NOAA NATIONAL STATUS & TRENDS

MUSSEL WATCH PROGRAM

An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone

Citation for this Report

Kimbrough, K.L., W.E. Johnson, G.G. Lauenstein, J.D. Christensen and D.A. Apeti. 2008. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp.

An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone

K. L. Kimbrough, W. E. Johnson, G. G. Lauenstein, J. D. Christensen and D. A. Apeti.

National Oceanic and Atmospheric Administration
National Ocean Service
National Centers for Coastal Ocean Science
Center for Coastal Monitoring and Assessment
1305 East-West Highway
Silver Spring, Maryland 20910

Director's Summary

It is with great pleasure that I welcome you to the National Status & Trends Program's "Mussel Watch: An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone." Based upon one of the National Oceanic and Atmospheric Administration (NOAA) foundational datasets, and one of the nation's longest running ecosystem monitoring programs, this report is the first in what will become a series of routine updates. The National Status and Trends Program is part of NOAA's mandate called for by Congress under the National Coastal Monitoring Act and is a crucial component of NOAA's mission. Mussel Watch is but one of the many scientific activities undertaken by NOAA's National Ocean Service and its National Centers for Coastal Ocean Science (NCCOS). NCCOS' mission is to provide coastal managers with scientific information and tools needed to balance society's environmental, social, and economic goals, and this report takes a significant step in that direction by providing a clear and concise summary of coastal contamination levels over the past 20 years. The report examines the impacts of regulating contaminants on their presence, distribution and levels in our coastal and Great Lakes waters, as well as other intriguing interpretations of why the levels are what they are today.

National scale assessments such as this are of immense value, but they are rare in the ecological world. They provide a science based approach to highlight and quantify connectivity that is otherwise lost in a local or regional study alone. As can be seen with mercury contamination in the US coastal zone, what happens in one region can affect localities thousands of miles away. Linking localities, regions and ecosystems together is an important and necessary part of solving environmental problems. The long-term data collections (monitoring) necessary for assessments are expensive and difficult to sustain. These kinds of long-term, data collections are not the kind of glamorous, short-term items that gain much of society's everyday attention. But, the benefits of having these types of data over the long-term far outweigh the costs of continuing them. Without these data, the kinds of scientifically based assessments presented in this report are not even possible.

NCCOS performs a wide range of coastal and Great Lakes characterization activities, including coral reef ecosystem assessments, land use impact assessments on coastal resources in the form of an annual oxygen depleted area ("dead zone") forecast, and harmful algal bloom (HAB) detection and forecasts, among many others. This impressive range of scientific endeavor is made possible through a world-class staff of scientists that work in laboratories and offices throughout the United States, including in Maryland, North and South Carolina, Alaska and Hawaii, and through its strength in partnership with other Federal, State, Territorial, Academic, Tribal and non-governmental organizations, and with private sector partners the world over. This collective body of work is intended to provide a basis for sound coastal management. By providing relevant and timely information and creative approaches for examining ecological issues, we strengthen the linkage between sound science and management. By using NCCOS' scientific information and tools, managers can balance the impacts of ecosystem stressors with social and economic goals. NCCOS is committed to implementing this vision by providing world-class science that is credible, relevant, and timely. The Mussel Watch Program is central to this vision, and we stand committed to continuing this important activity for years to come. I hope you find the information provided herein to be both enlightening and useful, and welcome your comments on the first ever National Status & Trends Program summary of coastal contamination.

Gary Matlock, Ph.D.
Director
National Center for Coastal Ocean Science

Executive Summary

Information found in this report covers the years 1986 through 2005. Mussel Watch began monitoring a suite of trace metals and organic contaminants such as DDT, PCBs and PAHs. Through time additional chemicals were added, and today approximately 140 analytes are monitored. The Mussel Watch Program is the longest running estuarine and coastal pollutant monitoring effort conducted in the United States that is national in scope each year. Hundreds of scientific journal articles and technical reports based on Mussel Watch data have been written; however, this report is the first that presents local, regional and national findings across all years in a Quick Reference format, suitable for use by policy makers, scientists, resource managers and the general public.

Pollution often starts at the local scale where high concentrations point to a specific source of contamination, yet some contaminants such as PCBs are atmospherically transported across regional and national scales, resulting in contamination far from their origin. Findings presented here showed few national trends for trace metals and decreasing trends for most organic contaminants; however, a wide variety of trends, both increasing and decreasing, emerge at regional and local levels. For most organic contaminants, trends have resulted from state and federal regulation. The highest concentrations for both metal and organic contaminants are found near urban and industrial areas.

In addition to monitoring throughout the nation's coastal shores and Great Lakes, Mussel Watch samples are stored in a specimen bank so that trends can be determined retrospectively for new and emerging contaminants of concern. For example, there is heightened awareness of a group of flame retardants that are finding their way into the marine environment. These compounds, known as polybrominated diphenyl ethers (PBDEs), are now being studied using historic samples from the specimen bank and current samples to determine their spatial distribution. We will continue to use this kind of investigation to assess new contaminant threats.

We hope you find this document to be valuable, and that you continue to look towards the Mussel Watch Program for information on the condition of your coastal waters.

Gunnar G. Lauenstein, Ph.D., Mussel Watch Program Manager

Report Description

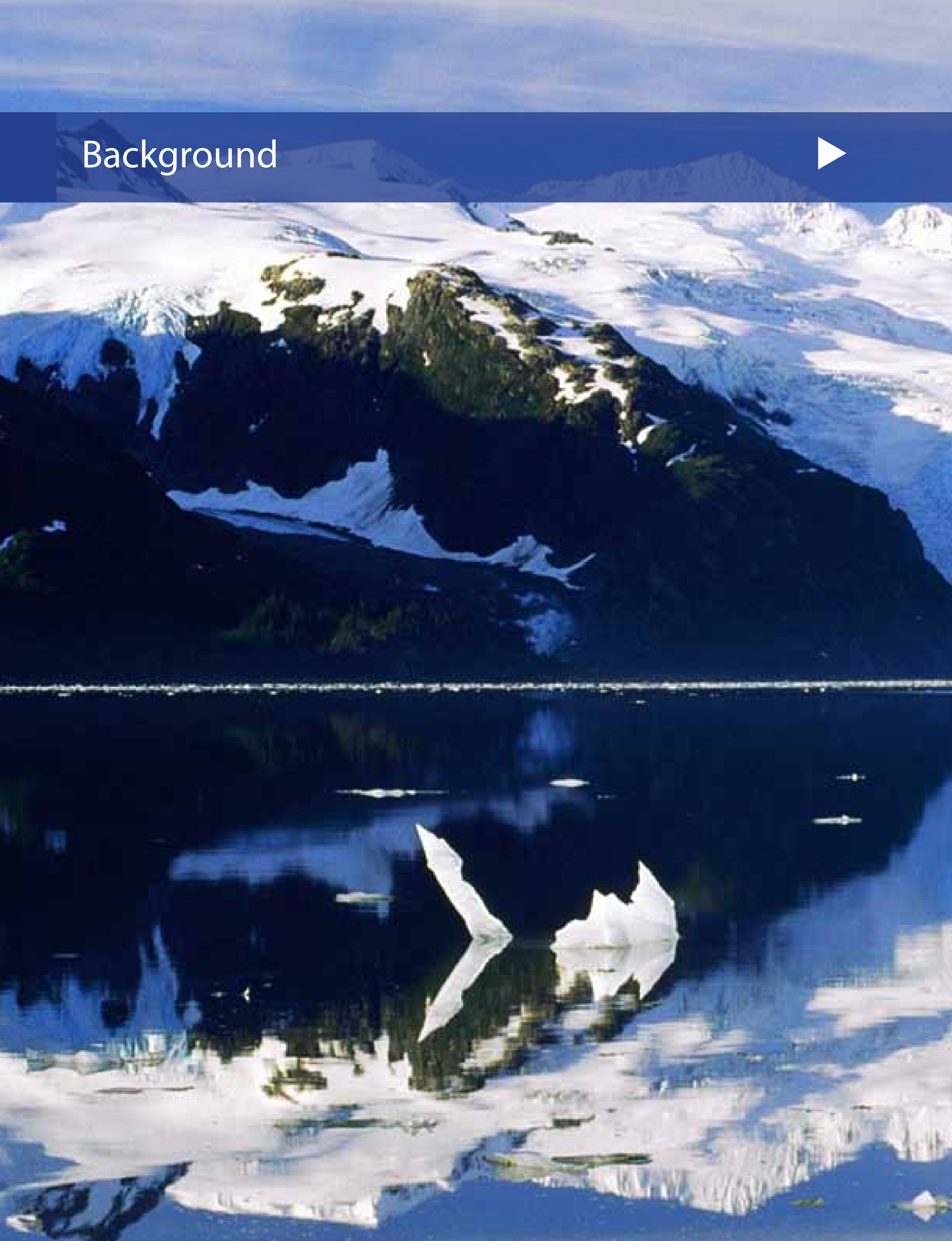
This report is designed to present background information, results and data interpretations in a clear and concise format. The results include a guide with the information needed to interpret the maps and graphs. Appendix 2 summarizes the information for each site by state.

Acknowledgements

This report could not have been completed without the cooperation, time and effort contributed by many, whose collective input has resulted in a document far superior to that which we envisioned on our own. We would like to thank all of the reviewers and collaborators for their invaluable assistance.

Richard Batuik	U.S. Environmental Protection Agency
Benoit Beliaeff	IFREMER - Institut français de recherche pour l'exploitation de la mer
Ken Buja	National Oceanic and Atmospheric Administration
Chris Caldow	Consolidated Safety Services, Inc.
Eric Carr	Consolidated Safety Services, Inc.
Alicia Clark	National Oceanic and Atmospheric Administration
Cliff Cosgrove	National Oceanic and Atmospheric Administration
Russ Flegal	University of California, Santa Cruz
Mike Fulton	National Oceanic and Atmospheric Administration
Dominic Gregorio	California Water Resources Control Board
Carl Hershner	Virginia Institute of Marine Science, College of William & Mary
Katherine Nielsen	National Oceanic and Atmospheric Administration
John Macauley	U.S. Environmental Protection Agency
Keith Maruya	Southern California Coastal Water Resources Project
Tom McDonald	Texas A&M University
Terry McTigue	National Oceanic and Atmospheric Administration
Kevin McMahon	National Oceanic and Atmospheric Administration
Alan Mearns	National Oceanic and Atmospheric Administration
Christine Negra	The H. John Heinz III Center for Science, Economics and the Environment
Tony Pait	National Oceanic and Atmospheric Administration
Oren Perez	Aster Engineering Inc.
Gerhardt Riedel	Smithsonian Environmental Research Center
Larry Robinson	Florida A&M University
Michele Schantz	National Institute of Standards and Technology
Jack Schwartz	Division of Marine Fisheries, Massachusetts, Annisquam River Marine Fisheries Station
Michelle Tomlinson	National Oceanic and Atmospheric Administration
Terry Wade	Texas A&M University
Dave Whitall	National Oceanic and Atmospheric Administration
Ed Wirth	National Oceanic and Atmospheric Administration

Table of Contents



Background

NOAA's Mussel Watch Program was designed to monitor the status and trends of chemical contamination of U.S. coastal waters, including the Great Lakes. The Program began in 1986 and is one of the longest running, continuous coastal monitoring programs that is national in scope. The Program is based on yearly collection and analysis of oysters and mussels. These bivalves are sessile organisms that filter and accumulate particles from water; thus, measuring contaminant levels in their tissue is a good indicator of local contamination. Mussel Watch data are useful for characterizing the environmental impact of new and emerging contaminants, extreme events (hurricanes and oil spills), and for assessing the effectiveness of legislation, management decisions and remediation of coastal contamination levels.

NOAA established Mussel Watch in response to a legislative mandate under Section 202 of Title II of the Marine Protection, Research and Sanctuaries Act (MPRSA) (33 USC 1442), which called on the Secretary of Commerce to, among other activities, initiate a continuous monitoring program "to assess the health of the marine environment, including monitoring of contaminant levels in biota, sediment and the water column." As part of the NOAA Authorization Act of 1992, the overall approach and activities of NOAA's National Status and Trends Program (NS&T), including Mussel Watch, were codified under provisions of the National Coastal Monitoring Act (Title V of the MPRSA).

In 1986, the inaugural year of the Mussel Watch Program, 145 sites were sampled. Today, Mussel Watch is comprised of nearly 300 monitoring sites, where more than 140 chemical contaminants, chosen through consultation with experts and scientists from academia and government, are measured. Many of these contaminants are listed as Environmental Protection Agency (EPA) Priority Pollutants (Keith and Teillard, 1979). Legislation has been passed to regulate most of the organic contaminants analyzed by the Mussel Watch Program. Most are toxic to aquatic organisms, and some are taken up and stored in animal tissues with the potential to be transferred through food chains to humans.

Program Goal

To support ecosystem-based management through an integrated nationwide program of environmental monitoring, assessment and research to describe the status and trends of our nation's estuaries and coasts.

Highlight

Many mussel Watch sites are coincident with the 1976-1978 EPA Mussel Watch sites.

Program staff consulted with state officials, academic professionals and others when sites were established.

Many sites are located in or near NOAA-managed areas (National Estuarine Research Reserves, National Marine Sanctuaries).

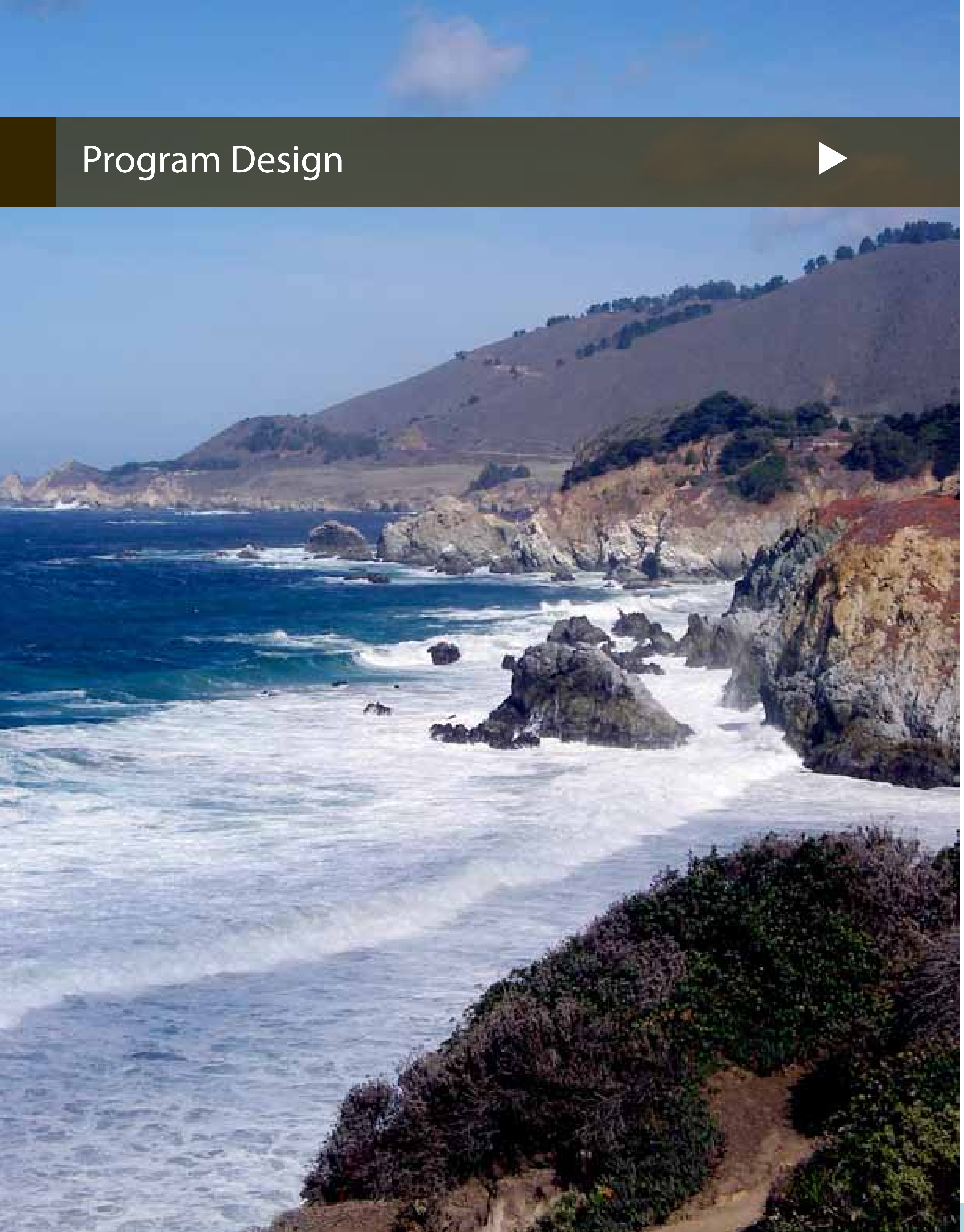
Sites were selected in shellfish beds large enough for repeated sampling.

Samples are only collected from natural substrates, caged mussels are not used.

Municipal sewage outfalls or industrial effluents are generally avoided when sites are established.

This first ever national summary brings together twenty years of Mussel Watch data on contaminant levels in mussels and oysters, and is intended for use by resource managers, policy makers, legislators and concerned citizens. This report compares the status and trends of chemical concentrations at the national level to those found locally or regionally. In cases where no human consumption guidelines are available for shellfish, comparisons can be used to determine if the concentrations are high relative to the rest of the nation.

More detailed information can be accessed at http://NSandT.noaa.gov.



Program Design

Mussels and oysters are widely distributed along the coasts, minimizing the problems inherent in comparing data from markedly different and mobile species, and making them better integrators of contaminants in a given area (Berner et al., 1976; Farrington et al., 1980; Farrington, 1983; and Tripp and Farrington, 1984). They are good surrogates for monitoring environmental quality because contaminant levels in their tissue respond to changes in ambient environmental levels and accumulate with little metabolic transformation (Roesijadi et al., 1984; Sericano, 1993).

Mussel Watch sites were selected to represent large coastal areas that can be used to construct a nationwide assessment. Sites selected for monitoring are generally 10 to 100 km apart along the entire U.S. coastline, including the Great Lakes, Puerto Rico and Hawaii. Where possible, sites were selected to coincide with historical mussel and oyster monitoring locations from other programs, such as the U.S. EPA's Mussel Watch sites that were sampled from 1976 to 1978 (Goldberg et al., 1983), and to complement sites sampled through state programs, such as the California Mussel Watch Program (Martin, 1985).

Because one single species of mussel or oyster is not common to all coastal regions, a variety of species are collected to gain a national perspective. A target species is identified for each site based on abundance and ease of collection. Mussels (*Mytilus species*) are collected from the North Atlantic and Pacific coasts, oysters (*Crassostrea virginica*) from the mid-Atlantic (Delaware Bay) southward and along the Gulf Coast, and zebra mussels (*Dreissena species*), an invasive species, are collected from sites in the Great Lakes (Figure 1; Table 1; Appendix 2).

In spite of the number of sites for a coastline as large as that of the U.S., relatively few species are required to determine a national contaminant perspective. For organic contaminants it is possible to compare across all sites because Mussel Watch species have a similar ability to bioaccumulate contaminants. For trace metals there are clear differences in bioaccumulation abilities between coastal mussels and oysters. Oysters have a greater affinity for zinc, copper and silver while mussels are better able to accumulate lead and chromium.

Program at a Glance

- Approximately 300 active monitoring sites in the continental U.S., Alaska, Puerto Rico and Hawaii.
- Stations 10 to 100 km apart along the entire U.S. coastline.
- Approximately 140 contaminants monitored in resident bivalve populations

Table 1. Mussel and oyster species used to assess national coastal contamination.

Region	Number of Sites*	Target Species	Name Used in this Report
Northeast, Southwest, Northwest and Alaska	108	*Mytilus edulis, Mytilus californianus, Mytilus galloprovincialis and Mytilus trossulus*	Mussels
Southeast and Gulf of Mexico	105	*Crassostrea virginica*	Oysters
Great Lakes	23	*Dreissena polymorpha and Dreissena bugensis*	Zebra Mussels

* A subset of sites were used in this report.

Zebra Mussels

Oysters

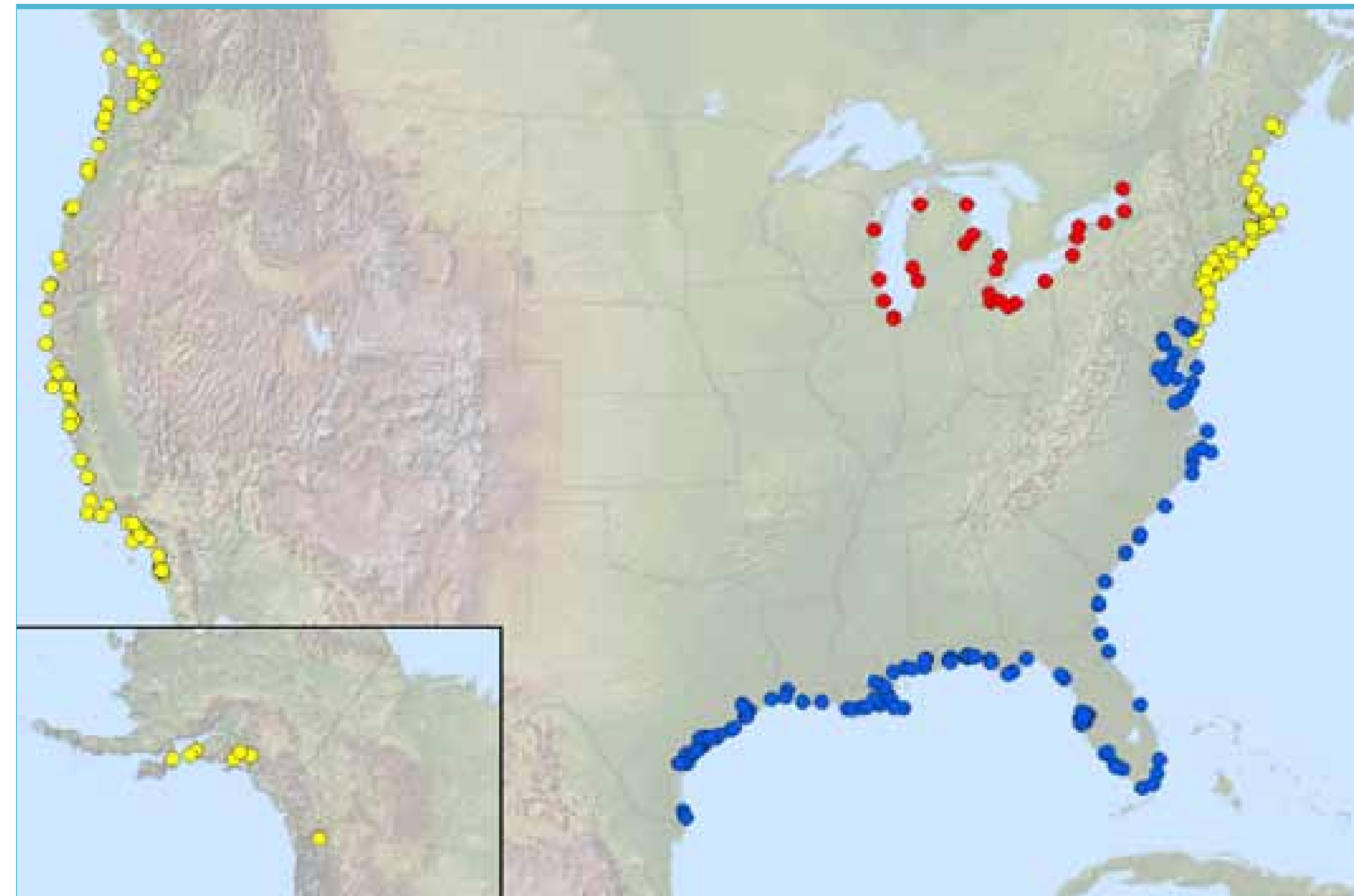


Figure 1. Distribution of oysters (*Crassostrea virginica*), mussels (*Mytilus species*), and zebra mussels (*Dreissena species*) collected and measured as part of the Mussel Watch Program.

Mussels *(Mytilus species)*
Oysters *(Crassostrea virginica)*
Zebra Mussels *(Dreissena species)*

The oysters and mussels analyzed are collected by hand or dredged from intertidal to shallow subtidal zones, brushed clean, packed in iced containers and shipped to analytical laboratories within two days of collection. Sample collection protocols are described in detail in McDonald et al., (2006), Lauenstein et al., (1997), and Lauenstein and Cantillo (1993a-d and 1998). Sample preparation, extraction techniques and analytical methods are too voluminous to report in this document. Detailed analytical methods used by the Mussel Watch Program are available (Kimbrough and Lauenstein, 2006; Kimbrough et al., 2006) online at http://NSandT.noaa.gov.

Along with partner laboratories, sampling and analytical methods for monitoring chemicals in oysters, mussels and sediment have been developed. The Mussel Watch Program uses a performance based quality assurance (QA) process to ensure data quality. This effort has been in operation since 1985 and is designed to document sampling protocols, analytical procedures and laboratory performance. Analytical laboratories used by the Mussel Watch Program are required to participate in exercises with assistance from the National Institute of Standards and Technology (NIST) and the National Research Council of Canada (NRC) to ensure data are comparable in accuracy and precision (Willie, 2000; Schantz et al., 2000).

Contaminants

The Mussel Watch Program monitors approximately 140 contaminants including both metals and organic compounds. A subset of this broad suite of contaminants was chosen for presentation in this report, drawing from compounds that have the greatest geographic and temporal extent, and contemporary relevance. Eight metals (Table 2), representing 35% of all metals evaluated by the Mussel Watch Program, and 61 unique organic contaminants aggregated into eight chemical classes are reported here (Table 3; Appendix 2).

Table 2. Metals measured in the Mussel Watch Program. Those in bold type are included in this report because of their spatial and temporal extent of coverage and relevance.

Symbol	Element
Al	Aluminum
Sb	Antimony
As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Fe	Iron
Pb	Lead
Mn	Manganese
Hg	Mercury
Ni	Nickel
Se	Selenium
Si	Silicon
Ag	Silver
Tl	Thallium
Sn	Tin
Zn	Zinc

* For simplicity, the term metal is used without distinction between the true metals and metalloids (elements with metal-like properties, e.g., antimony, arsenic and silicon).

Metals

Metals occur naturally in the environment, but human use of metals, particularly since the industrial age, has resulted in excessive releases. How metals are released into the environment is most important in determining distribution and concentration. Anthropogenic sources of metals include fossil fuel and waste burning, mining and ore processing, chemical production, and agriculture. These sources are largely responsible for the elevated environmental concentrations observed in coastal waters. Transport of metals to coastal and estuarine water occurs primarily from runoff and atmospheric deposition. The relative contribution from each mechanism varies by metal, proximity to sources, and chemical phase (dissolved or particulate-bound). Metals can exist in the environment in several forms of varying toxicity. The analytical methods used by the Mussel Watch Program do not distinguish between these various forms, but instead report values as total metal (aggregation of all species of a metal).

We have chosen to present a subset of the status and trends for trace metals in this report. There are two principal reasons for this, 1) several of these elements are considered to be abundant "earth metals" and 2) the current state of science and associated methods are less certain of guaranteeing accurate and precise quantitation of several metals. Chromium (Cr), Antimony (Sb), Silver (Ag) and Thallium (Tl) can be counted among those difficult to quantify. Moreover, Thallium is generally found in such low concentrations that our ability to detect its mere presence is restricted. Aluminum (Al), Iron (Fe), Silicon (Si) and Manganese (Mn) are all abundant earth metals. As such, the overriding signal for these chemicals tends to be a direct correlation to local earth crustal composition.

Creosote piling are sources of polycylic aromatic hydrocarbons.

Organics

Organic chemicals reported here are mostly manufactured and released to the environment either intentionally (e.g., pesticides) or through manufacturing or disposal processes, such as PCBs. Others, such as PAHs, occur both naturally and as a result of human activities. Some of the chemicals presented here are industrial byproducts and represent major components of other manufactured chemicals. An example of this is the pesticide dieldrin, which itself is a pesticide but also a degradation product of aldrin.

Table 3. Organic contaminant classes summarized in this report. A complete list of the organic contaminants monitored by the Mussel Watch Program is available online at http://NSandT.noaa.gov.

Compound class	Organic compound
PCB* (Sum of 18 PCBs) Polychlorinated biphenyls	PCB8/5, PCB18, PCB28, PCB44, PCB52, PCB66, PCB101/90, PCB105, PCB118, PCB128, PCB138, PCB153/132/168, PCB170/190, PCB180, PCB187, PCB195/208, PCB206, PCB209
PAH** Polycyclic aromatic hydrocarbons (Sum of 19 parent PAH compounds plus 19 groups of alkylated PAHs)	Sum of 7 parent low molecular weight PAHs (with 2 or 3 rings): naphthalene, biphenyl, acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene plus the sum of 12 parent high molecular weight PAHs (4 or more rings): fluoranthene, pyrene, benz[*a*]anthracene, chrysene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, benzo[*e*]pyrene, benzo[*a*]pyrene, perylene, dibenz[*a,h*]anthracene, indeno[*1,2,3-cd*]pyrene, benzo[*ghi*]perylene plus the sum of 19 groups of alkylated PAHs: C1-Chrysenes, C1-Dibenzothiophenes, C1-Fluoranthenes/Pyrenes, C1-Fluorenes, C1-Naphthalenes, C1-Phenanthrenes/Anthracenes, C2-Chrysenes, C2-Dibenzothiophenes, C2-Fluorenes, C2-Naphthalenes, C2-Phenanthrenes/Anthracenes, C3-Chrysenes, C3-Dibenzothiophenes, C3-Fluorenes, C3-Naphthalenes, C3-Phenanthrenes/Anthracenes, C4-Chrysenes, C4-Naphthalenes, C4-Phenanthrenes/Anthracenes
DDT (Sum of 6 compounds)	2,4'-DDD; 2,4'-DDE; 2,4'-DDT; 4,4'-DDD; 4,4'-DDE; 4,4'-DDT
Butyltin (Sum of 3 compounds)	Monobutyltin, Dibutyltin, Tributyltin
Chlordane (Sum of 4 compounds)	Alpha-Chlordane, Heptachlor, Heptachlor-Epoxide, Trans-Nonachlor
Dieldrin (Sum of 2 compounds)	Aldrin, Dieldrin

* Currently 51 PCB congeners are quantified by the program.
** Currently 65 PAHs are quantified by the program.

Chemical Behavior

Chemical contaminants enter the environment through point or non-point sources. Point source pollution, such as industrial and municipal effluents from a pipe or smokestack, are more easily regulated. In contrast, pollution from non-point sources are diffuse releases of chemicals to the environment such as runoff from agricultural and urban lawns and volatilization of chemicals from land or water to the atmosphere. As a result, non-point source pollution is difficult to measure and regulate.

Once released, a chemical will interact with its environment based upon its unique chemical and physical properties, and the prevailing environmental conditions. These properties can be used to predict a chemical's movement (transport) and its transformation (fate) into other chemicals of greater or lesser environmental consequence. Once a chemical is regulated, over time one would expect a net decrease in the contaminant (parent compound) and net increase in transformation products. These processes can result in dilution and/or concentration of chemicals in specific environmental media, such as water, sediment or biota. Fate and transport processes are briefly summarized here. For a more detailed discussion, see Manahan (2005).

Atmospheric Fate and Transport

Atmosphere releases can occur from both point and nonpoint sources such as smokestack emission, motor vehicle exhaust, volatilization of pesticides from soil and plants, volcanic eruptions, and forest fires. Many chemical contaminants spend part of their life in the atmosphere bound to airborne particles and transported short or long distances. Contamination of remote environments including coastal areas occurs in the form of wet and dry deposits of particles.

