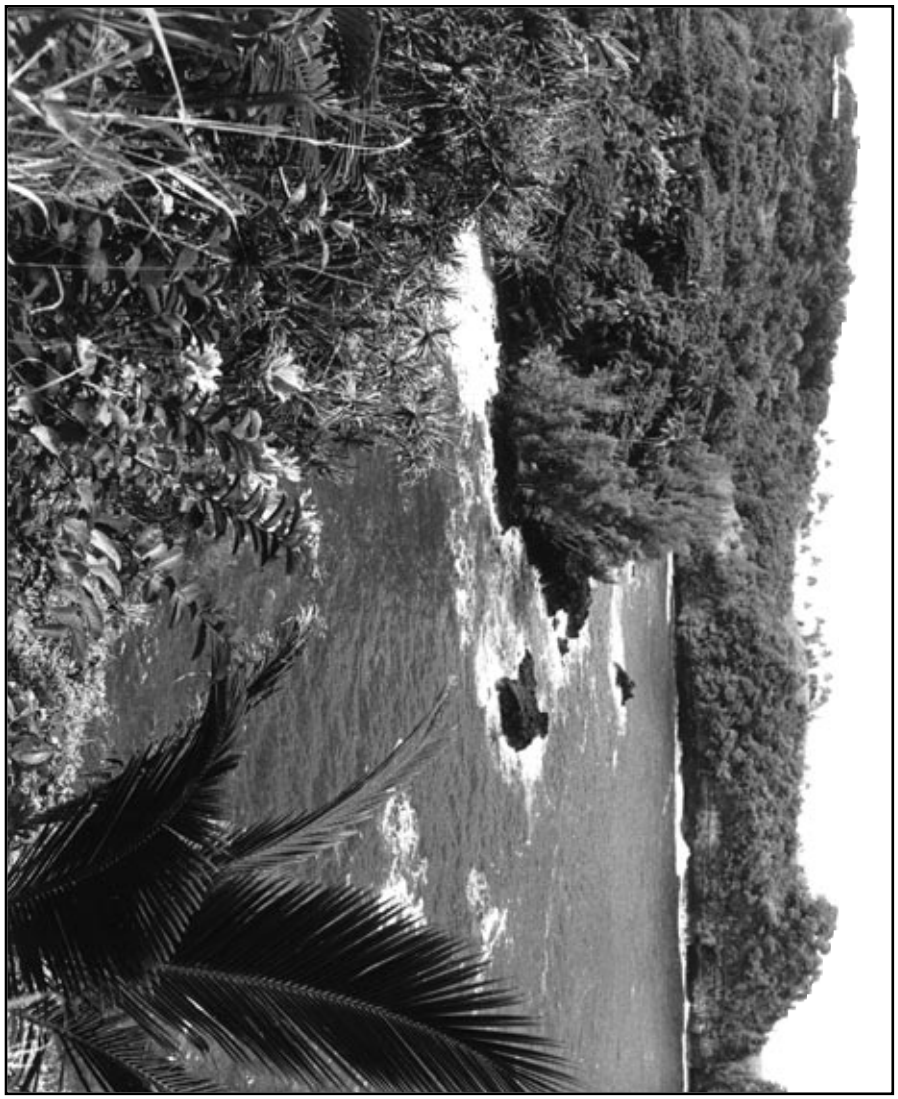
Paul Goetz, Cary, NC



Tidal Estuaries and Ocean Shoreline Waters

Rivers meet the oceans, Gulf of Mexico, and the Great Lakes in coastal waters called estuaries. This chapter describes conditions in tidal estuaries, where tides mix fresh water from rivers with saline water from the oceans and the Gulf of Mexico. Fresh water estuaries around the Great Lakes are discussed in Chapter 12.

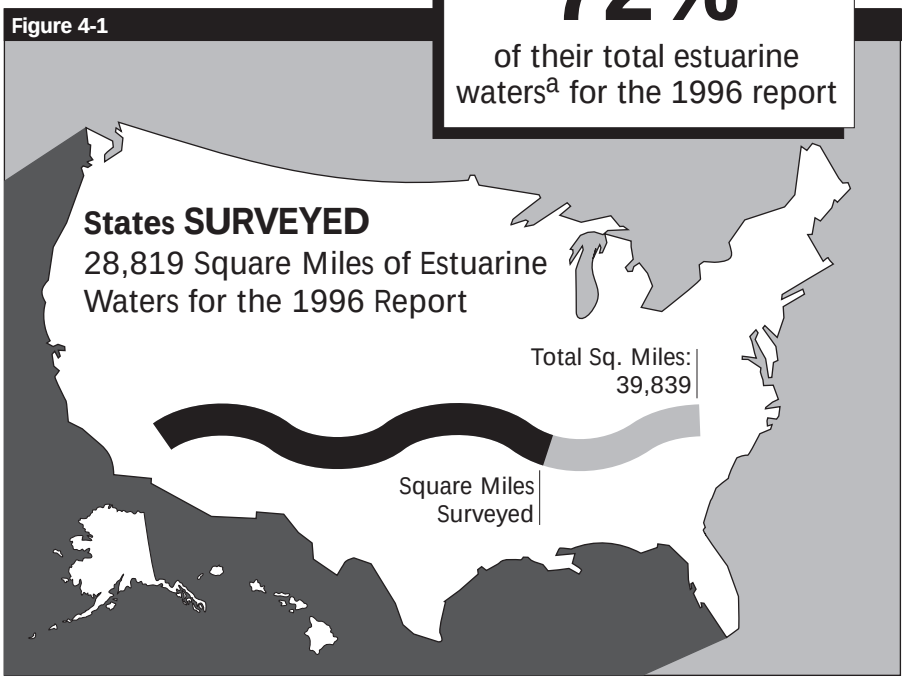
Estuarine waters include bays and tidal rivers that serve as nursery areas for many commercial fish and most shellfish populations, including shrimp, oysters, crabs, and scallops. Most of our Nation's fish and shellfish industry relies on productive estuarine waters and their adjacent wetlands to provide healthy habitat for some stage of fish and shellfish development. Recreational anglers also enjoy harvesting fish that reproduce or feed in estuaries, such as striped bass and flounder.

Estuaries

Twenty-three of the 27 coastal States and other government entities (hereafter collectively referred to as States) rated general water quality conditions in some of their estuarine waters (Appendix C, Table

States SURVEYED 72% of their total estuarine waters[a] for the 1996 report

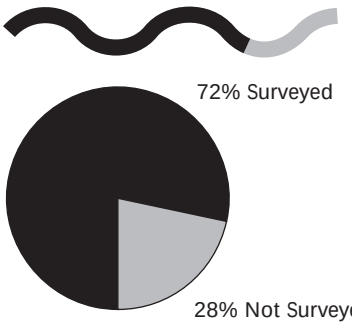
Figure 4-1



Based on data contained in Appendix C, Table C-1.

Estuaries Surveyed by States and Territories

1996 ■ 28,819 square miles = 72% surveyed
■ Total square miles: 39,839[a]



1994 ■ 26,847 square miles = 78% surveyed
■ Total square miles: 34,388[a]

1992 ■ 27,227 square miles = 74% surveyed
■ Total square miles: 36,890[b]

1990 ■ 26,692 square miles = 75% surveyed
■ Total square miles: 35,624[c]

[a]Source: 1996 State Section 305(b) reports.
[b]Source: 1994 State Section 305(b) reports.
[c]Source: 1992 State Section 305(b) reports.
[d]Source: 1990 State Section 305(b) reports.

62% OF SURVEYED estuaries have good water quality.

C-2, contains individual State data). In addition, Delaware reported individual use support status in estuarine waters but did not summarize general water quality conditions. The EPA used aquatic life use support status to represent general water quality conditions in Delaware's estuarine waters.

Altogether, these States surveyed 28,819 square miles of estuarine waters, which equals 72% of the 39,839 square miles of estuarine waters in the Nation (Figure 4-1). The States based 49% of their survey on monitored data and evaluated 35% of the surveyed estuarine waters with qualitative information (including best professional judgment by water quality managers). The States did not specify whether 16% of the surveyed estuarine waters were monitored or evaluated.

The States constantly revise their survey methods in an effort to improve their accuracy and precision. These changes limit the comparability of summary data presented herein and summary data presented in previous Reports to Congress. Similarly, discrepancies in State survey methods undermine comparisons of estuarine information submitted by individual States. Estuarine data should not be compared among States, which devote varying resources to monitoring biological integrity, water chemistry, and toxic pollutants in fish tissues. The discrepancies in State monitoring and survey methods, rather than actual differences in water quality, often account for the wide range in water quality ratings reported by individual States.

Summary of Use Support

EPA directs the States to rate whether their water quality is good enough to fully support a healthy community of aquatic organisms and human activities such as swimming, fishing, and drinking. The States designate individual estuaries for specific activities, termed "individual designated uses." EPA and the States use the following terminology to rate their water quality:

- **Good/Fully Supporting:** Good water quality supports a diverse community of fish, plants, and aquatic insects, as well as the array of human activities assigned to an estuary by the State.

- **Good/Threatened:** Good water quality currently supports aquatic life and human activities on the estuary, but changes in such features as land use threaten water quality, or data indicate a trend of increasing pollution in the estuary.

- **Fair/Partially Supporting:** Fair water quality supports aquatic communities with fewer species of fish, plants, and aquatic insects, and/or occasional pollution interferes with human activities. For example, runoff during severe thunderstorms may temporarily elevate fecal coliform bacteria densities and indicate that shellfish are not safe to harvest and eat immediately after summer storms.

