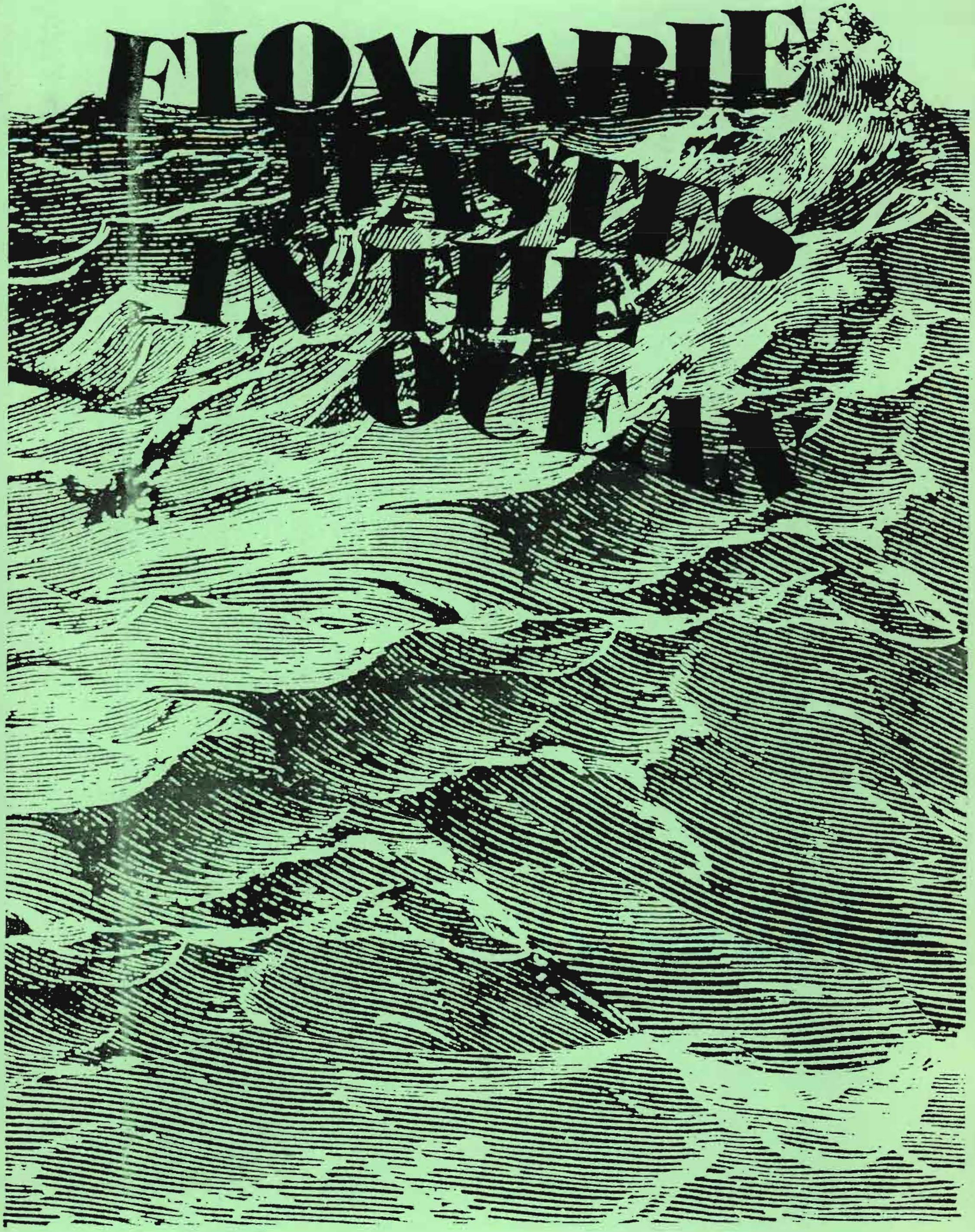
FLOATABLE WASTES IN THE OCEAN



SOCIAL, ECONOMIC, AND PUBLIC HEALTH IMPLICATIONS

FLOATABLES WASTES IN THE OCEAN

Social, Economic, and Public Health Implications

March 21-22, 1989

Waste Management Institute

Marine Sciences Research Center

State University of New York

Stony Brook, New York 11794-5000

Special Report 104

Reference No. 93-1

Approved for Distribution

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Introduction

For years the washup of floatables on area beaches has been a common, unsightly occurrence. But the floatable washup events of the summers of 1987 and 1988 were different, in that medical wastes were part of the floatable signal. The threat of AIDS heightened public health and safety concerns relative to previous events. In response to these growing fears, the Waste Management Institute of Marine Sciences Reseach Center at the State University of New York at Stony Brook convened a scientific symposium titled "Floatable Wastes in the Ocean: Economic, Social and Public Health Implications."

This conference was held March 21 & 22, 1989, at the Jacob Javits Center, SUNY Stony Brook. It brought together technical experts who focused attention on the severe economic impacts that the past summers' washups of medical- and sewage-related wastes had on tourism, beaches, marine recreation, and the seafood industry. The conference also addressed the issues of public health, safety, and the consumption of seafood products.

Langdon Marsh, Executive Deputy Commissioner of the New York State Department of Environmental Conservation was the luncheon speaker. He addressed New York's response to the floatables crisis.

List of Speakers

Environmental Emotionalism vs. Good Science: Who is Winning the War?

Richard T. Dewling
Chairman and Chief Executive Officer
Metcalf & Eddy, Inc.
(Former Commissioner, N.J. Dept. of Environmental Protection)

Introduction

There is little doubt that the environmental movement has been among the most important social movements of the 2Oth century. Since its inception twenty years ago, the movement has grown from a passionate cause supported only by "eccentrics," to a mature, stable series of laws and public policy that have been woven into the fabric of our society. Inspired by the activism of the late 1960's, national and state environmental laws set out to change strongly-held public sentiments, and they have succeeded. The residents of New York and New Jersey, year after year in public opinion polls, rank environmental issues their number one concern: above crime, economy, taxes, or jobs. Of course, this fact is not lost on elected officials who scurry wildly to introduce bills to address a myriad of real and perceived environmental woes. Today, no less than 1,850 environmental bills are