Atmospheric transport, in contrast to other forms of chemical transport, results in diffuse regional, intercontinental and global distribution of contaminants, especially for persistent compounds that degrade slowly. Wide dispersion results in ambient levels being found globally. The "grasshopper effect" (global distillation) is a type of atmospheric transport whereby volatile chemicals released to the environment in lower (warmer) latitudes volatilize from land and surface waters and are transported in the atmosphere and redeposited in higher (cooler) latitudes. The process is repeated in "hops" and leads to a net gain in concentration at higher latitudes where these chemicals remain trapped. The Arctic and near Arctic environments have become a sink for some chemicals far from where they were used or released by human activities.

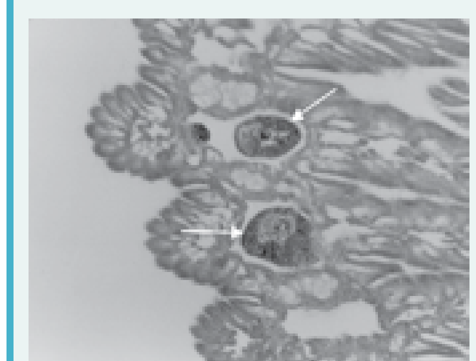
Aquatic Fate and Transport

Point and non-point sources of pollution to our streams, rivers and coastal waters have left a legacy of pollution in some areas from industrial discharges, along with agricultural and urban runoff. Contaminants that enter water may become more reactive, attach to suspended particles, settle to the bottom or be taken up by organisms. Resuspension of sediments can reintroduce contaminants to the overlying water column, thereby making sediments both a source and a sink for contaminants. In addition, sediment accumulation is also associated with permanent storage of contaminants.

Bioaccumulation

An organism's behavior and physiology, coupled with a chemical contaminant's physico-chemical properties and bioavailability, determine which compounds are taken up by an organism and the associated biological effects. Some chemicals may be toxic to an organism while others may simply accumulate in tissue without harm. Metals tend to accumulate in selected tissues such as liver, kidney or bone, while organic contaminants usually accumulate in fat tissues. Carnivores, particularly those at the top of the food chain (including humans), can be exposed to large amounts of contaminants that are accumulated in tissue of their prey. Mussels and oysters accumulate contaminants across their gills and by ingestion of particles. For some metals, mussels and oysters do not regulate concentrations in their tissue, but instead respond to changes in their immediate environment. Zebra mussels may have elevated levels of some metals as a result of differences between fresh and saline water chemistry.

Mussel Watch Histopathology



Ciliated parasites in *Crassostrea virginica*. Arrows indicate examples.

The histopathology component of the Mussel Watch Program, quantifies the stage of gamete development, and the prevalence of nearly 70 diseases and parasites found in mussels and oysters. Trends in histopathology data may help to assess the effects of global warming.

Special Event Sampling

Mussel Watch assesses environmental impacts in response to catastrophic events. By using historical Mussel Watch measurements, environmental impacts in affected areas are determined. Special event assessments include, but are not limited to:

- San Francisco Bay Cosco Busan oil spill
- Gulf Coast Hurricanes Katrina and Rita
- Delaware Bay Athos 1 oil spill
- Attack on the World Trade Center
- North Puget Sound Point Wells oil spill

Mussel Watch site under bridge in Mississippi after Hurricane Katrina.

Data Analysis and Interpretation

Results for each contaminant presented in this report are divided into two sections. Status provides a current measure of the degree of chemical contamination in the environment, while trends provides historical context about how concentrations have changed over time. This report provides our interpretation to help the reader better understand how human actions have resulted in what we see today. Armed with this information, the nation can take meaningful action to improve future coastal conditions. A short discussion of how we have chosen to convey both status and trends in this report follows. Understanding how these components are derived and presented is critical to the interpretation of information presented in results section of this report.

Status

The status of a contaminant was derived from the most recent (2004-2005) chemical concentration measurements taken at each sampling site. These site-specific measurements were assigned to a concentration range: high, medium or low. Ranges were calculated using a statistical procedure called "clustering" – or statistical classification – that partitions contamination levels into groups so that the data in each subset share a common trait. Numbers contained within a group are more like each other than any number in a different group. Cluster values are not associated with action levels or human health advisory concentrations. Each designated classification shows relative differences between sites. Clustering was performed on regional, national and summarized data as described below.

Concentration ranges for each contaminant were determined separately for each species group - mussels (*Mytilus species*), oysters (*Crassostrea virginica*) and zebra mussels (*Dreissena species*) - to account for species behavior and physiological differences that effect the levels of chemicals measured in their tissues. The results of these analyses appear in the Regional Species Comparison maps found in the Trace Metals and Organic Contaminant Status and Trends section. Species related concentration differences are found for some metals. For example, zinc and copper concentrations are usually 10 times higher in oysters than in mussels, whereas lead is often three times higher in mussels than in oysters. This implies that the presentation of Great Lakes results is distinct from the results of analysis of oysters, which are distinct from mussels. As such, it is equally important to note that each classification analysis will result in a separate high, medium or low category, and that when compared among species will not necessarily be the same range. As presented, the status can be viewed as a relative measure among locations that share a common species.

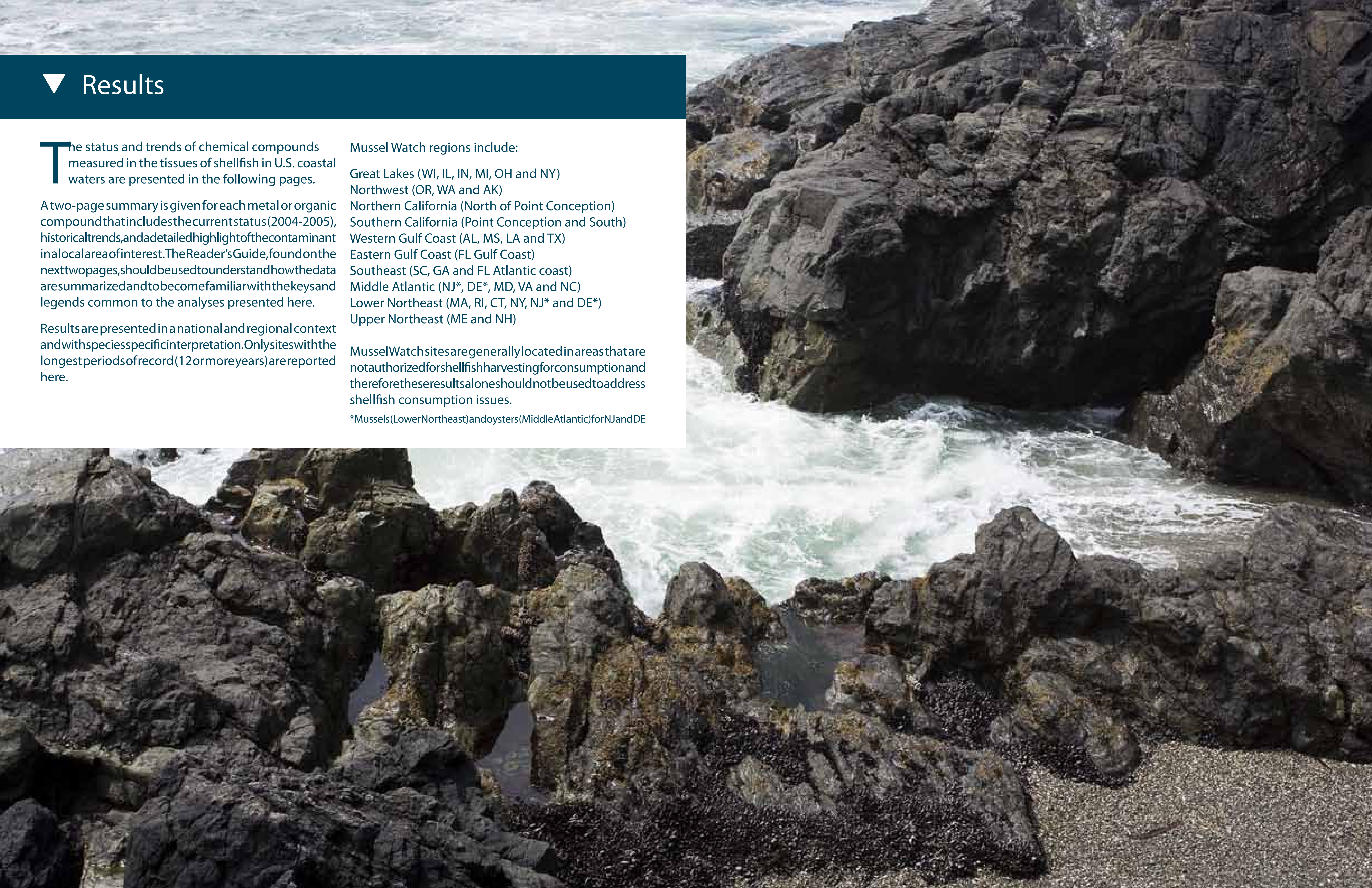
Towards developing an overall national summary, results of the aforementioned national assessment cluster analyses were used. Specifically, low, medium and high cluster results were numerically weighted by assigning each a value of 0, 1 and 2 respectively. For example, if a measurement for a metal was categorized as low it received a score of 0. For each site the numbers were added to determine the site with the most elevated concentrations of metals or organic contaminants. The results were grouped using cluster analysis, into three categories resulting in the low, medium and high categories that are found in the National Summary section of the results. Cluster analysis was applied to all concentration measurements, irrespective of species, to highlight national variability for each contaminant. This presentation can be used to make inter-species comparisons and assess national differences in contaminant concentration. Differences in species uptake will be apparent in the National Comparison Map and the Regional Comparison of Concentration bar charts.

Trends

Chemical concentration trends were assessed by correlating contaminant measurements with time. Spearman's rank correlation was used to evaluate whether concentrations co-varied predictably as a function of time (Zar, 1998). That is, as time progressed from the beginning of our monitoring records (1986) to the end of our records (2005), did the concentration of contaminants also progress in an increasing or decreasing manner? The Spearman's rank correlation procedure is a nonparametric technique that is free of assumptions about concentrations being normally distributed with a common variance about sites. The variables used for the Spearman's test were year and site concentration rank median (n=10). Concentration was standardized by ranking to allow for inter-species comparison.

Spearman's rank correlation statistical test was used to evaluate individual contaminants at the site, regional and national scales. Results are presented as decreasing (G), increasing (H) or exhibiting no trend (4). The symbology allows the reader to quickly ascertain if concentrations are changing. It is important to note that "no trend" is not necessarily an indication of a lack of management. Rather, it is possible that some contaminants are already at very low levels and that significant reductions are unlikely. As such, it is critical to keep the status component in mind as the reader interprets the trends section.

Great Lakes field sampling.



Results

The status and trends of chemical compounds measured in the tissues of shellfish in U.S. coastal waters are presented in the following pages.

A two-page summary is given for each metal or organic compound that includes the current status (2004-2005), historical trends, and a detailed highlight of the contaminant in a local area of interest. The Reader's Guide, found on the next two pages, should be used to understand how the data are summarized and to become familiar with the keys and legends common to the analyses presented here.

Results are presented in a national and regional context and with species specific interpretation. Only sites with the longest periods of record (12 or more years) are reported here.

Mussel Watch regions include:

Great Lakes (WI, IL, IN, MI, OH and NY)
Northwest (OR, WA and AK)
Northern California (North of Point Conception)
Southern California (Point Conception and South)
Western Gulf Coast (AL, MS, LA and TX)
Eastern Gulf Coast (FL Gulf Coast)
Southeast (SC, GA and FL Atlantic coast)
Middle Atlantic (NJ*, DE*, MD, VA and NC)
Lower Northeast (MA, RI, CT, NY, NJ* and DE*)
Upper Northeast (ME and NH)

Mussel Watch sites are generally located in areas that are not authorized for shellfish harvesting for consumption and therefore these results alone should not be used to address shellfish consumption issues.

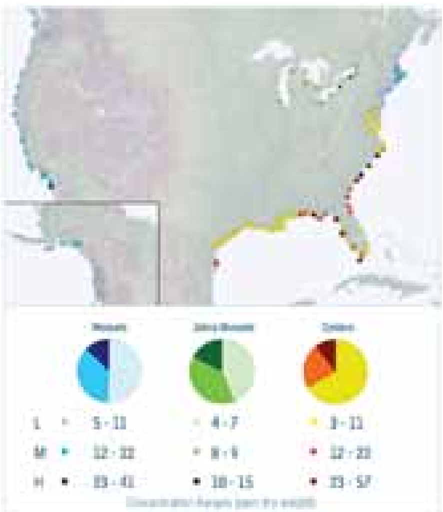
*Mussels (Lower Northeast) and oysters (Middle Atlantic) for NJ and DE

Status Summary

Nation at a Glance:

Look here to find one or more of the most significant findings from our analysis of this particular contaminant. We will draw your attention to items with national significance.

Regional Species Characterization



Colors indicate current levels of contamination, and are common to the map and pie chart summaries.

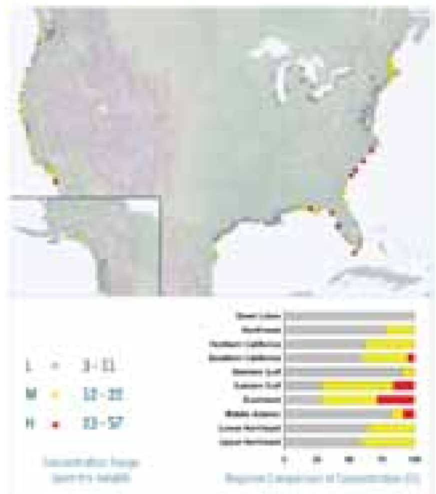
Color themes represent different organisms.

L = Low
M = Medium
H = High

Concentrationareinparts per million (ppm) for metalsandpartsperbillion (ppb) for organics.

Interpretation
The oyster pie chart indicates that for oysters, about 70% of sites along the Gulf, Southeastern and Middle Atlantic U.S. coasts exhibited low concentrations(3-11ppm),about23%exhibitedmediumconcentrations(12 - 22 ppm), and about 7% exhibited high concentrations (23 - 57 ppm).

National Characterization



This figure does not distinguishbetweenspecies and thus can be used for interspeciescomparisons.

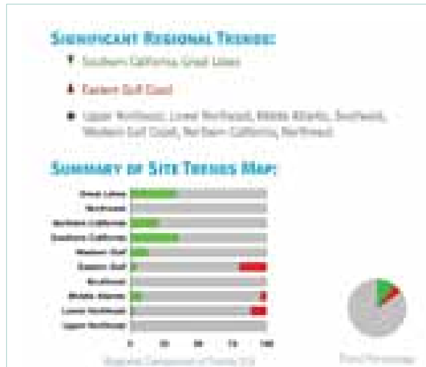
Regional comparison of contaminantconcentrations from National Characterization Map.

Interpretation
In this example, the bar chart indicates that in the Southeastern US, roughly25%ofsitesexhibitedlowconcentrations,50%exhibitedmedium concentrations , and 25% exhibited high arsenic concentrations.

Trends Summary

Site Trends

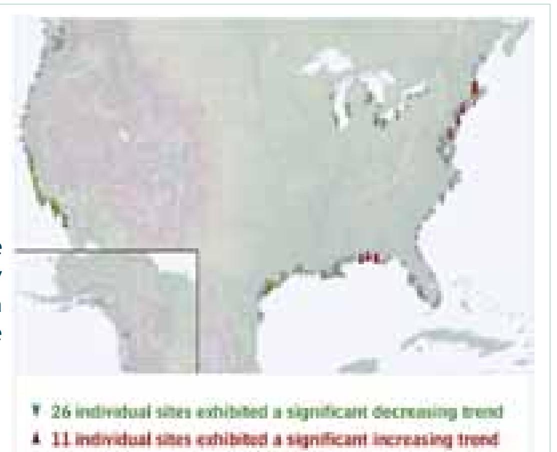
No Overall National Trend 4



Spearman's rank correlations used to determine nationalandsitetrends.Arrowcoloranddirection indicate contamination trends at each site.

Interpretation
Inthisexample,thepiechartindicatesthatforthe nation,roughly11%ofsitesexhibitedastatistically significant decreasing trend, 5% exhibited a statisticallysignificantincreasingtrend,andthe remaining 84% showed no discernable trend.

Summaryofnationaltrendspiechartgraphically displays the percentage of sites that have decreasing, increasing or have no trend.



Interpretation
Inthisexample,thebarchartindicatesthat in the Great Lakes, roughly 35% of sites exhibitedstatisticallysignificantdecreasing trends, while the remainder exhibited no discernable trend.

Chemical Description

Sources
Theprimarysources,relativeimportance,andoriginofcontaminants for the coastal ocean and Great Lakes are mentioned here.

Urbanareasrepresentamajorsourceofdiffuse pollution to U.S. coastal waters.

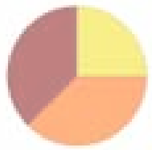
Toxicity
Exposurepathwaysandtoxicitytohumansisdiscussedherealong with any Food and Drug Administration (FDA) safety guidelines or threshold levels designed to protect human health. General informationaboutaquaticlifeexposure,bioaccumulationandtoxicity is also mentioned.

Fate and transport
Chemicalsreleasedtotheenvironmentaresubjecttophysical,chemicalandbiologicalforcesthatmaytransformortransportachemical.Themost importantprocessesrelativetothecoastalenvironmentarementioned,particularlyinregardtotransportfromsourcestosinksandpartitioningof a chemical between environmental matrices; including air, water, soil/sediment and biota.

Case Study Highlight

Detailed highlight map derived from Species Characterization Map.

Background
Astatementofrelevantfactsregardingthehighlightedregion.Each highlightedregionrepresentsanareawithuniqueresultsorareasof national concern.



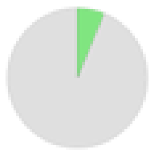
SummaryofHighlightStatus Map.

Status Map
- Significantcontaminantstatusfindingsforthehighlightedarea.
- ComparisonofStatusinsetmaptoRegionalSpeciesCharacterization Map.
- Discussion and comparison region based on the National Characterization Map.
- Overall interpretation of regional status.

No Trend 4

Detailedhighlightmapderivedfrom Site Trends Map.

Trend Map
- Regional trend statement
- Comparison to nation
- Overall interpretation of regional trend

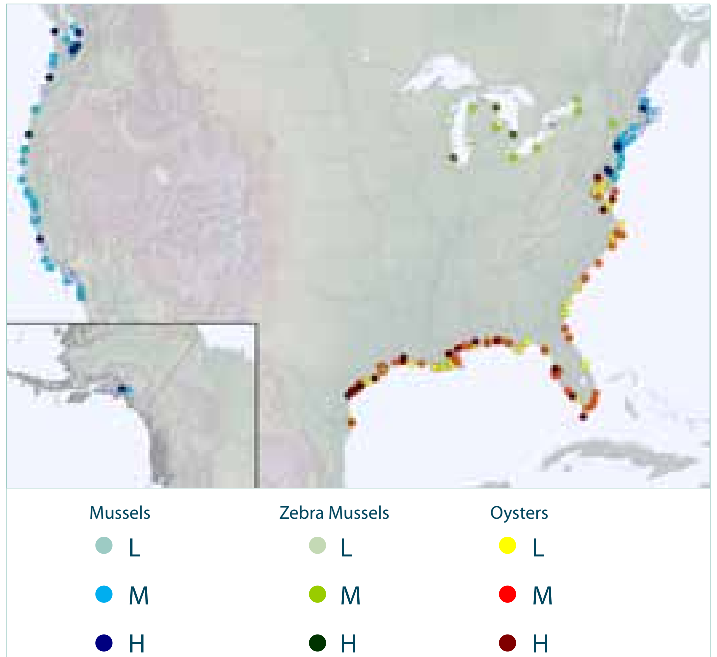


SummaryofHighlightTrends Map.

National Summary

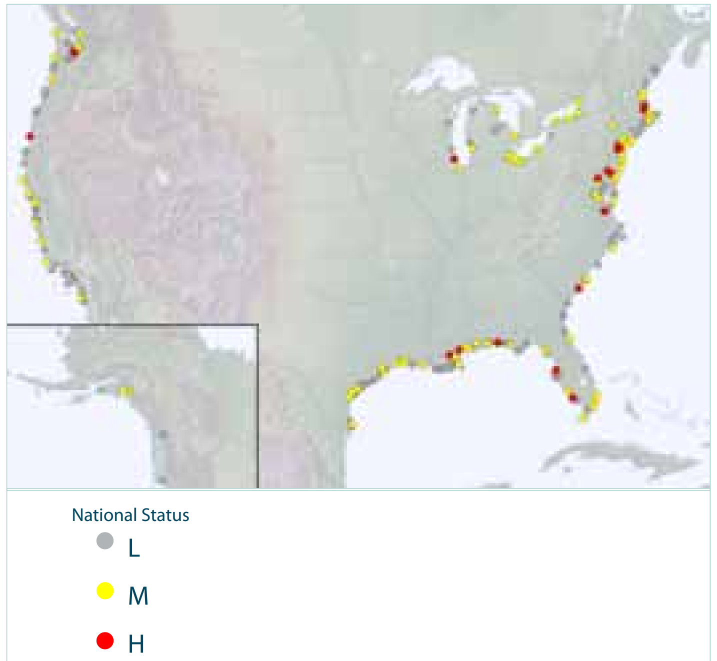
Metals Status

Regional Species Characterization



Regional concentrations are affected by both anthropogenic and natural phenomena.

National Characterization



High metal concentrations are associated with urbanized and industrialized regions.

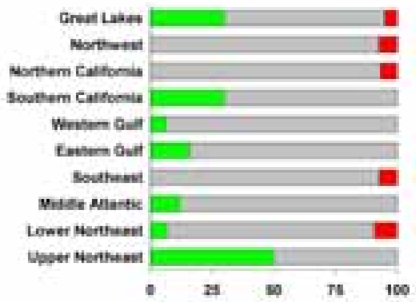
Metal Trends

Significant Regional Trends:

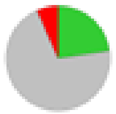
G Southern California

4UpperNortheast,LowerNortheast,MiddleAtlantic,Southeast,Eastern GulfCoast,WesternGulfCoast,NorthernCalifornia,Northwest,Great Lakes

Summary of Site Trends Map:



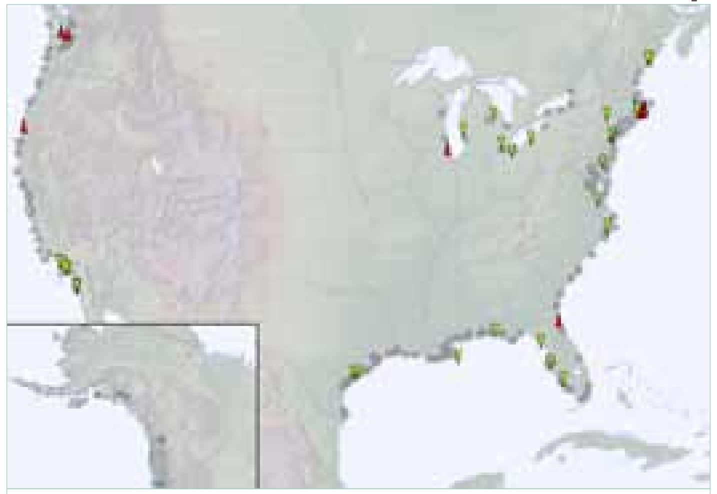
Regional Comparison of Trends (%)



Trend Percentage

Site Trends

No Overall National Trend 4



G 27 individual sites exhibited a significant decreasing trend

H 9 individual sites exhibited a significant increasing trend

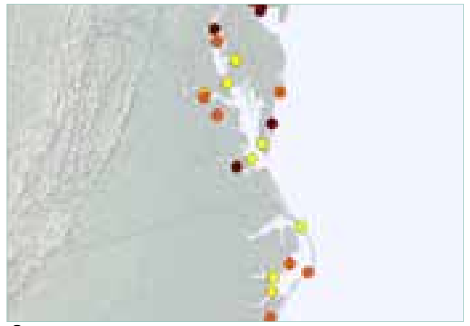
Metals Status

- Elevated levels of metals are found near urban and industrial areas.
- In Alaska elevated levels of metals occur naturally in some areas.
- Elevated levels of metals were found in oysters and mussels from Delaware Bay.
- Although different species accumulate metals at different rates, elevated summary levels were found throughout the country.
- The Middle Atlantic Region has the highest percentage of sites with medium and high concentrations.
- The Southern California Region has the lowest percentage of sites with elevated metal concentrations.
- Elevated levels of metals were found in mussels from the Hudson-Raritan Estuary.

Great Lakes Characterization

Zebra Mussels
4 Low 4 Medium 4 High

Middle Atlantic Characterization



Oysters
4 Low 4 Medium 4 High

Alaska Characterization

Mussels
4 Low 4 Medium 4 High

* Overall Status Findings

Urban and industrial areas represent the largest source of contaminants to the environment.

Metals Trends

- Nationally metal trends vary by site and region.
- Southern California has a regional decrease in metal concentrations.
- The Northeast shows a mixture of increasing and decreasing sites.

California Characterization

G Decreasing H Increasing

Northwest Characterization

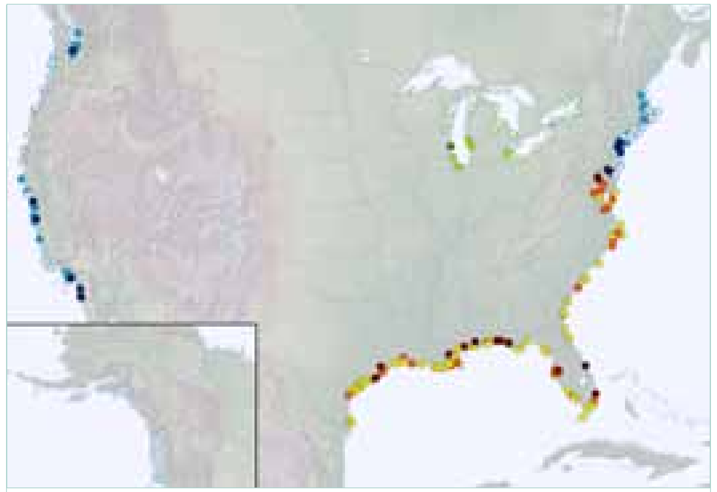
G Decreasing H Increasing

Northeast Characterization

G Decreasing H Increasing

Organic Status

Regional Species Characterization



Mussels
- L
- M
- H

Zebra Mussels
- L
- M
- H

Oysters
- L
- M
- H

Elevatedconcentrationsoforganiccontaminants are predominantly found in urban areas at the regional level.

National Characterization

National Status
- L
- M
- H

A small number of sites in urbanized areas have elevated concentrations nationally.

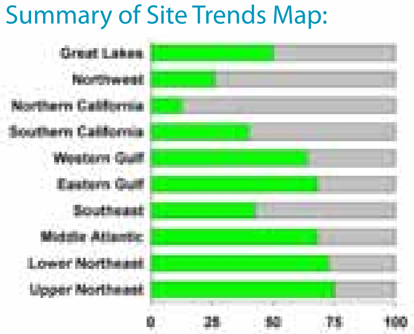
Organic Trends

Significant Regional Trends:

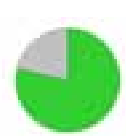
GUpperNortheast,LowerNortheast,MiddleAtlantic,Southeast,Eastern GulfCoast,WesternGulfCoast,SouthernCalifornia,Northwest,Great Lakes

4 Northern California

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

Site Trends

Decreasing National Trend G

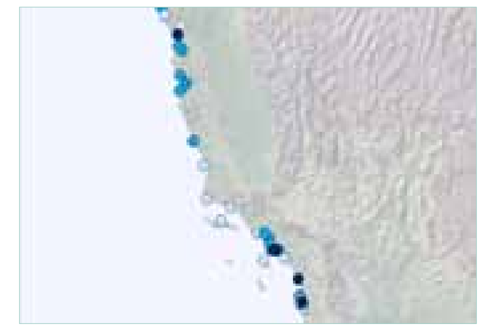
G 133 individual sites exhibited a significant decreasing trend

H 0 individual sites exhibited a significant increasing trend

Organic Status

- Elevated levels of organic contaminants are found near urban and industrial areas.
- Most organic contaminants do not have natural sources; yet, their distributions are ubiquitous.
- ElevatedlevelsoforganiccontaminantswerefoundinoystersandmusselsfromtheHudson-RaritanEstuaryinthesouthernNortheastregion.
- The Lower Northeast Region has the highest percentage of sites with elevated organic contaminant levels.
- The Eastern Gulf and Upper Northeast Regions have the lowest percentage of sites with elevated organic contaminant levels.
- TheSouthernCaliforniaRegionhasthehighestpercentageofmediumandhighorganiccontaminantconcentrationlevels,asresultofhistoric use and manufacturing of TBT and DDT, respectively.

California Characterization



Mussels
4 Low 4 Medium 4 High

Northeast Characterization

Mussels
4 Low 4 Medium 4 High

Northwest Characterization

Mussels
4 Low 4 Medium 4 High

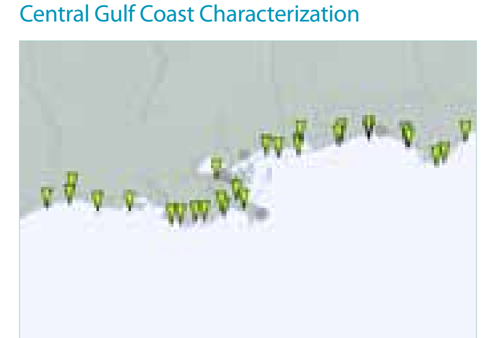
* Overall Status Findings

Organic contaminants are higher in areas of historic use and production.

Organic Trends

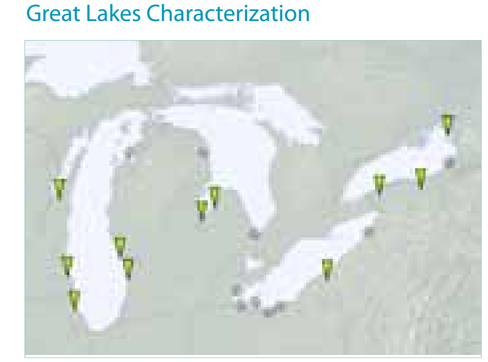
- Areaswiththehighestlevelsoforganicsareexperiencingdecliningconcentrations,especiallyinSouthernCaliforniaandtheCentralGulf.
- Theregionsthathistoricallyhadthehighestorganiccontaminantconcentrationsnowhavethehighestpercentageofdecliningconcentration trends.
- The Great Lakes and the Middle Atlantic both show significant decreasing regional trends.

