



## Chapter 5: Indicators of the Condition and Use of Coasts and Oceans

The coasts and oceans of the United States extend from the narrow ribbon of shoreline that defines the water's edge out some 200 miles into the open ocean. The cold and rocky coast of Maine and the mangrove swamps of Florida, the glacial fjords of Alaska and the black lava cliffs of Hawaii, the seagrass beds of the Chesapeake Bay and the pebble beaches of California—all these and more are found along the thousands upon thousands of miles of U.S. coastline. Offshore, kelp beds, coral reefs, and the open ocean provide habitat for fish, shellfish, birds, and mammals, as well as recreational and economic opportunities for many Americans (more than half of all Americans live within 50 miles of the coast). This vast expanse and the myriad plant and animal species that inhabit it are defined by the interaction between land and sea, between fresh water and salt water, an interaction that produces a rich mix of species and also of human activities.

### What can we say about the condition and use of U.S. coasts and oceans?

Sixteen indicators describe the condition and use of America's coasts and oceans. Partial or complete data are available for nine of the indicators. Of these, five have a data record that is long enough to judge trends, and three have a federally adopted reference point or other type of benchmark for comparison. For seven indicators, we report no data. In five of these cases, some data exist, but they are of uncertain coverage or consistency and have not been aggregated for national reporting. Two indicators require additional refinement or other development before reporting is possible. Eight of the indicators are, or should be, reported on a regional basis.

After the following brief summaries of the findings and data availability for each indicator, the remainder of this chapter consists of the indicators themselves. Each indicator page offers a graphic representation of the available data, defines the indicator and explains why it is important, and describes either the available data or the gaps in those data.

Each of the indicators in this section focuses on some part of the overall “coasts and oceans” system: estuaries, bays, and the like; shorelines; waters within 25 miles of the coast; waters out to 200 miles; and combinations of these four components. See Table 5.1 (p. 68) for the reporting area for each indicator.

### System Dimensions

Tracking changes in selected types of coastal land and water habitat is important for understanding the goods and services that this system can provide. There are two basic indicators of coastal system dimensions. The first tracks the changes in area of such key habitat types as coastal wetlands, coral reefs, and seagrasses; the second focuses on the nature of the shoreline itself—beach, wetlands, cliff, bulkhead, and so on.

- **What is the area of coastal wetlands, coral reefs, seagrasses, and shellfish beds?** These features are key habitat for many species of crabs, fish, and seabirds, as well as for the smaller creatures that serve as food for these larger animals. These habitats are unique in that they are created by living (or once-living) organisms, such as mangrove trees and coral. From the mid-1950s to the mid-1990s, wetland acreage on the Atlantic and Gulf coasts declined by about 400,000 acres, or about 8%, with the rate of loss slowing in the 1990s. Data are not adequate for national reporting on wetlands in other regions or on seagrasses, shellfish beds, or coral reefs.

- **How much of the nation’s shoreline is composed of beach, sand or mudflats, steep cliffs, wetlands and mangroves, and how much has bulkheads or riprap?** More than two-thirds of the 37,000 miles of shoreline mapped to date is coastal wetlands, most of which are in the South Atlantic region. Sixteen percent, or 6,000 miles, is beach. Steep shorelines and mud and sand flats each make up about 8% of the total, and armored shorelines account for about 11%. (Some areas, such as sandy beaches backed by steep cliffs, may be counted twice.) These data are for the Pacific and South Atlantic coasts; data for other regions have not yet been analyzed.

### Chemical and Physical Condition

Four quite varied indicators describe the chemical and physical condition of the nation’s coasts and oceans. Oxygen and temperature are two key determinants of the kinds of marine plants and animals that can inhabit a region. Thus, we track the area of coastal waters with abnormally low oxygen levels and changes in regional sea surface temperature. Chemical contamination is also of concern, so we track changes in harmful man-made chemicals that can accumulate in bottom sediments. The fourth indicator will track the percentage of the nation’s shoreline that is eroding.

- **How extensive are areas with low dissolved oxygen levels?** Low-oxygen (hypoxic) and no-oxygen (anoxic) conditions can cause mass mortalities among aquatic animals and disrupt migration patterns. Data are not adequate to report on the extent of these areas.
- **How contaminated are bottom sediments in estuaries and coastal ocean waters?** About 60% of the area of estuaries on the Mid-Atlantic, South Atlantic, and Gulf Coasts has levels of contaminants that might harm fish or wildlife, and 2% has levels that probably will harm these organisms. Neither trend data nor data on other regions are available.
- **How much of the nation’s coastline is eroding?** Erosion can damage coastal properties and decrease the recreational value of beaches. Data are not adequate for national reporting on erosion and the opposite process, accretion, for the U.S. coastline.
- **What is the temperature of the ocean’s surface?** Plants and animals are accustomed to certain water temperature ranges, and changes in temperature may cause species to disappear (or appear) in certain areas. Data for a 14-year period show neither warming nor cooling trends for waters within 25 miles of the U.S. coast.

