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Public Health and Aquatic Life Concerns

This chapter describes how impaired water quality may affect public health and aquatic life. Several sections describe efforts to evaluate impacts on different beneficial uses. These uses include fish and wildlife consumption, shellfish consumption, drinking water, recreation, and aquatic life.

Public Health Concerns

Water pollution threatens both public health directly through the consumption of contaminated food or drinking water, or indirectly through skin exposure to contaminants present in recreational or bathing waters. Contaminants that threaten human health include toxic chemicals and waterborne disease-causing pathogens such as viruses, bacteria, and protozoans.

Toxic chemicals have been linked to human birth defects, cancer, neurological disorders, and kidney ailments. Waterborne pathogens can cause acute respiratory illness, gastrointestinal problems, jaundice, dehydration, inflammation of the brain, eye infections, and heart anomalies.

Fish and Wildlife Consumption Advisories

To protect the public from ingesting harmful quantities of toxic pollutants in contaminated noncommercial fish and wildlife, states and tribes issue fish and wildlife consumption advisories. Advisories may completely ban consumption in severely polluted waters or limit consumption to several meals per month in cases of less severe contamination. They may target a subpopulation at risk (such as children, pregnant women, or nursing mothers), specific fish species that concentrate toxic pollutants in their flesh, or larger fish within a species that may have accumulated higher concentrations of a pollutant over a longer lifetime than a smaller (i.e., younger) fish.

Many toxic chemicals concentrate in fish and shellfish.

EPA evaluates the national extent of toxic contamination in noncommercial fish and shellfish by counting the total number of waterbodies with consumption advisories in effect. The National Listing of Fish and Wildlife Advisories (NLFWA) database, which centralizes fish consumption advisory information maintained by various state and tribal agencies, was updated in 2000 and can be accessed on the Internet at *http://www.epa.gov/ost/fish/*.

The 2000 EPA NLFWA listed 2,838 advisories in effect in 48 states, the District of Columbia, and American Samoa (Figure 7-1). An advisory may represent one waterbody or one type of waterbody within a state's jurisdiction. Statewide advisories are counted as one advisory (see Appendix E, Table E-1, for individual state data).

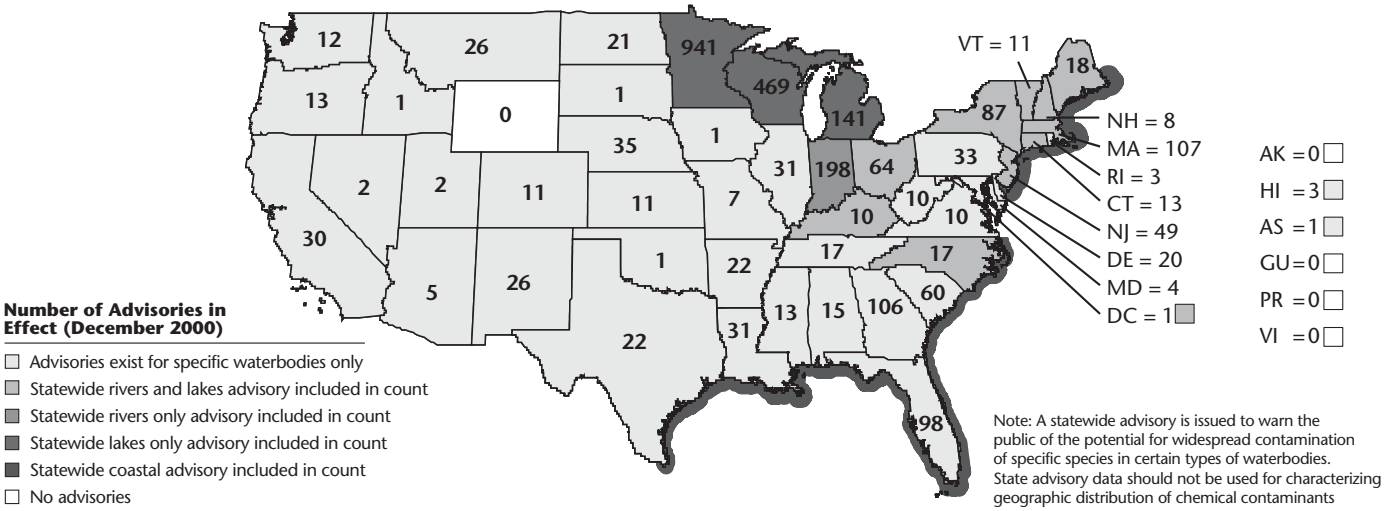
National statistics on advisories are difficult to interpret because the intensity and coverage of state monitoring programs vary widely. In addition, each state sets its own criteria for issuing advisories. EPA has provided guidance to the states and tribes for developing consistent criteria and methods for issuing and communicating fish consumption advisories in several recent publications and at conferences. However, it will be several years before states implement consistent methods and criteria and establish a baseline inventory of advisories. EPA expects the states to issue more advisories as they sample more sites and detect new areas of contamination.