Central Gulf Coast Characterization



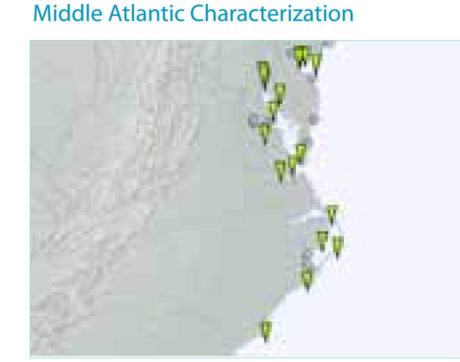
G Decreasing H Increasing

Great Lakes Characterization



G Decreasing H Increasing

Middle Atlantic Characterization



G Decreasing H Increasing

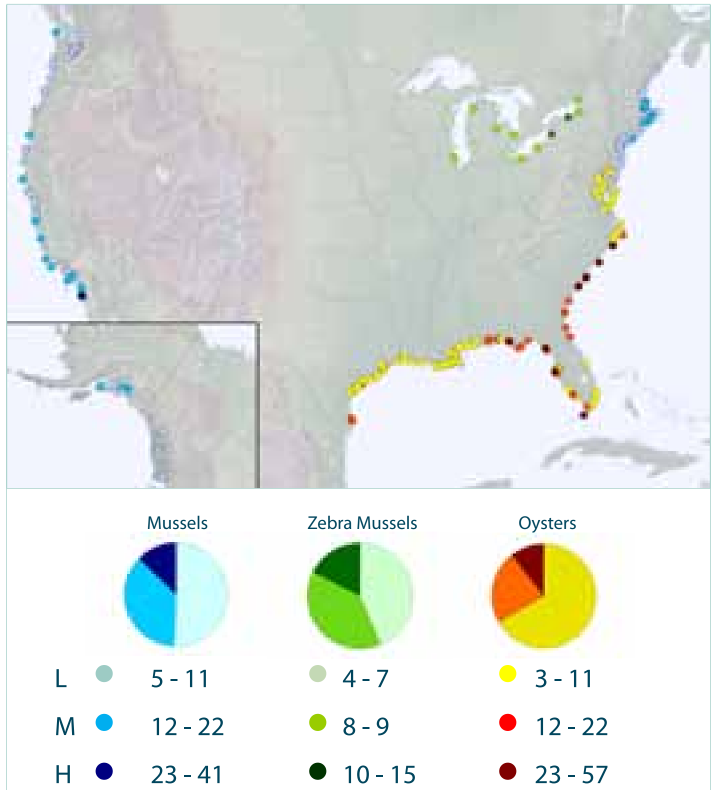
Trace Metal and Organic Contaminant Status and Trends

Nation at a Glance:

Status Summary

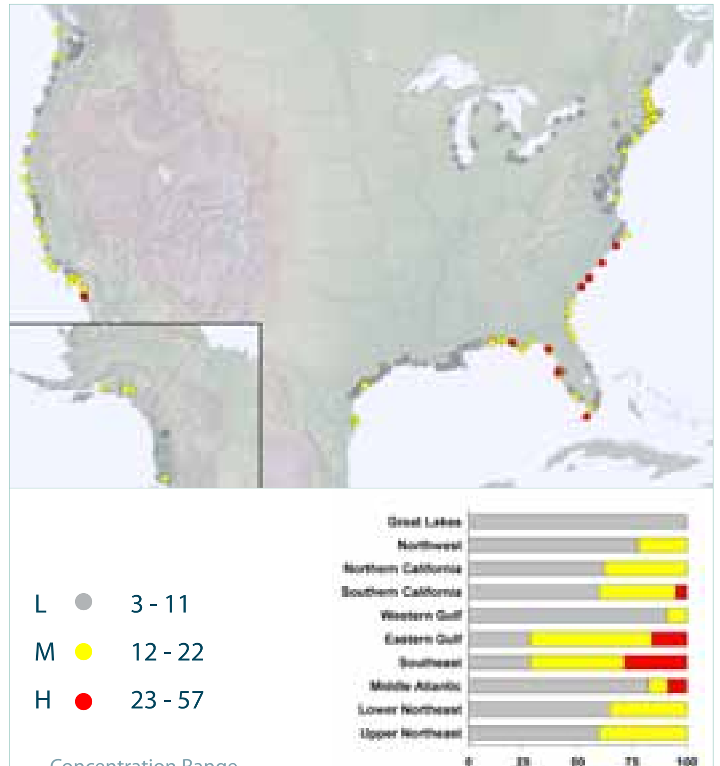
Elevated arsenic levels are associated with natural land-based sources. None of the measurements exceed the FDA action level.

Regional Species Characterization



Concentration Ranges (ppm dry weight)

National Characterization



Concentration Range (ppm dry weight)

Regional Comparison of Concentration (%)

Trends Summary

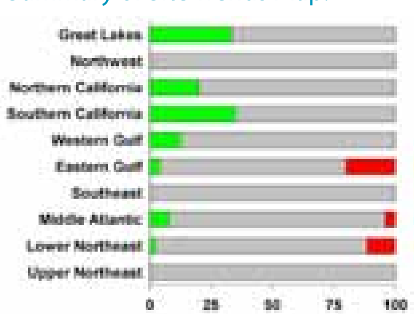
Significant Regional Trends:

G Western Gulf Coast, Southern California, Great Lakes

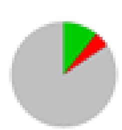
H Eastern Gulf Coast

4 Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Northern California, Northwest

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

Site Trends

Decreasing National Trend G

G 26 individual sites exhibited a significant decreasing trend

H 11 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Arsenic is found in the environment at high levels as a result of natural sources and industrial production. Products that contain arsenic include: preserved wood, semiconductors, pesticides, defoliants, pigments, antifouling paints, and veterinary medicines. In the recent past, as much as 90% of arsenic was used for wood preservation (ATSDR, 2007a). Atmospheric sources of arsenic include smelting, fossil fuel combustion, power generation, and pesticide application.

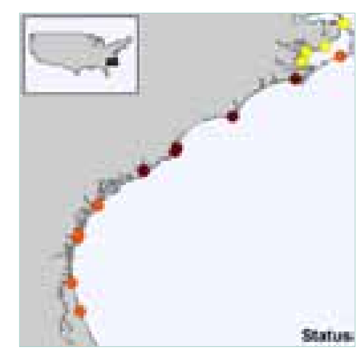
Toxicity

Arsenic is toxic at high concentrations to fish, birds and plants. In animals and humans prolonged chronic exposure is linked to cancer (Goyer, 1986). Inorganic arsenic, the most toxic form, represents approximately 10% of total arsenic in bivalves. Less harmful organic forms, such as arsenobetaine, predominate in seafood (Edmonds and Francesconi, 1977, 1988, 1993; Phillips, 1990; FDA, 1993a). The FDA action level for arsenic in clams, oysters and mussels is 86 ppm wet weight (FDA, 2001). In years 2004-2005 of the Mussel Watch Program, a maximum arsenic concentration of 4.8 ppm wet weight was measured in Beaufort Inlet, North Carolina (BIPI).

Fate and Transport

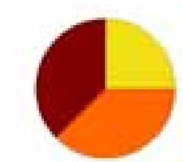
Centuries of human activities have changed the natural biogeochemical cycle of arsenic resulting in contamination of land, water and air. Movement of arsenic to coastal and estuarine water occurs primarily from river runoff and atmospheric deposition. The major source of elevated levels of arsenic in the nation is natural crustal rock. This is important because it affects concentrations on the regional level. As it relates to trend analysis, continuous natural sources are associated with neither decreasing nor increasing trends.

Southeast Highlight



Background

The Savannah River basin drains an area that encompasses a Department of Energy Superfund site known to have elevated levels of metal contaminants (WSRC, 1997). However, relatively high levels of arsenic in the Southeast region are of geologic origin (Valette-Silver et al., 1999).



ConcentrationPercentage

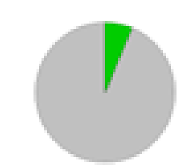
Status

- Elevated levels of arsenic exist in the Southeast.
- Arsenic in oysters from the Southeast is among the highest in the nation for all species.
- Arsenic concentrations are elevated compared to the rest of the nation, but still are an order of magnitude lower than the FDA action level.

No Trend 4

Trends

- In contrast to the nation, there is no trend for the Southeast region.
- The Southeast region has a low percentage of decreasing sites.



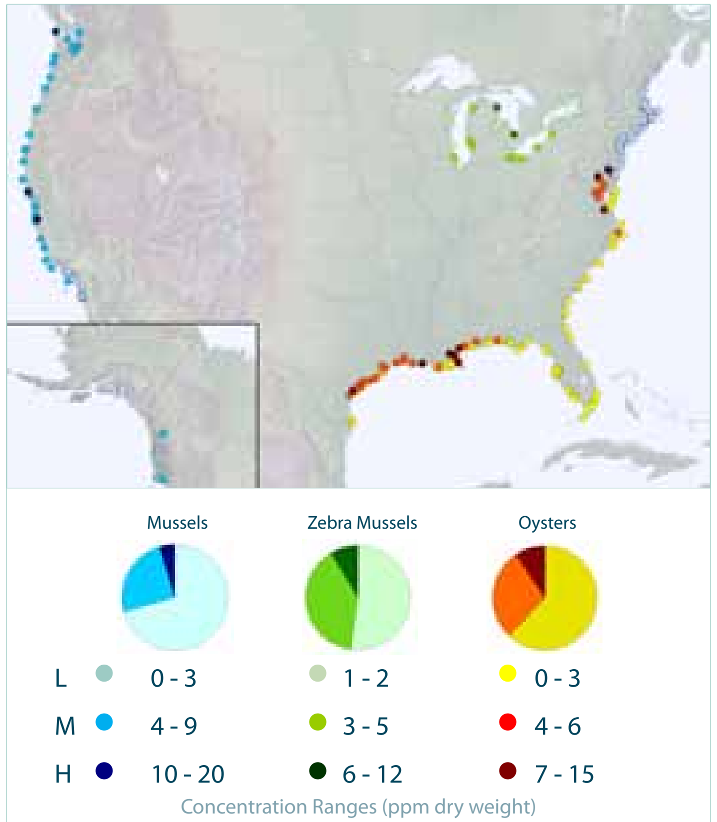
TrendPercentage

Nation at a Glance:

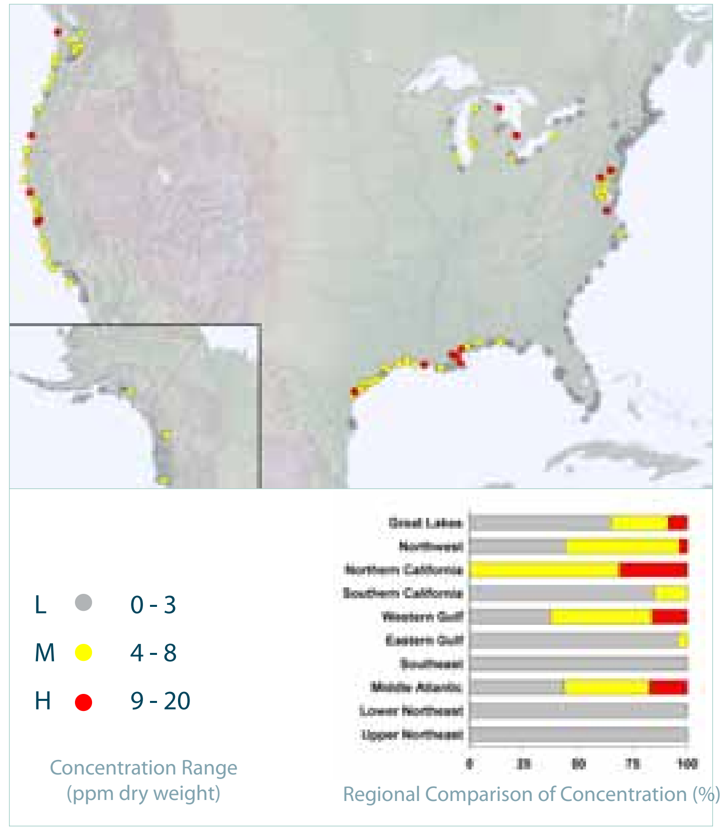
Status Summary

High and medium cadmium measurements are absent from the Northeast and Southeast regions. None of the cadmium measurements exceed the FDA action level.

Regional Species Characterization



National Characterization



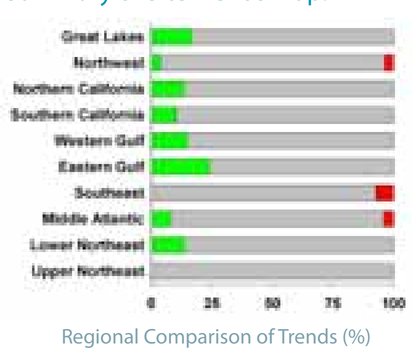
Trends Summary

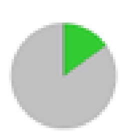
Significant Regional Trends:

G Western Gulf Coast

4 Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

Summary of Site Trends Map:





Site Trends

Decreasing National Trend G

G 29 individual sites exhibited a significant decreasing trend

H 3 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Cadmium occurs naturally in the earth's crust as complex oxides and sulfides in ores (Plachy, 2003) but is not an essential element for life. In addition to the abundant industrial applications, other products that contain cadmium include: batteries, color pigment, plastics and phosphate fertilizers. Industrial sources and uses include: zinc, lead and copper production; electroplating and galvanizing; smelting; mining; fossil fuel burning; waste slag; and sewage sludge (ATSDR, 1999a; FDA 1993b). Anthropogenic emissions, originating from a large number of diffuse sources, exceed natural emissions.

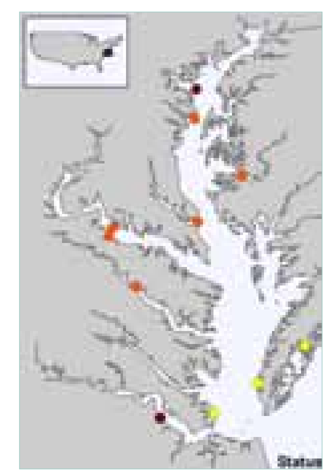
Toxicity

Cadmium is toxic to fish, salmonoid species and juveniles are especially sensitive, and chronic exposure can result in reduction of growth. Respiration and food represent the two major exposure pathways for humans to cadmium; exposure to high levels occurs primarily as a result of occupational exposure. The FDA action level for cadmium in clams, oysters and mussels is 4 ppm wet weight (FDA, 2001). In years 2004-2005 of the Mussel Watch Program, a maximum cadmium concentration of 1.6 ppm wet weight was measured in Delaware Bay.

Fate and Transport

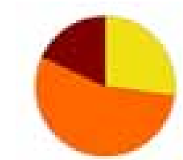
Environmental contamination of cadmium in coastal and estuarine environments can be linked to both natural and non-point anthropogenic sources (Roesijadi, 1984). Natural sources can be linked to river runoff from cadmium rich soils, leaching from bedrock, and upwelling from marine sediment deposits (Sokolova et al., 2005). As a result of fossil fuel burning, erosion, and biological activities, cadmium is transported by atmospheric processes. Land-based runoff and ocean upwelling are the main conveyors of cadmium into coastal environments. Nationally, elevated cadmium levels are primarily located in freshwater-dominated estuaries (e.g., Mississippi Delta, Great Lakes and Chesapeake Bay; see status chart) consistent with river transport of cadmium to coastal environments.

Chesapeake Bay Highlight



Background

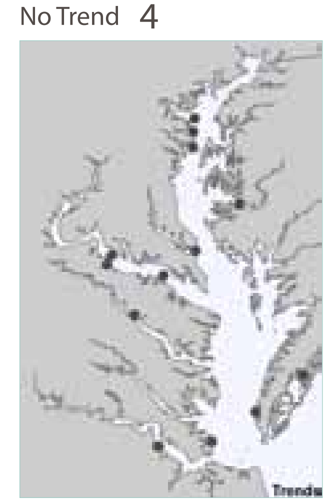
Cadmium is identified as a toxin of concern by the Chesapeake Bay Program. Inputs of cadmium were estimated to be 27,800 kg/year (Eskin et al., 1996). The Chesapeake Bay watershed stretches across five states (NY, PA, MD, DE, VA) and the District of Columbia and is a mixed use watershed with some developed and industrialized areas. Chemical contaminant discharge into the Bay originates from industrial wastewater discharge, urban stormwater runoff, and atmospheric deposition (Chesapeake Bay Program, 1999).



Status

- The Chesapeake Bay has a much higher proportion of high and medium measurements relative to oysters nationwide.
- In comparison to the nation, the Chesapeake Bay has elevated levels of cadmium.

No Trend 4



Trends

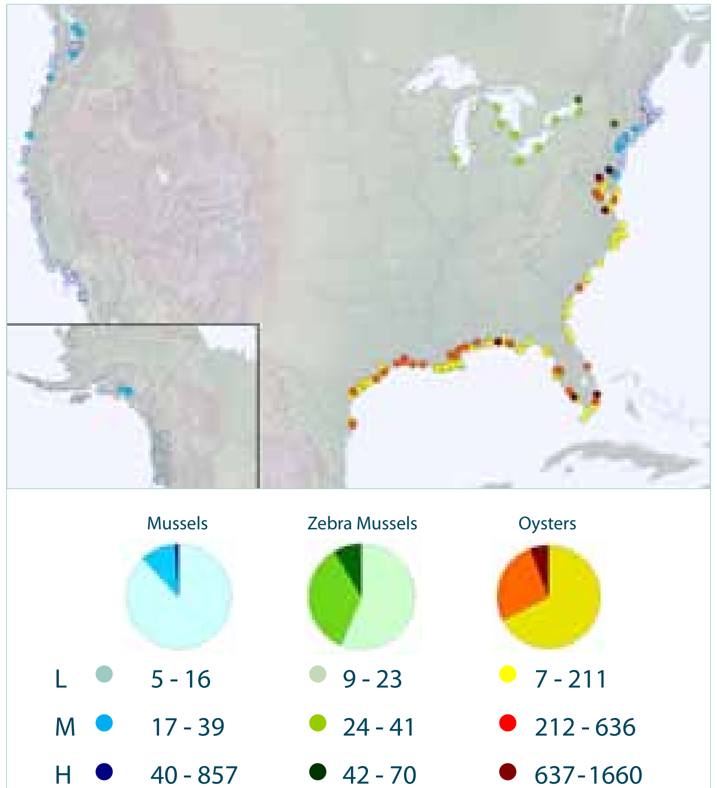
- As a region there is no cadmium trend.
- Cadmium is of a particular concern in Chesapeake Bay because, in contrast to the nation, its concentration is not decreasing despite years of restoration efforts.

Status Summary

Nation at a Glance:

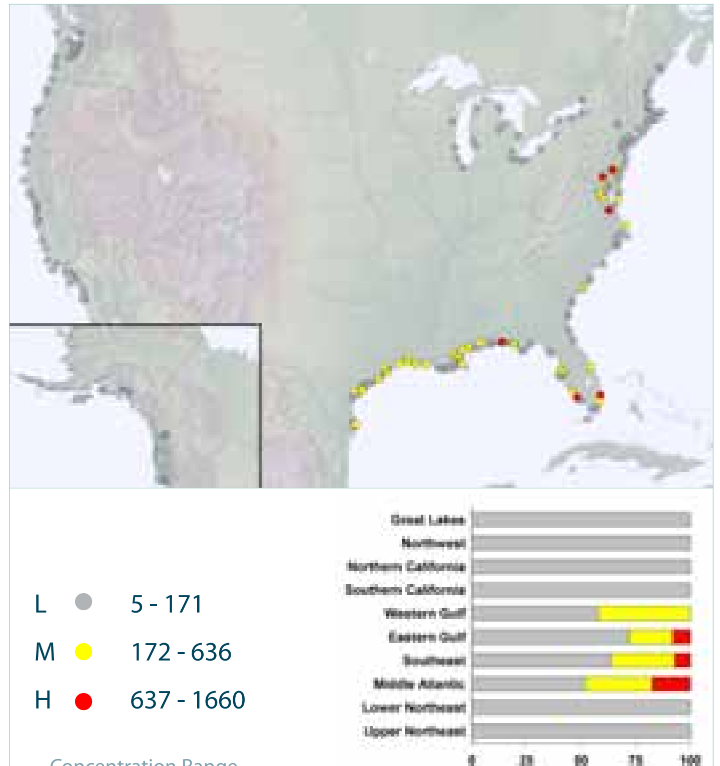
The highest concentrations are observed in oysters, which have an enhanced ability to concentrate copper, relative to mussels and zebra mussels.

Regional Species Characterization



Concentration Ranges (ppm dry weight)

National Characterization



Concentration Range (ppm dry weight)

Regional Comparison of Concentration (%)

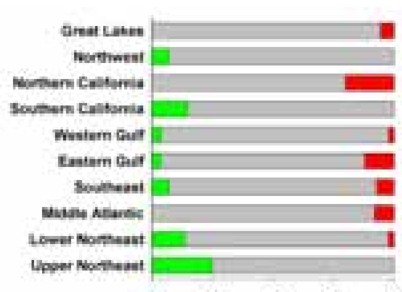
Trends Summary

Significant Regional Trends:

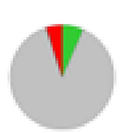
G Southern California

4 Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Eastern Gulf Coast, Northern California, Northwest, Great Lakes

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

Site Trends

No Overall National Trend 4

G 16 individual sites exhibited a significant decreasing trend

H 12 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Copper is a naturally occurring element that is ubiquitous in the environment. Trace amounts of copper are an essential nutrient for plants and animals. Anthropogenic sources include: mining, manufacturing, agriculture, sewage sludge, antifouling paint, fungicides, wood preservatives, and vehicle brake pads (ASTDR, 2004; Denier van der Gon et al., 2007). The U.S. ranks third in the world for utilization and second in production. The EPA phase-out of chromated copper arsenate (CCA) wood preservatives and the 1980s restrictions on tributyltin marine antifouling paint has stimulated a transition to copper-based wood preservatives and marine antifouling paint.

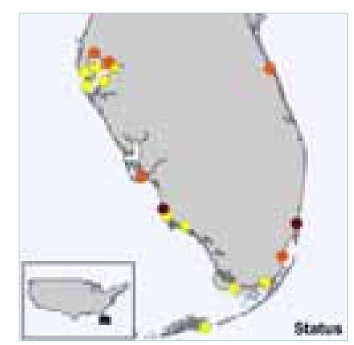
Toxicity

Copper can be toxic to aquatic organisms; juvenile fishes and invertebrates are much more sensitive to copper than adults. Although copper is not highly toxic to humans, chronic effects of copper occur as a result of prolonged exposure to large doses and can cause damage to the digestive tract and eye irritation (ATSDR, 2004). There is no recommended FDA safety level for copper in fish and fish products.

Fate and Transport

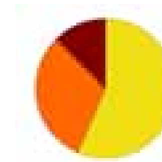
The most common form of copper in water is Cu(II), it is mostly found bound to organic matter. Transport of copper to coastal and estuarine water occurs as a result of runoff and river transport. Atmospheric transport (Denier van der Gon et al., 2007) and deposition of particulate copper into surface waters may also be a significant source of copper to coastal waters.

South Florida Highlight



Background

In a special study of oyster tissue from five sites in southeast Florida (St. Lucie River), elevated levels of copper were attributed to copper used in agriculture (Hameedi, et al. 2006). Copper is an active ingredient in some antifouling paints, fungicides and algaecides, which are heavily used in the region (USGS, 2008; Srinivasan and Swain, 2006; Gianessi, et al., 2002; Leslie, 1992).

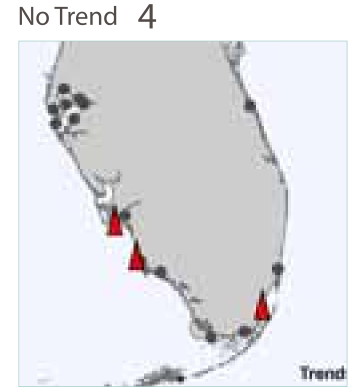


ConcentrationPercentage

Status

- The proportion of middle and high sites found in South Florida is similar to those found nationally.
- Two of the sites in South Florida are among the highest in the nation.

No Trend 4



Trends

- As a region, South Florida copper does not have a significant trend.
- Three sites, located near urban population centers on the Gulf and Atlantic Coasts (Fort Myers, Naples Bay, and Gould's Canal in southern Biscayne Bay), have increasing copper trends.
- No site in South Florida has a decreasing trend.

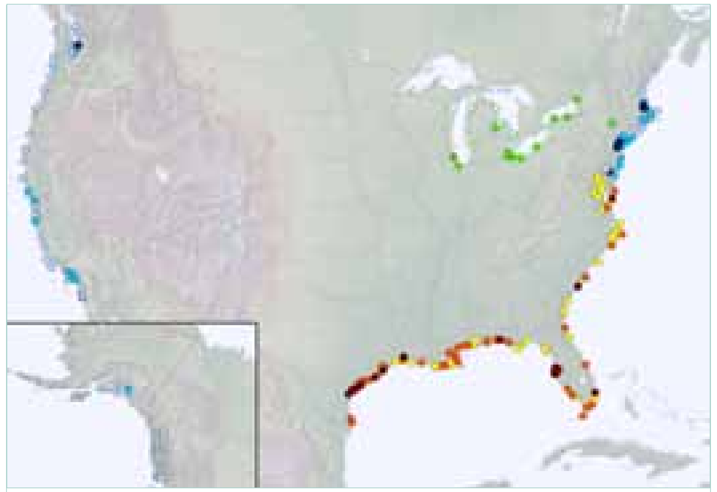
TrendPercentage

Status Summary

Nation at a Glance:

The highest concentrations of lead are found in mussels near urban and industrial centers.

Regional Species Characterization



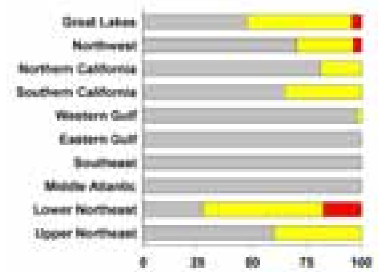
	Mussels	Zebra Mussels	Oysters
L	0 - 3	0 - 2	0.1-0.5
M	4 - 6	3 - 4	0.6-0.9
H	7 - 13	5 - 18	1.0-2.2

Concentration Ranges (ppm dry weight)

National Characterization

L	0 - 2
M	3 - 6
H	7 - 18

Concentration Range (ppm dry weight)



Regional Comparison of Concentration (%)

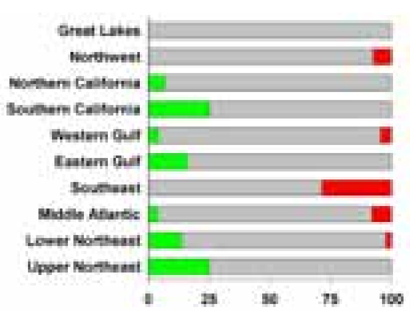
Trends Summary

Significant Regional Trends:

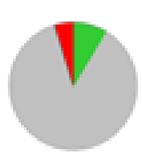
G Lower Northeast, Southern California

4 Upper Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Northern California, Northwest, Great Lakes

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

Site Trends

No Overall National Trend 4

G 20 individual sites exhibited a significant decreasing trend

H 11 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Lead is a ubiquitous metal that occurs naturally in the earth's crust. Environmental levels of lead increased worldwide over the past century because of leaded gasoline use (ATSDR, 2007b). Significant reductions in source and load resulted from regulation of leading gasoline and lead based paints. High levels found in the environment are usually linked to anthropogenic activities such as manufacturing processes, paint and pigment, solder, ammunition, plumbing, incineration and fossil fuel burning. In the communications industry, lead is still used extensively as protective sheathing for underground and underwater cables, including transoceanic cable systems (USGS, 2008).

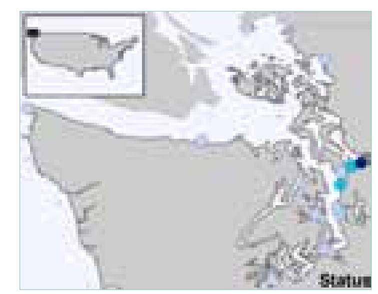
Toxicity

Lead has no biological use and is toxic to many organisms, including humans. Exposure of fish to elevated concentrations of lead results in neurological deformities and black fins in fish (Mance, 1987). Lead primarily affects the nervous system, which results in decreased mental performance and mental retardation in humans. Exposure to lead may also cause brain and kidney damage, and cancer (IARC, 2006). The FDA action level for lead in clams, oysters and mussels is 1.7 ppm wet weight (FDA, 2001 and 1993c). In years 2004-2005 of the Mussel Watch Program, a maximum lead concentration of 1.9 ppm wet weight was measured in Lake Michigan.

Fate and Transport

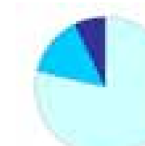
Loadings of lead into coastal waters are primarily linked with wastewater discharge, river runoff, atmospheric deposition and natural weathering of rock. Lead can be found in air, soil and surface water. (ATSDR, 2007b).

Puget Sound Highlight



Background

Lead contamination in Puget Sound resulted in elevated concentrations in fish, and has been identified as a chemical of concern based on an evaluation performed by the Puget Sound Action Team (2007)

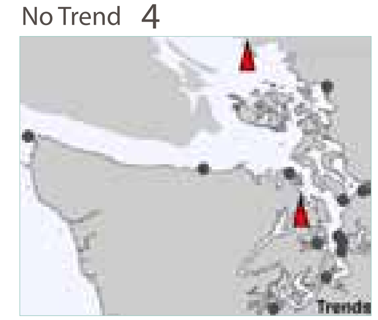


ConcentrationPercentage

Status

- Three sites with the highest levels in Puget Sound were Mukilteo Ferry, Everett Harbor and Edmonds Ferry.
- The proportion of low, medium and high is similar to mussels nationally, but is different than proportions for oysters and zebra mussels.

No Trend 4



Trends

- Two sites in Puget Sound have significant increasing trends; however, as a region there is no significant trend.
- In comparison to the national trend, the overall proportion of sites with increasing lead is higher in Puget Sound.

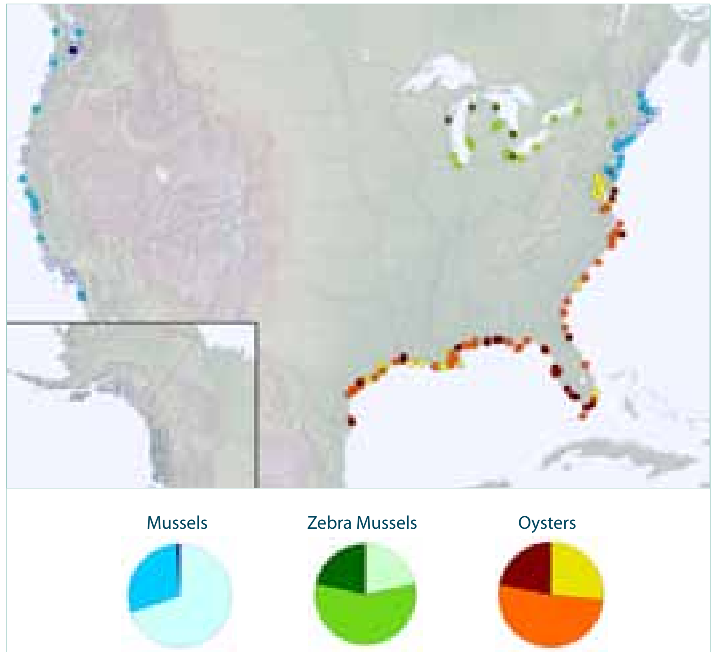
TrendPercentage

Status Summary

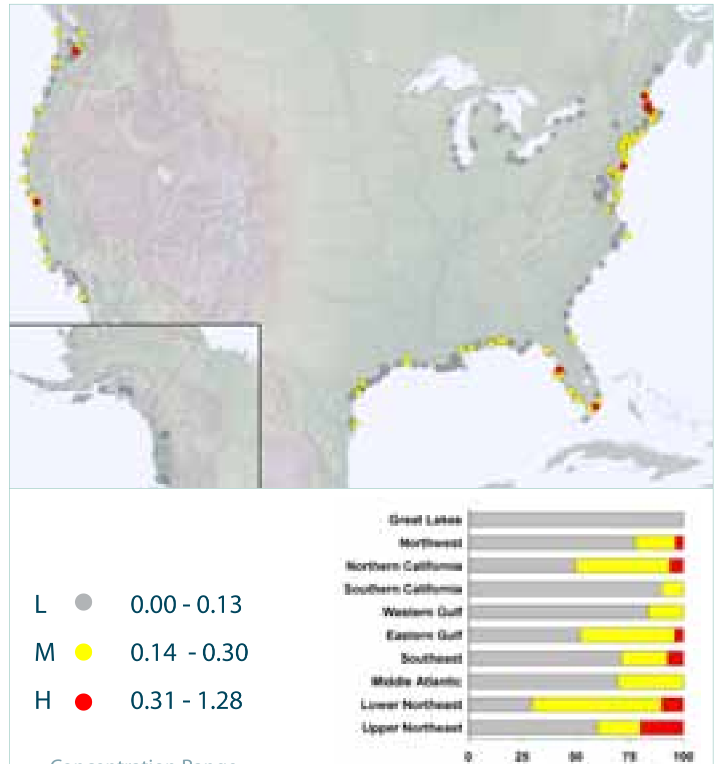
Nation at a Glance:

The national characterization map indicates medium and high concentrations are spread throughout the nation with the exception of the Great Lakes and Alaska. Relative to mussels and oysters, zebra mussels have low concentrations.

