CLEARER THAN MUD
ASSESSMENT OF SEDIMENT IN CASCO BAY (1991-2011)

CASCO BAY ESTUARY PARTNERSHIP
MANAGEMENT COMMITTEE MEETING

RAMBOLL ENVIRON

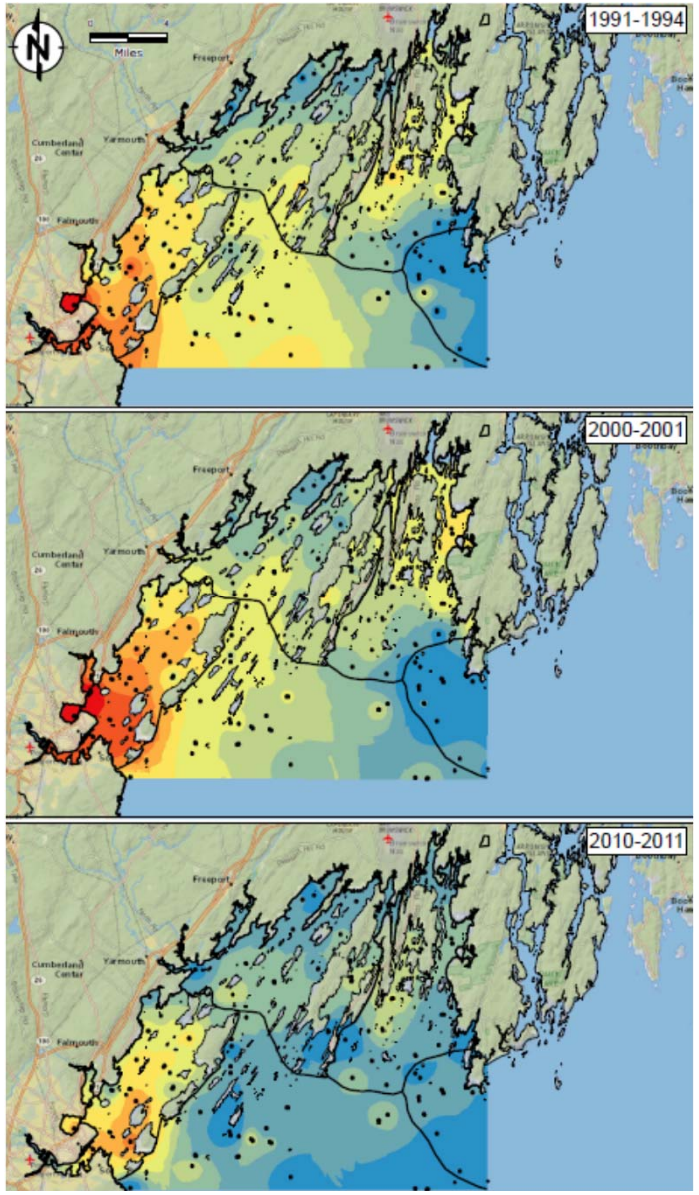
AGENDA

- Report objectives
- Overview
  - Why does mud matter?
  - History of sediment sampling
- Methodology
- Results
  - 2010-2011 sediment data review
  - 1991-2011 data trends
  - Regional comparisons
- Summary and conclusions

RESULTS: SNEAK PEEK

Good news for Casco Bay

- Almost without exception, concentrations of chemicals of concern in surface sediments were lower in 2010-2011 than in previous sampling events.
  - Notable exceptions: mercury, selenium



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REPORT OBJECTIVES

- Document current status of chemical concentrations in Casco Bay sediments
- Compare to sediment screening values
- Evaluate trends
  - Within areas of Casco Bay
  - Over time
- Regional context (i.e., Gulf of Maine)
- Identify appropriate future studies, if any

WHY DOES MUD MATTER?

- Integrates sources from the entire watershed
  - Ultimate downstream sink
- Historical record
- Pathway into the food chain
  - Ecological exposure
  - Human exposure