before the New Jersey State Legislature. Today, environmental issues are front page material in New Jersey newspapers. We have converted our 7.6 million residents into environmental enthusiasts, concerned and demanding. This is in pronounced contrast to 1970 when we could not interest our residents in environmental matters, could not even cajole reporters into covering an environmental conference, or convince legislators to sponsor needed laws.

Yes, things have changed. But almost as if in some Faustian bargain, to obtain this great public interest we have sometimes compromised the facts and traded our scientific "souls." In my opinion, the last several years of environmental law and policy have frequently been more closely aligned with public opinion than with scientific evidence and risk assessment. Most notably, the recent past can be characterized as a time when our residents rallied to emotional appeals without understanding the facts--a time when our political leaders have been pressured into unwise and sometimes very damaging choices. I submit to you that we must restore scientific reason to the process, or the environmental movement is in jeopardy.

There is no better evidence of this predicament than the 1,850 environmental bills pending in the New Jersey State Legislature. There are bills that would have the Department of Environmental Protection (DEP) measure ultraviolet light in tanning booths, man blimps to patrol our coast, sample the tap water in every home in the state, and on and on. Most of these bills address areas of real environmental concern; some, however, are nothing more than fluff intended to curry favor with a narrow constituency. And still some other bills are extremely destructive to the environmental fabric we have worked so hard to weave. Bills like the Ciba-Geigy Bill, which would close a discharge pipe carrying tertiary-treated effluent, not because there is any scientific evidence which indicates a public health or environmental threat, but rather because public sentiment demands it. Each scientist must feel some discomfort in such actions!

Statutes that ignore scientific principles are doomed to fail

I am reminded of a wonderful story that I routinely shared with undergraduate students at Rutgers University, the Tale of King Canute. King Canute was King of England around 900 A.D. He found the sea level change associated with the tides to be offensive, so he commanded the sea to stop rising and falling. With fanfare, he returned the following morning to the shoreline only to find that his command had not been obeyed. Enraged, he whipped the sea. In his mind, the matter was resolved; he commanded nature, she failed to obey, and he punished her transgression. Chapter closed. He had demonstrated to his subjects that he had dominion over nature.

