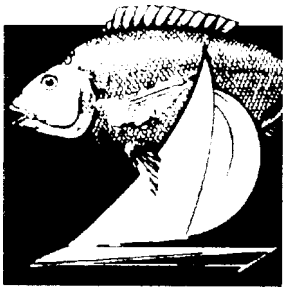


LONG ISLAND SOUND STUDY

Toxic Contamination in Long Island Sound

Of the 55,000 chemicals in use today, many are poisonous or toxic. The effect of toxic contaminants on the health of Long Island Sound, and on those who use it, is a major concern of the Long island Sound Study (LISS).

What is Being Done About Toxic Contamination?

LISS Investigators are evaluating information that identifies which toxic substances are of concern, where they come from, where they end up, how they affect the ecosystem, and what the health risks are for human consumers of seafood products. Ultimately, the LISS will produce a Comprehensive Conservation and Management Plan (CCMP) that will include a section on management of toxic substances. One goal of the Study is to reduce impacts from toxic contamination on Long Island Sound resources. Another is to minimize human health risks

Which Toxic Contaminants Should We Be Concerned About?

Land use and the manufacture, use, and disposal of everyday products all contribute contaminants to the system. The LISS has established a list of toxic pollutants we should be concerned about in our area that reflect past and present activities in the Sound's drainage basin (Table 1). Although metals are naturally found in the environment, their levels are often elevated by human activities. Because copper, zinc, cadmium, and chromium are commonly used in industry, they are found on the LISS target list. Other metals on the list such as lead have also built up in the Sound as a result of everyday activities, primarily automobile use.

The LISS list also contains organic (carbon-based) pollutants. Many of these substances are synthetic, that is, they do not occur naturally in the environment. Polychlorinated biphenyls (PCBs) and most of the pesticides listed are no longer in general production; some are still found in the Sound, however, because they take years to disperse and break down. Also listed are polynuclear aromatic hydrocarbons (PAHs) which are ubiquitous components of petroleum products. They are also produced during the combustion of organic materials such as fossil fuels, trees, trash, and even charcoal barbecues. PAHs are widely distributed by the atmosphere Long Island Sound is likely to be contaminated with PAHs near sources such as petroleum terminals, urban harbors, coal piles, and industrialized basins. Some PAHs are known carcinogens and pose a potential problem wherever they are found.

What Are The Sources of Toxic Contaminants in Long Island Sound'

Understanding the relative contributions of the various sources of toxic substances is necessary in order to develop effective strategies to protect the Sound. Both active sources or discharges and any environmental contamination resulting from historic activities must be evaluated. Currently, active discharges are regulated under the pollution discharge elimination system (PDES) permits. Management strategies are more cost effective when they are preventative, i.e. developed for ongoing activities and discharges. Once contamination occurs, cleanup is extremely costly and diff icult.

Toxic substances enter the Sound's waters as a result of natural processes and human activities. Pollution sources are categorized as either **point**

Table 1. LISS Chemical Contaminant Target List

INORGANIC COMPOUNDS

Metals

- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Zinc

ORGANIC COMPOUNDS

Pesticides

- Chlordane
- Dieldrin
- DDT, DDD, DDE
- Heptachlor
- Lindane
- Trans-nonachlor

Polychlorinated biphenyls (PCBs)
Polyaromatic hydrocarbons (PAHs)

sources, for example, discharge pipes, or **nonpoint** sources, such as stormwater runoff and atmospheric deposition (see Fact Sheet #7). Wastewater and runoff have different types and concentrations of contaminants. For example, in the Long Island Sound area, sewage treatment plants appear to be a major source of copper pollution, whereas urban runoff contributes much of the lead contamination. Recent research has shown atmospheric deposition is an important source of heavy metals such as copper, lead, mercury, and zinc. Another pollution source which cannot be ignored, is sediment already in the Sound. Prior to the 1970s, lack of stringent discharge controls led to locally contaminated sediment that can release pollutants when resuspended (see Figure 1). The contaminants may also be accumulated and redistributed by marine organisms when ingested or physically disturbed.

What Happens to Toxic Substances Once They Enter The Sound?

