

▼ 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

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

Concentration are in parts per million (ppm) for metals and parts per billion (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 - 11 ppm), about 23% exhibited medium concentrations (12 - 22 ppm), and about 7% exhibited high concentrations (23 - 57 ppm).

NATIONAL CHARACTERIZATION

This figure does not distinguish between species and thus can be used for interspecies comparisons.

Regional comparison of contaminant concentrations from National Characterization Map.

Interpretation
In this example, the bar chart indicates that in the Southeastern US, roughly 25% of sites exhibited low concentrations, 50% exhibited medium concentrations, and 25% exhibited high arsenic concentrations.

TRENDS SUMMARY

SITE TRENDS

NO OVERALL NATIONAL TREND

SIGNIFICANT REGIONAL TRENDS:

- ▼ Southern California, Great Lakes
- ▲ Eastern Gulf Coast
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Northern California, Northwest

SUMMARY OF SITE TRENDS MAP:

Interpretation
In this example, the bar chart indicates that in the Great Lakes, roughly 35% of sites exhibited statistically significant decreasing trends, while the remainder exhibited no discernible trend.

Spearman's rank correlations used to determine national and site trends. Arrow color and direction indicate contamination trends at each site.

Interpretation
In this example, the pie chart indicates that for the nation, roughly 11% of sites exhibited a statistically significant decreasing trend, 5% exhibited a statistically significant increasing trend, and the remaining 84% showed no discernible trend.

Summary of national trends pie chart graphically displays the percentage of sites that have decreasing, increasing or have no trend.

▼ 26 individual sites exhibited a significant decreasing trend
▲ 11 individual sites exhibited a significant increasing trend

CHEMICAL DESCRIPTION

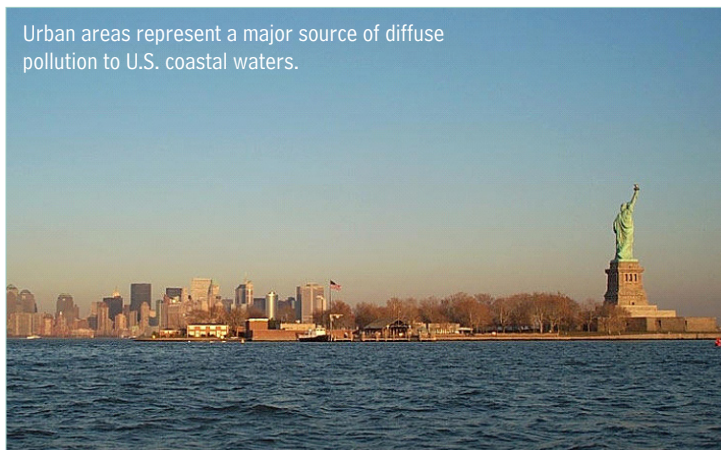
SOURCES

The primary sources, relative importance, and origin of contaminants for the coastal ocean and Great Lakes are mentioned here.

TOXICITY

Exposure pathways and toxicity to humans is discussed here along with any Food and Drug Administration (FDA) safety guidelines or threshold levels designed to protect human health. General information about aquatic life exposure, bioaccumulation and toxicity is also mentioned.

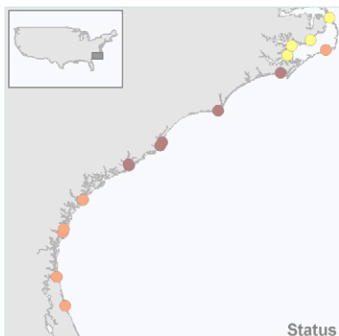
Urban areas represent a major source of diffuse pollution to U.S. coastal waters.



FATE AND TRANSPORT

Chemicals released to the environment are subject to physical, chemical and biological forces that may transform or transport a chemical. The most important processes relative to the coastal environment are mentioned, particularly in regard to transport from sources to sinks and partitioning of a chemical between environmental matrices; including air, water, soil/sediment and biota.

CASE STUDY HIGHLIGHT



Detailed highlight map derived from Species Characterization Map.

BACKGROUND

A statement of relevant facts regarding the highlighted region. Each highlighted region represents an area with unique results or areas of national concern.



Summary of Highlight Status Map.

STATUS MAP

- Significant contaminant status findings for the highlighted area.
- Comparison of Status inset map to Regional Species Characterization Map.
- Discussion and comparison region based on the National Characterization Map.
- Overall interpretation of regional status.

No Trend ●



Detailed highlight map derived from Site Trends Map.

TREND MAP

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



Summary of Highlight Trends Map.

NATIONAL SUMMARY

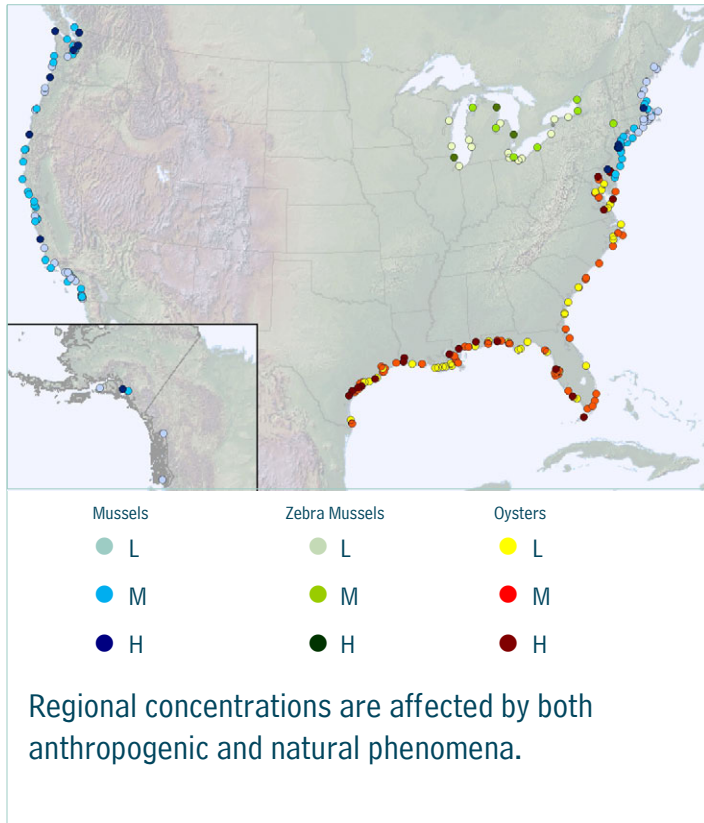




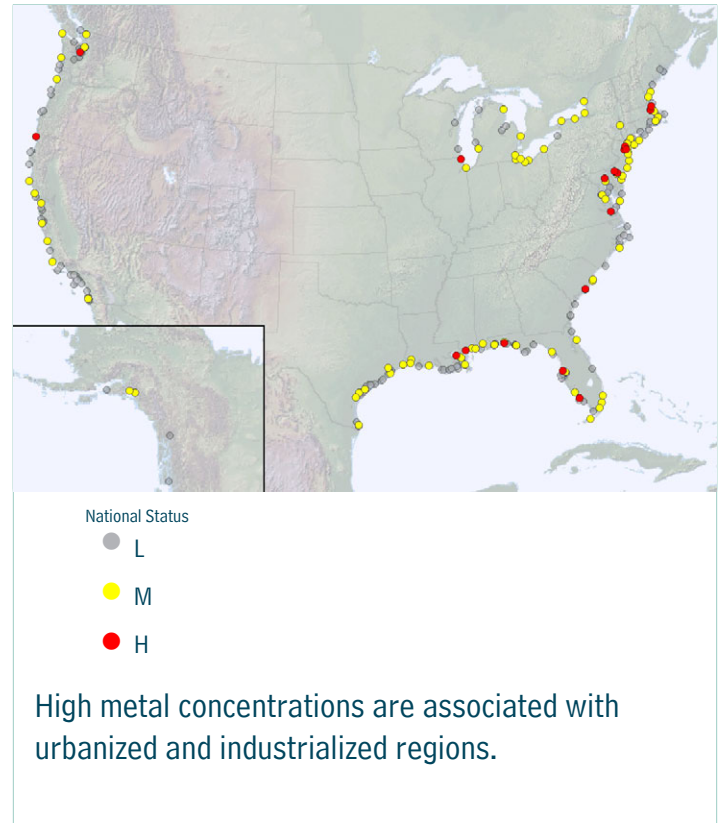
NATIONAL SUMMARY

METALS STATUS

REGIONAL SPECIES CHARACTERIZATION



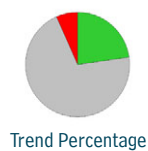
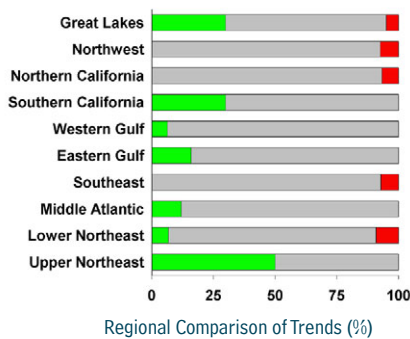
NATIONAL CHARACTERIZATION



METAL TRENDS

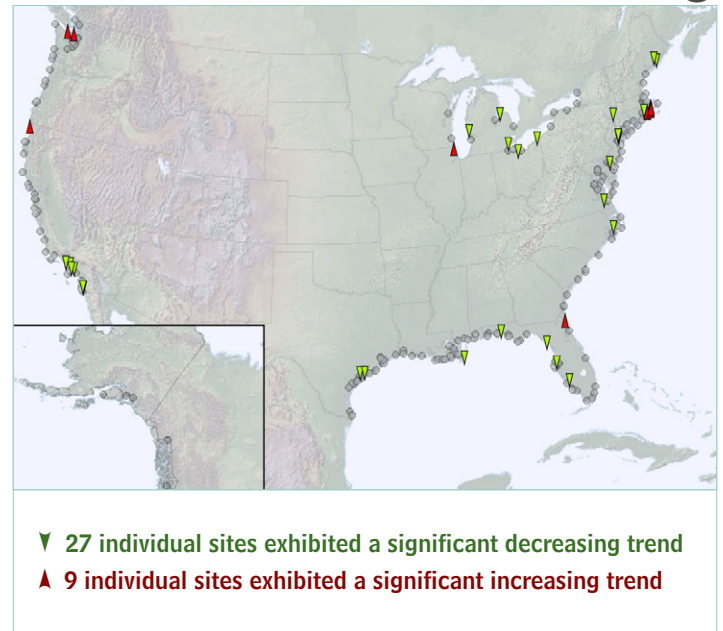
SIGNIFICANT REGIONAL TRENDS:

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



SITE TRENDS

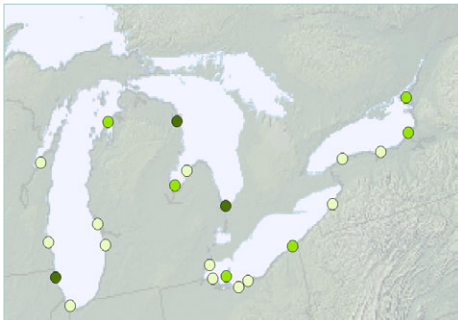
NO OVERALL NATIONAL TREND ●



METALS STATUS

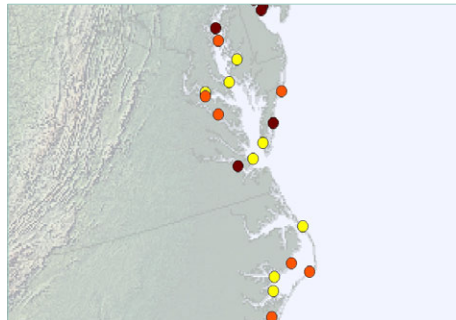
- Elevated levels of metals are found near urban and industrial areas.
- In Alaska elevated levels of metals occur naturally in some areas.
- Elevated levels of metals were found in oysters and mussels from Delaware Bay.
- Although different species accumulate metals at different rates, elevated summary 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



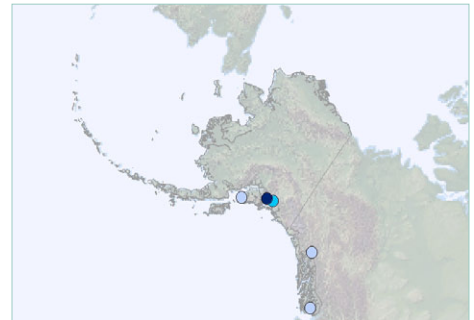
Zebra Mussels
 ● Low ● Medium ● High

MIDDLE ATLANTIC CHARACTERIZATION



Oysters
 ● Low ● Medium ● High

ALASKA CHARACTERIZATION



Mussels
 ● Low ● Medium ● High

* OVERALL STATUS FINDINGS

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

METALS TRENDS

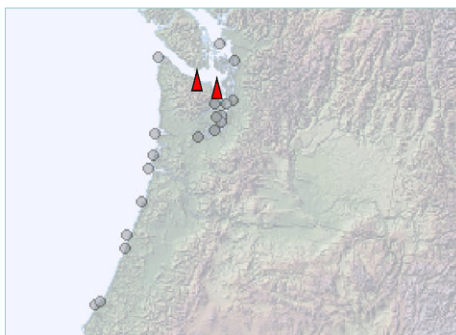
- Nationally metal trends vary by site and region.
- Southern California has a regional decrease in metal concentrations.
- The Northeast shows a mixture of increasing and decreasing sites.

