Chapter 1

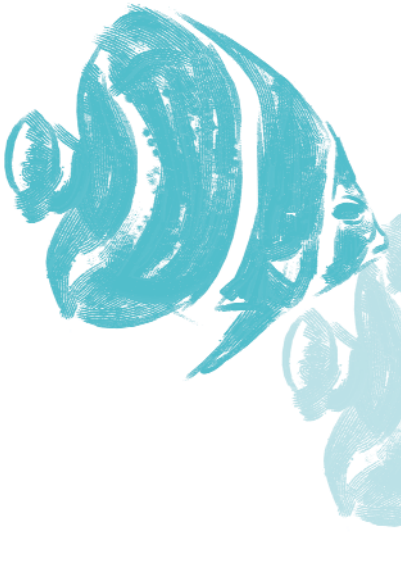
Introduction

The Clean Water Action Plan (U.S. EPA, 1998) is intended to "protect public health and restore our nation's waterways" by setting strong goals and providing states, tribes, communities, and individual land owners with the tools and resources to meet these goals.

Several coast-related action items are recommended in the Action Plan's 111 key actions. This report is designed to fulfill action No. 60, which calls for the development of a comprehensive report to the public on the condition of the nation's coastal waters to be prepared by the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the Department of the Interior (DOI), and the U.S. Department of Agriculture (USDA) in cooperation with other federal agencies, states, and tribes.

The current condition of our nation's coasts can be explored using data provided by several existing coastal programs. For example, EPA's Environmental Monitoring and Assessment Program (EMAP) and NOAA's Status and Trends Program (NS&T) provide data for many indicators of coastal condition for nearly 70% of the estuarine area of the conterminous United States.

Why Are Coastal Waters Important?



Our Nation's Coasts Are Valuable and Productive Natural Ecosystems

Coastal waters are productive and diverse, including estuaries, coastal wetlands, coral reefs, mangrove forests, and upwelling areas. Critical coastal habitats provide spawning grounds, nurseries, shelter, and food for finfish, shellfish, birds, and other wildlife. Our coasts also provide essential nesting, resting, feeding, and breeding habitat for 85% of waterfowl and other migratory birds.

Estuaries are bodies of water that are balanced by freshwater and sediment influx from rivers and the tidal actions of the oceans, thus providing transition zones between the fresh water of a river and the saline environment of the sea. This interaction produces a unique environment that supports wildlife and fisheries and contributes substantially to the economy of coastal areas.

Wetlands are the vegetated interface between the aquatic and terrestrial components of estuarine systems. Wetland habitats are critical to the life cycles of fish, shellfish, migratory birds, and other wildlife, and they help improve surface water quality by filtering residential, agricultural, and industrial wastes. Wetlands also serve to buffer coastal areas against storm and wave damage. Because of their close interface with terrestrial systems, wetlands are vulnerable to land-based sources of pollutant discharges and other human activities.

Female humpback whales and their calves are sometimes accompanied by a single adult male humpback whale, otherwise known as an "escort" whale. This escort protects the female and her calf from other whales and may sometimes attempt to mate with her (Photo: Joseph Mobely - NMFS Permit #810).

More Than Half of the U.S. Population Lives on the Coast

Coastal areas are the most developed areas in the nation. This narrow fringe—only 17% of total contiguous U.S. land area—is home to more than 53% of the nation's population (Figure 1-1). This means that over half of the U.S. population lives in less than one-fifth of its total area (NRC, 2000). Further, this coastal population is increasing by 3,600 people per day, giving a projected total increase of 27 million people between now and 2015. This rate of growth is faster than that for the nation as a whole (Figure 1-2).

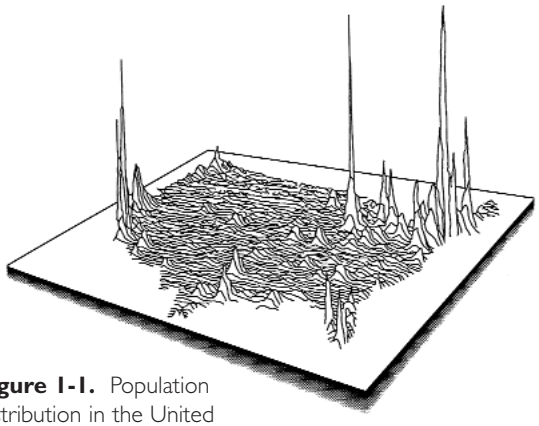


Figure 1-1. Population distribution in the United States (NRC, 1993).

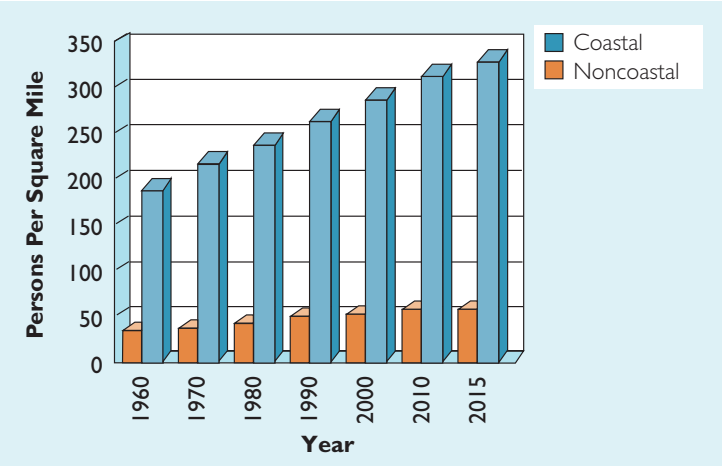


Figure 1-2. Population density from 1960 to 2015 (NOAA, 1998).

Photo: © John Theilgard

In addition to being a popular place to live, the U.S. coasts are a source of many other valuable commodities. Almost 31% of the Gross National Product (GNP) is produced in coastal counties. Almost 85% of commercially harvested fish depend on estuaries and nearby coastal waters at some stage in their life cycle (NRC, 1997). Beaches have become one of the most popular vacation destinations in America, with 180 million people using the coast each year (Cunningham and Walker, 1996). Estuaries supply water, provide a point of discharge for municipalities and industries, and support agriculture, commercial and sport fisheries, and recreational uses such as swimming, diving, and boating.

U.S. coastal waters are the largest economic and environmental zone of the nation in terms of surface area. These valuable coastal resources provide

- Habitat for a wide range of plant and animal species that are essential to the global ecosystem
- Fish and shellfish that support the majority of commercial and recreation fisheries
- Reserves of oil, gas, and other minerals
- Travel ways for coastal and international shipping and maneuvering area for the U.S. Navy
- Outdoor recreational opportunities such as swimming and boating
- A basis for tourism and recreation industries.

(ADEM, 1998)

Why Be Concerned about Coastal Condition?

Because a disproportionate percentage of the nation's population lives in coastal areas, the activities of municipalities, commerce, industry, and tourism have created environmental pressures that threaten the very resources that make the coast desirable. Population pressures include increased solid waste production, higher volumes of urban nonpoint runoff, loss of green space and wildlife habitat, declines in ambient water and sediment quality, and increased demands for wastewater treatment, potable water, and energy supplies.

Development pressures have resulted in substantial physical changes along many areas of the coastal zone. Coastal wetlands continue to be lost to residential and commercial development, while the quantity and timing of freshwater flow, critical to river and estuarine function, continue to be altered.

In 1998, states reported that the leading pollutants/stressors impairing estuaries were

- *Pathogens*
- *Oxygen-depleting substances*
- *Metals*
- *Nutrients*
- *Thermal modifications*
- *PCBs*
- *Priority toxic organic chemicals*

Indicators of Coastal Condition

This report examines several available data sets from different agencies and areas of the country and summarizes them to present a broad baseline picture of the condition of coastal waters. Two different types of data are presented in this report:

- Coastal monitoring data from programs like EMAP and NOAA NS&T that have been analyzed for this report and used to develop indicators of condition
- Assessment and advisory data provided by states or other regulatory agencies and compiled in national databases.

Available coastal monitoring information is presented on a national scale for the conterminous United States; these data are then broken down and analyzed at four geographic levels: Northeast Coast, Southeast Coast, Gulf Coast, and West Coast (Figure 1-3). Chapters presenting

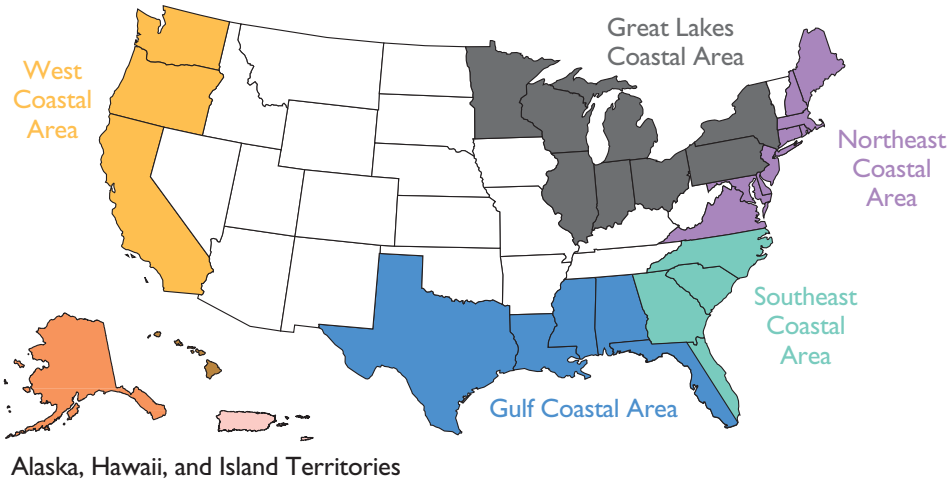


Figure 1-3. Coastal areas presented in the chapters of this report.

available data for Alaska, Hawaii, and Island Territories, as well as the Great Lakes, are also included. The assessment and advisory data are presented at the end of each chapter. Although inconsistencies in the way different agencies collect and provide data to these national programs prevent their use for comparing conditions between coastal areas, the information is valuable in that it helps identify and illuminate some of the causes of coastal impairment and the impacts of these impairments on human uses.