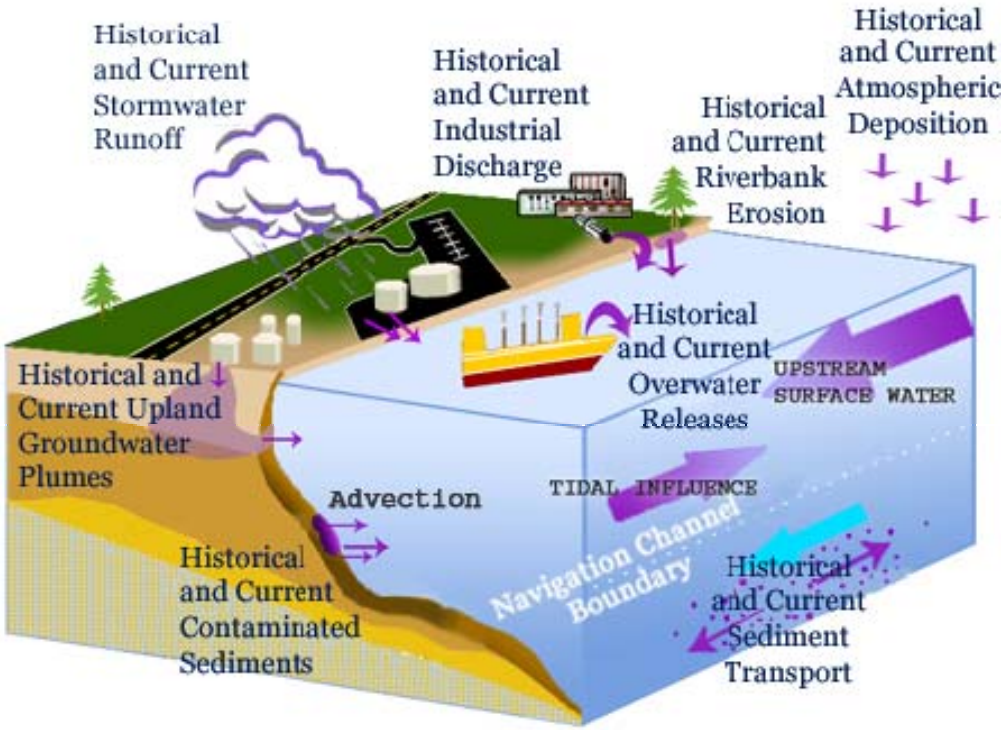

Image credit: USEPA

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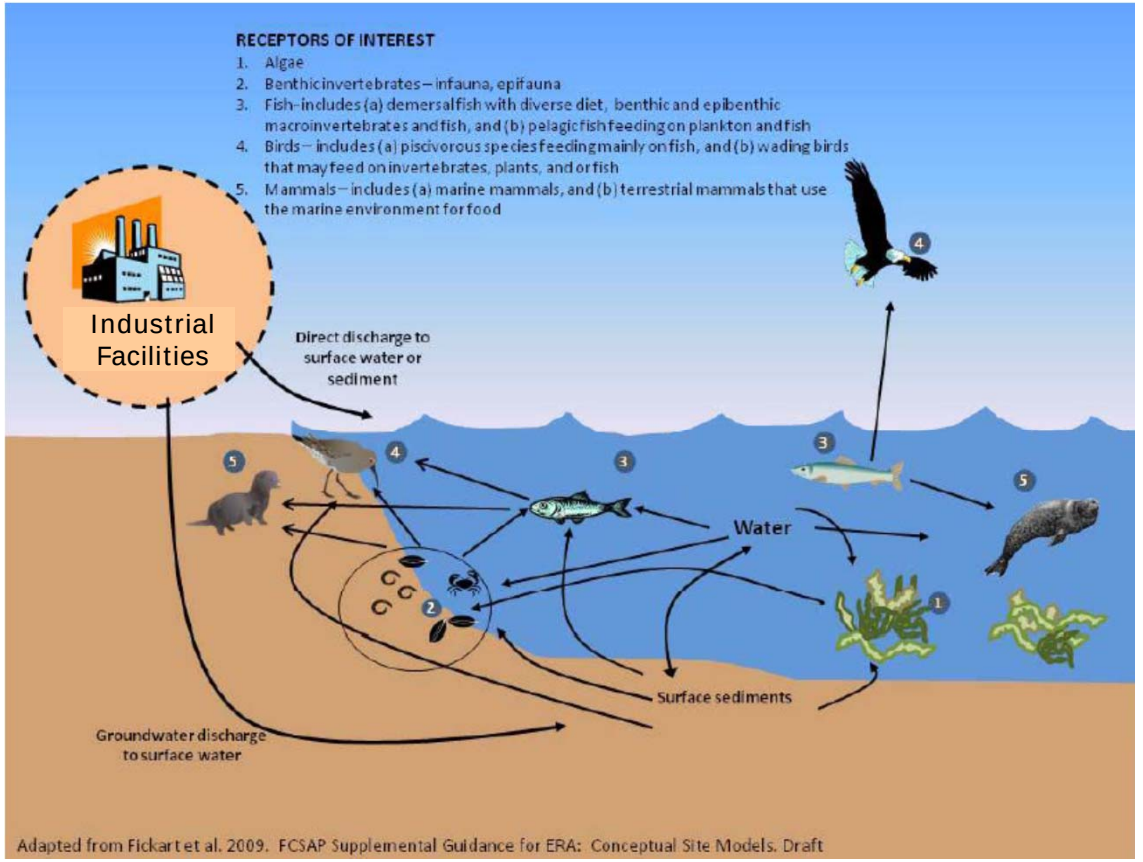