Mercury, PCBs, chlordane, dioxins, and DDT (with its byproducts) caused 99% of all the fish consumption advisories in effect in 2000 (Figure 7-2). EPA banned or restricted the use of PCBs, chlordane, and DDT over 20 years ago, yet these chlorinated hydrocarbon compounds persist in sediments and fish tissues and still threaten public health.

The source of mercury contamination is difficult to identify because mercury occurs naturally in soils and rock formations. Natural processes, such as weathering of mercury deposits, release some mercury into surface waters. However, human activities have accelerated the rate at which mercury accumulates in our waters and enters the food web. Air pollution may, in fact, be the most significant source of mercury contamination in surface waters and fish. According to EPA's Toxics Release Inventory, almost all of the mercury released by permitted polluters enters the air; industries and waste treatment plants discharge very little mercury directly into surface waters.

Figure 7-1

Fish and Wildlife Consumption Advisories in the United States



Note: States that perform routine fish tissue analysis (such as the Great Lakes states) will detect more cases of fish contamination and issue more advisories than states with less rigorous fish sampling programs. In many cases, the states with the most fish advisories support the best monitoring programs for measuring toxic contamination in fish, and their water quality may be no worse than the water quality in other states.

Based on data contained in EPA's National Listing of Fish and Wildlife Advisories database acquired from the states in December 2000 (see Appendix E, Table E-1, for individual state data).

Shellfish Consumption Advisories

Contaminated shellfish pose a public health risk particularly to those who consume raw shellfish. Shellfish, such as oysters, clams, and mussels, extract their food (plankton) by filtering water over their gills. In contaminated waters, shellfish accumulate bacteria and viruses on their gills, mantle, and within their digestive systems. If shellfish grown in contaminated waters are not cooked properly, consumers may ingest live bacteria and viruses.

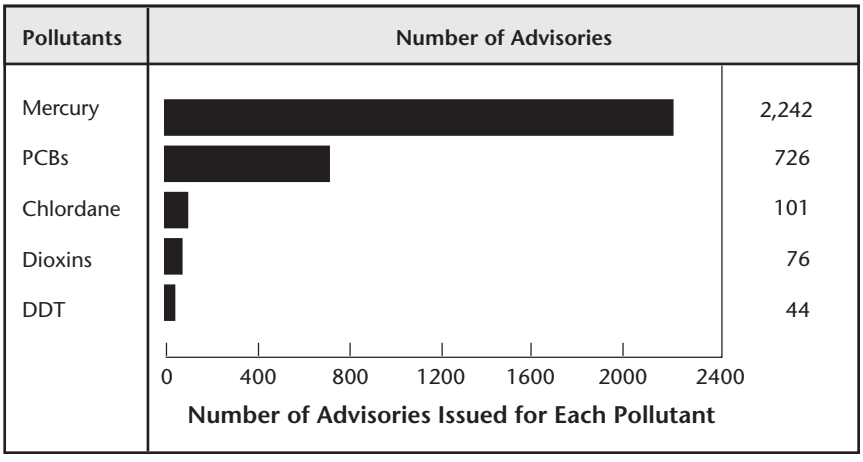
To protect public health, the U.S. Food and Drug Administration administers the National Shellfish Sanitation Program (NSSP). The NSSP establishes minimum quality monitoring requirements and criteria for state shellfish programs that want to sell and transport their shellfish in interstate commerce. Coastal states routinely monitor water quality in shellfish harvesting areas for bacterial contamination and restrict shellfish harvests in contaminated waters. Most often, states measure concentrations of fecal coliform or total coliform bacteria, which are bacteria that populate human digestive systems and occur in fecal wastes. Their presence in water samples is an indicator of sewage contamination that may pose a human health risk from pathogenic viruses and bacteria.