Shortcomings of Available Data

Very little information to support the kind of analysis used in this report (i.e., spatial estimates of condition based on indicators measured consistently across broad regions) exists for estuarine conditions in Alaska. Nearly 75% of the area of all the bays, sounds, and estuarine areas in the United States is located in Alaska, and no national report on estuarine condition can be truly complete without information on the condition of living resources and use attainment of these waters. Similarly, little information to support estimates of conditions based on the indicators used in this report is available for Hawaii and the Caribbean/Pacific commonwealths. Although these latter systems make up only a small portion of the nation's estuarine area, they do represent a unique set of estuarine subsystems (such as coral reefs and tropical bays) that are not located anywhere else in the United States with the exception of the Florida Keys and the Flower Gardens. These unique systems should not be excluded from future national assessments, and plans are already under way for monitoring programs in Alaska, Hawaii, and Puerto Rico.

Attaining consistent reporting in all of the coastal ecosystems in the United States depends on our ability to focus fiscal and intellectual resources on the creation of a national coastal monitoring program. The conceptual framework for such a program is outlined in the National Coastal Research and Monitoring Strategy (www.cleanwater.gov). This Strategy calls for a national program organized at the state level and carried out by a partnership between federal departments and agencies (EPA, NOAA, DOI, and USDA) and state natural resource agencies, as well as with academia and industry. This monitoring program would provide the capability to measure, understand, analyze, and forecast ecological change at national, regional, and local scales. A first step in the development of this type of program was the initiation of EPA's *Coastal 2000* program, a national estuarine monitoring program organized and executed at the state level. However, this program is merely a starting point for what is needed to achieve a comprehensive national coastal monitoring program that can offer a nationwide coastal assessment.

Coastal Monitoring Data

Data from several programs are used to evaluate coastal condition throughout this report. A large percentage of the data come from programs administered by EPA and NOAA. EPA's EMAP provides data on biota (plankton, benthos, and fish) as well as environmental stressors (water quality, sediment quality, and tissue bioaccumulation). NOAA's NS&T provides data on toxic contaminants and their ecological effects. NOAA also conducted the National Estuarine Eutrophication Assessment in the mid-1990s to assess the effects of nutrient concentrations based on existing data and expert opinion. Coastal condition is also evaluated using information from the U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory (NWI). The NWI provides information on the status of the nation's wetlands.

Data from these programs were used to evaluate overall coastal condition with respect to seven primary indicators: water clarity, dissolved oxygen, coastal wetland loss, eutrophic condition, sediment contaminants, benthic condition, and fish tissue contaminants. These indicators were selected because of the availability of relatively consistent data sets for these indicators for most of the country. These indicators do not address all characteristics of estuaries and coastal waters that are valued by society, but they do provide information on both ecological condition and human use of estuaries. In some areas, additional information, such as algae concentration and sediment toxicity data, is also available. These data are also presented where available to help provide an overall picture of the condition of the estuaries.

If multiple programs provided data for the same indicator (e.g., dissolved oxygen), program information that was quantitative was used over qualitative data in the assessment. If multiple sets of quantitative data existed, information based on quantitative field measurements was used over questionnaire data in this assessment.

How the Indicators Are Calculated

Overall condition for each coastal area was calculated by summing the scores for the seven indicators and dividing by 7, where good = 5, fair = 3, and poor = 1. The Gulf Coast, for example, received the following scores:

Indicator	Score
Water Clarity	3
Dissolved Oxygen	5
Coastal Wetland Loss	1
Eutrophic Condition	1
Sediment Contamination	1
Benthic Index	1
Fish Tissue Contaminants	1
Total Score Divided by 7 = Overall Score	13/7 = 1.86

To create the national indicator numbers, a weighted average for each of the seven indicators was calculated. The indicator scores are weighted by the percent area contributed by each geographic area (Figure 1-4). For example, the weighted average for water clarity would be calculated by summing the products of the regional water clarity scores and the area contributed by each region.

Surveying the submerged habitat of Cordell Bank (Photo: Cordell Bank Expeditions).

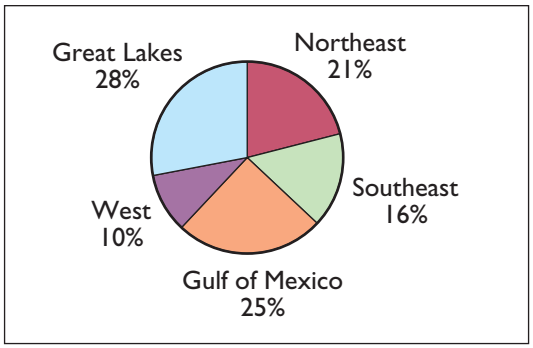


Figure 1-4. Percent estuarine area contributed by each geographic area assessed in this report.

The overall national score was calculated by summing each national indicator score and dividing by seven, similar to the method described in Table 1-1.

Table 1-1. Calculating the Water Clarity Indicator on a National Scale

Coastal Area	Water Clarity Score	Percent of Area Contributed by Region	Product of Score and Percent Area
Northeast	5	21	105
Southeast	4	16	64
Gulf of Mexico	3	25	75
West	5	10	50
Great Lakes	5	28	140
	Sum of Products Divided by Total Area = National Water Clarity Score		4.34/100 = 4.34 (Good)

Characterizing coastal areas using each of the seven indicators involves two value determinations. The first value is the definition of "poor" for an indicator. The definition of poor condition for each indicator is based on existing criteria, guidelines, or interpretation of scientific literature. For example, dissolved oxygen conditions are considered poor if dissolved oxygen concentrations are less than 2 ppm (2 parts of oxygen per million parts of water). This value is widely accepted as representative of hypoxic conditions, so this benchmark for poor condition is strongly supported by scientific evidence (Diaz and Rosenberg, 1995; U.S. EPA, 2000a). The second determination is how widespread a "poor" condition must be to result in a poor rating for an area as measured by the indicator. For example, in order for an area to be rated as poor with regard to the dissolved oxygen indicator, more than 15% of a coastal area must have dissolved oxygen measured at less than 2 ppm. The percent areas used for each indicator are value judgments and were largely determined by informally surveying environmental managers, resource experts, and the knowledgeable public.

Water Clarity

Clear waters are valued by society and contribute to the maintenance of healthy and productive ecosystems. Light penetration into estuarine waters is important for submerged aquatic vegetation, which serves as food and habitat for the resident biota. EMAP-Estuaries (EMAP-E) estimates water clarity using specialized equipment that compares the amount and type of light reaching the water surface to the light at a depth of 1 meter. Water clarity is considered poor if less than 10% of surface light reaches 1 meter. (This is equivalent to being able to see your hand 1 meter from your face under water.) The water clarity data presented throughout the report were collected by the EMAP-E program unless otherwise noted. This measure is used to determine water quality for an area as follows:

Good	Less than 10% of the coastal waters have poor light penetration.
Fair	10% to 25% of the coastal waters have poor light penetration.
Poor	More than 25% of the coastal waters have poor light penetration.

Caution about Indicator Data

Using indicators to compare estuarine conditions throughout the nation can be misleading because the natural state of estuaries varies throughout the nation. For example, estuaries in the Southeast tend to have poor water clarity due to high turbidity that results from naturally high productivity and strong sediment transport and resuspension processes. So the "fair" water clarity rating in southeastern estuaries does not necessarily mean that water quality is poor or degraded.

O_2 Dissolved Oxygen

Dissolved oxygen (DO) is a fundamental requirement for all estuarine life. A threshold concentration of 4 to 5 ppm (5 parts of oxygen per million parts of water) is used by many states to set their water quality standards. Concentrations below approximately 2 ppm are thought to be stressful to many estuarine organisms (Diaz and Rosenberg, 1995; U.S. EPA, 2000a). These low levels most often occur in bottom waters and impact the organisms that live in the sediments. Low levels of oxygen (hypoxia) or lack of oxygen (anoxia) often accompany the onset of severe bacterial degradation, sometimes resulting in the presence of algal scums and noxious odors. However, in some estuaries, low levels of oxygen, at least periodically, are part of the natural ecology. Therefore, while it is easy to show the conditions of the nation's estuaries concerning oxygen concentrations, it is difficult to interpret whether the observed effects are the result of natural processes or human intervention. The DO data presented throughout the report were collected under the EMAP-E program unless otherwise noted. This indicator is used to measure water quality for an area as follows:

Good	Less than 5% of the coastal waters have less than 2 ppm DO.
Fair	5% to 15% of the coastal waters have less than 2 ppm DO.
Poor	More than 15% of the coastal waters have less than 2 ppm DO.

Coastal Wetland Loss

Wetlands are the vegetated interface between aquatic and terrestrial components of estuarine ecosystems. Wetland habitats are critical to the life cycles of fish, shellfish, migratory birds, and other wildlife. These habitats also filter and process residential, agricultural, and industrial wastes, thereby improving surface water quality. Wetland habitats also buffer coastal areas against storm and wave damage. An estimated 95% of commercial fish and 85% of sport fish spend a portion of their life cycles in coastal wetland and estuarine habitats. Adult stocks of commercially harvested shrimp, blue crabs, oysters, and other species throughout the United States are directly related to wetland quality and quantity (Turner and Boesch, 1988). Wetlands throughout the United States have been and are being rapidly destroyed by human activities (e.g., flood control, agriculture, waste disposal, real estate development, shipping, commercial fishing, oil/gas exploration and production) and natural processes (e.g., sea level rise, sediment compaction, droughts, hurricanes, floods).

