraction blank. In addition to test sediment extracts, a sediment sample from Florissant, Missouri was used as a procedural control.

<u>Microbial Bioluminescence Mutatox™ Test</u>. Samples collected during Year 2 (1994) from Bayou Chico, Pensacola Bay, Choctawhatchee Bay and Appalachicola Bay were additionally tested for toxicity with the Mutatox™ assay. The Mutatox™ assay used a dark mutant strain of the luminescent bacterium *P. phosphoreum* for detection of environmental genotoxins. DNA-damaging substances were detected by measuring the ability of a test extract to restore the luminescent capability in the bacterial cells (Johnson, 1992, 1994). The degree of light increase indicated the relative genotoxicity of the sample.

A 100 ml aliquot of Mutatox™ Assay Medium (MAM) was prepared in a 250 ml beaker using a magnetic stirrer and adjusted to 25±1∞C. Rat hepatic S9 was thawed at 25∞C. An ampoule of freeze-dried bacteria was hydrated with 1.0 ml of MAM at 25∞C. MAM was immediately inoculated with the hydrated bacteria at a ratio of 100:1, stirred, and pre-incubated for 15 minutes at 25∞C. Rat hepatic S9 was introduced into the MAM mixture at 1%, stirred for 5 seconds and dispensed into sample cuvettes. Sediment extracts were tested in a dilution series. The treated cuvettes were covered with foil, preincubated in a water bath at 37∞C for 15 minutes, transferred to a closed storage container, and placed in a dark incubator with a vented hood at 25±1∞C for 16 to 24 hours.

Three controls were used in the Mutatox™ assay: positive, negative and procedural. The positive controls consisted of four known progenotoxins. An environmental control from a previous study was used in some batches to monitor the sensitivity of the assay. The negative control was the carrier solvent; this control identified the spontaneous light emission of the dark mutant strain. The procedural control was an organic extract of a fine silt and clay particle sediment from Florissant, MO.

The response of the luminescent bacteria was determined by measuring the light intensity of each cuvette with a model 500 analyzer (Microbics Corp.). A light value of 100 or more and at least three times the intensity of the negative control was defined as a "genotoxic response"; sensitivity limits were the maximum peak concentration and the lowest detected concentration in each dilution series. The "dose response number" was defined as the number of genotoxic responses recorded at different concentrations per dilution series. A dilution series with a dose response number of 3 or more was considered genotoxic, with a dose response number less than 3, the series was considered suspect, and without a genotoxic response, the series was designated negative. Therefore, the sample was considered genotoxic when replicate series indicated an average dose response number of three or more, suspect when at least three replicate series indicated an average dose response number less than three, or negative when at least three replicate series contained no genotoxic response. Replicate dilution series were conducted on different days before each test sample was finally evaluated.

Chemical Analyses. Not all samples collected were analyzed for bulk chemical content. Sediment samples were chosen for chemical analyses based upon an examination of the toxicity test results. Samples were chosen that represented gradients in the toxicity results and furthermore represented contiguous geographic strings of stations. In Year 1, chemical analyses of Pensacola Bay sediments were performed by Skidaway Institute of Oceanography, Savannah, Georgia. Battelle Ocean Sciences analyzed sediments collected from St. Andrew Bay in Year 1, and Choctawhatchee and Apalachicola Bays in Year 2. Both laboratories conformed with performance-based analytical protocols and employed quality-assurance steps of the NS&T Program (Lauenstein and Cantillo, 1993).

During the 1993 studies of Pensacola Bay, Skidaway Institute of Oceanography received samples directly from the field. Upon receipt of the samples at the laboratory, sediments were frozen until selection for analysis. Total digestion was performed for the trace metal analyses with nitric, perchloric and hydrofluoric acids. Following digestion, samples were analyzed for lithium, aluminum, iron, manganese, cadmium, copper, chromium, nickel, lead, zinc, silver, arsenic, vanadium, barium, titanium, and total phosphorus by inductively coupled plasma mass spectrometry (ICP-MS). Mercury was quantified by ICP-MS (isotope dilution) methods (Smith, 1993). Total organic carbon and nitrogen were analyzed on a carbonate free basis, using a Perkin Elmer model 240C elemental analyzer. Total carbonate was determined from the loss in weight in acidified samples.

Procedures used in the analyses of organic compounds followed the basic methods of MacLeod et al (1985). For the polynuclear aromatic hydrocarbon (PAH) analyses, 50 g. of wet sediment was sequentially extracted with methanol, 1:1 methanol-CH_2Cl_2 and CH_2Cl_2. The organic phase was concentrated to several ml. and stored refrigerated until fractionation with column chromatography. The extracts were fractionated on columns of silica gel over alumina packed over activated copper to remove elemental sulfur. Aliphatic hydrocarbons were eluted with hexane (fraction SA1), while aromatic hydrocarbons/ PCBs/ pesticides were eluted with 1:1 pentane: CH_2Cl_2 (fraction SA2). Further separation of the SA2 fraction was accomplished by Sephadex LH-20 chromatography. PAHs were quantified by capillary gas chromatography-mass spectrometry utilizing full scan and selected ion monitoring modes. PCB congeners and chlorinated pesticides were separated using silica gel column chromatography.

Pesticides and PCBs were quantified by high-resolution fused silica capillary gas chromatography (GC) with electron capture detection on a Varian 3400cx and Varian 8200 Auto sampler instruments. DB-5 capillary column (60m length, 0-25mm i.d. and 0.25 micron film thickness) was used to resolve the PCB congeners and pesticides. Pesticides were identified and quantified by comparison to authentic pesticide standards. PCBs could not be quantified after a high level of cleanup, due to the presence of interfering compounds, identified later as nitro aromatic compounds. Butlyltins were analyzed with a Hewett-Packard 5890 GC interfaced with a Finnigan Incos mass spectrometer operated in the electron impact mode.

Chemical analyses were performed according to the quality control/quality assurance procedures of the NS&T Program, including instrument calibration, use of internal standards, replication of some analyses, percent recoveries of spiked blanks, and analyses of standard reference materials.

During the remaining portions of the study, samples stored either at Skidaway Institute of Oceanography or at the NBS laboratory were shipped to Battelle Ocean Sciences for analyses. Sediments were extracted by Battelle Ocean Sciences in two batches containing approximately 19 field samples each. One procedural blank, one standard reference material, a matrix spike sample and a matrix spike duplicate sample were extracted with each batch. Each field sample contained 30 g to 50 g of sediment. Sediment dry weight was determined using approximately 5 g of sample material. Analyses were performed for total trace metals, simultaneously-extracted metals (SEM), acid-volatile sulfides (AVS), PCB congeners, pesticides, and polynuclear aromatic hydrocarbons (PAHs). Analyses were performed for total organic carbon and sediment grain size.

Extraction and analytical methods followed those of Peven and Uhler (1993). Sediment was weighed into pre-weighed Teflon jars; surrogate internal standards (to monitor extraction efficiency), sodium sulfate, and 1:1 methylene chloride (DCM):acetone were added to each jar. Samples were extracted with the solvent mixture three times using shaker table techniques. After each extraction, the jar was centrifuged and the overlying solvent decanted into a labeled Erlenmeyer flask. Solvent from each of the three extractions was combined in the flask. The combined extract was chromatographed through a 5 g, 2% deactivated alumina column eluted with dichloromethane (DCM). After column cleanup, the sample extract was concentrated to approximately 900 *u*L and further processed using a size-exclusion high performance liquid chromatography (HPLC) procedure. Six-hundred microliters of the extract were fractionated in this procedure, and the remaining 300 *u*L archived. After HPLC cleanup, the sample extract was concentrated to approximately 1000 uL and recovery internal standards were added to quantify surrogate recovery. The final sample was split in half by volume; one half was dedicated to GC/MS analysis of PAHs and the other half was solvent-exchanged with iso-octane and analyzed by GC/ECD for PCBs and pesticides.

The analytical methods for the trace metals followed those of Crecelius et al. (1993). Samples were completely digested with 4:1 $HNO_3/HClO_4$ and heated. The digestates were analyzed either by graphite furnace atomic absorption (Ag, Cd, Se) or cold vapor atomic absorption (Hg) or x-ray fluorescence (Al, As, Cr, Cu, Fe, Mn, Ni, Zn) or inductively-coupled plasma mass spectrometry (Sb, Sn). Two reagent blanks and three standard reference materials were analyzed in each analytical string of 50 samples.

The concentrations of acid volatile sulfides (AVS) and simultaneously-extracted metals (SEM) were determined in the samples. The analytical methods employed selective generation of hydrogen sulfide by acidifying the sample with 1N HCl, cryogenic trapping of the evolved H_2S, and gas chromatographic separation with photoionization detection. This method gives high sensitivity, low detection limits and very limited chemical interference with minimal sample handling. The AVS analytical system is made of glass and Teflon because of the reactivity of sulfide with metals. The filtered acid solution resulting from the AVS analysis was subsequently analyzed for SEM using graphite furnace atomic absorption, cold-vapor atomic absorption, and inductively-coupled/mass spectrometry.

Sediment samples were analyzed for total organic carbon (TOC) and total carbonate (TIC) by Global Geochemistry Corporation, Canoga Park, California. Before the samples were analyzed, LECO filtration crucibles were precombusted for at least 2 hours at 450°C and allowed to cool. Between approximately 175 mg and 250 mg of dried, finely ground and homogenized sample was placed in a pretreated crucible and 6N HCl added to remove inorganic carbon. After approximately 1 hour deionized water was flushed through the crucible removing the acid, and the sample was dried overnight. Immediately prior to sample analysis, iron and copper chips were added to accelerate the combustion. A LECO model 761-100 carbon analyzer was used to determine both the TOC and TIC content. The analyzer converts all carbon in the sample to CO_2 at high temperature in the presence of oxygen. The CO_2 was then quantified by thermal conductivity detection. Before sample analysis for TIC, the filtration crucibles were precombusted for at least 2 hours at 450°C and allowed to cool. Between approximately 175 mg and 250 mg of dried, finely ground, homogenized sample was placed in a pretreated crucible, and the sample was placed in a 450°C oven for 2 hours to remove organic carbon.

The methods used to determine sediment grain size are those according to Folk (1974). Briefly, coarse and fine fractions were separated by wet-sieving. The fine fractions (silt and clay) were further separated by suspending the sediment in a deflocculant solution and taking aliquots of the settling sediment at timed intervals after the solution was thoroughly mixed. The coarse fraction (sand and gravel) was dried and then separated by sieving through a 2 mm screen.

Statistical Methods.

Amphipod test. Percent amphipod survival data from each station that had a mean survival less than that of the control was compared to the control using a one-way, unpaired t-test (alpha = 0.05) assuming unequal variance. Data were not transformed since examination of data from previous tests have shown that *A. abdita* percentage survival data met the requirement for normality. A one-sample t-test was used to compare data from each sampling block with the mean performance control (CLIS) for each stratum.

Significant toxicity for *A. abdita* is defined here as survival statistically less than that in the performance control (alpha = 0.05). In addition, samples in which survival was significantly less than controls and less than 80% of control values were regarded as “highly toxic” or “numerically significant”. The 80% criterion is used by EPA as a critical statistical value for *A. abdita* test data in EMAP-Estuaries methods (Holland, 1990). Similarly, the EPA/COE dredged material guidance manual (the “green book”) also consider sediments toxic if survival relative to a reference sediment is less than 80% (U.S. EPA/U.S. ACOE, 1990). Furthermore, statistical power curves created from SAIC’s extensive testing database with *A. abdita* show that the power to detect a 20% difference from the control is 90%.

Microtox™. Microtox™ data were analyzed using the computer software package developed by Microbics Corporation to determine concentrations of the extract that inhibit luminescence by 50% (EC50). This value was then converted to mg dry wt. using the calculated dry weight of sediment present in the original extract. To determine significant differences of samples from each station, pair-wise comparisons were made between contaminated samples and results from control sediments using analysis of covariance (ANCOVA). Concentrations tested were expressed as mg dry wt. based on the percentage extract in the 1 ml exposure volume and the calculated dry wt. of the extracted sediment. Both the concentration and response data were log-transformed before the analysis. ANCOVA was used first to determine if two lines had equal slopes (alpha = 0.05). If the slopes were equal, ANCOVA then determined the quality of the Y-intercepts (alpha = 0.05). A one-sample t-test was used to compare data from each sampling block within each of the bays with the mean of the duplicate performance control data.

Significant toxicity for Microtox™ is defined here as an EC50 statistically less than that in the performance control. Samples were considered highly toxic or numerically significant when the EC50s were significantly different from controls and less than 80% of the controls. The statistical significance of the 80% criterion has not been determined for this test, however, the 80% criterion was used to be consistent with the other toxicity tests. Also, in surveys performed in the Hudson-Raritan estuary and Long Island Sound, 81.4% and 90.0%, respectively, of samples were significantly different from controls (alpha <0.05) when EC50 values were less than 80% of control responses (Long et al., 1995; Wolfe et al., 1994).

Sea urchin fertilization and morphological development. For both the sea urchin fertilization and morphological development tests, statistical comparisons among treatments were made using ANOVA and Dunnett’s one-tailed *t*-test (which controls the experiment-wise error rate) on the arcsine square root transformed data with the aid of SAS (SAS, 1989). The trimmed Spearman-Karber method (Hamilton et al., 1977) with Abbott’s correction (Morgan, 1992) was used to calculate EC_{50} (50% effective concentration) values for dilution series tests. Prior to statistical analyses, the transformed data sets were screened for outliers (SAS, 1992). Outliers were detected by comparing the studentized residuals to a critical value from a t-distribution chosen using a Bonferroni-type adjustment. The adjustment is based on the number of observations (n) so that the overall probability of a type 1 error is at most 5%. The critical value (CV) is given by the following equation: $cv = t(df_{Error}, .05/(2 \times n))$. After omitting outliers but prior to further analyses, the transformed data sets were tested for normality and for homogeneity of variance using SAS/LAB Software (SAS, 1992).

Spatial patterns in toxicity Spatial patterns in toxicity were estimated by plotting data on base maps of each bay. Estimates of the spatial extent of toxicity were determined with cumulative distribution functions in which the toxicity results from each station were weighted to the dimensions (km^2) of the sampling stratum in which the samples were collected (Schimmel et al., 1994). The size of each stratum (km^2) was determined by use of a planimeter applied to navigation charts, upon which the boundaries of each stratum were outlined. A critical value of less than 80% of control response was used in the calculations of the spatial extent of toxicity for all tests.

Chemistry data. Similarly, chemical data from the sample analyses were plotted on base maps to identify spatial patterns, if any, in concentrations. Trace metal concentrations were plotted against aluminum concentrations and compared to expected ratios for uncontaminated sediments developed by Schropp et al., 1988.

Chemistry/toxicity relationships. Chemistry/toxicity relationships were determined in a five-step sequence (Long et al., 1995). First, simple Spearman-rank correlations were determined for each toxicity test and each physical/chemical variable. The correlation coefficients and their statistical significance were recorded and compared among chemicals. Second, for those chemicals in which a significant correlation was observed, the data were examined in scatterplots to determine if there was a reasonable pattern of increasing toxicity with increasing chemical concentration and if any chemical in the toxic samples equaled or exceeded published numerical guidelines.

Chemical concentrations expressed in dry wt. were compared with the ERM values of Long et al. (1995) developed for NOAA and the PEL values of MacDonald (1994) developed for the state of Florida. Also, the concentrations of three PAHs (acenaphthene, fluoranthene, and phenanthrene) and two pesticides (dieldrin and endrin) expressed in units of organic carbon were compared to proposed National sediment quality criteria (SQCs) developed by U.S. EPA (1994). Finally, the concentrations of unionized ammonia were compared to LOEC concentrations determined for the sea urchin tests by the U.S. National Biological Service (Long et al., in press - Boston Harbor) and NOEC concentrations determined for amphipod survival tests published by Kohn et al. (1994).

Third, the numbers of samples out of those that were analyzed that exceeded the respective guidelines were determined. Fourth, the average concentrations of chemicals in nontoxic samples were compared with the average concentrations in significantly toxic samples, and ratios between the two averages were calculated and compared. In this step, the ratios of chemical concentrations in toxic samples to respective ERL/ERM values from Long et al. (1995) and TEL/PEL values from MacDonald (1994) were also determined. Finally, the average concentrations of chemicals in the toxic samples were compared with the respective numerical guidelines. The combined results of these steps were examined to determine which chemical(s), if any, may have contributed to the observed toxicity and which probably had a minor or no role in toxicity.

The data were treated separately for each bay. However, in the case of Bayou Chico, the 1994 data were merged with those from Apalachicola Bay since the data sets for both bays were too small to analyze alone and these two areas showed relatively high and relatively low toxicity, respectively. In addition, the toxicity/chemistry correlations were determined for the entire combined data set formed by merging the data from all the bays.

Correlations were determined for all the substances that were quantified in each bay, usually including total (bulk) trace metals, metalloids, trace metals simultaneously extracted (SEM) with acid volatile sulfides (AVS), unionized ammonia (UAN), percent fines, total organic carbon (TOC), chlorinated organic hydrocarbons (COHs), and polynuclear aromatic hydrocarbons (PAHs). In addition, a chemical index calculated as the sums of quotients formed by dividing the chemical concentrations in the samples by their respective ERM values (from Long et al., 1995) are shown. Those substances that showed significant correlations were indicated with asterisks. In correlation analyses involving a large number of variables, some correlations could appear to be significant by random chance alone. Adjustments are often needed to account for this possibility. Note that in the results tables only those correlations shown with two or three asterisks would remain significant if the number of variables were taken into account in these analyses.

RESULTS

Information recorded in field sample logs for station coordinates, sampling dates, water depths, and water column salinity, temperature, and dissolved oxygen concentrations are listed in Appendix A for each bay.

Physical Parameters.

Pensacola Bay. In Pensacola Bay, water depths at the sampling stations ranged from 1.2 through 10.0 meters, and the temperature, salinity, and dissolved oxygen concentrations indicated the water column at most stations were relatively well mixed (Appendix A1). However, dissolved oxygen concentrations in some Blackwater Bay stations were very low and surface salinities were zero. Bottom water dissolved oxygen concentrations were low near the head of Bayou Chico in 1994, but not in 1993. Most sediments in Pensacola Bay were fine silts and clays, often sulfurous and odiforous, occasionally with petroleum sheens.

Choctawhatchee Bay. In Choctawhatchee Bay most sampling stations were 2 to 6 meters deep (Appendix A2). Bottom and surface temperatures were similar at most stations, however, in the Boggy Bayou/Rocky Bayou/ Tom's Bayou area surficial salinities were very low, indicative of freshwater inputs. Except for a few stations in small bayous, bottom water dissolved oxygen concentrations were relatively high at most stations. Sediments typically were olivine-colored silty clays, often accompanied with numerous benthic organisms, occasionally with sulfurous odors. Sediments in Tom's Bayou were noticeably enriched with organic matter.

St. Andrews Bay. Most stations in St. Andrews Bay were 2 - 6 meters deep, except for a few stations that were up to 12 meters deep (Appendix A3). All but station 55 at the head of Watsons Bayous showed good water column mixing. Bottom water dissolved oxygen at station 55 was noticeably depressed. Sediments usually were silty clays, often either grey or olivine in color, and usually with numerous benthic organisms. Sediments at some stations in Watsons Bayou were anoxic and had a sulfurous odor.

Apalachicola Bay. Apalachicola Bay stations ranged in depth from 1.6 to 5.4 meters (Appendix A4). Salinities were relatively low, especially in the stations located in Apalachicola River; however, dissolved oxygen concentrations were high at all stations. Most stations in the bay had brown to olivine sandy mud whereas several stations in the river had silty sand or silty clay with some sand.

Distribution and Concentrations of Chemical Contaminants. Most of the samples collected and testing for toxicity were also analyzed for chemical concentrations. During both years of the study, 123 samples were tested for toxicity; 101 of which were tested for chemistry. This division of analytical tests for each bay is summarized in Table 2.

All of the 40 samples from Pensacola Bay were analyzed for metals, and one-half (20) were analyzed for organics. All six of the 1994 Bayou Chico samples were analyzed for all substances. In 1994, 21 of the 37 samples from Choctawhatchee Bay were analyzed for chemistry. In St. Andrew Bay, organics were analyzed for all samples, and trace metals were analyzed on 22 samples. Three of the nine samples from Apalachicola Bay were analyzed for both organic and metals parameters. When sufficient funding was not available to perform analyses on all samples, a subset was chosen following a review of the data from all toxicity tests. These samples were not chosen randomly; rather, they were selected to represent toxicity gradients within selected regions of each bay or among contiguous stations. Raw chemical data from all bays and both years are listed in Appendix B. Distributions of representative substances among and within the four bays are illustrated in Figures 18-42. Note that the concentration scales differ among these figures.

Inter-bay comparisons. The maximum concentrations of total PAHs, total PCBs, total pesticides, and total DDTs are compared among the four bays in Figure 18. The concentrations of the PAHs were considerably higher than those of the other substances, obscuring between-bay patterns in concentrations. The maximum concentration of total PAHs was highest at a station in Pensacola Bay, intermediate in St. Andrew and Choctawhatchee bays, and lowest in Apalachicola Bay. To further define the distributions of PAHs, the maximum, mean, and minimum concentrations were compared (Figure 19). These summarized data indicated the same pattern: relatively high concentrations in Pensacola Bay, intermediate and nearly equivalent to each other in St. Andrew and Choctawhatchee bays, and lowest in Apalachicola Bay. The maximum and minimum concentrations of total PAHs among all samples differed by over four orders of magnitude.

Shown separately from the PAH data, between-bay distribution patterns are evident in the concentrations of total PCBs, total pesticides, and total DDTs (Figure 20). Samples from Pensacola, St. Andrew, and Choctawhatchee bays had considerably higher concentrations of these compounds than the samples from Apalachicola Bay. The maximum concentration of PCBs occurred in a St. Andrew Bay sample, but the mean concentrations were highest in Pensacola Bay samples. Total pesticide concentrations were highest in St. Andrew and Choctawhatchee bays and lowest in Pensacola and Apalachicola bays. Mean concentrations of total DDTs were roughly equivalent among Pensacola, St. Andrew, and Choctawhatchee bays.

Lead and total mercury were selected to illustrate patterns found with metals in the different bay systems. The maximum, mean, and minimum concentrations of lead were approximately equivalent among Pensacola, St. Andrew, and Choctawhatchee bays, and relatively low in Apalachicola Bay (Figure 21). In contrast, total mercury concentrations were relatively high in Pensacola and St. Andrew bays, intermediate in Choctawhatchee Bay, and lowest in Apalachicola Bay (Figure 22).

Overall, these data suggest that the chemical concentrations and mixtures differed among the four bays. All data suggest that, on average, the Apalachicola Bay samples were the least contaminated of the four bays. The following data summarize chemical gradients within each of the four bays and Bayou Chico, an industrialized tributary to Pensacola Bay.

Pensacola Bay. Chemical analyses were performed for metals on samples from all basins of Pensacola Bay and the three adjoining, urbanized and industrialized bayous (Texar, Chico, and Grande). Organic compounds were analyzed for samples from the three bayous and adjacent portions of Pensacola Bay. Among the Pensacola Bay samples analyzed for organics, the concentrations of total PAHs were considerably higher in Bayou Chico (stations 4-9) than in all other stations (Figure 23). PAH concentrations were intermediate in three samples from Bayou Texar, and lowest in the main basin of the system. PAH concentrations diminished rapidly outside the mouths of both bayous. Two samples from inner Bayou Chico had high PCB concentrations relative to all other samples from Pensacola Bay (Figure 24). Total mercury concentrations were elevated in Bayou Texar and near the Pensacola harbor (Figure 25). Lead concentrations were relatively high in all three urban bayous and near the Pensacola harbor (Figure 26). Overall, these data suggest that most chemical substances were elevated in concentration in the three urban bayous, especially Bayou Chico, but each substance had a unique distributional pattern within the bay.

Bayou Chico. Within Bayou Chico, total PAH concentrations were highest in samples collected in the middle and lower reaches of the system (Figure 27). In contrast the concentrations of total PCBs were highest in stations from the upper and middle reaches of the bayou (Figure 28). There was no clear pattern in the concentrations of mercury and lead; samples with relatively high concentrations were scattered along the length of the bayou (Figures 29, 30). Overall, these data suggest highly variable distributional patterns of chemical substances within the bayou.

Choctawhatchee Bay. Bulk chemical analyses were done on 21 samples from Choctawhatchee Bay, including many from adjoining bayous. PAH concentrations were highest at station A1-1 from Garnier Bayou and relatively low in samples from the other stations (Figure 31). Concentrations of total PCBs were high in station A1-1 as well as in stations F1-1 and F2-1 in Boggy Bayou (Figure 32). Relatively high concentrations of total mercury occurred in samples from Garnier Bayou (A1-1, C2-1, C1-2), Boggy Bayou (F1-1, F2-1, E3-1), and Rocky Bayou (G2-1) and low concentrations were found elsewhere in the bay (Figure 33). The concentrations of lead showed a distributional pattern similar to that of mercury in this bay system (Figure 34).

St. Andrew Bay. Among the 31 samples from St. Andrew Bay analyzed for organics, samples from Watsons Bayou (stations 55-63) and Massalino Bayou (stations 53-54) had the highest PAH concentrations (Figure 35). PAH concentrations decreased relatively quickly beyond the mouths of these two urban bayous. The concentrations of total PCBs showed a similar pattern (Figure 36). The sample from station 53 had the highest PCB concentration. Among the 22 samples analyzed for metals, those collected in Watsons Bayou and Massalino Bay had the highest concentrations of both mercury and lead (Figures 37, 38).

Apalachicola Bay. Chemical concentrations in samples from Apalachicola Bay were considerably lower than those in the other three bays; note the differences in concentration scales between Figures 39-42 and the previous figures. Among the four samples analyzed for chemistry, station A2-1 had the highest PAH concentrations (Figure 39), but had the lowest concentrations of mercury and lead (Figures 41-42). PCB concentrations were relatively uniform among the four stations (Figure 40).

Comparisons of Trace Metals Concentrations to Background. The Florida Department of Environmental Regulation (Schropp et al., 1990, Schropp and Windom, 1988) determined that in Florida, and generally throughout the S.E. Coastal Plain, trace metal concentrations can be expressed as a function of the amount of aluminum and metals in sediments, based on naturally occurring geochemical relationships. The relationship between metals concentrations and aluminum content were determined in a series of field surveys involving collection of sediments from sites throughout the state far removed from any known or suspect sources of contamination. The correlation of natural metals relationships with aluminum were determined and bracketed by the 95% confidence interval. Stations with corresponding values above the upper 95% confidence limit were considered to be “enriched”. The level of enrichment was expressed as a unitless ratio. Enrichment in most cases can be considered contributable to anthropogenic sources, whether introduced by point or nonpoint sources or by atmospheric deposition. The probability that the metal was contributed by anthropogenic sources increases with increasing enrichment ratios.

Concentrations of arsenic, cadmium, chromium, copper, lead, nickel and zinc in the western Florida sediments were compared to expected, background concentrations based upon normalization to aluminum. These relationships are summarized in Figures 43-47 for each bay and each trace metal, with the exception of nickel, which was enriched in only a few samples throughout the entire four bay study area. Mercury was considered, however, because of the lack of correlation of mercury with aluminum in the background dataset (Schropp et al., 1990, Schropp and Windom, 1988), the highest value found in reference stations was set as a background value (0.21 mg/kg dry wt.).

In the first year samples from Pensacola Bay, arsenic was not elevated above expected background (Figure 43a); however, cadmium, chromium, copper, lead, and zinc were elevated considerably in many samples (Figures 43b-43f). Pensacola Bay samples collected during the first year included six samples from Bayou Chico. In the second year, concentrations of copper, lead, and zinc were elevated above expected background in all six samples from Bayou Chico (Figures 44 d, and g) and cadmium and chromium were elevated in three or four samples (Figures 44b, c).

Lead and zinc were enriched in most of the Choctawhatchee Bay sediments (Figures 45 e,f); correspondingly, cadmium, chromium and copper were elevated in many samples (Figures 45 b, c, d). In St. Andrew Bay a slightly different mixture; copper, lead, and zinc, were enriched (Figures 46d, e, f) in many samples along with cadmium in some samples (Figure 46b). None of the three samples from Apalachicola Bay that were analyzed had enriched metals concentrations (Figures 47a, b, c).

In Pensacola Bay, the enriched samples were collected mainly from sites in Bayou Chico, Bayou Grande, and Bayou Texar. In Choctawhatchee Bay, enriched samples were collected mainly from Garnier Bayou, Boggy Bayou, and Destin Harbor. In St. Andrew Bay, enriched samples came from Massamino Bayou and Watsons Bayou.

Stations that showed metals enrichment within the different bays usually were enriched with several of the metals analyzed. Lead, mercury, copper and zinc were most frequently enriched, with no stations showing enrichment with respect to arsenic and nickel.

Based upon the chemistry data acquired as a part of this survey, toxicant concentrations were considerably higher in the urbanized bayous of Pensacola, Choctawhatchee, and St. Andrew bays than in the main basins of those systems or in Apalachicola Bay. Chemical concentrations were particularly high in Bayou Chico, and to a lesser degree, Watsons Bayou, Bayou Texar, Garnier Bayou, Boggy Bayou, and Massamino Bayou. Therefore, the hypothesis is that higher levels of chemical contaminants will predict probable toxic effects, and that toxicity would be most probable in Bayou Chico, somewhat less likely in the other urban bayous, and least likely in the main basins of all four bays.

Toxicity Tests. Results of all toxicity tests are listed in Tables 3-7. Sample means and statistical significance relative to controls are listed for each sampling station. Each station is listed as either: not significantly different from controls (ns), or statistically significantly different from the controls (@p <0.05 *), or both significantly different from controls (p<0.05) and less than 80% of the control value (**).

Solid phase amphipod tests. Results of the amphipod tests performed with Ampelisca abdita are summarized for both years in Table 3. In the first year (1993) samples from Pensacola Bay and St. Andrew Bay were tested by the NBS (now, USGS) laboratory. Mean 96-h LC50 concentrations for the two test series were >20 mg SDS/l and 7.27 mg SDS/l. Mean survival in home (San Francisco Bay) sediments was 68±10.4% and 93±8.4%, respectively, in the two test series. Mean survival in the Redfish Bay reference sediments was 55±3.5% and 97±2.7%, respectively. The results of the two test series were considerably different, suggesting differences in the health of the animals used in the two test series. The results of the tests of the positive controls (SDS) suggest that the animals used in the first tests were unusually insensitive, however, their low survival in the reference and control sediments suggests they were very sensitive. Collectively, the data from the first test series did not meet required quality assurance standards and, therefore, are of marginal value. The data from the second test series met quality assurance standards and were of higher quality.

In the second year (1994) tests were performed by the SAIC laboratory. Mean 96-h LC50 concentrations for the 4 test series ranged from 7.41 to 7.47 mg SDS/l, indicating a very small range in variability and animal sensitivity. Mean survival in Central Long Island Sound (CLIS) controls ranged from 85% to 98% and were acceptable.

In the first series of tests performed in 1993, mean percent survival for all samples from Pensacola Bay was 88% or more of controls (Table 3). In the second test series (St. Andrew Bay), amphipod survival ranged from 89% to 106% of controls. No statistically significant differences in survival between treatments and controls were detected with ANOVA in either test series 1 (p=0.9705) or test series 2 (p=0.1144).

In Year 2, four test series were run with samples from the western Florida estuaries. Mean amphipod survival ranged from 74% to 105% of controls in the six samples from Bayou Chico (Table 3). One sample from station 5-3 was significantly different from controls and mean survival was less than 80% of the control response. Mean amphipod survival ranged from 87% to 113% of controls in the Choctawhatchee Bay samples and one sample from station K2-1 was significantly different from controls (Table 3). In the nine samples from Apalachicola Bay, mean survival ranged from 90% to 99% of controls and one sample from station A3-1 was different from controls.

Spatial patterns in toxicity determined in the amphipod survival tests are illustrated in Figures 48-52. As described above, none of the Pensacola Bay samples collected in 1993 were toxic, i.e. significantly different from controls in this test (Figure 48). However, one sample collected in 1994 near the mouth of Bayou Chico was highly toxic, i.e., different from controls and <80% of controls (Figure 49). The one sample from Choctawhatchee Bay that was toxic in the amphipod tests was collected in the relatively undeveloped LaGrange Bayou adjoining the far eastern reaches of the estuary (Figure 50). None of the samples collected in St. Andrew Bay were toxic in the amphipod survival tests (Figure 51). One sample collected at the mouth of the Apalachicola River across the river from the town of Apalachicola was toxic in the amphipod tests (Figure 52).

Overall, the amphipod test data showed a general lack of toxicity. No spatial patterns in toxic effects could be measured from the results of this test. Only three stations throughout all four bays were significantly toxic in the amphipod test; one in Apalachicola Bay, one in Choctawhatchee Bay, and one in Bayou Chico Bay in the Pensacola Bay estuary. Amphipod survival was less than 80% of controls in only one sample, collected from Bayou Chico.

<u>Microtox™ and Mutatox™ microbial bioluminescence tests of organic extracts</u>. Microtox™ tests were conducted on all samples collected in both years. Mutatox™ tests were performed only on the 1994 samples. In contrast to results from the amphipod toxicity test, there was a broad- scale toxic response in the Microtox™ and Mutatox™ bioluminescence tests. Mean EC_{50} concentrations, standard deviations and results of one-tailed Dunnetts comparisons with reference materials in the Microtox™ tests are summarized by bay and by station in Table 4. Additionally, results of the Mutatox™ tests are reported in Table 5.

In Year 1, EC_{50} values for organic extracts of samples from Pensacola and St. Andrew Bays ranged from 0.07 to 12.34 mg equivalent sediment wet weight. Expressed as percent of controls, the Microtox™ test results ranged from 0.6% to 119%. Mean EC_{50} values were statistically compared to the NFCRC standard reference sediment. In this initial analysis, all test samples had significantly reduced EC_{50}s (alpha $\leq$ 0.01). Subsequently, test results for the station with the highest EC_{50} (station 22 in Pensacola Bay with an EC_{50} of 12.34 mg equivalent sediment wet weight) was used as the least toxic reference treatment. The majority of the stations in Year 1 sampling had significantly reduced EC_{50} values (alpha $\leq$ 0.05) as compared to the 'reference' station 22 (Table 4). In Year 1 results, only 7 stations of 71 from both Pensacola and St. Andrew bays were not significantly different from the 'reference' EC_{50} values.

Fifty-two samples from the remainder of the study area were tested during Year 2, including those from all stations in Bayou Chico, Choctawhatchee and Apalachicola bays. Mean EC_{50} values were statistically compared to the reference sediments collected from Redfish Bay, Texas (EC_{50} value = 48.9±2.8). With the exception of one sample in Apalachicola Bay, all stations were significantly different from the reference material (alpha = 0.01). In addition, most EC_{50} concentrations were less than 80% of control means and many were less than 10% of controls. Expressed as percent of the control response, the range in response varied from 1.21 to 175% of the reference value.

Spatial patterns in Microtox™ test results are illustrated in Figures 53-57. In Pensacola Bay all samples tested from Bayou Grande, Bayou Chico and inner Pensacola Harbor were highly toxic (different from controls and <80% of controls) in this test (Figure 53). Many of bioluminescence responses were less than 10% of controls, especially in samples from Bayou Grande, Bayou Chico, and the Pensacola inner harbor. Samples from the outer Pensacola Harbor were not toxic and one sample each in Escambia Bay, East Bay, and Bayou Texar were not toxic. Samples from three stations (16, 24, and 25) collected nearest the mouth of the estuary were not toxic and the sample from station 14 was toxic but did not show results less than 80% of controls. The combined 1993/1994 data (Figure 54) showed widespread toxicity in the Microtox™ tests throughout Bayou Chico. All of the samples that showed the highest toxicity were collected near the mouth of Bayou Chico (Figure 54).

Spatial patterns in toxicity were difficult to discern in Choctawhatchee and St. Andrew bays, since all samples were highly toxic (Figures 55, 56). Most of the samples in which responses were less than 10% of controls were collected in the peripheral bayous adjoining Choctawhatchee and St. Andrew bays. All of the samples from Watson’s Bayou and Massamino Bayou, for example, were very highly toxic. In Apalachicola Bay, the upstream station in the Apalachicola River, which had a considerable amount of coarse sand, was not toxic in Microtox™ tests; the other eight samples were highly toxic (Figure 57). Samples in which responses were less than 10% of controls were collected from stations scattered throughout the bay.

Collectively, the data from the Microtox™ tests indicated that the majority of the samples from the four bays were toxic; 114 of 123 samples were significantly different from controls. Toxicity in this test was pervasive, extending throughout most or all of each bay. Mean test results often were less than 10% of reference response levels. All of the samples from Choctawhatchee Bay, St. Andrew Bay, and Bayou Chico were significantly different from controls. All except one sample from Apalachicola Bay were toxic and all except eight samples from Pensacola Bay were toxic. Non-toxic samples came from an up-stream station in the Apalachicola River, several stations near the mouth of Pensacola Bay, and several stations scattered throughout Pensacola Bay.

An analysis of Mutatox™ results from the Year 2 stations revealed that 22 of 52 samples produced a strong genotoxic response (G category, Table 5). An additional 11 stations produced suspect (S) results. All stations tested in Bayou Chico Bay provided a genotoxic response. In contrast only one of the nine samples from Apalachicola Bay showed a genotoxic response and five of the samples showed no genotoxicity.

No spatial patterns in Mutatox™ test results were evident in Bayou Chico, since all samples collected in 1994 were genotoxic (therefore, no map was prepared). In Choctawhatchee Bay genotoxic samples were most evident in the adjoining bayous, including Destin Harbor (D stations), Joes Bayou (H stations), the two arms of Garnier Bayou, Boggy Bayou, Rocky Bayou, and LaGrange Bayou (Figure 58). Most of the M and N stations in the main basin of the bay were not genotoxic and the three stations sampled near the north shore were suspected as genotoxic. One sample from Apalachicola Bay determined to be genotoxic was collected near the mouth of the Apalachicola River (Figure 59). Three samples, one from each sampling stratum in Apalachicola Bay, were suspected as genotoxic, whereas, two samples collected near the mouth of the bay were not toxic.

Sea urchin fertilization and embryological development. Sea urchin fertilization and embryological development tests were performed in two test series in 1993, and in one test series in 1994. Sulfide concentrations in all but two samples (BC1-2 and BC2-2, in Bayou Chico, Pensacola Bay 1994) were below the detection limit of 0.01 mg/l. Test porewater dissolved oxygen concentrations ranged from 86 to 128%. Values for pH ranged from 6.97 to 8.67. Total ammonia nitrogen (TAN) concentrations ranged from 0.04 - 18.2 mg/l for both years, and unionized ammonia (UAN) ranged from 2.4 - 208.1 mg/l (test series one) and 1.2 - 239.4 mg/l (test series two) during 1993, and from 4.1 - 299.5 mg/l in the 1994 tests. The lowest observable effect concentrations (LOEC- the concentration above which toxicity begins) determined in the NBS laboratory for sea urchin development and fertilization tests are 90 mg UAN/L and 800 mg UAN/L, respectively (Carr et al., 1996). There were 11 samples in which the 90 mg/l LOEC for urchin development tests was exceeded in 1993, and 5 samples in 1994. No samples in either year exceeded the 800 mg/l LOEC for urchin fertilization.

Results of the urchin fertilization tests of 100%, 50%, and 25% porewater are listed for each station in Table 6. In Pensacola Bay four samples were significantly different from controls in tests of 100% porewater. In tests of 100% and 50% porewater only one sample from Pensacola Bay was toxic. In contrast five of the six samples from Bayou Chico collected in 1994 were toxic in tests of 100% porewater and all remained toxic in tests of both 50% and 25% porewater. The 1994 test results for Bayou Chico contrast with those from 1993, in which none of the samples was toxic in this test. Of all the bays, percent fertilization was most significantly reduced in Choctawhatchee Bay at the 100% porewater concentration. The mean values were lower overall than other bays, and toxicity was apparent in a higher proportion of stations (21 of 37 stations). However, toxicity was reduced considerably in subsequent dilutions; only 7 of 37 stations showed a significant level of toxic response at the 25% porewater concentration. In Apalachicola Bay four of the nine samples showed a highly significant reduction in fertilization success in 100% porewater; but only one of these samples remained toxic in 50% porewater and none was toxic in 25% porewater.

A number of different spatial patterns in the urchin fertilization tests were evident. One sample from upper Bayou Grande, one from upper East Bay, and two from the lower main basin of Pensacola Bay were toxic in 100% porewater (Figure 60). Only the sample from Bayou Grande was toxic in both 100% and 50% porewater. All stations sampled in Bayou Chico in 1993 were non-toxic and all sampled in 1994 were highly toxic (Figure 61), thus obscuring any possible spatial patterns in toxicity. In Choctawhatchee Bay the urchin fertilization tests showed spatial patterns in toxicity similar to those suggested with the Mutatox™ tests. That is, most of the highly toxic samples were collected within the adjoining bayous and many samples from the main basin were either non-toxic or toxic only in 100% porewater (Figure 62). Samples toxic to urchin fertilization at all porewater concentrations were collected in Garnier Bayou, Toms Bayou (stratum F, an arm of Boggy Bayou), and one sample each from strata L and M along the north shore of the main basin (Figure 62).

Three stations (stations 56, 58, 59) sampled in the Watsons Bayou tributary to St. Andrew Bay had significant responses in the fertilization tests at 100% porewater, but only one (station 56 at the upper end of the bayou) was toxic at 50% porewater, and none were toxic at 25% porewater (Figure 63). In addition, one sample collected off the mouth of Watsons Bayou was toxic in tests of 100% porewater. In Apalachicola Bay, four samples were toxic, two each in the lower Apalachicola River and the lower bay (Figure 64). The sample from station C3-1 was toxic in both 100% and 50% porewater.

Overall, the results of the sea urchin fertilization tests showed relatively high toxicity in several bayous of Choctawhatchee Bay, Watsons Bayou in St. Andrew Bay, and Bayou Chico of Pensacola Bay compared to the other areas and relatively low toxicity in most of main basins of Pensacola and St. Andrew bays. Most of the 1994 samples from Bayou Chico were highly toxic in all porewater concentrations, whereas none collected in 1993 was toxic in any porewater concentrations. Two samples each in the lower Apalachicola River and lower Apalachicola Bay were toxic in 100% porewater. Among the 123 samples tested, 38 (31%) were significantly toxic in tests of 100% porewater.

Results of the sea urchin embryological development tests are summarized in Table 7. Normal development was reduced to some degree in samples from all of the bays. Test results ranged from 0.0% to 99.6% normal development among all 123 samples. Eleven of 40 samples from Pensacola Bay collected in 1993 were significantly toxic in this test. All except one of the samples collected in 1993 and 1994 in Bayou Chico were highly toxic in both 100% and 50% porewater. Ten of the 12 Bayou Chico samples showed 0.0% normal development in 100% porewater.

In Choctawhatchee Bay, 18 of 37 samples were significantly toxic in the embryological development test with 100% porewater (Table 7). Five of these samples showed 0.0% normal development. However, only four samples were significantly toxic in tests of 50% porewater and none was toxic in 25% porewater. In St. Andrew Bay 7 of 31 stations were significantly toxic in tests of 100% porewater. Watsons Bayou stations 55-59 in St. Andrew Bay had a highly significant response in tests of 100% porewater. Two of these five were toxic at the 50% porewater concentration, but none were toxic at the 25% concentration.

Urchin development was significantly reduced (both significantly different from control and less that 80% of control) in tests of 100% porewater at four of the nine stations in Apalachicola Bay (Table 7). Two of these samples showed 0.0% normal development. However, none of the samples was toxic at either the 50% or 25% concentrations.

As in the urchin fertilization tests, a number of different spatial patterns in toxicity were apparent with the embryo development tests. In Pensacola Bay, toxicity was restricted mainly to Pensacola Harbor and Bayou Chico (Figure 65, Figure 66). Several samples from Bayou Chico were toxic in all porewater concentrations (Figure 66) and several from the Pensacola Harbor area were toxic in either 100% or 50% porewater. Toxicity diminished rapidly toward the lower bay and the mouth of the estuary. One sample each from Bayou Grande, the mouth of the Escambia River and Bayou Texar were toxic in 100% porewater. Only the upper-most station (number 4) in Bayou Chico was non-toxic (Figure 66).

In Choctawhatchee Bay, samples most toxic to embryo development were those from Destin Harbor (D stratum), Joes Bayou (H stratum) and Toms Bayou (F stratum) in which results were significant in both 100% and 50% porewater (Figure 67). In addition, samples from several other bayous, especially both arms of Garnier Bayou, were toxic only in the 100% porewater test. Only two samples from the main basin (strata L, M, N) were toxic. Toxicity in the embryo development test was restricted to five stations sampled in Watsons Bayou and two stations in the main basin of St. Andrew Bay (Figure 68). In Apalachicola Bay three samples from the main basin of the bay and one from the lower Apalachicola River were toxic, but only in tests of 100% porewater (Figure 69).

Overall, stations exhibiting toxicity in the embryo development tests largely were associated with urbanized tributaries to the bays in all cases except Apalachicola Bay. Toxicity was especially apparent in Bayou Chico, Watson Bayou, the Pensacola Harbor, Destin Harbor, and portions of Garnier Bayou. Among the 123 samples tested, a total of 46 (37%) was toxic in at least 100% porewater, a slightly higher proportion than observed in the fertilization tests. There was a relatively high incidence of toxicity in Choctawhatchee Bay, Apalachicola Bay and Bayou Chico as compared to other areas and a very low incidence of toxicity in St. Andrew Bay. Results agreed relatively well with those from the urchin fertilization tests.

Concordance among toxicity tests. In the preceding section it was apparent that there were different levels of agreement or concordance among the different toxicity tests. Spearman-rank correlations were determined for pairs of tests to quantify these relationships. In Pensacola Bay the only statistically significant ($p<0.05$) correlation was between sea urchin fertilization and microbial bioluminescence (Table 8). Although test results for the sea urchin development and fertilization bioassays showed a positive correlation coefficient, the relationship was not significant. There were no significant correlations among tests for the 1994 combined Bayou Chico/ Apalachicola samples (Table 9). There were no significant correlations among tests in Choctawhatchee Bay (Table 10). In St. Andrew Bay, sea urchin fertilization was significantly correlated with both microbial bioluminescence and sea urchin development (Table 11).

The Mutatox™ test results could not be correlated with other bioassay results because they were categorical scores, not numerical values. Nevertheless, all of the 21 samples that were scored as genotoxic in the Mutatox™ tests were highly toxic in the Microtox™ tests, resulting in 100% agreement. There were 39 samples that were scored as either non-toxic or genotoxic in the Mutatox™ tests: 22 (56%) of these samples agreed as to toxicity or non-toxicity in the sea urchin fertilization tests and 23 (59%) agreed in the urchin development tests.

Overall, these data suggest that the toxicity tests identified overlapping, but, generally different patterns in toxicity. The most consistent correlations were those between sea urchin fertilization and microbial bioluminescence and between the Mutatox™ test results and Microtox™ test results and both of the sea urchin tests. In the combined data set, urchin fertilization and development were significantly correlated ($Rho = +0.682$, $p<0.0001$) and Microtox™ EC50 values and amphipod survival were significantly correlated ($Rho = +0.363$, $p=0.005$). Microtox™ EC50 values were negatively correlated with both urchin fertilization and urchin development ($Rho = -0.305$ and -0.299, respectively, $p<0.05$). None of the other combinations of toxicity tests were significantly correlated

Incidence of toxicity. Table 12 summarizes the incidence of samples tested from each bay in which bioassay results were either significantly different from controls or both significantly different from controls and less than 80% of the control response. For the Mutatox™ test, the toxic samples included those determined to be either Genotoxic or Suspect (highly toxic samples were those determined to be Genotoxic).

In the amphipod survival tests, only three of the 123 samples were toxic; one each from Bayou Chico, Choctawhatchee Bay, and Apalachicola Bay. One sample from Bayou Chico was highly toxic (Table 12). In the urchin fertilization tests the incidence of toxicity was highest in Bayou Chico, followed by Choctawhatchee Bay, and Apalachicola Bay. However, the incidence of toxicity in this test decreased rapidly with porewater dilutions in all areas except Bayou Chico, where 5 of 6 samples were highly toxic in all porewater concentrations. Throughout the entire study area, approximately one-third (30.9%) of the samples were toxic in tests of 100% porewater.

In the urchin development tests, the incidence of toxicity was, again, highest in Bayou Chico, followed by Choctawhatchee and Apalachicola bays (Table 12). As in the fertilization tests, toxicity also dropped rapidly with porewater dilutions, except in Bayou Chico. In Apalachicola Bay none of the samples was toxic in tests of 50% or 25% porewater. In Pensacola, Choctawhatchee, and St. Andrew bays none of the samples was toxic in tests of 25% porewater.

Of the 123 samples tested in Microtox™ tests, 114 were toxic and of those, 113 were highly toxic, equivalent to 92.7% and 91.9% incidences of toxicity (Table 12). In the Mutatox™ tests all 6 Bayou Chico samples, 24 of 37 Choctawhatchee Bay samples, and 4 of 9 Apalachicola Bay samples were either genotoxic or suspected as genotoxic.

Overall, the highest incidence of toxicity occurred among the Bayou Chico samples, followed by Choctawhatchee Bay, and the other areas. All of the Bayou Chico samples were toxic in the sea urchin development, Microtox™, and Mutatox™ tests; all were highly toxic in the urchin development and Mutatox™ tests; and all except one sample was highly toxic in the urchin fertilization tests. In addition, the only sample that was highly toxic in the amphipod survival tests was collected in Bayou Chico. In Choctawhatchee Bay all samples were toxic in Microtox™ tests, most were toxic in Mutatox™ tests, 57% were toxic in urchin fertilization tests, 49% were toxic in urchin development tests, and one sample was toxic in the amphipod tests. The incidence of toxicity in Pensacola Bay and St. Andrew Bay was relatively similar: zero and one sample toxic in amphipod tests (respectively); 10% and 13% toxic in urchin fertilization tests; 27% and 23% toxic in urchin development tests; and 80% and 100% toxic in Microtox™ tests. Among all areas Apalachicola Bay had the lowest incidence of toxicity in all tests.

Spatial extent of toxicity. Toxicity data were weighted to the sizes of each sampling stratum and the total area in each bay that was "highly" toxic (i.e., results were less than 80% of controls) was determined as the sum of the weighted areas. Data from both 1993 and 1994 sampling episodes in Bayou Chico were combined for these calculations. Calculations were not prepared for the Mutatox™ bioassay, since the results were categorical, not numerical.

In Apalachicola Bay, estimates of the spatial extent of toxicity were: 0.0 km^2 for amphipod survival; 157.5 km^2 (84% of total) for sea urchin development in 100% porewater; 63.6 km^2 (33.9%) for sea urchin fertilization in 100% porewater; and 186.8 km^2 (99.6%) for Microtox™ (Table 13). In St. Andrew Bay the estimates were: 0.0 km^2 for amphipod survival; 5.6% for sea urchin development; 1.8% for sea urchin fertilization; and 100% for Microtox™. The estimates for Pensacola Bay were very similar to those for St. Andrew Bay: 0.015% for amphipod survival; 2% for sea urchin development; 5.3% for sea urchin fertilization; and 96.4% for Microtox™. In Choctawhatchee Bay, estimates were: 0.0% for amphipod survival; 45.4% for sea urchin development; 44.5% for sea urchin fertilization; and 100% for Microtox™.

These data suggest that amphipod survival was affected in a tiny portion of the entire study area and microbial bioluminescence was affected in nearly all of the area. Both sea urchin fertilization and embryo development were affected in nearly one-half of Choctawhatchee Bay, and small portions of St. Andrew and Pensacola bays. In Apalachicola Bay the majority of the area was affected in sea urchin development tests, whereas about one-third was affected in the fertilization tests. Usually, small portions of each bay were affected in both tests of 50% and 25% porewater.

Relationships between Toxicity and Chemical Concentrations. The relationships between toxicity measured in the different toxicity tests and the concentrations of numerous chemical substances in the samples were examined for each bay and for the entire combined study area. The cause(s) of toxicity cannot be determined in field surveys such as those performed in these studies and determinations of causality were not among the objectives of the surveys. However, several statistical analyses were performed to identify those substances most clearly associated with measures of toxicity in the samples.

Pensacola Bay. In the 1993 Pensacola Bay samples, none of the substances were correlated with amphipod survival, not surprising because amphipod test results were similar among all samples (Table 14). Results of the

Microtox™ tests were highly correlated with the concentrations of numerous chemicals, notably, cadmium, copper, lead, zinc, and the sum of the eight metals/ERM ratios. Microtox™ results also were correlated with many individual PAHs, the sum of low molecular weight PAHs, total PAHs, the sum of the eight PAH/ERM quotients, several chlorinated organic hydrocarbons, several PCB congeners, and the sum of all 18 chemical/ERM quotients. The results of the urchin fertilization tests were significantly correlated with a few trace metals, many PAHs, a few chlorinated hydrocarbons, and the sum of all 18 chemical/ERM quotients. Urchin development was most correlated with the concentrations of un-ionized ammonia, followed by barium and the sum of the eight PAH/ERM quotients. In addition, urchin development was significantly correlated with the concentrations of a number of trace metals, PAHs, pesticides, and the sum of all 18 chemical/ERM quotients.

Collectively, these data suggest that toxicity in Pensacola Bay was associated with mixtures of many substances acting together, notably including cadmium, copper, lead, zinc, PAHs, several pesticides, and in the case of urchin development, ammonia. The significant relationship between the sum of the 18 chemical/ERM quotients and the results of both urchin tests and Microtox™ tests is noteworthy because it further suggests that mixtures of substances co-varying with each other contributed to toxicity.

Concentrations of several trace metals, PAHs, and chlorinated organic hydrocarbons equaled or exceeded respective guideline values in Pensacola Bay (Table 15). Notably, concentrations of zinc, dibenzo(a,h)anthracene, dieldrin, and isomers of DDT were elevated relative to guideline concentrations. These substances were correlated with toxicity, and they exceeded either the respective PEL or ERM concentration or both in some samples. None of the concentrations of un-ionized ammonia equalled or exceeded toxicity thresholds for amphipod survival (236 ug/l, Kohn et al., 1994) or urchin fertilization (800 ug/l, Long et al., 1996). However, seven un-ionized ammonia concentrations exceeded the low observable effects concentration (90 ug/l, Long et al., 1996) for urchin development and all seven samples were toxic.

Selected toxicity/chemistry relationships are illustrated in Figures 70-74 in which data are shown as bivariate scatterplots. These scatterplots include the Spearman-rank correlation coefficients, and either sediment quality guidelines or toxicity thresholds as reference points. Percent normal development of urchins dropped to zero in many samples with relatively high zinc concentrations, i.e., above the PEL concentration of 271 ppm (Figure 70). Conversely, percent normal development was relatively high in most samples with zinc concentrations below the TEL concentration of 124 ppm. Also, zero percent normal development occurred in some (but, not all) samples with total high molecular weight PAH concentrations above the PEL value of 6676 ppb (Figure 71). A sample from Bayou Chico was unusual in having over 25000 ppb total HPAH and over 90% normal urchin development. This sample also had an unusually high TOC concentration (6 %) which may have inhibited the bioavailability of hydrocarbons.

In the Microtox™ tests, there was very strong association with concentrations of DDT, including the sum of the DDT isomers (Figure 72). Microtox™ EC50 concentrations decreased rapidly with increasing concentrations of total DDT and all samples that exceeded the PEL concentration were highly toxic. To determine if mixtures of substances acting together may have contributed to toxicity, chemical concentrations were normalized to (i. e., divided by) their respective ERM values and these quotients were added to form cumulative ERM quotients. Microtox™ test results were correlated with the cumulative ERM quotients; there was a strong pattern of decreasing EC50 concentrations with increasing ERM quotient values (Figure 73).

Ammonia is known to be a highly toxic substance in marine sediments (Kohn et al., 1994) and can be a major contributor to toxicity, especially in the un-ionized form. Results of the urchin embryo development tests were highly correlated with the concentrations of un-ionized ammonia. The scattergram of the data confirmed this strong association (Figure 74). All except one sample with a concentration of ammonia above the LOEC of 90 ug/l were highly toxic in tests of embryo development. The majority of the samples with low ammonia concentrations were not toxic.

In the Microtox™ tests, the average concentrations of six trace metals and many organic compounds or classes of compounds in toxic samples exceeded the average concentrations in non-toxic samples by factors of up to 5.8 (Table 16). As expected in these analyses, there was considerable variability in these concentrations as indicated with the relatively high standard deviations relative to the means. Nevertheless, there was a pattern of higher concentrations, on average, of many substances in the 32 toxic samples than in the 8 non-toxic samples.

The average concentrations of all other substances that were measured, but not listed in Table 16, were lower in the toxic samples than in the non-toxic samples.

The average concentrations of many substances in the samples that were toxic in Microtox™ tests exceeded either the ERL or TEL concentrations of Long et al. (1995) or MacDonald (1994), respectively. Only 4,4'-DDT, however, equaled or exceeded the ERM or PEL concentrations (Table 16). Furthermore, the average concentrations of total DDTs in the toxic samples exceeded the ERL value by a factor of 17.1 and the TEL value by a factor of 6.9. The concentrations of total DDTs and two isomers were correlated with toxicity (Table 14). Concentrations of high molecular weight PAHs, total PAHs, and total PCBs in toxic samples were high relative to the non-toxic samples and guideline values (Table 16).

In contrast, although cadmium was highly correlated with Microtox™ test results (Table 14), the concentrations of this metal were not remarkably elevated compared to guideline values. Silver was neither correlated with toxicity test results nor particularly elevated in the toxic samples relative to either non-toxic samples or numerical guidelines. Both lead and zinc were correlated with Microtox™ results but only slightly elevated in toxic samples relative to both non-toxic samples and guideline concentrations.

These data suggest that the high molecular weight PAHs and DDTs, and to a lesser extent, total PCBs, total PAHs, and several trace metals (e.g., copper, lead, and zinc) may have contributed to toxicity in the Microtox™ tests. Most other trace metals and organic compounds probably had either a minor role or no role in contributing to toxicity.

In the urchin fertilization tests, only three trace metals and two pesticides were elevated in concentrations in the three toxic samples relative to the 36 non-toxic samples (Table 17). The ratios between the toxic and non-toxic averages, however, were very small (<2.0) and the average concentrations in toxic samples exceeded respective guideline values by very small amounts (ratios of 1.1 to 3.6). None of these five substances showed significant correlations with fertilization success (Table 14).

Numerous substances were correlated with urchin embryological development (Table 14). The concentrations of many of these chemicals also were elevated in the toxic samples relative to non-toxic samples and numerical guidelines (Table 18). Notable among these chemicals were zinc, the sum of low molecular weight PAHs, 4,4'-DDD, 4,4'-DDT, and dieldrin, all of which had average concentrations in toxic samples 3.5 to 6.8 times higher than in the non-toxic samples and 3.3 to 26.4 times higher than respective numerical guidelines. The average concentrations of these five substances exceeded PEL values as well as the lower TEL concentrations. All of these substances were significantly correlated with urchin development. They may have contributed to toxicity in this test. The other substances listed in Table 18 may have made minor contributions to toxicity.

Table 19 provides a summary of the analyses of the relationships between toxicity and chemistry for Pensacola Bay. Table 19 includes the number of toxicity tests in which each substance was significantly correlated; the number of samples in which each substance exceeded either the ERL or TEL value; the ratio between the average chemical concentrations in toxic and non-toxic samples for each test; and the ratios between the average concentrations in toxic samples versus the respective TEL value. Based upon these summarized data, it appears that the concentrations of zinc, high molecular weight PAHs, two DDD/DDT isomers, total DDT, and dieldrin were most closely associated with toxicity. To a lesser extent, cadmium, copper, lead, low molecular weight PAHs, and in the case of urchin embryo development, un-ionized ammonia, were associated with toxicity in Pensacola Bay. The significant correlations between three measures of toxicity (Microtox™, urchin fertilization, urchin development) and the sums of the chemical concentrations normalized to (i.e., divided by) the ERM values suggests that these substances acted together in complex mixtures to contribute to toxicity. Substances not included in Table 19 probably had no role or a minor role in contributing to toxicity. Other major contributors to toxicity may have included substances not measured in the chemical analyses, such as the extensive findings of nitro aromatic compounds later identified in cleanup of the PAH analyses.

Bayou Chico/Apalachicola Bay. Because the Bayou Chico and Apalachicola Bay datasets were relatively small, they were combined to examine chemistry/toxicity relationships. In the combined Bayou Chico/Apalachicola Bay data set from 1994, very few substances were correlated with toxicity (Table 20). Only six substances (five PAHs and one PCB congener) were correlated with toxicity and they were correlated only with urchin fertilization. Many correlation coefficients were numerically relatively high (i.e., > 0.5), but, because of considerable variability and the relatively small sample size (n=10), they were not significant.

Scatterplots of the data showed that, despite the non-significant correlations, toxicity increased with increasing concentrations of many substances (Figures 75-79). Except for one sample, urchin fertilization dropped to zero as zinc concentrations increased to approximately 100 ppm and four samples exceeded both the PEL and ERM values for zinc (Figure 75). Similarly, Microtox™ EC50 concentrations decreased rapidly with increasing concentrations of fluoranthene (Figure 76) and one sample exceeded the proposed national sediment quality criterion (300 ug/goc, U. S. EPA, 1994). Except for one sample with high urchin fertilization, test results dropped rapidly as total PAHs increased; two samples exceeded the PEL value of 16770 (Figure 77). Reflecting the association between the complex mixtures of substances in the samples and toxicity, urchin normal development decreased markedly with increasing cumulative ERM quotients (Figure 78).

Urchin development showed a strong association with un-ionized ammonia concentrations in the porewater and several samples exceeded the LOEC concentration of 90 ug/l (Figure 79). Dissolved oxygen concentrations were relatively high in the 1993 samples and very low in most 1994 samples; however, there was no apparent relationship between in situ bottom water dissolved oxygen concentrations and toxicity in either the fertilization or embryo development tests.

One sample from Bayou Chico (station 3-2) stood out as unusual in some scatterplots (i.e., Figures 75, 77) since the concentrations of many substances were relatively high, but the sample was not toxic in either of the amphipod or urchin fertilization tests. This sample had an unusually high concentration of total organic carbon (7.1%), thereby possibly reducing the bioavailability of the toxicants. The Microtox™ test indicated toxicity in this sample which is not unusual since this test was performed with an extract of the sediments prepared with an organic solvent. The solvent would be expected to elute mixtures of organics and, to a lesser extent, trace metals thus increasing their bioavailability in the extract.

As noted earlier, the concentrations of several trace metals (especially, copper, lead, and zinc) were anthropogenically-elevated relative to background concentrations in the Bayou Chico samples and not in the Apalachicola Bay samples. In addition, the concentrations of many substances in the Bayou Chico samples equalled or exceeded applicable, effects-based, sediment quality guidelines.

A summary of the exceedances of numerical guidelines is listed in Table 21. Numerous aromatic hydrocarbons were particularly elevated in concentration, including the sums of both low and high molecular weight compounds. One sample from Bayou Chico exceeded the national criterion for fluoranthene. The concentrations of zinc were particularly high in several samples relative to the guideline values. Two isomers of DDT and total PCBs were found in relatively high concentrations. All of the samples that had high contaminant concentrations were collected in Bayou Chico; none came from Apalachicola Bay, as expected. All stations except number 1-2 in the upper reach of Bayou Chico had particularly high chemical concentrations. The average of the cumulative ERM quotients among the three samples from Apalachicola Bay was 0.6 (range = 0.3 to 1.0), considerably lower than the average cumulative ERM quotient for the six Bayou Chico samples (10.6, range = 1.9 to 14.2).

Comparisons between chemical concentrations in toxic and non-toxic samples could not be performed with amphipod test results because only one sample was classified as toxic. Conversely, all samples were identified as toxic in the Microtox™ tests, providing no non-toxic samples for comparisons. In the urchin development tests only two samples were classified as non-toxic. Therefore, comparisons between toxic and non-toxic samples were restricted to the data from the urchin fertilization tests, in which three samples analyzed for chemistry were non-toxic and six were toxic in 100% porewater.

The average concentrations of many substances were elevated in the toxic samples as compared to the non-toxic samples from Bayou Chico and Apalachicola Bay (Table 22). Numerous individual PAHs occurred in high concentrations in the toxic samples; the sums of the low and high molecular weight compounds and all compounds listed in Table 22 reflect this pattern. Expressed in units of organic carbon, the concentrations of three individual PAHs for which national criteria have been developed, were particularly elevated in the toxic samples. The average concentrations of the low and high molecular weight PAHs in the toxic samples exceeded the ERL, TEL, and PEL concentrations, indicating a relatively high probability that they contributed to toxicity.

The concentrations of zinc were remarkably high in many samples, including those that were toxic in the urchin fertilization tests (Table 22). They exceeded both the ERM and PEL concentrations, the only substance that did so in Bayou Chico. Also, noteworthy were the concentrations of lindane, heptachlor epoxide, several isomers of DDT, total PCBs, and lead which occurred in moderately elevated concentrations in the toxic samples.

In summary, although Spearman-rank correlations failed to show significant correlations between toxicity in samples from Bayou Chico and Apalachicola Bay, there were numerous obvious associations between elevated chemical levels and toxicity. The concentrations of zinc and many organic compounds, notably the PAHs and to a lesser extent some chlorinated organic hydrocarbons, were relatively high in these samples, especially those that were toxic in the urchin fertilization tests. The toxicity of one sample with high chemical concentrations may have been inhibited by high concentrations of organic carbon which may have reduced the bioavailability of the organic compounds.

Choctawhatchee Bay. Spearman-rank correlations for Choctawhatchee Bay samples are listed in Table 23. Amphipod test results were significantly correlated with only the concentrations of total indeno-type pesticides. However, this correlation was positive, not negative as expected, and therefore meaningless. The Microtox™ tests were not significantly correlated with any chemical concentrations. In the amphipod tests, only one sample was significantly different from controls and none were highly toxic. In Microtox™ tests, all samples were highly toxic, thus providing no meaningful toxicity gradients with which to compare chemical concentrations. Sea urchin embryo development was significantly correlated with the concentrations of only un-ionized ammonia and two individual PAHs (fluoranthene, phenanthrene) expressed in units of organic carbon (Table 23). None of the other substances were significantly correlated with the results of this toxicity test.

In the urchin fertilization tests, results were significantly correlated with the concentrations of numerous individual trace metals, the sum of the trace metals/ERMs quotients, the sum of 5 simultaneously-extracted metals (SEM), the sum of 5 SEM minus total AVS, many individual PAHs, the sums of classes of PAHs, the sum of 13 PAHs/ERMs quotients, numerous chlorinated hydrocarbons, total PCBs, and the sum of all 25 chemical concentrations/ERM quotients (Table 23). Expressed in units of dry wt., phenanathrene and fluoranthene were significantly correlated with urchin fertilization; however, when expressed in units of organic carbon, neither were significantly correlated with these test results.

The incidence of toxicity was similar in the urchin fertilization and embryological tests (46% and 43%, respectively). However, the toxicity/chemistry correlations differed considerably between them.

Five samples from Choctawhatchee Bay (those from station A1-1 in Cinco Bayou, C3-1 in Garnier Bayou, D3-1 in Destin Harbor, and F1-1 and F2-1 in Tom's Bayou) had chemical concentrations that exceeded guideline values (Table 24). Concentrations of silver and several DDT isomers were elevated in the samples from Tom's Bayou and concentrations of four individual PAHs and total PAHs were elevated in the sample from Cinco Bayou. In addition, the concentrations of un-ionized ammonia exceeded the LOEC concentration (90 ug/l) for urchin embryo development in two samples (B3-1 and K2-1).

Average concentrations of chemicals in non-toxic and toxic samples were compared for the urchin fertilization tests (Table 25). Equivalent analyses of the data for the other tests could not be performed because the data either showed toxicity in all samples (Microtox™) or too few samples (urchin development, amphipod survival) to provide comparison groups. Average concentrations of silver, dieldrin, DDT isomers, and total DDT were considerably higher in the toxic samples than in the non-toxic samples (ratios of about 20.0 of higher). Concentrations of many trace metals and PAHs were elevated in the toxic samples. However, concentrations of all substances were not very high compared to the sediment quality guidelines. None of the average concentrations in toxic samples equalled or exceeded respective PEL, ERM, or SQC values. These concentrations often approximated or were only slightly higher than the respective TEL or ERL values.

Although concentrations of silver were considerably higher in the toxic samples than in the non-toxic samples, average concentrations in the toxic samples were lower than the ERL and TEL values (Table 25). The same situation occurred with cadmium, zinc, the sum of low molecular weight PAHs, dieldrin, and total PCBs. Among the substances analyzed, the sum of DDT isomers was most elevated in concentration in toxic samples: average concentrations in toxic samples exceeded both the ERL and the TEL by factors of 11.4 and 4.7, respectively.

The relationship between results of the sea urchin fertilization tests and the concentrations of total DDT in sediments is illustrated in Figure 80. Fertilization success decreased remarkably with increasing concentrations of DDT. All samples with DDT concentrations that exceeded the TEL value were highly toxic in this test. Fertilization success was zero in the sample with the highest concentration of total DDT. The Spearman-rank correlation showed a significant association between fertilization success and total DDT.

The association between urchin embryo development and un-ionized ammonia was significant; the resulting scatterplot showed a pattern of decreasing normal development with increasing ammonia concentrations (Figure 81). Two samples either equalled or exceeded the lowest observed effects concentration (LOEC) of 90 ug/l and both were highly toxic in this assay.

In summary, the associations between toxicity and concentrations of potentially toxic substances in Choctawhatchee Bay were strongest for the urchin fertilization tests in which a large gradient in response was observed. Microtox™ and amphipod test results were not negatively correlated with any substances. Urchin embryo development test results were correlated with only three substances: un-ionized ammonia and two individual PAHs. In sharp contrast, numerous substances were correlated with urchin fertilization. Most notable among these were the concentrations of DDT isomers, total DDT, silver, the sum of PAHs, and dieldrin. However, the concentrations of these substances exceeded TEL and ERL values by small amounts and rarely equaled or exceeded respective PEL and ERM values. Therefore, there is insufficient evidence to suggest which measured substances may have contributed substantially to toxicity. As in the other bays, mixtures of contaminants and unmeasured compounds may be culprit in their contribution to toxicity.

St. Andrew Bay. Of the 30 samples collected within St. Andrew Bay, organic compounds were quantified in all samples, total organic carbon and grain size were determined in 25 samples, and both total trace metals in bulk sediments and simultaneously extracted metals in acid volatile sulfides were measured in 22 samples.

Percent amphipod survival was significantly correlated with concentrations of copper, two isomers of DDT, total DDT, and total pesticides (Table 26). The relationship between amphipod survival and copper is consistent with the copper/aluminum plot which indicates a high incidence of anthropogenic enrichment for copper in this area. Given that none of the samples was significantly toxic in this test and test results were relatively similar among all samples, these correlations were unexpected. The relationship between amphipod survival and total DDT concentrations is illustrated in Figure 82. Although most of the samples showed a pattern of decreasing amphipod survival with increasing total DDT concentrations, three samples in which amphipod survival was relatively high had elevated concentrations of DDT. The sample with the highest DDT concentration was collected in upper Massamino Bayou and probably had a high concentration of TOC (no analyses were performed). The concentration of total AVS was highest recorded among all St. Andrew Bay samples (>29 umoles/g). Some samples exceeded respective ERM values (Long et al., 1995) and PEL values (MacDonald, 1994), including several that were not toxic.

Concentrations of un-ionized ammonia were significantly correlated with toxicity to sea urchin development in 100% porewater (Table 26). This correlation was highly significant and showed a strong pattern of decreasing normal development with increasing ammonia concentrations (Figure 83). Samples were invariably toxic (less than 80% normal development) when un-ionized ammonia concentrations exceeded 40 ug/l. Furthermore, percent normal development was zero when un-ionized ammonia concentrations exceeded the LOEC of 90 ug/l.

Results of the sea urchin fertilization tests were significantly correlated with many trace metals, the sum of the nine metals concentrations-to-ERM quotients, un-ionized ammonia, several DDT isomers, and the sum of the three chlorinated organic hydrocarbon-to-ERM ratios (Table 26). The relationship between sea urchin fertilization and zinc (Figure 84) is typical of that for the other trace metals. In four of the samples, fertilization success decreased with increasing zinc concentrations; however, in the other samples fertilization success remained relatively high despite exposure to elevated zinc concentrations.

The correlation between sea urchin fertilization and un-ionized ammonia was significant (Table 26). There was a strong pattern of decreasing fertilization success with increasing ammonia concentrations. However, none of the samples equalled or exceeded the LOEC concentration (800 ug/l) for this test (Figure 85), suggesting that this substance occurred at concentrations well below that which would have been expected to contribute to toxicity.

Microbial bioluminescence tests were significantly correlated with many substances (Table 26), including many trace metals, many chlorinated organic compounds, and all classes of PAHs. In addition, test results were correlated with the sums of the three classes of ERM quotients (9 metals, 3 chlorinated compounds, 13 PAHs). These data indicated that the Microtox™ test was sensitive to complex mixtures of substances in the sediments, many of which co-varied with each other. The correlation with trans-nonachlor was the strongest observed (Rho =-0.722, $p<0.0001$) and the data showed a strong pattern of association (Figure 86). The Microtox™ data were scattered at trans-nonachlor concentrations below 0.5 ng/g. As the concentrations of this substance increased, however, microbial bioluminescence EC50 values decreased markedly. Sample 53 had the highest trans-nonachlor concentration (9 ng/g) and was the most toxic to microbial bioluminescence.

The relationship between the sum of the 25 chemical concentration-to-ERM quotients and microbial bioluminescence is illustrated in Figure 87. This chemical index accounts for variability among 25 substances in the samples, including 9 trace metals, 3 chlorinated organic compounds, and 13 PAHs, and, therefore, integrates the potential contributions of all of these substances in mixtures to the measure of toxicity. The index calculated with the ERM values was correlated with the microbial bioluminescence test results and the data showed a strong pattern of association (Figure 87). The two least toxic samples had among the lowest ERM index values and the most toxic sample (station 53) had the highest index value.

Sampling stations in which chemical concentrations equalled or exceeded either interpretive guideline values or toxicity thresholds are listed in Table 27. PEL values generally were lower than the corresponding ERM values, therefore, more samples exceeded the PELs than the ERMs (Table 27). Concentrations of several trace metals, PAHs, and chlorinated compounds exceeded the respective ERM values in the sample collected at station 53. Chemical concentrations in sample 53 as well as several others exceeded the respective PEL values. Chemical concentrations often were elevated in samples 53, 54, 56, 57, and 58. Among the chemicals that were quantified, the concentrations of DDT isomers (particularly p, p'-DDD) were most frequently elevated relative to the guidelines. The concentrations of un-ionized ammonia were elevated in five samples relative to the LOEC for the sea urchin development test (90 ug/l), in one sample relative to the NOEC for the amphipod test (236 ug/l), however, none of the samples exceeded the LOEC (800 ug/l) for the sea urchin fertilization test.

The co-occurrence analyses of these data in which average chemical concentrations in toxic and non-toxic samples are compared was not performed with the St. Andrew Bay data. There were no samples that were toxic to amphipods, all samples were toxic to Microtox™, only ammonia was correlated with sea urchin development, and only four samples were toxic to sea urchin fertilization. Therefore, we chose to forego these analyses with these data.

In summary, the four toxicity end-points measured in St. Andrew Bay appeared to co-vary with different substances in the samples. Despite significant correlations between amphipod survival and the concentrations of copper and DDT, none of the bioassay results were significantly different from controls. Sea urchin development was significantly correlated only with un-ionized ammonia in the porewater and zero percent normal development occurred in some samples with relatively high ammonia concentrations. Urchin fertilization was correlated with a number of trace metals, DDT, and ammonia and the concentrations of some metals and DDT exceeded numerical guideline values. Microtox™ test results were highly correlated with complex mixtures of substances, including many trace metals and organic compounds. Microtox™ test results showed a strong association with the cumulative ERM quotients, again, suggesting that microbial bioluminescence responded to complex mixtures of substances in the organic solvent extracts.

All Areas Combined. To determine if any of the toxicity/chemistry relationships observed in the individual bays also were significant throughout the entire study area, the data from all four bays were combined and correlations were calculated. Correlations between bioassay results and chemical concentrations for all 102 western Florida samples are summarized in Table 28. No data are included for the amphipod tests because none of the correlations were significant. Correlations are shown for major elements, classes of organic compounds, and organic compounds for which national sediment quality criteria have been proposed.

In the Microtox™ tests, the strongest correlations were noted with concentrations of total DDT, total pesticides, and the sum of the chlorinated hydrocarbon/ERM quotients (Table 28). Concentrations of five trace metals, the sums of classes of individual PAHs, and total PCBs were correlated with Microtox™ results. The sums of all 25 chemicals/ERM quotients were correlated with toxicity in this test, although the correlation with the sums of the

9 metals/ERM quotients were not significant. Likewise, correlations with the sums of the 5 simultaneously-extracted metals were not significant. Among the strongest correlations was that of Microtox™ test results and the concentrations of total DDTs (Figure 88). Microtox™ results showed considerable scatter and variability at DDT concentrations below the PEL value of 51.7 ppb; however, as DDT concentrations increased above 51.7 ppb, all samples showed very high toxicity in this test. Two samples from Tom's Bayou adjacent to Choctawhatchee Bay had the highest DDT concentrations and were highly toxic in the microbial bioluminescence tests.

Urchin fertilization was highly correlated with the sum of concentrations of all PAHs ("sum all PAHs", Table 28). This sum included the parent aromatic hydrocarbons (sum PAHs) and many classes of substituted compounds, including alkylated- and methylated-compounds, and sulfurous compounds. The data illustrated in Figure 89 display a pattern of decreasing fertilization success in samples with total PAH concentrations of approximately 25000 or greater. There is no ERM or PEL value for the sum of all PAHs. Fertilization success also was significantly correlated with the concentrations of un-ionized ammonia, and to a lesser degree, many trace metals, total DDT, and the sum of the 25 chemical/ERM quotients.

Urchin development was highly correlated with un-ionized ammonia in the porewater test chambers (Table 28). This was the highest and most significant correlation coefficient observed for the combined data set. The data illustrated in Figure 90 show a sharp decrease in normal embryo development as un-ionized ammonia concentrations approach and exceed the LOEC concentration of 90 ug/l. Ten of the 102 samples exceeded the un-ionized ammonia LOEC concentration and all were highly toxic in tests of 100% porewater. Urchin embryo development also was correlated with the concentrations of copper, selenium, zinc, the sum of all PAHs, two individual PAHs normalized to organic carbon, and dieldrin normalized to organic carbon.

DISCUSSION

This survey was conducted over a two-year period in the late spring of both 1993 and 1994 and extended throughout four large bays and adjoining bayous in the panhandle of western Florida. The objectives of the survey were to determine: (1) spatial patterns in toxicity throughout each bay, (2) the spatial extent of toxicity throughout and among bays, (3) the severity or degree of toxicity, (4) and relationships between chemical contamination and toxicity. Surficial sediments were collected to represent the quality of recently-deposited sediments. Four toxicity tests were conducted on each of the 123 samples collected in the four bays. A fifth toxicity test for genotoxic response was performed on samples collected in 1994. Chemical analyses were done on most (102) of the samples.

Chemical Concentrations in Sediments. Before the survey was conducted, chemical data available from previous studies in this region were reviewed to identify areas (including "hotspots") that contained levels of contaminants (and mixtures of contaminants) that had high potential to cause harm in marine ecosystems. These historical chemistry data indicated that toxicant concentrations were relatively high in the urbanized bayous of Pensacola, Choctawhatchee, and St. Andrew bays. Chemical concentrations were particularly high in Bayou Chico, and to a lesser degree, Watsons Bayou, Bayou Texar, Garnier Bayou, Boggy Bayou, and Massamino Bayou.

In these previous studies, concentrations of total DDT and other chlorinated organic hydrocarbons were extremely high at some locations in Choctawhatchee Bay. Other substances reported as occurring in high concentrations at several locations in the study area included lead, arsenic, other trace metals, total PCBs, and total PAHs. The hypothesis was, then, that in the presence of elevated toxic chemical concentrations, we would expect concomitant elevated incidence and severity of toxicity in these urbanized bayous.

Stratified-random sampling designs similar to the probabalistic designs of EPA's Environmental Monitoring and Assessment Program (EMAP), were used in the selection of sampling stations. Samples were collected both from strata with historically high to moderate chemical concentrations, where toxicity was expected, and from strata in which historic chemical concentrations were low, therefore, where toxicity was not expected.

Sediment chemistry data from this survey indicated concentrations of total PCBs, total pesticides, and total DDTs differed considerably among the four bays. Samples from Pensacola, St. Andrew, and Choctawhatchee bays had considerably higher concentrations of these compounds than samples from Apalachicola Bay. A similar pattern was evident with lead. Total mercury showed a different spatial distribution; concentrations of mercury were relatively high in samples from Pensacola and St. Andrew bays, intermediate in Choctawhatchee Bay, and lowest in Apalachicola Bay. Concentrations of PAHs were relatively high in samples from Pensacola Bay (especially in Bayou Chico), intermediate in samples from St. Andrew and Choctawhatchee bays, and lowest in samples from Apalachicola Bay. The maximum and minimum concentrations of total PAHs differed among all samples by over four orders of magnitude.

Some regions were clearly more contaminated with complex mixtures of substances than others. In Pensacola Bay, concentrations of PAHs, PCBs, mercury, and lead were elevated in three urban bayous (Bayou Chico, Bayou Texar, and Bayou Grande) when compared to the main basin of the system. Samples from Bayou Chico had especially high concentrations of many substances. In Choctawhatchee Bay, a similar pattern was evident; chemical concentrations were highest in the adjoining bayous (Garnier Bayou, Rocky Bayou, and Boggy Bayou) and lowest in the main basin of the bay. Chemical concentrations in St. Andrew Bay were highest in Watson's Bayou and Massamino Bayou when compared to other regions of the system. No clear pattern in contamination was evident in Apalachicola Bay, as all samples had relatively low chemical concentrations.

Based upon normalization to aluminum content (Schropp et al., 1990 ; Schropp and Windom, 1988), trace metals concentrations in all bays sampled during this survey except Apalachicola Bay were anthropogenically enriched. Pensacola Bay and Bayou Chico had the highest number of exceedances of background concentrations overall, followed by Choctawhatchee and St. Andrew Bays. The chemicals that most frequently exceeded background levels were cadmium, copper, lead, mercury and zinc. In addition, many substances equalled or exceeded effects-based, numerical guidelines (PEL and/or ERM values), indicating a high probability that they contributed to toxicity. Samples with chemical concentrations higher than effects-based numerical guidelines would be more likely to be toxic than those with all chemical concentrations below these levels. Notable among these substances were zinc, many individual PAHs, several isomers of DDT, total DDT, total PCBs, and unionized ammonia. Overall, the chemical data suggested that toxicity would be most probable and severe in Bayou Chico, somewhat less likely and severe in the other urban bayous, and least likely in the main basins of all four bays.

Incidence and Severity of Toxicity. Surficial sediment samples were collected from 123 randomly-chosen locations throughout the four bays. Toxicity was determined using a battery of four laboratory tests performed on all samples: (1) percent survival of marine amphipods (*Ampelisca abdita*) in 10-day tests of solid-phase (bulk) sediments; (2) changes in bioluminescent activity of a marine bacterium, *Photobacterium phosphoreum*, in 5-minute assays of organic extracts; (3) fertilization success of the sea urchin *Arbacia punctulata* in one hour tests of the sediment porewater; and (4) normal embryological development of *A. punctulata* in 48-hour tests of the porewater. In addition, the Mutatox™ variant of the microbial bioluminescence test was performed on samples collected in Year 2 from Bayou Chico, Choctawhatchee and Apalachicola bays. The incidence and severity of toxicity differed considerably among the four tests and among the four bays.

Amphipod solid phase assay. The amphipod survival test showed a general lack of toxicity in all bays. From the total 123 samples, only 2.4% were toxic (i.e., significantly different from controls) and 0.8% were highly toxic (significantly different from controls and less than 80% of controls). Therefore, no spatial patterns in toxic effects could be measured from the results of this test. Only three stations throughout all four bays were significantly toxic in the amphipod test; one in Apalachicola Bay, one in Choctawhatchee Bay, and one in Bayou Chico in the Pensacola Bay estuary.

Microtox™. In sharp contrast, the data from the Microtox™ tests indicated that the majority of the samples from the four bays were toxic; 114 (92.7%) of 123 samples were significantly different from controls. In all but one of these samples the test response was less than 80% of the controls. Test results ranged from <1.0% to >100% of control responses. Microbial bioluminescence EC50's were less than 10% of controls in 79 (64%) of the 123 samples. All except one sample from Apalachicola Bay were toxic and all except eight samples from Pensacola Bay were toxic. Nontoxic samples came from an upstream station in the Apalachicola River, several stations near the mouth of Pensacola Bay, and several stations scattered throughout Pensacola Bay.

Mutatox™.An analysis of Mutatox™ results revealed that 65.4% of the samples tested produced either a suspect (S category) or genotoxic (G category) test result and 40.4% produced a strong genotoxic response. All stations tested in Bayou Chico showed a genotoxic response. In contrast, only one of the nine samples from Apalachicola Bay showed a genotoxic response and five of the samples showed no genotoxicity.

Sea urchin fertilization. The incidence of toxicity in the urchin fertilization tests (100% porewater) was 10% in Pensacola Bay, 83.3% in Bayou Chico, 56.8% in Choctawhatchee Bay, 12.9% in St. Andrew Bay, and 44.4% in Apalachicola Bay. In 100% porewater, urchin fertilization was less than 50% in eight samples from Choctawhatchee Bay. Overall, among all 123 samples, 30.9% were toxic in this test. In 100% porewater, urchin fertilization ranged from 0.2% to 99.8% of controls. The overall incidence of toxicity diminished gradually in 50% and 25% porewater sample dilutions to 16.3% and 10.6%, respectively. However, in Bayou Chico 5 of 6 (83.3%) of the samples were both significantly toxic and highly toxic in all porewater concentrations; in addition, urchin fertilization was less than 1.0% of controls in 5 of the 6 samples of 100% porewater.

Sea urchin development.. Urchin development tests showed a wide range in test results. In tests of 100% porewater, normal urchin development was 0.0% in nine of twelve samples from Bayou Chico and in one sample from Bayou Texar. Zero normal development in 100% porewater also was observed in some samples from peripheral bayous of St. Andrew Bay and Choctawhatchee Bay. The two most toxic samples tested, both collected in upper Bayou Chico, showed zero normal development in all porewater concentrations. Overall, there was a relatively high incidence of toxicity in Choctawhatchee Bay (48.6%), Apalachicola Bay (44.4%) and Bayou Chico (100%) in the embryo development tests as compared to Pensacola Bay (27.5%) and St. Andrew Bay (22.6%). Among the 123 samples tested, a total of 46 (37%) were toxic in at least 100% porewater, a slightly higher proportion than observed in the fertilization tests.

Overall, the highest incidence of toxicity among all tests combined occurred among the Bayou Chico samples, followed by Choctawhatchee Bay, and the other areas. All of the Bayou Chico samples were toxic in the sea urchin development, Microtox™, and Mutatox™ tests; all were highly toxic in the urchin development and Mutatox™ tests; and all except one sample were highly toxic in the urchin fertilization tests. In addition, the only sample that was highly toxic in the amphipod survival tests was collected in Bayou Chico. In Choctawhatchee Bay all samples were toxic in Microtox™ tests, most were toxic in Mutatox™ tests, 57% were toxic in urchin fertilization tests, 49% were toxic in urchin development tests, and one sample was toxic in the amphipod tests. The incidence of toxicity in Pensacola Bay and St. Andrew Bay was relatively similar: zero and one sample toxic in amphipod tests (respectively); 10% and 13% toxic in urchin fertilization tests; 27% and 23% toxic in urchin development tests; and 80% and 100% toxic in Microtox™ tests, respectively. Among all areas included in this survey, Apalachicola Bay had the lowest incidence of toxicity in all tests.

Spatial Extent of Toxicity. The data from the toxicity tests were weighted to the sizes of the strata within which they were collected. Therefore, the spatial significance of the toxicity could be estimated. Estimates of the spatial extent of toxicity were developed for all four bioassays for each of the four bays and for the entire survey area combined. Bioassay results that were less than 80% of control responses were treated as “toxic” in these calculations. The entire survey area encompassed approximately 840 km^2.

These data suggest that amphipod survival was affected in a tiny portion of the entire study area (0.005%), and in sharp contrast, microbial bioluminescence was affected in nearly all of the area (98.9%). Both sea urchin fertilization and embryo development were affected in nearly one-half of Choctawhatchee Bay, and small portions of St. Andrew and Pensacola bays. In Apalachicola Bay, the majority of the area was affected in the development tests, whereas about one-third was affected in the fertilization tests. Throughout the entire study area, 23% was toxic in fertilization tests and 34% was toxic in the development tests. Usually, small portions of each bay were affected in both tests of 50% and 25% porewater.

As part of its Environmental Monitoring and Assessment Program (EMAP), U.S. EPA estimated that 7% of the Louisianian estuarine province, which includes the western Florida panhandle, was toxic in laboratory tests with *Ampelisca abdita* (Summers et al., 1993). The Louisianian province extends from the Rio Grande, Texas to Anclote Key, Florida. The considerable difference in the estimated areas of toxicity (7% by U.S. EPA and 0.005% by this study) is probably attributable to the differences in the two survey areas. In the EMAP-E studies, U.S. EPA included large riverine systems, especially the Mississippi River, and other urbanized regions that may be contaminated in their survey area, whereas in this study the survey area was restricted to four large bays of which only relatively small portions were highly urbanized. Nevertheless, both estimates suggest that toxicity as determined with the amphipod acute survival test was not extensive.

Spatial Patterns in Toxicity. Concordance among bioassay results was relatively poor and the four tests showed overlapping, but different patterns in toxicity. Spearman-rank correlations among tests were significant in only three of 24 combinations of results. The most consistent correlations were those: (a) between sea urchin fertilization and microbial bioluminescence, (b) between the Mutatox™ and Microtox™ tests and (c) between both of the sea urchin tests.

Toxicity in the Microtox™ tests was pervasive, extending throughout most or all of each bay. All of the samples from Choctawhatchee Bay, St. Andrew Bay, and Bayou Chico were significantly different from controls. Mean EC50 values were lowest, indicating highest toxicity, in samples from Bayou Chico and inner Pensacola Harbor in Pensacola Bay; Garnier Bayou, Destin Harbor, Boggy Bayou, Tom's Bayou, and Rocky Bayou in Choctawhatchee Bay; and Watsons Bayou and other portions of St. Andrew Bay. Therefore, toxicity in these tests followed the patterns often predicted by the available chemistry data from previous studies. Toxicity was relatively low in Apalachicola Bay compared to the other bays.

No spatial patterns in Mutatox™ test results were evident in Bayou Chico, since all samples collected in 1994 were genotoxic. In Choctawhatchee Bay, genotoxic samples were most evident in the adjoining bayous, including Destin Harbor (D stations), Joe's Bayou (H stations), the two arms of Garnier Bayou, Boggy Bayou, Rocky Bayou, and La Grange Bayou. Most of the "M" and "N" series stations in the main basin of the bay were not genotoxic, and the three stations sampled near the north shore were suspected as genotoxic. One sample from Apalachicola Bay determined to be genotoxic was collected near the mouth of the Apalachicola River. Three samples, one from each sampling stratum in Apalachicola Bay, were suspected as genotoxic. Two samples collected near the mouth of the bay were not toxic.

The results of the sea urchin fertilization tests showed relatively high toxicity in several bayous of Choctawhatchee Bay, Watsons Bayou in St. Andrew Bay, and Bayou Chico of Pensacola Bay compared to the other areas, and relatively low toxicity in most of the main basin stations of Pensacola and St. Andrew bays. Most of the 1994 samples from Bayou Chico were highly toxic in all porewater concentrations, whereas none collected in 1993 was toxic in any porewater concentrations. Two samples each in the lower Apalachicola River and lower Apalachicola Bay were toxic in 100% porewater.

Stations exhibiting toxicity in the embryo development tests were largely associated with urbanized tributaries to the bays in all cases except Apalachicola Bay. Toxicity was especially apparent in Bayou Chico, Watson Bayou, the Pensacola Harbor, Destin Harbor, and portions of Garnier Bayou.

Toxicity/Chemistry Relationships. The relationships between toxicity measured in the four bioassays and solid-phase (bulk) sediment chemistry were explored in a multistep approach. The causes of toxicity could not be determined in these studies. Additional, experimental work would be needed to tease out the substances that caused or significantly contributed to toxicity. Instead, the relative probability or likelihood of different substances contributing to toxicity was determined with analyses of the matching toxicity and chemistry data. Data from each of the four bays were treated separately to identify bay-specific toxicity/chemistry relationships and the data from all areas were combined to identify broad-scale relationships, if any.

In all cases, there was no single chemical or class of chemicals that stood out from the others as the primary cause of toxicity. The chemicals that were most associated with toxicity differed among the four bays. Furthermore, chemicals most associated with toxicity differed among the four different toxicity tests. In all cases it was apparent that complex mixtures of substances co-varied with toxicity and probably contributed to the toxic responses.

In Pensacola Bay, zinc, high molecular weight PAHs, two DDD/DDT isomers, total DDT, and dieldrin were most closely associated with toxicity. To a lesser extent, cadmium, copper, lead, low molecular weight PAHs, and in the case of urchin embryo development, unionized ammonia, were moderately associated with toxicity. The significant correlations between three measures of toxicity (Microtox™, urchin fertilization, urchin development) and cumulative ERM quotients suggests that these substances acted together in complex mixtures to contribute to toxicity. In addition, high levels of nitro aromatic compounds were found in samples that masked much of the PAH signal, and were not accounted for in the analyses of chemistry/toxicity correlations.

Spearman-rank correlations failed to show significant correlations between toxicity in samples from Bayou Chico and Apalachicola Bay, probably largely because of the small sample sizes. However, there were numerous obvious (but nonsignificant) associations between elevated chemical levels and toxicity. The concentrations of zinc and many organic compounds, notably the PAHs and to a lesser extent some chlorinated organic hydrocarbons, were relatively high in these samples, especially those that were toxic in the urchin fertilization tests. The toxicity of one sample with high chemical concentrations may have been inhibited by high concentrations of organic carbon which may have reduced the bioavailability of the organic compounds. Samples from Bayou Chico had considerably higher chemical concentrations than those from Apalachicola Bay, as expected, and often higher concentrations than applicable numerical guidelines.

In Choctawhatchee Bay, the associations between toxicity and concentrations of potentially toxic substances were strongest for the urchin fertilization tests in which a large gradient in response was observed. Amphipod and Microtox™ test results were not correlated with any substances. Urchin embryo development test results were correlated with only three substances: unionized ammonia and two individual PAHs. In sharp contrast, numerous substances were correlated with urchin fertilization. Most notable among these were the concentrations of DDT isomers, total DDT, silver, the sum of PAHs, and dieldrin. However, the concentrations of these substances exceeded TEL and ERL values by relatively small amounts and rarely equaled or exceeded respective PEL and ERM values. Therefore, there is insufficient evidence to suggest which substances individually may have contributed substantially to toxicity.

The four toxicity endpoints measured in St. Andrew Bay appeared to co-vary with different substances in the samples. Despite significant correlations between amphipod survival and the concentrations of copper and DDT, none of the bioassay results were significantly different from controls. Sea urchin development was significantly correlated only with unionized ammonia in the porewater and zero percent normal development occurred in some samples with relatively high ammonia concentrations. Urchin fertilization was correlated with a number of trace metals, DDT, and ammonia and the concentrations of some metals and DDT exceeded numerical guideline values. Microtox™ test results were highly correlated with complex mixtures of substances, including many trace metals and organic compounds. Microtox™ test results showed a strong association with the cumulative ERM quotients, again suggesting that microbial bioluminescence responded to complex mixtures of substances in the organic solvent extracts.

Although toxicity/chemistry relationships differed considerably among the four tests and four bays, there were a few common threads in these associations. In all four bays, the concentrations of selected trace metals (notably zinc, silver, and copper), DDT and its isomeric derivatives, and selected PAHs were associated with at least one measure of toxicity. Also, dieldrin and unionized ammonia showed associations with toxicity. In Pensacola Bay and St. Andrew Bay the cumulative ERM index, which takes into account the concentrations of 24 substances, showed a strong association with toxicity.

Some of the common associations observed in each bay were borne out in the correlations performed with the combined toxicity/chemistry data set of 102 samples. Microtox™ test results were highly correlated with the concentrations of chlorinated compounds, including DDTs, PCBs, and total pesticides. To a lesser degree Microtox™ test results were also significantly correlated with the concentrations of some trace metals and PAHs. Urchin fertilization was highly correlated with the concentrations of PAHs, numerous trace metals, and DDT. Urchin embryo development was primarily correlated with the concentrations of unionized ammonia, and to a lesser degree, PAHs, three trace metals, and one pesticide, dieldrin. It is significant that the results of the Microtox™ and urchin fertilization tests were significantly correlated with the sum of the cumulative ERM quotients, since these quotients account for the contribution of 25 different substances to toxicity. The correlations strongly suggest that mixtures of toxicants, co-varying with each other, contributed significantly to the observed toxicity. This association, on the other hand, was not observed in the embryo development tests, in which ammonia was obviously a likely contributor to toxicity.

The differences in toxicity/chemistry relationships among the bays and toxicity tests are expected and have been observed in previous studies in other major estuaries of the USA (Long et al., 1994; 1996). The species of organisms used in the toxicity tests often display different responses to the many substances that occur in sediments. Different species have different responses to the same chemicals. The amphipod, sea urchin, and microbial bioluminescence toxicity tests were performed with three different phases of the sediments; the solid-phase, porewater phase, and an extract prepared with an organic solvent. Therefore, substances bound to the sediment particles are expected to differ in their relative bioavailability - and toxicological response - among the different phases. Finally, there is a strong possibility that the substances quantified in the chemical analyses co-varied with mixtures of chemicals that were not quantified. It is likely that in any survey, including the present study, that there will be other unmeasured constituents that can add significantly to the toxic response, with no way to account for the extent of the contribution.

Relevance of Different Toxicity Tests. The ecological significance of sediment toxicity tests performed with amphipods has been established in correlative sediment quality studies performed elsewhere, including Commencement Bay, the Palos Verdes shelf and San Francisco Bay, California (Swartz et. al., 1982, 1986, 1994, respectively). Those studies indicated that resident benthic communities often were altered at locations shown to be highly toxic to the amphipod *Rhepoxinius abronius* in laboratory tests. Alterations to resident communities usually consisted of diminished abundance or a lack of certain sensitive crustacean groups, especially burrowing amphipods, relative to stations with high amphipod survival in laboratory tests. Other studies in San Francisco Bay (Chapman et. al., 1987) and Puget Sound (Long and Chapman, 1985) have shown similar results; that is missing or depauperate crustacean abundances in stations shown to be toxic in laboratory tests to amphipods. In Tampa Bay, some stations in which toxicity to *Ampelisca abdita* was observed had severely diminished benthic populations, but some of these alterations may have been attributable to local hypoxic conditions (Coastal Environmental, Inc., 1966). In estuaries, benthic populations are under frequent stress from short-term changes in salinity, cyclical hypoxia and/or ammonia events, and other natural factors such as depth, slope, sediment texture, and predators. Therefore, attribution of benthic population changes to only anthropogenic toxicants, as suggested in laboratory toxicity tests, is a difficult analytical step. Consequently, some have argued that toxicity tests are sufficiently robust to stand alone without the need for accompanying benthic data (Chapman, 1995).

Field validation data for the urchin and Microtox™/Mutatox™ tests currently are not available. However, in Tampa Bay the areas in which toxicity was most severe in both these and the amphipod tests had the most severely altered benthic populations (Coastal Environmental, Inc., 1996). Fertilization and developmental tests of urchin gametes and embryos exposed to the porewaters provide highly sensitive assays of sediment samples. These tests combine evidence of the disruption in essential reproductive functions in the test animals with exposures to the porewater in which toxicants are mainly in a dissolved state and, therefore, readily bioavailable. These are sublethal test endpoints, not acute toxicity tests. They can be viewed as indicators of slightly to moderately degraded conditions that, if allowed to deteriorate, may lead to toxicity expressed in the acute amphipod tests. They should be considered as important instruments for environmental managers in the prevention of further harm to environmental quality. As expected, based upon experience in previous surveys, these two tests showed more sensitivity than the amphipod tests.

The highly sensitive Microtox™ test can be best viewed as an indicator of the potential for biological effects. Because the tests are performed with solvent extracts of the sediments, all solvent-extractable substances in the samples are potentially drawn out or extracted from the sediment matrix, and, therefore, artificially made bioavailable in the tests. Therefore, the test organisms are probably exposed to a greater dose of toxicants than the amphipods or urchins. In addition, the test is conducted with an assay of metabolic activity, not acute mortality, as in the amphipod tests. This test, therefore, is expected to be triggered by much lower chemical concentrations than the other assays. These microbial tests can be regarded as a flag or precursor for further harm in the environment. The Mutatox™ variant of this test indicates the presence of potentially mutagenic substances in the samples, most of which are not highly toxic in acute mortality tests, but would be highly problematic when one considers long-term impacts to a healthy, well balanced biotic population .

CONCLUSIONS

• The concentrations of many different substances in some samples collected during this survey exceeded applicable toxicity thresholds or guideline values. Noteworthy among these chemicals were copper, lead, zinc, many high molecular weight PAHs, total PAHs, total DDT, several isomers of DDT, and dieldrin. Trace metals concentrations in many samples exceeded background levels.

• Chemical concentrations, on average, were most elevated in Pensacola, Choctawhatchee, and St. Andrew bays and lowest in Apalachicola Bay. Within these bays, contamination was highest in Bayou Chico, followed by several other bayous, all of which exceeded the main basins of all bays in contaminant levels. Samples from Bayou Chico equalled or exceeded guideline concentrations for the greatest number of substances and all samples there exceeded background concentrations of trace metals.

• All five laboratory tests indicated the presence of toxicity in western Florida samples. Amphipod survival was the least sensitive test, indicating highly significant toxicity in only one of the 123 samples (0.8% of the total). Microtox™ tests, in contrast, indicated that 91.9% of the samples were highly toxic. In the sea urchin tests of 100% porewater, 26.0% and 35.0% of the samples were highly toxic in assays of fertilization success and normal embryological development.

• Some of the tests, notably the two urchin tests, the Microtox™ and Mutatox™ tests, and the Microtox™ and amphipod survival tests, showed relatively strong concordance with each other, whereas the others showed no or weak concordance. The differences in toxicity among the tests were attributable to differences in the sediment phases tested and the differential sensitivities of the test organisms.

• The entire four bay survey area encompassed approximately 850 km^2 of the western Florida panhandle. The spatial extent of toxicity throughout this area was estimated for each test except Mutatox™. Approximately 90% of the area represented in the survey was toxic in the Microtox™ test, 34% was toxic in the urchin development test, 23% was toxic in the urchin fertilization test, and 0.005% was toxic in the amphipod survival test.

• In 30 independent trials (6 samples, 5 toxicity tests), 23 (76.7%) of the tests showed highly significant results in Bayou Chico. This area was clearly the most toxic region of the study area. The overall incidences of highly significant toxicity in the other areas were: 45.4% (84 of 185 trials) in Choctawhatchee Bay, 37.8 % (17 of 45 trials) in Apalachicola Bay, 33.1% (41 of 120 trials) in St. Andrew Bay, and 28.1% (45 of 160 trials) in Pensacola Bay.

• Overall, the incidence and severity of toxicity were higher in Bayou Chico, an industrialized basin adjoining Pensacola Bay, than in all other bays. All of 1994 samples from Bayou Chico were highly toxic in the urchin embryo and Mutatox™ tests. All except one sample was highly toxic in the Microtox™ tests. The only sample in the entire survey showing a highly significant result in the amphipod tests was collected in Bayou Chico.

• Other bayous in which toxicity was apparent included Watson’s Bayou and Massamino Bayou adjoining St. Andrew Bay; Garnier Bayou and Tom’s Bayou adjoining Choctawhatchee Bay; and Bayou Grande and Bayou Texar adjoining Pensacola Bay. Toxicity also was apparent in the Pensacola Harbor and harbor entrance.

• The mixtures of chemical substances associated with toxicity differed among tests and among the four bays. Overall, however, the concentrations of DDT, ammonia, several trace metals (notably copper), and PAHs were most frequently associated with toxicity throughout the entire survey area.