- **Poor/Not Supporting:** Poor water quality does not support a healthy aquatic community and/or

prevents some human activities on the estuary. For example, estuarine waters may be devoid of fish for short periods each summer because excessive nutrients from runoff initiate algal blooms that deplete oxygen concentrations.

■ **Not Attainable:** The State has performed a use-attainability analysis and demonstrated that use support of one or more designated beneficial uses is not attainable due to one of six specific biological, chemical, physical, or economic/social conditions (see Chapter 1 for additional information).

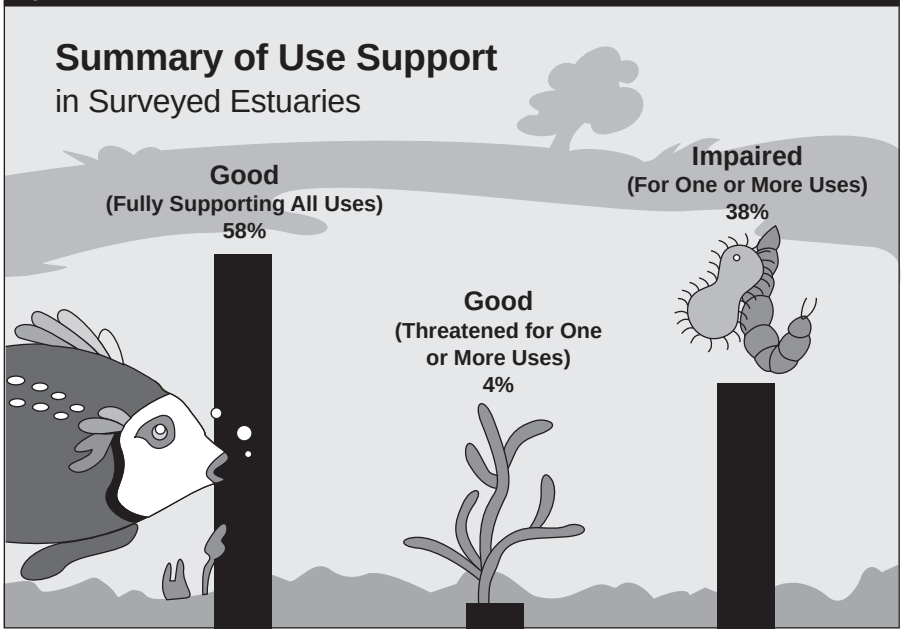
Most States rate how well an estuary supports individual uses (such as swimming and aquatic life) and then consolidate individual use ratings into a summary water quality rating. This table divides estuaries into those fully supporting all of their uses, those fully supporting all uses but threatened for one or more uses, and those impaired for one or more uses (see Chapter 1 for a complete discussion of use support).

The States reported that 62% of the surveyed estuarine waters have good water quality that fully supports designated uses (Figure 4-2). Of these waters, 4% are threatened and might deteriorate if we fail to manage potential sources of pollution. Some form of pollution or habitat degradation impairs the remaining 38% of the surveyed estuarine waters.

Individual Use Support

Individual use support information provides additional detail about water quality problems in our

Figure 4-2



Based on data contained in Appendix C, Table C-2.

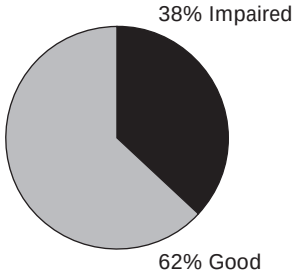
Surveyed Waters

Total estuaries = 39,839 square miles[a]
Total surveyed = 28,819 square miles[b]

Of the surveyed estuarine waters:

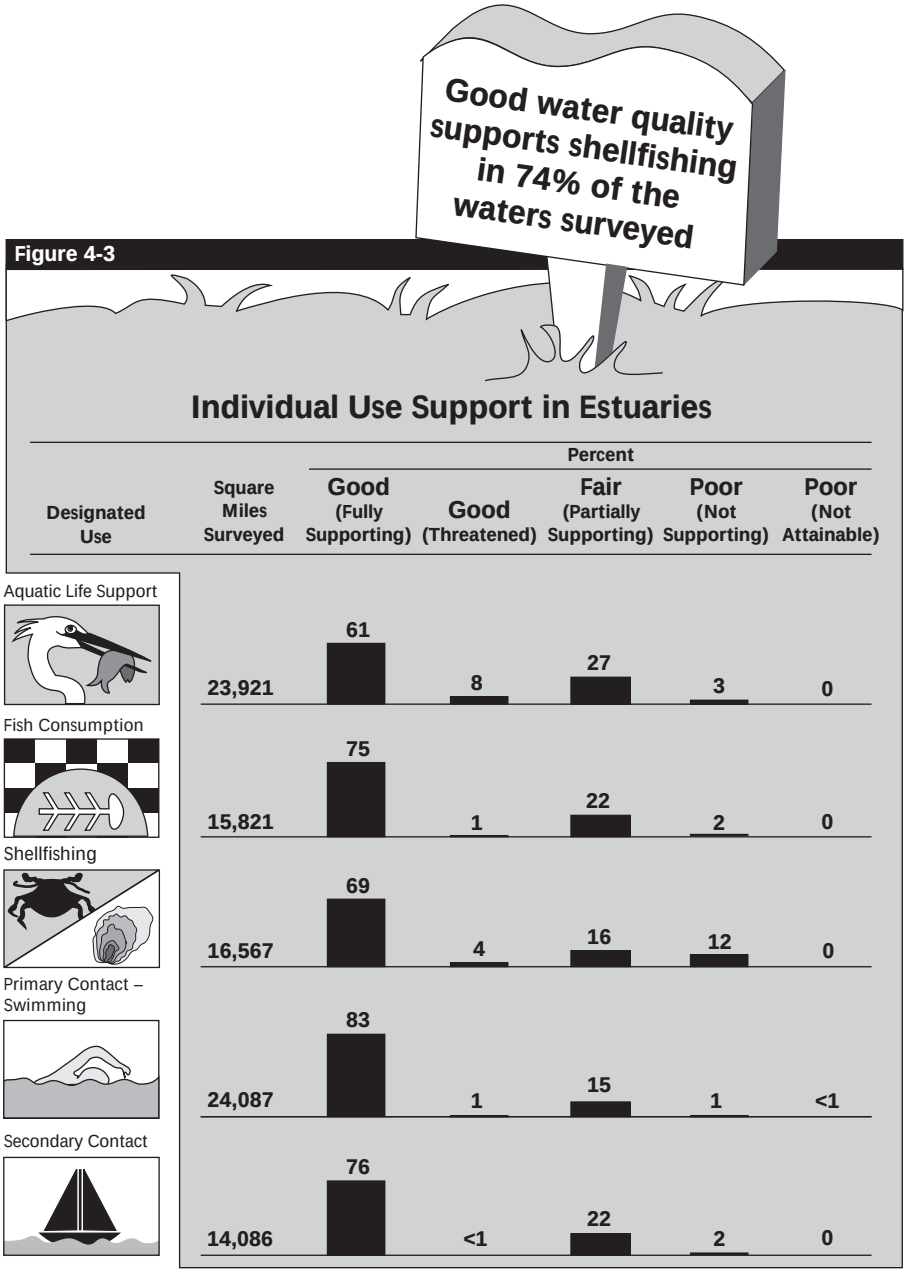
- 49% were monitored
- 35% were evaluated
- 16% were not specified

Surveyed Water Quality



[a]Source: 1996 State Section 305(b) reports.
[b]Does not include square miles assessed as not attainable (<0.1% total estuaries).

Figure 4-3



Based on data contained in Appendix C, Table C-3.

Nation's surface waters. The States are responsible for designating their estuaries for State-specific uses, but EPA requests that the States rate how well their estuaries support five standard uses so that EPA can summarize the State data. The standard uses are aquatic life support, fish consumption, shellfish harvesting, primary contact recreation (such as swimming and diving), and secondary contact recreation (such as boating) (see Chapter 1 for a description of each individual use). Few States designate saline estuarine waters for drinking water supply use and agricultural use because of high treatment costs.

Nineteen States reported the individual use support status of their estuarine waters (see Appendix C, Table C-3, for individual State information). Most often, these States examined aquatic life conditions and swimming use in their estuarine waters (Figure 4-3). The States reported that pollutants impact aquatic life in 7,358 square miles of estuarine waters (31% of the 23,920 square miles surveyed for aquatic life support) and violate shellfish harvesting criteria in 4,509 square miles of estuarine waters (27% of the 15,794 square miles surveyed for shellfishing use support). Pollutants also violate swimming criteria in 3,839 square miles of estuarine waters (16% of the 24,087 square miles surveyed for swimming use support).

Water Quality Problems Identified in Estuaries

Figures 4-4 and 4-5 identify the pollutants and sources of pollutants that impair (i.e., prevent from fully supporting designated uses) the most square miles of estuarine waters, as reported by the States. The two figures are based on the same data (contained in Appendix C, Tables C-4 and C-5), but each figure provides a different perspective on the extent of impairment attributed to individual pollutants and sources. Figure 4-4 shows the relative impact of the leading pollutants and sources in surveyed estuarine waters. Figure 4-5 presents the relative impact of the leading pollutants and sources in estuaries with identified problems (i.e., impaired estuaries), a subset of surveyed estuarine waters.