Data on wetland acreage are available for all coastal states for the 1780s (estimated) and 1980s (surveyed) and for the southeastern and Gulf states for the mid-1970s to mid-1980s. The indicator that has been used to characterize estuarine wetland condition is the percentage change for the 200-year period from 1780 to 1980 and the 10-year period

from the mid-1970s to mid-1980s. The indicator used to measure the condition of coastal wetlands is as follows:

Good	Less than 25% decline in wetland acreage from 1780 to 1980 and/or less than 5% decline from the mid-1970s to mid-1980s.
Fair	Between 25% and 40% decline from 1780 to 1980 and/or between 5% and 10% decline from the mid-1970s to mid-1980s.
Poor	Greater than 40% decline from 1780 to 1980 and/or greater than 10% decline from the mid-1970s to mid-1980s.

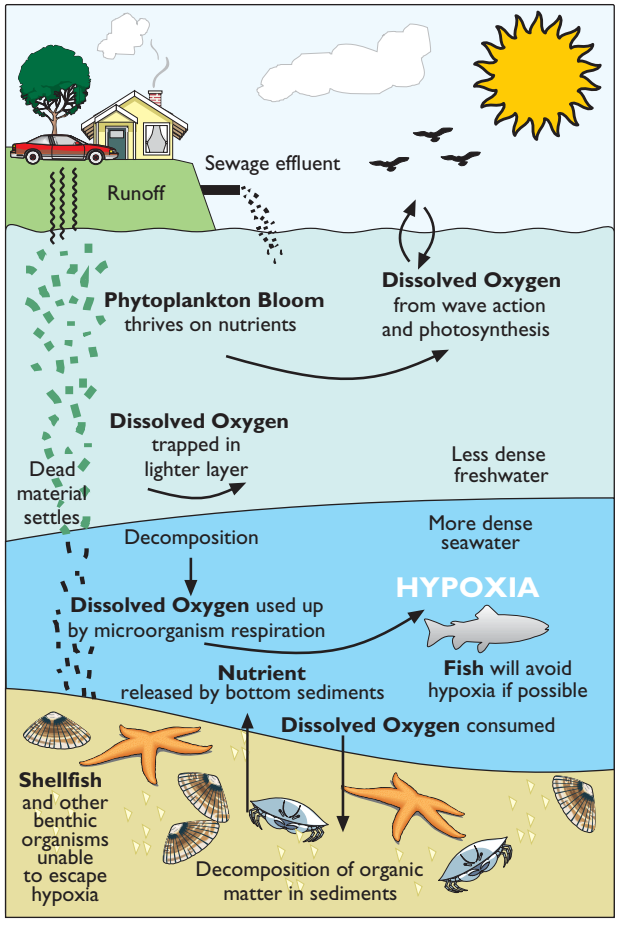


Figure 1-5. Eutrophication is when the concentration of available nutrients increases beyond normal levels.

Eutrophic Condition

Some nutrient inputs to coastal waters are necessary for a healthy, functioning estuarine ecosystem. When nutrients from various sources such as sewage and fertilizers are introduced into an estuary, the concentration of available nutrients will increase beyond natural background levels, resulting in a process called eutrophication, which may result in a host of undesirable conditions (Figure 1-5).

Eutrophication due to the accelerated input of nitrogen and phosphorus can promote a complex array of symptoms such as excessive growth of algae that may lead to other more serious problems. For its National Estuarine Eutrophication Assessment, NOAA developed a system that evaluates several symptoms of eutrophication in an estuary to provide a single categorical value to represent the status of overall eutrophic condition for each estuary (Bricker et al., 1999). This value is the measure of eutrophic condition presented in this report. The primary symptoms examined for this value are chlorophyll *a*, macroalgal abundance, and epiphyte abundance. Secondary symptoms include loss of submerged aquatic vegetation, harmful algae, and low dissolved oxygen. This indicator is used to measure water quality for an area as follows:

Good	Less than 10% of the coastal waters have symptoms indicating a high potential for eutrophication.
Fair	10% to 20% of the coastal waters have symptoms indicating a high potential for eutrophication.
Poor	More than 20% of the coastal waters have symptoms indicating a high potential for eutrophication.

Sediment Contaminants

Evaluation of the potential effects of contaminated sediments on estuarine organisms is difficult because few applicable state or federal regulatory criteria exist to determine "acceptable" sediment concentrations of all substances. Guidelines such as effects range low (ERL) and effects range medium (ERM) values provide environmental managers with benchmarks to determine if contaminated sediments have the potential to affect aquatic organisms adversely. The ERM criterion is the concentration of a contaminant that will result in ecological effects approximately 50% of the time based on literature studies. A more protective indicator of contaminant concentrations is the ERL criterion, which is the concentration of a contaminant that will result in ecological effects about 10% of the time. A poor rating for sediment quality is given to an estuary if the ERM criteria for one or more contaminants are exceeded or if the ERL criteria for five or more contaminants are exceeded. The sediment contaminants data presented throughout the report were collected by the EMAP-E program unless otherwise noted. This indicator is used to measure water quality for an area as follows:

Good	Less than 5% of the coastal waters exceed one ERM criterion or five ERL criteria.
Fair	5% to 15% of the coastal waters exceed one ERM criterion or five ERL criteria.
Poor	More than 15% of the coastal waters exceed one ERM criterion or five ERL criteria.

The ERL/ERM guidelines were first developed by NOAA researchers in 1990 (Long and Morgan, 1990) and further modified and improved over the next 10 years (Long et al., 1995; Long et al., 1998a; and Long et al., 1998b). However, these guidelines are still considered experimental, and several publications have questioned their reliability in assessing sediment toxicity (O'Connor et al., 1998).

Benthic Condition

The worms, clams, and crustaceans that inhabit the bottom substrates of estuaries are collectively called benthic macroinvertebrates or benthos. These organisms play a vital role in maintaining sediment and water quality and are an important food source for bottom-feeding fish, shrimp, ducks, and marsh birds. Benthos are often used as indicators of disturbances in estuarine environments because they are not very mobile and thus cannot avoid environmental problems. Benthic population and community characteristics are sensitive indicators of contaminant and dissolved-oxygen stress, salinity fluctuations, and disturbance and serve as reliable indicators of estuarine environmental quality. EMAP-E developed a benthic index of environmental condition for estuaries that incorporates changes in diversity and populations of indicator species to distinguish degraded benthic habitats from undegraded benthic habitats (Engle and Summers, 1999; Engle et al., 1994; Van Dolah et al., 1999; Weisburg et al., 1997). This index reflects changes in benthic community diversity and the abundance of pollution-tolerant and pollution-sensitive species. A high benthic index rating for benthos means that samples taken from an

estuary's sediments contain a wide variety of species, a low proportion of pollution-tolerant species, and a high proportion of pollution-sensitive species. A low benthic index rating indicates that the benthic communities are less diverse than expected, are populated by more than expected pollution-tolerant species, and contain fewer than expected pollution-sensitive species. The benthic condition data presented throughout the report were collected by the EMAP-E program unless otherwise noted. This indicator is used to measure regional water quality as follows:

Good	Less than 10% of the coastal waters have a low benthic index score.
Fair	10% to 20% of the coastal waters have a low benthic index score.
Poor	More than 20% of the coastal waters have a low benthic index score.

Fish Tissue Contaminants

Chemical contaminants may enter a marine organism in several ways—direct uptake from contaminated water, consumption of contaminated sediment, or consumption of previously contaminated organisms. Once these contaminants enter an organism, they tend to remain in the animal tissues and so may build up with subsequent feedings. When fish consume contaminated organisms, they may "inherit" the levels of contaminants in the organisms they consume. This same "inheritance" of contaminants occurs when humans consume fish with contaminated tissues. Contaminant residues are examined in target fish and shellfish species and are compared to Food and Drug Administration (FDA) criteria, international standards, and EPA Guidance Values. In this report, if more than 10% of fish sampled have tissue residues greater than FDA and international criteria or 20% of fish sampled have tissue residues greater than EPA Guidance Values, then the estuary is determined to be in poor condition. The fish tissue contaminant data presented throughout the report were collected by the EMAP-E program unless otherwise noted. This indicator is used to measure regional water quality as follows:

Good	Less than 2% of the coastal estuaries have significant numbers of contaminated fish (>10% sampled).
Fair	2% to 10% of the coastal estuaries have significant numbers of contaminated fish (>10% sampled).
Poor	More than 10% of the coastal estuaries have significant numbers of contaminated fish (>10% sampled).

The FDA and international criteria have some limitations, as these values were developed to protect the average consumer from contaminated fish and shellfish sold in interstate commerce. These criteria are not intended to be protective of recreational, tribal, ethnic, and subsistence fishers who typically consume larger quantities of fish than the general population and often harvest the fish and shellfish they consume from the same local waterbodies repeatedly over many years. EPA has developed more stringent screening values to protect consumers from contaminants in noncommercial fish (e.g., recreational and subsistence) based on a human health risk assessment methodology (U.S. EPA, 2000b). This EPA methodology is currently used by most states to identify waterbodies where contaminant levels in locally caught fish may pose human health risks and is described in the following Assessment and Advisory Data section under State Fish Consumption Advisories.

Assessment and Advisory Data

The following programs maintain databases that are repositories for information about how well coastal waters support their designated or desired uses. These uses are important factors in public perception of the condition of the coast and also say a lot about the condition of the coast as it relates to public health.

Clean Water Act Section 305(b) and 303(d) Assessments

States report water quality assessment information and water quality impairments under Sections 305(b) and 303(d) of the Clean Water Act. States and tribes rate water quality by comparing data to their state and tribal water quality standards. Water quality standards include narrative and numeric criteria that support specific designated uses and also specify goals to prevent degradation of good quality waters. States and tribes use their numeric criteria to evaluate whether the designated uses assigned to waterbodies are supported. The states then consolidate their more detailed uses into general categories so that EPA can present a summary of state and tribal data. The most common designated uses are

- Aquatic life support
- Drinking water supply
- Recreation, such as swimming, fishing, and boating
- Fish consumption.

After comparing water quality data to the criteria set by water quality standards, states and tribes classify their waters into the following categories:

Fully Supporting	These waters meet applicable water quality standards, both criteria and designated use.
Threatened	These waters currently meet water quality standards, but states are concerned they may degrade in the near future.
Partially Supporting	These waters meet water quality standards most of the time, but exhibit occasional exceedances.
Not Supporting	These waters do not meet water quality standards.