Once toxic chemicals are released into the environment, they may move back and forth between the water column, bottom sediment, and the food chain many times. This cycle ends when they are buried deep in the sediment or, as for some toxic organic substances (DDTs), broken down into harmless compounds (Figure 2). The residence time (average length of time a contaminant remains in a system) of a toxic organic substance depends upon the characteristics of the substance as well as the environment in which it is found. Controlling factors include the compound's structure, the medium's chemistry, and the presence of other chemicals. PCBs and chlorinated hydrocarbons such as DDT have long environmental residence times. They are foreign to the natural environment and natural metabolic processes have not evolved that quickly break them down.

Although toxic substances are found in organisms and in the water of Long Island Sound, the majority of the contaminants are attached or bound to sediment particles. Sediment found in urban harbors often contains high concentrations of contaminants since the harbors are adjacent to past or existing pollutant sources (Figure 1). It follows that sedentary and some mobile marine life living in areas that have highly contaminated sediment usually contain higher concentrations of contaminants than those found in cleaner areas such as the open Sound (Figure 3).

The uptake of organic and inorganic substances by fish and invertebrates is controlled by environmental conditions, the character of the substance, and the physiology of the organism. Generally the level of a pollutant in an organism's tissue is determined by factors such as the length of exposure (concentration over a period of time), how much fat tissue the organism has, and by its ability to metabolize and/or excrete the pollutant. Considering the wide range of contaminants, physical and chemical conditions, and marine life, it's not surprising that straightforward relationships between exposure and pollutant concentration in living tissues have not been defined.

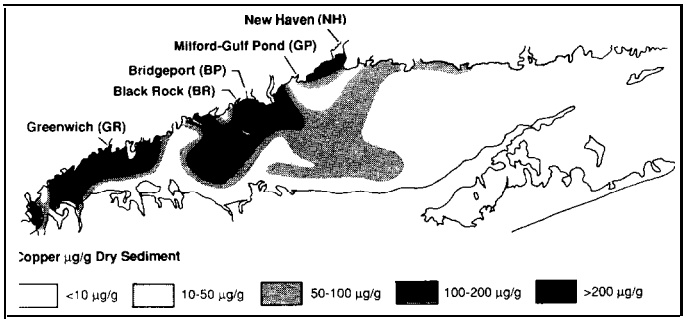


Figure 1. Distribution of Copper in surface sediments of Long Island Sound. Source: Greig, et al., 1977.

Studies conducted for the LISS and the National Oceanic and Atmospheric Administration's Mussel Watch indicate that levels of some metals and pesticides in Long Island Sound shellfish tissues have declined. Figure 4 shows the levels of metals in oyster meats have declined since the 1970s. This is the result of numerous factors, including improved treatment of industrial and sewage treatment plant discharges as required by the Federal Clean Water Act. Other factors are the movement of industries that pollute away from the Northeast and the phasing out of products that pollute such as leaded gasoline, lead paint, and persistent pesticides.

How do Toxic Substances Affect The Ecosystem?

Some substances in high concentrations can kill marine life. Other substances have a more subtle effect on marine life in terms of behavior, reproduction, or how they impact the key components of intricately balanced food webs. The net result could be a reduction in productivity and an imbalance in marine life communities towards pollution tolerant species such as the opportunistic benthic worm Capitella. This factor is more pertinent to the condition or "health" of marine resource populations rather than to the health of seafood consumers.

What Are The Human Health Risks?

Often, toxic substances are found at higher levels in organisms than in the water in which the organisms are found. This phenomenon, bioaccumulation, has special significance for seafood. Bioaccumulation occurs when the amount of