CALIFORNIA CHARACTERIZATION



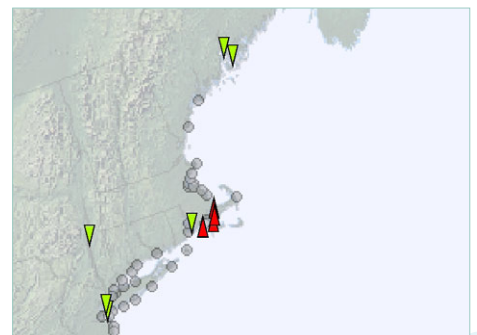
▼ Decreasing ▲ Increasing

NORTHWEST CHARACTERIZATION



▼ Decreasing ▲ Increasing

NORTHEAST CHARACTERIZATION

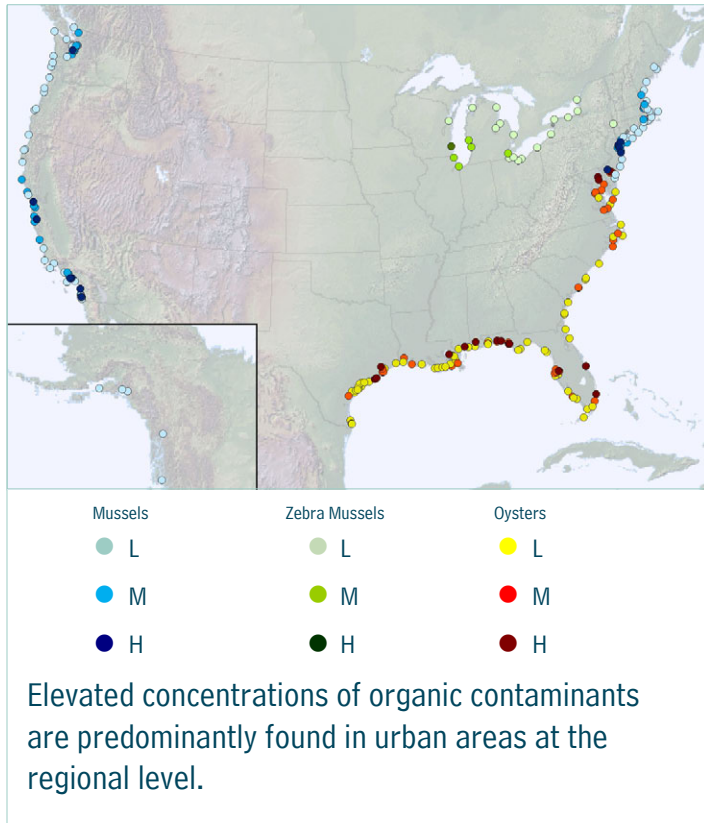


▼ Decreasing ▲ Increasing

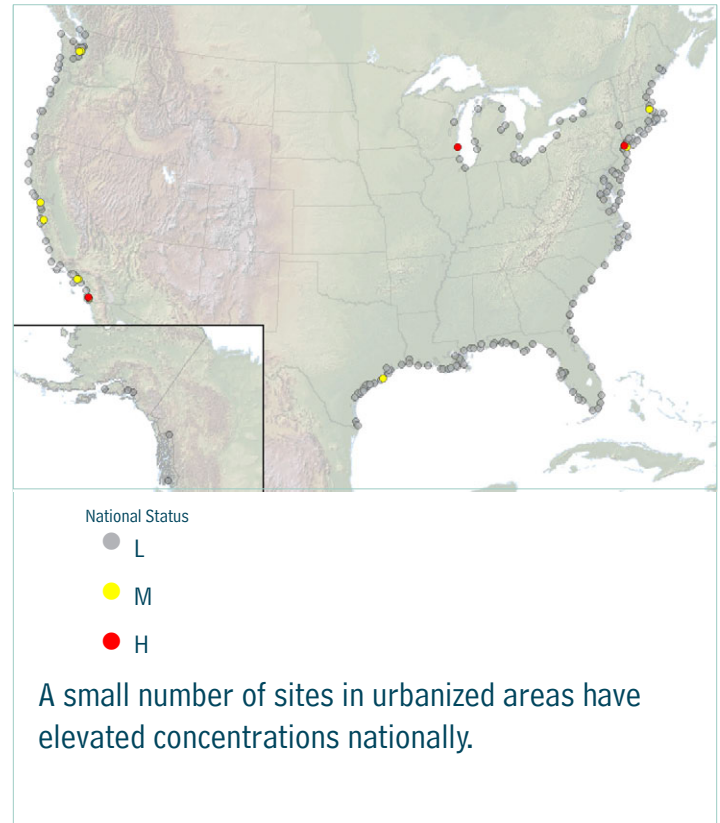
NATIONAL SUMMARY

ORGANIC STATUS

REGIONAL SPECIES CHARACTERIZATION



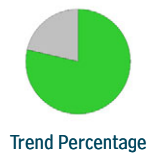
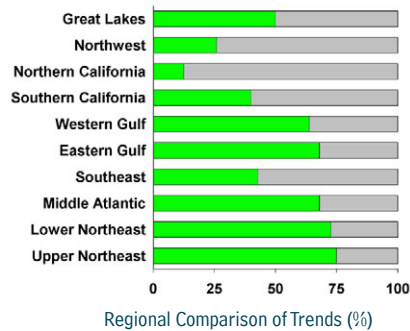
NATIONAL CHARACTERIZATION



ORGANIC TRENDS

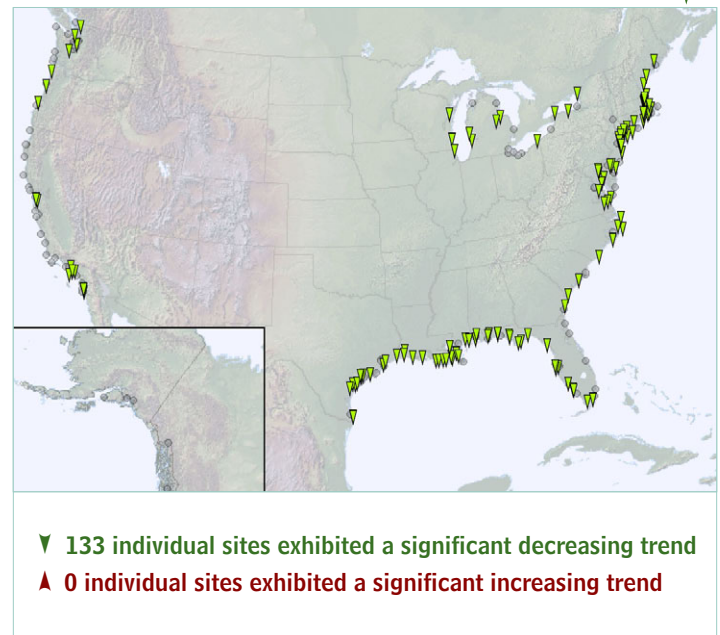
SIGNIFICANT REGIONAL TRENDS:

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



SITE TRENDS

DECREASING NATIONAL TREND ▼



ORGANIC STATUS

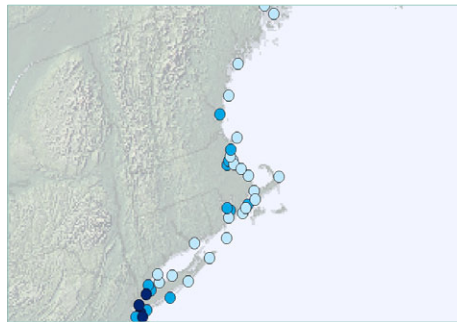
- Elevated levels of organic contaminants are found near urban and industrial areas.
- Most organic contaminants do not have natural sources; yet, their distributions are ubiquitous.
- Elevated levels of organic contaminants were found in oysters and mussels from the Hudson-Raritan Estuary in the southern Northeast region.
- 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.
- The Southern California Region has the highest percentage of medium and high organic contaminant concentration levels, as result of historic use and manufacturing of TBT and DDT, respectively.

CALIFORNIA CHARACTERIZATION



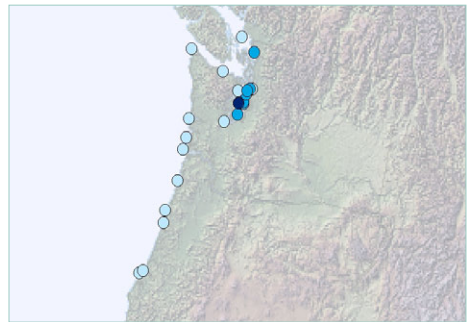
Mussels
● Low ● Medium ● High

NORTHEAST CHARACTERIZATION



Mussels
● Low ● Medium ● High

NORTHWEST CHARACTERIZATION



Mussels
● Low ● Medium ● High

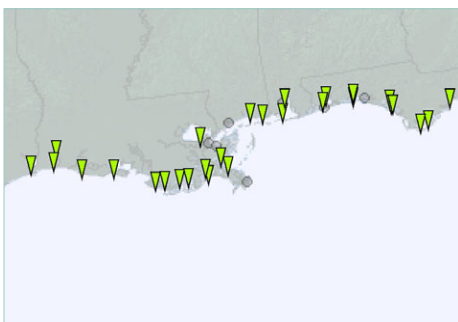
* OVERALL STATUS FINDINGS

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

ORGANIC TRENDS

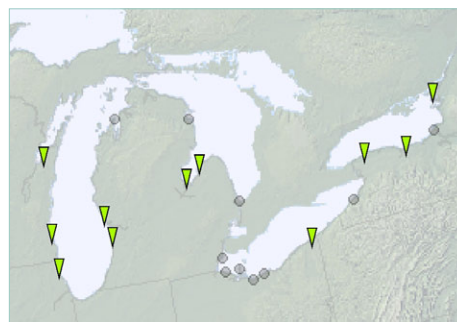
- Areas with the highest levels of organics are experiencing declining concentrations, especially in Southern California and the Central Gulf.
- The regions that historically had the highest organic contaminant concentrations now have the highest percentage of declining concentration trends.
- The Great Lakes and the Middle Atlantic both show significant decreasing regional trends.

CENTRAL GULF COAST CHARACTERIZATION



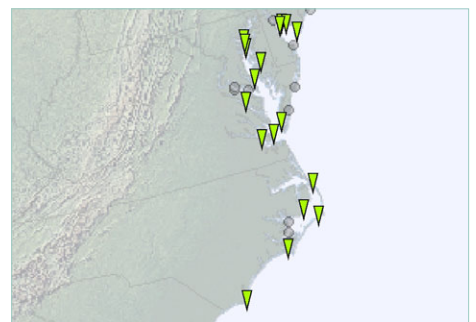
▼ Decreasing ▲ Increasing

GREAT LAKES CHARACTERIZATION



▼ Decreasing ▲ Increasing

MIDDLE ATLANTIC CHARACTERIZATION



▼ Decreasing ▲ Increasing



**TRACE METAL AND ORGANIC
CONTAMINANT STATUS AND TRENDS**



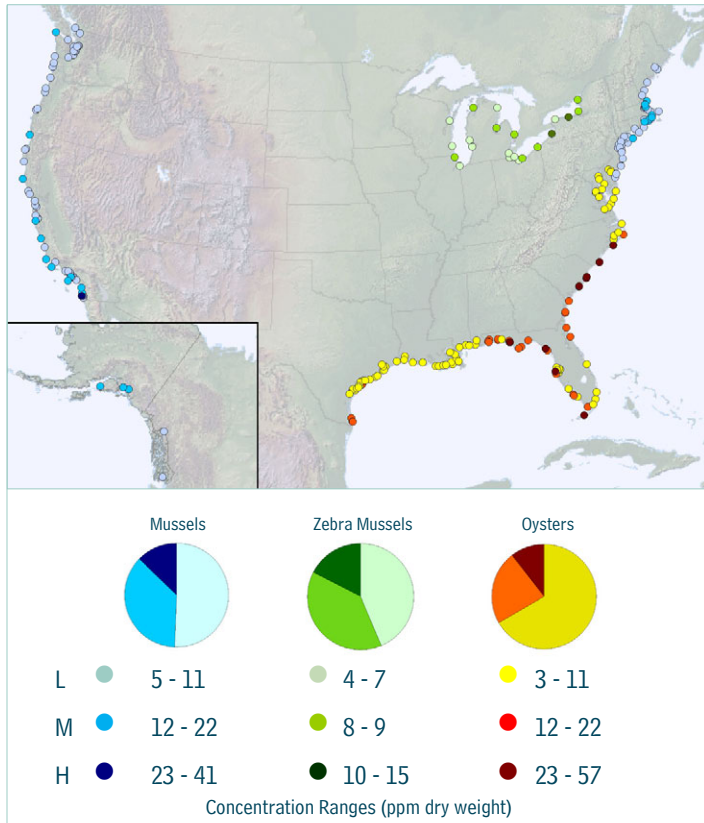
ARSENIC (As)

Nation at a Glance:

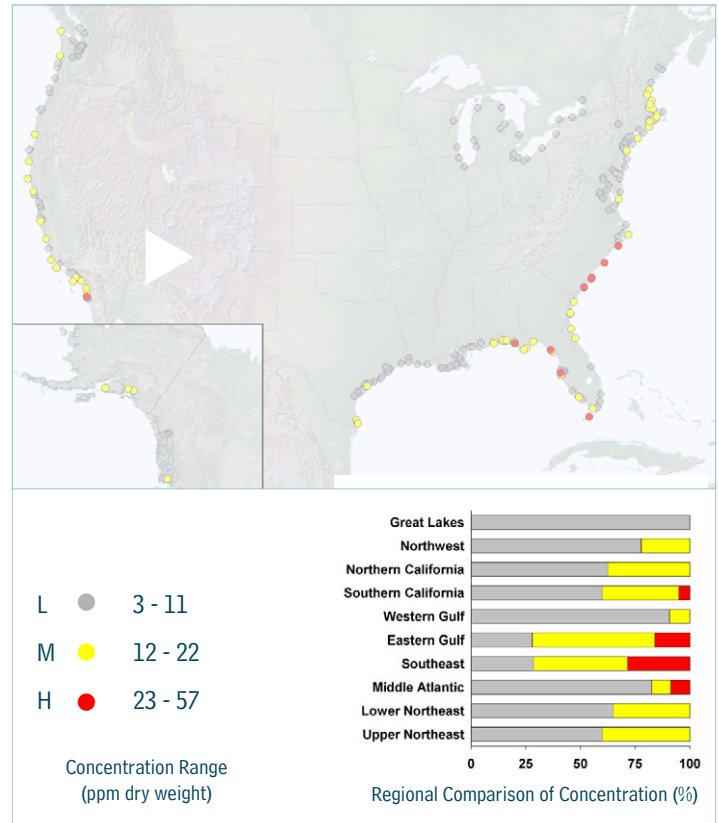
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

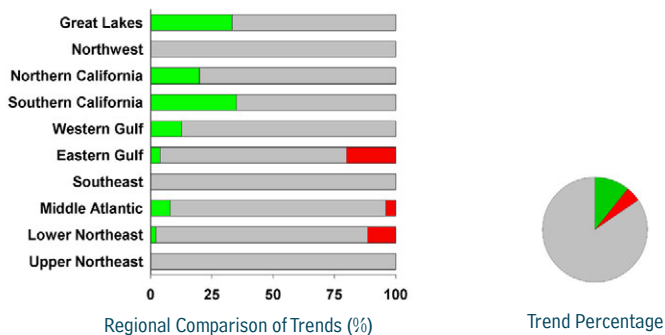


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

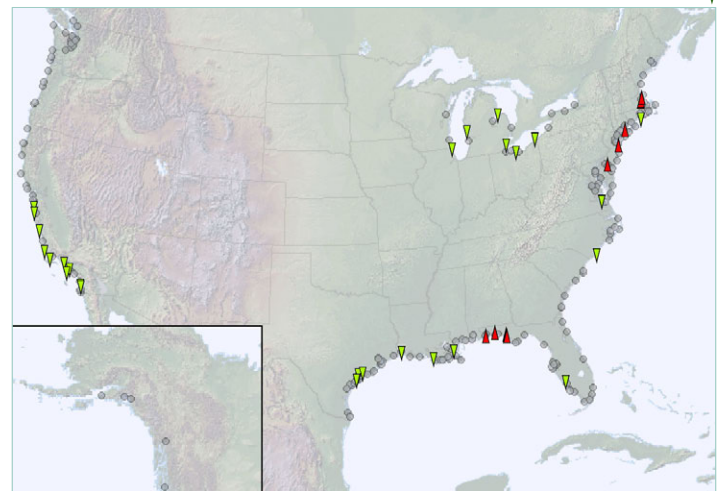
- ▼ Western Gulf Coast, Southern California, Great Lakes
- ▲ Eastern Gulf Coast
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Northern California, Northwest

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

DECREASING NATIONAL TREND ▼



- ▼ 26 individual sites exhibited a significant decreasing trend
- ▲ 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.

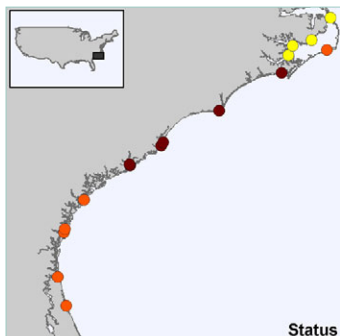
TOXICITY

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

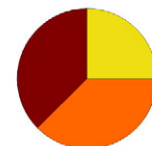
Centuries of human activities have changed the natural biogeochemical cycle of arsenic resulting in contamination of land, water and air. Movement of arsenic to coastal and estuarine water occurs primarily from river runoff and atmospheric deposition. The major source of elevated levels of arsenic in 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).