• Overall, within the combined study area the Microtox™ test results were most correlated with the concentrations of DDT and other pesticides, and to a lesser degree, with the concentrations of several trace metals and PAHs. Notably, this test showed a strong association with the sums of 25 toxicants normalized to their respective guideline values. In Pensacola Bay test results were highly correlated with cadmium, copper, lead, and zinc. None of the substances measured was correlated with Microtox™ results in Choctawhatchee Bay. However, in St. Andrew Bay numerous trace metals, individual PAHs, classes of PAHs, chlordane, other pesticides and DDT were correlated with test results.

• Sea urchin fertilization showed a strong association with porewater ammonia, numerous trace metals and the sum of all PAHs quantified. In Pensacola Bay fertilization success was correlated with a mixture of trace metals, PAHs and a few pesticides. The concentrations of these substances were particularly elevated in the highly toxic samples collected in Bayou Chico. Similarly, numerous trace metals, many PAHs, PCB congeners, total PCBs, DDT and other pesticides were correlated with urchin fertilization success in Choctawhatchee Bay. In St. Andrew Bay, fewer substances were correlated with urchin fertilization, notably including unionized ammonia, several trace metals, total DDT and two DDT isomers.

• In the combined study area, sea urchin development was highly correlated with ammonia and, to a considerably lesser degree, three trace metals, PAHs, and dieldrin. In Pensacola Bay, embryo development was highly correlated with unionized ammonia, and to a lesser degree, many trace metals, PAHs, and total DDT. Zinc, PAH, DDT, and dieldrin concentrations in toxic samples exceeded applicable guideline concentrations in some Pensacola Bay samples. Although most of the samples from Bayou Chico exceeded guideline values for many substances, none of the correlations with urchin embryo development were significant. In both Choctawhatchee and St.

Andrew bays, urchin development was correlated strongly with unionized ammonia concentrations, which exceeded toxicity threshold values in numerous samples.

• The ecological relevance of the toxicity tests differs among the different bioassays. Severe toxicity in amphipod tests has been associated with altered benthic populations in several field studies. Therefore, this test may be an indicator of relatively degraded conditions in the environment. Results of the toxicity survey performed in the four western Florida bays suggest that resident benthic communities may be impacted in some of the regions, especially in the urbanized bayous in which chemical concentrations were highest and toxicity was most severe. The sea urchin test indicates reduced reproductive success of a sensitive marine invertebrate in exposures to the porewaters, a component of sediments in which toxicants are readily bioavailable. In the Microtox™ tests, toxicants are drawn out of the sediment matrix with an organic solvent, and, therefore, are indicative of the potential for toxicity in the samples. The Mutatox™ tests provide information on the mutagenic potential of sediment-associated toxicants.

In summary, the incidence of toxicity, whether acute or otherwise indicative of chronic problems, should be used to draw attention to these systems whose capability to sustain a healthy, well balanced benthic population is compromised. Changes in upland land management practices and better source controls are needed to prevent long term harm.

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FIGURES

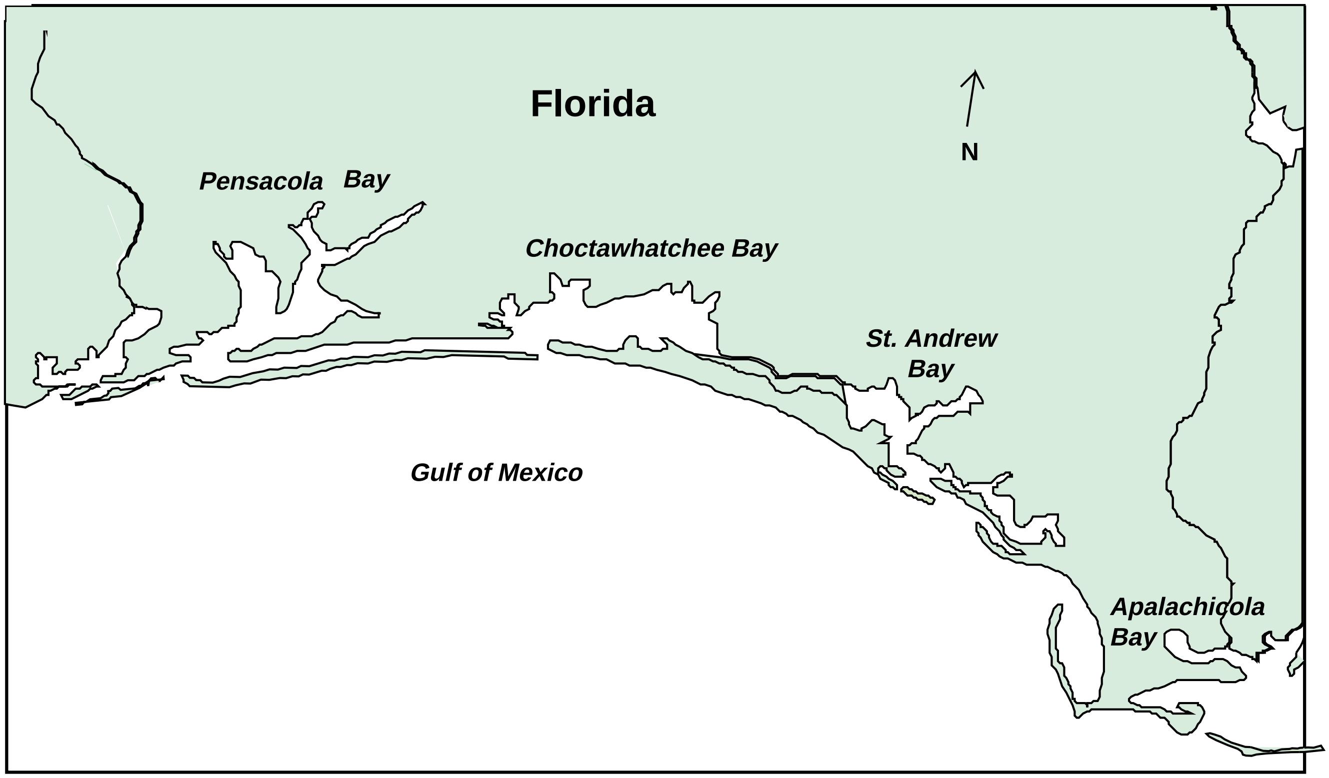


Figure 1. Study area encompassing Pensacola, Choctawhatchee, St. Andrew, and Apalachicola bays.

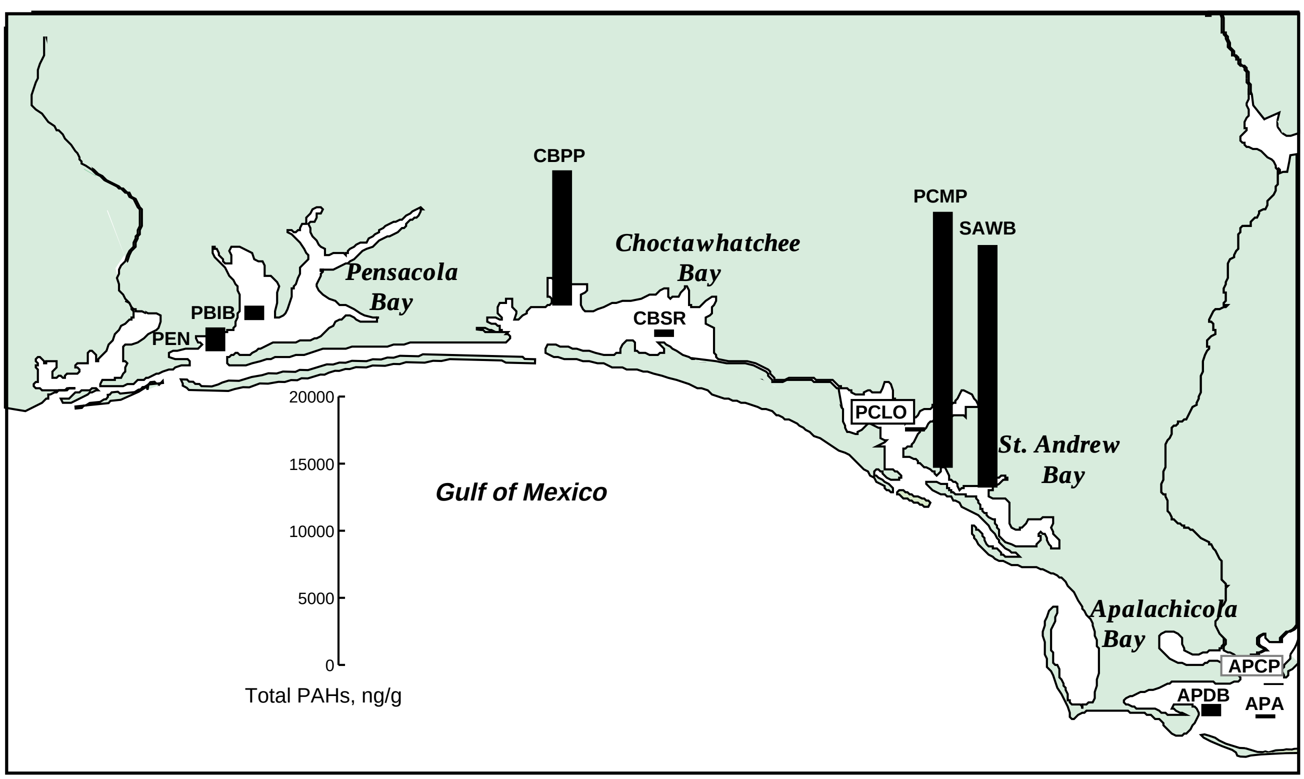


Figure 2. Total PAH concentrations in sediments from 10 NOAA NS &T Program sampling sites.

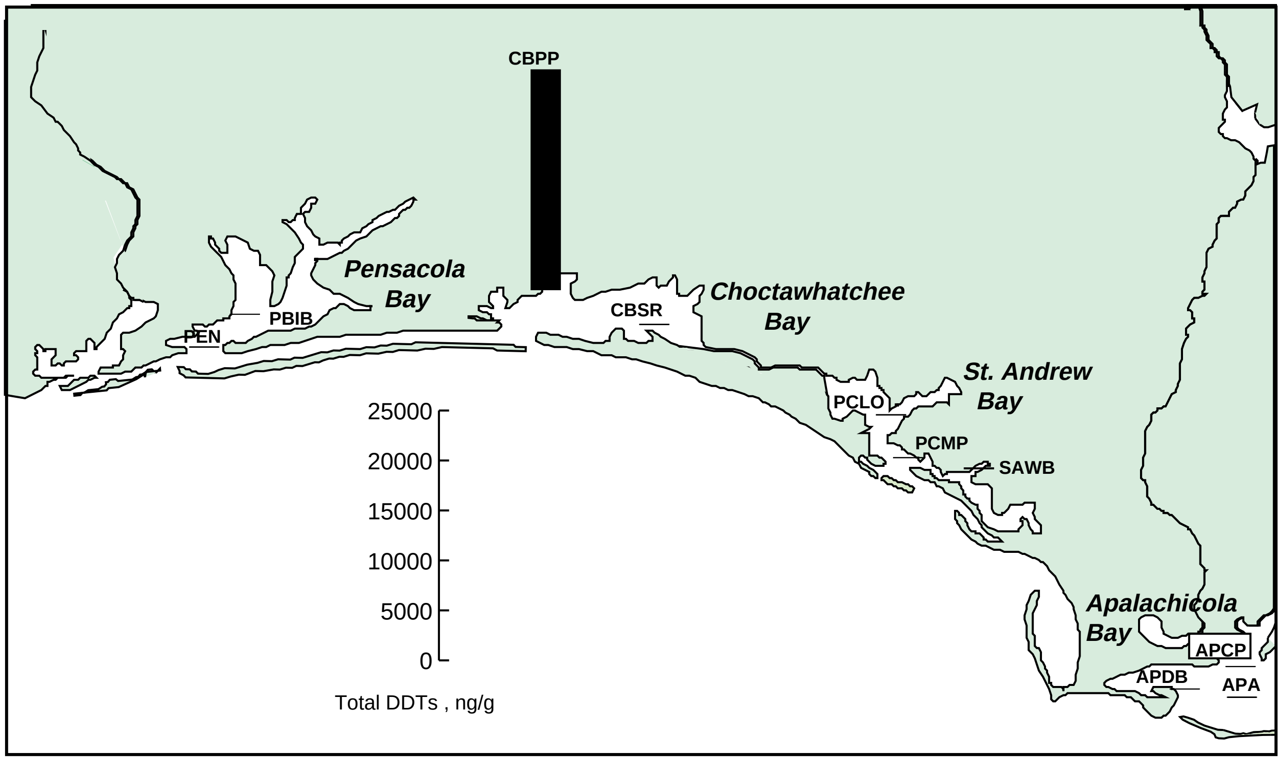


Figure 3. Total DDT concentrations in sediments from 10 NOAA NS&T Program sites.

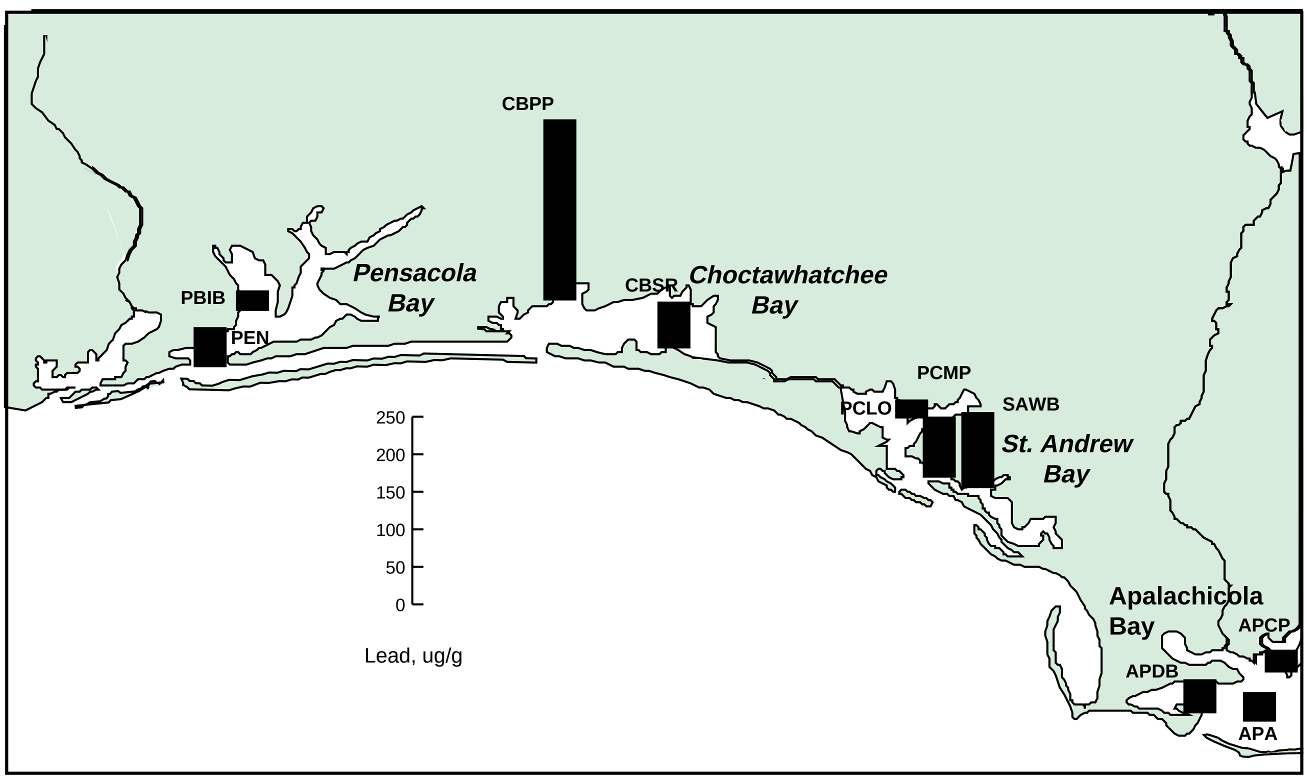
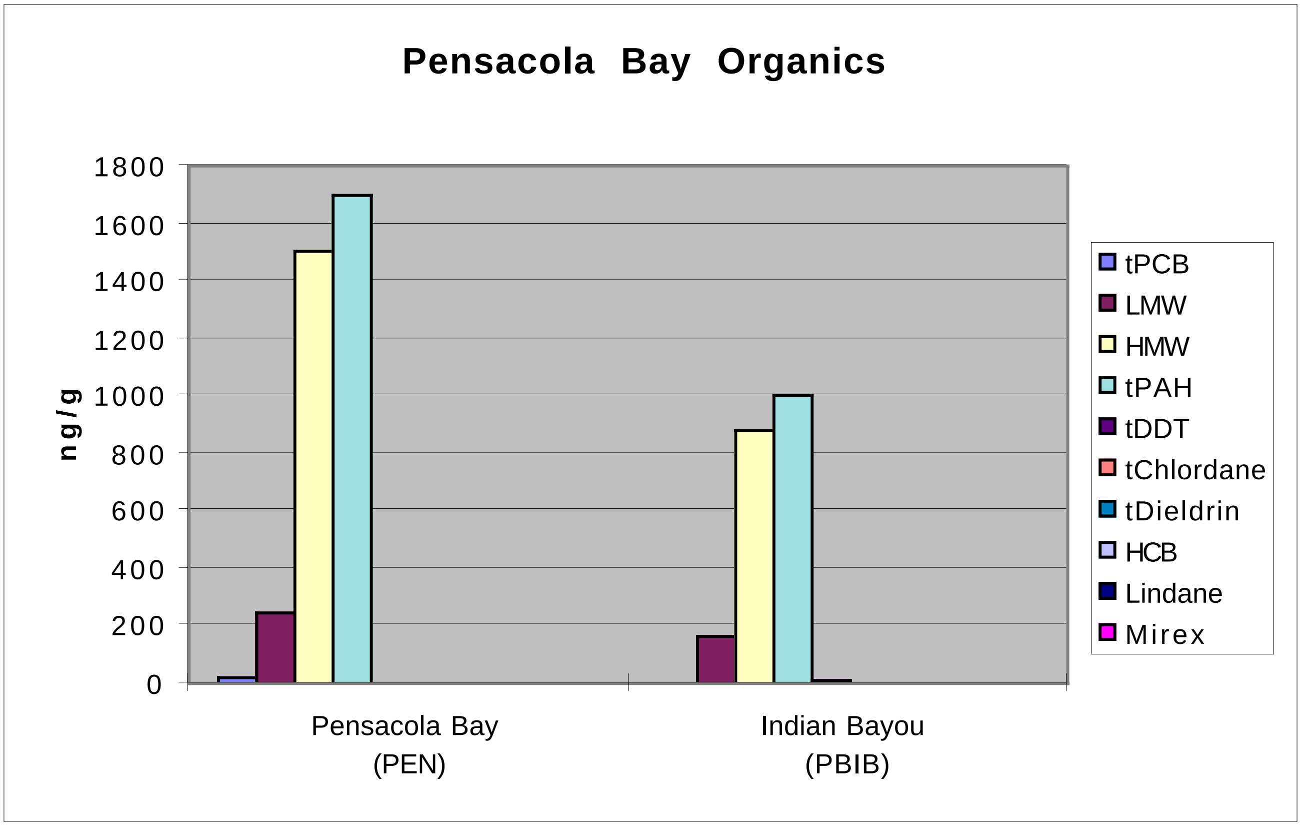


Figure 4. Lead concentrations in sediments from 10 NOAA NS&T Program sites.



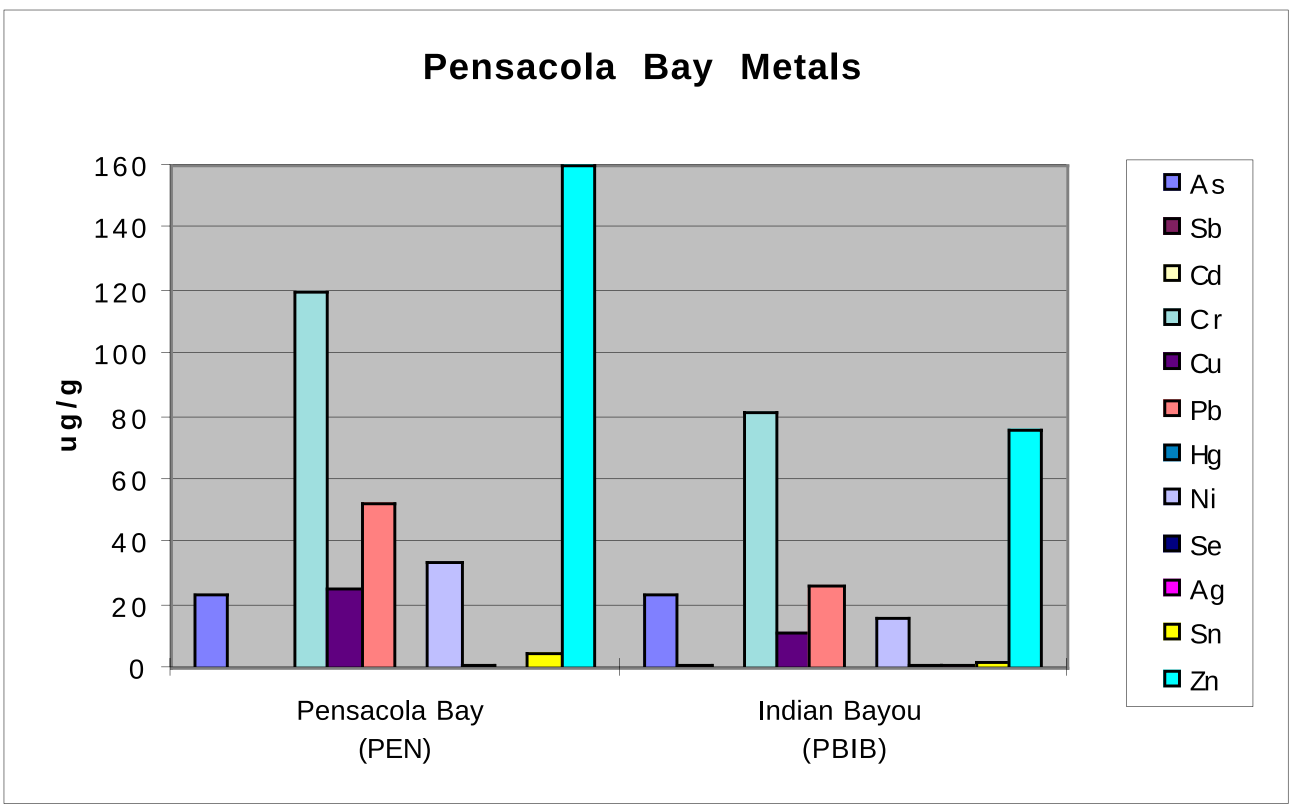
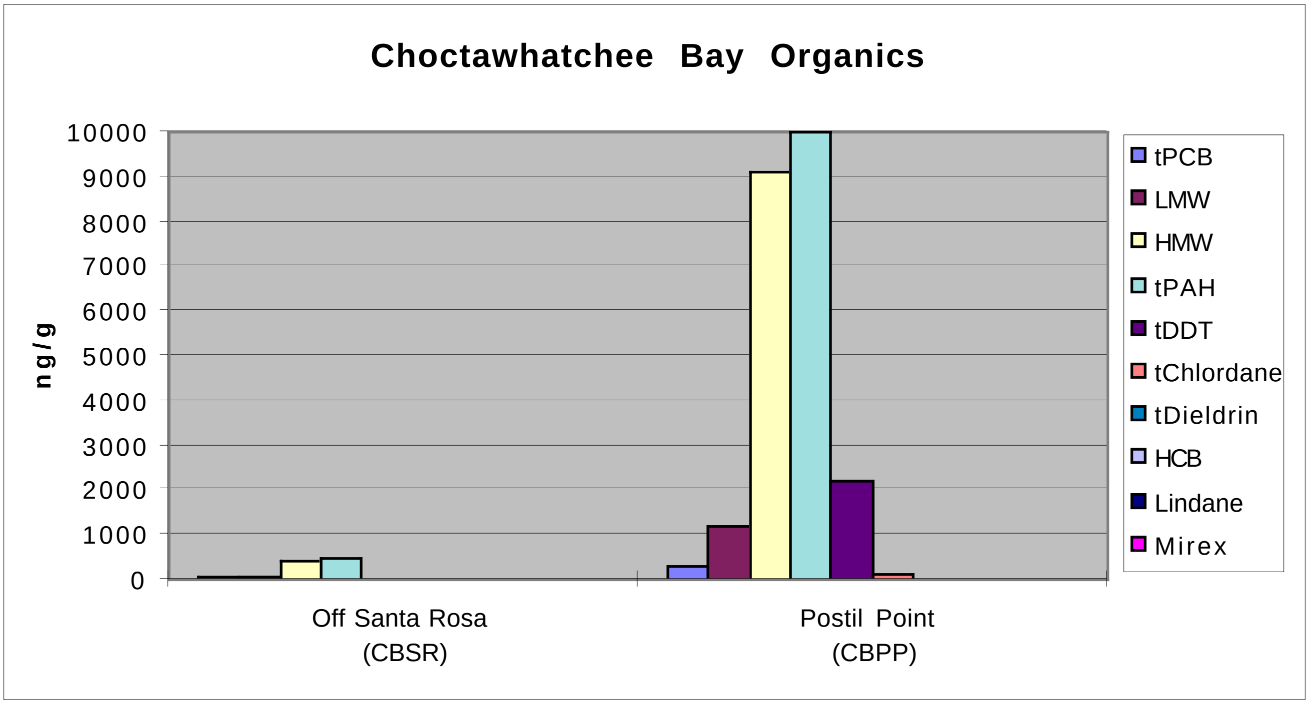


Figure 5. Concentrations of organics and trace metals in sediments from NS&T Program sites sampled in Pensacola Bay in 1991.



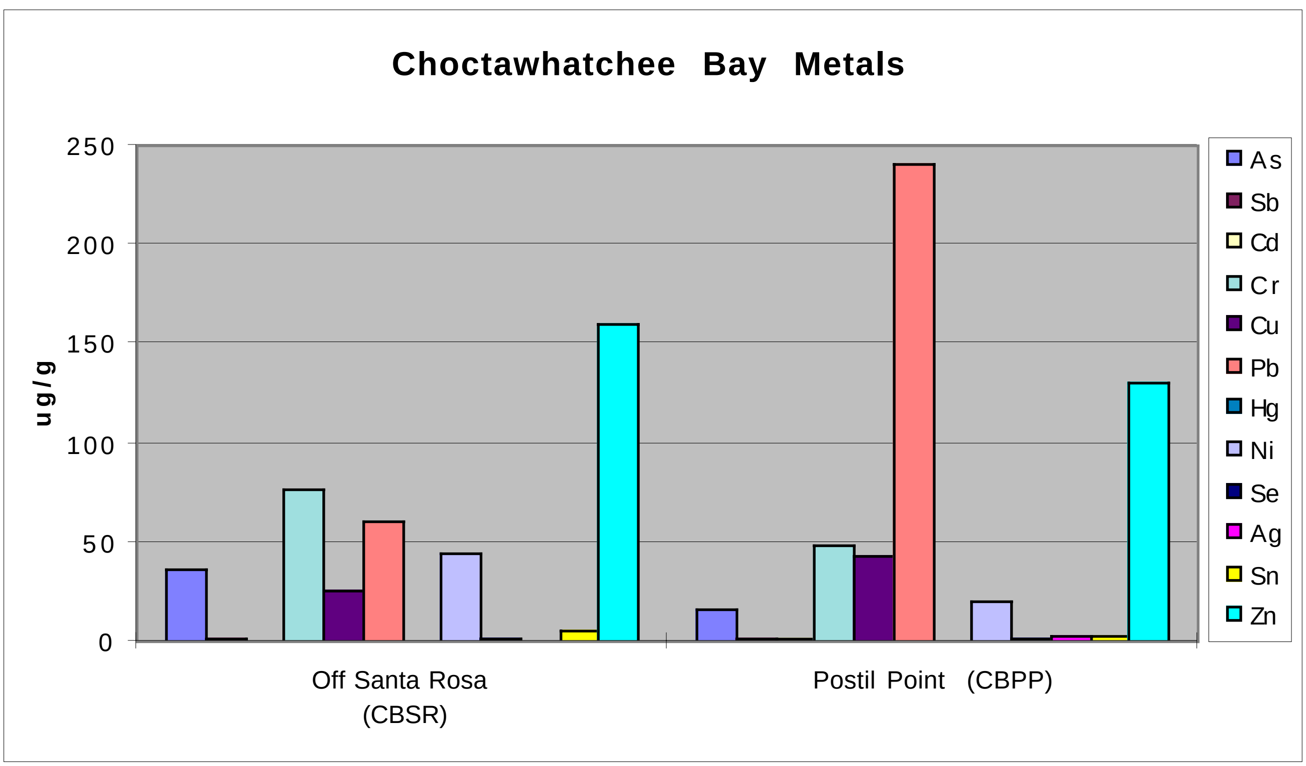
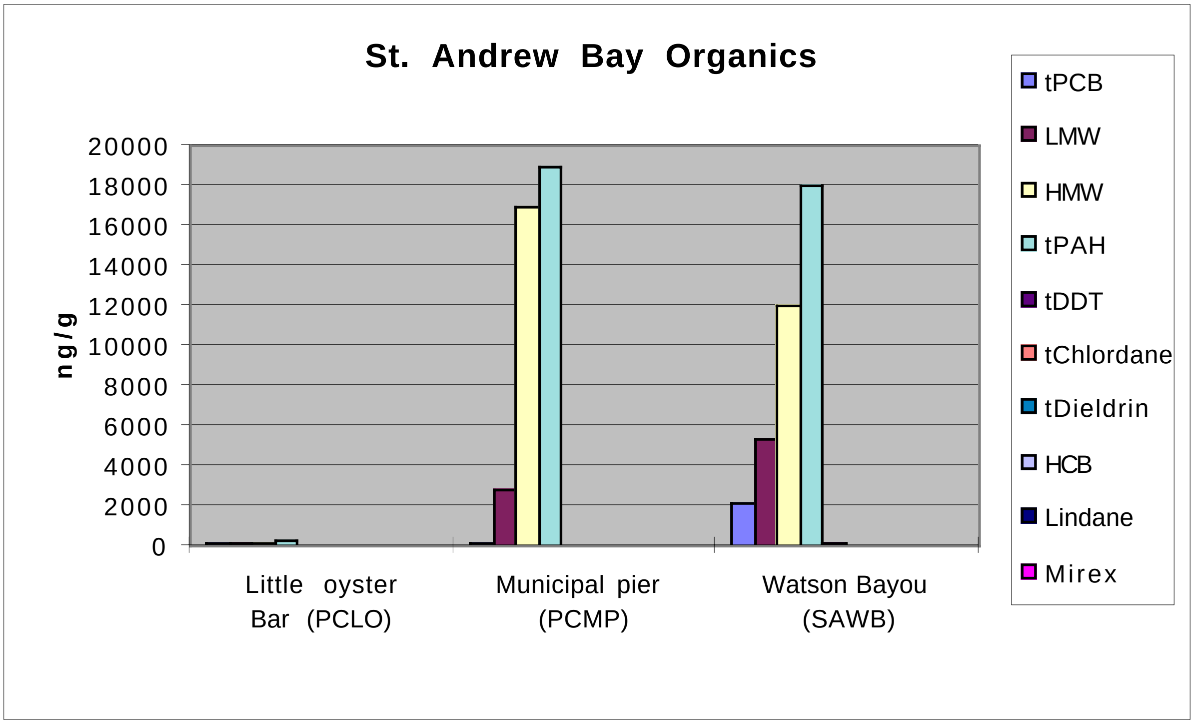


Figure 6. Concentrations of organics and trace metals in sediments from NS&T Program sites sampled in Choctawhatchee Bay in 1991.



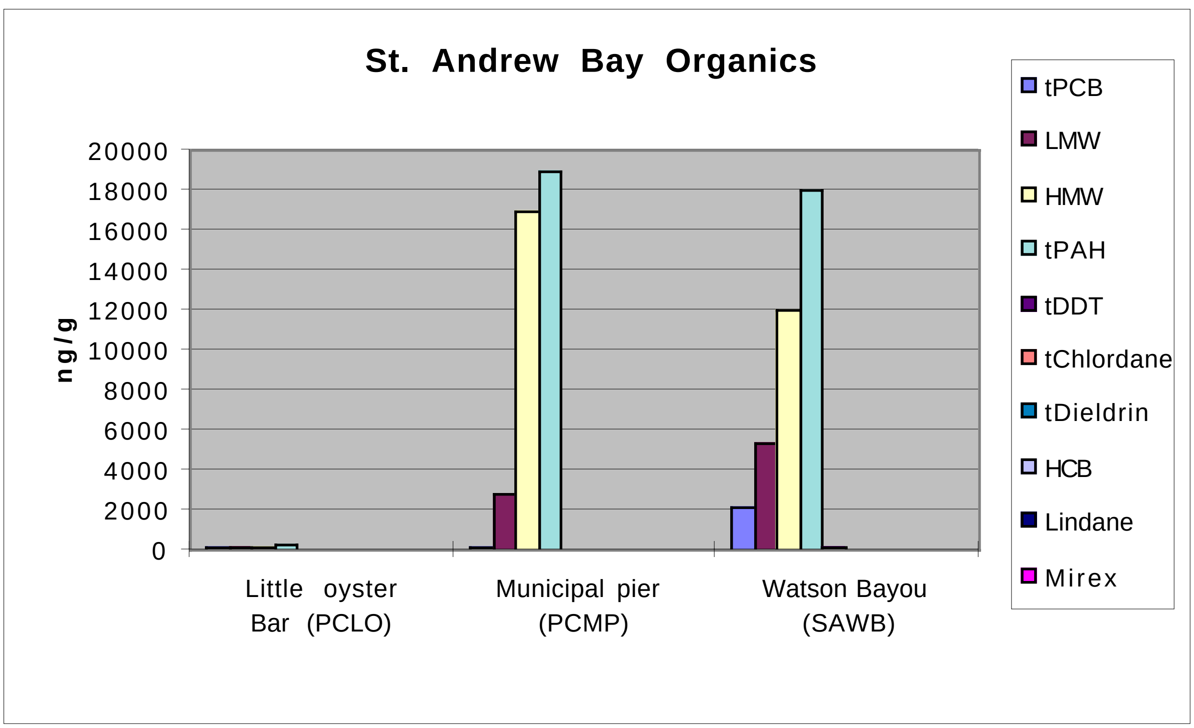
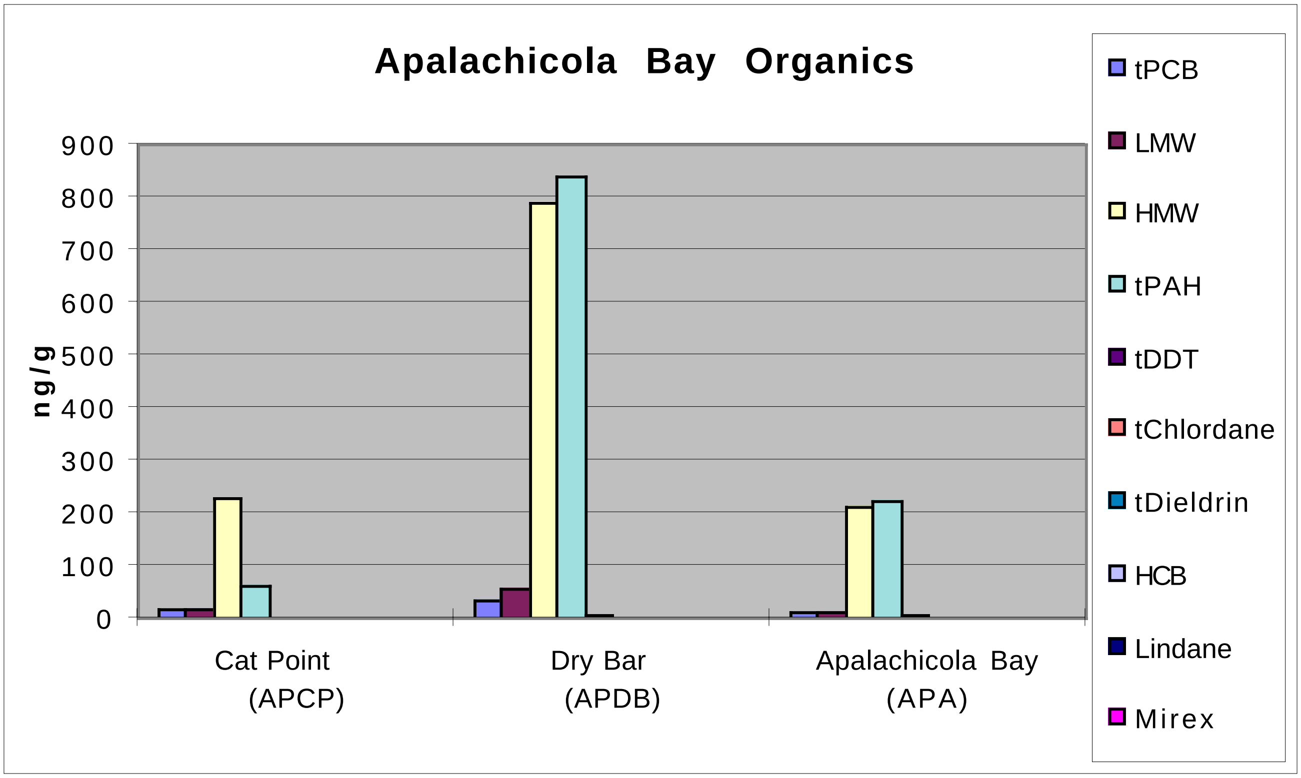


Figure 7. Concentrations of organics and trace metals in sediments from NS&T Program sites sampled in St. Andrew Bay in 1991.



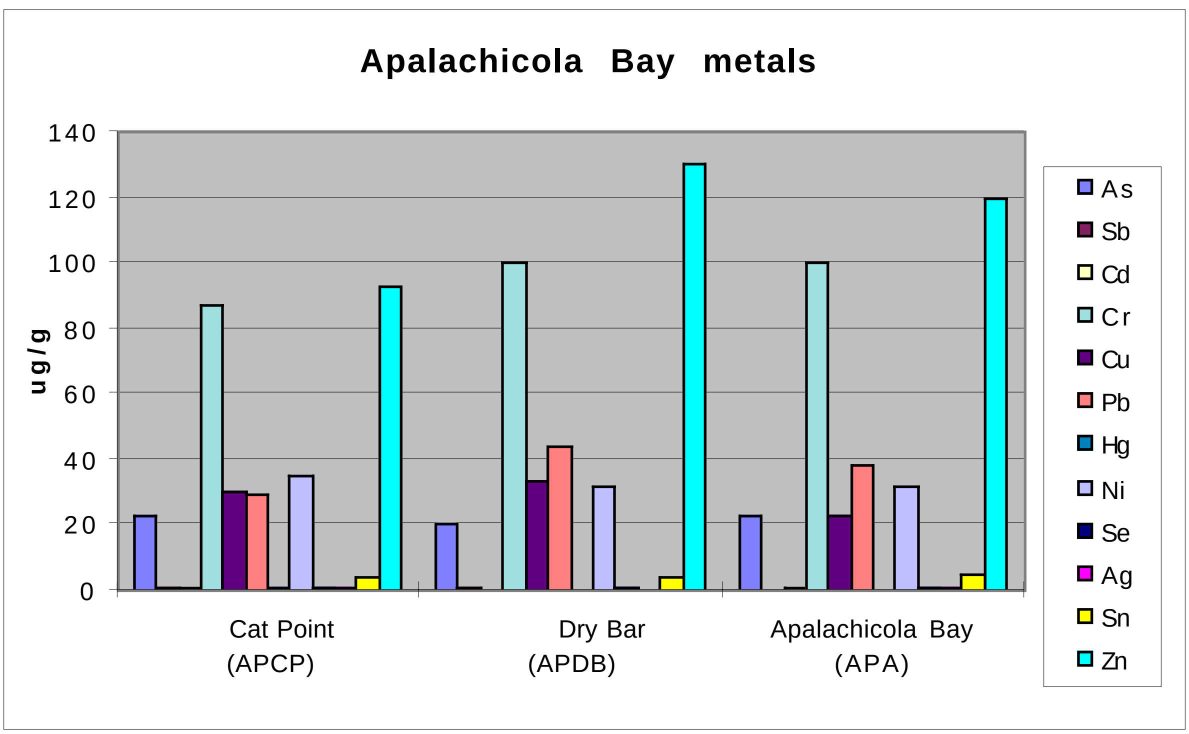


Figure 8. Concentrations of organics and trace metals in sediments from NS&T Program sites sampled in Apalachicola Bay in 1991.

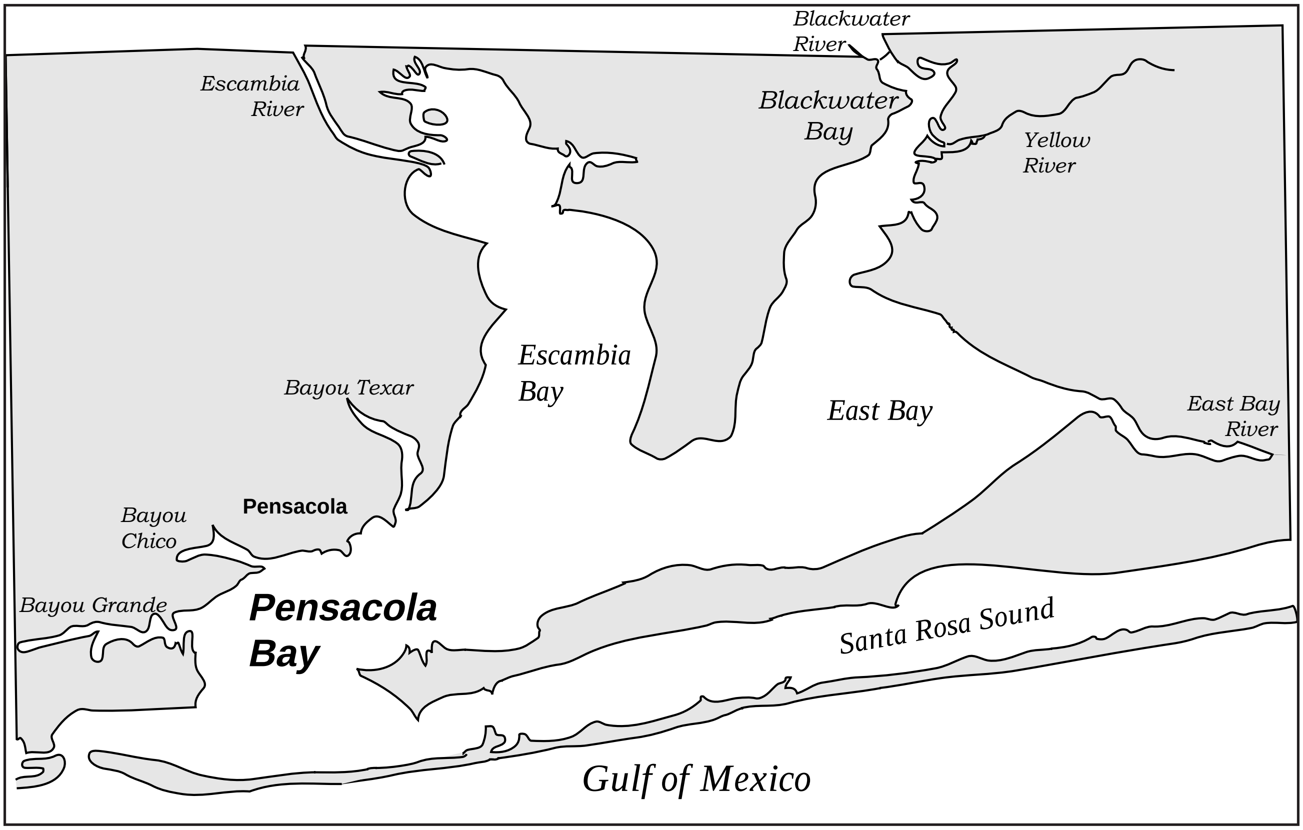


Figure 9. Pensacola Bay study area.

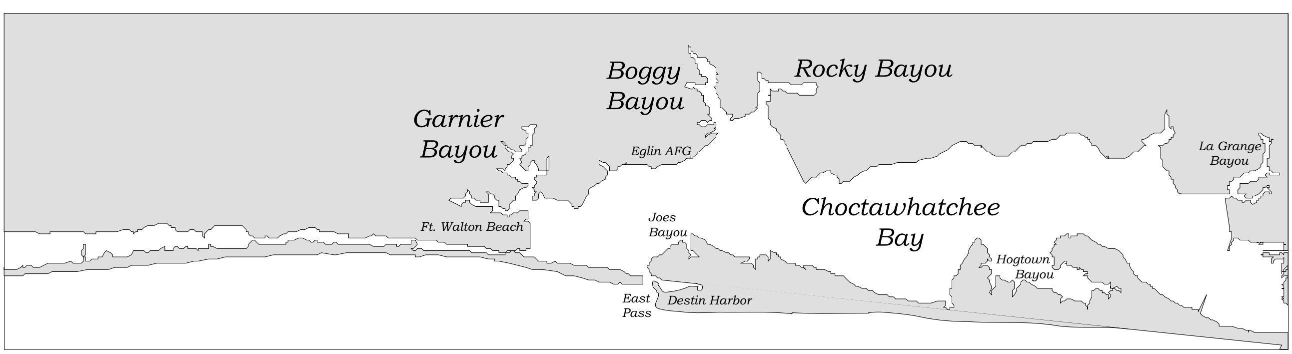


Figure 10. Choctawhatchee Bay study area.

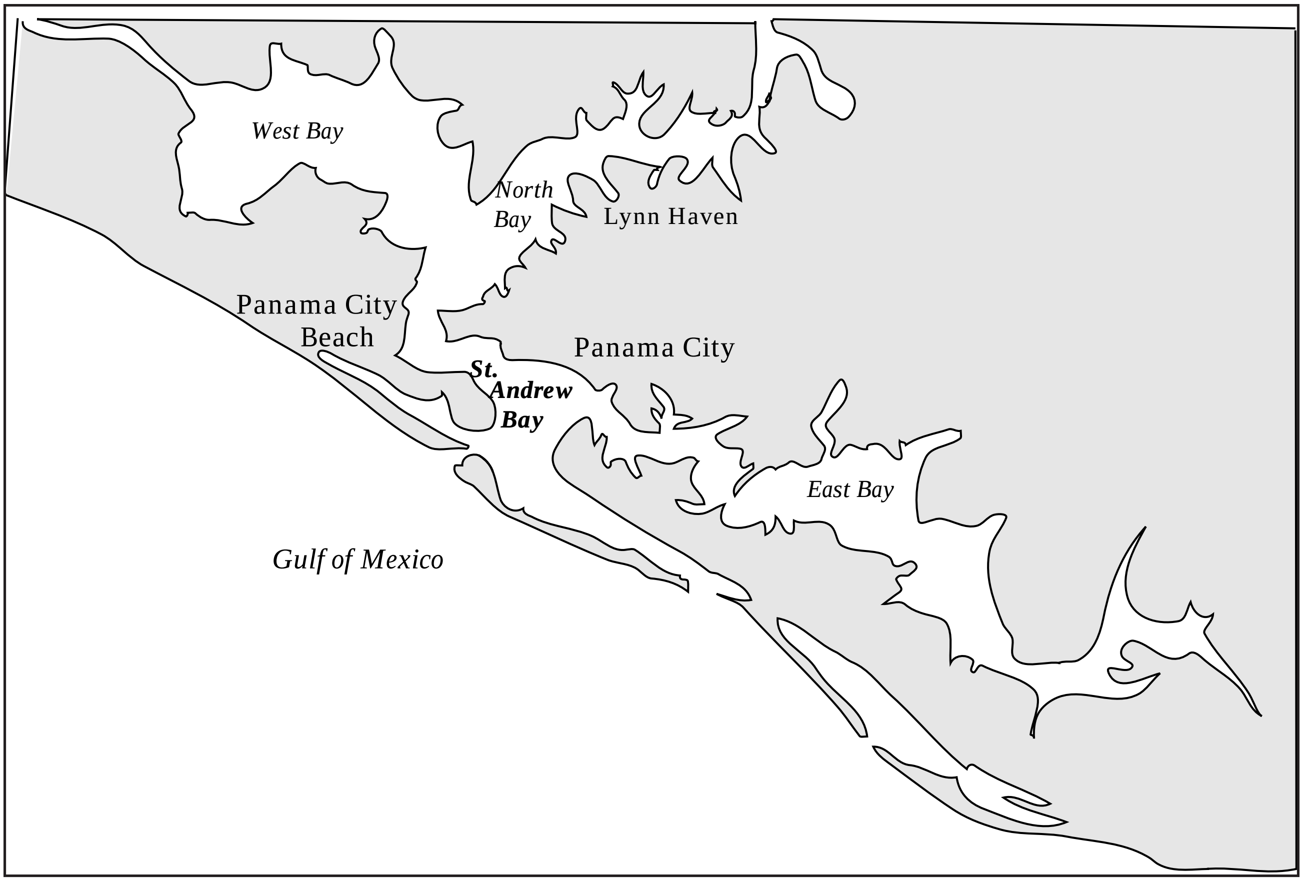


Figure 11. St. Andrew Bay study area.

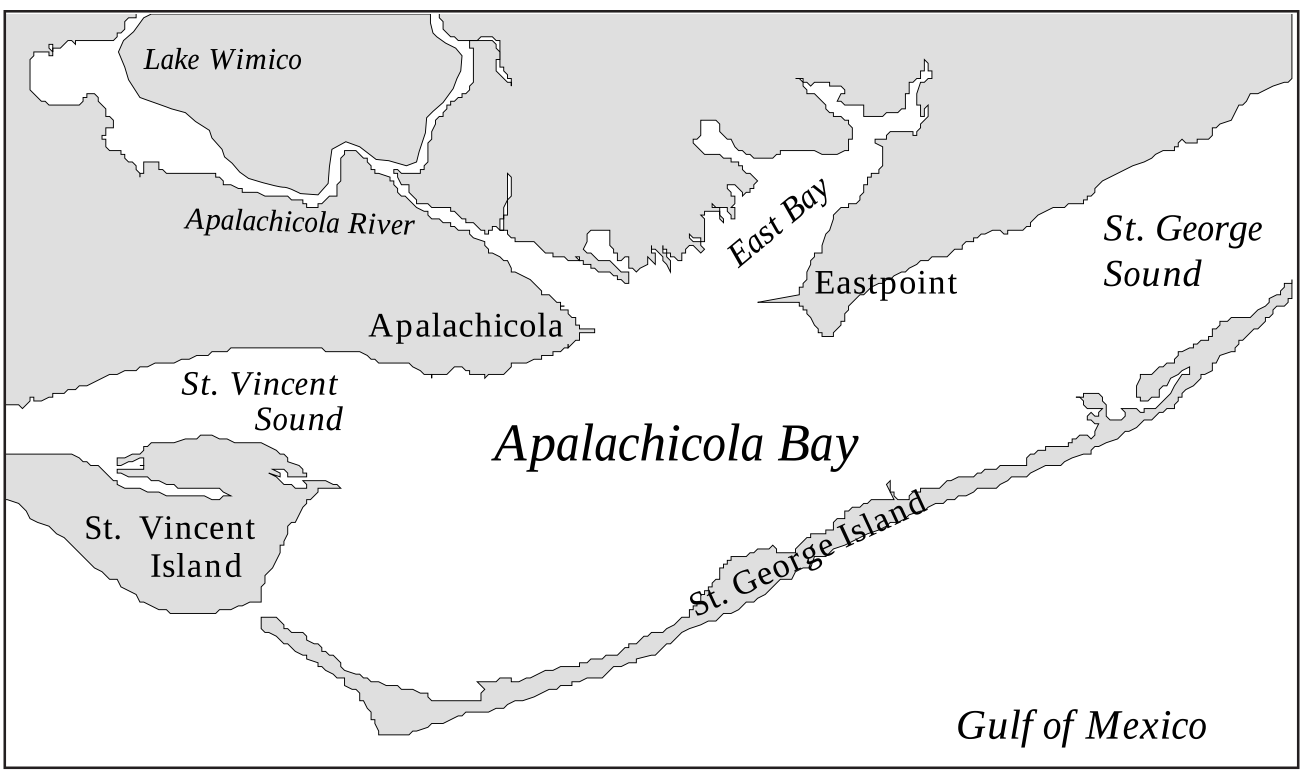


Figure 12. Apalachicola Bay study area.

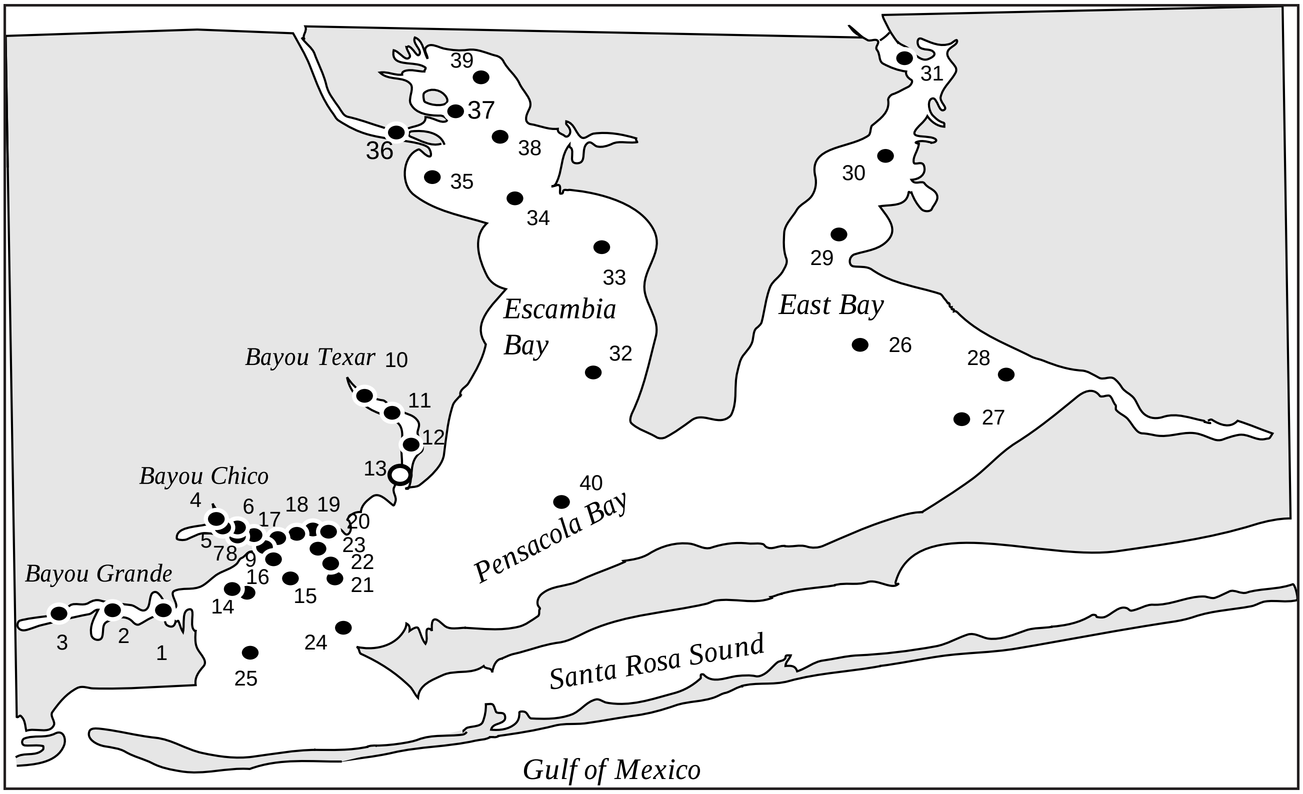


Figure 13. Locations of sampling stations in Pensacola Bay.

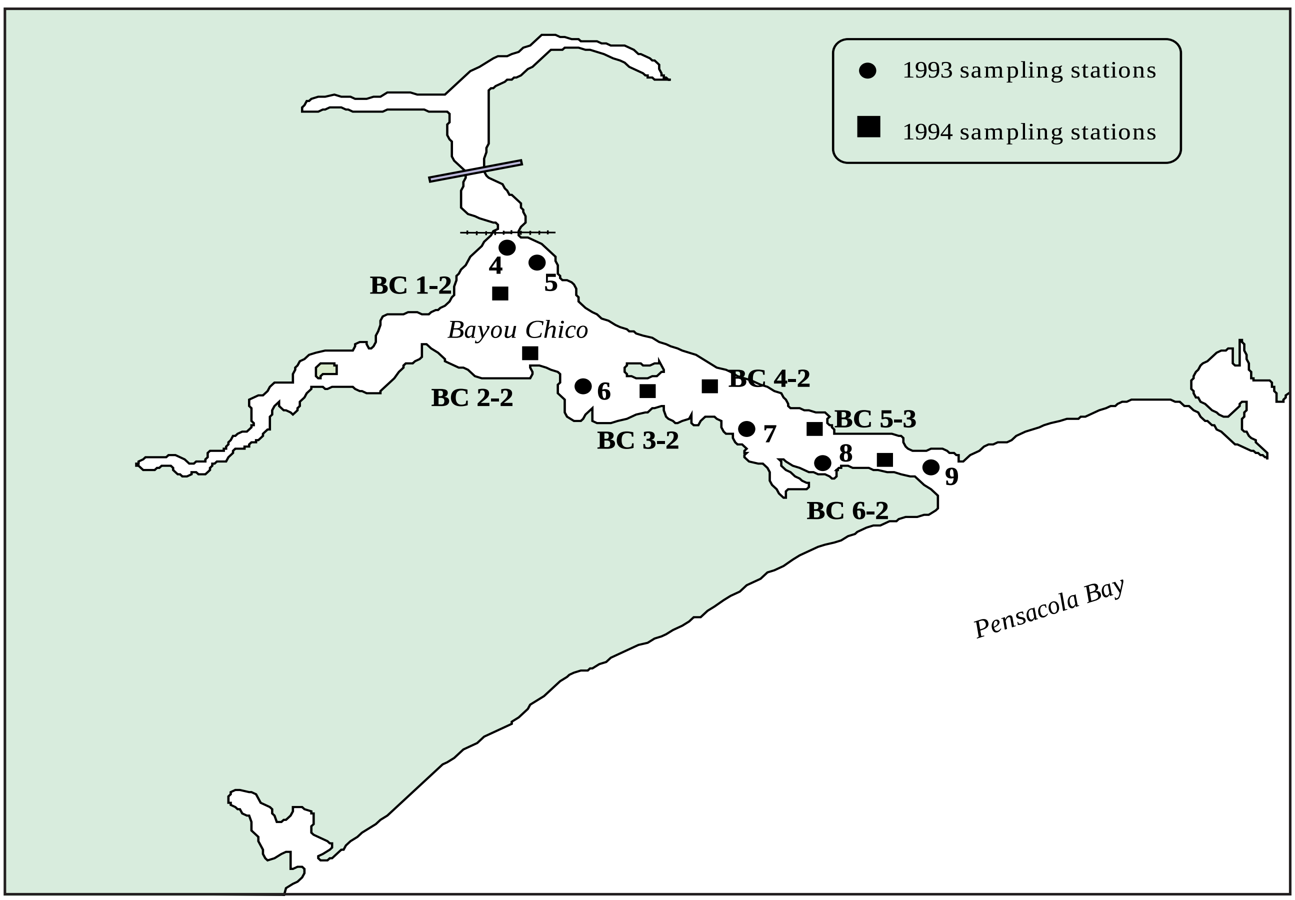


Figure 14. Locations of sampling stations in Bayou Chico.

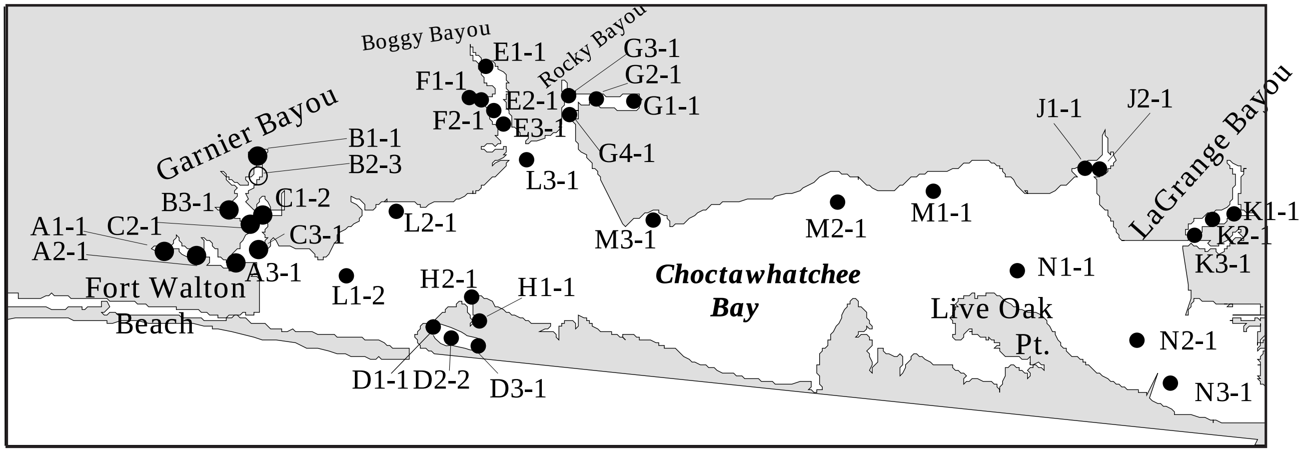


Figure 15. Locations of sampling stations in Choctawhatchee Bay.

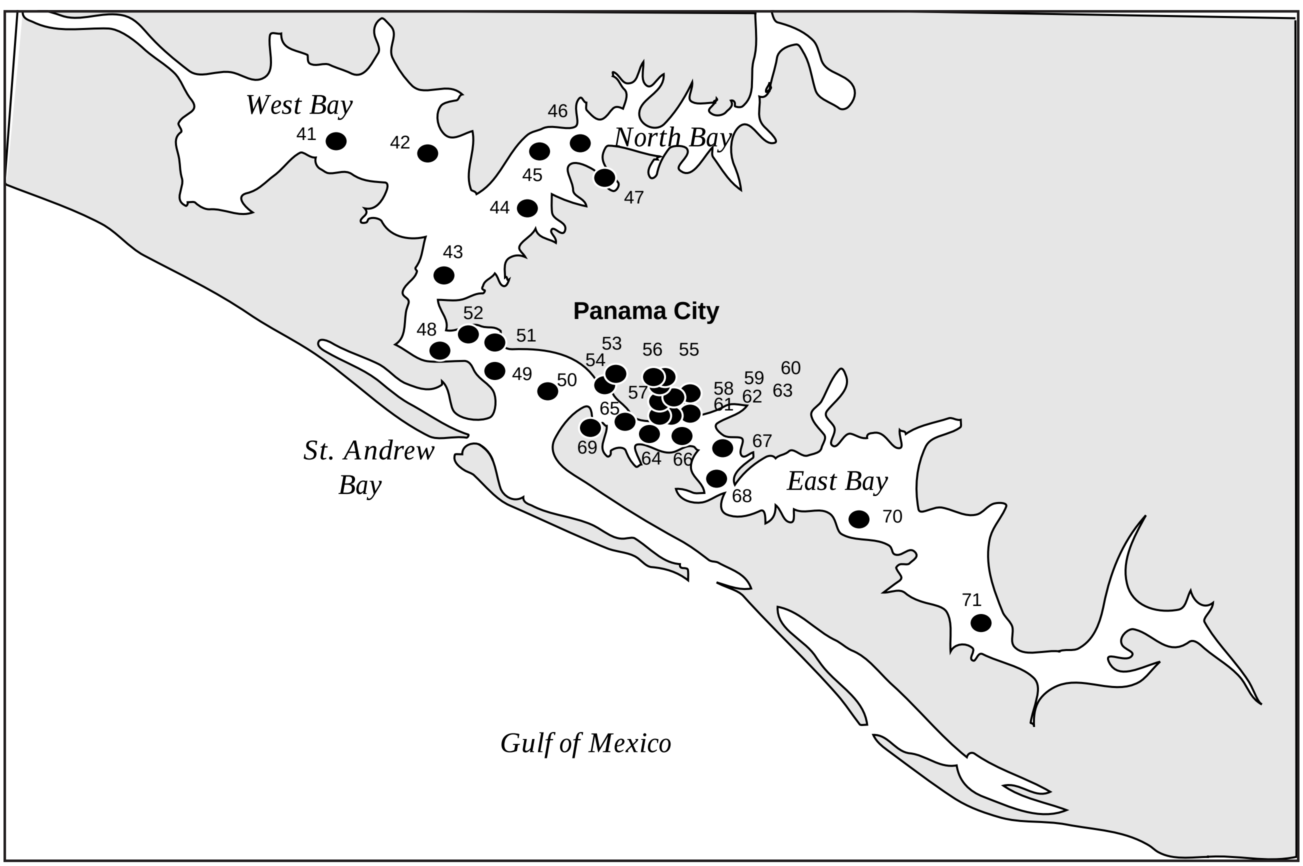


Figure 16. Locations of sampling stations in St. Andrew Bay.

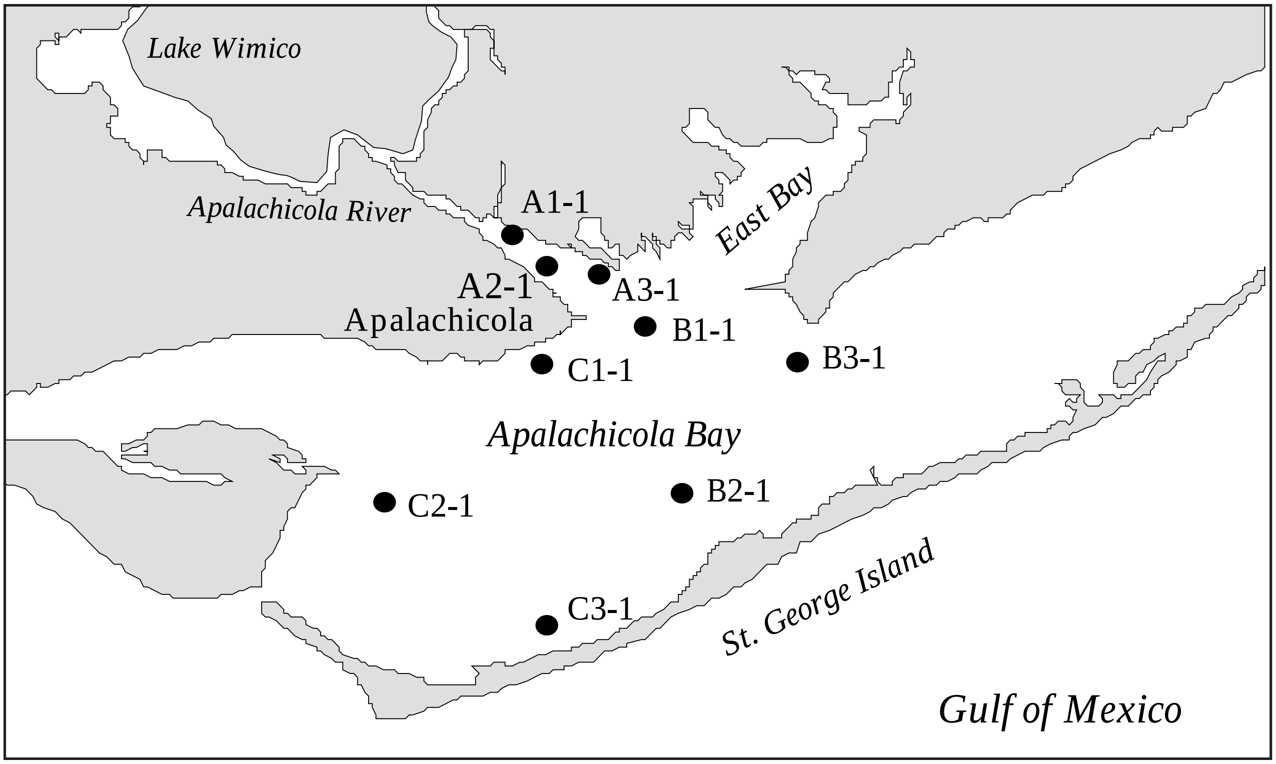


Figure 17. Locations of sampling stations in Apalachicola Bay.

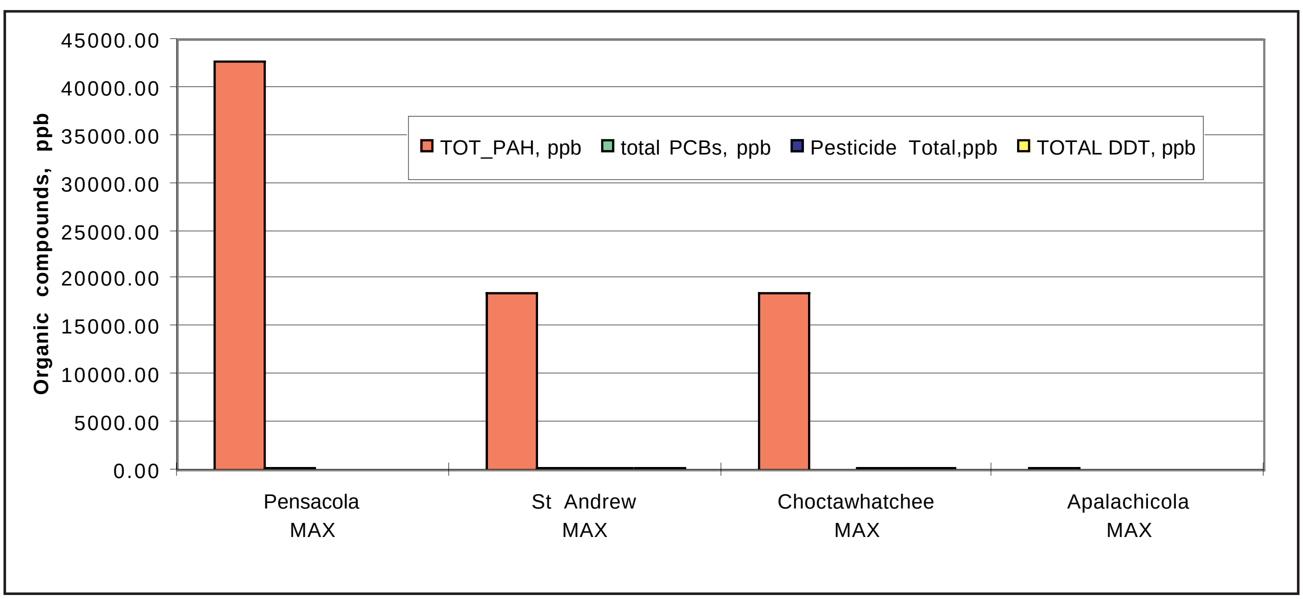


Figure 18. Maximum concentrations of major classes of organic compounds (total PAHs, total PCBs, total pesticides and total DDTs) in sediments from four western Florida bays.

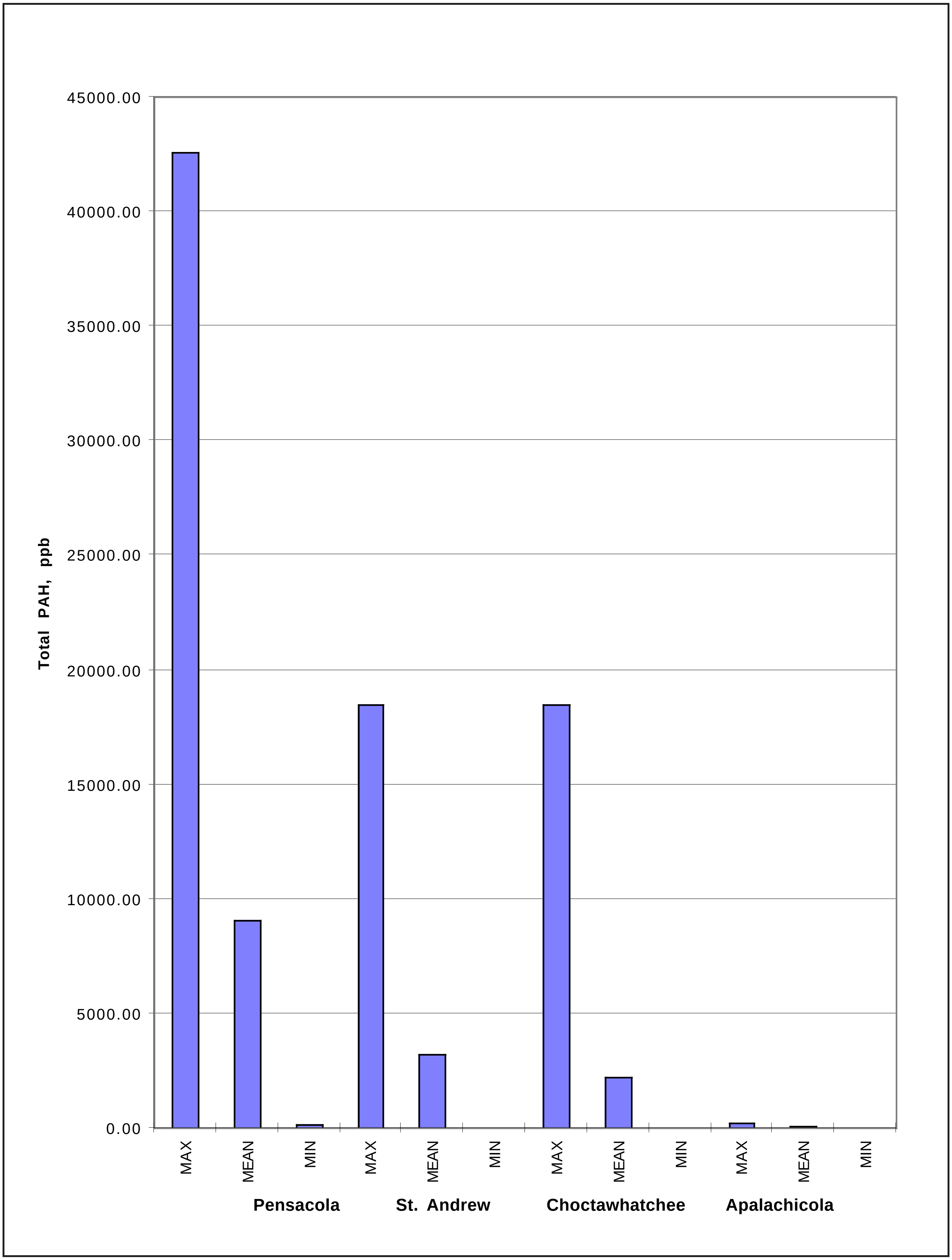
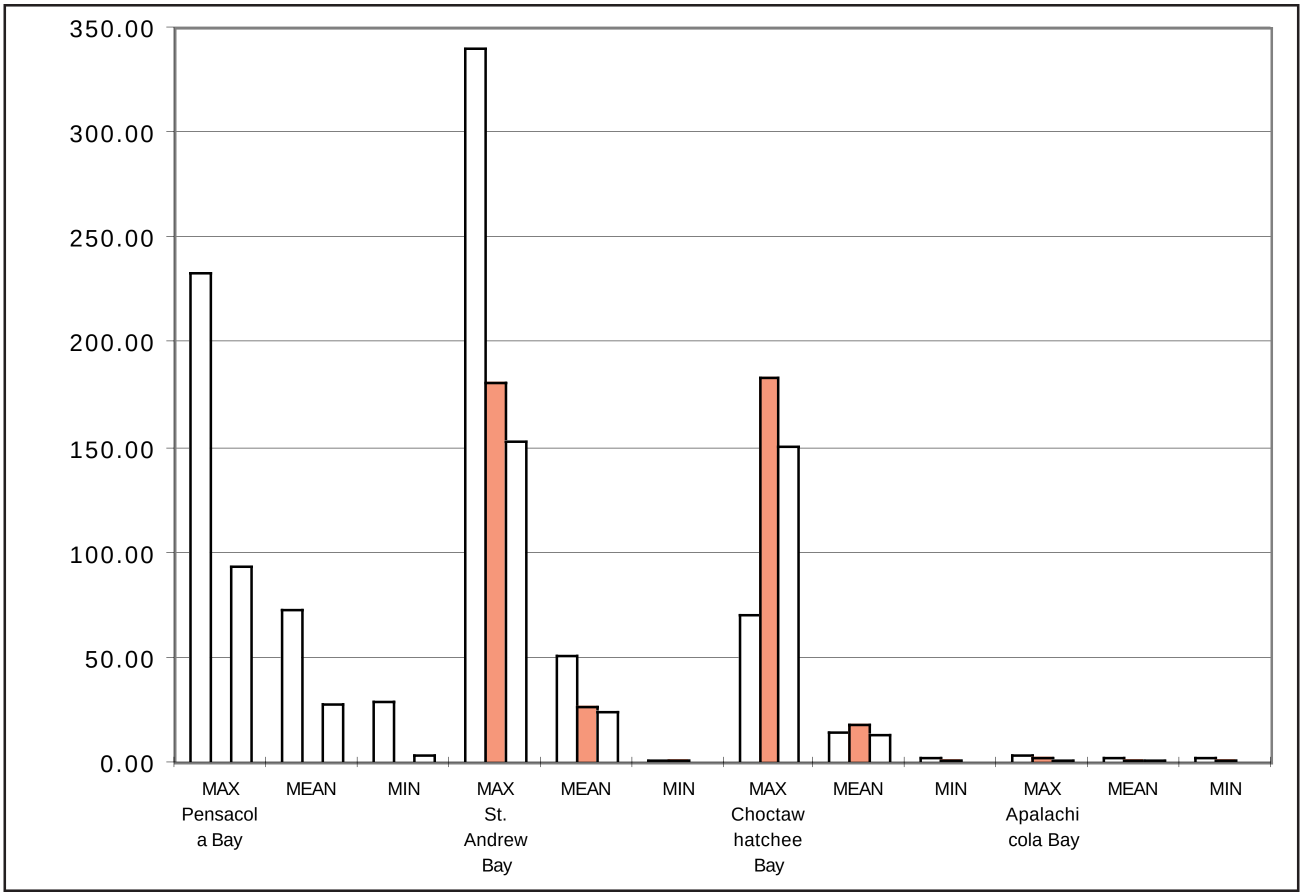
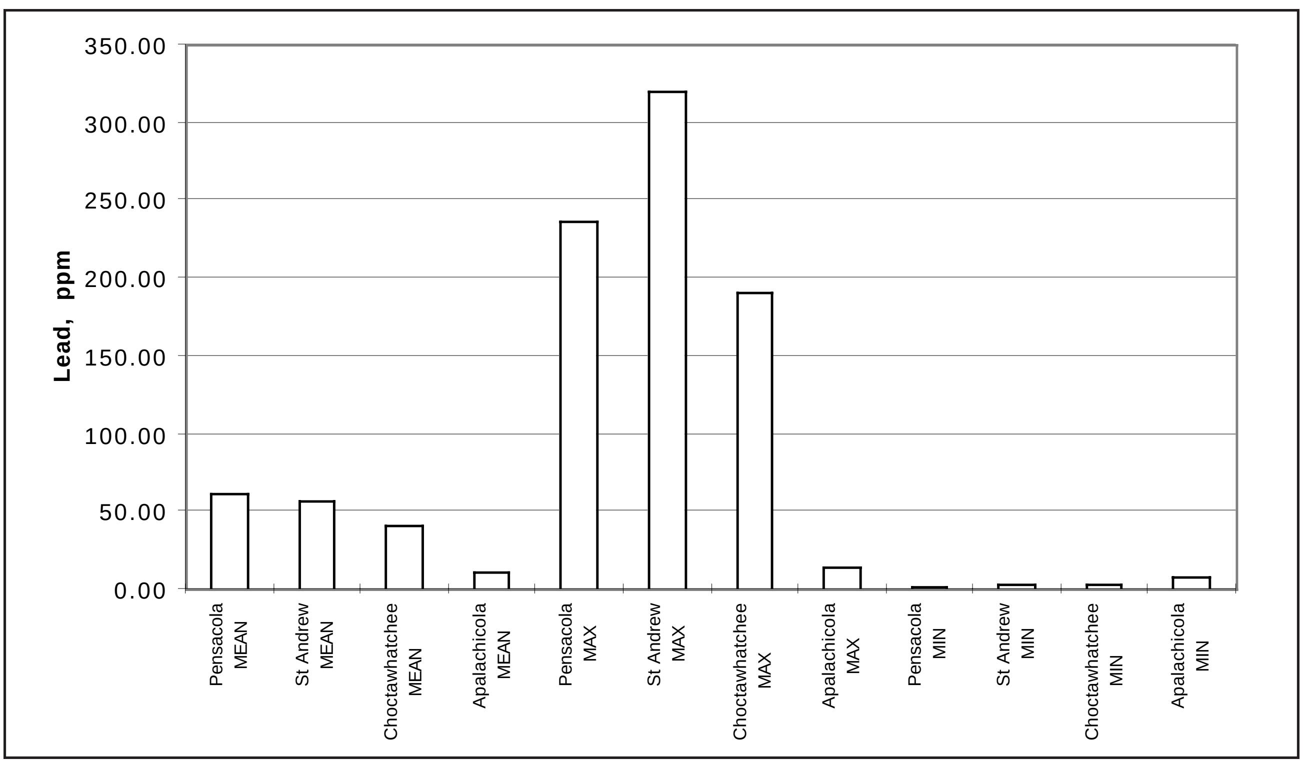


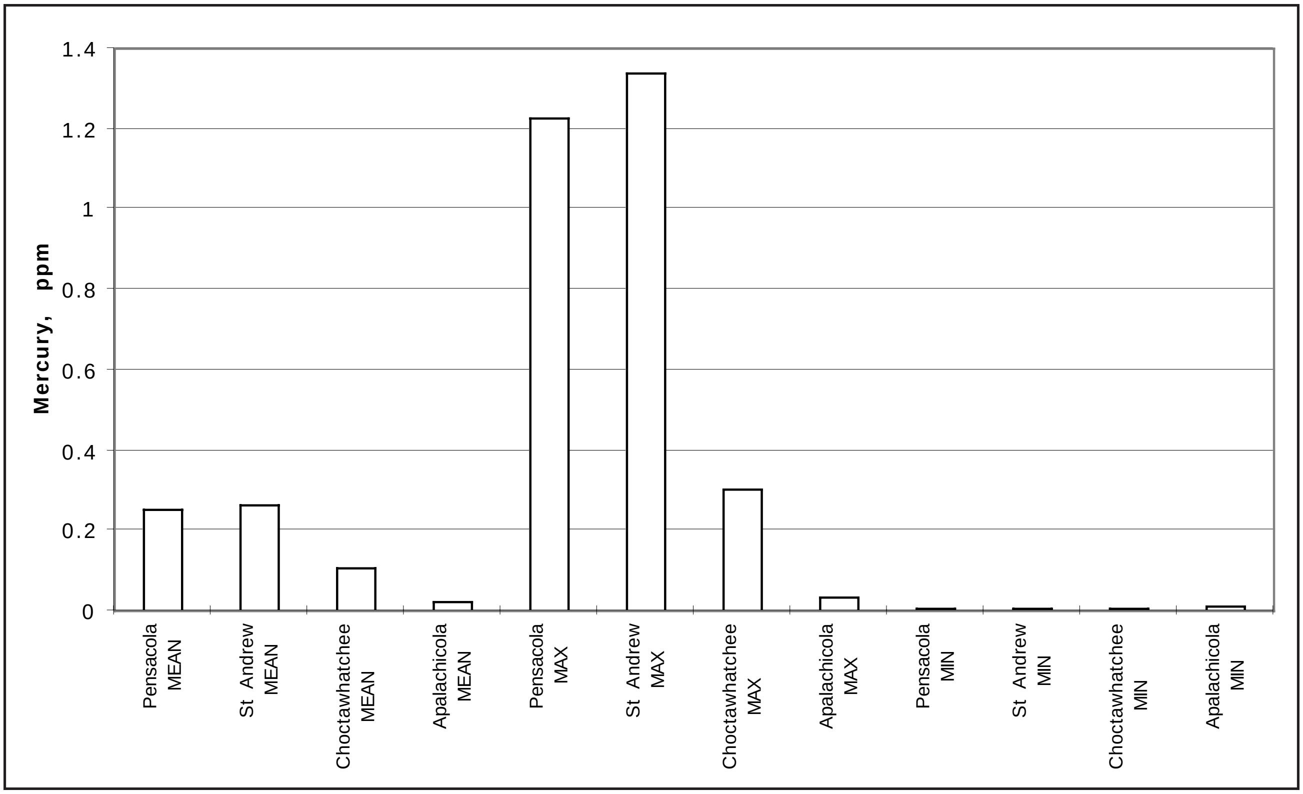
Figure 19. Maximum, mean and minimum concentrations of total PAHs in western Florida bays.



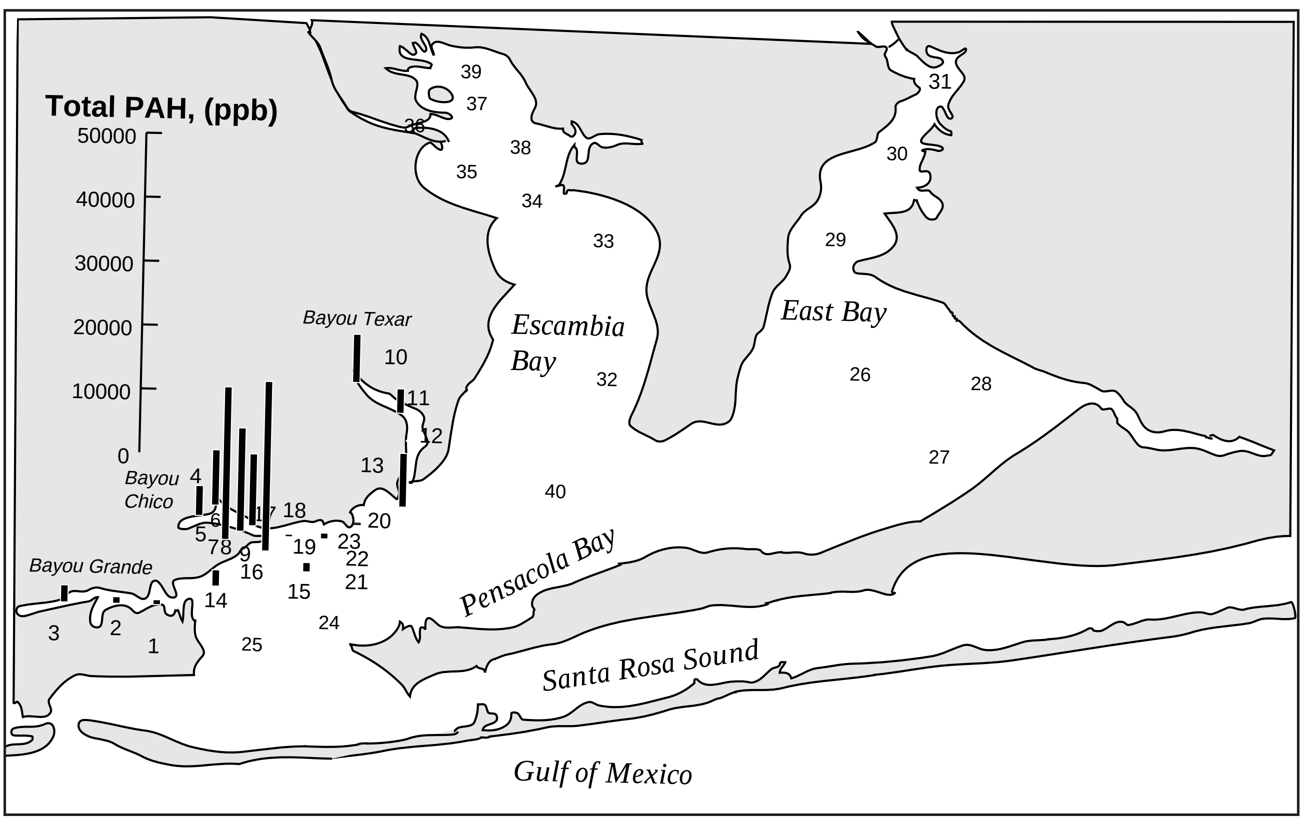
20. Maximum, mean and minimum concentrations of total PCBs, total pesticides and total DDTs in western Florida bays.



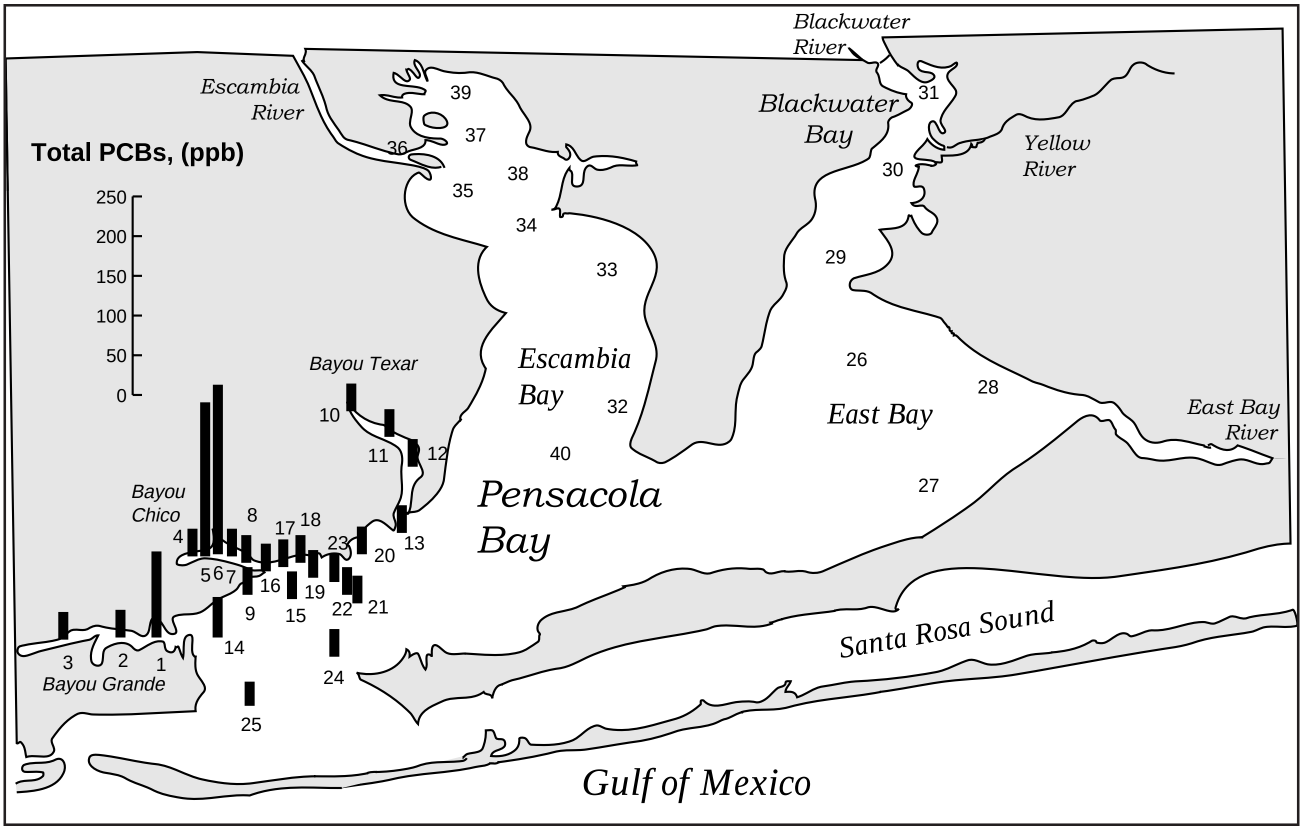
21. Maximum, mean and minimum lead concentrations in western Florida bays.



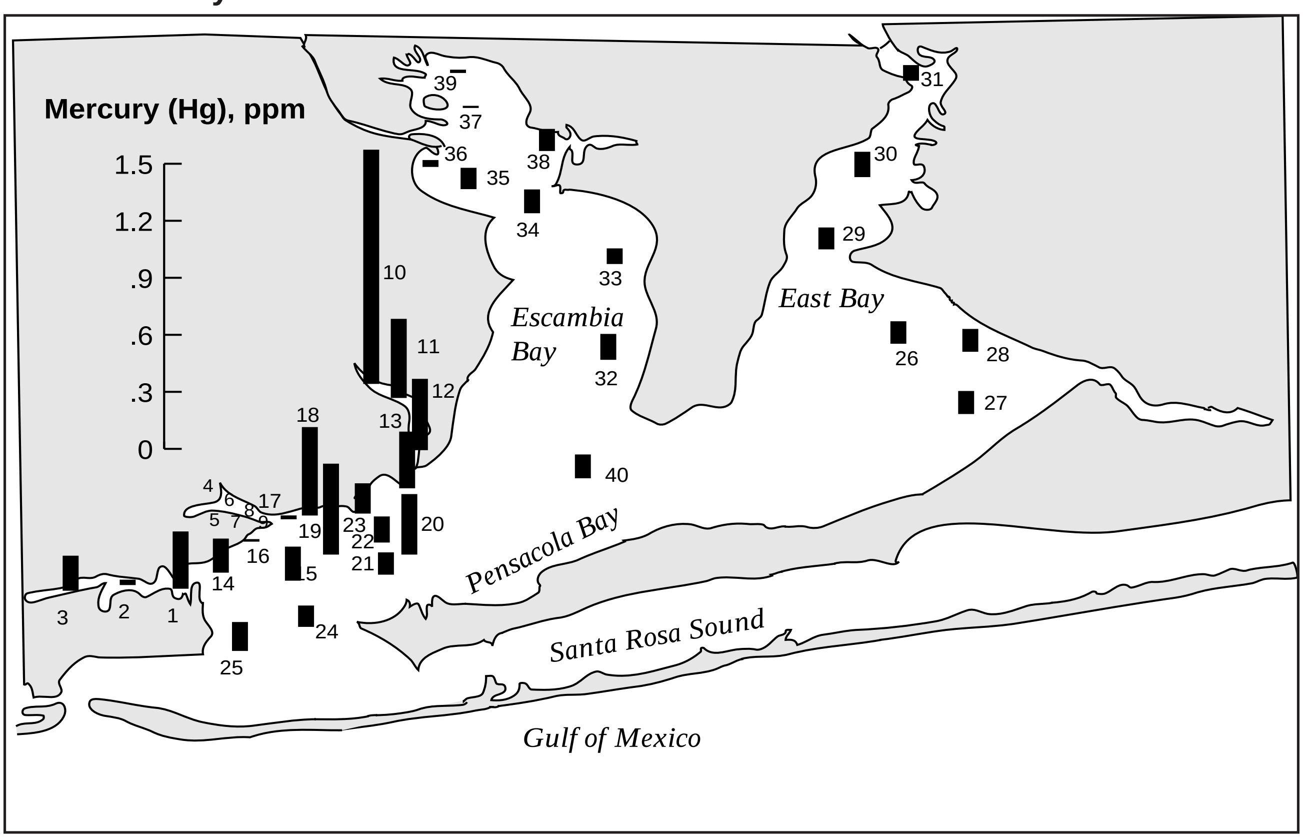
22. Maximum, mean and minimum mercury concentrations in western Florida bays.



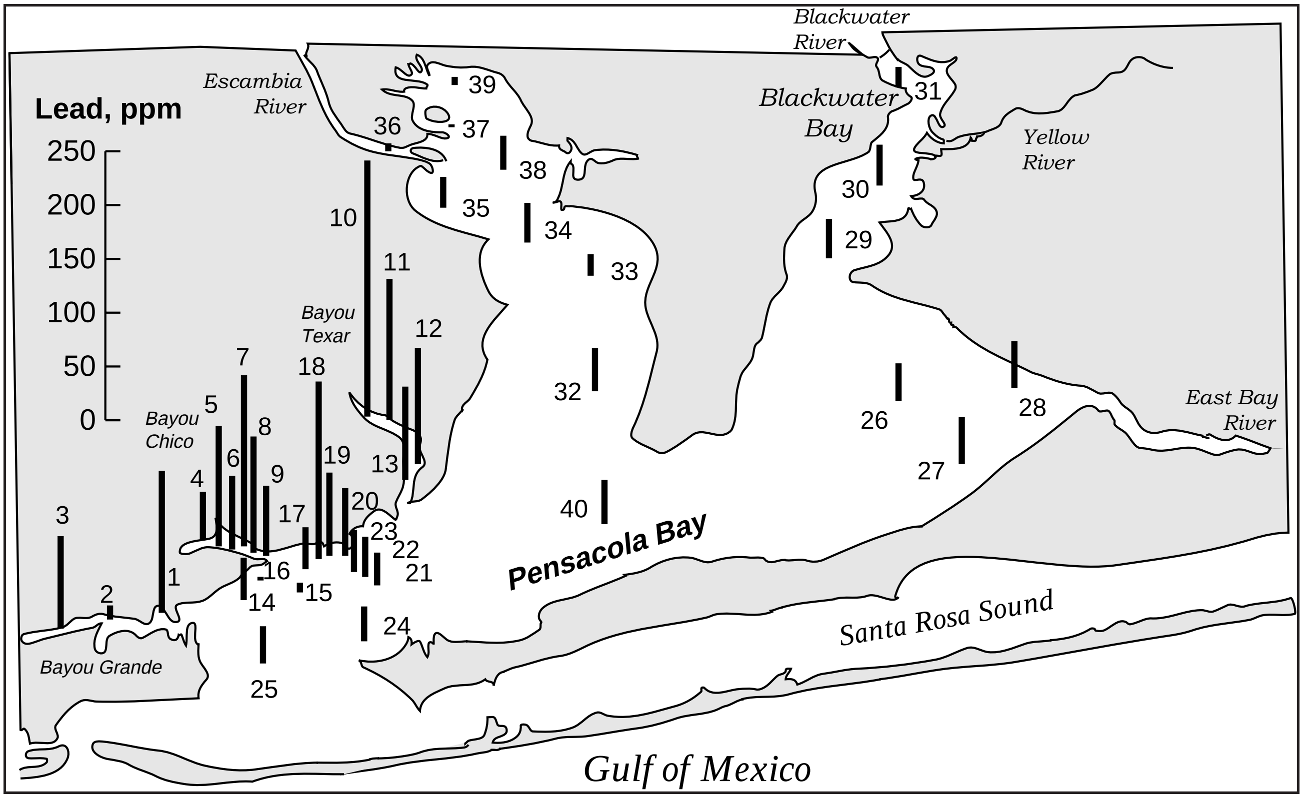
23. Distribution of total PAH concentrations among selected sampling stations in Pensacola Bay.



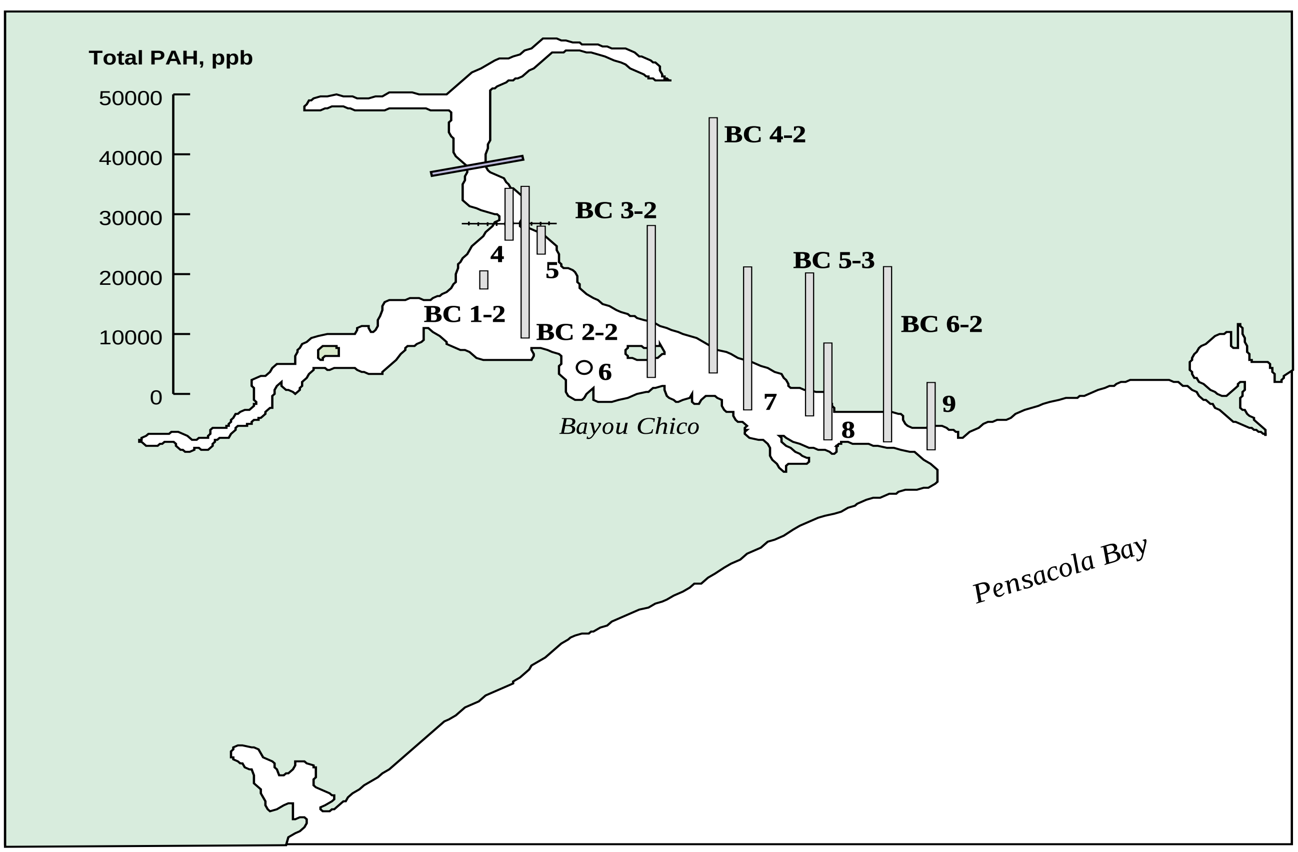
24. Distribution of total PCB concentrations among selected sampling stations in Pensacola Bay.



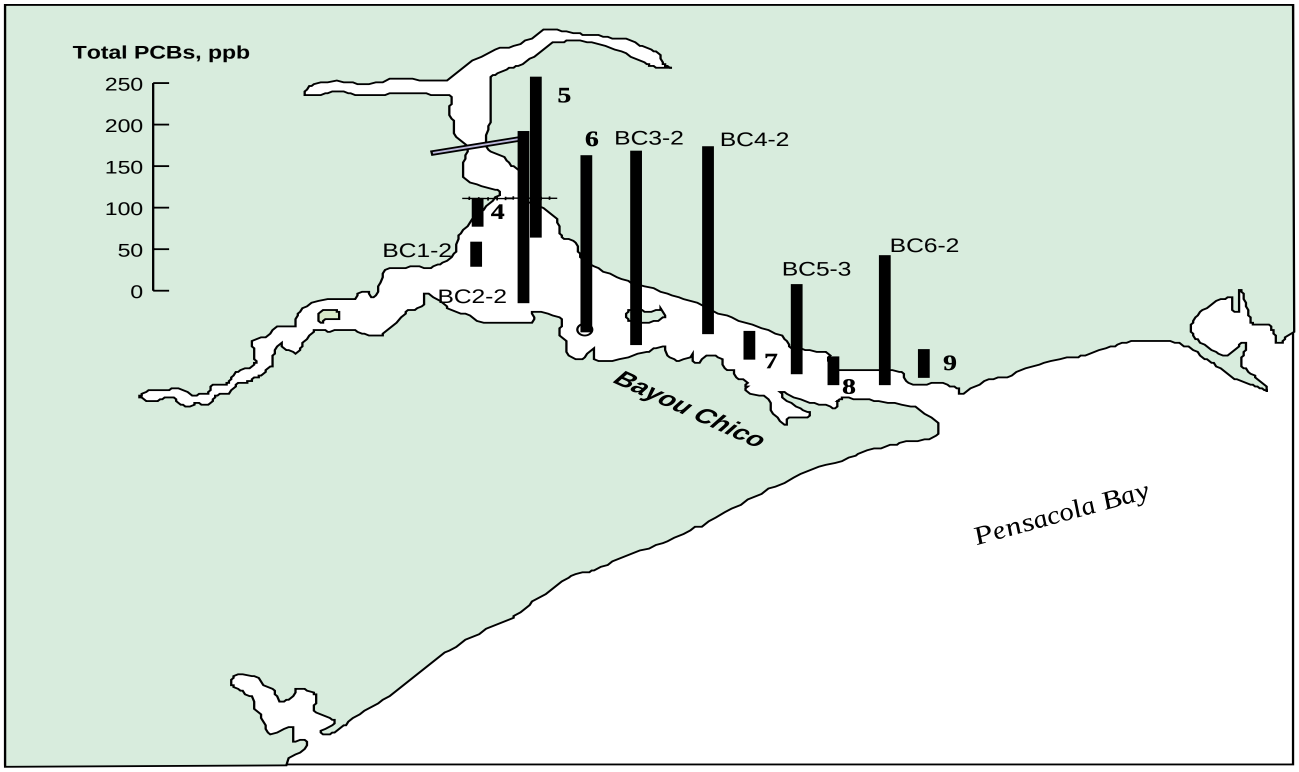
25. Distribution of mercury concentrations among selected sampling stations in Pensacola Bay.