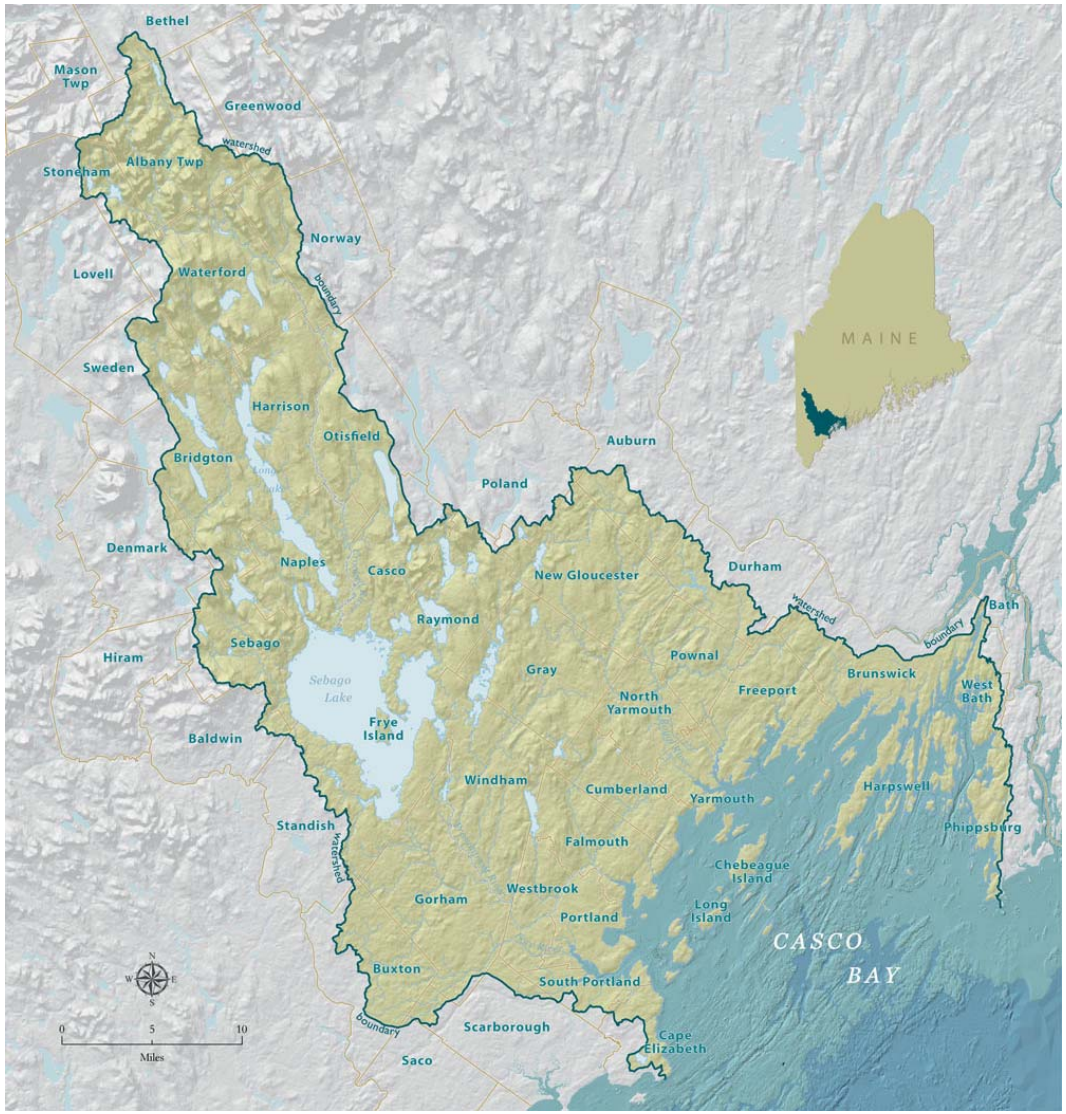


SETTING

- Basin – < 1,000 square miles
- Population - ~250,000 people
- Bay - ~200 square miles
  - Shoreline – 575 linear miles
  - 785 islands