The legacy of this tale is evident today in many pieces of bad environmental law. Statutes or regulations that ignore scientific principles are doomed to failure. Too often, a solution does not address the scientific or engineering principles, but punishes only the violators and imposes more stringent rules. And should any of you believe I have exaggerated, the Clean Water Enforcement Bill now pending in the New Jersey State Legislature demands levels of performance from wastewater treatment plants that the laws of physics and chemistry make impossible. But should the operators of these facilities fail to satisfy these impossible levels, the bill requires that the DEP take stiff enforcement measures such as penalties and criminal sanctions, including imprisonment, against these operators. Who is the sponsor? Who is the modern-day Canute? That Assembly bill had 44 sponsors. Every appeal for reason made by the DEP and professionals who know wastewater treatment plants has been ignored.

As we look toward the environmental challenges of the 1990's, restoring balance to the process of developing environmental law will be one of the most difficult. Of course, public opinion and sentiment are important elements, but they cannot be substituted for science and engineering. The laws of nature are immutable, while public opinion changes. How and why have the environmental professionals who have devoted their lives to environmental matters lost control? And more importantly, how do we regain it? All too often, the answer to this vexing problem is to "educate the public" or "inform the public." I agree, but how and by whom? I have spent the past twenty-five years of my life at the EPA and the NJDEP studying and observing. My colleagues and I have attended public meeting after public meeting, written countless letters to the editor, conducted hundreds of press interviews, and published hundreds of easy-to-read brochures--all actions with the common purpose and goal that an informed citizenry will make prudent decisions. And we are losing. The following are a few of the factors working against us.

The "negative proposition"

It is difficult to counter the distorted claims of environmental alarmists. These individuals and organizations are not bound by scientific principles or fact. They will craft the story as they need to. They capitalize on one major facet of human nature, fear. Chemophobia has been a powerful force--and they have exploited it. Even amateur opposition groups to a landfill site or hazardous waste incinerator know the recipe for success: throw in a pinch of the terms "toxic," "carcinogen," or "dioxin," add a large measure of threats to children, attack the credibility and integrity of scientists or government officials who endorse the proposal, attract media attention, and whip to a froth. Very effective.

Another element used by the alarmist groups on the unsuspecting community is the "negative proposition." Let me explain. If I were genuinely interested in the health effects of coffee, I would ask a toxicologist, "Do you have any data which indicate health effects of coffee on man?" That toxicologist today would respond by saying, "We have conducted lab and clinical investigations and find no evidence of any harmful effects." But, this is not the way that alarmist groups form the questions. They ask, "Can you demonstrate the coffee is not harmful to man?" Any reputable scientist must respond "No" to that question. And so the alarmist shapes public opinion. This "negative proposition" is being used hundred of times each day when we are asked, "Can you assure me that this new landfill, incinerator, or new industrial facility will present no health threat?" To that question, we must respond, "No." The alarmist has only to make a charge, however preposterous; the reputable scientist assumes the burden of proving the charge groundless. It is a difficult situation, and one that we handle badly.

The media have had a strong role in creating confusion. Today, our residents receive their environmental "facts" mainly from television, and to a lesser degree, from the print media and radio. Sensitive tidbits of science are communicated in a condensed, two-column newspaper story, or the hyperbole of a thirty-second spot on the evening news. Example: "Blood Vials Found on New Jersey Beaches ... stay tuned." Were blood vials found? Most certainly, but on the tidal mud flats of Bayonne, New Jersey, which certainly are not beaches where people recreate or swim. My favorite television report, however, was by WCBS in which the announcer stated that a five-mile garbage slick was found off shore of Long Beach Island, New Jersey, when in fact it was off Long Beach, Long Island, New York. They retracted the statement four hours later, after they were taken to task by the writer, but the damage was done!