Regional Species Characterization



National Characterization



Trends Summary

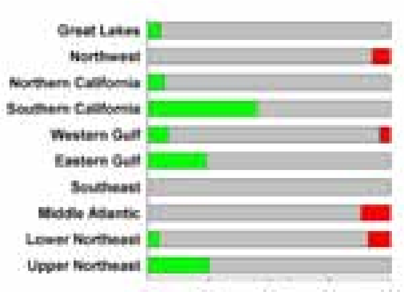
Significant Regional Trends:

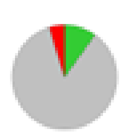
G Upper Northeast, Eastern Gulf Coast, Southern California

H Middle Atlantic

4 Lower Northeast, Southeast, Western Gulf Coast, Northern California, Northwest, Great Lakes

Summary of Site Trends Map:




Trend Percentage

Site Trends

No Overall National Trend 4

G 24 individual sites exhibited a significant decreasing trend

H 11 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Mercury is a highly toxic, non-essential trace metal that occurs naturally. Elevated levels occur as a result of human activity (ATSDR, 1999b). In the U.S., coal fired-electric turbines, municipal and medical waste incinerators, mining, landfills, and sewage sludge are the primary emitters of mercury into the air.

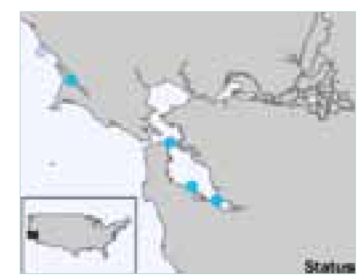
Toxicity

Mercury is a human neurotoxin that also affects the kidneys and developing fetuses. The most common human exposure route for mercury is the consumption of contaminated food. The FDA has not established a safety level for mercury but has set an action level of 1.0 ppm wet weight for methylmercury (FDA, 2001). The Mussel Watch Program measures total mercury. Children, pregnant women or women likely to become pregnant are advised to avoid consumption of swordfish, shark, king mackerel and tilefish and should limit consumption of fish and shellfish recommended by FDA and EPA.

Fate and Transport

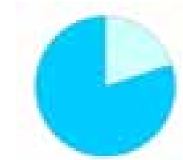
In the environment, mercury may change forms between elemental, inorganic and organic. Natural sinks, such as sediment and soil, represent the largest source of mercury to the environment. Estimates suggest that wet and dry deposition accounts for 50-90% of the mercury load to many estuaries, making atmospheric transport a significant source of mercury worldwide. Long range atmospheric transport is responsible for the presence of mercury at or above background levels in surface waters in remote areas.

San Francisco Highlight



Background

Mercury has been identified as one of the top water quality concerns in San Francisco Bay (SFEI, 2005). Mining in local watersheds of Tomales Bay and San Francisco Bay have left a legacy of sediment contamination. Sediment concentrations throughout San Francisco Bay exceed the Total Mean Daily Limit (TMDL) regulatory target (SFEI, 2005).


Concentration Percentage

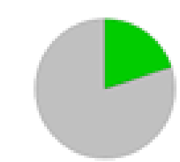
Status

- Elevated mercury levels were measured throughout San Francisco Bay and in Tomales Bay at Point Reyes National Seashore.
- San Francisco Bay measurements are amongst the highest in the nation.

Decreasing Trend G

Trends

- San Francisco Bay has a higher mercury concentration than the national average, but has a significant decreasing trend.

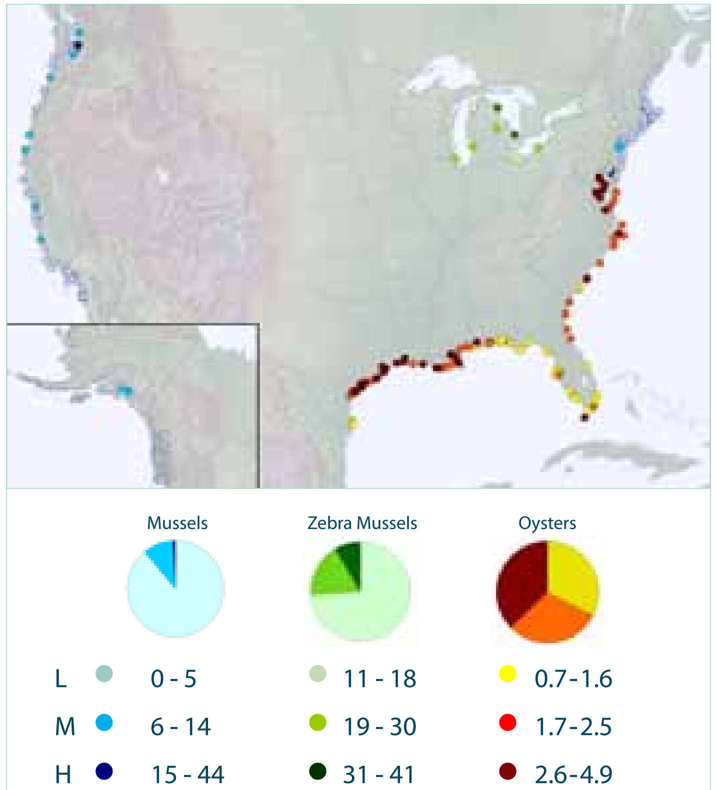

Trend Percentage

Status Summary

Nation at a Glance:

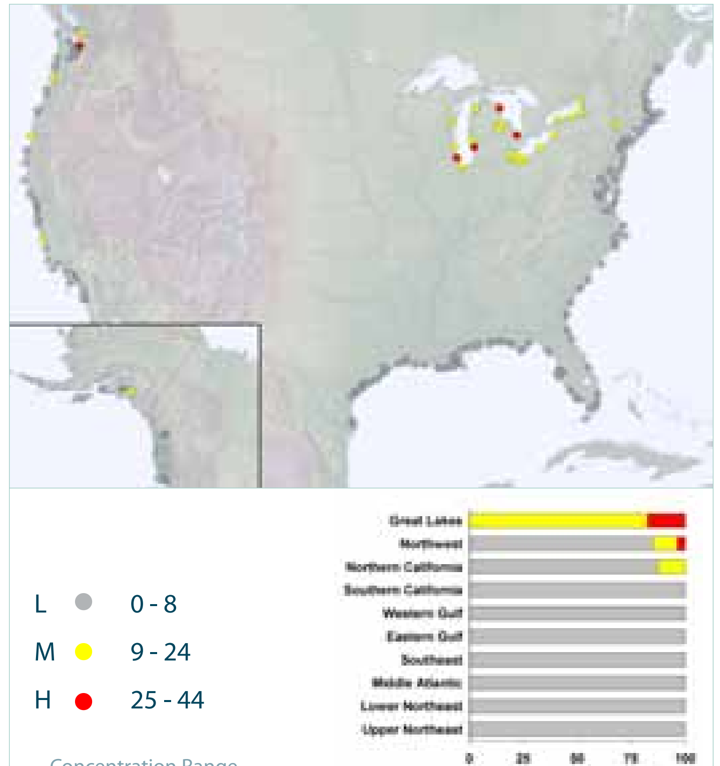
The highest concentrations of nickel occur in the Great Lakes. All other regions in the nation generally exhibit low concentrations. None of the measurements exceed the FDA action level.

Regional Species Characterization



Concentration Ranges (ppm dry weight)

National Characterization



Concentration Range (ppm dry weight)

Regional Comparison of Concentration (%)

Trends Summary

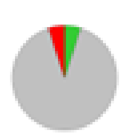
Significant Regional Trends:

G Middle Atlantic

4 Upper Northeast, Lower Northeast, Southeast, Eastern Gulf Coast, Western Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

Summary of Site Trends Map:

Regional Comparison of Trends (%)



Trend Percentage

Site Trends

No Overall National Trend 4

G 12 individual sites exhibited a significant decreasing trend

H 12 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Nickelisanaturallyoccurring,biologicallyessentialtraceelementthatiswidelydistributedintheenvironment.Itexistsinitsalloyformandasa solubleelement.Nickelisfoundinstainlesssteel,nickel-cadmiumbatteries,pigments,computers,wire,andcoinage;andisusedforelectroplating (ATSDR, 2005b).

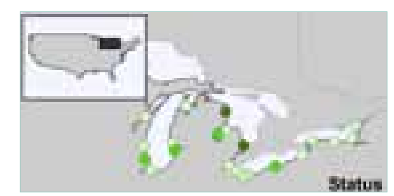
Toxicity

Foodisthemajorsourceofhumanexposuretonickel(ATSDR,2005b).Exposuretolargedosesofnickelcancauseserioushealtheffects,such asbronchitis,whilelong-termexposurecanresultincancer.TheFDAhasestablishedanactionlevelof80ppmwetweightfornickelinshellfish (FDA,2001and1993d).Inyears2004-2005oftheMusselWatchProgram,amaximumnickelconcentrationof10ppmwetweight(equivalent)was measuredinPugetSound(PSMF).Thereisnoevidencethatnickelbiomagnifiesinthefoodchain(McGeeretal.,2003;Suedeletal.,1994).

Fate and Transport

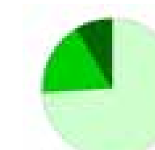
Nickelderivedfromweatheringrocksandsoilistransportedtostreamsandriversbyrunoff.Itaccumulatesinsedimentandbecomesinertwhen itisincorporatedintominerals.Riverandstreaminputofnickelarethelargestsourcesforoceansandcoastalwaters.Atmosphericsourcesare usuallynotsignificant,exceptintheGreatLakeswheretheatmosphericinputofnickelaccountsfor60-80%ofthetotalanthropogenticinputtoLake Superior and 20-70% of total inputs to Lakes Erie and Ontario (Nriagu et al., 1996).

Great Lakes Highlight



Background

Possiblesourcesinthisregionincludeminingandsmeltingoperationsin Sudbury, Ontario, Canada where the largest nickel smelting operation in the western hemisphereisfound.EPAthroughitsGreatLakesSedimentRemediationactivities found that sediment contaminated with nickel and other contaminants are a significantproblemandraisedconcernaboutpotentialrisksto aquaticorganisms and humans (EPA, 2004) .

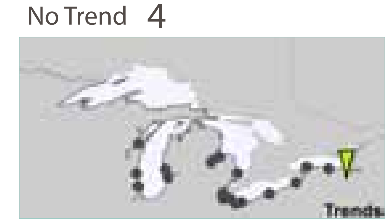


ConcentrationPercentage

Status

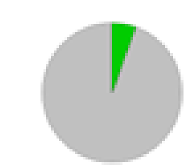
- Whencomparedtobothmusselsandoysters,concentrationsinzebramussels from the Great Lakes are relatively high.
- AlthoughthehighestsitesoccurinLakeHuronandthelowestinLakeOntario, allmeasurementsarehigherthanthosefoundinotherregionsforoystersand mussels.

No Trend 4



Trends

- Proportionallythepercentageofdecreasingsitesissimilartowhatisseenfor the nation.



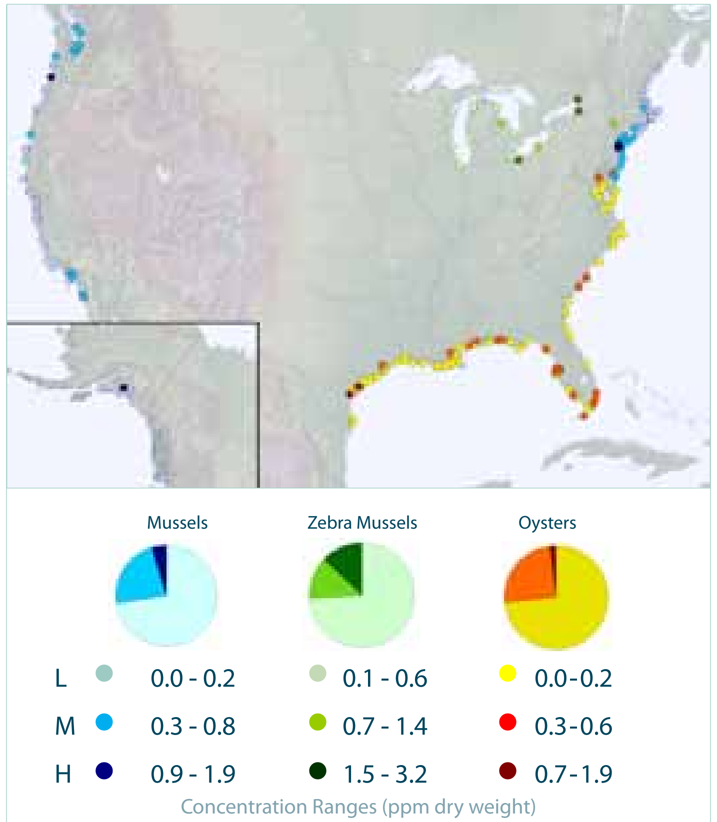
TrendPercentage

Status Summary

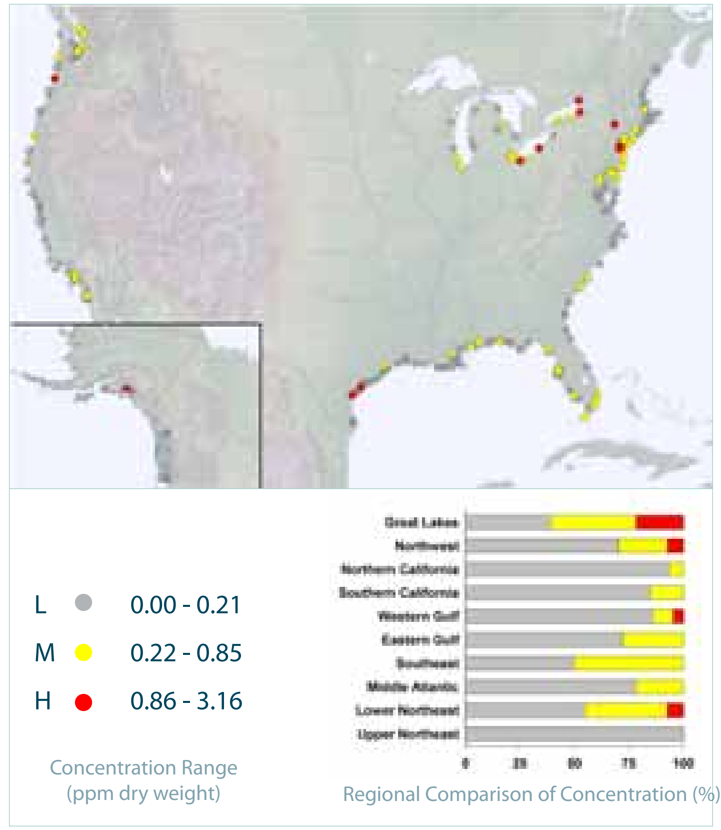
Nation at a Glance:

Medium and high tin concentrations are found nationwide. The highest concentrations occur in eastern Great Lakes zebra mussels.

Regional Species Characterization



National Characterization

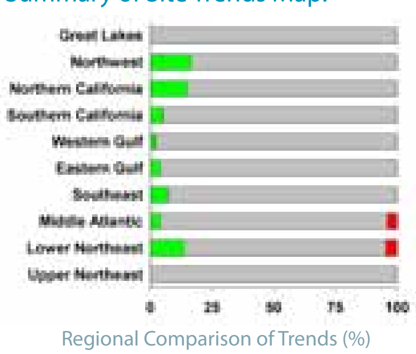


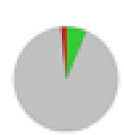
Trends Summary

Significant Regional Trends:

4 Lower Northeast, Upper Northeast, Middle Atlantic, Southeast, WesternGulfCoast,EasternGulfCoast,SouthernCalifornia,Northern California, Northwest, Great Lakes

Summary of Site Trends Map:





Site Trends

No Overall National Trend 4

G 15 individual sites exhibited a significant decreasing trend

H 3 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Tin sources in coastal water and soil include manufacturing and processing facilities. It also occurs in trace amounts in natural waters. Concentrationsinunpollutedwatersandtheatmosphereareoftennearanalyticaldetectionlimits.TinhasnotbeenminedintheU.S.since1993 (USGS, 2008); however, Canadian tin mining occurs in the Great Lakes Region.

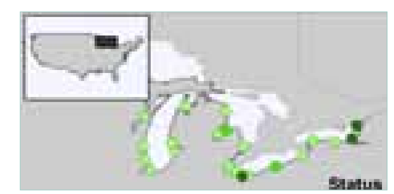
Toxicity

Humansareexposedtoelevatedlevelsoftinbyeatingfromtin-linedcansandbyconsumingcontaminatedseafood(ATSDR,2005b).Exposureto elevatedlevelsoftincompoundsbyhumansleadstoliverdamage,kidneydamage,andcancer.ThereisnoU.S.FDArecommendedguidelinefortin in seafood.

Fate and Transport

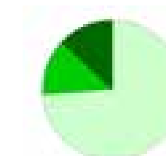
Tinenterscoastalwatersboundtoparticulates,andfromriverinesourcesderivedfromsoilandsedimenterosion.Bioconcentrationfactors forinorganictinwerereportedtobe1,900and3,000formarinealgaeandfish(Seideletal.,1980;Thompsonetal.,1972).Inorganictincanbe transformedintoorganometalicformsbymicrobialmethylationandiscorrelatedwithincreasingorganiccontentinsediment(Hadjispyouetal., 1998).Tinisregardedasbeingrelativelyimmobileintheenvironmentandisrarelydetectedintheatmosphere.Itismainlyfoundintheatmosphere near industrial sources as particulates from combustion of fossil fuels and solid waste (Gerritse et al., 1982; WHO, 1980).

Great Lakes Highlight



Background

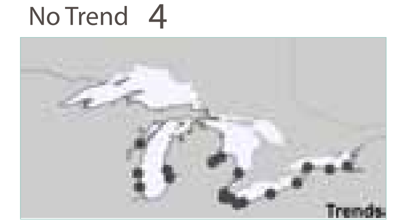
Possiblesourcesinthisregionincludeminingandsmeltingoperations.



Status

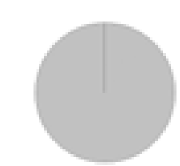
- Someofthehighesttinconcentrationsinthenationoccurinzebramussels.
- The highest concentrations are found in the eastern Great Lakes.

No Trend 4



Trends

- The Great Lakes, like the nation, has no trend.

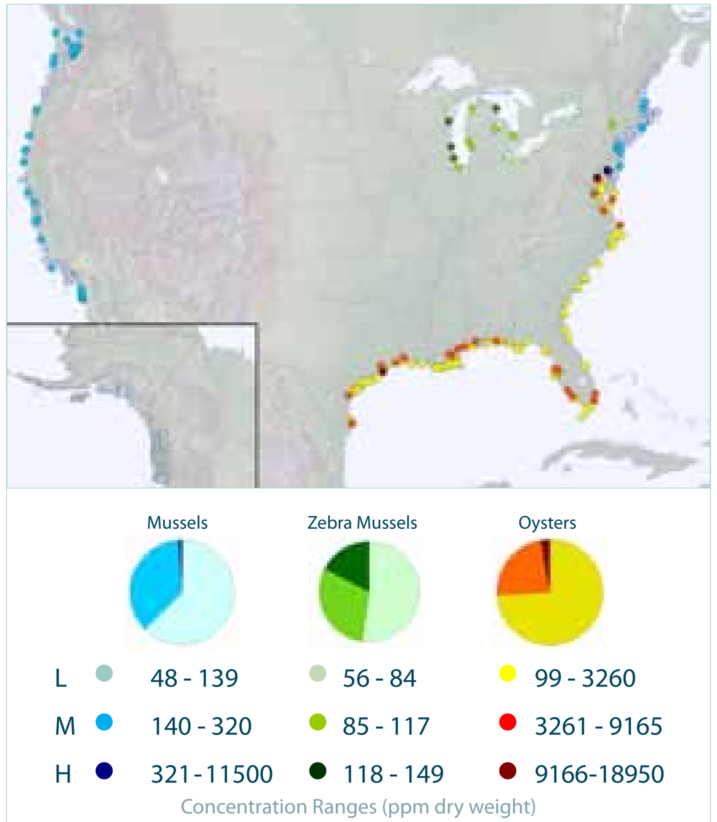


Status Summary

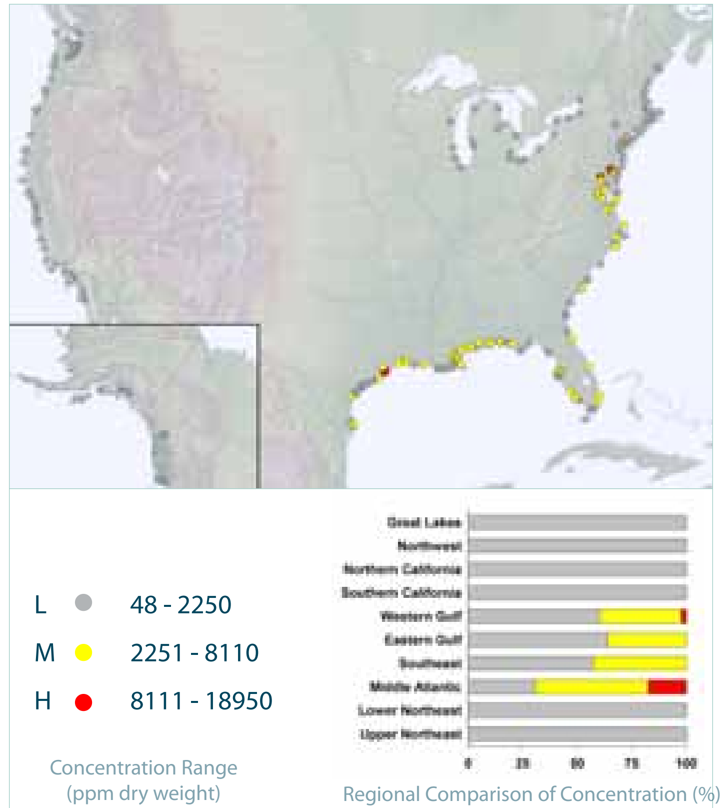
Nation at a Glance:

Regional differences can be attributed to variability in species uptake of zinc. An increased ability of oysters to concentrate zinc results in high concentrations relative to mussels and zebra mussels.

Regional Species Characterization



National Characterization



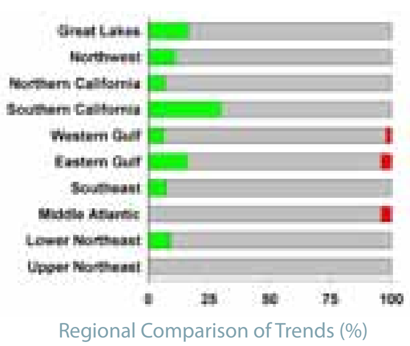
Trends Summary

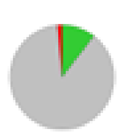
Significant Regional Trends:

G Southern California, Northwest, Great Lakes

4 Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Northern California

Summary of Site Trends Map:





Trend Percentage

Site Trends

Decreasing National Trend G

G 25 individual sites exhibited a significant decreasing trend

H 3 individual sites exhibited a significant increasing trend

Chemical Description

Sources

As the fourth most widely used metal, zinc's anthropogenic sources far exceed its natural ones. The major industrial sources include electroplating, smelting and drainage from mining operations (Mirenda, 1986). The greatest use of zinc is as an anti-corrosive coating for iron and steel products (sheet and strip steel, tube and pipe, and wire and wire rope). Canada is one of the largest producers and exporters of zinc. The United States is the largest customer for Canadian refined zinc, and the automobile industry is the largest user of galvanized steel.

Toxicity

Zinc is an essential nutrient. Human exposure to high doses of zinc may cause anemia or damage to the pancreas and kidneys (ATSDR, 2005c). However, zinc does not bioaccumulate in humans; therefore, toxic effects are uncommon and associated with excessively high doses. Fish exposed to low zinc concentrations can sequester it in some cases (McGee et al., 2003). There is no FDA recommended safety level for zinc in fish and fish products.

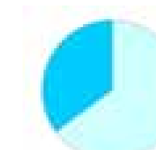
Fate and Transport

Dissolved zinc occurs as the free hydrated ion and as dissolved complexes. Changes in water conditions (pH, redox potential, chemical speciation) can result in dissolution from or sorption to particles (EPA, 1979d). In air, zinc is primarily found in the oxidized form bound to particles. Zinc precipitates as zinc sulfide in anaerobic or reducing environments, such as wetlands, and thus is less mobile, while remaining as the free ion at lower pHs. As a result of natural and anthropogenic activities, zinc is found in all environmental compartments (air, water, soil, and biota).

Southern California Highlight

Background

The Southern California Bight is a heavily populated and industrialized coastal region that extends from Point Conception to San Diego. Previous assessments have identified zinc as a contaminant of concern. Most pollution to the Bight is derived from stormwater, outfall pipes, power plants, harbor activities, natural upwelling phenomenon, and erosion of metal-rich soil.



ConcentrationPercentage

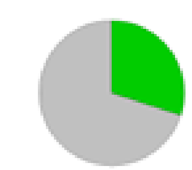
Status

- Seven of the 20 sites in this region have concentrations in the medium range and all but one of these lie in San Diego County.

Decreasing Trend G

Trends

- Significant decreasing zinc trends are observed throughout the Bight, and appears to be the result of efforts to improve water quality by the State of California.
- The decreasing national trend is duplicated in Southern California.



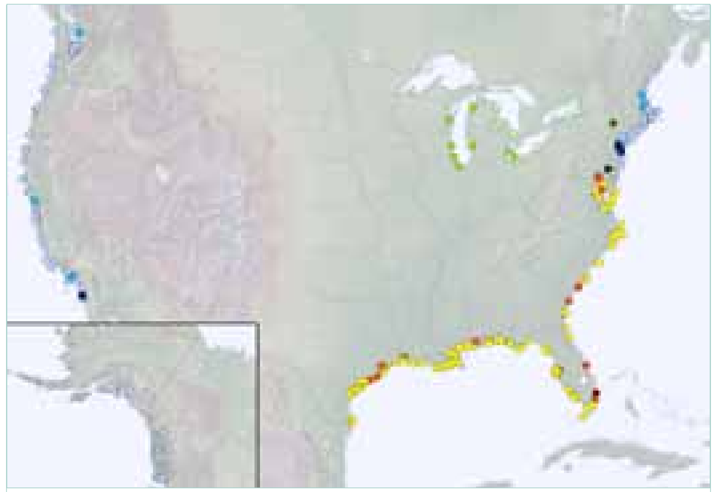
TrendPercentage

Nation at a Glance:

Status Summary

High and medium concentrations appear to be associated with boating activity and use of marine antifouling paint.

Regional Species Characterization



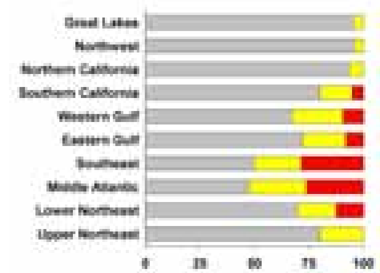
	Mussels	Zebra Mussels	Oysters
L	1 - 39	0 - 11	2 - 87
M	40 - 108	12 - 21	88 - 366
H	109 - 281	22 - 44	367-876

Concentration Ranges (ppb dry weight)

National Characterization

L	0 - 57
M	58 - 251
H	252 - 876

Concentration Range (ppb dry weight)



Regional Comparison of Concentration (%)

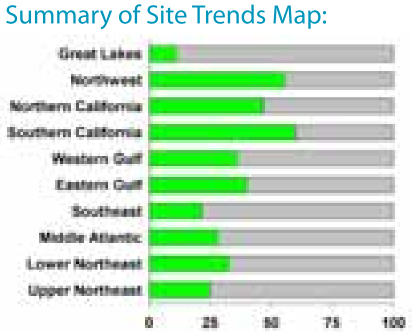
Trends Summary

A Summary of Regional Trends:

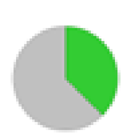
G Lower Northeast, Eastern Gulf Coast, Southern California, Northern California, Northwest

4 Upper Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Great Lakes

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 88 individual sites exhibited a significant decreasing trend

H 0 individual sites exhibited a significant increasing trend

Chemical Description

For this document, butyltin is the sum of three organometalic compounds: tributylin, the parent compound, and two of its transformation products (dibutyltin and monobutyltin).

Sources

Tributyltin is used as an antifouling agent in marine paints applied to boat hulls. Slow release from the paint into the aquatic system retards organism attachment and increases ambient environmental levels. The U.S. partially banned the use of tributyltin in 1988 for use on boats less then 25 m in length, drastically limiting use on many recreational vessels.

Toxicity

Tributyltin is an extremely toxic biocide that is regulated as a result of its toxic effects (reproduction and endocrine disruption) on non-target aquatic species. Organotin compounds are readily bioaccumulated by aquatic organisms from water but there is no evidence for biomagnification up the food chain. Sex changes have been shown to occur in gastropods exposed to elevated levels of tributyltin. There is no FDA recommended safety level for butyltins in fish and fish products.

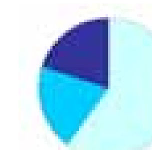
Fate and Transport

Tributyltin is sparingly soluble in water and associates readily with suspended particles in the water column. Butyltins are persistent in the aquatic environment and accumulate in sediment; therefore, they will continue to be a source of butyltin to the aquatic environment (Gibbs and Bryan, 1994; EPA, 2003). Tributyltin transforms to dibutyltin and then to monobutyltin. Releases of organotins to the atmosphere are not significant due to their low vapor pressure and rapid photodegradation.

San Diego Bay Highlight

Background

San Diego Bay supports commercial, military and recreational boating.



ConcentrationPercentage

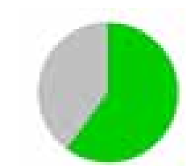
Status

- Concentrations inside the bay are higher than those outside the bay.
- Relative to the nation, San Diego Bay has an elevated level of butyltin contamination, however they are not among the highest in the country.

Decreasing Trend G

Trends

- Sites with decreasing concentrations are found inside and outside the bay.
- The proportion of sites with decreasing trends is greater than that found nationally.
- Regional butyltin concentrations are decreasing in San Diego Bay like the rest of nation.