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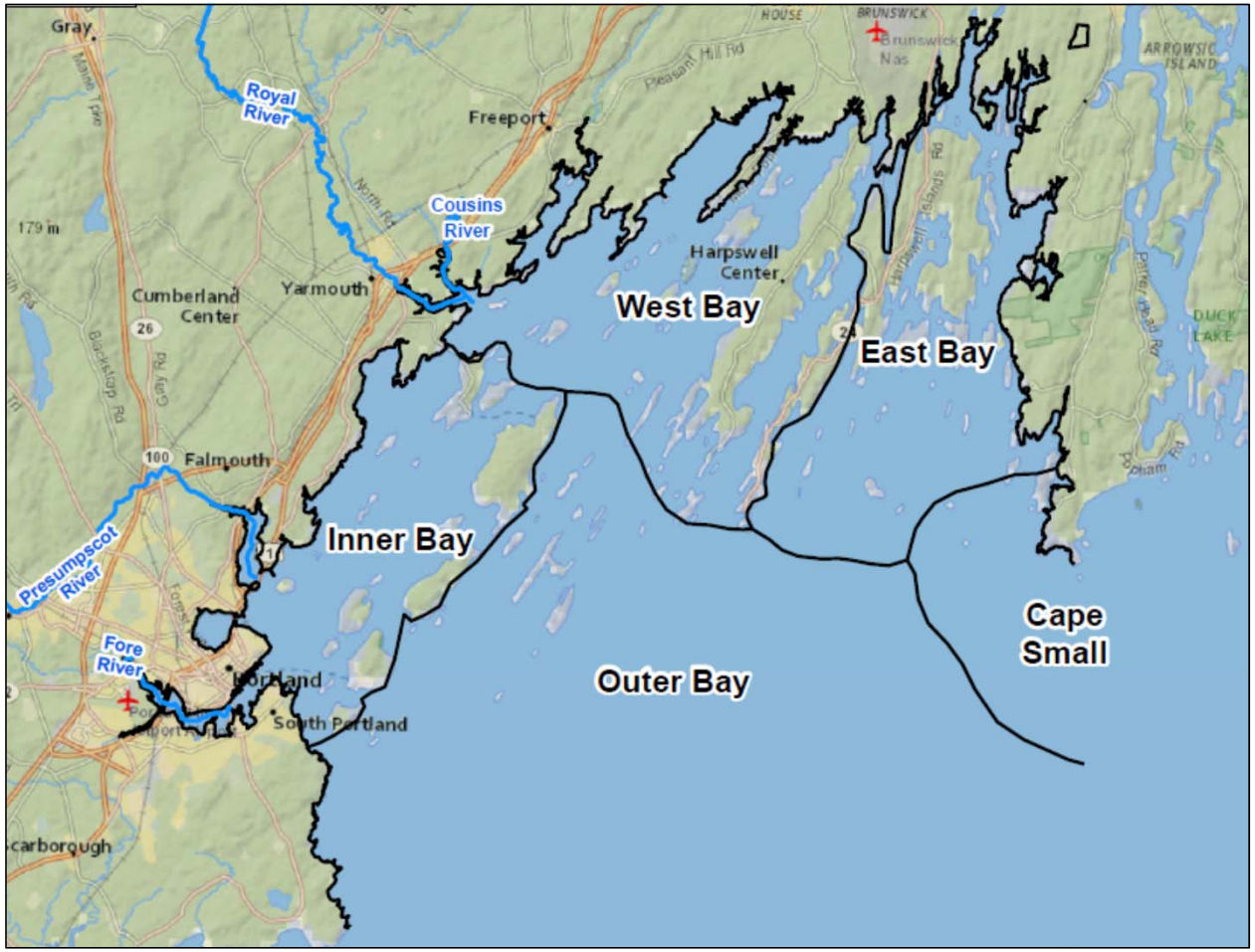
SETTING

- Inner Bay: Portland, SoPo, Presumpscot River, Fore River, Back Cove
- Outer Bay: Connection to Gulf of Maine
- West Bay: Yarmouth, Freeport, Harpswell, Royal River, Cousins River, Harraseeket River
- East Bay: Brunswick, New Meadows River, Quahog Bay
- Cape Small: Lower Kennebec River discharge