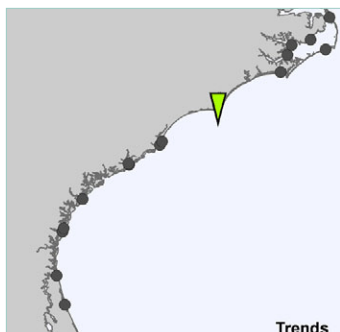


Concentration Percentage

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 ●



TRENDS

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



Trend Percentage

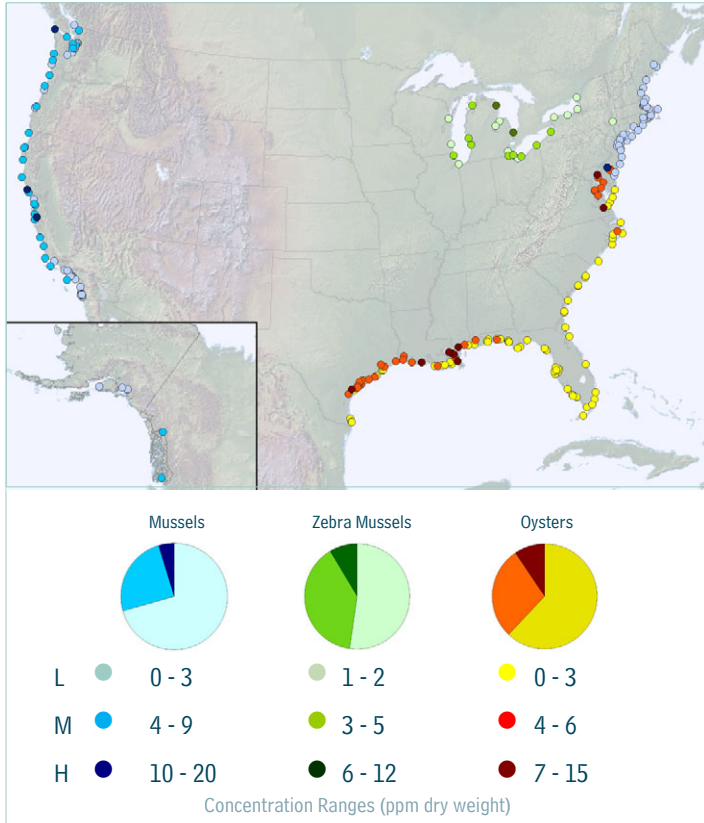
CADMIUM (Cd)

Nation at a Glance:

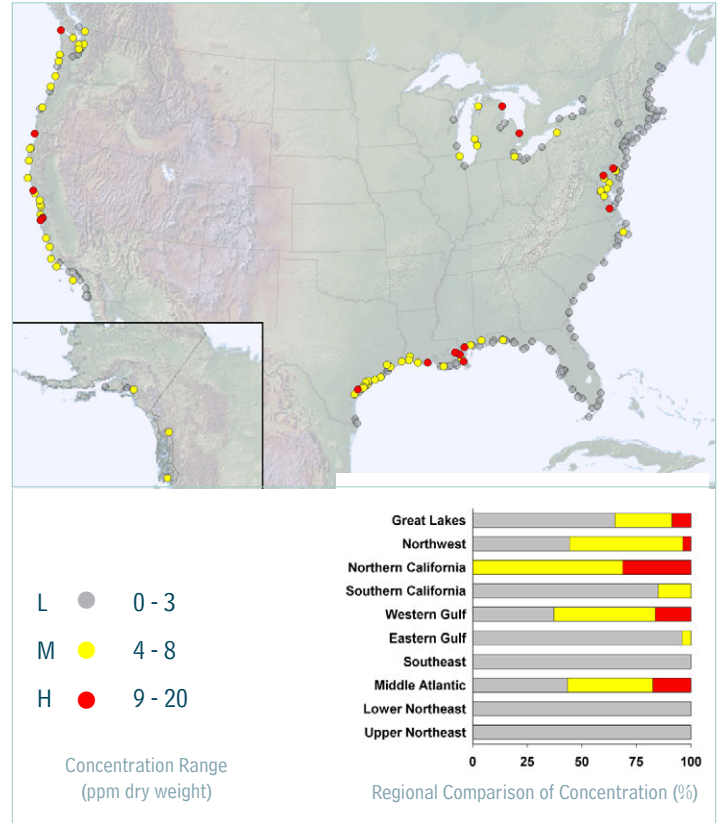
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

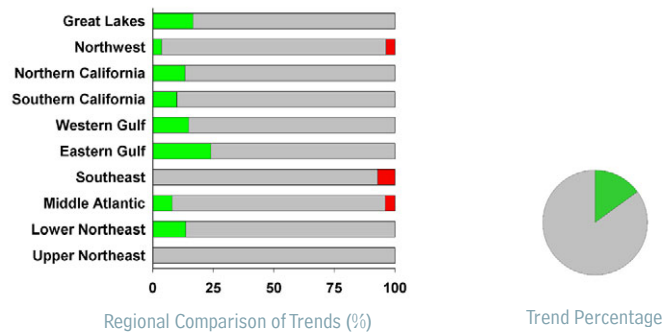


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

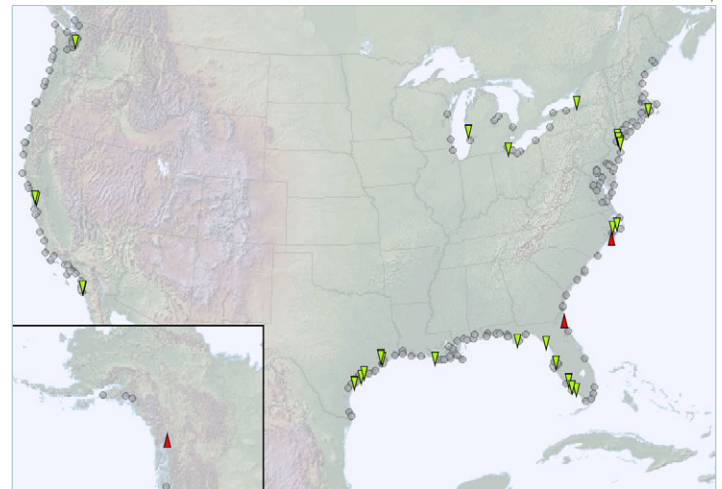
- Western Gulf Coast
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

DECREASING NATIONAL TREND



- 29 individual sites exhibited a significant decreasing trend
- 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.

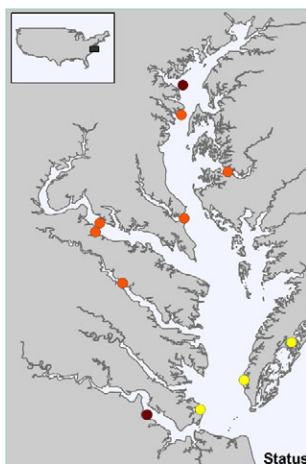
TOXICITY

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



No Trend ●



BACKGROUND

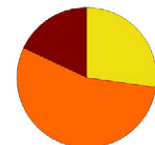
Cadmium is identified as a toxin of concern by the Chesapeake Bay Program. Inputs of cadmium were estimated to be 27,800 kg/year (Eskin et al., 1996). The Chesapeake Bay watershed stretches across five states (NY, PA, MD, DE, VA) and the District of Columbia and is a mixed use watershed with some developed 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.

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.



Concentration Percentage



Trend Percentage

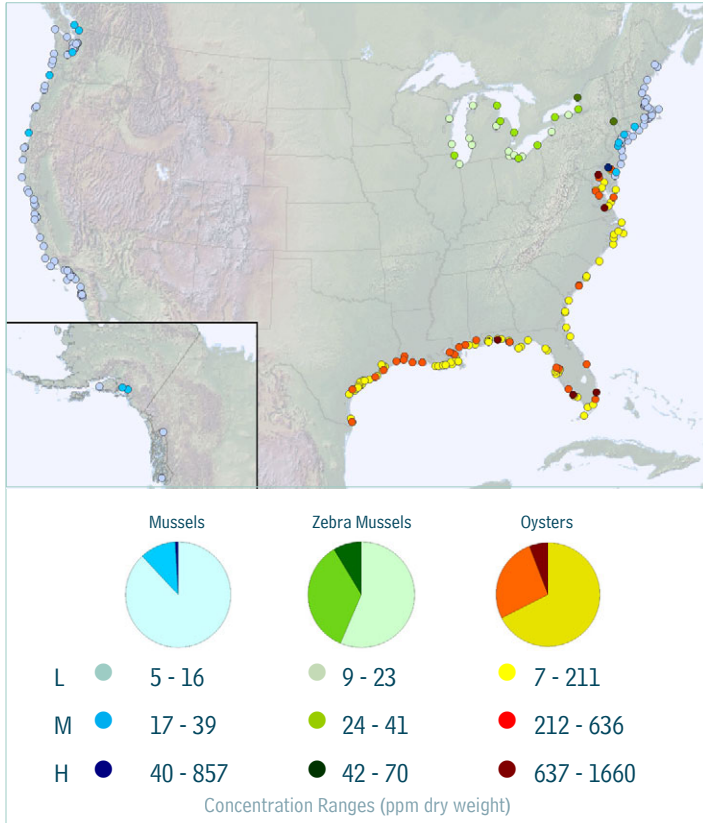
COPPER (Cu)

Nation at a Glance:

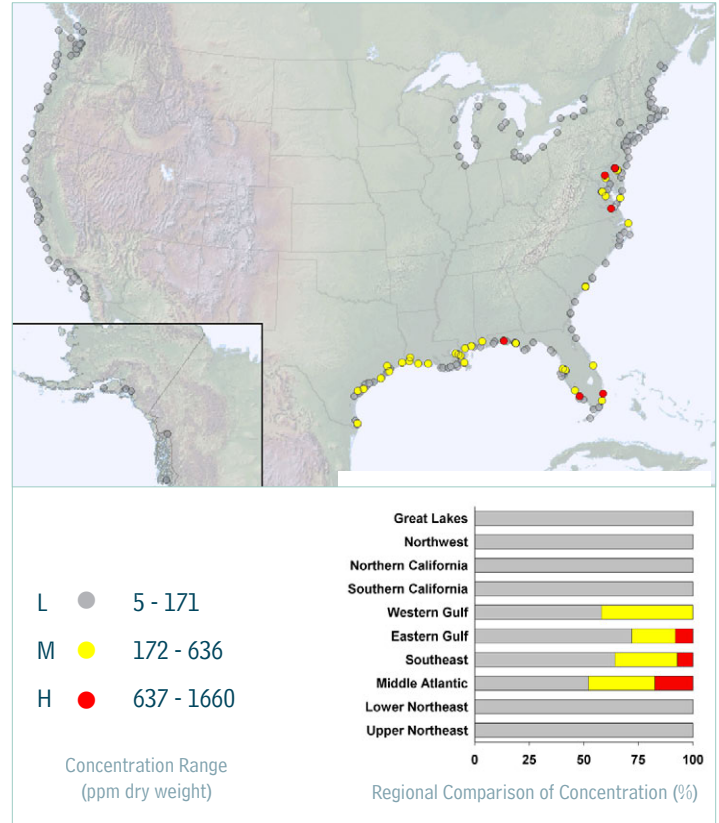
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

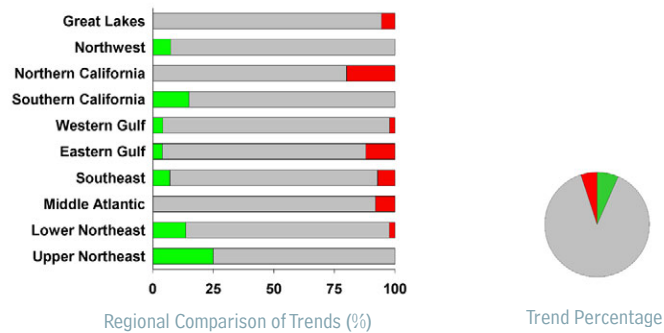


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

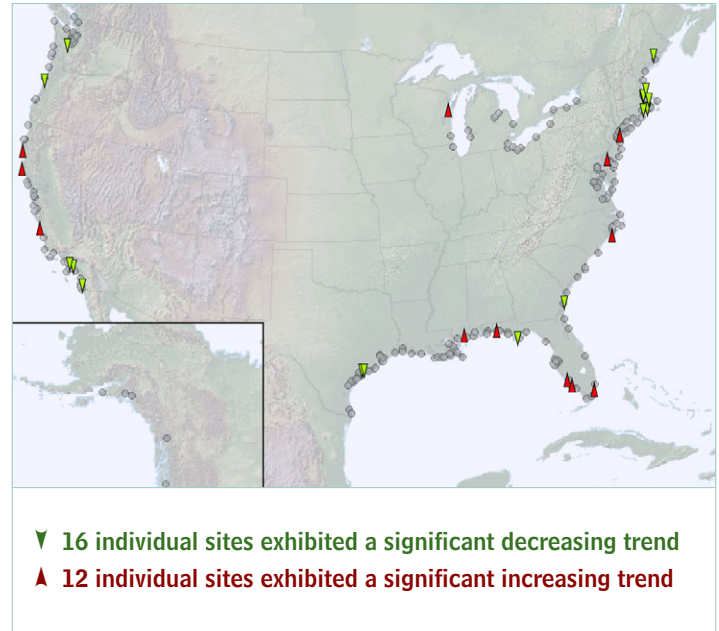
- ▼ Southern California
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Eastern Gulf Coast, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

NO OVERALL NATIONAL 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.

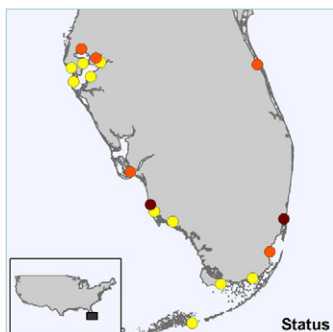
TOXICITY

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).

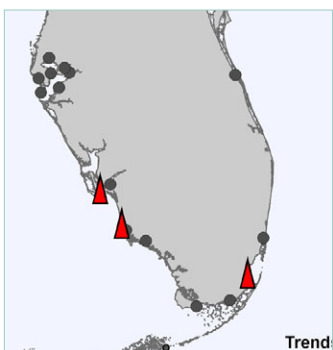


Concentration Percentage

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 ●



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.