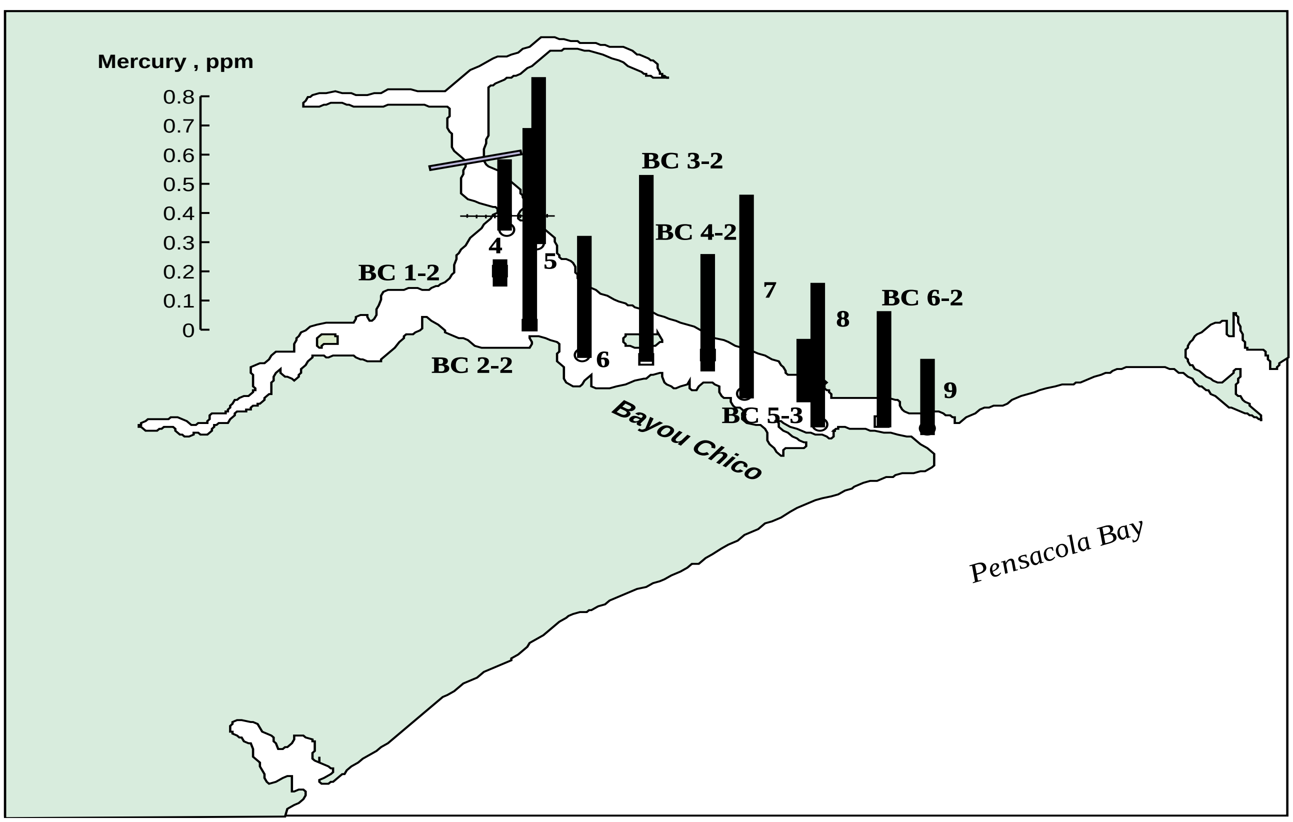
26. Distribution of lead concentrations among selected sampling stations in Pensacola Bay.



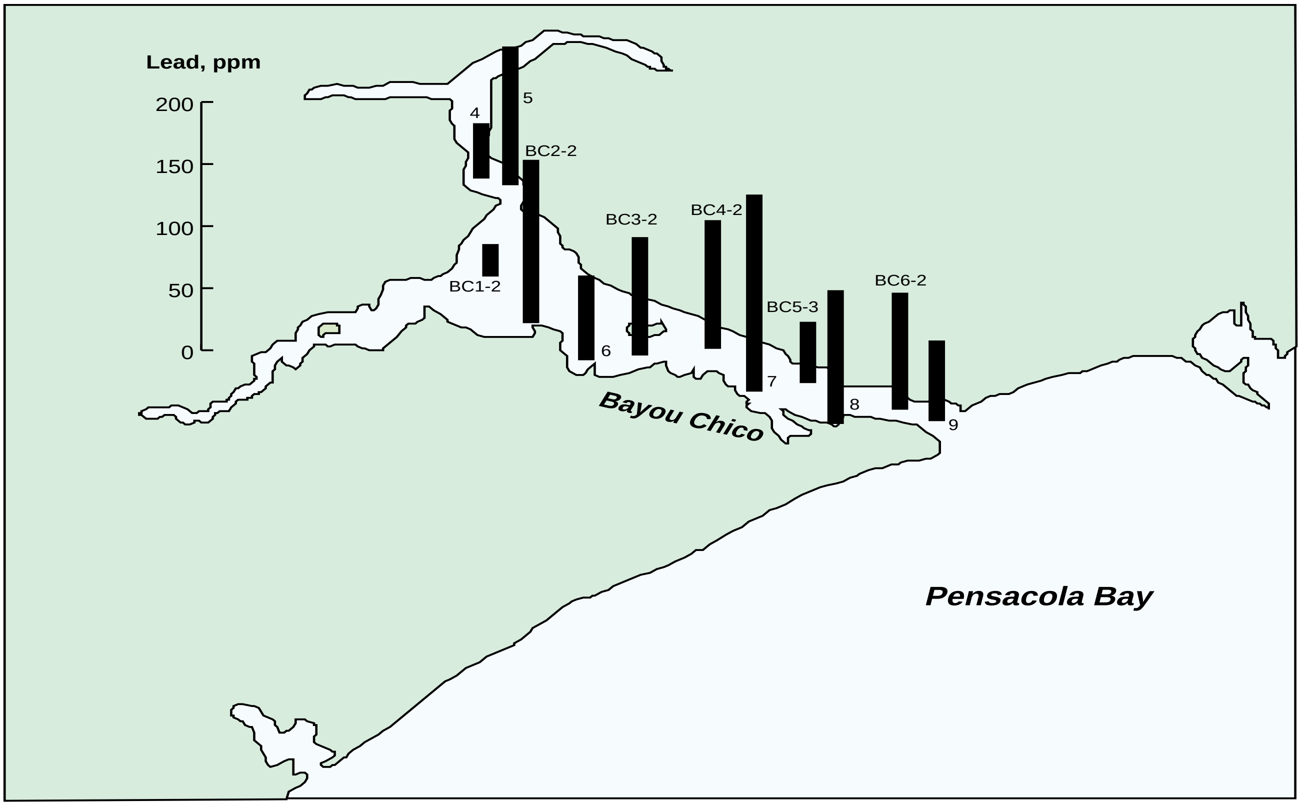
27. Distribution of total PAH concentrations among selected sampling stations in Bayou Chico.



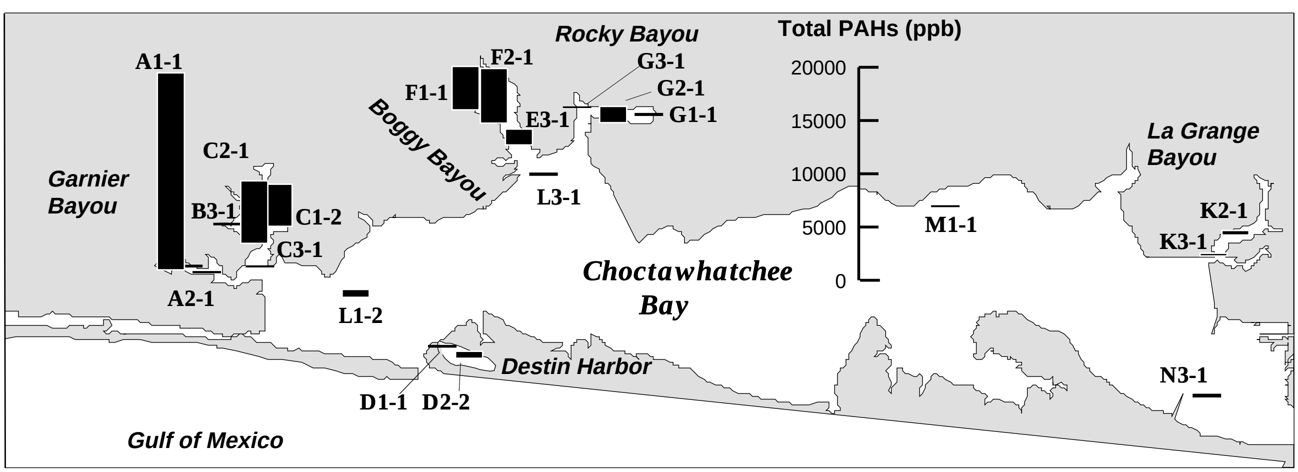
28. Distribution of total PCB concentrations among selected sampling stations in Bayou Chico.



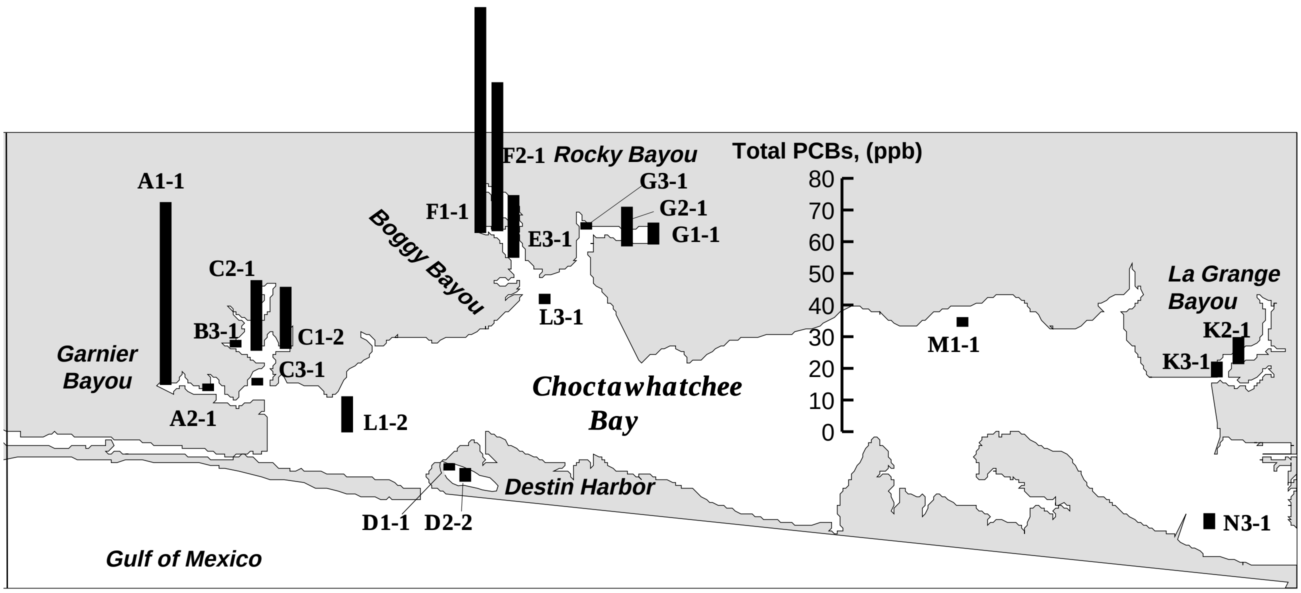
29. Distribution of mercury concentrations among selected sampling stations in Bayou Chico.



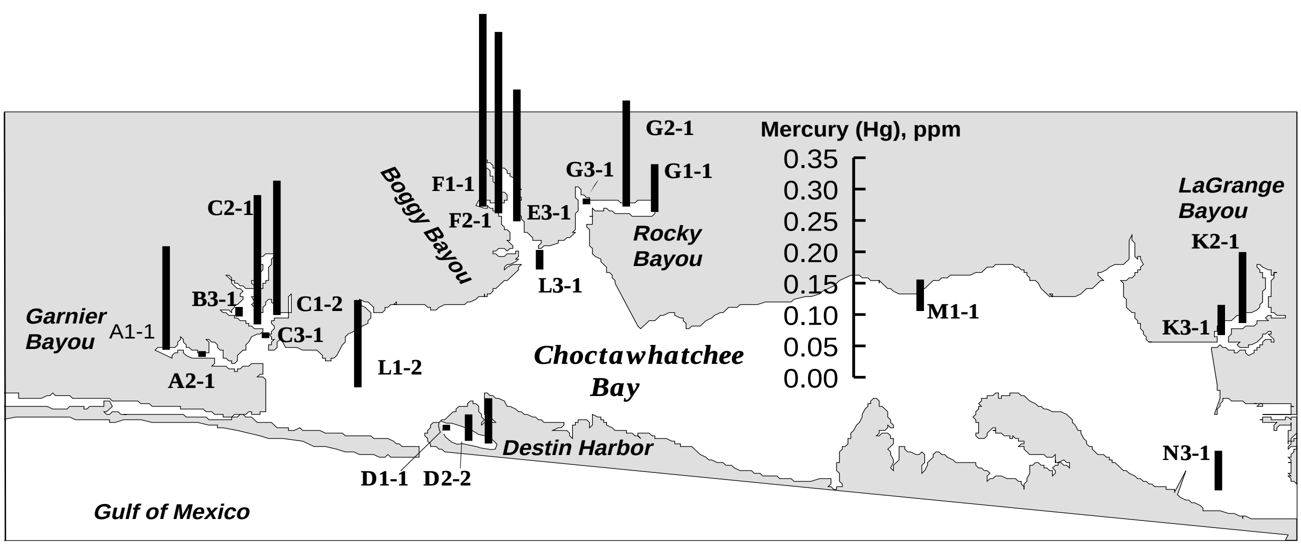
30. Distribution of lead concentrations among selected sampling stations in Bayou Chico.



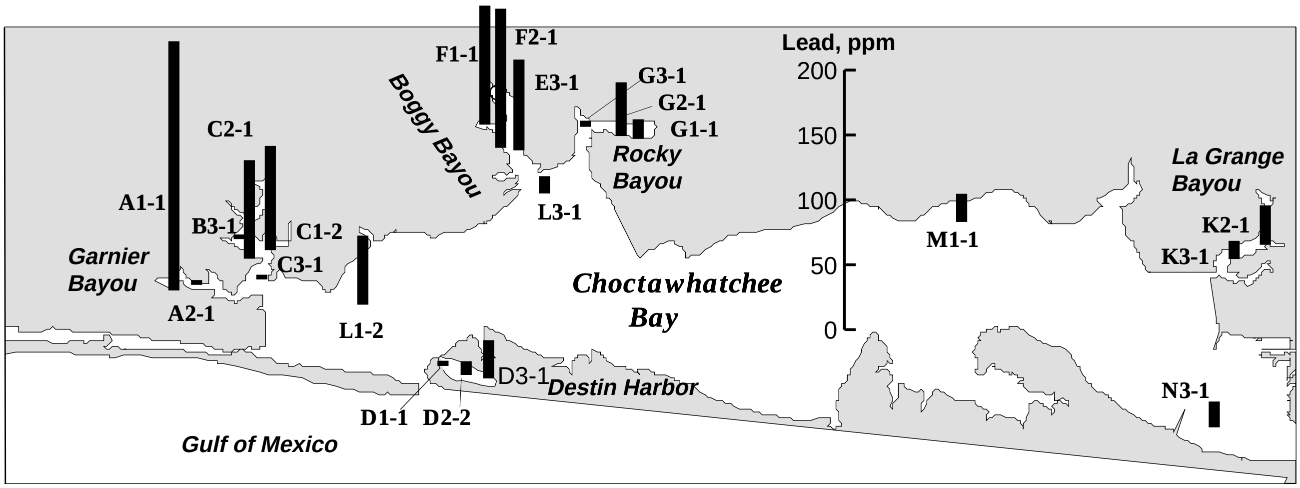
31. Distribution of total PAH concentrations among selected sampling stations in Choctawhatchee Bay.



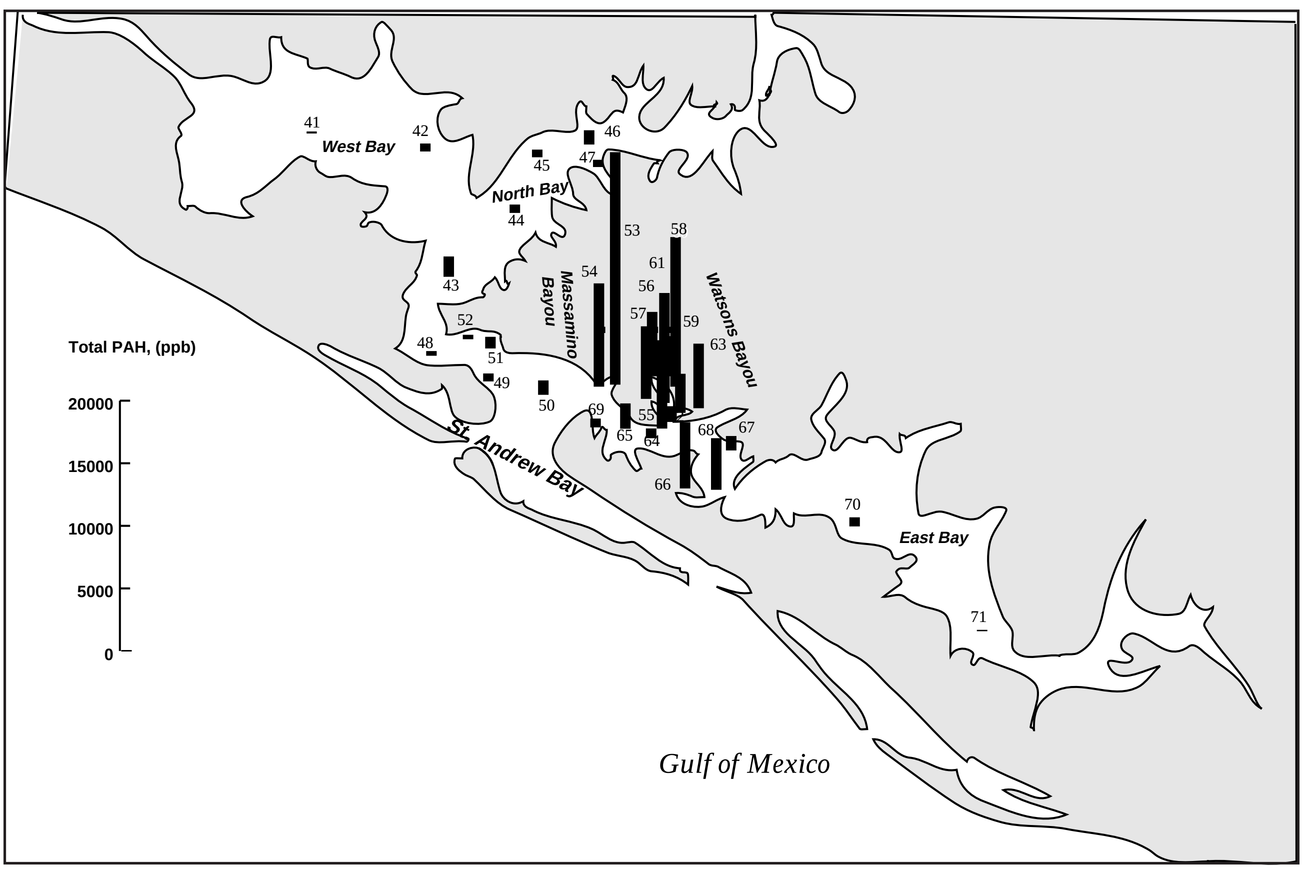
32. Distribution of total PCB concentrations among selected sampling stations in Choctawhatchee Bay.



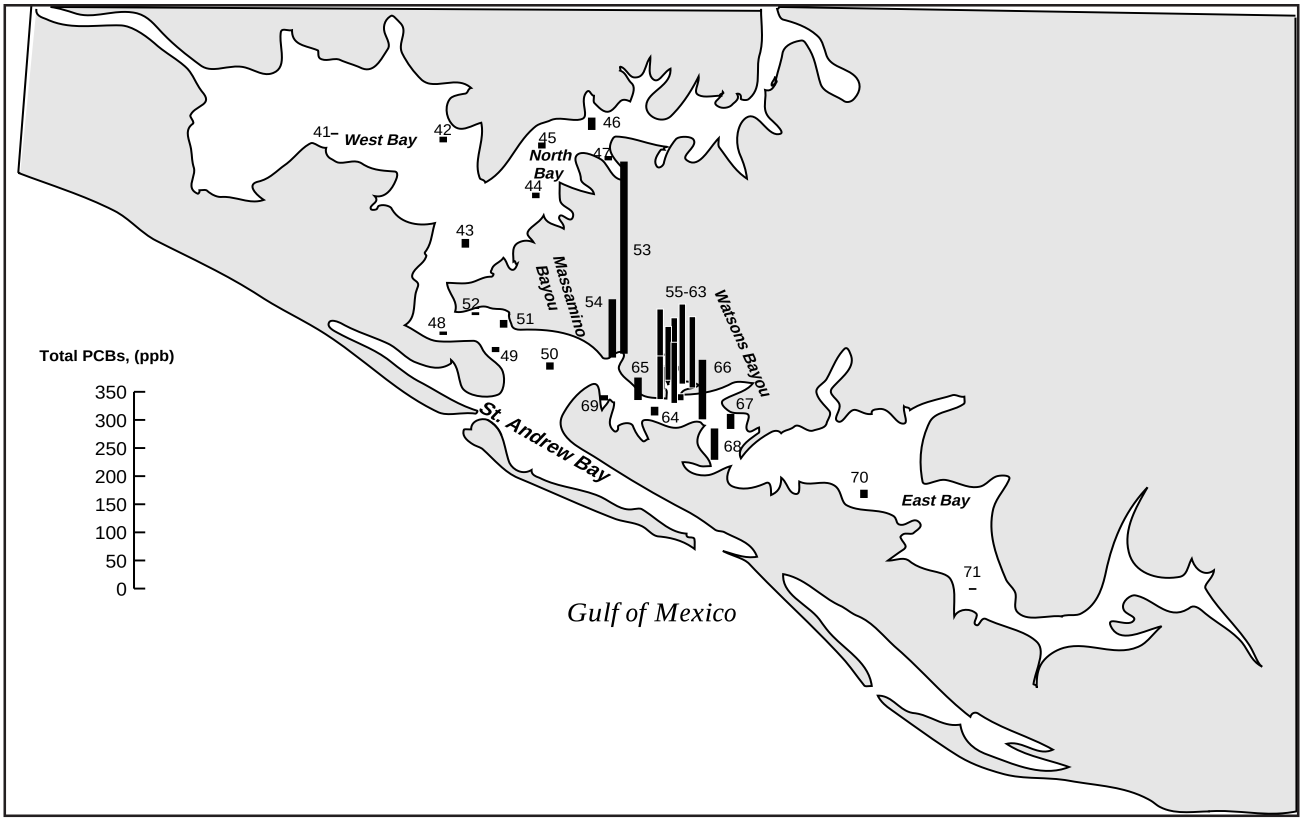
33. Distribution of mercury concentrations among selected sampling stations in Choctawhatchee Bay.



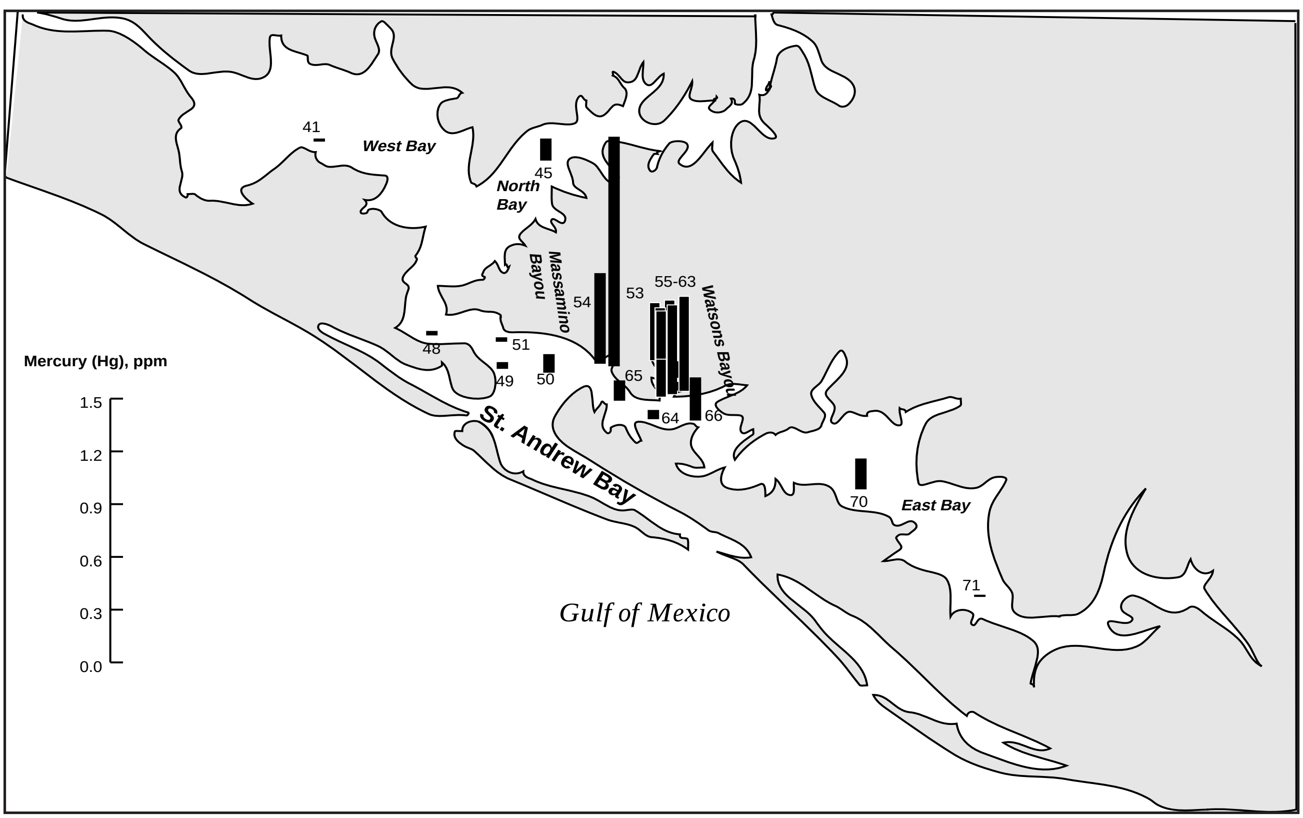
34. Distribution of lead concentrations among selected sampling stations in Choctawhatchee Bay.



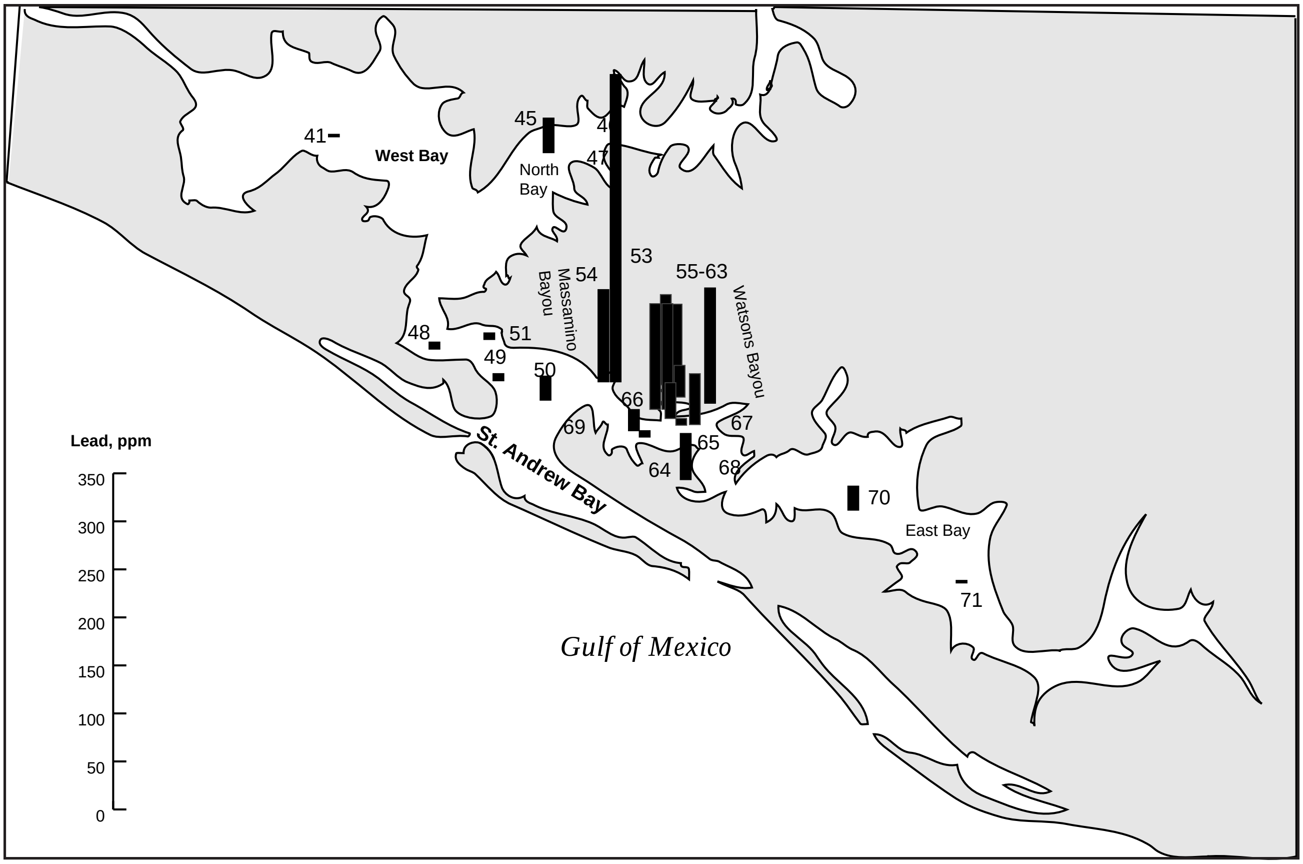
35. Distribution of total PAH concentrations among selected sampling stations in St. Andrew Bay.



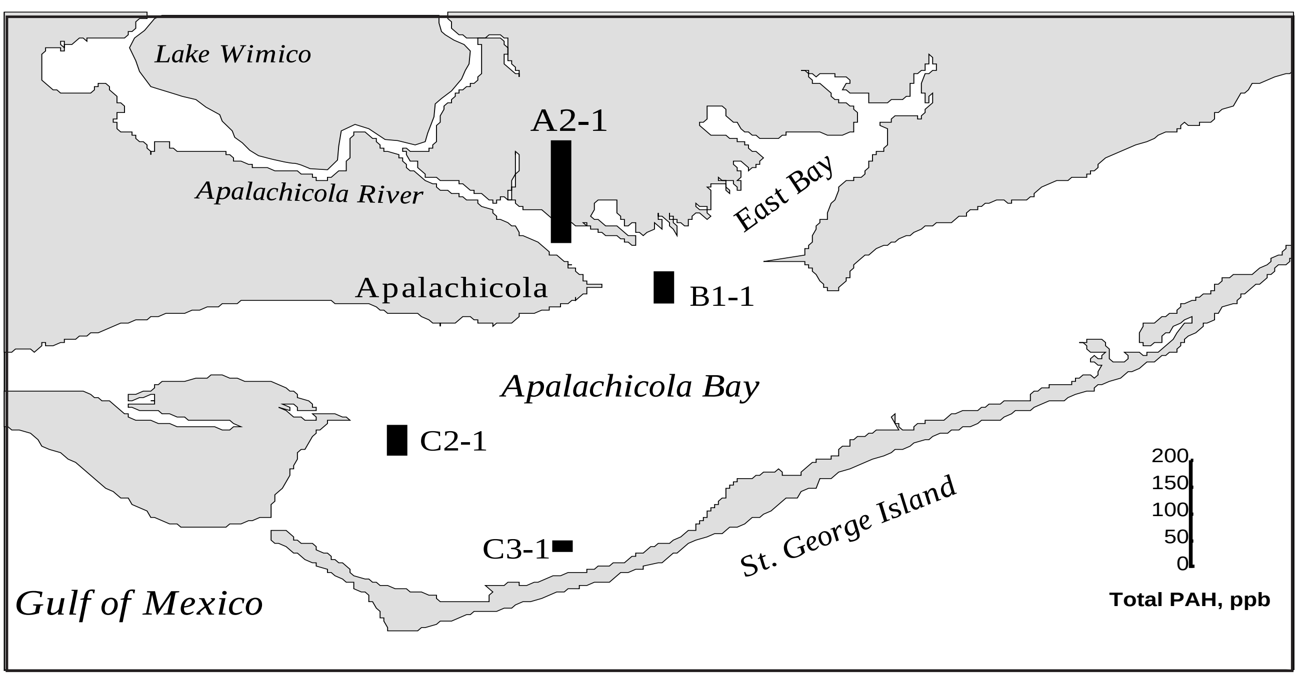
36. Distribution of total PCB concentrations among selected sampling stations in St. Andrew Bay.



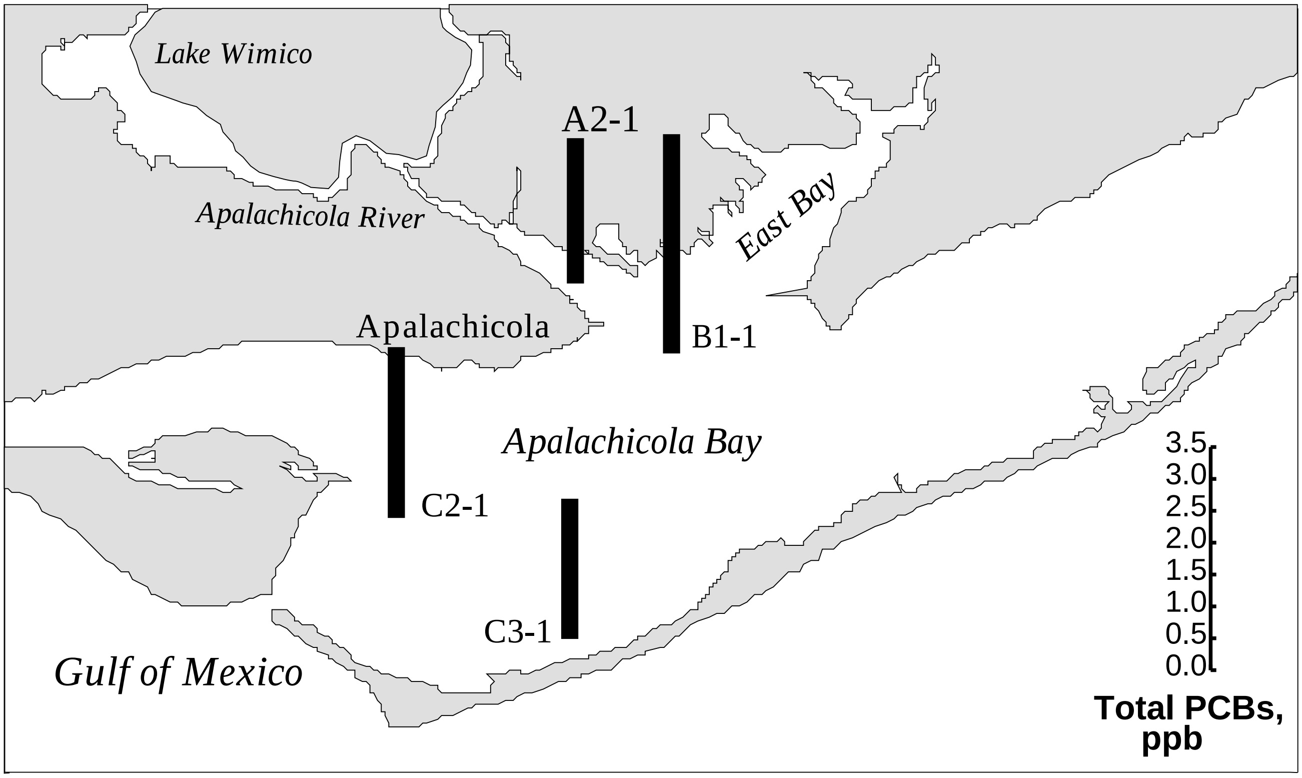
37. Distribution of mercury concentrations among selected sampling stations in St. Andrew Bay.



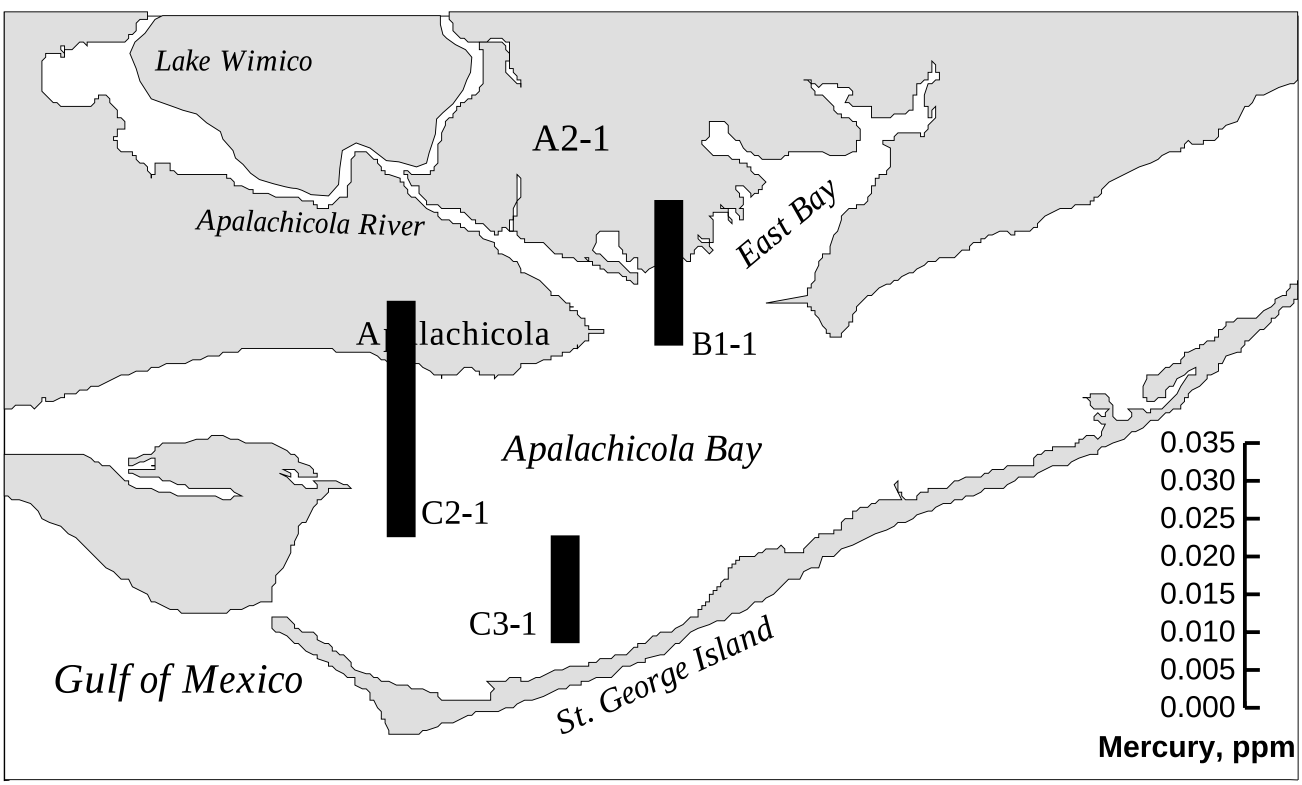
38. Distribution of lead concentrations among selected sampling stations in St. Andrew Bay.



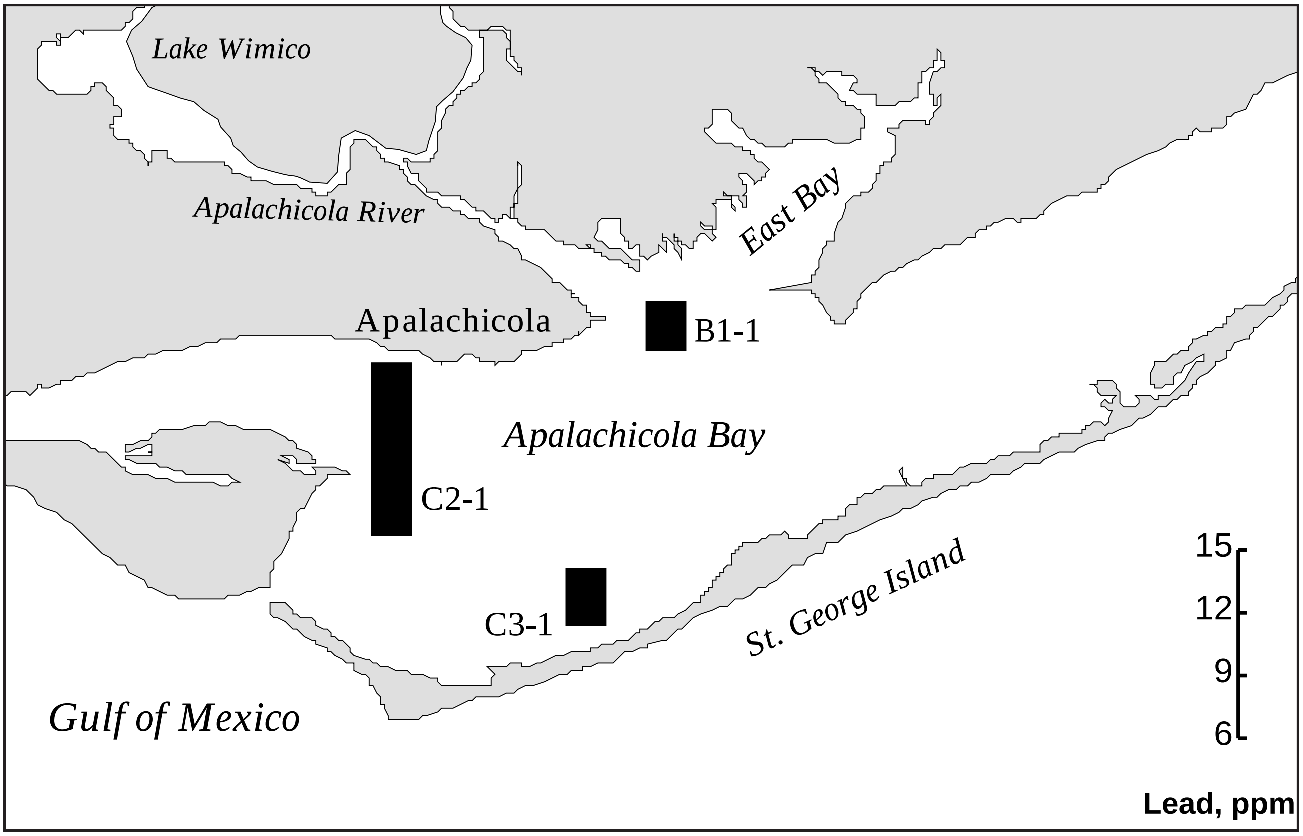
39. Distribution of total PAH concentrations among selected sampling stations in Apalachicola Bay.



40. Distribution of total PCB concentrations among selected sampling stations in Apalachicola Bay.



41. Distribution of mercury concentrations among selected sampling stations in Apalachicola Bay.



42. Distribution of lead concentrations among selected sampling stations in Apalachicola Bay.

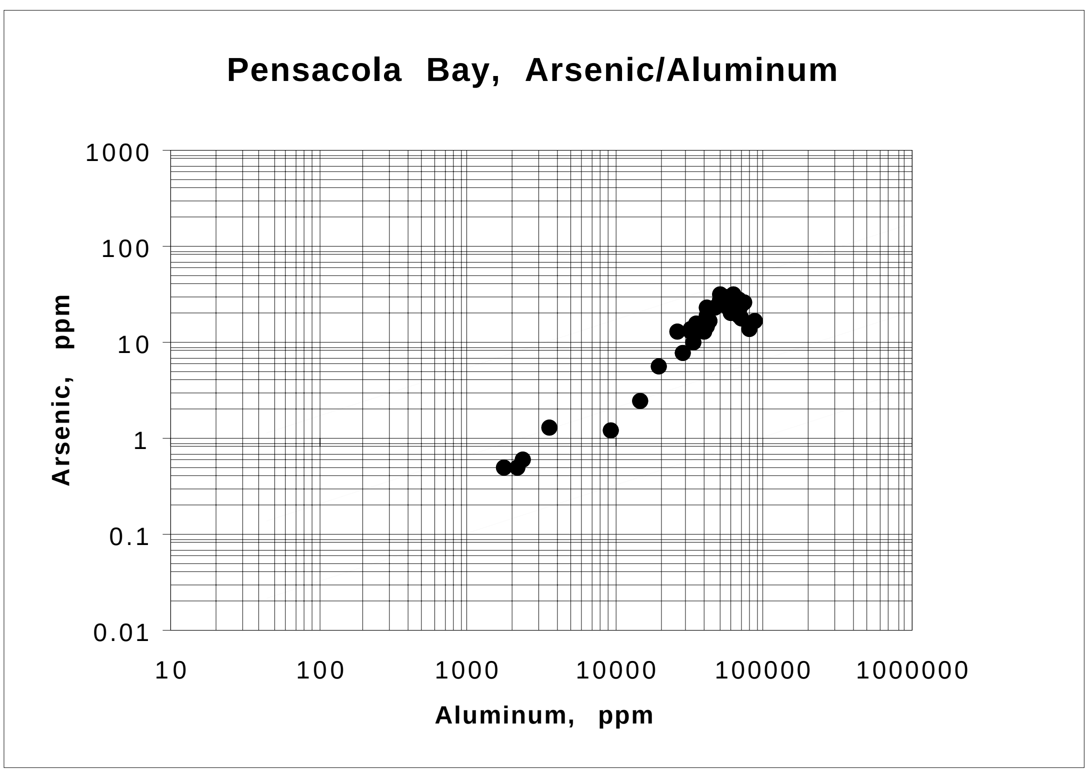


Figure 43a. Relationship between arsenic and aluminum in 1993 Pensacola Bay samples.

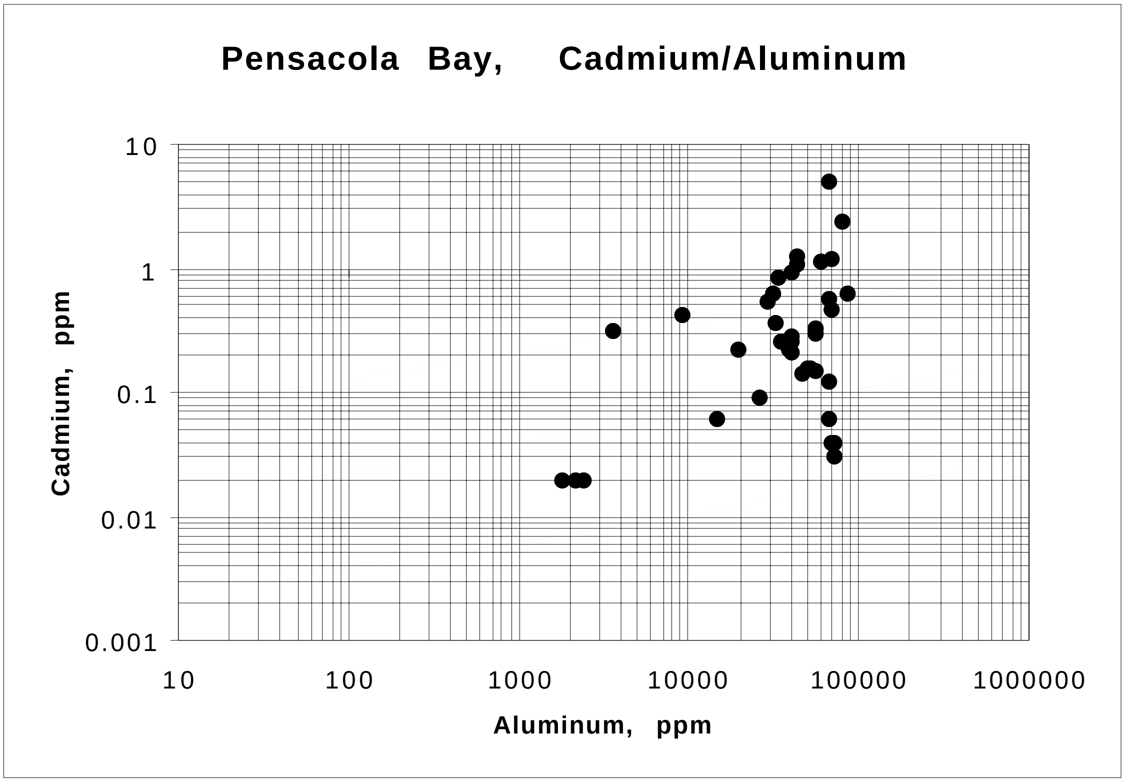


Figure 43b. Relationship between cadmium and aluminum in 1993 Pensacola Bay samples.

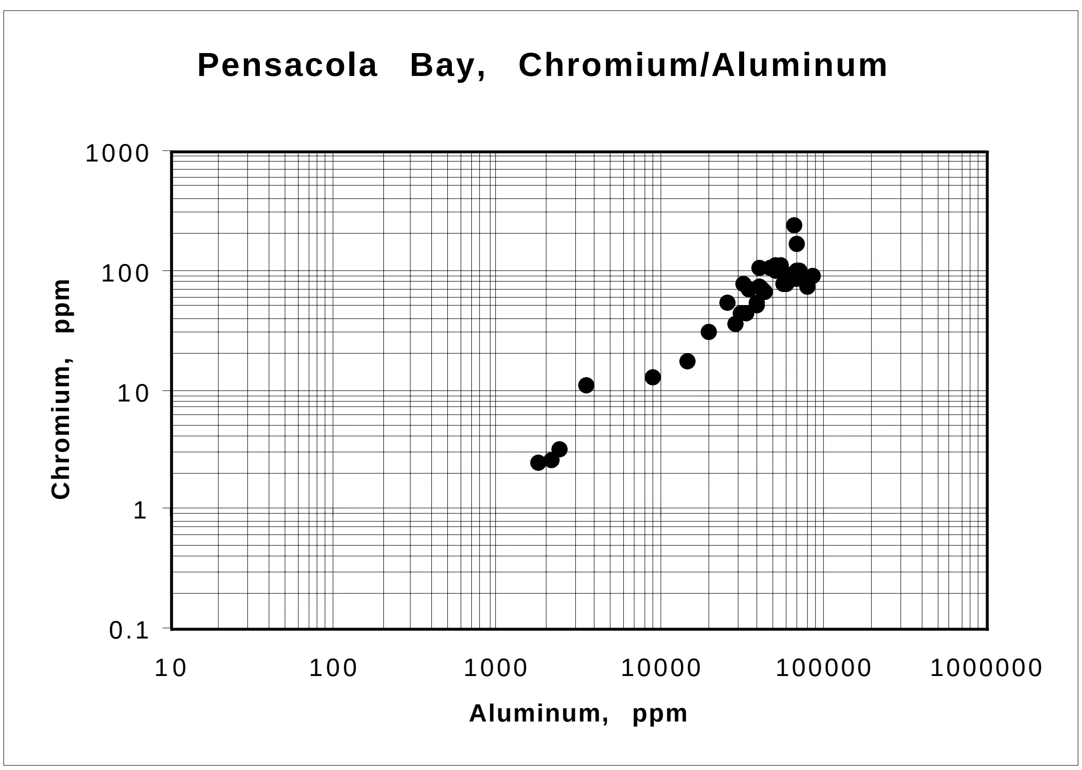


Figure 43c. Relationship between chromium and aluminum in 1993 Pensacola Bay samples.

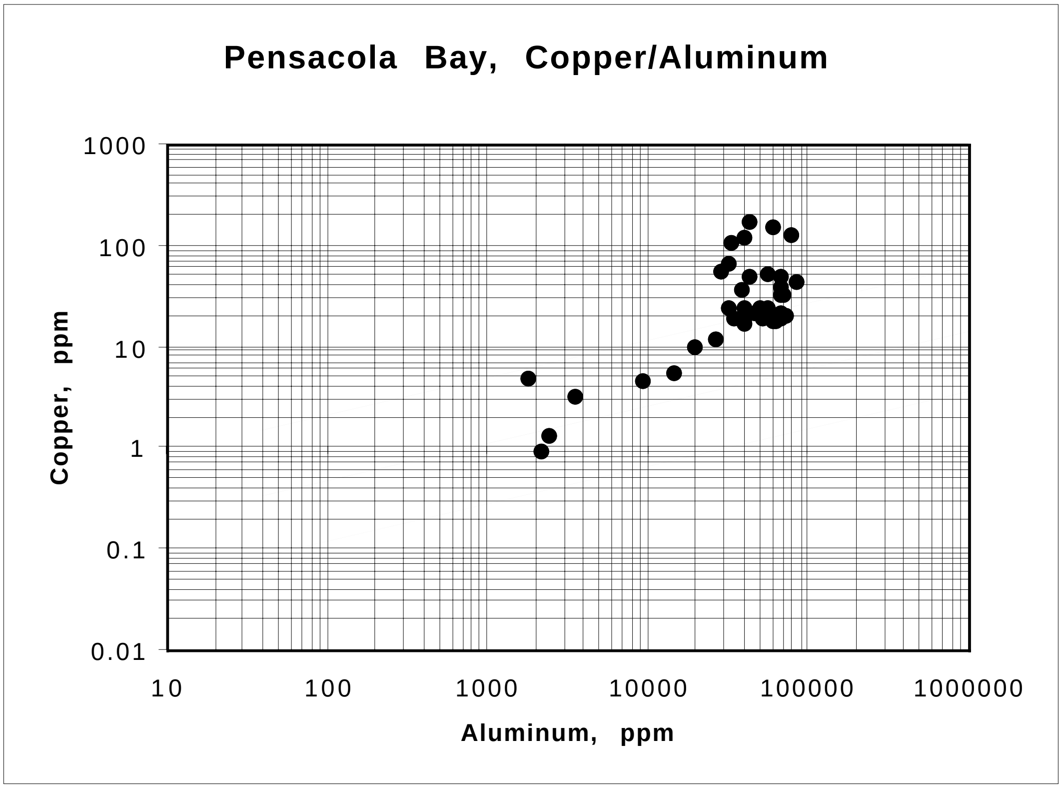


Figure 43d. Relationship between copper and aluminum in 1993 Pensacola Bay samples.

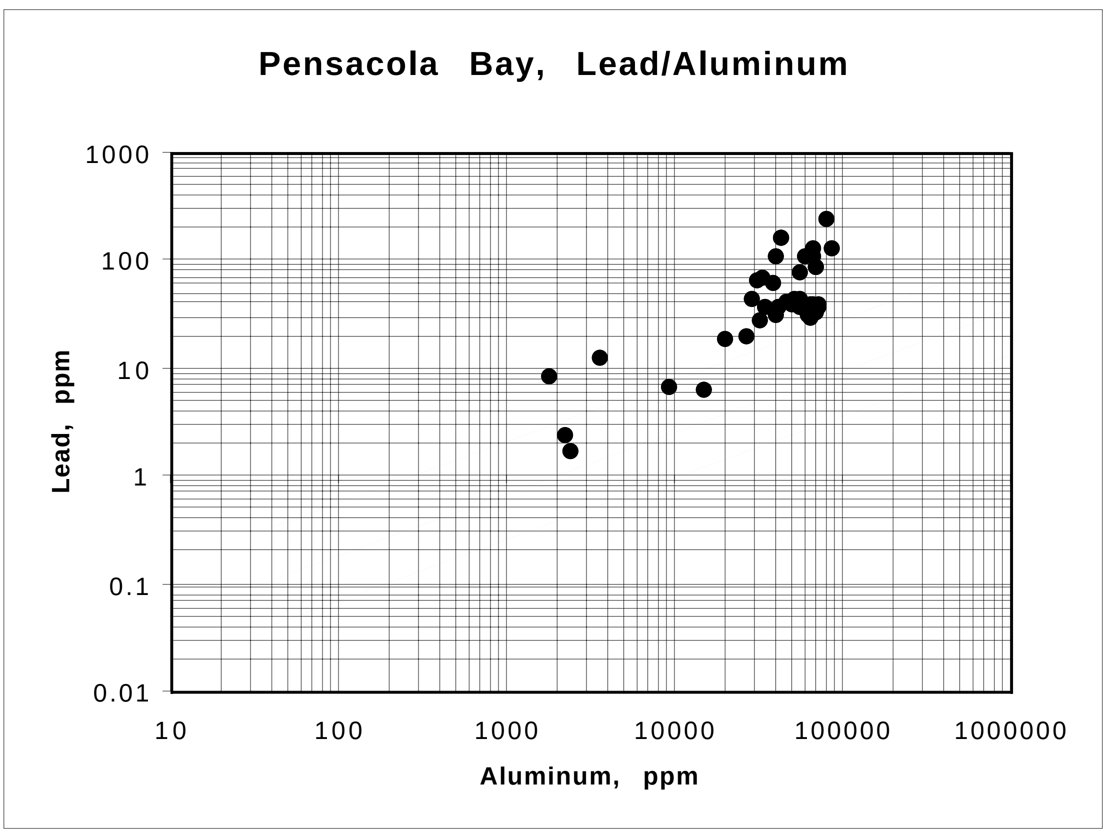


Figure 43e. Relationship between lead and aluminum in 1993 Pensacola Bay samples.

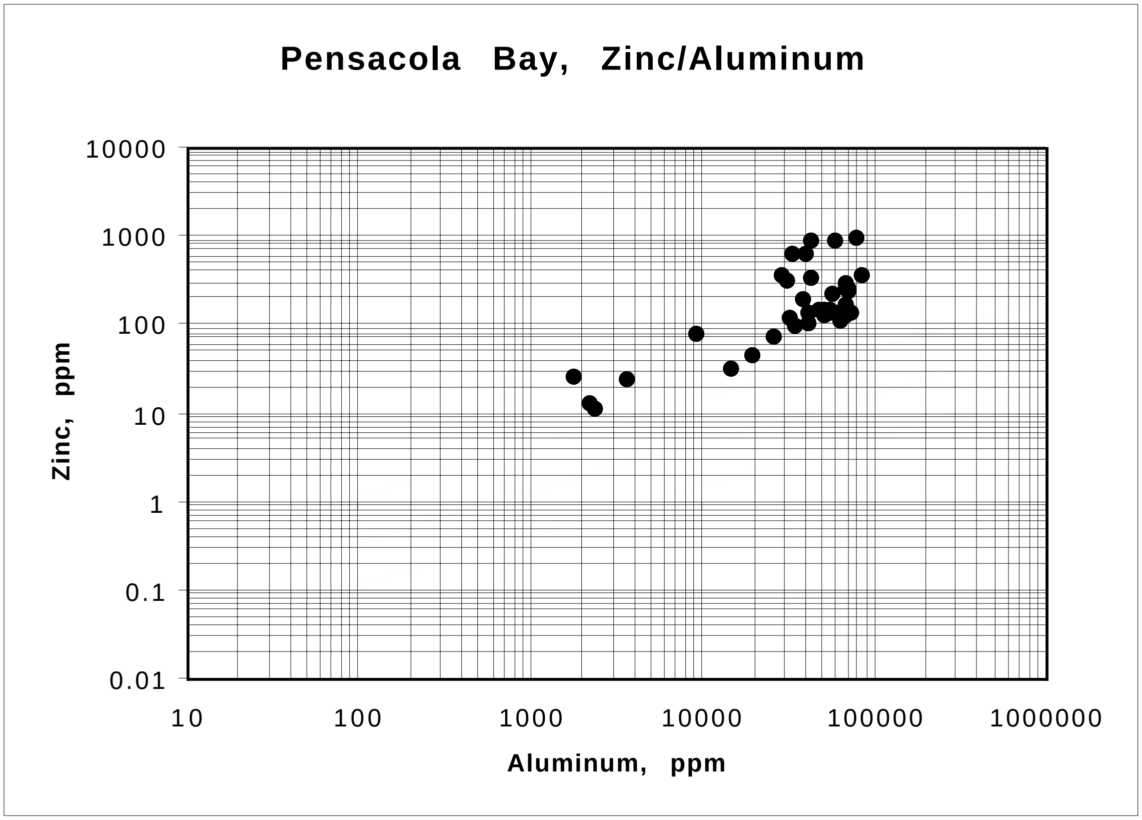


Figure 43f. Relationship between zinc and aluminum in 1993 Pensacola Bay samples.

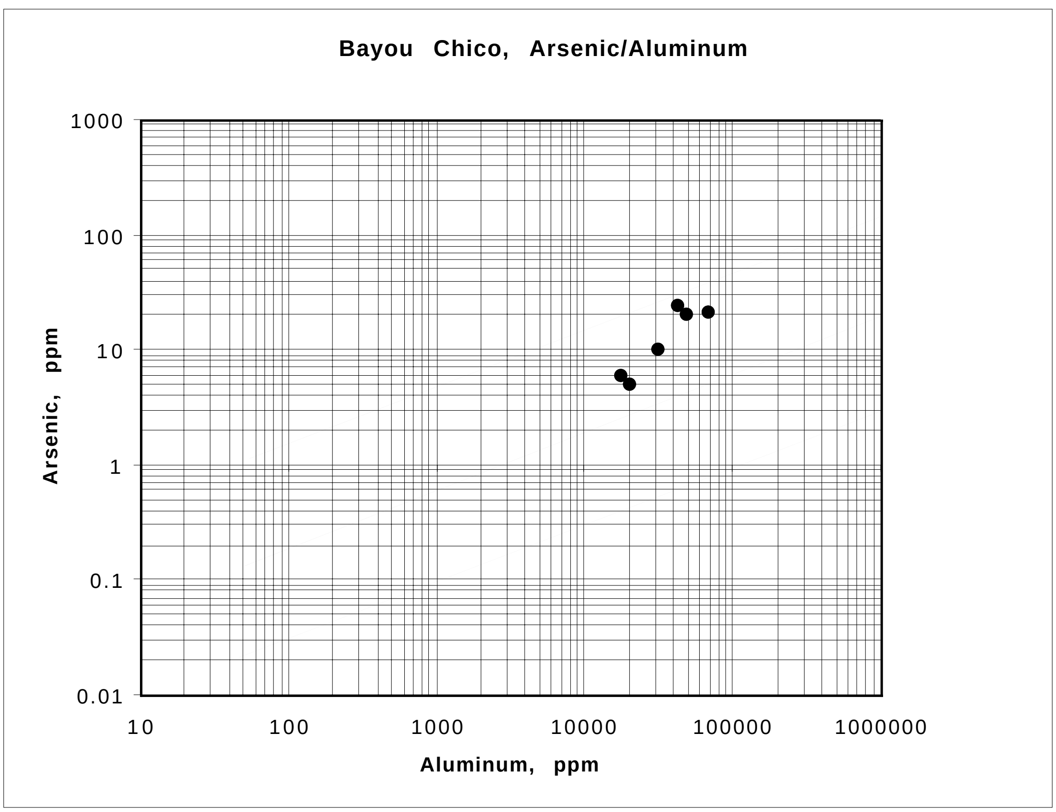


Figure 44a. Relationship between arsenic and aluminum in 1994 Bayou Chico samples.

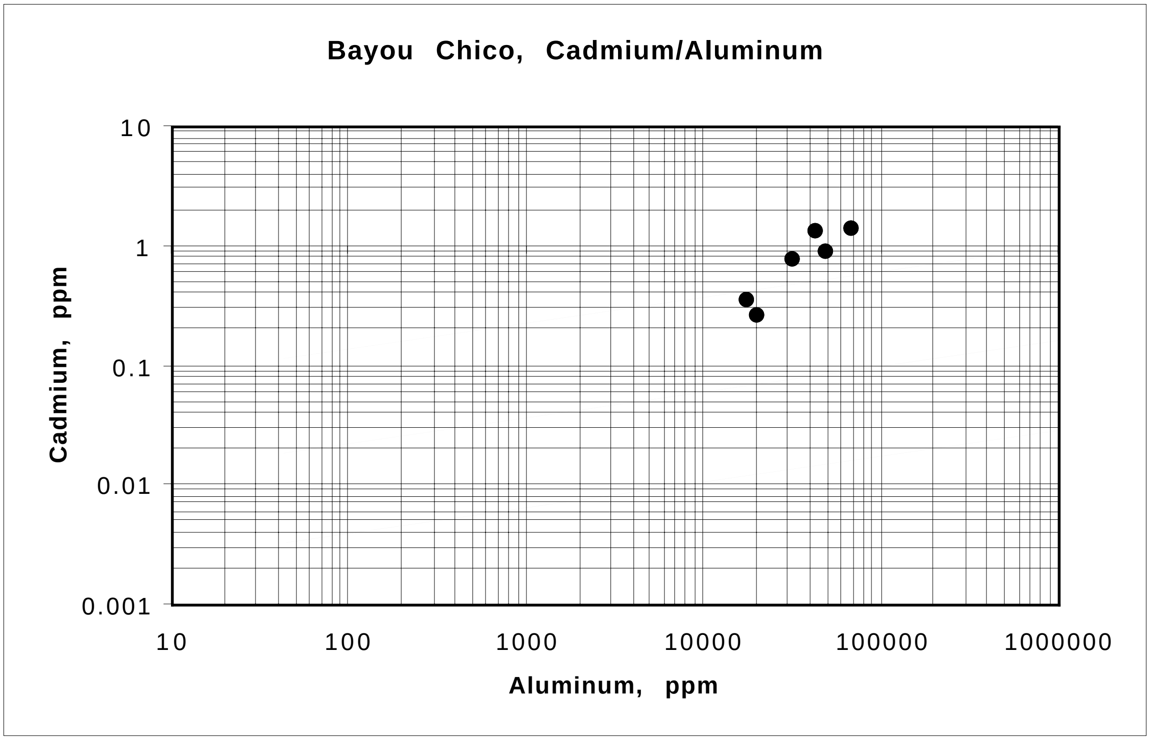


Figure 44b. Relationship between cadmium and aluminum in 1994 Bayou Chico samples.

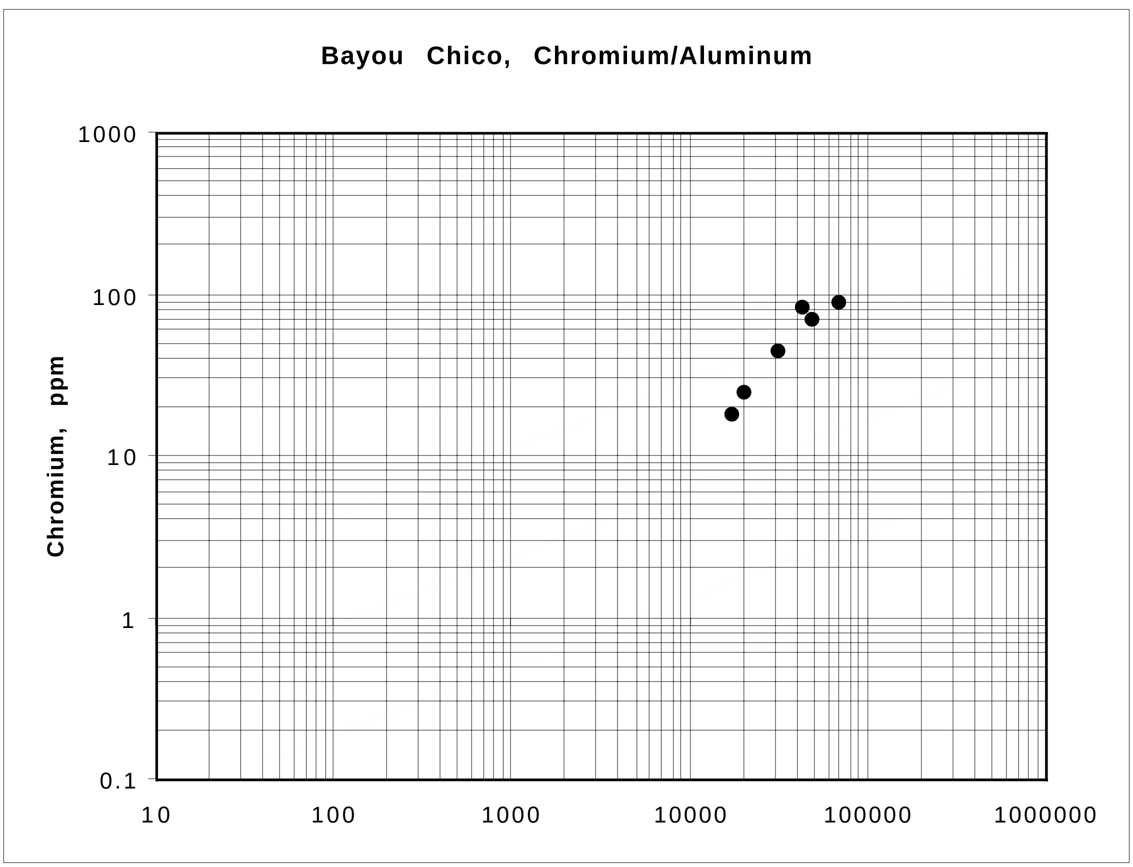


Figure 44c. Relationship between chromium and aluminum in 1994 Bayou Chico samples.

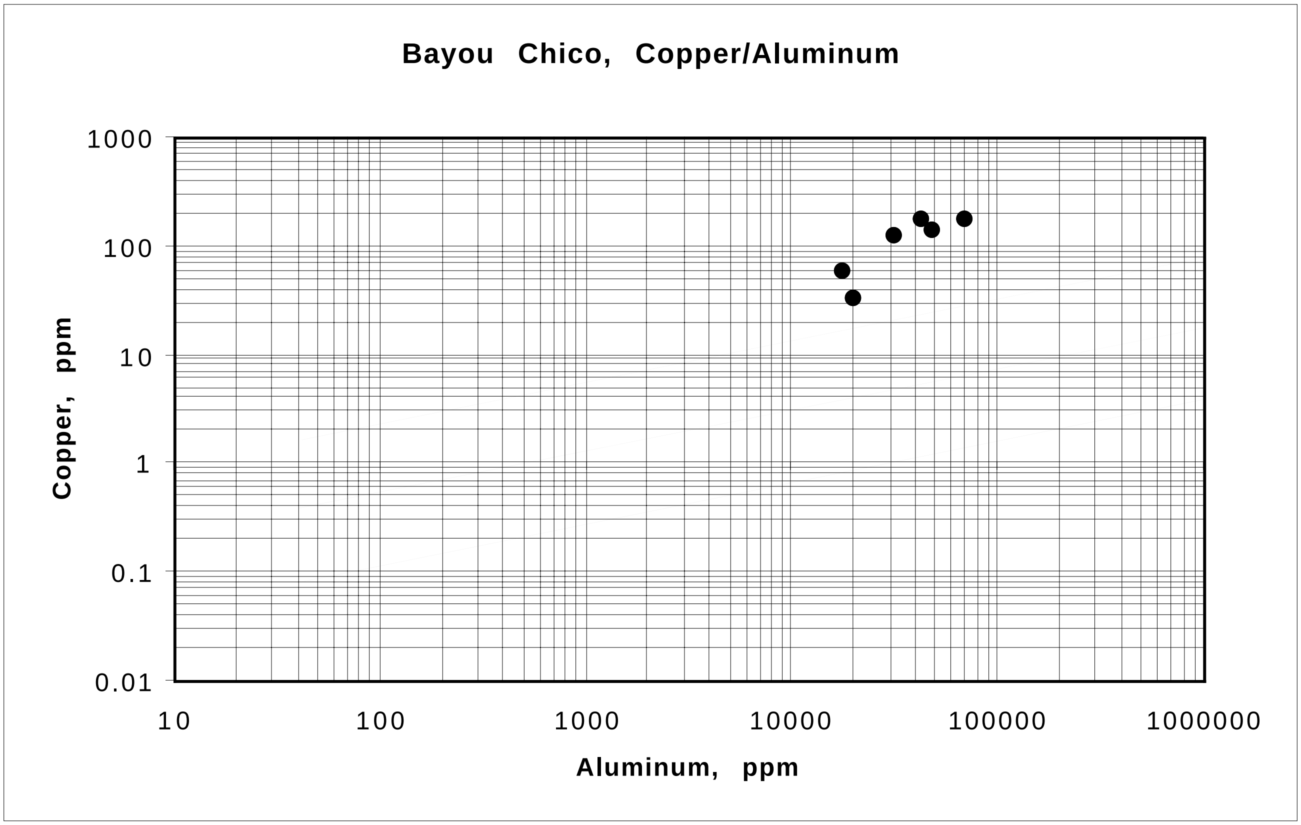


Figure 44d. Relationship between copper and aluminum in 1994 Bayou Chico samples.

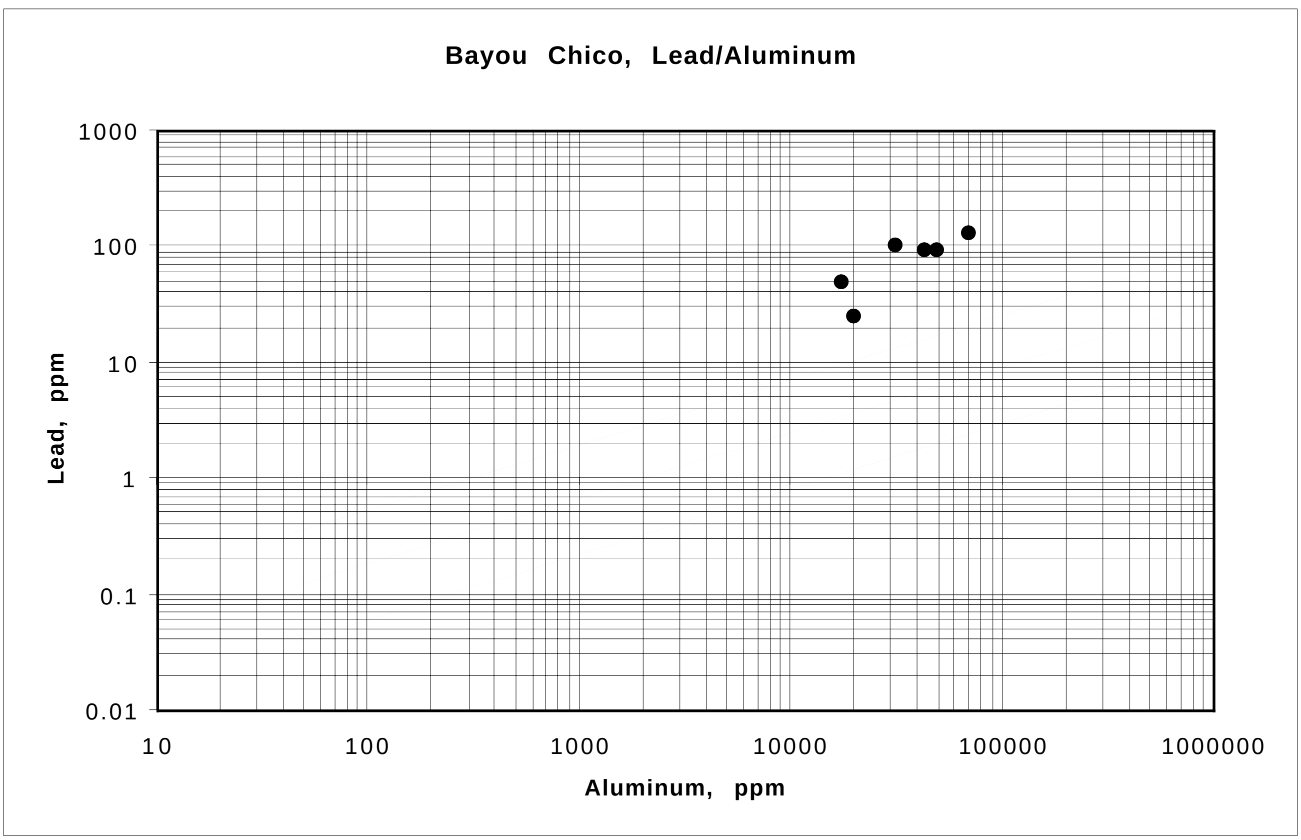


Figure 44e. Relationship between lead and aluminum in 1994 Bayou Chico samples.

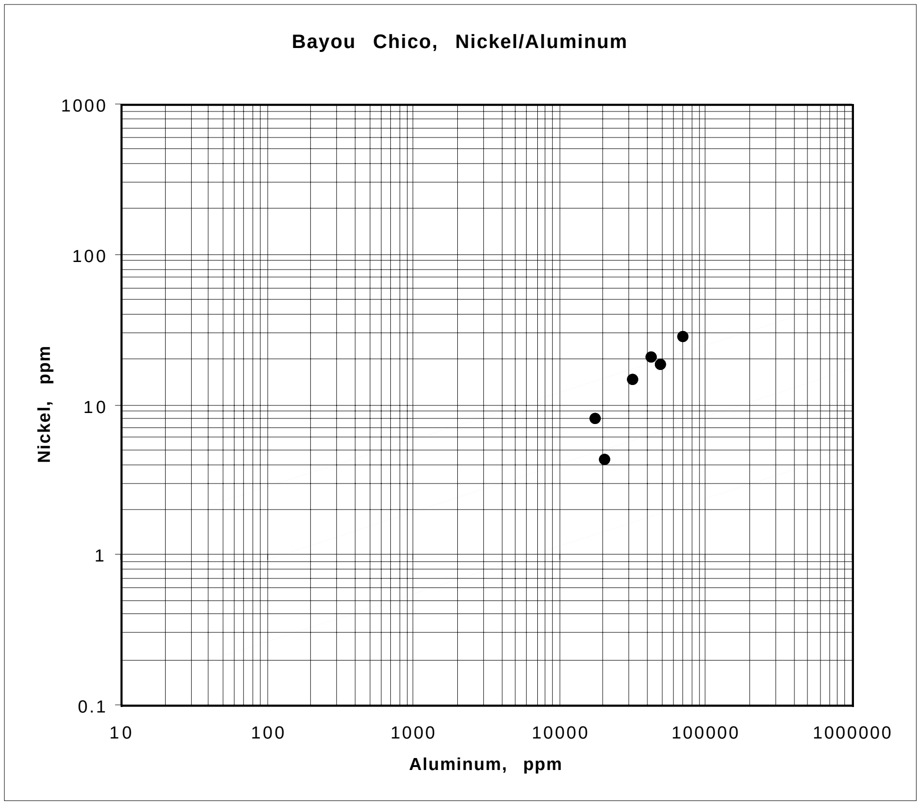


Figure 44f. Relationship between nickel and aluminum in 1994 Bayou Chico samples.

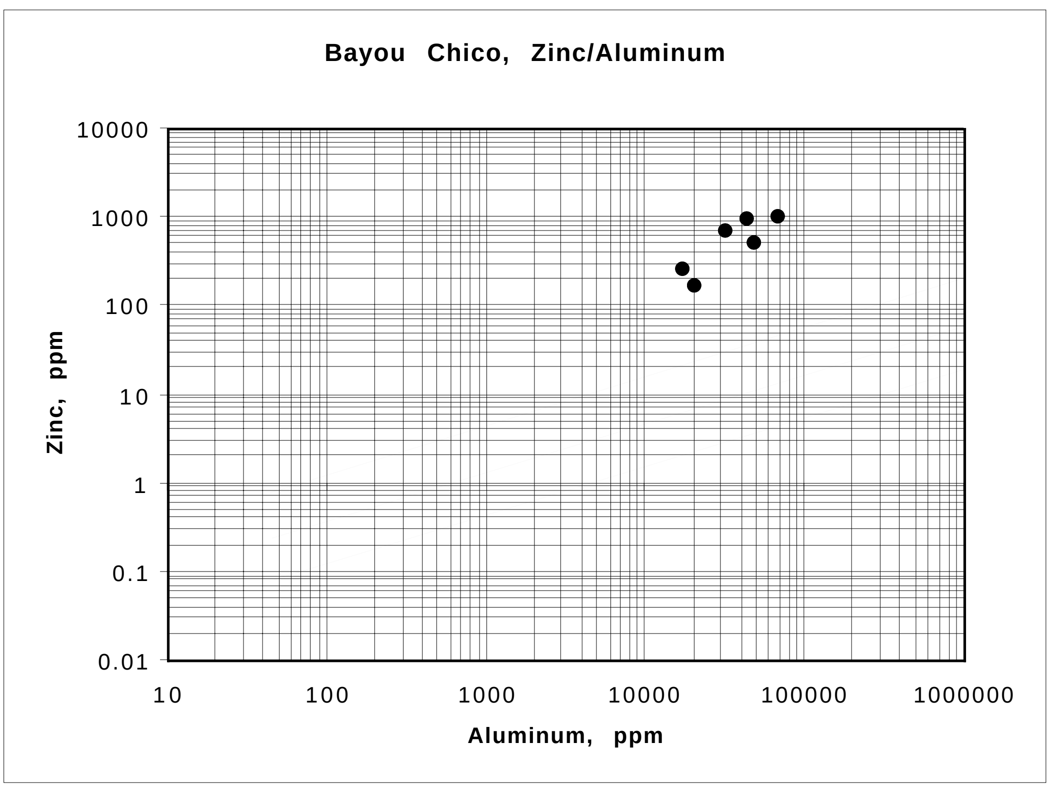


Figure 44g. Relationship between zinc and aluminum in 1994 Bayou Chico samples.

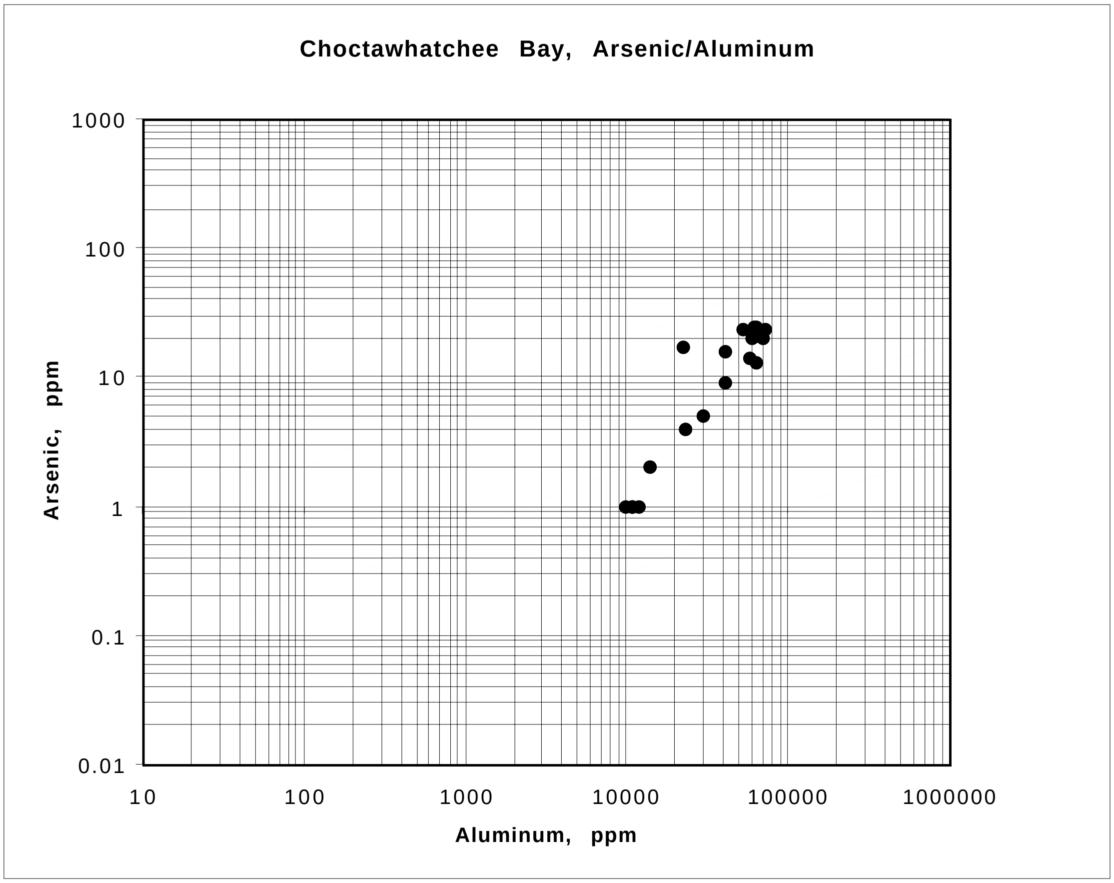


Figure 45a. Relationship between arsenic and aluminum in Choctawhatchee Bay samples.

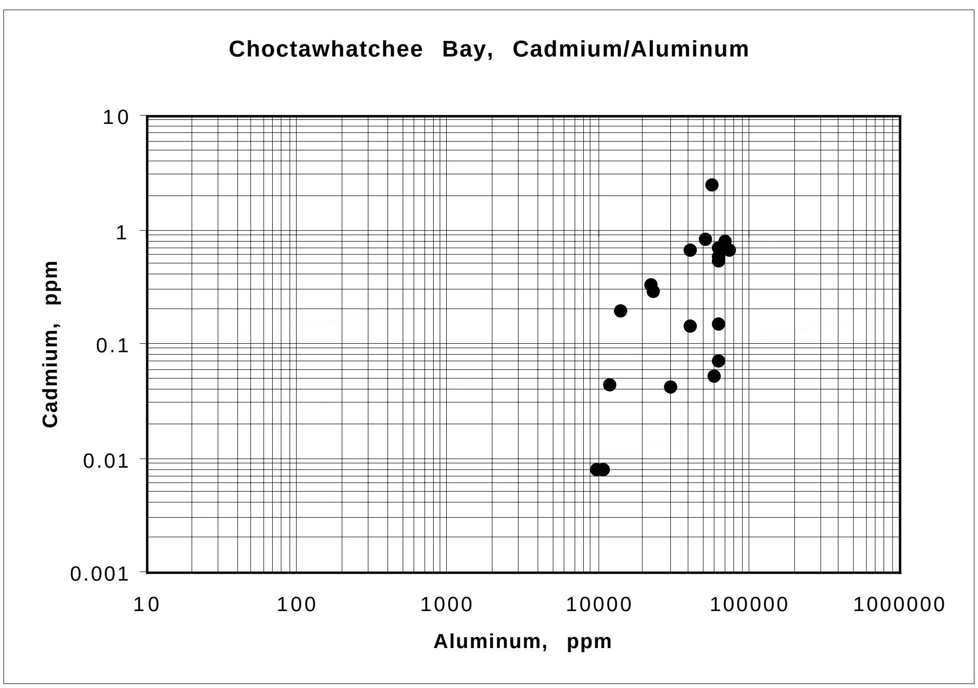


Figure 45b. Relationship between cadmium and aluminum in Choctawhatchee Bay samples.

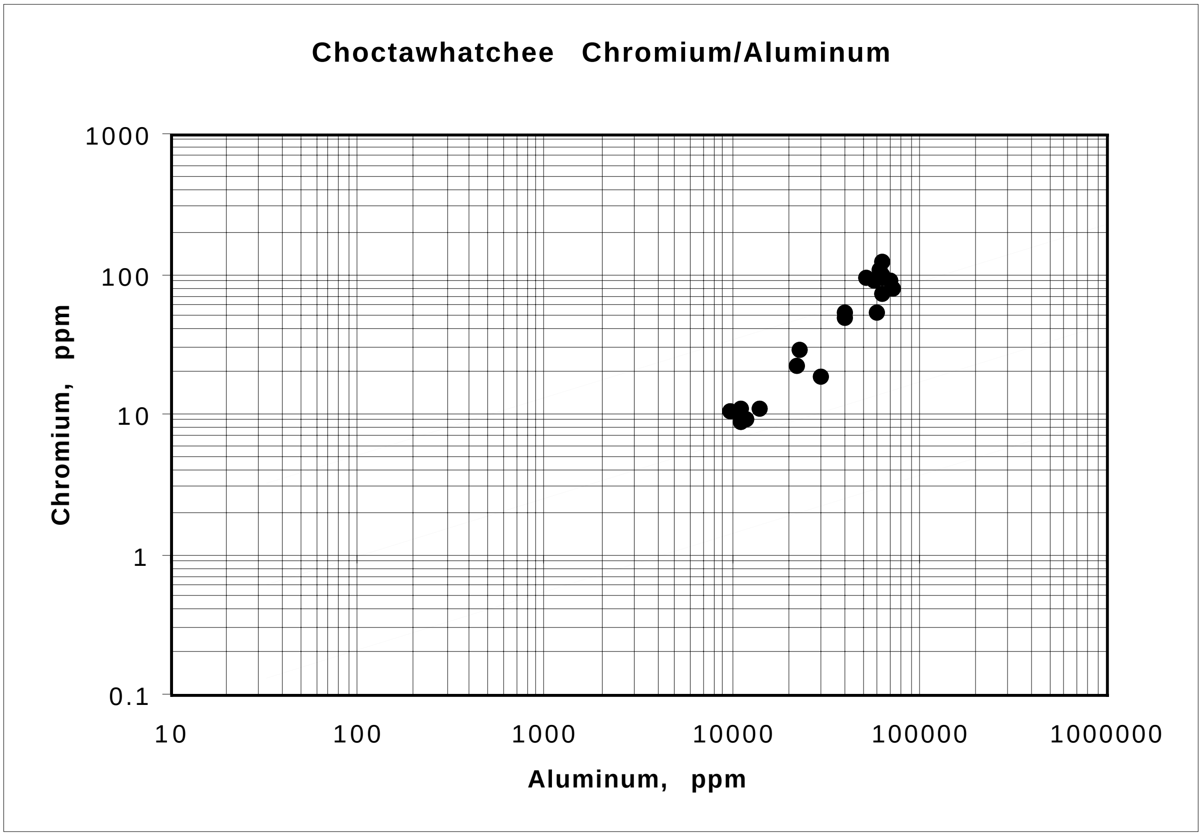


Figure 45c. Relationship between chromium and aluminum in Choctawhatchee Bay samples.

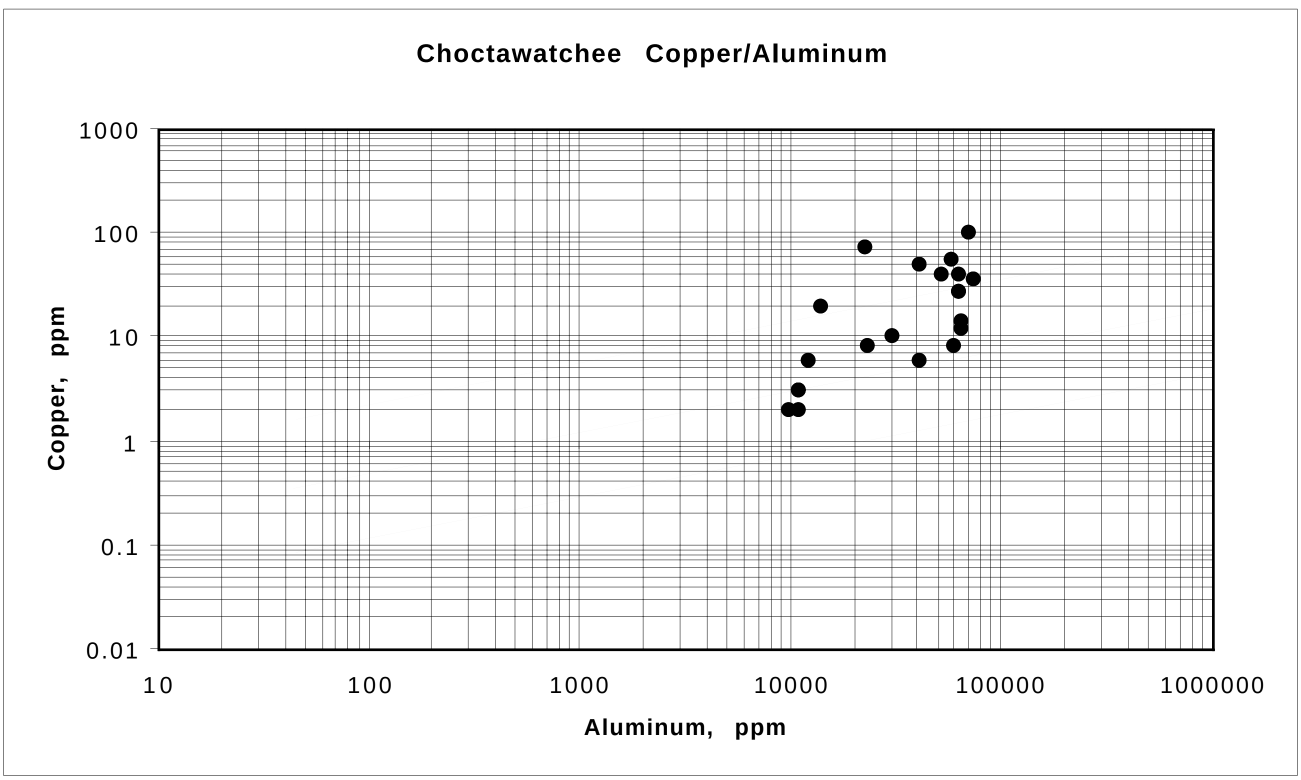


Figure 45d. Relationship between copper and aluminum in Choctawhatchee Bay samples.

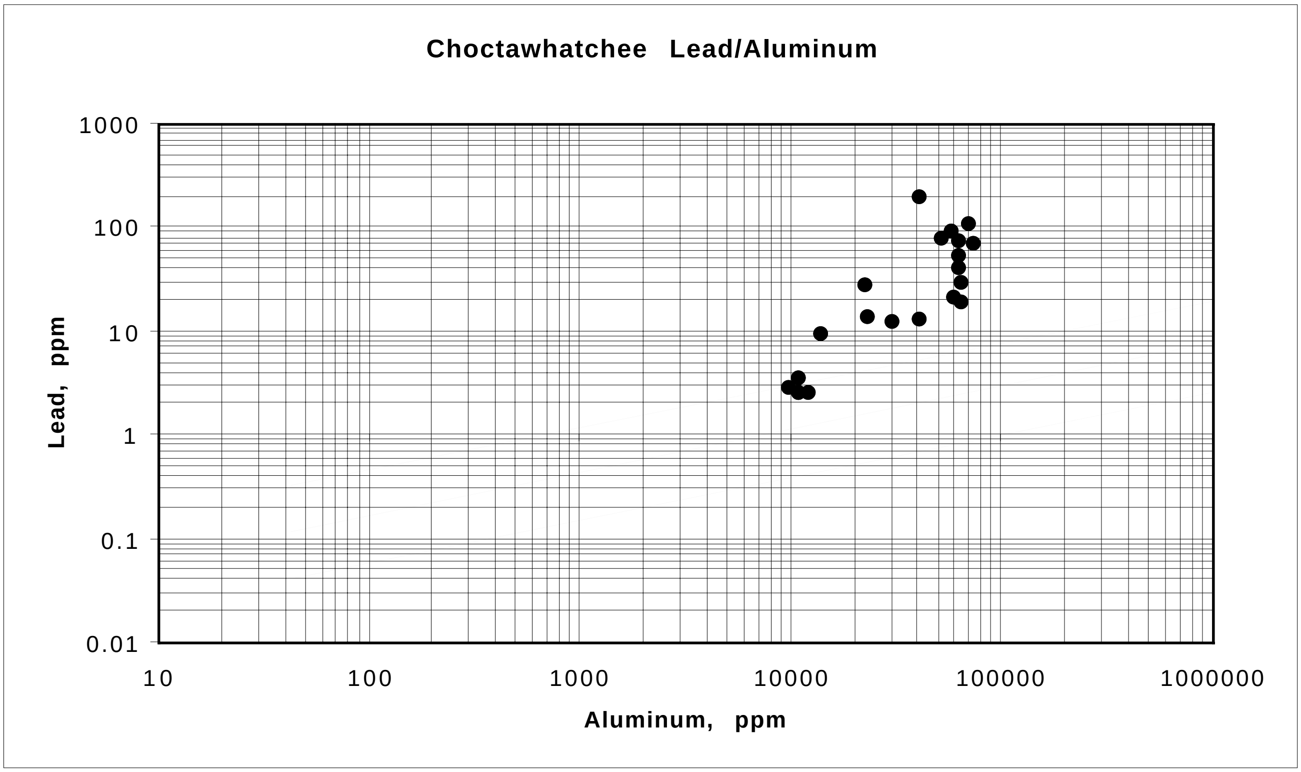


Figure 45e. Relationship between lead and aluminum in Choctawhatchee Bay samples.

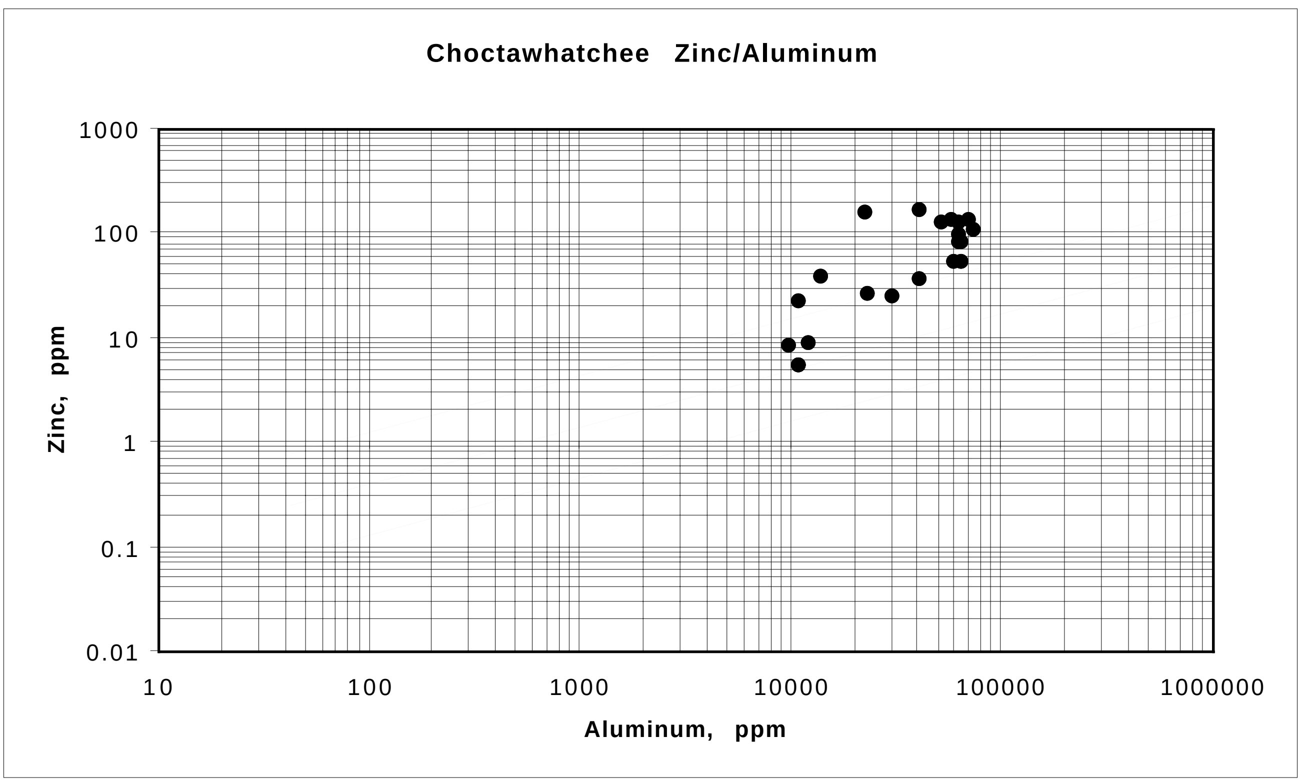


Figure 45f. Relationship between zinc and aluminum in Choctawhatchee Bay samples.

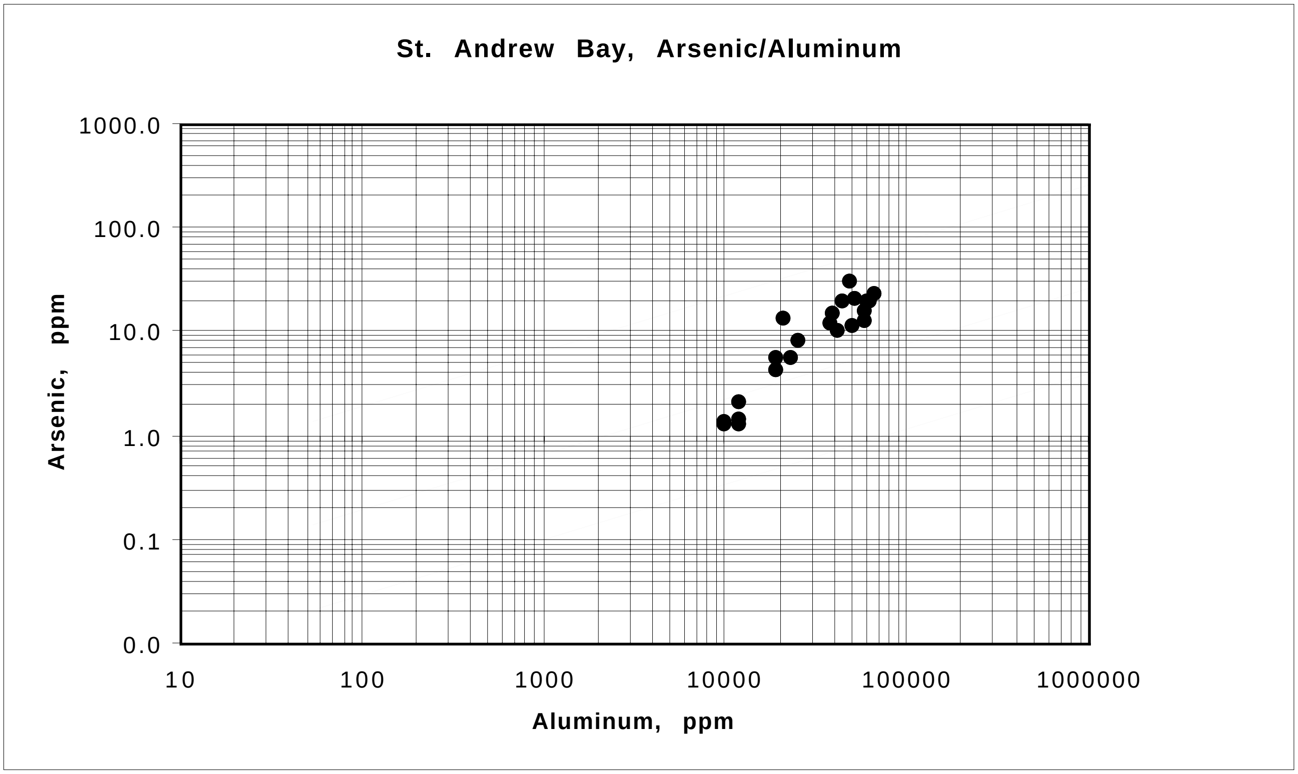


Figure 46a. Relationship between arsenic and aluminum in St. Andrew Bay samples.