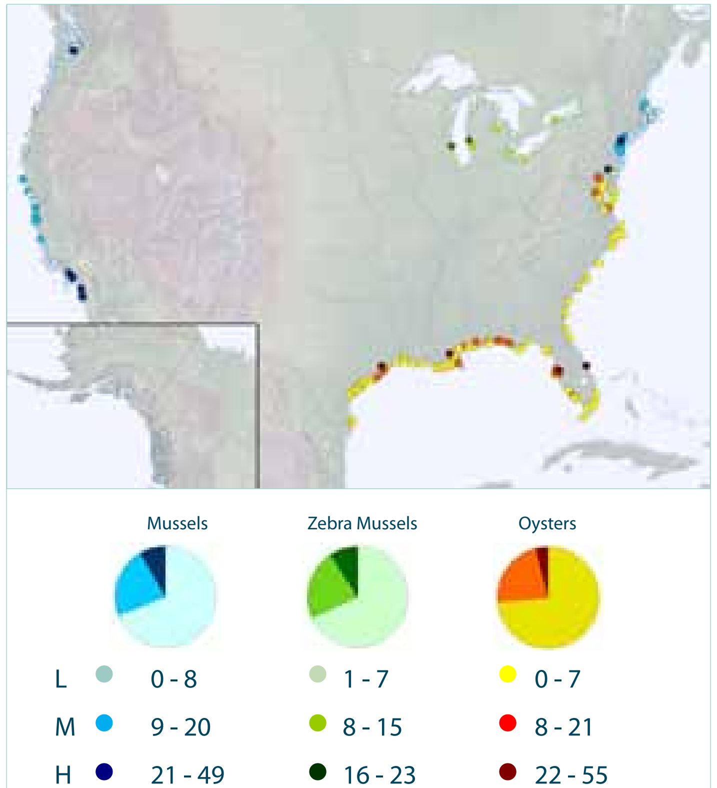
TrendPercentage

Nation at a Glance:

Status Summary

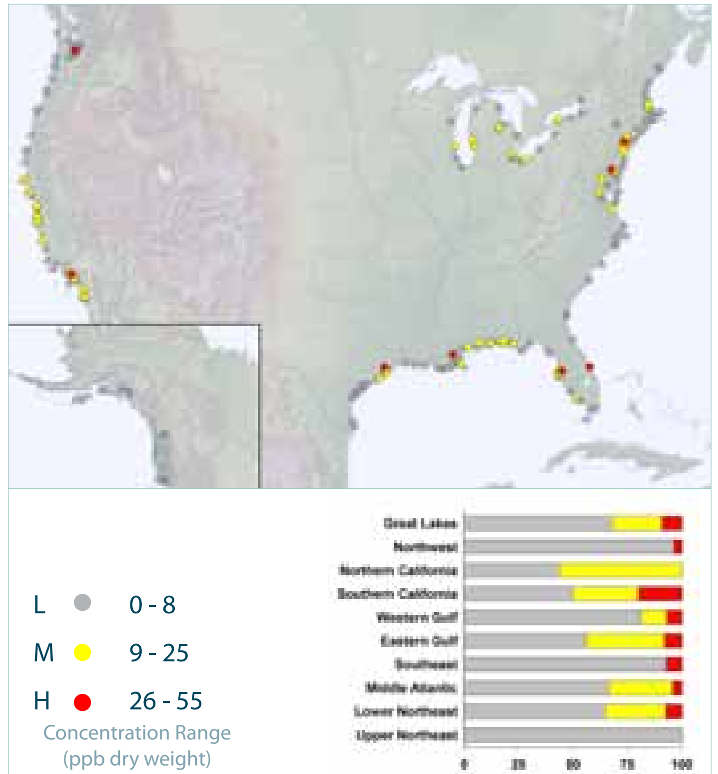
The highest concentrations are associated with historic agricultural use and urban termite control. High chlordane concentrations are found near urban centers and metropolitan areas.

Regional Species Characterization



Concentration Ranges (ppb dry weight)

National Characterization



Concentration Range (ppb dry weight)

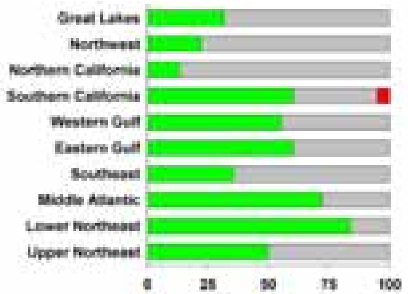
Regional Comparison of Concentration (%)

Trends Summary

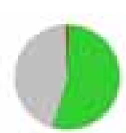
A Summary of Regional Trends:

G Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, EasternGulfCoast,WesternGulfCoast,SouthernCalifornia,Northern California, Northwest, Great Lakes

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 129 individual sites exhibited a significant decreasing trend

H 1 individual sites exhibited a significant increasing trend

Chemical Description

Chlordanebelongstoagroupoforganicpesticidescalledcyclodienes.Itisatechnicalmixturewhoseprinciplecomponentsarealpha-chlordane, gamma-chlordane,heptachlorandnonachlor.Chlordaneasreportedhereisthesumofthreeprominentcompounds,alpha-chlordane,heptachlorand trans-nonachlor, plus one transformation product (heptachlor epoxide).

Sources

Technicalchlordane,aninsecticide,isacomplexmixtureofatleastfiftycompounds.ItwasusedintheU.S.from1948-1983foragriculturaland urbansettingstocontrolinsectpests.Itwasalsothepredominantinsecticideforthecontrolofsubterraneantermites.Agriculturaluseswere bannedin1983andalluseswerebannedby1988.ThesecompoundsaresomeofthemostubiquitouscontaminantsmeasuredbytheMusselWatch Program.TheFDAactionlevelforchlordaneinallfishis0.3ppmwetweight(FDA,2001).Inyeas2004-2005oftheMusselWatchProgram,a maximumchlordaneconcentrationof0.01ppmwetweightwasmeasuredinIndianRiver,Florida(IRSR)andSinclairInlet,Washington(SIWP).

Toxicity

Exposuretochlordanecanoccurthrougheatingcropsfromcontaminatedsoil,fishandshellfishfromcontaminatedwaters,orbreathing contaminatedair.Chlordanecanenterthebodybybeingabsorbedthroughtheskin,inhalationandingestion.Athighlevels,chlordanecanaffectthe nervous system, digestive system, brain and liver, and is also carcinogenic. Chlordane is highly toxic to invertebrates and fish.

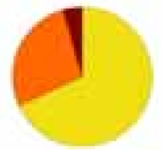
Fate

Removalfrombothsoilandwatersourcesisprimarilybyvolatilizationandparticle-boundrunoff.Inair,chlordanedegradesasaresultofphotolysis andoxidation.Chlordaneexistsintheatmosphereprimarilyinthevapor-phase,buttheparticle-boundfractionisimportantforlong-rangetransport. ChlordaneisprevalentintheArcticduetothegrasshoppereffectanddistributedinthefoodweb(Hargraveetal.,1992).Chlordanebindsto dissolved organic matter, further facilitating its transport in natural waters.

Central Gulf Coast Highlight

Background

Decreasing concentration trends are consistent with earlier reporting.

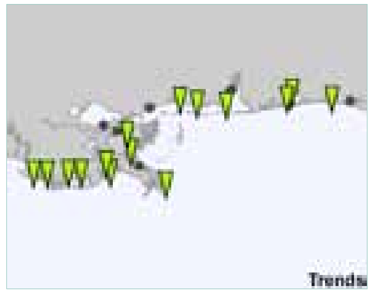


ConcentrationPercentage

Status

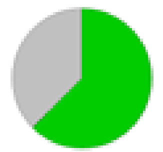
- On the Western Gulf Coast chlordane is the highest in enclosed bays.
- Regional concentrations are similar to those found for nationwide.

Decreasing Trend G



Trends

- Nearlyallsitesshowdecreasingconcentrationtrends,whichisconsistentwith the ban of all chlordane use in 1988.
- Regionally and nationally chlordane concentrations are decreasing.



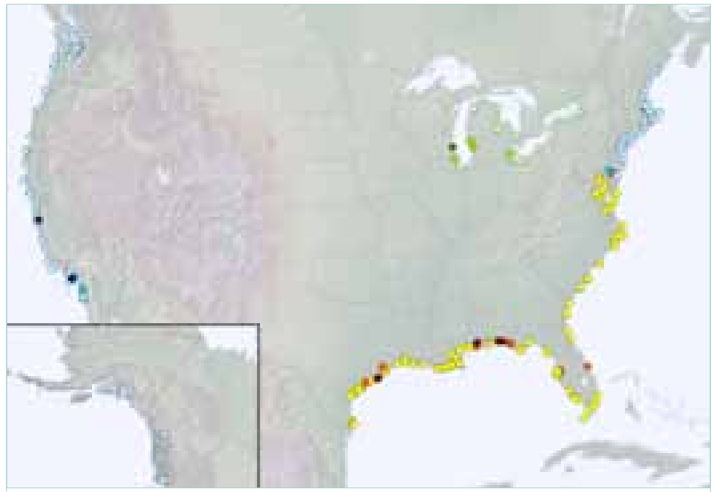
TrendPercentage

Nation at a Glance:

Status Summary

The highest concentrations are associated with historic DDT manufacturing facilities. High and moderate concentrations occur primarily in estuaries and bays as a result of industrial discharge on the Southwest Coast.

Regional Species Characterization



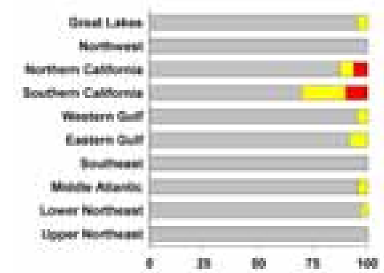
	Mussels	Zebra Mussels	Oysters
L	0 - 112	2 - 26	1 - 34
M	113 - 286	27 - 68	35 - 105
H	287 - 520	69 - 148	106 - 202

Concentration Ranges (ppb dry weight)

National Characterization

L	0 - 62
M	63 - 250
H	251 - 520

Concentration Range (ppb dry weight)



Regional Comparison of Concentration (%)

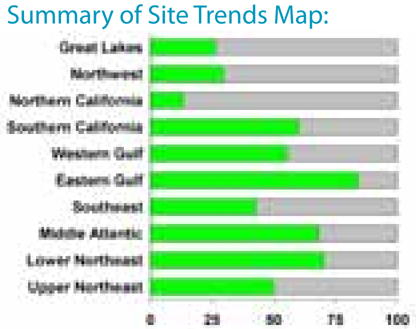
Trends Summary

A Summary of Regional Trends:

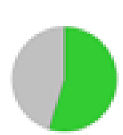
G Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Southern California, Northwest, Great Lakes

4 Northern California

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 130 individual sites exhibited a significant decreasing trend

H 0 individual sites exhibited a significant increasing trend

Chemical Description

Sources

DDT was used worldwide as an insecticide for agricultural pests and mosquito control. Its use in the United States was banned in 1972, but it is still used in some countries today (ATSDR, 2002a).

Toxicity

Due to its environmental persistence and hydrophobic nature, DDT bioaccumulates in organisms. Many aquatic and terrestrial organisms are highly sensitive to DDT. As a result of DDT's toxic effect on wildlife, in particular birds, its usage was banned in the United States. The FDA action level for DDT in all fish (edible portion) is 5 ppm wet weight (FDA, 2001). In years 2004-2005 of the Mussel Watch Program, a maximum DDT concentration of 0.09 ppm wet weight was measured in Southern California Bight.

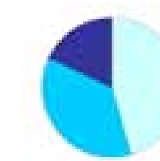
Fate and Transport

DDT transforms to DDD and DDE, the latter being the predominant form found in the environment. Evaporation of DDT from soil followed by long distance transport (the grasshopper effect) results in its widespread global distribution. DDT and its transformation products are very persistent and accumulate in the environment because they resist biodegredation. DDT that enters surface waters is subject to volatilization, adsorption to suspended particulates and sediment, and bioaccumulation. About half of the atmospheric DDT is adsorbed to particulates (Bidleman, 1988).

Southern California Highlight

Background

DDT is present in sediments of the Palos Verdes Shelf largely as a result of wastewater discharges from the former Montrose Chemical Corporation, a DDT manufacturing plant in Torrance, California, that operated from 1947 to 1983.



ConcentrationPercentage

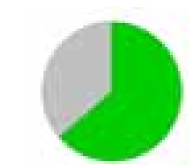
Status

- The Southern Californian Coast has a much higher proportion of middle and high DDT measurements relative to the rest of the nation.
- The majority of sites characterized as high in the nation are in the Southern Californian region.
- High concentrations are primarily found in the vicinity of the manufacturing plant.

Decreasing Trend G

Trends

- Decreases in DDT concentrations in Southern California are similar to what is recorded for the nation.
- The decreases found in Southern California come as a result of the cessation of manufacturing of DDT in the region and transport to the deep ocean.



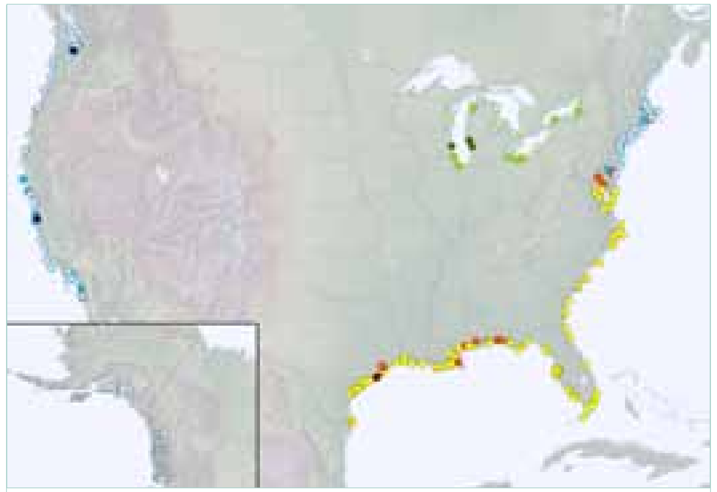
TrendPercentage

Status Summary

Nation at a Glance:

The highest concentrations are associated with pesticide use and manufacturing adjacent to urban bays and estuaries.

Regional Species Characterization



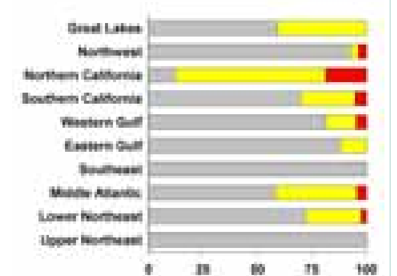
	Mussels	Zebra Mussels	Oysters
L	0 - 8	1 - 3	0 - 5
M	9 - 34	4 - 6	6 - 30
H	35 - 95	7 - 16	31 - 65

Concentration Ranges (ppb dry weight)

National Characterization

L 0 - 9
M 10 - 34
H 35 - 95

Concentration Range (ppb dry weight)



Regional Comparison of Concentration (%)

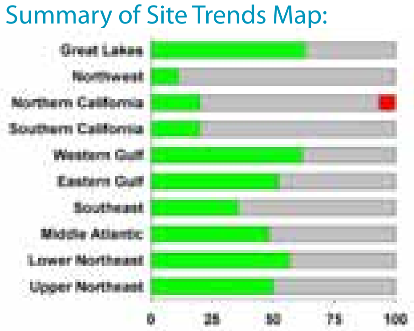
Trends Summary

A Summary of Regional Trends:

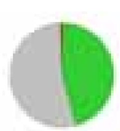
GUpperNortheast,LowerNortheast,MiddleAtlantic,Southeast,Eastern Gulf, Coast, Western Gulf Coast, Great Lakes

4 Southern California, Northern California, Northwest

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 108 individual sites exhibited a significant decreasing trend

H 1 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Inthisdocument,dieldrinisdefinedasthesumoftwocompounds,dieldrinandaldrin.Dieldrinandarelatedcompound(aldrin)werewidelyusedas insecticidesinthe1960sforthecontroloftermitesaroundbuildingsandgeneralcropprotectionfrominsects(ATSDR,2002b).In1970,allusesof aldrinanddieldrinwerecanceledbasedonconcernthattheycouldcausesevereaquaticenvironmentalchangeandtheirpotentialascarcinogens (EPA,1980).Thecancellationwasliftedin1972toallowlimiteduseofaldrinanddieldrin,primarilyfortermitecontrol.Allusesofaldrinanddieldrin were again cancelled in 1989 (EPA, 1990).

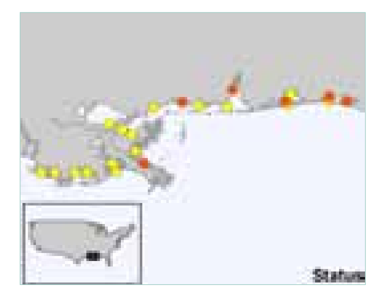
Toxicity

Exposuretoaldrinanddieldrinoccursthroughingestionofcontaminatedwaterandfoodproducts,includingfishandshellfish,andthroughinhalation ofindoorairinbuildingstreatedwiththeseinsecticides.Aldrinisrapidlymetabolizedtodieldrininthehumanbody.Acuteandlong-termhuman exposuresareassociatedwithcentralnervoussystemintoxication.Aldrinanddieldrinarecarcinogenictoanimalsandclassifiedaslikelyhuman carcinogens.TheFDAhasestablishedanactionlevelof0.3ppmwetweightforaldrin/dieldrininallfish(FDA,2001).Inyears2004-2005ofthe MusselWatchProgram,amaximumdieldrinconcentrationof0.02ppmwetweight(equivalent)wasmeasuredinMontereyBay,California(MBES).

Fate and Transport

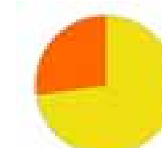
Aldrinisreadilyconvertedtodieldrin,whiledieldrinisresistanttotransformation.Dieldrinbioaccumulatesandismagnifiedthroughaquaticfood chainsandhasbeendetectedintissueoffreshwaterandsaltwaterfish,andmarinemammals.Aldrinanddieldrinappliedtosoilaretightlybound, butmaybetransportedtostreamsandriversbysoilerosion.Volatilizationistheprimarylossmechanismfromsoil.Dieldrinundergoesminor degradation to photodieldrin in marine environments.

Central Gulf Coast Highlight



Background

Highlypersistentandwidelyappliedasapesticide,dieldrincontinuestobefound at medium levels in the region.



ConcentrationPercentage

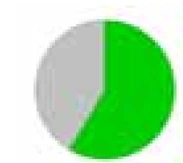
Status

- On the Central Gulf Coast dieldrin is the highest in enclosed bays.
- Regionalconcentrationsareelevatedrelativetothosefoundnationwide.

Decreasing Trend G

Trends

- Morethanhalfthesitesshowdecreasingtrends,whichisconsistentwith the 1974 ban from agricultural use.
- The region as a whole has a significant decreasing trend.



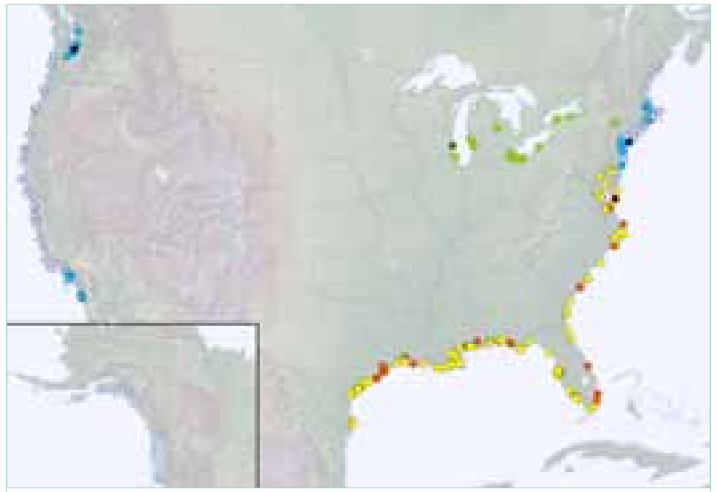
TrendPercentage

Status Summary

Nation at a Glance:

Elevated concentrations are associated with petroleum manufacturing, creosote use and wood burning.

Regional Species Characterization



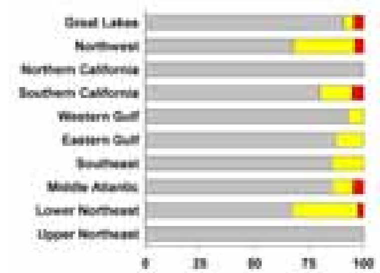
	Mussels	Zebra Mussels	Oysters
L	63 - 1187	128 - 389	47 - 828
M	1188-4434	390 - 1595	829 - 2511
H	4435-7561	1596-6519	2512-10717

Concentration Ranges (ppb dry weight)

National Characterization

L 47 - 1250
M 1251 - 4434
H 4435 - 10717

Concentration Range (ppb dry weight)



Regional Comparison of Concentration (%)

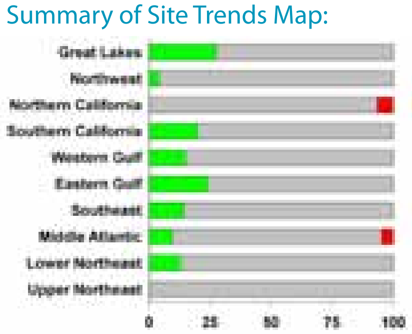
Trends Summary

A Summary of Regional Trends:

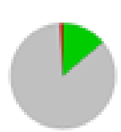
G Southeast, Eastern Gulf Coast, Great Lakes

4 Lower Northeast, Upper Northeast, Middle Atlantic, Western Gulf Coast, Southern California, Northern California, Northwest

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 33 individual sites exhibited a significant decreasing trend

H 2 individual sites exhibited a significant increasing trend

Chemical Description

Sources

Polycyclic aromatic hydrocarbons (PAHs) are found in creosote, soot, petroleum, coal, and tar; and are the only organic contaminants measured by the Mussel Watch Program that have natural sources (e.g., forest fires, volcanoes) in addition to anthropogenic sources (automobile emissions, home heating, coal fired power plants). PAHs are formed from the fusing of benzene rings during the incomplete combustion of organic materials. They are also found in oil and coal. The main sources of PAHs to the environment are forest fires, coal fired power plants, and automobile exhaust and local releases of oil.

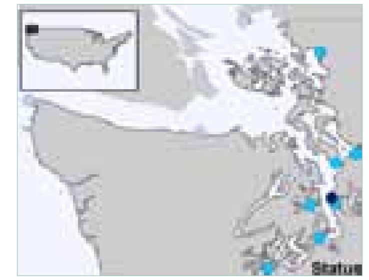
Toxicity

Made up of a suite of hundreds of compounds, PAHs exhibit a wide range of toxicities. Sources appear on the 2005 Priority List of Hazardous Substances, as do specific compounds (ATSDR, 1995). Human exposure to PAHs can come as a result of being exposed to smoke from forest fires, automobile exhaust, home heating using wood, grilling and cigarettes. Toxic responses to PAHs also occur in aquatic organisms and includes reproduction inhibition, mutations, liver abnormalities and mortality. Exposure to aquatic organisms can come as a result of oil spills, boat exhaust and urban runoff. There is no FDA recommended safety level for PAHs in fish and fish products.

Fate and Transport

The fate and transport of PAHs is variable and dependent on the physical properties of each individual compound. Most PAHs strongly associate with particles; larger PAH compounds (high molecular weight) associate to a higher degree with particles relative to smaller PAH compounds (low molecular weight). Smaller compounds predominate in petroleum products whereas larger compounds are associated with combustion. (ATSDR, 1995).

Puget Sound Highlight



Background

Decreases in PAHs observed in Puget Sound in the 1970s and 1980s are likely due to a switch from coal to oil and natural gas power generation. The increase of PAHs in recent years has been attributed to urban sprawl and increased vehicle traffic. In the past 15 years the amount of ship traffic transporting oil has increased but the number of oil releases have decreased steadily since 2000, while the volume of spilled oil has remained steady (Puget Sound Action Team, 2007).

ConcentrationPercentage

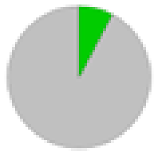
Status

- Sites in Puget Sound have PAH concentrations that are among the highest in the nation.
- Nearly 2/3 of the sites in the Puget Sound are categorized as medium to high, nearly double what is observed nationally.

No Trend 4

Trends

- Overall there is no significant Puget Sound wide trend.



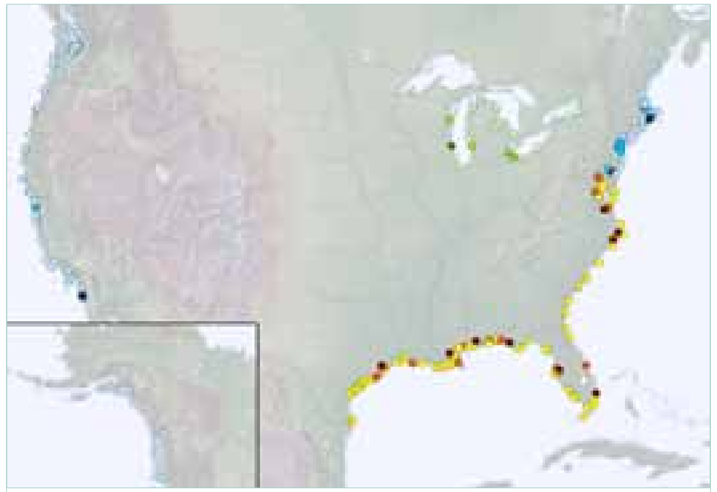
TrendPercentage

Status Summary

Nation at a Glance:

At the national level high and medium PCB contamination is localized, a limited number of sites at the national level have elevated concentrations.

Regional Species Characterization



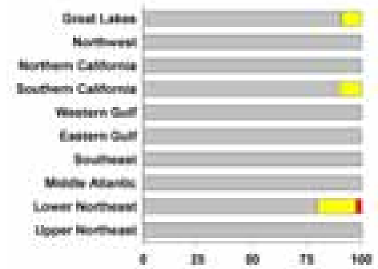
	Mussels	Zebra Mussels	Oysters
L	3 - 153	15 - 154	4 - 38
M	154 - 478	155 - 424	39 - 87
H	479 - 1413	425 - 924	88-157

Concentration Ranges (ppb dry weight)

National Characterization

L	0 - 131
M	132 - 478
H	479 - 1413

Concentration Range (ppb dry weight)



Regional Comparison of Concentration (%)

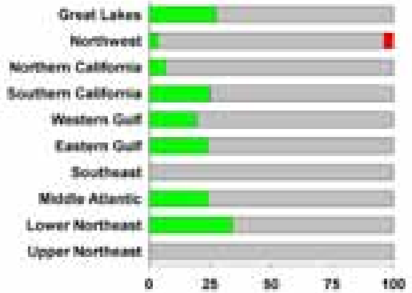
Trends Summary

A Summary of Regional Trends:

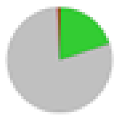
G Lower Northeast, Eastern Gulf Coast, Western Gulf Coast, Great Lakes

4 Upper Northeast, Middle Atlantic Southeast, Southern California, Northern California, Northwest

Summary of Site Trends Map:



Regional Comparison of Trends (%)



Trend Percentage

National Trends

Decreasing National Trend G

G 46 individual sites exhibited a significant decreasing trend

H 1 individual sites exhibited a significant increasing trend

Chemical Description

There are 209 possible PCB (polychlorinated biphenyl) compounds, called "congeners", that were marketed as mixtures known as Aroclor.

Sources

PCBs are synthetic organic chemicals composed of biphenyl substituted with varying numbers of chlorine atoms. They were manufactured between 1929 and 1977. Polychlorinated biphenyls appear on the 2005 list of hazardous substances (ATSDR, 2000). PCB use was regulated in 1971, new uses were banned in 1976. PCBs were used in electrical transformers, capacitors, lubricants and hydraulic fluids. Other uses included paints, adhesives, plasticizers and flame retardants. Manufacturing of PCBs for use as flame retardants and lubricants stopped in 1977 (ATSDR, 2000). Currently, PCBs are predominately used in electrical applications and can still be found in transformers and electrical equipment.

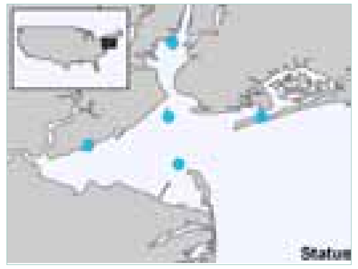
Toxicity

The main human exposure route for PCBs is through eating contaminated seafood and meats. PCBs are associated with skin ailments, neurological and immunological responses and at high doses can decrease motor skills and cause liver damage, and memory loss. Exposure of aquatic life to PCBs results in birth defects, lowered fecundity, cancer and death. PCBs are hazardous because they are toxic, degrade slowly and bioaccumulate. The FDA tolerance level for PCBs in all fish (edible portion) is 2 ppm wet weight, irrespective of which mixture of PCBs is present as the residue (FDA, 2001; CFR, 2003). In years 2004-2005 of the Mussel Watch Program, a maximum PCB concentration of 0.28 ppm wet weight was measured in Buzzards Bay, Massachusetts.

Fate and Transport

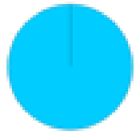
PCBs are persistent in the environment and associate with particles in aquatic systems as a result of their strong hydrophobic nature. They are long lived in the environment; improper disposal and leakage is responsible for environmental introduction.

Hudson Raritan Highlight



Background

Sediment in parts of the upper Hudson River remain heavily contaminated with PCBs and will remain a source of PCBs in the lower Hudson River for years to come.



ConcentrationPercentage

Status

- The Hudson Raritan Estuary has a higher proportion of moderate levels of contamination relative to other mussels measured.

Decreasing Trend G

Trends

- Four of the five sites show decreasing concentration trends.
- Like the nation, this region exhibits a decreasing trend.

TrendPercentage

ATSDR (Agency for Toxic Substances and Disease Registry). 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). August 1995.

ATSDR (Agency for Toxic Substances and Disease Registry). 1999a. Toxicological Profile for Cadmium. July 1999.

ATSDR (Agency for Toxic Substances and Disease Registry). 1999b. Toxicological Profile for Mercury. March 1999.

ATSDR (Agency for Toxic Substances and Disease Registry). 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). November 2000.

ATSDR (Agency for Toxic Substances and Disease Registry), 2002a. Toxicological Profile for DDT, DDE, DDD. September 2002.

ATSDR (Agency for Toxic Substances and Disease Registry), 2002b. Toxicological Profile for Aldrin/Dieldrin. September 2002.

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Toxicological Profile for Copper. September 2004.

ATSDR (Agency for Toxic Substances and Disease Registry). 2005a. Toxicological Profile for Nickel. August 2005.

ATSDR (Agency for Toxic Substances and Disease Registry), 2005b. Toxicological Profile for Tin. August 2005.

ATSDR (Agency for Toxic Substances and Disease Registry). 2005c. Toxicological Profile for Zinc. August 2005.

ATSDR (Agency for Toxic Substances and Disease Registry). 2007a. Toxicological Profile for Arsenic. August 2007.

ATSDR (Agency for Toxic Substances and Disease Registry). 2007b. Toxicological Profile for Lead. August 2007.

Berner, L.H., J. McGowan, J.H. Martin, and J. Teal. 1976. Sampling marine organisms. In: Strategies for Marine Pollution Monitoring, E.D. Goldberg, (ed.). John Wiley & Sons, NY. pp. 269-73.

Bidleman, T. 1988. Atmospheric processes: Wet and dry deposition of organic compounds are controlled by their vapor-particle partitioning. Environmental Science and Technology 22(4):361-367.

CFR (Code of Federal Regulations). 2003. Tolerances for polychlorinated biphenyls (PCB's). Title 21, part 109, section 30, U.S. Government Printing Office, Washington, DC.

Chesapeake Bay Program. 1999. Chesapeake Bay Basin Toxic Loading and Release Inventory. Chesapeake Bay Program, Annapolis, MD. 22 Apr. 2008 <http://www.chesapeakebay.net/content/publications/cbp_12982.pdf>.

Denier van der Gon, H.A.C., J.H.J. Hulskotte, A.J.H. Visschedijk, and M. Schaap. 2007. A revised estimate of copper emissions from road transport in UNECE Europe and its impact on predicted copper concentrations. Atmospheric Environment 41(38):8697-8710.

Edmonds, J.S., and K.A. Francesconi. 1977. Methylated arsenic from marine fauna. Nature 265:436.

Edmonds, J.S., and K.A. Francesconi. 1988. The origin of arsenobetaine in marine animals. Applied Organometallic Chemistry 2:297-302.

Edmonds, J.S., and K.A. Francesconi. 1993. Arsenic in seafood: human health aspects and regulations. Marine Pollution Bulletin 26:665-674.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wildlife. Service. Biol. Rep. 85(1.11).

EPA (U.S. Environmental Protection Agency). 1980. Ambient water quality criteria for aldrin/dieldrin. Criteria and Standards Division. PB81-11730/OWRS. Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1990. Suspended, canceled, and restricted pesticides. Office of Pesticides and Toxic Substances, Office of Compliance Monitoring. EPA/2OT-1002. Washington, D.C.

EPA (U.S. Environmental Protection Agency). 2003. Ambient aquatic life water quality criteria for tributyltin (TBT) – Final. Office of Science and Technology EPA822-R-03-031. Washington, D.C.

Eskin, R.A., K.H. Rowland, and D.Y. Alegre. 1996. Contaminants in Chesapeake Bay 1984-1991. U.S. Environmental Protection Agency, EPA903-R-96-003, Chesapeake Bay Program (CPB), CPB/TRS 145/96. Annapolis, MD.

Farrington, J. W. 1983. Bivalves as sentinels of coastal chemical pollution: the Mussel (and oyster) Watch. Oceanus 26(2):18-29.

