CHAPTER SIX

Aquatic Resources

The nation's aquatic resources—water, coasts, oceans, wetlands, fish and shellfish—are generally abundant, though there are significant geographic and seasonal differences. In many cases, aquatic resources are under stress, threatened either by development, resource exploitation, or impaired water quality.

Water Resources

The United States is a water-rich nation, blessed with 3.6 million miles of rivers and streams, 41 million acres of lakes, almost 40,000 square miles of estuaries (excluding Alaska), and 33,000 trillion gallons of groundwater.

There is significant geographic and seasonal variation in precipitation. For example, the area east of the Mississippi River typically receives more than twice as much annual rainfall as the area west of the Rocky Mountains (Figure 6.1).

Surface waters provide about three fourths of overall freshwater requirements and groundwater one fourth. Groundwater is the source of drinking water for about half the general population and nearly all the rural population. The renewable water supply is more than 4 times the amount withdrawn and almost 15 times the amount consumed. But some parts of the country, especially the West and Southwest, are beginning to approach the physical limits of their water resources. Continued growth will require some combination of importing more water and/or managing water more efficiently.

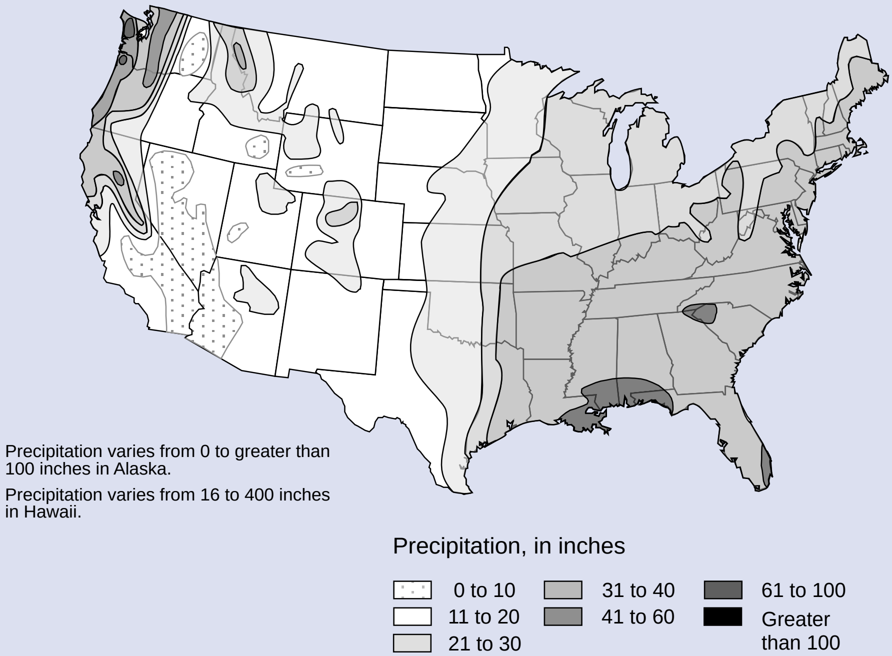
For the nation as a whole, precipitation trends have been generally above normal during the 1970-97 period. In 1997, according to preliminary estimates, 3.5 percent of the country experienced severe to extreme drought, while 25.7 percent was characterized by severe to extreme wetness.

Water Quality

Since passage of the Clean Water Act in 1972, most of the conspicuous water pollution of the later 1960s and 1970s has been eliminated. Over the 1972-92 period, despite population growth and an increase in the amount of sewage entering wastewater treatment plants, biochemical oxygen demand from treatment plants declined by 36 percent. Direct discharges of toxic pollutants are also down dramatically since 1988 (Figure 6.2).

In EPA's 1996 National Water Quality Inventory, states, territories, and tribes evaluated water quality in 19 percent of the nation's river and stream miles, 40 percent of lake areas, and 72 percent of estuary square miles. The results showed that, for the assessed waters, 64 percent of the river

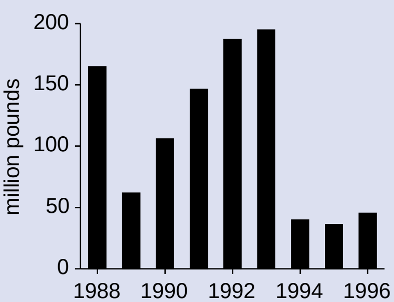
Figure 6.1 Mean Annual Precipitation in the United States



Source: Adapted and generalized from National Climatic Data Center, *Climatography of the United States No. 81.*

and stream miles, 61 percent of lake, pond, and reservoir acres, and 62 percent of estuary square miles are fully supporting their designated uses.

Figure 6.2 Toxic Discharges to U.S. Surface Waters, 1988-1996



Source: See Source for Part III, Table 8.6.
Note: Data are based on "core chemicals" to account for changes in reporting requirements.

These estimates should be treated with some caution. Since different states use different standards for evaluating the support of designated uses, and the sampling approaches also vary across states, the aggregate picture drawn by the National Water Quality Inventory may not appropriately depict the actual status of the nation's waters.

Aquatic life impacts are caused by persistent toxic pollutant burdens in waters and sediments, habitat degradation and destruction, and competition from and predation by nonnative species. Metals, priority toxic organic chemicals, pesticides, and oil and grease are among the leading persistent toxic pollutants cited as causing water quality impairments. Siltation, nutrient enrichment, and oxygen-depleting substances are among the leading causes of habitat degradation and destruction (aside from wetlands losses). Noxious aquatic plants are the leading type of non-native species cited as causing impairments, although specific regions like the Great Lakes have significant problems with other non-native aquatic organisms.

Drinking Water

The United States enjoys one of the best, safest supplies of drinking water in the world. The federal-state approach to drinking water protection emphasizes protection of groundwater and surface water supplies and improved drinking water monitoring, treatment, and distribution.

Under the Safe Drinking Water Act, EPA has developed maximum contaminant levels (MCLs) and treatment technique requirements for more than 80 contaminants in drinking water. (MCLs are contaminant concentrations set at or near levels at which there are no known human health effects. Treatment techniques are developed instead of MCLs for contaminants that are difficult to measure.) Public water systems must use appropriate treatment and conduct routine monitoring to ensure that the water provided to consumers consistently meets health-based standards at the tap.

The 1996 SDWA amendments strengthen and improve efforts to protect the quality of drinking water. Among the new provisions are better approaches for preventing contamination of drinking water (e.g., wellhead and watershed protection programs), improved consumer information, improved regulatory strategies, and new funding mechanisms for infrastructure.