Trend Percentage

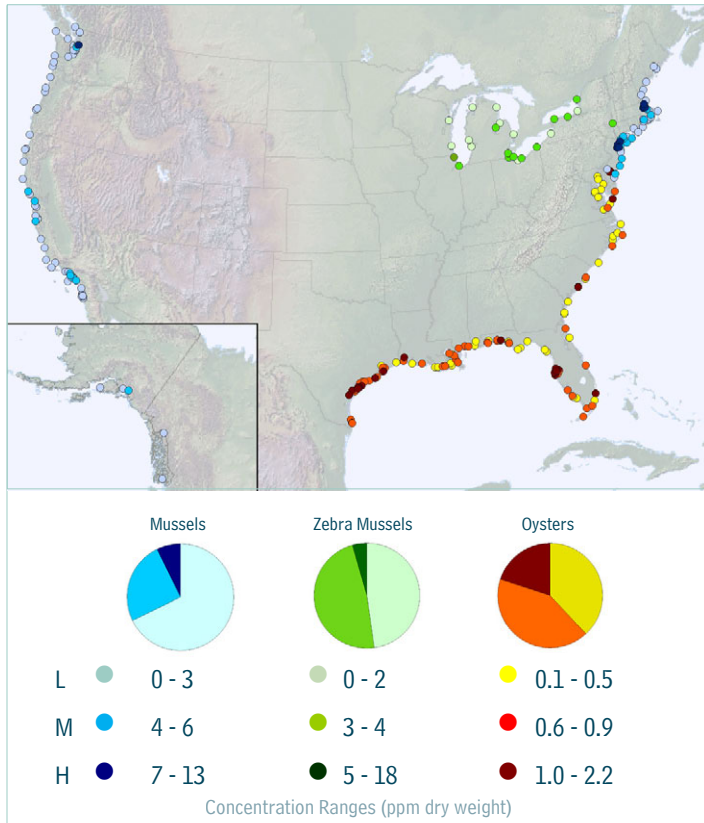
LEAD (Pb)

Nation at a Glance:

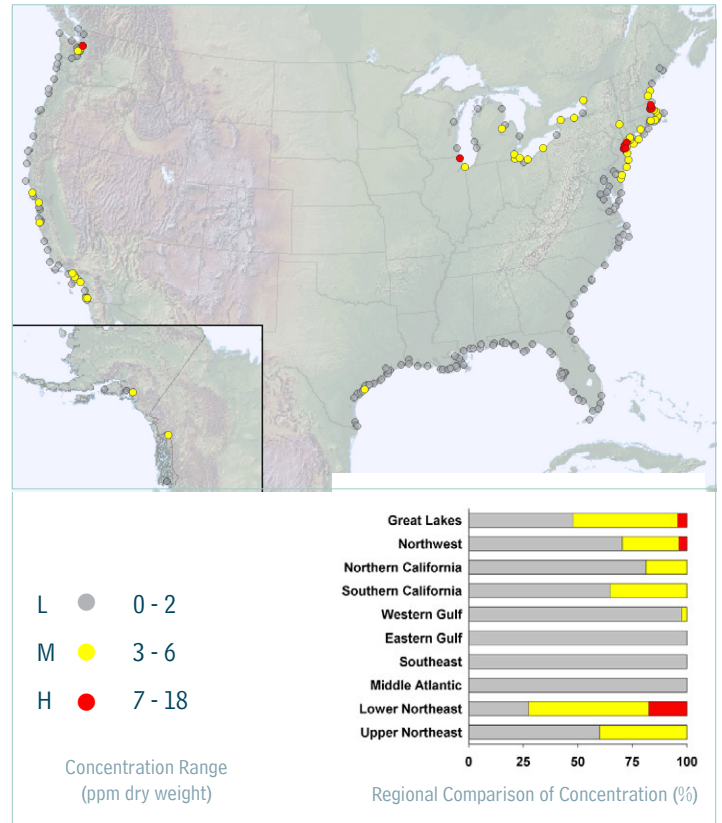
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

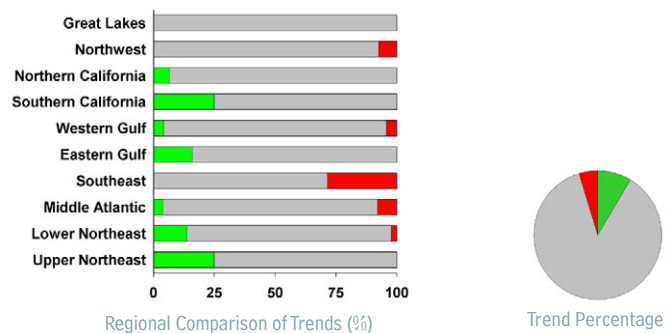


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

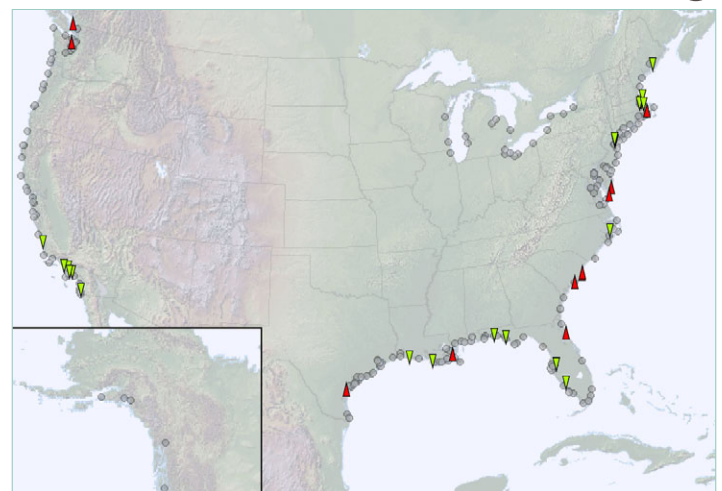
- ▼ Lower Northeast, Southern California
- Upper Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

NO OVERALL NATIONAL TREND ●



- ▼ 20 individual sites exhibited a significant decreasing trend
- ▲ 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 lead in 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)

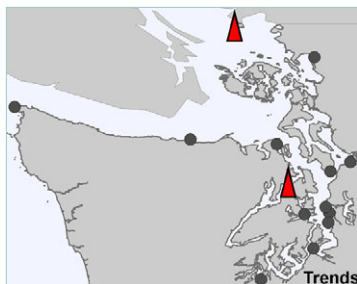


Concentration Percentage

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 ●



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.



Trend Percentage

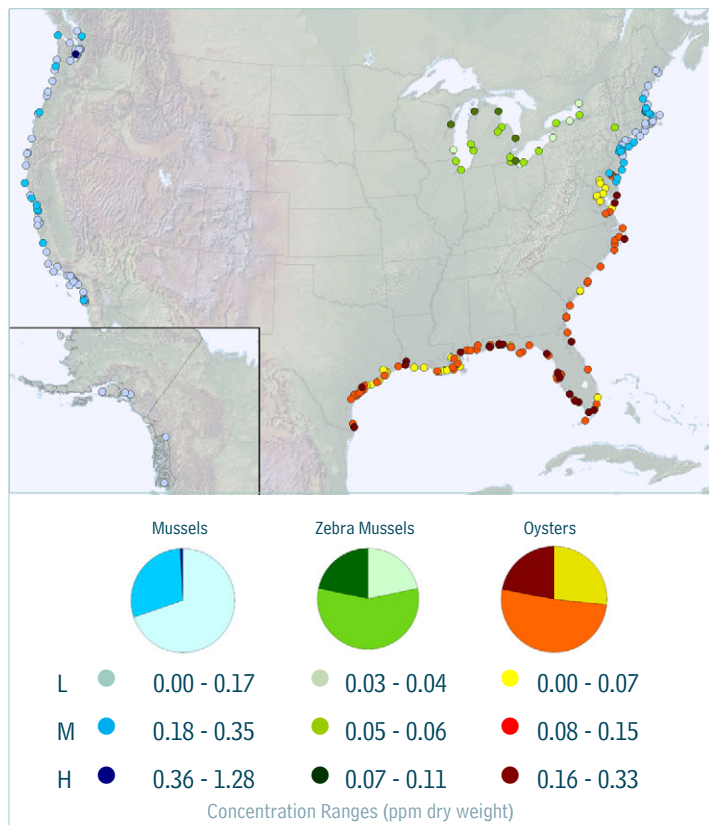
MERCURY (Hg)

Nation at a Glance:

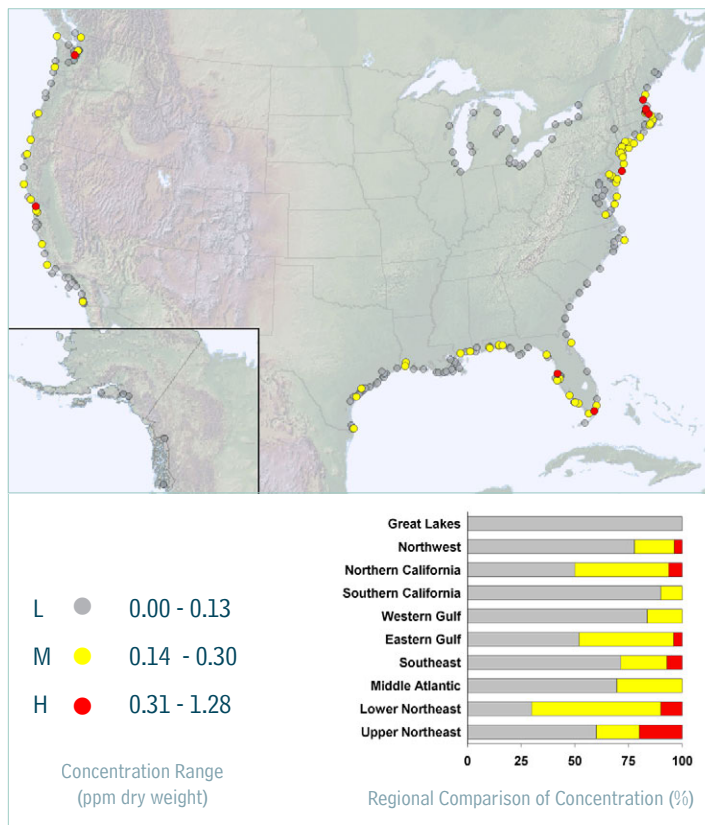
STATUS SUMMARY

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

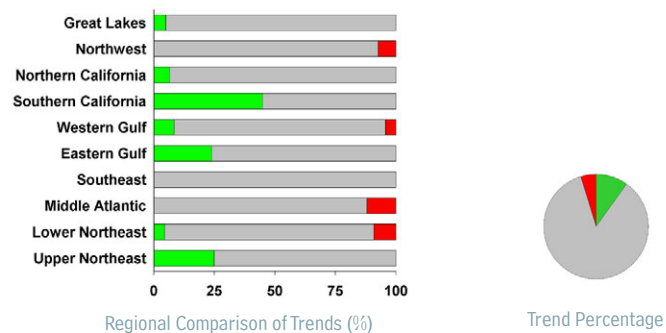


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

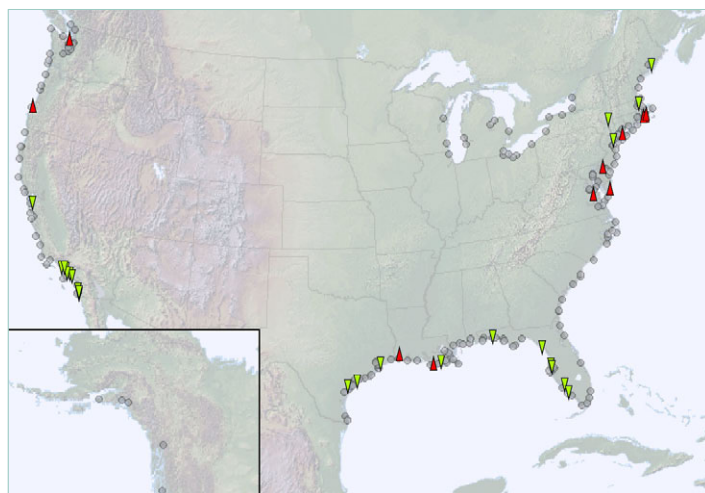
- ▼ Upper Northeast, Eastern Gulf Coast, Southern California
- ▲ Middle Atlantic
- Lower Northeast, Southeast, Western Gulf Coast, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

NO OVERALL NATIONAL TREND ●



- ▼ 24 individual sites exhibited a significant decreasing trend
- ▲ 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.

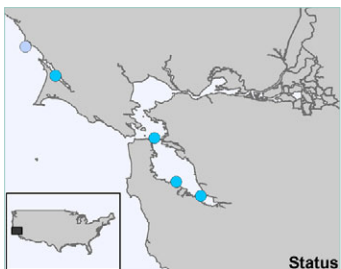
TOXICITY

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 methyl mercury (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 to 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 ▼



TRENDS

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



Trend Percentage

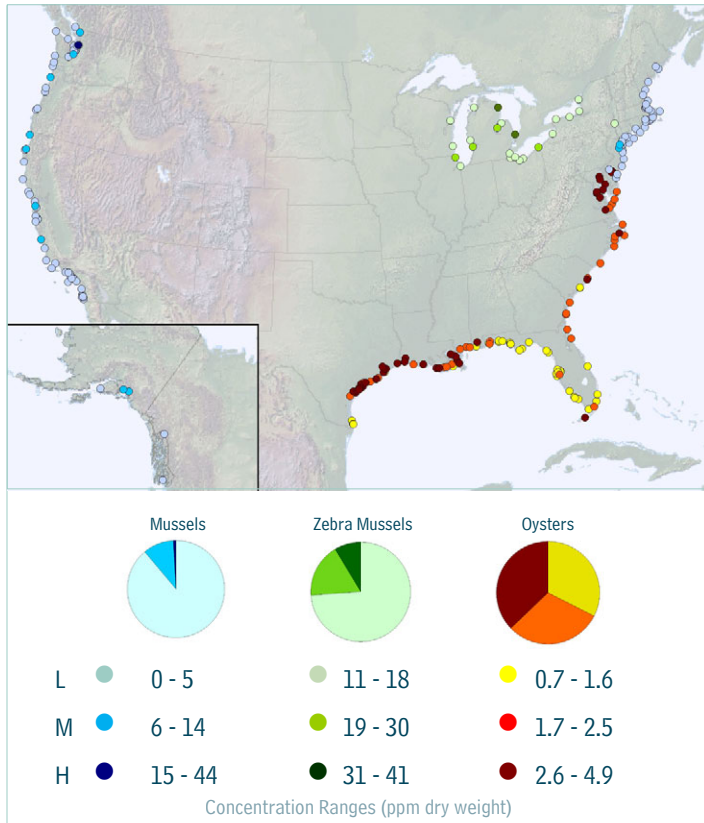
NICKEL (Ni)

Nation at a Glance:

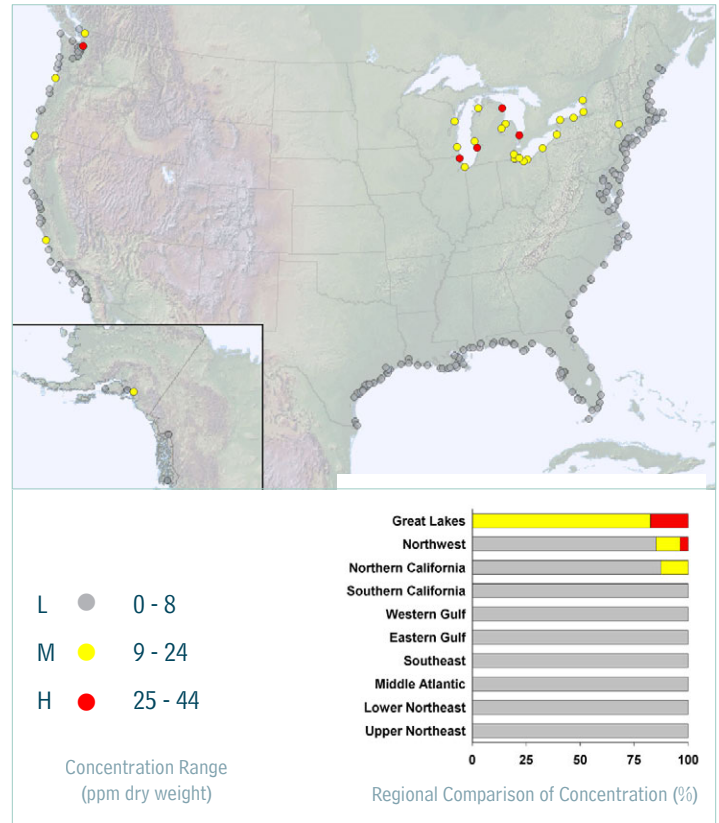
STATUS SUMMARY

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



NATIONAL CHARACTERIZATION

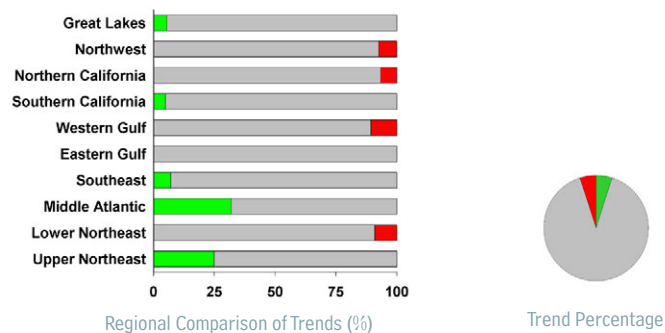


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

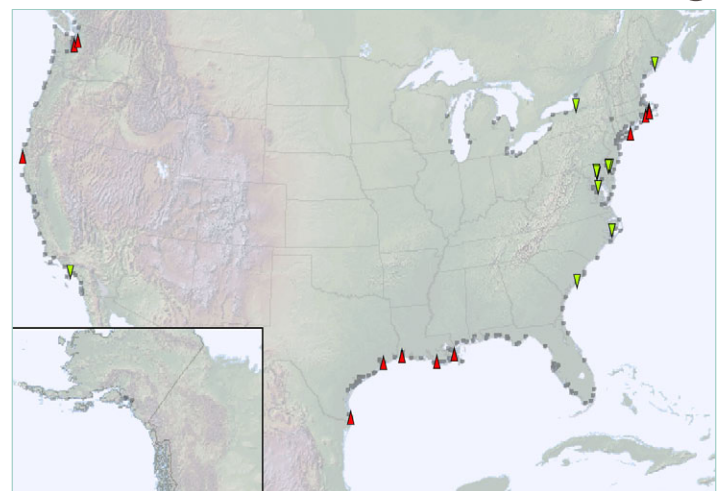
- ▼ Middle Atlantic
- Upper Northeast, Lower Northeast, Southeast, Eastern Gulf Coast, Western Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

NO OVERALL NATIONAL TREND ●



- ▼ 12 individual sites exhibited a significant decreasing trend
- ▲ 12 individual sites exhibited a significant increasing trend

CHEMICAL DESCRIPTION

SOURCES

Nickel is a naturally occurring, biologically essential trace element that is widely distributed in the environment. It exists in its alloy form and as a soluble element. Nickel is found in stainless steel, nickel-cadmium batteries, pigments, computers, wire, and coinage; and is used for electroplating (ATSDR, 2005b).

