LONG ISLAND SOUND STUDY

Pathogens

Long Island Sound is as famous for its fish and shellfish as it is for boating, swimming, and scuba diving. The Sounds sheltered embayments are the most desirable areas for many recreational and commercial activities. Yet, it is on the shorelines of these embayments that developments are concentrated. Pathogen contamination, caused poor land use and flawed waste disposal practices, often impairs our ability to swim or harvest shellfish in many bays. In 1989, the dockside value of Long Island Sound's commercial bivalve shellfishery – clams, oysters, and mussels (excluding bivalves harvested in relay and depuration programs) – was over $30 million. Because pathogen contamination closes beaches and restricts shellfish harvesting, it seriously affects the region, economically and socially.

Origins and Effects of Pathogens

Certain bacteria, viruses, and protozoa are known as pathogens. When people ingest these microorganisms or allow them to enter their bodies, they may incur illnesses and diseases such as gastroenteritis, cholera, typhoid fever, salmonella, or hepatitis A. Pathogens that concentrate in the fecal waste of infected humans and warm-blooded animals, find their way to Long Island Sound via both point and nonpoint routes (see Fact Sheets #3 and #7). Specific sources of pathogens include improperly and untreated sewage discharges from combined sewer overflows (CSOs), sewage treatment plant breakdowns, and pumping station bypasses; stormwater runoff; waterfowl and animal wastes; septic systems; inadequately treated sewage discharges from boats; and illegal connections to storm drain systems.

Testing for Pathogens

As yet, there is no practical test for pathogens, human or otherwise. Consequently, their presence cannot be accurately measured. Instead, the appearance of indicator organisms determines the presence of pathogenic organisms. Coliform bacteria are used as indicators and, like pathogens, are found in the digestive tracts of all warm-blooded animals, on plant matter, and in the soil. Because coliform bacteria are typically discharged with sewage wastes, their presence in significant numbers serves as an indication that other harmful bacteria or viruses may be present.

Because coliforms are not always pathogens, they are not perfect indicators. Despite the limitations, standards based on coliforms have minimized typhoid and cholera outbreaks caused by eating shellfish or swimming polluted waters. Scientists are evaluating the reliability of other indicators. These new indicators may improve our ability to identify the presence of human pathogens.

Currently, three types of indicators are measured: total coliform, which comes from decaying matter, feces, and soil; fecal coliform, which is a component of total coliform bacteria; and enterococcus, which comes from feces of warm-blooded animals, including humans. All suggest the possible presence of harmful bacteria and viruses.

Stormwater runoff that contains animal wastes and soil washed from the land is often a major source of fecal coliform bacteria (see Figure 1). In many older cities, sanitary and storm sewer systems are combined. So when it rains, the volume of these combined flows often exceeds the capacity of the sewage treatment plant. This results in the discharge of untreated wastes containing fecal and other coliforms into coastal waters. (In Figure 1, CSOs are part of the urban runoff category.) The outflows of combined sewers and sewage treatment plants have a higher probability of disease transmission because they carry high levels of bacteria in a concentrated form.

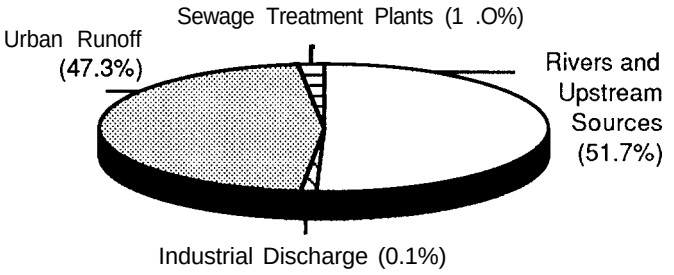

Figure 1. Estimated fecal coliform discharges to Long Island Sound in 1986. The urban runoff category includes CSOs; the river load includes point and nonpoint sources from upstream. Source: National Coastal Pollutant Discharge Inventory: Estimates for Long Island Sound.