Waters classified as partially supporting or not supporting their uses are categorized as impaired. Section 303(d) of the Clean Water Act requires states to submit a list of these impaired waters. These waters are targeted for Total Maximum Daily Load (TMDL) development. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and an allocation of that amount to the pollutant's sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the state has designated.

The 305(b) assessment data reported by the states are stored in EPA's National Assessment Database (U.S. EPA, 2000d). Impaired waters are reported on state 303(d) lists, and the data are stored in EPA's TMDL Tracking System. These data are useful for analyzing whether or not efforts to improve water quality within a state are successful. Unfortunately, each state monitors water quality parameters differently,

so it is difficult to make generalized statements about the condition of the nation's coasts based on these data alone.

State Fish Consumption Advisories

The 50 states, U.S. territories, and Native American tribes (hereafter referred to as states) have primary responsibility for protecting their residents from the health risks of consuming contaminated noncommercially caught fish and shellfish. (Sale of commercial fish in interstate commerce is regulated by the FDA.) States do this by issuing consumption advisories for the general population, including recreational and subsistence fishers, as well as for sensitive subpopulations (such as pregnant women, nursing mothers, and children). These advisories inform the public that high concentrations of chemical contaminants (such as mercury and polychlorinated biphenyls or PCBs) have been found in local fish and shellfish. The advisories include recommendations to limit or avoid consumption of certain fish and shellfish species from specific waterbodies or, in some cases, from specific waterbody types within a state (e.g., all coastal waters).

The 2000 National Listing of Fish and Wildlife Advisories (NLFWA) is a database—available from EPA—that can be searched on the Internet at http://www.epa.gov/ost/fish. This database contains fish advisory information provided to EPA by the states. The NLFWA database can generate national, regional, and state maps that illustrate any combination of advisory parameters.

Classified Shellfish-Growing Waters

NOAA's National Shellfish Register is published to summarize the status of the shellfish-growing waters around the country (Table 1-2 defines the classifications). Seven Registers have been published since 1966. The 1995 Register characterizes over 4,200 shellfish-growing waters in 21 coastal states, reflecting an assessment of nearly 25 million acres of estuarine and nonestuarine waters. Over 77 million pounds (meat weight) was harvested from these waters in 1995, with a dockside value of $200 million. The 1995 Register data are available on the Internet at http://sposerver.nos.noaa.gov/projects/95register. The 1995 Register will be the last published version. NOAA is currently investing their efforts into making state shellfish advisory data available on-line.

Table 1-2. Classifications for Shellfish-Growing Waters

Approved Waters	Shellfish may be harvested for direct marketing. Fecal coliform median or geometric mean most probable number (MPN) does not exceed 14 per 100 mL, and not more than 10% of samples exceed MPN of 43 per 100 mL for 5-tube decimal dilution test.
Conditionally Approved Waters	Growing waters meet approved classification standards under predictable conditions. Open to harvest when water quality standards are met, but closed at other times. Fecal coliform standards are the same as for Approved.
Restricted Waters	Shellfish may be harvested only if they are relayed or depurated before direct marketing. Fecal coliform median or geometric mean MPN does not exceed 88 per 100 mL, and not more than 10% of the samples exceed MPN of 260 per 100 mL.
Conditionally Restricted Waters	Growing waters do not meet the criteria for restricted waters, but may be harvested if shellfish are subjected to a suitable purification process. Fecal coliform standards same as for Restricted.
Prohibited Waters	Shellfish may not be harvested for marketing under any conditions.
Unclassified Waters	Waters that are part of a state's shellfish program but are inactive, and the state does not conduct any water quality monitoring or maintain a sanitary survey.

Total Maximum Daily Load (TMDL) Program

You can view maps of the nation's 303(d) listed waters and associated impairments at EPA's Total Maximum Daily Load website. You can view local information and download geographic information system (GIS) and database files from this site as well:

http://www.epa.gov/owow/tmdl

The NLFWA database includes information on

- Geographic location of each advisory
- Species and size ranges of fish and shellfish included in each advisory
- Chemical contaminants identified in the advisory
- Geographic extent of advisories in estuaries (square mileage) and coastal areas (miles)
- Population for whom the advisory was issued (general population or subpopulations).

http://www.epa.gov/ost/fish

EPA's BEACH Watch Website

EPA has created a new website called "BEACH Watch" to serve as an online directory of information about the water quality at beaches nationwide and about local protection programs. The website address is

http://www.epa.gov/ost/beaches

Beach Closures

There is growing concern in the United States about public health risks posed by polluted bathing beaches. Scientific evidence documenting the rise of infectious diseases caused by microbial organisms in recreational waters continues to grow. However, there is not enough information currently available to define the extent of beach pollution throughout the country. A primary goal of EPA's Beaches Environmental Assessment, Closure, and Health (BEACH) Program, established in 1997, is to work with state, tribal, and local governments to compile information on beach pollution to define the national extent of the problem.

A few states have comprehensive beach monitoring programs to test the safety of water for swimming. Many other states have only limited beach monitoring programs, and some states have no monitoring programs linked directly to water safety at swimming beaches. What we do know is that beach pollution is a persistent problem, based on the number of beach closings and swimming advisories that continue to be issued annually. In 1999, there were over 1,830 beach closures and advisories in coastal and Great Lakes waters. This represents a substantial increase over previous years, although changes in the number of closures may result from improved monitoring and reporting activities.

Photo: © John Theilgard

Purpose of This Report

The purpose of this report is to present a broad baseline picture of the condition of estuaries across the United States and, where available, snapshots of the condition of offshore waters. This report uses currently available data sets to discuss the condition of the nation's coasts. This report is not intended to be a comprehensive literature review of coastal information. The data sets presented in this report can begin to tell a story about coastal condition. For example, EMAP has monitoring data on a variety of indicators for the Virginian, Louisianian, and Carolinian provinces, which make up 70% of U.S. estuarine acreage. This report will serve as a useful benchmark for analyzing the progress of coastal programs in the future and will be followed in subsequent years by reports for more specialized coastal issues. It will also serve as a reminder of the data gaps and other pitfalls that we are constantly faced with and must try to overcome in the future in order to make more reliable assessments of how the condition of our nation's coastal resources may be changing with time.

This report also highlights several exemplary programs at the federal, state, tribal, and local levels that show coastal conditions at various regional scales. These highlights are not intended to be comprehensive or exhaustive of all coastal programs, but are presented to show that information about the health of coastal systems is being collected for decision-making at these local and regional levels.

NOAA's State of the Coast Report

Assessing the Health of the Nation's Coastal Resources

NOAA's State of the Coast Report is an account of the status of the environmental condition for the nation's coastal areas and resources. The report consists of a series of essays on important coastal issues ranging from population growth to the extent and condition of U.S. coral reefs to efforts to reduce the impacts of coastal hazards. The essays present information from the national, regional, and local perspectives. Each essay also includes the responses and opinions of an expert panel on two key questions relevant to the issue. Essays are currently available for 16 topics.

http://state-of-coast.noaa.gov

The Heinz Center

Designing a Report on the State of the Nation's Ecosystems

Selected Measurements for Croplands, Forests, and Coasts & Oceans

The Heinz Center Report on the State of the Nation's Ecosystems, funded by USDA, DOI, Departments of Defense and Energy, EPA, the National Aeronautics and Space Administration, NOAA, and the National Science Foundation, presents a framework for reporting ecological condition and applies this framework to coasts and oceans. The purpose of the report is to identify and present a suite of measures that can be used to gauge the condition and use of the nation's natural resources. One of the major findings of the report is that national data are available for only about one-third of the measures of condition for coasts and oceans.

http://www.us-ecosystems.org

Federal Programs and Initiatives That Address Coastal Issues

CWAP: Coastal Research and Monitoring Strategy

http://www.cleanwater.gov

The National Coastal Research and Monitoring Strategy was developed to address the lack of nationally consistent data for analyzing the status and trends of coastal conditions. The objectives of the strategy are to

- Document the status and trends in environmental conditions at scales necessary for scientific investigation and policy development
- Evaluate the causes and consequences of changes in environmental status and trends
- Assess environmental, economic, and sociological impacts of alternative policies for dealing with these changes
- Implement programs and policies to correct observed environmental problems.

The key attributes of the proposed Coastal Research and Monitoring Strategy include co-funding by federal and state programs; nested designs that allow state-specific issues to be addressed in a national context; and attention to specific state issues, collective reporting, and cross-system comparisons.

National Coastal Assessment – Coastal 2000

http://www.epa.gov/emfjulte/nca

EPA's National Coastal Assessment (also known as Coastal 2000 or C2000) is a 5-year effort led by EPA's Office of Research and Development to evaluate the assessment methods it has developed to advance the science of ecosystem condition monitoring. This program will survey the condition of the nation's coastal resources (estuaries and offshore waters) by creating an integrated, comprehensive coastal monitoring program among the coastal states to assess the coastal ecological condition.

The strategy for Coastal 2000 focuses on a strategic partnership with NOAA, USGS, and all 24 U.S. coastal states. Using a compatible, probabilistic design and a common set of survey indicators, each state will conduct the survey and assess the condition of its coastal resources independently, yet these estimates can be aggregated to assess conditions at EPA Regional, biogeographical, and national levels. The map in Figure 1-6 shows the states (and Puerto Rico) that are included in the survey, the intended number of sampling sites in each state for 2000-01, and the stage of development of the survey.