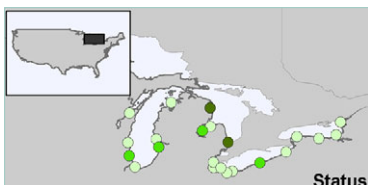
TOXICITY

Food is the major source of human exposure to nickel (ATSDR, 2005b). Exposure to large doses of nickel can cause serious health effects, such as bronchitis, while long-term exposure can result in cancer. The FDA has established an action level of 80 ppm wet weight for nickel in shellfish (FDA, 2001 and 1993d). In years 2004-2005 of the Mussel Watch Program, a maximum nickel concentration of 10 ppm wet weight (equivalent) was measured in Puget Sound (PSMF). There is no evidence that nickel biomagnifies in the food chain (McGeer et al., 2003; Suedel et al., 1994).

FATE AND TRANSPORT

Nickel derived from weathering rocks and soil is transported to streams and rivers by runoff. It accumulates in sediment and becomes inert when it is incorporated into minerals. River and stream input of nickel are the largest sources for oceans and coastal waters. Atmospheric sources are usually not significant, except in the Great Lakes where the atmospheric input of nickel accounts for 60-80% of the total anthropogenic input to Lake Superior and 20-70% of total inputs to Lakes Erie and Ontario (Nriagu et al., 1996).

GREAT LAKES HIGHLIGHT



BACKGROUND

Possible sources in this region include mining and smelting operations in Sudbury, Ontario, Canada where the largest nickel smelting operation in the western hemisphere is found. EPA through its Great Lakes Sediment Remediation activities found that sediment contaminated with nickel and other contaminants are a significant problem and raised concern about potential risks to aquatic organisms and humans (EPA, 2004).



Concentration Percentage

STATUS

- When compared to both mussels and oysters, concentrations in zebra mussels from the Great Lakes are relatively high.
- Although the highest sites occur in Lake Huron and the lowest in Lake Ontario, all measurements are higher than those found in other regions for oysters and mussels.

No Trend ●



TRENDS

- Proportionally the percentage of decreasing sites is similar to what is seen for the nation.

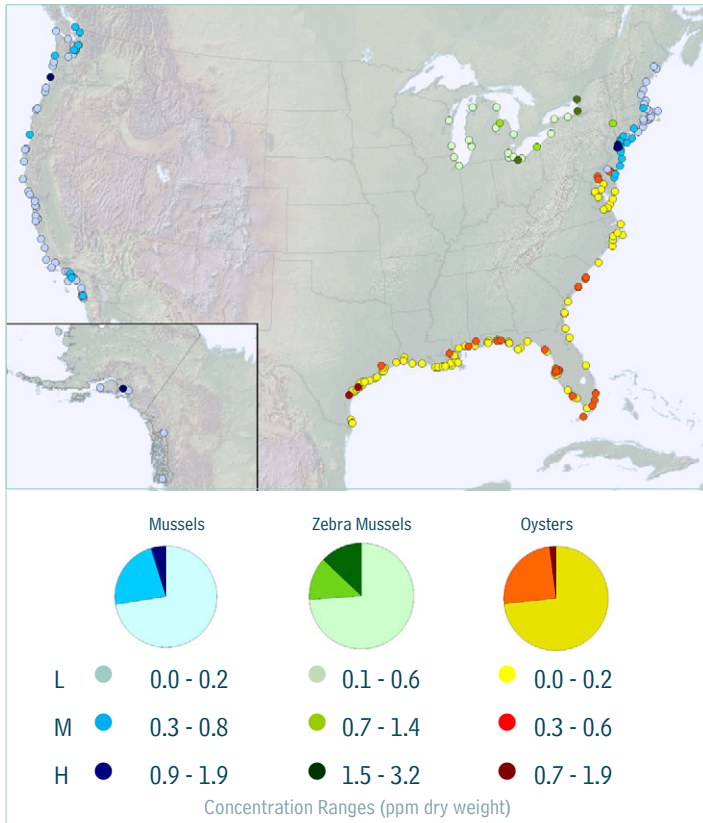


Trend Percentage

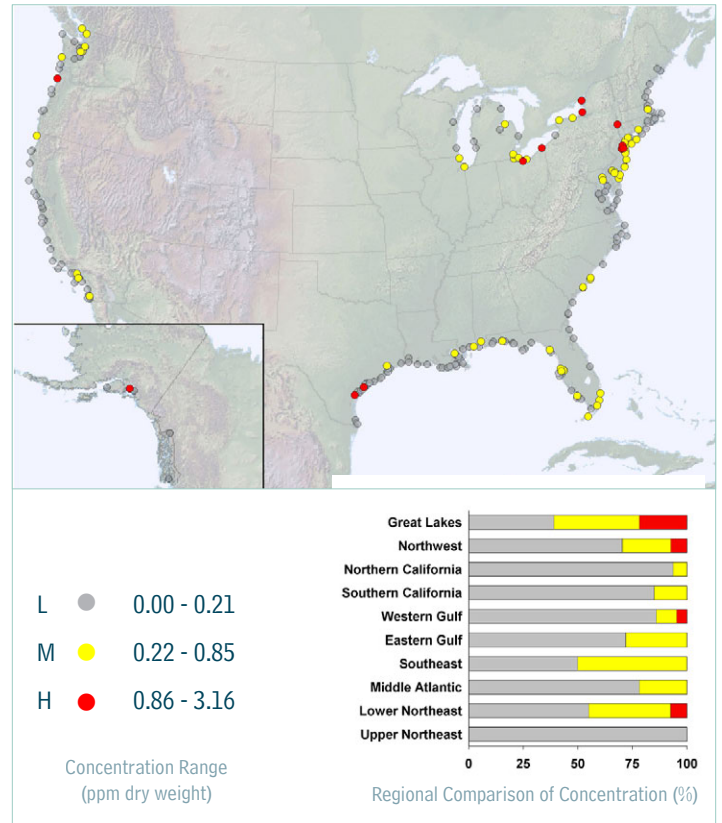
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

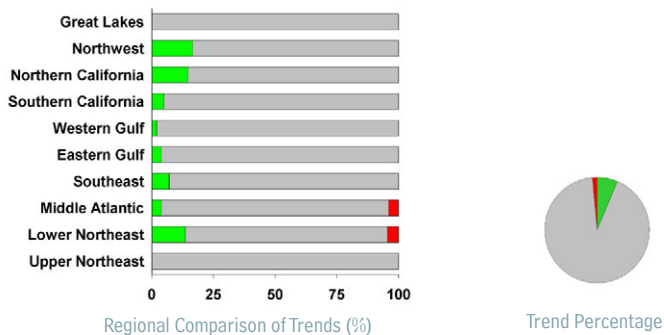


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

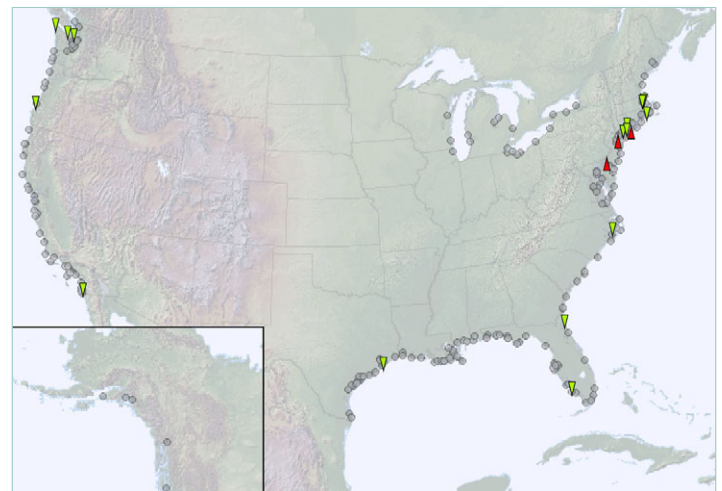
- Lower Northeast, Upper Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Eastern Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

NO OVERALL NATIONAL TREND ●



- ▼ 15 individual sites exhibited a significant decreasing trend
- ▲ 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. Concentrations in unpolluted waters and the atmosphere are often near analytical detection limits. Tin has not been mined in the U.S. since 1993 (USGS, 2008); however, Canadian tin mining occurs in the Great Lakes Region.

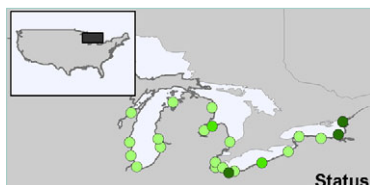
TOXICITY

Humans are exposed to elevated levels of tin by eating from tin-lined cans and by consuming contaminated seafood (ATSDR, 2005b). Exposure to elevated levels of tin compounds by humans leads to liver damage, kidney damage, and cancer. There is no U.S. FDA recommended guideline for tin in seafood.

FATE AND TRANSPORT

Tin enters coastal waters bound to particulates, and from riverine sources derived from soil and sediment erosion. Bioconcentration factors for inorganic tin were reported to be 1,900 and 3,000 for marine algae and fish (Seidel et al., 1980; Thompson et al., 1972). Inorganic tin can be transformed into organometallic forms by microbial methylation and is correlated with increasing organic content in sediment (Hadjispyou et al., 1998). Tin is regarded as being relatively immobile in the environment and is rarely detected in the atmosphere. It is mainly found in the atmosphere near industrial sources as particulates from combustion of fossil fuels and solid waste (Gerritse et al., 1982; WHO, 1980).

GREAT LAKES HIGHLIGHT



BACKGROUND

Possible sources in this region include mining and smelting operations.



Concentration Percentage

STATUS

- Some of the highest tin concentrations in the nation occur in zebra mussels.
- The highest concentrations are found in the eastern Great Lakes.

No Trend ●



TRENDS

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



Trend Percentage

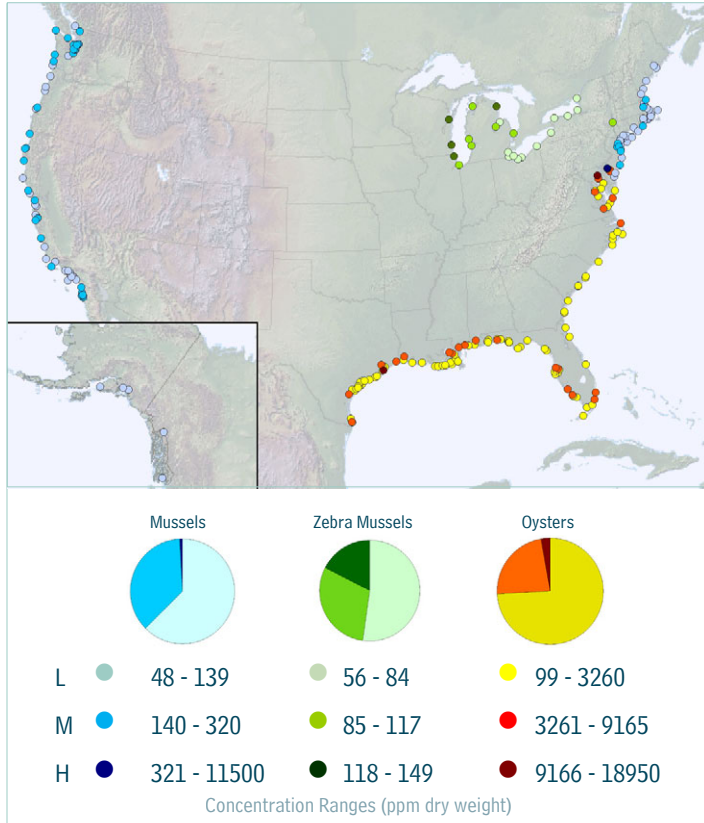
ZINC (Zn)

Nation at a Glance:

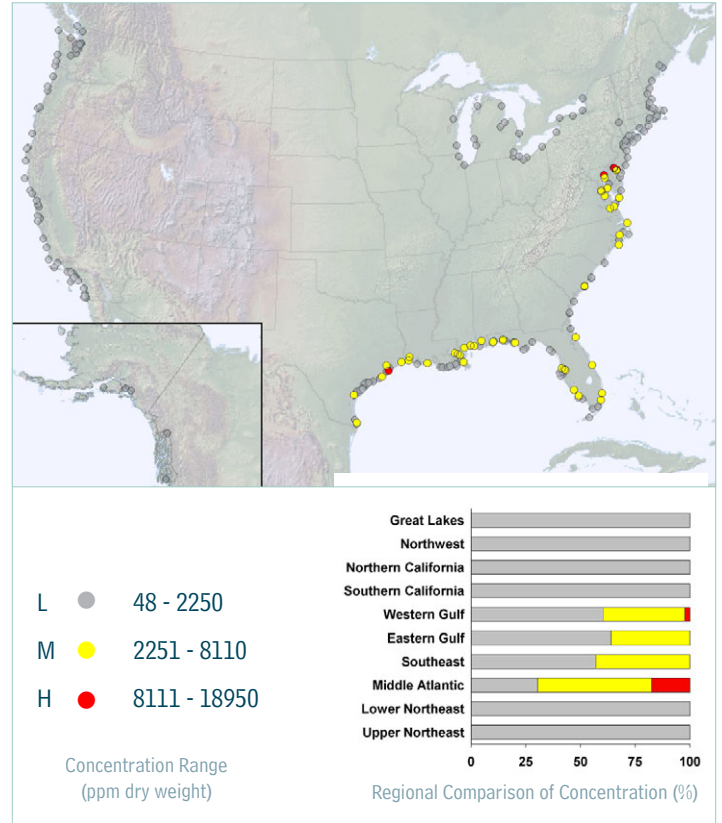
STATUS SUMMARY

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

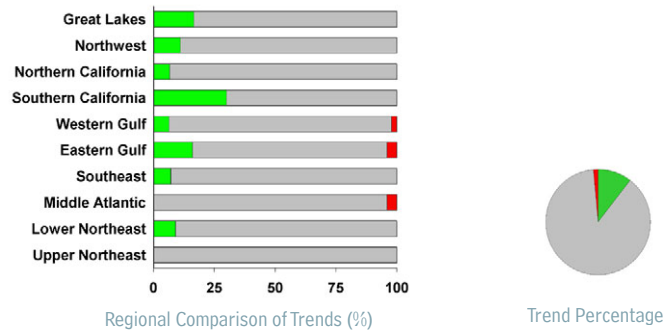


TRENDS SUMMARY

SIGNIFICANT REGIONAL TRENDS:

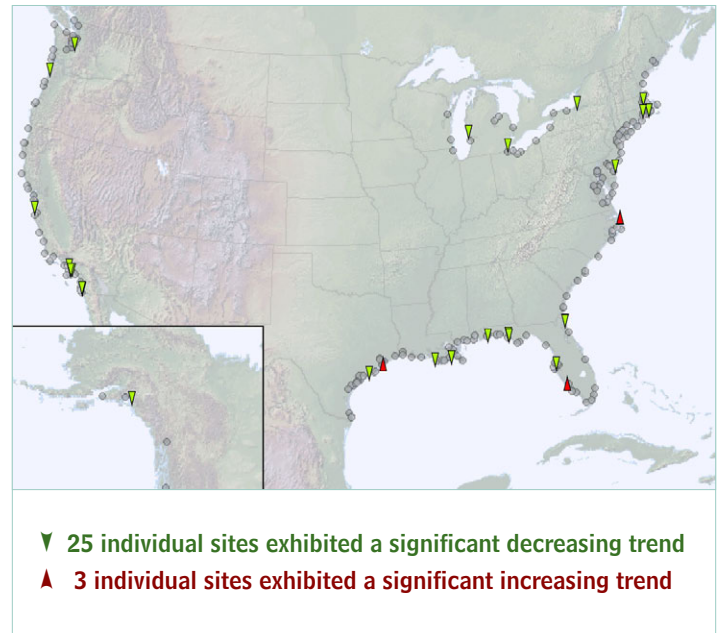
- ▼ Southern California, Northwest, Great Lakes
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Northern California

SUMMARY OF SITE TRENDS MAP:



SITE TRENDS

DECREASING NATIONAL 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 (McGeer 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.