Public water systems are classified according to the number of people they serve, the source of their water, and whether they serve the same customers year-round or only on an occasional basis (Table 6.1). State and federal managers supervise approximately 171,000 public water systems in the United States. Most of the information on trends refers to the nation's 55,000 community water systems (CWSs) which serve about 248 million people or 91 percent of Americans.

Coasts

The nation's coastal and marine domain is vast. It includes some 34,000 square miles of estuaries (excluding Alaska) and about 59,000 miles of ocean shoreline.

Coasts and estuaries are stressed by a wide range of human activities. They receive pollutants from farmland and developed areas; support marinas, commercial fishing fleets, and recreational activities; and are highly prized areas for both commercial and residential development. These pressures have increased over the past few decades as the population in coastal areas has grown. The U.S. coastal zone represents only about one fourth of total U.S. land area, yet the Bureau of the Census estimates that in 1997 over 141 million people—roughly

Table 6.1 U.S. Public Water System Inventory Data, 1996

Water Source	Community Water Systems		Non-Transient Non-Community Water Systems		Transient Non-Community Water Systems	
	Systems	Population Served	Systems	Population Served	Systems	Population Served
	(number)	*(millions)*	*(number)*	*(millions)*	*(number)*	*(millions)*
Surface	10,500	160.0	760	0.8	2,143	0.9
	(19%)	(64%)	(4%)	(13%)	(2%)	(6%)
Ground	44,219	89.0	19,300	5.3	94,009	15.3
	(81%)	(36%)	(96%)	(87%)	(98%)	(94%)
Total	54,728	249.0	20,061	6.1	96,153	16.2
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)

Source: U.S. Environmental Protection Agency, Office of Water, Office of Ground Water and Drinking Water, Office of Enforcement and Compliance Assurance. *Providing Safe Drinking Water in America: 1996 National Public Water System Annual Compliance Report and Update on Implementation of the 1996 Safe Drinking Water Act Amendments* (EPA, OECA, Washington, DC, 1998).

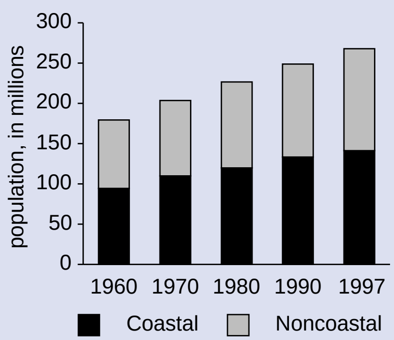
Notes: Data for the report cited above are from EPA's Safe Drinking Water System (SDWIS) for the 12-month period ending December 1996, as reported to EPA by the states as of June 1998. Populations are not summed because some people may be served by multiple systems and counted twice. Community Water System = supplies water to the same population year round. Non-Transient Non-Community Water System = regularly supplies water to at least 25 of the same people at least six months per year, but not year-round. Some examples are schools, factories, office buildings, and hospitals which have their own water systems. Transient Non-Community Water System = provides water in a place such as a gas station or campground where people do not remain for long periods of time.

53 percent of the total U.S. population—were living within the coastal zone area (Figure 6.3).

Many coastal areas continue to suffer from overutilization, loss of important habitats, and damage from pollution. More than one third of the nation's assessed estuarine waters do not fully support designated uses.

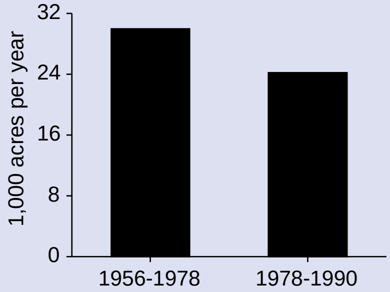
Important coastal habitats include estuaries, salt and fresh water marshes, tidal flats, estuarine forested wetlands, sandy beaches, barrier islands, seagrass beds, coral reefs, and deltas and dunes. These habitats are nurseries and spawning

Figure 6.3 U.S. Population by Coastal and Noncoastal Place of Residence, 1960-1997



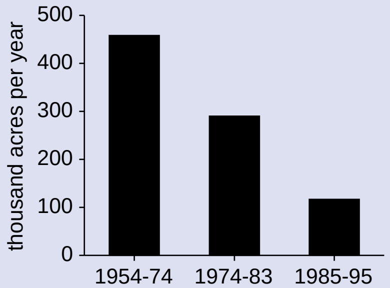
Source: See Part III, Table 1.7.

Figure 6.4 Louisiana Wetlands Losses, 1956-1990



Source: Johnson et al., "Gulf of Mexico Coastal Wetlands: Case Studies of Loss Trends," In: *Our Living Resources,* LaRoe et al, eds., U.S. Department of the Interior, National Biological Service (GPO, Washington, DC, 1995).

Figure 6.5 Average Annual Rate of U.S. Wetlands Losses, 1950s to 1990s



Source: See Part III, Table 6.14.

grounds for many commercially valuable species.

Along the Gulf of Mexico, for example, coastal wetlands and seagrass beds are diminishing. This loss is of special interest because of the role these coastal habitats play in supporting fish and shellfish of economic importance. It is estimated that the loss of wetlands in Louisiana is the largest of any state and accounted for 67 percent of the nation's total loss for the period 1978-90 (Figure 6.4).

Long-term survey data by the U.S. Geological Survey show that coastal erosion is affecting each of the 30 coastal states. About 80 percent of U.S. coastal barriers are undergoing net long-term erosion at rates ranging from less than 3.3 feet to as much as 65 feet per year.

Wetlands

Wetlands in the United States support about 5,000 plant species, 190 amphibian species, and one third of all bird species. In addition, they provide habitat for nearly one half of the fish, one third of the birds, one fourth of the plants, and one sixth of the mammals on the threatened and endangered species list.

Until the mid-1980s, conversions to cropland accounted for most wetlands losses. In the 1954-74 period, 87 percent of the annual net losses of 458,000 acres were converted to cropland. In the 1974-84 period, estimated annual losses dropped to an average of 290,000 acres, with agriculture still accounting for over half of the total. Since the early 1980s, wetlands losses have slowed significantly. Over the 1985-95 period, total net losses of wetlands dropped to an estimated 117,000 acres per year (Figure 6.5).

Among regions, there are a variety of different threats to wetlands. In the Southeast, which has more wetlands area and has lost more wetland acres than any other region, remaining wetlands are declining in quality because of nutrient loading, altered hydrology, and urban encroachment. In the Northern Plains, nearly half of the original wetlands in the prairie pothole region have been drained; of those remaining, many are cropped when the weather permits.