Repeatedly, we have petitioned editors to understand their social responsibility and to use their medium to inform or educate. Unfortunately, scientists do not inform the public directly--the media acts as a filter. So we are married, the scientist and the reporter, but what a strange couple. Scientists think in shades of gray; reporters demand black and white. Scientists are more concerned with quality, not volume; reporters stress volume as they condense complex issues into two-columns or thirty-second television spots. Scientists work at their own pace with few deadlines; reporters have hourly or daily deadlines imposed by editors. Scientists devote their entire careers to one specialty; reporters are generalists, covering the environment on Monday and a drug bust on Tuesday. And last, a scientist's work is reviewed by his peers before it is published; reporters are reviewed by an editor who may be focused more on attention-grabbing headlines than accuracy.

With these fundamental differences, we have, not surprisingly, a necessary, but strained relationship. While I understand our differences, I have difficulty condoning or understanding some press behavior I have watched as article after article attributes to unqualified individuals the status of "environmental scientist" or "public health official." In fact, any resident who expresses a view about a pollutant, or discharge, will be quoted alongside a Ph.D. scientist who has specialized in that area of concern. In short, reporters make no distinction between scientific fact and mere opinion. While it is true that anyone is entitled to an opinion, only those technically qualified should be asked to offer a scientific judgment. Scientific fact dictates that a baseball will fall to the earth when dropped; an opinion to the contrary is worthless. It is no wonder then our residents have difficulty knowing whom to believe and whom to trust.

Summer of 1987--what really happened

This issue of perception and reality, and whom to believe, was most clearly illustrated during the summer of 1987, as a series of articles appeared suggesting swimmers could contract AIDS by swimming in the ocean. Scientific and medical fact tells us otherwise, but unqualified individuals were quoted to the contrary. To further set the record straight on what was perceived and what really happened, it is appropriate to summarize the events of the summer of 1987. None of the perceptions below are trivial: they were an insult and blight on the shore and a burden on shore communities. A positive and redeeming effect, however, has been that the public has been outraged. Finally, there is recognition that the ocean has limits and we cannot continue to burden this system with insult after insult.

And so, a major misconception was created. More than misconception, creditability was damaged. This in turn has made it difficult for scientists to protect public health. Press freedom is not the issue; responsible, factual reporting is.

Industry and government--poor track record

Both industry and government have contributed to the overall problem: industry through its Bhopal, Chernobyl, and Institute, West Virginia, accidents; and government by failing to see emerging issues before they develop into crises. In short, our residents, once completely enamored of technology, have lost confidence in industry to control that technology, and in government to regulate it. In fact, industry today is facing its greatest challenge since the days when scientists first pulled chemistry away from the Alchemists. Public confidence in science has scarcely ever been lower. Communicating science and technology is difficult enough; not being believed makes communicating impossible.

Conclusion

In summation, restoring science and fact to their rightful place in environmental law and policy-making is a vitally important element for environmental protection in the 1990's. Without the strong underpinning of environmental science in lawmaking, we are in danger of embracing inappropriate, expensive, or unproductive environmental policy.

If developing sound, balanced, and reasonable environmental policy in the next decade is our goal, we need to replace the merchants of fear with reputable scientists. We need to support those few courageous political leaders who are willing to rise above the tactics of alarmists, those who will rely on facts in their decision-making. Restoring science and fact in environmental policy-making is the challenge. I leave you with General Omar Bradley's words: "It is time to steer by the light of the stars, rather than by the light of each passing ship."

OCEAN WATER QUALITY - SUMMER OF 1987
PERCEPTION vs. REALITY

- THE PERCEPTION IS:

  - THE 127 MILES OF NEW JERSEY BEACHES WERE CONTINUOUSLY ASSAULTED BY GARBAGE AND HOSPITAL WASTES.