The following sections describe the leading pollutants and sources of impairment identified in estuaries. It is important to note that the information about pollutants and sources is incomplete because the States cannot identify the pollutant or source of pollutants impairing every estuarine waterbody. In some cases, a State may recognize that water quality does not fully support a designated use, but the State may not have adequate data to document that a specific pollutant or stressor is responsible for the impairment. Sources of impairment are even more difficult to identify than pollutants and stressors.

Pollutants and Processes Impacting Estuaries

Twenty-one States reported the number of estuarine waters impacted by individual pollutants and stressors such as habitat alterations (see Appendix C, Table C-4, for individual State information). EPA ranks the pollutants and stressors by the geographic extent of their impacts on aquatic life and human activities (measured as estuarine square miles impaired by each pollutant or process) rather than actual pollutant loads entering estuaries. This approach targets the pollutants and stressors causing the most harm to aquatic life and public use of our waters, rather than the most abundant pollutants in our estuaries.

Often, more than one pollutant or stressor impacts a single estuarine waterbody. In such cases, the States and other jurisdictions count a single square mile of estuary under each pollutant or stressor category that impacts the estuary. Therefore, the percentages of estuarine waters impaired by all the pollutant and process categories do not add up to 100% in Figures 4-4 and 4-5.

The States identified more square miles of estuarine waters polluted by nutrients than any other pollutant or stressor (Figures 4-4 and 4-5). Eleven States reported that extra nutrients pollute 6,254 square miles of estuarine waters (22% of the surveyed estuarine waters). As in lakes, extra inputs of nutrients destabilize

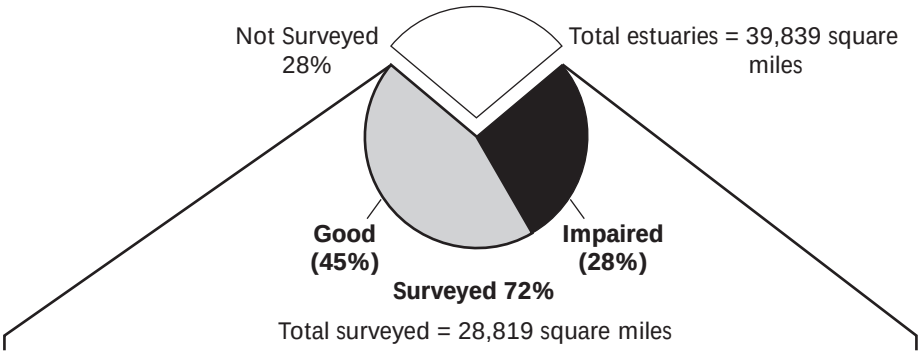
The pollutants/processes and sources shown here may not correspond directly to one another (i.e., the leading pollutant may not originate from the leading source). This may occur for a number of reasons, such as a major pollutant may be released from many minor sources or States may not have the information to determine all the sources of a particular pollutant/stressor.

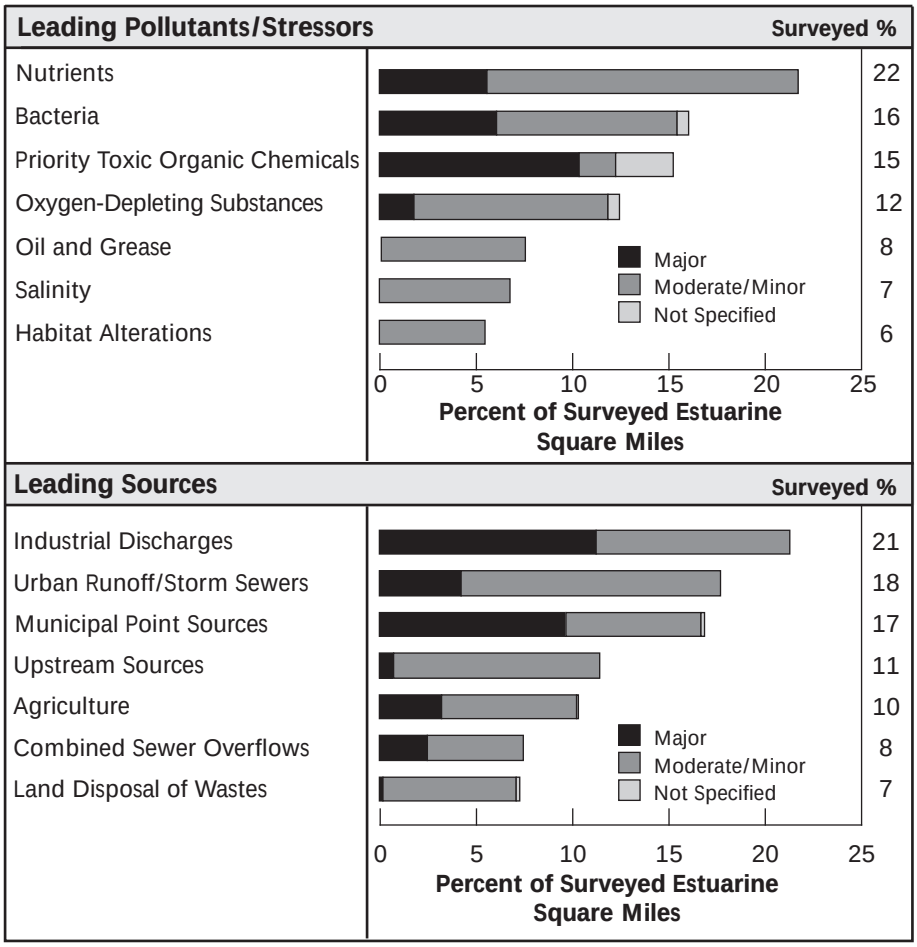
NUTRIENTS are the most common pollutants affecting surveyed estuaries. Nutrients

- are found in 22% of all estuaries surveyed, and
- contribute to 57% of all the water quality problems (see Figure 4-5).

Figure 4-4

SURVEYED Estuaries: Pollutants and Sources



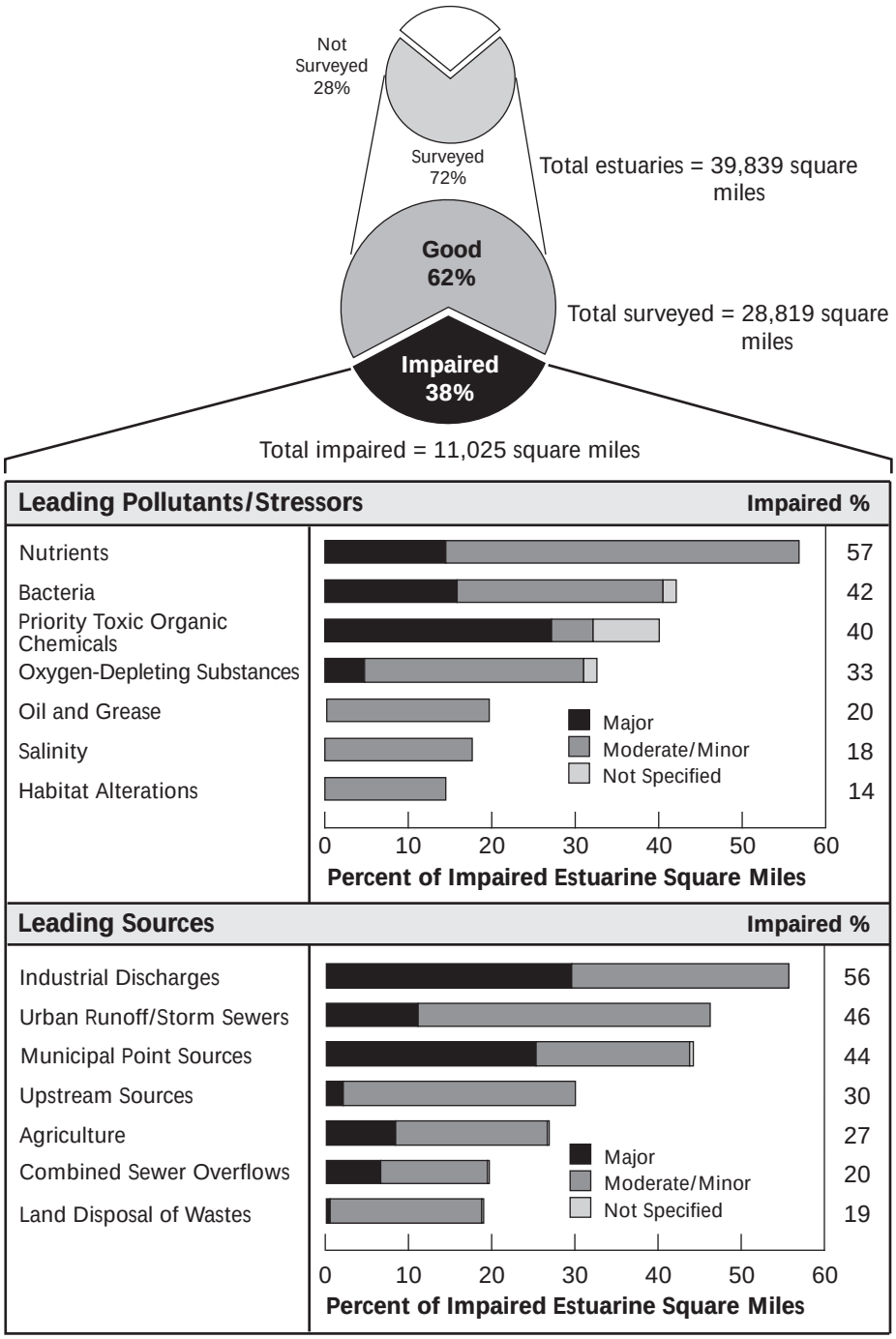


Based on data contained in Appendix C, Tables C-4 and C-5.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair an estuary.