The size of waters with shellfishing restrictions is our most direct measure of impacts on shellfishing resources. However, only 10 of the 28 coastal states and territories reported the size of their estuarine waters affected by shellfish harvesting restrictions. With so few states reporting numerical data, EPA cannot summarize the national scope of shellfish harvesting conditions at this time. The National Oceanic and Atmospheric Administration is developing a database to track state restrictions that should provide a more complete profile of shellfishing conditions in the future.

The reporting states prohibit, restrict, or conditionally approve shellfish harvesting in 1,630 square

Figure 7-2

Pollutants Causing Fish and Wildlife Consumption Advisories in Effect in 2000



Note: An advisory can be issued for more than one pollutant.

Based on data contained in EPA's National Listing of Fish and Wildlife Advisories database acquired from the states in December 2000 (see Appendix E, Table E-2, for individual state data).

MERCURY is the most common contaminant found in fish.

miles of estuarine waters. About 11% of these waters are conditionally approved, so the public can harvest shellfish from these waters when the state lifts temporary closures. For comparison, nine states reported that over 7,300 square miles of estuarine waters are fully approved for harvesting shellfish at all times (Appendix E, Table E-3, contains individual state data).

Only three states reported the size of shellfish restrictions caused by specific sources of pathogen indicators (Figure 7-3). Other states provided narrative information about sources degrading shellfish waters. The reported sources included marinas, stormwater runoff, waterfowl, industrial and municipal discharges, agriculture, and septic tanks.

Drinking Water Contamination

Thanks to decades of effort by public and private organizations and the enactment of safe drinking water legislation, most Americans can turn on their taps without fear of receiving unsafe water. Ensuring consistently safe drinking water requires the cooperation of federal, state, tribal, and municipal governments to protect the water as it moves through three stages of the system—the raw source water, the water treatment plant, and the pipes that deliver treated water to consumers' taps. Polluted source waters greatly increase the level and expense of treatment needed to provide treated water that meets public health standards.

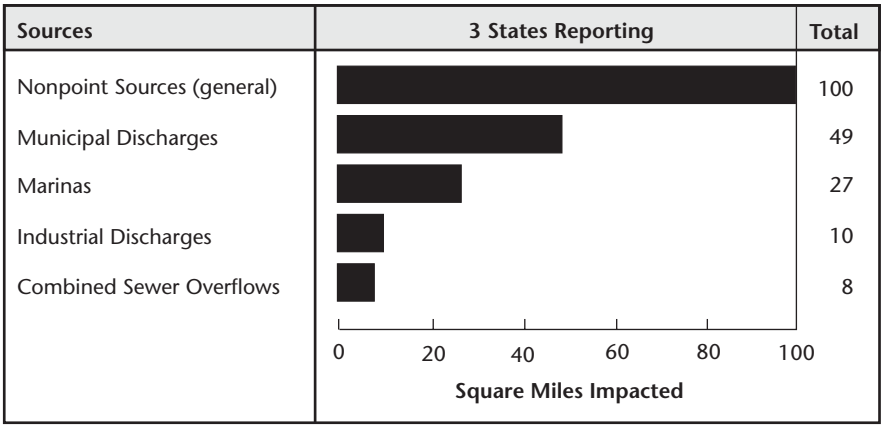
The Safe Drinking Water Act (SDWA) calls for states to determine the susceptibility of waters to contamination, and Section 305(b) of the Clean Water Act calls for them to assess the ability of waters to support drinking water use. States use the general criteria outlined in Table 7-1 to determine the degree of drinking water use support for their waterbodies. These criteria may be modified by the states to fit their individual situations.

In 2000, 39 states, tribes, or territories submitted drinking water use data in their reports. Table 7-2 shows the total number of miles of rivers and streams and acres of lakes and reservoirs assessed and the degree of drinking water use support for the entire nation. The majority of waterbodies assessed, 86% of river and stream miles and 84% of lake and reservoir acres, are considered to be supporting their drinking water use.

While reporting on drinking water use has improved over the past 10 years, many challenges still remain. Seventeen states did not report data on drinking water use support. Many of the 39 states that reported data did not present any information on how they classified their waterbodies for drinking water use support, and did not identify specific contaminants or sources of water contamination. This lack of information complicates data

Figure 7-3

Sources Associated with Shellfish Harvesting Restrictions



Based on data contained in Appendix E, Table E-4.

interpretation and presents challenges for accurately assessing and representing drinking water use support. Table 7-3 summarizes all of the contaminants cited as causing drinking water use impairment, based on the limited number of states identifying contaminants.