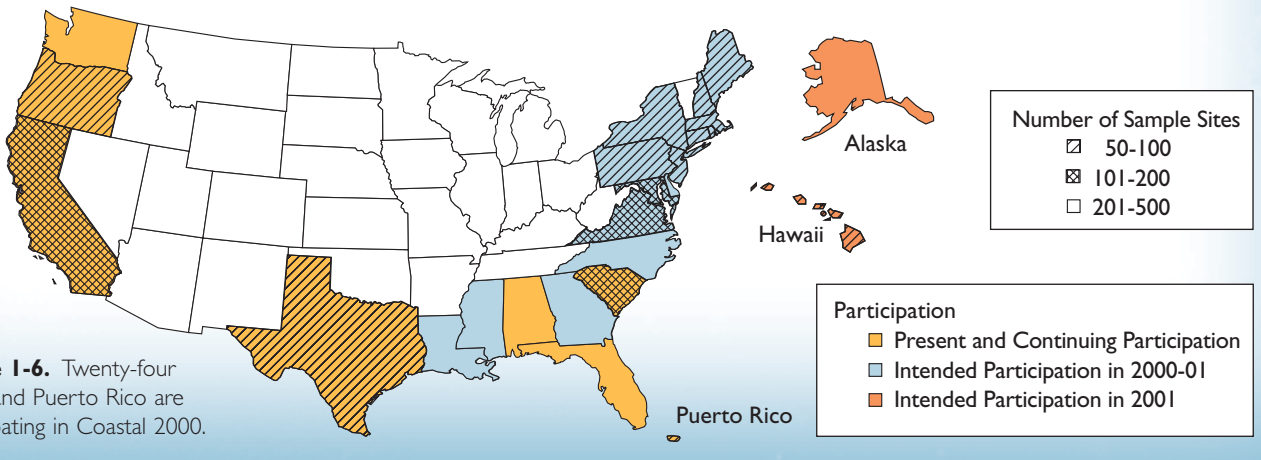


Figure 1-6. Twenty-four states and Puerto Rico are participating in Coastal 2000.

Environmental Monitoring and Assessment Program

http://www.epa.gov/emap

The Environmental Monitoring and Assessment Program (EMAP) conducts annual surveys to measure indicators of the health of plants and animals, the quality of their surroundings, and the presence of pollutants. The program, at present, is developing the appropriate designs and sets of indicator measurements to characterize the condition of the nation's resources. Once these developmental issues are addressed, the goal of the program is long-term monitoring activity that will provide information on the overall health of the environment and the effectiveness of pollution prevention and control measures.

EMAP-Estuaries (EMAP-E), implemented through partnerships between EPA, NOAA, U.S. Geological Survey (USGS), coastal states, and academia, will provide information on the ecological condition of the nation's estuaries as part of this larger program. Ecological health is being assessed by investigating the regional distributions of fish and bottom-dwelling organisms. EMAP-E is determining what portions of estuaries can support these plants and animals and finding out why certain areas do not support them.

The EMAP-E approach places all coastal waters, bays, and estuaries into defined areas for study (Figure 1-7). From 1990 to 1993, EMAP-E investigated the ecological condition of the estuaries of the Middle Atlantic states from Cape Cod, Massachusetts, to Cape Henry, Virginia (Virginian Province), and the estuaries of the Gulf of Mexico from Anclote Anchorage, Florida, to the Rio Grande, Texas (Louisianian Province). EMAP-E conducted provincewide monitoring in the Carolinian province from 1994 to 1995. The estuarine resources in these three provinces represent 70% of the estuarine acreage of the United States. EMAP-E also conducted monitoring of North Carolina's estuaries from 1994 to 1997 and site-specific sampling of the Neuse River during 1998 and 1999.

Figure 1-7. EMAP-Estuaries study areas.

Office of Ocean and Coastal Resource Management • National Ocean Service • National Oceanic and Atmospheric Administration

COASTAL ZONE MANAGEMENT

Coastal Zone Management Program

http://www.ocrm.nos.noaa.gov/czm

The Coastal Zone Management (CZM) Act of 1972 established a voluntary partnership between federal and state governments for management of the coast. The program provides funding through NOAA to coastal states (including the Great Lakes states) and territories (see Figure 1-8) for the development and implementation of measures to conserve and develop coastal resources (NRC, 1997). The CZM program focuses on efforts to protect the nation's coastal zones, assists states in their responsibilities for coastal zone management, develops special area management plans, and encourages the participation and coordination of all public and private stakeholders who affect the coastal zone. States have the flexibility to address their most pressing coastal issues, and many states have supported the revitalization of urban waterfronts and the reuse of waterfront sites impaired by contamination. States develop and implement coastal zone management programs with enforceable policies designed to meet national objectives (NRC, 2000). Over 99.7%, or 95,093 miles, of U.S. shoreline is managed by federally approved state coastal zone management programs (NRC, 2000).

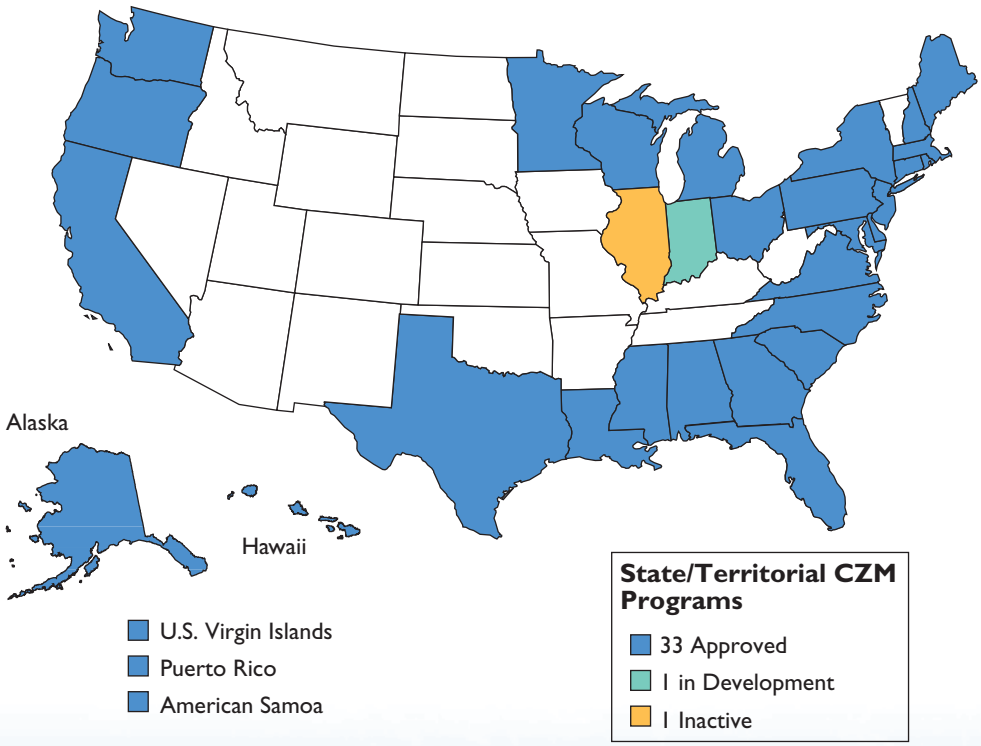


Figure 1-8. Coastal Zone Management Program.

National Marine Sanctuary System

http://www.sanctuaries.nos.noaa.gov

The National Marine Sanctuary (NMS) System, a network of 13 marine protected areas, was established in 1972 in response to public concern over ocean pollution and its impact on marine mammals and ecosystems (Figure 1-9).

National marine sanctuaries embrace part of our collective riches as a nation. Within their protected waters, giant humpback whales breed and calve their young, coral colonies flourish, and shipwrecks tell the story of our maritime history. The Sanctuary System is today administered under the National Ocean Service of the National Oceanic and Atmospheric Administration. The objectives of the NMS System program are to

- Identify and designate areas of special national significance as sanctuaries
- Develop and implement coordinated protection and managements plans for sanctuaries
- Facilitate public and private uses insofar as they are compatible with resource protection
- Support scientific research and public education in sanctuaries (NRC, 1997).

The system's objectives work to conserve, protect, and enhance the biodiversity, ecological integrity, and cultural legacy of our nation's oceans and Great Lakes. Marine sanctuaries contain natural classrooms for students and scientists, cherished recreational spots, and valuable cultural artifacts. National Marine Sanctuaries are committed to protecting American's ocean treasures for this and future generations.

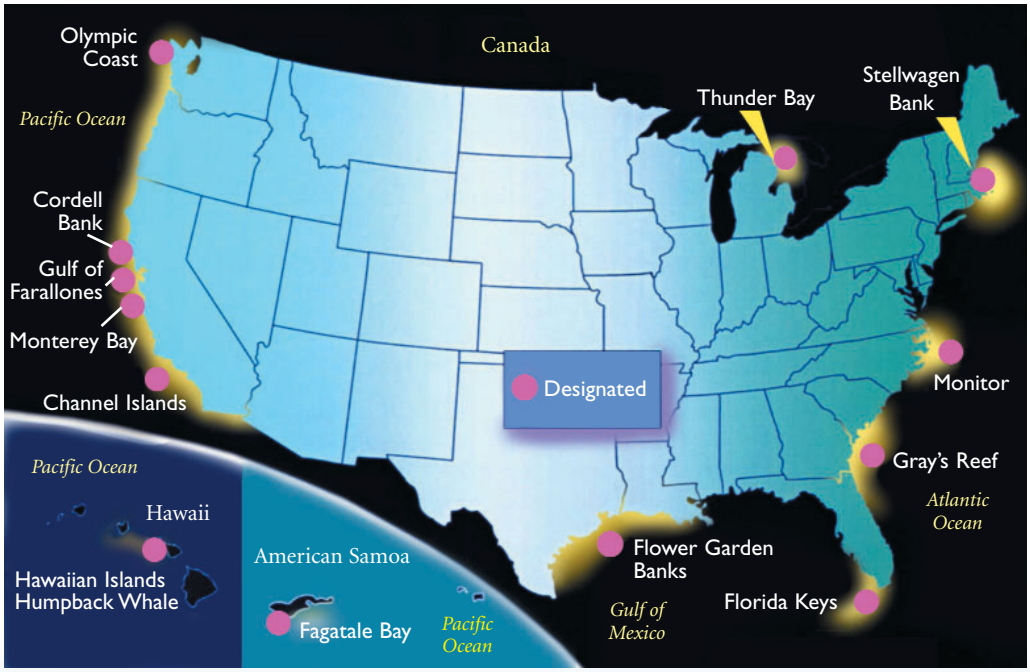


Figure 1-9. National Marine Sanctuaries.