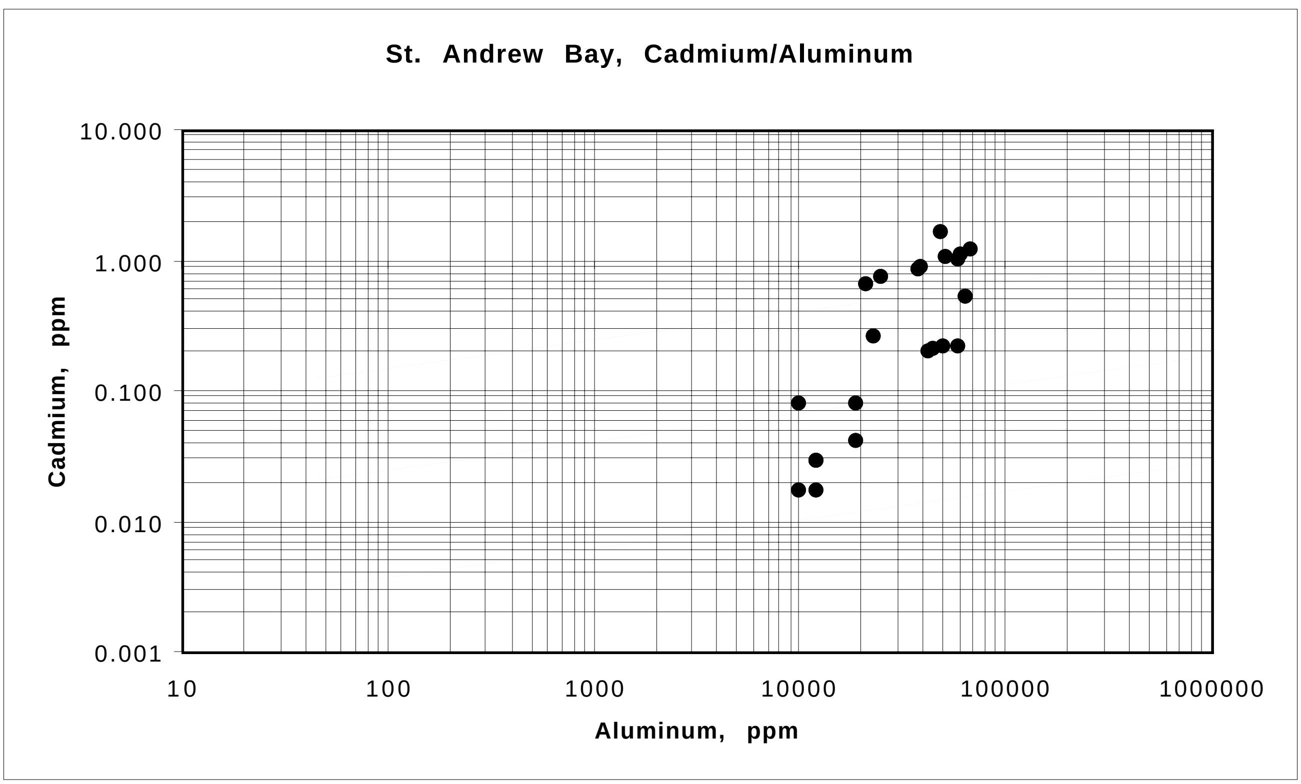


Figure 46b. Relationship between cadmium and aluminum in St. Andrew Bay samples.

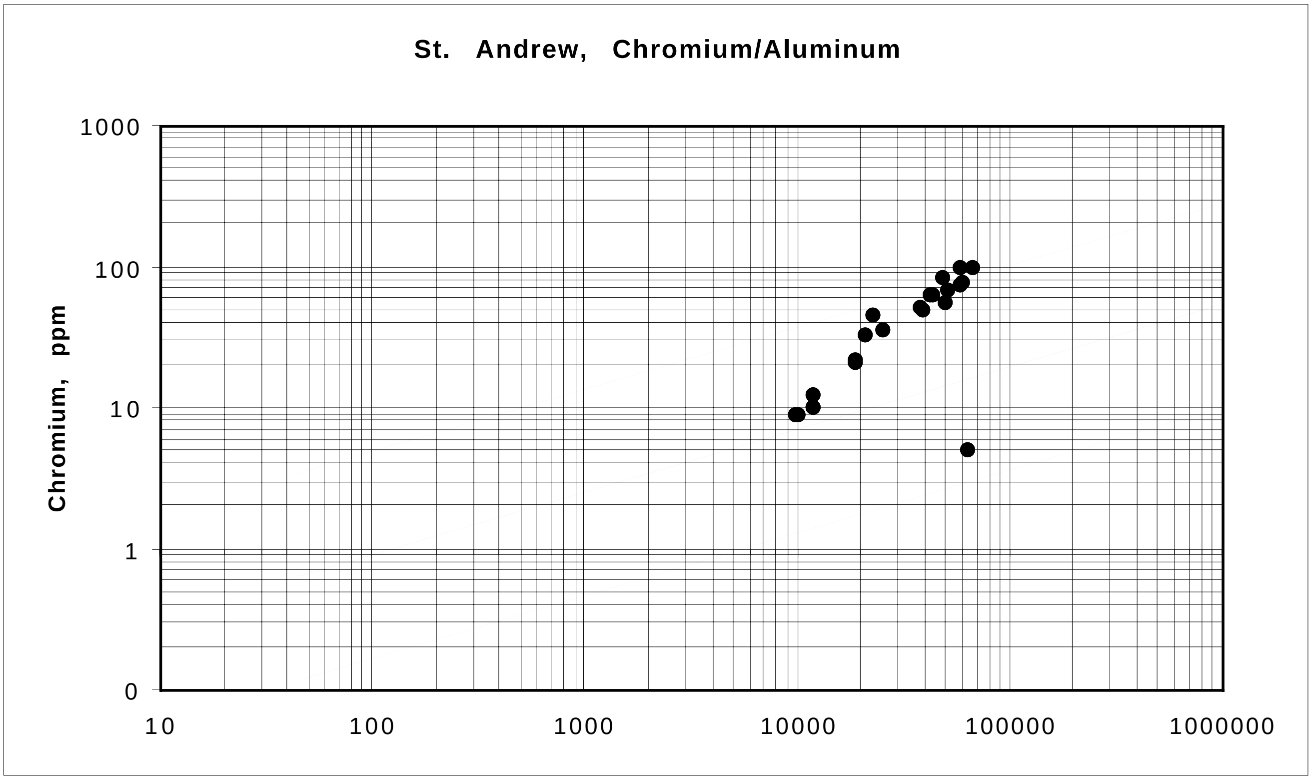


Figure 46c. Relationship between chromium and aluminum in St. Andrew Bay samples.

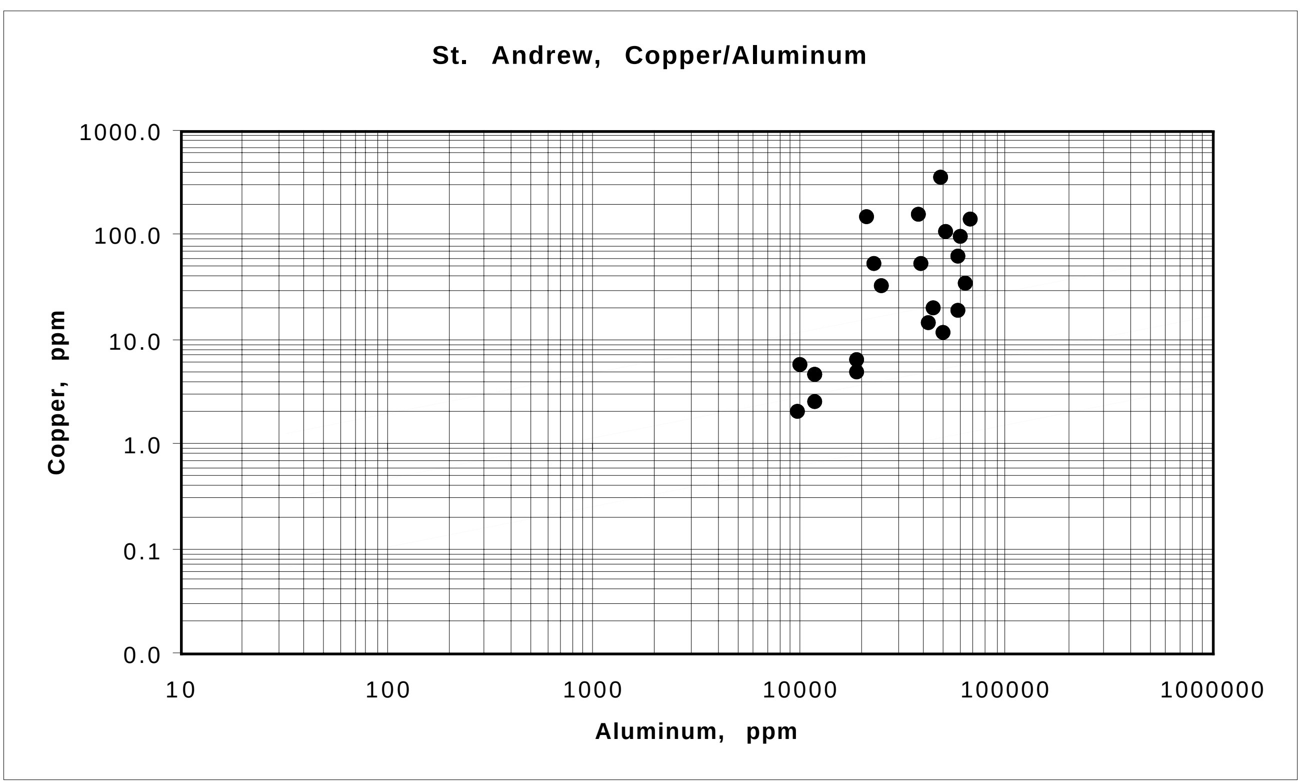


Figure 46d. Relationship between copper and aluminum in St. Andrew Bay samples.

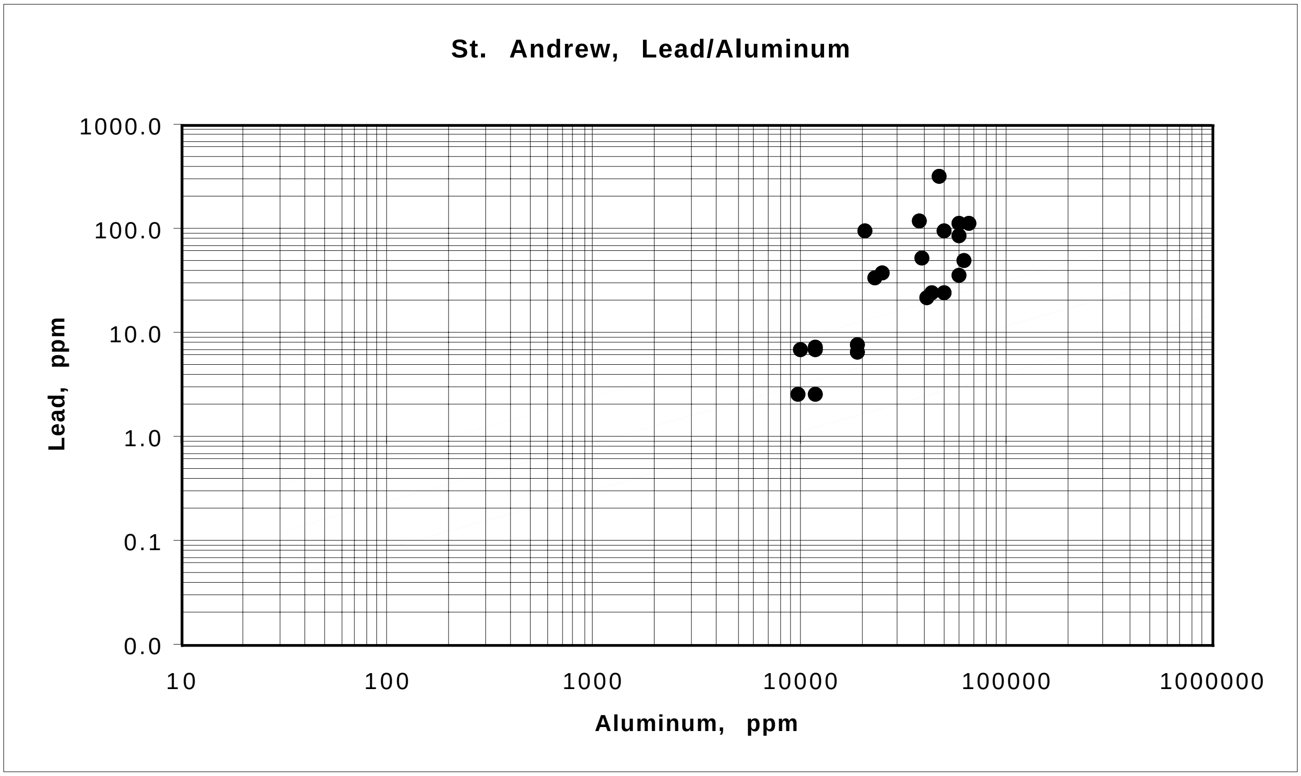


Figure 46e. Relationship between lead and aluminum in St. Andrew Bay samples.

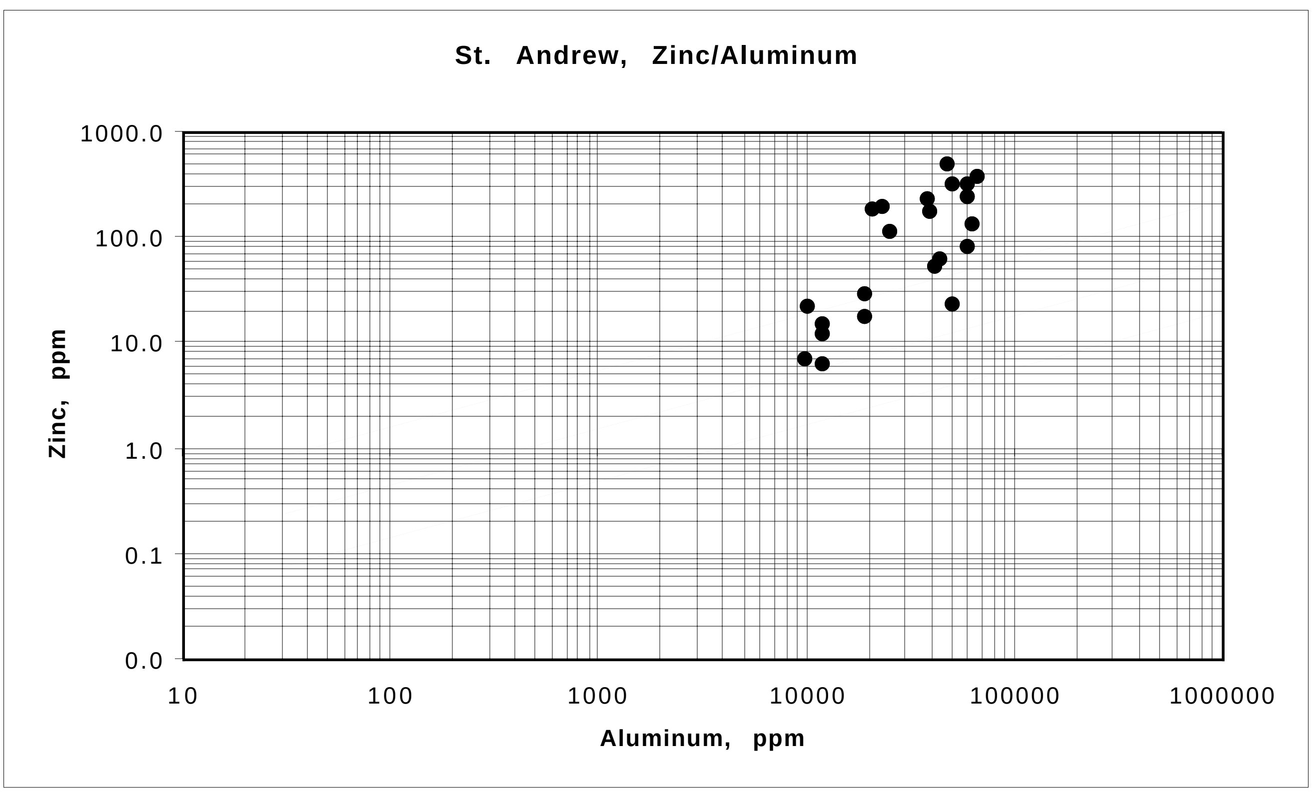


Figure 46f. Relationship between zinc and aluminum in St. Andrew Bay samples.

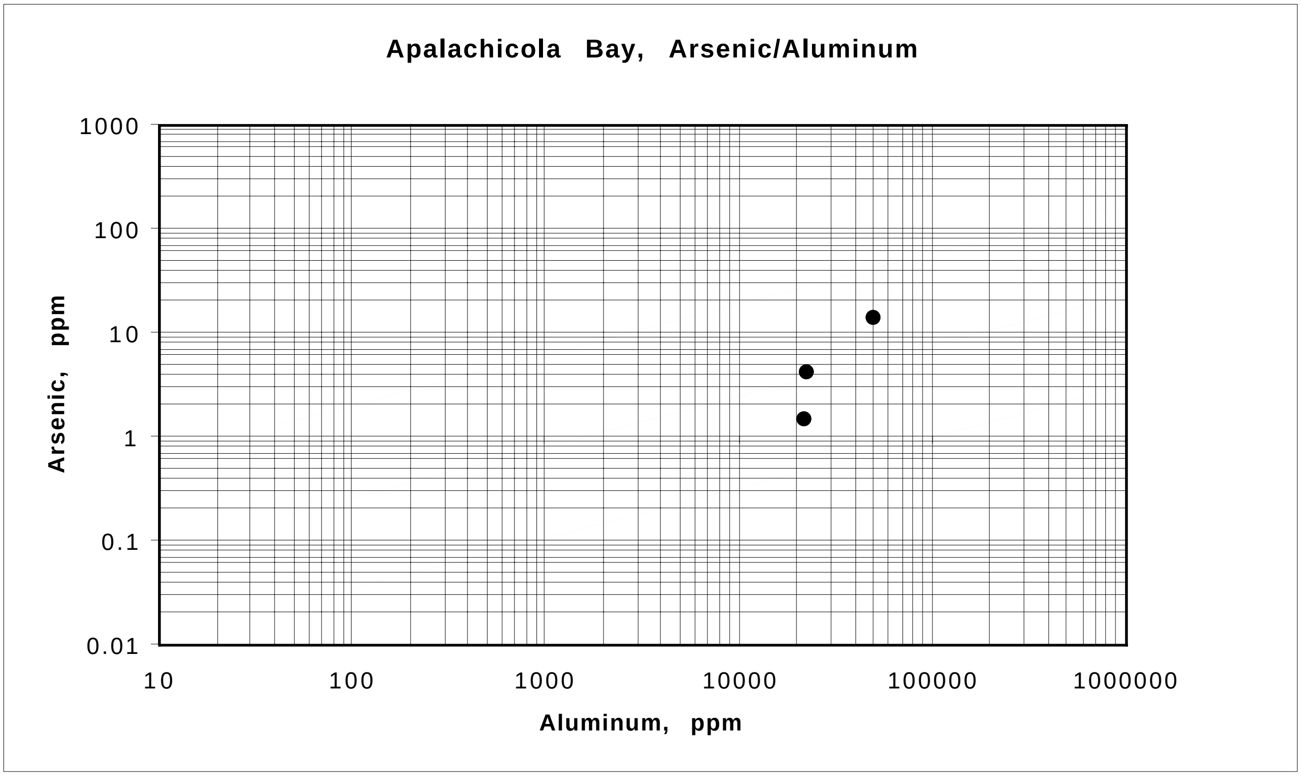


Figure 47a. Relationship between arsenic and aluminum in Apalachicola Bay samples.

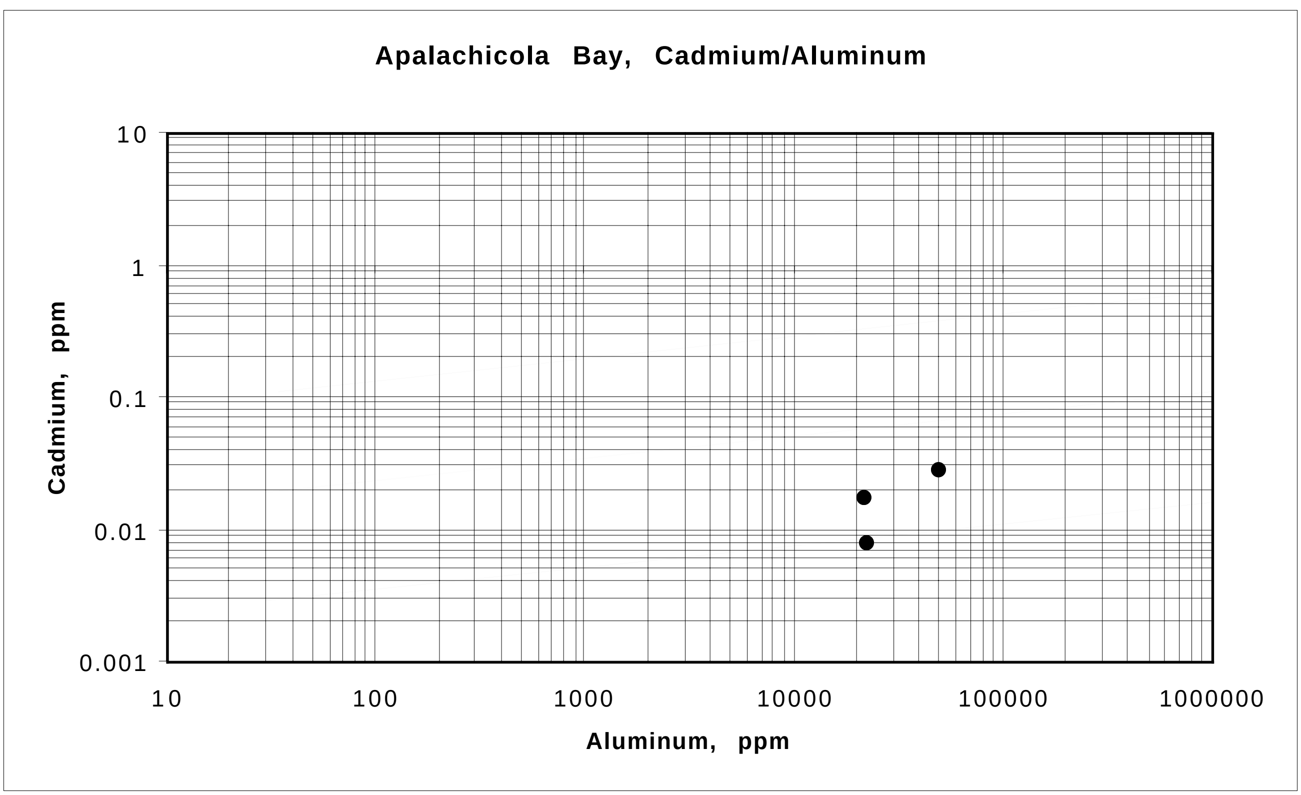


Figure 47b. Relationship between cadmium and aluminum in Apalachicola Bay samples.

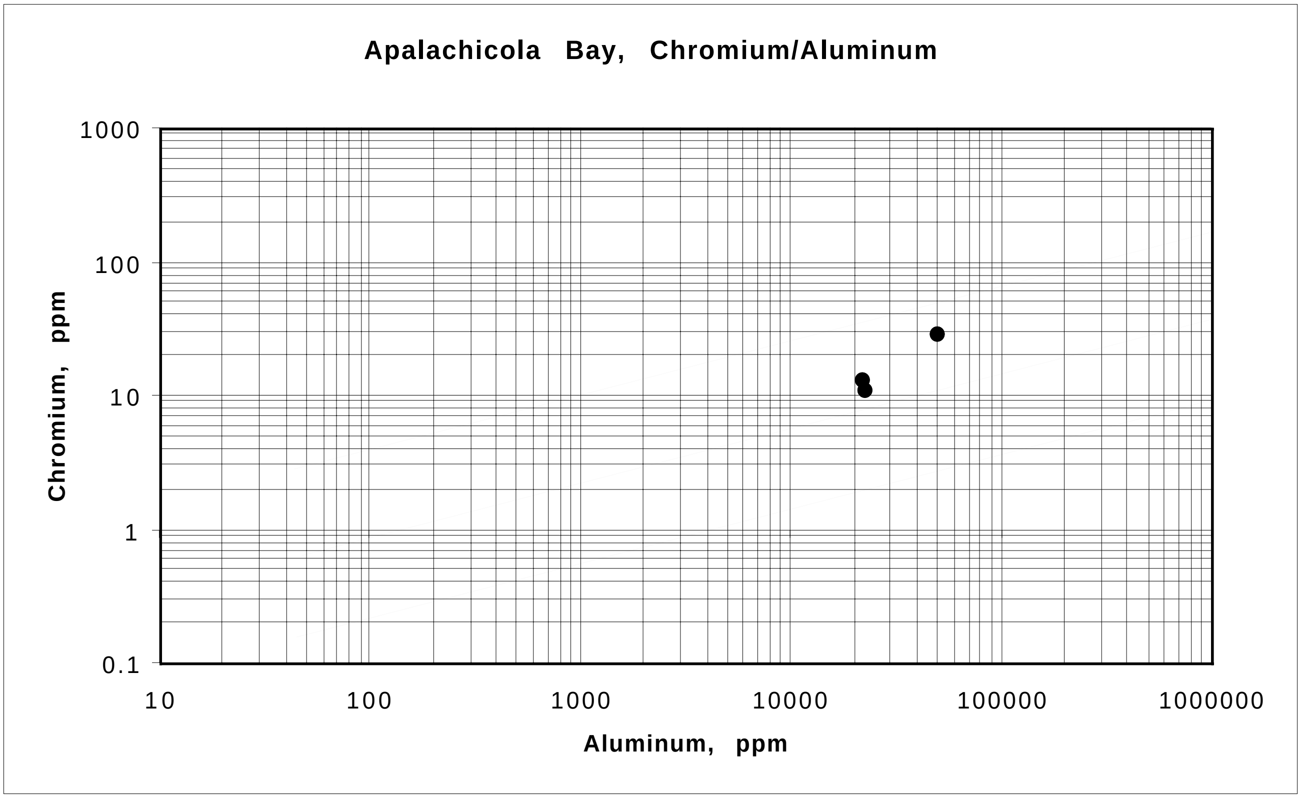


Figure 47c. Relationship between chromium and aluminum in Apalachicola Bay samples.

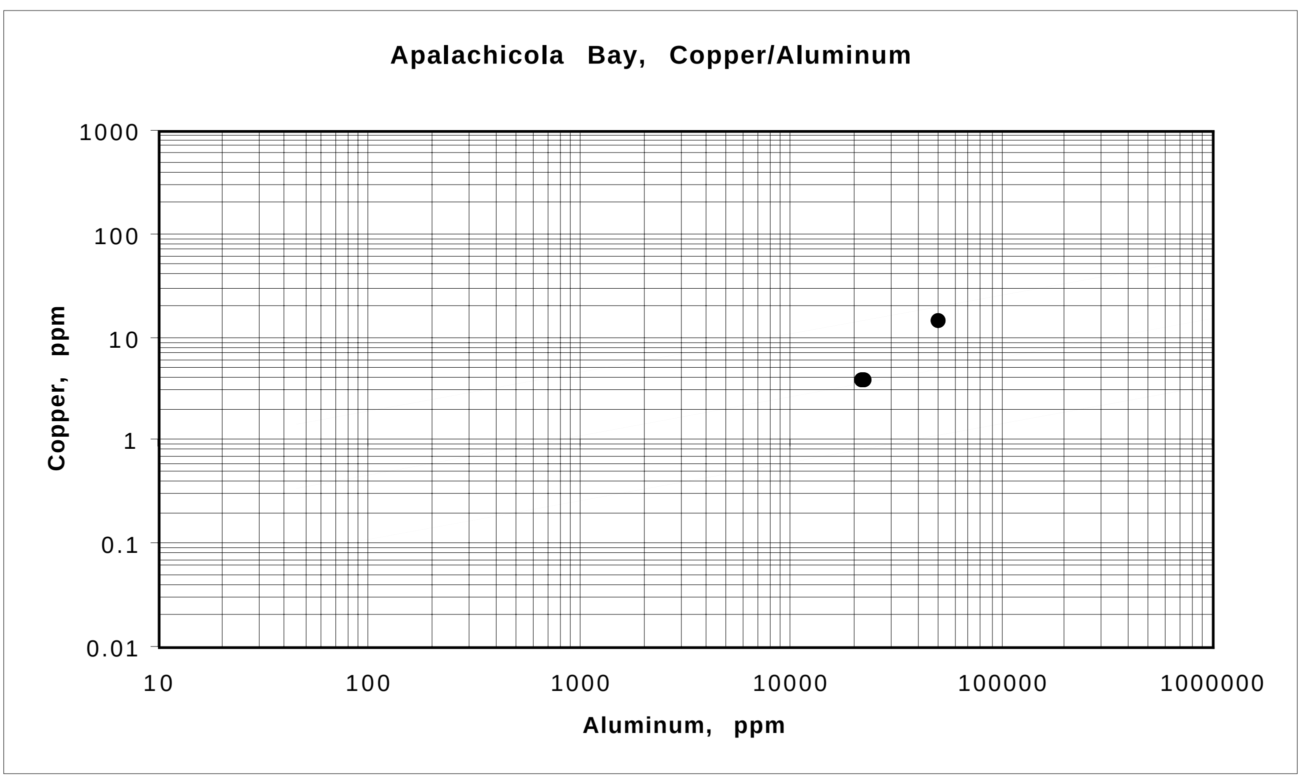


Figure 47d. Relationship between copper and aluminum in Apalachicola Bay samples.

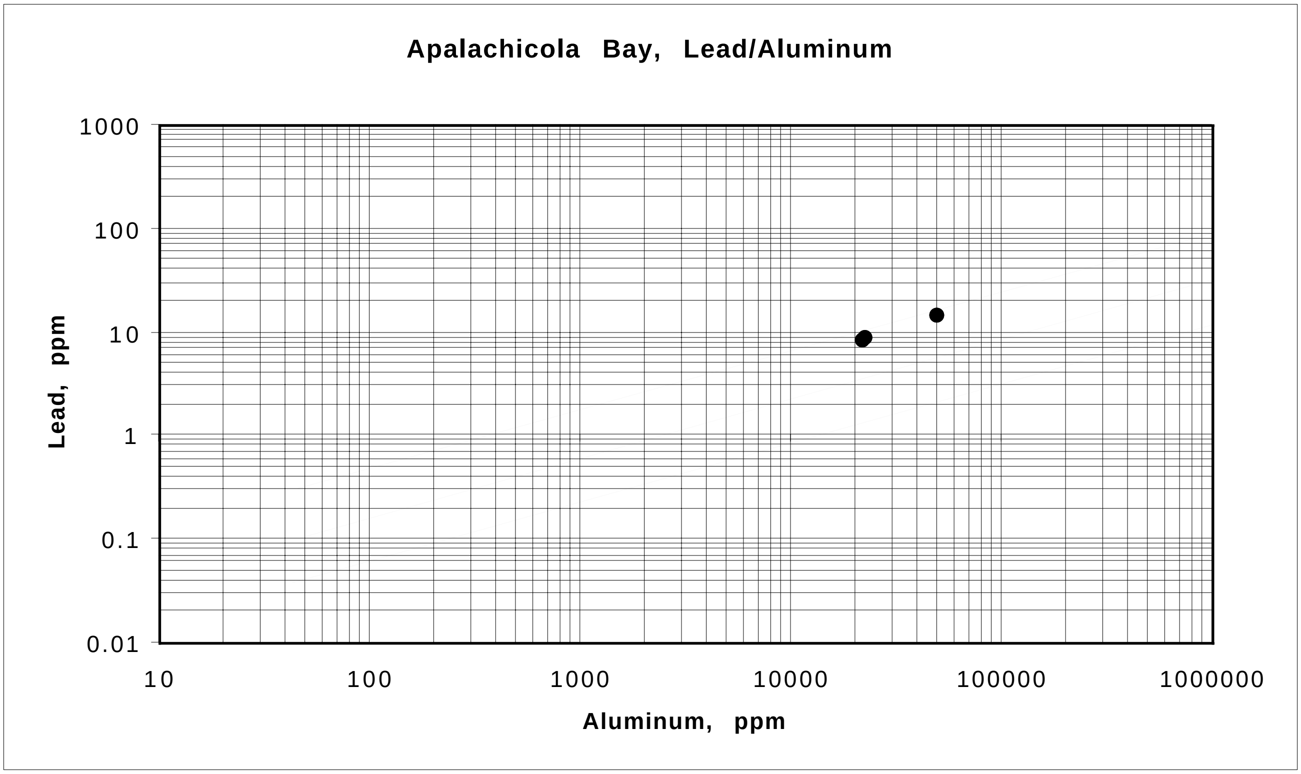


Figure 47e. Relationship between lead and aluminum in Apalachicola Bay samples.

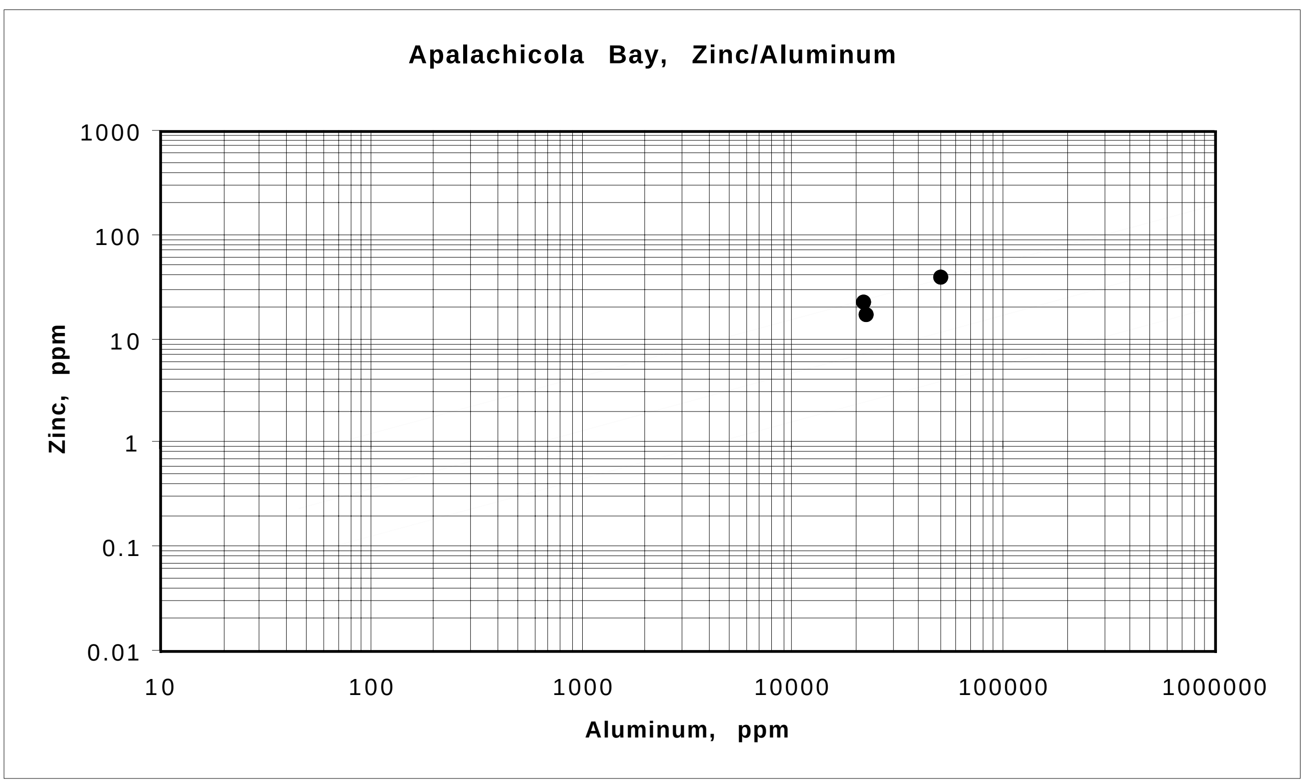
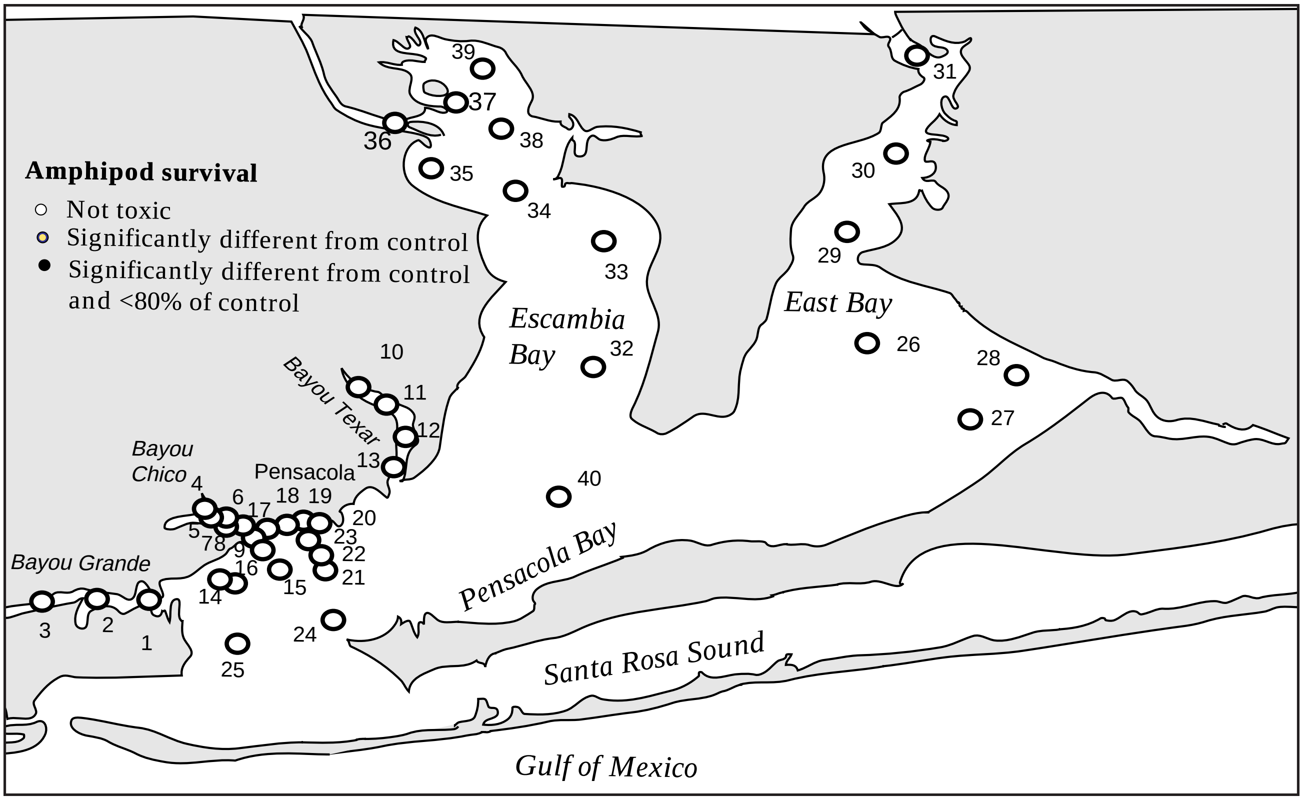


Figure 47f. Relationship between zinc and aluminum in Apalachicola Bay samples.



48. Sampling stations in Pensacola Bay in which sediments were either not toxic to amphipod survival, significantly different from controls, or highly toxic.

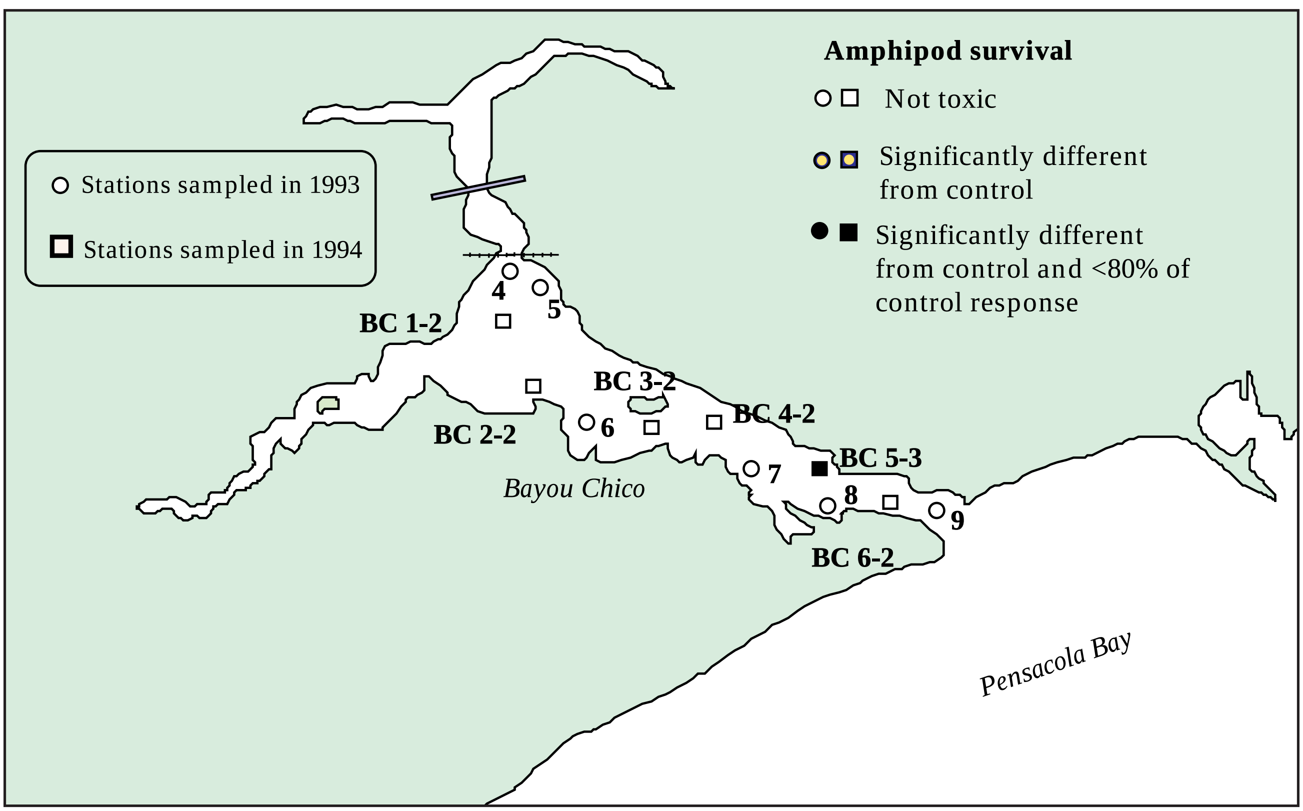


Figure 49. Sampling stations in Bayou Chico in which sediments were either not toxic to amphipod survival, significantly different from controls, or highly toxic.

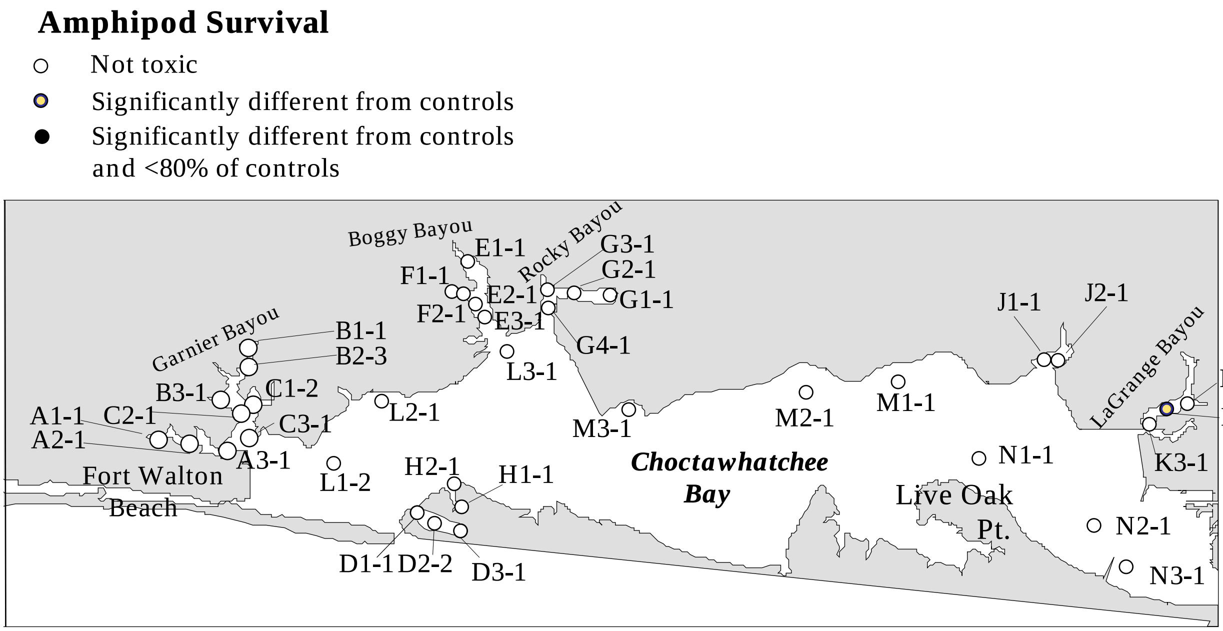


Figure 50. Sampling stations in Choctawhatchee Bay in which sediments were either not toxic to amphipod survival, significantly different from controls, or highly toxic.

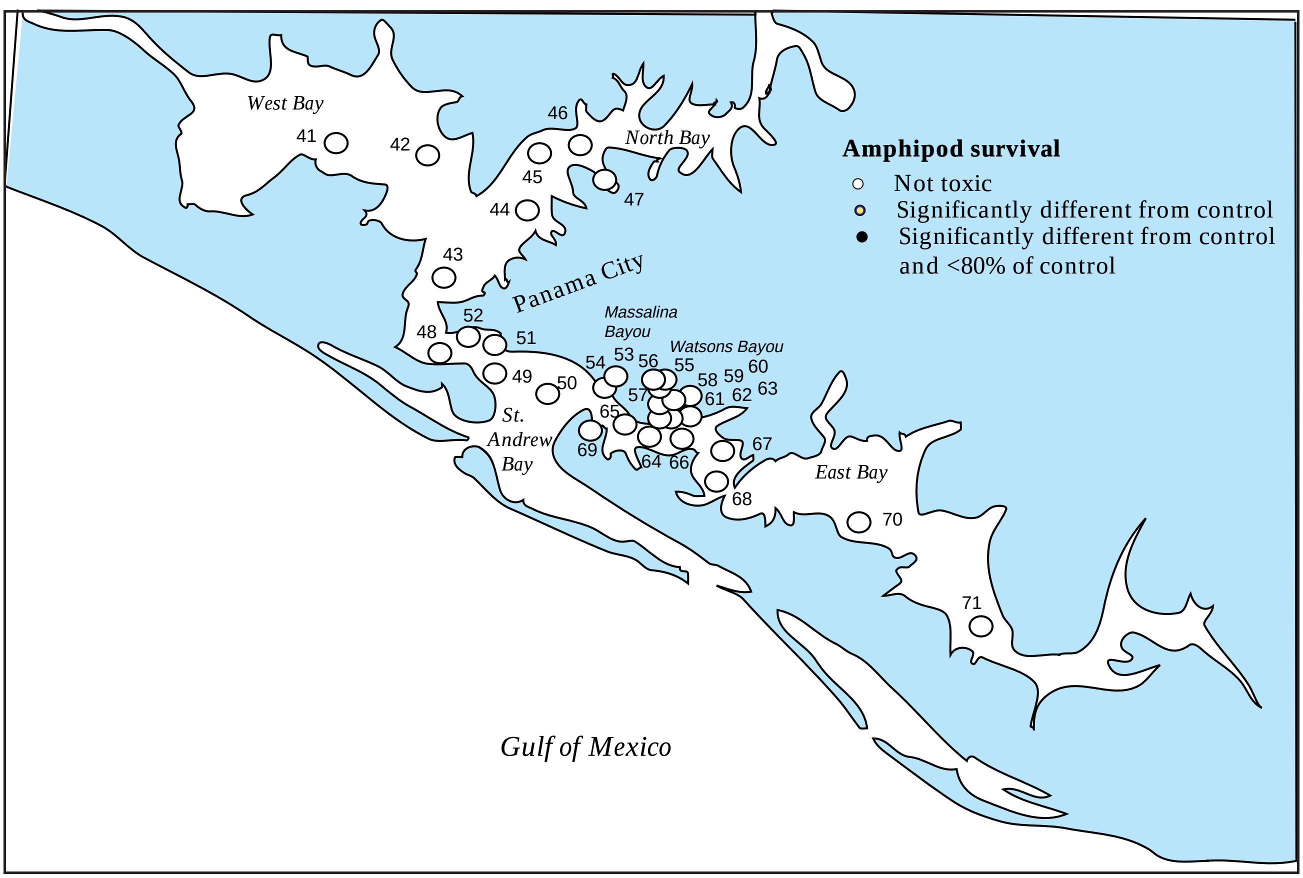


Figure 51. Sampling stations in St. Andrew Bay in which sediments were either not toxic to amphipod survival, significantly different from controls, or highly toxic.

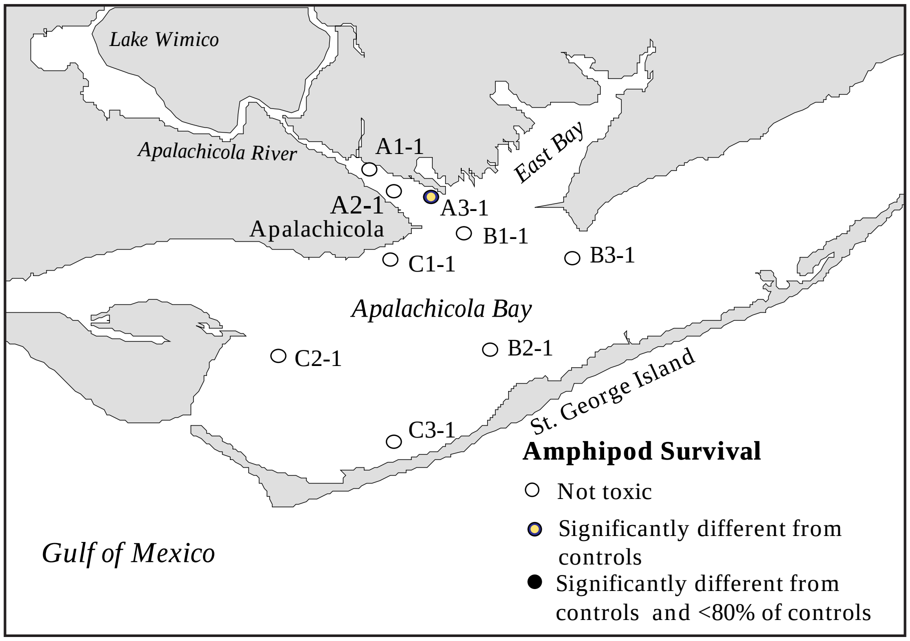


Figure 52. Sampling stations in Apalachicola Bay in which sediments were either not toxic to amphipod survival, significantly different from controls, or highly toxic.

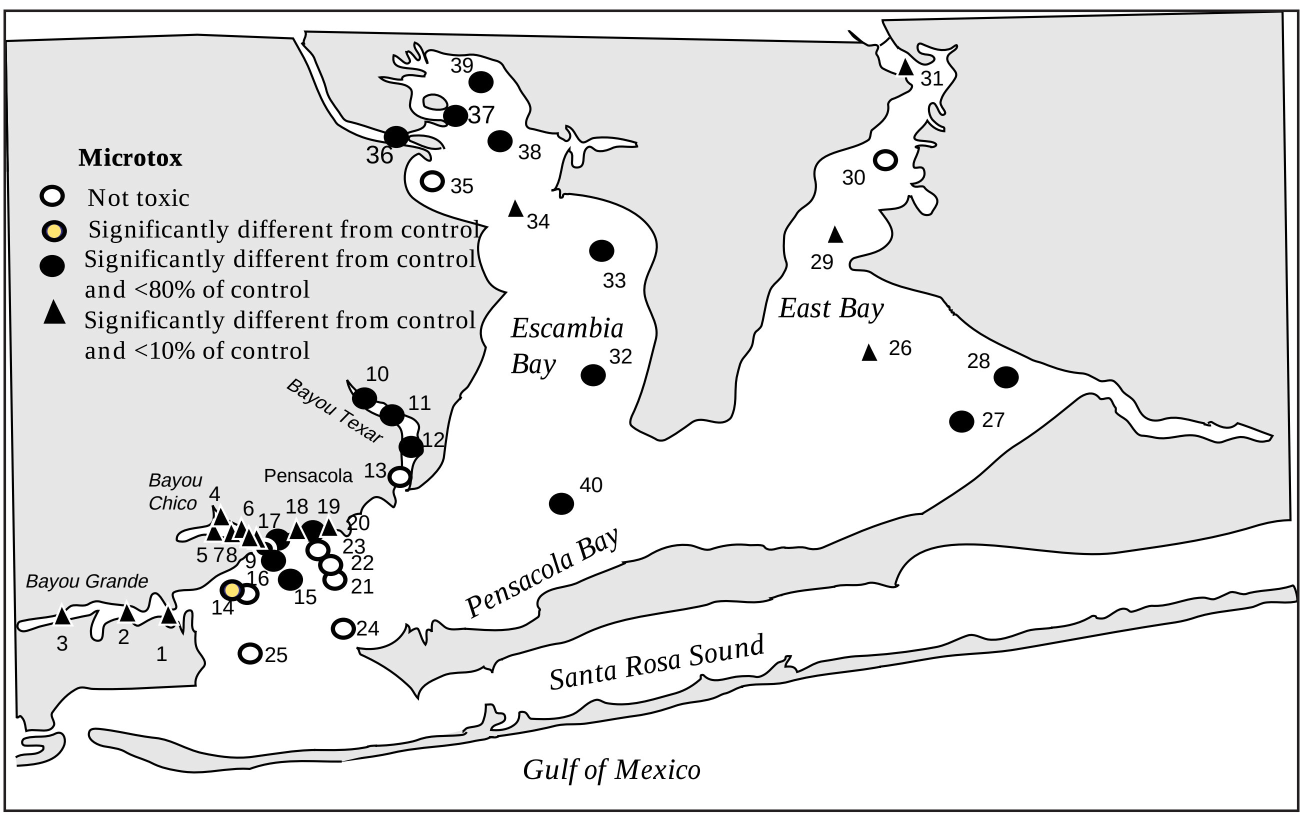


Figure 53. Sampling stations in Pensacola Bay in which sediments were either not toxic in Microtox™ tests, significantly different from controls, or highly toxic.

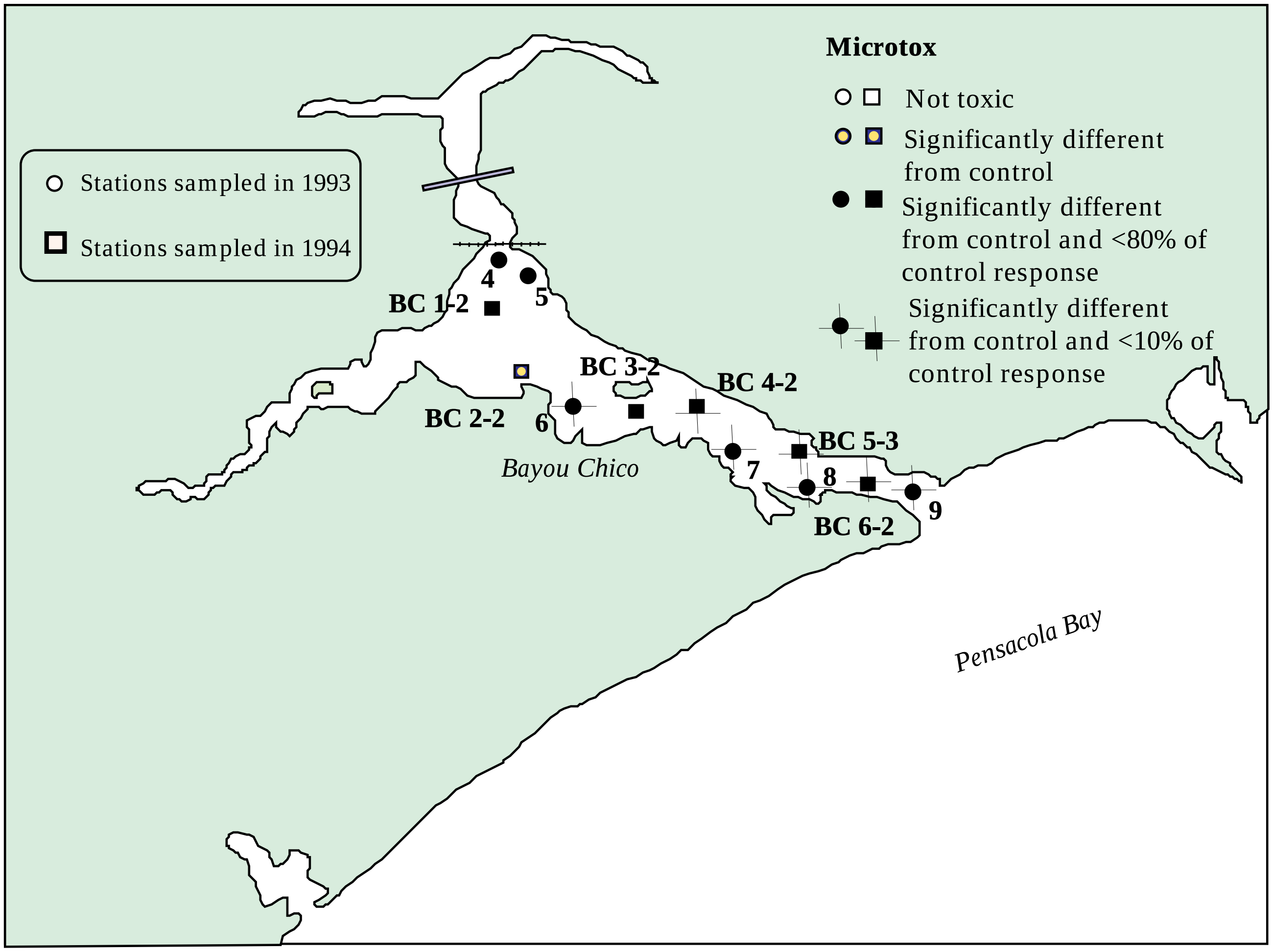


Figure 54. Sampling stations in Bayou Chico in which sediments were either not toxic to Microtox™ tests, significantly different from controls, or highly toxic.

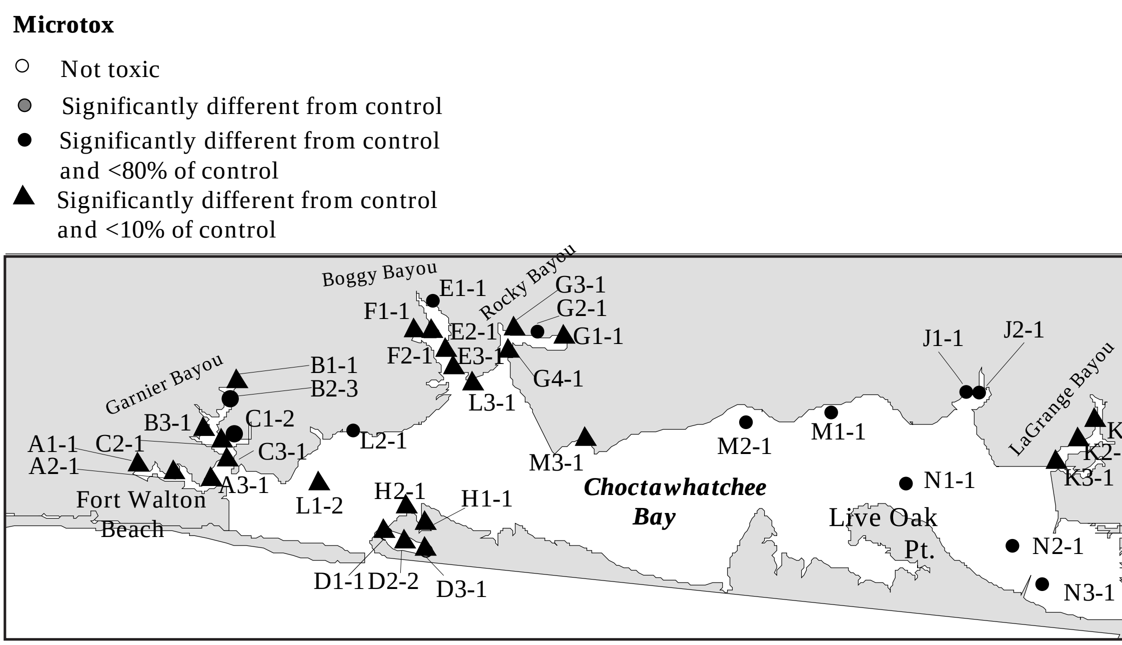


Figure 55. Sampling stations in Choctawhatchee Bay in which sediments were either not toxic to Microtox™ tests, significantly different from controls, or highly toxic.

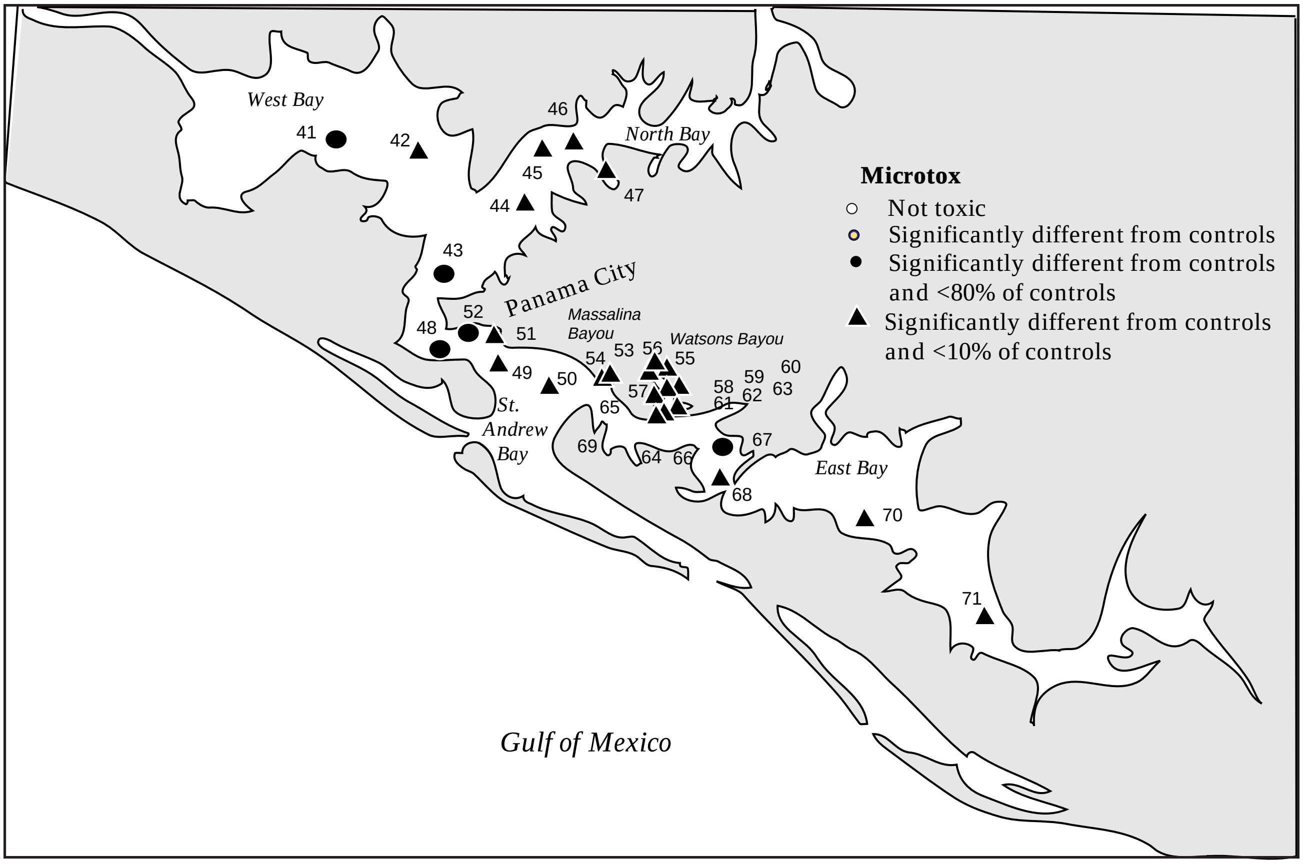


Figure 56. Sampling stations in St. Andrew Bay in which sediments were either not toxic to Microtox™ tests, significantly different from controls, or highly toxic.

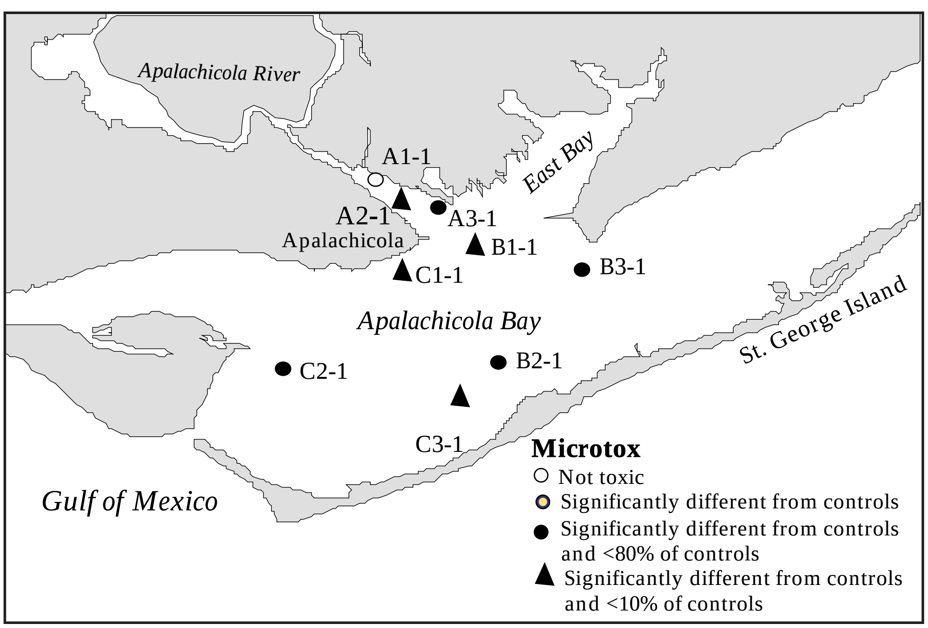


Figure 57. Sampling stations in Apalachicola Bay in which sediments were either not toxic to Microtox™ tests, significantly different from controls, or highly toxic.

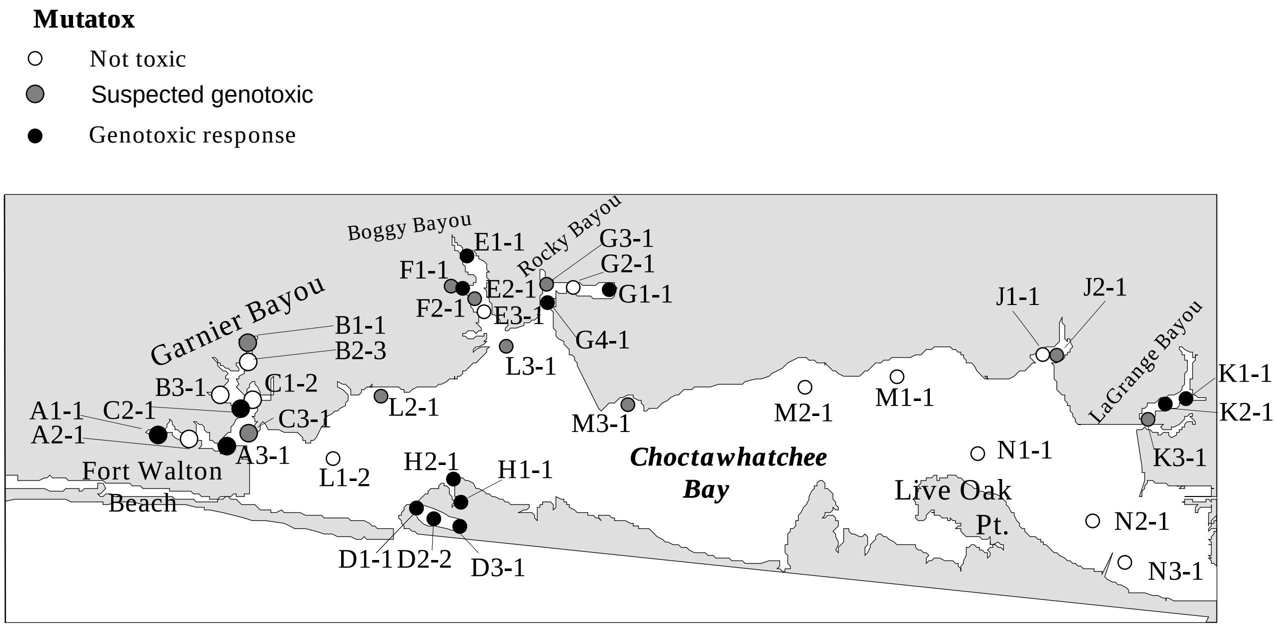


Figure 58. Sampling stations in Choctawhatchee Bay in which sediments were either not toxic, suspected genotoxic, or genotoxic in Mutatox™ tests.

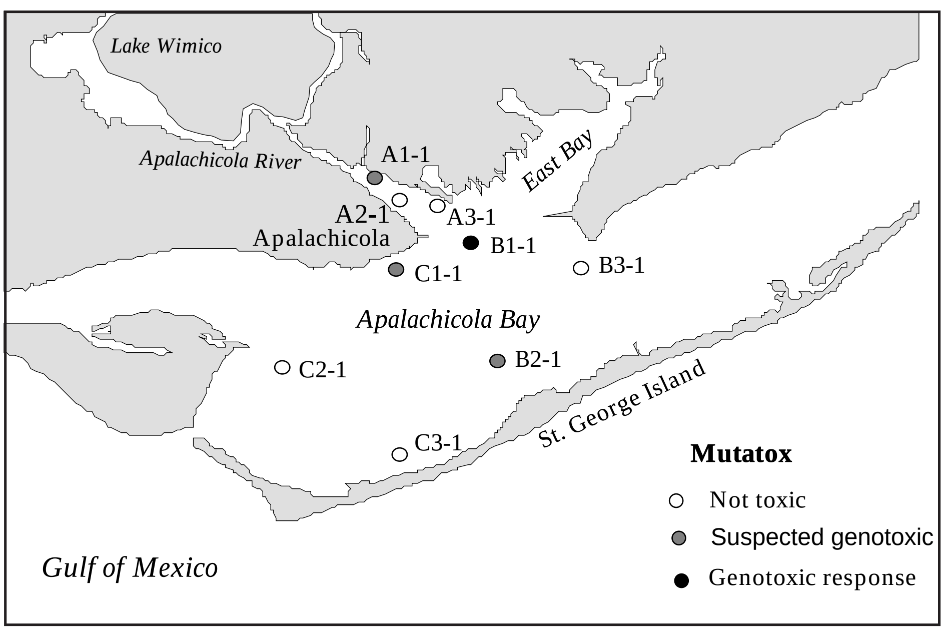


Figure 59. Sampling stations in Apalachicola Bay in which sediments were either not toxic, suspected genotoxic, or genotoxic in Mutatox™ tests.

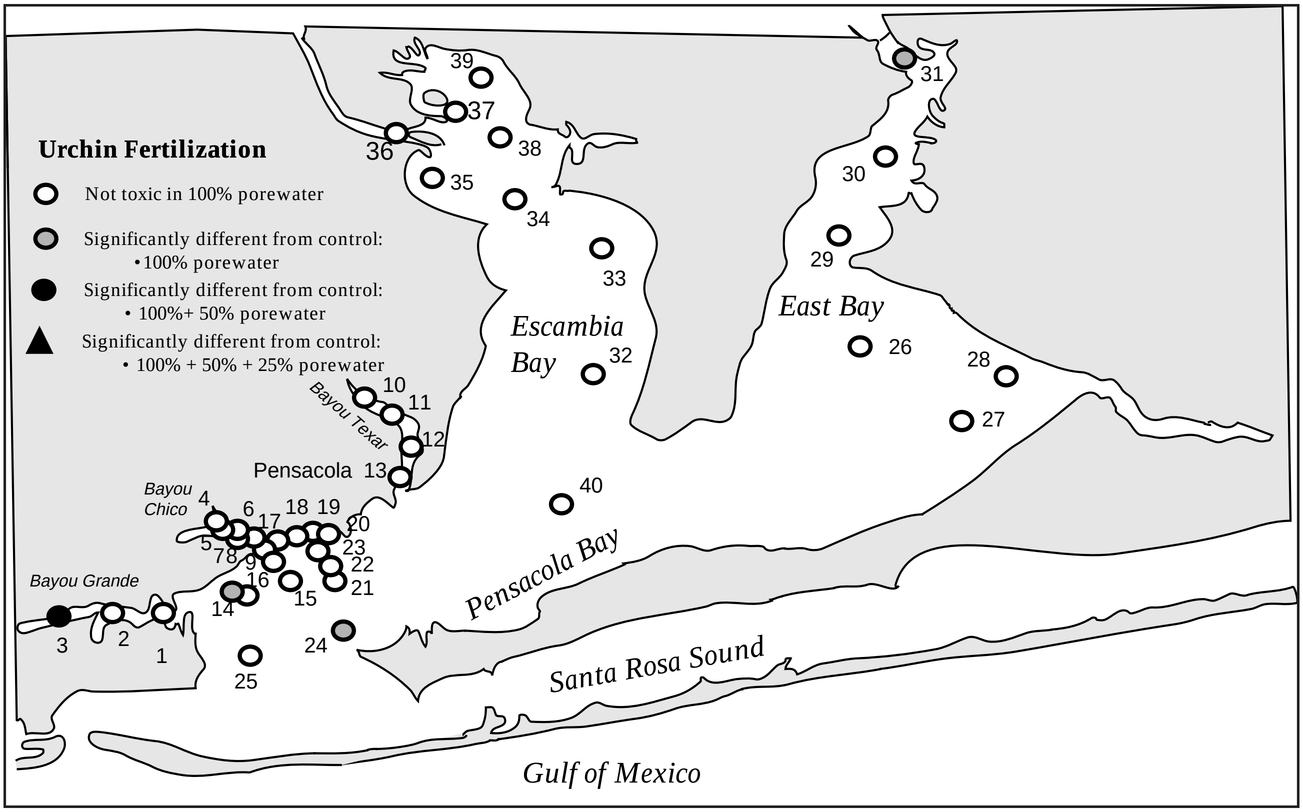


Figure 60. Sampling stations in Pensacola Bay in which sediments were either not toxic or significantly different from controls in sea urchin fertilization tests of sediment porewaters.

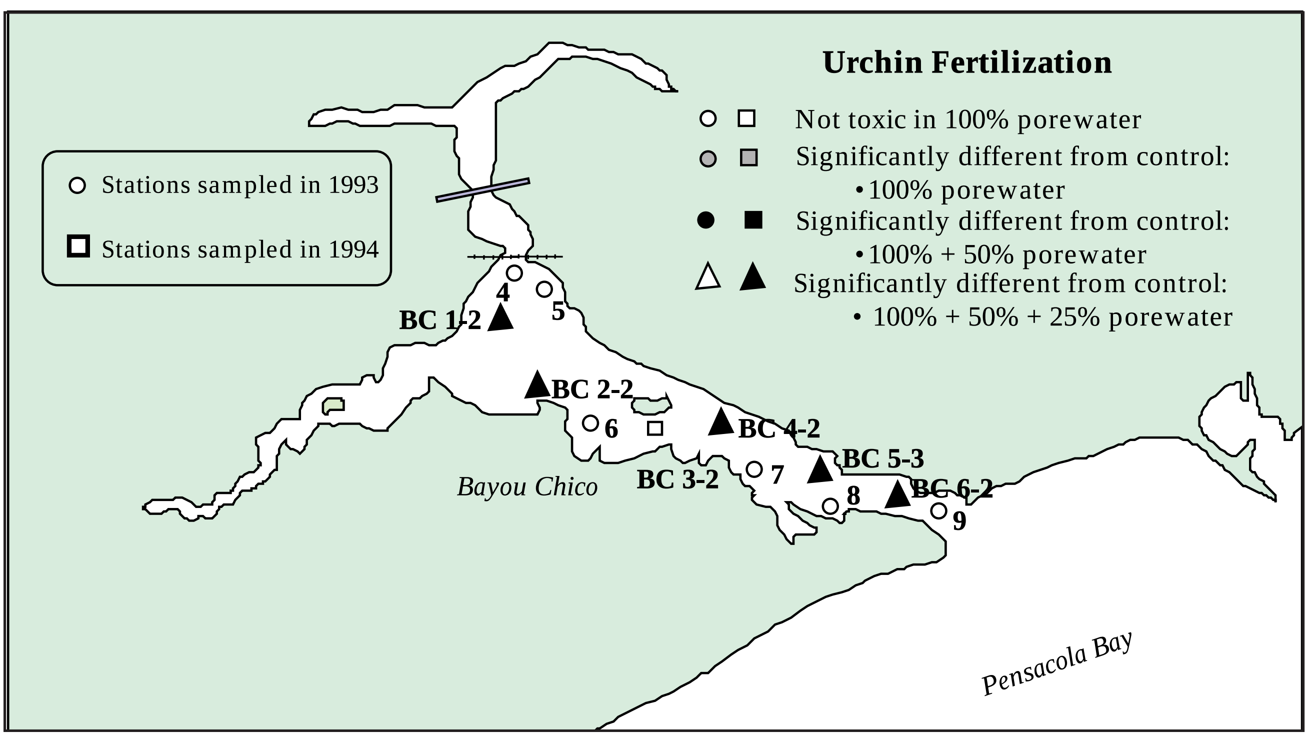


Figure 61. Sampling stations in Bayou Chico that were either not toxic or significantly different from controls in sea urchin fertilization tests of sediment porewaters.

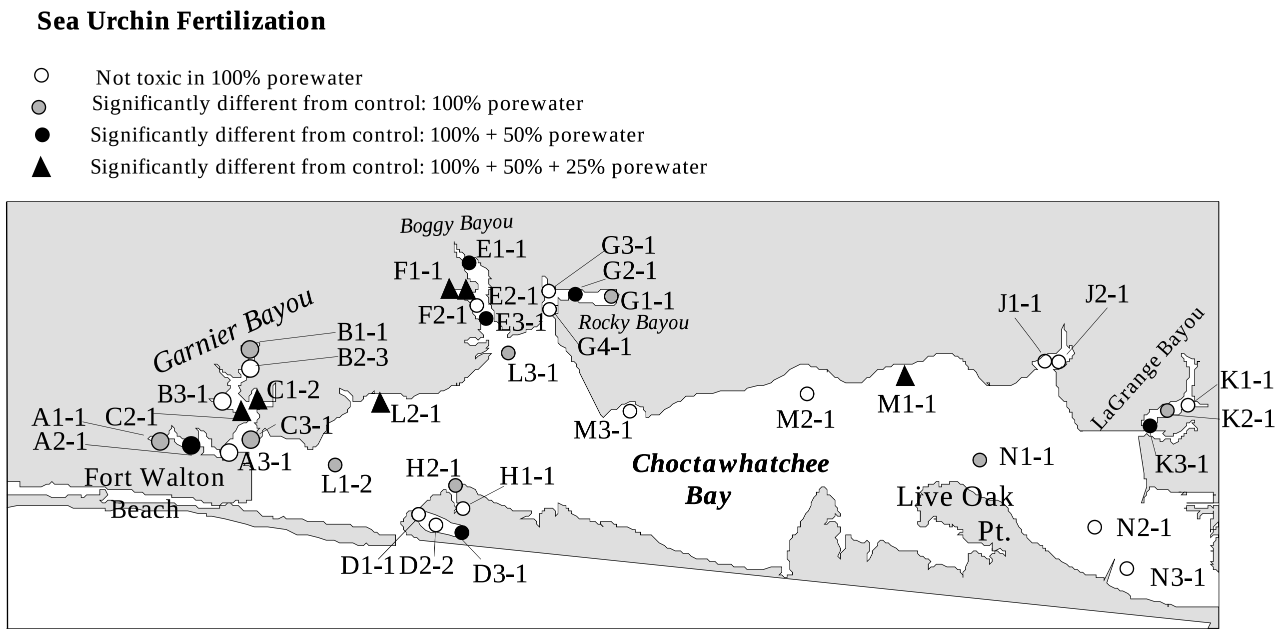


Figure 62. Sampling stations in Choctawhatchee Bay that were either not toxic or significantly different from controls in sea urchin fertilization tests of sediment porewaters.

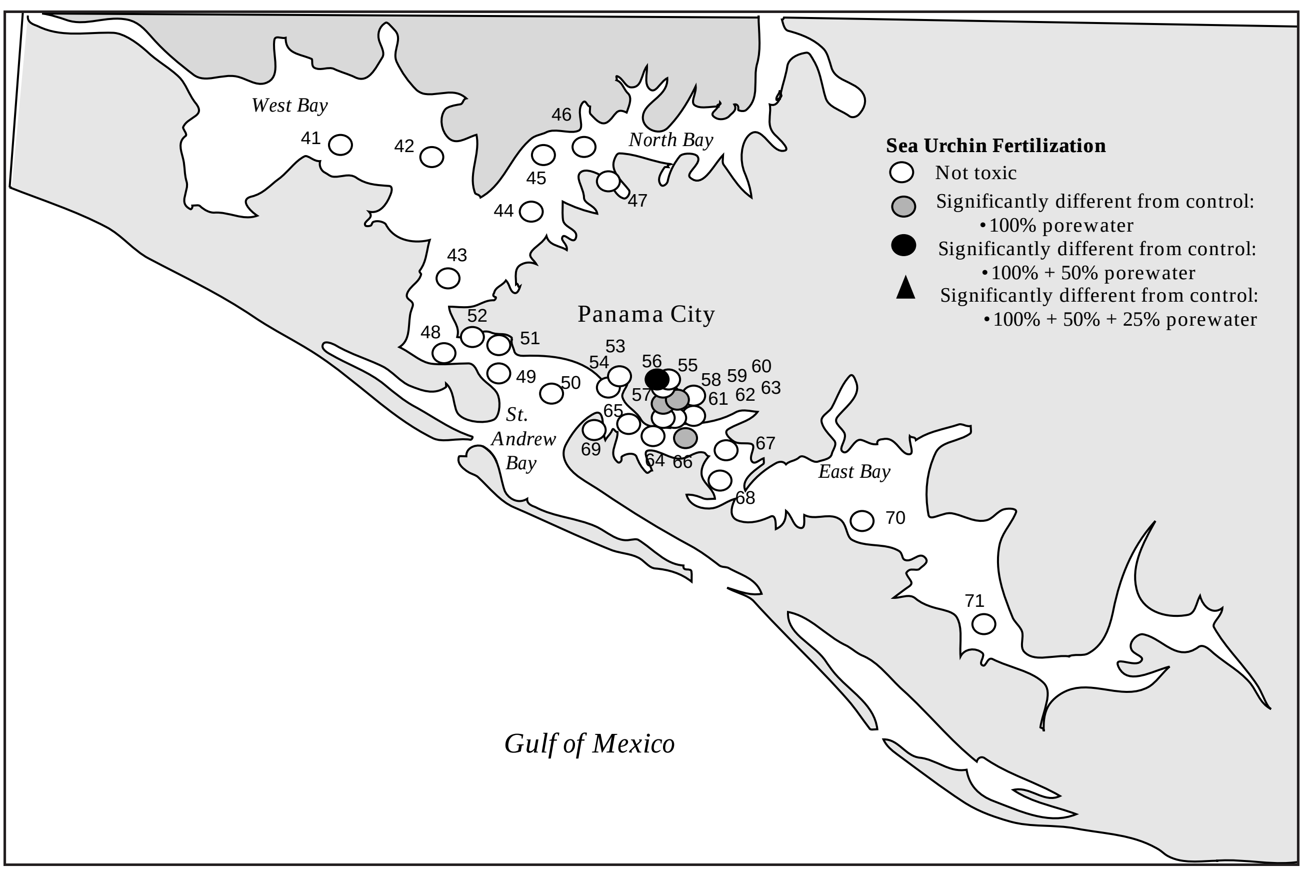


Figure 63. Sampling stations in St. Andrew Bay that were either not toxic or significantly different from controls in sea urchin fertilization tests of sediment porewaters.

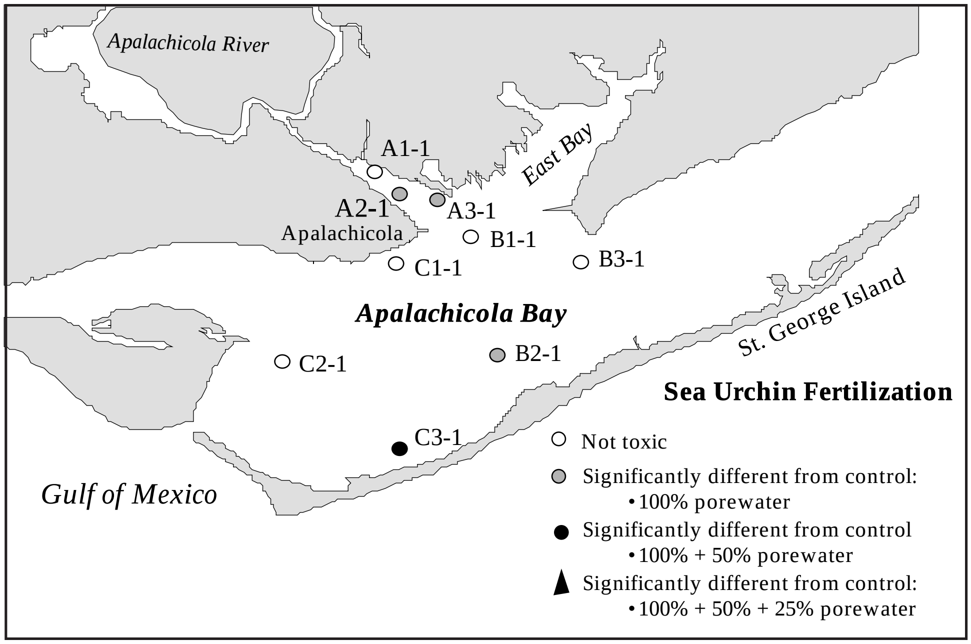


Figure 64. Sampling stations in Apalachicola Bay that were either not toxic or significantly different from controls in sea urchin fertilization tests of sediment porewaters.

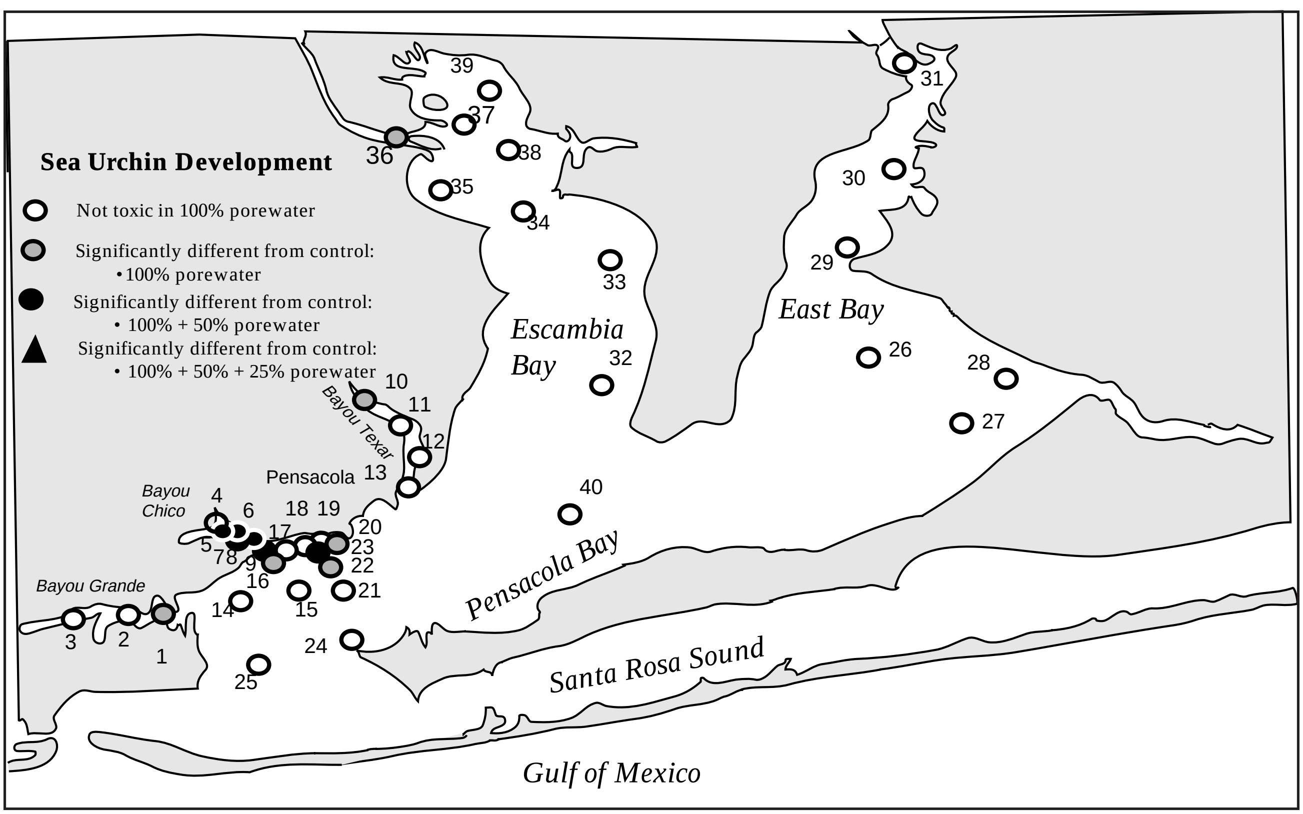


Figure 65. Sampling stations in Pensacola Bay that were either not toxic or significantly different from controls in sea urchin developmente tests of sediment porewaters.

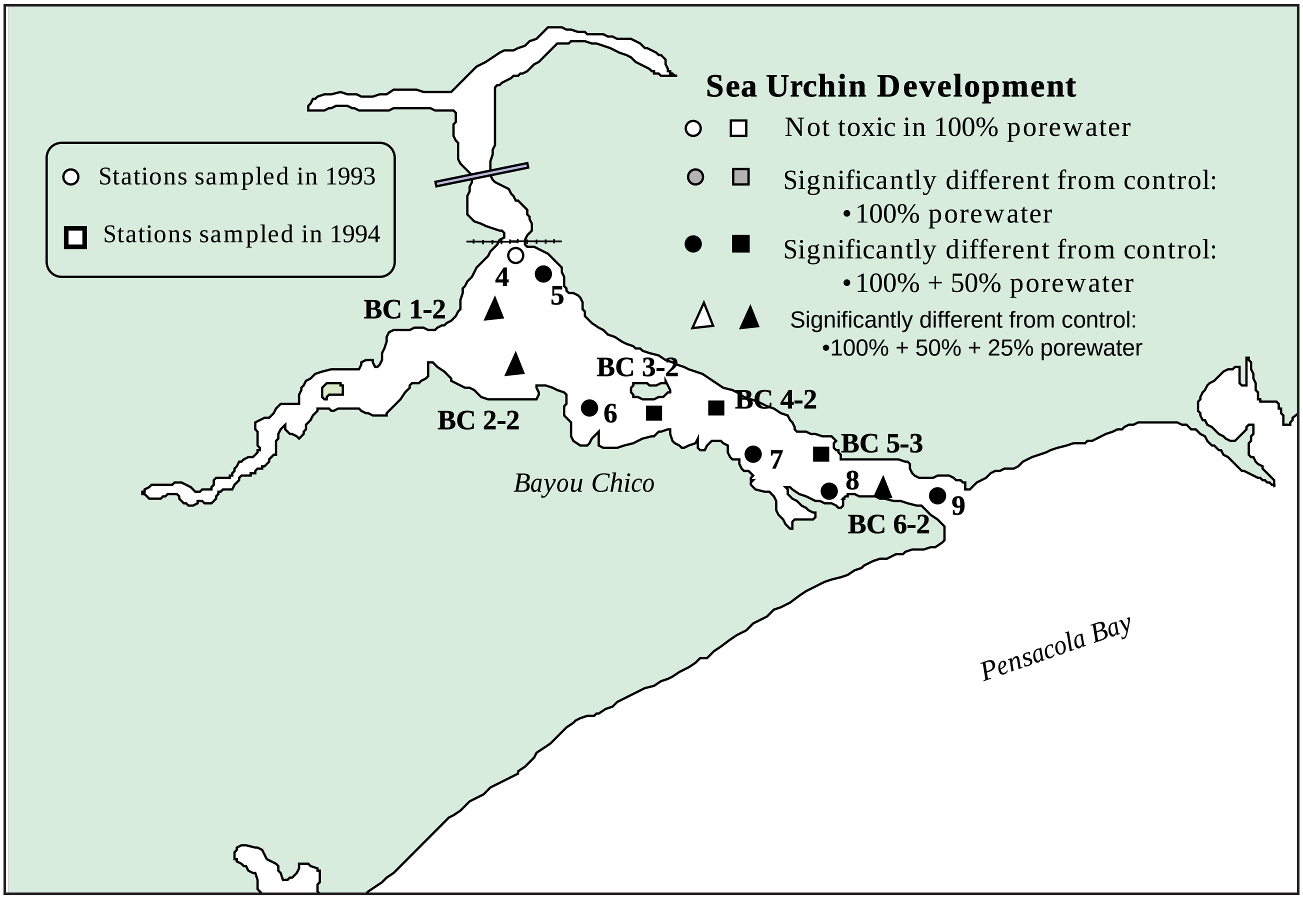


Figure 66. Sampling stations in Bayou Chico that were either not toxic or significantly different from controls in sea urchin development tests of sediment porewaters.

Sea Urchin Development

- Not toxic in 100% porewater
- Significantly different from control: 100% porewater
- Significantly different from control: 100% + 50% porewater
- Significantly different from control: 100% + 50% + 25% porewater

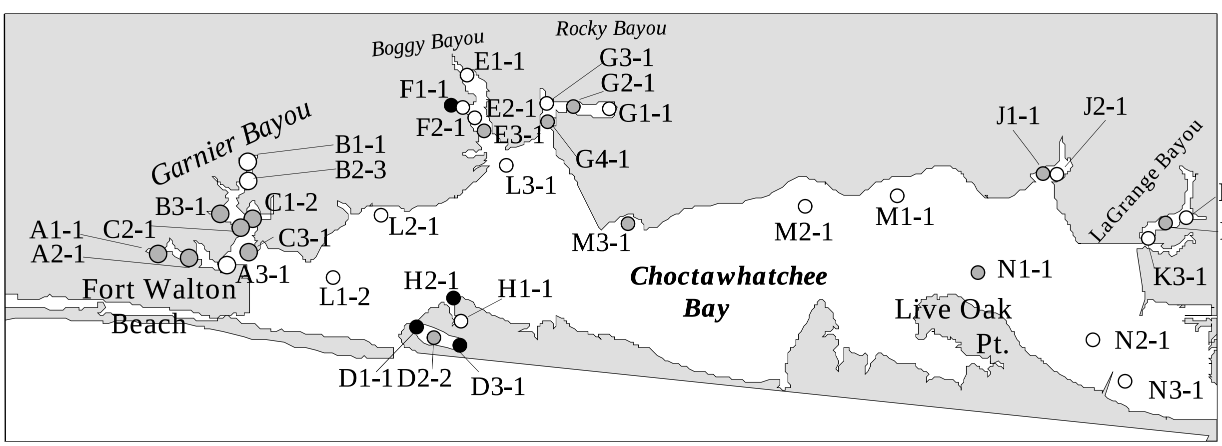


Figure 67. Sampling stations in Choctawhatchee that were either not toxic or significantly different from controls in sea urchin embryo development tests of sediment porewaters.

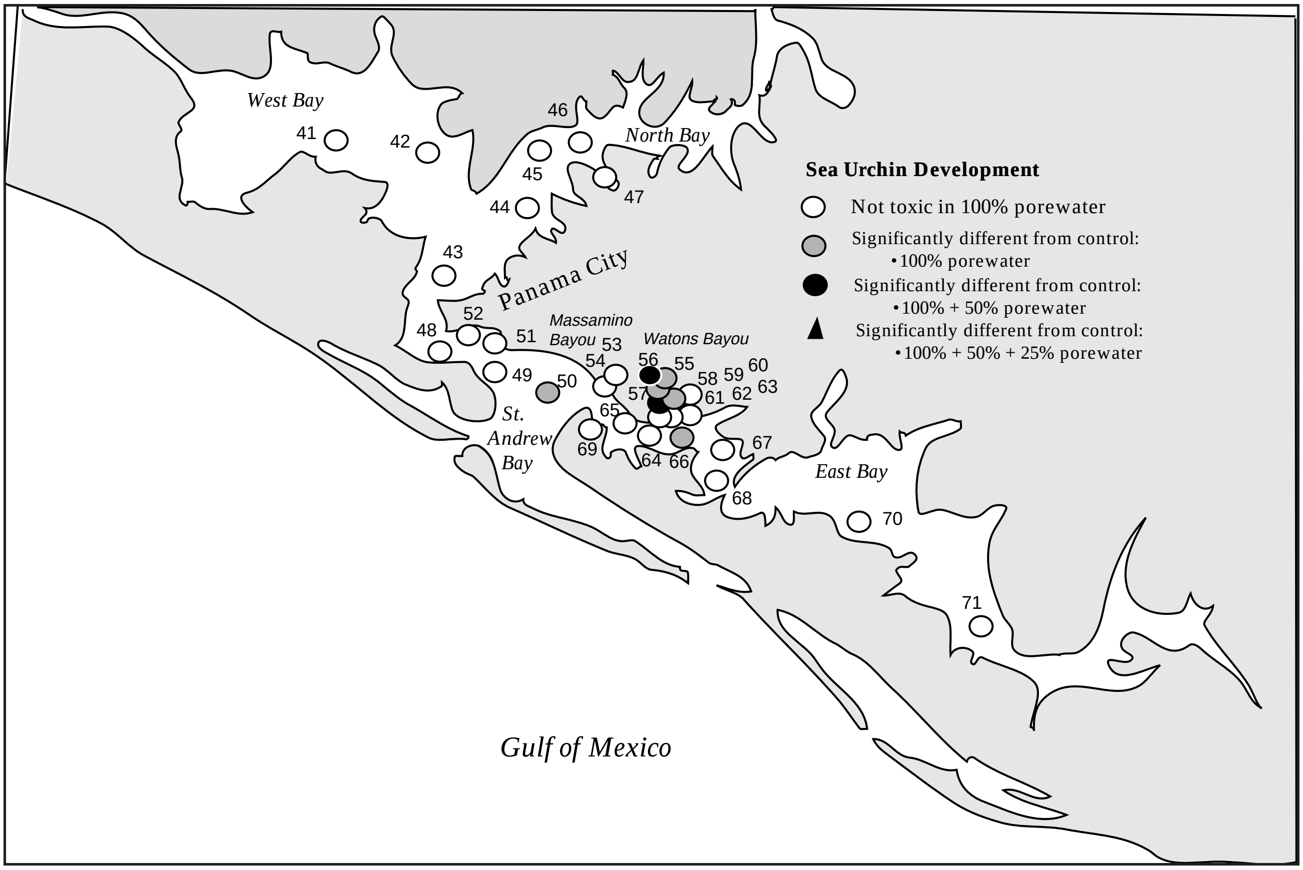


Figure 68. Sampling stations in St. Andrew Bay that were either not toxic or significantly different from controls in sea urchin development tests of sediment porewaters.

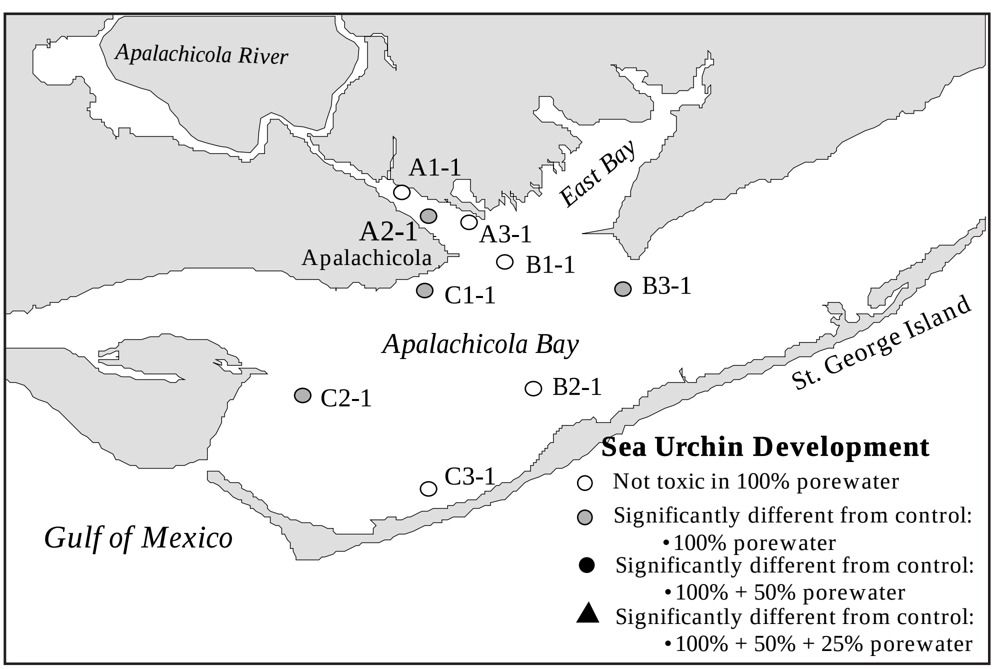


Figure 69. Sampling stations in Apalachicola Bay that were either not toxic or significantly different from controls in sea urchin development tests of sediment porewaters.

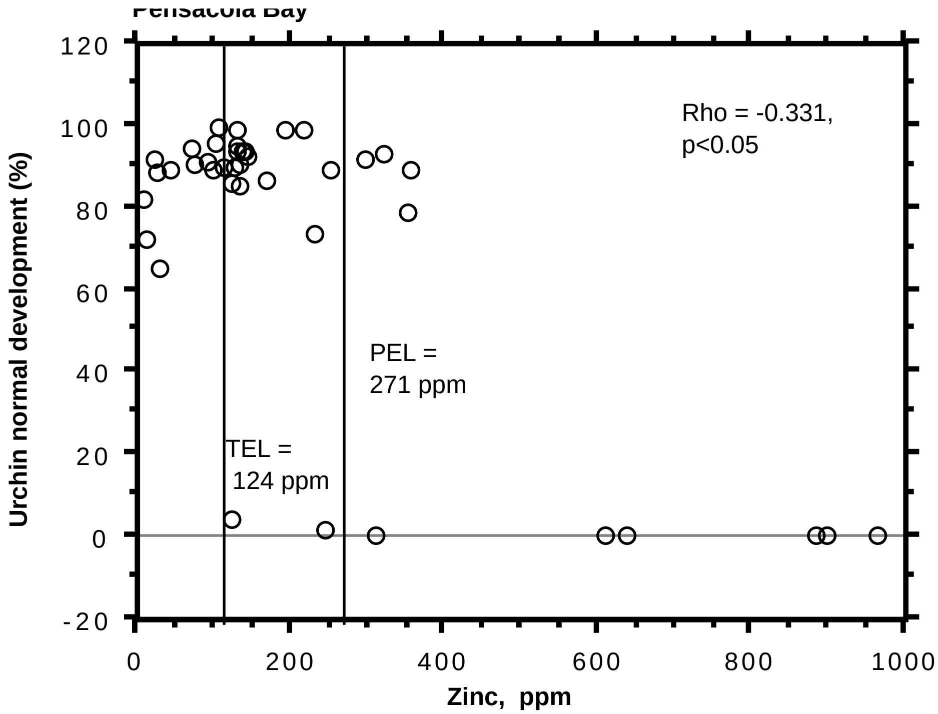


Figure 70. Relationship between normal urchin embryo development and the concentrations of zinc in Pensacola Bay.

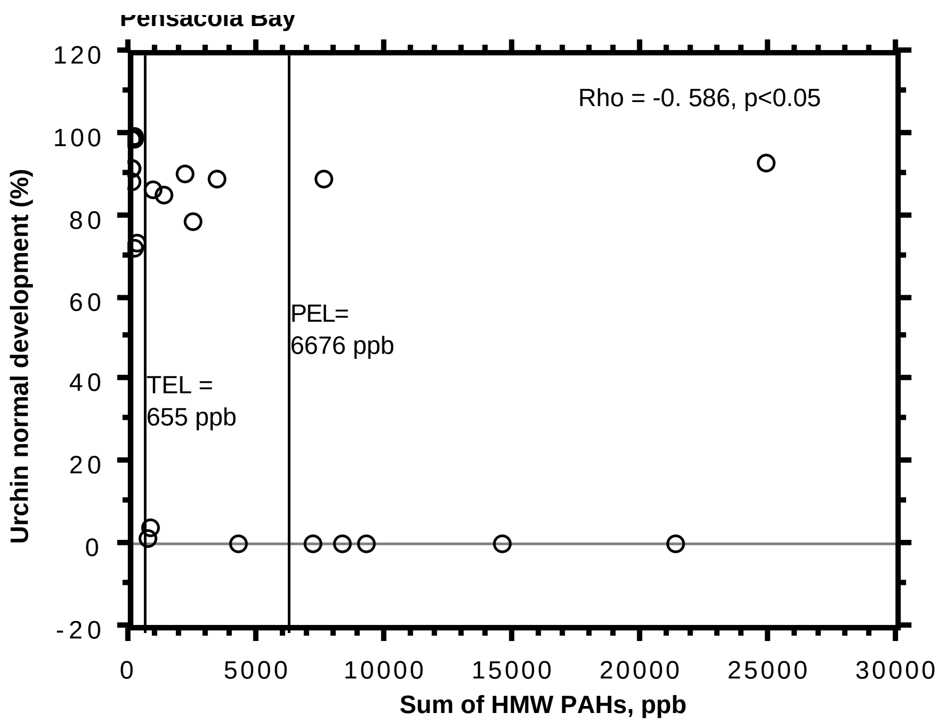


Figure 71. Relationship between urchin normal development and concentrations of high molecular weight PAHs in Pensacola Bay.