Farrington, J.W., J. Albaiges, K.A. Burns, B.P. Dunn, P. Eaton, J.L. Laseter, P.L. Parker, and S. Wise. 1980. Fossil fuels. In: The International Mussel Watch. National Research Council. National Academy of Sciences - Office of Publications, Washington, D.C. pp. 7-77.

FDA (Food and Drug Administration). 1993a. Guidance Document for Arsenic in Shellfish. U.S. Department of Health and Human Services, Public Health Service, Office of Seafood (HFS-416), 200 C Street, SW, Washington, D.C. 44 pp.

FDA (Food and Drug Administration). 1993b. Guidance Document for Cadmium in Shellfish. U.S. Department of Health and Human Services, Public Health Service, Office of Seafood (HFS-416), 200 C Street, SW, Washington, D.C. 20204. 44 pages.

FDA (Food and Drug Administration). 1993c. Guidance Document for Lead in Shellfish. U.S. Department of Health and Human Services, Public Health Service, Office of Seafood (HFS-416), 200 C Street, SW, Washington, D.C. 45 pp.

FDA (Food and Drug Administration). 1993d. Guidance Document for Nickel in Shellfish. U.S. Department of Health and Human Services, Public Health Service, Office of Seafood (HFS-416), 200 C Street, SW, Washington, D.C. 39 pp.

FDA (Food and Drug Administration). 2001. Fish and Fishery Products Hazards and Controls Guide. 3rd Ed. Department of Health and Human Services, Public Health Service, Center for Food Safety and Applied Nutrition, Office of Seafood, Washington, DC. 22 Apr. 2008 <http://www.cfsan.fda.gov/~comm/haccp4.html>.

Gerritse, R.G., R. Vriesema, J.W. Daleberg, and H.P. de Roos. 1982. Effect of sewage sludge on trace element mobility in soils. Journal of Environmental Quality 11:359-364.

Gianessi, L.P., C.S. Silvers, S. Sankula and J.E. Carpenter, 2002. Plant Biotechnology: Current and Potential Impact for Improving Pest Management in U.S. Agriculture an Analysis of 40 Case Studies: Bacterial Resistant Citrus. National Center for Food and Agriculture Policy. Washington, DC. 22 Apr. 2008 <http://www.ncfap.org/40CaseStudies/CaseStudies/CitrusBR.pdf>.

Gibbs, P.E., and G.W. Bryan. 1994. Biomonitoring of tributyltin (TBT) pollution using the imposex response of neogastropod mollusks. In: Biomonitoring of coastal waters and estuaries. K. J. M. Kramer (ed.). CRC Press: Boca Raton, Florida. pp. 209-222.

Goldberg, E.D., M. Koide, V. Hodge, A.R. Flegal, and J. Martin. 1983. U.S. Mussel Watch: 1977-1978 results on trace metals and radionuclides. Estuarine Coastal Shelf Science 16:69-93.

Goyer, R.A. 1996. "Toxic Effects of Metals." In: Casarett and Doull's Toxicology: The Basic Science of Poisons. 5th Edition. C.D. Klaassen, M.O. Amdur, and J. Doull, (eds). New York, NY. McGraw Hill. Chap. 23, pp 691-736.

Hargrave, B.T., G.C. Harding, W.P. Vass, P. Eriksson, B.R. Fowler, and V. Scott. 1992. Organochlorine pesticides and polychlorinated biphenyls in the Arctic Ocean food web. Archives of Environmental Contamination and toxicology 22(1):41-54.

Hadjispyrou, S.A., A. Anagnostopoulos, K. Nicholson, M.K. Nimfopoulos, and K.M. Michailidis. 1998. Correlation of the methylating capacity of river and marine sediments to their organic sediment index. Environmental Geochemistry and Health 20(1):19-27.

Hameedi, M.J., W.E. Johnson, K.L. Kimbrough, and J.A. Browder. 2006. Sediment contamination, toxicity and infaunal community composition in St. Lucie Estuary, Florida based upon measures of the sediment quality triad. Final Report. 22 Apr. 2008 <http://www8.nos.noaa.gov/cit/nsandt/download/documents/SLE/SLE_report.pdf>.

References

IARC (International Agency for Research on Cancer). 2006. Inorganic and organic lead compounds 10-17 February 2004. . Vol. 87.

Keith, L.H., and W.A. Teillard. 1979. Priority pollutants I: a perspective view. Environmental Science and Technology 13(4):416-423.

Kimbrough, K.L., and G.G. Lauenstein (eds.). 2006. Trace Metal Analytical Methods of the National Status and Trends Program: 2000-2006. NOAA Technical Memorandum NOS NCCOS 29 Silver Spring, MD. 21 pp.

Kimbrough, K.L., G.G. Lauenstein, and W.E. Johnson (eds.). 2006. Organic Contaminant Analytical Methods of the National Status and Trends Program: Update 2000-2006. NOAA Technical Memorandum NOS NCCOS 30 Silver Spring, MD. 137 pp.

Lauenstein, G.G., and A.Y. Cantillo. 1993a. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Overview and Summary of Methods, Volume I NOAA Technical Memorandum NOS ORCA 71 Silver Spring, MD.

Lauenstein, G.G., and A.Y. Cantillo (eds.). 1993b. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Complementary Measurements, Volume II NOAA Technical Memorandum NOS ORCA 71 Silver Spring, MD.

Lauenstein, G.G., and A.Y. Cantillo (eds.). 1993c. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Elemental Analytical Methods, Volume III NOAA Technical Memorandum NOS ORCA 71 Silver Spring, MD.

Lauenstein, G.G., and A.Y. Cantillo (eds.). 1993d. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Trace Organic Analytical Methods, Volume IV. NOAA Technical Memorandum NOS ORCA 71 Silver Spring, MD.

Lauenstein, G.G., and A.Y. Cantillo, 1998. Analytical Methods of the National Status and Trends Program Mussel Watch Project-1993-1997 Update. NOAA Technical Memorandum NOS ORCA 130 Silver Spring, MD.

Lauenstein, G.G., A.Y. Cantillo, S. Kokkinakis, J. Jobling, and R. Fay. 1997. Mussel Watch Project Site Descriptions, through 1997. NOAA Technical Memorandum NOS ORCA 112 Silver Spring, MD. 354 pp.

Leslie, A.J. 1992. Copper Herbicide Use-Patterns in Florida Waters. Florida Department of Natural Resources, Tallahassess, Florida. 9 pp. 22 Apr. 2008 <http://www.floridadep.org/lands/invaspec/2ndlevpgs/pdfs/cuconfnc.pdf>.

Manahan, S.E., 2005. Environmental Chemistry. 8th Edition. CRC Press: Boca Raton, Florida. 783 pp.

Mance, G. 1987. Pollution Threat of Heavy Metals in Aquatic Environments. Elsevier Science New York, NY.

Martin, M. 1985. State Mussel Watch: Toxics surveillance in California. Marine Pollution Bulletin 16(4):140-146.

McDonald, S.J., D.S. Frank, J.A. Ramirez, B. Wang, and J.M. Brooks. 2006. Ancillary Methods of the National Status and Trends Program: 2000-2006 Update. NOAA Technical Memorandums NOS NCCOS 28 Silver Spring, MD. 17 pp.

McGeer, J.C., K.V. Brix, J.M. Skeaff, D.K. DeForest, S.I. Brigham, W.J. Adams, and A. Green. 2003. Inverse relationship between bioconcentration factor and exposure concentration for metals: implications for hazard assessment of metals in the aquatic environment. Environmental Toxicology and Chemistry 22(5):1017-1037.

Mirenda R.J. 1986. Acute toxicity and accumulation of zinc in the crayfish *Orconectes virilis* (Hagen). Bulletin of Environmental Contamination and Toxicology 37(1):387-394.

Mercury Study Report to Congress. 1997. Volume 7: Characterization of Human Health and Wildlife Risks from Mercury Exporsure in the United States. 52 pp. EPA-452/R-97-009. Washington, DC U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards and Office of Research and Development. 22 Apr. 2008 <http://www.epa.gov/mercury/report.htm>.

Nriagu, J.O., G. Lawson, H.K.T. Wong, and V. Cheam. 1995. Dissolved trace metals in Lakes Superior, Erie, and Ontario. Environmental Science and Technology 30(1):178-187.

Phillips, D.J.H. 1990. Arsenic in aquatic organisms: a review, emphasizing chemical speciation. Aquatic Toxicology 16(3):151-186.

Plachy, J. 2003. Cadmium. Minerals Yearbook. US. Geological Survey. 22 Apr. 2008 <http://minerals.usgs.gov/minerals/pubs/commodity/cadmium/cadmimyb03.pdf>.

Puget Sound Action Team. 2007. 2007 Puget Sound Update: Ninth Report of the Puget Sound Assessment and Monitoring Program. Puget Sound Action Team. Olympia, Washington. 260 pp.

Roesijadi, G., J.S. Young, A.S. Drum, and J.M. Gurtisen. 1984. Behavior of trace metals in *Mytilus edulis* during a reciprocal transplant field experiment. Marine Ecology Progress Series 18:155-70.

Schantz, M.M., R.M. Parris, and S.A. Wise. 2000. NIST/NOAA NS&T Intercomparison Exercise Program for Organic Contaminants in the Marine Environments. Descriptions and Results of the 1999 Organic Intercomparison Exercise. NOAA Technical Memorandum NOS NCCOS CCMA 146 Silver Spring, MD.

Seidel, S.L., V.F. Hodge, and E.D. Goldberg. 1980. Tin as an environmental pollutant. Thalassia Jugoslavica 16:209-223.

Sericano, J.L. 1993. The American Oyster (*Crassostrea virginica*) as a Bioindicator of Trace Organic Contamination. Doctoral dissertation, Texas A&M University, College Station, TX. 242 pp.

SFEI (San Francisco Estuary Institute). 2005. The Pulse of the Estuary: Monitoring and Managing Water Quality in the San Francisco Estuary. SFEI Contribution 78 Oakland, CA.

Suedel, B.C., J.A. Boraczek, R.K. Peddicord, P.A. Clifford, and T.M. Dillon. 1994. Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. Reviews of Environmental Contamination and Toxicology 136:21-89.

Sokolova, I.M., A.H. Ringwood, and C. Johnson. 2005. Tissue-specific accumulation of cadmium in subcellular compartments of eastern oysters *Crassostrea virginica* Gmelin (Bivalvia: Ostreidae). Aquatic Toxicology 74(3):218-228.

Srinivasan, M., and G.W. Swain. 2006. Managing the use of copper-based antifouling paints. Environmental Management 39(3):423-441.

Thompson, S.E., C.A. Burton, D.J. Quinn, Y.C. Ng. 1972. Concentration factors of chemical elements in edible aquatic organisms. Livermore, CA: Lawrence Livermore Laboratory, Biomedical Division, University of California. 77 pp.

Tripp, B.W., and J.W. Farrington. 1984. Using sentinel organisms to monitor chemical changes in the coastal zone: progress or paralysis. Submitted to the Coastal Society, 9th Annual Conference, October 1984, Atlantic City, NJ. Woods Hole Oceanographic Institution Contribution No. 5830.

USGS (U.S. Geological Survey). 2008. Minerals Yearbook: Volume I. Metals and Minerals. Reston, Virginia. 22 Apr. 2008 <http://minerals.usgs.gov/minerals/pubs/commodity/myb/>.

Valette-Silver, N.J., G.F. Riedel, E.A. Crecelius, H. Windom, R.G. Smith, and S.S. Dolvin. 1999. Elevated arsenic concentrations in bivalves from the southeast coasts of the USA. Marine Environmental Research 48:311-333.

Willie, S. 2000. NOAA National Status and Trends Program Thirteenth Round Intercomparison Exercise Results for Trace Metals in Marine Sediments and Biological Tissues. NOAA Technical Memorandum NOS NCCOS CCMA 142 Silver Spring, MD.

WHO (World Health Organization). 1980. Tin and organotin compounds: A preliminary review. Environmental Heath criteria 15. Geneva, Switzerland. 22 Apr. 2008 <http://www.inchem.org/documents/ehc/ehc/ehc015.htm>.

References

WSRC(WestinghouseSavannahRiverCompany).1997.RecordofDecisionRemedialAlternativeSelection.ReporttotheU.S.DepartmentofEnergy UnderContractDE-AC09-96SR18500SavannahRiverOperationsOffice,Aiken,SouthCarolina.22Apr.2008<http://www.epa.gov/superfund/sites/rods/fulltext/r0497026.pdf>.

Zar, J.H. 1999. Biostatistical Analysis. 4th Edition. Prentice-Hall: Upper Saddle River, NJ. 931 pp.

The concept of environmental monitoring and characterization using bivalve mollusks as the sentinel organisms has a long history dating back at least to 1895. The references provided below contain information about all aspects of NOAA's Mussel Watch Program that has been actively quantifying contaminants in the nation's coastal and estuarine waters since 1986. A more comprehensive list of publications and the related electronic files can be found at our website: http://www8.nos.noaa.gov/nccos/ccma/publications.aspx. For a larger perspective of this kind of work performed internationally, including the earliest work alluded to above, see our publication "World Mussel Watch Database" found at: http://www.ccma.nos.noaa.gov/publications/tm109.pdf

Peer Reviewed

Johnson, W.E., K.L. Kimbrough, G.G. Lauenstein, and J. Christensen. (In press). Chemical Contamination Assessment of Gulf of Mexico Oysters in Response to Hurricanes Katrina and Rita, Environmental Monitoring and Assessment.

Lauenstein, G.G., and K.L. Kimbrough. 2007. Chemical contamination of the Hudson-Raritan Estuary as a result of the attack on the World Trade Center: Analysis of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in mussels and sediment, Marine Pollution Bulletin 54(3):284-289.

Kim, Y., and E.N. Powell. 2007. Distribution of parasites and pathologies in sentinel bivalves: NOAA Status and Trends "Mussel Watch" Program, Journal of Shellfish Research 26(4):1115-1151

Apeti, D.A., and G.G Lauenstien. 2006. An assessment of mirex concentrations along the southern shorelines of the Great Lakes, USA. American Journal of Environmental Sciences 2(3):95-103.

O'Connor, T.P., and G.G. Lauenstein. 2006. Trends in chemical concentrations in mussels and oysters collected along the U.S. coast: update to 2003. Marine Environmental Research 62:261-285.

O'Connor, T.P., and G.G. Lauenstein. 2004. Status and trends of copper concentrations in mussels and oysters in the USA, Marine chemistry 97:45-49.

Cantillo, A.Y. 2003. Comparison of results of Mussel Watch Programs of the United States and France with worldwide Mussel Watch studies, Marine Pollution Bulletin 39(9):712-717.

Valette-Silver, N.J., and G.G. Lauenstein. 1995. Radionuclide concentrations in bivalves collected along the coastal United States, Marine Pollution Bulletin 30(5):320-333.

noaa technical Memoranda

Lauenstein, G.G., and A.Y. Cantillo. 2002. Contaminant trends in US National Estuarine Research Reserves, NOAA Technical Memorandum, NOAA NOS NCCOS 156, Silver Spring, MD. 22 Apr. 2008 <http://www.coastalscience.noaa.gov/documents/nerrs.pdf>.

Willie, S. 2000. Thirteen Round Intercomparison for Trace Metals in Marine Sediments and Biological Tissues, NOAA Technical Memorandum, NOS NCCOS CCMA 142, Silver Spring, MD. 22 Apr 2008 <http://ccma.nos.noaa.gov/publications/techmemo142.pdf>.

Schantz, M.M., R.M. Parris, and S.A. Wise. 2000. NIST/NOAA NS&T Intercomparison Exercise Program for Organic Contaminants in the Marine Environment - Description and Results of 1999 Organic Intercomparison Excercises, NOAA Technical Memorandum, 146, Silver Spring, MD. 22 Apr. 2008 <http://ccma.nos.noaa.gov/publications/techmemo142.pdf>.

Johnson, W.E., T.P. O'Connor, A.Y. Cantillo, and G.G. Lauenstein. 1999. Spatial Distribution of Chlorpyrifos and Endosulfan in USA Coastal Waters and the Great Lakes NOAA Technical Memorandum, NOS NCCOS CCMA 140, Silver Spring, MD. 22 Apr. 2008 <http://ccma.nos.noaa.gov/publications/tm140.pdf>.

Lauenstein, G.G., A.Y. Cantillo, S. Kokkinakis, J. Jobling, and R. Fay. 1997. National Status and Trends Program for Marine Environmental Quality: Mussel Watch Project Site Descriptions, through 1997, NOAA Technical Memorandum, NOS ORCA 112, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm112.pdf>.

Daskalakis, K.D., and T.P. O'Connor. 1994. Inventory of Chemical Concentrations in Coastal and Estuarine Sediments, NOAA Technical Memorandum, 76, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm112.pdf>.

National Oceanic and Atmospheric Administration. 1991. Second Summary of Data on Chemical Concentrations in Sediments from the National Status and Trends Program, NOAA Technical Memorandum, NOS OMA 59, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm59.pdf>.

Mearns, A.J., M. Matta, G. Shigenaka, D. MacDonald, M. Buchman, H. Harris, J. Golas, and G. Lauenstein. 1991. Contaminant Trends in the Southern California Bight: Inventory and Assessment, NOAA Technical Memorandum, NOS ORCA 62, Silver Spring, MD.

Methods Documents

Kimbrough, K.L., G.G. Lauenstein, and W.E. Johnson. 2007. Organic Contaminant Analytical Methods of the National Status and Trends Program: Update 2000-2006, NOAA Technical Memoranda, NOS NCCOS 30, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/organicsmethods.pdf>.

Kimbrough, K.L., and G.G. Lauenstein. 2007. Major and Trace Element Analytical Methods of the National Status and Trends Program: 2000-2006, NOAA Technical Memorandum, NOS NCCOS 29, Silver Spring, MD. 22 Apr 2008 <http://www.ccma.nos.noaa.gov/publications/nsandtmethods.pdf>.

McDonald, S. J., D. S. Frank, J. A. Ramirez, B. Wang, and J. M. Brooks. 2006. Ancillary Methods of the National Status and Trends Program: Update 2000-2006, NOAA Technical Memorandum, NOS NCCOS 28, Silver Spring, MD. 22 Apr. 2008 <http://coastalscience.noaa.gov/documents/ancillarymethodsnsandt.pdf>.

Kim, Y., K.A. Ashton-Alcox, and E.N. Powell. 2006. Histological Techniques for Marine Bivalve Molluscs: Update, NOAA Technical Memorandum, NOS NCCOS 27, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/histopathtechmemofinal.pdf>.

Lauenstein, G.G., and A.Y. Cantillo. 1998. Sampling and Analytical Methods of the National Status and Trends Program Mussel Watch Project: 1993-1996 Update, NOAA Technical Memorandum, 130, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm130.pdf>.

Lauenstein, G.G., and A.Y. Cantillo. 1993. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Overview and Summary of Methods - Vol I, NOAA Technical Memorandum, NOS ORCA 71, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm71v1.pdf>.

Lauenstein, G.G., and A.Y. Cantillo. 1993. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Complementary Measurements - Vol II, NOAA Technical Memorandum, NOS ORCA 71, Silver Spring, MD. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm71v2.pdf>.

Lauenstein, G.G., and A.Y. Cantillo. 1993. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Elemental Analytical Methods - Volume III, NOAA Technical Memorandum, NOS ORCA 71. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm71v3.pdf>.

Lauenstein, G.G., and A.Y. Cantillo. 1993. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Trace Organic Analytical Methods - Vol IV, NOAA Technical Memorandum, NOS ORCA 71. 22 Apr. 2008 <http://www.ccma.nos.noaa.gov/publications/tm71v4.pdf>.

Alaska (AK)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
KTMP	55.2938	-131.5480	Ketchikan	Mountain Point
NBES	59.4533	-135.3365	Nahku Bay	East Side
PVMC	61.1328	-146.4610	Port Valdez	Mineral Creek Flats
UISB	60.9608	-147.6460	Unakwit Inlet	Siwash Bay
CIHS	59.6145	-151.4442	Cook Inlet	Homer Spit

Concentrations derived from 2004-2005 data.

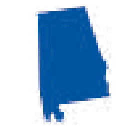
Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
KTMP	M	11		4		7.1	4	4		7				0.06				1.2				0.59				0				97			
NBES	M	9.2				5.4	4	4	H	6				0.1				2				2.1		4		0				72			
PVMC	M	12	4	4		3.5		4		27	4			0.09				8.9	4	4		3	4	4		0.18				89			G
UISB	M	12	4	4		2.6				33	4			0.11				7.4	4			2				1.4	4	4		108			
CIHS	M	12	4	4		1.7				10				0.12				3.4				1.3				0				105			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
KTMP	M	2.1				0.47				1.4				0.58				152				3.5			
NBES	M	3.7				2.7				2.2				0.98				316				7.7			
PVMC	M	7.3				2.6				1.7				0.31				441				6.4			
UISB	M	1.7				0.87				0.38				0.56				176				3.7			
CIHS	M	4.4				1.1				0.3				0.42				250				11			



Alabama (AL)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
MBDR	30.5917	-88.0398	Mobile Bay	Dog River
MBCP	30.3155	-88.1338	Mobile Bay	Cedar Point Reef

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
MBDR	O	5.7				3.7	4	4		287	4	4		0.11	4			2.8	4			0.23				0.27	4	4		4410	4	4	
MBCP	O	7.1				2.4				86				0.07	4			1.5				0.29				0.16				876			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
MBDR	O	106	4	4		9.5		4		202	4	4		6.8		4		1187		4		125		4	
MBCP	O	20			G	3.1			G	45		4	G	3.5			G	190			G	36			G

California (CA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
IBNJ	32.5877	-117.1335	Imperial Beach	North Jetty
SDCB	32.6865	-117.1592	San Diego Bay	Coronado Bridge
PLLH	32.6805	-117.2488	Point Loma	Lighthouse
SDHI	32.7247	-117.1947	San Diego Bay	Harbor Island
MBVB	32.7675	-117.2420	Mission Bay	Ventura Bridge
LJLJ	32.8515	-117.2738	La Jolla	Point La Jolla
OSBJ	33.2017	-117.3937	Oceanside	Municipal Beach Jetty
SCBR	33.4517	-118.4873	South Catalina Island	Bird Rock
NBWJ	33.5910	-117.8900	Newport Beach	West Jetty

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
IBNJ	M	9.2				0.78				7.6				0.05			G	0.54				1.5				0				146	4		
SDCB	M	6.7				2.5			G	14			G	0.12			G	1.1				2.5		4		0.21			G	196	4		G
PLLH	M	27	4	4		2.3				9.9				0.25	4	4		3.8				2.6		4		0				320	4		
SDHI	M	7.5				2.7			G	15				0.12				1				1.9			G	0.25	4	4		187	4		G
MBVB	M	8			G	1.4				5.9				0.04				0.66				0.8				0				133			
LJLJ	M	15	4	4	G	1.6				7.4				0.07			G	1.5				1.7				0				148	4		
OSBJ	M	12	4	4		2.6				7.6				0.05				1				1.3				0.06				203	4		
SCBR	M	15	4	4	G	5	4	4		6.9				0.08				2.5				1.4				0				130			
NBWJ	M	11		4		1.3				6.8				0			G	0.9				4.7	4	4		0.14				125			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
IBNJ	M	20				3.6			G	58			G	2			G	268				99			
SDCB	M	81	4	4	G	12		4	G	54				1.7				1811	4	4	G	571	4	4	
PLLH	M	16			G	6.8			G	12			G	2.8				268				50			G
SDHI	M	133	4	4		23	4	4	G	97	4			3				3762	4	4	G	642	4	4	
MBVB	M	18			G	5.9			G	14			G	1.1				297			G	40			G
LJLJ	M	14				11		4	G	14				4.5		4		133				20			
OSBJ	M	30				25	4	4		177	4	4		22	4	4		195				129			
SCBR	M	5.1				0.85			G	8.9			G	0.23			G	63				16			
NBWJ	M	8.4			G	8.2				61				3.6				96				31			

California (CA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
ABWJ	33.7335	-118.1010	Anaheim Bay	West Jetty
LBBW	33.7232	-118.1735	Long Beach	Breakwater
SPFP	33.7067	-118.2742	San Pedro Harbor	Fishing Pier
PVRP	33.7170	-118.3227	Palos Verdes	Royal Palms State Pk.
RBMJ	33.8320	-118.3928	Redondo Beach	Municipal Jetty
MDSJ	33.9618	-118.4580	Marina Del Rey	South Jetty
TBSM	34.0390	-118.5972	Las Tunas Beach	Santa Monica Bay
PDPD	34.0010	-118.8088	Point Dume	Point Dume
SCFP	34.0580	-119.9203	Santa Cruz Island	Fraser Point

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
ABWJ	M	8.7				0.59				7.7			G	0			G	1				1.4			G	0.1				82			
LBBW	M	7.3				0.57				7.9				0.06				1.1				3	4	4		0				127			G
SPFP	M	9.5				0.71				13				0				1.9				1.7				0.55	4	4		99			G
PVRP	M	14	4	4	G	1.4				8.9				0.07			G	1.4			G	1.1			G	0.14				93			G
RBMJ	M	9.6				0.62				8.6			G	0.1				1.9				3.2	4	4		0				114			
MDSJ	M	8.4				1.4				9.5				0.07			G	1				4.7	4	4	G	0.26	4	4		86			G
TBSM	M	7.7				0.96				9.4				0.08			G	2.5				2.5		4		0.12				108			
PDPD	M	7.9			G	1.6				8				0			G	1.4				2			G	0.14				88			
SCFP	M	18	4	4	G	5.5	4	4		6.5				0.05				1.8				0.83				0				204	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
ABWJ	M	13			G	17	4	4	G	175	4	4	G	2.5			G	522				107			G
LBBW	M	44		4	G	25	4	4		286	4	4		14	4	4		222				104			
SPFP	M	75	4	4	G	5.5			G	452	4	4	G	1.8				4434	4	4		94			G
PVRP	M	13			G	5.9			G	462	4	4	G	1.9			G	90			G	44			G
RBMJ	M	18			G	15		4		152	4	4		6.6		4		278				58			
MDSJ	M	11			G	37	4	4	G	96	4		G	12	4	4		2093	4	4		75			
TBSM	M	6.7				15		4		77	4		G	5.6		4		347				35			
PDPD	M	6.3			G	4.7			G	57			G	1.9				69				20			
SCFP	M	3.5				6.2				12			G	3.4				121				15			

California (CA)

Regional (r)

Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)

National Status
4 Medium
4 High

Trend (t)

National Trend
G Decreasing
H Increasing

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
SBSB	34.3957	-119.7275	Point Santa Barbara	Point Santa Barbara
PCPC	34.4438	-120.4570	Point Conception	Point Conception
SLSL	35.1607	-120.7558	San Luis Obispo Bay	Point San Luis
SSSS	35.6347	-121.1947	San Simeon Point	San Simeon Point
PGLP	36.6272	-121.9165	Pacific Grove	Lovers Point
MBML	36.8012	-121.7897	Monterey Bay	Moss Landing
MBES	36.8098	-121.7852	Monterey Bay	Elkhorn Slough
MBSC	36.9542	-122.0247	Monterey Bay	Point Santa Cruz
SFSM	37.5780	-122.2537	San Francisco Bay	San Mateo Bridge

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SBSB	M	8.6				1.3				6.7				0				1.5				0.68				0				68			
PCPC	M	12	4	4	G	6.8	4	4		6.6				0.15		4		2.7				1.9				0.17				126			
SLSL	M	11				5.7	4	4		10				0.08				1.9				0.61			G	0				107			
SSSS	M	17	4	4	G	7.6	4	4		11			H	0.3	4	4		9.2	4	4		1.6				0				157	4		
PGLP	M	13	4	4	G	8.4	4	4		7.8				0.08				1.7				5.5	4	4		0				166	4		
MBML	M	8.5				13	4	4		8.1				0.04				1.7				0.98				0				145	4		
MBES	M	8.1				11	4	4		8.7				0.04				1.5				0.6				0				110			
MBSC	M	10			G	4.5	4	4		7.4				0.06				1.6				1.5				0				111			G
SFSM	M	7.2				3.7	4	4	G	11				0.21	4	4		5.6	4			1.4				0.11				114			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SBSB	M	3.2			G	7.9			H	18			G	2.7				112				18			
PCPC	M	4.1				3.3				26				1.5				247				17			
SLSL	M	7.3			G	7.5			G	101	4			6.8		4		348				72			
SSSS	M	2			G	14		4		15				5.3		4		117				17			
PGLP	M	3.6				17	4	4		33				11	4	4		131				23			
MBML	M	6.9			G	9.6		4		250	4	4		34	4	4		218				27			
MBES	M	16				17	4	4		520	4	4		95	4	4		174				46			
MBSC	M	4.9			G	16	4	4		91	4			19	4	4		193				13			
SFSM	M	38			G	11		4	G	56				6.6		4	G	834				257	4		G

California (CA)

Regional (r)

Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)

National Status
4 Medium
4 High

Trend (t)

National Trend
G Decreasing
H Increasing

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
SFYB	37.8152	-122.3715	San Francisco Bay	Yerba Buena Island
SFDB	37.5027	-122.1213	San Francisco Bay	Dumbarton Bridge
TBSR	38.1495	-122.9040	Tomales Bay	Spenger's Residence
BBBE	38.3050	-123.0660	Bodega Bay	Bodega Bay Entrance
PALH	38.9530	-123.7430	Point Arena	Lighthouse
PDSC	40.0225	-124.0733	Point Delgada	Shelter Cove
HMBJ	40.7642	-124.2375	Eureka	Humboldt Bay Jetty
EUSB	40.8215	-124.1713	Eureka	Samoa Bridge
SGSG	41.7478	-124.2077	Crescent	Point St. George

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SFYB	M	6.6				3.2		4		13				0.34	4	4		5				2.8	4	4		0.14				197	4		
SFDB	M	4.9				3.6	4	4	G	7.2				0.19	4	4	G	3.7				0.88				0				92			
TBSR	M	7.4				5.3	4	4		4.9				0.19	4	4		3.7				0.46				0				94			
BBBE	M	11		4		11	4	4		8.1				0.12				2.7				3.5	4	4		0				142	4		
PALH	M	15	4	4		7.7	4	4		7.9			H	0.18	4	4		3.4				1				0				139			
PDSC	M	11		4		5.1	4	4		8.2			H	0.11				1.2			H	1.7				0				161	4		
HMBJ	M	10				7.3	4	4		8.4				0.06				2.9				1.7				0				180	4		
EUSB	M	8.2				4.6	4	4		8.4				0.14		4		6.2	4			0.81				0				146	4		
SGSG	M	13	4	4		8.5	4	4		36	4			0.17		4		14	4	4		1.6				0.85	4	4		155	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SFYB	M	87	4	4		7.2				56				7.9		4						153	4		
SFDB	M	12			G	14		4		75	4		G	6.2		4	G	831				259	4		
TBSR	M	4.7				2.8				13				1.2				424				13			
BBBE	M	5.8				16	4	4		24				14	4	4		125				68			
PALH	M	4.7				14		4		68	4		G	11	4	4	G	159				100			
PDSC	M	2.2				5.8				3.6				6.4		4		184			H	4.4			
HMBJ	M	1.2				2.7				2				4.7		4	H	169				6.9			
EUSB	M	19			G	1.9				5.3				0.68				721				23			
SGSG	M	1.9				8.2				4.8				6.5		4		172				7.3			

Connecticut (CT)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
LICR	41.3183	-72.3583	Long Island Sound	Connecticut River
LISI	41.0527	-73.4173	Long Island Sound	Sheffield Island

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

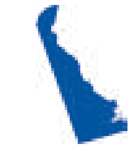
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LICR	M	9.2				1.4				19	4			0.13				3.9				2.6		4		0.28	4	4		103			
LISI	M	8.2				1.5				18	4			0.15		4		2.9				4.5	4	4		0.25	4	4		82			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LICR	M	10			–	6.8			–	26			–	1.6			–	439				117			
LISI	M	14				9		4	–	30			–	3.5			–	1069				126			–