National Estuary Program

http://www.epa.gov/owow/estuaries

The National Estuary Program (NEP) was established under Sections 317 and 320 of the Water Quality Act of 1987 (amendments to the Clean Water Act) to:

- Identify potentially significant estuaries that are threatened by pollution, development, or overuse
- Promote comprehensive planning for, and conservation and management of, nationally significant estuaries
- Encourage the preparation of management plans for estuaries of national significance and enhance the coordination of estuarine research
- Create a monitoring program to evaluate the management plan's effectiveness.

The mission of the NEP is to protect and restore the health of estuaries while supporting economic and recreational activities. To achieve this, EPA designates local NEPs to develop partnerships among the government agencies that oversee estuarine resources and the people who depend on these resources for their livelihood and quality of life. Each NEP brings together officials at the federal, state, and local levels; interest group representatives; the scientific and academic communities; and private citizens to work together as a management conference to develop a Comprehensive Conservation and Management Plan (CCMP). Twenty-eight estuary programs are currently working to safeguard the health of some of our nation's most important coastal waters (Figure 1-10).

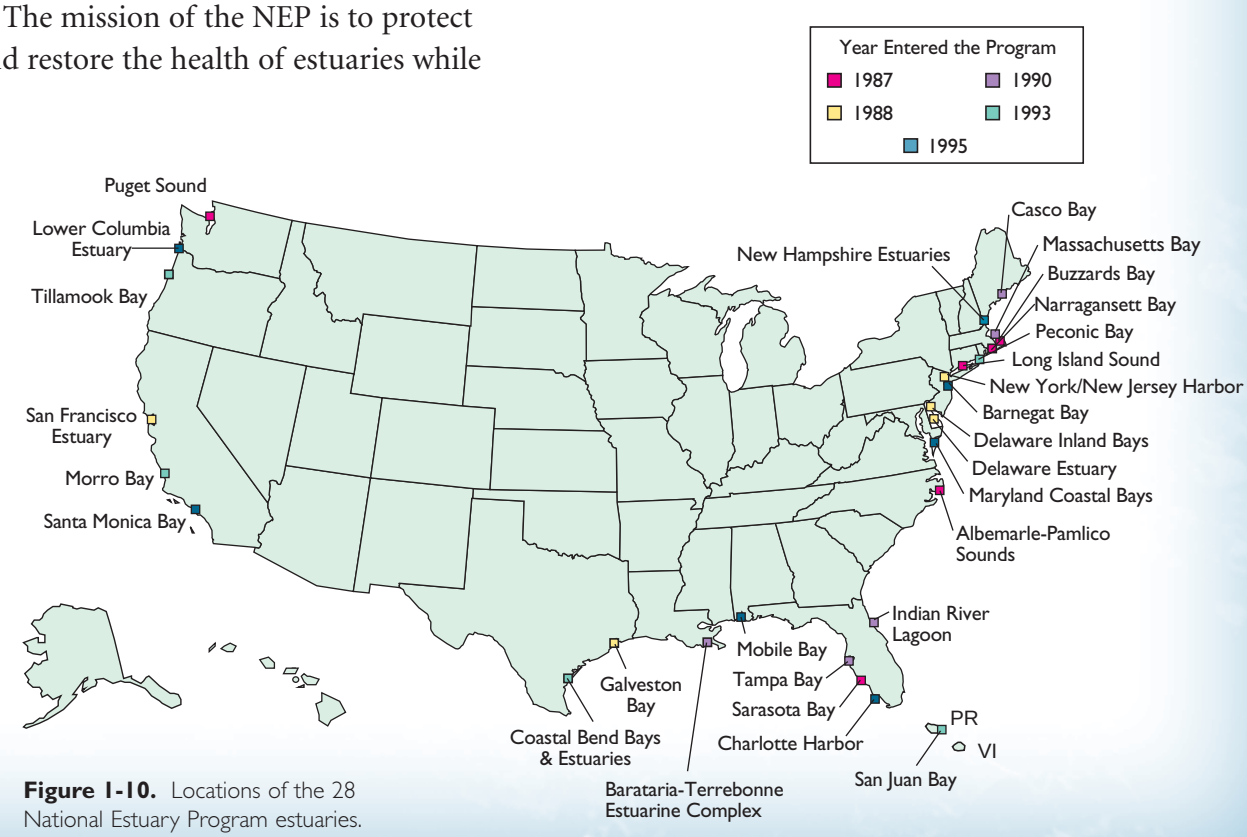


Figure 1-10. Locations of the 28 National Estuary Program estuaries.

NOAA's National Estuarine Research Reserve System

http://inlet.geol.sc.edu/cdmohome.html

The National Estuarine Research Reserve System (NERRS) is a network of protected areas established to develop and provide information that promotes informed resource management (Figure 1-11). The reserve system was created by the Coastal Zone Management Act of 1972. Currently, there are 25 reserves in the system representing the wide range of estuarine and coastal habitats found in the United States.

The reserves implement a System-Wide Monitoring Program (SWMP) to detect physical and biological change in estuaries. The SWMP provides critical information on national estuarine trends and allows flexibility to assess coastal issues of regional or local concern. The SWMP makes onsite research easier and promotes use of the reserves as demonstration sites for new approaches to estuarine management. The SWMP provides valuable long-term data and information to researchers, natural resource program managers, and other coastal decision makers.

The SWMP is an integrated monitoring program that consists of three components (phased in over several years):

- Estuarine water quality monitoring
- Biodiversity monitoring
- Land use and habitat change analysis.

Further details on SWMP and preliminary results are presented in a highlight on page 37 in Chapter 2.

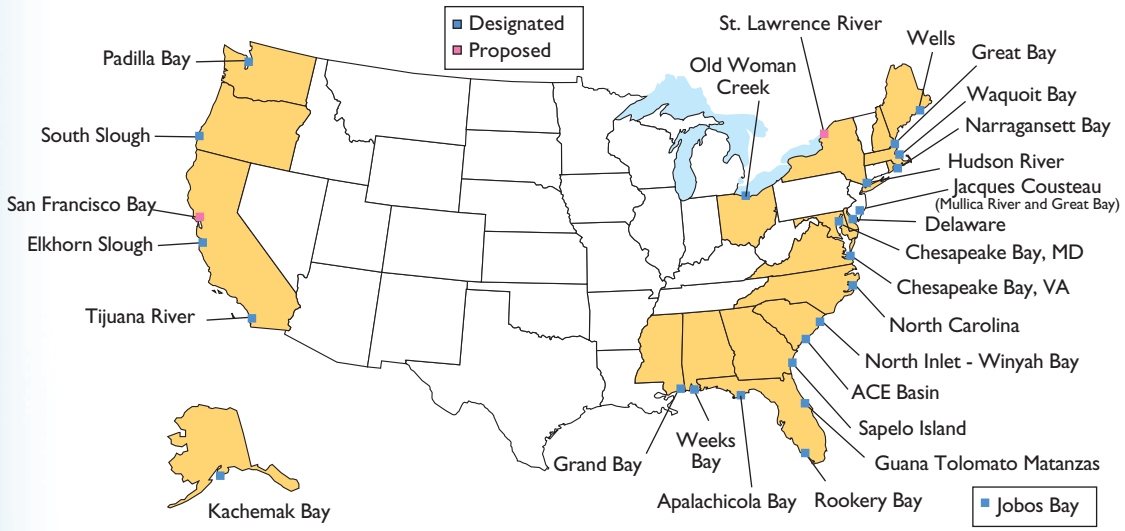


Figure 1-11. Locations of the 25 NERRS sites (NOAA).

NOAA's National Status and Trends (NS&T) Program

http://ccmaserver.nos.noaa.gov/NSandT/New_NSandT.html

In 1984, NOAA initiated the National Status and Trends (NS&T) Program to determine the current status of, and to detect changes in, the environmental quality of our nation's estuarine and coastal waters. NS&T sites are identified in Figure 1-12. The NS&T

- Conducts long-term monitoring of contaminants and other environmental conditions at more than 350 sites along the U.S. coast
- Studies biotic effects intensively at more than 25 coastal ecosystems
- Partners with other agencies in a variety of environmental activities
- Advises and participates in local, regional, national, and international projects related to coastal monitoring and assessment.

The NS&T Program comprises several projects: the Mussel Watch Project, the Quality Assurance Project, the Specimen Banking Project, Sediment Toxicity Surveys, Biomarkers, Environmental Indices, and Regional Assessment. Information from the NS&T Program is synthesized and reported to those responsible for managing coastal natural resources and to the public.