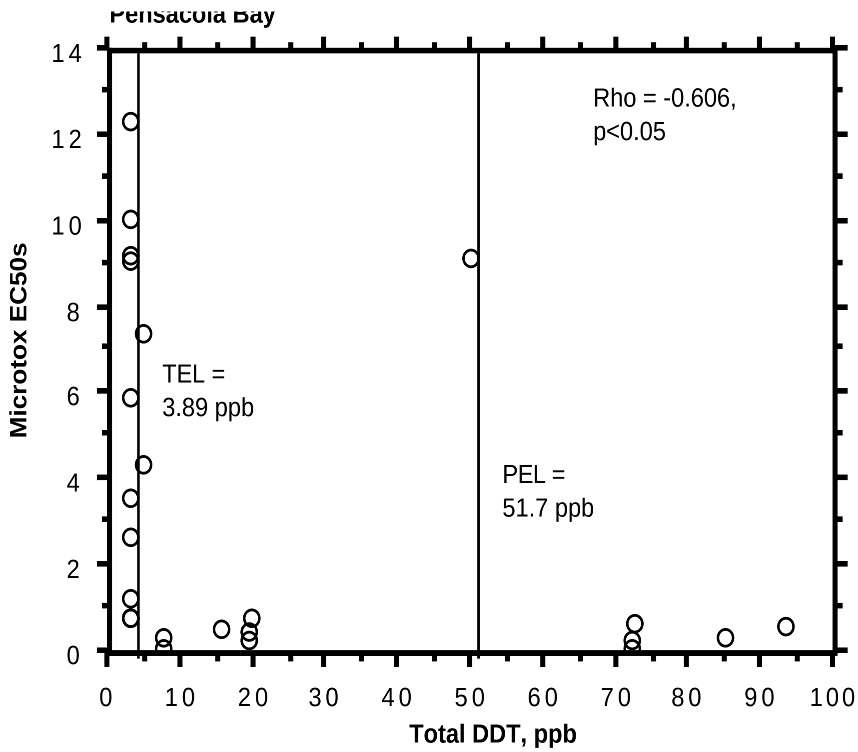


Figure 72. Relationship between Microtox™ EC50's and the contrations of total DDT in Pensacola Bay.

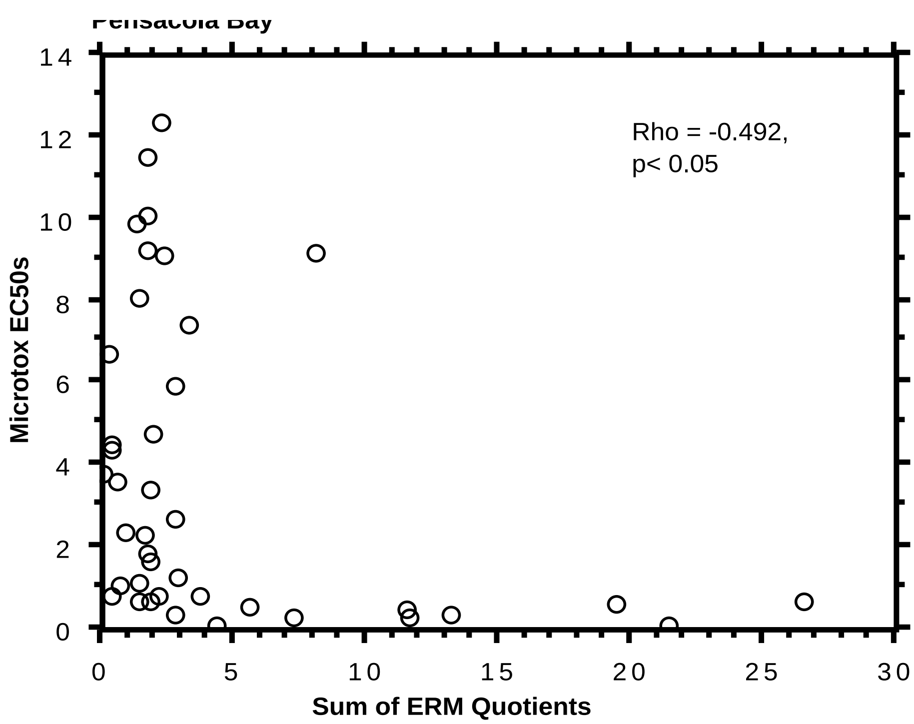


Figure 73. Relationship between Microtox™ EC50's and the sum of 18 chemical concentration/ERM quotients for Pensacola Bay.

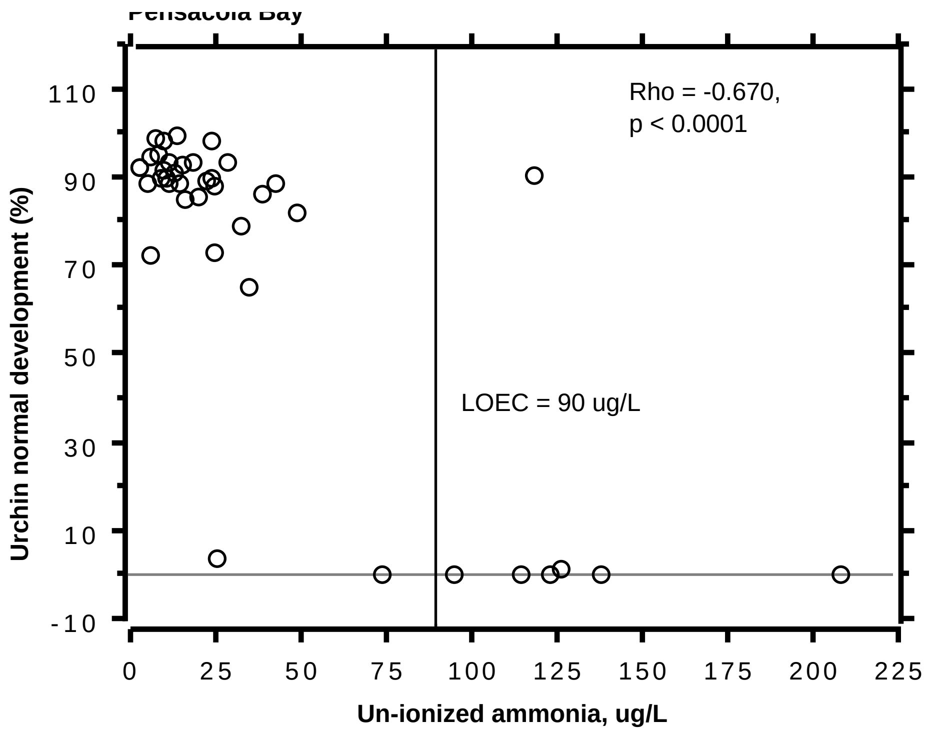


Figure 74. Relationship between urchin percent normal development and the concentrations of un-ionized ammonia in porewater from Pensacola Bay.

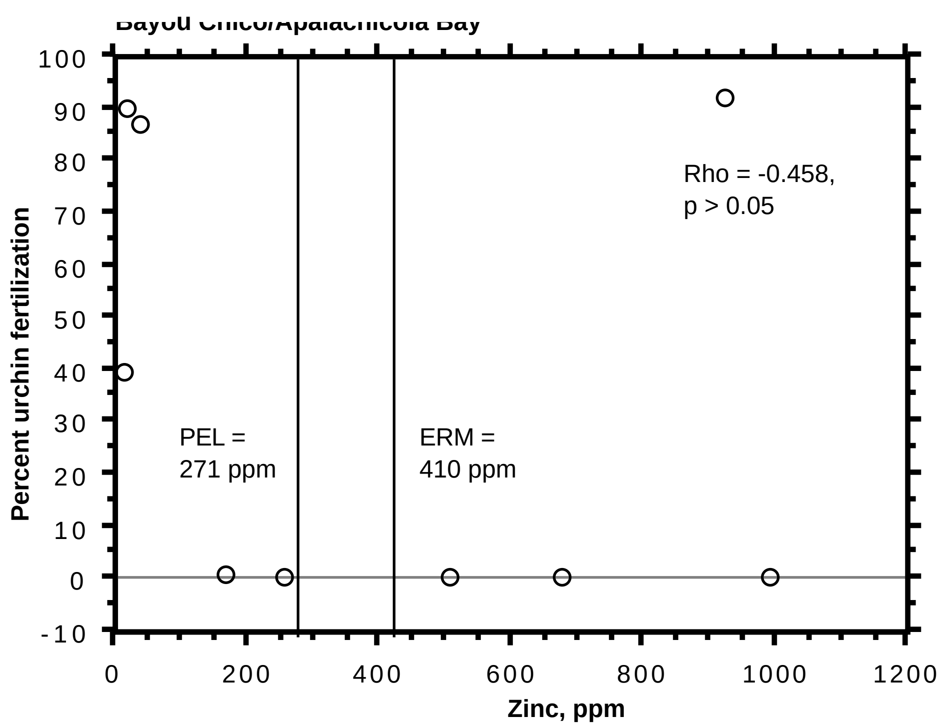


Figure 75. Relationship between sea urchin fertilization and the concentrations of zinc in samples from Bayou Chico and Apalachicola Bay.

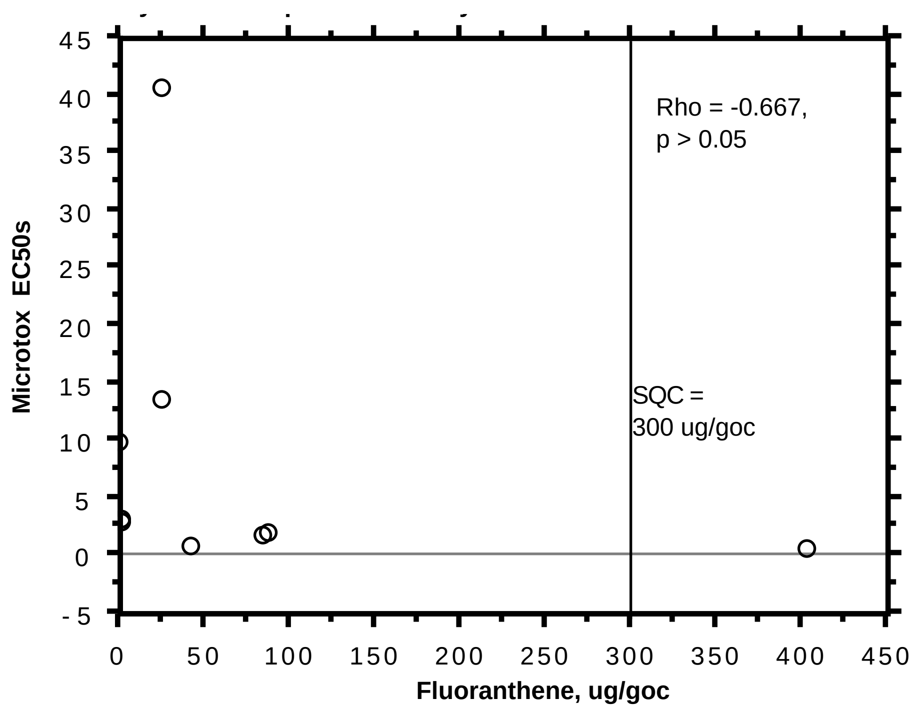


Figure 76. The relationship between Microtox™ EC50's and the concentrations of fluoranthene (ug/goc) in samples from Bayou Chico and Apalachicola Bay.

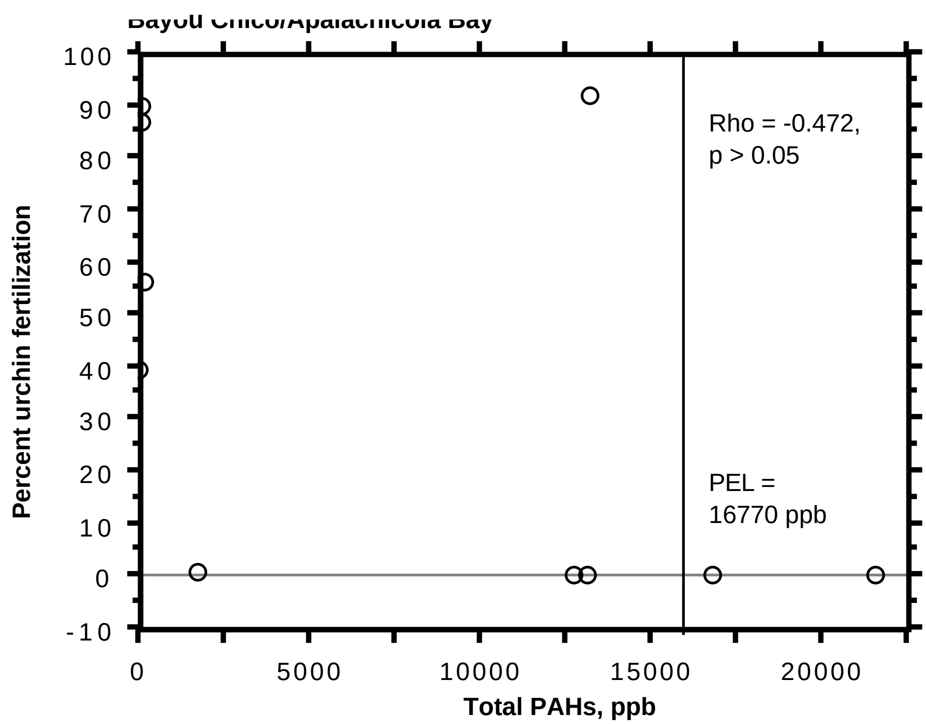


Figure 77. Relationship between sea urchin fertilization and concentrations of total PAHs in Bayou Chico and Apalachicola Bay.

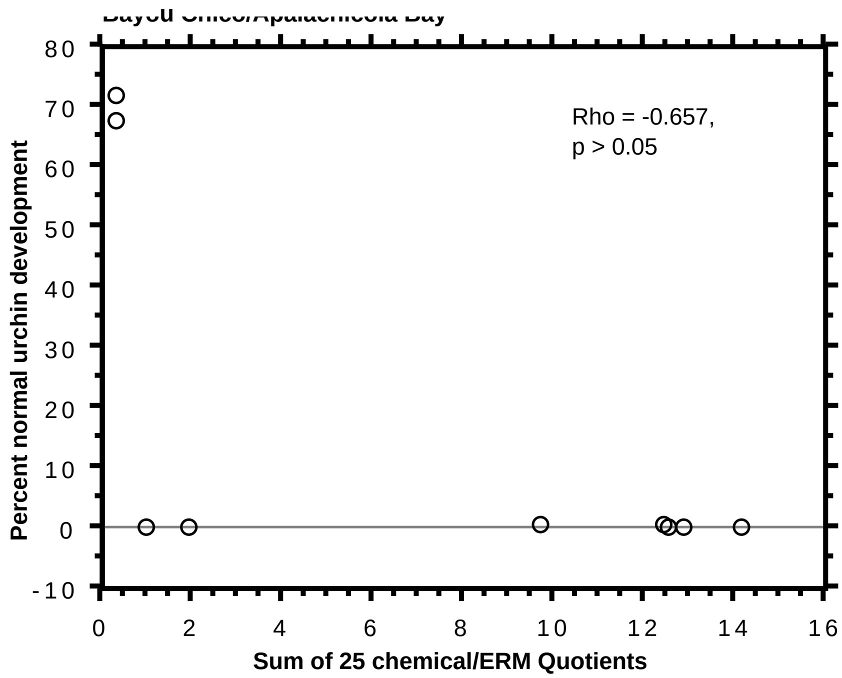


Figure 78. Relationship between urchin embryo development and the sum of 25 chemical concentration/ERM quotients in Bayou Chico and Apalachicola Bay.

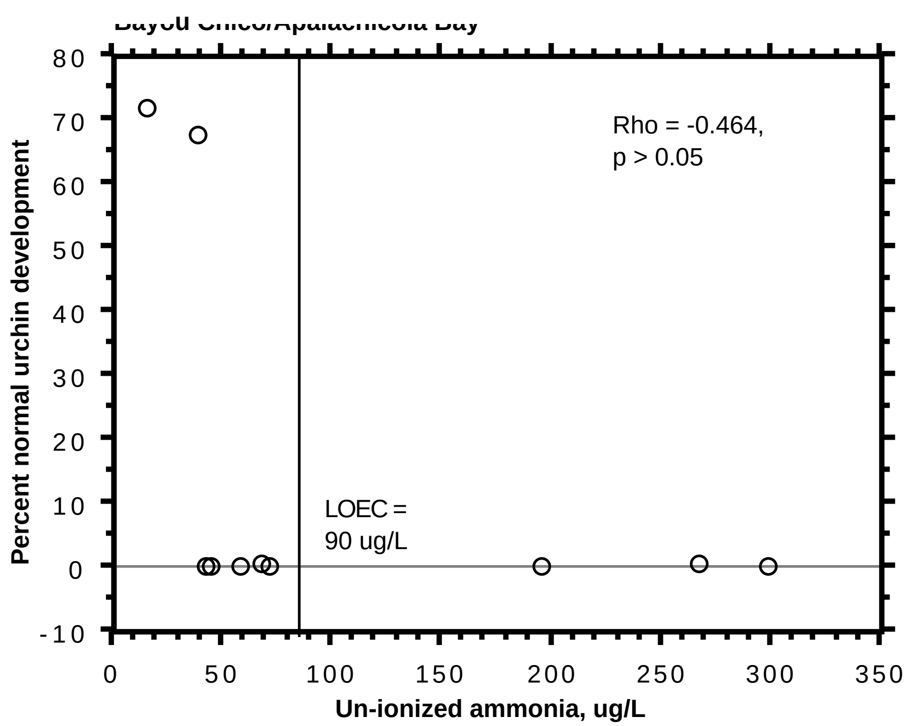


Figure 79. Relationship between urchin embryo development and concentrations of un-ionized ammonia in porewater in Bayou Chico and Apalachicola Bay.

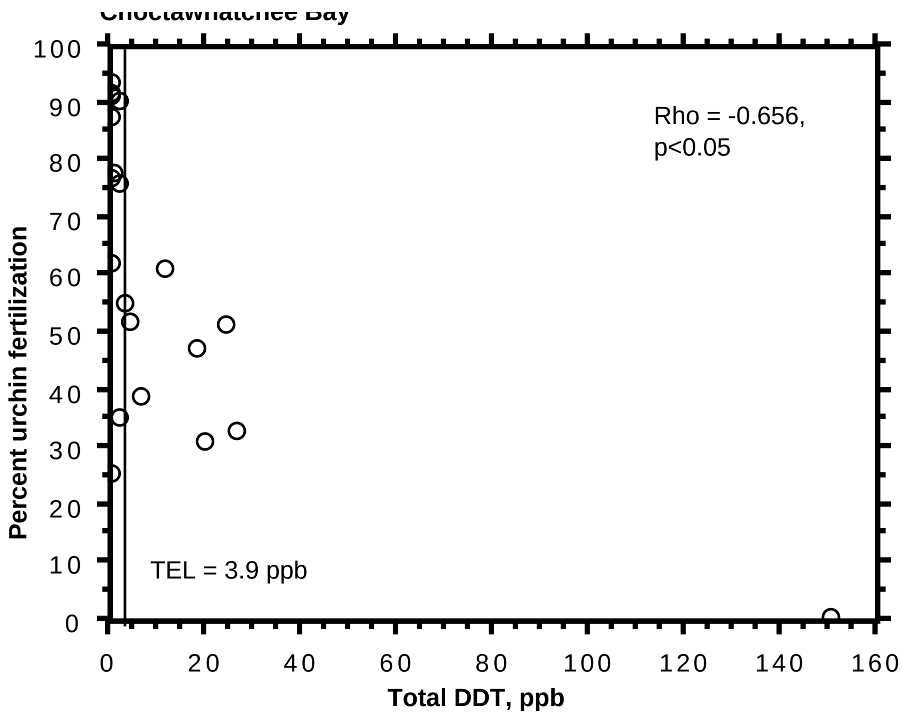


Figure 80. Relationship between sea urchin fertilization and the concentrations of total DDTs in Choctawhatchee Bay.

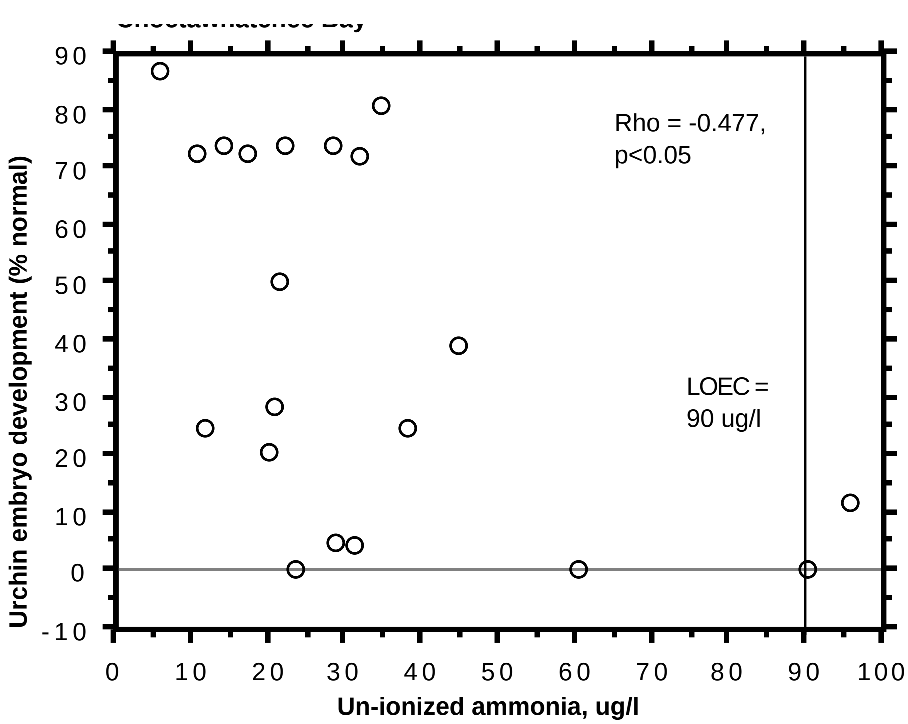


Figure 81. Relationship between urchin embryo development and concentrations of un-ionized ammonia in porewater in Choctawhatchee Bay.

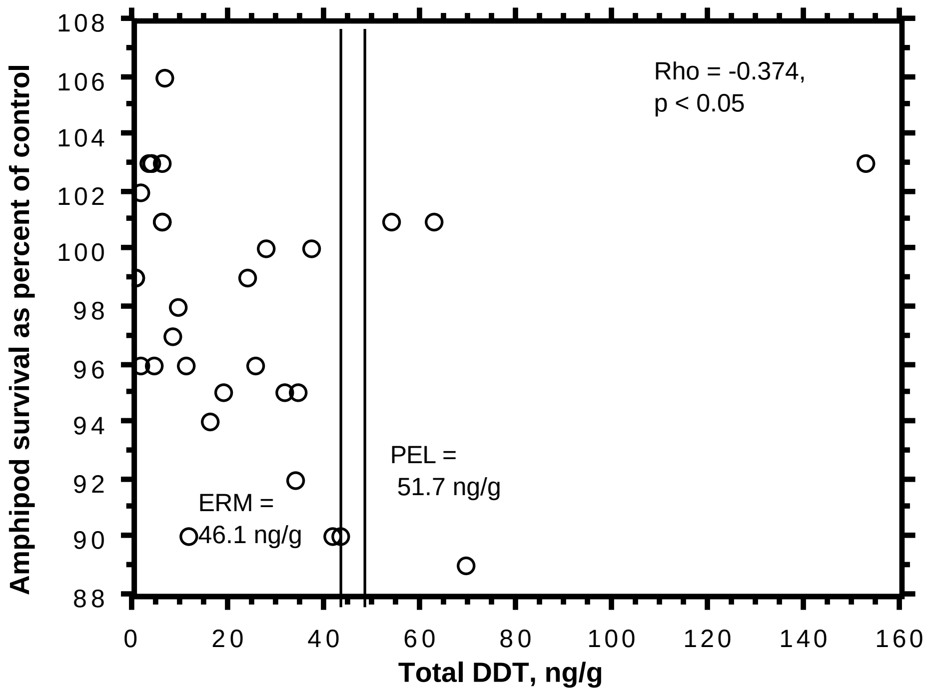


Figure 82. Relationship between amphipod survival and the concentrations of total DDT in St. Andrew Bay sediments.

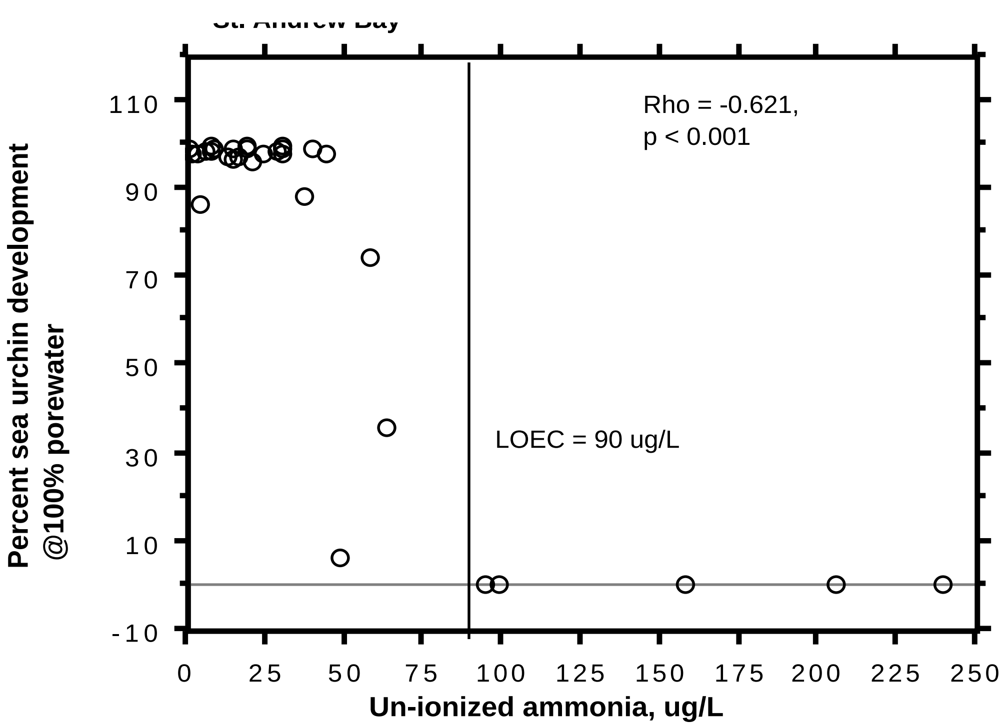


Figure 83. Relationship between sea urchin normal development and the concentrations of un-ionized ammonia in the porewater of St. Andrew Bay sediments.

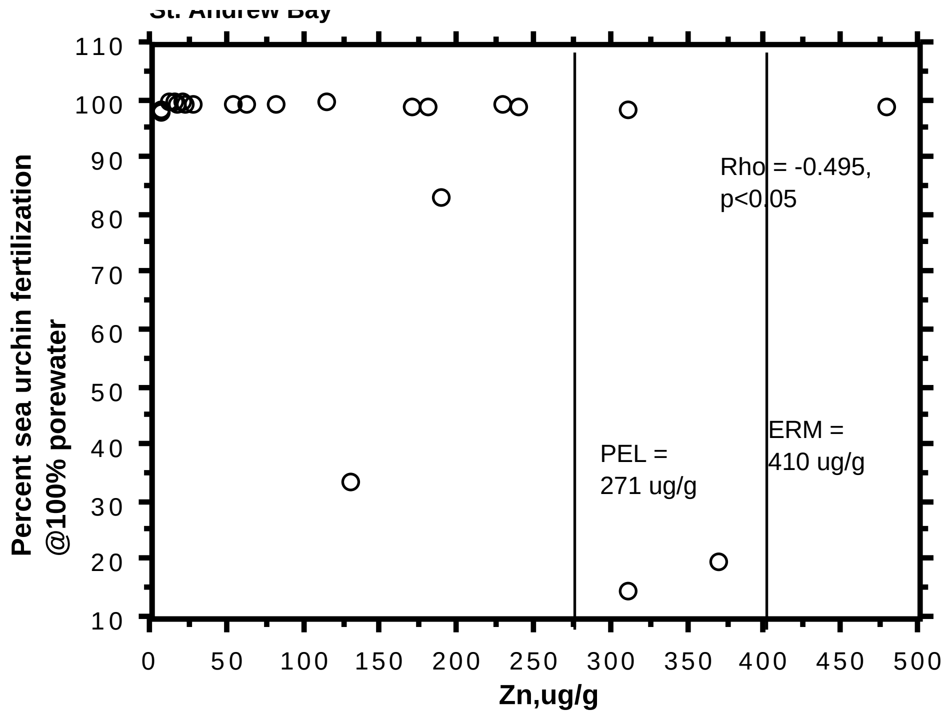


Figure 84. Relationship between percent sea urchin fertilization and the concentrations of zinc in St. Andrew Bay sediments.

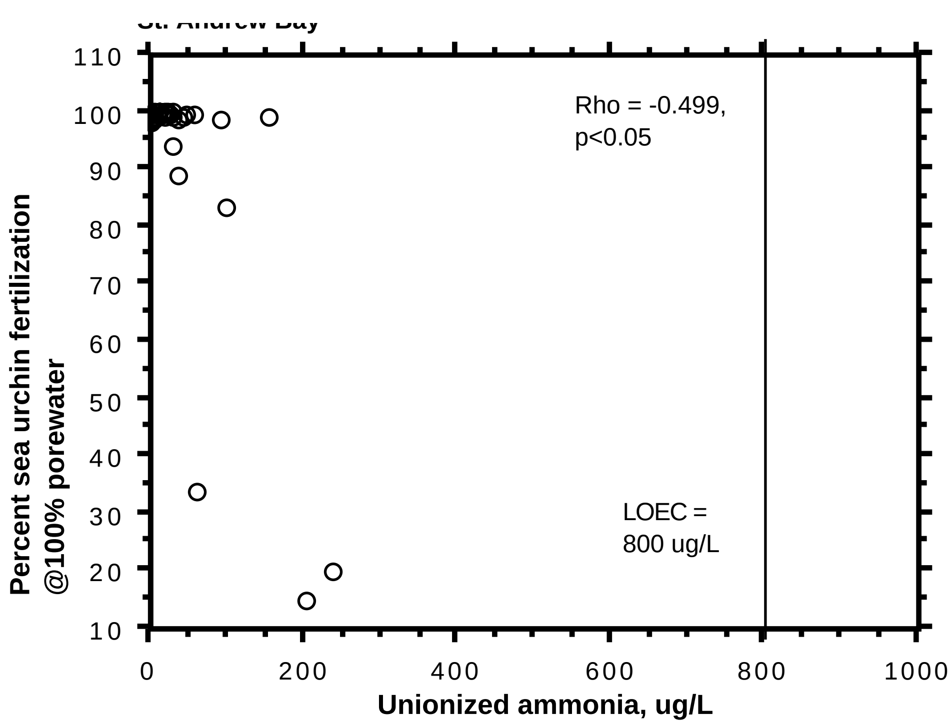


Figure 85. Relationship between sea urchin fertilization and the concentrations of un-ionized ammonia in porewater of sediments from St. Andrew Bay.

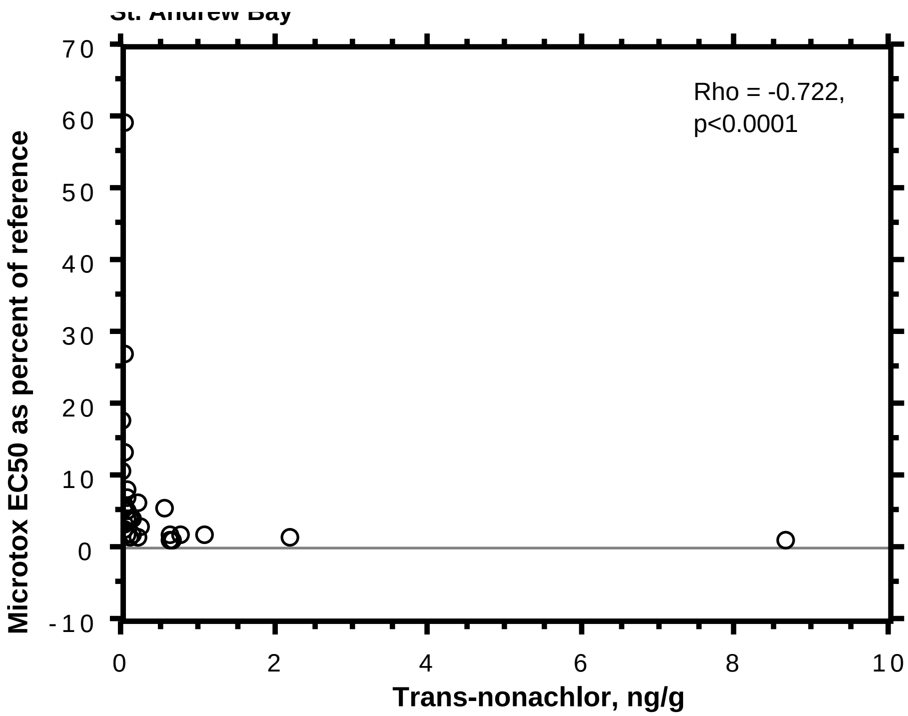


Figure 86. Relationship between microbial bioluminescence (Microtox EC50's) and the concentrations of trans-nonachlor in St. Andrew Bay sediments.

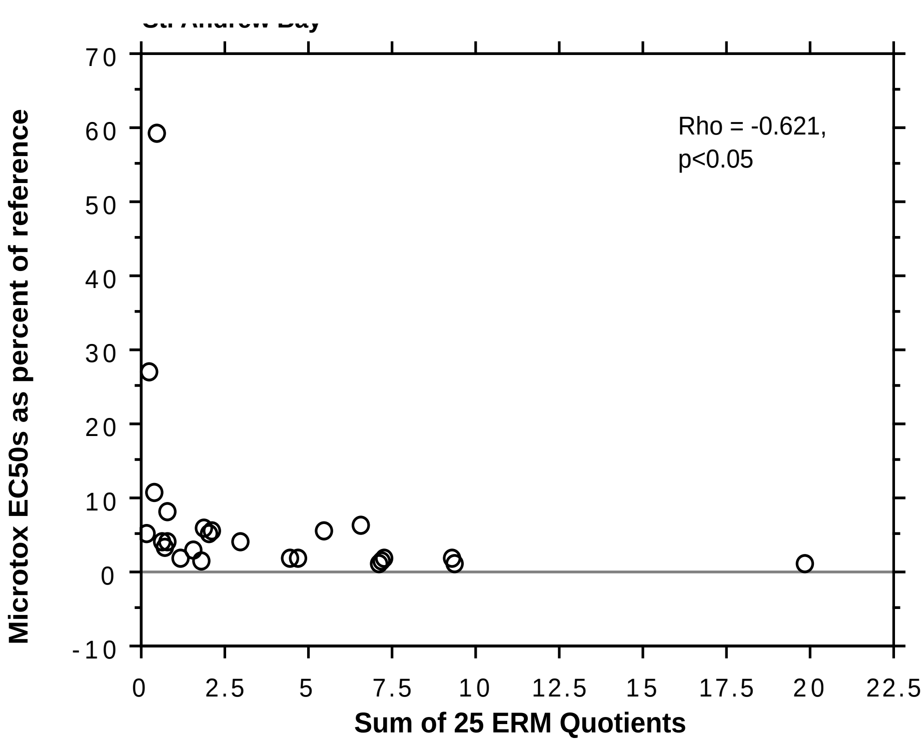


Figure 87. Relationship between the sum of 25 chemical concentration-to-ERM quotients and microbial bioluminescence (Microtox EC50's) in St. Andrew Bay sediments.

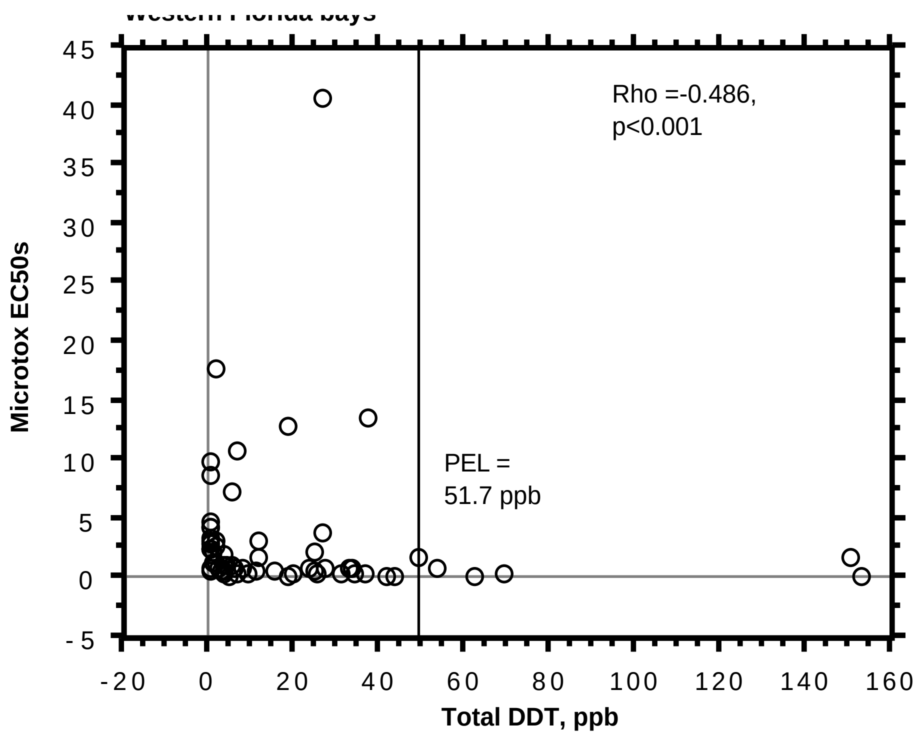


Figure 88. Relationship between Microtox™ EC50's and the concentrations of total DDTs in western Florida samples.

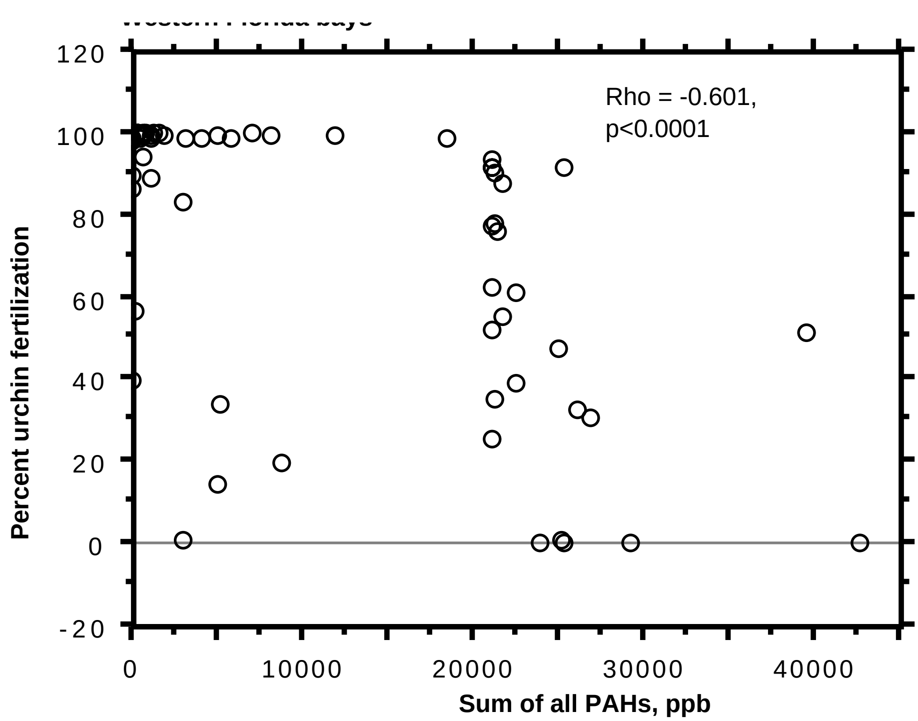


Figure 89. The relationship between urchin fertilization and the concentrations of all PAHs in western Florida samples.

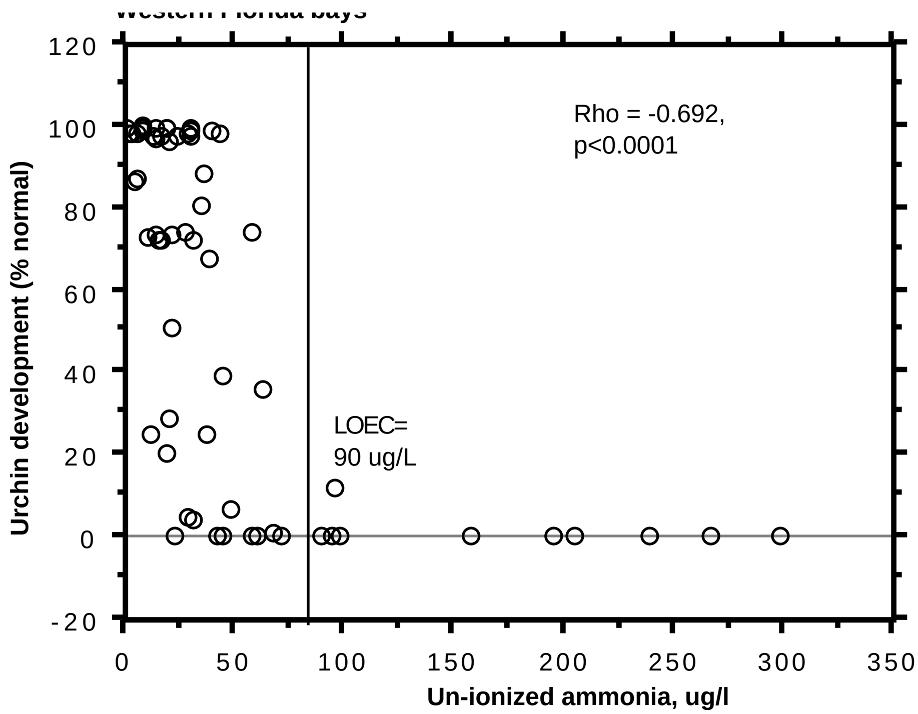


Figure 90. Relationship between urchin embryo normal development and the concentrations of un-ionized ammonia in porewater in western Florida samples.

Table 1. Coordinates of sampling stations in each bay.

Apalachicola Bay, 1994

Stratum	Station	Location	Latitude	Longitude
(A)B	1-1	Apalachicola Bay	30°28.43 ‘N	86°35.47 ‘W
(A)B	3-1	Apalachicola Bay	29°42.65 ‘N	84°53.98 ‘W
(A)B	2-1	Apalachicola Bay	29°39.65 ‘N	84°56.53 ‘W
(A)C	3-1	Apalachicola Bay	29°36.81 ‘N	84°59.66 ‘W
(A)C	2-1	Apalachicola Bay	29°39.28 ‘N	85°03.21 ‘W
(A)C	1-1	Apalachicola Bay	29°42.96 ‘N	84°59.23 ‘W
(A)A	1-1	Apalachicola Bay	29°45.29 ‘N	85°00.69 ‘W
(A)A	2-1	Apalachicola Bay	29°44.47 ‘N	84°59.89 ‘W
(A)A	3-1	Apalachicola Bay	29°43.63 ‘N	84°58.46 ‘W

Choctawhatchee Bay, 1994

Stratum	Station	Location	Latitude	Longitude
(C)B	1-1	Garnier Bayou	30°28.43 ‘N	86°35.46 ‘W
(C)B	2-3	Garnier Bayou	30°27.80 ‘N	86°35.75 ‘W
(C)B	3-1	Dons Bayou	30°27.05 ‘N	86°36.18 ‘W
(C)C	1-2	Hand Cove, Garnier Bayou	30°26.95 ‘N	86°35.37 ‘W
(C)C	2-1	Garnier Bayou	30°26.65 ‘N	86°35.58 ‘W
(C)C	3-1	Garnier Bayou	30°25.88 ‘N	86°35.45 ‘W
(C)L	1-2	Choctawhatchee Bay	30°25.22 ‘N	86°32.64 ‘W
(C)A	1-1	Cinco Bayou	30°25.74 ‘N	86°38.06 ‘W
(C)A	2-1	Cinco Bayou	30°25.71 ‘N	86°37.12 ‘W
(C)A	3-1	Cinco Bayou	30°25.54 ‘N	86°36.51 ‘W
(C)L	3-1	Choctawhatchee Bay	30°28.51 ‘N	86°28.15 ‘W
(C)L	2-1	Choctawhatchee Bay	30°26.72 ‘N	86°30.77 ‘W
(C)H	1-1	Joes Bayou	30°24.55 ‘N	86°29.30 ‘W
(C)H	2-1	Joes Bayou	30°24.92 ‘N	86°29.48 ‘W
(C)D	3-1	Destin Harbor	30°23.37 ‘N	86°29.57 ‘W
(C)D	2-2	Destin Harbor	30°23.37 ‘N	86°29.94 ‘W
(C)D	1-1	Destin Harbor	30°23.44 ‘N	86°30.20 ‘W
(C)E	1-1	Boggy Bayou	30°30.95 ‘N	86°29.49 ‘W
(C)E	2-1	Boggy Bayou	30°29.83 ‘N	86°29.13 ‘W
(C)E	3-1	Boggy Bayou	30°29.72 ‘N	86°28.93 ‘W
(C)F	1-1	Tom’s Bayou	30°30.18 ‘N	86°30.02 ‘W
(C)F	2-1	Tom’s Bayou	30°30.16 ‘N	86°29.58 ‘W
(C)G	1-1	Boggy Bayou	30°30.23 ‘N	86°25.15 ‘W
(C)G	2-1	Rocky Bayou	30°30.27 ‘N	86°26.24 ‘W
(C)G	3-1	Rocky Bayou	30°30.34 ‘N	86°27.10 ‘W
(C)G	4-1	Rocky Bayou	30°29.94 ‘N	86°27.17 ‘W
(C)M	3-1	Choctawhatchee Bay	30°27.21 ‘N	86°24.53 ‘W
(C)M	2-1	Choctawhatchee Bay	30°27.77 ‘N	86°19.08 ‘W
(C)M	1-1	Choctawhatchee Bay	30°28.16 ‘N	86°16.87 ‘W
(C)N	1-1	Choctawhatchee Bay	30°26.37 ‘N	86°14.09 ‘W
(C)N	2-1	Choctawhatchee Bay	30°24.61 ‘N	86°10.55 ‘W
(C)N	3-1	Choctawhatchee Bay	30°23.59 ‘N	86°10.02 ‘W
(C)J	1-1	Alaqua Bayou	30°29.12 ‘N	86°12.62 ‘W
(C)J	2-1	Alaqua Bayou	30°29.02 ‘N	86°12.34 ‘W
(C)K	1-1	La Grange Bayou	30°28.23 ‘N	86°08.23 ‘W
(C)K	2-1	La Grange Bayou	30°28.09 ‘N	86°08.65 ‘W
(C)K	3-1	La Grange Bayou	30°27.50 ‘N	86°09.31 ‘W

Table 1 Continued.

Pensacola Bay, 1993

Stratum	Station	Location	Latitude	Longitude
A	1	Bayou Grande	30°22.548'	87°16.743'
A	2	Bayou Grande	30°22.095'	87°17.091'
A	3	Bayou Grande	30°22.258'	87°18.771'
B	4	Bayou Chico	30°24.425'	87°15.387'
B	5	Bayou Chico	30°24.317'	87°15.377'
B	6	Bayou Chico	30°24.196'	87°15.245'
B	7	Bayou Chico	30°24.041'	87°14.786'
B	8	Bayou Chico	30°23.966'	87°14.667'
B	9	Bayou Chico	30°23.935'	87°14.385'
C	10	Bayou Texar	30°27.113'	87°12.078'
C	11	Bayou Texar	30°26.646'	87°11.241'
C	12	Bayou Texar	30°25.910'	87°11.168'
C	13	Bayou Texar	30°25.661'	87°11.362'
D	14	Warrington	30°22.836'	87°15.130'
E	15	Bayou Chico	30°23.389'	87°13.587'
E	16	Bayou Channel	30°23.558'	87°13.989'
F	17	Inner Harbor Channel	30°24.141'	87°13.622'
F	18	Inner Harbor	30°24.175'	87°13.296'
F	19	Inner Harbor	30°24.134	87°12.895
F	20	Inner Harbor	30°24.138'	87°12.855'
G	21	Pensacola Bay	30°23.010'	87°13.012'
G	22	Pensacola Bay	30°23.463'	87°12.949'
G	23	Inner Harbor	30°23.853'	87°13.010'
H	24	Lower Bay	30°22.081'	87°12.650'
H	25	Lower Bay	30°22.521'	87°14.464'
J	26	East Bay	30°28.289'	87°03.152'
K	27	East Bay	30°26.634'	86°59.533'
K	28	East Bay	30°27.744'	86°58.686'
L	29	Blackwater Bay	30°31.726'	87°00.973'
L	30	Blackwater Bay	30°32.602'	87°00.788'
L	31	Blackwater Bay	30°34.817'	87°00.661'
M	32	Escambia Bay	30°28.886'	87°07.199'
N	33	Escambia Bay	30°31.169'	87°07.219'
N	34	Escambia Bay	30°31.621'	87°08.723'
O	35	Escambia Bay	30°32.137'	87°10.797'
O	36	Escambia Bay	30°32.923'	87°11.299'
O	37	Escambia River Mouth	30°33.754'	87°10.479'
P	38	Escambia	30°33.337'	87°09.150'
P	39	Floridatown	30°34.470'	87°09.960'
I	40	Central Bay	30°24.335'	87°07.090'

Pensacola Bay, 1994

Stratum	Station	Location	Latitude	Longitude
(BC)	1-2	Bayou Chico	30°24.42 ‘N	87°15.48 ‘W
(BC)	2-2	Bayou Chico	30°24.25 ‘N	87°15.34 ‘W
(BC)	3-2	Bayou Chico	30°24.15 ‘N	87°15.20 ‘W
(BC)	4-2	Bayou Chico	30°24.15 ‘N	87°14.91 ‘W
(BC)	5-3	Bayou Chico	30°24.01 ‘N	87°14.65 ‘W
(BC)	6-2	Bayou Chico	30°23.96 ‘N	87°14.48 ‘W

Table 1 continued.

St. Andrew Bay, 1993

Stratum	Station	Location	Latitude	Longitude
A	41	West Bay	30°15.492'	85°47.389'
A	42	West Bay	30°15.166'	85°45.219'
B	43	North Bay	30°12.011'	85°44.116'
B	44	North Bay	30°13.752'	85°41.849'
B	45	North Bay	30°14.781'	85°41.072'
B	46	North Bay	30°15.194'	85°40.090'
B	47	Lynn Haven	30°14.741'	85°39.662'
C	48	St. Andrew Bay	30°09.929'	85°43.562'
C	49	St. Andrew Bay	30°09.562'	85°42.415'
C	50	St. Andrew Bay	30°08.956'	85°40.785'
C	51	St. Andrew Bay	30°10.016'	85°42.345'
C	52	St. Andrew Bay	30°10.533'	85°43.315'
D	53	Massalina Bayou	30°09.239'	85°39.354'
D	54	Massalina Bayou	30°09.140'	85°39.384'
E	55	Watson Bayou	30°09.346'	85°38.418'
E	56	Upper Watson	30°09.179'	85°38.380'
E	57	Upper Watson	30°09.077'	85°38.336'
E	58	Mid Watson	30°08.834'	85°38.006'
E	59	Mid Watson	30°08.656'	85°37.960'
E	60	Mid Watson	30°08.862'	85°37.707'
E	61	Lower Watson	30°08.480'	85°38.469'
E	62	Lower Watson	30°08.454'	85°38.146'
E	63	Watson Bayou	30°08.444'	85°37.993'
F	64	St. Andrew Bay	30°08.443'	85°39.369'
F	65	St. Andrew Bay	30°08.039'	85°38.948'
F	66	Mouth of Watson Bayou	30°08.058'	85°38.092'
F	67	St. Andrew Bay	30°07.573'	85°36.759'
F	68	Mouth of Pearl Bayou	30°06.214'	85°36.669'
F	69	Smak Bayou	30°07.729'	85°40.003'
G	70	West-East Bay	30°05.284'	85°33.068'
G	71	East-East Bay	30°02.498'	85°30.093'

Table 2. Numbers of stations sampled and tested for toxicity and numbers of stations tested for chemistry in four western Florida bays.

Bay name	Year sampled	Total number of stations	Number of stations tested for chemistry
Pensacola Bay	1993	40	20 (organics) 40 (metals)
Bayou Chico	1994	6	6
Choctawhatchee Bay	1994	37	21
St. Andrew Bay	1993	31	31 (organics) 22 (metals)
Apalachicola Bay	1994	9	3

Table 3. Summary of data from amphipod toxicity tests performed in both years on all samples; listed as mean percent survival, statistical significance and percent of control for each station.

Pensacola Bay, 1993	Station number	Location	Mean % survival ± standard deviation	Statistical Significance	% of Control
Control ("home" sediments)		San Francisco Bay	68 ± 10.4		
Reference		Redfish Bay, Texas	55 ± 3.5		
Stratum					
A	1	Bayou Grande	72 ± 8.4	ns	106
A	2	Bayou Grande	68 ± 15.6	ns	100
A	3	Bayou Grande	72 ± 12.0	ns	106
B	4	Bayou Chico	71 ± 11.4	ns	104
B	5	Bayou Chico	73 ± 14.4	ns	107
B	6	Bayou Chico	67 ± 5.7	ns	98
B	7	Bayou Chico	68 ± 16.0	ns	100
B	8	Bayou Chico	69 ± 13.9	ns	101
B	9	Bayou Chico	75 ± 7.9	ns	110
C	10	Bayou Texar	66 ± 16.7	ns	97
C	11	Bayou Texar	76 ± 10.2	ns	112
C	12	Bayou Texar	74 ± 16.7	ns	109
C	13	Bayou Texar	66 ± 12.9	ns	97
D	14	Warrington	71 ± 9.6	ns	104
E	15	Bayou Chico	76 ± 8.9	ns	112
E	16	Bayou Channel	70 ± 11.2	ns	103
F	17	Inner Harbor Channel	75 ± 16.6	ns	110
F	18	Inner Harbor	75 ± 10.0	ns	110
F	19	Inner Harbor	74 ± 16.4	ns	109
F	20	Inner Harbor	70 ± 12.7	ns	103
G	21	Pensacola Bay	70 ± 20.9	ns	103
G	22	Pensacola Bay	74 ± 14.3	ns	109
G	23	Inner Harbor	69 ±16.7	ns	101
H	24	Lower Bay	68 ± 17.9	ns	100
H	25	Lower Bay	63 ± 9.7	ns	93
J	26	East Bay	77 ± 13.5	ns	113
K	27	East Bay	74 ± 12.4	ns	109
K	28	East Bay	77 ± 7.6	ns	113
L	29	Blackwater Bay	61 ± 16.4	ns	88
L	30	Blackwater Bay	72 ± 14.8	ns	106
L	31	Blackwater Bay	74 ± 6.5	ns	109
M	32	Escambia Bay	71 ± 10.8	ns	104
N	33	Escambia Bay	67 ± 11.5	ns	98
N	34	Escambia Bay	63 ± 19.6	ns	93
O	35	Escambia Bay	60 ± 15.4	ns	88
O	36	Escambia Bay	65 ± 9.4	ns	96
O	37	Escambia River Mouth	62 ± 23.1	ns	91
P	38	Escambia	73 ± 7.6	ns	107
P	39	Floridatown	73 ± 7.6	ns	107
I	40	Central Bay	66 ± 11.9	ns	97

Table 3 continued.

Pensacola Bay, 1994	Station Number	Location	Mean % survival ± standard deviation	Statistical Significance	% of Control
Control		Central Long Island Sd.	92±4.5		
Stratum					
(BC)	1-2	Bayou Chico	93 ± 2.7	ns	101
(BC)	2-2	Bayou Chico	97 ± 4.5	ns	105
(BC)	3-2	Bayou Chico	94 ± 2.2	ns	102
(BC)	4-2	Bayou Chico	86 ± 9.6	ns	93
(BC)	5-3	Bayou Chico	68 ± 15.7	**	74
(BC)	6-2	Bayou Chico	94 ± 6.5	ns	102

Choctawhatchee Bay, 1994	Station number	Station Location	Mean % survival ± standard deviation	Statistical Significance	% of Control
Control		Central Long Island Sd.	92±4.5		
Control		Central Long Island Sd.	85±6.1		
Control		Central Long Island Sd.	98±2.7		
Control		Central Long Island Sd.	97±4.5		
Control		Central Long Island Sd.	98±2.7		
Stratum					
(C)A	1-1	Cinco Bayou	88 ± 4.5	ns	104
(C)A	2-1	Cinco Bayou	95 ± 3.5	ns	97
(C)A	3-1	Cinco Bayou	87 ± 7.6	ns	102
(C)B	1-1	Garnier Bayou	94 ± 4.2	ns	102
(C)B	2-3	Garnier Bayou	95 ± 5.0	ns	103
(C)B	3-1	Dons Bayou	94 ± 6.5	ns	102
(C)C	1-2	Hand Cove, Garnier Bayou	98 ± 2.7	ns	107
(C)C	2-1	Garnier Bayou	87 ± 6.7	ns	102
(C)C	3-1	Garnier Bayou	93 ± 4.5	ns	109
(C)D	1-1	Destin Harbor	93 ± 2.7	ns	106
(C)D	2-2	Destin Harbor	95 ± 3.5	ns	108
(C)D	3-1	Destin Harbor	94 ± 8.9	ns	107
(C)E	1-1	Boggy Bayou	96 ± 2.2	ns	98
(C)E	2-1	Boggy Bayou	99 ± 2.2	ns	113
(C)E	3-1	Boggy Bayou	95 ± 5.0	ns	108
(C)F	1-1	Tom's Bayou	93 ± 5.7	ns	106
(C)F	2-1	Tom's Bayou	94 ± 4.2	ns	107
(C)G	1-1	Boggy Bayou	96 ± 4.2	ns	109
(C)G	2-1	Rocky Bayou	94 ± 4.2	ns	107
(C)G	3-1	Rocky Bayou	95 ± 3.5	ns	108
(C)G	4-1	Rocky Bayou	98 ± 2.7	ns	111
(C)H	1-1	Joes Bayou	89 ± 6.5	ns	105
(C)H	2-1	Joes Bayou	92 ± 7.6	ns	108
(C)J	1-1	Alaqua Bayou	94 ± 5.5	ns	97
(C)J	2-1	Alaqua Bayou	94 ± 4.2	ns	96
(C)K	1-1	La Grange Bayou	90 ± 7.1	ns	93
(C)K	2-1	La Grange Bayou	84 ± 8.2	*	87
(C)K	3-1	La Grange Bayou	92 ± 7.6	ns	95
(C)L	1-2	Choctawhatchee Bay	87 ± 5.7	ns	102

Table 3 continued.

Choctawhatchee Bay, 1994	Station number	Station Location	Mean % survival ± standard deviation	Statistical Significance	% of Control
(C)L	2-1	Choctawhatchee Bay	88 ± 7.6	ns	104
(C)L	3-1	Choctawhatchee Bay	97 ± 4.5	ns	99
(C)M	1-1	Choctawhatchee Bay	98 ± 2.7	ns	100
(C)M	2-1	Choctawhatchee Bay	92 ± 7.6	ns	105
(C)M	3-1	Choctawhatchee Bay	93 ± 2.7	ns	106
(C)N	1-1	Choctawhatchee Bay	96 ± 4.2	ns	109
(C)N	2-1	Choctawhatchee Bay	91 ± 10.8	ns	94
(C)N	3-1	Choctawhatchee Bay	98 ± 2.7	ns	101

St. Andrew Bay, 1993	Station number	Station location	Mean % survival ± standard deviation	Statistical Significance	% of Control
Control ("home") sediments		San Francisco Bay	93 ± 8.4		
Reference		Redfish Bay, Texas	97 ± 2.7		
Stratum					
A	41	West Bay	92 ± 5.7	ns	99
A	42	West Bay	94 ± 5.5	ns	101
B	43	North Bay	84 ± 8.9	ns	90
B	44	North Bay	91 ± 4.2	ns	98
B	45	North Bay	90 ± 10.0	ns	97
B	46	North Bay	88 ± 11.5	ns	95
B	47	Lynn Haven	86 ± 4.2	ns	92
C	48	St. Andrew Bay	95 ± 5.0	ns	102
C	49	St. Andrew Bay	96 ± 6.5	ns	103
C	50	St. Andrew Bay	89 ± 6.5	ns	96
C	51	St. Andrew Bay	85 ± 3.5	ns	103
C	52	St. Andrew Bay	89 ± 6.5	ns	96
D	53	Massalina Bayou	96 ± 5.5	ns	103
D	54	Massalina Bayou	84 ± 7.4	ns	90
E	55	Watson Bayou	93 ± 5.7	ns	100
E	56	Upper Watson	84 ± 14.7	ns	90
E	57	Upper Watson	93 ± 2.7	ns	100
E	58	Mid Watson	94 ± 6.5	ns	101
E	59	Mid Watson	87 ± 10.4	ns	94
E	60	Mid Watson	83 ± 29.9	ns	89
E	61	Lower Watson	88 ± 5.7	ns	95
E	62	Lower Watson	85 ± 17.3	ns	103
E	63	Watson Bayou	94 ± 6.5	ns	101
F	64	St. Andrew Bay	96 ± 4.2	ns	103
F	65	St. Andrew Bay	89 ± 8.9	ns	96
F	66	Mouth of Watson Bayou	89 ± 8.9	ns	96
F	67	St. Andrew Bay	94 ± 6.5	ns	101
F	68	Mouth of Pearl Bayou	92 ± 4.5	ns	99
F	69	Smak Bayou	88 ± 7.6	ns	95
G	70	West-East Bay	99 ± 2.2	ns	106
G	71	East-East Bay	92 ± 5.7	ns	99

Table 3 continued.

Apalachicola Bay, 1994	Station number	Station location	Mean % survival ± standard deviation	Statistical Significance	% of Control
Control		Central Long Island Sd.	97±4.5		
		Central Long Island Sd.	98±2.7		
Stratum					
(A)A	1-1	Apalachicola Bay	93 ± 5.7	ns	96
(A)A	2-1	Apalachicola Bay	86 ± 14.7	ns	89
(A)A	3-1	Apalachicola Bay	87 ± 6.7	*	90
(A)B	1-1	Apalachicola Bay	93 ± 4.5	ns	96
(A)B	2-1	Apalachicola Bay	96 ± 5.5	ns	99
(A)B	3-1	Apalachicola Bay	96 ± 4.2	ns	99
(A)C	1-1	Apalachicola Bay	95 ± 5.0	ns	97
(A)C	2-1	Apalachicola Bay	96 ± 4.2	ns	99
(A)C	3-1	Apalachicola Bay	94 ± 4.2	ns	97

ns = not significant (p>0.05)
* = significantly different from controls (p<0.05)
** = survival <80% of controls

Table 4. Results from Microtox (TM) tests for both years and from all stations in the four western Florida Bays; expressed as mean EC 50s (mg equivalents, wet wt.) and standard deviations, statistical significance, and percent of controls.

Microtox			EC 50 Mean± SD	significance
Apalachicola Bay, 1994				
Block	**Station**	**Station Location**	**Mean± SD**	**significance**
(A)A	1-1	Apalachicola Bay	58.5± 10.2	ns
(A)A	2-1	Apalachicola Bay	3.1± 0.8	**
(A)A	3-1	Apalachicola Bay	5.6± 1.1	**
(A)B	1-1	Apalachicola Bay	2.8± 0.4	**
(A)B	2-1	Apalachicola Bay	22.7± 3.7	**
(A)B	3-1	Apalachicola Bay	7.8± 1.0	**
(A)C	1-1	Apalachicola Bay	2.2± 0.5	**
(A)C	2-1	Apalachicola Bay	9.9± 1.3	**
(A)C	3-1	Apalachicola Bay	1.2± 0.1	**
Choctawhatchee Bay, 1994				
Block	**Station**	**Station Location**	**Mean± SD**	**significance**
(C)A	1-1	Cinco Bayou	2.1± 0.2	**
(C)A	2-1	Cinco Bayou	4.7± 1.3	**
(C)A	3-1	Cinco Bayou	1.2± 0.1	**
(C)B	1-1	Garnier Bayou	1.6± 0.2	**
(C)B	2-3	Garnier Bayou	6.3± 1.3	**
(C)B	3-1	Dons Bayou	2.3± 0.2	**
(C)C	1-2	Hand Cove, Garnier Bayou	12.8± 2.1	**

Table 4 continued.

Choctawhatchee Bay, 1994

Block	Station	Station Location	Mean± SD	significance
(C)C	2-1	Garnier Bayou	0.4± 0.1	**
(C)C	3-1	Garnier Bayou	4.3± 0.5	**
(C)D	1-1	Destin Harbor	3.2± 0.5	**
(C)D	2-2	Destin Harbor	0.8± 0.2	**
(C)D	3-1	Destin Harbor	0.3± 0.0	**
(C)E	1-1	Boggy Bayou	2.2± 0.6	**
(C)E	2-1	Boggy Bayou	1.7± 0.3	**
(C)E	3-1	Boggy Bayou	3.1± 0.2	**
(C)F	1-1	Tom's Bayou	1.6± 0.4	**
(C)F	2-1	Tom's Bayou	3.8± 0.7	**
(C)G	1-1	Boggy Bayou	1.0± 0.3	**
(C)G	2-1	Rocky Bayou	10.8± 1.8	**
(C)G	3-1	Rocky Bayou	2.5± 0.4	**
(C)G	4-1	Rocky Bayou	0.8± 0.2	**
(C)H	1-1	Joes Bayou	0.3± 0.1	**
(C)H	2-1	Joes Bayou	0.5± 0.0	**
(C)J	1-1	Alaqua Bayou	17.3± 5.1	**
(C)J	2-1	Alaqua Bayou	7.3± 2.1	**
(C)K	1-1	La Grange Bayou	1.0± 0.3	**
(C)K	2-1	La Grange Bayou	0.9± 0.2	**
(C)K	3-1	La Grange Bayou	2.7± 0.4	**
(C)L	1-2	Choctawhatchee Bay	1.1± 0.2	**
(C)L	2-1	Choctawhatchee Bay	16.8± 4.9	**
(C)L	3-1	Choctawhatchee Bay	1.3± 0.1	**
(C)M	1-1	Choctawhatchee Bay	8.6± 0.2	**
(C)M	2-1	Choctawhatchee Bay	15.8± 2.0	**
(C)M	3-1	Choctawhatchee Bay	2.4± 0.7	**
(C)N	1-1	Choctawhatchee Bay	25.9± 5.3	**
(C)N	2-1	Choctawhatchee Bay	18.3± 3.7	**
(C)N	3-1	Choctawhatchee Bay	17.6± 3.4	**

Pensacola Bay, 1993

Station	Location	Mean± SD	significance
1	Bayou Grande	0.07± 0.02	**
2	Bayou Grande	0.76± 0.03	**
3	Bayou Grande	0.2:± 0.07	**
4	Bayou Chico	0.77± 0.0:	**
5	Bayou Chico	0.25± 0.06	**
6	Bayou Chico	0.24± 0.07	**
7	Bayou Chico	0.63± 0.17	**
8	Bayou Chico	0.57± 0.06	**
9	Bayou Chico	0.45± 0.13	**
10	Bayou Texar	0.32± 0.03	**
11	Bayou Texar	0.53± 0.10	**

Table 4 continued.

Choctawhatchee Bay, 1994

Block	Station	Station Location	Mean± SD	significance
	12	Bayou Texar	1.21± 0.16	**
	13	Bayou Texar	9.12± 1.76	ns
	14	Warrington	7.38± 1.92	*

Pensacola Bay, 1993

Station	Location	Mean± SD	significance
15	Bayou Chico	5.89± 0.23	**
16	Bayou Channel	3.56± 0.74	**
17	Inner Harbor Channel	4.33± 0.32	**
18	Inner Harbor	0.09± 0.01	**
19	Inner Harbor	2.68± 0.55	**
20	Inner Harbor	0.75± 0.09	**
21	Pensacola Bay	10.03± 2.6:	ns
22	Pensacola Bay	12.34± 1.22	ns
23	Inner Harbor	9.08± 1.37	ns
24	Lower Bay	9.23± 2.16	ns
25	Lower Bay	11.49± 1.19	ns
26	East Bay	1.11± 0.24	**
27	East Bay	3.36± 0.61	**
28	East Bay	1.62± 0.35	**
29	Blackwater Bay	0.66± 0.16	**
30	Blackwater Bay	8.01± 1.24	ns
31	Blackwater Bay	1.05± 0.11	**
32	Escambia Bay	4.72± 1.02	**
33	Escambia Bay	2.33± 0.21	**
34	Escambia Bay	0.66± 0.14	**
35	Escambia Bay	9.84± 1.53	ns
36	Escambia Bay	6.65± 0.07	**
37	Escambia River Mouth	3.76± 0.58	**
38	Escambia	2.29± 0.14	**
39	Floridatown	4.49± 0.88	**
40	Central Bay	1.84± 0.25	**

Pensacola Bay, 1994

Block	Station	Location	Mean± SD	significance
(BC)	1-2	Bayou Chico	1.93± 0.35	**
(BC)	2-2	Bayou Chico	40.53± 2.35	*
(BC)	3-2	Bayou Chico	13.47± 3.66	**
(BC)	4-2	Bayou Chico	0.62± 0.09	**
(BC)	5-3	Bayou Chico	1.73± 0.21	**
(BC)	6-2	Bayou Chico	0.81± 0.22	**

Table 4 continued.
St. Andrew Bay, 1993

Block	Station	Location	Mean± SD	significance
	41	West Bay	3.35± 0.83	**
	42	West Bay	0.89± 0.08	**
	43	North Bay	1.66± 0.27	**
	44	North Bay	0.31± 0.08	**
	45	North Bay	0.68± 0.04	**
	46	North Bay	0.1:± 0.02	**
	47	Lynn Haven	0.74± 0.07	**
	48	St. Andrew Bay	1.32± 0.3:	**
	49	St. Andrew Bay	0.42± 0.06	**
	50	St. Andrew Bay	0.18± 0.03	**
	51	St. Andrew Bay	0.48± 0.10	**
	52	St. Andrew Bay	2.1:± 0.28	**
	53	Massalina Bayou	0.15± 0.04	**
	54	Massalina Bayou	0.20± 0.02	**
	55	Watson Bayou	0.68± 0.08	**
	56	Upper Watson	0.14± 0.02	**
	57	Upper Watson	0.23± 0.06	**
	58	Mid Watson	0.14± 0.02	**
	59	Mid Watson	0.50± 0.03	**
	60	Mid Watson	0.23± 0.05	**
	61	Lower Watson	0.22± 0.04	**
	62	Lower Watson	0.99± 0.25	**
	63	Watson Bayou	0.7:± 0.16	**
	64	St. Andrew Bay	0.51± 0.09	**
	65	St. Andrew Bay	0.66± 0.05	**
	66	Mouth of Watson Bayou	0.22± 0.01	**
	67	St. Andrew Bay	7.29± 2.17	**
	68	Mouth of Pearl Bayou	0.73± 0.19	**
	69	Smak Bayou	0.23± 0.02	**
	70	West-East Bay	0.35± 0.05	**
	71	East-East Bay	0.62± 0.16	**

Table 5. Results of Mutatox tests, expressed as categorical responses. This test was performed on samples collected during 1994.

Pensacola Bay, 1994

Stratum	Station	Location	Genotoxic Response Category
(BC)	1-2	Bayou Chico	G
(BC)	2-2	Bayou Chico	G
(BC)	3-2	Bayou Chico	G
(BC)	4-2	Bayou Chico	G
(BC)	5-3	Bayou Chico	G
(BC)	6-2	Bayou Chico	G

Table 5 continued.

Choctawhatchee Bay, 1994			**Genotoxic Response**
Stratum	**Station**	**Location**	**Category**
(C)A	1-1	Cinco Bayou	G
(C)A	2-1	Cinco Bayou	N
(C)A	3-1	Cinco Bayou	G
(C)B	1-1	Garnier Bayou	S
(C)B	2-3	Garnier Bayou	N
(C)B	3-1	Dons Bayou	N
(C)C	1-2	Hand Cove, Garnier Bayou	N
(C)C	2-1	Garnier Bayou	G
(C)C	3-1	Garnier Bayou	S
(C)D	1-1	Destin Harbor	G
(C)D	2-2	Destin Harbor	G
(C)D	3-1	Destin Harbor	G
(C)E	1-1	Boggy Bayou	G
(C)E	2-1	Boggy Bayou	S
(C)E	3-1	Boggy Bayou	N
(C)F	1-1	Tom's Bayou	S
(C)F	2-1	Tom's Bayou	G
(C)G	1-1	Boggy Bayou	G
(C)G	2-1	Rocky Bayou	N
(C)G	3-1	Rocky Bayou	S
(C)G	4-1	Rocky Bayou	G
(C)H	1-1	Joes Bayou	G
(C)H	2-1	Joes Bayou	G
(C)J	1-1	Alaqua Bayou	N
(C)J	2-1	Alaqua Bayou	S
(C)K	1-1	La Grange Bayou	G
(C)K	2-1	La Grange Bayou	G
(C)K	3-1	La Grange Bayou	S
(C)L	1-2	Choctawhatchee Bay	N
(C)L	2-1	Choctawhatchee Bay	S
(C)L	3-1	Choctawhatchee Bay	S
(C)M	1-1	Choctawhatchee Bay	N
(C)M	2-1	Choctawhatchee Bay	N
(C)M	3-1	Choctawhatchee Bay	S
(C)N	1-1	Choctawhatchee Bay	N
(C)N	2-1	Choctawhatchee Bay	N
(C)N	3-1	Choctawhatchee Bay	N

Apalachicola Bay, 1994			**Genotoxic Response**
Stratum	**Station**	**Location**	**Category**
(A)A	1-1	Apalachicola Bay	N
(A)A	2-1	Apalachicola Bay	S
(A)A	3-1	Apalachicola Bay	N
(A)B	1-1	Apalachicola Bay	G
(A)B	2-1	Apalachicola Bay	S
(A)B	3-1	Apalachicola Bay	N
(A)C	1-1	Apalachicola Bay	S
(A)C	2-1	Apalachicola Bay	N
(A)C	3-1	Apalachicola Bay	N

(N=Negative, or not toxic, G= Genotoxic and S= Suspect).

Table 6. Mean percent fertilization success of sea urchins in 100% , 50% and 25% concentrations of sediment porewater.

Pensacola Bay, 1993			100% WQAP	Significance	50% WQAP	Significance	25% WQAP	Significance
Stratum	**Station**	**Location**	**Mean± SD**		**Mean± SD**		**Mean± SD**	
	Control	Redfish Bay, Texas	94.8± 1.5	ns	96.6± 1.1	ns	94.6± 2.9	ns
A	1	Bayou Grande	96.8± 2.8	ns	95.8± 1.3	ns	95.0± 3.0	ns
A	2	Bayou Grande	95.6± 2.9	ns	94.8± 2.7	ns	93.8± 2.4	ns
A	3	Bayou Grande	46.0± 13.7	**	86.8± 5.0	*	92.8± 2.8	ns
B	4	Bayou Chico	94.8± 1.8	ns	96.0± 3.3	ns	93.6± 3.8	ns
B	5	Bayou Chico	89.2± 3.0	ns	94.4± 2.5	ns	93.6± 2.1	ns
B	6	Bayou Chico	93.0± 3.2	ns	93.4± 4.2	ns	96.4± 2.7	ns
B	7	Bayou Chico	93.0± 2.0	ns	96.8± 2.2	ns	95.4± 1.8	ns
B	8	Bayou Chico	94.0± 1.0	ns	95.8± 1.1	ns	93.8± 1.9	ns
B	9	Bayou Chico	94.8± 1.5	ns	94.6± 3.6	ns	95.8± 1.6	ns
C	10	Bayou Texar	94.2± 2.3	ns	96.0± 2.2	ns	95.4± 3.2	ns
C	11	Bayou Texar	95.6± 2.1	ns	98.0± 1.9	ns	95.4± 1.9	ns
C	12	Bayou Texar	95.2± 2.2	ns	93.4± 1.9	ns	94.6± 2.6	ns
C	13	Bayou Texar	94.8± 2.2	ns	96.6± 2.7	ns	80.6± 14.8	*
D	14	Warrington	74.6± 6.3	**	89.2± 4.0	ns	83.4± 15.3	ns
E	15	Bayou Chico	94.8± 1.6	ns	92.8± 4.4	ns	90.2± 12.2	ns
E	16	Bayou Channel	95.6± 2.7	ns	96.4± 1.7	ns	96.4± 1.9	ns
F	17	Inner Harbor Channel	94.8± 2.0	ns	97.6± 2.7	ns	96.2± 1.6	ns
F	18	Inner Harbor	95.8± 3.0	ns	98.2± 1.3	ns	98.4± 1.5	ns
F	19	Inner Harbor	99.2± 0.8	ns	99.2± 1.3	ns	99.4± 0.5	ns
F	20	Inner Harbor	97.2± 1.9	ns	98.6± 0.5	ns	98.2± 1.6	ns
G	21	Pensacola Bay	98.2± 0.8	ns	98.4± 1.3	ns	99.0± 0.7	ns
G	22	Pensacola Bay	98.0± 2.9	ns	99.4± 0.5	ns	98.2± 2.2	ns
G	23	Inner Harbor	98.8± 1.3	ns	97.8± 1.1	ns	98.6± 0.5	ns
H	24	Lower Bay	75.2± 8.3	**	95.8± 2.9	ns	99.0± 1.4	ns
H	25	Lower Bay	97.4± 1.9	ns	95.8± 2.2	ns	94.8± 2.9	ns
J	26	East Bay	96.6± 1.3	ns	96.2± 2.6	ns	95.6± 1.5	ns

Table 6 continued.

Stratum	Station	Location	100% WQAP Mean± SD	Significance	50% WQAP Mean± SD	Significance	25% WQAP Mean± SD	Significance
Pensacola Bay, 1993								
K	27	East Bay	96.0± 1.6	ns	97.6± 2.4	ns	95.8± 2.4	ns
K	28	East Bay	93.6± 3.4	ns	94.4± 3.2	ns	93.6± 3.0	ns
L	29	Blackwater Bay	96.0± 2.9	ns	98.4± 1.5	ns	95.8± 2.4	ns
L	30	Blackwater Bay	96.4± 0.5	ns	94.8± 2.2	ns	95.4± 2.3	ns
L	31	Blackwater Bay	80.8± 8.6	*	96.0± 2.2	ns	97.0± 2.9	ns
M	32	Escambia Bay	95.0± 3.5	ns	94.2± 1.1	ns	92.6± 3.6	ns
N	33	Escambia Bay	97.8± 1.6	ns	97.8± 0.8	ns	93.6± 4.7	ns
N	34	Escambia Bay	95.8± 1.3	ns	94.2± 5.4	ns	90.2± 6.9	ns
O	35	Escambia Bay	95.4± 3.4	ns	97.6± 1.1	ns	97.6± 1.1	ns
O	36	Escambia Bay	98.6± 0.9	ns	99.0± 0.7	ns	99.8± 0.4	ns
O	37	Escambia River Mouth	99.4± 0.5	ns	99.2± 0.4	ns	98.8± 1.3	ns
P	38	Escambia	97.2± 0.4	ns	96.6± 2.3	ns	91.8± 6.1	ns
P	39	Floridatown	97.2± 2.2	ns	94.8± 3.3	ns	96.2± 2.6	ns
I	40	Central Bay	96.0± 1.4	ns	94.6± 2.9	ns	93.0± 2.6	ns
Pensacola Bay, 1994								
Stratum	**Station**	**Location**	**Mean± SD**		**Mean± SD**		**Mean± SD**	
	Control	Redfish Bay, Texas	93.4± 3.5		94.8± 4.1		93.2± 3.5	
(BC)	1-2	Bayou Chico	0.6± 0.5	**	0.0± 0.0	**	6.8± 2.8	**
(BC)	2-2	Bayou Chico	0.2± 0.4	**	2.0± 1.6	**	27.6± 10.4	**
(BC)	3-2	Bayou Chico	91.6± 3.0	ns	91.6± 3.4	ns	89.2± 5.0	ns
(BC)	4-2	Bayou Chico	0.4± 0.5	**	0.8± 0.8	**	0.4± 0.5	**
(BC)	5-3	Bayou Chico	0.4± 0.5	**	0.0± 0.0	**	3.8± 5.8	**
(BC)	6-2	Bayou Chico	0.4± 0.5	**	17.6± 10.3	**	67.6± 15.8	**

Table 6 continued.

Choctawhatchee Bay, 1994

Stratum	Station	Station Location	100% WQAP Mean± SD	Significance	50% WQAP Mean± SD	Significance	25% WQAP Mean± SD	Significance
	Control	Redfish Bay, Texas	93.4± 3.5		94.8± 4.1		93.2± 3.5	
(C)A	1-1	Cinco Bayou	51.6± 12.0	**	84.2± 7.0	ns	93.0± 4.8	ns
(C)A	2-1	Cinco Bayou	25.6± 12.6	**	80.2± 5.3	*	89.8± 6.1	ns
(C)A	3-1	Cinco Bayou	95.4± 2.9	ns	96.0± 2.3	ns	96.2± 2.7	ns
(C)B	1-1	Garnier Bayou	75.4± 9.9	*	90.2± 2.2	ns	89.4± 12.8	ns
(C)B	2-3	Garnier Bayou	90.8± 7.4	ns	92.0± 5.5	ns	91.2± 9.2	ns
(C)B	3-1	Dons Bayou	91.4± 2.3	ns	96.2± 1.5	ns	91.6± 4.7	ns
(C)C	1-2	Hand Cove, Garnier Bayou	47.2± 11.3	**	78.4± 7.6	**	77.4± 12.6	*
(C)C	2-1	Garnier Bayou	30.8± 10.5	**	70.0± 8.8	**	76.4± 11.7	**
(C)C	3-1	Garnier Bayou	77.0± 5.1	*	92.2± 3.7	ns	90.3± 4.3	ns
(C)D	1-1	Destin Harbor	93.3± 3.4	ns	92.0± 1.4	ns	88.4± 4.2	ns
(C)D	2-2	Destin Harbor	87.6± 5.5	ns	89.8± 3.6	ns	89.8± 2.6	ns
(C)D	3-1	Destin Harbor	19.2± 19.5	**	65.4± 18.8	**	89.0± 4.6	ns
(C)E	1-1	Boggy Bayou	51.8± 20.3	**	77.4± 6.0	**	87.6± 9.1	ns
(C)E	2-1	Boggy Bayou	79.6± 5.4	ns	90.0± 4.0	ns	91.2± 4.1	ns
(C)E	3-1	Boggy Bayou	61.3± 4.5	**	74.8± 10.6	**	81.5± 5.3	ns
(C)F	1-1	Tom's Bayou	0.6± 0.9	**	0.2± 0.4	**	0.6± 0.9	**
(C)F	2-1	Tom's Bayou	32.8± 12.3	**	81.4± 15.3	*	80.2± 9.2	*
(C)G	1-1	Boggy Bayou	51.8± 11.5	**	86.4± 7.0	ns	87.2± 8.2	ns
(C)G	2-1	Rocky Bayou	39.0± 7.3	**	81.2± 6.1	*	92.8± 3.4	ns
(C)G	3-1	Rocky Bayou	91.6± 5.9	ns	91.8± 3.3	ns	93.2± 1.6	ns
(C)G	4-1	Rocky Bayou	80.4± 5.1	ns	85.6± 4.9	ns	91.2± 5.6	ns
(C)H	1-1	Joes Bayou	95.2± 2.8	ns	94.4± 5.0	ns	93.8± 5.0	ns
(C)H	2-1	Joes Bayou	72.2± 10.3	**	87.8± 4.6	ns	91.0± 3.5	ns
(C)J	1-1	Alaqua Bayou	92.6± 1.5	ns	93.4± 2.4	ns	93.8± 1.3	ns
(C)J	2-1	Alaqua Bayou	87.6± 7.9	ns	95.2± 3.0	ns	94.8± 2.4	ns
(C)K	1-1	La Grange Bayou	93.2± 3.0	ns	92.0± 4.3	ns	88.0± 6.4	ns
(C)K	2-1	La Grange Bayou	76.0± 2.4	*	87.2± 10.1	ns	93.4± 3.3	ns
(C)K	3-1	La Grange Bayou	35.2± 19.3	**	74.8± 12.0	**	88.0± 3.2	ns
(C)L	1-2	Choctawhatchee Bay	55.2± 15.3	**	83.6± 23.0	ns	88.2± 9.0	ns

Table 6 continued.

Stratum	Station	Station Location	100% WQAP Mean± SD	Significance	50% WQAP Mean± SD	Significance	25% WQAP Mean± SD	Significance
Choctawhatchee Bay, 1994								
(C)L	2-1	Choctawhatchee Bay	71.0± 10.9	**	75.2± 11.3	**	75.0± 11.4	**
(C)L	3-1	Choctawhatchee Bay	78.0± 13.3	*	85.0± 6.0	ns	78.8± 8.39:	*
(C)M	1-1	Choctawhatchee Bay	62.2± 21.0	**	72.0± 8.2	**	76.0± 7.3	**
(C)M	2-1	Choctawhatchee Bay	91.4± 2.4	ns	89.8± 9.7	ns	85.8± 10.9	ns
(C)M	3-1	Choctawhatchee Bay	89.6± 6.5	ns	94.0± 3.7	ns	93.2± 3.3	ns
(C)N	1-1	Choctawhatchee Bay	65.4± 15.2	**	84.8± 9.1	ns	85.6± 13.0	ns
(C)N	2-1	Choctawhatchee Bay	86.6± 14.9	ns	94.6± 5.0	ns	90.6± 6.0	ns
(C)N	3-1	Choctawhatchee Bay	90.2± 9.5	ns	92.0± 6.7	ns	89.6± 13.6	ns
St. Andrew Bay, 1993								
	Control	Redfish Bay, Texas	98.2± 1.8	ns	98.8± 1.3	ns	99.2± 0.4	ns
A	41	West Bay	98.6± 1.1	ns	99.4± 0.9	ns	99.8± 0.4	ns
A	42	West Bay	99.6± 0.5	ns	99.8± 0.4	ns	98.4± 0.9	ns
B	43	North Bay	99.6± 0.5	ns	99.6± 0.5	ns	99.4± 0.9	ns
B	44	North Bay	93.8± 2.9	ns	99.2± 1.1	ns	99.2± 0.8	ns
B	45	North Bay	99.4± 0.9	ns	99.4 ±0.9	ns	98.6 ±0.9	ns
B	46	North Bay	88.6± 3.2	ns	98.0 ±1.6	ns	98.6 ±1.5	ns
B	47	Lynn Haven	98.6± 1.1	ns	99.4 ±0.5	ns	98.8 ±1.3	ns
C	48	St. Andrew Bay	99.6± 0.9	ns	99.8 ±0.4	ns	98.8 ±1.6	ns
C	49	St. Andrew Bay	99.2± 0.8	ns	99.0 ±0.7	ns	99.0 ±0.7	ns
C	50	St. Andrew Bay	99.4± 0.9	ns	99.2 ±1.3	ns	99.2 ±1.1	ns
C	51	St. Andrew Bay	99.6± 0.9	ns	99.4 ±0.9	ns	99.2 ±1.3	ns
C	52	St. Andrew Bay	99.6± 0.5	ns	99.4 ±0.5	ns	99.8 ±0.4	ns
D	53	Massalina Bayou	98.8± 1.6	ns	99.4 ±0.9	ns	99.4 ±0.9	ns
D	54	Massalina Bayou	99.0± 1.2	ns	99.4 ±0.9	ns	98.2 ±2.0	ns
E	55	Watson Bayou	98.8± 0.8	ns	99.0 ±0.7	ns	99.4 ±0.5	ns
E	56	Upper Watson	14.4± 3.7	**	82.8 ±11.2	*	95.2 ±2.2	ns
E	57	Upper Watson	86.4± 4.8	ns	98.8 ±1.3	ns	99.4 ±0.9	ns
E	58	Mid Watson	19.8± 8.0	**	87.2 ±3.3	ns	98.4 ±2.1	ns

Table 6 continued.

Stratum	Station	Station Location	100% WQAP Mean± SD	Significance	50% WQAP Mean± SD	Significance	25% WQAP Mean± SD	Significance
St. Andrew Bay, 1993								
E	59	Mid Watson	83.2± 7.8	*	99.2 ±0.8	ns	99.4 ±0.5	ns
E	60	Mid Watson	99.4± 0.5	ns	99.6 ±0.5	ns	99.8 ±0.4	ns
E	61	Lower Watson	99.6± 0.5	ns	99.6 ±0.5	ns	98.8 ±0.8	ns
E	62	Lower Watson	99.8± 0.4	ns	99.6 ±0.5	ns	99.2 ±1.1	ns
E	63	Watson Bayou	99.0± 1.7	ns	98.2 ±1.3	ns	99.2 ±0.4	ns
F	64	St. Andrew Bay	99.4± 0.5	ns	99.4 ±0.9	ns	98.4 ±1.3	ns
F	65	St. Andrew Bay	99.4± 0.9	ns	99.6 ±0.5	ns	99.4 ±0.9	ns
F	66	Mouth of Watson Bayou	33.6± 14.9	**	96.0 ±2.3	ns	99.4 ±1.3	ns
F	67	St. Andrew Bay	98.8± 1.1	ns	99.4 ±0.5	ns	98.6 ±1.3	ns
F	68	Mouth of Pearl Bayou	98.6± 1.7	ns	98.8 ±1.3	ns	99.2 ±0.4	ns
F	69	Smak Bayou	99.4± 0.5	ns	98.8 ±1.3	ns	98.4 ±0.5	ns
G	70	West-East Bay	99.4± 1.3	ns	99.2 ±0.4	ns	98.4 ±1.8	ns
G	71	East-East Bay	98.0± 1.2	ns	99.4 ±0.5	ns	99.6 ±0.5	ns
Apalachicola Bay, 1994								
Block	**Station**	**Station Location**	**Mean± SD**		**Mean± SD**		**Mean± SD**	
	Control	Redfish Bay, Texas	93.4± 3.5		94.8± 4.1		93.2± 3.5	
(A)A	1-1	Apalachicola Bay	89.4± 5.6	ns	92.8± 2.5	ns	95.0± 2.1	ns
(A)A	2-1	Apalachicola Bay	56.4± 10.5	**	90.0± 7.4	ns	93.6± 5.0	ns
(A)A	3-1	Apalachicola Bay	71.8± 6.9	**	88.8± 6.9	ns	91.6± 4.4	ns
(A)B	1-1	Apalachicola Bay	89.8± 4.7	ns	89.8± 2.7:	ns	91.0± 4.0	ns
(A)B	2-1	Apalachicola Bay	67.2± 15.3	**	89.0± 4.3	ns	91.4± 0.5	ns
(A)B	3-1	Apalachicola Bay	84.2± 5.7	ns	92.2± 1.3	ns	94.0± 2.5	ns
(A)C	1-1	Apalachicola Bay	79.6± 7.7	ns	85.6± 6.5	ns	92.2± 2.2	ns
(A)C	2-1	Apalachicola Bay	86.6± 8.6	ns	89.6± 5.0	ns	90.0± 4.2	ns
(A)C	3-1	Apalachicola Bay	39.6± 13.2	**	81.6± 5.6	*	90.2± 6.2	ns

WQAP = water quality adjusted porewater
* significantly different from controls (t-test, *a* < 0.05);
** significantly different from controls and 80% or less than the control response.

Table 7. Mean normal embryo development in 100% , 50% and 25% concentrations of sediment porewater.

Pensacola Bay, 1993

Stratum	Station	Location	100% WQAP Mean±	SD	Significance	50% WQAP Mean±	SD	Significance	25% WQAP Mean±	SD	Significance
	Control	Redfish Bay, Texas	88.0±	3.2		94.2±	3.1		92.6±	2.1	
A	1	Bayou Grande	1.2±	1.8	**	82.8±	11.4	ns	90.4±	5.2	ns
A	2	Bayou Grande	91.5±	1.3	ns	92.4±	3.4	ns	89.6±	5.0	ns
A	3	Bayou Grande	86.0±	4.7	ns	93.2±	5.7	ns	88.2±	2.6	ns
B	4	Bayou Chico	78.8±	4.3	ns	90.4±	4.3	ns	91.0±	2.1	ns
B	5	Bayou Chico	0.0±	0.0	**	0.0±	0.0	**	85.2±	5.0	ns
B	6	Bayou Chico	0.0±	0.0	**	47.4±	7.3	**	91.2±	2.8	ns
B	7	Bayou Chico	0.0±	0.0	**	0.0±	0.0	**	88.2±	2.3	ns
B	8	Bayou Chico	0.0±	0.0	**	1.2±	0.8	**	88.8±	4.1	ns
B	9	Bayou Chico	0.0±	0.0	**	0.0±	0.0	**	84.8±	5.1	ns
C	10	Bayou Texar	0.0±	0.0	**	88.8±	4.6	ns	88.0±	3.6	ns
C	11	Bayou Texar	88.6±	3.5	ns	90.0±	3.0	ns	90.8±	3.1	ns
C	12	Bayou Texar	91.4±	5.5	ns	91.2±	1.6	ns	92.6±	3.0	ns
C	13	Bayou Texar	88.8±	2.9	ns	91.4±	1.5	ns	90.8±	3.6	ns
D	14	Warrington	90.2±	0.8	ns	91.0±	3.5	ns	90.6±	3.4	ns
E	15	Bayou Chico	84.8±	3.9	ns	91.2±	3.7	ns	88.4±	1.5	ns
E	16	Bayou Channel	72.3±	3.3	*	84.0±	4.2	ns	91.4±	4.2	ns
F	17	Inner Harbor Channel	88.4±	4.2	ns	88.4±	4.7	ns	92.0±	2.2	ns
F	18	Inner Harbor	92.6±	2.3	ns	91.0±	1.9	ns	92.4±	1.7	ns
F	19	Inner Harbor	98.8±	0.8	ns	99.8±	0.4	ns	98.4±	1.7	ns
F	20	Inner Harbor	98.4±	0.9	ns	99.0±	0.7	ns	98.8±	1.6	ns
G	21	Pensacola Bay	99.4±	0.9	ns	98.6±	1.5	ns	98.2±	1.6	ns
G	22	Pensacola Bay	73.3±	10.1	**	97.6±	0.5	ns	99.0±	1.2	ns
G	23	Inner Harbor	4.0±	7.4	**	97.0±	1.6	ns	98.8±	1.1	ns
H	24	Lower Bay	98.6±	0.9	ns	98.6±	0.9	ns	98.6±	1.1	ns
H	25	Lower Bay	85.8±	4.9	ns	95.4±	2.3	ns	95.2±	2.3	ns
J	26	East Bay	95.4±	2.4	ns	93.0±	1.0	ns	94.8±	2.4	ns
K	27	East Bay	95.0±	2.1	ns	93.4±	4.5	ns	95.8±	2.8	ns
K	28	East Bay	89.8±	3.8	ns	95.6±	1.1	ns	95.0±	1.9	ns

Table 7 continued.

			100% WQAP		Significance	50% WQAP		Significance	25% WQAP		Significance
Pensacola Bay, 1993											
Stratum	**Station**	**Location**	Mean±	SD		Mean±	SD		Mean±	SD	
L	29	Blackwater Bay	89.0±	2.8	ns	93.0±	1.0	ns	94.8±	1.3	ns
L	30	Blackwater Bay	90.6±	2.3	ns	94.6±	2.1	ns	94.4±	3.3	ns
L	31	Blackwater Bay	89.0±	4.0	ns	91.8±	4.6	ns	95.8±	1.1	ns
M	32	Escambia Bay	92.2±	3.5	ns	95.0±	1.4	ns	97.0±	2.0	ns
N	33	Escambia Bay	93.8±	2.9	ns	94.6±	2.1	ns	95.6±	1.7	ns
N	34	Escambia Bay	93.2±	2.8	ns	96.2±	2.9	ns	95.8±	2.3	ns
O	35	Escambia Bay	89.6±	3.4	ns	95.4±	2.3	ns	96.6±	3.4	ns
O	36	Escambia Bay	65.2±	15.4	**	76.4±	20.7	ns	85.8±	12.8	ns
O	37	Escambia River Mouth	81.8±	10.6	ns	89.6±	5.7	ns	79.8±	13.2	ns
P	38	Escambia	93.6±	2.7	ns	96.2±	1.8	ns	96.2±	1.6	ns
P	39	Floridatown	90.0±	4.1	ns	93.6±	2.9	ns	94.8±	1.8	ns
I	40	Central Bay	93.4±	1.9	ns	94.6±	2.9	ns	95.2±	3.1	ns
Pensacola Bay, 1994											
Block	**Station**	**Location**	Mean±	SD		Mean±	SD		Mean ±	SD	
	control	Redfish Bay, Texas	90.4±	5.1		80.2±	2.6		79.2±	5.2	
(BC)	1-2	Bayou Chico	0.0±	0.0	**	0.0±	0.0	**	0.0±	0.0	**
(BC)	2-2	Bayou Chico	0.4±	0.9	**	0.0±	0.0	**	0.0±	0.0	**
(BC)	3-2	Bayou Chico	0.0±	0.0	**	49.6±	5.7	**	79.0±	3.9	ns
(BC)	4-2	Bayou Chico	0.0±	0.0	**	41.2±	23.8	**	80.8±	10.2	ns
(BC)	5-3	Bayou Chico	0.6±	1.3	**	12.6±	15.6	**	81.4±	2.7	ns
(BC)	6-2	Bayou Chico	0.0±	0.0	**	0.0±	0.0	**	23.4±	35.5	**
Choctawhatchee Bay, 1994											
Block	**Station**	**Station Location**	Mean±	SD		Mean±	SD		Mean±	SD	
	control	Redfish Bay, Texas	90.4±	5.1		80.2±	2.6		79.2±	5.2	
(C)A	1-1	Cinco Bayou	4.2±	6.6	**	78.6±	4.7	ns	81.6±	6.9	ns
(C)A	2-1	Cinco Bayou	0.0±	0.0	**	87.0±	1.2	ns	87.8±	5.5	ns
(C)A	3-1	Cinco Bayou	71.8±	4.1	ns	79.8±	7.9	ns	86.4±	1.9	ns
(C)B	1-1	Garnier Bayou	82.4±	4.2	ns	79.6±	4.8	ns	82.0±	5.5	ns
(C)B	2-3	Garnier Bayou	80.6±	1.8	ns	83.8±	5.8	ns	76.6±	4.6	ns
(C)B	3-1	Dons Bayou	11.8±	16.4	**	73.2±	7.5	ns	77.4±	4.7	ns

Table 7 continued.

Stratum	Station	Location	100% WQAP Mean±	SD	Significance	50% WQAP Mean±	SD	Significance	25% WQAP Mean±	SD	Significance
(C)C	1-2	Hand Cove, Garnier Bayou	24.8±	18.0	**	76.0±	3.9	ns	76.6±	8.3	ns
(C)C	2-1	Garnier Bayou	20.4±	29.7	**	75.4±	6.9	ns	82.0±	6.0	ns
(C)C	3-1	Garnier Bayou	28.6±	38.1	**	72.2±	12.6	ns	82.6±	3.7	ns
(C)D	1-1	Destin Harbor	0.0±	0.0	**	46.8±	43.0	**	76.8±	1.9	ns
(C)D	2-2	Destin Harbor	50.4±	38.7	**	79.0±	5.6	ns	78.0±	5.1	ns
(C)D	3-1	Destin Harbor	0.0±	0.0	**	5.4±	10.0	**	81.0±	3.8	ns
(C)E	1-1	Boggy Bayou	73.2±	6.8	ns	77.0±	5.4	ns	69.8±	8.6	ns
(C)E	2-1	Boggy Bayou	76.8±	3.1	ns	73.6±	8.6	ns	75.6±	2.7	ns
(C)E	3-1	Boggy Bayou	4.6±	7.4	**	79.2±	5.8	ns	72.6±	5.2	ns
(C)F	1-1	Tom's Bayou	24.6±	9.4	**	36.5±	2.6	**	87.2±	5.3	ns
(C)F	2-1	Tom's Bayou	72.2±	10.4	ns	77.0±	5.1	ns	67.4±	8.0	ns
(C)G	1-1	Boggy Bayou	74.0±	9.7	ns	82.0±	3.8	ns	82.2±	5.0	ns
(C)G	2-1	Rocky Bayou	39.0±	39.0	**	83.2±	4.4	ns	86.0±	3.7	ns
(C)G	3-1	Rocky Bayou	86.8±	4.2	ns	81.2±	5.0	ns	80.2±	1.6	ns
(C)G	4-1	Rocky Bayou	1.8±	4.0	**	81.4±	3.4	ns	82.8±	8.3	ns
(C)H	1-1	Joes Bayou	70.5±	4.1	ns	79.4±	3.2	ns	79.4±	3.8	ns
(C)H	2-1	Joes Bayou	0.0±	0.0	**	54.6±	36.8	**	85.2±	3.3	ns
(C)J	1-1	Alaqua Bayou	62.4±	8.4	*	77.4±	9.1	ns	82.6±	3.2	ns
(C)J	2-1	Alaqua Bayou	72.0±	3.3	ns	77.4±	8.5	ns	79.0±	4.0	ns
(C)K	1-1	La Grange Bayou	65.6±	3.6	ns	77.0±	5.6	ns	80.4±	3.2	ns
(C)K	2-1	La Grange Bayou	0.0±	0.0	**	72.2±	10.2	ns	78.2±	4.8	ns
(C)K	3-1	La Grange Bayou	73.6±	4.9	ns	78.2±	7.6	ns	75.2±	5.6	ns
(C)L	1-2	Choctawhatchee Bay	80.6±	5.0	ns	80.4±	5.9	ns	82.8±	3.9	ns
(C)L	2-1	Choctawhatchee Bay	65.2±	7.5	ns	78.0±	6.6	ns	81.4±	2.4	ns
(C)L	3-1	Choctawhatchee Bay	72.0±	4.8	ns	82.0±	3.7	ns	76.6±	7.4	ns
(C)M	1-1	Choctawhatchee Bay	73.6±	7.1	ns	79.0±	3.9	ns	75.4±	5.6	ns
(C)M	2-1	Choctawhatchee Bay	80.2±	2.9	ns	83.6±	2.6	ns	81.2±	5.7	ns
(C)M	3-1	Choctawhatchee Bay	5.8±	13.0	**	83.2±	6.5	ns	79.6±	6.2	ns
(C)N	1-1	Choctawhatchee Bay	63.8±	7.2	*	72.2±	2.2	ns	81.5±	1.3	ns
(C)N	2-1	Choctawhatchee Bay	72.8±	6.5	ns	77.2±	8.8	ns	74.0±	4.4	ns
(C)N	3-1	Choctawhatchee Bay	72.4±	9.0	ns	75.0±	6.2	ns	79.2±	4.9	ns

Table 7 continued.