Delaware (DE)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
DBKI	39.2032	-75.3590	Delaware Bay	Kelly Island
DBCH	38.7835	-75.1205	Delaware Bay	Cape Henlopen

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
DBKI	O	9				4.3	4	4		201		4		0.12	4			3.2	4		–	1.4	4			0.28	4	4		4980	4	4	
DBCH	M	9.8				0.76				8.8				0.19	4	4		2.7				2.3		4		0.23	4	4		112			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
DBKI	O	49				6.2			–	75	4	4	–	8.5		4	–	207				69		4	–
DBCH	M	17			–	2.2			–	22			–	1.5				241				37			–

Florida (FL)

Regional (r)

Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)

National Status
4 Medium
4 High

Trend (t)

National Trend
G Decreasing
H Increasing

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
SJCB	30.3810	-81.4400	St. Johns River	Chicopit Bay
MRCB	29.7640	-81.2618	Matanzas River	Crescent Beach
IRSR	27.8295	-80.4743	Indian River	Sebastian River
NMML	25.9377	-80.1497	North Miami	Maule Lake
BBGC	25.5333	-80.3232	Biscayne Bay	Gould's Canal
FBJB	25.2122	-80.5340	Florida Bay	Joe Bay
FBFO	25.1412	-80.9237	Florida Bay	Flamingo
EVFU	25.9023	-81.5123	Everglades	Faka Union Bay
RBHC	26.0270	-81.7388	Rookery Bay	Henderson Creek

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SJCB	O	20	4	4		1.6			–	71				0.1	4			1.8	4			0.49	4			0			–	2010			–
MRCB	O	16	4	4		1.9				89				0.19	4	4		1.8	4			0.38			–	0				2560		4	
IRSR	O	7.3				1.2				374	4	4		0.08	4			0.81				0.67	4			0				2910		4	
NMML	O	8.3				0.81				984	4	4		0.06				1				1.7	4			0.63	4	4		4690	4	4	
BBGC	O	9.5				0.25				572	4	4	–	0.15	4	4		0.72				0.29				0.24	4	4		4180	4	4	
FBJB	O	7.5				1.5				44				0.32	4	4		1.9	4			0.5	4			0.32	4	4		994			
FBFO	O	17	4	4		1.7				52				0.16	4	4		0.91				0.53	4			0.16				1210			
EVFU	O	7.9				1.8			–	91				0.21	4	4		1.5				0.44				0.13				1660			
RBHC	O	12	4	4		2.9				121				0.16	4	4	–	1.2				0.38				0.11				1180			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SJCB	O	70	4		–	2.5				6.6				1.1				638				34			
MRCB	O	23				0.86				2.4				0				234				13			
IRSR	O	113	4	4		55	4	4		42		4		3.4				875		4		68		4	
NMML	O	876	4	4		6.6			–	25				1.7				1598	4	4		109		4	
BBGC	O	288	4	4		4.6				13				0.58				2280	4	4		33			
FBJB	O	6.5				1.3				1.1				0.09				244				15			
FBFO	O	6.7			–	0.79				3.5			–	0			–	371			–	20			
EVFU	O	18				0.72			–	1.4			–	0.09				591				19			
RBHC	O	27			–	2.3				3			–	0.36				286				20			

Florida (FL)

Regional (r)
Mussels (M)
4 Medium
4 High
Zebra Mussels (ZM)
4 Medium
4 High
Oysters (O)
4 Medium
4 High
Status (s)
National Status
4 Medium
4 High
Trend (t)
National Trend
G Decreasing
H Increasing
Concentrations derived from 2004-2005 data.
Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
NBNB	26.1118	-81.7852	Naples Bay	Naples Bay
CBBI	26.5143	-82.0345	Charlotte Harbor	Bird Island
TBCB	27.6810	-82.5177	Tampa Bay	Cockroach Bay
TBHB	27.8548	-82.3947	Tampa Bay	Hillsborough Bay
TBKA	27.9097	-82.4538	Tampa Bay	Peter O. Knight Airport
TBOT	28.0237	-82.6328	Tampa Bay	Old Tampa Bay
TBPB	27.8443	-82.6115	Tampa Bay	Papys Bayou
TBMK	27.6208	-82.7265	Tampa Bay	Mullet Key Bayou
TBNP	27.7872	-82.7540	Tampa Bay	Navarez Park
CKBP	29.2067	-83.0695	Cedar Key	Black Point

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
NBNB	O	12	4	4		1.1			–	1400	4	4	–	0.11	4			1.1				0.63	4			0.41	4	4	–	6300	4	4	
CBBI	O	10			–	2.2				256	4	4	–	0.24	4	4		1.1				0.49	4			0				4930	4	4	–
TBCB	O	7.3				3				92				0.16	4	4		1.6	4			0.55	4			0.11				1550			
TBHB	O	6.3				2.6				81				0.08	4			1.1				0.71	4		–	0.36	4	4		2490		4	
TBKA	O	6.5				2.2				234	4	4		0.09	4			1.2				1.6	4			0.52	4	4		4460	4	4	
TBOT	O	4.2				3.1				229	4	4		0.33	4	4	–	1.6				1.1	4			0.22	4	4		6450	4	4	
TBPB	O	7.2				1.7			–	72				0.12	4		–	1.4				1.6	4			0.21	4	4		1650			–
TBMK	O	15	4	4		2.7				23				0.14	4	4		1.5				1.2	4			0.15				374			
TBNP	O	37	4	4		1.3				99				0.08	4			1				1	4			0.2	4			1970			
CKBP	O	17	4	4		1			–	14				0.1	4		–	0.74				0.18				0				364			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
NBNB	O	87	4		–	12		4		7.1			–	3.9				1443	4	4		27			
CBBI	O	46				2.7			–	3.8			–	0.62			–	217				6.5			
TBCB	O	8.8			–	10		4	–	20			–	0.39			–	228				21			
TBHB	O	67	4			7.5		4		14				1.3				993		4		49		4	
TBKA	O	134	4	4		37	4	4	–	62		4	–	4			–	507			–	126		4	–
TBOT	O	5.9				14		4		19				1.1				637				44		4	
TBPB	O	9.9				21	4	4		12			–	2.3				628				32			
TBMK	O	1.5				5.5			–	3.1			–	0.61			–	115			–	19			
TBNP	O	15				20	4	4	–	14			–	2.4				375			–	32			–
CKBP	O	5.8				1.7			–	1.8			–	0.34			–	138				3.9			

Florida (FL)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
SRWP	29.3292	-83.1742	Suwannee River	West Pass
AESP	30.0633	-84.3220	Apalachee Bay	Spring Creek
APCP	29.7242	-84.8842	Apalachicola Bay	Cat Point Bar
APDB	29.6725	-85.0657	Apalachicola Bay	Dry Bar
SAWB	30.1425	-85.6322	St. Andrew Bay	Watson Bayou
PCMP	30.1512	-85.6630	Panama City	Municipal Pier
PCLO	30.2513	-85.6810	Panama City	Little Oyster Bar
CBSR	30.4120	-86.2037	Choctawhatchee Bay	Off Santa Rosa

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SRWP	O	35	4	4		1.7				16				0.17	4	4		0.93				0.14				0.25	4	4		819			
AESP	O	15	4	4		2.6				24				0.1	4			0.89				0.27				0				381			
APCP	O	15	4	4		2.1				45				0.08	4			1.4				0.23				0				356			
APDB	O	15	4	4		2.2			G	36			G	0.08	4			1.5				0.24				0				322			
SAWB	O	31	4	4	H	1				266	4	4		0.08	4			0.78				0.69	4			0.09				2530		4	G
PCMP	O	36	4	4	H	1.4				308	4	4		0.1	4			0.82				0.49	4		G	0				2050			
PCLO	O	22	4	4	H	1.2				38				0.06				0.7				0.32				0				1580			G
CBSR	O	11		4		2.3				61				0.25	4	4		1.3				1.3	4			0.21	4			2030			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SRWP	O	5.7				2.3				1.7				0.19								3.9			
AESP	O	8.3			G	2.1				7.7			G	0.27			G	194				5.1			G
APCP	O	5.2			G	4.1			G	11			G	2.5			G	340			G	10			
APDB	O	5.7				5			G	14			G	3.7			G	342				11			
SAWB	O	79	4			11		4	G	52		4	G	1.8			G	1202		4		103		4	G
PCMP	O	110	4	4	G	10		4		52		4	G	1.2			G	1374	4	4		66		4	
PCLO	O	8.4			G	4.3			G	77	4	4	G	1.4				359				23			
CBSR	O	14				13		4		138	4	4		9.8	4	4		479				43		4	

Florida (FL)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
CBPP	30.4823	-86.4793	Choctawhatchee Bay	Postil Point
CBJB	30.4108	-86.4908	Choctawhatchee Bay	Joe's Bayou
PBSP	30.3498	-87.1547	Pensacola Bay	Sabine Point
PBIB	30.5167	-87.1117	Pensacola Bay	Indian Bayou
PBPH	30.4137	-87.1913	Pensacola Bay	Public Harbor

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CBPP	O	12	4	4	H	2.4				79				0.24	4	4		1				0.84	4			0.11				2540		4	
CBJB	O	17	4	4		3.5	4	4		821	4	4	H	0.16	4	4	G	1.1				0.64	4		G	0.23	4	4		7710	4	4	
PBSP	O	17	4	4	H	2.7				52				0.17	4	4		1.7	4			0.54	4			0.17				1010			G
PBIB	O	13	4	4		2.2				41				0.1	4			2.1	4			0.36				0				739			
PBPH	O	12	4	4		2.8				84				0.17	4	4		1.4				0.75	4			0.13				3200		4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CBPP	O	14				13		4		138	4	4	G	9.2		4		451			G	38			
CBJB	O	42			G	6.5			G	26			G	1.9			G	2372	4	4		45		4	
PBSP	O	8.1				3.2				7.9				1.7				187				28			
PBIB	O	1.7			G	3.2			G	9.9			G	1.7			G	142				83		4	G
PBPH	O	8.1			G	11		4	G	20			G	9.5	4	4		360			G	58		4	G

Georgia (GA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
SRTI	32.0165	-80.8825	Savannah River Estuary	Tybee Island
SSSI	31.3928	-81.2880	Sapelo Sound	Sapelo Island
ARWI	31.3242	-81.3108	Altamaha River	Wolfe Island

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SRTI	O	20	4	4		2.5				87				0.08	4			2.2	4			0.43				0				1530			
SSSI	O	19	4	4		1.7				51				0.1	4			1.8	4			0.41				0				969			
ARWI	O	21	4	4		1.8				54			–	0.08	4			1.7	4			0.18				0				947			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SRTI	O	101	4	4		2.1			–	4.3			–	0			–	561			–	10			
SSSI	O	8.8				0.77			–	2.7			–	0.62			–	175				5.8			
ARWI	O	8.7				1.8				4.2				0.8				192				11			

Appendix 2: Results by State

Illinios (IL)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
LMNC	42.3047	-87.8273	Lake Michigan	North Chicago

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

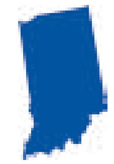
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LMNC	ZM	6.8	4		–	5	4	4		31	4			0.05	4			30	4	4		18	4	4		0.25		4		149	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LMNC	ZM	15		4		3.1			–	45		4		6.2		4	–	1120		4		90			

Indiana (IN)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
LMHM	41.6987	-87.5083	Lake Michigan	Hammod Marina

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LMHM	ZM	4				2.4				19				0.05	4			12		4		2.9	4	4		0.27		4		91	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LMHM	ZM	21		4		4.5				18				6		4						128		4	

Louisiana (LA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
LPNO	30.0363	-90.0413	Lake Pontchartrain	New Orleans
LBGO	29.9448	-89.8353	Lake Borgne	Gulf Outlet
LBMP	29.8670	-89.6785	Lake Borgne	Malheureux Point
BSBG	29.5980	-89.6208	Breton Sound	Bay Gardene
BSSI	29.4057	-89.4838	Breton Sound	Sable Island
BBMB	29.2767	-89.9420	Barataria Bay	Middle Bank
BBSD	29.4048	-89.9988	Barataria Bay	Bayou Saint Denis
TBLF	29.2642	-90.3982	Terrebonne Bay	Lake Felicity
TBLB	29.2595	-90.5943	Terrebonne Bay	Lake Barre
CLCL	29.2532	-90.9267	Caillou Lake	Caillou Lake

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

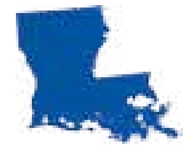
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LPNO	O	4.7				9.4	4	4		636	4	4		0				4.1	4			0.63	4			0.28	4	4		6440	4	4	
LBGO	O	7.2				7.9	4	4		300	4	4		0.08	4			2.5	4			0.41				0.17				4260	4	4	
LBMP	O	6				9.9	4	4		238	4	4		0.06				3	4			0.93	4			0.11				3210		4	
BSBG	O	3.5			G	3.7	4	4		93				0.09	4			2.9	4		H	0.94	4		H	0.12				1350			
BSSI	O	6.7				12	4	4		211		4		0				2.7	4			0.81	4			0.17				2600		4	
BBMB	O	6.4				1.5				45				0.09	4			1.5				0.46				0.14				1170			G
BBSD	O	7.5				1.4				39				0.09	4			1.9	4			0.31				0				969			
TBLF	O	7.2				2.6				93				0			G	2	4			0.61	4			0				1890			
TBLB	O	6.9				2.3				79				0				2.1	4			0.62	4			0				1380			
CLCL	O	5.6				4.2	4	4		152				0.05			H	2.9	4		H	0.47				0				1970			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LPNO	O	76	4		G	40	4	4		28				5				828			G	96		4	G
LBGO	O	13				4				4.5				1.8				350				24			
LBMP	O	11				1.5			G	4			G	1.5			G	291				23			
BSBG	O	4.8				0.49			G	2			G	0.54			G	177			G	18			
BSSI	O	22				9.4		4		32				6.2		4	G	550			G	62		4	
BBMB	O	79	4		G	0.83			G	5.1			G	1.3			G	703				14			
BBSD	O	45				1			G	3.7			G	0.85			G	437				12			
TBLF	O	1.9			G	0.09			G	2.8			G	0.13			G	171				13			
TBLB	O	2.4				0.36			G	1.5			G	0.26			G	220				21			
CLCL	O	6.3				1.5			G	3.5			G	0.43			G	249				17			

Louisiana (LA)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
ABOB	29.2555	-91.1362	Atchafalaya Bay	Oyster Bayou
VBSP	29.5795	-92.0510	Vermilion Bay	Southwest Pass
JHJH	29.6368	-92.7668	Joseph Harbor Bayou	Joseph Harbor Bayou
CLSJ	29.8290	-93.3840	Calcasieu Lake	St. Johns Island
CLLC	30.0587	-93.3075	Calcasieu Lake	Lake Charles
SLBB	29.7908	-93.9063	Sabine Lake	Blue Buck Point

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

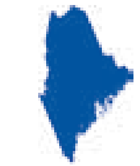
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
ABOB	O	5.3			G	2.9			G	77				0.09	4			2.6	4			0.39			G	0				1430			G
VBSP	O	6.5				9	4	4		545	4	4		0.07				2.7	4			0.81	4			0				3260		4	
JHJH	O	5.7				6.3	4	4		250	4	4		0.06				2.1	4			0.33			G	0				2000			
CLSJ	O	5.1			G	4.7	4	4		252	4	4		0.22	4	4		3.3	4		H	0.71	4			0				3230		4	
CLLC	O	4.2				6.4	4	4		382	4	4		0.24	4	4	H	3.5	4			1.3	4			0.18				5220	4	4	
SLBB	O	4.3				4.7	4	4		257	4	4		0.11	4			2.9	4			0.25				0				3810	4	4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
ABOB	O	10				0.99			G	5.6			G	0			G	250				31			
VBSP	O	3.7			G	2.5			G	25				2.3			G	295				34			
JHJH	O	13				1.3			G	31				1.8			G	932		4		54		4	
CLSJ	O	38				1.6				6.4			G	0.84			G	465				23			
CLLC	O	97	4	4		2.7			G	6.5			G	1.5				950		4		36			
SLBB	O	65	4			4.2				7.8			G	1.5			G	551				30			

Maine (ME)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
PBPI	44.2648	-68.7337	Penobscot Bay	Pickering Island
PBSI	44.4567	-68.8832	Penobscot Bay	Sears Island
MSSP	43.7578	-69.9977	Merriconeag Sound	Stover Point
CAKP	43.3453	-70.4743	Cape Arundel	Kennebunkport

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

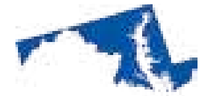
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
PBPI	M	7.8				1.1				5.3				0.09			G	0.92			G	0.89			G	0				81			
PBSI	M	8.5				0.75				5.2			G	0.12				1.1				1				0				78			
MSSP	M	9.5				0.8				6.4				0.11				1				1.3				0				79			
CAKP	M	11		4		1.4				6.7				0.17		4		1.5				2.4		4		0				104			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
PBPI	M	1.3				1.6				7.4				1.2				202				17			
PBSI	M	6			G	1.4			G	10			G	0.89			G	995				19			
MSSP	M	3.2				1.7				8			G	0.79				256				24			
CAKP	M	11				1.7			G	15				0.64			G	507				22			

Maryland (MD)



Regional (r)	Status (s)	Trend (t)
Mussels (M)	National Status	National Trend
4 Medium	4 Medium	G Decreasing
4 High	4 High	H Increasing

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
CBBO	39.1573	-76.4048	Chesapeake Bay	Bodkin Point
CBHP	38.9695	-76.4147	Chesapeake Bay	Hackett Point Bar
CBCP	38.6073	-76.1200	Chesapeake Bay	Choptank River
CBHG	38.3123	-76.3978	Chesapeake Bay	Hog Point
PRSP	38.2817	-76.9337	Potomac River	Swan Point

Metals (ppm)

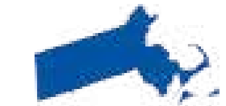
Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CBBO	O	7.4				14	4	4		867	4	4		0.07				3.7	4		—	0.33				0.44	4	4		12000	4	4	
CBHP	O	7.2				6.4	4	4		301	4	4		0.03				4.7	4		—	0.24				0.25	4	4		4570	4	4	
CBCP	O	5.7				3.9	4	4		121				0.04				3.4	4			0.12				0				2170			
CBHG	O	6.4				4.1	4	4		96				0.03				3.6	4			0.22				0.11				2550		4	
PRSP	O	5.9				3.2	4	4		141				0.07				3.3	4			0.2				0				2660		4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CBBO	O	366	4	4	—	12		4	—	29			—	6.9		4		481				79		4	—
CBHP	O	297	4	4		11		4	—	29			—	6.6		4	—					64		4	
CBCP	O	22				6			—	14			—	6.9		4		306				23			
CBHG	O	112	4	4		5.7			—	13			—	3.9			—					21			
PRSP	O	76	4			9.6		4	—	27			—	5.2				266				60		4	

Appendix 2: Results by State

Massachusetts (MA)



Regional (r)	Status (s)	Trend (t)
Mussels (M)	National Status	National Trend
4 Medium	4 Medium	G Decreasing
4 High	4 High	H Increasing

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

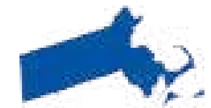
Site	Latitude	Longitude	General Location	Location
CAGH	42.6577	-70.5973	Cape Ann	Gap Head
SHFP	42.5135	-70.8442	Salem Harbor	Folger Point
MBNB	42.4198	-70.9072	Massachusetts Bay	Nahant Bay
BHDI	42.3573	-70.9730	Boston Harbor	Deer Island
BHDB	42.3022	-71.0363	Boston Harbor	Dorchester Bay
BHHB	42.2760	-70.8833	Boston Harbor	Hingham Bay
BHBI	42.3432	-70.8783	Boston Harbor	Brewster Island
MBNR	42.1603	-70.7425	Massachusetts Bay	North River
DBCI	42.0137	-70.6365	Duxbury Bay	Clarks Island

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CAGH	M	14	4	4		1				7.1			—	0.13				2.8				1.8			—	0.16				148	4		
SHFP	M	14	4	4	—	1.2				9.1				0.35	4	4		1.9				10	4	4		0.17				115			
MBNB	M	10				1.7				7.9				0.33	4	4		1.6				3.6	4	4		0				128			
BHDI	M	11			—	1.4				7.7			—	0.19	4	4	—	1				4.6	4	4		0.13				91			—
BHDB	M	11		4	—	1.6				9.9			—	0.28	4	4		1.5				11	4	4	—	0.23	4	4	—	172	4		
BHHB	M	8.8				1.1				9				0.26	4	4		1.1				7.3	4	4		0.12				121			
BHBI	M	13	4	4		1				6.4				0.25	4	4		1.3				3.9	4	4	—	0			—	110			
MBNR	M	11		4		1.2				6.5				0.33	4	4		1.1				2.9	4	4	—	0				86			
DBCI	M	8.5				0.81				6.6			—	0.18	4	4		0.81				2.6		4		0				94			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CAGH	M	7.9				3.2				7.6			—	0.73			—	284				23			
SHFP	M	57	4	4		11		4		51			—	1.4			—	671				121			—
MBNB	M	16				3.8			—	15			—	0.83				557				85			
BHDI	M	81	4	4	—	9.1		4	—	52			—	2.2				2089	4	4	—	390	4	4	
BHDB	M	108	4	4		11		4	—	59			—	2.2			—	2752	4	4	—	478	4	4	—
BHHB	M	55		4		6.4			—	34			—	1.7				956			—	231	4		
BHBI	M	12				5.4			—	24			—	1			—	959			—	162	4		
MBNR	M	20				7			—	46				2.6				1764	4	4		159	4		
DBCI	M	10				3.9			—	23			—	1.9			—	407				102			



Massachusetts (MA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
CCNH	41.7958	-69.9462	Cape Cod	Nauset Harbor
BBWF	41.6067	-70.6528	Buzzards Bay	West Falmouth
BBCC	41.7402	-70.6157	Buzzards Bay	Cape Cod Canal
BBAR	41.5797	-70.8590	Buzzards Bay	Angelica Rock
BBRH	41.5397	-70.9283	Buzzards Bay	Round Hill
BBGN	41.4817	-71.0373	Buzzards Bay	Goosebury Neck

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CCNH	M	10				0.68				7.5				0.09				0.62				1.1				0				95			
BBWF	M	19	4	4		1.4				9.7				0.13			H	2.1			H	1.3				0				95			
BBCC	M	15	4	4		0.94				7.3				0.16		4		1.6			H	3.8	4	4	H	0				77			
BBAR	M	14	4	4		0.86			G	7.9				0.1				1.4				1.9				0				88			G
BBRH	M	16	4	4		1.1				8.4				0.16		4	H	1.7				2.2		4		0				109			
BBGN	M	16	4	4		1				7.6			G	0.16		4		2.2			H	1.8				0			G	102			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CCNH	M	7.4				3.2			G	13				1.5			G	252				33			
BBWF	M	6.9			G	4.9				13				3.1			G	198				163	4		
BBCC	M	6.7			G	4.2				14				3.8				238				105			
BBAR	M	17			G	2.7			G	47			G	2.9				780				1413	4	4	
BBRH	M	9.4			G	1.5			G	22				1.2			G	662			G	632	4	4	
BBGN	M	5.6			G	0.97			G	7.8			G	1.5			G	305				126			

Michigan (MI)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
LMHB	42.7732	-86.2150	Lake Michigan	HollandBreakwater
LMMU	43.2258	-86.3470	Lake Michigan	Muskegon
TBLL	45.2057	-85.5368	Traverse Bay	LeelanauStatePark
LHTB	44.9222	-83.4135	Lake Huron	Thunder Bay
SBSR	43.6735	-83.8367	Saginaw Bay	Saginaw River
SBSP	43.9098	-83.4002	Saginaw Bay	Sandpoint
LHBR	43.0443	-82.4387	Lake Huron	Black River Canal
LESP	41.9587	-83.2330	Lake Erie	Stony Point
LERB	41.6745	-83.2262	Lake Erie	Reno Beach

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LMHB	ZM	5.6				3.8	4	4		11				0.06	4			25	4	4		0.44				0.08				114	4		
LMMU	ZM	4.9			G	3.6	4	4	G	9.1				0.05	4			14		4		0.7				0.09				101	4		G
TBLL	ZM	7.1	4			4.1	4	4		23				0.11	4			18		4		0.39				0.09				101	4		
LHTB	ZM	5.1				12	4	4		26	4			0.09	4			33	4	4		0.49				0.09				140	4		
SBSR	ZM	6.9	4			0.95				18				0.05	4			24	4	4		2.1	4	4		0.2				113	4		
SBSP	ZM	3.1			G	2				33	4			0.06	4			16		4		0.95				0.74	4	4		81			
LHBR	ZM	7.5	4			11	4	4		31	4			0.11	4			41	4	4		0.99				0.08				117	4		
LESP	ZM	5.1			G	2.2				16				0.06	4			16		4		3.2	4	4		0.3		4		77			G
LERB	ZM	6.4	4			3.3	4	4	G	21				0.05	4			17		4		2.4	4	4		0.36		4		67			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LMHB	ZM	19		4		15		4	G	68	4	4	G	12	4	4	G	745		4		266	4	4	G
LMMU	ZM	7.8				22	4	4	G	67	4	4	G	16	4	4		960		4	G	154	4	4	G
TBLL	ZM	14		4		1.7				3.2				5.4		4		128				20			
LHTB	ZM	8.3				1.4				3.5				2.3				205				17			
SBSR	ZM	6.2			G	9.7		4		26				1			G	730		4	G	119		4	
SBSP	ZM	11				3.1				4.9			G	1.9			G	173				25			
LHBR	ZM	7.6				4.8				4.1				2.9		4	G	235				17			
LESP	ZM	12		4		13		4		57		4		2.4				1595	4	4	G	424	4	4	
LERB	ZM	7.2				4.7				12				5.7		4	G	607		4		96		4	

Mississippi(MS)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
MSPB	30.3360	-88.5892	Mississippi Sound	Pascagoula Bay
MSBB	30.3925	-88.8575	Mississippi Sound	Biloxi Bay
MSPC	30.3023	-89.3272	Mississippi Sound	Pass Christian

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
MSPB	O	11				2.3				133				0.15	4	4		2	4			0.89	4			0.4	4	4		3070		4	
MSBB	O	7.6				3.6	4	4		373	4	4	H	0.11	4			1.6	4			0.66	4			0.16				6660	4	4	
MSPC	O	5.8				8.2	4	4		232	4	4		0.19	4	4		1.8	4			0.57	4			0				5020	4	4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
MSPB	O	83	4		G	2.6			G	11			G	1.4			G	373				30			G
MSBB	O	62	4		G	15		4	G	22			G	6.5		4	G	928		4		72		4	G
MSPC	O	5.8			G	5.7				16				2				596				24			

North Carolina (NC)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
RSJC	35.8898	-75.6337	Roanoke Sound	John Creek
PSWB	35.4123	-76.0397	Pamlico Sound	Wysocking Bay
PSPR	35.2960	-76.4392	Pamlico Sound	Pungo River
PSNR	35.0897	-76.5290	Pamlico Sound	Neuse River
PSCH	35.2028	-75.7162	Pamlico Sound	Cape Hatteras
BIPI	34.7183	-76.6755	Beaufort Inlet	Pivers Island
CFBI	33.9158	-78.0035	Cape Fear	Battery Island

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

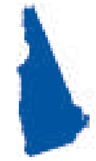
Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
RSJC	O	6.2				2.9				178		4		0.08	4			2.1	4			0.41				0				4400	4	4	H
PSWB	O	8.2				3.8	4	4	G	86				0.09	4			3.1	4			0.36				0				1260			
PSPR	O	6.6				2.5			G	59				0.07	4			1.8	4		G	0.2			G	0			G	2870		4	
PSNR	O	8.3				3				72				0.09	4			2.5	4			0.23				0				1880			
PSCH	O	15	4	4		2				52				0.2	4	4		2	4			0.68	4			0.11				1470			
BIPI	O	47	4	4		1.2			H	136			H	0.11	4			1.7	4			0.62	4			0.16				2320		4	
CFBI	O	32	4	4	G	1.6				78				0.13	4			2.3	4			0.44				0.16				1910			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
RSJC	O	53				2.7			G	5.3			G	0.88				856		4		13			
PSWB	O	7.2				2			G	4.5			G	1.5			G	190				150	4	4	
PSPR	O	5				2.6				11				1.6			G	183			H	14			
PSNR	O	5.1				2.6				8.9			G	2.1			G	168				96		4	
PSCH	O	6.8			G	2.6				6.8				1				333			G	31			
BIPI	O	29			G	3				15				0.94				1543	4	4		18			
CFBI	O	17			G	1.2			G	3			G	0.57			G	152				13			

Appendix 2: Results by State

New Hampshire (NH)



Regional (r)
Mussels (M)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
GBDP	43.1207	-70.8265	Great Bay	Dover Point

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
GBDP	M	11		4		1.3				6.7				0.34	4	4		1.9				2.7		4		0.14				111			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
GBDP	M	50		4		2.5				14				1.2								70			

Appendix 2: Results by State

New Jersey (NJ)

Regional (r)
Mussels (M)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
NYSH	40.4875	-74.0333	New York Bight	Sandy Hook
NYLB	40.2948	-73.9787	New York Bight	Long Branch
NYSR	40.1870	-74.0090	New York Bight	Shark River
BIBL	39.7617	-74.0950	Barnegat Inlet	Barnegat Light
AIAC	39.3672	-74.4112	Absecon Inlet	Atlantic City
DBCM	38.9822	-74.9613	Delaware Bay	Cape May
DBBD	39.2523	-75.3028	Delaware Bay	BenDavisPt.Shoal
DBAP	39.3833	-75.4500	Delaware Bay	ArnoldsPointShoal
DBHC	39.4267	-75.4933	Delaware Bay	Hope Creek

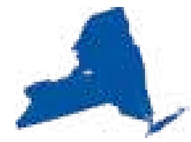
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
NYSH	M	8.2				1.5			G	15				0.25	4	4		3.3				8.3	4	4		1.1	4	4	H	148	4		
NYLB	M	11		4		0.88			G	13				0.16		4		2.3				1.7				0.31	4	4		158	4		
NYSR	M	10			H	0.79			G	12				0.16		4		2.3				2.2		4		0.35	4	4		143	4		
BIBL	M	8.9				0.74				10				0.25	4	4		3.1				4.3	4	4		0.38	4	4		100			
AIAC	M	9.3				1.2				13				0.33	4	4		3.6				5.1	4	4		0.28	4	4		165	4		
DBCM	M	10				1				18	4			0.22	4	4		4.5				4	4	4		0.47	4	4		118			G
DBBD	O	8.1			H	5.4	4	4		498	4	4		0.14	4	4		4	4		G	1.3	4			0.39	4	4		9165	4	4	
DBAP	O	5.1				15	4	4		1660	4	4	H	0.24	4	4	H	4.9	4			1.4	4			0.28	4	4	H	18950	4	4	
DBHC	O	4.3				20	4	4		857	4	4		0.2	4	4		4.4				0.72				0.17				11500	4	4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
NYSH	M	143	4	4		11		4	G	80	4		G	4.6		4		3014	4	4		331	4	4	G
NYLB	M	160	4	4		13		4	G	50			G	4			G	2026	4	4		195	4		G
NYSR	M	158	4	4		13		4	G	48			G	4.4		4		1928	4	4		186	4		
BIBL	M	20				2.1			G	13			G	0.68			G	761				59			G
AIAC	M	18				1.8				11			G	0.86			G	1508	4	4		56			
DBCM	M	35				1			G	16				0.81			G	622				38			G
DBBD	O	92	4	4		12		4	G	105	4	4	G	13	4	4	G	368				105		4	G
DBAP	O	129	4	4		11		4	G	87	4	4	G	10	4	4		701				94		4	
DBHC	M	184	4	4		27	4	4		219	4	4		24	4	4						225	4		