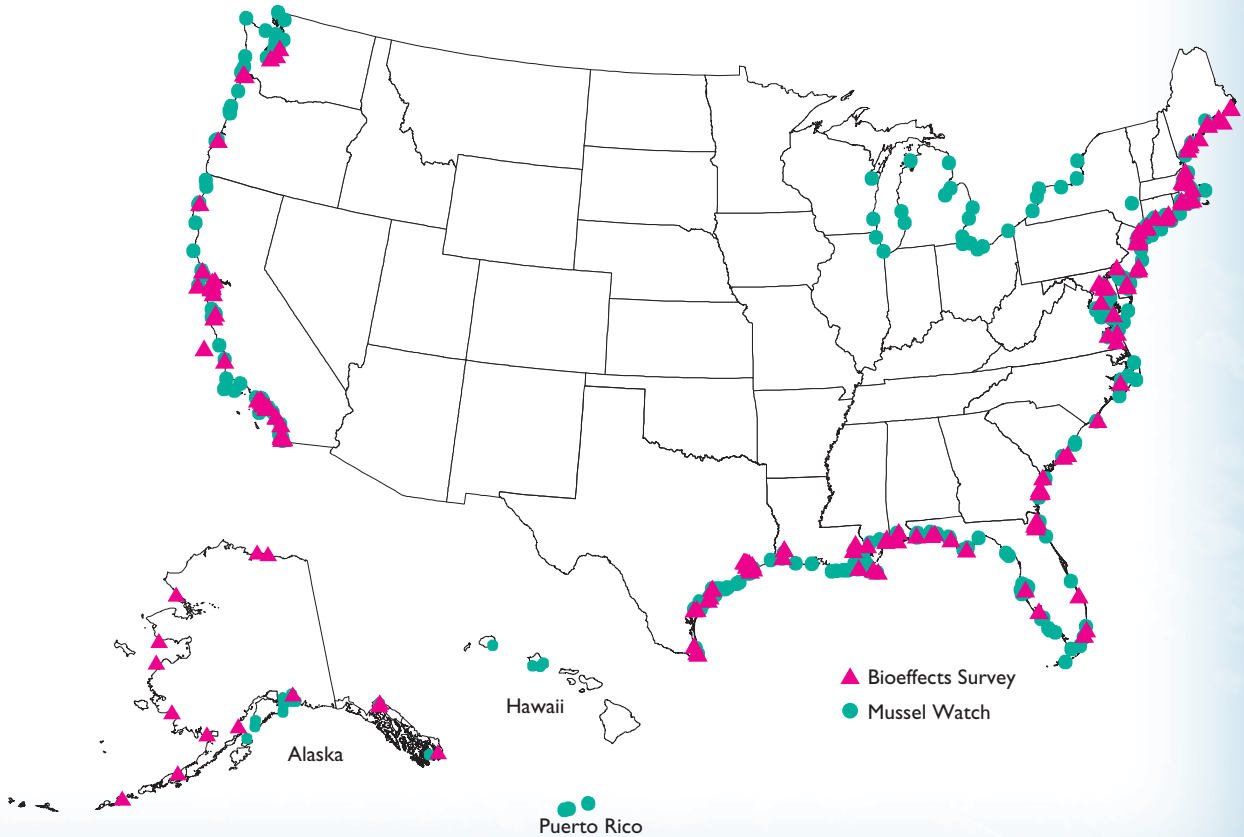


Figure 1-12. NOAA NS&T sites.

NOAA's National Marine Fisheries Service National Habitat Program

http://www.nmfs.noaa.gov/habitat/index.html

The Office of Habitat Conservation, within NOAA's National Marine Fisheries Service (NMFS), together with the five NMFS Regions make up the National Habitat Program. The Program works to manage, conserve, restore, and enhance habitats for fishery resources and protected marine species. Through research and management, the National Habitat Program's primary mandates focus on ensuring that living marine resources have sufficient healthy habitat to sustain populations of fish and shellfish. Those mandates emphasize wetlands, anadromous fish habitat, and habitat of managed fish species and invariably include close partnerships with state and federal agencies, industry, environmental groups, and academia (Figure 1-13).

Since the enactment of the Sustainable Fisheries Act of 1996, the Program has worked with regional fishery management councils in identifying habitats essential to the long-term sustainability of the nation's fishery resources. The identification of this essential fish habitat (EFH) supports the conservation and enhancement of habitat through coordination and consultation with other federal and state agencies that undertake activities affecting EFH. The Program is working to stem the tide of wetland loss in Louisiana, which is beset by the highest rate of coastal wetland loss in the nation. Through its mandated role in the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), the NMFS works to develop and implement habitat projects to restore salt marshes lost to erosion, subsidence, and hydrological alterations. The Program also seeks to restore, replace, or acquire the equivalent of resources injured as a result of discharges of oil or hazardous substances or other human-induced environmental disturbances.

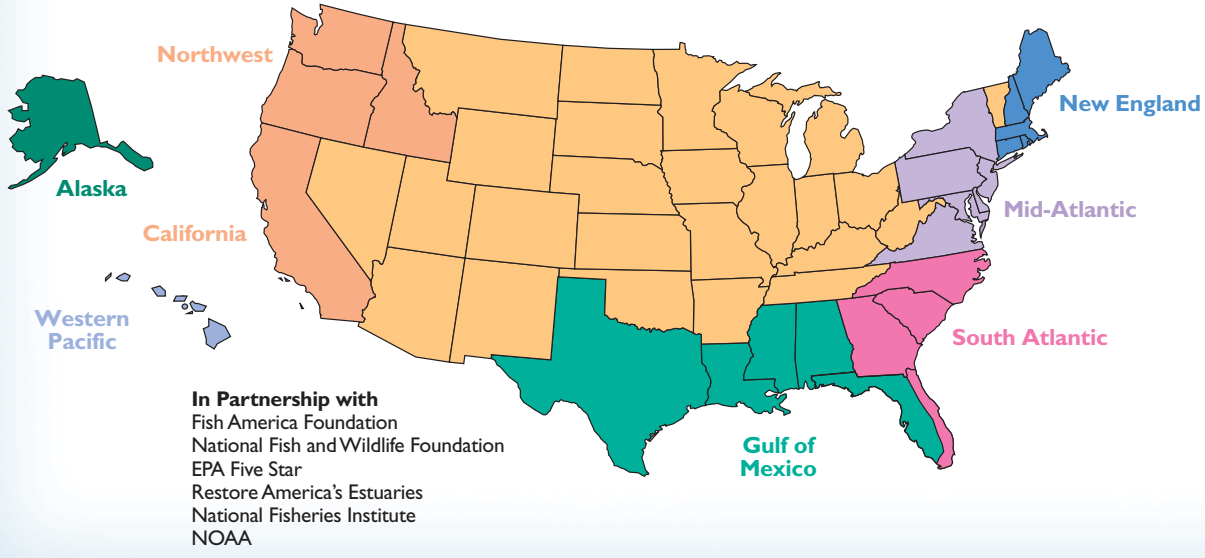


Figure 1-13. National Habitat Program.

Office of Air Quality Planning and Standards

EPA's Great Waters Program

http://www.epa.gov/oar/oaqps/gr8water

On November 15, 1990, in response to mounting evidence that air pollution contributes to water pollution, Congress amended the Clean Air Act and included provisions that established research and reporting requirements that related to the deposition of hazardous air pollutants to the "Great Waters." The waterbodies designated by these provisions are the Great Lakes, Lake Champlain, Chesapeake Bay, and certain other coastal waters (identified by their designation as NEP or NERRS sites, Figure 1-14). The amendments require EPA to establish deposition monitoring networks in the Great Waters, as well as conduct additional studies, such as assessing sources and deposition rates, evaluating adverse affects, and researching monitoring methods and biotic sampling. The amendment also requires EPA to report its findings to Congress in periodic reports. These reports to Congress address three main issues:

- Contribution of atmospheric deposition to total pollutant loading to the Great Waters
- Adverse effects on human health and the environments
- Sources of the pollutants.

The third report to Congress was completed in June 2000.

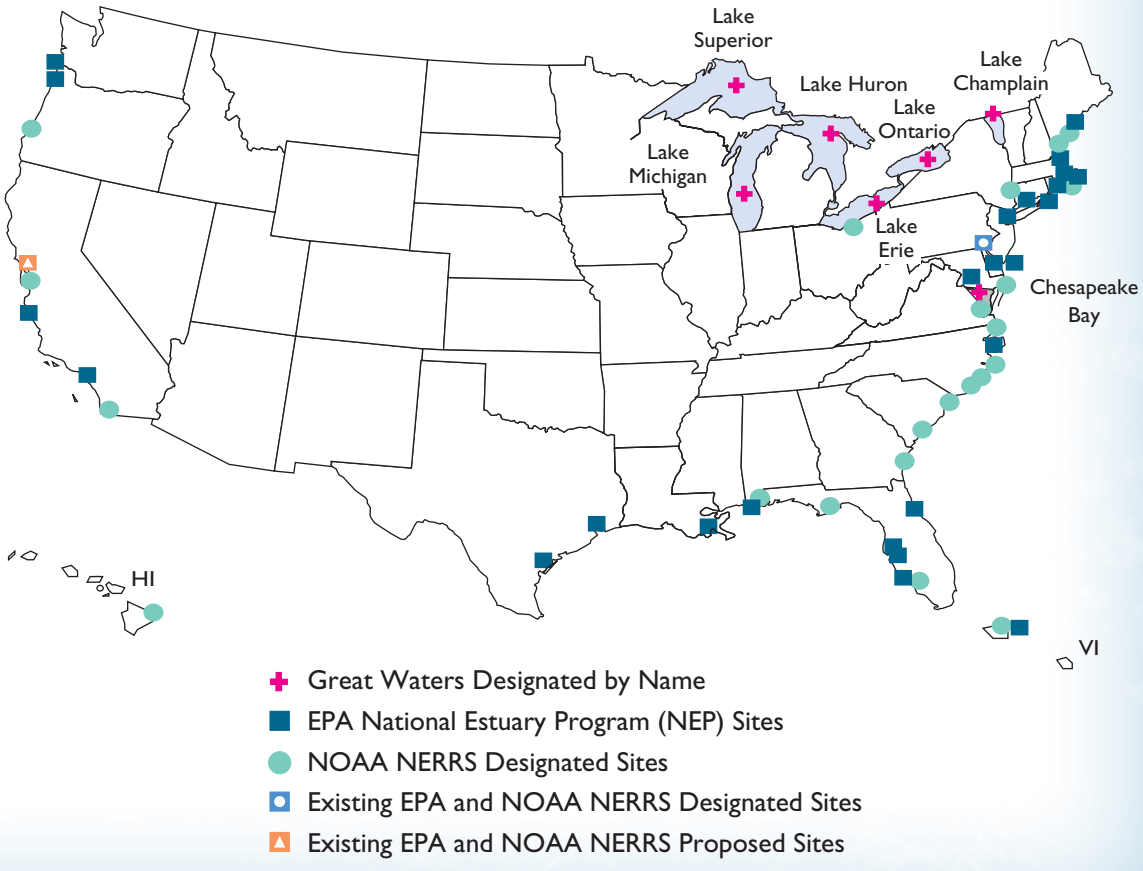


Figure 1-14. EPA's "Great Waters" as designated by the Clean Air Act.