Concentration Percentage

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 ▼



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.



Trend Percentage

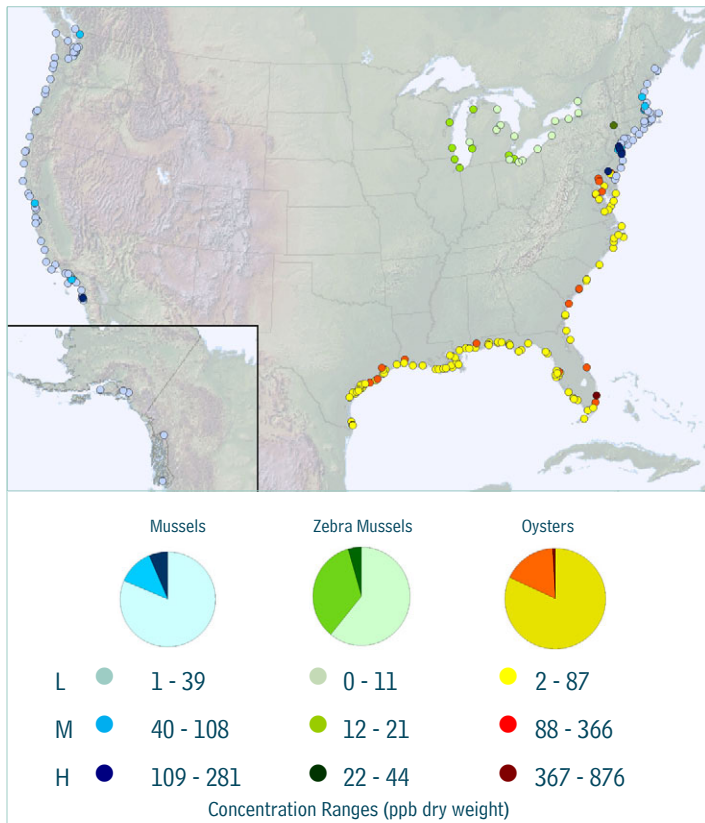
BUTYLINS

Nation at a Glance:

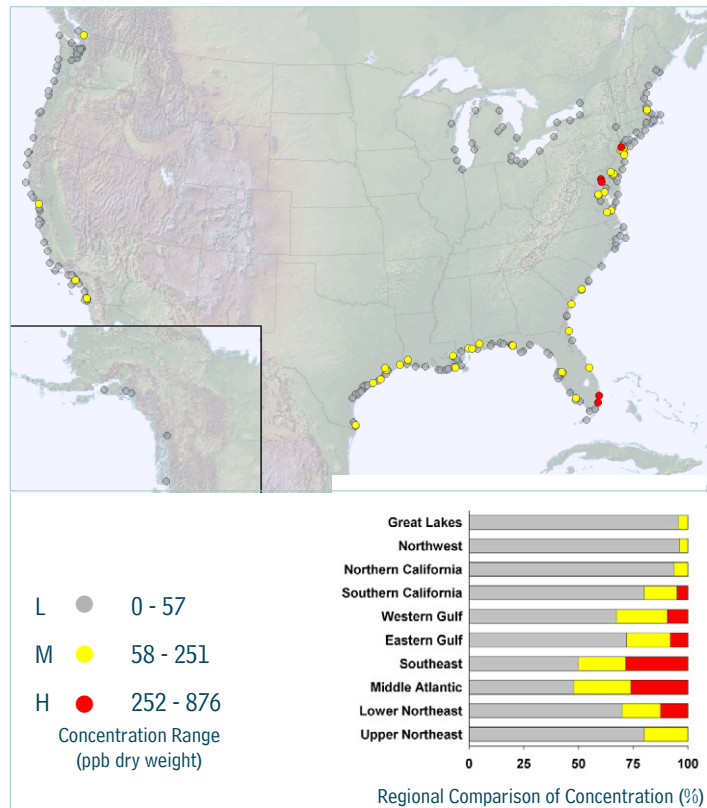
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

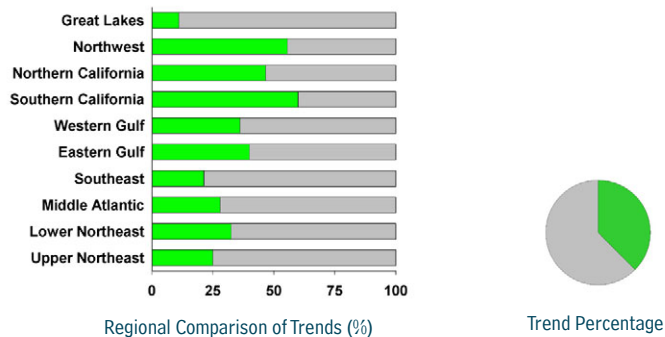


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

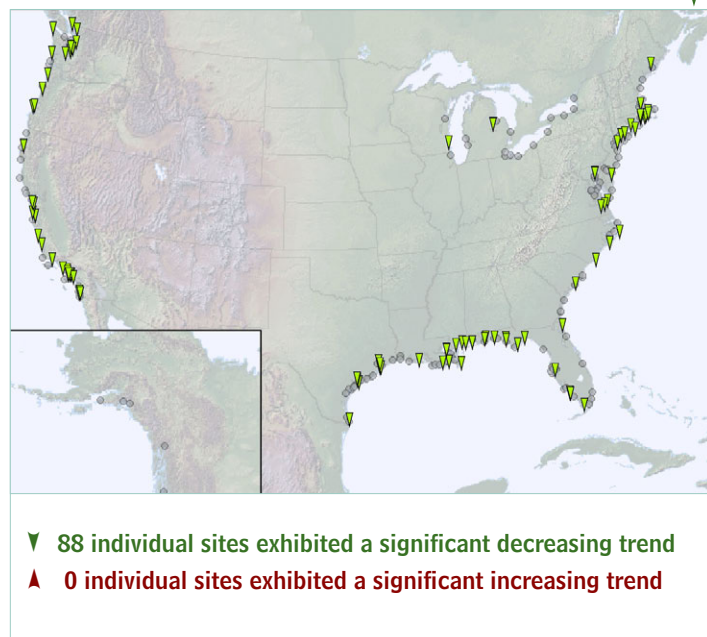
- ▼ Lower Northeast, Eastern Gulf Coast, Southern California, Northern California, Northwest
- Upper Northeast, Middle Atlantic, Southeast, Western Gulf Coast, Great Lakes

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND ▼



CHEMICAL DESCRIPTION

For this document, butyltin is the sum of three organometallic compounds: tributyltin, 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 than 25 m in length, drastically limiting use on many recreational vessels.

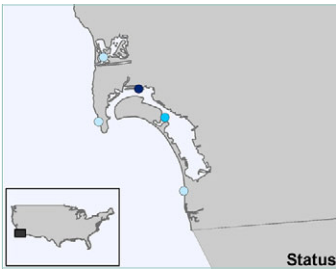
TOXICITY

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.

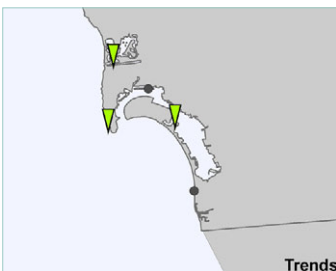


Concentration Percentage

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 ▼



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.



Trend Percentage

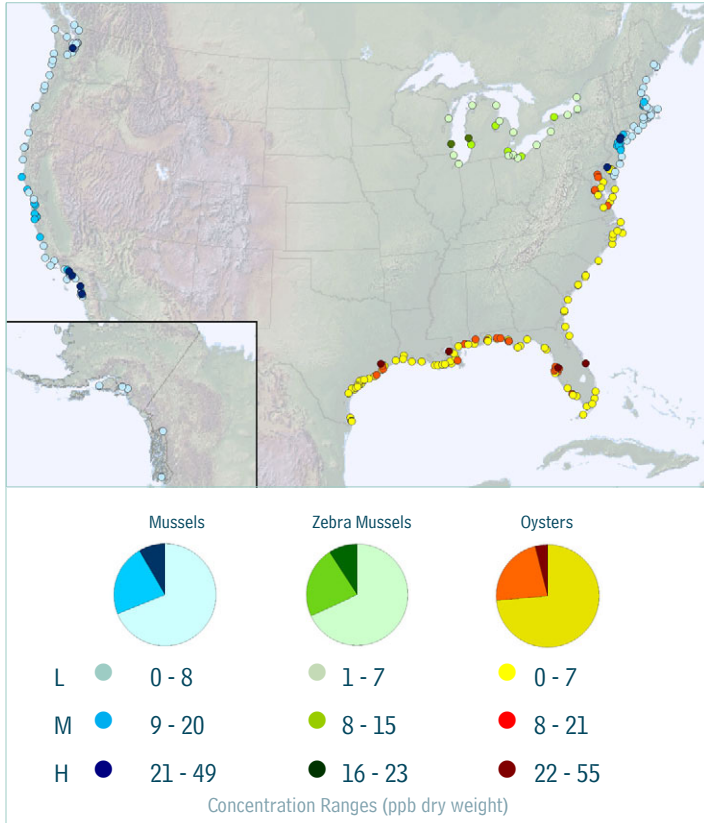
CHLORDANES

Nation at a Glance:

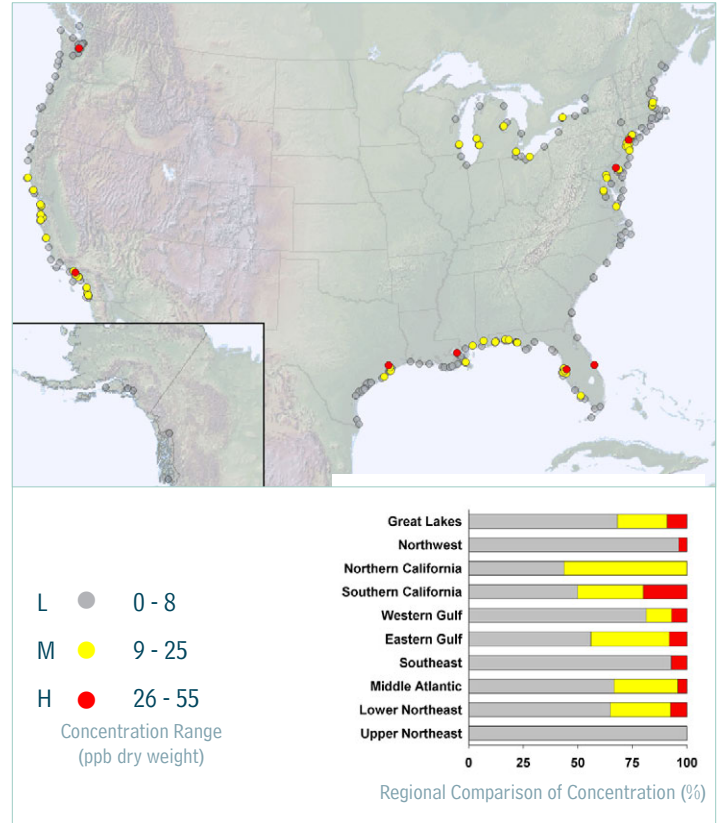
STATUS SUMMARY

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



NATIONAL CHARACTERIZATION

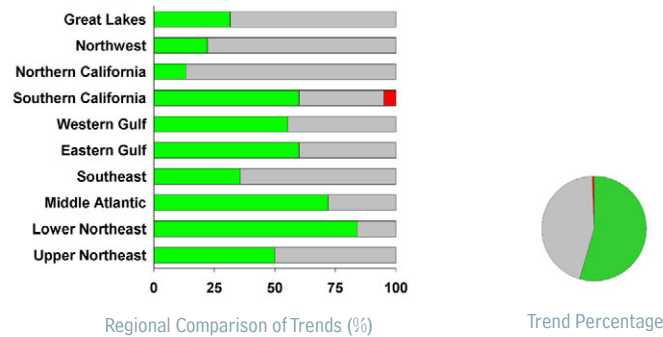


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

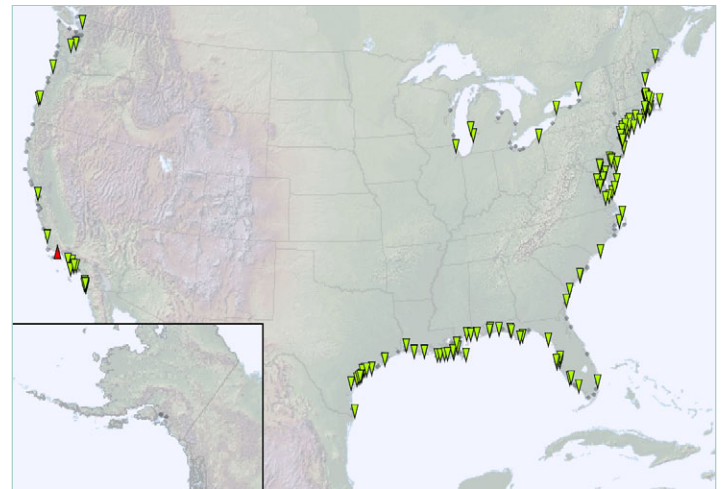
- Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Southern California, Northern California, Northwest, Great Lakes

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND



- 129 individual sites exhibited a significant decreasing trend
- 1 individual sites exhibited a significant increasing trend

CHEMICAL DESCRIPTION

Chlordane belongs to a group of organic pesticides called cyclodienes. It is a technical mixture whose principle components are alpha-chlordane, gamma-chlordane, heptachlor and nonachlor. Chlordane as reported here is the sum of three prominent compounds, alpha-chlordane, heptachlor and trans-nonachlor, plus one transformation product (heptachlor epoxide).

SOURCES

Technical chlordane, an insecticide, is a complex mixture of at least fifty compounds. It was used in the U.S. from 1948-1983 for agricultural and urban settings to control insect pests. It was also the predominant insecticide for the control of subterranean termites. Agricultural uses were banned in 1983 and all uses were banned by 1988. These compounds are some of the most ubiquitous contaminants measured by the Mussel Watch Program. The FDA action level for chlordane in all fish is 0.3 ppm wet weight (FDA, 2001). In years 2004-2005 of the Mussel Watch Program, a maximum chlordane concentration of 0.01 ppm wet weight was measured in Indian River, Florida (IRSR) and Sinclair Inlet, Washington (SIWP).