New York (NY)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
LIMR	40.9418	-73.7032	Long Island Sound	Mamaroneck
LITN	40.8167	-73.7983	Long Island Sound	Throgs Neck
LIHH	40.8558	-73.6753	Long Island Sound	HempsteadHarbor
LIHU	40.9220	-73.4285	Long Island Sound	HuntingtonHarbor
LIPJ	40.9573	-73.0937	Long Island Sound	Port Jefferson
LIGB	40.9982	-72.1162	Long Island	Gardiners Bay
MBTH	40.7767	-72.7558	Moriches Bay	Tuthill Point
LIFI	40.6252	-73.2795	Long Island	Fire Island Inlet
HRJB	40.5667	-73.8953	Hudson/RaritanEstuary	Jamaica Bay

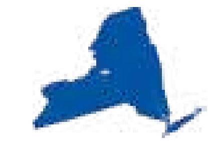
Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
LIMR	M	5.2				1.8				15				0.11				2.4				6	4	4		0.26	4	4		97			
LITN	M	8				2.2				16				0.15		4		2.7				7.6	4	4		0.4	4	4		138			
LIHH	M	6.5				1.8				12				0.11				2.5				3.7	4	4		0.18				109			
LIHU	M	5.1				1.9				11				0.11				2.3				2.9	4	4		0.14			G	100			
LIPJ	M	8.3			H	2.1				11				0.16		4	H	2.9				2				0.12			G	107			
LIGB	M	9.4				1.4				9.7				0.15		4		3.2				1.6				0				90			
MBTH	M	17	4	4		0.77				10				0.2	4	4		2.8			H	3.9	4	4		0.31	4	4	H	119			
LIFI	M	9.7				1.2				12				0.28	4	4		2.4				3.5	4	4		0.33	4	4		105			
HRJB	M	9.1				1.3				15			H	0.27	4	4		2.8				5	4	4		0.52	4	4		127			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
LIMR	M	25				22	4	4	G	50			G	6.5		4	G	635				143	4		G
LITN	M	25				32	4	4	G	81	4		G	7.9		4		2868	4	4		337	4	4	
LIHH	M	16				20	4	4	G	47			G	6.8		4	G	699				169	4		
LIHU	M	13			G	6.4			G	21			G	2.5			G	342				93			
LIPJ	M	18			G	4.5			G	16			G	1.7			G	352				69			G
LIGB	M	7.1			G	1.2			G	12			G	0.85				759				31			
MBTH	M	8.7				2.6			G	11			G	0.8			G	324				38			G
LIFI	M	15				2.5			G	11				1.1				7561	4	4		36			G
HRJB	M	64	4	4	G	11		4	G	44			G	4.2				2921	4	4		201	4		G

New York (NY)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Site	Latitude	Longitude	General Location	Location
HRUB	40.6893	-74.0432	Hudson/RaritanEstuary	Upper Bay
HRLB	40.5660	-74.0508	Hudson/RaritanEstuary	Lower Bay
HRRB	40.5190	-74.1845	Hudson/RaritanEstuary	Raritan Bay
LEDK	42.5292	-79.2777	Lake Erie	Dunkirk
LOOC	43.3553	-78.6867	Lake Ontario	Olcott
LORC	43.2578	-77.4953	Lake Ontario	Rochester
LOOS	43.4528	-76.5508	Lake Ontario	Oswego
LOCV	44.1442	-76.3247	Lake Ontario	Cape Vincent
HRCI	42.0338	-73.9293	Hudson River	Cruger Island

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
HRUB	M	5.6				2.5			G	26	4			0.29	4	4	G	8.1	4			13	4	4	G	1.9	4	4		143	4		
HRLB	M	8.1				1.5			G	13				0.22	4	4		2.6				3.5	4	4	G	0.49	4	4		113			
HRRB	M	7				1.9				17	4			0.22	4	4		7	4			13	4	4		1.7	4	4		203	4		
LEDK	ZM	9.9	4			3.8	4	4		13				0.04				14		4		1.5				0.16				56			
LOOC	ZM	6.6	4			1.6				35	4			0.05	4			13		4		3.2	4	4		0.38		4		67			
LORC	ZM	9.3	4			1.2				16				0.04				15		4		4.1	4	4		0.58		4		66			
LOOS	ZM	8.4	4			1.2			G	27	4			0.05	4			14		4	G	0.38				2.3	4	4		56			G
LOCV	ZM	8.5	4			1.9				70	4			0.04				16		4		2.5	4	4		3.2	4	4		65			
HRCI	ZM	2.7				0.98				51	4			0.05	4		G	12		4		3.8	4	4		1.4	4	4		109	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
HRUB	M	281	4	4		12		4	G	86	4		G	5.9		4	G					422	4	4	G
HRLB	M	156	4	4		12		4	G	78	4		G	4.6		4		2873	4	4		338	4	4	G
HRRB	M	85	4	4		15		4		112	4			5.6		4	G					202	4		
LEDK	ZM	2.8				3.9				7.3				2.6		4	G	389		4	G	42			
LOOC	ZM	5.1				10		4	G	19				3.9		4		569		4		73			
LORC	ZM	4.3				4.9				13			G	3		4	G	844		4		34			
LOOS	ZM	0				4.9				12				4.4		4		290				65			
LOCV	ZM	4				2.7			G	2.4				1.9			G	166				15			
HRCI	ZM	44		4														606		4					

Ohio (OH)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
SBPP	41.6597	-82.8250	Lake Erie	Peach Orchard Pt.
LEOW	41.3850	-82.5187	Lake Erie	Old Woman Creek
LELR	41.4612	-82.2070	Lake Erie	Lorain
LEAB	41.9247	-80.7183	Lake Erie	Ashtabula

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
SBPP	ZM	6.1	4			2.8	4			20				0.08	4			17		4		3.2	4	4		0.47		4		69			
LEOW	ZM	5			G	2				39	4			0.03				17		4		1.5				1.9	4	4		84			
LELR	ZM	6.8	4			3	4			19				0.05	4			17		4		2.9	4	4		0.53		4		76			
LEAB	ZM	7.3	4		G	2.7	4			41	4			0.05	4			20	4	4		3.2	4	4		1.1	4	4		70			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
SBPP	ZM	14		4		5.7				14				3.1		4	G	624		4		198	4	4	
LEOW	ZM	4.2				7.2				13				5.8		4		558		4		51			
LELR	ZM	8.4				10		4		11				4.2		4		1047		4		64			
LEAB	ZM	4.9				5.7			G	9.1				3.1		4	G	598		4		108		4	

Oregon (OR)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
CBCH	43.3500	-124.3308	Coos Bay	Coos Head
CBRP	43.4313	-124.2212	Coos Bay	Russell Point
YBOP	44.5752	-123.9890	Yaquina Bay	Oneatta Point
YHFC	44.8370	-124.0520	Yaquina Bay	Fogarty Creek
TBHP	45.5472	-123.9075	Tillamook Bay	Hobsonville Point
CRSJ	46.2287	-124.0232	Columbia River	South Jetty

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CBCH	M	8.7				2.9				7.1				0.07				1.7				0.7				0			G	92			
CBRP	M	10				4.2	4	4		13				0.2	4	4	H	3.4				1.6				0.12				231	4		
YBOP	M	5.3				2.2				6.1			G	0.08				1.7				0.28				0				96			
YHFC	M	7.7				4.3	4	4		7.4				0.06				2.1				0.52				0				96			
TBHP	M	7.3				4.4	4	4		39	4			0.07				13	4	4		1.1				1.6	4	4		96			G
CRSJ	M	9.7				3				9.8				0.08				2.6				0.87				0.06				115			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CBCH	M	1.6			G	2.7			G	2.6			G	3.7				96				14			
CBRP	M	9.8			G	0.24			G	2.6			G	0.21			G	441				21			
YBOP	M	10			G	0.89				5.4			G	0.29			G	1187				30			
YHFC	M	3.3				6.6				4.1				3.8				78				11			
TBHP	M	6			G	0.34			G	2.4				0.24				298				14			
CRSJ	M	25				1.8				23				1.1				380				33			

Rhode Island (RI)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
NBDI	41.6048	-71.3052	Narragansett Bay	Dyer Island
NBPI	41.6523	-71.3567	Narragansett Bay	Patience Island
NBDU	41.5013	-71.3928	Narragansett Bay	Dutch Island
BIBI	41.1982	-71.5922	Block Island Sound	Block Island

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
NBDI	M	9.9				0.94				9.7				0.12				1.1				2.9	4	4		0.16				132			
NBPI	M	8				0.4				10				0.06				0				0.82				0				48			—
NBDU	M	13	4	4		1				8.4			—	0.12				1.8				2				0				117			
BIBI	M	11		4	—	1.3				8.9				0.12				1.8				1.4				0				150	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
NBDI	M	50		4		8			—	26				6.4		4		1540	4	4		239	4		
NBPI	M	12			—	6.1			—	27			—	20	4	4	—					141	4		
NBDU	M	14			—	4.5			—	14				4.6		4		520				102			
BIBI	M	13				1.8			—	4.3			—	0.87			—	285				24			

South Carolina (SC)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
WBLB	33.2433	-79.1972	Winyah Bay	Lower Bay
SRNB	33.1683	-79.2417	Santee River	North Bay
CHFJ	32.7505	-79.9003	Charleston Harbor	Fort Johnson
CHSF	32.7735	-79.9122	Charleston Harbor	Shutes Folly Island

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
WBLB	O	45	4	4		1.9				97				0.13	4			1.8	4			0.57	4		—	0.34	4	4		1460			
SRNB	O	34	4	4		1.5				77				0.08	4			3.3	4			0.41			—	0.6	4	4		783			
CHFJ	O	31	4	4		1.7				221	4	4		0.07				1.4			—	1.2	4		—	0.39	4	4		2840		4	
CHSF	O	31	4	4		1.9				188		4		0.07				1.2				0.3				0.28	4	4		3160		4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
WBLB	O	5.9				1.2				3.1			—	0.7				122				14			
SRNB	O	3.2				1.2				4.7				0.65				162				15			
CHFJ	O	72	4			6			—	9.4			—	0.96			—	1013		4		23			
CHSF	O	127	4	4	—	2.4			—	5.6			—	0.74			—	885		4		19			

Appendix 2: Results by State

Texas (TX)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
GBHR	29.4803	-94.7418	Galveston Bay	Hanna Reef
GBYC	29.6220	-94.9958	Galveston Bay	Yacht Club
GBTD	29.5030	-94.8960	Galveston Bay	Todd's Dump
GBOB	29.2840	-94.8363	Galveston Bay	Offatts Bayou
GBCR	29.2633	-94.9163	Galveston Bay	Confederate Reef
BRFS	28.9212	-95.3395	Brazos River	Freeport Surfside
BRCL	28.8580	-95.4647	Brazos River	Cedar Lakes
MBEM	28.7112	-95.8833	Matagorda Bay	East Matagorda
MBTP	28.6663	-96.2335	Matagorda Bay	Tres Palacios Bay

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
GBHR	O	4.7				3.8	4	4		117				0.04			—	3.5	4		—	0.5	4			0				1440			
GBYC	O	4.5				3.4	4	4	—	185		4		0.06				3.1	4			0.47				0.25	4	4		4220	4	4	
GBTD	O	4.9				3.2			—	145				0.03				3.1	4			0.67	4			0.08				2250			
GBOB	O	6.2				0.67				287	4	4		0.03				1.5				1.2	4			0.08			—	12700	4	4	—
GBCR	O	5.8				2.7				111				0.1	4			2.7	4			0.6	4			0				1450			
BRFS	O	6.7				2.3				171				0.06				2.5	4			0.8	4			0.16				2320		4	
BRCL	O	6.4				3.7	4	4		237	4	4		0.09	4			3.3	4			1.4	4			0.08				1960			
MBEM	O	9.8				5.5	4	4		142				0.06				2.5	4			0.58	4			0.11				809			—
MBTP	O	4			—	2.9			—	95			—	0.05				3.1	4			0.61	4			0				1080			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
GBHR	O	36				3.7				6.7			—	1.7				447				22			
GBYC	O	251	4	4		31	4	4		55		4		15	4	4		2511	4	4		144	4	4	
GBTD	O	66	4		—	11		4		14				6		4		1640	4	4		48		4	
GBOB	O	21			—	20	4	4		9.1			—	4.1				1250		4		28			
GBCR	O	55			—	1.8			—	3.4			—	0.52			—	588			—	21			—
BRFS	O	123	4	4		8.8		4		182	4	4		65	4	4		1399	4	4		87		4	
BRCL	O	34				5.7				73	4	4		30	4	4		972		4		42		4	
MBEM	O	133	4	4		1.9			—	6.3			—	1.3			—	221			—	9.9			—
MBTP	O	5.6				1.4			—	43		4		0.56			—	259				8.6			

Appendix 2: Results by State

Texas (TX)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
MBCB	28.6650	-96.3830	Matagorda Bay	Carancahua Bay
MBGP	28.5788	-96.5630	Matagorda Bay	Gallinipper Point
ESBD	28.4118	-96.4490	Espiritu Santo	Bill Days Reef
ESSP	28.2982	-96.6220	Espiritu Santo	South Pass Reef
SAMP	28.3440	-96.7123	San Antonio Bay	Mosquito Point
SAPP	28.2323	-96.7082	San Antonio Bay	PantherPointReef
MBAR	28.1730	-96.8350	Mesquite Bay	Ayres Reef
ABLR	28.0548	-96.9512	Aransas Bay	Long Reef

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
MBCB	O	5.2				3.5	4	4		126			—	0.11	4			2.3	4			0.6	4			0				1370			
MBGP	O	5.3			—	3.8	4	4		155				0.2	4	4		3	4			0.51	4			0				1780			
ESBD	O	11	4	4		3.2	4	4	—	110				0.09	4		—	3.4	4			1.3	4			0				924			
ESSP	O	9.6				4.7	4	4		139				0.11	4			2.8	4			2.2	4	4		0				1070			
SAMP	O	4.6				4	4	4		68				0				3.2	4			1.4	4			1.9	4	4		562			
SAPP	O	5.4			—	6.3	4	4		200		4		0.1	4			3.1	4			1.8	4			0				1150			
MBAR	O	4.7				3.9	4	4		104				0.09	4			2.8	4			0.48	4			0				690			
ABLR	O	8.2				3			—	80				0.15	4	4		2.9	4			0.51	4			0				682			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
MBCB	O	7				2.2			—	26				1.8			—	217				13			
MBGP	O	32			—	1			—	25				1.2				248				14			
ESBD	O	13			—	0.98				8.1				0.57			—	171				19			
ESSP	O	4.1				0.43			—	1.6				0.1			—	93				9.7			
SAMP	O	3.4				1.6				6.4				1.3				171				31			
SAPP	O	4.4				0.25			—	2.2			—	0.34			—	153				14			
MBAR	O	9.4				0.84			—	2.3			—	0.66			—	113				9.1			—
ABLR	O	5.5				0.73			—	1.8			—	0.11			—	100				8.9			

Appendix 2: Results by State

Texas (TX)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
CBCR	28.1420	-97.1280	Copano Bay	Copano Reef
CCNB	27.8522	-97.3598	Corpus Christi	Nueces Bay
LMAC	26.2825	-97.2853	Lower Laguna Madre	Arroyo Colorado
LMPI	26.0748	-97.1995	Lower Laguna Madre	Port Isabel
LMSB	26.0432	-97.1760	Lower Laguna Madre	South Bay

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

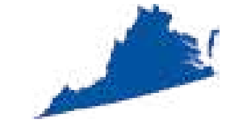
Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
CBCR	O	7.9				8	4	4		322	4	4		0.11	4		G	2.9	4			1.3	4			0				1330			
CCNB	O	8.6				4.2	4	4		141				0.11	4			1.8	4			1.6	4		H	1.1	4	4		5070	4	4	
LMAC	O	18	4	4		1.9				43				0.12	4			1.4				0.82	4			0				898			
LMPI	O	16	4	4		1.1				402	4	4		0.1	4			1.3			H	0.85	4			0.17				6260	4	4	
LMSB	O	13	4	4		2.1				134				0.17	4	4		1.3				0.67	4			0				2180			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
CBCR	O	3.4				1.3				7.1			G	0.37			G	123				19			
CCNB	O	25				2			G	6.6			G	0.49			G	553				24			G
LMAC	O	3.1				1.1				7.9				0.91				117				12			
LMPI	O	115	4	4	G	0.39				3.6				0.04			G	780				31			
LMSB	O	24				0			G	0.88			G	0			G	47				11			

Appendix 2: Results by State

Virginia (VA)



Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
PRMC	38.2233	-76.9615	Potomac River	Mattox Creek
RRRR	37.9020	-76.7878	Rappahannock River	Ross Rock
CBDP	37.0983	-76.2948	Chesapeake Bay	Dandy Point
CBJR	37.0653	-76.6322	Chesapeake Bay	James River
CBCC	37.2845	-76.0153	Chesapeake Bay	Cape Charles
CBCI	37.9385	-75.3758	Chincoteague Bay	ChincoteagueInlet
QIUB	37.5250	-75.7138	Quinby Inlet	Upshur Bay

Concentrations derived from 2004-2005 data.

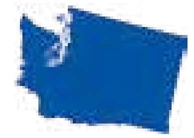
Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
PRMC	O	5.3				4.8	4	4		308	4	4		0.05				2.8	4			0.26				0.15				3770	4	4	
RRRR	O	5.4				4.8	4	4		285	4	4		0.06			H	2.8	4			0.15				0				2720		4	
CBDP	O	9.3				1.3				77				0.11	4			1.9	4			0.67	4			0				3200		4	
CBJR	O	4.3			G	10	4	4		1460	4	4		0.15	4	4		3.8	4			0.39				0.1				8110	4	4	
CBCC	O	10				1.2				43				0.07				1.7	4			0.34				0				1340			
CBCI	O	10				2.6				66				0.21	4	4	H	2	4			0.7	4		H	0				2230			
QIUB	O	11		4		2.4				552	4	4		0.22	4	4		2.5	4			1.3	4		H	0				4750	4	4	

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
PRMC	O	119	4	4		12		4		26				4.8				207				57		4	
RRRR	O	24				3.8			G	8.1			G	0.92			G	200				21			G
CBDP	O	62	4		G	9.3		4	G	34				2.9			G	1583	4	4		50		4	
CBJR	O	65	4		G	3.6			G	13			G	0				232				157	4	4	
CBCC	O	14			G	3.9			G	30				4.1				307			G	21			
CBCI	O	6.8				2.8			G	14			G	0.99			G	315				25			G
QIUB	O	6.9				0			G	12			G	0				10717	4	4		14			



Washington (WA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
WBNA	46.4992	-124.0272	Willapa Bay	Nahcotta
GHWJ	46.9097	-124.1177	Gray's Harbor	Westport Jetty
JFCF	48.3825	-124.7280	Strait of Juan de Fuca	Cape Flattery
PSPA	48.1397	-123.4202	Puget Sound	Port Angeles
PSHC	47.8318	-122.6883	Puget Sound	Hood Canal
SSBI	47.0993	-122.8942	South Puget Sound	Budd Inlet
CBTP	47.3312	-122.5043	Commencement Bay	Tahlequah Point
EBDH	47.5958	-122.3867	Elliott Bay	Duwamish Head

Concentrations derived from 2004-2005 data.

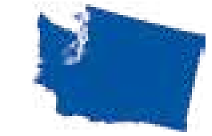
Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
WBNA	M	6.9				3.8	4	4		7.5				0.18	4	4		2.5				0.55				0				176	4		
GHWJ	M	11		4		6.9	4	4		12				0.07				2.9				0.89				0.28	4	4		162	4		
JFCF	M	16	4	4		11	4	4		14				0.25	4	4		4.6				1.1				0			G	186	4		
PSPA	M	8.1				5.6	4	4		13				0.07				0.91				0.62				0			G	142	4		
PSHC	M	8.3				4	4	4		6.5				0.11				1.7				0.73			H	0				156	4		
SSBI	M	5.3				2.1				5.6			G	0.09				0.88				0.83				0				118			
CBTP	M	7.9				2.8				18	4			0.09				7	4			1.3				0				174	4		
EBDH	M	6.8				2.2				8.9				0.07				3.1				2.6		4		0.19				160	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
WBNA	M	13				0.87				4.1				0.46				617				15			H
GHWJ	M	15			G	2.9				9				4.9		4		167				20			
JFCF	M	5.4			G	6.4				1.6				4.2				134				12			
PSPA	M	10				1.3				4.6			G	0.81				471			G	27			
PSHC	M	16				0.83				2.3				0.55				528				16			
SSBI	M	9.6			G	3.1			G	6.7			G	1.9				1502	4	4		62			
CBTP	M	14			G	2.7			G	8				1				2214	4	4		48			
EBDH	M	36			G	4.4				16			G	1.3				3277	4	4		131			



Washington (WA)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
EBFR	47.6388	-122.4138	Elliott Bay	Four-Mile Rock
SIWP	47.5852	-122.5708	Sinclair Inlet	Waterman Point
PSEF	47.8140	-122.3823	Puget Sound	Edmonds Ferry
PSMF	47.9497	-122.3016	Puget Sound	Mukilteo
WIPP	47.9053	-122.3770	Whidbey Island	Possession Point
PSEH	47.9727	-122.2303	Puget Sound	Everett Harbor
BBSM	48.7522	-122.4978	Bellingham Bay	Squalicum Marina Jet.
PRPR	48.9903	-123.0883	Point Roberts	Point Roberts

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
EBFR	M	7.7				2.2			G	12				0.1				4.2			H	2.4		4		0.38	4	4		204	4		
SIWP	M	11				3.6	4	4		16				1.3	4	4		2.2				2.4		4		0.33	4	4		257	4		
PSEF	M	8.4				3.7	4	4		8.1				0.09				2.3				3.1	4	4		0.13				183	4		
PSMF	M	8.4				2.6				14				0.07				44	4	4		4.7	4	4		0.6	4	4		172	4		
WIPP	M	8.1				2.7				14				0.15		4		3.5				1.3				0.14				201	4		
PSEH	M	7.4				3.3		4		13				0.13				4.1			H	7.6	4	4		0.16				187	4		
BBSM	M	9.1				4	4	4		18	4			0.21	4	4		8.9	4	4		1.4				0.44	4	4		238	4		
PRPR	M	6.2				2.7				20	4			0.1				4.2				1.8			H	0.37	4	4		126			

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
EBFR	M	39			G	4.2				29				1.2				6962	4	4		144	4		
SIWP	M	11			G	49	4	4		15				82	4	4		2397	4	4		82			
PSEF	M	15				3.6				13				1.3								45			
PSMF	M					5.8				15				2.1								53			
WIPP	M	25				0.8				4.7				0.94				2329	4	4		33			
PSEH	M	9.4			G	1.9				4				1.8				1445	4	4		30			
BBSM	M	106	4	4	G	3			G	8.5				1.5				2586	4	4		40			
PRPR	M	11			G	0.32				1.9			G	0.28			G	364				14			

Wisconsin (WI)

Regional (r)
Mussels (M)
4 Medium
4 High

Zebra Mussels (ZM)
4 Medium
4 High

Oysters (O)
4 Medium
4 High

Status (s)
National Status
4 Medium
4 High

Trend (t)
National Trend
G Decreasing
H Increasing

Site	Latitude	Longitude	General Location	Location
GBBS	44.6370	-87.8082	Green Bay	Bayshore Park
LMMB	43.0322	-87.8952	Lake Michigan	Milwaukee Bay

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

Metals (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	s	t	PB	r	s	t	SN	r	s	t	ZN	r	s	t
GBBS	ZM	5.4				0.75				18			–	0.1	4			15		4		1.1				0.11				141	4		
LMMB	ZM	4.4				1.2				11				0.04				11		4		1.6				0.18				140	4		

Organics (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
GBBS	ZM	21		4		2.4				16				0.99			–	387			–	213	4	4	–
LMMB	ZM	21		4	–	23	4	4		148	4	4	–	15	4	4		6519	4	4	–	924	4	4	

Hawai'i (HI)

Site		Latitude	Longitude	General Location	Location
HHKL	4	21.3167	-157.8860	Honolulu Hrb.	Keehi Lagoon
BPBP	4	21.3203	-158.1200	Barber's Point	Barber's Pt. Harbor
HHKB	4	21.4118	-157.7790	Hawaii	Kaneohe Bay
KAUI	4	21.9567	-159.3560	Kauai	Nawiliwili Harbor

Metals

Site	Year	AS	CD	CU	HG	NI	PB	SN	ZN
HHKL	2004	15	0.41	2510	0.28	2.6	6.2	0.79	970
HHKL	2002	14	2.26	2280	0.36	1.3	1.8	3.1	909
HHKL	2000	0	0.00	2280	0.23	2.7	1.6	2.1	834
HHKL	1998	19	0.64	3460	0.27	19.8	2.6	1.7	1090
HHKL	1996	16	0.87	2456	0.20	4.9	8.4	0.9	1061
HHKL	1994	16	0.30	3100	0.33	3.1	5.5	3.2	1000
HHKL	1992	21	0.41	2500	0.29	5.2	33.7	2.9	1400
HHKL	1990	14	0.33	1600	0.24	3.1	13.0	3.0	890
HHKL	1989	12	0.30	2100	0.21	2.2	6.8	5.1	1100
HHKL	1988	23	0.50	2600	0.37	2.1	9.7	5.6	1100
BPBP	2002	11	0.47	1610	0.05	1.3	5.3	0.36	742
BPBP	2000	0	0.00	2390	0.00	2.7	1.7	1.6	608
BPBP	1998	9	0.43	2840	0.18	4.6	1.5	0.7	1010
BPBP	1992	18	0.86	1700	0.11	9.6	1.4	2.6	3800
BPBP	1990	17	0.49	1900	0.08	4.1	0.6	3.3	990
BPBP	1989	21	0.65	1800	0.10	2.1	0.6	1.9	730
BPBP	1988	13	0.66	640	0.09	3.8	0.8	1.6	720
BPBP	1986	18	2.50	950	0.21	1.5	0.7	0.00	940
HHKB	2004	16	0.76	724	0.12	1.9	0.8	0.23	1450
HHKB	2002	14	0.65	1150	0.15	1.8	0.8	0.26	1590
HHKB	2000	11	0.59	1010	0.10	1.6	0.4	0.00	1270
HHKB	1998	9	0.50	884	0.14	2.1	0.6	0.00	1400
HHKB	1996	12	0.48	665	0.08	0.6	0.2	0.07	1012
KAUI	1986	6	0.28	840	0.16	38.0	0.7	2.0	690

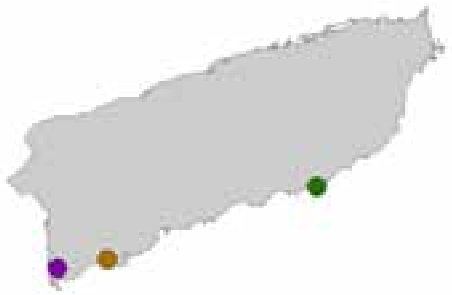
Hawai'i (HI)

The Hawaiian oyster (*Ostrea sandvicensis*) unlike most of the other bivalves found in the saline waters of the US has no close relatives in the Mussel Watch Program. These oysters grow in clusters on rocks and pilings and are a dominant element on the reefs in Kaneohe Bay, Oahu.

Organics

Sites	Year	Butyltins	Chlordanes	DDTs	Dieldrins	PAHs	PCBs
HHKL	2004	247	34	47	12	14200	115
HHKL	2002	723	11	12	5.6	1163	68
HHKL	2000	1963	13	14	5.1	5254	84
HHKL	1998	1605	14	15	5.4	4553	116
HHKL	1996	2531	32	50	10	15105	149
HHKL	1994	141	39	39	38	6101	84
HHKL	1992	1501	8.4	9.2	3.5		80
HHKL	1990	2862	68	40	45		147
HHKL	1989		41	28	13		135
HHKL	1988		18	20	4.4		
BPBP	2002	1386	1.5	1.7	0.2		32
BPBP	2000	1066	0.3	1.2	0.2		54
BPBP	1996	198	1.5	0.8	0.0		16
BPBP	1994	1774	0.0	0.0	0.0		7.2
BPBP	1992	1584	2.7	2.1	0.0		19
BPBP	1990		1.9	2.0	1.6		22
BPBP	1989		27	29	11.5		
HHKB	2004	6	233	20	314	677	119
HHKB	2002	19	55	15	125	124	55
HHKB	2000	28	11	6.0	5.1	79	31
HHKB	1998	30	64	14	62	292	68
HHKB	1996	48	274	44	114	896	163
KAUI	1986		13	36	1.5		113

Puerto Rico (PR)



Site		Latitude	Longitude	General Location	Location
PRBB	4	18.0078	-67.1752	Puerto Rico	BahiadeBoqueron
PRBJ	4	17.9391	-66.1813	Puerto Rico	Bahia de Jobos
PRBM	4	17.9710	-66.9895	Puerto Rico	Bahia Montalva

Metals

Site	Year	AS	CD	CU	HG	NI	PB	SN	ZN
PRBB	2002	18	0.35	55	0.09	1.4	0.33	0.41	807
PRBB	2000	8	0.32	28	0.04	1.2	0.10	0.07	414
PRBB	1998	8	0.40	39	0.05	2.9	0.22	0.00	522
PRBB	1996	18	0.25	37	0.08	2.2	0.10	0.20	1187
PRBB	1994	9	0.44	53	0.08	1.8	0.28	1.3	907
PRBB	1992	10	0.41	51	0.09	1.8	0.09	0.04	631
PRBJ	2002	14	0.66	190	0.09	0.7	0.37	0.28	2260
PRBJ	2000	18	0.44	129	0.08	0.7	0.13	0.00	1200
PRBJ	1998	11	0.74	155	0.07	1.2	0.35	0.00	971
PRBJ	1996	12	0.65	141	0.11	0.8	0.20	0.18	960
PRBJ	1994	12	0.95	121	0.10	0.7	0.28	0.00	689
PRBJ	1992	14	0.75	141	0.09	1.1	0.16	0.00	708
PRBM	2004	13	0.83	225	0.12	1.6	0.35	0.33	2810
PRBM	2002	16	0.50	155	0.10	1.4	0.21	0.27	2130
PRBM	2000	16	0.73	333	0.15	1.3	0.17	0.70	3680
PRBM	1998	13	0.64	358	0.11	1.7	0.30	0.00	3100
PRBM	1994	13	0.53	189	0.10	0.9	0.23	0.00	2334
PRBM	1992	15	0.65	266	0.16	1.3	0.22	0.00	2803

Puerto Rico (PR)

The Caribbean oyster (*Crassostrea rhizophorae*) is collected at the three sites in Puerto Rico. Unlike the common oyster (*Crassostrea virginica*) which is found in oyster beds or attached to other hard substrates the Caribbean oyster is found attached to mangrove roots.

Organics

Sites	Year	Butyltins	Chlordanes	DDTs	Dieldrins	PAHs	PCBs
PRBB	2002	66	0.16	1.5	0.00	245	5
PRBB	2000	44	0.28	0.56	0.09	63	4
PRBB	1998	44	2.52	2.1	0.11	92	9
PRBB	1996	291	0.83	3.0	0.85	227	25
PRBB	1994	191				459	
PRBB	1992	236	0.53	2.1	0.81	164	5
PRBJ	2002	24	0.27	0.91	0.39	379	21
PRBJ	2000	12	0.54	0.76	0.11	41	9
PRBJ	1998	28	0.61	2.6	0.91	123	8
PRBJ	1996		0.89	1.4	0.77	127	14
PRBJ	1994	165				389	
PRBJ	1992	15	0.91	1.8	1.0	149	8
PRBM	2004	31	0.14	3.2	0.00	324	28
PRBM	2002	88	0.47	4.4	0.00	88	31
PRBM	2000	314	0.61	2.4	0.12	76	22
PRBM	1998	11	1.62	6.5	0.35	140	59
PRBM	1994	59				424	
PRBM	1992	10	0.94	5.8	0.89	181	19

United States Department of Commerce

Carlos M. Gutierrez
Secretary

National Oceanic and Atmospheric Administration

Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret.)
Under Secretary of Commerce for Oceans and Atmospheres

National Ocean Service

John H. Dunnigan
Assistant Administrator for Ocean Service and Coastal Zone Management