  THE FACTS ARE:

  - OVER AN 18-WEEK SUMMER SEASON THERE WERE 3 EVENTS, INVOLVING A TOTAL OF 8 DAYS, THAT CAUSED BEACH CLOSURES DUE TO FLOATABLE DEBRIS
  - ONLY ONE OF THOSE EVENTS INVOLVED MEDICAL-TYPE WASTE

- THE PERCEPTION IS:

  - HUNDREDS OF OCEAN BEACH CLOSURES OCCURRED DUE TO POOR WATER QUALITY TEST RESULTS

  THE FACTS ARE:

  - THERE WERE A TOTAL OF 15 OCEAN BEACH CLOSURES IN 1987 DUE TO WATER QUALITY TEST RESULTS
  - TWELVE OF THESE CLOSURES WERE LESS THAN THREE DAYS AND COVERED AREA OF ONLY TWO TO THREE BLOCKS

- THE PERCEPTION IS:

  - MOST BEACH CLOSURES OCCUR BECAUSE OF INADEQUATE WASTE WATER TREATMENT OR OTHER POINT SOURCES

  THE FACTS ARE:

  - NINETY PER CENT OF ALL BEACH CLOSURES OCCUR IN BACK BAY AREAS WHERE THERE ARE NO POINT SOURCES
  - NINETY PER CENT OF ALL BEACH CLOSURES OCCUR AFTER RAINSTORMS AS A RESULT OF NON-POINT SOURCE POLLUTION

  THE FACTS ARE:

  - NOT ONE BEACH CLOSURE HAS RESULTED FROM ANY FORM OF PERMITTED OCEAN DISPOSAL DURING THE PAST TEN YEARS

- THE PERCEPTION IS:

  - THE DOLPHINS THAT DIED ALONG OUR COAST DIED FROM POLLUTION OR AIDS

  THE FACTS ARE:

  - EIGHTY-THREE BOTTLE-NOSED DOLPHINS DIED ALONG OUR COAST
  - BETWEEN NEW JERSEY AND FLORIDA, MORE THAN 400 DOLPHINS HAVE DIED
  - AIDS AND CHEMICAL CONTAMINANTS HAVE BEEN RULED OUT BY FEDERAL INVESTIGATORS AS THE CAUSE
  - THE CONSENSUS AMONG EXPERTS IS THAT AN INFECTIOUS AGENT, SPECIFIC TO BOTTLE-NOSED DOLPHINS, IS THE LIKELY CAUSE OF THE DEATHS (the federal investigation continues)

- THE PERCEPTION IS:

  - OCEAN WATER IS DIRTIER NOW THAN EVER

  THE FACTS ARE:

- CHEMICAL AND BACTERIAL MEASUREMENTS OF OCEAN WATER QUALITY SHOW QUALITY IMPROVING, NOT WORSENING

- OCEAN WATER QUALITY WAS BETTER LAST SUMMER THAN IT HAS BEEN IN YEARS

- THE PERCEPTION IS:

  - IF YOU SWIM IN THE OCEAN YOU'LL PROBABLY GET SICK

THE FACT IS:

- A TWO YEAR, $ 1 MILLION, PEER REVIEWED, EPIDEMIOLOGICAL STUDY CONDUCTED BY THE N.J. HEALTH DEPARTMENT FOUND NO LINK BETWEEN SWIMMING IN THE OCEAN AND ILLNESS. WHILE SWIMMERS DID REPORT MORE ILLNESSES THAN NON-SWIMMERS, THESE ILLNESSES APPEARED TO BE LINKED TO THE ACTIVITY OF SWIMMING ITSELF OR TO THE PASSAGE OF VIRUSES FROM PERSON TO PERSON, AS OPPOSED TO ANY PROBLEM OF OCEAN WATER QUALITY.

"Social Impacts:" What Are They?

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Introduction

The 1989 battle lines against floatable wastes have already been drawn. Federal and state surveillance and cleanup programs have been put into place. The U.S. Army Corps of Engineers (U.S. ACE), U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (U.S. EPA), and New York State and City agencies have promised to improve coordination in equipment use, waste tracking, and cleanup. Still, prospects for trouble-free summers are uncertain and those responsible for protecting waters, shores, and beaches remain cautious. As Dr. R.L. Swanson, Director of SUNY-Stony Brook's Waste Management Institute, discussed in his Congressional testimony (Swanson, 1988), one of the effects of spring freshets in the upper Hudson River is to flush floatables into coastal waters at the onset of summer beach seasons. Ultimately, though, the timing and intensity of floatable onslaughts are governed by unpredictable rainfall patterns (Swanson, 1988).