Fish and Shellfish

At the global and national level, there are many signs that fishery resources are imperiled. The Food and Agriculture Organization of the United Nations estimates that, of 200 stocks fished worldwide, more than 25 percent are overexploited, depleted, or recovering, while 38 percent are fully exploited.

The situation for U.S. fishery resources is similarly troubling. Of the 201 stock groups whose biological status is monitored by the National Oceanic and Atmospheric Administration, 36 percent (73 groups) are currently below estimated optimum long-term levels.

By the late 1900s, for example, west coast salmon abundance had declined to only 10 to 15 percent of what it had been in the late 1800s. In recent years, precipitous salmon declines have hurt the economies of fishing-dependent coastal and rural inland communities throughout the Pacific Northwest and northern California. Along the Pacific Coast, 15 distinct population segments of Pacific salmon and anadromous trout are listed as either endangered or threatened under the Endangered Species Act. Others are proposed for listing.

While no “species” of anadromous trout or salmon is in danger of near-term extinction, individual population segments within these species have declined substantially or have even been extirpated. The American Fisheries Society considers at least 214 Pacific Coast anadromous fish populations to be “at risk,” while at least 106 historically abundant populations have already become extinct.

The Northeast’s valuable crustacean and bivalve molluscs, both offshore (lobsters, sea scallops, etc.) and inshore (blue crabs, oysters) are fully or overexploited. In the Southeast, the three major shrimp species (brown, white, and pink) are considered fully utilized in both the Gulf of Mexico and the Atlantic.

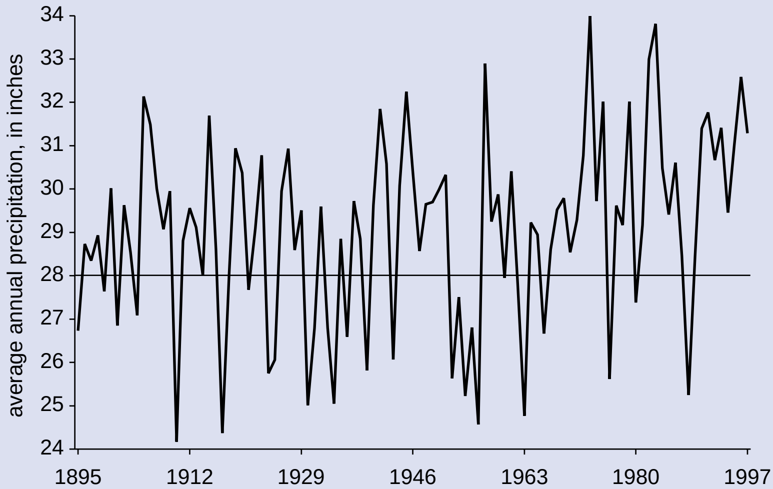
TRENDS

Precipitation

The contiguous United States usually receives about 28-30 inches of precipitation annually. In dry years, average annual precipitation may drop to 24-25 inches; in wet years, average annual precipitation can rise to 32-33 inches (Figure 6.6). Data indicate that annual 1997 precipitation averaged across the contiguous United States was above the long-term mean, ranking as the 43rd wettest year on record. Each of the last eight years has averaged near to much wetter than the long-term mean. (Part III, Table 6.1)

The national precipitation index, another indicator of trends, expresses precipitation departure from the 60-year mean in terms of standard deviations, thus indicating how precipitation across the country compares to the local normal (60-year average) climate. Each year’s value is computed by standardizing the annual precipitation in each of 344 cli-

Figure 6.6 U.S. Precipitation Trends, 1895-1997



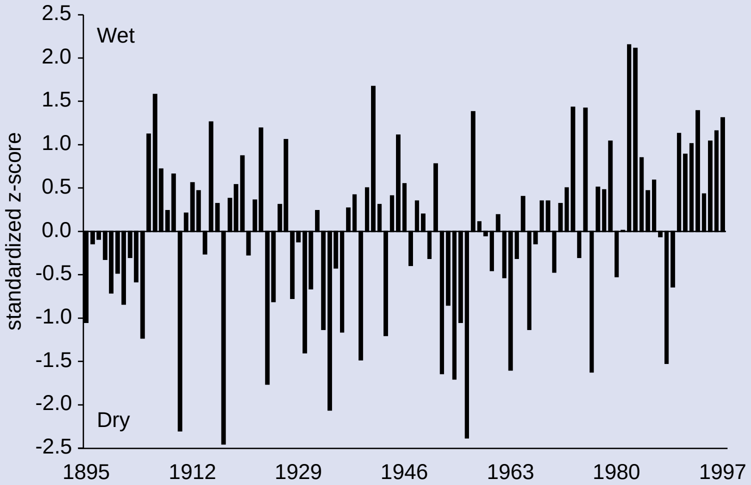
Source: See Part III, Table 6.1.

mate divisions across the U.S. using the gamma distribution over the 1931-90 period. The gamma statistical distribution takes into account heavy precipitation years and extremely dry years in the historical record (in mathematical parlance, "a zero-bounded skewed distribution"). These gamma-standardized divisional values are then weighted by area and averaged to determine a national standardized value for each year. These national values are normalized over the period of record. Negative values are drier and positive values are wetter than the mean. The national standardized precipitation index ranked 1997 as the 26th wettest year on record. About twelve percent of the country averaged much wetter than normal for the year, with only five percent averaging much drier than normal (Figure 6.7).

In an average year, about 9 percent of the contiguous United States is severely to extremely dry and about 9 percent is severely to extremely wet. But there is considerable variation in these numbers. In 1983, 36 percent of the country experienced unusually wet weather. In the Dust Bowl year of 1934, almost half the country—48.8 percent—was unusually dry.

In both 1995 and 1996, roughly one fourth of the country experienced unusually wet weather. In addition, much of the country has been struck by natural disasters in the past few years. During July and August 1993, devastating floods hit the lower Missouri River, the upper Mississippi River, the Illinois River, and many of their tributaries. Thirty-eight lives were lost, and estimated damages were between \$10 billion and \$16 billion. In 1997, according to preliminary data, 3.5 percent of the conterminous United States experienced severe to extreme drought and 25.7 percent of the nation

Figure 6.7 U.S. Precipitation Index, 1895-1997



Source: See Part III, Table 6.1.
Note: The standardized z-score is an index computed from precipitation records. It expresses precipitation departure from the 60-year mean in terms of standard deviations. See notes for Table 6.1.