St. Andrew Bay, 1993

Stratum	Station	Location	100% WQAP Mean±	SD	Significance	50% WQAP Mean±	SD	Significance	25% WQAP Mean ±	SD	Significance
	Control	Redfish Bay, Texas	96.6±	2.2	ns	86.4±	17.5	ns	86.0±	12.2	ns
A	41	West Bay	97.8±	1.9	ns	87.4±	15.3	ns	90.0±	8.4	ns
A	42	West Bay	99.2±	1.3	ns	90.0±	9.9	ns	85.0±	9.7	ns
B	43	North Bay	96.6±	1.8	ns	88.6±	10.6	ns	91.6±	9.1	ns
B	44	North Bay	97.6±	1.1	ns	98.2±	1.9	ns	96.0±	4.3	ns
B	45	North Bay	99.2±	0.8	ns	98.4±	0.9	ns	98.6±	1.1	ns
B	46	North Bay	98.8±	0.8	ns	99.2±	0.8	ns	98.6±	0.5	ns
B	47	Lynn Haven	99.2±	1.3	ns	98.6±	1.3	ns	99.0±	1.0	ns
C	48	St. Andrew Bay	97.6±	2.1	ns	98.8±	2.2	ns	98.8±	1.1	ns
C	49	St. Andrew Bay	98.2±	1.9	ns	99.2±	0.4	ns	98.2±	1.9	ns
C	50	St. Andrew Bay	6.4±	11.3	**	98.4±	0.5	ns	99.0±	1.2	ns
C	51	St. Andrew Bay	99.2±	0.4	ns	99.0±	1.0	ns	98.2±	1.6	ns
C	52	St. Andrew Bay	97.4±	1.7	ns	98.6±	1.1	ns	97.2±	1.5	ns
D	53	Massalina Bayou	97.8±	2.2	ns	98.4±	1.5	ns	98.0±	1.0	ns
D	54	Massalina Bayou	99.6±	0.9	ns	98.2±	1.3	ns	98.8±	1.1	ns
E	55	Watson Bayou	0.0±	0.0	**	98.0±	2.1	ns	98.6±	1.1	ns
E	56	Upper Watson	0.2±	0.4	**	0.0±	0.0	**	98.4±	1.7	ns
E	57	Upper Watson	0.0±	0.0	**	99.2±	0.8	ns	99.0±	0.7	ns
E	58	Mid Watson	0.2±	0.4	**	0.0±	0.0	**	98.2±	1.8	ns
E	59	Mid Watson	0.0±	0.0	**	98.8±	0.8	ns	98.2±	0.4	ns
E	60	Mid Watson	74.2±	23.7	ns	97.2±	1.3	ns	99.2±	0.8	ns
E	61	Lower Watson	98.8±	1.3	ns	98.8±	1.6	ns	98.2±	1.1	ns
E	62	Lower Watson	98.2±	1.3	ns	99.4±	0.5	ns	98.8±	0.8	ns
E	63	Watson Bayou	99.4±	0.9	ns	98.8±	0.4	ns	98.6±	1.5	ns
F	64	St. Andrew Bay	97.0±	2.7	ns	98.6±	1.1	ns	98.4±	1.5	ns
F	65	St. Andrew Bay	99.4±	0.5	ns	98.2±	0.5	ns	98.2±	1.5	ns
F	66	Mouth of Watson Bayou	36.0±	36.:	**	99.0±	1.0	ns	97.6±	2.3	ns
F	67	St. Andrew Bay	96.0±	4.1	ns	96.6±	3.4	ns	94.8±	8.4	ns
F	68	Mouth of Pearl Bayou	88.0±	4.5	ns	99.2±	0.8	ns	96.8±	4.4	ns
F	69	Smak Bayou	98.4±	1.8	ns	98.4±	1.7	ns	97.6±	1.1	ns
G	70	West-East Bay	97.8±	2.8	ns	95.0±	4.5	ns	95.4±	4.1	ns
G	71	East-East Bay	86.0±	9.9	ns	86.4±	6.8	ns	97.6±	3.8	ns

Table 7 continued.

Apalachicola Bay, 1994

Stratum	Station	Station Location	100% WQAP Mean±	SD	Significance	50% WQAP Mean±	SD	Significance	25% WQAP Mean±	SD	Significance
	control	Redfish Bay, Texas	90.4±	5.1		80.2±	2.6		79.2±	5.2	
(A)A	1-1	Apalachicola Bay	66.4±	6.1	ns	72.6±	7.7	ns	77.2±	7.7	ns
(A)A	2-1	Apalachicola Bay	0.0±	0.0	**	77.0±	7.7	ns	72.0±	5.5	ns
(A)A	3-1	Apalachicola Bay	73.0±	4.6	ns	75.4±	5.5	ns	77.2±	3.6	ns
(A)B	1-1	Apalachicola Bay	67.4±	5.9	ns	75.4±	3.3	ns	80.2±	5.0	ns
(A)B	2-1	Apalachicola Bay	78.0±	8.3	ns	79.4±	2.5	ns	81.2±	2.9	ns
(A)B	3-1	Apalachicola Bay	36.6±	43.1	**	82.2±	5.3	ns	77.4±	6.0	ns
(A)C	1-1	Apalachicola Bay	46.8±	9.7	**	81.8±	6.7	ns	82.8±	4.0	ns
(A)C	2-1	Apalachicola Bay	0.0±	0.0	**	75.6±	3.4	ns	80.4±	5.4	ns
(A)C	3-1	Apalachicola Bay	71.8±	5.4	ns	78.8±	5.3	ns	80.4±	7.4	ns

WQAP = water quality adjusted porewater
* significantly different from controls (t-test, *a* < 0.05);
** significantly different from controls and 80% or less than the control response.

Table 8. Spearman-rank correlations (Rho) among the four toxicity tests performed on 1993 samples from Pensacola Bay.

	Microbial bioluminescence EC50's		Sea urchin fertilization (100% WQAP)		Sea urchin development (100% WQAP)	
Amphipod survival	-0.164	ns	-0.1429999:	ns	0.1189999:	ns
Microbial bioluminescence			0.3529999:	*	0.2859999:	ns
Sea urchin fertilization					0.3009999:	ns

WQAP = water quality adjusted porewater

Table 9. Spearman-rank correlations (Rho) among the four toxicity tests performed on 1994 samples from Bayou Chico and Apalachicola Bays.

	Microbial bioluminescence EC50's		Sea urchin fertilization (100% WQAP)		Sea urchin development (100% WQAP)	
Amphipod survival	0.18199999:	ns	-0.049	ns	0.1779999:	ns
Microbial bioluminescence			0.350	ns	-0.0609999:	ns
Sea urchin fertilization					0.0619999:	ns

WQAP = water quality adjusted porewater

Table 10. Spearman-rank correlations (Rho) among the four toxicity tests from Choctawhatchee Bay.

	Microbial bioluminescence EC50's		Sea urchin Fertilization 100% WQAP		Sea urchin Development 100% WQAP	
Amphipod Survival	0.029	ns	0.127	ns	0.1859999:	ns
Microbial bioluminescence			-0.003	ns	0.021	ns
Sea Urchin Fertilization					0.1029999:	ns

WQAP = water quality adjusted porewater

Table 11. Spearman-rank correlations (Rho) among the four different toxicity tests performed in St. Andrew Bay.

	Microbial bioluminescence EC50's	Sea urchin fertilization @ 100% WQAP	Sea urchin development @ 100% WQAP
Amphipod survival	+0.212 ns	+0.211 ns	+0.075 ns
Microbial bioluminescence		+0.408 *	+0.179 ns
Sea urchin fertilization			+0.461 *

WQAP = water quality adjusted porewater
* $p<0.05$

Table 12. Percent of samples from each bay that were either toxic (i.e., significantly different from controls) or highly toxic (i.e., significantly different from controls and <80% of controls).

	Pensacola (n=40)		Bayou Chico (n=6)		Choctawhatchee (n=37)		St. Andrew (n=31)		Apalachicola (n=9)		All samples (n=123)	
	toxic	highly	toxic	highly	toxic	highly	toxic	highly	toxic	highly	toxic	highly
Amphipod survival	0.0	0.0	16.7	16.7	2.7	0.0	11.1	0.0	0.0	0.0	2.4	0.8
Urchin fertilization												
• 100% WQAP	10.0	7.5	83.3	83.3	56.8	45.9	12.9	9.7	44.4	44.4	30.9	26.0
• 50% WQAP	2.5	0.0	83.3	83.3	32.4	24.3	3.2	0.0	11.1	0.0	16.3	11.4
• 25% WQAP	2.5	0.0	83.3	83.3	18.9	10.8	0.0	0.0	0.0	0.0	10.6	7.3
Urchin development												
• 100% WQAP	27.5	25.0	100.0	100.0	48.6	43.2	22.6	22.6	44.4	44.4	37.4	35.0
• 50% WQAP	12.5	12.5	100.0	100.0	10.8	10.8	6.4	6.4	0.0	0.0	13.8	13.8
• 25% WQAP	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4
Microtox	80.0	80.0	100.0	83.3	100.0	100.0	100.0	100.0	88.9	88.9	92.7	91.9
Mutatoxa	nd	nd	100.0	100.0	64.9	37.8	nd	nd	44.4	11.1	65.4	40.4
Combined incidence	48/160	45/160	24/30	23/30	101/185	84/185	42/124	41/124	21/45	17/45	236/544	211/544
Percent incidence	30.0	28.1	80.0	76.7	54.6	45.4	33.9	33.1	46.7	37.8	43.4	38.6

a Suspect or genotoxic = toxic category; genotoxic = highly toxic category; nd = no data.

Table 13. Estimates of the spatial extent of toxicity in Western Florida bays with results of four different tests.

Apalachicola Bay

Toxicity test	*Kilometer²*	*Percent of Total*
Amphipod Survival	0.0	0.0
Sea Urchin Development		
100% porewater	157.5	83.96
50% porewater	0.0	0.0
25% porewater	0.0	0.0
Sea Urchin Fertilization		
100% porewater	63.56	33.89
50% porewater	0.0	0.0
25% porewater	0.0	0.0
Microtox	186.84	99.6
Survey area	187.58	

St. Andrew Bay

Toxicity test	*Kilometer²*	*Percent of Total*
Amphipod Survival	0.0	0.0
Sea Urchin Development		
100% porewater	7.17	5.6
50% porewater	0.123	0.1
25% porewater	0.0	0.0
Sea Urchin Fertilization		
100% porewater	2.28	1.8
50% porewater	0.0	0.0
25% porewater	0.0	0.0
Microtox	127.22	100
Survey area	127.22	

Choctawhatchee Bay

Toxicity test	*Kilometer²*	*Percent of Total*
Amphipod Survival	0.0	0.0
Sea Urchin Development		
100% porewater	116.06	45.4
50% porewater	0.75	0.30
25% porewater	0.0	0.0
Sea Urchin Fertilization		
100% porewater	113.14	44.46
50% porewater	35.73	13.87
25% porewater	0.09	0.04
Microtox	254.47	100
Survey area	254.47	

Table 13 continued.

Pensacola Bay

Toxicity test	*Kilometer²*	*Percent of Total*
Amphipod Survival	0.04	0.015
Sea Urchin Development		
100% porewater	5.41	1.98
50% porewater	0.61	0.22
25% porewater	0.19	0.07
Sea Urchin Fertilization		
100% porewater	14.4	5.28
50% porewater	0.28	.102
25% porewater	0.28	.102
Microtox	262.75	96.37
Survey area	272.63	

Combined Western Florida survey area

Toxicity test	*Kilometer²*	*Percent of Total*
Amphipod Survival	0.04	0.005
Sea Urchin Development		
100% porewater	286.1	34.0
50% porewater	1.5	0.2
25% porewater	0.2	0.02
Sea Urchin Fertilization		
100% porewater	193.4	23.0
50% porewater	36.0	4.3
25% porewater	0.4	0.04
Microtox	831.2	98.7
Total Survey area	841.9	

Table 14. Test results for Pensacola Bay.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Unionized ammonia in toxicity test chambers								
UAN-amphipod	-0.138	**ns**						
UAN-porewater	-0.20899999:	**ns**			-0.195	**ns**	-0.67	***
Major and trace elements, and grain size								
Aluminum	0.129	**ns**	0.05899999:	**ns**	-0.103999:	**ns**	-0.024	**ns**
Arsenic	0.162	**ns**	0.254	**ns**	-0.022999:	**ns**	0.35599:	*
Barium	0.056	**ns**	0.275	**ns**	0.084	**ns**	0.525	**
Cadmium	0.079	**ns**	-0.766	***	-0.373999:	*	-0.34899:	*
Chromium	0.1	**ns**	0.094	**ns**	-0.000899:	**ns**	0.24399:	**ns**
Copper	0.05	**ns**	-0.563999999	**	-0.343	*	-0.336	*
Iron	0.126	**ns**	0.129	**ns**	-0.007	**ns**	0.33	*
Lead	0.23	**ns**	-0.588999999	**	-0.370999:	*	-0.259	**ns**
Lithium	0.131	**ns**	0.17199999:	**ns**	-0.045	**ns**	0.17399:	**ns**
Manganese	0.083	**ns**	0.471999999	**ns**	0.268	**ns**	0.41099:	*
Mercury	0.167	**ns**	-0.495	*	-0.308999:	**ns**	-0.323	*
Phosphorus	0.193	**ns**	0.195	**ns**	0.029	**ns**	0.175	**ns**
Nickel	0.06199999:	**ns**	0.227	**ns**	0.025	**ns**	0.158	**ns**
Silver	0.175	**ns**	-0.252	**ns**	0.038999:	**ns**	0.327	*
Titanium	-0.003	**ns**	0.09299999:	**ns**	-0.004999:	**ns**	0.266	**ns**
Vanadium	0.064	**ns**	0.277	**ns**	0.057	**ns**	0.37299:	*
Zinc	0.14299999:	**ns**	-0.524	**	-0.405	**ns**	-0.331	*
Sum of 8 metals ERMs	0.18399999:	**ns**	-0.556	**	-0.37	*	-0.332	*
Carbon	0.114	**ns**	-0.426999999	*	-0.352999:	**ns**	-0.323	*
Nitrogen	0.203	**ns**	-0.251	**ns**	-0.203999:	**ns**	-0.11	**ns**
Carbonate as CO3	0.127	**ns**	0.137	**ns**	-0.010999:	**ns**	0.082	**ns**
Grain size as phi	0.069	**ns**	0.243999999	**ns**	0.012999:	**ns**	0.12299:	**ns**

Table 14 continued.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
ORGANIC COMPOUNDS								
Polycyclic aromatic hydrocarbons (PAH)								
fluorene	-0.216999999	ns	0.067	ns	-0.243999:	ns	-0.21199:	ns
phenanthrene	-0.17699999:	ns	-0.352999999	ns	-0.449	*	-0.605	*
anthracene	-0.290999999	ns	-0.19	ns	-0.259	ns	-0.328	ns
Sum of 3 LMW PAH	-0.10799999:	ns	-0.405	ns	-0.441	*	-0.60699:	*
fluoranthene	-0.15599999:	ns	-0.45	*	-0.421999:	*	-0.615	*
fluoranthene (ug/goc)	-0.041	ns	-0.433999999	*	-0.281	ns	-0.48099:	*
benzo(a)anthracene	-0.158	ns	-0.545	*	-0.446	*	-0.544	*
chrysene	-0.033	ns	-0.442	*	-0.323	ns	-0.633	*
benzo(b,k)fluoranthene	-0.10399999:	ns	-0.459	*	-0.404	ns	-0.541	*
benzo(e)pyrene	-0.114	ns	-0.589999999	*	-0.462	*	-0.60699:	*
benzo(a)pyrene	-0.21	ns	-0.575	*	-0.396	ns	-0.514	*
perylene	-0.254	ns	-0.404	ns	-0.529999:	*	-0.379	ns
indeno(1,2,3)pyrene	-0.12199999:	ns	-0.480999999	*	-0.431999:	*	-0.47199:	*
dibenz(a,h)anthracene	-0.245999999	ns	-0.381	ns	-0.376	ns	-0.321	ns
benzo(g,h,i)perylene	-0.162	ns	-0.523	*	-0.514999:	*	-0.523	*
Sum of 11 HMW PAH	-0.10399999:	ns	-0.461	*	-0.425	*	-0.58599:	*
Total PAH	-0.111	ns	-0.475	*	-0.435	*	-0.6	*
Sum of 8 PAH ERMs	-0.15199999:	ns	-0.461	*	-0.436999:	*	-0.61099:	**
Pesticides								
Lindane	nd	nd	nd	nd	nd	nd	nd	nd
Heptachlor epoxide	0.10599999:	ns	-0.256	ns	-0.257	ns	-0.273	ns
Alpha CHL	-0.243999999	ns	-0.459	*	-0.586999:	*	-0.516	*
Trans Nono	-0.18299999:	ns	-0.14699999:	ns	-0.025999:	ns	-0.00899:	ns
2,4-DDD	-0.15599999:	ns	-0.522	*	-0.298999:	ns	-0.41799:	*
4,4-DDD	-0.193	ns	-0.669	*	-0.385	ns	-0.549	*
2,4'-DDE	0.06099999:	ns	-0.226	ns	-0.347999:	ns	0.01499:	ns
2,4-DDT	-0.14499999:	ns	-0.033	ns	-0.267	ns	-0.20899:	ns
4,4-DDT	-0.326	ns	-0.38	ns	-0.595	*	-0.59099:	*
Total DDT	-0.18	ns	-0.605999999	*	-0.517	*	-0.58999:	*
Endrin	-0.31	ns	-0.12199999:	ns	-0.377	ns	-0.406	ns
endrin (ug/goc)	0.4	ns	-0.4	ns	-0.8	ns	-0.775	ns

Table 14 continued.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Pesticides								
Dieldrin	-0.01499999:	ns	-0.44	*	-0.167	ns	-0.495	*
Dieldrin (ug/goc)	-0.408999999	ns	0.08599999:	ns	-0.323	ns	0.10599:	ns
Mirex	-0.14699999:	ns	-0.272	ns	-0.386	ns	-0.49399:	*
PCB congeners								
PCBCON8	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON18	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON29	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON52	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON44	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON66	-0.286999999	ns	-0.285999999	ns	-0.22	ns	-0.273	ns
PCBCON101	-0.17399999:	ns	-0.455	*	-0.022999:	ns	-0.321	ns
PCBCON77	-0.17399999:	ns	-0.455	*	-0.022999:	ns	-0.321	ns
PCBCON118	-0.068	ns	-0.373999999	ns	-0.343	ns	-0.324	ns
PCBCON153	-0.07099999:	ns	-0.531	*	-0.186999:	ns	-0.435	*
PCBCON105	-0.03699999:	ns	-0.38	ns	-0.306999:	ns	-0.314	ns
PCBCON138	-0.06099999:	ns	-0.345999999	ns	0.197	ns	-0.167	ns
PCBCON126	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON187	0.03099999:	ns	0.063	ns	-0.314	ns	-0.07399:	ns
PCBCON128	0.10599999:	ns	-0.256	ns	-0.257	ns	-0.273	ns
PCBCON180	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON170	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON195	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON206	nd	nd	nd	nd	nd	nd	nd	nd
PCBCON209	nd	nd	nd	nd	nd	nd	nd	nd
Sum of 20 PCBs	-0.083	ns	-0.4	ns	-0.318	ns	-0.337	ns
Total PCBs	-0.083	ns	-0.4	ns	-0.318	ns	-0.337	ns
Sum of 2 COH ERMs	0.138	ns	-0.477999999	*	-0.492999:	*	-0.524	*
Sum of 18 ERMs	0.198	ns	-0.491999999	*	-0.431999:	*	-0.35899:	*

ns = not significant (p>0.05)
* significant (p<0.05)
nd = no data

Table 15. Stations within Pensacola Bay in which chemical concentrations equalled or exceeded their respective sediment quality guidelines or toxicity thresholds (n=20 for organics, n=40 for metals). Stations with two-fold or greater exceedances are listed in bold.

Chemical substance	Greater than or equal to ERM value	Greater than or equal to PEL value	Greater than or equal to SQC or LOEC/NOEC
Copper	none	7, 8, 10	na
Mercury	none	10	na
Lead	10	1, 7, 10, 18	na
Zinc	**5**, 6, **7**, 8, **10**	4, 5, 6,7, 8, 9, 10, 12, 18	na
Dibenzo (a, h) anthracene	**7**, 8, **18**	**7**, **8**, 10, 11, 13, **18**	na
Chrysene	none	**7**, 8, 9, **18**	na
Benzo(a) pyrene	none	7, 18	na
Benz(a)anthracene	7, 8, 18	5, **7**, 8, **18**	na
Sum LPAHs	none	7, 8, 9, 18	na
Sum HPAHs	7, 8, 18	5, **7, 8**, 9, 10, 13, **18**	
Sum total PAHs	none	7, 18	na
Total chlordane	na	10, 11, 13, 18	na
Dieldrin	na	3, **5, 8, 10, 13**, 18	na
p, p'-DDD	na	4, **5**, 6, 7, **8**, 9, **10**, **13**, 18	na
p,p'-DDT	na	**5, 7, 8**, 9, **10**, 11, **13**	na
Total DDTs	**5**, 7, 8, 10, 13, 18	5, 7, 8, 10, 13, 18	na
Total PCBs	6	6	na
UAN LOEC for urchin development	na	na	1, **5**, 6, 7, 8, 9, 30
UAN LOEC for amphipod survival	na	na	none

* ERL and ERM values from Long et al. (1995); TEL and PEL values from MacDonald (1994),SQCs from U. S. EPA, 1994; urchin development LOEC from Long et al, In press; and amphipod NOEC from Kohn et al., 1994.

na = no applicable values.

Table 16. A comparison of the chemical concentrations (ave ± std dev) in toxic and non-toxic samples in Pensacola Bay in Microtox™ tests, ratios between the two averages, and ratios between the toxic average and applicable numerical guidelines (metals in ppm, organics in ppb)*.

Chemical substance	Not toxic (n=8)	Toxic (n=32)	Ratio of averages	Guidelines Exceeded (ratio to toxic average) guideline value	ratio	guideline value	ratio
Cadmium	0.2±0.2	0.6±0.9	4.1	<ERL (1.2 ppm)	<1.0	< TEL (0.67 ppm)	<1.0
Copper	21.2±4.6	41.9±43.9	2.0	>ERL (34.0 ppm)	1.2	>TEL (18.7 ppm)	2.2
Lead	39.9±17.6	63.4±54.7	1.6	>ERL (46.7 ppm)	1.3	>TEL (30.2 ppm)	2.1
Mercury	0.15±0.06	0.25±0.25	1.7	<ERL (0.15 ppm)	1.0	>TEL (0.13 ppm)	1.1
Silver	0.3±0.2	0.3±0.2	1.2	<ERL (1.0 ppm)	<1.0	<TEL (0.73 ppm)	<1.0
Zinc	147.5±56.2	252.2±261.0	1.7	>ERL (150 ppm)	1.7	>TEL (124 ppm)	2.0
Sum LMW PAH	206.0±298.0	540.5±740.0	2.6	<ERL (552 ppb)	<1.0	>TEL (312 ppb)	1.7
Sum HMW PAH	1826±2896	5360±7247	2.9	>ERL (1700 ppb)	3.1	>TEL (655 ppb)	8.2
Sum total PAH	2032±3193	5900±7896	2.9	>ERL (4022 ppb)	1.5	>TEL (1684 ppb)	3.5
Heptachlor epoxide	0.1±0.0	0.2±0.2	1.6	na		na	
alpha chlordane	4.8±7.2	6.8±8.3	1.4	na		na	
trans-nonachlor	1.3±0.0	1.7±1.8	1.3	na		na	
2,4'-DDD	1.0±0.0	5.0±7.7	5.0	na		na	
4,4'-DDD	5.5±10.1	13.7±17.4	2.5	na		>TEL (7.81 ppb)	1.7
4,4'-DDT	4.5±7.9	6.8±10.9	1.5	na		>TEL (1.19 ppb)	5.7
						>PEL (4.77 ppb)	1.4
Sum DDTs	12.5±18.8	27.0±32.0	2.2	>ERL (1.58 ppb)	17.1	>TEL (3.89 ppb)	6.9
Endrin	1.6±1.2	4.5±9.1	2.8	na		na	
Mirex	0.5±0.0	2.9±6.0	5.8	na		na	
Total PCBs	33.5±0.0	56.0±53.0	1.7	>ERL (22.7 ppb)	2.5	>TEL (21.6 ppb)	2.6

* ERL and ERM values from Long et al. (1995) and TEL and PEL values from MacDonald (1994). na = no applicable values.

Table 17. A comparison of the chemical concentrations (ave ± std dev) in toxic and non-toxic samples in Pensacola Bay in urchin fertilization tests, ratios between the two averages, and ratios between the toxic average and applicable numerical guidelines (metals in ppm, organics in ppb)*.

Chemical substance	Not toxic (n=37)	Highly toxic (n=3)	Ratio of averages	Guidelines Exceeded (ratio to toxic average) guideline value	ratio	guideline value	ratio
Arsenic	16.6±8.9	26.2±3.8	1.6	>ERL (8.2 ppm)	3.2	>TEL (7.2 ppm)	3.6
Chromium	71.4±42.4	114.7±34.9	1.6	>ERL (81.0 ppm)	1.3:	>TEL (52.3 ppm)	2.2
Nickel	19.0±8.9	23.5±1.6	1.2	>ERL (20.9 ppm)	1.1	>TEL (15.9 ppm)	1.5
2,4'-DDE	1.0±0.0	1.4±0.5	1.39999:	na		na	
Dieldrin	0.1±0.1	0.1±0.0	1.1	na		<TEL (0.71 ppb)	

* ERL and ERM values from Long et al. (1995) and TEL and PEL values from MacDonald (1994). na = no applicable values.

Table 18. A comparison of the chemical concentrations (ave ± std dev) in toxic and non-toxic samples in Pensacola Bay in urchin development tests, ratios between the two averages, and ratios between the toxic average and applicable numerical guidelines (metals in ppm, organics in ppb)*.

Chemical substance	Not toxic (n=31)	Toxic (n=9)	Ratio of averages	Guidelines Exceeded (ratio to toxic average) guideline value	ratio	guideline value	ratio
Cadmium	0.3±0.3	1.2±1.4	4.2	=ERL (1.2 ppm)	1.0	>TEL (0.67 ppm)	1.8
Chromium	74.3±36.6	78.7±55.8	1.1	<ERL (81.0 ppm)	<1.0	>TEL (52.3 ppm)	1.5
Copper	23.4±13.9	82.8±55.9	3.5	>ERL (34.0 ppm)	2.4	>TEL (18.7 ppm)	4.4
Lead	46.8±36.4	95.7±64.8	2.1	>ERL (46.7 ppm)	2.0	>TEL (30.2 ppm)	3.2
Mercury	0.17±0.13	0.43±0.33	2.6	>ERL (0.15 ppm)	2.6	>TEL (0.13 ppm)	3.3
Nickel	19.3±8.7	20.0±7.1	1.0	<ERL (20.9 ppm)	<1.0	>TEL (15.9 ppm)	1.3
Zinc	147.9±91.4	494.9±329.9	3.5	>ERL (150 ppm)	3.3	>TEL (124 ppm)	4.0
						>PEL (271 ppm)	1.8
Sum LMW PAH	265±422	814±888	3.1	>ERL (552 ppb)	1.5	>TEL (312 ppb)	2.6
Sum HMW PAH	3136±6369	7430±6665	2.4	>ERL (1700 ppb)	4.4	>TEL (655 ppb)	11.3
						>PEL (6676 ppb)	1.1
Sum total PAH	3401±6780	8244±7460	2.4	>ERL (4022 ppb)	2.0	>TEL (1684 ppb)	5.0
Heptachlor epoxide	0.1±0.0	0.2±0.3	2.2	na		na	
Alpha chlordane	4.4±6.0	10.2±9.8	2.3	na		na	
2,4'-DDD	2.5±4.2	7.1±9.6	2.9	na		na	
4,4'-DDD	7.7±14.6	20.0±16.8	2.6	na		>TEL (1.22 ppb)	16.4
						>PEL (7.81 ppb)	2.6
2,4'-DDT	0.4±0.6	0.7±1.3	2.1	na		na	
4,4'-DDT	2.5±5.1	12.9±13.3	5.2	na		>TEL (1.2 ppb)	10.8
						>PEL (4.8 ppb)	2.7
Sum total DDTs	14.1±20.3	41.8±35.9	3.0	>ERL (1.58 ppb)	26.4	>TEL (3.89 ppb)	10.7
Endrin	1.2±0.8	8.3±12.0	6.8	na		na	
Dieldrin	2.0±2.9	6.2±7.5	3.0	na		>TEL (0.71 ppb)	8.7
						>PEL (4.3 ppb)	1.4
Sum total PCBs	34.7±4.2	79.2±69.8	2.3	>ERL (22.7 ppb)	3.5	> TEL (21.6 ppb)	3.7

* ERL and ERM values from Long et al. (1995) and TEL and PEL values from MacDonald (1994). na = no applicable values.

Table 19. Summary of toxicity/chemistry relationships for samples from Pensacola Bay.

Chemical	No. of significant correlations	No. of samples > SQGs ERLs	No. of samples > SQGs TELs	Toxic/non-toxic ratios Micro-tox	Toxic/non-toxic ratios Urchin fert'n.	Toxic/non-toxic ratios Urchin dev't.	Toxic/SQGs ratios (TELs) Micro-tox	Toxic/SQGs ratios (TELs) Urchin fert'n.	Toxic/SQGs ratios (TELs) Urchin dev't.
Cadmium	3	0.0	0.0	4.1	<1.0	4.2	<1.0	<1.0	1.8
Copper	3	0.0	3	2.0	<1.0	3.5	2.2	<1.0	4.4
Lead	2	1	4	1.6	<1.0	2.1	2.1	<1.0	3.2
Zinc	2	5	10	1.7	<1.0	3.5	2.0	<1.0	4.0
Sum LMW PAH	3	0.0	4	2.6	<1.0	3.1	1.7	<1.0	2.6
Sum HMW PAH	3	3	7	2.9	<1.0	2.4	8.2	<1.0	11.3
4,4'-DDD	2	na	9	2.5	<1.0	2.6	1.7	<1.0	16.4
4,4'-DDT	2	na	7	1.5	<1.0	5.2	5.7	<1.0	10.7
Total DDTs	3	6	6	2.2	<1.0	3.0	6.9	<1.0	10.7
Dieldrin	2	na	6	<1.0	1.1	3.0	<1.0	<1.0	8.7

na = no applicable Sediment Quality Guidelines available

Table 20. Test Results for Bayou Chico and Apalachicola Bay.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Unionized ammonia in toxicity test chambers								
UAN - amphipod	0.413	ns						
UAN - porewater					-0.497	ns 999	-0.464	ns
Major and trace elements, and grain size								
Silver	0.245	ns	0.218	ns	-0.443	ns	-0.296	ns
Aluminum	0.494	ns	0.383	ns	-0.153	ns	-0.365	ns
Arsenic	0.285	ns	0.383	ns	-0.186	ns	-0.602	ns
Cadmium	0.142	ns	0.267	ns	-0.458	ns	-0.493	ns
Chromium	0.243	ns	0.367	ns	-0.322	ns	-0.639	ns
Copper	0.193	ns	0.243	ns	-0.477	ns	-0.486	ns
Iron	0.234	ns	0.550	ns	-0.186	ns	-0.639	ns
Mercury	0.067	ns	0.250	ns	-0.458	ns	-0.493	ns
Manganese	0.286	ns	0.469	ns	0.417	ns	0.303	ns
Nickel	0.201	ns	0.517	ns	-0.153	ns	-0.365	ns
Lead	0.092	ns	0.083	ns	-0.593	ns	-0.475	ns
Antimony	0.142	ns	0.267	ns	-0.458	ns	-0.493	ns
Selenium	0.261	ns	0.259	ns	-0.433	ns	-0.559	ns
Silicon	-0.360	ns	-0.383	ns	0.119	ns	0.456	ns
Tin	0.142	ns	0.267	ns	-0.458	ns	-0.493	ns
Zinc	0.067	ns	0.250	ns	-0.458	ns	-0.493	ns
Sum of 8 metals ERMs	0.167	ns	0.200	ns	-0.49199	ns	-0.475	ns
% gravel	0.291	ns	0.111	ns	-0.388	ns	-0.319	ns
% sand	-0.644	ns	-0.350	ns	0.322	ns	0.337	ns
%silt	0.628	ns	0.300	ns	-0.373	ns	-0.248	ns
% clay	0.611	ns	0.367	ns	-0.271	ns	-0.228	ns
% fines (silt and clay)	0.644	ns	0.356	ns	-0.322	ns	-0.337	ns
% TOC	0.519	ns	0.433	ns	-0.186	ns	-0.139	ns
AVS	0.209	ns	-0.200	ns	-0.661	ns	-0.329	ns
SEM-Cd	0.126	ns	0.150	ns	-0.542	ns	-0.402	ns
SEM-Cu	0.142	ns	0.267	ns	0.458	ns	-0.493	ns

Table 20 continued.

Major and trace elements, and grain size

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**
SEM-Hg	-0.143	ns	0.100	ns	0.698	ns	-0.266	ns
SEM-Ni	0.611	ns	0.333	ns	0.339	ns	-0.365	ns
SEM-Pb	0.109	ns	0.250	ns	-0.525	ns	-0.420	ns
SEM-Zn	0.209	ns	0.283	ns	-0.424	ns	-0.566	ns
Sum 5SEM	0.209	ns	0.283	ns	-0.424	ns	-0.566	ns
Sum 5SEM/AVS	-0.017	ns	0.500	ns	-0.356	ns	-0.420	ns
Sum 5SEM-AVS	0.142	ns	0.267	ns	-0.458	ns	0.493	ns
ORGANIC COMPOUNDS								
Polycyclic aromatic hydrocarbons (PAH)								
% TOC	0.519	ns	0.433	ns	-0.186	ns		
NAPHTHALENE	-0.128	ns	-0.188	ns	-0.399	ns	-0.471	ns
2-METHYLNAPHTHALENE	-0.182	ns	-0.406	ns	-0.576	ns	-0.261	ns
1-METHYLNAPHTHALENE	-0.182	ns	-0.406	ns	-0.576	ns	-0.261	ns
C1-NAPHTHALENES	-0.182	ns	-0.406	ns	-0.576	ns	-0.261	ns
2,6-DIMETHYLNAPHTHALENE	-0.182	ns	-0.406	ns	-0.487	ns	-0.261	ns
C2-NAPHTHALENES	-0.182	ns	-0.406	ns	-0.576	ns	-0.261	ns
1,6,7-TRIMETHYLNAPHTHALENE	-0.207	ns	-0.369	ns	-0.576	ns	-0.197	ns
C3-NAPHTHALENES	-0.207	ns	-0.369	ns	-0.576	ns	-0.197	ns
C4-NAPHTHALENES	-0.195	ns	-0.239	ns	**-0.674**	*	-0.015	ns
BIPHENYL	-0.182	ns	-0.319	ns	-0.487	ns	-0.261	ns
ACENAPHTHYLENE	0.148	ns	-0.129	ns	-0.652	ns	-0.380	ns
ACENAPHTHENE	-0.207	ns	-0.369	ns	-0.576	ns	-0.197	ns
DIBENZOFURAN	-0.100	ns	-0.431	ns	-0.576	ns	-0.324	ns
FLUORENE	-0.182	ns	-0.406	ns	-0.576	ns	-0.261	ns
C1-FLUORENES	-0.208	ns	-0.304	ns	-0.439	ns	-0.182	ns
C2-FLUORENES	-0.195	ns	-0.239	ns	**-0.674**	*	-0.015	ns
C3-FLUORENES	0.084	ns	-0.265	ns	-0.582	ns	-0.277	ns
PHENANTHRENE	-0.280	ns	-0.328	ns	-0.566	ns	-0.418	ns
1-METHYLPHENANTHRENE	-0.092	ns	-0.252	ns	-0.491	ns	-0.339	ns
ANTHRACENE	-0.123	ns	-0.387	ns	-0.578	ns	-0.401	ns
C1-PHENANTHRENE/ANTHRACENES	-0.178	ns	-0.399	ns	-0.578	ns	-0.401	ns
C2-PHENANTHRENE/ANTHRACENES	-0.082	ns	-0.419	ns	**-0.690**	*	-0.275	ns

Table 20 continued.

Polycyclic aromatic hydrocarbons (PAH)

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**
SC3-PHENANTHRENE/ANTHRACENES	-0.025	ns	-0.406	ns	**-0.690**	*	-0.275	ns
C4-PHENANTHRENE/ANTHRACENES	0.138	ns	-0.281	ns	-0.513	ns	-0.402	ns
DIBENZOTHIOPHENE	-0.207	ns	-0.369	ns	-0.576	ns	-0.197	ns
C1-DIBENZOTHIOPHENES	-0.182	ns	-0.319	ns	-0.487	ns	-0.261	ns
C2-DIBENZOTHIOPHENES	0.082	ns	-0.294	ns	-0.513	ns	-0.402	ns
C3-DIBENZOTHIOPHENES	0.119	ns	-0.094	ns	-0.563	ns	-0.303	ns
FLUORANTHENE	-0.316	ns	-0.309	ns	-0.546	ns	-0.423	ns
PYRENE	-0.237	ns	-0.333	ns	-0.546	ns	-0.485	ns
C1-FLUORANTHENES/PYRENES	-0.061	ns	-0.200	ns	-0.485	ns	-0.560	ns
BENZ(A)ANTHRACENE	-0.043	ns	-0.188	ns	-0.595	ns	-0.512	ns
CHRYSENE	-0.067	ns	-0.236	ns	**-0.681**	*	-0.451	ns
C1-CHRYSENES	-0.055	ns	-0.042	ns	-0.411	ns	-0.437	ns
C2-CHRYSENES	0.038	ns	-0.069	ns	-0.563	ns	-0.23:	ns
C3-CHRYSENES	0.019	ns	-0.081	ns	-0.449	ns	-0.289	ns
C4-CHRYSENES	0.019	ns	-0.081	ns	-0.449	ns	-0.289	ns
BENZO(B)FLUORANTHENE	0.000	ns	-0.200	ns	-0.583	ns	-0.437	ns
BENZO(K)FLUORANTHENE	0.128	ns	-0.006	ns	-0.522	ns	-0.389	ns
BENZO(E)PYRENE	-0.036	ns	-0.02:	ns	-0.522	ns	-0.389	ns
BENZO(A)PYRENE	-0.036	ns	-0.02:	ns	-0.522	ns	-0.389	ns
PERYLENE	0.097	ns	0.127	ns	-0.522	ns	-0.341	ns
INDENO(1,2,3-C,D)PYRENE	0.036	ns	-0.006	ns	-0.632	ns	-0.341	ns
DIBENZ(A,H)ANTHRACENE	0.128	ns	-0.006	ns	-0.522	ns	-0.389	ns
BENZO(G,H,I)PERYLENE	-0.024	ns	-0.006	ns	-0.534	ns	-0.464	ns
Sum 10 LPAH	-0.243	ns	-0.345	ns	-0.583	ns	-0.410	ns
Sum 12 HPAH	-0.055	ns	-0.212	ns	-0.583	ns	-0.437	ns
sum 22 PAHs	-0.073	ns	-0.224	ns	-0.472	ns	-0.485	ns
sum all PAHs	-0.073	ns	-0.224	ns	-0.472	ns	-0.485	ns
acenaphthene (ug/goc)	0.176	ns	-0.567	ns	-0.661	ns	-0.257	ns
fluoranthene (ug/goc)	-0.092	ns	-0.667	ns	-0.492	ns	-0.218	ns
phenanthrene (ug/goc)	-0.134	ns	-0.683	ns	-0.576	ns	-0.238	ns
Sum of 13 PAH ERMs	-0.237	ns	-0.333	ns	-0.546	ns	-0.485	ns

Table 20 continued.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Chlorinated organic hydrocarbons								
CL2(08)	0.104	ns	-0.071	ns	-0.517	ns	-0.226	ns
HEXACHLOROBENZENE								
LINDANE	-0.576	ns	-0.261	ns	0.098	ns	-0.134	ns
CL3(18)	0.345	ns	0.215	ns	-0.503	ns	-0.256	ns
CL3(28)	0.177	ns	-0.097	ns	-0.449	ns	-0.373	ns
HEPTACHLOR								
CL4(52)	0.238	ns	0.069	ns	-0.652	ns	-0.127	ns
ALDRIN								
CL4(44)	0.164	ns	0.042	ns	-0.485	ns	-0.253	ns
HEPTACHLOREPOXIDE	-0.200	ns	-0.467	ns	-0.280	ns	-0.390	ns
CL4(66)	0.270	ns	0.019	ns	-0.361	ns	-0.352	ns
2,4-DDE	-0.58:	ns	-0.545	ns	-0.438	ns	-0.004	ns
CL5(101)	0.100	ns	-0.106	ns	-0.449	ns	-0.352	ns
CIS-CHLORDANE	0.289	ns	0.119	ns	-0.386	ns	-0.303	ns
TRANS-NONACHLOR	0.282	ns	0.081	ns	-0.589	ns	-0.190	ns
DIELDRIN	0.332	ns	0.031	ns	-0.336	ns	-0.416	ns
4,4-DDE	0.103	ns	0.212	ns	-0.350	ns	-0.328	ns
CL4(77)								
2,4-DDD	-0.178	ns	-0.178	ns	-0.354	ns	-0.124	ns
ENDRIN								
CL5(118)	0.157	ns	-0.006	ns	-0.361	ns	-0.352	ns
4,4-DDD	-0.140	ns	-0.024	ns	-0.400	ns	-0.195	ns
2,4-DDT	-0.291	ns	-0.522	ns	-0.294	ns	-0.261	ns
CL6(153)	0.061	ns	0.055	ns	-0.288	ns	-0.362	ns
CL5(105)	0.110	ns	0.000	ns	-0.314	ns	-0.168	ns
4,4-DDT	-0.314	ns	-0.294	ns	-0.627	ns	-0.148	ns
CL6(138)	-0.165	ns	-0.182	ns	**-0.708**	*	-0.223	ns
CL5(126)	nd	nd	nd	nd	nd	nd	nd	nd
CL7(187)	0.067	ns	-0.061	ns	-0.314	ns	-0.442	ns
CL6(128)	0.289	ns	0.119	ns	-0.386	ns	-0.303	ns
CL7(180)	0.232	ns	0.106	ns	-0.386	ns	-0.303	ns
MIREX	0.05:	ns	-0.037	ns	0.068	ns	-0.202	ns
CL7(170)	0.270	ns	-0.069	ns	-0.449	ns	-0.352	ns

Table 20 continued.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**
Chlorinated organic hydrocarbons								
CL8(195)	0.259	ns	-0.149	ns	-0.295	ns	-0.524	ns
CL9(206)	0.082	ns	-0.206	ns	-0.424	ns	-0.402	ns
CL10(209)	0.037	ns	0.436	ns	-0.267	ns	-0.332	ns
sum of 20 PCB congeners	0.061	ns	0.055	ns	-0.288	ns	-0.362	ns
Pesticide Total :	-0.091	ns	0.067	ns	-0.301	ns	-0.300	ns
DDT Total :	-0.170	ns	-0.006	ns	-0.387	ns	-0.239	ns
Indeno Total :	0.251	ns	0.119	ns	-0.500	ns	-0.254	ns
PCB Total (No MDL):	0.061	ns	0.055	ns	-0.288	ns	-0.362	ns
Pesticide Total (No MDL):	-0.091	ns	0.067	ns	-0.301	ns	-0.300	ns
DDT Total (No MDL):	-0.170	ns	-0.006	ns	-0.387	ns	-0.239	ns
Indeno Total (No MDL):	0.251	ns	0.119	ns	-0.500	ns	-0.254	ns
dieldrin (ug/goc)	0.293	ns	-0.417	ns	-0.288	ns	-0.307	ns
endrin (ug/goc)	-0.369	ns	-0.219	ns	0.365	ns	0.042	ns
Sum of 3 COH ERMs	0.073	ns	0.164	ns	-0.350	ns	-0.389	ns
Sum of 25 ERMs	-0.159	ns	-0.233	ns	-0.458	ns	-0.657	ns

Table 21. Stations within Bayou Chico in which chemical concentrations equalled or exceeded their respective sediment quality guidelines or toxicity thresholds (n=6 for organics, n=6 for metals). Stations with two-fold or greater exceedances are listed in bold.

Chemical substance	Greater than or equal to ERM value	Greater than or equal to PEL value	Greater than or equal to SQC or LOEC/NOEC
Copper	none	2-2; 3-2; 4-2; 6-2	na
Lead	none	2-2	na
Zinc	**2-2**, **3-3**, **4-2**, 6-2	**2-2**, **3-2**,**4-2**,6-2	na
Naphthalene	none	4-2	na
2-methylnaphthalene	none	4-2	na
Acenaphthylene	none	2-2, 3-2, 4-2, 6-2	na
Acenaphthene	5-3	**4-2, 5-3, 6-2**	na
Fluorene	none	**4-2, 5-3, 6-2**	na
Anthracene	none	2-2, 3-2, 4-2, 5-3, 6-2	na
Phenanthrene	none	4-2, 5-3, 6-2	na
Dibenzo (a, h) anthracene	6-2	2-2, 3-2, 6-2	na
Pyrene	4-2	2-2, 3-2, 4-2, 5-3, 6-2	na
Benzo(a) pyrene	none	2-2, 3-2, 4-2, 6-2	na
Benz(a)anthracene	none	2-2, 3-2, 4-2, 5-3, 6-2	na
Chrysene	none	4-2, 6-2	na
Fluoranthene	none	2-2, 3-2, 4-2, 5-3, 6-2	4-2
Sum LPAHs	4-2	3-2, 4-2, 5-3, 6-2	na
Sum HPAHs	2-2, 3-2, 4-2, 5-3, 6-2	4-2	na
Sum total PAHs	none	**4-2, 6-2**	na
Dieldrin	na	2-2, 3-2, 6-2	none
p, p'-DDD	na	2-2, 3-2, 5-3, 6-2	na
p,p'-DDT	na	4-2, 5-3, 6-2	na
Total DDTs	5-3	none	na
Total PCBs	2-2, 3-2, 4-2	2-2, 3-2, 4-2	na
UAN LOEC for urchin development	na	na	1-2, 2-2, 6-2
UAN LOEC for amphipod survival	na	na	6-2

* ERL and ERM values from Long et al. (1995); TEL and PEL values from MacDonald (1994),SQCs from U. S. EPA, 1994; urchin development LOEC rom Long et al, In press; and amphipod NOEC from Kohn et al., 1994.
na = no applicable values.

Table 22. A comparison of the chemical concentrations (ave ± std dev) in toxic and non-toxic samples from Bayou Chico and Apalachicola Bay in urchin fertilization tests, the ratio between the two averages, and the ratio between the toxic average and applicable numerical guidelines (metals in ppm, organics in ppb)*.

Chemical substance	Not toxic (n=3)	Toxic (n=6)	Ratio of averages	Guidelines Exceeded (ratio to toxic average) guideline value	ratio	guideline value	ratio
Silver	0.1±0.1	0.2±0.2	1.3	<ERL (8.2 ppm)	<1.0	<TEL (7.2 ppm)	<1.0
Cadmium	0.5±0.6	0.6±0.5	1.3	<ERL (1.2 ppm)	<1.0	<TEL (0.67 ppm)	<1.0
Chromium	41.3±24.4	42.5±28.0	1.0	<ERL (81.0 ppm)	<1.0	<TEL (52.3 ppm)	<1.0
Copper	63.7±77.2	89.9±61.8	1.4	>ERL (34.0 ppm)	2.6	>TEL (18.7 ppm)	4.8
Lead	39.0±39.4	68.3±43.8	1.8	>ERL (46.7 ppm)	1.5	>TEL (30.2 ppm)	2.3
Mercury	0.2±0.3	0.3±0.2	1.3	>ERL (0.15 ppm)	1.3	>TEL (0.13 ppm)	1.5
Nickel	19.3±8.7	20.0±7.1	1.0	<ERL (20.9 ppm)	<1.0	>TEL (15.9 ppm)	1.3
Zinc	329.2±422.0	438.0±330.3	1.3	>ERL (150 ppm)	2.9	>TEL (124 ppm)	3.5
				>ERM (410 ppm)	1.1	>PEL (271 ppm)	1.6
Sum LMW PAH	581±815	1723±1708	3.0	>ERL (552 ppb)	3.1	>TEL (312 ppb)	5.5
						>PEL (1442 ppb)	1.2
Sum HMW PAH	3850±5387	7716±6533	2.0	>ERL (1700 ppb)	4.5	>TEL (655 ppb)	11.8
						>PEL (6676 ppb)	1.2
Sum total PAH	4430±6202	9440±8106	2.1	>ERL (4022 ppb)	2.3	>TEL (1684 ppb)	5.6
Acenaphthene (ug/goc)	0.9±1.2	6.8±6.8	7.6	<SQC (230 ug/goc)	<1.0		
Fluoranthene (ug/goc)	9.0±11.6	107.3±135.7	11.9	<SQC (300 ug/goc)	<1.0		
Phenanthrene (ug/goc)	1.7±2.3	26.8±37.6	15.8	<SQC (240 ug/goc)	<1.0		
Lindane	0.06±0.01	0.5±1.1	8.2	na		>TEL (0.32 ppb)	1.6
Heptachlor epoxide	0.03±0.0	0.24±0.5	8.0	na		na	
2,4' DDE	0.04±0.0	0.3±0.5	8.1	na		na	
4,4'-DDE	4.2±5.7	5.6±4.7	1.3	>ERL (2.2 ppb)	1.9	>TEL (2.07 ppb)	2.7
2,4'-DDD	2.1±2.9	2.8±2.6	1.3	na		na	
4,4'-DDD	6.1±8.5	7.2±8.1	1.2	na		>TEL (1.22 ppb)	5.9
2,4'-DDT	0.1±0.0	0.2±0.4	3.2	na		na	
4,4'-DDT	0.3±0.4	3.8±3.9	12.1	na		>TEL (1.2 ppb)	3.2
Sum total DDTs	12.9±17.4	20.0±17.4	1.6	>ERL (1.58 ppb)	12.6	>TEL (3.89 ppb)	5.1
Dieldrin (ug/goc)	0.1±0.1	0.2±0.1	2.4	<SQC (20 ug/goc)	<1.0		
Sum total PCBs	79.7±108.4	103.9±87.9	1.3	>ERL (22.7 ppb)	4.6	> TEL (21.6 ppb)	4.8

* ERL/ERM values from Long et al. (1995), TEL/PEL values from MacDonald (1994), SQC values from U. S. EPA (1994).
na = no applicable values.

Table 23. Test Results for Choctawhatchee Bay.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Un-ionized ammonia in toxicity test chambers								
UAN - amphipod	-0.006	ns	nd		nd		nd	
UAN - porewater	nd	nd	0.156	ns			-0.477	*
Major and trace elements, and grain size								
Silver	0.247	ns	-0.001	ns	-0.621	*	-0.154	ns
Aluminum	-0.163	ns	0.051	ns	-0.352	ns	0.059	ns
Arsenic	-0.062	ns	0.134	ns	-0.449	*	0.076	ns
Cadmium	0.185	ns	-0.100	ns	-0.609	*	-0.096	ns
Chromium	-0.126	ns	-0.087	ns	-0.442	*	0.035	ns
Copper	0.139	ns	-0.154	ns	-0.492	*	-0.061	ns
Iron	-0.207	ns	-0.039	ns	-0.326	ns	0.096	ns
Mercury	0.109	ns	-0.059	ns	-0.624	*	-0.034	ns
Manganese	-0.056	ns	-0.003	ns	-0.454	*	0.202	ns
Nickel	0.042	ns	0.093	ns	-0.434	ns	0.141	ns
Lead	0.019	ns	-0.065	ns	-0.58:	*	-0.023	ns
Antimony	0.026	ns	-0.018	ns	-0.529	*	0.188	ns
Selenium	0.117	ns	-0.041	ns	-0.684	*	-0.001	ns
Silicon	0.061	ns	0.032	ns	0.630	*	-0.067	ns
Tin	0.091	ns	-0.047	ns	-0.594	*	0.049	ns
Zinc	0.012	ns	-0.135	ns	-0.553	*	-0.046	ns
Sum of 9 metals ERMs	0.048	ns	-0.039	ns	-0.550	*	-0.006	ns
% gravel	-0.109	ns	-0.171	ns	-0.070	ns	-0.190	ns
% sand	0.026	ns	0.035	ns	0.635	*	0.094	ns
%silt	0.050	ns	-0.067	ns	-0.620	*	-0.019	ns
% clay	-0.198	ns	-0.112	ns	-0.464	*	-0.086	ns
% fines (silt & clay)	-0.026	ns	-0.035	ns	-0.635	*	-0.094	ns
% TOC	-0.013	ns	-0.167	ns	-0.630	*	-0.091	ns
AVS	0.201	ns	-0.144	ns	-0.629	*	0.094	ns
SEM-Cd	0.277	ns	-0.178	ns	-0.627	*	-0.006	ns
SEM-Cu	0.276	ns	-0.117	ns	-0.349	ns	0.164	ns
SEM-Hg	-0.069	ns	-0.126	ns	0.015	ns	0.176	ns

Table 23 continued.	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
SEM-Ni	-0.181	ns	0.027	ns	-0.265	ns	0.285	ns
SEM-Pb	0.200	ns	-0.089	ns	-0.583	*	0.082	ns
SEM-Zn	0.256	ns	-0.205	ns	-0.510	*	-0.029	ns
Sum 5SEM	0.226	ns	-0.223	ns	-0.508	*	-0.009	ns
Sum 5SEM/AVS	-0.198	ns	0.153	ns	0.191	ns	-0.219	ns
Sum 5SEM-AVS	0.223	ns	-0.254	ns	-0.472	*	0.059	ns
ORGANIC COMPOUNDS								
Polycyclic aromatic hydrocarbons (PAH)								
NAPHTHALENE	0.276	ns	-0.114	ns	-0.550	*	-0.111	ns
2-METHYLNAPHTHALENE	-0.299	ns	-0.270	ns	-0.324	ns	-0.152	ns
1-METHYLNAPHTHALENE	-0.312	ns	-0.273	ns	-0.319	ns	-0.183	ns
C1-NAPHTHALENES	-0.299	ns	-0.270	ns	-0.324	ns	-0.152	ns
2,6-DIMETHYLNAPHTHALENE	-0.114	ns	0.150	ns	-0.271	ns	-0.079	ns
C2-NAPHTHALENES	-0.250	ns	-0.062	ns	-0.227	ns	-0.033	ns
1,6,7-TRIMETHYLNAPHTHALENE	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
BIPHENYL	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
ACENAPHTHYLENE	0.158	ns	-0.063	ns	-0.442	*	-0.134	ns
ACENAPHTHENE	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
DIBENZOFURAN	-0.084	ns	-0.336	ns	-0.281	ns	-0.294	ns
FLUORENE	-0.117	ns	-0.185	ns	-0.220	ns	-0.225	ns
C1-FLUORENES	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
C2-FLUORENES	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
C3-FLUORENES	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
PHENANTHRENE	0.011	ns	-0.183	ns	-0.483	*	-0.206	ns
1-METHYLPHENANTHRENE	-0.066	ns	-0.198	ns	-0.423	*	-0.021	ns
ANTHRACENE	0.074	ns	-0.132	ns	-0.383	*	-0.246	ns
C1-PHENANTHRENE/ANTHRACENES	0.011	ns	-0.142	ns	-0.446	*	-0.128	ns
C2-PHENANTHRENE/ANTHRACENES	-0.003	ns	-0.049	ns	-0.487	*	-0.216	ns
C3-PHENANTHRENE/ANTHRACENES	-0.163	ns	-0.084	ns	-0.504	*	-0.130	ns
C4-PHENANTHRENE/ANTHRACENES	-0.108	ns	-0.001	ns	-0.506	*	-0.208	ns
DIBENZOTHIOPHENE	-0.046	ns	-0.223	ns	-0.302	ns	-0.130	ns
C1-DIBENZOTHIOPHENES	-0.154	ns	-0.094	ns	-0.403	ns	-0.161	ns
C2-DIBENZOTHIOPHENES	-0.141	ns	-0.055	ns	-0.395	ns	-0.157	ns

Table 23 continued.	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**
ORGANIC COMPOUNDS								
Polycyclic aromatic hydrocarbons (PAH)								
C3-DIBENZOTHIOPHENES	-0.154	ns	-0.094	ns	-0.403	ns	-0.161	ns
FLUORANTHENE	0.062	ns	-0.238	ns	-0.549	*	-0.250	ns
PYRENE	0.044	ns	-0.224	ns	-0.547	*	-0.231	ns
C1-FLUORANTHENES/PYRENES	0.035	ns	-0.230	ns	-0.57:	*	-0.224	ns
BENZ(A)ANTHRACENE	0.057	ns	-0.179	ns	-0.529	*	-0.237	ns
CHRYSENE	0.147	ns	-0.122	ns	-0.423	ns	-0.324	ns
C1-CHRYSENES	0.112	ns	-0.237	ns	-0.538	*	-0.205	ns
C2-CHRYSENES	0.119	ns	-0.024	ns	-0.348	ns	-0.013	ns
C3-CHRYSENES	0.129	ns	0.106	ns	-0.519	*	-0.183	ns
C4-CHRYSENES	-0.058	ns	-0.012	ns	-0.498	*	-0.079	ns
BENZO(B)FLUORANTHENE	0.148	ns	-0.140	ns	-0.433	ns	-0.344	ns
BENZO(K)FLUORANTHENE	0.152	ns	-0.122	ns	-0.424	ns	-0.342	ns
BENZO(E)PYRENE	0.147	ns	-0.140	ns	-0.435	ns	-0.316	ns
BENZO(A)PYRENE	0.098	ns	-0.125	ns	-0.444	ns	-0.268	ns
PERYLENE	-0.05:	ns	-0.236	ns	-0.608	*	-0.203	ns
INDENO(1,2,3-C,D)PYRENE	0.161	ns	-0.146	ns	-0.426	ns	-0.347	ns
DIBENZ(A,H)ANTHRACENE	0.146	ns	-0.144	ns	-0.432	ns	-0.306	ns
BENZO(G,H,I)PERYLENE	0.184	ns	-0.179	ns	-0.432	ns	-0.324	ns
Sum 10 LPAH	0.101	ns	-0.183	ns	-0.504	*	-0.200	ns
Sum 12 HPAH	0.111	ns	-0.232	ns	-0.555	*	-0.222	ns
sum 24 PAHs	0.088	ns	-0.229	ns	-0.546	*	-0.230	ns
sum all PAHs	0.052	ns	-0.224	ns	-0.585	*	-0.224	ns
acenaphthene (ug/goc)	0.359	ns	0.111	ns	0.082	ns	-0.284	ns
fluoranthene (ug/goc)	0.239	ns	0.054	ns	-0.015	ns	-0.608	*
phenanthrene (ug/goc)	0.351	ns	-0.007	ns	0.139	ns	-0.461	*
Sum of 13 PAH ERMs	0.048	ns	-0.175	ns	-0.523	*	-0.246	ns
Chlorinated organic hydrocarbons								
LINDANE	-0.072	ns	-0.285	ns	-0.015	ns	0.255	ns
CL3(18)	0.377	ns	-0.011	ns	-0.215	ns	-0.068	ns
CL3(28)	0.074	ns	-0.065	ns	-0.644	*	0.133	ns
HEPTACHLOR	0.315	ns	-0.046	ns	-0.203	ns	0.070	ns
CL4(52)	-0.009	ns	-0.109	ns	-0.315	ns	0.000	ns
ORGANIC COMPOUNDS								

Table 23 continued.

Chlorinated organic hydrocarbons								
CL4(44)	-0.114	ns	0.079	ns	-0.194	ns	-0.026	ns
HEPTACHLOREPOXIDE	-0.01:	ns	-0.099	ns	-0.099	ns	-0.259	ns
CL4(66)	0.209	ns	-0.127	ns	-0.581	*	-0.090	ns
2,4-DDE	0.069	ns	0.083	ns	-0.353	ns	-0.062	ns
CL5(101)	0.417	ns	-0.006	ns	-0.544	*	-0.101	ns
CIS-CHLORDANE	0.311	ns	-0.250	ns	-0.621	*	-0.131	ns
TRANS-NONACHLOR	0.259	ns	0.137	ns	-0.537	*	-0.285	ns
DIELDRIN	0.038	ns	0.209	ns	-0.586	*	-0.278	ns
4,4-DDE	0.041	ns	-0.137	ns	-0.705	*	-0.081	ns
2,4-DDD	0.056	ns	-0.11:	ns	-0.524	*	-0.065	ns
CL5(118)	-0.007	ns	-0.198	ns	-0.513	*	-0.212	ns
4,4-DDD	0.085	ns	-0.219	ns	-0.634	*	-0.048	ns
CL6(153)	-0.004	ns	-0.205	ns	-0.616	*	-0.098	ns
CL5(105)	0.071	ns	-0.212	ns	-0.535	*	-0.171	ns
4,4-DDT	-0.200	ns	-0.031	ns	-0.418	ns	0.135	ns
CL6(138)	0.193	ns	-0.250	ns	-0.630	*	-0.107	ns
CL7(187)	0.297	ns	-0.101	ns	-0.607	*	0.035	ns
CL6(128)	0.067	ns	-0.119	ns	-0.253	ns	0.036	ns
CL7(180)	0.276	ns	-0.042	ns	-0.520	*	-0.159	ns
MIREX	-0.002	ns	-0.111	ns	-0.324	ns	-0.291	ns
CL7(170)	0.041	ns	-0.167	ns	-0.458	*	-0.23:	ns
CL8(195)	0.181	ns	-0.003	ns	-0.403	ns	-0.261	ns
CL9(206)	0.203	ns	0.339	ns	-0.293	ns	0.065	ns
CL10(209)	-0.029	ns	-0.049	ns	-0.459	*	-0.057	ns
sum of 20 PCBs	0.098	ns	-0.174	ns	-0.665	*	-0.084	ns
total PCBs	0.098	ns	-0.174	ns	-0.665	*	-0.084	ns
Pesticide Total :	0.065	ns	-0.167	ns	-0.654	*	-0.02:	ns
DDT Total :	0.091	ns	-0.159	ns	-0.656	*	-0.001	ns
Indeno Total :	0.491	*	-0.128	ns	-0.529	*	-0.035	ns
PCB Total (No MDL):	0.11:	ns	-0.188	ns	-0.621	*	-0.075	ns
Pesticide Total (No MDL):	0.052	ns	-0.178	ns	-0.716	*	-0.111	ns
DDT Total (No MDL):	0.048	ns	-0.155	ns	-0.695	*	-0.046	ns
Indeno Total (No MDL):	0.466	*	-0.108	ns	-0.558	*	-0.068	ns
dieldrin (ug/goc)	0.183	ns	0.325	ns	0.226	ns	-0.310	ns
endrin (ug/goc)	-0.009	ns	0.260	ns	0.637	*	-0.008	ns
Sum of 3 COH ERMs	0.261	ns	-0.166	ns	-0.699	*	-0.05:	ns
Sum of 25 ERMs	-0.017	ns	-0.099	ns	-0.573	*	-0.047	ns

nd = no data; ns = not significant (p>0.05)

Table 24. Stations within Choctawhatchee Bay in which chemical concentrations equalled or exceeded their respective sediment quality guidelines or toxicity thresholds (n=20 for organics, n=20 for metals). Stations with two-fold or greater exceedances are listed in bold.

Chemical substance	Greater than or equal to ERM value	Greater than or equal to PEL value	Greater than or equal to SQC or LOEC/NOEC
Silver	F1-1, F2-1	**F1-1, F2-1**	na
Dibenzo (a, h) anthracene	none	A1-1	na
Chrysene	none	A1-1	na
Benzo(a) pyrene	none	A1-1	na
Benz(a)anthracene	none	A1-1	na
Dieldrin	na	A1-1	none
Endrin	na	na	C3-1, D1-1
p, p'-DDE	**F1-1**	none	na
p,p'-DDD	na	**F1-1**	na
p,p'-DDT	na	F1-1	na
Total DDTs	**F1-1**	**F1-1**	na
UAN LOEC for urchin development	na	na	B3-1, K2-1
UAN LOEC for amphipod survival	na	na	none

* ERL and ERM values from Long et al. (1995); TEL and PEL values from MacDonald (1994),SQCs from U. S. EPA, 1994;
urchin development LOEC from Long et al, In press; and amphipod NOEC from Kohn et al., 1994.
na = no applicable values.

Table 25. A comparison of the chemical concentrations (ave ± std dev) in toxic and non-toxic samples from Choctawhatchee Bay in urchin fertilization tests, the ratio between the two averages, and the ratio between the toxic average and applicable numerical guidelines (metals in ppm, organics in ppb)*.

Chemical substance	Not toxic (n=5)	Toxic (n=15)	Ratio of averages	Guidelines Exceeded (ratio to toxic average) guideline value	ratio	guideline value	ratio
Silver	0.03±0.0	0.65±1.2	19.8	<ERL (8.2 ppm)	<1.0	<TEL (7.2 ppm)	<1.0
Arsenic	5.4±8.0	14.6±8.1	2.7	>ERL (8.2 ppm)	1.7:	>TEL (7.2 ppm)	2.0
Cadmium	0.1±0.1	0.5±0.6	8.1	<ERL (1.2 ppm)	<1.0	<TEL (0.67 ppm)	<1.0
Chromium	22.4±24.2	66.1±35.7	3.0	<ERL (81.0 ppm)	<1.0	>TEL (52.3 ppm)	1.3
Copper	8.7±6.7	28.4±25.6	3.3	<ERL (34.0 ppm)	<1.0	>TEL (18.7 ppm)	1.5
Lead	7.5±6.2	53.1±49.2	7.1	>ERL (46.7 ppm)	1.1	>TEL (30.2 ppm)	1.8
Mercury	0.03±0.02	0.13±0.1	5.2	<ERL (0.15 ppm)	<1.0	>TEL (0.13 ppm)	1
Nickel	6.0±6.5	18.4±10.0	3.1	<ERL (20.9 ppm)	<1.0	>TEL (15.9 ppm)	1.2
Zinc	26.2±17.3	80.5±50.1	3.1	<ERL (150 ppm)	<1.0	<TEL (124 ppm)	<1.0
Sum LMW PAH	12.6±12.7	118.8±183.2	9.4	<ERL (552 ppb)	<1.0	<TEL (312 ppb)	<1.0
Sum HMW PAH	179.7±184.7	2164±3618	3.3	>ERL (1700 ppb)	1.3	>TEL (655 ppb)	3.3
Sum total PAH	192±197	2283±3801	11.9	<ERL (4022 ppb)	<1.0	>TEL (1684 ppb)	1.4
Lindane	0.07±0.02	0.29±0.34	4.4	na		<TEL (0.32 ppb)	<1.0
Dieldrin	0.04±0.0	0.69±1.4	17.3	na		<TEL (0.71 ppb)	<1.0
4,4'-DDE	0.3±0.3	10.0±18.3	33.5	>ERL (2.2 ppb)	4.5	>TEL (2.07 ppb)	4.8
4,4'-DDD	0.2±0.1	5.2±12.9	33.2	na		>TEL (1.22 ppb)	4.3
4,4'-DDT	0.2±0.2	1.2±2.4	6.8	na		>TEL (1.2 ppb)	1.0
Sum total DDTs	0.8±0.6	18.3±36.5	21.6	>ERL (1.58 ppb)	11.4	>TEL (3.89 ppb)	4.7
Sum total PCBs	2.8±1.2	19.1±21.0	6.8	<ERL (22.7 ppb)	<1.0	<TEL (21.6 ppb)	<1.0

* ERL/ERM values from Long et al. (1995), TEL/PEL values from MacDonald (1994), SQC values from U. S. EPA (1994).
na = no applicable values.

Table 26. Test Results for St. Andrew Bay.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Unionized ammonia in toxicity test chambers								
UAN - amphipod	0.056	ns	nd					
UAN - porewater			nd		-0.499	*	-0.621	**
Major and trace elements, and grain size								
Silver	-0.324	ns	-0.541	*	-0.420	ns	-0.364	ns
Aluminum	-0.181	ns	-0.506	*	-0.452	*	-0.386	ns
Arsenic	-0.221	ns	-0.680	*	-0.473	*	-0.344	ns
Cadmium	-0.242	ns	-0.598	*	-0.428	*	-0.31:	ns
Chromium	-0.111	ns	-0.379	ns	-0.246	ns	-0.224	ns
Copper	-0.432	*	-0.632	*	-0.436	*	-0.273	ns
Iron	-0.164	ns	-0.528	ns	-0.431	*	-0.310	ns
Mercury	-0.23:	ns	-0.564	*	-0.331	ns	-0.073	ns
Manganese	-0.026	ns	-0.395	ns	-0.229	ns	-0.230	ns
Nickel	-0.173	ns	-0.513	*	-0.404	ns	-0.308	ns
Lead	-0.346	ns	-0.624	*	-0.380	ns	-0.250	ns
Antimony	-0.269	ns	-0.561	*	-0.534	*	-0.301	ns
Selenium	-0.128	ns	-0.514	*	-0.444	*	-0.351	ns
Silicon	0.112	ns	0.58:	*	0.31:	ns	0.251	ns
Tin	-0.277	ns	-0.660	*	-0.420	ns	-0.219	ns
Zinc	-0.339	ns	-0.611	*	-0.495	*	-0.415	ns
Sum of 9 metals ERMs	-0.301	ns	-0.630	*	-0.454	*	-0.324	ns
% fines (silt & clay)	-0.250	ns	-0.36	ns	-0.153:	ns	-0.1869:	ns
% TOC	-0.11:	ns	-0.313	ns	-0.224	ns	-0.097	ns
Sum 5 SEM	-0.336	ns	-0.656	*	-0.431	*	-0.265	ns
Sum 5 SEM/AVS	-0.283	ns	0.123	ns	0.027	ns	-0.142	ns
Sum 5 SEM-AVS	0.056	ns	0.676	*	0.282	ns	0.23:	ns
ORGANIC COMPOUNDS								
Polycyclic aromatic hydrocarbons (PAH)								
Sum 8 LPAH	-0.18:	ns	-0.475	*	-0.255	ns	-0.291	ns
Sum 16 HPAH	-0.292999:	ns	-0.556	*	-0.275	ns	-0.1559:	ns
sum 24 PAHs	-0.285	ns	-0.544	*	-0.257	ns	-0.186	ns
sum all PAHs	-0.186	ns	-0.545	*	-0.230	ns	-0.239	ns
acenaphthene (ug/goc)	-0.286	ns	-0.233	ns	-0.215	ns	-0.241	ns

Table 26. Test Results for St. Andrew Bay.

	Amphipod survival		Microtox		Urchin fertilization		Urchin development	
	Rho	signif.	Rho	signif.	Rho	signif.	Rho	signif.
Polycyclic aromatic hydrocarbons (PAH)								
fluoranthene (ug/goc)	-0.076	ns	-0.414	*	-0.007	ns	-0.050	ns
phenanthrene (ug/goc)	-0.201	ns	-0.395	ns	-0.035	ns	-0.098	ns
Sum of 13 PAH ERMs	-0.286	ns	-0.535	*	-0.211	ns	-0.180	ns
Chlorinated organic hydrocarbons								
2,4-DDE	-0.292	ns	-0.609	**	-0.434	*	-0.134	ns
CIS-CHLORDANE	-0.302	ns	-0.470	*	-0.245	ns	-0.253	ns
TRANS-NONACHLOR	-0.110	ns	-0.722	***	-0.276	ns	-0.149	ns
DIELDRIN	-0.179	ns	-0.627	**	-0.213	ns	-0.099	ns
4,4-DDE	-0.317	ns	-0.540	*	-0.394	*	-0.141	ns
2,4-DDD	-0.540	*	-0.377	*	-0.337	ns	-0.151	ns
ENDRIN	<mdl		<mdl		<mdl		<mdl	
4,4-DDD	-0.311	ns	-0.520	*	-0.315	ns	-0.039	ns
2,4-DDT	-0.370	*	-0.328	ns	-0.201	ns	0.074	ns
4,4-DDT	-0.340	ns	-0.487	*	-0.23:	ns	0.119	ns
sum of 23 PCBs	-0.124	ns	-0.516	*	-0.315	ns	-0.222	ns
DDT Total :	-0.374	*	-0.552	*	-0.360	*	-0.055	ns
Pesticide Total (No MDL):	-0.375	*	-0.556	*	-0.356	ns	-0.062	ns
dieldrin (ug/goc)	-0.066	ns	-0.450	*	-0.121	ns	-0.068	ns
endrin (ug/goc)	0.308	ns	0.472	*	0.229	ns	0.127	ns
Sum of 3 COH ERMs	-0.348	ns	-0.538	*	-0.386	*	-0.129	ns
Sum of 25 ERMs	-0.351	ns	-0.621	*	-0.380	ns	-0.219	ns

AVS = acid volatile sulfides
SEM = simultaneously-extracted metals
UAN = un-ionized ammonia
ERM = effects range-median
TOC = total organic carbon
Fines = silt + clay
COHs = chlorinated organic hydrocarbons
PAHs = polynuclear aromatic hydrocarbons
LPAHs = low moluecular weight PAHs
HPAHs = high molecular weight PAHs
< mdl = less than method detection limit
nd = no data

Table 27. Stations within St. Andrew Bay in which chemical concentrations equalled or exceeded their respective sediment quality guidelines or toxicity thresholds. Stations with a two-fold or greater exceedance listed in bold.

Chemical substance	Greater than or equal to ERM value	Greater than or equal to PEL value	Greater than or equal to SQC or LOEC/NOEC
Silver	none	55, 56, 57, 58	na
Copper	53	**53**, 54, 56, 58, 60	na
Mercury	53	53	na
Lead	53	**53**, 60	na
Zinc	53	**53**, 56, 57, 58	na
Dibenzo(a,h)anthracene	53	53, 54	na
Chrysene	none	53	na
Benzo(a)pyrene	none	53	na
Benz(a)anthracene	none	53	na
Sum HPAH	53	53	na
Total chlordanes	na	**53**, 54	na
Dieldrin	na	53	na
Sum tPCBs	53	53	na
p, p'-DDE	**53**, 58, 60, 63	none	na
p, p'-DDD	none	**53**, 54, 56, 57, **58**, 60, 61, **63**, 66, 68, **69**	
p, p'-DDT	none	46, **47**, 60	na
total DDTs	none	**53**, 58, 60, 63	na
total PCBs	none	53	na
Sea urchin development LOEC for UAN			55, **56**, 57, **58**, 59
Amphipod survival NOEC for UAN		58	

ERL/ERM values from Long et al. (1995); TEL/PEL values from MacDonald (1994); SQC's from U. S. EPA (1994).
na = no applicable guidelines available
Urchin UAN LOEC from Long et al. (in press); amphipod UAN NOEC from Kohn et al. (1994).

Table 28. Correlations between bioassay results and chemical concentrations for all 102 western Florida samples.

	Microtox		Urchin fertilization		Urchin development	
	Rho	**signif.**	**Rho**	**signif.**	**Rho**	**signif.**
Unionized ammonia in toxicity test chambers						
UAN - porewater	nd	-0.453	**	-0.6919:	***	
Major and trace elements						
Silver	-0.341	*	-0.188	ns	-0.177	ns
Arsenic	-0.061	ns	-0.308	*	-0.222	ns
Cadmium	-0.307	*	-0.270	ns	-0.238	ns
Chromium	-0.043	ns	-0.243	ns	-0.183	ns
Copper	-0.287	*	-0.309	*	-0.291	*
Mercury	-0.351	*	-0.211	ns	-0.142	ns
Nickel	-0.042	ns	-0.295	*	-0.201	ns
Lead	-0.262	ns	-0.329	*	-0.255	ns
Antimony	-0.239	ns	-0.282	*	-0.166	ns
Selenium	-0.020	ns	-0.426	*	-0.279	*
Tin	-0.324	*	-0.259	*	-0.186	ns
Zinc	-0.271	ns	-0.370	*	-0.365	*
Sum of 9 metals ERMs	-0.245	ns	-0.330	*	-0.273	ns
Sum 5 SEM	-0.342	ns	-0.298	*	-0.270	ns
Organic compounds						
Sum LPAH	-0.421	*	-0.079	ns	-0.090	ns
Sum HPAH	-0.341	*	-0.238	ns	-0.172	ns
Sum PAHs	-0.355	*	-0.206	ns	-0.158	ns
Sum all PAHs	+0.224	ns	-0.601	***	-0.454	**
Acenaphthylene (ug/goc)	+0.084	ns	-0.341	*	-0.379	*
Fluoranthene (ug/goc)	-0.065	ns	-0.250	ns	-0.335	*
Phenanthrene (ug/goc)	-0.224	ns	-0.121	ns	-0.248	ns
Sum of 13 PAH ERMs	-0.375	*	-0.175	ns	-0.143	ns
Total PCBs	-0.397	*	-0.159	ns	-0.107	ns
Total DDTs	-0.486	**	-0.060	*	+0.057	ns
Total Pesticides	-0.443	**	-0.125	ns	+0.001	ns
dieldrin (ug/goc)	+0.094	ns	-0.268	ns	-0.360	*
endrin (ug/goc)	+0.616	***	-0.212	ns	-0.225	ns
Sum of 3 COH ERMs	-0.442	**	-0.124	ns	-0.015	ns
Sum of 25 ERMs	-0.293	*	-0.312	*	-0.252	ns

SEM = simultaneously-extracted metals
UAN = un-ionized ammonia
ERM = effects range-median
COHs = chlorinated organic hydrocarbons
PAHs = polynuclear aromatic hydrocarbons
LPAHs = low moluecular weight PAHs
HPAHs = high molecular weight PAHs
nd = no data

APPENDICES

Appendix A1: Field notes from Pensacola Bay; 1993 and 1994.

APPENDIX A2. Field notes from Choctawhatchee Bay.

Appendix A3. Field notes from St. Andrews Bay.

APPENDIX A4. Field notes from Apalachicola Bay.

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Appendix B4. Chemistry and toxicity data from Bayou Chico and Appalachicola Bay.

APPENDIX A1. Field notes from Pensacola Bay; 1993 and 1994.									
Pensacola	***Bay***								
	Station No.	**Location**	**Date**	**Time**	**Latitude ° N**	**Longitude ° W**	**Water Depth(M)**	**Air Temp. °C**	**Top Temp. °C**
1993									
	1	Bayou Grande	3/31/93	15:45	30°22.548'	87°16.743'	3.4	Not Recorded	22
	2	Bayou Grande	3/31/93	15:05	30°22.095'	87°17.091'	2.9	"	22
	3	Bayou Grande	3/31/93	14:44	30°22.258'	87°18.771'	3	"	22
	4	Bayou Chico	3/31/93		30°24.425'	87°15.387'	3.2	"	22.8
	5	Bayou Chico	3/31/93	10:32	30°24.317'	87°15.377'	2.6	"	21.5
	6	Bayou Chico	3/31/93	10:07	30°24.196'	87°15.245'	2	"	22
	7	Bayou Chico	3/31/93	9:40	30°24.041'	87°14.786'	3	"	20.8
	8	Bayou Chico	3/31/93	9:10	30°23.966'	87°14.667'	3.7	"	20.8
	9	Bayou Chico	3/31/93	8:50	30°23.935'	87°14.385'	5.1	"	19.9
	10	Bayou Texar	3/30/92	8:55	30°27.113'	80°12.078'	1.1	"	18
	11	Bayou Texar	3/30/92	9:26	30°26.646'	87°11.241'	2	"	18
	12	Bayou Texar	3/30/92	9:49	30°25.910'	87°11.168'	2.1	"	19.1
	13	Bayou Texar	3/30/92	11:17	30°25.661'	87°11.362'	2.5	"	19.5
	14		3/31/93	16:43		87°15.130'	7	"	20
	15	Bayou Chico	4/2/93	7:22	30°23.389'	87°13.587'	7.5	"	18
	16	Bayou Channel	4/1/93	11:34	30°23.558'	8713.989'	3.5	"	20
	17		3/31/93	13:12	30°24.141'	87°13.622'	2.2	"	21
	18	Inner Harbor	3/31/93	13:39	30°24.175'	87°13.296'	3.5	"	21
	19	Inner Harbor	4/1/93	9:38	30°24.134	87°12.895	4.5	"	19.5
	20	Inner Harbor	4/1/93	10:10	30°24.138'	87°12.855'	4.5	"	19.1
	21		3/30/93	12:15	30°23.010'	87°13.012'		"	20
	22			12:46	30°23.463'	87°12.949'	9.5	"	20
	23	Inner Harbor	4/1/93	9:00	30°23.853'	87°13.010'	10	"	19.5
	24	Lower Bay	4/1/93	8:23	30°22.081'	87°12.650'	5.5	"	19.5
	25	Lower Bay	3/31/93	16:15	30°22.521'	87°14.464'	7.8	"	21
	26	East Bay	4/2/93	12:36	30°28.289'	87°03.152'	2	"	19
	27	East Bay	4/2/93	13:01	30°26.634'	86°59.533'	3	"	19.5
	28	East Bay	4/2/93	13:38	30°27.744'	86°58.686'	2.7	"	19.5
	29	Blackwater Bay	4/2/93	14:15	30°31.726'	87°00.973'	1.7	"	19.9
	30	Blackwater Bay	4/2/93	14:49	30°32.602'	87°00.788'	3.2	"	20.5
	31	Blackwater Bay	4/2/93	15:18	30°34.817'	87°00.661'	4.5	"	19.9
	32		3/29/93	15:39	30°28.886'	87°07.199'	3.1	"	21
	33		3/29/93	14:52	30°31.169'	87°07.219'	2.4	"	18.5
	34		3/29/93	14:21	30°31.621'	87°08.723'	2.5	"	20
	35		3/29/93	13:49	30°32.137'	87°10.797'	1.7	"	20.5
	36		3/29/93	13:16	30°32.923'	87°11.299'	1.3	"	21.2
	37		3/29/93	12:02	30°33.754'	87°10.479'	1	"	20
	38	Escambia	3/29/93	11:24	30°33.337'	87°09.150'	2.4	"	18.5
	39	Floridatown	3/29/93	10:21	30°34.470'	87°09.960'	2.5	"	22
	40	Central Bay	3/30/93	7:46	30°24.335'	87°07.090'	5.5	"	20

Appendix A1. Field notes from Pensacola Bay; 1993 and 1994.

APPENDIX A1. Field notes from Pensacola Bay; 1993 and 1994.

Station No.	Btm. Temp. °C	Top Salinity ppt	Top. D. O. mg/l	Btm. Sal. ppt	Bottom D.O. mg/L	Surface Conductivity micro moles	Bottom Conductivity micro moles
1	20.5	12.1	9.2	14.3	9	14100	22000
2	20.1	12	9.1	16.6	8	17900	24100
3	21	11.5	8.7	12	5.9	17100	18100
4	20	6.2	8.2	4.3	5.4	10200	21800
5	20.5	8.6	8.2	11.7	6.6	13100	17800
6	20.7	8.9	8.2	10	7.6	13800	15100
7	19.2	8.9	8	14.8	7.7	13800	21500
8	21	9.7	8.4	15	6.9	14800	22000
9	22	10.1	8	21.5	6.8	15200	31000
10	22	2.1	7.1	7.7			11800
11	21	7.1	6.9	8.2	5.9	11100	13000
12	20	7.8	7.3	9.1	5.2	12100	13900
13	19.1	7.5	7.2	8.4	5.3	11600	13200
14	17.5	19.9	9.1	25		29100	
15	16.9	12	8.4	28.9	6.1	17000	
16	19.5	16.5	8.3	17.5	8.2	23500	26900
17	20	13.2	8.1	17.7	8.9	19600	
18	19.3	16	9.4	18.1	8.2	23600	26900
19	19.5	13	8.5	18.5	7.5	19100	27000
20	19.5	13	8.5	18.5	7.6	18500	26600
21	17	11	8.1	25.6	1.6	16300	36000
22		0.1				15200	
23	21	13.5	8.3	27	6.7	19900	38900
24	17.5	13.5	8.5	23	7.4	19500	31200
25	18	17	9.1	25.2	3.6	26200	35800
26	18.5	2.8	8.3	11	7.5	4000	16200
27	18.1	8.1	8.7	8.9	8.2	12500	13800
28	19	7.5	9	7.1	8.6	11100	11200
29	20	0	7.2	9.5	7.1	272	14000
30	20	0	7.2	8.9	5.9	191	14500
31	20	0	6.9	0	6.7	151	145
32	19	5.5	8.5	15.5	6.7	9000	21000
33	19	5.5	9.4	9.3	8.7	8000	14500
34	18	1.5	7.9	14.7	4.1	2400	21200
35	18.8	0	7.5	1.3	7.3	105	3000
36	21.5	0	7	0	6.9	65	63
37	19	0	7.3	0.3	7.5	350	490
38	19	0.1	8	16	3.4	500	20000
39	21	1	7.9	3.5	7.9	1800	3900
40	21.8	7.9	7.95	24.5	6.2	110000	35200

Appendix A1. Field notes from Pensacola Bay; 1993 and 1994 (continued).

APPENDIX A1. Field notes from Pensacola Bay; 1993 and 1994.

Station No.	Location	Sediment Description
1	Bayou Grande	Chocolate brown pudding, oxic brown fine silt, sulfurous below 1 cm.
2	Bayou Grande	1 cm. oxic silty sediment surface over light grey clayey sand. No odors. No benthos
3	Bayou Grande	Puddin extraordinaire, fine silty clay,oxic lt. brn oozy over drk green silty clay. No benthos.
4	Bayou Chico	Clayey, light brown oxic layer over dark sticky clay (consolidated), sand component.
5	Bayou Chico	Very sulfurous, stinko yukko. Silty brown mud overlying sulfurous dark anoxic silt.
6	Bayou Chico	Soupy silt. 1st cm. thick oxic layer, lt. brn over blk silt, sm. sand component, organic silty mud.
7	Bayou Chico	Slight H2S, slight petro. sheen,brn. silty mud, thin oxic layer over drk silt, nonconsolidated goo.
8	Bayou Chico	Petro sheen mainly gooey Drk. brn silty mud, very organic w/thin brn layer on top.
9	Bayou Chico	Oily sheen,drk brn,1cm blk anoxic under runny silty clay w/distinct petro sheen, Petro blobs.
10	Bayou Texar	Puddin w/ debris. Very silty, light brown on surface, runny... CAN'T READ Very light H2S
11	Bayou Texar	Lt. brn, 2-3 cm deep, dark gray brown, runny silt. Very slight H2S odor,sm. organic component.
12	Bayou Texar	Same as number 11.
13	Bayou Texar	Silty, soupy brown puddin 2cm. Rich in organics (leaf debris) over gray clay puddin layer.
14		Brown 1 cm oxic layer over black silty clay.
15	Bayou Chico	Homogeneous,one layer of drk olive green,grey clay-no odor,brn oxic on olive consoldated clay.
16	Bayou Channel	Fine to med grade sand with silt component over brn-grey mud, a few shell fragments.
17		Lt. brn on drk sandy retro sheen from sediments,silt fractions, mostly sand, blk organic detritus.
18	Inner Harbor	Dark brown 1cm muddy silt,dark grey beneath small sand component-some leaves.
19	Inner Harbor	Thin flocculent surface. Lt. brn, very small shell frags. on surface over green/grey silty clay.
20	Inner Harbor	1cm brown oxic flocculent over green/black, muddy, silty clay--shell frags. & some rocks.
21		Lt. brn clayey silt over a dark grey clay: small shrimp.
22		Same as 21
23	Inner Harbor	Oxic, light, brown, silty clay. Over green/grey, silty clay.
24	Lower Bay	5cm thin, solid, brown, oxic, silty, clay layer over dark greenish/grey, silty clay.
25	Lower Bay	Silty brn goo,1/2in oxic floc surface, tan lt. brown over grey silty over semi-consolodated clay.
26	East Bay	Dark olive, brown clay 2cm. No distinct odor. 1st layer over dark brown clay. No vis benthos.
27	East Bay	1cm oxic, brown,silty, clay over semi CAN'T READ
28	East Bay	1cm brown/gray , oxic clay surface layer over grey clay w/ slit.
29	Blackwater Bay	Brn oxic layer 1cm on drk grey, silty clay. Worm tube, organic matter,wood decay, lot of worms.
30	Blackwater Bay	Brown oxic 1-2cm clayey over dark grayish green clay silt
31	Blackwater Bay	Brown oxic thin silty clay surface layer over brown sandy clay. Sandy dark gray clay.
32		2.5cm silty,oxic, tan brown layer over grayish clay.
33		Brown, runny, oozy clay. 2.5cm surface, darker clay below.
34		Runny, gooey, brown/black clay.
35		2cm brown, oxic clay layer over dark green/black clay. NUSL in first grabs. Wormtubes.
36		Silty tan mud, 2cm oxic, sm. sand component, amphipods, leaf debris on blk anoxic layer w/sand
37		1.3cm thick sandy oxic layer on top of black organic silty sand.
38	Escambia	Soupy,runny silty clay,med. tan clay w/drk blue-grey lens under 1cm brn layer, organic debris.
39	Floridatown	Green filamentous simple cell scum layer on top lt. tan few shell frags. Clay, sand composition.
40	Central Bay	Olive gray clay "like pudding". 1cm layer over darker grayish black clay.

Appendix A1. Field notes from Pensacola Bay; 1993 and 1994 (continued).

APPENDIX A1. Field notes from Pensacola Bay; 1993 and 1994.

Strata No. 1994	Station No.	Location	Date	Time	Latitude ° N	Longitude ° W	Water Depth(M)	Air Temp. °C	Top Temp. °C
(BC)	1-2	Bayou Chico	6/4/94	9:15 AM	30°24.42 'N	87°15.48 'W	3.7	32.0	29*
(BC)	2-2	Bayou Chico	6/4/94	10:44 AM	30°24.25 'N	87°15.34 'W	2.4	n d	27.0
(BC)	3-2	Bayou Chico	6/4/94	11:20 AM	30°24.15 'N	87°15.20 'W	1.2	n d	31.0
(BC)	4-2	Bayou Chico	6/4/94	12:05 PM	30°24.15 'N	87°14.91 'W	3.9	36.0	30.5
(BC)	5-3	Bayou Chico	6/4/94	13:40 PM	30°24.01 'N	87°14.65 'W	3.6	n d	27.5
(BC)	6-2	Bayou Chico	6/4/94	14:20 PM	30°23.96 'N	87°14.48 'W	2.7	n d	30.8

Strata No. 1994	Station No.	Btm. Temp. °C	Top Salinity ppt	Top D.O. mg/L	Btm. Sal. ppt	Bottom D.O. mg/L	Conductivity micro moles	micro moles
(BC)	1-2	25°*	n d	6.0*	n d	0.5*	n d	n d
(BC)	2-2	27.0	14.0	5.1	25.0	0.7	23,800	41,500
(BC)	3-2	29.0	19.0	5.2	22.0	4.0	33,800	36,500
(BC)	4-2	26.5	17.0	8.9	27.1	2.4	29,200	43,000
(BC)	5-3	31.0	25.5	3.2	19.0	9.0	41,900	34,200
(BC)	6-2	28.0	19.5	8.9	24.2	4.2	34,500	39,900

Station No.		Sediment Description
1-2	Bayou Chico	1st grab: 1/2 cm black anoxic layer over medium-coarse sand, H2S odor; 2nd grab: black mayonnaise, NVSL; 3rd grab: back into some sand; 4th grab: black mayonnaise with some sand, ctenophore.
2-2	Bayou Chico	Highly sulfurous - H2S odor, black-olivine/charcoal silt, "baby food mud", NVSL.
3-2	Bayou Chico	Light brown silty clay, gelatenous, runny, oxic, crustaceans; bird rookery on island.
4-2	Bayou Chico	1st grab: 1/2 cm light brown floc over anoxic black sulfurous silty clay, some plant debris, fraction of sand, clay in lumps; 2nd grab: more sand under floc layer, petroleum sheen.
5-3	Bayou Chico	Light brown sand layer below some shell hash, sandy clay, oxic, petroleum sheen; 3rd grab: sticky clay, petroleum sheen, plant fragments, H2S odor, 1 cm oxic at surface, anoxic below; painting a boat 30 m from sampling site.
6-2	Bayou Chico	Olivine silty clay, anoxic below, plant debris, small sand component; Phragmites spp. on adjacent shoreline (Giant reed grass).

Appendix A1. Field notes from Pensacola Bay; 1993 and 1994 (continued).

APPENDIX A2. Field notes from Choctawhatchee Bay.

Choctawhatchee Block #	*Bay* Station #	Station Location	Date	Time	Latitude	Longitude	Depth (meters)	Air Temperature °C
(C)B	1-1	Garnier Bayou	6/5/94	9:45 AM	30°28.43 'N	86°35.46 'W	1.5	30.0
(C)B	2-3	Garnier Bayou	6/5/94	10:40 AM	30°27.80 'N	86°35.75 'W	4.5	n d
(C)B	3-1	Dons Bayou	6/5/94	12:15 PM	30°27.05 'N	86°36.18 'W	5.4	n d
(C)C	1-2	Hand Cove, Garnier Bayou	6/5/94	13:40 PM	30°26.95 'N	86°35.37 'W	6.8	n d
(C)C	2-1	Garnier Bayou	6/5/94	14:25 PM	30°26.65 'N	86°35.58 'W	7.6	n d
(C)C	3-1	Garnier Bayou	6/5/94	15:40 PM	30°25.88 'N	86°35.45 'W	5.2	n d
(C)L	1-2	Choctawhatchee Bay	6/6/94	17:00 PM	30°25.22 'N	86°32.64 'W	~11.0	n d
(C)A	1-1	Cinco Bayou	6/6/94	17:55 PM	30°25.74 'N	86°38.06 'W	3.2	n d
(C)A	2-1	Cinco Bayou	6/6/94	18:32 PM	30°25.71 'N	86°37.12 'W	3.9	n d
(C)A	3-1	Cinco Bayou	6/6/94	19:11 PM	30°25.54 'N	86°36.51 'W	6.3	n d
(C)L	3-1	Choctawhatchee Bay	6/7/94	9:25 AM	30°28.51 'N	86°28.15 'W	6.4	n d
(C)L	2-1	Choctawhatchee Bay	6/7/94	10:15 AM	30°26.72 'N	86°30.77 'W	9.0	n d
(C)H	1-1	Joes Bayou	6/7/94	11:06 AM	30°24.55 'N	86°29.30 'W	3.3	n d
(C)H	2-1	Joes Bayou	6/7/94	12:25 PM	30°24.92 'N	86°29.48 'W	4.7	n d
(C)D	3-1	Destin Harbor	6/7/94	13:46 PM	30°23.37 'N	86°29.57 'W	5.1	n d
(C)D	2-2	Destin Harbor	6/7/94	14:27 PM	30°23.37 'N	86°29.94 'W	2.7	n d
(C)D	1-1	Destin Harbor	6/7/94	15:24 PM	30°23.44 'N	86°30.20 'W	3.5	n d
(C)E	1-1	Boggy Bayou	6/8/94	10:10 AM	30°30.95 'N	86°29.49 'W	2.1	n d
(C)E	2-1	Boggy Bayou	6/8/94	10:50 AM	30°29.83 'N	86°29.13 'W	2.5	n d
(C)E	3-1	Boggy Bayou	6/8/94	11:26 AM	30°29.72 'N	86°28.93 'W	5.1	n d
(C)F	1-1	Tom's Bayou	6/8/94	12:10 PM	30°30.18 'N	86°30.02 'W	2.7	n d
(C)F	2-1	Tom's Bayou	6/8/94	12:47 PM	30°30.16 'N	86°29.58 'W	4.3	n d
(C)G	1-1	Boggy Bayou	6/8/94	14:20 PM	30°30.23 'N	86°25.15 'W	2.3	n d
(C)G	2-1	Rocky Bayou	6/8/94	15:09 PM	30°30.27 'N	86°26.24 'W	5.2	n d
(C)G	3-1	Rocky Bayou	6/8/94	15:41 PM	30°30.34 'N	86°27.10 'W	2.5	n d
(C)G	4-1	Rocky Bayou	6/8/94	16:18 PM	30°29.94 'N	86°27.17 'W	4.4	n d
(C)M	3-1	Choctawhatchee Bay	6/9/94	9:27 AM	30°27.21 'N	86°24.53 'W	4.2	n d
(C)M	2-1	Choctawhatchee Bay	6/9/94	10:10 AM	30°27.77 'N	86°19.08 'W	5.0	34.6
(C)M	1-1	Choctawhatchee Bay	6/9/94	10:55 AM	30°28.16 'N	86°16.87 'W	4.0	n d
(C)N	1-1	Choctawhatchee Bay	6/9/94	12:45 PM	30°26.37 'N	86°14.09 'W	4.6	32.0
(C)N	2-1	Choctawhatchee Bay	6/9/94	13:31 PM	30°24.61 'N	86°10.55 'W	3.3	n d
(C)N	3-1	Choctawhatchee Bay	6/9/94	14:04 PM	30°23.59 'N	86°10.02 'W	2.5	n d
(C)J	1-1	Alaqua Bayou	6/9/94	15:11 PM	30°29.12 'N	86°12.62 'W	1.8	n d
(C)J	2-1	Alaqua Bayou	6/9/94	15:50 PM	30°29.02 'N	86°12.34 'W	1.7	n d
(C)K	1-1	La Grange Bayou	6/10/94	11:09 AM	30°28.23 'N	86°08.23 'W	1.1	n d
(C)K	2-1	La Grange Bayou	6/10/94	11:45 AM	30°28.09 'N	86°08.65 'W	3.0	n d
(C)K	3-1	La Grange Bayou	6/10/94	12:20 PM	30°27.50 'N	86°09.31 'W	2.9	n d

*meter readings unreliable

Appendix A1. Field notes from Pensacola Bay; 1993 and 1994 (continued).

APPENDIX A2. Field notes from Choctawhatchee Bay.

Choctawhatchee Block #	*Bay* Station #	Surface Temperature °C	Bottom Temperature °C	Surface Salinity ppt	Bottom Salinity ppt	Surface D.O. mg/L	Bottom D.O. mg/L
(C)B	1-1	28.0	30.0	10.0	15.0	5.6	7.6
(C)B	2-3	29.8	26.3	13.6	26.4	7.0	4.6
(C)B	3-1	29.7	26.5	16.8	26.0	6.8	7.5
(C)C	1-2	28.4	25.5	16.2	28.9	6.4	5.5
(C)C	2-1	28.5	25.2	17.3	26.9	6.6	4.6
(C)C	3-1	28.0	26.0	19.4	28.5	6.2	6.2
(C)L	1-2	26.8	24.0	21.0	33.9	6.2	4.6
(C)A	1-1	27.9	28.2	15.8	23.8	5.6	1.6
(C)A	2-1	27.0	28.0	14.8	23.9	6.0	5.1
(C)A	3-1	27.6	26.1	17.5	31.0	6.1	3.1
(C)L	3-1	27.5	26.5	16.5	29.0	6.1	3.5
(C)L	2-1	27.0	24.0	20.9	26.8	6.5	4.8
(C)H	1-1	28.0	28.0	20.2	25.0	6.0	4.6
(C)H	2-1	27.6	27.0	20.2	28.0	6.1	5.5
(C)D	3-1	28.0	28.0	23.0	31.5	6.3	5.6
(C)D	2-2	28.5	27.5	24.0	28.6	6.2	4.5
(C)D	1-1	28.0	28.0	24.8	31.4	6.1	4.5
(C)E	1-1	26.8	28.2	1.4	16.4	5.8	4.6
(C)E	2-1	29.0	28.0	4.2	16.8	6.2	5.7
(C)E	3-1	28.0	26.0	6.0	26.0	6.6	2.6
(C)F	1-1	30.0	28.9	7.0	17.0	5.9	4.8
(C)F	2-1	31.0	28.5	4.5	22.0	6.6	1.5
(C)G	1-1	28.5	29.2	0.2	14.1	5.7	4.6
(C)G	2-1	29.9	27.1	2.3	21.0	5.6	2.0
(C)G	3-1	29.5	29.0	2.3	16.0	6.0	4.3
(C)G	4-1	29.9	27.8	5.1	20.8	6.3	5.3
(C)M	3-1	30.5	28.1	15.0	21.0	6.3	4.4
(C)M	2-1	29.5	28.0	16.5	22.8	6.2	4.0
(C)M	1-1	29.0	28.5	15.7	16.0	6.2	5.6
(C)N	1-1	30.0	28.0	14.5	19.0	6.4	3.7
(C)N	2-1	31.5	29.0	9.0	15.5	6.9	2.4
(C)N	3-1	31.8	29.9	7.1	13.9	7.2	5.0
(C)J	1-1	28.0	28.0	0.2	9.0	5.3	2.8
(C)J	2-1	30.0	29.0	1.3	10.2	5.6	2.8
(C)K	1-1	29.8	28.9	1.0	1.4	6.1	5.7
(C)K	2-1	29.4	29.9	2.3	8.7	5.8	4.2
(C)K	3-1	30.8	30.0	4.6	9.8	6.0	4.3

*meter readings unreliable

Appendix A2. Field notes from Choctawhatchee Bay; 1993 and 1994.

APPENDIX A2. Field notes from Choctawhatchee Bay.						
Choctawhatchee Bay						
Block #	**Station #**	**Conductivity micro moles**	**Conductivity micro moles**	**Block #**	**Station #**	**Sediment Description**
(C)B	1-1	7,200	26,000	(C)B	1-1	70-80% lt.brn sand w/silt component,oxic top 2cm-blk under,harpacticoids-crustaceans,grabs similar.
(C)B	2-3	24,600	42,100	(C)B	2-3	Lt. brn. med-silty sand,diatom scum,gastropods,crustaceans,shell bits; first 2 alternates too shallow.
(C)B	3-1	28,100	42,500	(C)B	3-1	Muddy med. size sand, brn oxic sediments,shell fragments,plant debris,gastropods and polychaetes
(C)C	1-2	31,200	45,100			polychaetes visible; first grab,oyster shells, rejected
(C)C	2-1	30,700	43,800	(C)C	1-2	Thin olivine floc layer on drk olivine,"silty clay olivine pudding",anoxic,no odor;grab1: sand-rejected.
(C)C	3-1	32,100	44,000	(C)C	2-1	Silty clay olivine "pudding", small amount of plant debris, no odor.
(C)L	1-2	33,600	48,700	(C)C	3-1	Grab1: tan brn sand w/minor silt, shell bits, sm. bits of drk organic matter, "smells like fish", gastropod;
(C)A	1-1	26,000	39,200			grab 2: 2 fish; grab 3; sandy, shell bits, diatom scum; grab 4: fine shell bits, 1 fish, "healthy sediment".
(C)A	2-1	25,000	39,300	(C)L	1-2	Grab 1:lt. olivine silty-clay on drk grey silty-clay; 2:fine silt, no odor; 3:lt. olivine layer on drk olivine.
(C)A	3-1	29,000	47,600	(C)A	1-1	Black, consolidated silty sticky-clay, H2S odor, leaf debris, gastropod.
(C)L	3-1	27,200	45,500	(C)A	2-1	Sandy! Slight muddy sand, thin lt. brn anoxic layer ~ 2 cm below top, shell bits, leaf debris, polychaetes,
(C)L	2-1	33,300	42,200			polychaete tubes, amphipods, gastropods "sediment looks healthy".
(C)H	1-1	33,000	39,500	(C)A	3-1	Drk brn mud-sand,brn layer on top,shell hash,juvenile shrimp&crab,amphipods,oyster shell;silty sand
(C)H	2-1	32,400	43,000	(C)L	3-1	Olivine silt clay on drk brn silt clay, polychaete; grab 3&4: sandier than 1&2, ampilisca tube; gastropod.
(C)D	3-1	38,600	>500,000	(C)L	2-1	Olivine/brown silty clay.
(C)D	2-2	39,900	47,000	(C)H	1-1	Silty clay with minor sand, some plant debris, H2S odor.
(C)D	1-1	41,100	>500,000	(C)H	2-1	Olivine silty clay, floc on surface "perfect mud", H2S odor.
(C)E	1-1	2,500	28,000	(C)D	3-1	Grab 1: Silty mud, big H2S odor; grab 2: sandy w/2 cm clay/organic matter; grab 3&4: silty mud, H2S odor
(C)E	2-1	7,900	28,400	(C)D	2-2	Tannish sand with mud, polychaetes; 3rd grab: more sandy than first two.
(C)E	3-1	10,500	41,500	(C)D	1-1	Slightly muddy med-fine lt. brn sand, polychaetes, a lot of polychaete tubes, trace shell bits, amphipods.
(C)F	1-1	13,100	29,900	(C)E	1-1	Grab 1: drk brwn muddy sand with clay below; grab 2: sandy clay, sulfur odor, oyster shell; blackwater
(C)F	2-1	8,600	36,800			from tannis and lignins (organic,clean H2O);locals:"there have been diesel fuel spills in the Bayou"
(C)G	1-1	100	24,100	(C)E	2-1	1/2 cm light brown muddy sand over grey muddy sand, gastropod.
(C)G	2-1	4,400	36,000	(C)E	3-1	Very fine silty runny mud, thin olive-brown surface layer over grey, occasional pieces of shell.
(C)G	3-1	4,200	28,200	(C)F	1-1	Brown organically enriched silt, highly sulfurous.
(C)G	4-1	9,900	34,500	(C)F	2-1	Dark greenish-brown silty clay, slight H2S odor.
(C)M	3-1	25,800	34,900	(C)G	1-1	Thin brn med. sand top layer over brn silt, organically enriched, leaf debris, oyster shells, gastropod;
(C)M	2-1	27,900	37,800			grab 2:sticky sediment,live oysters,polychaetes and polychaete tubes; blackwater.
(C)M	1-1	26,700	27,000	(C)G	2-1	Greenish-brown silt over dark grey-green-brown runny silt, slight H2S odor.
(C)N	1-1	22,900	31,500	(C)G	3-1	Muddy sand, large mollusc burrow, crustaceans.
(C)N	2-1	15,600	26,200	(C)G	4-1	Brown-green silt
(C)N	3-1	12,200	23,700	(C)M	3-1	Drk brn muddy sand, copious polychaete tubes, mysids, some plant debris, brittle star; all grabs similar.
(C)J	1-1	1,000	15,800	(C)M	2-1	1st grab: olivine silt; 2nd grab: soft runny material, grey clay balls, floc.
(C)J	2-1	2,200	17,900	(C)M	1-1	1/4 cm lt. brn sandy mud overlying drk brn sandy mud and sticky clay, numerous polychaete tubes.
(C)K	1-1	1,900	2,600	(C)N	1-1	Grab 1: 2 cm drk brn mud over drk grey clay, trace of sand; grab 2: shell hash on top; grab 3: silty mud,
(C)K	2-1	4,100	15,300			med brn thin superficial layer over drk grey silt w/blk mottling w/sand inclusions and sticky clay.
(C)K	3-1	9,100	17,800	(C)N	2-1	1/2 cm drk brn silty clay over sticky grey clay containing small globules throughout, amphipod tubes.
*meter readings unreliable				(C)N	3-1	Dark brown silt over dark grey sandy silt, polychaete tubes.
		(C)J	1-1	Olivine silty sticky clay, slight H2S odor, piece of shell, mud has polished looking surface.		
		(C)J	2-1	Olivine silty clay, trace shell fragments, mud has polished looking surface.		
		(C)K	1-1	Dark brown silt, slight H2S odor.		
		(C)K	2-1	Drak brown to black silt, slight H2S odor, shell hash, more clay than K1-1, has been previously dredged.		
		(C)K	3-1	Dark brown sandy silt, oyster and clam shells, polychaetes.		
		*meter readings unreliable				

Appendix A2. Field notes from Choctawhatchee Bay; 1993 and 1994 (continued).