Effects of Pathogen Contamination

1. Closure of Bathing Beaches

Swimming in contaminated waters can lead to

Beach Closure Standards

Westchester County *	Total coliform greater than 2,400/100 ml
New York City and Nassau County *	
Suffolk County, New York	Fecal coliform greater than 400/100 ml
Connecticut (single sample)	Enterococcal organisms greater than 61/100 ml

* Rainwater runoff can raise total coliform levels because it carries decaying matter and animal and human waste. Certain beaches in Mamaroneck Harbor are automatically closed following rain events. Nassau County recommends people refrain from swimming in certain areas after significant rainfall because the coliform levels may be increased but not exceed the standard.

Coliform standards are based on a log-mean average for 5 or more samples within 30 days.

bacterial and viral infections. Therefore, beaches are monitored and closed by the health department when levels of indicator organisms exceed acceptable standards. But because these standards are set by local health departments, they may vary among jurisdictions (see box). Figure 2 shows the number of Long Island Sound beach days lost due to coliform contamination. Many of New York's beach closures were not the direct result of measured coliform levels - rather, they were precautionary closings caused by sewage treatment or pumping station failures in the vicinity of a bathing beach. The increased number of beach closures in 1989 is related to the record rainfall experienced that year.

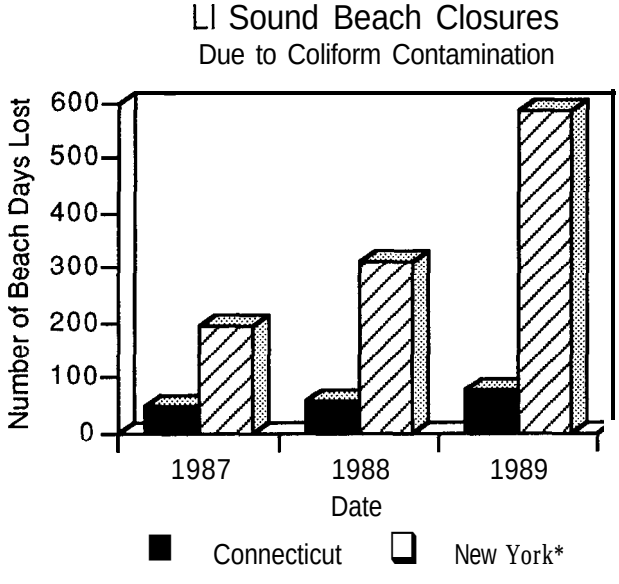

Figure 2. Long Island Sound beach closings due to coliform contamination. Number of beach days lost equals the sum of the number of days all beaches were closed. • Excludes New York City beaches

2. Closure of Shellfishing Grounds

Pathogen contamination also limits the use of shellfish resources. Bivalve shellfish, such as oysters, mussels, and clams, feed by filtering large quantities of water and extracting food particles. If the shellfish are growing in polluted areas, this process will collect and even concentrate pathogens in their digestive systems. By eating whole, partially cooked, or raw contaminated shellfish, viable pathogens can be passed on to the consumer. Other forms of seafood, such as lobsters, crabs, and shrimp, are not filter feeders, and are usually cooked before eating. Therefore, they are not as likely to be contaminated with pathogens. The LISS Fact Sheet #9, "Seafood Issues," describes how to ensure the shellfish you eat are safe and are of high quality.

Shellfish Sanitation Program

Shellfish growing waters are routinely tested for coliform levels. This is to assure the shellfish being harvested are safe for human consumption. Under the National Shellfish Sanitation Program, initiated in 1925, States are responsible for ensuring that shellfish are harvested only from clean waters. The New York State Department of Environmental Conservation and the Connecticut Department of Agriculture, along with some coastal municipalities, monitor and regulate the Sound's shellfish resources and enforce contaminated shellf'ishing area closures. Shellfish can be harvested only from areas where the median coliform values are routinely found to be below 70 total or 14 fecal coliforms per 100 milliliters of water.

Shellfish can be moved from pathogen contaminated waters to clean waters, where they will flush out the pathogens over a period of several weeks. Transplanting or relaying shellfish to clean waters allows for natural purification or flushing. Controlled purification takes place in depuration plants in which shellfish are held in tanks with rapidly circulating water. Both types of activities are carefully regulated by state agencies.