Figure 4-5

IMPAIRED Estuaries: Pollutants and Sources



Based on data contained in Appendix C, Tables C-4 and C-5.

INDUSTRIAL DISCHARGES are the leading source of pollution in surveyed estuaries. According to the States, industrial discharges

- affect 21% of all estuaries surveyed (see Figure 4-4), and
- contribute to 56% of all water quality problems identified.

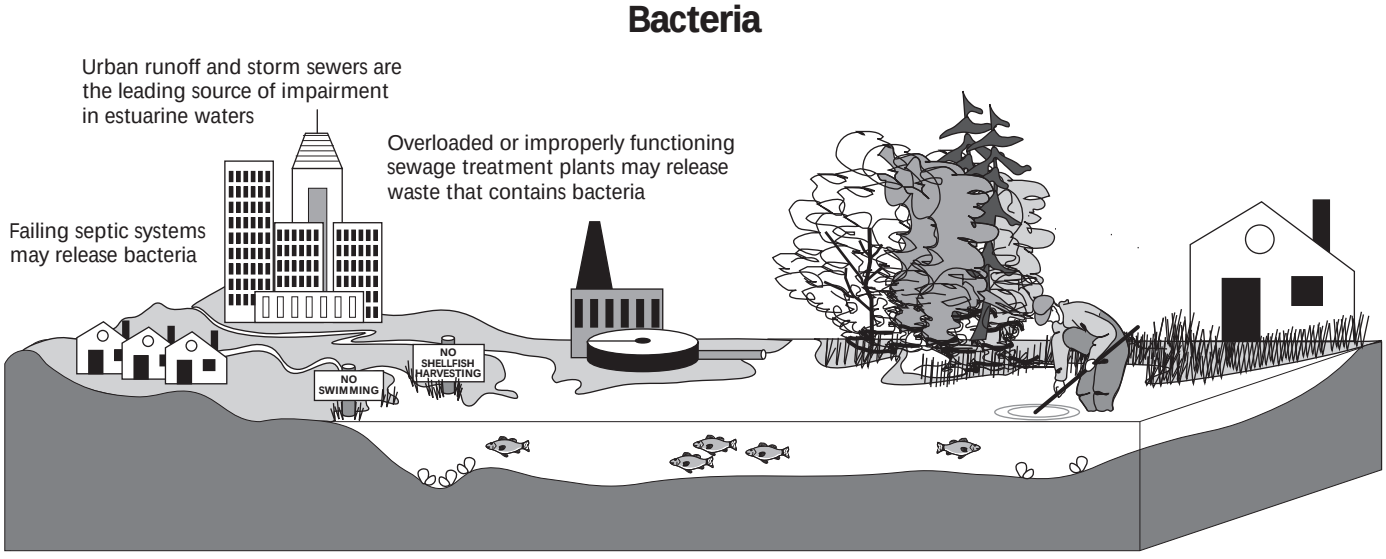
Note: Percentages do not add up to 100% because more than one pollutant or source may impair an estuary.

estuarine ecosystems. When temperature and light conditions are favorable, excessive nutrients stimulate population explosions of undesirable algae. Decomposition of dead algae depletes oxygen, which may trigger fish kills and foul odors. Explosive growth of algal populations can reduce light penetration and inhibit growth of beneficial aquatic plants. Submerged aquatic plants provide critical habitat for desirable shellfish, such as scallops.

Twenty-one States reported that bacteria pollute 4,634 square miles of estuarine waters (16% of the surveyed estuarine waters). Most States monitor harmless bacteria, such as *Escherichia coli*, that inhabit the digestive tracts of humans and other warm-blooded animals and populate sewage in high densities. Such bacteria provide evidence that an estuary is contaminated with sewage that may contain numerous viruses and bacteria that cause illness in people. Most States monitor the indicator bacteria rather than run multiple tests to detect the numerous harmful viruses and bacteria in sewage.

Pathogenic viruses and bacteria seldom impact aquatic organisms such as fish and shellfish. However, shellfish can accumulate bacteria and viruses from contaminated water and cause illness when ingested. Therefore, the Food and Drug Administration and the States restrict the harvest and sale of shellfish grown in waters polluted with indicator bacteria. Bacteria also interfere with recreational activities because some pathogens can be

Figure 4-6



Some bacteria, such as fecal coliforms, provide evidence that an estuary is contaminated with fecal material that may contain pathogenic bacteria and viruses harmful to people. Often, the pathogenic viruses and bacteria do not adversely impact aquatic life such as fish and shellfish. However, shellfish may accumulate bacteria and viruses that cause human diseases when ingested. Therefore, officials restrict shellfish harvesting in contaminated waters to protect public health. Bacteria also impair swimming uses because some pathogenic bacteria and viruses can be transmitted by contact with contaminated water.

transmitted by contact with contaminated water or ingestion during swimming (Figure 4-6).

The States also report that priority organic toxic chemicals pollute 4,398 square miles (15% of the surveyed estuarine waters), oxygen depletion from organic wastes impacts 3,586 square miles (12% of the surveyed estuarine waters), oil and grease pollute 2,170 square miles (8% of the surveyed estuarine waters), salinity, total dissolved solids, and/or chlorides impact 1,944 square miles (7% of the surveyed estuarine waters), and habitat alterations degrade 1,586 square miles (6% of the surveyed estuarine waters). Priority organic toxic chemical pollution and dissolved oxygen depletion are widespread problems reported by more than 15 States. In contrast, only two States (Florida and Louisiana) reported extensive impacts from habitat alterations and oil and grease.

Most States rate pollutants and stressors as major or moderate/minor contributors to impairment. A major pollutant or stressor is solely responsible for an impact or predominates over other pollutants and stressors. A moderate/minor pollutant or stressor is one of multiple pollutants and stressors that degrade aquatic life or interfere with human use of estuarine waters.

The States report that nutrients have a major impact on more estuarine waters than any other pollutant or stressor. The individual State 305(b) reports provide more detailed information about the severity of pollution in specific locations.

Sources of Pollutants Impacting Estuaries

Twenty-one States reported sources of pollution related to human activities that impact some of their estuarine waters (see Appendix C, Table C-5, for individual State information). These States reported that industrial discharges are the most widespread source of pollution in the Nation's surveyed estuarine waters. Pollutants in industrial discharges degrade aquatic life or interfere with public use of 6,144 square miles of estuarine waters (21% of the surveyed estuarine waters) (Figure 4-4).

The States also reported that pollution from urban runoff and storm sewers impacts 5,099 square miles of estuarine waters (18% of the surveyed estuarine waters), municipal sewage treatment plants pollute 4,874 square miles of estuarine waters (17% of the surveyed estuarine waters), upstream sources pollute 3,295 square miles of estuarine waters (11% of the surveyed estuarine waters), agriculture pollutes 2,971 square miles of

Key Management Issues for the National Estuary Programs

ANEP is a newly organized not-for-profit organization whose purpose is to promote responsible stewardship and a common vision for the preservation of our Nation's bays and estuaries.

What are the most common problems facing the 28 estuaries in the National Estuary Program (NEP), and what should the public and decision-makers know about those problems? These questions were the focus of the NEP Key Management Issues Workshop held in San Francisco, California, February 26-28, 1997. Cosponsored by EPA and the Association of National Estuary Programs (ANEP), the purpose of the workshop was to begin a national dialogue to define the key issues and identify themes that should be conveyed in an upcoming *Citizens' Report to the Nation*.

The workshop employed an interactive format, where over 125 representatives from the local NEPs and EPA convened to exchange ideas and experiences concerning issues facing the NEPs. Attendees included NEP directors, scientists, outreach coordinators, citizens, business representatives, local government officials, and EPA Headquarters and Regional managers and staff.

Common Management Issues

Toxic Chemicals

Changing the normal balance of chemical concentrations in an ecosystem can jeopardize the health and reproductive capacity of the organisms in that ecosystem. In the marine environment, toxics of the greatest concern are polycyclic aromatic hydrocarbons (PAHs), toxic metals, polychlorinated biphenols (PCBs), and pesticides. Several classes of toxic chemicals collect in sediments, where bottom-dwelling organisms can be exposed to them and pass the toxicity on through the food web.

NEPs from every region of the United States identified chemicals as an important water quality management issue. A variety of management approaches are being undertaken by NEPs, including promotion of best management practices (BMPs), public education and outreach, wasteload allocations, numerical criteria, and discharge permits.

Alteration of Natural Flow Regimes

Alteration of the natural flow regimes in tributaries can have significant effects on the water quality and health and distribution of living resources in the receiving estuaries. Reduced inflow can reduce the total productivity and economic value of an estuary.

A number of NEPs identified flow alterations as a highly significant issue. The majority of these NEPs were in the Southeast and Gulf and Caribbean regions. Management approaches being undertaken include establishment of minimum flows, promotion of BMPs, wastewater reuse, and promotion of more efficient use of limited water supplies.

Declines in Fish and Wildlife Populations

The distribution and abundance of fish and wildlife depend on factors such as light, turbidity, nutrient availability, temperature, salinity, habitat and food availability, as well as natural and human-induced events that disturb or change environmental conditions.

Most of the NEPs from across all regions identified declines in fish and wildlife as either a high or medium program priority. Management approaches to protect living species include the purchase of ecologically valuable lands, pollutant reduction, habitat restoration, and augmentation of existing populations.

For more information, see the NEP section in Chapter 12.