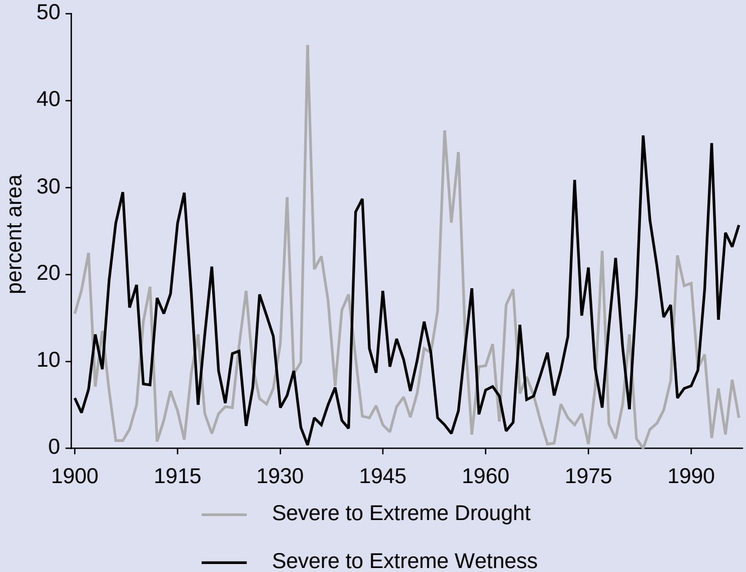
experienced severe to extreme wetness (Figure 6.8). (Part III, Table 6.2) Core wet areas included the Northern Rockies, Central and Southern Plains, and portions of the Southeast. Core dry areas included portions of the Southwest, Ohio valley, Northern Great Lakes, and portions of New England.

On a global scale, 1997 was the warmest year of this century, based on land and ocean surface temperature data analyzed by NOAA's National Climatic Data Center. (Also see Chapter 11). In the United States, however, the annual 1997 temperature averaged across the lower 48 states was near the long-term mean, due primarily to the strong El Nino conditions that resulted in milder-than-normal conditions over much of central North America. In 1997, nearly fourteen percent of the country was much cooler than normal for the year while over ten percent of the country was much warmer than normal. Nine out of the last 13 years have averaged near to much warmer than the long-term mean.

Water Use

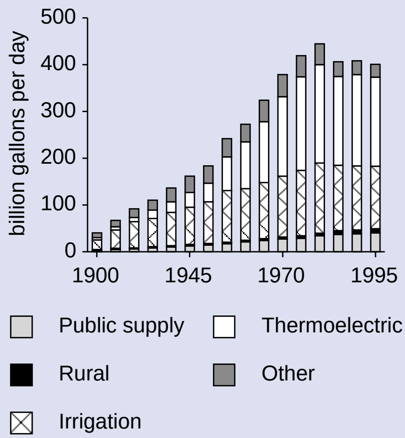
From 1900 to 1980, national water use grew by more than a factor of 10, rising from 40 to 445 billion gallons per day. From 1980 to 1995, water use declined from 444 to 401 billion gallons per day. This decline occurred even though population increased 16 percent over the period. Among sectors, the largest declines were in irrigation and thermoelectric utilities (Figure 6.9). In 1995, about 80 percent of total water use—323 billion gallons per day—was from surface water, with the remainder from groundwater. (Part III, Table 6.3) On a per capita basis,

Figure 6.8 Severe to Extreme Wetness and Drought in the Contiguous United States, 1900-1997



Source: See Part III, Table 6.2.

Figure 6.9 U.S. Water Use by Sector, 1900-1995



Source: See Part III, Table 6.3.

total water use declined from 1,916 gallons per day to 1,498 gallons per day.

The "Public supply" and "Rural domestic and livestock" categories are the only two categories to show continual increases from 1950 to 1995, largely because of continual increases in population. The 4 percent increase in public-supply withdrawals from 1990 to 1995, compared to a 7 percent increase in population served by public supply, indicates that conservation programs have been effective in lowering public supply per capita use. The 13 percent increase in rural domestic and livestock withdrawals is attributable to an increase in livestock withdrawals, especially animal specialities withdrawals (such as fish farms), which were 43 percent higher during 1995 than during 1990.

More water (fresh and saline) continues to be withdrawn for thermoelectric power generation than for any other category, peaking in 1980 at 210 billion gallons per day and fluctuating around 190 billion gallons per day since then. Instream use (hydroelectric power) increased steadily from 1950 to 1975 and has fluctuated above 3,000 billion gallons per day since then. Changes in hydroelectric power water use are closely related to the availability of surface water.

Industrial withdrawals declined from 1980 to 1995 after remaining about the same for the years reported between 1965 and 1980. Lower industrial withdrawals are the result of new industries and technologies that require less water, improved plant efficiencies, increased water recycling, changes in laws and regulations to reduce the discharge of pollutants, and conservation measures.

Irrigation withdrawals during 1995 were 2 percent less than during 1990 and 1985. The 1995 irrigation application rate—2.1 acre-feet per acre—was slightly less than the 1985 average of 2.2 acre-feet and well below the 1975 and 1980 average of 2.5 acre-feet per acre. The decline in irrigation rates is the result of improved irrigation techniques, implementation of more efficient irrigation systems, and application rates in the eastern United States that tend to be less than in the western United States.

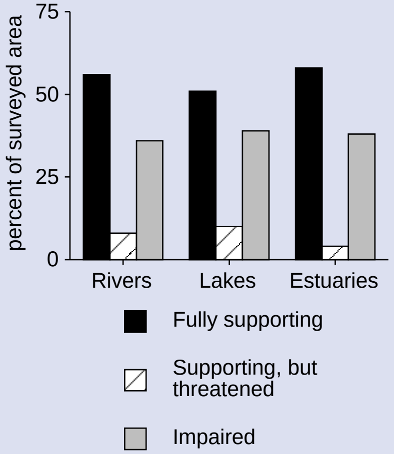
Total freshwater consumptive use—that part of water withdrawn that is evaporated, transpired, or incorporated into products or crops—is estimated to have been 100 billion gallons per day during 1995, or 6 percent more than during 1990. Consumptive use for irrigation accounts for the largest part of total consumptive use—an estimated 81 bgd for 1995. Freshwater consumptive use is about 12 percent of withdrawals in the East and 47 percent of withdrawals in the West. The higher consumptive use in the West is attributable to the 90 percent of water withdrawn for irrigation.