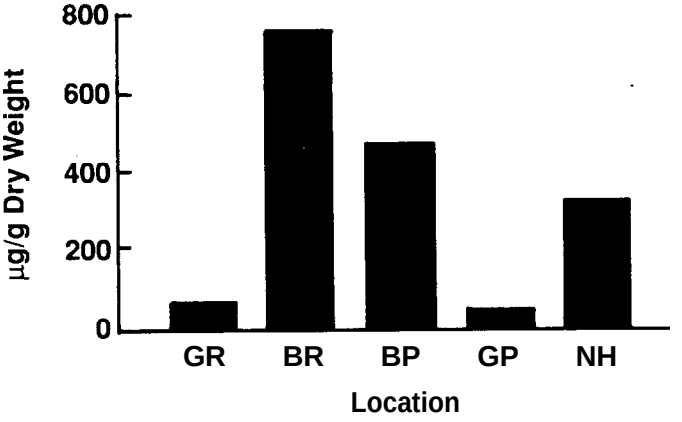
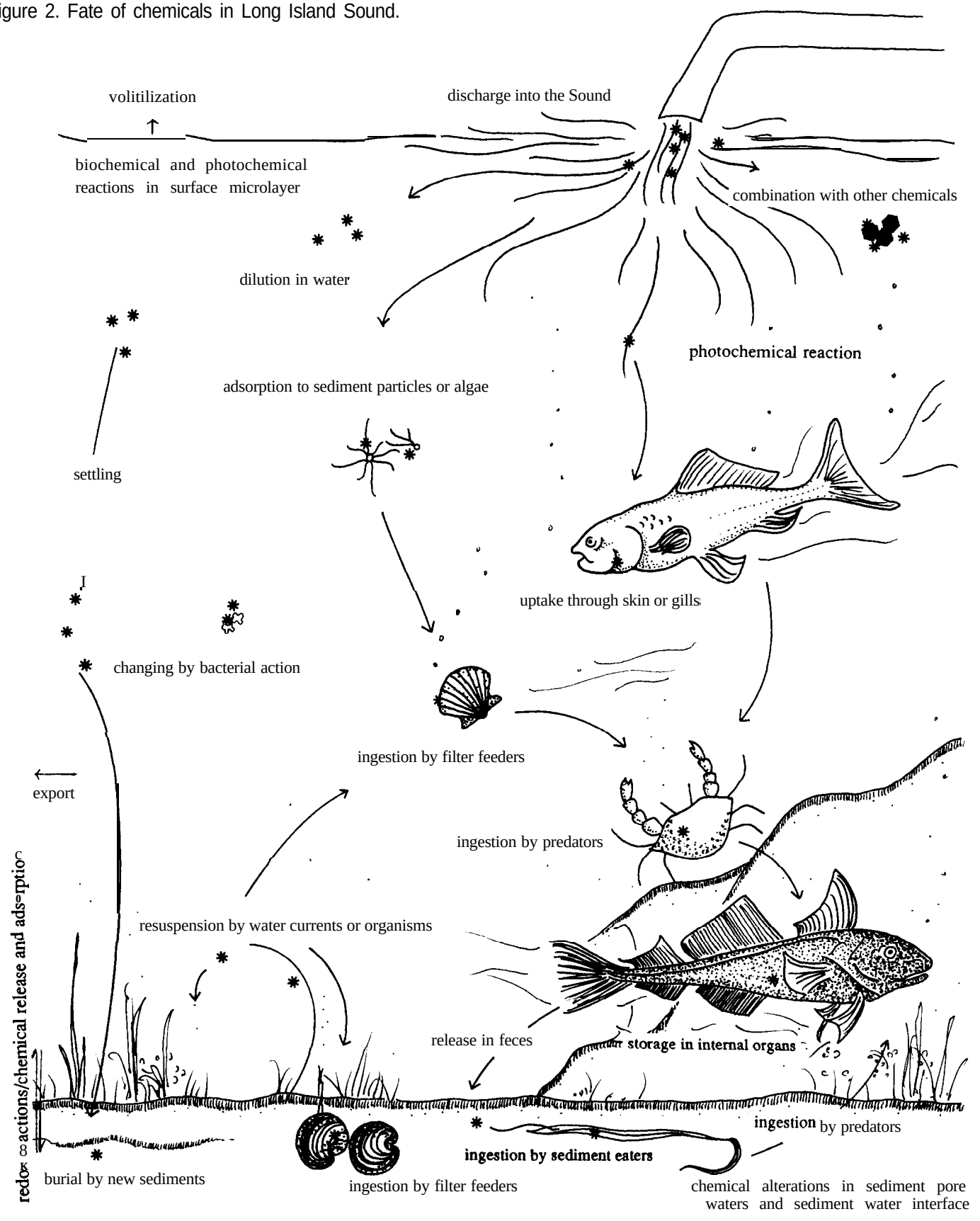


Figure 3. Copper in oysters from Long Island Sound. Source: Connecticut Department of Environmental Protection, 1986.