Still, despite the difficulties of timing impacts, floatables should be relatively easy to control. As a class of pollutants, floatables are more tangible, visible, and trackable than most other marine contaminants, and their sources, input paths, transport dynamics, ecological effects, health effects, and sinks are relatively well-known. It is not necessary to enter the murky realm of toxicants, nutrients, sediments, fish tissues, bioassays, and transformation processes for answers to the floatables problem. Scientists are collectively seeking a better understanding of what happened in past summers and why floatable events occurred, in hopes of restoring confidence in beach, sea, and seafood safety. As seekers and purveyors of knowledge, and as guardians and keepers of the public trust, we hope to be able to place the problem in a clearer, less-threatening perspective.

Why should this be so difficult? Why is it necessary to have a two-day conference to rally for fairness and greater wisdom regarding the floatables issue? The answer, quite simply, is that people are driven by the need to mollify something called "social impacts." But what are "social impacts?" Presumably, they have something to do with the effects of floatables on marine industries and recreation, but when the matter is considered more carefully we realize that people know very little about how to precisely characterize or define this easily-used but poorly-understood term.

Apprehensiveness toward the specter of "social impact" is revealed in the public statements of those with a proprietary interest in floatables, such as those who must daily deal with or talk about floatable wastes for a living. In anticipation of recurring problems in summers to come, officials, legislators, and environmentalists defensively temper confidence in preventive measures underway with admonishments not to expect perfect results. In March, 1989, for example, *The New York Times* reported on the U.S. EPA Regional Administrator's cautious warning that a pilot program to predict floatables' movements from tide and current data may not be the "be-all and end-all answer." (Severo, 1989). Similarly, a New Jersey Congressman noted that floatables are only part of the pollution problem, and blamed the Bush Administration for failure to budget sufficiently for New York Harbor cleanup and improved regional sewerage treatment (Severo, 1989). In addition, an environmentalist demeaned official efforts as nothing more than a "Band-Aid" approach to stem inevitable complaints over bureaucratic disregard of public interests, and the inadequacy of existing regulatory measures (Severo, 1989).

Why this defensiveness? What is everyone so worried about? While officials and interest groups must anticipate responses to unpredictable events that will affect the public's judgment of their performance and legitimacy, there is no way of knowing how and why the public responds in certain ways. In fact, people don't know what the expression "social impact" means, except in vague terms. When one speaks of "social and economic impacts," it is assumed that floatables somehow disrupt peoples' usual ways of harvesting, purchasing, consuming, and enjoying marine-related products, services, and amenities. Beyond this self-evident truth, however, it is far more difficult to be specific about what motivates behavior than about the details of declining seafood markets, waste manifesting, or beach attendance.

Understanding social impacts rests on the ability to relate what is known of public health threats and economic costs to producers, providers, and consumers of marine products and services, to predictable and manageable indicators of social response to floatables. More is involved in the floatable situation than presenting the best appearance for media consumption. This can easily become nothing more than a public relations exercise which may not turn out as well as anticipated. A more challenging task is to clarify why the considerable knowledge of technical, scientific, health, and regulatory professionals involved with the floatable problem cannot be more effectively utilized, to deter misinformation and to help put the issue into a more realistic perspective today than was the case in 1987 and 1988.

Issues

Why are people continually frustrated in attempts to make meaningful connections between what is known and what can be done? Why are people unable to improve regulatory efficiency and thereby gain greater public acceptance of the best efforts of hard-working officials? Why is the concept of "social impact" so elusive? The problem cannot simply be accounted for as an unavoidable consequence of population pressures on coastal, land, and marine resources; nor should it be viewed as a panic reaction to syringes, needles, or blood bags. There are several reasons why knowledge of physical characteristics and processes cannot be better used to help allay public fears. These reasons have to do with institutional obstacles, with difficulties in knowing how to gauge and predict public response, and with the ways in which scientific knowledge affects social relevance.