The Shellfish Sanitation Program has been very

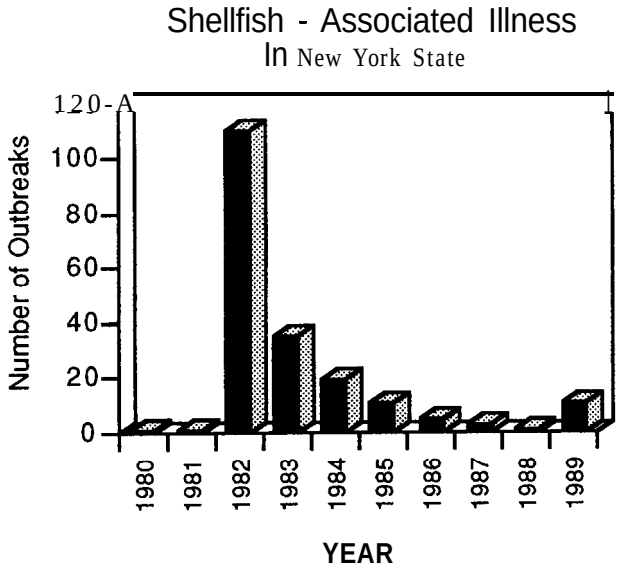

Figure 3. Shellfish-associated illness reported in New York State. Source: Bureau of Community Sanitation and Food Protection, New York State Dept. of Health.

effective in controlling outbreaks of shellfish-borne disease. Figure 3 summarizes shellfish-associated illnesses reported in New York State over the past decade (it includes shellfish harvested outside state waters). In 1982, many reported illnesses were traced to clams harvested in New England and Europe. In 1989, only ten outbreaks were reported in Connecticut, no major outbreaks were reported in previous years. An outbreak represents two or more illnesses at one location.

Shellfish Area Classifications

Approved or Certified Areas:
Shellfish can be freely harvested from areas that meet appropriate state and National Shellfish Sanitation Program bacterial standards. These areas are regularly sampled by shellfish regulatory agencies.

Conditionally Approved or Certified Areas:
Any area influenced by occasional and predictable deterioration of water quality. Shellfish can be directly harvested only under specified conditions (i.e., when water quality meets certified criteria under identified situations of reduced pollutant inputs). The area is temporarily closed when certified criteria are not met. Rainfall is a major factor that affects conditional closings.

Restricted Areas:
Areas that do not meet the certified area criteria. Shellfish may be harvested from these areas for transplanting or depuration under special permits from the State Shellfish Control Agency.

Conditionally Restricted Areas:
Any area predictably influenced by pathogenic contamination, as with conditionally certified areas.

Prohibited Areas:
No harvesting is permitted from areas that are grossly contaminated or for which no shoreline survey and water quality assessment has been recently completed.

Extent of Pathogen Contamination in Long Island Sound

	Connecticut (acres)	New York (acres)	Total (acres)
Potential shellfishing grounds	392,419	471,220	863,639
Prohibited or restricted areas	78,009 (20%)	82,445 (18%)	160,454
Productive shellfish beds	52,500	66,000	118,500
Prohibited or restricted areas where beds are productive	18,375 (35%)	48,500 (73.5%)	66,875

As of January 1990. Source: NY Dept. of Environmenta Conservation and CT Dept. of Agriculture.

The LISS and Pathogen Contamination

Figure 4 compares average total coliform concentrations for wet and dry weather conditions from June to September 1989. This type of data, when combined with other available information, will be used to characterize pathogen contamination in Long Island Sound. Figure 5 shows the decreasing trends in total coliform levels in the East River and Western Sound.