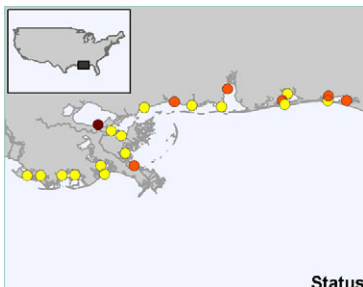
TOXICITY

Exposure to chlordane can occur through eating crops from contaminated soil, fish and shellfish from contaminated waters, or breathing contaminated air. Chlordane can enter the body by being absorbed through the skin, inhalation and ingestion. At high levels, chlordane can affect the nervous system, digestive system, brain and liver, and is also carcinogenic. Chlordane is highly toxic to invertebrates and fish.

FATE

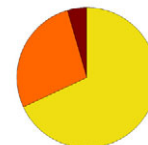
Removal from both soil and water sources is primarily by volatilization and particle-bound runoff. In air, chlordane degrades as a result of photolysis and oxidation. Chlordane exists in the atmosphere primarily in the vapor-phase, but the particle-bound fraction is important for long-range transport. Chlordane is prevalent in the Arctic due to the grasshopper effect and distributed in the food web (Hargrave et al., 1992). Chlordane binds to dissolved organic matter, further facilitating its transport in natural waters.

CENTRAL GULF COAST HIGHLIGHT



BACKGROUND

Decreasing concentration trends are consistent with earlier reporting.

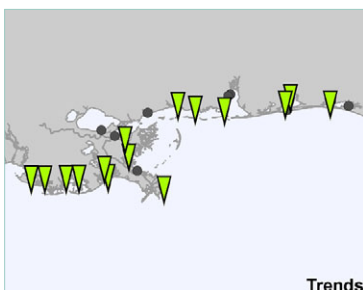


Concentration Percentage

STATUS

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

Decreasing Trend ▼



TRENDS

- Nearly all sites show decreasing concentration trends, which is consistent with the ban of all chlordane use in 1988.
- Regionally and nationally chlordane concentrations are decreasing.

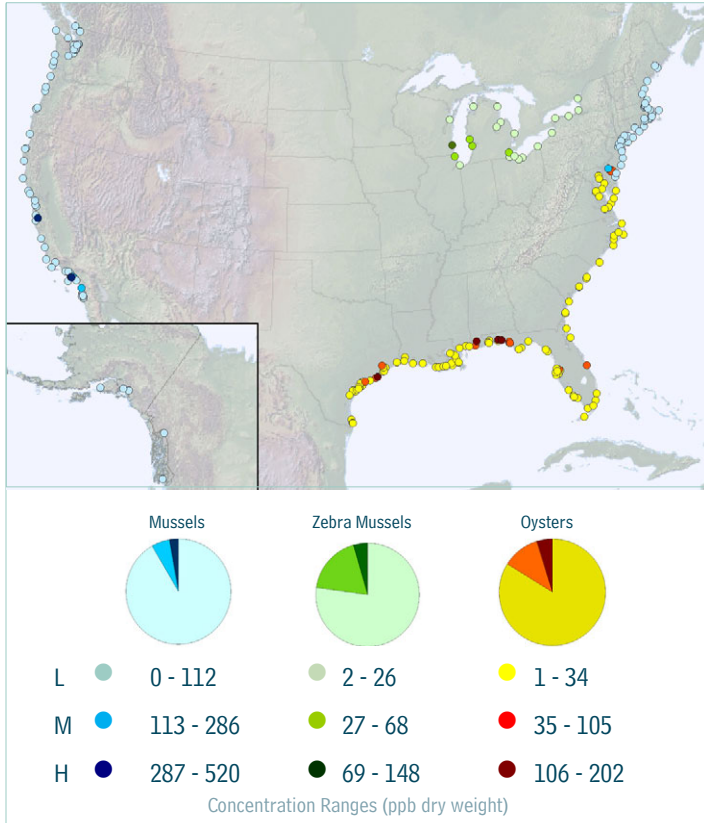


Trend Percentage

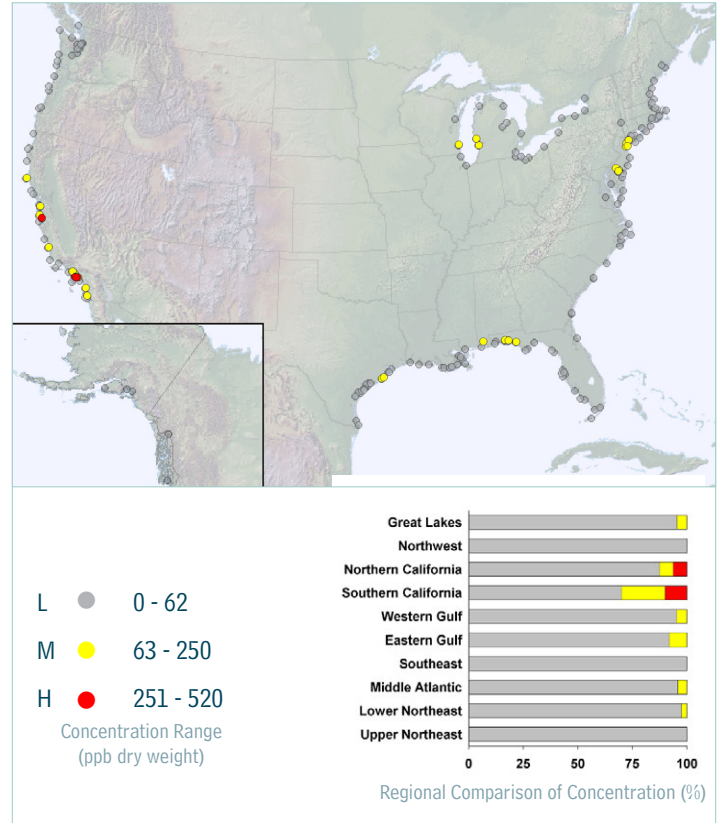
STATUS SUMMARY

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



NATIONAL CHARACTERIZATION

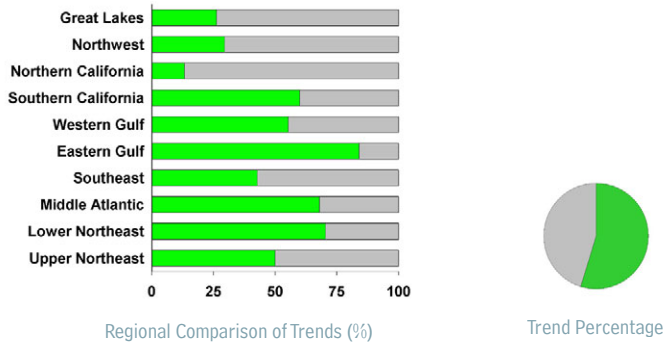


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

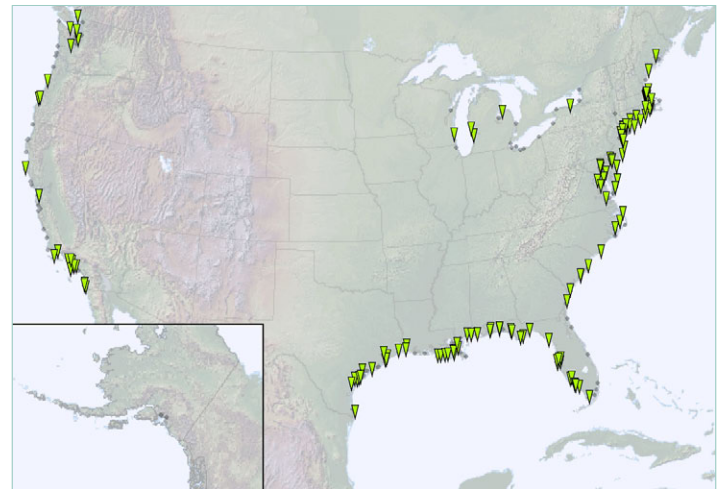
- ▼ Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf Coast, Western Gulf Coast, Southern California, Northwest, Great Lakes
- Northern California

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND ▼



▼ 130 individual sites exhibited a significant decreasing trend
 ▲ 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

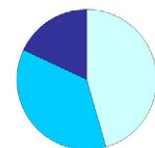
DDT transforms to DDD and DDE, the latter being the predominant form found in the environment. Evaporation of DDT from soil followed by long distance transport (the grasshopper effect) results in its widespread global distribution. DDT and its transformation products are very persistent and accumulate in the environment because they resist biodegradation. 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.



Concentration Percentage

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 ▼



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.



Trend Percentage

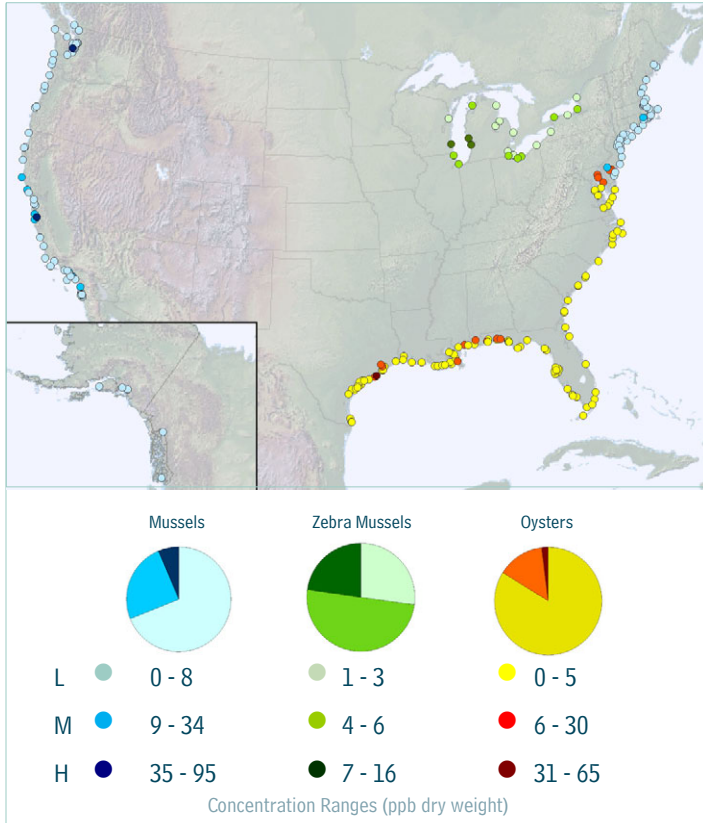
DIETDRINS

Nation at a Glance:

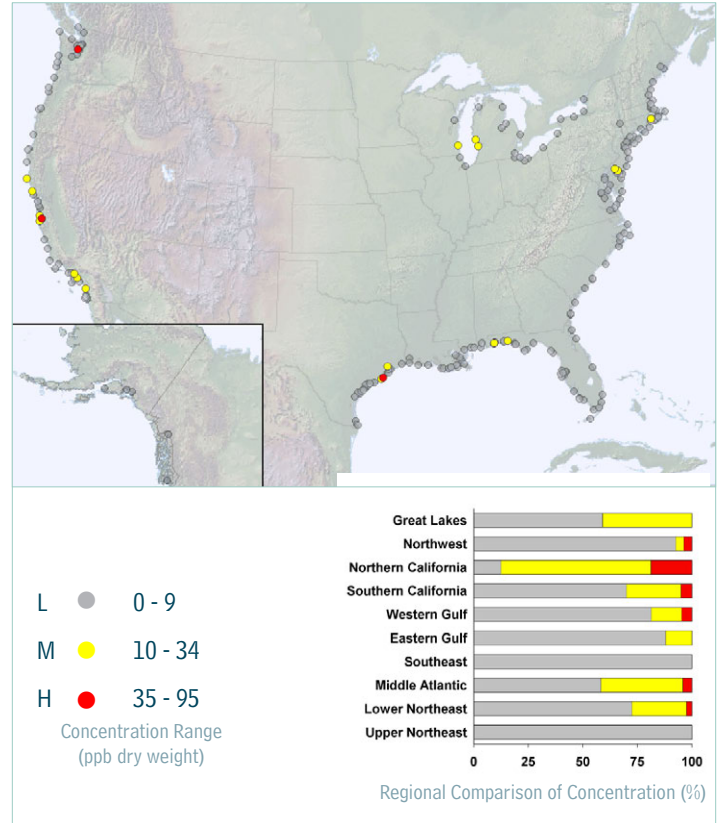
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

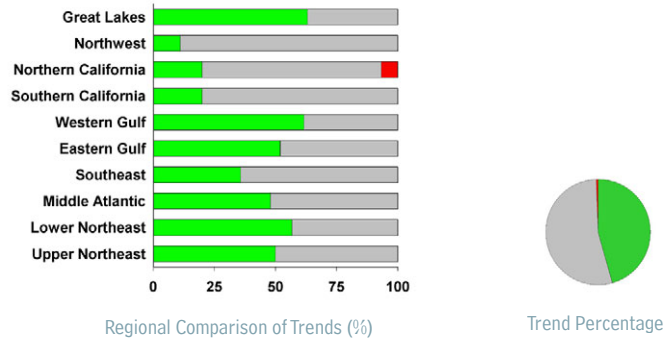


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

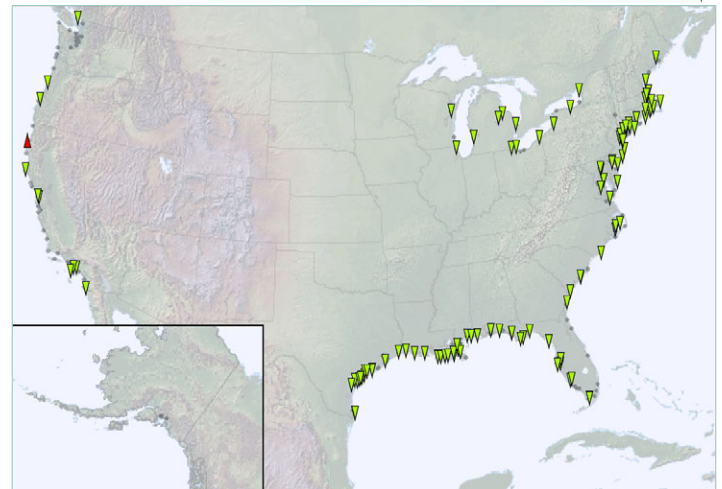
- ▼ Upper Northeast, Lower Northeast, Middle Atlantic, Southeast, Eastern Gulf, Coast, Western Gulf Coast, Great Lakes
- Southern California, Northern California, Northwest

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND ▼



- ▼ 108 individual sites exhibited a significant decreasing trend
- ▲ 1 individual sites exhibited a significant increasing trend

CHEMICAL DESCRIPTION

SOURCES

In this document, dieldrin is defined as the sum of two compounds, dieldrin and aldrin. Dieldrin and a related compound (aldrin) were widely used as insecticides in the 1960s for the control of termites around buildings and general crop protection from insects (ATSDR, 2002b). In 1970, all uses of aldrin and dieldrin were canceled based on concern that they could cause severe aquatic environmental change and their potential as carcinogens (EPA, 1980). The cancellation was lifted in 1972 to allow limited use of aldrin and dieldrin, primarily for termite control. All uses of aldrin and dieldrin were again cancelled in 1989 (EPA, 1990).

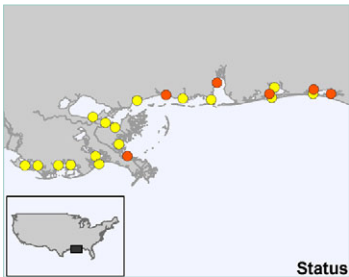
TOXICITY

Exposure to aldrin and dieldrin occurs through ingestion of contaminated water and food products, including fish and shellfish, and through inhalation of indoor air in buildings treated with these insecticides. Aldrin is rapidly metabolized to dieldrin in the human body. Acute and long-term human exposures are associated with central nervous system intoxication. Aldrin and dieldrin are carcinogenic to animals and classified as likely human carcinogens. The FDA has established an action level of 0.3 ppm wet weight for aldrin/dieldrin in all fish (FDA, 2001). In years 2004-2005 of the Mussel Watch Program, a maximum dieldrin concentration of 0.02 ppm wet weight (equivalent) was measured in Monterey Bay, California (MBES).