The use of reclaimed wastewater is estimated at 1,020 million gallons per day in 1995, which is more than double the amount used in the 1970s and 1980s. Wastewater is water released from private and public wastewater treatment facilities after use. The releases can be returned either to the natural environment or reclaimed for beneficial uses, such as irrigation of golf courses and parks. Illinois, Ohio, Florida, California, and Arizona all reported large uses of reclaimed wastewater.

Water Quality

Environmental Protection Agency surveys provide useful insights into the quality of the nation's surface waters. The latest *National Water Quality Inventory* was conducted in 1996. It compiles data reported by states, territories, and tribes. Of 693,905 river and stream miles surveyed (about 19 percent of the total), about 64 percent were supporting their designated uses, while about 36 percent were impaired. In the case of lakes, ponds, and reservoirs, 40 percent of the 41 million acres were surveyed. About 61 percent of the 16.8 million acres surveyed were supporting their

Figure 6.10 Overall Use Support in U.S. Surface Waters, 1996



Source: See Part III, Table 6.4.
Note: Based on an assessment of 19% of U.S. river and stream miles, 40% of U.S. lake acres, and 72% of U.S. estuary square miles.

designated uses. Of the 28,819 square miles of estuaries surveyed (about 72 percent of the total), about 62 percent were supporting their designated uses (Figure 6.10). (Part III, Table 6.4)

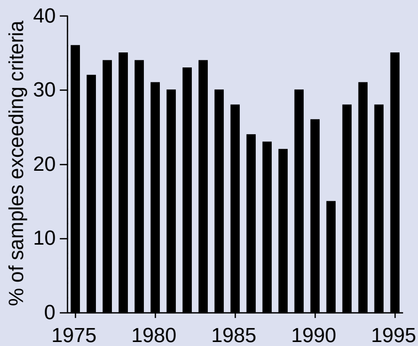
Trends for selected water quality indicators in streams during the period from 1980 to 1989 were compiled at the U.S. Geological Survey's National Stream Quality Accounting Network (NASQAN) stations. For most stations, water quality indicators stayed about the same during this period. (Part III, Table 6.5)

Ambient water quality seems to be generally improving in U.S. rivers and streams. The percentage of measurements exceeding state water quality criteria has declined for dissolved oxygen, total phosphorus, total cadmium, and total lead. The one exception is fecal coliform bacteria, where violation rates have remained in the 30-35 percent range (Figure 6.11). (Part III, Table 6.6)

EPA's 1996 Clean Water Needs Survey includes detailed estimates of the capital costs eligible for funding under the State Revolving Fund (SRF) provisions of the 1987 Amendments to the Clean Water Act (CWA). The survey covers publicly owned, municipal wastewater collection and treatment facilities, facilities for the control of combined sewer overflows (CSOs), activities designed to control storm water (SW) runoff and nonpoint source (NPS) pollution, and programs designed to protect the nation's estuaries. The primary objective of the survey is to update and expand the documented costs for all program categories eligible for SRF funding.

Nationally, 16,024 wastewater treatment facilities are identified in the 1996 survey. These facilities provide service to 190 million people, representing 73 percent of the total population. When all

Figure 6.11 Coliform Bacteria Violation Rates, 1975-1995



Source: See Part III, Table 6.6.

Table 6.2 Improvements in Treatment Level of Wastewater Treatment Facilities, 1988-1996

Level of Treatment	1988	1992	1996	1996 facilities design capacity	1996 population served	
		number of facilities		*mgd*	*millions*	*%*
Non-discharge	1,854	1,981	2,032	1,421	7.66	2.9
< Secondary	1,769	868	176	3,054	17.18	6.5
Secondary	3,536	9,086	9,388	17,734	81.94	31.0
> Secondary	3,412	3,678	4,428	20,016	82.93	31.4
Total	15,591	15,613	16,024	42,225	189.71	71.8

Source: U.S. Environmental Protection Agency, Office of Wastewater Management, *1996 Clean Water Needs Survey Report to Congress* (Washington, DC, 1998), and earlier reports in this series.

Notes: mgd = millions of gallons per day. Non-discharge = facilities that do not discharge effluent to surface waters (e.g., spray irrigation, ground water recharge). A secondary treatment level is defined as an effluent biochemical oxygen demand (BOD) of between 25 and 30 milligrams per liter.

needs are met in 2016, there will be an estimated 18,303 publicly owned wastewater treatment facilities serving 275 million people, or 90 percent of the projected population of 305 million.

According to the 1996 survey, the level of treatment has changed significantly over the last eight years. The number of facilities providing less than secondary treatment has declined by 90 percent since 1988. In 1988, 1,789 (11 percent) of the 15,591operational facilities were providing less than secondary treatment. This declined to 868 (6 percent) in 1992 and to 176 (1 percent) in 1996.

At the same time, there has been a steady increase in the proportion of facilities providing secondary and greater than secondary treatment. The number of facilities providing secondary treatment has increased by 10 percent, while those providing advanced wastewater treatment increased by almost 30 percent since 1988. In 1996, 28 percent (4,428 out of 16,024) of the operational treatment facilities are providing greater than secondary treatment (Table 6.2).

From 1992 to 1996, total needs decreased by $15.5 billion. This reflects, in part, progress made in meeting the nation's water quality infrastructure needs. For a given facility, a reduction in need may signify completion of project construction, reduction in the original project scale, or elimination of the need for projects included in previous surveys. In contrast, an increase in need signifies entirely new facilities being required or new projects to upgrade or expand existing facilities. Underlying factors that influence these changes include continued population growth, deterioration of existing facilities, and increasingly stringent water quality requirements. Changes in needs also reflect efforts to improve the quality of the data in the needs survey database through a substantial redocumentation effort.

The largest needs occur in New York, Illinois, and California. New York has $16 billion in needs, while California and Illinois have needs in excess of $11 billion. Sixteen additional states have needs in excess of $2 billion. Needs continue to be generally concentrated in the highly populated northeastern states (New Jersey, New York, and Pennsylvania) and in the Great Lakes states (Illinois, Michigan, and Ohio) as well as in Florida and Texas. The less populated states, generally located in the Rocky Mountains and the Plains, have lower levels of needs.

Most combined sewer overflow (CSO) needs are concentrated in the northeastern states (Massachusetts, New Jersey, New York, and Pennsylvania) and in the Great Lakes states (Illinois, Indiana, Michigan, and Ohio). Illinois has the largest documented CSO needs ($9.4 billion), indicating that considerable effort has gone into documenting this state's CSO problems and into developing municipal CSO program plans. Indiana, Massachusetts, Michigan, New Jersey, New York, Ohio, and Pennsylvania all have CSO needs in excess of $2 billion. This geographical concentration of CSO needs reflects the age of the infrastructure in these areas and the fact that combined sewers were considered acceptable practice at the time many older sewer systems were built.