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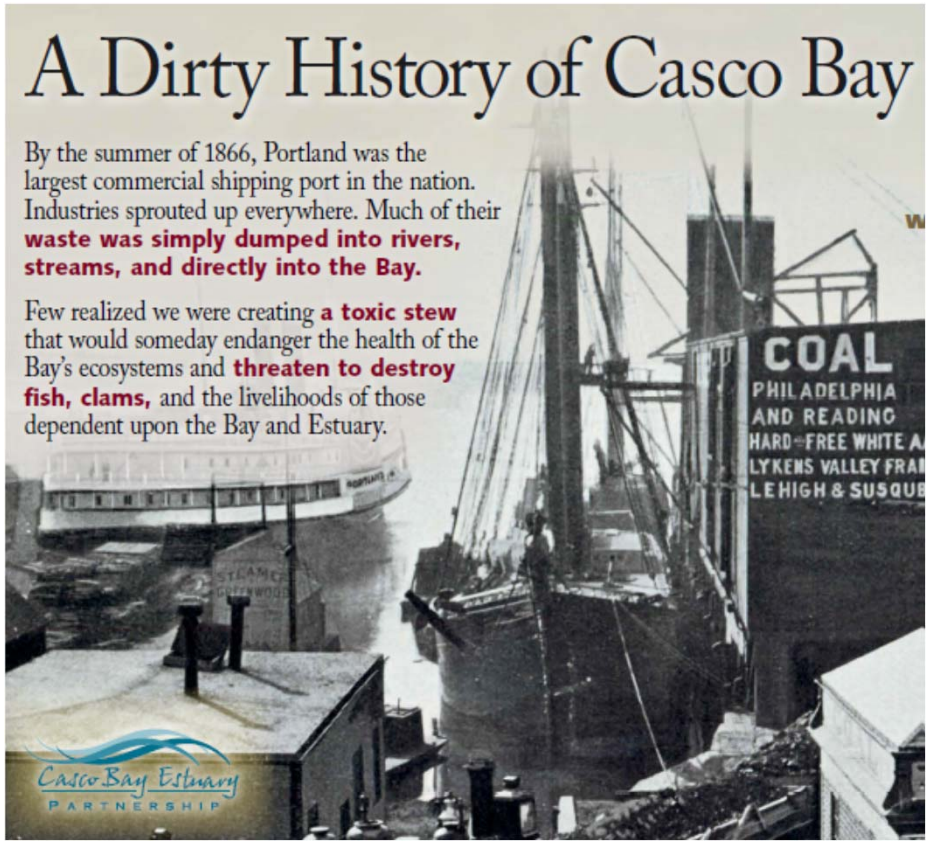
SOURCES OF CHEMICALS TO CASCO BAY

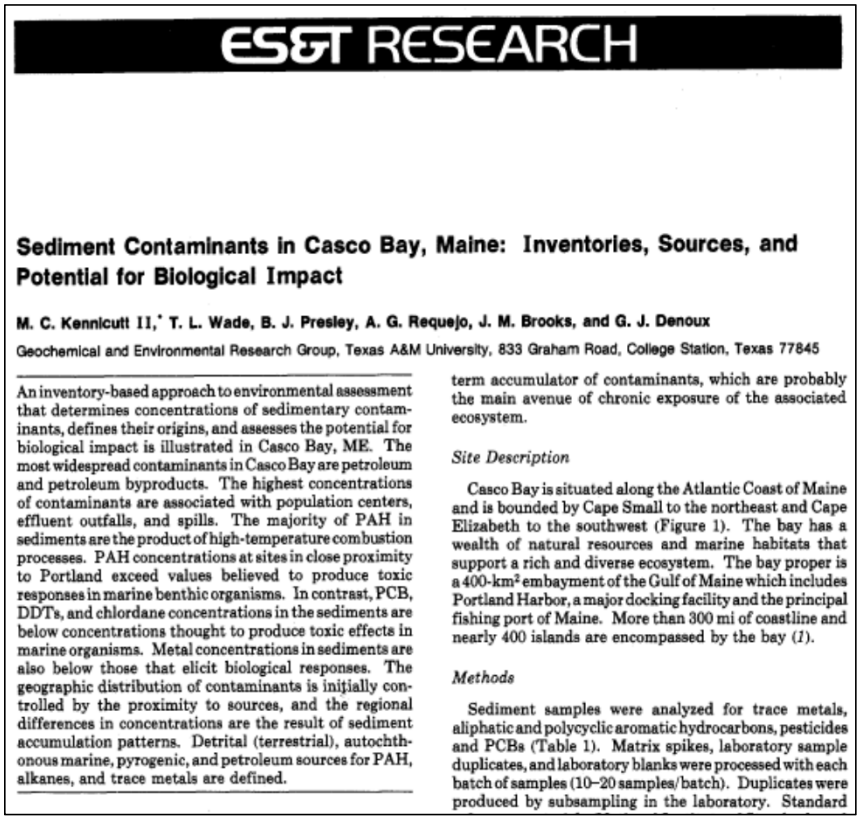
- Historical
  - Manufactured Gas Plants – PAHs, organics
  - Foundaries – metals
  - Shipyards – organotins, metals
  - Tanneries – metals
  - Rail yards – PAHs, metals, organics
  - Paint factories – metals
  - Various industries – PCBs, mercury, pesticides, dioxins and furans
- Ongoing
  - Wastewater – nutrients, metals, etc.
  - Combustion – PAHs, dioxins and furans
  - Stormwater – metals, PAHs, pesticides…