FATE AND TRANSPORT

Aldrin is readily converted to dieldrin, while dieldrin is resistant to transformation. Dieldrin bioaccumulates and is magnified through aquatic food chains and has been detected in tissue of freshwater and saltwater fish, and marine mammals. Aldrin and dieldrin applied to soil are tightly bound, but may be transported to streams and rivers by soil erosion. Volatilization is the primary loss mechanism from soil. Dieldrin undergoes minor degradation to photodieldrin in marine environments.

CENTRAL GULF COAST HIGHLIGHT



BACKGROUND

Highly persistent and widely applied as a pesticide, dieldrin continues to be found at medium levels in the region.

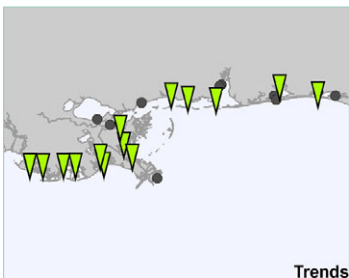


Concentration Percentage

STATUS

- On the Central Gulf Coast dieldrin is the highest in enclosed bays.
- Regional concentrations are elevated relative to those found nationwide.

Decreasing Trend ▼



TRENDS

- More than half the sites show decreasing trends, which is consistent with the 1974 ban from agricultural use.
- The region as a whole has a significant decreasing trend.

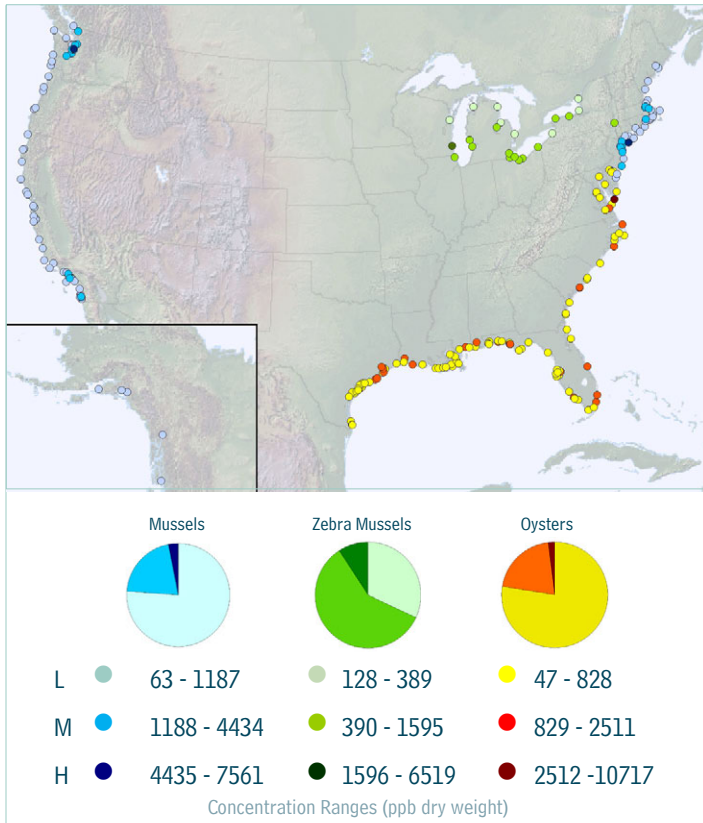


Trend Percentage

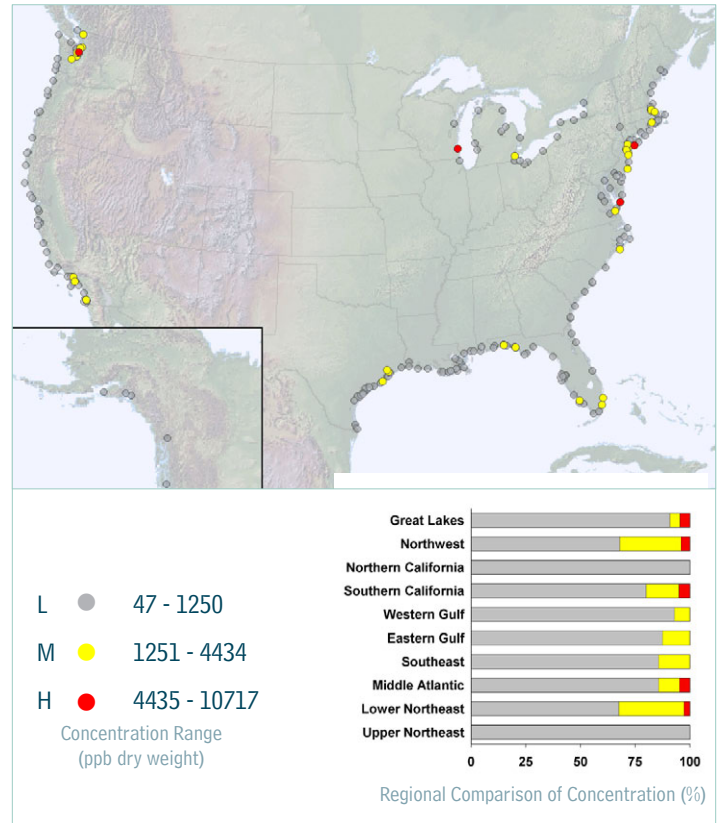
STATUS SUMMARY

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

REGIONAL SPECIES CHARACTERIZATION



NATIONAL CHARACTERIZATION

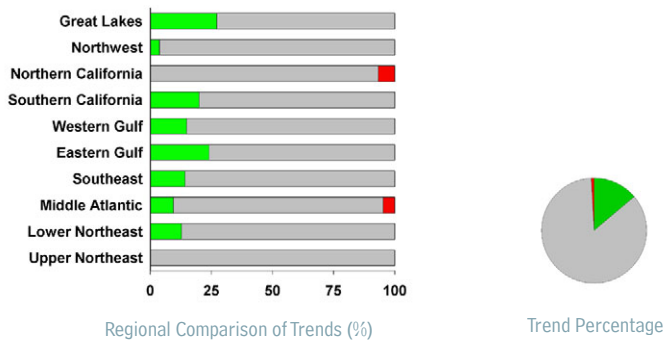


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

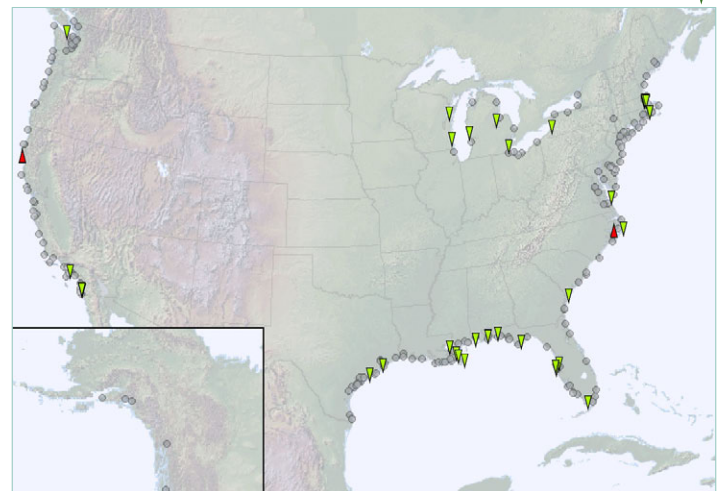
- ▼ Southeast, Eastern Gulf Coast, Great Lakes
- Lower Northeast, Upper Northeast, Middle Atlantic, Western Gulf Coast, Southern California, Northern California, Northwest

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND ▼



- ▼ 33 individual sites exhibited a significant decreasing trend
- ▲ 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.

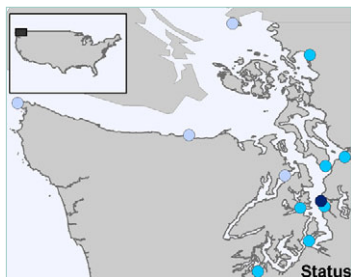
TOXICITY

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

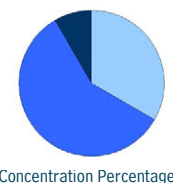
The fate and transport of PAHs is variable and dependent on the physical properties of each individual compound. Most PAHs strongly associate with particles; larger PAH compounds (high molecular weight) associate to a higher degree with particles relative to smaller PAH compounds (low molecular weight). 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).

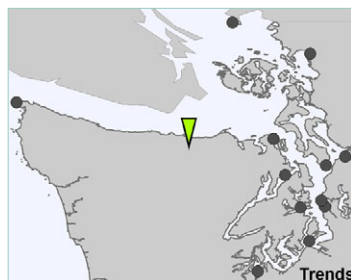


Concentration Percentage

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 ●



TRENDS

- Overall there is no significant Puget Sound wide trend.

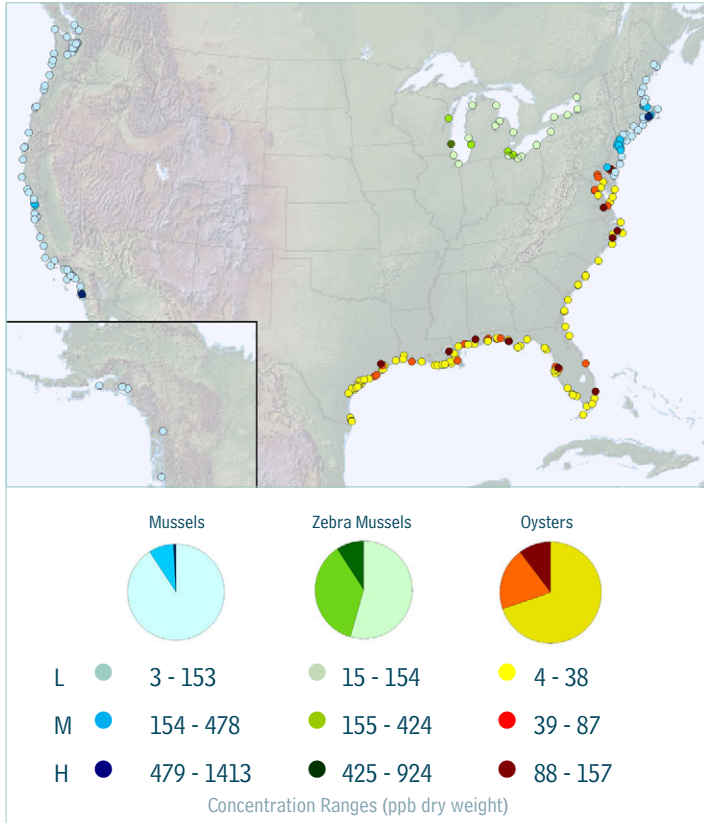


Trend Percentage

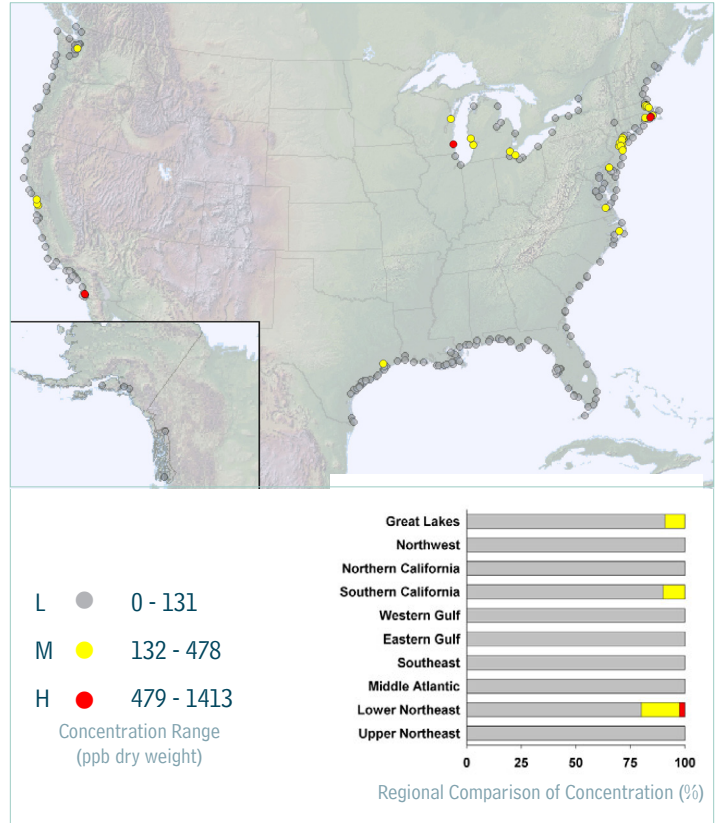
STATUS SUMMARY

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



NATIONAL CHARACTERIZATION

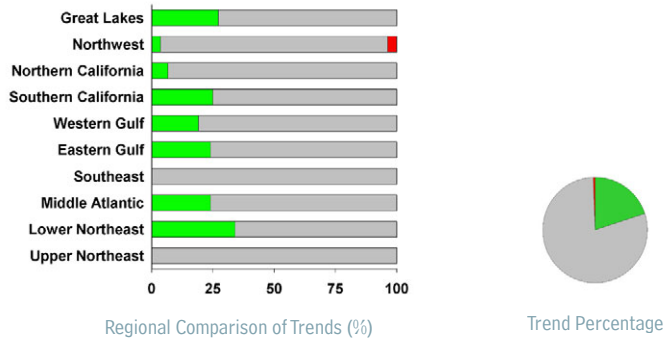


TRENDS SUMMARY

A SUMMARY OF REGIONAL TRENDS:

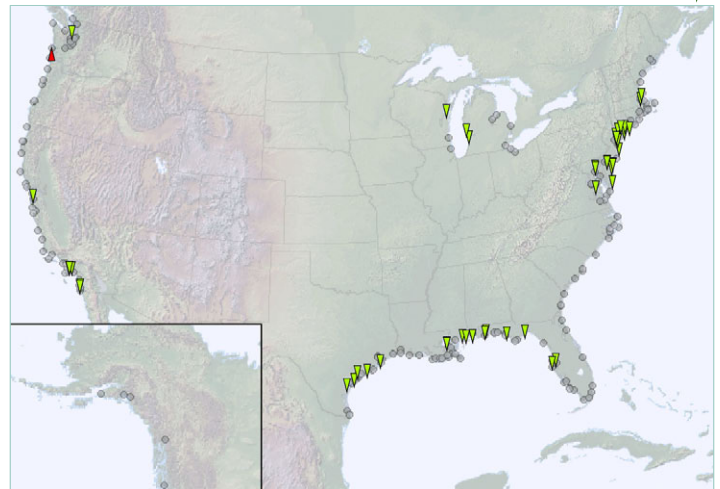
- ▼ Lower Northeast, Eastern Gulf Coast, Western Gulf Coast, Great Lakes
- Upper Northeast, Middle Atlantic, Southeast, Southern California, Northern California, Northwest

SUMMARY OF SITE TRENDS MAP:



NATIONAL TRENDS

DECREASING NATIONAL TREND ▼



- ▼ 46 individual sites exhibited a significant decreasing trend
- ▲ 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.

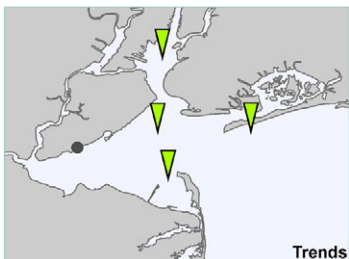


Concentration Percentage

STATUS

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

Decreasing Trend ▼



TRENDS

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



Trend Percentage

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