Recreational Restrictions

State reporting on recreational restrictions, such as beach closures, is often incomplete. Most state agencies rely on local health departments to voluntarily monitor and report beach closures, and this information may not always be shared with the state water quality agency. In addition, health departments that monitor infrequently will detect fewer bacteria violations than health departments with rigorous beach monitoring schedules.

Four states reported that no contact recreation restrictions were reported to them during the 2000 reporting cycle. Thirteen states and tribes identified 233 sites where recreation was restricted at least once during the reporting cycle (Appendix E, Table E-6, contains individual state data). Three states (California, Louisiana, and New Jersey) reported on the number of restrictions but did not specify the number of sites at which the restrictions occurred. Local health departments closed many sites more than once.

Most of the restrictions were caused by pathogen indicator bacteria. Other contaminants cited include gasoline from spills, debris found in the water, algal blooms, a cluster of Shigellosis cases, and pollutants in urban runoff.

The states identified sewage treatment plant bypasses and malfunctions, urban runoff storm sewers, faulty septic systems, and agricultural runoff as the most common sources of elevated bacteria concentrations in bathing areas. The states also reported that natural sources (e.g., migratory water fowl) and waste spills restricted recreational activities.

EPA initiated a Beach Watch program in 1997 to significantly reduce the risk of waterborne illness at the nation's beaches and recreational waters through improvements in recreational water protection programs, risk communication, and scientific advances. EPA conducted the third annual National Health Protection Survey of Beaches on the 2001 swimming season. State and local environmental and public health officials voluntarily returned information on 2,445 beaches—over 1,400 more beaches than in 1997, the first

Table 7-1. Criteria To Determine Drinking Water Use Support

Classification	Monitoring Data		Use Support Restrictions
Full support	Contaminants do not exceed water quality criteria	and/or	Drinking water use restrictions are not in effect
Full support but threatened	Contaminants are detected but do not exceed water quality criteria	and/or	Some drinking water use restrictions have occurred and/or the potential for adverse impacts to source water quality exists
Partial support	Contaminants exceed waterquality criteria intermittently	and/or	Drinking water use restrictions resulted in the need for more than conventional treatment
Nonsupport	Contaminants exceed water quality criteria consistently	and/or	Drinking water use restrictions resulted in closures
Unassessed	Source water quality has not been assessed		

Table 7-2. National Drinking Water Use Support*

Waterbody	Good	Impaired	Total Assessed
Rivers and Streams			
Miles	132,080	20,989	153,155
Percentage	86%	14%	
Lakes and Reservoirs			
Acres	6,041,725	1,202,850	7,259,955
Percentage	84%	17%	

*Does not include waters rated not attainable.

year of the survey. This information is now on the Beach Watch web site at *http://www.epa.gov/waterscience/beaches/*. The survey shows that 672 beaches (27% of the reported beaches) were affected by at least one advisory or closing. This percentage of beaches affected is essentially the same percentage reported over the last 2 years. The leading reasons cited for water quality impairment at beaches were elevated bacteria levels and rain events (stormwater runoff).

Aquatic Ecosystem Concerns

Although aquatic organisms can tolerate most viruses, bacteria, and protozoans harmful to humans, they may be more severely affected by the presence of toxic chemicals in their environment. Toxic chemicals have the potential to kill all or selected aquatic organisms within a community, increase their susceptibility to disease, interfere with reproduction, or reduce the viability of their young. Toxic chemicals may also affect aquatic organisms indirectly by altering the delicate physical and chemical balance that supports life in an aquatic community. Aquatic organisms are also susceptible to changes in the physical quality of their environments such as changes in pH, temperature, dissolved oxygen, amount of sediment, and habitat.

To strengthen their ability to protect the biological integrity of aquatic ecosystems, EPA encourages states to adopt designated uses or biological criteria that define the aquatic community structure and function for a specific waterbody or class of waterbodies. These can be descriptive characteristics or a numeric score based on multiple measures of community structure and function. The challenge for EPA is to summarize the states' individual assessments, which often are based on very diverse standards. The basis for EPA's summary is the information reported by the states on the extent to which their waters support the aquatic life use goal.

In 2000, states reported that aquatic life uses were supported in 66% of their river and stream miles, 71% of their lake and reservoir acres, 48% of their estuarine square miles, 94% of their coastal shoreline miles, and 82% of their Great Lakes shoreline miles.