HISTORY OF SEDIMENT SAMPLING IN CASCO BAY

1991/1994 sediment sampling

- PAHs are most widespread chemicals of concern in Casco Bay
  - Most prevalent near Portland
  - Concentrations exceed screening values
- Concentrations of metals, pesticides, and PCBs are below screening values



ES&T RESEARCH

Sediment Contaminants in Casco Bay, Maine: Inventories, Sources, and Potential for Biological Impact

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An inventory-based approach to environmental assessment that determines concentrations of sedimentary contaminants, defines their origins, and assesses the potential for biological impact is illustrated in Casco Bay, ME. The most widespread contaminants in Casco Bay are petroleum and petroleum byproducts. The highest concentrations of contaminants are associated with population centers, effluent outfalls, and spills. The majority of PAH in sediments are the product of high-temperature combustion processes. PAH concentrations at sites in close proximity to Portland exceed values believed to produce toxic responses in marine benthic organisms. In contrast, PCB, DDTs, and chlordane concentrations in the sediments are below concentrations thought to produce toxic effects in marine organisms. Metal concentrations in sediments are also below those that elicit biological responses. The geographic distribution of contaminants is initially controlled by the proximity to sources, and the regional differences in concentrations are the result of sediment accumulation patterns. Detrital (terrestrial), autochthonous marine, pyrogenic, and petroleum sources for PAH, alkanes, and trace metals are defined.

term accumulator of contaminants, which are probably the main avenue of chronic exposure of the associated ecosystem.

Site Description

Casco Bay is situated along the Atlantic Coast of Maine and is bounded by Cape Small to the northeast and Cape Elizabeth to the southwest (Figure 1). The bay has a wealth of natural resources and marine habitats that support a rich and diverse ecosystem. The bay proper is a 400-km² embayment of the Gulf of Maine which includes Portland Harbor, a major docking facility and the principal fishing port of Maine. More than 300 mi of coastline and nearly 400 islands are encompassed by the bay (*1*).

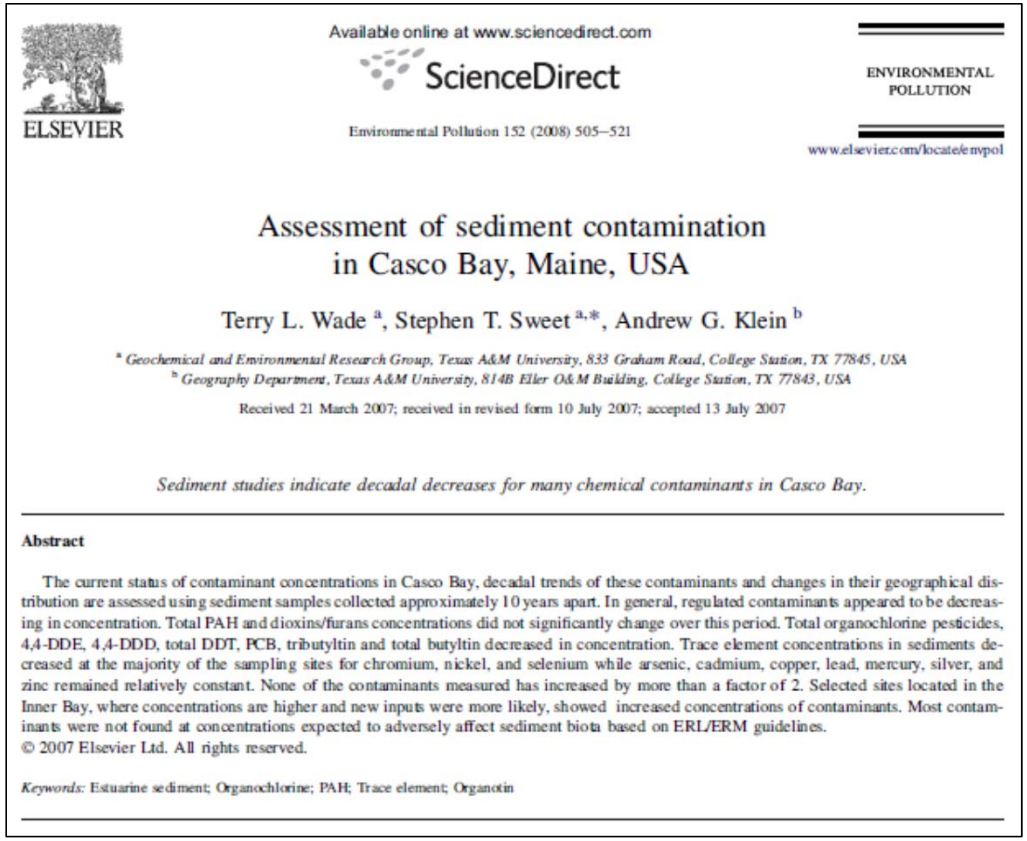
Methods

Sediment samples were analyzed for trace metals, aliphatic and polycyclic aromatic hydrocarbons, pesticides and PCBs (Table 1). Matrix spikes, laboratory sample duplicates, and laboratory blanks were processed with each batch of samples (10–20 samples/batch). Duplicates were produced by subsampling in the laboratory. Standard