### Biological Components

Six indicators describe biological conditions within coastal waters. As in other ecosystems, one indicator tracks species that are at risk of extinction. Another records unusual “mortality events” among such marine animals as whales, sea turtles, seabirds, and fish, and a third considers the condition of worms, snails, and other bottom-dwelling animals. Three indicators, two still under development, focus on undesirable species or conditions. One of the indicators that needs further development would track the “blooms” of several toxic algae harmful to people or marine animals; the other would report on invasions of non-native species that can supplant more desirable natives. The last of the indicators measures the concentration of chlorophyll in coastal waters—chlorophyll is a measure of the presence of algae, which in excess can be harmful to fish and other animals and plants and interfere with swimming and other recreation.

- **How many native marine species are at different levels of risk of extinction?** The nation’s coastal waters are home to a staggering diversity of plants and animals, from microscopic organisms to the world’s largest animals. However, we know the status of only a very few of these species; data are not adequate for national reporting on marine species at risk of extinction.
- **What is the extent of invasion by non-native species?** More work is needed to develop this indicator, which will consider both the number of non-native species and what fraction of available habitat they occupy.



- **How many marine mammals, turtles, and other animals die in unusual “mortality events”?** For both major groups of marine mammals (whales, dolphins, and porpoises; and seals, sea lions, sea otters, and manatees), there were at least three years out of the last ten in which no unusual mortalities occurred. Years with high mortalities included 1992 (more than 2500 sea lions) and 1999 (215 harbor porpoises and 270 gray whales). Data are not adequate for national reporting on sea turtles, seabirds, fish, and shellfish.
- **How frequent and extensive are harmful algal blooms?** Harmful algae produce toxins that pose a danger to people as well as to marine animals. Data are not adequate for national reporting on this indicator.
- **What is the condition of small bottom-dwelling animals (worms, clams, snails, and shrimplike animals)?** About half the estuary area in along the Mid-Atlantic, South Atlantic, and Gulf coasts has bottom-dwelling communities that are considered to be in “undegraded” condition when compared to a relatively undisturbed site. About 20% are in “degraded” condition. Data are not available for reporting on other regions or for oceans.
- **What is the concentration of chlorophyll in coastal waters?** Chlorophyll is a measure of the abundance of algae, which are the source of food, directly or indirectly, for most marine animals, but too many algae can be harmful to other marine life. Only very short-term data are available for ocean waters (3 years); additional data are needed to establish trends. Data are not adequate for national reporting on estuaries.

### Human Use

Four indicators describe the way people use the coasts and oceans. Three indicators focus on commercially important fish and shellfish: trends in commercial fish landings; trends in commercially important fish populations; and trends in chemical contaminants found in fish and shellfish, which might affect human health. The fourth indicator tracks contamination of beaches by bacteria from human or animal waste—a constraint to beach use that complements the core national outdoor recreation indicator (p. 60).

- **What is the size of the commercial fish catch from U.S. waters?** Since the late 1970s, landings of fish and shellfish from U.S. waters have totaled around 5 million tons per year. Over this time, and for most regions, landings have remained more or less constant (the catch in Alaska from U.S. boats has increased). Estimates of catches before the late 1970s are uncertain because of the presence then of large foreign fleets, which are no longer permitted to fish in U.S. waters.
- **What is the condition of commercially important fish stocks in U.S. waters?** Overall, about 40% of stocks with known populations were declining in size and 20% were increasing in size. However, data are not available on the population trends of about three-fourths of all U.S. fish stocks.
- **What is the concentration of DDT, PCBs, and mercury in fish and shellfish caught in U.S. waters?** Seafood containing high levels of these contaminants can be harmful to human health, but data are not adequate for national reporting on this indicator.
- **How often are bacteria associated with human and animal waste found in bathing water at the nation’s beaches?** Swimming in sewage-contaminated waters can cause disease. Data are not adequate for national reporting on this indicator.

### What do we mean by “coasts and oceans”?

“Coasts and oceans” consists of three components: estuaries, ocean waters under U.S. jurisdiction, and the shoreline along both estuaries and oceanfront areas.