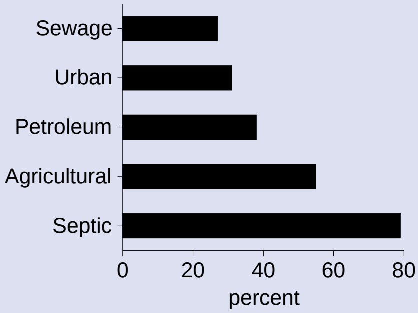
Water quality program needs for small communities are significant, reflecting, in part, the continuing efforts to extend wastewater collection and treatment to small communities. The total documented needs for communities with populations less than 10,000 are $13.8 billion, representing 11 percent of the total documented needs for the nation.

Drinking Water

Today, most people drink water that meets federal and state standards, but there are continued threats to the safety of some drinking water supplies. Figure 6.12 shows potential sources of contamination within two miles of community water system supply intakes or wells.

Most large community water systems, 95 percent of medium-size systems, and between 70 and 88 percent of small systems provide some treatment of drinking water supplies. Of those reporting no treatment, 80 percent rely on groundwater as their only source. Over one third of all community systems participate in

Figure 6.12 Percentage of CWSs Reporting Potential Sources of Contamination by Source, 1995



Source: U.S. Environmental Protection Agency, Office of Water, *Community Water System Survey*. Volume I. EPA 815-R-97-001a (EPA, OW, Washington, DC, 1997).
Notes: CWSs = Community Water Systems. Data refer to potential sources of contamination within two miles of CWS supply intake or wells.

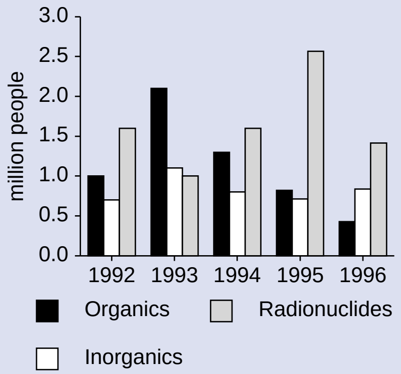
some type of source water protection, primarily zoning or land use controls, best management practices, and education on land use impacts.

In 1996, of the 248 million people served by community systems, 86 percent drank water from systems that reported no violations of any health-based drinking water standards. Small systems have the largest number of violations, but a much larger population is served by large systems with violations.

The population served by systems violating the Total Coliform Rule MCL peaked in 1993 (Figure 6.13) and decreased thereafter as systems, particularly those serving very large populations, took action to correct treatment or operational deficiencies causing the violations. The population served by systems violating the Surface Water Treatment Rule remains stable at around 11 million people. The reason is that installation of filtration treatment, which was required by Safe Drinking Water Act to be in place by 1993 for a number of large systems, has taken longer than anticipated for a variety of reasons, including planning, design and construction of the complex infrastructure needed. Violations of both the total coliform and surface water treatment rules indicate a potential for contamination by microbial pathogens, rather than the actual presence of such pathogens in drinking water. Of the 12,000 total coliform violations in 1996, about 19 percent included detections of either fecal coliforms or *E. coli*, which are considered more direct indicators of pathogen contamination.

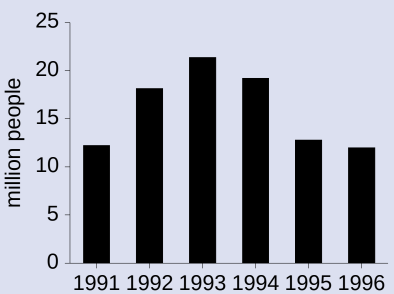
The population served by community systems violating one or more of the chemical and radiological MCLs is relatively small (Figure 6.14). These standards cover volatile and synthetic organic

Figure 6.14 Population Served by CWSs with Violations of Chemical and Radiological MCLs, 1992-1996



Source: U.S. Environmental Protection Agency, Safe Drinking Water Information System.
Notes: CWSs = Community Water Systems. MCLs = Maximum Contaminant Levels.

Figure 6.13 Population Served by CWSs with Violations of the MCL for Total Coliform, 1991-1996



Source: U.S. Environmental Protection Agency, Safe Drinking Water Information System.
Notes: CWSs = Community Water Systems. MCL = Maximum Contaminant Level.

compounds (e.g., benzene and atrazine), inorganic compounds (e.g., nitrate), and radionuclides (e.g., radium).

Some 22 million people were served by community systems with significant violations in monitoring and reporting requirements in 1996. The rules pertaining to total coliform, surface water treatment, organic chemicals, and nitrate accounted for most of these violations. While monitoring and reporting violations do not necessarily indicate a health risk, if a system fails to monitor it may not be aware of the potential health risk posed by a contaminant that may be present but undetected.

In its first report to Congress from the 1996 Drinking Water Infrastructure Needs Survey, EPA concludes that much of the nation's drinking water infrastructure suffers from long-term neglect and serious deterioration and that significant investments (Figure 6.15) are needed to protect public health and ensure the availability of safe drinking water.

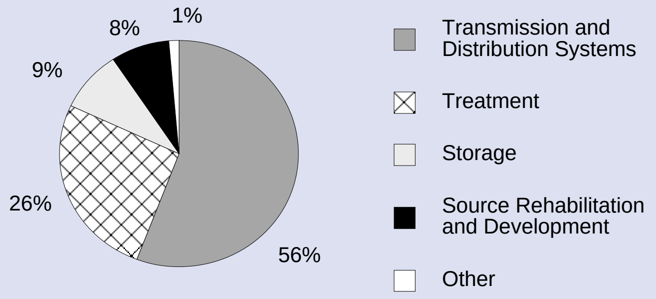
Oil Pollution

Oil polluting incidents in and around U.S. waters have fluctuated somewhat since 1970, but the recent trend in the annual number of incidents is down. In the 1970s, typically 8-10,000 incidents per year resulting in an annual total of 10-20 million gallons of spilled oil were reported annually. In 1997, about 8,624 incidents were reported involving 942,574 gallons (Figure 6.16). (Part III, Table. 6.8)

Fish and Shellfish

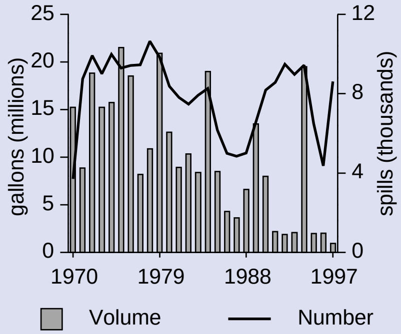
NOAA's National Shellfish Register collects data on the number of shellfish-rearing areas with harvest restrictions.