Pathogens

Pathogens commonly found in marine waters include those causing gastroenteritis, salmonellosis, and hepatitis A. Pathogen contamination, as suspected from indicator organisms, results in the closure of shellfishing areas and bathing beaches.

A majority of NEPs from every region of the United States identified pathogens as a water quality management issue. Management approaches include stormwater runoff and combined sewer overflow mitigation, land use controls for new developments, BMP implementation, reduction of raw or inadequately treated sewage discharges, development of information clearinghouses, septic tank inspections, maintenance of sewer lines, and establishment of "no discharge" zones.

Introduced Species

Intentional or accidental introductions of invasive species may often result in unexpected ecological, economic, and social impacts to the marine environment. These species may now constitute the largest single threat to the biological diversity of the world's coastal waters.

Management approaches include planting of native vegetation, development of regulatory permitting processes for mariculture operations, and public outreach and education.

Nutrient Overloading

Although nutrients occur naturally in animal wastes, soils, and even the atmosphere, land use practices and a growing population have greatly increased the amount of nutrients entering estuaries, resulting in nuisance algal conditions and low dissolved oxygen.

A large number of NEPs from across the United States identified the impacts of nutrient overloading as either a high or medium priority. Management approaches include promotion of BMPs, land use controls, local education and outreach, dissolved oxygen targets, advanced wastewater treatment standards, septic tank replacement, point/nonpoint source trading, and improving riparian buffer areas.

Habitat Loss and Degradation

The continued health and biodiversity of marine and estuarine systems depends on the maintenance of high-quality habitat. The same areas that often attract human development also provide essential food, cover, migratory corridors, and breeding and nursery areas for a broad array of coastal and marine organisms.

A majority of the NEPs in all regions of the United States identified habitat loss and degradation, including reduced or changed submerged aquatic vegetation, habitat alteration, and reduced or degraded wetlands, as a high-priority management issue. Management approaches include habitat restoration and management, wetlands protection, acquisition of ecologically valuable habitat, management of future growth, fisheries management practices, and public education.

Natural Resource Valuation

An understanding of the economic value of natural resources is critical in gaining the support of citizens, industry, and government in the preservation of the natural environment. Natural resource valuation can help demonstrate to local communities the benefits of investments in management actions to sustain or improve the health of the ecosystem.

Many of the NEPs are beginning to collect natural resource valuation information. For example, researchers have estimated that the Tampa Bay estuary supports more than $1 billion in economic benefits to residents, local governments, and businesses through recreational and commercial fishing, boating, wastewater disposal, enhanced property values, savings in shipping costs, and power plant cooling.

Looking to the Future

Although these challenges are being dealt with locally, management approaches have national implications and applicability. Collectively, the NEPs have a significant knowledge base and wealth of experience in dealing with the serious problems that threaten the health of these nationally significant estuaries.

The NEP workshop identified not only solutions, but also some of the obstacles to successful implementation of management actions. The need for long-term commitment, support, and coordination at all levels of government, and strong public participation was identified as a critical component for NEP success in developing and implementing management actions.

For More Information

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State and Federal Partners in Integrated Estuarine Monitoring in the Mid-Atlantic (1997 & 1998)

Background

The Mid-Atlantic Integrated Assessment (MAIA) began as a partnership between EPA's Region 3 and the Office of Research and Development (ORD) Environmental Monitoring and Assessment Program (EMAP) to develop and respond to the best available information on the condition of various ecological resources and to adapt environmental management over time, based on careful monitoring of environmental indicators and related new information. Additional partnerships have been developed with other Federal and State environmental organizations. MAIA has implemented an Assessment Framework that begins by defining realistic environmental goals and related environmental assessment questions. MAIA then strives to answer the assessment questions and to characterize ecological resource conditions based on exposure and effect information.

MAIA is producing assessments at four levels of integration: (1) single resource assessments which determine the status and trends in the condition of individual ecological resources (e.g., estuaries); (2) within-resource associations for a single resource group; (3) determining landscape condition and the associations between resource condition and landscapes; and (4) determining relationships among multiple resources at various spatial scales.

Initial efforts are ongoing for individual resources (e.g., estuaries, surface waters, forests, and agriculture) between the Region, EMAP, other Federal agencies, and States. The *Condition of the Mid-Atlantic Estuaries Report*, written by ORD/Atlantic Ecology Division has been reviewed and is in final production. This report responded to specific assessment questions developed by the MAIA Estuaries Team, which fall into the following broad areas: (1) Is there a problem? (2) Where is the problem located? What is the magnitude, extent, and distribution? (3) What is the cause of the problem? (4) Are things changing? (5) What does it mean to the community? (6) What can we do about it?

The data sources underlying this report were the ORD's Environmental Monitoring and Assessment Program (EMAP) and related monitoring efforts (e.g., Regional-EMAP (REMAP) and other special ORD monitoring efforts in the MAIA

geographic area), State programs on the coastal and estuarine resource area, the Chesapeake Bay Program (CBP) and National Estuary Program (NEP) efforts.

Although the report answers many of the assessment questions, data gaps remained—either because there has not been adequate monitoring in some geographic areas (i.e., additional monitoring is required) or because there are no environmental indicators available to adequately answer the question (i.e., additional research is required).

Development of an Integrated Monitoring Program

In 1997, MAIA began a coordinated monitoring effort of the mid-Atlantic estuaries to respond to the data gaps identified during the development of the *Condition of the Mid-Atlantic Estuaries Report*.

The integrated monitoring program built upon existing monitoring activities conducted by the National Oceanographic and Atmospheric Administration (NOAA), the Chesapeake Bay Program (CBP), the National Park Service (NPS), the Delaware Estuary Program, and the States, using a suite of common core indicators or measurements. Monitoring will be conducted in large estuarine systems, large tidal rivers, and small estuarine systems.

The goal of the integrated estuarine monitoring in MAIA is to assess the environmental condition of large estuarine systems in the Mid-Atlantic such as the Chesapeake Bay and the Delaware Bay including specific attention to their large river components such as the Susquehanna, Potomac, James, and Delaware. The monitoring will assess the condition of smaller estuarine systems as a whole with specific attention to 10 small systems such as Virginia Coastal Bays, Pocomoke River, and Salem River. To reach this goal, existing monitoring programs will be guided, integrated, and leveraged to improve spatial coverage and strengthen their capabilities to assess environmental condition through use of a core list of indicators. Field validation will be conducted of new indicators and the feasibility assessed of merging alternative monitoring designs such as probabilistic (EMAP) and targeted (Chesapeake Bay Program) monitoring programs.

MAIA partners participated fully in the planning and execution of the Integrated Estuarine Monitoring. The partners are:

- EPA, Region 3
  Office of Research and Development, EMAP, Atlantic Ecology Division
  Office of Research and Development, EMAP, Gulf Ecology Division
- Chesapeake Bay Program
- National Oceanographic and Atmospheric Administration
- National Park Service – Assateague Island

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- Delaware River Basin Commission
- Maryland Department of Natural Resources
- Virginia Department of Environmental Quality

Process

The concept of using Integrated Estuarine Monitoring was developed by the joint EPA Region 3/ORD/EMAP Team. Representatives of the various Federal and State monitoring programs participated in a series of workshops in Annapolis, MD, to discuss how to integrate estuarine monitoring efforts. The purpose of integrating monitoring efforts was to better characterize estuaries across the Region and to design a monitoring program that also responded to the information needs at all scales from regional to smaller, local scales. Other issues addressed include how the EMAP design could be linked to regional and intensive sites and whether a core set of indicators can be identified that all groups could agree on.

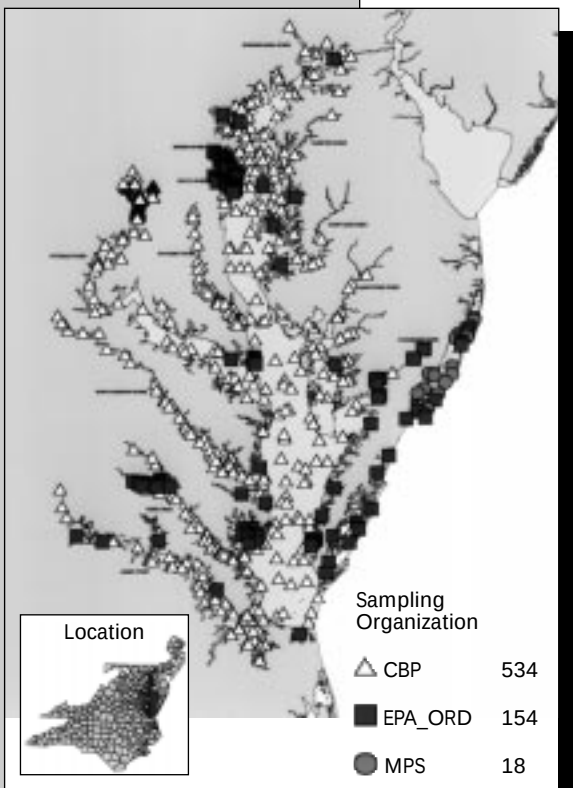

Figure 1. MAIA 1997 Chesapeake Bay Sampling Stations

The programs agreed to work together and to approach integration through the assessment process, not by comparing monitoring designs. Using the draft *Condition of the Mid-Atlantic Estuaries Report* as a starting point, they were able to identify assessment questions that would help characterize the condition of the estuaries. In addition, they identified questions that could not be answered because indicators had not yet been developed or field-verified.

The group agreed to develop a set of core existing indicators that would be monitored by all parties. They determined the ideal set of indicators would cover the food chain, water quality, habitat quality, eutrophication, and chemical contamination.