Estuaries are partially enclosed bodies of water (often referred to as bays, sounds, lagoons, fjords, and the like), where fresh water from the land is mixed with salt water from the ocean. They are generally considered to begin at the upper end of tidal or saltwater influence and end where they meet the ocean, although major rivers often have plumes of brackish water (mixed fresh and salt) that extend

**Table 5.1. Reporting Areas for Coasts and Oceans Indicators**

Shorelines	Estuaries	Estuaries and Ocean Waters within 25 Miles of Shore <sup>a</sup>	Estuaries and Ocean Waters to 200 Miles	Ocean Waters within 25 Miles of Shore <sup>a</sup>
<ul style="list-style-type: none"> <li>■ Shoreline Types</li> <li>■ Coastal Erosion</li> <li>■ Recreational Water Quality</li> </ul>	<ul style="list-style-type: none"> <li>■ Non-native Species</li> <li>■ Condition of Bottom-Dwelling Animals</li> </ul>	<ul style="list-style-type: none"> <li>■ Areas with Depleted Oxygen</li> <li>■ Contamination in Bottom Sediments</li> <li>■ Chlorophyll Concentrations</li> </ul>	<ul style="list-style-type: none"> <li>■ Coastal Living Habitats</li> <li>■ At-Risk Marine Species</li> <li>■ Unusual Marine Mortalities</li> <li>■ Harmful Algal Blooms</li> <li>■ Commercial Fish and Shellfish Landings</li> <li>■ Status of Commercially Important Fish Stocks</li> <li>■ Selected Contaminants in Fish and Shellfish</li> </ul>	<ul style="list-style-type: none"> <li>■ Sea Surface Temperature</li> </ul>

<sup>a</sup> While it would be preferable in many cases to adjust the width of the reporting zone to conform to the extent of brackish water, the lack of consistent national monitoring of the extent of brackish water makes this impractical at this time. Because of this, these indicators focus on the area within 25 miles of the coast, a relatively conservative value for the width of this zone.

**Map 5.1. Regions Used for Reporting Selected Coasts and Oceans Indicators**



*Note: The regions shown here conform to those used by the National Oceanic and Atmospheric Administration in its National Estuarine Eutrophication Assessment and the Environmental Protection Agency's Environmental Monitoring and Assessment Program; they also match the regional structure established for regional marine research under Public Law 101-593. For some indicators, regions are combined for reporting purposes.*

for great distances. Many estuaries are highly productive, highly variable environments, and many have been greatly affected by human activities.

In general, ocean waters along the coast are largely influenced by the deep ocean, while terrestrial ecosystems are the main influence on estuaries. Both estuaries and ocean encompass a wide variety of habitats, including salt and brackish water, subtidal habitats (e.g., soft and hard bottom communities, coral and oyster reefs, and beds of seagrasses and kelp) and intertidal habitats (rocky shores, mud flats, marshes, and mangrove forests).

By definition, U.S. waters extend to the boundaries of the 200-mile Exclusive Economic Zone (EEZ),<sup>1</sup> but not all indicators report on this entire zone. In reporting the extent of coastal waters (see the core national extent indicator, p. 40), we have selected the area of “brackish water”—the area in which the influence of fresh

water from rivers and groundwater reduces salinity below that of the open ocean. The width of this area varies; along the Pacific Coast it is relatively narrow, while along parts of the Atlantic Coast it may be as wide as 200 miles. Table 5.1 shows the reporting area for each of the 16 indicators.

### A Note about Regions

Eight of the sixteen Coasts and Oceans indicators are reported on a regional basis, and they all make use of the same regional definitions (see Map 5.1). These indicators are shoreline types (p. 70); areas with depleted oxygen (p. 71), sea surface temperature (p. 74), at-risk species (p. 75), condition of bottom-dwelling animals (p. 79), chlorophyll concentration (p. 80), commercial fish and shellfish landings (p. 81), and the status of commercially important fish stocks (p. 82).

<sup>1</sup> The Exclusive Economic Zone of the United States was established in 1983 by presidential proclamation (#5030). See text at <http://www.nara.gov/fedreg/codific/procs/p05030.html>. According to the United Nations Convention on the Law of the Sea, nations have sovereign rights in a 200-nautical-mile exclusive economic zone (EEZ) with respect to natural resources and certain economic activities, and they exercise jurisdiction over marine science research and environmental protection in the EEZ. [http://www.un.org/Depts/los/convention\\_agreements/convention\\_overview\\_convention.htm](http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm) (accessed November 21, 2001).