Figure 6.15 Total 20-Year Estimated Needs of Community Drinking Water Systems by Category



Source: U.S. Environmental Protection Agency, Office of Ground Water and Drinking Water, *Drinking Water Infrastructure Needs Survey: First Report to Congress* (EPA, OGWDW, Washington, DC, 1997).
Notes: Total needs = $138.4 billion (1995) dollars. Data are estimates based on a survey of 4,000 of the 55,000 U.S. Community Water Systems. Other includes projects to protect water systems against earthquake damage, automate treatment plant operations, and improve laboratory facilities.

Figure 6.16 Oil Spills In and Around U.S. Waters, 1970-1997



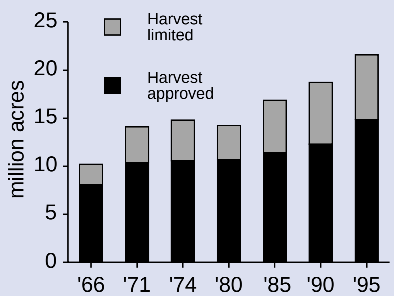
Source: See Part III, Table 6.8.

The number of acres of restricted shellfish-growing acres seems to be increasing, both in percentage and absolute terms. In 1980, for example, 25 percent (3.5 million acres) of the 14.2 million acres reported to NOAA were harvest-limited. In 1995, 31 percent (6.7 million acres) of 21.5 million acres were harvest-limited, including 2.8 million acres that were prohibited (Figure 6.17). (Part III, Table 6.9)

Commercial harvests of shellfish, crabs, and lobsters were mixed in 1997. Landings of all clams totaled 114.2 million pounds of meats, down 7 percent from 1996. Landings of all species of crabs were 430 million pounds, up 10 percent from 1996. The American lobster catch totaled 83.9 million pounds, up 17 percent. U.S. landings of bay, calico, and sea scallops totaled 15.5 million pounds of meats, down 17 percent from 1996.

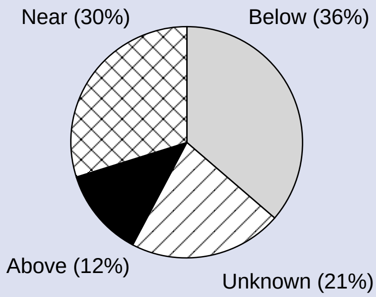
Of the 201 fish stock groups in high seas waters whose biological status is monitored by NOAA, 36 percent (73 groups) are currently below estimated optimum long-term levels (i.e., productivity is below the estimated long-term potential yield) and the fishery is overutilized. Another 30 percent are near optimum long-term levels (Figure 6.18). Of the 73 overutilized stocks, fully one third (19 stocks) occur among the demersal fisheries (groundfish and flounder) in the Northeast. A notable trend in the Northeast is the continued decline in landings of the region's traditional groundfish species (cod, haddock, and flounder) (Figure 6.19). One by one, many of the most productive stocks collapsed in the wake of an unprecedented fleet build-up from the mid-1970s to mid-1980s, increasingly efficient fishing methods, competition between fleet sectors employing various gears, and failure to heed scientific advice before stocks declined to historically low levels. When quota management systems, controls on net mesh size, closed fishing areas, and minimum fish sizes proved ineffective, additional efforts to restrict entry into the fishery, days at sea, and where vessels can fish as well as a multi-million dollar, government-spon-

Figure 6.17 Classified U.S. Shellfish Waters, 1966-1995



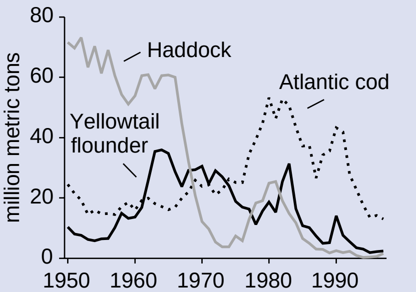
Source: See Part III, Table 6.9.
Note: Harvest limited = sum of conditionally approved, restricted, conditionally restricted, and prohibited.

Figure 6.18 Status of U.S. Fishery Resources Relative to Abundance Levels That Would Produce Sustainable Yield, 1994



Source: See Part III, Table 6.10.
Note: Based on 201 monitored stocks.

Figure 6.19 Commercial Landings of Northeast Groundfish, 1950-1997



Source: National Marine Fisheries Service (NMFS), *Fisheries of the United States* (NMFS, Washington, DC, annual).

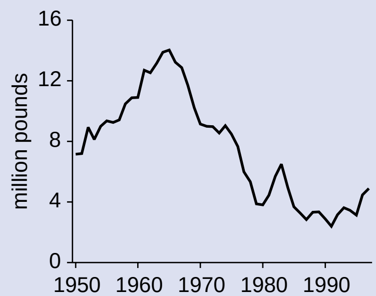
sored vessel buy-out and job retraining program were initiated in an attempt to salvage the fishery.

In addition, 9 stocks or stock groups of Atlantic and Gulf of Mexico reef fish are overutilized at dockside. (Part III, Table 6.10) One of the species in this group, the red snapper, is seriously depleted (Figure 6.20), due in part to incidental bycatch of juveniles by the shrimp fishery in the Gulf of Mexico. NOAA estimates that red snapper stocks cannot recover unless the mortality from shrimp trawling can be reduced by at least 50 percent. Management strategies being considered to achieve this goal include area closures, seasonal closures, and the use of bycatch reduction devices on shrimp trawls.

Wetlands

In the mid-1950s, it was estimated that the nation had about 107.5 million acres of wetlands, including 55 million acres of palustrine forested wetlands and 33 million acres of palustrine marshes. By the mid-1990s, the total had slipped by 6 percent to 100.9 million acres. (Part III, Table 6.12) This continues a long trend of wetland losses. Between the 1780s and 1980s, some 22 states lost more than 50

Figure 6.20 Commercial Landings of Red Snapper in the Atlantic and Gulf, 1950-1997



Source: National Marine Fisheries Service (NMFS), *Fisheries of the United States* (NMFS, Washington, DC, annual).