National Streamgaging Program

http://water.usgs.gov/osw

The U.S. Geological Survey (USGS) National Streamgaging Program provides freshwater inflow data for estuary subsystems across the nation. Freshwater inflow, a major determinant of the physical, chemical, and biological characteristics of most estuaries, is measured by USGS river gauges. Freshwater inflow affects the concentration and retention of pollutants, the distribution of salinity, and the stratification of fresh and salt water within an estuary. These characteristics help define the ecological processes and habitats within an estuary and determine how human activities affect an estuary's overall condition.

The National Stream Water Quality Accounting Network (NASQAN, Figure 1-15) collects water chemistry and sediment data along the nation's largest streams that can be used to characterize large subbasins of these rivers and identify regional sources for the contaminants and sediments carried by the stream. NASQAN stations are sampled frequently enough to characterize variations in chemical and sediment concentrations that occur during a year, particularly the variation that occurs between low and high flows, during different seasons of a year, and during different hydrologic regimes such as periods when snowmelt dominates river discharge. By sampling a river under these different conditions, the amount of material that passes a station, known as the mass flux of a constituent (expressed as tons per day), can be reliably determined by multiplying the concentration of a constituent by the stream discharge.

Constituent mass fluxes can be compared among stations and across spatial scales. For example, yields of contaminants (expressed as tons per square mile) can be compared between stations; gains or losses in a river reach can be determined between any two stations; and amounts of materials delivered to a reservoir or estuary can be calculated. The ability to determine these three values—source, transport, and delivery of constituents—enables a broad range of scientific and policy issues to be addressed.

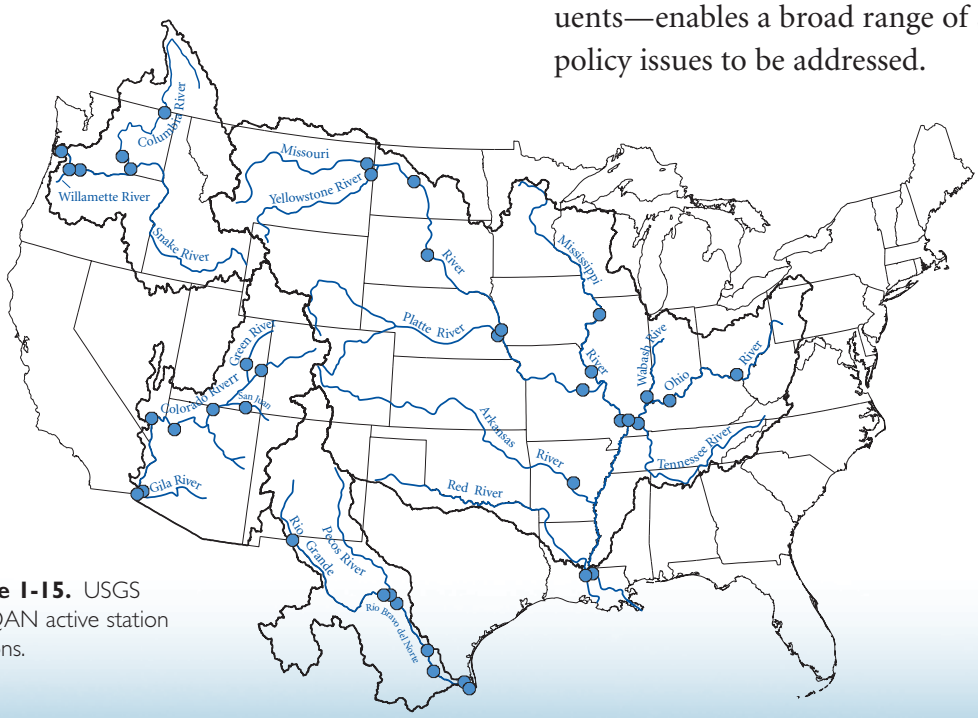


Figure 1-15. USGS NASQAN active station locations.

U.S. Fish and Wildlife Service Coastal Program

http://www.fws.gov/cep/coastweb.html

The U.S. Fish and Wildlife Service Coastal Program works with partners to conserve coastal habitats for the benefit of fish, wildlife, and people. Coastal Program biologists provide technical and financial assistance to a wide variety of partners, including other federal agencies, state and local governments, conservation organizations, local land trusts and watershed councils, businesses, and private landowners. The program forms cooperative partnerships that

- Restore coastal wetlands, uplands, and riparian areas
- Protect coastal habitats through voluntary conservation easements and fee-title acquisition from willing sellers
- Remove or retrofit barriers to fish passage in coastal watersheds
- Control exotic invasive species that threaten estuarine health. Program funds are more than tripled through leveraging with partners, and the focus is achieving on-the-ground results.

From 1994 to 1999, Coastal Program partnerships restored more than 46,550 acres of coastal wetlands, 17,130 acres of coastal uplands, and 320 miles of riparian habitat; protected more than 166,000 acres of coastal habitat through conservation easements and acquisition; and reopened 2,260 miles of coastal streams for access by anadromous fish.

In FY2000, the Fish and Wildlife Service's Coastal Program funded activities in 14 coastal watersheds around the country: Puget Sound, San Francisco Bay, San Diego Bay, Galveston Bay, South Florida, South Carolina, Albemarle/Pamlico Sound, Chesapeake Bay, Delaware Bay, New York Bight, the Gulf of Maine, the Great Lakes, Alaska, and the Pacific Islands (Figure 1-16).

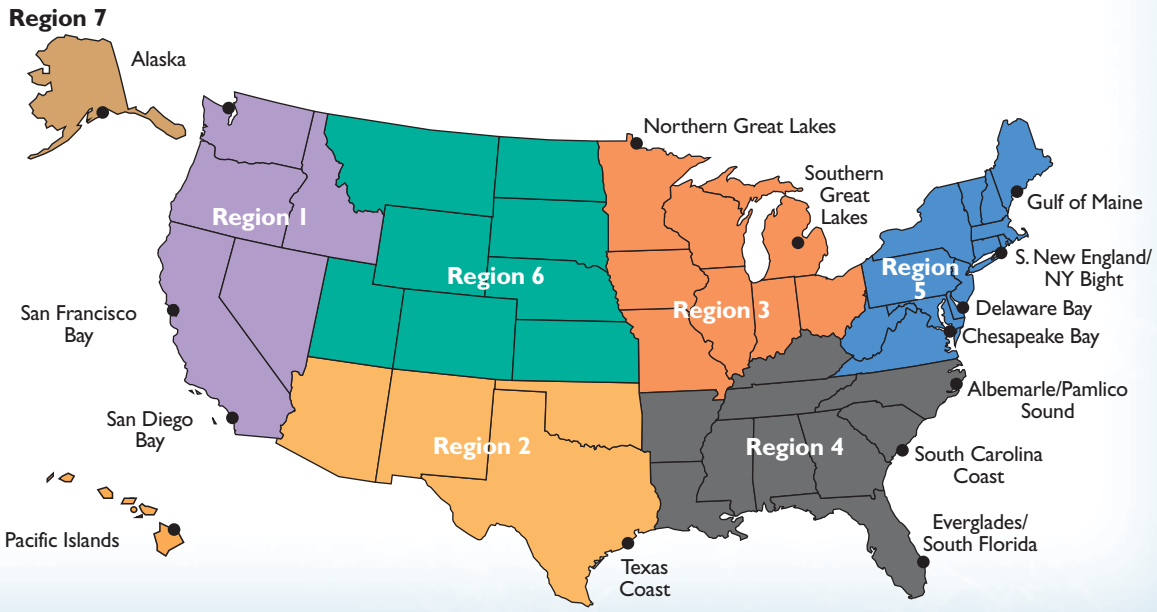


Figure 1-16. Location of Fish and Wildlife Service Coastal Program activities.

U.S. Fish and Wildlife Service National Wetlands Inventory

http://wetlands.fws.gov

The National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service produces information on the characteristics, extent, and status of the nation's wetlands and deep water habitats. This information is used by federal, state, and local agencies, academic institutions, U.S. Congress, and the private sector. The Emergency Wetland Resources Act of 1986 directs the Service to map the wetlands of the United States. The NWI has mapped 89% of the lower 48 states and 31% of Alaska. The Act also requires the Service to produce a digital wetland database for the United States. About 39% of the lower 48 states' wetlands and 11% of Alaska's wetlands are digitized. Congressional mandates require the NWI to produce status and trends reports to Congress at 10-year intervals. In 1982, the NWI produced the first comprehensive and statistically valid estimate of the status of the nation's wetlands and wetland losses and in 1990 produced the first update. Future national updates are scheduled for 2000, 2010, and 2020. In addition to the status and trends reports, the NWI has produced over 130 publications, including manuals, plant and hydric soils lists, field guides, posters, wall-size resource maps, atlases, and state reports and has had numerous articles published in professional journals.

EPA's BEACH Watch Program

http://www.epa.gov/ost/beaches

EPA's BEACH Program was established in 1997 to strengthen U.S. beach water protection programs and water quality standards, better inform the public, and promote scientific research to further protect the health of beachgoers. The BEACH Program is designed to encourage government agencies at the federal, state, tribal, and local level to strengthen beach water quality standards and testing methods, use predictive water pollution models to better inform the public about beach water quality conditions, and make information about the risks associated with swimming in contaminated beach water available to the public. Under the BEACH Program, EPA will improve laboratory test methods for detecting contaminants in beach water; invest additional resources in beach water quality health and testing methods research; and help state, local, and tribal government agencies adopt and carry out effective water quality monitoring programs.

The Beaches Environmental Assessment and Coastal Health Act (BEACH Act) was passed in 2000 and amended the CWA to require that states with recreational beaches adopt new or revised water quality standards for pathogens and pathogen indicators. The BEACH Act amendment also authorizes EPA to award grants to states to help them develop and implement beach monitoring and public notification programs for pathogens. If a state does not have a monitoring program that meets EPA criteria, the BEACH Act requires EPA to perform the monitoring and notification activities in that state's coastal recreational waters.