Appendix A3. Field notes from St. Andrews Bay.

St. Andrews Bay

Station #	Location	Date	Time	Latitude	Longitude	Water Depth(m)	Surface Temp.°C	Top Sal. ppt	Surface D. O.mg/l
41		4/20/93	8:32	30°15.492'	85°47.389'	3.25	21	19	7.2
42	West Bay	4/20/93	9:22	30°15.166'	85°45.219'	5	20	19.8	7.4
43	North Bay	4/20/93	12:25	30°12.011'	85°44.116'	11	21	22.8	7.6
44	North Bay	4/20/93	11:40	30°13.752'	85°41.849'	6.9	18.9	21	7.5
45	North Bay	4/20/93	11:00	30°14.781'	85°41.072'	4.6	19	13	7.8
46	North Bay	4/20/93	10:12	30°15.194'	85°40.090'	3.9	20.2		7.7
47		4/20/93	10:32	30°14.741'	85°39.662'		20.5		7.5
48		4/20/93	13:40	30°09.929'	85°43.562'	7	20.9	23	7.4
49	St. Andrews	4/20/93	14:10	30°09.562'	85°42.415'	40 ft.	20.8	22.5	7.6
50	St. Andrews	4/20/93	15:00	30°08.956'	85°40.785'	12	20	25.3	7.4
51		4/21/93	9:20	30°10.016'	85°42.345'	6.1	20.1	26.2	7.7
52	St. Andrews	4/20/93	13:00	30°10.533'	85°43.315'	6.5	21.2	22.5	7.8
53	Massalina Bayou		10:40	30°09.239'	85°39.354'	2.2	19	24	6.7
54	Massalina Bayou	4/22/93	11:10	30°09.140'	85°39.384'	2.3	19	23.2	6.9
55	Watson Bayou	4/21/93	10:15	30°09.346'	85°38.418'	4	22	21.3	7.1
56	Upper Watson	4/21/93	10:40	30°09.179'	85°38.380'	2.9	22	25	7.3
57	Upper Watson	4/21/93	11:03	30°09.077'	85°38.336'	3.6	22.1	23.6	7.4
58	Mid Watson	4/21/93	11:21	30°08.834'	85°38.006'	4.4	22.9	20.9	7.6
59	Mid Watson	4/21/93	11:52	30°08.656'	85°37.960'	4.7	23.2	19.5	7.4
60	Mid Watson	4/21/93	12:17	30°08.862'	85°37.707'	2.4	23	19.5	7.6
61	Lower Watson	4/21/93	12:51	30°08.480'	85°38.469'	2.7	23	20.5	7.3
62	Lower Watson	4/21/93	13:52	30°08.454'	85°38.146'	2	23	22.2	7.4
63	Watson Bayou	4/21/93	14:24	30°08.444'	85°37.993'	4.4	23	22.1	7.7
64	St. Andrew Bay	4/22/93	9:07	30°08.443'	85°39.369'	10.4	19	25.2	7.3
65	St. Andrew Bay	4/22/93	8:40	30°08.039'	85°38.948'	7.2	19	24.5	7.2
66	Mouth of Watson Bayou	4/21/93	14:50	30°08.058'	85°38.092'	5.4	23	22	7.6
67		4/19/93	15:46	30°07.573'	85°36.759'	7.5	21	19	8.2
68	Mouth of Pearl Bayou	4/19/93	17:08	30°06.214'	85°36.669'	6.7	21	17.2	8.2
69	Smak Bayou	4/22/93	9:50	30°07.729'	85°40.003'	3.4	19	22.6	7.1
70	West-East Bay	4/19/93	16:24	30°05.284'	85°33.068'	3.4	20.5	19.1	8.3
71	East-East Bay	4/19/93	15:36	30°02.498'	85°30.093'	2	24	12	8.3

Appendix A3. Field notes from St. Andrew Bay.

Appendix A3. Field notes from St. Andrews Bay.

St. Andrews Bay

tation	Location	Top Cond.	Bottom Temp.	Bottom Sal.	Bottom D. O.	Bottom Cond.	Sediment Description
41		28300	21	19.7	6.6	28800	Lt. brn silty oxic 1cm on top of 2cm sand (lt. gray) over drk gray clay, silty sand
42	West Bay	28900	20	26.8	7.4	38100	Olive, gray, silty clay homogenous. Brown flocculent layer on top.
43	North Bay	32600	21	24.3	3.3		
44	North Bay	31100	20.2	24.2	5.3	36100	Olive 1cm silt surface over black, anoxic, silty, clay. Plant debris.
45	North Bay	19800	19.1	25.9	6.8	37900	
46	North Bay	22800	20.5	26	5.8		
47			23.9		7		
48		33800	19	28.5	5.9	41000	Olive gray brown sandy clay. Some shell frags. Polychaetes, amphipods--signs.
49	St. Andrews	33000	18.9	29.9	6.6	42800	Sandy mud oxic--surface greenish brown 1cm over clay sand layer CAN'T READ
50	St. Andrews	36900	21	30.7		39100	Grey-brn silt clay on drk grey anoxic silty clay,poorly consolidated,no sand,sulfur odor.
51		32300	19.5	34.9	6.4	40000	5cm brown oxic surface over dark grey-silty, sandy clay. Few shell frags.
52	St. Andrews	32900	20.5	28.5	6.3	40900	Brown oxic layer over dark gray silty sand. Shell fragments.
53	Massalina Bayou	34000	20.2	28.7	6.3	39000	Brown green flocculent surface over grey black silty clay-leaf debris.
54	Massalina Bayou	32900	20.5	29	5.7	40000	.5cm brown flocculent over grey black sandy silty clay. Plant debris abundant.
55	Watson Bayou	31800	20.8	25.5	1.1	36200	No surface layer=homogenous sandy, silty clay drk, gray-blk color, sulfur odor, anoxic.
56	Upper Watson	31800	21	29.6	3.1	36500	Gray-blk anoxic silty clay (H2S), flocculent layer, blk flecks on surface, 1mm brn silty top.
57	Upper Watson	31400	20.9	26	6.4	36600	Black grey anoxic silty clay (H2S) poorly consolidated. 1mm light brown silty surface.
58	Mid Watson	31000	20.5	28.1	6.3	38100	Black grey anoxic silty clay (H2S) poorly consolidated. 1mm brown silty surface.
59	Mid Watson	30500	20.8	27.2	7	39900	.5cm grey surface over sandy silty dark grey clay. Shell fragments.
60	Mid Watson	30900	22.2	21.1	6.3	33300	Med gray top 1cm silt on sandy clay-med gray. Slight H2S, organic debris, flocculent on top.
61	Lower Watson	30100	21.9	27.1	7.6	37200	Brn flocculent layer on top,brn oxic 1cm-over drk gray blk silty clay,tiny amt. plant debris.
62	Lower Watson	32000	22.5	22.8	6.9	32500	Light brown oxic no H2S. Sandy mud, some pine needles CAN'T READ
63	Watson Bayou	32000	20.9	29	7.7	31.9	Olive surface layer 1mm on top. Olive gray silty clay.
64	St. Andrew Bay	35900	18.8	31.2	6.3	42200	Fine shell frags. on surface. Brownish green 1cm over gray green sandy clay.
65	St. Andrew Bay	36500	18.9	30.2	6.2	41500	Brown, olive, green, over grayish green sandy clay w/ shell frags. "luminous surface"
66	Mouth of Watson Bayou	32700	20.1	28.1	7.3	40900	Algal scum on top over grey green clayey mud. Diatom scum.
67		27900	18.5	30	6.3		
68	Mouth of Pearl Bayou	25300	18.1	29.8	6	39800	Surface brown grey 1cm. Silty clay over dark green grey clay.
69	Smak Bayou	32200	19.5	26.9	6.6	37500	Brn .5cm silty surface over grey silty sand worm tubes. Algae green-brn scum flocculent.
70	West-East Bay	27900	20	23	7.6	33000	Floc. layer,olive brn semi-consolidated 2cm on grey grn silty clay w/fine sand,H2S light.
71	East-East Bay	19100	20	19	8.4	27000	Lt. brn 1cm over brn-blk med-fine grained silty sand. Worm tubes, silty clayey fraction.

Appendix A3. Field notes from St. Andrew Bay (continued).

APPENDIX A4. Field notes from Apalachicola Bay.

Apalachicola Bay

Block #	Station #	Station Location	Date	Time	Latitude	Longitude	Depth m	Air Temp. °C	Surface Temp °C	Bottom Temp. °C
(A)B	1-1	Apalachicola Bay	6/11/94	8:58 AM	30°28.43 'N	86°35.47 'W	1.7	26.0	28.0	27.4
(A)B	3-1	Apalachicola Bay	6/11/94	9:35 AM	29°42.65 'N	84°53.98 'W	n d	n d	2.7	28.5
(A)B	2-1	Apalachicola Bay	6/11/94	10:20 AM	29°39.65 'N	84°56.53 'W	3.4	n d	27.9	27.8
(A)C	3-1	Apalachicola Bay	6/11/94	11:08 AM	29°36.81 'N	84°59.66 'W	3.6	n d	28.5	29.0
(A)C	2-1	Apalachicola Bay	6/11/94	12:11 PM	29°39.28 'N	85°03.21 'W	2.7	30.0	29.9	29.0
(A)C	1-1	Apalachicola Bay	6/11/94	13:36 PM	29°42.96 'N	84°59.23 'W	1.6	n d	25.1	30.1
(A)A	1-1	Apalachicola River	6/11/94	15:04 PM	29°45.29 'N	85°00.69 'W	4.4	30.5	28.5	28.1
(A)A	2-1	Apalachicola River	6/11/94	15:50 PM	29°44.47 'N	84°59.89 'W	5.4	n d	29.1	28.9
(A)A	3-1	Apalachicola River	6/11/94	16:49 PM	29°43.63 'N	84°58.46 'W	1.7	n d	29.8	29.5

Appendix A4. Field notes from Apalachicola Bay.

APPENDIX A4. Field notes from Apalachicola Bay.

Apalachicola Bay

Block #	Station #	Air Temp. °C	Surface Temp °C	Bottom Temp. °C	Surface Salinity ppt	Bottom Salinity ppt	Surface D.O. mg/L	Bottom D.O. mg/L
(A)B	1-1	26.0	28.0	27.4	12.4	13.0	7.0	6.9
(A)B	3-1	nd	2.7	28.5	10.4	10.6	6.5	5.7
(A)B	2-1	nd	27.9	27.8	15.9	28.7	6.9	5.7
(A)C	3-1	nd	28.5	29.0	29.8	28.9	6.2	4.7
(A)C	2-1	30.0	29.9	29.0	28.5	28.6	6.7	6.4
(A)C	1-1	nd	25.1	30.1	2.6	17.2	7.7	7.4
(A)A	1-1	30.5	28.5	28.1	0.0	0.0	6.2	6.1
(A)A	2-1	nd	29.1	28.9	0.0	22.8	6.5	3.6
(A)A	3-1	nd	29.8	29.5	0.3	0.2	6.6	6.6

Appendix A4. Field notes from Apalachicola Bay (continued).

APPENDIX A4. Field notes from Apalachicola Bay.

Apalachicola Bay

Block #	Station #	Station Location	Date	Time	Latitude	Longitude	Depth m
(A)B	1-1	Apalachicola Bay	6/11/94	8:58 AM	30°28.43 'N	86°35.47 'W	1.7
(A)B	3-1	Apalachicola Bay	6/11/94	9:35 AM	29°42.65 'N	84°53.98 'W	n d
(A)B	2-1	Apalachicola Bay	6/11/94	10:20 AM	29°39.65 'N	84°56.53 'W	3.4
(A)C	3-1	Apalachicola Bay	6/11/94	11:08 AM	29°36.81 'N	84°59.66 'W	3.6
(A)C	2-1	Apalachicola Bay	6/11/94	12:11 PM	29°39.28 'N	85°03.21 'W	2.7
(A)C	1-1	Apalachicola Bay	6/11/94	13:36 PM	29°42.96 'N	84°59.23 'W	1.6
(A)A	1-1	Apalachicola River	6/11/94	15:04 PM	29°45.29 'N	85°00.69 'W	4.4
(A)A	2-1	Apalachicola River	6/11/94	15:50 PM	29°44.47 'N	84°59.89 'W	5.4
(A)A	3-1	Apalachicola River	6/11/94	16:49 PM	29°43.63 'N	84°58.46 'W	1.7

Appendix A4. Field notes from Apalachicola Bay (continued).

Appendix A4. Field notes from Apalachicola Bay (continued).

APPENDIX A4. Field notes from Apalachicola Bay.

Apalachicola Bay

Block #	Station #	Conductivity micro moles	Conductivity micro moles	Block #	Station #	Sediment Description
(A)B	1-1	16,700	23,200	(A)B	1-1	Light brown sandy mud, 1 cm of brown sediment over a grey brown sandy mud.
(A)B	3-1	19,300	27,700	(A)B	3-1	Light brown silty clay over gray silty clay, polychaetes, oligochaetes.
(A)B	2-1	28,200	48,200	(A)B	2-1	Dark brown-olive-green silty clay, polychaete tubes, oligochaete tubes.
(A)C	3-1	49,800	49,400	(A)C	3-1	Lt. brown sandy silt overlying a dark grey to black sandy silt, some coarse sand and clay, gastropod, oligochaetes, polychaetes.
(A)C	2-1	49,300	49,300	(A)C	2-1	Light brown sandy mud overlying dark gray-green sandy mud, oligochaete and polychaete tubes, ~5% shell hash.
(A)C	1-1	5,000	31,200	(A)C	1-1	2 cm chocolate brown sandy clayish-silt overlying black sandy clayish-silt, abundent substrate attached plants, trace muscovite mica "flakes", fresh water mussels and gastropods, juvenile crab.
(A)A	1-1	200	200	(A)A	1-1	1st grab: light brown silty sand (low % silt), plant detritus; 2nd grab: entirely sand; 4th grab: micro layer of silt, juvenile crab, amphipod.
(A)A	2-1	140	38,500	(A)A	2-1	1st grab: dark brown-black silty clay, lots of organic material-plant material hanging out of grab; 2nd grab: floc layer, trace sand, more clay than previouse grab, no plant material.
(A)A	3-1	900	890	(A)A	3-1	Green algae scum on top of sediment, brown silty clay, trace sand, trace shell debris, polychaete tubes.

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	Amphipod	Pod%control	UAN-amphipod ug/L	Microtox	mtox%control	UAN-porewater ug/L	fert@100	fert@50	fert@25	dev@100	dev@50
1	Bayou Grande	72	105.88	18.3	0.07	0.57	125.4	96.8	95.8	95	1.2	82.8
2	Bayou Grande	68	100	42.7	0.76	6.19	9	95.6	94.8	93.8	91.5	92.4
3	Bayou Grande	72	105.88	13.3	0.3	2.4	38.5	46	86.8	92.8	86	93.2
4	Bayou Chico	71	104.41	19.8	0.77	6.27	31.8	94.8	96	93.6	78.8	90.4
5	Bayou Chico	73	107.35	56.2	0.25	2.03	208.1	89.2	94.4	93.6	0	0
6	Bayou Chico	67	98.53	44.2	0.24	1.97	94.2	93	93.4	96.4	0	47.4
7	Bayou Chico	68	100	52.3	0.63	5.11	137.8	93	96.8	95.4	0	0
8	Bayou Chico	69	101.47	53.6	0.57	4.62	114.1	94	95.8	93.8	0	1.2
9	Bayou Chico	75	110.29	74.1	0.45	3.67	122.6	94.8	94.6	95.8	0	0
10	Bayou Texar	66	97.06	44.5	0.32	2.62	73.4	94.2	96	95.4	0	88.8
11	Bayou Texar	76	111.76	20.3	0.53	4.27	42	95.6	98	95.4	88.6	90
12	Bayou Texar	74	108.82	14	1.21	9.83	12.5	95.2	93.4	94.6	91.4	91.2
13	Bayou Texar	66	97.06	16.2	9.12	73.91	13.9	94.8	96.6	80.6	88.8	91.4
14	Warrington	71	104.41	11.9	7.38	59.83	23.1	74.6	89.2	83.4	90.2	91
15	Bayou Chico	76	111.76	5.1	5.89	47.73	15.6	94.8	92.8	90.2	84.8	91.2
16	Bayou Channel	70	102.94	80.3	3.56	28.88	5.3	95.6	96.4	96.4	72.3	84
17	Inner Harbor Channel	75	110.29	75.8	4.33	35.06	24.5	94.8	97.6	96.2	88.4	88.4
18	Inner Harbor	75	110.29	3.6	0.09	0.76	2.4	95.8	98.2	98.4	92.6	91
19	Inner Harbor	74	108.82	11.9	2.68	21.72	7	99.2	99.2	99.4	98.8	99.8
20	Inner Harbor	70	102.94	23.4	0.75	6.1	9.5	97.2	98.6	98.2	98.4	99
21	Pensacola Bay	70	102.94	7.5	10.03	81.28	13.5	98.2	98.4	99	99.4	98.6
22	Pensacola Bay	74	108.82	9	12.34	99.97	24.6	98	99.4	98.2	73.3	97.6
23	Inner Harbor	69	101.47	38.2	9.08	73.58	24.8	98.8	97.8	98.6	4	97
24	Lower Bay	68	100	3.6	9.23	74.8	23.1	75.2	95.8	99	98.6	98.6
25	Lower Bay	63	92.65	7	11.49	93.11	19.6	97.4	95.8	94.8	85.8	95.4
26	East Bay	77	113.24	1.1	1.11	9	7.5	96.6	96.2	95.6	95.4	93
27	East Bay	74	108.82	2	3.36	27.26	5.6	96	97.6	95.8	95	93.4
28	East Bay	77	113.24	3	1.62	13.1	8.6	93.6	94.4	93.6	89.8	95.6
29	Blackwater Bay	61	89.71	0.9	0.66	5.35	10.6	96	98.4	95.8	89	93
30	Blackwater Bay	72	105.88	2.2	8.01	64.88	117.6	96.4	94.8	95.4	90.6	94.6
31	Blackwater Bay	74	108.82	2	1.05	8.48	5	80.8	96	97	89	91.8
32	Escambia Bay	71	104.41	1.8	4.72	38.22	2.7	95	94.2	92.6	92.2	95
33	Escambia Bay	67	98.53	2.7	2.33	18.92	11	97.8	97.8	93.6	93.8	94.6
34	Escambia Bay	63	92.65	12.3	0.66	5.32	14.7	95.8	94.2	90.2	93.2	96.2
35	Escambia Bay	60	88.24	16.9	9.84	79.74	22	95.4	97.6	97.6	89.6	95.4
36	Escambia Bay	65	95.59	21.7	6.65	53.92	34	98.6	99	99.8	65.2	76.4
37	Escambia River Mouth	62	91.18	63.2	3.76	30.47	48.8	99.4	99.2	98.8	81.8	89.6
38	Escambia	73	107.35	18.5	2.29	18.53	18	97.2	96.6	91.8	93.6	96.2
39	Floridatown	73	107.35	101.9	4.49	36.39	10.2	97.2	94.8	96.2	90	93.6
40	Central Bay	66	97.06	11.6	1.84	14.94	27.9	96	94.6	93	93.4	94.6
MDL												

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	dev@	AMPL	AL %	AS ppm	BA ppm	CD ppm	CR ppm	CU ppm	FE %	PB ppm	LI ppm	MN ppm	HG ppb	P ppm	NI ppm	AG ppm	TI ppm	V ppm	ZN ppm
1	Bayou Grande	90.4	1	6.73	19.2	82.6	4.9	232	48.1	4.21	131	62.1	291	296	799	23.4	0.75	34000	74.4	246
2	Bayou Grande	89.6	2	0.36	1.3	1.3	0.31	10.9	3.1	0.28	12.1	5.1	15.4	23	46	1.4	0.001	3000	5	23.3
3	Bayou Grande	88.2	3	6.85	21.6	98	1.21	164	31.2	3.87	85	76.5	177	179	708	21.5	0.3	36000	86.2	170
4	Bayou Chico	91	4	2.87	7.6	55.1	0.55	34.9	55.6	2	43.8	28.6	88.2	241	253	11.2	0.11	19000	33	354
5	Bayou Chico	85.2	5	5.96	20	119	1.16	76.5	151	4.11	111	57.7	202	569	617	25.4	0.35	33000	71.6	886
6	Bayou Chico	91.2	6	3.38	10.3	67.9	0.86	43.6	106	2.48	67.5	33.9	117	415	357	14.8	0.15	24000	38.6	638
7	Bayou Chico	88.2	7	4.36	16.8	88.9	1.22	64.3	170	3.26	158	44.7	168	695	620	23.9	0.21	27000	56.7	901
8	Bayou Chico	88.8	8	4	12.8	77.1	0.93	52.9	121	2.9	107	38.6	148	492	477	18	0.19	21000	45.5	611
9	Bayou Chico	84.8	9	3.16	13.5	65	0.64	42.3	63.9	2.28	64.2	29.7	133	258	534	13	0.1	18000	45.2	314
10	Bayou Texar	88	10	7.93	14	113	2.43	71	123	4.08	237	105	147	1227	769	20.7	0.25	52000	78.1	965
11	Bayou Texar	90.8	11	8.55	16.3	133	0.61	87.1	44	4.69	130	77.3	204	411	674	24.2	0.26	46000	88.8	359
12	Bayou Texar	92.6	12	6.73	19.7	131	0.56	84.8	38.1	4.58	107	70.9	179	370	726	22.2	0.25	46000	85.7	298
13	Bayou Texar	90.8	13	6.97	17.5	120	0.46	83.5	32	4.55	85.7	70.1	203	293	704	22.7	0.21	39000	86	253
14	Warrington	90.6	14	6.56	26	133	0.12	93.5	20.5	4.32	38.5	74.3	600	174	947	25.3	0.22	33000	87.7	135
15	Bayou Chico	88.4	15	7.24	26.8	137	0.04	98.6	20.3	4.47	38	81.1	940	174	1012	27.2	0.16	35000	103	134
16	Bayou Channel	91.4	16	0.22	0.5	0.02	0.02	2.6	0.9	0.14	2.4	3.5	32.4	8	47	0.8	0.001	3000	4.1	13
17	Inner Harbor Channel	92	17	0.18	0.5	0.02	0.02	2.4	4.7	0.12	8.1	3	8.2	15	51	0.8	0.001	2000	2.6	26.2
18	Inner Harbor	92.4	18	4.29	16.3	94.6	1.1	69.6	49.3	2.91	164	43.4	214	460	1073	18.9	0.47	29000	78.4	324
19	Inner Harbor	98.4	19	5.67	22.8	135	0.33	77.3	52.4	4.3	76.4	62	519	473	875	22.6	0.48	31000	74.9	220
20	Inner Harbor	98.8	20	3.87	15.2	186	0.22	50.6	36	2.59	61.9	42.4	313	313	855	17.9	0.25	20000	54.1	195
21	Pensacola Bay	98.2	21	6.36	25.5	125	0	88.6	17.5	4.11	29.5	74.5	633	112	931	24.5	0.13	35000	86.1	107
22	Pensacola Bay	99	22	7.14	25	133	0.03	93.7	19.4	4.15	36.4	80.7	855	132	1186	27.3	0.18	34000	97.4	232
23	Inner Harbor	98.8	23	6.78	24	105	0.06	93.5	20.7	3.96	38.2	79.4	956	154	1083	29	0.17	35000	99.8	124
24	Lower Bay	98.6	24	6.12	30.9	133	0	86.7	17.2	3.97	31.4	70.9	592	107	1148	23.8	0.07	32000	95.5	131
25	Lower Bay	95.2	25	6.9	27.8	127	0.04	99.6	19.3	4.48	33.6	84	822	147	1051	27.7	0.19	35000	99.7	124
26	East Bay	94.8	26	4.08	19	111	0.21	73.5	16.2	4.06	33.8	65.3	356	113	465	20.2	0.6	40000	86.9	105
27	East Bay	95.8	27	5.61	29.1	138	0.15	102	20.1	5.25	42.9	87.7	629	116	694	27.2	0.67	44000	116	131
28	East Bay	95	28	5.17	27.6	142	0.16	101	18.8	4.77	42.7	86.2	592	115	690	27	0.61	43000	111	128
29	Blackwater Bay	94.8	29	4.09	14.4	127	0.26	72	19.1	3.75	35.7	60.7	231	110	501	20	0.62	48000	87.7	101
30	Blackwater Bay	94.4	30	3.52	16.1	129	0.25	70.4	19.1	3.64	37	60.5	358	128	640	20.5	0.65	51000	93.4	93
31	Blackwater Bay	95.8	31	1.97	5.5	69.2	0.22	30.5	10	1.98	18.1	26.4	74	77	161	7.9	0.4	31000	39.9	45.3
32	Escambia Bay	97	32	5.08	32.1	156	0.16	110	23.5	5.75	39.2	79.5	528	131	634	28.4	0.67	48000	132	145
33	Escambia Bay	95.6	33	2.64	12.8	85.9	0.09	52.4	11.9	2.97	19.1	34	256	77	278	13.7	0.36	31000	62.1	71.9
34	Escambia Bay	95.8	34	5.53	27.4	176	0.29	112	24.1	5.71	35.9	69.9	450	120	613	27.4	0.6	45000	136	141
35	Escambia Bay	96.6	35	3.24	12.8	195	0.36	76.2	24	3.98	27.6	37.2	320	107	477	19.9	0.46	47000	87.9	116
36	Escambia Bay	85.8	36	1.47	2.4	69	0.06	17.5	5.4	0.97	6.4	8.2	175	31	116	4.8	0.11	15000	19.7	32.4
37	Escambia River Mouth	79.8	37	0.24	0.6	24.7	0.02	3.1	1.3	0.15	1.7	2.5	28	6	5	0.9	0.03	4000	2.9	11
38	Escambia	96.2	38	4.08	22.7	162	0.28	102	23.9	4.87	30.6	58.1	370	111	640	24.4	0.44	48000	120	131
39	Floridatown	94.8	39	0.92	1.2	97.8	0.42	12.7	4.6	0.54	6.6	5.9	69	12	37	2.6	0.08	22000	13.3	76
40	Central Bay	95.2	40	4.71	23.7	136	0.14	106	21.6	4.8	40.2	81.7	575	120	608	28.8	0.23	41000	117	140
MDL				65	1.4	0.02	0.03	4	1.1	26	0.9	0.58	1	7	5.1	0.1	0.04	5	0.01	1.1

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	C %	N %	CO3 %	GRAIN Phi	AVS %	SAMPLE	fluorene ppb	phenanthrene ppb	anthracene ppb	SUM_LMW ppb	fluoranthene ppb	C %	C/100
1	Bayou Grande	5.9	0.58	19.23	9.01	0	1	10	40	10	60	140	5.94	0.06
2	Bayou Grande	0.5	0.05	1.94	2.61	0	2	10	10	10	30	20	0.45	0
3	Bayou Grande	4.6	0.41	17.96	8.69	0	3	10	90	10	110	200	4.59	0.05
4	Bayou Chico	3	0.11	8.21	5	0	4	10	150	10	170	420	2.96	0.03
5	Bayou Chico	6.3	0.36	15.4	8.59	0	5	10	260	10	280	1330	6.32	0.06
6	Bayou Chico	5.3	0.26	8.47	3.97	0	6	10	360	50	420	830	5.25	0.05
7	Bayou Chico	9.4	0.34	15.68	7.28	0	7	740	1380	370	2490	6330	9.39	0.09
8	Bayou Chico	6	0.29	13.15	4.72	0	8	540	930	120	1590	4770	6.04	0.06
9	Bayou Chico	5.6	0.34	13.68	3.66	0	9	10	1970	10	1990	3650	5.56	0.06
10	Bayou Texar	6	0.46	14.39	7.16	0	10	10	310	10	330	1720	5.99	0.06
11	Bayou Texar	3.9	0.35	12.86	9.14	0	11	70	10	270	350	570	3.85	0.04
12	Bayou Texar	3.8	0.32	9.62	8.3	0	12	10	10	10	30	10	3.8	0.04
13	Bayou Texar	3.6	0.31	9.89	8.4	0	13	20	740	40	800	1340	3.6	0.04
14	Warrington	3.3	0.32	26.02	9.59	0	14	20	370	10	400	440	3.31	0.03
15	Bayou Chico	3.4	0.33	23.91	10.25	0	15	10	70	10	90	390	3.38	0.03
16	Bayou Channel	0.2	0.02	1.62	2.36	0	16	70	180	10	260	70	0.17	0
17	Inner Harbor Channel	0.3	0.02	1.6	2	0	17	10	10	10	30	10	0.29	0
18	Inner Harbor	6	0.38	14.72	4.86	0	18	10	1560	10	1580	5110	5.95	0.06
19	Inner Harbor	3.5	0.25	17.96	6.72	0	19	10	10	10	30	10	3.45	0.03
20	Inner Harbor	2.4	0.18	11.7	3.22	0	20	10	10	10	30	10	2.42	0.02
21	Pensacola Bay	3.2	0.33	27.25	9.77	0	21	10	10	10	30	30	3.18	0.03
22	Pensacola Bay	3.2	0.34	28.56	8.54	0	22	10	70	10	90	60	3.24	0.03
23	Inner Harbor	3	0.3	30.72	10.16	0	23	10	60	10	80	210	3.01	0.03
24	Lower Bay	3.1	0.33	22.94	8.04	0	24	10	10	10	30	20	3.11	0.03
25	Lower Bay	3.4	0.35	25.54	9.97	0							3.44	0.03
26	East Bay	3.1	0.29	10.91	6.23	0							3.14	0.03
27	East Bay	3.9	0.37	15.13	9.37	0							3.88	0.04
28	East Bay	3.9	0.39	13.25	9.3	0							3.9	0.04
29	Blackwater Bay	5.2	0.37	8.46	8.95	0							5.18	0.05
30	Blackwater Bay	7.1	0.48	9.9	8.89	0							7.06	0.07
31	Blackwater Bay	2.6	0.17	4.25	3.44	0							2.56	0.03
32	Escambia Bay	2.9	0.25	16.6	9.52	0							2.89	0.03
33	Escambia Bay	1.5	0.14	6.97	5.64	0							1.47	0.01
34	Escambia Bay	3	0.26	14.98	8.92	0							2.95	0.03
35	Escambia Bay	4.2	0.26	7.2	7.07	0							4.18	0.04
36	Escambia Bay	0.6	0.04	1.7	3.5	0							0.6	0.01
37	Escambia River Mouth	0.3	0.03	1.13	2.45	0							0.3	0
38	Escambia	3.3	0.31	14.56	8.09	0							3.32	0.03
39	Floridatown	0.9	0.04	1.59	3.98	0							0.86	0.01
40	Central Bay	3.2	0.33	23.76	8.59	0							3.22	0.03
MDL		10	10	10				10ppb	10ppb	10ppb	10ppb	10ppb		

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	fluoranthene ug/goc	fluoranthene ppb	benzo(a)anthracene ppb	chrysene ppb	benzo(b,k)fluoranthene ppb	benzo(e) ppb	benzo(a)pyrene ppb	perylene ppb	indeno(1,2,3)pyrene ppb
1	Bayou Grande	2.36	140	70	90	230	70	40	10	20
2	Bayou Grande	4.44	20	20	10	20	10	10	10	10
3	Bayou Grande	4.36	200	80	60	150	50	10	20	160
4	Bayou Chico	14.19	420	230	250	470	300	140	90	170
5	Bayou Chico	21.04	1330	710	590	1610	1090	640	360	560
6	Bayou Chico	15.81	830	320	330	770	600	280	90	260
7	Bayou Chico	67.41	6330	2250	1690	2850	1900	1200	560	1220
8	Bayou Chico	78.97	4770	1830	1230	2060	1100	630	330	800
9	Bayou Chico	65.65	3650	390	1520	2080	560	20	10	370
10	Bayou Texar	28.71	1720	590	530	1190	420	170	90	1110
11	Bayou Texar	14.81	570	250	240	630	210	70	60	650
12	Bayou Texar	10	10	10	10	10	10	10	10	10
13	Bayou Texar	37.22	1340	570	580	1470	480	210	100	1330
14	Warrington	13.29	440	170	130	330	100	30	170	350
15	Bayou Chico	11.54	390	90	140	380	60	10	10	130
16	Bayou Channel	41.18	70	10	40	10	10	10	20	10
17	Inner Harbor Channel	10	10	10	10	10	10	10	10	10
18	Inner Harbor	85.88	5110	1910	2400	5430	1820	950	460	3140
19	Inner Harbor	10	10	10	10	10	10	10	10	10
20	Inner Harbor	10	10	10	10	10	10	10	10	10
21	Pensacola Bay	0.94	30	20	30	90	10	10	10	10
22	Pensacola Bay	1.85	60	10	140	30	10	10	10	10
23	Inner Harbor	6.98	210	30	80	250	40	10	10	80
24	Lower Bay	0.64	20	10	10	70	10	10	10	10
25	Lower Bay									
26	East Bay									
27	East Bay									
28	East Bay									
29	Blackwater Bay									
30	Blackwater Bay									
31	Blackwater Bay									
32	Escambia Bay									
33	Escambia Bay									
34	Escambia Bay									
35	Escambia Bay									
36	Escambia Bay									
37	Escambia River Mouth									
38	Escambia									
39	Floridatown									
40	Central Bay									
MDL			10ppb	10ppb	10ppb	10ppb	10ppb	10ppb	10ppb	10ppb

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station	Location	dibenz(a,h)anthracene	benzo(g,h,i)perylene	SUM HMW	TOT_PAH		SAMPLE	Lindane	Heptachlor epoxide	Alpha CHL	Trans Nono	
No.		ppb	ppb	ppb	ppb			ppb	ppb	ppb	ppb	
1	Bayou Grande	10	30	710	770		1	1	0.1	0.5	1	
2	Bayou Grande	10	10	130	160		2	1	0.1	0.5	1	
3	Bayou Grande	10	180	920	1030		3	1	0.1	4.86	1	
4	Bayou Chico	30	410	2510	2680		4	1	0.1	4.46	7.94	
5	Bayou Chico	100	1380	8370	8650		5	1	1.2	25.36	1	
6	Bayou Chico	30	740	4250	4670		6	1	0.1	6.48	1	
7	Bayou Chico	630	2750	21380	23870		7	1	0.1	20.56	1	
8	Bayou Chico	280	1550	14580	16170		8	1	0.1	8.06	1	
9	Bayou Chico	10	640	9250	11240		9	1	0.1	4.04	1	
10	Bayou Texar	200	1190	7210	7540		10	1	0.1	24.66	4.08	
11	Bayou Texar	140	650	3470	3820		11	1	0.1	5.82	1	
12	Bayou Texar	10	10	100	130		12	1	0.1	0.5	1	
13	Bayou Texar	240	1280	7600	8400		13	1	0.1	19.24	2.26	
14	Warrington	30	400	2150	2550		14	1	0.1	2.14	1	
15	Bayou Chico	10	150	1370	1460		15	1	0.1	2.42	1	
16	Bayou Channel	10	10	200	460		16	1	0.1	0.5	1	
17	Inner Harbor Channel	10	10	100	130		17	1	0.1	0.5	1	
18	Inner Harbor	890	2830	24940	26520		18	1	0.1	17.74	4.16	
19	Inner Harbor	10	10	100	130		19	1	0.1	0.5	1	
20	Inner Harbor	10	10	100	130		20	1	0.1	0.5	1	
21	Pensacola Bay	10	10	230	260		21	1	0.1	0.5	1	
22	Pensacola Bay	10	10	300	390		22	1	0.1	0.5	1	
23	Inner Harbor	10	100	820	900		23	1	0.1	1.98	1	
24	Lower Bay	10	20	180	210		24	1	0.1	1.74	1	
25	Lower Bay						25					
26	East Bay						26					
27	East Bay						27					
28	East Bay						28					
29	Blackwater Bay						29					
30	Blackwater Bay						30					
31	Blackwater Bay						31					
32	Escambia Bay						32					
33	Escambia Bay						33					
34	Escambia Bay						34					
35	Escambia Bay						35					
36	Escambia Bay						36					
37	Escambia River Mouth						37					
38	Escambia						38					
39	Floridatown						39					
40	Central Bay						40					
MDL		10ppb	10ppb	10ppb	10ppb			1	0.1	0.5	1	
								ppb	ppb	ppb	ppb	ppb

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	2,4-DDD ppb	4,4-DDD ppb	2,4'-DDE ppb	2,4-DDT ppb	4,4-DDT ppb	TOTAL DDT ppb	Endrin ppb	C/100	endrin ug/goc	Dieldrin ppb	C/100	Dieldrin ug/goc
1	Bayou Grande	1	5	1	0.1	0.5	7.6	1	0.06		2.84	0.06	0.05
2	Bayou Grande	1	0.5	1	0.1	0.5	3.1	1	0		0.1	0	
3	Bayou Grande	1	2.58	2.1	0.1	2.02	7.8	1	0.05		5.76	0.05	0.13
4	Bayou Chico	5.92	12.36	1	0.1	0.5	19.88	1	0.03		1.72	0.03	0.06
5	Bayou Chico	19.24	36.98	1	4.26	10.8	72.28	20.3	0.06	0.39	24.98	0.06	0.4
6	Bayou Chico	2.76	12.64	1	0.1	2.86	19.36	1	0.05		1.54	0.05	0.03
7	Bayou Chico	1	43.82	1	0.1	26.78	72.7	37.2	0.09	0.62	0.1	0.09	
8	Bayou Chico	29	35.12	1	0.1	28.08	93.3	11.28	0.06	0.2	9.54	0.06	0.16
9	Bayou Chico	1	8.6	1	0.1	8.84	19.54	1	0.06		1.36	0.06	0.02
10	Bayou Texar	8.16	37.24	1	1.72	37.06	85.18	1	0.06		10.26	0.06	0.17
11	Bayou Texar	1	8.52	1	0.1	4.94	15.56	1	0.04		2.44	0.04	0.06
12	Bayou Texar	1	0.5	1	0.1	0.5	3.1	1	0.04		0.1	0.04	
13	Bayou Texar	1	25.72	1	2.1	20.3	50.12	4.02	0.04	0.12	8.8	0.04	0.24
14	Warrington	1	0.5	1	0.1	2.32	4.92	1	0.03		0.1	0.03	
15	Bayou Chico	1	0.5	1	0.1	0.5	3.1	1	0.03		1.76	0.03	0.05
16	Bayou Channel	1	0.5	1	0.1	0.5	3.1	1	0		0.1	0	
17	Inner Harbor Channel	1	0.5	1	1.76	0.5	4.76	1	0		0.1	0	
18	Inner Harbor	16.76	53.84	1	0.1	0.5	72.2	1	0.06		7.26	0.06	0.12
19	Inner Harbor	1	0.5	1	0.1	0.5	3.1	1	0.03		0.1	0.03	
20	Inner Harbor	1	0.5	1	0.1	0.5	3.1	1	0.02		0.1	0.02	
21	Pensacola Bay	1	0.5	1	0.1	0.5	3.1	1	0.03		0.1	0.03	
22	Pensacola Bay	1	0.5	1	0.1	0.5	3.1	1	0.03		1.92	0.03	0.06
23	Inner Harbor	1	0.5	1	0.1	0.5	3.1	1	0.03		2.78	0.03	0.09
24	Lower Bay	1	0.5	1	0.1	0.5	3.1	1	0.03		0.1	0.03	
25	Lower Bay								0.03			0.03	
26	East Bay								0.03			0.03	
27	East Bay								0.04			0.04	
28	East Bay								0.04			0.04	
29	Blackwater Bay								0.05			0.05	
30	Blackwater Bay								0.07			0.07	
31	Blackwater Bay								0.03			0.03	
32	Escambia Bay								0.03			0.03	
33	Escambia Bay								0.01			0.01	
34	Escambia Bay								0.03			0.03	
35	Escambia Bay								0.04			0.04	
36	Escambia Bay								0.01			0.01	
37	Escambia River Mouth								0			0	
38	Escambia								0.03			0.03	
39	Floridatown								0.01			0.01	
40	Central Bay								0.03			0.03	
MDL		1	0.5	1	0.1	0.5	1	1			0.1		
		ppb	ppb	ppb	ppb	ppb							

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	Mirex ppb	SAMPLE	PCBCON8 ppb	PCBCON18 ppb	PCBCON29 ppb	PCBCON52 ppb	PCBCON44 ppb	PCBCON66 ppb	PCBCON101 ppb	PCBCON77 ppb
1	Bayou Grande	0.5	1	0.75	0.51	0.94	0.51	0.58	0.96	11.31	7.17
2	Bayou Grande	0.5	2	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
3	Bayou Grande	0.5	3	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
4	Bayou Chico	0.5	4	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
5	Bayou Chico	24.28	5	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
6	Bayou Chico	0.5	6	0.75	0.51	0.94	0.51	0.58	6.48	18	49.92
7	Bayou Chico	11.18	7	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
8	Bayou Chico	11.22	8	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
9	Bayou Chico	0.5	9	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
10	Bayou Texar	0.5	10	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
11	Bayou Texar	0.5	11	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
12	Bayou Texar	0.5	12	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
13	Bayou Texar	0.5	13	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
14	Warrington	0.5	14	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
15	Bayou Chico	0.5	15	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
16	Bayou Channel	0.5	16	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
17	Inner Harbor Channel	0.5	17	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
18	Inner Harbor	0.5	18	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
19	Inner Harbor	0.5	19	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
20	Inner Harbor	0.5	20	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
21	Pensacola Bay	0.5	21	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
22	Pensacola Bay	0.5	22	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
23	Inner Harbor	0.5	23	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
24	Lower Bay	0.5	24	0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03
25	Lower Bay		25								
26	East Bay		26								
27	East Bay		27								
28	East Bay		28								
29	Blackwater Bay		29								
30	Blackwater Bay		30								
31	Blackwater Bay		31								
32	Escambia Bay		32								
33	Escambia Bay		33								
34	Escambia Bay		34								
35	Escambia Bay		35								
36	Escambia Bay		36								
37	Escambia River Mouth		37								
38	Escambia		38								
39	Floridatown		39								
40	Central Bay		40								
MDL		0.5		0.75	0.51	0.94	0.51	0.58	0.96	0.83	1.03

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	PCBCON118 ppb	PCBCON153 ppb	PCBCON105 ppb	PCBCON138 ppb	PCBCON126 ppb	PCBCON187 ppb	PCBCON128 ppb	PCBCON180 ppb	PCBCON170 ppb	PCBCON195 ppb
1	Bayou Grande	5.02	3.26	12.95	2.99	0.87	0.71	0.91	0.88	0.85	0.78
2	Bayou Grande	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
3	Bayou Grande	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
4	Bayou Chico	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
5	Bayou Chico	12.6	36.2	17.8	1.01	0.87	7.46	10.2	0.88	0.85	0.78
6	Bayou Chico	8.8	7.52	4.24	1.01	0.87	0.95	0.91	0.88	0.85	0.78
7	Bayou Chico	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
8	Bayou Chico	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
9	Bayou Chico	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
10	Bayou Texar	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
11	Bayou Texar	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
12	Bayou Texar	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
13	Bayou Texar	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
14	Warrington	5.78	0.85	4.28	1.01	0.87	0.95	0.91	0.88	0.85	0.78
15	Bayou Chico	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
16	Bayou Channel	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
17	Inner Harbor Channel	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
18	Inner Harbor	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
19	Inner Harbor	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
20	Inner Harbor	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
21	Pensacola Bay	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
22	Pensacola Bay	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
23	Inner Harbor	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
24	Lower Bay	1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78
25	Lower Bay										
26	East Bay										
27	East Bay										
28	East Bay										
29	Blackwater Bay										
30	Blackwater Bay										
31	Blackwater Bay										
32	Escambia Bay										
33	Escambia Bay										
34	Escambia Bay										
35	Escambia Bay										
36	Escambia Bay										
37	Escambia River Mouth										
38	Escambia										
39	Floridatown										
40	Central Bay										
MDL		1.07	0.85	0.9	1.01	0.87	0.95	0.91	0.88	0.85	0.78

Appendix B1. Chemistry and toxicity data from Pensacola Bay, 1993.

Station No.	Location	PCBCON206	PCBCON209	total (20)PCB	PCB*2
1	Bayou Grande	0.82	0.76	53.53	107.06
2	Bayou Grande	0.82	0.76	16.76	33.52
3	Bayou Grande	0.82	0.76	16.76	33.52
4	Bayou Chico	0.82	0.76	16.76	33.52
5	Bayou Chico	0.82	0.76	96.34	192.68
6	Bayou Chico	0.82	0.76	106.08	212.16
7	Bayou Chico	0.82	0.76	16.76	33.52
8	Bayou Chico	0.82	0.76	16.76	33.52
9	Bayou Chico	0.82	0.76	16.76	33.52
10	Bayou Texar	0.82	0.76	16.76	33.52
11	Bayou Texar	0.82	0.76	16.76	33.52
12	Bayou Texar	0.82	0.76	16.76	33.52
13	Bayou Texar	0.82	0.76	16.76	33.52
14	Warrington	0.82	0.76	24.85	49.7
15	Bayou Chico	0.82	0.76	16.76	33.52
16	Bayou Channel	0.82	0.76	16.76	33.52
17	Inner Harbor Channel	0.82	0.76	16.76	33.52
18	Inner Harbor	0.82	0.76	16.76	33.52
19	Inner Harbor	0.82	0.76	16.76	33.52
20	Inner Harbor	0.82	0.76	16.76	33.52
21	Pensacola Bay	0.82	0.76	16.76	33.52
22	Pensacola Bay	0.82	0.76	16.76	33.52
23	Inner Harbor	0.82	0.76	16.76	33.52
24	Lower Bay	0.82	0.76	16.76	33.52
25	Lower Bay				
26	East Bay				
27	East Bay				
28	East Bay				
29	Blackwater Bay				
30	Blackwater Bay				
31	Blackwater Bay				
32	Escambia Bay				
33	Escambia Bay				
34	Escambia Bay				
35	Escambia Bay				
36	Escambia Bay				
37	Escambia River Mouth				
38	Escambia				
39	Floridatown				
40	Central Bay				
MDL		0.82	0.76		

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location		%amph surv	amphsurv%ctl	signif.	Microtox EC50	Microtox % ctl	signif.	Mutatox	Urchinfert@100%	Signif.	Urchdevp@100%
PE02	A1-1	Cinco Bay	Choctawhatchee Bay	88	104	ns	2.1	4.3	**	G	51.6	**	4.2
PE19	A2-1	Cinco Bayou	Choctawhatchee Bay	95	97	ns	4.7	9.6	**	N	25.6	**	0
PE22	B3-1	U. Garnier Bayou	Choctawhatchee Bay	94	102	ns	2.3	4.7	**	N	91.4	ns	11.8
PE05	C1-2	L. Garnier Bayou	Choctawhatchee Bay	98	107	ns	12.8	26.2	**	N	47.2	**	24.8
PE03	C2-1	L. Garnier Bayou	Choctawhatchee Bay	87	102	ns	0.4	0.8	**	G	30.8	**	20.4
PE16	C3-1	L. Garnier Bayou	Choctawhatchee Bay	93	109	ns	4.3	8.8	**	S	77	*	28.6
PE12	D1-1	Destin Harbor	Choctawhatchee Bay	93	106	ns	3.2	6.5	**	G	93.3	ns	0
PD98	D2-2	Destin Harbor	Choctawhatchee Bay	95	108	ns	0.8	1.6	**	G	87.6	ns	50.4
	D3-1	Destin Harbor	Choctawhatchee Bay										
PE13	E3-1	Boggy Bayou	Choctawhatchee Bay	95	108	ns	3.1	6.3	**	N	61.3	**	4.6
PE23	F1-1	Toms Bayou	Choctawhatchee Bay	93	106	ns	1.6	3.3	**	S	0.6	**	24.6
PE11	F2-1	Tom's Bayou	Choctawhatchee Bay	94	107	ns	3.8	7.8	**	G	32.8	**	72.2
PD91	G1-1	Rocky Bayou	Choctawhatchee Bay	96	109	ns	1.1	2	**	G	51.8	**	74
PD96	G2-1	Rocky Bayou	Choctawhatchee Bay	94	107	ns	10.8	22.1	**	N	39	**	39
PD99	G3-1	Rocky Bayou	Choctawhatchee Bay	95	108	ns	2.5	5.1	**	S	91.6	ns	86.8
PE06	K2-1	La Grange Bayou	Choctawhatchee Bay	84	87	*	0.9	1.8	**	G	76	*	0
PE04	K3-1	La Grange Bayou	Choctawhatchee Bay	92	95	ns	2.7	5.5	**	S	35.2	**	73.6
PE01	L1-2	western basin	Choctawhatchee Bay	87	102	ns	1.1	2.3	**	N	55.2	**	80.6
PE21	L3-1	western basin	Choctawhatchee Bay	97	99	ns	1.3	2.7	**	S	78	*	72
PE09	M1-1	central basin	Choctawhatchee Bay	98	100	ns	8.6	17.6	**	N	62.2	**	73.6
PE07	N3-1	eastern basin	Choctawhatchee Bay	98	101	ns	17.6	36	**	N	90.2	ns	72.4
PO15PB	NA	Procedural Blank											
PO19SSRM	BOS ID #940504-4	SRM 1941a											
MDLs													

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

attelle I	Sta. No.	Site Location	signif.	Urch UAN, ug/l	Amph UAN, ug/l	%TOC	Sample Size (g)	Units	Percent	Dry Weight	NAPHTHALENE
1994											
PE02	A1-1	Cinco Bay	**	31.3	22	7.6	18.811	ng/g, dry wt.		36.176	46.55
PE19	A2-1	Cinco Bayou	**	23.5	95	0.02	36.067	ng/g, dry wt.		81.655	0.79
PE22	B3-1	U. Garnier Bayou	**	95.9	119	0.07	29.869	ng/g, dry wt.		80.055	0.95
PE05	C1-2	L. Garnier Bayou	**	38.1	22	5.25	11.072	ng/g, dry wt.		23.673	11.86
PE03	C2-1	L. Garnier Bayou	**	20	7	5.32	8.858	ng/g, dry wt.		28.247	12.44
PE16	C3-1	L. Garnier Bayou	**	21	97	0.004	29.017	ng/g, dry wt.		80.894	6.49
PE12	D1-1	Destin Harbor	**	60.5	143	0.004	29.46	ng/g, dry wt.		82.451	0.84
PD98	D2-2	Destin Harbor	**	21.5	77	0.27	30.823	ng/g, dry wt.		76.428	2.3
	D3-1	Destin Harbor		59	38						
PE13	E3-1	Boggy Bayou	**	28.7	8	5.6	3.561	ng/g, dry wt.		27.389	14.46
PE23	F1-1	Toms Bayou	**	11.8	7	12.72	1.025	ng/g, dry wt.		16.062	27.91
PE11	F2-1	Tom's Bayou	ns	17.2	1	7.7	3.523	ng/g, dry wt.		26.667	13.99
PD91	G1-1	Rocky Bayou	ns	28.4	33	5.2	17.525	ng/g, dry wt.		50.859	3.55
PD96	G2-1	Rocky Bayou	**	44.7	7	7.48	11.45	ng/g, dry wt.		28.844	7.6
PD99	G3-1	Rocky Bayou	ns	6	26	0.02	30.176	ng/g, dry wt.		81.581	0.85
PE06	K2-1	La Grange Bayou	**	90.4	61	6.51	12.425	ng/g, dry wt.		34.833	5.19
PE04	K3-1	La Grange Bayou	ns	22.1	16	2.42	26.982	ng/g, dry wt.		57.033	2.31
PE01	L1-2	western basin	ns	34.8	1	4.36	14.199	ng/g, dry wt.		27.82	6.69
PE21	L3-1	western basin	ns	32.1	45	1.77	28.995	ng/g, dry wt.		64.821	1.76
PE09	M1-1	central basin	ns	14.2	53	1.62	26.407	ng/g, dry wt.		50.891	1.45
PE07	N3-1	eastern basin	ns	10.9	1	1.85	17.798	ng/g, dry wt.		52.469	2.4
PO15PE	NA	Procedural Blank					18.784	ng/g, dry wt.	NA		0.85
PO19SS	BOS ID	SRM 1941a					5.408	ng/g, dry wt.		97.8	863.96
	#940504-4										
MDLs											

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	2-METHYLNAPHTHALENE	1-METHYLNAPHTHALENE	C1-NAPHTHALENES	2,6-DIMETHYLNAPHTHALENE	C2-NAPHTHALENES	ETHYLNAP
PE02	A1-1	Cinco Bay	19.86	8.27	15.81	10.74	24.77	6.78
PE19	A2-1	Cinco Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE22	B3-1	U. Garnier Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE05	C1-2	L. Garnier Bayou	5.94	3.18	5.56	7.03	0.21	0.21
PE03	C2-1	L. Garnier Bayou	5.63	3.04	5.2	0.21	0.21	0.21
PE16	C3-1	L. Garnier Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE12	D1-1	Destin Harbor	0.21	0.21	0.21	0.21	0.21	0.21
PD98	D2-2	Destin Harbor	0.21	0.21	0.21	0.21	0.21	0.21
	D3-1	Destin Harbor						
PE13	E3-1	Boggy Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE23	F1-1	Toms Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE11	F2-1	Tom's Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PD91	G1-1	Rocky Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PD96	G2-1	Rocky Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PD99	G3-1	Rocky Bayou	0.21	0.21	0.21	0.21	0.21	0.21
PE06	K2-1	La Grange Bayou	2.87	1.95	2.96	0.21	0.21	0.21
PE04	K3-1	La Grange Bayou	2.14	1.17	1.96	2.49	4.99	0.21
PE01	L1-2	western basin	3.13	1.56	3.04	0.21	0.21	0.21
PE21	L3-1	western basin	0.21	0.21	0.21	0.21	0.21	0.21
PE09	M1-1	central basin	0.21	0.21	0.21	0.21	0.21	0.21
PE07	N3-1	eastern basin	0.21	0.21	0.21	0.21	0.21	0.21
PO15PB	NA	Procedural Blank	0.21	0.21	0.21	0.21	0.21	0.21
PO19SSRM	BOS ID #940504-4	SRM 1941a	368.28	176.64	297.89	194.42	299.45	91.2
MDLs			0.21	0.21	0.21	0.21	0.21	0.21

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	C3-NAPHTHALENES	C4-NAPHTHALENES	BIPHENYL	ACENAPHTHYLENE	ACENAPHTHENE	DIBENZOFURAN	FLUORENE	C1-FLUORENES
PE02	A1-1	Cinco Bay	0.21	0.21	7.71	82.15	16.79	20.66	24.77	11.02
PE19	A2-1	Cinco Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE22	B3-1	U. Garnier Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE05	C1-2	L. Garnier Bayou	0.21	0.21	0.2	35.83	0.28	0.23	4.54	0.23
PE03	C2-1	L. Garnier Bayou	0.21	0.21	0.2	46.37	0.28	4.82	7.41	0.23
PE16	C3-1	L. Garnier Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE12	D1-1	Destin Harbor	0.21	0.21	0.2	1.58	0.28	0.23	0.23	0.23
PD98	D2-2	Destin Harbor	0.21	0.21	0.2	12.34	0.28	0.23	0.23	0.23
	D3-1	Destin Harbor								
PE13	E3-1	Boggy Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE23	F1-1	Toms Bayou	0.21	0.21	0.2	50.53	0.28	0.23	0.23	0.23
PE11	F2-1	Tom's Bayou	0.21	0.21	0.2	39.25	0.28	0.23	0.23	0.23
PD91	G1-1	Rocky Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PD96	G2-1	Rocky Bayou	0.21	0.21	0.2	34.56	0.28	0.23	0.23	0.23
PD99	G3-1	Rocky Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE06	K2-1	La Grange Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE04	K3-1	La Grange Bayou	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE01	L1-2	western basin	0.21	0.21	0.2	7.46	0.28	0.23	0.23	0.23
PE21	L3-1	western basin	0.21	0.21	0.2	0.12	0.28	0.23	1.13	0.23
PE09	M1-1	central basin	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PE07	N3-1	eastern basin	0.21	0.21	0.2	3.37	0.28	0.23	0.23	0.23
PO15PB	NA	Procedural Blank	0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23
PO19SSRM	BOS ID #940504-4	SRM 1941a	286.32	165.88	101.39	89.71	38.09	105.71	76.75	75.79
MDLs			0.21	0.21	0.2	0.12	0.28	0.23	0.23	0.23

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	C2-FLUORENES	C3-FLUORENES	PHENANTHRENE	1-METHYLPHENANTHRENE	ANTHRACENE	C1-PHENANTHRENE/ANTHRACENES	C2-PHENANTHRENE/ANTHRACENES
PE02	A1-1	Cinco Bay	26.37	362.11	360.54	72.45	156.94	152.74	154.64
PE19	A2-1	Cinco Bayou	0.23	0.23	0.19	0.19	0.17	0.19	0.19
PE22	B3-1	U. Garnier Bayou	0.23	0.23	1.84	0.19	1.38	0.19	0.19
PE05	C1-2	L. Garnier Bayou	0.23	0.23	67.23	8.44	42.31	44.31	47.46
PE03	C2-1	L. Garnier Bayou	0.23	0.23	104.47	14.14	56.13	64.3	69.55
PE16	C3-1	L. Garnier Bayou	0.23	0.23	0.19	0.19	0.17	0.19	0.19
PE12	D1-1	Destin Harbor	0.23	0.23	0.77	0.19	1.9	0.19	0.19
PD98	D2-2	Destin Harbor	0.23	0.23	5.67	3.11	15.83	7.68	0.19
	D3-1	Destin Harbor							
PE13	E3-1	Boggy Bayou	0.23	0.23	33.66	0.19	7.25	31.27	66.93
PE23	F1-1	Toms Bayou	0.23	0.23	57.33	0.19	53.84	0.19	0.19
PE11	F2-1	Tom's Bayou	0.23	0.23	87.99	14.81	49.4	76.45	96.11
PD91	G1-1	Rocky Bayou	0.23	0.23	0.19	0.19	0.17	0.19	0.19
PD96	G2-1	Rocky Bayou	0.23	0.23	20.51	12.86	31.85	23.28	31.94
PD99	G3-1	Rocky Bayou	0.23	0.23	0.19	0.19	0.17	0.19	0.19
PE06	K2-1	La Grange Bayou	0.23	0.23	1.59	1.53	1.26	8.37	26.21
PE04	K3-1	La Grange Bayou	0.23	0.23	3.48	2.17	0.83	8.8	16.21
PE01	L1-2	western basin	0.23	0.23	12	1.98	8.61	12.06	18.21
PE21	L3-1	western basin	0.23	0.23	3.58	1.1	1.3	4.99	0.19
PE09	M1-1	central basin	0.23	0.23	0.66	0.19	0.38	0.19	0.19
PE07	N3-1	eastern basin	0.23	0.23	1.08	0.19	2.54	0.19	0.19
PO15PB	NA	Procedural Blank	0.23	0.23	0.19	0.19	0.17	0.19	0.19
PO19SSRM	BOS ID #940504-4	SRM 1941a	171.11	310.9	514.99	100.1	203.91	437.06	408.36
MDLs			0.23	0.23	0.19	0.19	0.17	0.19	0.19

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	C3-PHENANTHRENE/ANTHRACENES	C4-PHENANTHRENE/ANTHRACENES	DIBENZOTHIOPHENE	C1-DIBENZOTHIOPHENES	C2-DIBENZOTHIOPHENES
PE02	A1-1	Cinco Bay	118.2	403.72	38.74	51.99	54.54
PE19	A2-1	Cinco Bayou	0.19	0.19	0.23	0.23	0.23
PE22	B3-1	U. Garnier Bayou	0.19	0.19	0.23	0.23	0.23
PE05	C1-2	L. Garnier Bayou	46.67	89.21	4.6	5.79	14.71
PE03	C2-1	L. Garnier Bayou	59.98	145.47	5.72	9.79	14.41
PE16	C3-1	L. Garnier Bayou	0.19	0.19	0.23	0.23	0.23
PE12	D1-1	Destin Harbor	0.19	0.19	0.23	0.23	0.23
PD98	D2-2	Destin Harbor	0.19	0.19	0.66	0.23	0.23
	D3-1	Destin Harbor					
PE13	E3-1	Boggy Bayou	0.19	0.19	0.23	0.23	0.23
PE23	F1-1	Toms Bayou	0.19	0.19	0.23	0.23	0.23
PE11	F2-1	Tom's Bayou	93.2	149.57	0.23	0.23	0.23
PD91	G1-1	Rocky Bayou	0.19	0.19	0.23	0.23	0.23
PD96	G2-1	Rocky Bayou	34.46	65.65	0.23	0.23	0.23
PD99	G3-1	Rocky Bayou	0.19	0.19	0.23	0.23	0.23
PE06	K2-1	La Grange Bayou	36.21	24.32	0.23	0.23	0.23
PE04	K3-1	La Grange Bayou	16	17.12	0.92	2.69	7.73
PE01	L1-2	western basin	15.27	0.19	0.23	0.23	0.23
PE21	L3-1	western basin	0.19	0.19	0.23	0.23	0.23
PE09	M1-1	central basin	0.19	0.19	0.23	0.23	0.23
PE07	N3-1	eastern basin	0.19	0.19	0.23	0.23	0.23
PO15PB	NA	Procedural Blank	0.19	0.19	0.23	0.23	0.23
PO19SSRM	BOS ID #940504-4	SRM 1941a	361.14	464.74	66.87	100.81	176.98
MDLs			0.19	0.19	0.23	0.23	0.23

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	C3-DIBENZOTHIOPHENES	FLUORANTHENE	PYRENE	C1-FLUORANTHENES/PYRENES	BENZ(A)ANTHRACENE	CHRYSENE	C1-CHRYSENES
PE02	A1-1	Cinco Bay	87.22	2330.03	2121.9	793.94	742.02	1328.34	331.52
PE19	A2-1	Cinco Bayou	0.23	8.26	7.12	4.21	3.16	7.24	1.86
PE22	B3-1	U. Garnier Bayou	0.23	10.35	8.64	6.78	5.28	10.5	3.42
PE05	C1-2	L. Garnier Bayou	15.02	432.84	360.93	210.34	170.14	283.32	105.76
PE03	C2-1	L. Garnier Bayou	18.7	693.47	573.48	330.02	262.66	452.87	154.25
PE16	C3-1	L. Garnier Bayou	0.23	4.76	3.86	2.68	2.29	5.77	1.35
PE12	D1-1	Destin Harbor	0.23	10.66	9.8	7.33	6.06	11.44	3.23
PD98	D2-2	Destin Harbor	0.23	43.86	37.87	38.34	26.24	50.86	18.45
	D3-1	Destin Harbor							
PE13	E3-1	Boggy Bayou	0.23	145.01	147.31	114.6	58.36	86.96	80.55
PE23	F1-1	Toms Bayou	0.23	604.11	455.39	275.25	209.28	267.41	158.31
PE11	F2-1	Tom's Bayou	0.23	529.74	491.02	279.95	220.04	341.92	178.04
PD91	G1-1	Rocky Bayou	0.23	16.06	16.87	11.31	5.39	7.35	5.37
PD96	G2-1	Rocky Bayou	0.23	108.63	108.42	90.83	60.17	83.9	55.91
PD99	G3-1	Rocky Bayou	0.23	0.25	0.24	0.14	0.15	0.14	0.14
PE06	K2-1	La Grange Bayou	0.23	26.74	31.52	25.83	7.98	8.19	7.79
PE04	K3-1	La Grange Bayou	11.1	17.58	20.47	17.63	6.12	7.07	4.73
PE01	L1-2	western basin	0.23	82.16	70.73	44.76	29.79	55.64	20.99
PE21	L3-1	western basin	0.23	23.82	20.78	15.3	7.41	10.05	9.27
PE09	M1-1	central basin	0.23	4.75	4.65	3.02	1.33	1.8	0.14
PE07	N3-1	eastern basin	0.23	24.36	26.42	16.94	10.33	13.82	6.35
PO15PB	NA	Procedural Blank	0.23	0.11	0.6	0.14	0.87	0.73	0.14
PO19SSRM	BOS ID #940504-4	SRM 1941a	202.37	1147.36	914.28	633.87	471.64	656.62	371.59
MDLs			0.23	0.11	0.6	0.14	0.87	0.73	0.14

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	C2-CHRYSENES	C3-CHRYSENES	C4-CHRYSENES	BENZO(B)FLUORANTHENE	BENZO(K)FLUORANTHENE	BENZO(E)PYRENE	BENZO(A)PYRENE	PERYLENE	INDENO(1,2,3-C,D)PYRENE
PE02	A1-1	Cinco Bay	214.14	169.25	186.34	2387.81	860.89	1193.44	1169.64	278.25	989.7
PE19	A2-1	Cinco Bayou	0.14	0.14	0.14	10.86	3.66	5.5	4.23	1.21	5.24
PE22	B3-1	U. Garnier Bayou	0.14	0.14	0.14	16.86	5.33	8.31	6.72	2.22	7.59
PE05	C1-2	L. Garnier Bayou	81.54	43.86	56.68	546.91	178.07	250.63	242.92	81.96	216.83
PE03	C2-1	L. Garnier Bayou	97.79	55.39	61.68	784.5	253.84	362.08	367.26	111.96	321.4
PE16	C3-1	L. Garnier Bayou	0.14	0.14	0.14	6.66	2.21	3.49	2.91	0.89	3.42
PE12	D1-1	Destin Harbor	0.14	0.14	0.14	19.61	6.22	10.44	7.61	2.18	9.05
PD98	D2-2	Destin Harbor	12.73	0.14	0.14	114.35	35.22	62.11	41.69	11.32	51.34
	D3-1	Destin Harbor									
PE13	E3-1	Boggy Bayou	89.88	52.45	0.14	134.67	43.58	80.84	81.9	71.23	62.34
PE23	F1-1	Toms Bayou	0.14	0.14	0.14	578.08	174.82	282.28	232.64	170.81	217.78
PE11	F2-1	Tom's Bayou	162.8	116.26	83.72	617.46	208.45	310.75	299.63	146.79	239.98
PD91	G1-1	Rocky Bayou	0.14	0.14	0.14	13.14	4.08	6.53	4.93	37.95	5.31
PD96	G2-1	Rocky Bayou	53.29	32.67	0.14	187.42	59.9	92.11	90.88	91.35	65.52
PD99	G3-1	Rocky Bayou	0.14	0.14	0.14	0.14	0.2	0.15	0.15	0.15	0.23
PE06	K2-1	La Grange Bayou	0.14	0.14	0.14	14.42	4.65	8.14	6.2	153.78	5.67
PE04	K3-1	La Grange Bayou	5.72	4.61	5.8	9.8	3.24	5	5.04	26.57	3.9
PE01	L1-2	western basin	19.84	0.14	0.14	90.81	32.21	46.33	44.25	22.38	41.52
PE21	L3-1	western basin	10.06	0.14	0.14	14.38	4.44	8.71	9.35	6.94	7.02
PE09	M1-1	central basin	0.14	0.14	0.14	3.73	1.06	1.91	1.66	7.02	2
PE07	N3-1	eastern basin	6.88	0.14	0.14	26.04	8.66	12.44	11.88	16.14	8.83
PO15PB	NA	Procedural Blank	0.14	0.14	0.14	1.19	0.34	0.92	0.7	0.6	0.77
PO19SSRM	BOS ID #940504-4	SRM 1941a	308	227.74	115.19	1139.83	392.08	583.66	534.37	383.25	501.72
MDLs			0.14	0.14	0.14	1.19	0.34	0.92	0.7	0.6	0.77

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	DIBENZ(A,H)ANTHRACENE	BENZO(G,H,I)PERYLENE	Sum 10LPAH	Sum 12HPAH	sum 24 PAHs	sum all PAHs	acenaphthene/oc ug/goc	oranthene/ ug/goc	phenanthrene/oc ug/goc
PE02	A1-1	Cinco Bay	201	863	734.32	14466	15200.32	18497.7	1.08	30.66	4.74
PE19	A2-1	Cinco Bayou	0.92	4.93	2.61	62.33	64.94	75.28	0.59	41.31	0.93
PE22	B3-1	U. Garnier Bayou	1.49	7.14	5.64	90.42	96.06	110.52	0.17	14.78	2.63
PE05	C1-2	L. Garnier Bayou	43.11	187.18	178.4	2994.85	3173.25	3954.98	0.68	8.24	1.28
PE03	C2-1	L. Garnier Bayou	66.87	271.74	236.18	4522.13	4758.31	5871.08	0.87	13.04	1.96
PE16	C3-1	L. Garnier Bayou	0.7	3.34	8.31	40.28	48.6	56.89	2.94	119.06	4.63
PE12	D1-1	Destin Harbor	1.68	9.03	6.44	103.76	110.21	125.04	39.62	266.53	19.18
PD98	D2-2	Destin Harbor	9.69	49.19	37.51	533.74	571.25	655.75	4.57	16.24	2.1
	D3-1	Destin Harbor									
PE13	E3-1	Boggy Bayou	14.47	67.13	56.85	993.78	1050.63	1489.94	0	2.59	0.6
PE23	F1-1	Toms Bayou	47.64	211.91	190.97	3452.14	3643.12	4080.94	0.4	4.75	0.45
PE11	F2-1	Tom's Bayou	54.68	225.06	191.99	3685.52	3877.51	5131.35	0.51	6.88	1.14
PD91	G1-1	Rocky Bayou	1.38	5.9	5.38	124.9	130.28	151.22	0	0.31	0
PD96	G2-1	Rocky Bayou	16.71	59.74	95.88	1024.76	1120.64	1524.59	0.46	1.45	0.27
PD99	G3-1	Rocky Bayou	0.28	0.26	2.68	2.35	5.02	9.57	0.59	1.25	0.93
PE06	K2-1	La Grange Bayou	1.41	5.6	13.9	274.29	288.19	424.55	0	0.41	0.02
PE04	K3-1	La Grange Bayou	0.92	3.84	13.26	109.56	122.82	252.58	0	0.73	0.14
PE01	L1-2	western basin	7.91	36.69	40.38	560.43	600.81	740.15	0.17	1.88	0.28
PE21	L3-1	western basin	1.66	7.57	9.01	122.13	131.14	175.63	0.01	1.35	0.2
PE09	M1-1	central basin	0.42	2.18	3.97	32.51	36.47	43.9	0.01	0.29	0.04
PE07	N3-1	eastern basin	2.04	7.56	10.75	168.52	179.28	213.58	0.18	1.32	0.06
PO15PB	NA	Procedural Blank	0.28	1.63	2.68	8.74	11.42				
PO19SSRM	BOS ID	SRM 1941a	110.14	457.97	2628.13	7292.92	9921.05				
	#940504-4										
MDLs			0.28	1.63							

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	Sample ID	Sample Dry weight (g)	Units	Percent Moisture	CL2(08)	HEXACHLOROBENZENE	LINDANE	CL3(18)	CL3(28)	HEPTACHLOR	CL4(52)	ALDRIN	CL4(44)
PE02	A1-1	Cinco Bay	PE02	18.811	ng/g, dry	63.824	0.09	0.05	0.05	0.35	2	0.39	1.01	0.05	0.61
PE19	A2-1	Cinco Bayou	PE19	36.067	ng/g, dry	18.345	0.09	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04
PE22	B3-1	U. Garnier Bayou	PE22	29.869	ng/g, dry	19.945	0.09	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.05
PE05	C1-2	L. Garnier Bayou	PE05	11.072	ng/g, dry	76.327	0.09	0.05	0.05	0.18	1.43	0.05	1.11	0.05	0.22
PE03	C2-1	L. Garnier Bayou	PE03	8.858	ng/g, dry	71.753	0.09	0.05	0.05	0.23	1.34	0.05	0.7	0.05	0.28
PE16	C3-1	L. Garnier Bayou	PE16	29.017	ng/g, dry	19.106	0.09	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04
PE12	D1-1	Destin Harbor	PE12	29.46	ng/g, dry	17.549	0.09	0.05	0.05	0.05	0.01	0.05	0.05	0.05	0.06
PD98	D2-2	Destin Harbor	PD98	30.823	ng/g, dry	23.572	0.09	0.05	0.07	0.06	0.11	0.05	0.1	0.05	0.06
	D3-1	Destin Harbor													
PE13	E3-1	Boggy Bayou	PE13	3.561	ng/g, dry	72.611	0.09	0.05	0.64	0.05	1.12	0.05	0.48	0.05	0.69
PE23	F1-1	Toms Bayou	PE23	1.025	ng/g, dry	83.938	0.09	0.05	0.05	0.05	1.78	0.05	0.05	0.05	0.04
PE11	F2-1	Tom's Bayou	PE11	3.523	ng/g, dry	73.333	0.09	0.05	1.19	0.54	2.38	0.05	0.98	0.05	0.76
PD91	G1-1	Rocky Bayou	PD91	17.525	ng/g, dry	49.141	0.09	0.05	0.5	0.05	1.38	1.87	0.14	0.05	0.11
PD96	G2-1	Rocky Bayou	PD96	11.45	ng/g, dry	71.156	0.09	0.05	0.05	0.1	3.76	1.21	0.05	0.05	0.36
PD99	G3-1	Rocky Bayou	PD99	30.176	ng/g, dry	18.419	0.09	0.05	0.05	0.06	0.03	0.05	0.05	0.05	0.05
PE06	K2-1	La Grange Bayou	PE06	12.425	ng/g, dry	65.167	0.09	0.05	0.84	0.05	0.94	0.05	0.17	0.05	0.47
PE04	K3-1	La Grange Bayou	PE04	26.982	ng/g, dry	42.967	0.09	0.05	0.3	0.04	0.36	0.05	0.13	0.05	0.27
PE01	L1-2	western basin	PE01	14.199	ng/g, dry	72.18	0.09	0.05	0.31	0.05	2.35	0.05	0.3	0.05	0.1
PE21	L3-1	western basin	PE21	28.995	ng/g, dry	35.179	0.09	0.05	0.14	0.05	0.18	0.05	0.05	0.05	0.1
PE09	M1-1	central basin	PE09	26.407	ng/g, dry	49.109	0.09	0.05	0.05	0.05	0.21	0.05	0.08	0.05	0.15
PE07	N3-1	eastern basin	PE07	17.798	ng/g, dry	47.531	0.09	0.05	0.11	0.05	0.3	0.05	0.16	0.05	0.46
PO15PB	NA	Procedural Blank	PO15PB	18.784	ng/g, dry	NA	0.09	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.09
PO19SSRM	BOS ID #940504-4	SRM 1941a	PO19SSRM	5.408	ng/g, dry	2.2	3.77	0.05	3.92	4.26	5.22	0.05	7.09	0.05	6.09
MDLs							0.09	0.05	0.05	0.05	0.03	0.05	0.05	0.05	0.05

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	HEPTACHLOREPOXIDE	CL4(66)	2,4-DDE	CL5(101)	CIS-CHLORDANE	TRANS-NONACHLOR	DIELDRIN	4,4-DDE	CL4(77)	2,4-DDD	ENDRIN	CL5(118)
PE02	A1-1	Cinco Bay	0.91	0.87	0.04	1.38	4.77	5.25	5.42	14.29	0.06	4.52	0.06	1.33
PE19	A2-1	Cinco Bayou	0.03	0.06	0.04	0.07	0.06	0.07	0.22	0.15	0.06	0.04	0.06	0.04
PE22	B3-1	U. Garnier Bayou	0.03	0.06	0.04	0.07	0.05	0.17	0.04	0.31	0.06	0.11	0.06	0.04
PE05	C1-2	L. Garnier Bayou	0.03	0.26	0.44	0.63	0.29	0.48	1.11	11.31	0.06	1.24	0.06	0.43
PE03	C2-1	L. Garnier Bayou	0.03	0.2	0.32	0.6	0.25	0.4	0.85	11.49	0.06	1.41	0.06	0.29
PE16	C3-1	L. Garnier Bayou	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.1	0.06	0.11	0.06	0.04
PE12	D1-1	Destin Harbor	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.04	0.06	0.11	0.06	0.04
PD98	D2-2	Destin Harbor	0.03	0.09	0.04	0.07	0.09	0.05	0.04	0.3	0.06	0.11	0.06	0.11
	D3-1	Destin Harbor												
PE13	E3-1	Boggy Bayou	0.03	0.06	0.04	0.54	0.21	0.44	0.04	7.9	0.06	1.09	0.06	0.69
PE23	F1-1	Toms Bayou	0.03	1.29	0.04	2.82	1.86	30.38	0.04	75.32	0.06	13.14	0.06	4.01
PE11	F2-1	Tom's Bayou	0.03	0.84	0.04	1.24	0.35	0.87	1.92	17.06	0.06	2.63	0.06	1.64
PD91	G1-1	Rocky Bayou	0.03	0.06	0.04	0.09	0.25	0.05	0.04	3.05	0.06	0.11	0.06	0.04
PD96	G2-1	Rocky Bayou	0.03	0.15	1	0.22	0.05	0.86	0.52	4.37	0.06	0.39	0.06	0.04
PD99	G3-1	Rocky Bayou	0.03	0.06	0.04	0.07	0.05	0.36	0.04	0.03	0.06	0.18	0.06	0.04
PE06	K2-1	La Grange Bayou	0.03	0.06	0.04	0.06	0.05	0.05	0.04	1.21	0.06	0.21	0.06	0.29
PE04	K3-1	La Grange Bayou	0.03	0.06	0.04	0.04	0.05	0.05	0.04	0.96	0.06	0.19	0.06	0.18
PE01	L1-2	western basin	0.03	0.07	0.19	0.12	0.1	0.05	0.04	2.21	0.06	0.32	0.06	0.11
PE21	L3-1	western basin	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.69	0.06	0.12	0.06	0.04
PE09	M1-1	central basin	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.45	0.06	0.11	0.06	0.04
PE07	N3-1	eastern basin	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.82	0.06	0.12	0.06	0.1
PO15PB	NA	Procedural Blank	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.04	0.06	0.11	0.06	0.04
PO19SSRM	BOS ID #940504-4	SRM 1941a	1.99	7.91	0.04	12.23	2.17	0.05	3.99	6.55	0.06	5.93	0.06	5.81
MDLs			0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.07	0.06	0.11	0.06	0.04

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	4,4-DDD	2,4-DDT	CL6(153)	CL5(105)	4,4-DDT	CL6(138)	CL5(126)	CL7(187)	CL6(128)	CL7(180)	MIREX	CL7(170)	CL8(195	CL9(206)	CL10(209)
PE02	A1-1	Cinco Bay	5.73	0.07	2.04	0.65	0.07	2.49	0.05	0.66	0.98	1.95	2.03	8.85	1.82	0.04	1.4
PE19	A2-1	Cinco Bayou	0.07	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.07	0.02	0.04	0.04
PE22	B3-1	U. Garnier Bayou	0.15	0.07	0.03	0.05	0.07	0.04	0.05	0.02	0.04	0.04	0.07	0.03	0.02	0.04	0.04
PE05	C1-2	L. Garnier Bayou	2.49	0.07	1.09	0.22	3	0.55	0.05	0.33	0.33	0.29	0.58	1.71	0.22	0.1	0.28
PE03	C2-1	L. Garnier Bayou	2.61	0.07	1.23	0.2	3.99	0.66	0.05	0.43	0.53	0.42	0.73	2.6	0.34	0.04	0.63
PE16	C3-1	L. Garnier Bayou	0.07	0.07	0.13	0.02	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.02
PE12	D1-1	Destin Harbor	0.05	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.08	0.02	0.04	0.01
PD98	D2-2	Destin Harbor	0.11	0.07	0.19	0.07	0.07	0.19	0.05	0.05	0.09	0.08	0.07	0.36	0.02	0.04	0.04
	D3-1	Destin Harbor															
PE13	E3-1	Boggy Bayou	2.57	0.07	1.88	0.25	0.07	1.1	0.05	0.63	0.04	0.66	0.07	0.73	0.11	0.04	0.38
PE23	F1-1	Toms Bayou	53.02	0.07	5.64	2.3	9.05	6.17	0.05	3.19	0.04	4.15	0.07	3.59	0.02	0.04	0.04
PE11	F2-1	Tom's Bayou	6.83	0.07	3.34	1.09	0.07	2.34	0.05	0.97	0.53	1.21	0.07	3.6	0.38	0.21	1.05
PD91	G1-1	Rocky Bayou	1.24	0.07	0.27	0.22	0.07	0.22	0.05	0.24	0.04	0.04	0.07	0.03	0.02	0.04	0.04
PD96	G2-1	Rocky Bayou	0.89	0.07	0.34	0.11	0.07	0.26	0.05	0.18	0.04	0.1	0.07	0.03	0.02	0.04	0.04
PD99	G3-1	Rocky Bayou	0.11	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.04
PE06	K2-1	La Grange Bayou	0.89	0.07	1.11	0.25	0.07	0.2	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.04
PE04	K3-1	La Grange Bayou	0.61	0.07	0.44	0.13	0.3	0.12	0.05	0.04	0.04	0.04	0.07	0.04	0.02	0.04	0.05
PE01	L1-2	western basin	0.37	0.07	0.86	0.1	0.46	0.24	0.05	0.09	0.13	0.06	0.07	0.59	0.02	0.04	0.04
PE21	L3-1	western basin	0.23	0.07	0.19	0.05	0.07	0.08	0.05	0.05	0.04	0.04	0.07	0.1	0.02	0.04	0.04
PE09	M1-1	central basin	0.11	0.07	0.15	0.03	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.02
PE07	N3-1	eastern basin	0.36	0.07	0.29	0.14	0.58	0.08	0.05	0.09	0.06	0.05	0.07	0.06	0.02	0.04	0.05
PO15PB	NA	Procedural Blank	0.06	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.04
PO19SSRM	BOS ID #940504-4	SRM 1941a	5.43	0.07	12.16	3.65	6.9	8.92	0.05	6.64	3.53	6.87	0.07	5.56	2.19	6.39	8.04
MDLs			0.11	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02	0.04	0.04

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	sum 20PCBs	X2	total PCBs	Pesticide Total :	DDT Total :	Indeno Total :	PCB Total (No MDL):	Pesticide Total (No MDL):	DDT Total (No MDL):	ndeno Total (No MDL)
PE02	A1-1	Cinco Bay	28.65	2	57.29	43.67	24.71	11.32	28.4	43.3	24.54	11.32
PE19	A2-1	Cinco Bayou	0.97	2	1.94	1.13	0.43	0.21	0.11	0.62	0.26	0.13
PE22	B3-1	U. Garnier Bayou	0.97	2	1.94	1.33	0.73	0.29	0.16	0.62	0.45	0.17
PE05	C1-2	L. Garnier Bayou	9.58	2	19.15	21.29	18.55	0.85	9.37	20.94	18.48	0.78
PE03	C2-1	L. Garnier Bayou	10.93	2	21.86	22.4	19.88	0.73	10.69	22.06	19.82	0.66
PE16	C3-1	L. Garnier Bayou	0.98	2	1.96	0.92	0.45	0.17	0.26	0.17	0.17	0
PE12	D1-1	Destin Harbor	0.92	2	1.85	0.83	0.36	0.17	0.16	0.08	0.08	0
PD98	D2-2	Destin Harbor	1.95	2	3.89	1.23	0.69	0.21	1.63	0.57	0.41	0.09
	D3-1	Destin Harbor										
PE13	E3-1	Boggy Bayou	9.68	2	19.35	13.36	11.73	0.74	9.28	12.86	11.56	0.66
PE23	F1-1	Toms Bayou	35.44	2	70.88	183.25	150.63	32.32	34.94	182.77	150.53	32.24
PE11	F2-1	Tom's Bayou	23.3	2	46.6	31.32	26.7	1.3	23.1	30.85	26.52	1.22
PD91	G1-1	Rocky Bayou	3.23	2	6.47	7.52	4.56	2.2	2.66	6.91	4.29	2.12
PD96	G2-1	Rocky Bayou	6.04	2	12.08	9.73	6.78	2.15	5.56	9.24	6.65	2.08
PD99	G3-1	Rocky Bayou	0.93	2	1.87	1.27	0.48	0.48	0.14	0.56	0.2	0.36
PE06	K2-1	La Grange Bayou	4.05	2	8.11	3.74	2.48	0.17	3.49	3.15	2.3	0
PE04	K3-1	La Grange Bayou	2.26	2	4.53	2.88	2.16	0.17	1.89	2.35	2.06	0
PE01	L1-2	western basin	5.48	2	10.96	4.4	3.61	0.22	5.12	3.95	3.55	0.1
PE21	L3-1	western basin	1.41	2	2.82	1.78	1.21	0.17	0.84	1.22	1.04	0
PE09	M1-1	central basin	1.3	2	2.61	1.3	0.83	0.17	0.68	0.45	0.45	0
PE07	N3-1	eastern basin	2.3	2	4.6	2.52	1.98	0.17	1.85	1.99	1.87	0
PO15PB	NA	Procedural Blank	1	2		0.85	0.38	0.17	0.15	0.06	0.06	0
PO19SSRM	BOS ID #940504-4	SRM 1941a	116.43	2		37.29	24.91	4.26	116.32	36.88	24.8	4.16

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID 1994	Sta. No.	Site Location	dieldrin/oc ug/goc	endrin/oc ug/goc	MSL Code	Ag GFAA	Al XRF	As XRF	Cd GFAA	Cr XRF	Cu XRF	Fe XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS
PE02	A1-1	Cinco Bay	0.071	0.001	779EDL-9	0.21	40600	15.9	0.65	51.9	49	17200	0.163	116	16	191	0.7317
PE19	A2-1	Cinco Bayou	1.122	0.29	779EDL-10	0.033	11000	1.3	0.01	8.8	2.2	622	0.007	9	2.4	2.6	0.0465
PE22	B3-1	U. Garnier Bayou	0.05	0.083	779EDL-11	0.033	12000	1.3	0.04	9	6.3	1320	0.013	20.1	2.5	2.5	0.1027
PE05	C1-2	L. Garnier Bayou	0.021	0.001	779EDL-12	0.342	52000	22.6	0.82	93.5	40.1	44000	0.212	1140	28.9	79.2	0.6097
PE03	C2-1	L. Garnier Bayou	0.016	0.001	779EDL-13	0.332	62400	24.2	0.57	108	39	42000	0.204	1530	24.6	74.8	0.6757
PE16	C3-1	L. Garnier Bayou	0.875	1.45	779EDL-14	0.033	11000	1.3	0.01	9.5	3.2	859	0.007	22.3	2.9	2.5	0.0765
PE12	D1-1	Destin Harbor	0.875	1.45	779EDL-15	0.033	9900	1.3	0.01	10.4	2.3	599	0.007	8.8	2.7	2.9	0.0195
PD98	D2-2	Destin Harbor	0.013	0.021	779EDL-16	0.033	14000	1.5	0.19	11	20.3	2240	0.04	10	2.7	9.5	0.1757
	D3-1	Destin Harbor			779EDL-18	0.033	22600	17	0.32	22	73.2	7090	0.07	48.3	9.8	28.3	0.1547
PE13	E3-1	Boggy Bayou	0.001	0.001	779EDL-19	0.87	73400	23.2	0.65	80	35.3	43500	0.208	849	31.2	68.8	0.6487
PE23	F1-1	Toms Bayou	0	0	779EDL-20	4.06	57800	14.4	2.45	88.1	55.7	30000	0.305	302	23	90.6	0.6417
PE11	F2-1	Tom's Bayou	0.025	0.001	779EDL-21	3.45	70000	20.2	0.78	90.8	100	35200	0.287	502	25.9	106	0.8547
PD91	G1-1	Rocky Bayou	0.001	0.001	779EDL-22	0.033	23000	4.35	0.29	28.7	7.6	11000	0.074	98.7	4.9	14	0.2447
PD96	G2-1	Rocky Bayou	0.007	0.001	779EDL-23	0.15	63400	23.8	0.68	98	28	40700	0.167	732	28.4	40.3	0.7227
PD99	G3-1	Rocky Bayou	0.175	0.29	779EDL-24	0.033	11000	1.3	0.01	11	2.8	1360	0.007	23.5	3.1	3.6	0.2377
PE06	K2-1	La Grange Bayou	0.001	0.001	779EDL-25	0.033	64000	13	0.52	120	13.5	44900	0.111	216	19.5	29.3	0.4787
PE04	K3-1	La Grange Bayou	0.001	0.002	779EDL-27	0.033	40500	9	0.14	49.2	5.6	21900	0.046	110	9.8	12.9	0.3097
PE01	L1-2	western basin	0.001	0.001	779EDL-26	0.16	63000	20.8	0.15	92	28	44500	0.137	1900	30.2	52.1	0.7757
PE21	L3-1	western basin	0.002	0.003	779EDL-29	0.033	30100	5.39	0.04	18.8	10.4	11500	0.029	224	8.1	12.2	0.2087
PE09	M1-1	central basin	0.002	0.004	779EDL-28	0.033	59900	20.2	0.05	53.8	7.9	39300	0.048	409	19.5	20.6	0.5407
PE07	N3-1	eastern basin	0.002	0.003	779EDL-17	0.033	63700	21.4	0.07	70.7	11.9	39400	0.061	131	18.9	18.8	0.4807

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID	Sta. No.	Site Location	Se	Si	Sn	Zn	% gravel	% sand	% silt	% clay	% fines	% TOC	MSL Code	AVS	SEM-Cd
1994			GFAA	XRF	ICP/MS	XRF								µmole/g	µg/g
PE02	A1-1	Cinco Bay	1.35	266000	3.1274	163.8	0	47.4	40.9	11.8	52.7	7.6	779EDL-9	37.5135822	0.49701219
PE19	A2-1	Cinco Bayou	0.183	450000	0.1374	5.56	0	98.9	0.3	0.8	1.1	0.02	779EDL-10	0.10403844	0.012
PE22	B3-1	U. Garnier Bayou	0.183	425000	0.2994	8.8	0.8	96.6	1.1	1.5	2.6	0.07	779EDL-11 r	0	0
PE05	C1-2	L. Garnier Bayou	2.4	205000	3.5474	127.5	0	6	66.1	27.9	94	5.25	779EDL-12	28.399242	0.68847999
PE03	C2-1	L. Garnier Bayou	2.19	187000	3.6574	128.7	0.3	6.2	62.3	31.3	93.6	5.32	779EDL-13	43.7039586	0.46713037
PE16	C3-1	L. Garnier Bayou	0.183	451000	0.184	5.4	0	98.7	0.3	0.9	1.2	0.001	779EDL-14	0.006	0.012
PE12	D1-1	Destin Harbor	0.183	467000	0.0934	8.6	0	99	0.1	0.9	1	0.004	779EDL-15	0.15962	0.012
PD98	D2-2	Destin Harbor	0.31	453000	0.9584	39	0	94.6	3.4	2	5.4	0.27	779EDL-16	6.14563721	0.14420135
	D3-1	Destin Harbor	0.42	359000	1.6074	154.5							779EDL-17	32.8609213	0.34146903
PE13	E3-1	Boggy Bayou	2.08	208000	3.9474	107.1	1.1	6.5	66.4	26.1	92.5	5.6	779EDL-18	56.4498026	0.48734703
PE23	F1-1	Toms Bayou	4.89	169000	5.1674	132.3	0	5.8	68.1	26.1	94.2	12.72	779EDL-19	70.4323521	0.79850721
PE11	F2-1	Tom's Bayou	2.71	193000	4.7874	130.8	0	13.2	63.8	22.9	86.7	7.7	779EDL-20	110	0.53734938
PD91	G1-1	Rocky Bayou	1.26	337000	1.2374	26.9	0	76.5	19.4	4.1	23.5	5.2	779EDL-21 r	90.2161761	0.6679283
PD96	G2-1	Rocky Bayou	2.62	173000	3.2874	84.4	0	2	63.5	34.6	98.1	7.48	779EDL-22	74.7870387	0.47397426
PD99	G3-1	Rocky Bayou	0.183	441000	0.9424	21.8	0	99.2	0.4	0.4	0.8	0.02	779EDL-23	2.21861879	0.012
PE06	K2-1	La Grange Bayou	1.46	225000	2.4774	80.6	0	7.7	55.4	36.8	92.2	6.51	779EDL-24	10.0052446	0.29146387
PE04	K3-1	La Grange Bayou	0.73	350000	1.3574	35.8	0.3	66.3	22.8	10.1	32.9	2.42	779EDL-25	9.64944881	0.08238125
PE01	L1-2	western basin	1.68	177000	3.1974	98.9	0	19.5	52.4	28.1	80.5	4.36	779EDL-26	6.25617086	0.1126173
PE21	L3-1	western basin	0.183	413000	0.7694	25.5	0	85.9	8.8	5.2	14	1.77	779EDL-27	7.14201249	0.04292124
PE09	M1-1	central basin	0.52	297000	1.6974	54.4	0	78.2	13.2	8.5	21.7	1.62	779EDL-29	8.68040944	0.043529
PE07	N3-1	eastern basin	0.52	298000	1.7574	52.7	0	68.3	18.1	13.6	31.7	1.85	779EDL-28	2.70196833	0.041236

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID	Sta. No.	Site Location	SEM-Cd	SEM-Cu	SEM-Cu	SEM-Hg	SEM-Hg
1994			µmole/g	µg/g	µmole/g	µg/g	µmole/g
PE02	A1-1	Cinco Bay	0.00442182	6.7602147	0.10639305	0.00014408	7.18E-07
PE19	A2-1	Cinco Bayou	0.0001	0.27342741	0.00430323	0.00014408	7.18E-07
PE22	B3-1	U. Garnier Bay	0	0	0	0	0
PE05	C1-2	L. Garnier Bay	0.00612527	22.1808466	0.34908477	0.00321225	1.60E-05
PE03	C2-1	L. Garnier Bay	0.00415596	15.3623242	0.24177407	0.02291044	0.00011422
PE16	C3-1	L. Garnier Bay	0.0001	0.28566499	0.00449583	0.00060825	3.03E-06
PE12	D1-1	Destin Harbor	0.0001	1.33342339	0.02098557	0.00038747	1.93E-06
PD98	D2-2	Destin Harbor	0.00128293	12.9608499	0.20397938	0.00675231	3.37E-05
	D3-1	Destin Harbor	0.00303798	23.568283	0.37092041	0.00129637	6.46E-06
PE13	E3-1	Boggy Bayou	0.00433583	10.0626899	0.1583678	0.0029069	1.45E-05
PE23	F1-1	Toms Bayou	0.00710416	0.65952477	0.01037968	0.00014408	7.18E-07
PE11	F2-1	Tom's Bayou	0.00478069	15.9883751	0.25162693	0.00097312	4.85E-06
PD91	G1-1	Rocky Bayou	0.00594242	8.32394994	0.1310033	0.0005586	2.78E-06
PD96	G2-1	Rocky Bayou	0.00421685	4.36093175	0.06863286	0.00289692	1.44E-05
PD99	G3-1	Rocky Bayou	0.0001	0.01713002	0.00026959	0.00014408	7.18E-07
PE06	K2-1	La Grange Bayo	0.00259309	0.72855304	0.01146605	0.00577489	2.88E-05
PE04	K3-1	La Grange Bayo	0.00073293	1.40852437	0.02216752	0.00014408	7.18E-07
PE01	L1-2	western basin	0.00100193	7.93231074	0.12483964	0.01110954	5.54E-05
PE21	L3-1	western basin	0.00038186	2.5454102	0.04005997	0.00179503	8.95E-06
PE09	M1-1	central basin	0.00038727	3.46287923	0.0544992	0.00926947	4.62E-05
PE07	N3-1	eastern basin	0.00036687	1.39625289	0.02197439	0.00437983	2.18E-05

Appendix B2. Chemistry and toxicity data from Choctawhatchee Bay, 1994.

Battelle ID	Sta. No.	Site Location	SEM-Ni	SEM-Ni	SEM-Pb	SEM-Pb	SEM-Zn	SEM-Zn	Sum 5SEM	Sum 5SEM/AVS	
1994			µg/g	µmole/g	µg/g	µmole/g	µg/g	µmole/g	umole/g	umole/g	umole/g
PE02	A1-1	Cinco Bay	0.55705497	0.00948825	91.8252399	0.4431934	97.594929	1.49296204	2.0565	0.05481904	2.0016
PE19	A2-1	Cinco Bayou	0.03865132	0.00065834	1.25701263	0.00606696	1.0630723	0.01626239	0.0274	0.26327692	-0.2359
PE22	B3-1	U. Garnier Bayou	0	0	0	0	0	0	0	0	0
PE05	C1-2	L. Garnier Bayou	2.89069972	0.04923692	51.8849622	0.25042214	69.747804	1.06696962	1.7218	0.06062974	1.6612
PE03	C2-1	L. Garnier Bayou	2.65592688	0.04523807	49.381244	0.23833797	31.860996	0.48739477	1.0169	0.02326793	0.9936
PE16	C3-1	L. Garnier Bayou	0.05748627	0.00097916	0.52840752	0.00255035	0.7568896	0.01157855	0.0197	3.28398074	-3.2643
PE12	D1-1	Destin Harbor	0.08299636	0.00141367	0.67603813	0.00326289	2.6383431	0.04036015	0.0661	0.41424811	-0.3481
PD98	D2-2	Destin Harbor	0.29053794	0.0049487	7.9644046	0.0384401	37.186701	0.56886494	0.8175	0.13302381	0.6845
	D3-1	Destin Harbor	0.90552751	0.01542374	28.4784263	0.13745078	140	2.0704889	2.5973	0.07903984	2.5183
PE13	E3-1	Boggy Bayou	1.71444962	0.029202	34.1830743	0.16498419	45.127547	0.69034032	1.0472	0.01855153	1.0287
PE23	F1-1	Toms Bayou	0.34096841	0.00580767	24.1689982	0.11665137	57.04505	0.87264876	1.0126	0.0143768	0.9982
PE11	F2-1	Tom's Bayou	1.05286301	0.01793328	63.5924036	0.30692796	53.989758	0.82591032	1.4072	0.01279254	1.3944
PD91	G1-1	Rocky Bayou	0.69691571	0.01187048	43.8807009	0.21178967	55.517404	0.84927954	1.20988541	0.01358467	1.19630074
PD96	G2-1	Rocky Bayou	1.19930967	0.02042769	19.3523764	0.09340401	27.298456	0.41759915	0.6043	0.00808002	0.5962
PD99	G3-1	Rocky Bayou	0.01543302	0.00026287	0.7012136	0.0033844	0.4451153	0.00680917	0.0108	0.00487963	0.0059
PE06	K2-1	La Grange Bayou	0.42007911	0.00715515	4.74463301	0.02289991	29.473104	0.4508659	0.495	0.04947207	0.4455
PE04	K3-1	La Grange Bayou	0.8251356	0.01405443	4.6820474	0.02259784	12.896908	0.19729092	0.2568	0.02661744	0.2302
PE01	L1-2	western basin	3.95634341	0.0673879	22.7338762	0.10972478	35.323863	0.54036811	0.8433	0.13479849	0.7085
PE21	L3-1	western basin	36.3825829	0.61969993	7.21579394	0.03482694	8.8970771	0.13610337	0.8311	0.11636385	0.7147
PE09	M1-1	central basin	1.61126322	0.02744444	10.269278	0.04956454	17.89222	0.2737069	0.4056	0.04672618	0.3589
PE07	N3-1	eastern basin	1.60178633	0.02728302	8.07653284	0.03898129	18.981566	0.29037121	0.379	0.14025952	0.2387

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

MSL Code	Station location	Station Number	% Amph surv.	Amph Surv % ctl.	Signif.	Microtox EC50 mg wet wt.	Refer. station 22	Microtox % ref.	Signif.	% urch fert.@100%	Signif.	% urch fert.@50%	Signif.	% urch fert.@25%
		controls	93			12.34				98.2		98.8		99.2
782-TOX 1	St. Andrew Bay	41	92	99	ns	3.35	12.34	27.15	Sig.	98.60	ns	99.40	ns	99.80
782-TOX 2	St. Andrew Bay	42	94	101	ns	0.89	12.34	7.21	Sig.	99.60	ns	99.80	ns	98.40
782-TOX 3	St. Andrew Bay	43	84	90	ns	1.66	12.34	13.45	Sig.	99.60	ns	99.60	ns	99.40
782-TOX 4	St. Andrew Bay	44	91	98	ns	0.31	12.34	2.51	Sig.	93.80	ns	99.20	ns	99.20
782-TOX 5	St. Andrew Bay	45	90	97	ns	0.68	12.34	5.51	Sig.	99.40	ns	99.40	ns	98.60
	St. Andrew Bay	46	88	95	ns	0.2	12.34	1.62	Sig.	88.60	ns	98.00	ns	98.60
	St. Andrew Bay	47	86	92	ns	0.74	12.34	6.00	Sig.	98.60	ns	99.40	ns	98.80
782-TOX 6	St. Andrew Bay	48	95	102	ns	1.32	12.34	10.70	Sig.	99.60	ns	99.80	ns	98.80
782-TOX 7	St. Andrew Bay	49	96	103	ns	0.42	12.34	3.40	Sig.	99.20	ns	99.00	ns	99.00
782-TOX 8	St. Andrew Bay	50	89	96	ns	0.18	12.34	1.46	Sig.	99.40	ns	99.20	ns	99.20
782-TOX 9	St. Andrew Bay	51	85	103	ns	0.48	12.34	3.89	Sig.	99.60	ns	99.40	ns	99.20
	St. Andrew Bay	52	89	96	ns	2.2	12.34	17.83	Sig.	99.60	ns	99.40	ns	99.80
782-TOX 10	St. Andrew Bay	53	96	103	ns	0.15	12.34	1.22	Sig.	98.80	ns	99.40	ns	99.40
782-TOX 11	St. Andrew Bay	54	84	90	ns	0.2	12.34	1.62	Sig.	99.00	ns	99.40	ns	98.20
782-TOX 12	St. Andrew Bay	55	93	100	ns	0.68	12.34	5.51	Sig.	98.80	ns	99.00	ns	99.40
782-TOX 13	St. Andrew Bay	56	84	90	ns	0.14	12.34	1.13	Sig.	14.40	**	82.80	*	95.20
782-TOX 14	St. Andrew Bay	57	93	100	ns	0.23	12.34	1.86	Sig.	98.40	ns	98.80	ns	99.40
782-TOX 15	St. Andrew Bay	58	94	101	ns	0.14	12.34	1.13	Sig.	19.80	**	87.20	ns	98.40
782-TOX 16	St. Andrew Bay	59	87	94	ns	0.5	12.34	4.05	Sig.	83.20	*	99.20	ns	99.40
782-TOX 17	St. Andrew Bay	60	83	89	ns	0.23	12.34	1.86	Sig.	99.40	ns	99.60	ns	99.80
782-TOX 18	St. Andrew Bay	61	88	95	ns	0.22	12.34	1.78	Sig.	99.60	ns	99.60	ns	98.80
782-TOX 19	St. Andrew Bay	62	85	103	ns	0.99	12.34	8.02	Sig.	99.80	ns	99.60	ns	99.20
782-TOX 20	St. Andrew Bay	63	94	101	ns	0.8	12.34	6.48	Sig.	99.00	ns	98.20	ns	99.20
	St. Andrew Bay	64	96	103	ns	0.51	12.34	4.13	Sig.	99.40	ns	99.40	ns	98.40
782-TOX 21	St. Andrew Bay	65	89	96	ns	0.66	12.34	5.35	Sig.	99.40	ns	99.60	ns	99.40
782-TOX 22	St. Andrew Bay	66	89	96	ns	0.22	12.34	1.78	Sig.	33.60	**	96.00	ns	99.40
	St. Andrew Bay	67	94	101	ns	7.29	12.34	59.08	Sig.	98.80	ns	99.40	ns	98.60
	St. Andrew Bay	68	92	99	ns	0.73	12.34	5.92	Sig.	98.60	ns	98.80	ns	99.20
	St. Andrew Bay	69	88	95	ns	0.23	12.34	1.86	Sig.	99.40	ns	98.80	ns	98.40
MDL	St. Andrew Bay	70	99	106	ns	0.35	12.34	2.84	Sig.	99.40	ns	99.20	ns	98.40
	St. Andrew Bay	71	92	99	ns	0.62	12.34	5.02	Sig.	98.00	ns	99.40	ns	99.6
782-TOX 15														
782-TOX 15														
	St. Andrew Bay	61												
	St. Andrew Bay	61R												
		AVE.												