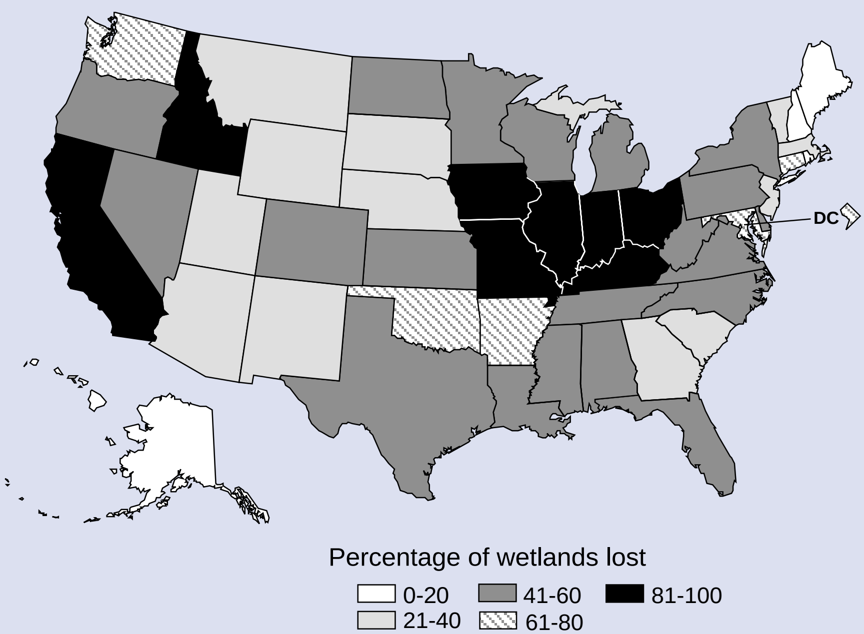
percent of their wetland area (Figure 6.21). (Part III, Table 6.13)

Historically, conversion of wetlands to cropland has been the single biggest factor in wetland losses. Recently, however, agricultural conversion has declined sharply, largely as a result of numerous federal laws and programs designed to preserve wetlands. (Part III, Table 6.14) The Wetlands Reserve Program, established in 1990, and the Emergency Wetlands Reserve Program, established in response to the 1993 flooding in the Upper Mississippi River and Lower Missouri Basins, were established to restore wetlands through the purchase of conservation easements from willing sellers. As of July 1997, 533,026 acres had been enrolled in 43 states. Fifty-eight percent (308,648 acres) of the total was enrolled in Louisiana, Mississippi, Missouri, Arkansas, and Iowa (Figure 6.22).

ONLINE RESOURCES

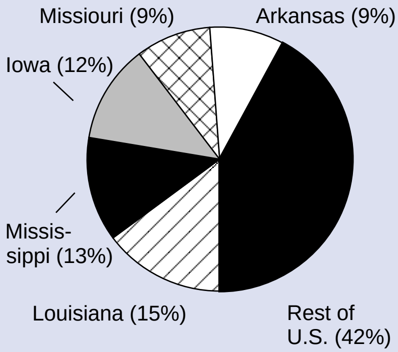
A good site for information on water resources is the Department of Interior's U.S. Geological Survey (http://water.usgs.gov). This site provides information about national water conditions, historical water data, fact sheets on a variety of water-related topics, and many other features.

Figure 6.21 Wetland Losses by State, 1780s to 1980s



Source: See Part III, Table 6.13.

Figure 6.22 States with Largest Acreages in Wetlands Reserve Programs, July 1997



Source: USDA, ERS, *Wetlands Reserve Programs*, AREI Updates 1997, No. 6 (Washington, DC, 1997).
Note: Data refer to percentage of total enrollment (533,026 acres).

Another valuable source of information is EPA's Office of Water (http://www.epa.gov/ow) and the new Watershed Information Network (http://www.epa.gov/win), which was developed by EPA in partnership with a number of other federal agencies. Within the Office of Water is the Office of Wetlands, Oceans, and Watersheds. This site includes special pages on wetlands (http://www.epa.gov/owow/wetlands) and oceans and coastal protection (http://www.epa.gov/owow/ocean). Interior's Fish and Wildlife Service also maintains a useful site devoted to wetlands (http://www.nwi.fws.gov).

The Office of Water also has posted selected chapters of the latest National Water Quality Inventory (http://www.epa.gov/OWOW/monitoring/wqreport.html). Information on the 1996 Clean Water Needs Survey is online (http://www.epa.gov/owm/toc.htm).

For information on drinking water, visit EPA's Office of Ground Water and Drinking Water online (http://www.epa.gov/OGWDW/) and the 1998 Drinking Water Infrastructure Needs Survey (http://www.epa.gov/OGWDW/docs/needs/).

At the Department of Commerce, the National Oceanic and Atmospheric Administration (http://www.noaa.gov) has a valuable website with information on coastal issues and fisheries, a does NOAA's "State of the Coast" site (http://state-of-coast.noaa.gov). NOAA's National Marine Fisheries site is also valuable (http://www.noaa.gov/nmfs). Information on fisheries is available from each NMFS regional office.

The U.S. Coast Guard maintains several sites devoted to marine environmental protection, including a general site on marine environmental protection programs (http://www.uscg.mil/hq//g-m), and a site with information on pollution incidents in and around U.S. waters (http://www.uscg.mil/hq/gm/nmc/response/stats/aa.htm). The Coast Guard's Sea Partners campaign is an environmental education and outreach program designed to increase awareness of maritime pollution and marine environmental laws (http://www.uscg.mil/hq/g-m/nmc/seapart.htm).

Globally, there are many valuable online sites. The Food and Agriculture Organization of the United Nations (http://www.fao.org) monitors the condition of global fisheries (http://www.fao.org/WAICENT/FAOINFO/FISHERY/FISHERY.HTM). The site also includes information about trends in world fish trade and management issues.

DG XIV (http://europa.eu.int/comm/dg14/dg14.html) is the European Commission's Directorate-General responsible for the Common Fisheries Policy, which covers all fishing activities under Article 39 of the Treaty of Rome. DG XIV maintains a large links site (http://europa.eu.int/comm/dg14/site.htm) that provide access to dozens of research institutes, academic sites, and government sites.

The International Center for Living Aquatic Resources Management (ICLARM), which is a member of the Consultative Group on International Agricultural Research, maintains a website (http://www.cgiar.org/iclarm). This site provides a variety of information on the management and conservation of aquatic resources.

NGOs with an interest in aquatic issues include American Rivers (http://www.amrivers.org), National Audubon Society (http://www.audubon.org), National Wildlife Federation (http://www.nwf.org), Center for Marine Conservation (http://www.cmc-ocean.org), Ducks Unlimited (http://www.ducks.org), and The Nature Conservancy (http://www.tnc.org).

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