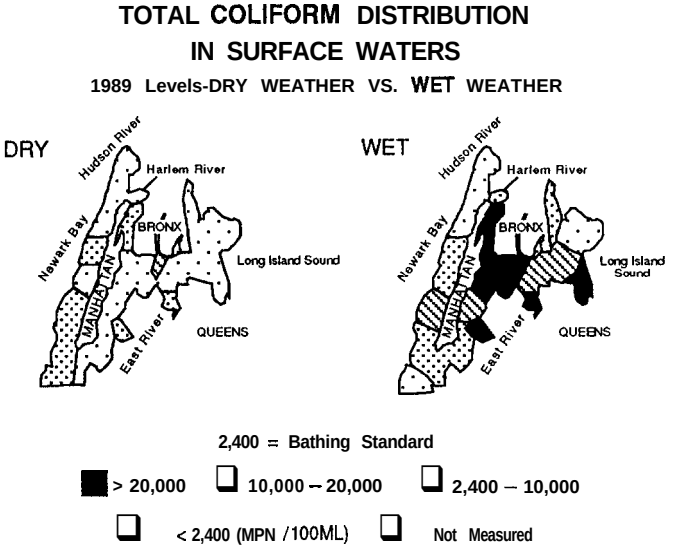

Figure 4. Comparison of wet and dry weather average total coliform concentrations measured at the surface from June to September 1989. Bathing standard is applicable in western Sound only. Source: New York City Department of Environmental Protection.

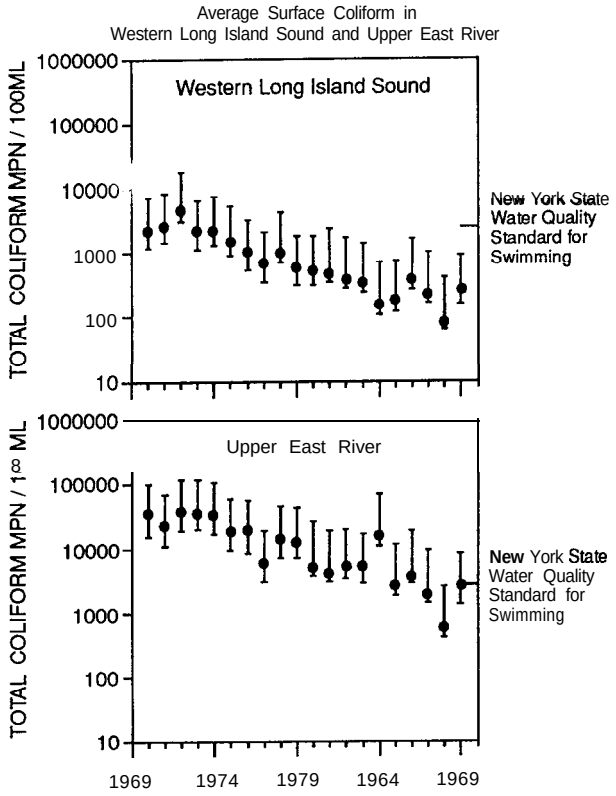

Figure 5. Average total coliform concentrations measured at the surface from June to September 1970 through 1989 in the East River and Western Sound. Bathing standard is applicable east of the Whitestone Bridge. Source: New York City Department of Environmental Protection.

The Long Island Sound Study (LISS) is investigating ways in which the Sound's water quality can be maintained or enhanced. Under an Action Plan Demonstration Project, the LISS is studying the relationship of urban stormwater runoff to coliform levels in the Mamaroneck Harbor area. Nonstructural coliform reduction management practices (catch basin cleaning, street sweeping, and an educational program on pet waste ordinances) have been implemented and evaluated. Although the results have shown that these measures alone did not reduce coliform levels, the project's goal of improving water quality can still be achieved. Coliform modeling will provide estimates of effluent limits for point source discharges into the Harbor. These estimates can be used to develop goals that will continue to reduce pathogen inputs to the Sound.

In its Comprehensive Conservation and Management Plan (due out in November 1991), the LISS will identify specific actions to reduce pathogen contamination in the Sound. Scientists and managers will characterize the conditions for pathogen closures in the Sound, identify standards used, and evaluate the need for a uniform beach closure standard.

The Long Island Sound Study

The Long Island Sound Study (LISS) is a six-year research and management project that began in 1985 as part of the National Estuary Program, a recent addition to the federal Clean Water Act created to protect estuaries of national importance. The LISS is a cooperative effort involving research institutions, regulatory agencies, marine user groups and other concerned organizations and individuals. The purpose of the Study is to produce a management plan for the Sound that will be administered by the three major LISS partners, the Environmental Protection Agency and the states of New York and Connecticut. To become involved with the Study, or for more information, contact the New York Sea Grant Extension Program, 125 Nassau Hall, SUNY, Stony Brook, NY 11794, Tel. (516) 632-8737; or the Connecticut Sea Grant Marine Advisory Program, 43 Marne Street, Hamden, CT 06514, Tel. (203) 789-7865.

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