HISTORY OF SEDIMENT SAMPLING IN CASCO BAY

Comparison of 1991/1994 with 2000-2002 sediment data

- "Regulated chemicals tend to be decreasing" throughout the bay
  - Pesticides, PCBs, some metals
- PAHs and dioxins and furans not changing
  - Nor are select metals
- Concentrations of PAHs and metals increased locally (i.e., Portland)
- Most chemicals below screening values



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Assessment of sediment contamination in Casco Bay, Maine, USA

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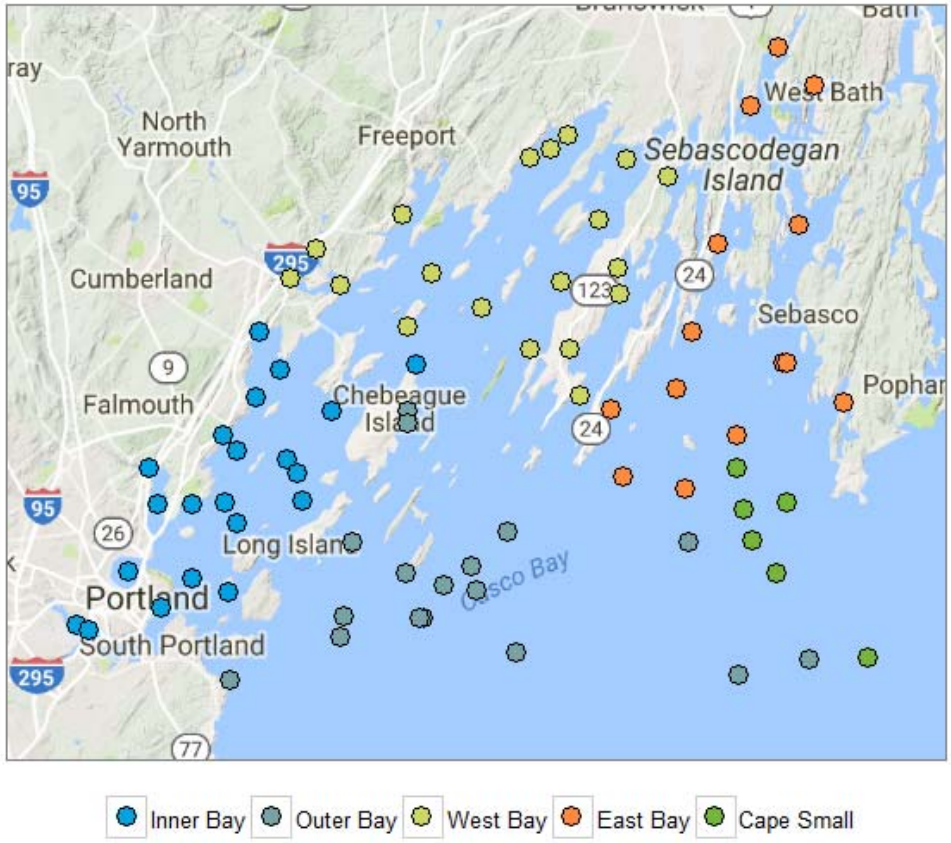
Sediment studies indicate decadal decreases for many chemical contaminants in Casco Bay.