The ORD Gulf Ecology Division (GED), with input from the partners, developed a comprehensive integrated monitoring design that met the various goals identified. The final design consists of more than 700 stations throughout the mid-Atlantic estuaries (see Figures 1, 2, and 3). The partners agreed to provide summary tables of water quality and sediment monitoring, including methods, maps, outlines, measurements, and schedules and to provide recent summary reports of their own monitoring activities. This information will be compiled by ORD/Atlantic Ecology Division (AED) into a summary overview of the MAIA integrated estuaries monitoring program, which will be put on the EMAP homepage.

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ORD/AED also provided a central Information Management clearinghouse, which includes a directory, catalog, and summary data sets. Formats and file specifications for transmission of summary data, including metadata requirements, were provided to the collaborators in the *MAIA-Estuaries 1997 Data Transfer and Format Manual*.

Using a Core List of Indicators

Selected parameters shown to be key indicators of overall environmental quality are measured by the various monitoring programs. These indicators are quantifiable and clearly related to ecological condition.

The partners developed a list of core indicators. Each partner initially presented the suite of indicators being used in their monitoring program. Detailed discussions about the choice of indicators and the protocols for collection followed. The ultimate result of these discussions was a detailed list of core indicators (see Figure 4) for which all partners would monitor. It was agreed that all partners would monitor these core indicators but could monitor additional indicators as required by their individual program. It was also agreed that, when monitoring for these core indicators, all partners would use the same protocols.

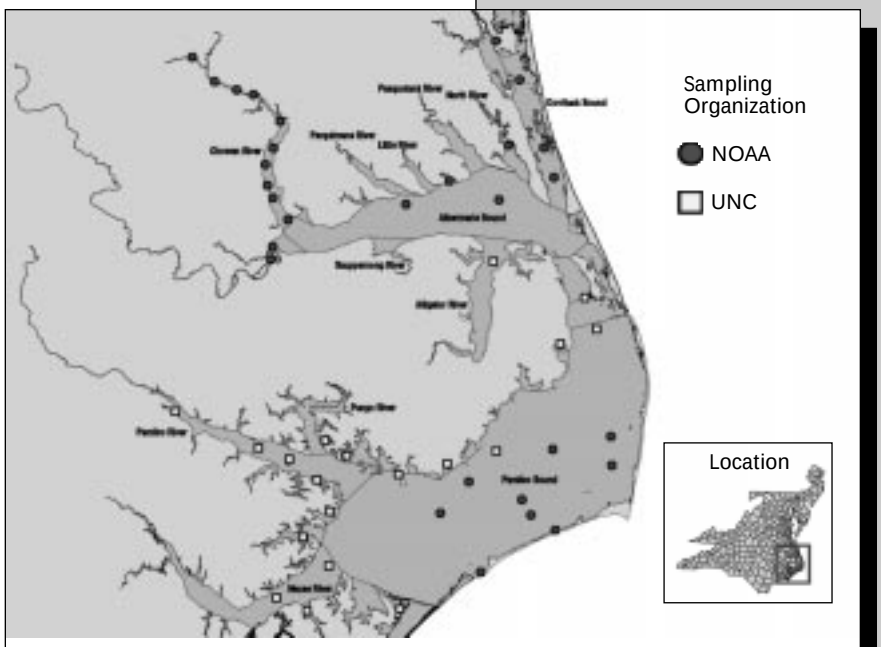

Figure 2. MAIA 1997 Albermarle / Pamlico Sound Sampling Stations

HIGHLIGHT HIGHLIGHT HIGHLIGHT

The partners will be collecting the field data at over 700 sites during July, August, and September of 1997. Data and assessment reports are scheduled to be available in 1998.

For Further Information

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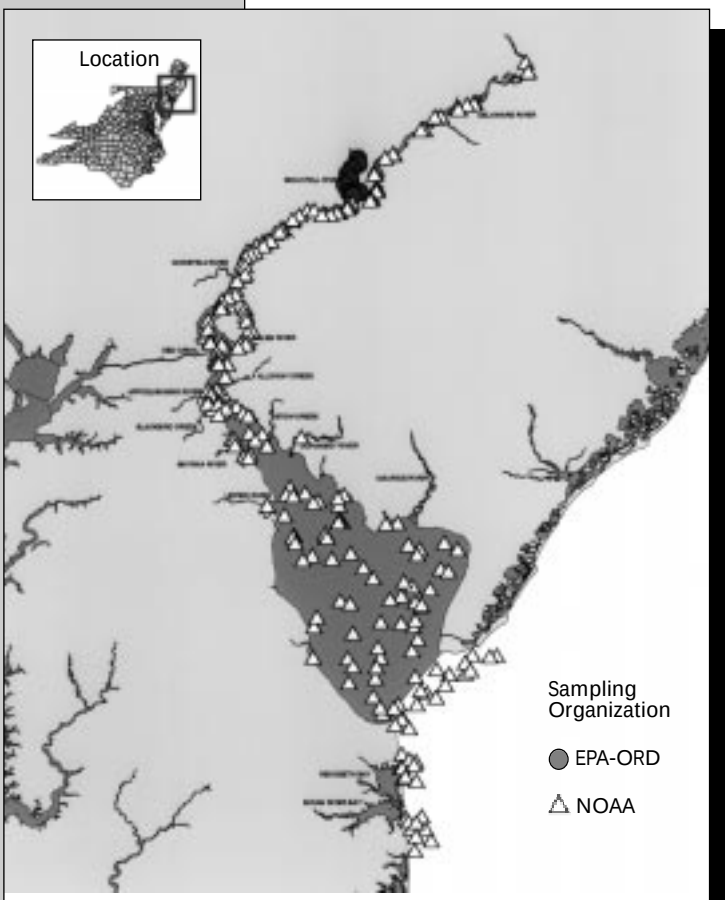


Figure 3. MAIA 1997 Delaware Bay Sampling Stations

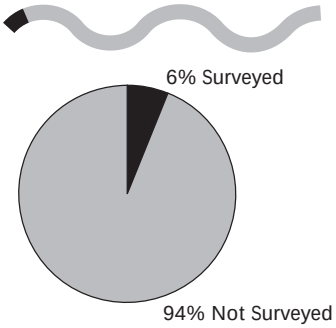
- Location (latitude and longitude)
- Time and Date of Sampling
- Depth of Water Column
- Water Column Measurements
  - Physical measurements (at surface and bottom; water column profiles at some stations): Temperature, Salinity, Dissolved oxygen, pH, Conductivity
  - Water Clarity (Secchi disk or turbidity) (measured once per station)
  - Water Column Chemistry (Chesapeake Bay Program Protocol) (surface and bottom): Dissolved silica (SI), Dissolved ammonia (NH_4), Dissolved nitrite and nitrate (NO_{23}), Dissolved nitrite (NO_2), Particulate organic nitrogen (PON), Total dissolved nitrogen (TDN), Total dissolved phosphorous (TDP), Dissolved orthophosphate (PO_4F), Total particulate phosphorous (PHOSP), Particulate organic carbon (POC), Total suspended solids (TSS), Chlorophyll *a* (CHLA), Pheaophytin (PHEA)
  - Sediment Measurements
    (1) Benthic macroinvertebrates: Species composition and enumeration, Biomass, Silt-clay content (%silt/clay)
    (2) Observational SAV (in conjunction with benthic gap)
    (3) Sediment chemistry (first year only): NOAA NS&T contaminants, acid volatile sulfides (AVS) and simultaneously extractable metals (SEM), silt-clay content (%silt/clay), total organic carbon
    (4) Sediment bioassay (first year only): Pore Water Concentrations of Ammonia and Hydrogen Sulfide, Microtox, Ampelisca, On a subsample of stations (MD initiative)– Leptocheirus plumulosis and Cyprinodon variegatus
  - Fish Measurements (second year only)
    Fish tissue contaminants
    Fish community
    External pathology
    Macrophage aggregates

Figure 4. Core Indicators (EMAP Protocol Unless Otherwise Specified)

Ocean Shoreline Waters Surveyed by States

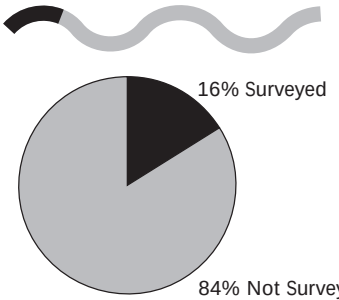
Including Alaska's Ocean Shoreline

1996 ■ 3,651 miles = 6%
Total ocean shoreline miles: 58,585[a]



Excluding Alaska's Ocean Shoreline

1996 ■ 3,651 miles = 16% surveyed
Total ocean shoreline miles: 22,585[a]



Of the surveyed ocean shoreline miles:

- 54% were monitored
- 42% were evaluated
- 4% were not specified

1994 ■ 5,208 miles = 9%
Total ocean shoreline miles: 58,421[b]

1992 ■ 3,398 miles = 17% surveyed
Total ocean shoreline miles: 20,121[c]

1990 ■ 4,230 miles = 22% surveyed
Total ocean shoreline miles: 19,200[d]

[a]Source: 1996 State Section 305(b) reports.
[b]Source: 1994 State Section 305(b) reports.
[c]Source: 1992 State Section 305(b) reports.
[d]Source: 1990 State Section 305(b) reports.
[e]Note: Figures may not add to 100% due to rounding.

estuarine waters (10% of the surveyed estuarine waters), pollution from combined sewer overflows impairs 2,163 square miles of estuarine waters (8% of the surveyed estuarine waters), and land disposal of wastes pollutes 2,093 square miles (7% of the surveyed estuarine waters). Urban sources contribute more to the degradation of estuarine waters than does agriculture because urban centers are located adjacent to most major estuaries. Upstream sources of pollution are sources across State lines or along a river upstream of an estuary.