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

MSL Code	Station Number	Signif.	% urchdevp@100%	Signif.	% urchdevp@50%	signif.	%urchdevp@25%	signif.	Sample I.D.	Ag,ug/g GFAA	Al,ug/g XRF	As,ug/g XRF	Cd,ug/g GFAA	Cr,ug/g XRF	Cu,ug/g XRF	Fe,ug/g XRF
	controls		96.6	ns	86.4	ns	86.0	ns								
782-TOX 1	41	ns	97.8	ns	87.4	ns	90.0	ns	00-22	0.008	12000	1.3	0.017	12	4.7	2400
782-TOX 2	42	ns	99.2	ns	90.0	ns	85.0	ns	00-23							
782-TOX 3	43	ns	96.6	ns	88.6	ns	91.6	ns	00-28							
782-TOX 4	44	ns	97.6	ns	98.2	ns	96.0	ns	00-27							
782-TOX 5	45	ns	99.2	ns	98.4	ns	98.6	ns	00-26	0.11	59000	13	0.22	97	19	32000
	46	ns	98.8	ns	99.2	ns	98.6	ns								
	47	ns	99.2	ns	98.6	ns	99.0	ns								
782-TOX 6	48	ns	97.6	ns	98.8	ns	98.8	ns	00-30	0.011	12000	2.1	0.029	10	4.7	4400
782-TOX 7	49	ns	98.2	ns	99.2	ns	98.2	ns	00-31	0.030	19000	4.4	0.041	21	6.5	6500
782-TOX 8	50	ns	6.4	**	98.4	ns	99.0	ns	00-32	0.11	44000	20	0.21	61	20	23000
782-TOX 9	51	ns	99.2	ns	99.0	ns	98.2	ns	00-02	0.019	12000	1.4	0.029	10	2.5	2500
	52	ns	97.4	ns	98.6	ns	97.2	ns								
782-TOX 10	53	ns	97.8	ns	98.4	ns	98.0	ns	00-16	1.6	48000	30	1.7	84	350	30000
782-TOX 11	54	ns	99.6	ns	98.2	ns	98.8	ns	00-17	0.59	21000	13	0.67	33	150	12000
782-TOX 12	55	ns	0.0	**	98.0	ns	98.6	ns	00-03	2.1	59000	16	1.0	74	63	27000
782-TOX 13	56	ns	0.2	**	0.0	**	98.4	ns	00-04	1.9	51000	20	1.1	69	110	27000
782-TOX 14	57	ns	0.0	**	99.2	ns	99.0	ns	00-05	2.5	60000	20	1.12	77	96	30000
782-TOX 15	58	ns	0.2	**	0.0	**	98.2	ns	00-06	1.9	67000	24	1.24	100	140	32000
782-TOX 16	59	ns	0.0	**	98.8	ns	98.2	ns	00-07	0.33	23000	5.7	0.26	46	53	8900
782-TOX 17	60	ns	74.2	ns	97.2	ns	99.2	ns	00-08	1.0	38000	12	0.87	51	160	15000
782-TOX 18	61	ns	98.8	ns	98.8	ns	98.2	ns	00-09 ave	0.645	25000	8.2	0.74	35.15	31.95	9700
782-TOX 19	62	ns	98.2	ns	99.4	ns	98.8	ns	00-10	0.060	10000	1.3	0.081	9.0	5.7	2100
782-TOX 20	63	ns	99.4	ns	98.8	ns	98.6	ns	00-11	0.96	39000	15	0.90	50	53	16000
	64	ns	97.0	ns	98.6	ns	98.4	ns	00-14	0.045	19000	5.6	0.080	21	5.0	6600
782-TOX 21	65	ns	99.4	ns	98.2	ns	98.2	ns	00-13	0.16	42000	10	0.20	62	15	17000
782-TOX 22	66	ns	36.0	**	99.0	ns	97.6	ns	00-12	0.55	63000	20	0.52	5.0	35	27000
	67	ns	96.0	ns	96.6	ns	94.8	ns								
	68	ns	88.0	ns	99.2	ns	96.8	ns								
	69	ns	98.4	ns	98.4	ns	97.6	ns								
MDL	70	ns	97.8	ns	95.0	ns	95.4	ns	00-18	0.11	50000	11	0.22	56	12	25000
	71	ns	86.0	ns	86.4	ns	97.6	ns	00-19	0.007	9900	1.3	0.017	8.7	2.1	3100
782-TOX 15										0.01	5400.00	1.30	0.01	11.0	2.30	20.00
782-TOX 15																
	61								00-09 R1	0.86	26000	9.2	0.89	36	32	10000
	61R								00-09 R2	0.43	24000	7.2	0.59	34	32	9400
	AVE.								ave	0.65	25000.00	8.20	0.74	35.15	31.95	9700.00

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	Hg,ug/g CVAA	Mn,ug/g XRF	Ni,ug/g XRF	Pb,ug/g XRF	Sb,ug/g ICP/MS	Se,ug/g GFAA		Si,ug/g XRF	Sn,ug/g ICP/MS	Zn,ug/g XRF	MSL Code	Sponsor ID	AVS µmole/g
controls													
41	0.012	31	3.5	2.6	0.071	0.15	U	440000	0.35	6.3	782TOX*1	00-22	0.146339474
42													
43													
44													
45	0.12	180	27	36	0.51	1.3		230000	2.7	82	782TOX*2	00-26	3.143570281
46													
47													
48	0.020	66	4.9	7.3	0.15	0.15	U	400000	0.51	15	782TOX*3	00-30	0.13576619
49	0.033	79	6.9	7.4	0.21	0.17		360000	0.81	18	782TOX*4	00-31	3.005709829
50	0.10	280	21	25	0.40	0.93		220000	2.1	63	782TOX*5	00-32	1.506374985
51	0.020	50	4.5	6.8	0.13	0.15	U	420000	0.53	12	782TOX*6 ave	00-02R ave	0.948582904
52													
53	1.3	130	25	320	1.1	1.3		210000	19	480	782TOX*7	00-16	29.74485158
54	0.51	55	9.2	96	0.54	0.33		350000	7.6	180	782TOX*8	00-17	3.912578603
55	0.33	120	21	84	0.81	1.5		280000	6.9	240	782TOX*9	00-03	3.235691091
56	0.41	120	19	94	0.80	1.4		260000	7.6	310	782TOX*10	00-4	11.03398336
57	0.45	130	21	110	1.0	1.5		260000	8.8	310	782TOX*11	00-5	7.407787974
58	0.51	150	27	110	1.0	1.9		220000	8.7	370	782TOX*12	00-6	21.82112956
59	0.088	61	11	33	0.22	0.15	U	410000	1.4	190	782TOX*13	00-7	2.809585862
60	0.49	68	12	120	0.72	0.75		340000	6.1	230	782TOX*14	00-8	8.045293711
61	0.216	60.8	7.45	37.25	0.41	0.555	#DIV/0!	350000	3.04465	115	782TOX*15	00-9	6.229896057
62	0.044	20.8	2.2	7.0	0.10	0.15	U	390000	0.39	21	782TOX*16	00-10	0.552155522
63	0.54	110	14	53	0.77	1.0		290000	4.7	170	782TOX*17	00-11	2.554487182
64	0.047	83	5.7	6.6	0.22	0.17		360000	0.79	28	782TOX*18	00-14	1.677563213
65	0.11	260	15	22	0.41	0.68		290000	2.1	53	782TOX*19	00-13	2.580121115
66	0.24	400	24	48	0.74	1.3		200000	3.9	130	782TOX*20	00-12	6.786758358
67													
68													
69													
70	0.17	210	15	25	0.38	0.76		280000	2.1	23	782TOX*21	00-18	4.8105311
71	0.0070	37	2.2	2.6	0.40	0.15	U	410000	0.15	6.9	782TOX*22	00-19	0.578764363
	0.003	10	2.7	2.9	0.021	0.15		2000	0.024	3	MDL		0.11
61	0.28	59	9.3	36	0.47	0.67		350000	3.7	120	782TOX*6 R1	00-02R	0.999079825
61R	0.15	62	5.6	38	0.35	0.44		350000	2.4	110	782TOX*6 R2	00-02R	0.898085983
AVE.	0.22	60.80	7.45	37.25	0.41	0.56	#DIV/0!	350000	3.04	115	ave.	ave	0.948582904

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	SEM-Cd µg/g	SEM-Cd µmole/g	SEM-Cu µg/g	SEM-Cu µmole/g	SEM-Hg µg/g	SEM-Hg µmole/g	SEM-Ni µg/g	SEM-Ni µmole/g	SEM-Pb µg/g	SEM-Pb µmole/g	SEM-Zn µg/g
controls											
41	0.005544442	4.93278E-05	0.51756852	0.008145554	0.001467995	7.32E-06	0.180769248	0.00307902	1.523804867	0.007354626	2.12501271
42											
43											
44											
45	0.100704406	0.000895947	4.478080864	0.070476564	0.00014	0.00000067	1.677854729	0.028578687	20.6050889	0.099450209	41.65141471
46											
47											
48	0.017323255	0.000154121	1.334318243	0.020999658	0.0006571	3.28E-06	0.663778468	0.011306055	4.272221475	0.020619825	5.957743706
49	0.059129596	0.000526064	3.615334141	0.056898554	0.002225821	1.10964E-05	2.424249326	0.041291932	5.995708294	0.028938213	9.619752974
50	0.180048321	0.001601853	9.727843731	0.15309795	0.00536523	2.67472E-05	6.780830876	0.115497034	17.4711912	0.084324491	25.58714455
51	0.021095014	0.000187678	1.782877891	0.028059142	0.001076738	5.36786E-06	0.621313721	0.010582758	4.213531683	0.020336559	6.402610261
52											
53	1.139211713	0.010135336	200	3.11167847	0.00607007	3.02611E-05	19.59255	0.333717425	260	1.249224814	310
54	0.380736736	0.003387338	86.72478164	1.364884823	0.007029311	3.50432E-05	1.520376106	0.025896374	84.34747054	0.407102035	140
55	0.693404616	0.00616908	25.92012133	0.407933921	0.001402791	6.99E-06	1.775115148	0.030235312	37.82360481	0.182555166	170
56	0.915217353	0.008142503	61.79456705	0.972530171	0.002416913	1.2049E-05	1.825027001	0.031085454	58.33260555	0.281541607	220
57	0.830684685	0.007390433	54.53988612	0.858355148	0.0038	0.000019	1.859900532	0.03167945	57.07263944	0.275460396	230
58	1.008452948	0.008972001	79.95739145	1.258378839	0.003350289	1.67022E-05	3.180955838	0.054180818	66.70447769	0.321948345	270
59	0.216660052	0.001927581	12.12984135	0.190900871	0.000549948	2.74E-06	0.814348695	0.013870698	12.09323497	0.058367851	62.76139394
60	0.461590567	0.004106678	56.62023105	0.891095862	0.002974091	1.48267E-05	1.040815575	0.01772808	46.62206788	0.22502084	150
61	0.370262717	0.003294152	22.849469287	0.359607638	0.002946830	0.000014691	1.352495750	0.023036889	26.347155312	0.127164223	89.439119842
62	0.069322607	0.000616749	3.640985957	0.057302266	0.000771669	3.84699E-06	0.215979823	0.003678757	4.312861828	0.020815975	13.32715389
63	0.636198441	0.005660128	28.75974433	0.452624242	0.001979565	9.86871E-06	1.760455816	0.029985621	30.06848407	0.14512517	110
64	0.039077686	0.000347666	2.720289264	0.042812233	0.001422786	7.09E-06	1.157688318	0.019718759	5.393158092	0.026030012	8.729211192
65	0.134866316	0.001199878	7.882882577	0.124061734	0.006666654	3.32352E-05	2.442759164	0.041607208	14.90593867	0.071943331	26.98685887
66	0.389751444	0.00346754	21.37332521	0.336375908	0.004304257	2.1458E-05	4.128769221	0.070324804	31.27479928	0.150947436	68.08732757
67											
68											
69											
70	0.182484394	0.001623527	6.51507916	0.102535083	0.004417741	2.20237E-05	1.926846806	0.032819738	17.66578579	0.085263699	24.59042977
71	0.010561669	9.3965E-05	0.441739295	0.006952145	0.000664147	3.31E-06	0.229411779	0.003907542	1.533419407	0.00740103	1.957825396
	0.011	0.000097	0.016	0.00025	0.00014	0.00000067	0.011	0.000097	0.0033	0.000016	0.006480962
61	0.022877142	0.000203533	1.677659409	0.026403201	0.000629417	3.14E-06	0.682460702	0.011624267	4.224833735	0.020391108	6.536385475
61R	0.019312886	0.000171823	1.888096374	0.029715083	0.00152406	7.60E-06	0.56016674	0.009541249	4.20222963	0.02028201	6.268835046
AVE.	0.021095014	0.000187678	1.782877891	0.028059142	0.001076738	5.36786E-06	0.621313721	0.010582758	4.213531683	0.020336559	6.402610261

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	SEM-Cd µg/g	SEM-Cd µmole/g	SEM-Cu µg/g	SEM-Cu µmole/g	SEM-Hg µg/g	SEM-Hg µmole/g	SEM-Ni µg/g	SEM-Ni µmole/g	SEM-Pb µg/g	SEM-Pb µmole/g	SEM-Zn µg/g
controls											
41	0.005544442	4.93278E-05	0.51756852	0.008145554	0.001467995	7.32E-06	0.180769248	0.00307902	1.523804867	0.007354626	2.12501271
42											
43											
44											
45	0.100704406	0.000895947	4.478080864	0.070476564	0.00014	0.00000067	1.677854729	0.028578687	20.6050889	0.099450209	41.65141471
46											
47											
48	0.017323255	0.000154121	1.334318243	0.020999658	0.0006571	3.28E-06	0.663778468	0.011306055	4.272221475	0.020619825	5.957743706
49	0.059129596	0.000526064	3.615334141	0.056898554	0.002225821	1.10964E-05	2.424249326	0.041291932	5.995708294	0.028938213	9.619752974
50	0.180048321	0.001601853	9.727843731	0.15309795	0.00536523	2.67472E-05	6.780830876	0.115497034	17.4711912	0.084324491	25.58714455
51	0.021095014	0.000187678	1.782877891	0.028059142	0.001076738	5.36786E-06	0.621313721	0.010582758	4.213531683	0.020336559	6.402610261
52											
53	1.139211713	0.010135336	200	3.11167847	0.00607007	3.02611E-05	19.59255	0.333717425	260	1.249224814	310
54	0.380736736	0.003387338	86.72478164	1.364884823	0.007029311	3.50432E-05	1.520376106	0.025896374	84.34747054	0.407102035	140
55	0.693404616	0.00616908	25.92012133	0.407933921	0.001402791	6.99E-06	1.775115148	0.030235312	37.82360481	0.182555166	170
56	0.915217353	0.008142503	61.79456705	0.972530171	0.002416913	1.2049E-05	1.825027001	0.031085454	58.33260555	0.281541607	220
57	0.830684685	0.007390433	54.53988612	0.858355148	0.0038	0.000019	1.859900532	0.03167945	57.07263944	0.275460396	230
58	1.008452948	0.008972001	79.95739145	1.258378839	0.003350289	1.67022E-05	3.180955838	0.054180818	66.70447769	0.321948345	270
59	0.216660052	0.001927581	12.12984135	0.190900871	0.000549948	2.74E-06	0.814348695	0.013870698	12.09323497	0.058367851	62.76139394
60	0.461590567	0.004106678	56.62023105	0.891095862	0.002974091	1.48267E-05	1.040815575	0.01772808	46.62206788	0.22502084	150
61	0.370262717	0.003294152	22.849469287	0.359607638	0.002946830	0.000014691	1.352495750	0.023036889	26.347155312	0.127164223	89.439119842
62	0.069322607	0.000616749	3.640985957	0.057302266	0.000771669	3.84699E-06	0.215979823	0.003678757	4.312861828	0.020815975	13.32715389
63	0.636198441	0.005660128	28.75974433	0.452624242	0.001979565	9.86871E-06	1.760455816	0.029985621	30.06848407	0.14512517	110
64	0.039077686	0.000347666	2.720289264	0.042812233	0.001422786	7.09E-06	1.157688318	0.019718759	5.393158092	0.026030012	8.729211192
65	0.134866316	0.001199878	7.882882577	0.124061734	0.006666654	3.32352E-05	2.442759164	0.041607208	14.90593867	0.071943331	26.98685887
66	0.389751444	0.00346754	21.37332521	0.336375908	0.004304257	2.1458E-05	4.128769221	0.070324804	31.27479928	0.150947436	68.08732757
67											
68											
69											
70	0.182484394	0.001623527	6.51507916	0.102535083	0.004417741	2.20237E-05	1.926846806	0.032819738	17.66578579	0.085263699	24.59042977
71	0.010561669	9.3965E-05	0.441739295	0.006952145	0.000664147	3.31E-06	0.229411779	0.003907542	1.533419407	0.00740103	1.957825396
	0.011	0.000097	0.016	0.00025	0.00014	0.00000067	0.011	0.000097	0.0033	0.000016	0.006480962
61	0.022877142	0.000203533	1.677659409	0.026403201	0.000629417	3.14E-06	0.682460702	0.011624267	4.224833735	0.020391108	6.536385475
61R	0.019312886	0.000171823	1.888096374	0.029715083	0.00152406	7.60E-06	0.56016674	0.009541249	4.20222963	0.02028201	6.268835046
AVE.	0.021095014	0.000187678	1.782877891	0.028059142	0.001076738	5.36786E-06	0.621313721	0.010582758	4.213531683	0.020336559	6.402610261

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	SEM-Zn µmole/g	total SEM	tSEM/tAVS	tSEM-tAVS	Battelle ID	Station Number	Sample Size (g)	Percent Dry Weight	NAPHTHALENE ng/g dry wt.	2-METHYLNAPHTHALENE ng/g dry wt.
controls										
41	0.032507461	0.051135988	0.349434002	-0.095203486	OO22	41	37.362	73.935	1.288	0.740
42					OO23	42	13.105	26.21	24.092	12.930
43					OO28	43	12.112	24.211	34.469	11.167
44					OO27	44	13.884	27.751	15.846	6.663
45	0.637164062	0.836565469	0.266119537	-2.307004812	OO26	45	12.057	24.112	19.898	8.745
46					OO24	46	11.074	22.122	17.978	8.017
47					OO25	47	21.201	42.376	14.238	3.521
48	0.091138805	0.144218464	1.062256105	0.008452274	OO30	48	32.476	63.499	6.517	2.480
49	0.147158528	0.274813291	0.091430413	-2.730896538	OO31	49	25.819	51.59	17.675	5.865
50	0.391420293	0.745941621	0.495189862	-0.760433364	OO32	50	12.27	24.497	40.017	18.311
51	0.097944168	0.157110305	0.16562633	-0.791472599	OO02	51	32.806	64.071	7.557	3.109
52					OO29	52	34.84	69.617	4.962	1.703
53	4.726033339	9.430789383	0.317056192	-20.3140622	OO16	53	13.577	27.077	138.572	54.082
54	2.196240102	3.997510671	1.021707441	0.084932068	OO17	54	23.573	46.587	52.626	20.917
55	2.635100054	3.261993533	1.008128848	0.026302441	OO03	55	17.323	34.603	138.681	23.023
56	3.398613289	4.691913024	0.425223863	-6.342070332	OO04	56	14.631	28.924	260.050	43.540
57	3.554211445	4.727096873	0.638125293	-2.680691101	OO05	57	13.896	27.743	190.244	36.794
58	4.195948518	5.839428522	0.267604319	-15.98170104	OO06	58	12.068	23.976	190.448	51.208
59	0.960094752	1.225161753	0.436064891	-1.58442411	OO07	59	25.944	51.684	128.095	24.645
60	2.325714532	3.463665991	0.430520764	-4.581627719	OO08	60	22.427	44.799	266.712	58.844
61	1.368198254	1.881301155	0.301979542	-4.348594901	OO09	61	20.656	41.272	175.731	43.106
62	0.203872631	0.286286378	0.518488661	-0.265869145	OO10	62	37.738	75.328	84.271	12.876
63	1.659256856	2.292652018	0.897499911	-0.261835164	OO11	63	16.956	33.609	306.094	58.236
64	0.133535432	0.222444101	0.132599534	-1.455119112	OO14	64	28.288	56.333	32.331	8.925
65	0.412832475	0.651644625	0.25256358	-1.92847649	OO13	65	16.704	33.392	46.591	18.195
66	1.041568419	1.602684107	0.236148692	-5.184074251	OO12	66	11.37	22.667	93.142	42.447
67					OO21	67	25.966	51.809	32.836	16.242
68					OO20	68	14.293	28.312	46.785	19.983
69					OO15	69	30.552	60.713	44.219	8.288
70	0.376173012	0.598415058	0.12439688	-4.212116042	OO18	70	15.043	30.071	16.967	5.502
71	0.029949907	0.048304588	0.08346158	-0.530459775	OO19	71	35.816	70.16	1.260	0.215
	9.91428E-05									
					OU12PB-R	NA	21.1568125	NA	2.637	0.215
61	0.099990599				OU16SSRM	NA	4.946	97.8	986.941	373.940
61R	0.095897737						*		B	ND
AVE.	0.097944168				OU17PB	NA	21.15453333	NA	0.755	0.215
	OU21SSRM	NA	4.912	97.8	1025.352	381.013	199.118	361.737	162.470	340.634
	Battelle ID	Station Number	Sample Size (g)	Percent Dry Weight	NAPHTHALENE	2-METHYLNAPHTHA	1-METHYLNAPHTHALENE	C1-NAPHTHALENES	2,6-DIMETHYLNAPHTHALENE	C2-NAPHTHALENES

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	1-METHYLNAPHTHALENE ng/g dry wt.	C1-NAPHTHALENES ng/g dry wt.	2,6-DIMETHYLNAPHTHALENE ng/g dry wt.	C2-NAPHTHALENES ng/g dry wt.	1,6,7-TRIMETHYLNAPHTHALENE ng/g dry wt.	C3-NAPHTHALENES ng/g dry wt.	C4-NAPHTHALENES ng/g dry wt.	BIPHENYL ng/g dry wt.
controls								
41	0.568	0.788	0.215	0.215	0.215	0.215	0.215	0.198
42	7.403	13.092	6.339	19.127	6.197	16.910	0.215	10.051
43	6.375	10.638	7.634	15.428	5.910	18.949	0.215	24.462
44	4.442	6.809	3.767	9.193	3.397	10.312	0.215	7.890
45	5.636	9.411	5.046	11.895	0.215	0.215	0.215	9.766
46	4.564	8.194	5.295	12.225	3.805	15.998	22.521	10.302
47	2.072	3.451	2.903	6.961	0.215	0.215	0.215	3.163
48	1.417	2.539	2.023	4.269	1.513	5.493	0.215	5.879
49	3.287	5.733	5.174	8.758	3.595	10.282	12.510	13.718
50	11.203	17.692	11.690	22.812	8.584	21.631	22.870	27.031
51	1.805	3.094	2.443	6.158	1.881	0.215	0.215	7.346
52	0.941	1.613	1.108	2.008	1.026	2.757	0.215	3.271
53	25.716	48.803	35.828	62.299	19.223	66.656	94.832	48.731
54	10.308	19.426	14.412	24.051	8.063	26.861	30.531	20.179
55	11.783	21.598	15.378	26.514	9.536	32.948	48.434	26.427
56	24.905	43.408	29.038	51.871	17.735	61.687	70.770	52.129
57	20.113	36.499	28.085	45.739	18.217	60.878	83.277	57.089
58	29.079	49.997	43.920	76.267	25.365	90.843	113.584	103.738
59	13.462	23.325	17.813	28.306	11.622	32.620	35.642	53.060
60	34.650	56.920	47.910	74.485	39.894	118.304	141.745	48.217
61	22.685	40.979	33.089	51.874	15.119	45.849	44.248	56.188
62	6.807	12.120	8.915	15.533	5.966	15.228	10.085	16.639
63	30.526	55.099	44.760	72.173	24.196	71.537	67.034	75.946
64	4.370	8.266	6.164	12.579	4.093	10.908	0.215	25.045
65	9.431	17.193	11.741	25.850	8.942	24.985	0.215	70.428
66	21.654	39.904	39.964	65.291	20.406	61.025	53.271	127.174
67	8.504	15.350	17.132	26.306	10.387	27.179	19.559	88.010
68	10.297	18.076	17.385	36.104	10.097	36.986	36.361	120.143
69	4.018	7.721	3.486	7.820	0.215	0.215	0.215	21.727
70	2.997	5.215	4.912	12.908	2.419	0.215	0.215	25.786
71	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.198
	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.198
61	185.568	348.854	180.998	323.238	112.627	268.751	158.181	106.447
61R	ND	ND	ND	ND	ND	ND	ND	ND
AVE.	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.198
	75.023	265.737	152.877	114.293	92.315	42.738	127.058	101.025
	1,6,7-TRIMETHYLNAPHTHALENE	C3-NAPHTHALENES	C4-NAPHTHALENES	BIPHENYL	ACENAPHTHYLENE	ACENAPHTHENE	DIBENZOFURAN	FLUORENE

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	ACENAPHTHYLENE ng/g dry wt.	ACENAPHTHENE ng/g dry wt.	DIBENZOFURAN ng/g dry wt.	FLUORENE ng/g dry wt.	C1-FLUORENES ng/g dry wt.	C2-FLUORENES ng/g dry wt.	C3-FLUORENES ng/g dry wt.	PHENANTHRENE ng/g dry wt.	1-METHYLPHENANTHRENE ng/g dry wt.
controls									
41	0.118	0.285	0.232	0.232	0.232	0.232	0.232	0.185	0.185
42	5.248	0.285	4.519	3.750	0.232	0.232	0.232	10.845	2.230
43	18.855	2.291	5.423	4.905	0.232	0.232	0.232	30.965	5.727
44	5.123	0.285	2.968	0.232	0.232	0.232	0.232	8.707	2.006
45	6.026	0.285	2.925	1.723	0.232	0.232	0.232	11.143	3.275
46	12.741	1.212	4.111	2.529	4.278	9.222	33.990	14.795	4.508
47	4.869	1.090	2.631	2.554	0.232	0.232	0.232	16.113	2.260
48	2.523	0.285	0.948	0.352	0.232	0.232	0.232	3.973	0.865
49	3.971	0.285	2.414	1.913	2.514	0.232	0.232	11.500	2.921
50	9.087	1.252	5.514	6.152	0.232	0.232	0.232	22.683	5.581
51	6.680	0.285	1.431	1.784	0.232	0.232	0.232	14.695	2.967
52	2.128	0.285	0.677	0.652	0.232	0.232	0.232	6.098	1.312
53	263.803	23.924	26.145	33.837	46.832	83.242	153.967	198.767	56.121
54	121.654	10.718	12.516	20.764	20.064	24.804	81.764	95.088	26.228
55	26.948	15.203	17.486	17.330	24.818	40.917	102.245	75.191	18.433
56	60.081	21.543	26.786	27.650	37.347	54.879	111.003	152.199	32.693
57	64.256	18.351	23.653	25.144	30.703	52.816	139.202	116.628	31.316
58	97.287	22.872	31.459	33.222	38.914	76.758	172.410	163.939	44.463
59	29.688	10.716	14.379	15.429	13.778	27.471	64.639	74.074	16.758
60	105.705	55.047	49.286	53.265	45.555	106.470	239.938	215.148	57.955
61	69.499	35.158	43.193	50.584	26.492	40.371	95.952	144.940	27.853
62	10.698	5.154	6.788	6.999	6.056	10.998	29.208	38.812	7.010
63	45.734	21.031	26.580	28.415	29.899	55.690	128.201	135.744	28.616
64	5.521	0.849	3.116	3.653	4.095	0.232	0.232	16.285	3.091
65	17.604	2.264	6.079	6.407	10.843	0.232	0.232	31.389	6.976
66	37.191	8.967	17.108	26.609	20.176	43.853	116.187	87.103	21.686
67	6.026	0.285	3.407	3.082	6.003	0.232	0.232	22.598	5.467
68	42.927	1.867	6.700	8.819	19.302	27.857	0.232	34.396	12.217
69	4.877	0.748	3.966	1.417	0.232	0.232	0.232	15.675	3.170
70	3.976	0.285	2.369	0.988	0.232	0.232	0.232	7.410	2.183
71	0.118	0.285	0.232	0.232	0.232	0.232	0.232	0.185	0.185
	0.118	0.285	0.232	0.232	0.232	0.232	0.232	0.185	0.185
61	88.381	42.174	120.121	90.859	104.643	177.310	312.152	568.301	79.757
61R	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVE.	0.118	0.285	0.232	0.232	0.232	0.232	0.232	0.185	0.185
	81.121	180.503	314.808	399.715	72.345	115.582	397.949	393.399	272.470
	C1-FLUORENES	C2-FLUORENES	C3-FLUORENES	PHENANTHRENE	1-METHYLPHENA	ANTHRACENE	C1-PHENANTHRENE/ANTHRACENES	C2-PHENANTHRENE/ANTHRACENES	C3-PHENANTHRENE/ANTHRACENES

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	ANTHRACENE ng/g dry wt.	1-PHENANTHRENE/ANTHRACENE ng/g dry wt.	C2-PHENANTHRENE/ANTHRACENES ng/g dry wt.	NANTHRENE/ANTHRA ng/g dry wt.	ng/g dry wt.	DIBENZOTHIOPHENE ng/g dry wt.	C1-DIBENZOTHIOPHENES ng/g dry wt.	C2-DIBENZOTHIOPHENES ng/g dry wt.	C3-DIBENZOTHIOPHENES ng/g dry wt.	FLUORANTHENE ng/g dry wt.
controls										
41	0.165	0.185	0.185	0.185	0.185	0.232	0.232	0.232	0.232	2.094
42	6.190	13.413	0.185	0.185	0.185	1.635	3.461	13.408	20.264	31.688
43	26.178	23.234	36.214	34.531	50.658	2.205	4.565	21.704	43.338	77.003
44	6.864	10.551	16.787	15.676	14.882	1.395	2.727	11.751	20.880	34.943
45	8.663	12.926	0.185	0.185	0.185	1.605	4.050	13.534	21.625	41.142
46	13.052	17.165	26.690	26.707	40.518	2.330	3.618	13.764	22.658	81.338
47	6.508	8.884	0.185	0.185	0.185	1.304	1.731	7.302	8.821	45.192
48	3.455	4.339	10.225	10.738	14.225	0.464	0.907	5.899	10.962	13.819
49	5.423	12.309	21.144	22.867	22.740	1.431	2.486	11.727	24.075	29.093
50	21.166	19.032	33.273	36.569	57.746	2.422	4.843	21.361	47.905	66.127
51	11.327	16.068	20.638	20.780	34.153	0.864	2.402	10.614	17.986	150.564
52	5.755	5.120	7.767	7.609	8.127	0.399	0.840	4.070	8.346	21.313
53	266.721	195.512	214.228	197.896	311.176	18.119	25.367	77.734	120.795	1079.074
54	145.608	100.101	90.891	79.116	137.924	7.276	8.955	27.980	44.298	470.688
55	33.840	66.953	96.300	117.424	111.696	9.881	12.022	63.500	96.340	194.514
56	50.699	108.301	133.434	161.536	197.972	18.811	24.029	85.099	143.121	333.837
57	72.730	114.159	146.294	144.350	144.992	17.544	25.659	101.422	164.063	335.118
58	146.963	161.942	200.543	244.790	230.748	21.216	34.627	145.963	258.022	487.170
59	36.985	59.150	70.133	69.896	74.313	9.263	14.219	49.547	86.742	182.563
60	161.824	219.733	325.092	283.635	258.975	29.001	44.998	166.946	252.228	1056.181
61	166.577	113.326	120.303	147.751	701.727	20.860	19.148	68.192	133.825	347.587
62	18.950	29.685	33.981	29.864	29.835	4.288	6.411	25.226	36.250	81.103
63	61.789	100.989	138.815	149.394	170.017	18.894	24.046	94.749	165.629	281.968
64	10.922	14.138	20.965	32.419	41.317	1.737	3.588	18.504	39.464	31.674
65	22.269	31.910	45.904	69.625	79.938	3.069	7.879	54.660	95.750	72.091
66	147.896	90.908	116.693	177.618	305.491	12.678	23.853	107.238	228.467	271.551
67	8.634	24.140	38.599	43.460	96.394	4.416	6.781	35.097	74.069	37.866
68	49.781	47.879	91.768	120.243	157.687	6.386	17.363	82.418	205.281	125.295
69	4.627	17.595	25.439	28.525	28.196	1.761	3.193	17.044	32.175	35.422
70	4.259	12.315	27.958	35.029	37.028	1.364	5.050	32.453	61.156	28.283
71	0.165	0.185	0.185	0.185	0.185	0.232	0.232	0.232	0.232	1.322
	0.165	0.185	0.185	0.185	0.185	0.232	0.232	0.232	0.232	0.111
61	143.873	433.349	400.166	295.574	181.777	76.552	95.515	208.208	249.960	1078.318
61R	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVE.	0.165	0.185	0.185	0.185	0.185	0.232	0.232	0.232	0.232	0.111
	317.758	76.046	86.563	188.775	212.949	790.543	703.077	492.064	437.619	654.371
	C4-PHENANTHRENE/ANTHRACENES	DIBENZOTHIOPHENE	C1-DIBENZOTHIOPHENES	C2-DIBENZOTHIOPHE	C3-DIBENZOTHIOPHENES	FLUORANTHENE	PYRENE	C1-FLUORANTHENES/PYRE	BENZ(A)ANTHRACENE	CHRYSENE

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	PYRENE ng/g dry wt.	C1-FLUORANTHENES/PYRENES ng/g dry wt.	BENZ(A)ANTHRACENE ng/g dry wt.	CHRYSENE ng/g dry wt.	C1-CHRYSENES ng/g dry wt.	C2-CHRYSENES ng/g dry wt.	C3-CHRYSENES ng/g dry wt.
controls							
41	2.031	1.960	0.919	1.011	1.021	0.137	0.137
42	27.927	26.340	13.205	17.105	15.023	18.721	13.479
43	66.440	71.831	54.253	87.797	59.882	54.131	34.514
44	27.638	22.892	15.807	22.261	17.375	19.039	12.279
45	36.297	29.196	14.251	18.930	15.014	18.218	12.622
46	78.085	60.827	29.949	46.484	26.170	26.503	18.193
47	40.941	32.138	17.978	28.801	16.086	16.633	12.275
48	11.797	11.148	8.102	9.265	8.997	11.784	8.424
49	24.063	21.835	14.539	18.199	15.317	20.356	15.102
50	53.030	39.302	28.016	42.301	26.174	25.494	22.054
51	88.583	48.138	24.592	68.295	21.331	19.890	13.335
52	17.376	14.128	11.224	14.408	8.747	8.204	4.921
53	1074.102	805.462	751.563	1072.590	713.462	691.698	381.550
54	458.811	398.887	361.002	569.836	259.421	215.214	140.321
55	216.339	116.534	90.913	115.785	76.519	87.909	83.895
56	337.837	182.224	158.924	211.388	141.719	141.119	80.803
57	350.211	227.563	217.357	304.965	199.340	195.121	93.333
58	562.124	414.440	361.246	463.954	331.020	288.907	166.630
59	224.606	155.972	148.297	132.280	107.780	98.263	57.885
60	1128.693	700.612	639.786	694.478	326.516	208.243	120.152
61	436.337	358.746	295.766	369.219	269.483	210.277	152.192
62	79.094	52.730	40.713	43.502	37.169	40.564	27.453
63	326.962	213.398	167.446	189.913	144.607	157.243	100.374
64	28.350	28.640	18.935	20.985	19.626	30.219	25.012
65	62.107	88.441	65.601	99.665	73.376	81.283	61.861
66	240.803	247.664	178.672	250.970	194.449	243.410	160.287
67	36.430	31.565	20.815	23.787	26.810	37.121	26.450
68	114.622	135.646	150.006	173.369	181.424	203.389	117.769
69	29.441	28.206	19.090	20.229	17.147	20.300	15.915
70	25.465	23.752	13.183	17.498	15.421	21.506	0.137
71	1.342	0.138	0.673	0.902	0.137	0.137	0.137
	0.138	0.138	0.153	0.137	0.137	0.137	0.137
61	873.406	587.943	521.336	760.594	494.533	404.359	278.462
61R	ND	ND	ND	ND	ND	ND	ND
AVE.	0.138	0.138	0.153	0.137	0.137	0.137	0.137
	430.664	360.212	240.546	206.183	1181.396	409.900	619.493
	C1-CHRYSENES	C2-CHRYSENES	C3-CHRYSENES	C4-CHRYSENES	BENZO(B)FLUORANTHENE	BENZO(K)FLUORANTHENE	BENZO(E)PYRENE

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	C4-CHRYSENES ng/g dry wt.	BENZO(B)FLUORANTHENE ng/g dry wt.	BENZO(K)FLUORANTHENE ng/g dry wt.	BENZO(E)PYRENE ng/g dry wt.	BENZO(A)PYRENE ng/g dry wt.	PERYLENE ng/g dry wt.	)(1,2,3-C,D)P ng/g dry wt.	DIBENZ(A,H)ANTHRACENE ng/g dry wt.	BENZO(G,H,I)PERYLENE ng/g dry wt.
controls									
41	0.137	2.888	0.849	1.352	1.245	5.198	1.572	0.325	1.622
42	17.362	45.379	14.830	23.402	19.677	20.463	20.971	5.780	22.328
43	35.633	154.370	58.013	75.562	79.010	32.386	72.754	20.269	62.381
44	17.863	58.331	18.959	29.384	25.998	17.633	25.064	6.905	25.548
45	0.137	48.376	16.113	24.846	21.122	24.485	21.853	5.535	23.254
46	32.977	86.590	27.281	41.769	23.349	39.676	35.184	8.953	31.444
47	14.685	49.615	16.710	23.685	20.731	16.233	19.997	5.089	19.364
48	7.998	28.195	9.843	13.181	13.002	7.081	12.219	3.066	11.765
49	14.737	41.498	14.604	19.675	19.214	10.371	17.828	4.438	17.056
50	20.845	66.589	24.369	35.271	35.356	16.544	32.870	7.525	30.312
51	12.719	68.425	23.278	29.511	23.339	9.326	23.659	5.488	20.215
52	5.047	24.401	8.784	12.000	12.983	5.413	11.911	2.805	11.398
53	592.840	2517.991	805.818	1081.070	1176.201	278.227	1103.179	361.182	1097.058
54	155.567	1192.460	360.272	528.626	576.926	138.766	486.027	185.445	391.427
55	61.658	194.609	62.415	102.119	95.833	114.869	95.927	22.953	90.970
56	107.406	332.353	104.112	170.212	167.513	122.071	165.628	39.294	160.536
57	129.055	453.517	149.477	228.184	241.046	104.547	224.676	53.789	200.278
58	161.419	747.469	245.021	359.890	381.408	139.343	335.427	83.747	275.112
59	47.987	227.330	75.912	109.343	115.627	51.540	92.562	22.376	85.612
60	109.794	948.890	352.084	479.342	509.153	200.936	404.984	105.777	325.900
61	97.259	593.706	207.197	273.089	292.203	85.000	209.108	58.971	165.696
62	14.713	71.788	22.534	35.026	33.575	13.534	26.376	6.607	24.446
63	87.751	326.471	109.069	169.564	163.047	71.972	154.950	39.195	143.217
64	15.532	43.716	14.269	19.188	20.359	10.593	18.858	4.679	17.495
65	46.881	161.424	53.980	80.485	85.190	31.164	70.268	19.030	62.904
66	98.995	328.286	113.339	169.576	178.070	63.709	143.270	38.085	128.749
67	22.778	48.116	15.967	23.181	23.137	11.583	20.937	5.550	19.093
68	132.695	383.307	136.848	185.381	221.947	73.096	197.628	57.744	167.687
69	14.783	40.655	12.813	19.714	18.432	6.878	16.528	4.114	16.635
70	0.137	44.975	14.473	24.888	22.363	22.985	23.388	5.669	29.394
71	0.137	2.776	0.917	1.640	1.157	3.581	1.759	0.424	1.804
	0.137	0.145	0.204	0.151	0.151	25.748	0.254	0.280	7.957
61	230.049	1313.582	430.247	700.937	537.707	414.304	664.911	164.335	594.667
61R	ND	ND	ND	ND	ND	B	ND	ND	B
AVE.	0.137	0.145	0.204	0.151	0.151	0.151	0.254	0.280	0.201
	453.870	413.456	640.786	153.617	571.725				
	BENZO(A)PYRENE	PERYLENE	INDENO(1,2,3-C,D)PYRENE	DIBENZ(A,H)ANTHRACENE	BENZO(G,H,I)PERYLENE				

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	Sample ID	sum 8LPAH ng/g dry wt.	sum 16HPAH ng/g dry wt.	sum 24tPAH ng/g dry wt.	sumTPH-all ng/g dry wt.	Percent Moisture	TCMX hide	CL2(08) ng/g dry wt.	HEXACHLOROBENZENE ng/g dry wt.	LINDANE ng/g dry wt.
controls										
41	OO22	3.624	21.872	25.497	237.919	26.065	2.95059151	0.093793609	0.047592447	0.047592447
42	OO23	72.544	285.768	358.313	766.535	73.79	12.75192675	0.093793609	0.047592447	0.047592447
43	OO28	111.162	908.014	1019.176	1757.968	75.789	8.854607001	0.093793609	0.047592447	0.047592447
44	OO27	47.412	326.279	373.691	807.980	72.249	9.462690867	0.093793609	0.047592447	0.047592447
45	OO26	55.617	321.009	376.627	756.467	75.888	12.57103757	0.093793609	0.047592447	0.047592447
46	OO24	63.913	564.986	628.899	1287.557	77.878	9.210222142	0.093793609	0.047592447	0.047592447
47	OO25	32.070	331.772	363.842	733.424	57.624	6.487854346	0.093793609	0.047592447	0.047592447
48	OO30	22.636	149.981	172.617	532.888	36.501	3.993410519	0.093793609	0.047592447	0.047592447
49	OO31	53.570	252.335	305.905	799.707	48.41	4.734226732	0.093793609	0.047592447	0.047592447
50	OO32	127.174	493.890	621.065	1319.302	75.503	10.15631622	0.093793609	0.047592447	0.047592447
51	OO02	31.105	566.049	597.153	1102.881	35.929	4.353624337	0.093793609	0.047592447	0.047592447
52	OO29	15.423	167.835	183.258	534.549	30.383	3.471469575	0.093793609	0.047592447	0.047592447
53	OO16	609.880	12953.499	13563.379	18756.996	72.923	9.859983796	0.093793609	0.047592447	0.047592447
54	OO17	258.877	6007.972	6266.850	8442.816	53.413	4.593263479	0.093793609	0.047592447	0.047592447
55	OO03	266.977	1542.039	1809.017	3399.610	65.397	5.578652658	0.093793609	0.047592447	0.047592447
56	OO04	509.022	2566.946	3075.967	5339.294	71.076	8.107648144	0.093793609	0.047592447	0.047592447
57	OO05	433.148	3108.983	3542.130	6002.794	72.257	9.795264824	0.093793609	0.047592447	0.047592447
58	OO06	563.918	4830.499	5394.417	8994.913	76.024	6.088415645	0.093793609	0.047592447	0.047592447
59	OO07	289.100	1611.294	1900.394	3336.703	48.316	4.065757015	0.093793609	0.047592447	0.047592447
60	OO08	656.979	7334.396	7991.375	12170.002	55.201	4.749052481	0.093793609	0.047592447	0.047592447
61	OO09	450.574	3723.833	4174.407	7281.453	58.728	7.058627033	0.093793609	0.047592447	0.047592447
62	OO10	151.326	550.070	701.396	1485.579	24.672	3.060390058	0.093793609	0.047592447	0.047592447
63	OO11	606.523	2398.338	3004.861	5391.981	66.391	7.473991507	0.093793609	0.047592447	0.047592447
64	OO14	87.298	283.053	370.352	1021.156	43.667	4.639917986	0.093793609	0.047592447	0.047592447
65	OO13	185.197	930.949	1116.145	2267.350	66.608	7.572617337	0.093793609	0.047592447	0.047592447
66	OO12	390.944	2388.375	2779.318	5533.883	77.333	15.21776605	0.093793609	0.047592447	0.047592447
67	OO21	179.422	326.242	505.665	1406.613	48.191	4.691057537	0.093793609	0.047592447	0.047592447
68	OO20	269.484	2092.143	2361.627	4383.194	71.688	12.04813545	0.093793609	0.047592447	0.047592447
69	OO15	87.576	264.841	352.416	968.328	39.287	4.41705944	0.093793609	0.047592447	0.047592447
70	OO18	62.844	287.404	350.248	995.173	69.929	9.378315496	0.093793609	0.047592447	0.047592447
71	OO19	2.718	19.063	21.782	380.925	29.84	3.639658253	0.093793609	0.047592447	0.047592447
	OU12PB					NA	21.47974795	0.093793609	0.103465491	0.047592447
	OU16SSRM					0	27.08997429	0.093793609	120.9086957	0.047592447
	OU17PB					NA	9.454096521	0.093793609	0.047592447	0.047592447
61	OU21SSRM					0	24.4489349	0.093793609	216.4669578	0.047592447
61R										
AVE.										

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	CL3(18) ng/g dry wt.	CL3(28) ng/g dry wt.	HEPTACHLOR ng/g dry wt.	CL4(52) ng/g dry wt.	ALDRIN ng/g dry wt.	CL4(44) ng/g dry wt.	CL5(103) ng/g dry wt.	HEPTACHLOREPOXIDE ng/g dry wt.	CL4(66) ng/g dry wt.	2,4-DDE ng/g dry wt.	CL5(101) ng/g dry wt.	CIS-CHLORDANE ng/g dry wt.
controls												
41	0.045781151	0.054233864	0.046883679	0.051871305	0.045676149	0.049515551	2.260398266	0.030477016	0.015122	0.01399818	0.01565762	0.037176811
42	0.167417016	0.054233864	0.046883679	0.127127051	0.045676149	0.258908813	7.453491034	0.030477016	0.186646	0.309958031	0.217932087	0.046883679
43	0.257017834	0.054233864	0.046883679	0.296647952	0.045676149	0.041817302	5.904474901	0.030477016	0.173217	0.144484808	0.462846764	0.076122853
44	0.29696053	0.054233864	0.046883679	0.144987035	0.045676149	0.255617978	6.558628637	0.030477016	0.121363	0.223638721	0.220685681	0.077931432
45	0.229907937	0.054233864	0.046883679	0.139918719	0.045676149	0.041817302	7.696276022	0.030477016	0.190761	0.720909016	0.298747615	0.044123746
46	0.165974354	0.054233864	0.046883679	0.073866715	0.045676149	0.364276684	8.595358497	0.030477016	0.496478	1.544789597	0.256817771	0.046883679
47	0.101551814	0.054233864	0.046883679	0.084099807	0.045676149	0.203858309	4.9607094	0.030477016	0.102731	0.203103627	0.204518655	0.057167115
48	0.163135854	0.054233864	0.046883679	0.023740608	0.045676149	0.041817302	2.697561276	0.030477016	0.065402	0.090867102	0.09850351	0.025742086
49	0.12180952	0.054233864	0.046883679	0.051871305	0.045676149	0.041817302	3.25554824	0.030477016	0.12363	0.122313025	0.198226113	0.00828847
50	0.248818256	0.054233864	0.046883679	0.051871305	0.045676149	0.041817302	7.103667482	0.030477016	0.150041	0.215077425	0.397799511	0.087775061
51	0.420258489	0.054233864	0.046883679	0.096506737	0.045676149	0.407029202	2.810095714	0.030477016	0.075261	0.132780589	0.223373773	0.214655856
52	0.076492537	0.054233864	0.046883679	0.051871305	0.045676149	0.041817302	2.401463835	0.030477016	0.022158	0.142192882	0.061394948	0.1163031
53	3.624953966	0.054233864	0.046883679	6.312292848	0.045676149	3.974810341	6.253590631	0.030477016	4.580762	3.864034765	10.96007955	14.55063711
54	1.202265304	0.054233864	0.046883679	2.009035761	0.045676149	1.416111653	3.609850252	0.030477016	1.430789	0.734569211	3.642345056	3.407881899
55	1.448478901	0.054233864	0.046883679	1.443976217	0.045676149	1.526179068	4.456560642	0.030477016	1.327888	0.82179761	2.680655776	0.988570109
56	1.220627435	0.054233864	0.046883679	2.986740483	0.045676149	1.494566332	5.353701046	0.030477016	1.010731	2.447747932	3.464766591	1.344063974
57	2.569012666	0.054233864	0.046883679	2.275259067	0.045676149	1.581102476	6.644142199	0.030477016	1.724813	2.76460852	3.538212435	1.427101324
58	3.051955585	0.054233864	0.046883679	2.723152138	0.045676149	2.329714949	7.645343056	0.030477016	2.438598	10.1182466	4.964285714	1.140536957
59	0.995374653	0.054233864	0.046883679	0.934050262	0.045676149	0.896584952	3.100794018	0.030477016	0.709451	0.237897009	1.60021585	0.342275671
60	2.484995764	0.054233864	0.046883679	2.800998796	0.045676149	2.449235297	3.783118562	0.030477016	2.668391	0.488384536	3.733847594	2.161813885
61	1.799331913	0.054233864	0.046883679	1.139378389	0.045676149	0.961367157	4.580412471	0.030477016	1.4253	0.33341402	2.948489543	1.367931836
62	0.347262706	0.054233864	0.046883679	0.329800201	0.045676149	0.295034183	2.029201336	0.030477016	0.315835	0.037468864	0.547750278	0.084980656
63	2.357749469	0.054233864	0.046883679	2.619367775	0.045676149	1.734666195	5.291696155	0.030477016	1.924628	0.784383109	5.905874027	0.660061335
64	0.492470305	0.054233864	0.046883679	0.370616516	0.045676149	0.277891686	3.027891686	0.030477016	0.238546	0.046486143	0.482678167	0.054227941
65	0.970965038	0.054233864	0.046883679	0.526400862	0.045676149	0.393019636	4.762631705	0.030477016	0.308908	0.161518199	1.483716475	0.211147031
66	2.567722076	0.054233864	0.046883679	2.209058927	0.045676149	0.601934916	7.907124011	0.030477016	1.644855	0.71292876	4.262445031	0.427616535
67	0.562042671	0.054233864	0.046883679	0.498883155	0.045676149	0.345451745	2.898559655	0.030477016	0.369637	0.049949935	1.149618732	0.179696526
68	0.975232631	0.054233864	0.046883679	0.895193451	0.045676149	0.760092353	5.542713216	0.030477016	0.748058	0.293780172	2.16217729	0.3227454
69	0.507691804	0.054233864	0.046883679	0.116391726	0.045676149	0.119272061	3.567982456	0.030477016	0.072303	0.151544907	0.27117701	0.105721393
70	0.361031709	0.054233864	0.046883679	0.247025194	0.045676149	0.319816526	6.222429037	0.030477016	0.269162	0.11613375	0.532473576	0.007977132
71	0.045781151	0.054233864	0.046883679	0.028813938	0.045676149	0.05036855	2.492628993	0.030477016	0.016724	0.035018381	0.022392227	0.046883679
	0.045781151	0.054233864	0.046883679	0.051871305	0.045676149	0.157585175	6.093261922	0.030477016	0.063973	0.035018381	0.068015461	0.046883679
	3.264386	5.630215543	1.813130314	4.68736405	0.045676149	6.36919122	16.574649	2.729879375	10.41685	0.035018381	10.69290093	2.042119834
	0.045781151	0.054233864	0.046883679	0.051871305	0.045676149	0.110756402	5.11280482	0.030477016	0.063973	0.035018381	0.068015461	0.046883679
61	2.901851483	5.905833167	1.116663349	3.783197292	0.045676149	5.956599642	14.44017519	2.433605415	5.301015	0.035018381	9.704957197	1.709735218
61R												
AVE.												

Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	TRANS-NONACHLOR ng/g dry wt.	CL5(112) ng/g dry wt.	DIELDRIN ng/g dry wt.	4,4-DDE ng/g dry wt.	CL4(77) ng/g dry wt.	2,4-DDD ng/g dry wt.	ENDRIN ng/g dry wt.	CL5(118) ng/g dry wt.	4,4-DDD ng/g dry wt.	2,4-DDT ng/g dry wt.	CL6(153) ng/g dry wt.	CL5(105) ng/g dry wt.	4,4-DDT ng/g dry wt.
controls													
41	0.045902254	0	0.020823296	0.27514587	0.063972859	0.142123013	0.057987708	0.030244634	0.13666292	0.06838297	0.031823778	0.015898507	0.158262406
42	0.080045784	0	0.150247997	3.27333079	0.063972859	0.843113316	0.057987708	0.467149943	1.510034338	0.06838297	0.564059519	0.215413964	0.183899275
43	0.034180978	0	0.176931968	2.882678336	0.063972859	3.044996697	0.057987708	0.726799868	2.377229194	0.06838297	1.055812417	0.316875826	3.421895641
44	0.038389513	0	0.127845001	3.589527514	0.063972859	1.240276577	0.057987708	0.407519447	2.091112071	0.228392394	0.586862576	0.155862864	1.99891962
45	0.046883679	0	0.240772995	4.370075475	0.063972859	0.823422078	0.057987708	0.397279589	1.842746952	0.06838297	0.565729452	0.245749357	0.496723895
46	0.202185299	0	0.201191981	6.134368792	0.063972859	1.806664259	0.057987708	0.442206971	3.010926494	0.06838297	4.443200289	1.602853531	6.131208236
47	0.046883679	0	0.083486628	6.321069761	0.063972859	1.602518749	0.057987708	0.180557521	7.673175794	0.313522947	0.202160275	0.497523702	17.50813641
48	0.012686291	0	0.064509176	0.732725705	0.063972859	0.383113684	0.057987708	0.228630373	0.54470994	0.06838297	0.328704274	0.094500554	0.046157162
49	0.030326504	0	0.106936752	0.84201557	0.063972859	0.821371858	0.057987708	0.330880359	1.007087804	0.06838297	0.498818699	0.08431775	1.01328479
50	0.097310513	0	0.212469438	1.317603912	0.063972859	1.299592502	0.057987708	0.650203749	1.46609617	0.06838297	0.913854931	0.25590872	0.352648737
51	0.083978541	0	0.246204963	0.809059318	0.063972859	1.146558556	0.057987708	0.239041639	1.079954886	0.06838297	1.923306712	0.707919283	0.168048528
52	0.008438576	0	0.078616533	0.358926521	0.063972859	0.408754305	0.057987708	0.127583238	0.376722158	0.06838297	0.210074627	0.106917336	0.061165327
53	8.649186124	0	5.045518156	66.39561314	0.063972859	36.02393754	0.057987708	19.12079252	43.68188533	0.06838297	24.01966561	6.581792738	2.913235619
54	2.181606075	0	1.446188436	15.46628738	0.063972859	11.61303186	0.057987708	5.962075256	14.15616387	0.67577313	5.652483774	3.068171213	0.915793493
55	0.548634763	0	0.479939964	17.43433585	0.063972859	2.876811176	0.057987708	5.412284246	6.124747446	0.06838297	3.993188247	2.257692086	0.276741904
56	0.619438179	0	0.981409336	23.20552252	0.063972859	6.079830497	0.057987708	6.779851001	9.409473037	0.06838297	5.78231153	3.787095892	0.564691409
57	0.626871042	0	0.791090961	19.55857801	0.063972859	4.779504893	0.057987708	6.376079447	9.339090386	0.06838297	5.728195164	2.871761658	0.578871618
58	0.652055022	0	1.689923765	22.71486576	0.063972859	7.0391117	0.057987708	10.58352668	19.18727212	1.143602917	8.638133908	4.066291018	2.45782234
59	0.155257478	0	0.305003084	6.802073697	0.063972859	2.701048412	0.057987708	3.077243293	5.897818378	0.06838297	2.571500154	1.275747764	0.156953438
60	1.077228341	0	0.640344228	28.04561466	0.063972859	16.73803897	0.057987708	6.847282294	17.80153601	0.750167209	5.354126722	3.163196148	5.438979801
61	0.747821456	0	1.581041828	13.24089853	0.063972859	4.204541053	0.057987708	4.791150271	13.11952943	0.06838297	4.288584431	2.338594113	0.555383424
62	0.054427898	0	0.125708835	1.753643542	0.063972859	0.956065504	0.057987708	0.776962213	2.732365255	0.06838297	0.755074461	0.343632413	0.323493561
63	0.199339467	0	0.653043171	25.4445624	0.063972859	8.398030196	0.057987708	8.700283086	18.85365014	0.06838297	9.317763623	3.47287096	0.475406936
64	0.110506222	0	0.058010464	1.161587952	0.063972859	0.7109375	0.057987708	0.758802319	1.713235294	0.06838297	0.768417704	0.343820701	0.109375
65	0.067528736	0	0.194085249	3.208213602	0.063972859	2.620150862	0.057987708	2.471264368	4.691810345	0.06838297	2.826688218	1.212164751	0.250778257
66	0.124890062	0	0.434828496	8.523658751	0.063972859	5.365171504	0.057987708	5.522427441	10.69199648	0.06838297	7.872031662	3.027616535	0.419876869
67	0.046883679	0	0.093660941	1.652468613	0.063972859	1.232380806	0.057987708	1.764230147	2.694215513	0.06838297	1.737849495	0.840791805	0.141954864
68	0.046883679	0	0.103827048	7.142517316	0.063972859	6.730707339	0.057987708	3.488280977	8.468690968	0.06838297	3.386482894	1.515357168	0.926257609
69	0.072401152	0	0.036396963	6.550602252	0.063972859	2.459217073	0.057987708	0.305282797	22.74718513	0.153377848	0.402035873	0.191018591	2.536789736
70	0.251346141	0	0.14478495	2.728578076	0.063972859	1.063551153	0.057987708	0.728112743	2.014957123	0.06838297	1.048859935	0.338030978	0.893571761
71	0.068321421	0	0.014937458	0.194159035	0.063972859	0.108498995	0.057987708	0.019488497	0.114753183	0.06838297	0.038334822	0.008599509	0.06838297
	0.046883679	0	0.035018381	0.035018381	0.063972859	0.106498928	0.057987708	0.035569645	0.136268164	0.06838297	0.034283362	0.048563721	0.06838297
	0.046883679	0	2.381253708	6.368004746	0.063972859	8.483290488	0.057987708	6.902313625	4.600158197	0.06838297	8.386592842	3.275459759	1.790587305
	0.046883679	0	0.035018381	0.035018381	0.063972859	0.106498928	0.057987708	0.035569645	0.039991428	0.06838297	0.034283362	0.048563721	0.06838297
61	0.046883679	0	1.964961179	5.932709536	0.063972859	10.3014135	0.057987708	6.434999005	3.776826598	0.06838297	7.002588095	4.132391001	0.86860442
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Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	CL6(138) ng/g dry wt.	CL5(126) ng/g dry wt.	CL6(166) ng/g dry wt.	CL7(187) ng/g dry wt.	CL6(128) ng/g dry wt	CL7(180) ng/g dry wt.	MIREX ng/g dry wt	CL7(170) ng/g dry wt.	CL8(195) ng/g dry wt.	CL9(206) ng/g dry wt.	CL10(209) ng/g dry wt.
controls											
41	0.041030994	0.048563721	3.550639687	0.026880676	0.0434	0.01228521	0.0684	0.011027247	0.005942	0.040426	0.004335956
42	0.591835177	0.048563721	12.95719191	0.335062953	0.1641	0.199618466	0.0684	0.117054559	0.057077	0.1209462	0.109576498
43	1.010898283	0.048563721	12.05242734	0.467140026	0.275	0.555399604	0.0684	0.304243725	0.132596	0.1386229	0.40596103
44	0.545736099	0.048563721	10.54271103	0.208225295	0.125	0.286949006	0.0684	0.099539038	0.066695	0.0675598	0.195692884
45	0.660860911	0.048563721	12.95206104	0.316745459	0.1961	0.208509579	0.0684	0.15036908	0.056316	0.064278	0.444472091
46	0.628318584	0.048563721	13.31406899	0.420444284	0.1525	0.210854253	0.0684	0.14999097	0.063392	0.0680874	0.348925411
47	0.322437621	0.048563721	7.9128343	0.240790529	0.0877	0.198575539	0.0684	0.144332814	0.062874	0.033206	0.098580256
48	0.329412489	0.048563721	5.193773864	0.136069713	0.0945	0.146169479	0.0684	0.043293509	0.031346	0.0264503	0.058443158
49	0.504938224	0.048563721	6.228126573	0.264688795	0.1314	0.316743483	0.0684	0.133816182	0.136334	0.3056664	0.2067857
50	0.782314588	0.048563721	12.08891606	0.47791361	0.2804	0.448410758	0.0684	0.245476773	0.108476	0.0572127	0.187123064
51	0.30210937	0.048563721	5.755867829	0.249771383	0.1466	0.164512589	0.0684	0.394440041	0.078217	0.0481924	0.25013717
52	0.196727899	0.048563721	4.253329506	0.079104478	0.051	0.090585534	0.0684	0.051349024	0.024713	0.0279277	0.17445465
53	36.2288429	0.048563721	13.66288576	11.21654268	6.3376	14.15901893	0.0684	8.747072255	4.445017	5.0877955	4.400235693
54	9.289483731	0.048563721	6.618122428	3.025664956	1.8974	4.568022738	0.0684	3.139057396	1.457048	1.6405209	1.368769355
55	6.415632396	0.048563721	8.075044738	1.437106737	1.3725	2.504185187	0.0684	1.525313167	0.422213	0.3525948	0.581019454
56	8.598933771	0.048563721	11.54316178	2.088989133	1.9649	3.666393275	0.0684	2.495249812	0.767617	0.4910122	1.054951815
57	8.287852619	0.048563721	13.78662925	2.405080599	1.9365	3.854058722	0.0684	2.078727691	0.825921	0.6373777	0.897380541
58	12.16050713	0.048563721	14.11725224	3.82424594	3.0834	5.752817368	0.0684	3.015081206	1.180892	1.8169539	1.299386808
59	3.545251311	0.048563721	6.938328708	1.146238051	0.9215	1.497032069	0.0684	0.952397471	0.310052	0.2379741	0.133749615
60	7.634726	0.048563721	6.664779061	2.780309448	1.9613	4.796762831	0.0684	3.081508896	1.168413	1.3145762	1.881749677
61	6.158549574	0.048563721	8.28718048	2.951684741	1.6511	3.98813904	0.0684	2.070826878	0.817777	0.4092273	0.782339272
62	0.850548519	0.048563721	4.303169219	0.240235307	0.2352	0.429090042	0.0684	0.194366421	0.094573	0.0570512	0.120091155
63	11.72464025	0.048563721	10.28373437	2.852441614	2.0538	5.621078084	0.0684	2.880219391	0.94468	0.6233192	0.396614768
64	0.937747455	0.048563721	5.828089649	0.451887726	0.2084	0.682656957	0.0684	0.25	0.120829	0.1202277	0.112980769
65	2.944264847	0.048563721	10.1272749	1.078603927	0.5626	1.687559866	0.0684	1.207136015	0.431573	0.4178041	0.356920498
66	8.928056288	0.048563721	17.22102023	3.344151275	1.4648	5.622515391	0.0684	2.095602463	0.94978	0.7913808	0.888566403
67	2.05106678	0.048563721	6.186898252	0.784641454	0.4521	0.99453131	0.0684	0.310444427	0.160441	0.1831241	0.055495648
68	4.247393829	0.048563721	12.44147485	2.41558805	1.0611	2.433289023	0.0684	0.817323165	0.717064	0.6056811	0.553347793
69	0.399286462	0.048563721	5.941051322	0.248985336	0.1405	0.285840534	0.0684	0.114231474	0.072172	0.0816313	0.193244305
70	0.968024995	0.048563721	10.89443595	0.406102506	0.2837	0.440204746	0.0684	0.160007977	0.082962	0.0396862	0.01721731
71	0.055813044	0.048563721	4.303048917	0.035179808	0.0189	0.018790485	0.0684	0.014099844	0.015356	0.040426	0.017980791
	0.142601822	0.048563721	16.19535079	0.026880676	0.0434	0.036882178	0.3524	0.064518226	0.023284	0.1029456	0.155647265
	9.856041131	0.048563721	35.21198339	6.515523037	3.1244	8.1908246	0.0684	9.986948784	3.279415	4.7609254	12.76666008
	0.038693473	0.048563721	7.877460466	0.026880676	0.0434	0.036882178	0.0684	0.032157059	0.023284	0.040426	0.038147852
61	8.357555246	0.048563721	34.27095361	5.449333068	2.6327	7.217997213	0.0684	6.502886721	2.950627	5.1919172	10.93509855
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Appendix B3. Chemistry and toxicity data from St. Andrew Bay.

Station Number	Total 23 PCB congs. ng/g dry wt.	tPCB 2X, ng/g	Pesticide Total : ng/g dry wt.	DDT Total : ng/g dry wt.	Indeno Total : ng/g dry wt.	PCB Total (No MDL): ng/g dry wt.	Pesticide Total (No MDL): ng/g dry wt.	DDT Total (No MDL) ng/g dry wt.	ng/g dry wt.
controls									
41	0.702	1.404	1.243	0.795	0.160	0.23	0.83	0.73	0.08
42	4.161	8.321	6.810	6.189	0.204	3.90	6.35	6.12	0.08
43	6.881	13.763	12.571	11.940	0.188	6.58	12.16	11.87	0.11
44	4.046	8.092	9.961	9.372	0.194	3.79	9.62	9.37	0.12
45	4.468	8.936	8.999	8.322	0.168	4.17	8.54	8.25	0.04
46	10.149	20.298	19.491	18.696	0.326	9.89	19.03	18.63	0.20
47	3.026	6.052	34.154	33.622	0.181	2.77	33.76	33.62	0.06
48	2.171	4.341	2.313	1.866	0.116	1.87	1.90	1.80	0.04
49	3.712	7.425	4.365	3.874	0.116	3.36	3.95	3.81	0.04
50	5.558	11.116	5.462	4.719	0.262	5.20	5.05	4.65	0.19
51	5.987	11.974	4.294	3.405	0.376	5.73	3.88	3.34	0.30
52	1.655	3.309	1.964	1.416	0.202	1.30	1.55	1.35	0.12
53	170.058	340.116	181.537	152.947	23.277	169.80	181.12	152.88	23.20
54	51.030	102.060	50.942	43.562	5.667	50.77	50.60	43.56	5.59
55	34.961	69.923	29.965	27.603	1.615	34.70	29.55	27.53	1.54
56	47.915	95.831	45.065	41.776	2.041	47.65	44.65	41.71	1.96
57	47.848	95.696	40.279	37.089	2.131	47.59	39.87	37.02	2.05
58	71.190	142.379	66.488	62.661	1.870	70.93	66.14	62.66	1.79
59	21.065	42.130	17.011	15.864	0.575	20.80	16.60	15.80	0.50
60	54.382	108.764	73.487	69.263	3.316	54.12	73.14	69.26	3.24
61	38.782	77.565	35.564	31.522	2.193	38.52	35.15	31.45	2.12
62	6.193	12.386	6.481	5.871	0.217	5.93	6.07	5.80	0.14
63	63.391	126.781	55.881	54.024	0.937	63.13	55.47	53.96	0.86
64	6.879	13.757	4.377	3.810	0.242	6.62	3.96	3.74	0.16
65	19.140	38.280	11.818	11.001	0.356	18.88	11.41	10.93	0.28
66	52.054	104.107	27.114	25.782	0.630	51.79	26.70	25.71	0.55
67	12.521	25.042	6.504	5.839	0.304	12.26	6.04	5.77	0.18
68	27.042	54.085	24.448	23.630	0.447	26.78	23.99	23.56	0.32
69	3.782	7.563	35.158	34.599	0.255	3.52	34.81	34.60	0.18
70	6.503	13.006	7.634	6.885	0.337	6.24	7.22	6.82	0.26
71	0.708	1.415	1.064	0.589	0.193	0.36	0.50	0.42	0.07
	1.362		1.263	0.450	0.171	0.62	0.59	0.14	0.00
	118.312		151.487	21.345	6.632	118.11	151.12	21.24	6.59
	0.999		0.827	0.353	0.171	0.15	0.04	0.04	0.00
61	100.568		244.941	20.983	5.307	100.36	244.57	20.88	5.26
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Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	%amph surv	amphsurv%ctl	signif.	Microtox EC50	Microtox % ctl	signif.	Mutatox	Mutatox score	UAN amphipod	UAN porewater
PE18	A2-1	Apalachicola Bay	86	89	ns	3.1	6.3	* *	S	5	17	45.34
PE15	B1-1	Apalachicola Bay	93	96	ns	2.8	5.7	* *	G	10	14	39.21
PE14	C2-1	Apalachicola Bay	96	99	ns	9.9	20.2	* *	N	1	8	42.86
PD93	C3-1	Apalachicola Bay	93	109	ns	4.3	2.4	* *	N	1	24	15.6
PD94	BC1-2	Bayou Chico Pensacola	93	101	ns	1.93	3.9	* *	G	10	142	299.55
PE08	BC2-2	Bayou Chico, Pensacola Bay	97	105	ns	40.53	82.9	* *	G	10	211	267.09
PD97	BC3-2	Bayou Chico Pensacola	94	102	ns	13.47	27.5	* *	G	10	68	71.69
PD92	BC4-2	Bayou Chico Pensacola	86	93	ns	0.62	1.3	* *	G	10	48	58.19
PE20	BC5-3	Bayou Chico Pensacola	68	74	* *	1.73	3.5	* *	G	10	57	68.17
PE17	BC6-2	Bayou Chico Pensacola	94	102	ns	0.81	1.7	* *	G	10	261	195.15
											ug/L	ug/L

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	Urchinfert@100%	Signif.	Urchdevp@100%	signif.	Client ID	%TOC	Sample Size (g)	Units	Percent Dry Weight	NAPHTHALENE	ERM
PE18	A2-1	Apalachicola Bay	56.4	* *	0	* *	A2-1	0.98	24.992	ng/g, dry wt.	66.468	2.14	2100
PE15	B1-1	Apalachicola Bay	89.8	ns	67.4	ns	B1-1	0.33	29.624	ng/g, dry wt.	68.798	1.34	2100
PE14	C2-1	Apalachicola Bay	86.6	ns	0	* *	C2-1	1.35	19.717	ng/g, dry wt.	50.805	3.07	2100
PD93	C3-1	Apalachicola Bay	39.6	* *	71.8	ns	C3-1	ND	23.858	ng/g, dry wt.	64.719	1.78	2100
PD94	BC1-2	Bayou Chico Pensacola	0.6	* *	0	* *	BC1-2	0.35	24.889	ng/g, dry wt.	67.179	19.95	2100
PE08	BC2-2	Bayou Chico, Pensacola Bay	0.2	* *	0.4	* *	BC2-2	6.45	4.332	ng/g, dry wt.	31.141	138.1	2100
PD97	BC3-2	Bayou Chico Pensacola	91.6	ns	0	* *	BC3-2	7.09	12.205	ng/g, dry wt.	34.96	262.98	2100
PD92	BC4-2	Bayou Chico Pensacola	0.4	* *	0	* *	BC4-2	0.94	16.085	ng/g, dry wt.	43.776	466.72	2100
PE20	BC5-3	Bayou Chico Pensacola	0.4	* *	0.6	* *	BC5-3	4.2	22.066	ng/g, dry wt.	55.921	233.17	2100
PE17	BC6-2	Bayou Chico Pensacola	0.4	* *	0	* *	BC6-2	5.91	7.777	ng/g, dry wt.	37.934	222.59	2100

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	Napth/ERM	2-METHYLNAPHTHALENE	ERM	2-metnap/ERM	1-METHYLNAPHTHALENE	C1-NAPHTHALENES	2,6-DIMETHYLNAPHTHALENE
PE18	A2-1	Apalachicola Bay	0.001019048	0.21	670	0.000313433	0.21	0.21	0.21
PE15	B1-1	Apalachicola Bay	0.000638095	`	670	0.000313433	0.21	0.21	0.21
PE14	C2-1	Apalachicola Bay	0.001461905	0.21	670	0.000313433	0.21	0.21	0.21
PD93	C3-1	Apalachicola Bay	0.000847619	0.21	670	0.000313433	0.21	0.21	0.21
PD94	BC1-2	Bayou Chico Pensacola	0.0095	7.79	670	0.011626866	5.57	6.89	8.78
PE08	BC2-2	Bayou Chico, Pensacola Bay	0.065761905	56.35	670	0.084104478	34.04	49.54	63.55
PD97	BC3-2	Bayou Chico Pensacola	0.125228571	93	670	0.13880597	54.78	78.74	121.67
PD92	BC4-2	Bayou Chico Pensacola	0.222247619	293.37	670	0.437865672	182.54	246.44	376.08
PE20	BC5-3	Bayou Chico Pensacola	0.111033333	130.74	670	0.195134328	71.23	109.37	135.21
PE17	BC6-2	Bayou Chico Pensacola	0.105995238	104.02	670	0.155253731	61.06	89.47	112.7

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	C2-NAPHTHALENES	1,6,7-TRIMETHYLNAPHTHALENE	C3-NAPHTHALENES	C4-NAPHTHALENES	BIPHENYL	ACENAPHTHYLENE	ERM	acenapy/ERM	ACENAPHTHENE
PE18	A2-1	Apalachicola Bay	0.21	0.21	0.21	0.21	0.2	1.96	640	0.0030625	0.28
PE15	B1-1	Apalachicola Bay	0.21	0.21	0.21	0.21	0.2	0.12	640	0.0001875	0.28
PE14	C2-1	Apalachicola Bay	0.21	0.21	0.21	0.21	0.2	0.12	640	0.0001875	0.28
PD93	C3-1	Apalachicola Bay	0.21	0.21	0.21	0.21	0.2	0.12	640	0.0001875	0.28
PD94	BC1-2	Bayou Chico Pensacola	15.32	8.31	29.47	0.21	9.78	26.55	640	0.041484375	15.86
PE08	BC2-2	Bayou Chico, Pensacola Bay	113.97	56.69	198.04	351.8	83.42	201.05	640	0.314140625	60.66
PD97	BC3-2	Bayou Chico Pensacola	176.78	81.41	223.63	139.45	167.91	188.08	640	0.293875	79.06
PD92	BC4-2	Bayou Chico Pensacola	631.42	407.53	1074.88	614.88	799.72	196.95	640	0.307734375	348.89
PE20	BC5-3	Bayou Chico Pensacola	368.93	479.46	1342.98	1130.79	207.8	113.43	640	0.177234375	610.99
PE17	BC6-2	Bayou Chico Pensacola	190.19	85.39	278.72	227.18	125.41	383.41	640	0.599078125	137.41

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	ERM	acen/ERM	DIBENZOFURAN	FLUORENE	ERM	fluorene/ERM	C1-FLUORENES	C2-FLUORENES	C3-FLUORENES	PHENANTHRENE	ERM
PE18	A2-1	Apalachicola Bay	500	0.00056	0.23	0.23	540	0.000425926	0.23	0.23	0.23	1.46	1500
PE15	B1-1	Apalachicola Bay	500	0.00056	0.23	0.23	540	0.000425926	0.23	0.23	0.23	0.19	1500
PE14	C2-1	Apalachicola Bay	500	0.00056	0.23	0.23	540	0.000425926	0.23	0.23	0.23	1.14	1500
PD93	C3-1	Apalachicola Bay	500	0.00056	0.23	0.23	540	0.000425926	0.23	0.23	0.23	0.19	1500
PD94	BC1-2	Bayou Chico Pensacola	500	0.03172	10.85	12.19	540	0.022574074	0.23	0.23	0.23	40.82	1500
PE08	BC2-2	Bayou Chico, Pensacola Bay	500	0.12132	57.46	67.02	540	0.124111111	46.1	238.47	330.17	181.13	1500
PD97	BC3-2	Bayou Chico Pensacola	500	0.15812	83.86	115.45	540	0.213796296	63.14	146.45	198.8	349.35	1500
PD92	BC4-2	Bayou Chico Pensacola	500	0.69778	198.67	426.62	540	0.790037037	216.1	263.95	436.96	1026.85	1500
PE20	BC5-3	Bayou Chico Pensacola	500	1.22198	89.24	261.39	540	0.484055556	146.69	281.53	136.17	942.17	1500
PE17	BC6-2	Bayou Chico Pensacola	500	0.27482	121.35	170.96	540	0.316592593	57.55	197.86	431.18	840.27	1500
												779EDL-11 r1	PE-22
												779EDL-11 r2	PE-22
												779EDL-21 r1	PD-91
												779EDL-21 r2	PD-91

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	phenan/ERM	1-METHYLPHENANTHRENE	ANTHRACENE	ERM	anth/ERM	C1-PHENANTHRENE/ANTHRACENES	C2-PHENANTHRENE/ANTHRACENES	C3-PHENANTHRENE/ANTHRACENES
PE18	A2-1	Apalachicola Bay	0.000973333	1.07	1.33	1100	0.001209091	4.8	0.19	0.19
PE15	B1-1	Apalachicola Bay	0.000126667	0.19	0.17	1100	0.000154545	0.19	0.19	0.19
PE14	C2-1	Apalachicola Bay	0.00076	0.19	0.17	1100	0.000154545	0.19	0.19	0.19
PD93	C3-1	Apalachicola Bay	0.000126667	0.19	0.17	1100	0.000154545	0.19	0.19	0.19
PD94	BC1-2	Bayou Chico Pensacola	0.027213333	15.02	44.99	1100	0.0409	45	78.33	142.87
PE08	BC2-2	Bayou Chico, Pensacola Bay	0.120753333	92.07	265.34	1100	0.241218182	252.26	513.31	928.04
PD97	BC3-2	Bayou Chico Pensacola	0.2329	123.57	300.65	1100	0.273318182	278.83	449.97	846.96
PD92	BC4-2	Bayou Chico Pensacola	0.684566667	117.94	494.49	1100	0.449536364	818.35	1108.31	1109.72
PE20	BC5-3	Bayou Chico Pensacola	0.628113333	130.44	375.33	1100	0.341209091	464.01	620.56	1020.11
PE17	BC6-2	Bayou Chico Pensacola	0.56018	185.14	855.37	1100	0.777609091	561.96	852.11	1246.33
			2.809280503		0.031157931		0.000277206		1.032938701	
			2.558072335		0.035903867		0.000319429		0.792610606	
			23.98691097		0.220831253		0.001964691		1.576342324	
			24.31885646		0.309216566		0.002751037		1.29156357	

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	C4-PHENANTHRENE/ANTHRACENES	DIBENZOTHIOPHENE	C1-DIBENZOTHIOPHENES	C2-DIBENZOTHIOPHENES	C3-DIBENZOTHIOPHENES	FLUORANTHENE	ERM
PE18	A2-1	Apalachicola Bay	0.19	0.23	0.23	0.23	0.23	14.94	5100
PE15	B1-1	Apalachicola Bay	0.19	0.23	0.23	0.23	0.23	3.96	5100
PE14	C2-1	Apalachicola Bay	0.19	0.23	0.23	0.23	0.23	5.27	5100
PD93	C3-1	Apalachicola Bay	0.19	0.23	0.23	0.23	0.23	1.06	5100
PD94	BC1-2	Bayou Chico Pensacola	120.95	5.9	14.88	33.35	64.81	308.05	5100
PE08	BC2-2	Bayou Chico, Pensacola Bay	806.37	23.19	42.45	250.12	511.58	1617.51	5100
PD97	BC3-2	Bayou Chico Pensacola	832.88	46.48	132.84	252.39	437.9	1806.51	5100
PD92	BC4-2	Bayou Chico Pensacola	1595.63	148.59	237.49	351.77	595.99	3788.13	5100
PE20	BC5-3	Bayou Chico Pensacola	599.82	198.65	151.03	220.29	366.95	3520.9	5100
PE17	BC6-2	Bayou Chico Pensacola	3442.83	83.88	91.83	257.93	381.83	2507.82	5100
			0.016256511		0.000289459		1.44E-06		
			0.012474199		0.000335488		1.67E-06		
			0.024808661		0.00296742		1.48E-05		
			0.02032678		0.001651318		8.23E-06		

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	fluoran/ERM	PYRENE	ERM	pyrene/ERM	C1-FLUORANTHENES/PYRENES	BENZ(A)ANTHRACENE	ERM	B(a)anth/ERM	CHRYSENE
PE18	A2-1	Apalachicola Bay	0.002929412	15.76	2600	0.006061538	12.55	5.75	1600	0.00359375	9.2
PE15	B1-1	Apalachicola Bay	0.000776471	4.36	2600	0.001676923	4.43	1.81	1600	0.00113125	2.53
PE14	C2-1	Apalachicola Bay	0.001033333	5.07	2600	0.00195	5.04	2	1600	0.00125	2.67
PD93	C3-1	Apalachicola Bay	0.000207843	1.18	2600	0.000453846	0.14	0.61	1600	0.00038125	0.78
PD94	BC1-2	Bayou Chico Pensacola	0.060401961	325.61	2600	0.125234615	222.04	110.36	1600	0.068975	95.35
PE08	BC2-2	Bayou Chico, Pensacola Bay	0.317158824	2252.24	2600	0.866246154	1575.4	933.12	1600	0.5832	714.83
PD97	BC3-2	Bayou Chico Pensacola	0.354217647	2315.12	2600	0.890430769	1629.4	810.15	1600	0.50634375	650.4
PD92	BC4-2	Bayou Chico Pensacola	0.742770588	3417.87	2600	1.314565385	3087.76	1365.1	1600	0.8531875	1416.95
PE20	BC5-3	Bayou Chico Pensacola	0.690372549	2428.27	2600	0.93395	1444.83	662.68	1600	0.414175	655.62
PE17	BC6-2	Bayou Chico Pensacola	0.491729412	2542.38	2600	0.977838462	1830.33	1117.54	1600	0.6984625	1458.76
				0.285706838				0.004866408			
				0.212337318				0.003616715			
				1.136962448				0.019365737			
				0.863343965				0.014705228			

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	ERM	chrysene/ERM	C1-CHRYSENES	C2-CHRYSENES	C3-CHRYSENES	C4-CHRYSENES	BENZO(B)FLUORANTHENE	BENZO(K)FLUORANTHENE	BENZO(E)PYRENE
PE18	A2-1	Apalachicola Bay	2800	0.00328571	4.71	0.14	0.14	0.14	11.36	3.69	5.77
PE15	B1-1	Apalachicola Bay	2800	0.00090357	1.96	0.14	0.14	0.14	5.15	1.86	2.8
PE14	C2-1	Apalachicola Bay	2800	0.00095357	1.68	0.14	0.14	0.14	4.19	1.42	2.59
PD93	C3-1	Apalachicola Bay	2800	0.00027857	0.14	0.14	0.14	0.14	1.51	0.44	0.85
PD94	BC1-2	Bayou Chico Pensacola	2800	0.03405357	106.07	152.93	141.57	87.76	177.63	51.2	128.16
PE08	BC2-2	Bayou Chico, Pensacola Bay	2800	0.25529643	1172.6	1882.84	1539.95	1167.82	1406.71	456.22	1297.9
PD97	BC3-2	Bayou Chico Pensacola	2800	0.23228571	1206.75	1660.14	1797.14	1274.66	1303.65	424.21	1291.61
PD92	BC4-2	Bayou Chico Pensacola	2800	0.50605357	1657	2233.03	2144.94	1733.13	1488.86	401.73	1628.65
PE20	BC5-3	Bayou Chico Pensacola	2800	0.23415	445.72	569.95	509.4	318.74	607.84	211.6	460.12
PE17	BC6-2	Bayou Chico Pensacola	2800	0.52098571	665.74	521.44	456.82	215.32	1740.89	626.68	907.64
					2.60659672	0.012580707	4.146774424	0.063435436	0.0974	0.03467659	0.0627
					2.22666405	0.010746967	3.654155702	0.055899582	0.0831	0.032468547	0.0506
					7.137361662	0.034448389	9.870275593	0.150990907	0.2316	0.009654365	0.2219
					7.228571542	0.034888612	9.454960971	0.144637616	0.2173	0.008935834	0.2084

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	BENZO(A)PYRENE	ERM	B(a)p/ERM	PERYLENE	INDENO(1,2,3-C,D)PYRENE	DIBENZ(A,H)ANTHRACENE	ERM	dibenz/ERM	BENZO(G,H,I)PERYLENE
PE18	A2-1	Apalachicola Bay	5.77	1600	0.00360625	70.44	4.4	1.04	260	0.004	4.32
PE15	B1-1	Apalachicola Bay	2.78	1600	0.0017375	11.95	2.64	0.57	260	0.002192308	2.57
PE14	C2-1	Apalachicola Bay	2.63	1600	0.00164375	5.71	2.57	0.52	260	0.002	2.61
PD93	C3-1	Apalachicola Bay	0.71	1600	0.00044375	1.4	0.74	0.28	260	0.001076923	0.72
PD94	BC1-2	Bayou Chico Pensacola	104.34	1600	0.0652125	40.51	61.47	16.7	260	0.064230769	106.51
PE08	BC2-2	Bayou Chico, Pensacola Bay	959.01	1600	0.59938125	574.72	541.53	147.62	260	0.567769231	1062.47
PD97	BC3-2	Bayou Chico Pensacola	951.92	1600	0.59495	268.16	480.47	142.04	260	0.546307692	1024.25
PD92	BC4-2	Bayou Chico Pensacola	1293.09	1600	0.80818125	257.28	528.18	129.9	260	0.499615385	1248.16
PE20	BC5-3	Bayou Chico Pensacola	350.27	1600	0.21891875	207.9	154.87	96.66	260	0.371769231	282.04
PE17	BC6-2	Bayou Chico Pensacola	948.26	1600	0.5926625	543.58	526.4	281.78	260	1.083769231	560.72

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Battelle ID	Client ID	Site Location	Sum 10LPAH	Sum 12HPAH	sum 22 PAHs	sum all PAHs	acenaphthene/oc ug/goc	fluoranthene/oc ug/goc	phenanthrene/oc ug/goc	Sum 13PAH ERMs
PE18	A2-1	Apalachicola Bay	8.25	152.44	160.7	187.73	0.2	1.52	0.15	0.031039995
PE15	B1-1	Apalachicola Bay	3.17	42.97	46.14	56.79	0.04	1.2	0.06	0.010824189
PE14	C2-1	Apalachicola Bay	5.85	37.26	43.11	54.09	0.01	0.39	0.08	0.012693964
PD93	C3-1	Apalachicola Bay	3.6	10.28	13.88	18.43	ND	ND	ND	0.005457874
PD94	BC1-2	Bayou Chico Pensacola	192.3	1525.89	1718.18	3021.43	7.59	88.01	11.66	0.603127065
PE08	BC2-2	Bayou Chico, Pensacola Bay	1150.68	11963.89	13114.57	25314.82	3.12	25.08	2.81	4.26046152
PD97	BC3-2	Bayou Chico Pensacola	1732.9	11468.49	13201.4	25363.55	2.65	25.48	4.93	4.560579593
PD92	BC4-2	Bayou Chico Pensacola	4612.21	16963.91	21576.12	42606.6	20.95	402.99	109.24	8.314141412
PE20	BC5-3	Bayou Chico Pensacola	3081.46	9638.75	12720.21	23865.89	2.7	83.83	22.43	6.022095546
PE17	BC6-2	Bayou Chico Pensacola	3013.19	13762.45	16775.63	29248.04	6.49	42.43	14.22	7.154976596

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Sample ID	Site Location	Site Description	Sample Dry weight (g)	Units	Percent Moisture	CL2(08)	HEXACHLOROBENZENE	LINDANE	CL3(18)	CL3(28)	HEPTACHLOR	CL4(52)	ALDRIN
PE18	Apalachicola Bay	A2-1	24.992	ng/g, dry wt.	33.532	0.09	0.05	0.12	0.05	0.08	0.05	0.05	0.05
PE15	Apalachicola Bay	B1-1	29.624	ng/g, dry wt.	31.202	0.09	0.05	0.08	0.03	0.08	0.05	0.05	0.05
PE14	Apalachicola Bay	C2-1	19.717	ng/g, dry wt.	49.195	0.09	0.05	0.05	0.05	0.27	0.05	0.05	0.05
PD93	Apalachicola Bay	C3-1	23.858	ng/g, dry wt.	35.281	0.09	0.05	0.05	0.05	0.17	0.05	0.05	0.05
PD94	Chico Bayou, Pensacola Bay	BC1-2	24.889	ng/g, dry wt.	32.821	0.09	0.05	0.05	0.76	0.87	0.05	1.75	0.05
PE08	Chico Bayou, Pensacola Bay	BC2-2	4.332	ng/g, dry wt.	68.859	2.67	0.05	0.05	5.64	6.18	0.05	11.69	0.05
PD97	Chico Bayou, Pensacola Bay	BC3-2	12.205	ng/g, dry wt.	65.04	1.92	0.05	0.05	4.84	8.78	0.05	1.98	0.05
PD92	Chico Bayou, Pensacola Bay	BC4-2	16.085	ng/g, dry wt.	56.224	4.22	0.05	3.09	0.57	8.89	0.05	1.22	0.05
PE20	Chico Bayou, Pensacola Bay	BC5-3	22.066	ng/g, dry wt.	44.079	0.45	0.05	0.05	1.93	1.82	0.05	5.06	0.05
PE17	Chico Bayou, Pensacola Bay	BC 6-2	7.777	ng/g, dry wt.	62.066	1.55	0.05	0.05	3.43	4.17	0.05	7.71	0.05

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Sample ID	Site Location	Site Description	CL4(44)	HEPTACHLOREPOXIDE	CL4(66)	2,4-DDE	CL5(101)	CIS-CHLORDANE	TRANS-NONACHLOR	DIELDRIN	4,4-DDE	ERM	44dde/ERM	CL4(77)	2,4-DDD	ENDRIN
PE18	Apalachicola Bay	A2-1	0.08	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.19	27	0.007037	0.06	0.11	0.06
PE15	Apalachicola Bay	B1-1	0.32	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.18	27	0.006667	0.06	0.12	0.06
PE14	Apalachicola Bay	C2-1	0.12	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.13	27	0.004815	0.06	0.11	0.06
PD93	Apalachicola Bay	C3-1	0.07	0.03	0.06	0.04	0.07	0.05	0.05	0.04	0.07	27	0.002593	0.06	0.11	0.06
PD94	Chico Bayou, Pensacola Bay	BC1-2	0.76	0.17	0.86	0.04	0.77	0.37	0.27	0.99	1.34	27	0.04963	0.06	0.36	0.06
PE08	Chico Bayou, Pensacola Bay	BC2-2	2.25	0.03	4.97	0.04	9.09	3.79	3.4	5.19	11.61	27	0.43	0.06	2.86	0.06
PD97	Chico Bayou, Pensacola Bay	BC3-2	1.34	0.03	8.72	0.04	13.35	3.86	3.08	11.88	12.3	27	0.455556	0.06	6.2	0.06
PD92	Chico Bayou, Pensacola Bay	BC4-2	1.11	1.36	4.89	1.37	13.58	2.62	1.85	3.32	6.61	27	0.244815	0.06	4.64	0.06
PE20	Chico Bayou, Pensacola Bay	BC5-3	1.23	0.03	3.22	0.69	4.2	1.61	2.66	0.8	7.79	27	0.288519	0.06	7.14	0.06
PE17	Chico Bayou, Pensacola Bay	BC 6-2	3.56	0.03	5.92	0.04	6.04	2.63	3.14	8.03	11.34	27	0.42	0.06	4.58	0.06

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Sample ID	Site Location	Site Description	CL5(118)	4,4-DDD	2,4-DDT	CL6(153)	CL5(105)	4,4-DDT	CL6(138)	CL5(126)	CL7(187)	CL6(128)	CL7(180)	MIREX	CL7(170)	CL8(195)
PE18	Apalachicola Bay	A2-1	0.04	0.77	0.07	0.06	0.04	0.41	0.06	0.05	0.1	0.04	0.04	0.07	0.03	0.02
PE15	Apalachicola Bay	B1-1	0.04	0.14	0.07	0.44	0.12	0.07	0.05	0.05	0.04	0.04	0.04	0.07	0.03	0.02
PE14	Apalachicola Bay	C2-1	0.04	0.11	0.07	0.11	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02
PD93	Apalachicola Bay	C3-1	0.04	0.11	0.07	0.03	0.05	0.07	0.04	0.05	0.03	0.04	0.04	0.07	0.03	0.02
PD94	Chico Bayou, Pensacola Bay	BC1-2	1.43	1.59	0.07	1.66	0.57	0.07	1.83	0.05	0.32	0.41	0.82	0.07	0.73	0.15
PE08	Chico Bayou, Pensacola Bay	BC2-2	10.92	9.98	0.07	12.36	5.83	2.44	11.73	0.05	2.33	2.67	4.77	0.07	5.02	1.3
PD97	Chico Bayou, Pensacola Bay	BC3-2	17.17	18.09	0.07	20.18	7.47	0.81	2.23	0.05	3.29	3.85	7.25	3.01	6.88	2.83
PD92	Chico Bayou, Pensacola Bay	BC4-2	12.94	2.09	1.15	16.56	5.84	9.12	18.32	0.05	2.38	2.31	4.51	0.07	4.81	4.59
PE20	Chico Bayou, Pensacola Bay	BC5-3	6.41	23.79	0.07	6.81	3.61	9.95	8.87	0.05	1.64	1.45	1.16	1.49	4.6	0.02
PE17	Chico Bayou, Pensacola Bay	BC 6-2	6.66	12.36	0.07	8.19	3.3	4.79	6.66	0.05	2.68	2.55	2.87	3	8.85	1.94

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Sample ID	Site Location	Site Description	CL9(206)	CL10(209)	sum 20PCBs	X2	total PCBs	ERM	tPCBs/ERM	Pesticide Total :	DDT Total :	ERM	tDDT/ERM	Indeno Total :	Sum 3COH/ERM
PE18	Apalachicola Bay	A2-1	0.04	0.06	1.13	2	2.25	180	0.0125	2.14	1.59	46.1	0.03449	0.17	0.054027276
PE15	Apalachicola Bay	B1-1	0.04	0.04	1.7	2	3.41	180	0.018944	1.12	0.61	46.1	0.01323	0.17	0.038843215
PE14	Apalachicola Bay	C2-1	0.04	0.07	1.33	2	2.65	180	0.014722	0.99	0.52	46.1	0.01128	0.17	0.030816864
PD93	Apalachicola Bay	C3-1	0.04	0.04	1.08	2	2.17	180	0.012056	0.93	0.46	46.1	0.00998	0.17	0.024626456
PD94	Chico Bayou, Pensacola Bay	BC1-2	0.22	0.45	14.55	2	29.1	180	0.161667	5.57	3.46	46.1	0.07505	0.86	0.286350526
PE08	Chico Bayou, Pensacola Bay	BC2-2	1.1	2.46	103.1	2	206.19	180	1.1455	39.72	27	46.1	0.58568	7.26	2.161183297
PD97	Chico Bayou, Pensacola Bay	BC3-2	2.58	1.69	116.48	2	232.97	180	1.294278	59.62	37.51	46.1	0.81367	7.02	2.563499277
PD92	Chico Bayou, Pensacola Bay	BC4-2	4.18	1.56	112.58	2	225.15	180	1.250833	37.5	24.99	46.1	0.54208	5.88	2.037730578
PE20	Chico Bayou, Pensacola Bay	BC5-3	0.73	0.35	53.7	2	107.4	180	0.596667	56.25	49.43	46.1	1.07223	4.34	1.957419459
PE17	Chico Bayou, Pensacola Bay	BC 6-2	1.44	0.04	77.7	2	155.4	180	0.863333	50.25	33.17	46.1	0.71952	5.85	2.00285611

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

Sample ID	Site Location	Site Description	PCB Total (No MDL):	Pesticide Total (No MDL):	DDT Total (No MDL):	Indeno Total (No MDL):		dieldrin/oc	endrin/oc	MSL
								ug/goc	ug/goc	Code
PE18	Apalachicola Bay	A2-1	0.48	1.5	1.38	0		0.004	0.006	NO DATA
PE15	Apalachicola Bay	B1-1	1.1	0.52	0.44	0		0.011	0.018	
PE14	Apalachicola Bay	C2-1	0.57	0.13	0.13	0		0.003	0.004	779EDL-7
PD93	Apalachicola Bay	C3-1	0.24	0.07	0.07	0		ND	ND	779EDL-30
PD94	Chico Bayou, Pensacola Bay	BC1-2	14.34	5.09	3.28	0.81		0.284	0.017	779EDL-1
PE08	Chico Bayou, Pensacola Bay	BC2-2	102.98	39.27	26.89	7.19		0.081	0.001	779EDL-2
PD97	Chico Bayou, Pensacola Bay	BC3-2	116.37	59.24	37.41	6.94		0.168	0.001	779EDL-3
PD92	Chico Bayou, Pensacola Bay	BC4-2	112.46	37.23	24.99	5.83		0.353	0.006	779EDL-4
PE20	Chico Bayou, Pensacola Bay	BC5-3	53.56	55.9	49.36	4.27		0.019	0.001	779EDL-5
PE17	Chico Bayou, Pensacola Bay	BC 6-2	77.54	49.87	33.07	5.78		0.136	0.001	779EDL-6
			MDL							
						0.033	5400	1.3	0.008	11

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

study	Sample ID	Ag	Al	As	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Si	Sn	Zn	% gravel	% sand
area		GFAA	XRF	XRF	GFAA	XRF	XRF	XRF	CVAA	XRF	XRF	XRF	ICP/MS	GFAA	XRF	ICP/MS	XRF		
Apalach. Bay	PE18																	0.3	76.3
Apalach. Bay	PE15	0.033	21800	1.47	0.017	13	3.8	9080	0.019	212	5.6	8.3	0.0907	0.183	378000	0.8514	22.1	0	86.9
Apalach. Bay	PE14	0.033	50000	14.1	0.028	29	14.5	29500	0.031	1080	19.9	14.2	0.2097	0.21	167000	1.1474	39.6	1.2	63.9
Apalach. Bay	PD93	0.033	22300	4.15	0.008	11	3.8	8560	0.014	204	5	8.7	0.0813	0.183	353000	0.619	16.6	ND	ND
Bayou Chico	PD94	0.033	20100	5.11	0.26	24.4	33.1	11600	0.09	48.9	4.3	25.4	0.2197	0.42	374000	1.2074	169.5	0.2	86
Bayou Chico	PE08	0.45	68900	21.5	1.38	88	176.1	45900	0.692	204	28.1	130.8	0.8687	1.56	218000	6.8474	995	0.3	4.6
Bayou Chico	PD97	0.32	42700	24.5	1.35	81.9	172.7	39500	0.637	186	20.5	94.6	0.8297	1.46	231000	6.4374	926	0	26.5
Bayou Chico	PD92	0.14	31700	9.9	0.76	44.4	127.7	19500	0.399	118	14.7	102.9	0.5347	0.63	285000	3.6874	679	0	62.1
Bayou Chico	PE20	0.066	17400	5.9	0.35	17.9	59.3	9100	0.214	50.6	8.1	48.6	0.4477	0.31	365000	2.5574	260	0.1	79.9
Bayou Chico	PE17	0.24	48600	20.4	0.91	69.1	139.3	28200	0.395	157	18.4	93.5	0.8017	0.83	251000	5.8074	508	1.3	57.1
2.3		10	2.7	2.9	0.005	0.183	2000	0.02	3							MDL		0.3	0.012

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

study area	Sample ID	%silt	% clay	% fines	%TOC	MSL Code	Sponsor ID	AVS µmole/g	SEM-Cd µg/g	SEM-Cd µmole/g	SEM-Cu µg/g	SEM-Cu µmole/g	SEM-Hg µg/g	SEM-Hg µmole/g
Apalach. Bay	PE18	11	12.4	23.4	0.98	NO DATA	PE-18							
Apalach. Bay	PE15	6.1	7	13.1	0.33	779EDL-7	PE-15	1.980337133	0.052982165	0.000471372	1.005242678	0.015820628	0.003685976	1.84E-05
Apalach. Bay	PE14	20.1	14.8	34.9	1.35	779EDL-8	PE-14	1.710483098	0.026463133	0.000235437	2.364232542	0.03720857	0.010403265	5.19E-05
Apalach. Bay	PD93	ND	ND	ND	ND	779EDL-30	PE-93	2.8	0.012	0.0001	0.95	0.015	0.0012	0.0000062
Bayou Chico	PD94	7.4	6.4	13.8	0.35	779EDL-1	PD-94	9.476691463	0.091432951	0.00081346	5.653416901	0.088974141	0.000144084	7.18E-07
Bayou Chico	PE08	67.7	27.4	95.1	6.45	779EDL-2	PE-08	34.97247839	0.854577778	0.007603005	29.24986667	0.460337845	0.000144084	7.18E-07
Bayou Chico	PD97	51.4	22.1	73.5	7.09	779EDL-3	PD-97	28.0605607	0.595301608	0.005296278	26.72786404	0.420646271	0.004902427	2.44E-05
Bayou Chico	PD92	21.5	16.4	37.9	0.94	779EDL-4	PD-92	33.69190483	0.354990966	0.003158283	13.66182671	0.215011437	0.001724726	8.60E-06
Bayou Chico	PE20	11.2	8.6	19.8	4.2	779EDL-5	PD-20	12.82024392	0.23412235	0.002082939	11.11346459	0.174905014	0.000946023	4.72E-06
Bayou Chico	PE17	25.1	16.5	41.6	5.91	779EDL-6	PE-17	61.66227986	0.609914562	0.005426286	22.01612562	0.346492377	0.00197338	9.84E-06
2.3		0.0001	0.017	0.00027	0.00014	0.0000007	0.015	0.00026	0.0035	0.000017	0.0057	0.000088		

Appendix B4. Chemistry and toxicity data from Apalachicola Bay and Bayou Chico

study area	Sample ID	SEM-Ni µg/g	SEM-Ni µmole/g	SEM-Pb µg/g	SEM-Pb µmole/g	SEM-Zn µg/g	SEM-Zn µmole/g	Sum 5SEM umole/g	Sum 5SEM/AVS umole/g	Sum 5SEM-AVS umole/g
Apalach. Bay	PE18									
Apalach. Bay	PE15	0.293959114	0.005006968	3.576396008	0.017261432	6.306799464	0.096478499	0.135	0.068189853	0.0668
Apalach. Bay	PE14	3.738152999	0.063671487	8.070377634	0.038951579	7.891451963	0.120719779	0.2608	0.152463858	0.1083
Apalach. Bay	PD93	0.86	0.015	3.3	0.016	3.2	0.048	0.094	0.03325338	0.0607
Bayou Chico	PD94	1.066985225	0.018173824	5.809402558	0.02803901	160	2.379351034	2.5154	0.265425067	2.2499
Bayou Chico	PE08	4.619899259	0.078690159	45.48549333	0.219535177	1300	20.30912578	21.0753	0.602625062	20.4727
Bayou Chico	PD97	0.841347921	0.014330573	34.33865001	0.165735074	410	6.218590283	6.8246	0.243209626	6.5814
Bayou Chico	PD92	0.435720244	0.007421568	21.7812314	0.105126847	350	5.327289866	5.658	0.167933752	5.4901
Bayou Chico	PE20	0.379883662	0.00647051	26.5063211	0.127932434	140	2.177092136	2.4885	0.194105748	2.2944
Bayou Chico	PE17	1.181439876	0.020123316	44.43781854	0.214478587	360	5.514080756	6.1006	0.098935708	6.0017