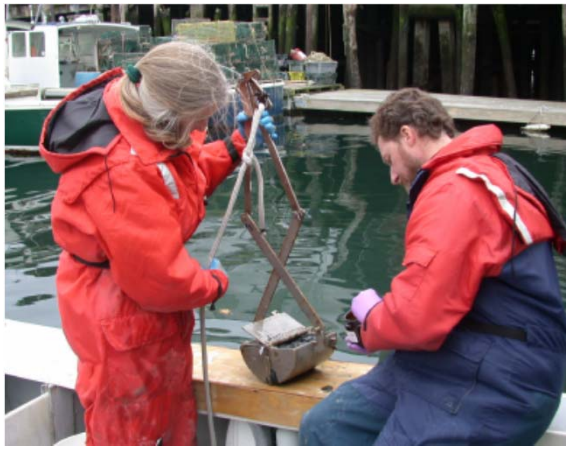
Abstract

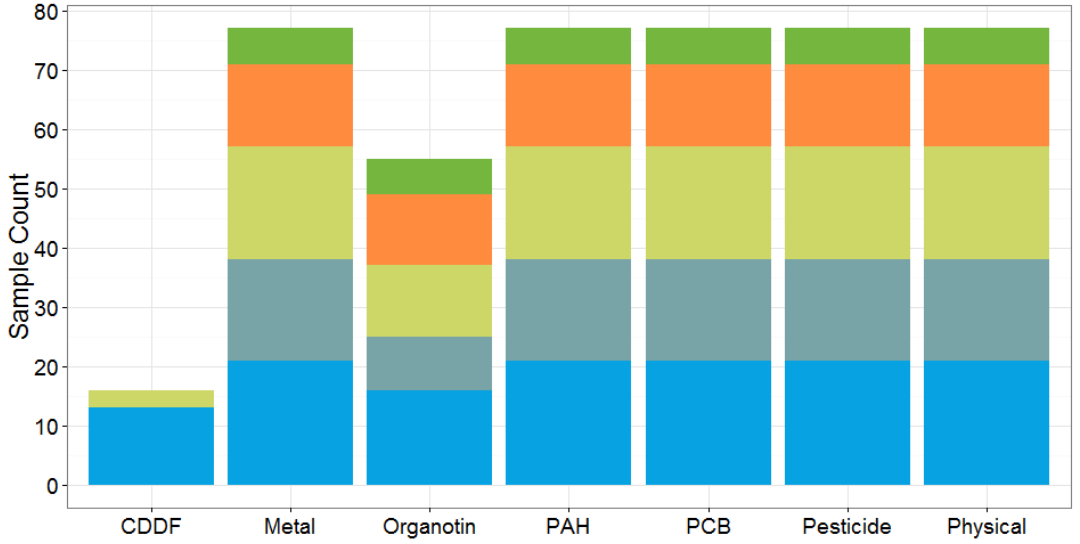
The current status of contaminant concentrations in Casco Bay, decadal trends of these contaminants and changes in their geographical distribution are assessed using sediment samples collected approximately 10 years apart. In general, regulated contaminants appeared to be decreasing in concentration. Total PAH and dioxins/furans concentrations did not significantly change over this period. Total organochlorine pesticides, 4,4-DDE, 4,4-DDD, total DDT, PCB, tributyltin and total butyltin decreased in concentration. Trace element concentrations in sediments decreased at the majority of the sampling sites for chromium, nickel, and selenium while arsenic, cadmium, copper, lead, mercury, silver, and zinc remained relatively constant. None of the contaminants measured has increased by more than a factor of 2. Selected sites located in the Inner Bay, where concentrations are higher and new inputs were more likely, showed increased concentrations of contaminants. Most contaminants were not found at concentrations expected to adversely affect sediment biota based on ERL/ERM guidelines.

Keywords: Estuarine sediment; Organochlorine; PAH; Trace element; Organotin

METHODOLOGY







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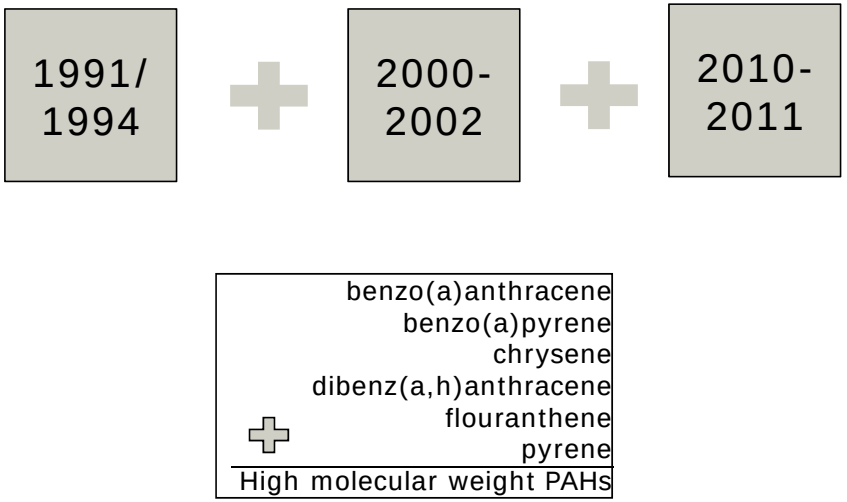
DATA ANALYSIS

- Integrate data, calculate sums



DATA ANALYSIS

- Integrate data, calculate sums
- Calculate summary statistics (baywide and by region)
  - Focusing on detects

Group	Analyte	Units	Frequency of Detection	Minimum Detected Concentration	Median Detected Concentration	Average Detected Concentration	Maximum Detected Concentration	Standard Deviation of Detected Concentration
Inorganic	Aluminum	µg/g dry	77 / 77	6700	47000	50000	90000	19000