Ocean Shoreline Waters

Ten of the 27 coastal States and Territories rated general water quality conditions in 3,651 miles of ocean shoreline. The surveyed waters represent 6% of the Nation's coastline (including Alaska's 36,000 miles of coastline), or 16% of the 22,585 miles of national coastline excluding Alaska (see Appendix C, Table C-6, for individual State information). Most of the surveyed waters (3,185 miles, or 87%) have good quality that supports a healthy aquatic community and public activities (Figure 4-7). Of these waters, 315 miles (9% of the surveyed shoreline) are threatened and may deteriorate in the future. Some form of pollution or habitat

Surveyed Water Quality

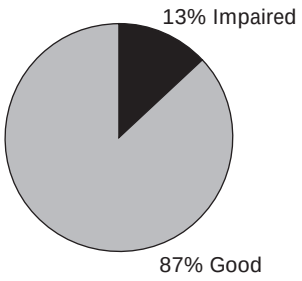
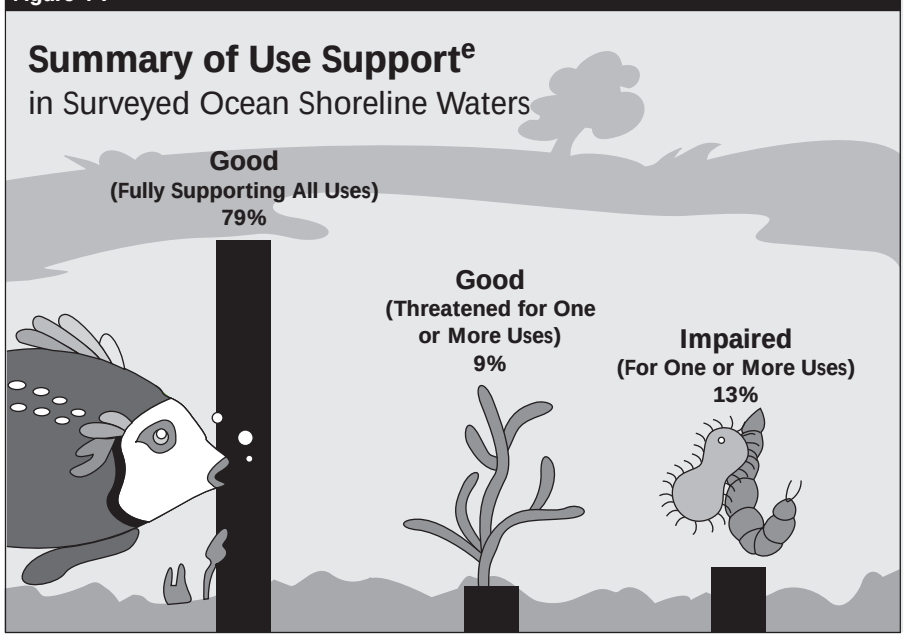


Figure 4-7



Based on data contained in Appendix C, Table C-6.

degradation impairs the remaining 13% of the surveyed shoreline (467 miles).

Individual Use Support

EPA requests that the States rate how well their ocean shoreline waters support five standard uses so that EPA can summarize the State data. The standard uses consist of aquatic life support, fish consumption, shellfish harvesting, primary contact recreation (such as swimming and diving), and secondary contact recreation (such as boating) (see Chapter 1 for a description of each individual use). Few States designate saline ocean waters for drinking water supply use and agricultural use because of high treatment costs.

The States provided limited information on individual use support in ocean shoreline waters (Appendix C, Table C-7, contains individual State information). Eight States rated aquatic life support and nine rated swimming use in their ocean shoreline waters, but fewer States rated their ocean waters for support of shellfishing, fish consumption, and secondary contact recreation. General conclusions cannot be drawn from information representing such a small fraction of the Nation's ocean shoreline waters (Figure 4-8).

Water Quality Problems Identified in Ocean Shoreline Waters

Only six of the 27 coastal States identified pollutants and sources of pollutants degrading ocean shoreline waters (Appendix C, Tables C-8 and C-9, contain individual State information). General conclusions cannot be drawn from this limited

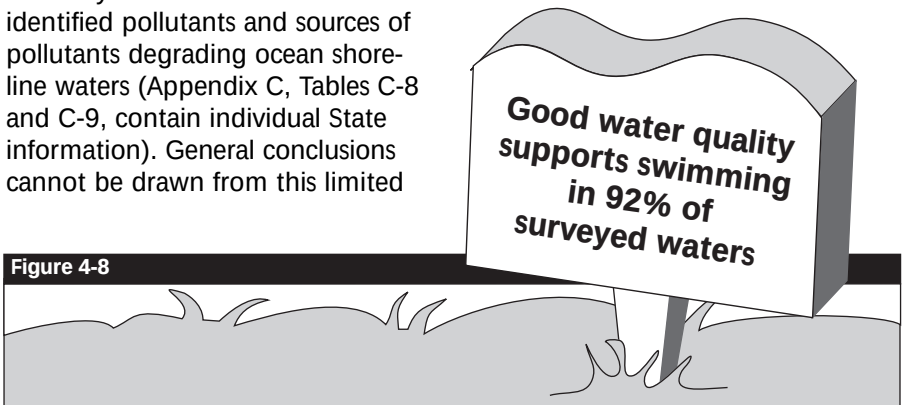


Figure 4-8

Individual Use Support in Ocean Shoreline Waters

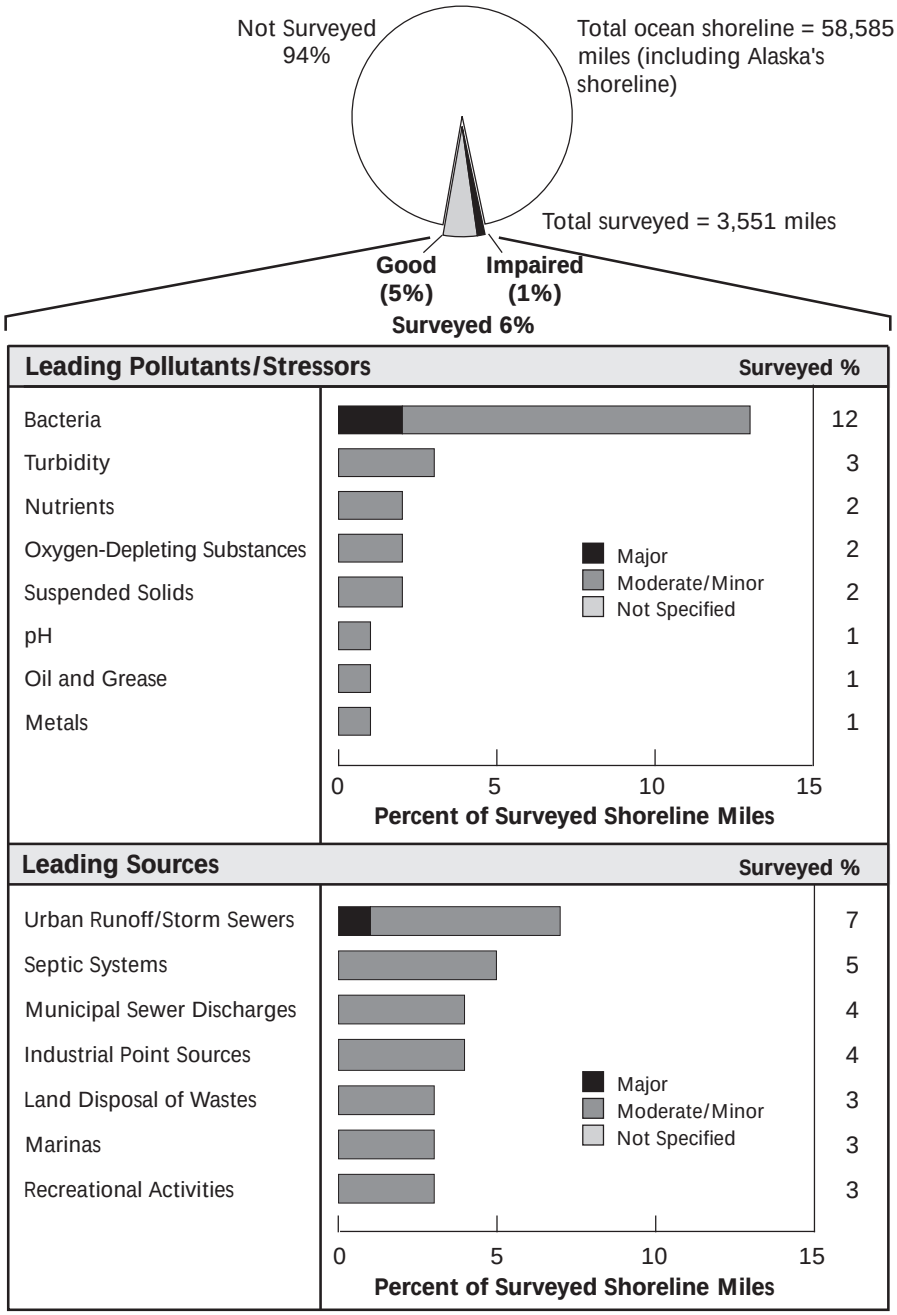
Designated Use	Miles Surveyed	Percent: Good (Fully Supporting)	Good (Threatened)	Fair (Partially Supporting)	Poor (Not Supporting)	Poor (Not Attainable)
	2,385	91	5	3	1	0
Shellfishing	1,178	91	1	5	3	0
Primary Contact – Swimming	1,856	84	5	6	5	0
Secondary Contact	2,594	82	10	5	2	0
	1,704	93	<1	5	2	0

Based on data contained in Appendix C, Table C-7.