Table 7-3. Sources of Drinking Water Use Impairment

Contaminant Group	Specific Contaminant	
Pesticides	Atrazine Metolachlor Triazine	Molinate Ethylene dibromide
Volatile organic chemicals	Trichloroethylene Tetrachloroethylene 1,1,1-Trichloroethane *cis*-1,2-Dichloroethylene Trihalomethanes Carbon tetrachloride Ethylbenzene 1,1,2,2-Tetrachloroethane	Dichloromethane 1,1-Dichloroethane 1,1-Dichloroethylene Toluene Benzene Dichlorobenzene Methyl tertiary butyl ether Xylene
Inorganic chemicals	Arsenic Nitrates Iron Copper Chloride	Fluoride Manganese Lead Sodium
Microbiological contaminants	Exceedance of total coliform rule	Exceedance of fecal coliform rule

Sediment Concerns (Sedimentation and Contamination)

Sedimentation (siltation) was the second most reported cause of impairment to rivers and streams, according to 2000 state 305(b) data. Sedimentation impairs 84,478 river and stream miles (12% of the assessed river and stream miles and 31% of the impaired river and stream miles). Sedimentation suffocates fish eggs and smothers the habitat of bottom-dwelling organisms such as aquatic insects. The loss of aquatic insects adversely impacts fish and other wildlife that prey on these insects. Excessive sedimentation can also interfere with drinking water treatment processes and recreational use of a river. Sources of sedimentation include agriculture, urban runoff, construction, and forestry.

Sediment contamination occurs when certain types of chemicals in water settle and collect in sediment. Chemicals in sediment often persist longer than those in water, in part because they tend to resist natural degradation and in part because conditions might not favor natural degradation. When present at elevated concentrations in sediment, contaminants can be taken up by organisms that dwell in or on sediments and can bioaccumulate up the food chain. Contaminants can also be released from sediment back into the water column. In both cases, excessive levels of chemicals in sediment may become hazardous to aquatic life and humans.

In their 2000 305(b) reports, 12 states and tribes listed 196 separate sites with contaminated sediments and identified specific pollutants detected in sediments. These states most frequently listed metals (e.g., lead, copper, cadmium), PCBs, pesticides, PAHs, and other priority organic toxic chemicals. These states also identified industrial and municipal discharges (past and present), landfills, railroad and construction sites, marinas, shipyards, and abandoned hazardous waste disposal sites (Superfund) sites as the primary sources of sediment contamination. Other states have not utilized numeric criteria for chemical contaminants in sediment or lack the analytical tools and resources to conduct extensive sediment sampling and analysis. Therefore, the limited information provided by states and tribes probably understates the extent of sediment contamination in the nation's surface waters.

In 2002, EPA plans to release the first update to the initial *National Sediment Quality Survey* report published in 1997. This report to Congress identifies locations in the United States where data suggest that sediment is contaminated at levels potentially harmful to aquatic life or human health. EPA expects that this information can be used to target further investigations of sediment contamination on a national, regional, and site-specific scale.

In support of the *National Sediment Quality Survey*, EPA has developed the National Sediment Inventory (NSI) database. This database presents a compilation of environmental monitoring data (sediment chemistry, tissue residue, and toxicity) from a variety of sources for the nation's freshwater and estuarine ecosystems. EPA has also developed guidance and information sources to provide states with better tools for assessing and managing sediment contamination. For more information on EPA's contaminated sediment program, visit the program on the Internet at *http://www.epa.gov/waterscience/cs/*.

Invasive Species

Invasive species, also called nonindigenous, exotic, or nuisance species, are species of plants and animals that establish a new range in which they reproduce, spread, and persist, to the detriment of the native species and the natural environment. Over the past decade, an increasing number of these invasive species have been unintentionally introduced into nonnative aquatic environments resulting in harmful, sometimes devastating, ecological, public health, and socioeconomic effects. These invasive species include fauna such as the Asian clam, Asian green mussel, zebra mussel, and Japanese shore crab; plant species such as the salt marsh grass *Spartina alterniflora* and Eurasian water milfoil; and pathogens like cholera. Introduction of invasive species has occurred through several routes, most notably through fouling of ships hulls, discharge of ship ballast water, Atlantic and Pacific Ocean oyster shipments, and stocked fish and shellfish via mariculture operations or the aquarium trade.

Through predation and competition, invasive species have contributed to drastic reductions in some native species and eradication of others, thereby fundamentally altering the food chain. For instance, salt marsh grass has spread rapidly and displaced native wetland species in northern California, Oregon, and Washington.