Figure 2. Fate of chemicals in Long Island Sound.



contaminant taken into the organism exceeds the amount removed or excreted. Bioaccumulation can cause organisms to have high levels of toxic substances in their tissues, and consequently may be a health risk to seafood consumers. Public health advisories are published to inform consumers about potential risks from eating large amounts of specific types of seafood (see Fact Sheet #9). In Long Island Sound, advisories for saltwater fish exist for only striped bass, bluefish, and lobster tomalleys. New York also has an advisory for American eels. These advisories are all because of elevated levels of PCBs. The state health officials in

Connecticut and New York involved with the LISS are working to ensure that health risks are addressed as part of the CCMP.

Managing Toxic Contaminants in Long Island Sound?

The LISS will provide information to help environmental managers focus on reducing toxic contamination in the Sound. The LISS is attempting to reduce toxic contamination in the Sound and educate the Long Island Sound community about contamination issues.

Presently, New York has water quality standards for over 20 chemicals. The LISS may also recommend additional or revised water quality standards for some toxic substances. Currently, criteria for toxic chemicals in the sediment are not well defined but they are being developed at the Federal level. The LISS will monitor progress in the development of sediment criteria and other guidelines for seafood and make recommendations for criteria usage when appropriate.

Control of toxic contaminants from point discharges around Long Island Sound is an ongoing process. The industrial pretreatment program requires industries to reduce levels of toxic substances in their effluent prior to discharging to sewage treatment plants. Conversely, any industries that discharge directly to surface waters are regulated by the PDES permitting program. The regulatory approach has evolved from being soley based on effluent limits to a combination of these limits with biological methods. Permits require some dischargers to conduct a **bioassay,** a test that exposes sensitive fish and aquatic invertebrates to its wastewater discharge. If the test organisms are impaired or die, the facility is required to determine the cause of the mortality and modify their operations to eliminate or neutralize the toxicity. Although the bioassay test does not evaluate the cumulative impacts of the buildup of pollutants within the system, it does evaluate the combined effect of all contaminants in the discharge, providing an added level of protection that numerical limits do not offer.

The densely populated nature of the land surrounding the Sound makes stormwater runoff a critical issue. Runoff carries contaminants picked up from the land to surface waters. Tackling the problem of runoff as a source of contaminants requires effective land use controls and wetland protection programs.

Until the controls being developed for all types of discharges and waste reduction become effective at reducing the levels of toxic substances in the Sound, health concerns are being identified and the public informed of them. In the future, additional control over the input from both point and nonpoint sources of chemical contamination should be the result of the coordinated efforts of an informed community of citizens, environmental scientists and managers, and elected government officials.

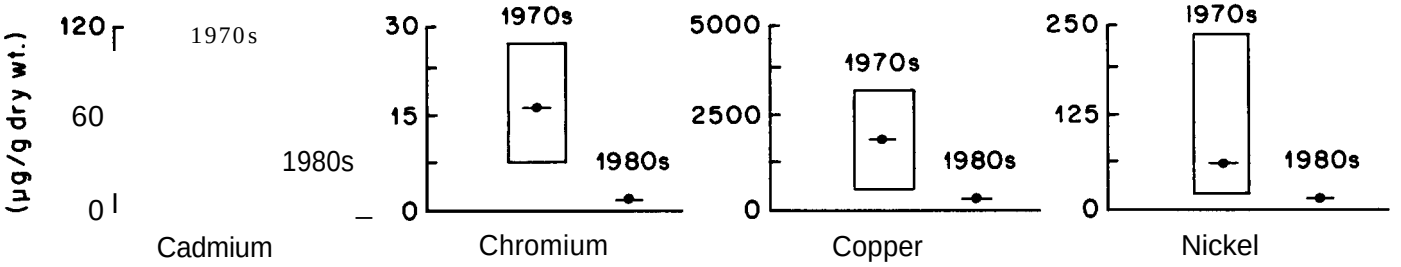


Figure 4. The mean and range of concentrations (mg/g dry wt) of selected heavy metals in oysters collected at the mouth of the Housatonic River in the 1970s compared to those collected in the 1980s. Source: 1970 data, Feng and Ruddy and 1980 data, CT Department of Environmental Protection.

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 get 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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