The pollutants/processes and sources shown here may not correspond directly to one another (i.e., the leading pollutant may not originate from the leading source). This may occur for a number of reasons, such as a major pollutant may be released from many minor sources or States may not have the information to determine all the sources of a particular pollutant/stressor.

Figure 4-9

SURVEYED Ocean Shoreline: Pollutants and Sources

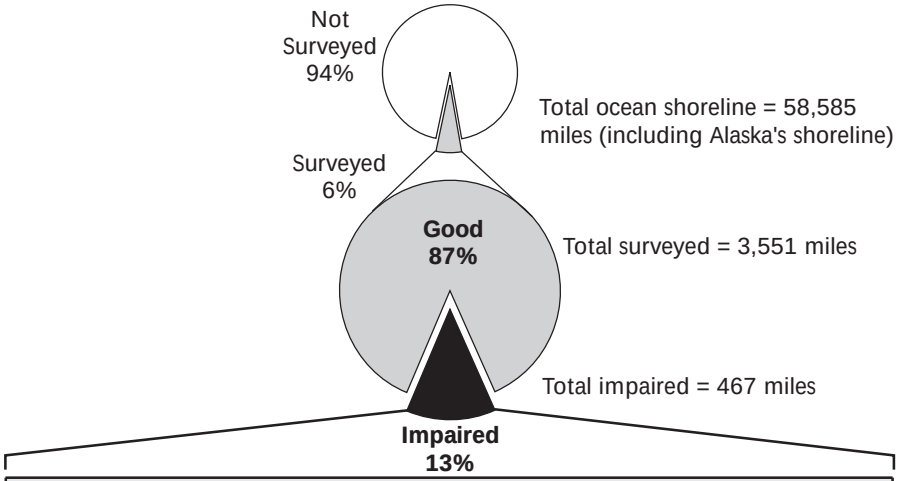


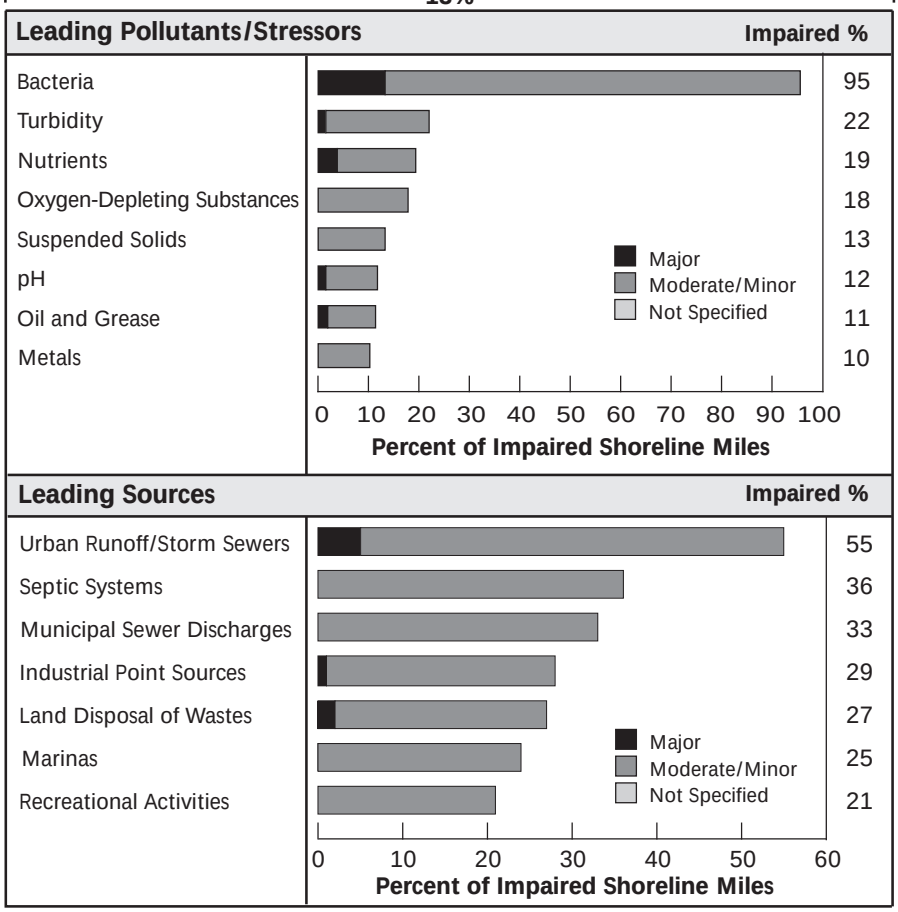
Based on data contained in Appendix C, Tables C-8 and C-9.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a segment of ocean shoreline.

Figure 4-10

IMPAIRED Ocean Shoreline: Pollutants and Sources

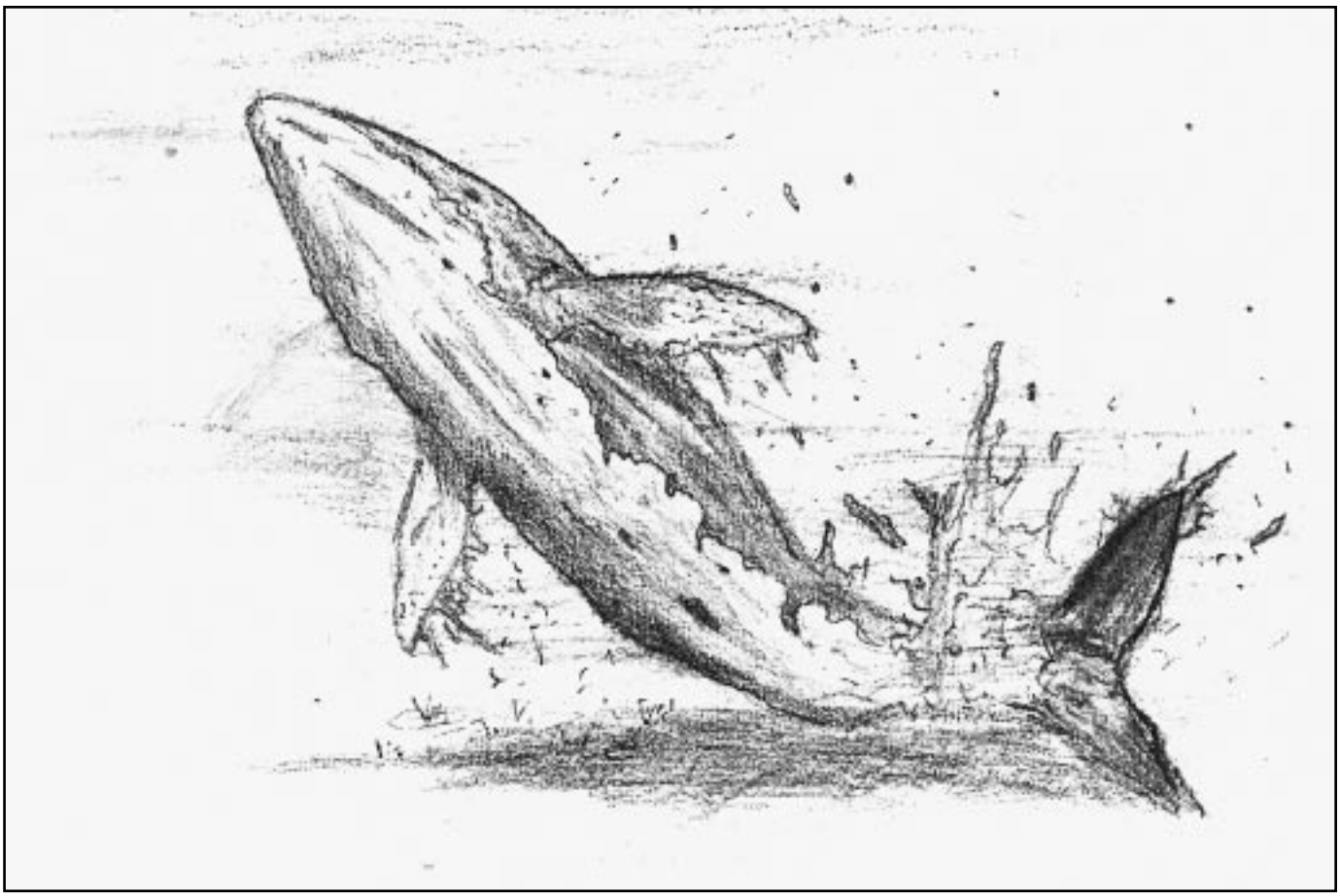




Based on data contained in Appendix C, Tables C-8 and C-9.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a segment of ocean shoreline

source of information. The six States identified impacts in their ocean shoreline waters from bacteria, turbidity, nutrients, oxygen-depleting substances, suspended solids, acidity (pH), oil and grease, and metals (Figures 4-9 and 4-10). The six States reported that urban runoff and storm sewers, septic systems, municipal sewer discharges, industrial discharges, land disposal of wastes, marinas, recreational activities, and spills and illegal dumping pollute their coastal shoreline waters (Figures 4-9 and 4-10).



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