To begin with, floatables' impacts can only become "social" in the context of several distinct policy systems. First, floatable wastes are worrisome to the extent that science and technology suggest that they are. Even the shadow of a doubt regarding needle use creates the understandable fear of AIDS. Scientists are faced with a dilemma. There are no simple cause-and-effect answers. Still, scientific advice and guidance is sought by affected parties to justify contending views on risks to public health and safety. Second, legislative, judicial, and regulatory bodies set the terms of conflict, debate, and accommodation. Adversarial dramas are played out with constantly shifting rules and procedures--usually without a satisfactory resolution to conflicting viewpoints. Third, market forces that set amenity and resource values of marine products and services influence the public's perception of impacts. Finally, media selectivity, in information-gathering and transmittal has an obvious impact on the way a floatables problem is perceived. Collectively, these policy processes define the "impacts" that are of concern here, be they beach avoidance, seafood phobia, or the brickbats aimed at bewildered politicians and bureaucrats.

A good deal is known about selected aspects of scientific, institutional, health, and informational components of the floatables problem. Very little is known, however, about how to apply collective knowledge to control and remediate the floatable problem. Individual studies have addressed physical and meteorological factors affecting floatables' movements, as well as cost aspects, regulatory bottlenecks, and technical problems faced in manifesting, tracking, garbage handling, and the like. Still, social implications and consequences of floatables' impacts remain unclear. At this conference, further impacts will be documented, processes described, and insights shared. But after disgorging ourselves of specialized knowledge and expertise, we will return to isolated bailiwicks to await the next opportunity for collective hand wringing. The challenge is to overcome the debilitating effects of specialized, yet isolated, perspectives on the problem. This is easier said than done.

Science, along with the public and private institutions that use scientific insights to guide, stimulate, and mediate public response to floatables, seems hopelessly caught up in a limitless web of inertia. At best, floatables become an addendum, a poor, newly-arrived cousin in the larger marine pollution family. This seems to be the case even in promising new management programs like the New York-New Jersey Harbor Estuary Program. Problem categorization seems more a reflection of administrative convenience than creative effort. Imaginative, visionary steps to more effectively integrate knowledge and policy are missing. Calls for a stronger national commitment to comprehensive attacks on coastal pollution fall upon deaf ears. If the spirit of the House of Representatives 1988 Oversight Hearings on coastal pollution held sway, floatables would be a non-issue, easily resolved through better agency coordination and more effective expenditure of funds (U.S. Congress, 1989). Unfortunately, as is well known, piecemeal approaches in an atmosphere of bureaucratic parochialism and legal thickets are more the order of the day and will likely remain so.

A case in point is the use of science in monitoring and assessing floatables' movements and impacts. Despite the visibility of floatables, there has been only limited success using simple indicators of health threats, such as coliform counts. Such indicators are used not only to determine whether regulatory standards are being met, but also serve as public pacifiers. The legal requirement that "unreasonable degradation" of the marine environment be avoided is not very helpful in specifying restrictions on floatables. This reflects a larger problem in applying marine pollution science.

As Dr. Joel O'Conner and others have pointed out, marine environmental health and safety as a social goal is achievable only to the extent that regulatory endpoints can be more precisely defined in terms of the specific water quality, health, or ecological impacts of various pollutants (O'Connor et al., 1987). One way of sharpening thinking about the social impacts of floatables then, is to ask how scientific work on monitoring, transport, and transformation can contribute more effectively to regulatory success.

Another issue is the growing gap between the increasing sophistication of scientific monitoring and the uncertainty, overlap, and general confusion that characterizes regulatory activities. Even for floatables, unique in the realm of marine contaminants for their visibility, we are unable to bring control measures successfully to bear. In this country, at least, cooperative private and public sector efforts seem unattainable. At the institutional end of the spectrum, more effective floatables management is stymied by the incompatibility of federal and state agencies' missions. Some agencies are charged with the task of determining what is unreasonable or socially unacceptable, while others are charged with keeping waterways clean. The irony here is that floatables can easily fall through bureaucratic cracks. To what extent are floatables considered simply obstacles to navigation, in contrast to their more nefarious incarnation as threats to public health or unreasonable degraders of the marine environment? Jurisdictional disputes among agencies not only deter effective prevention and response, they point out how poorly-equipped institutions are to control any aspect of marine pollution.

Conclusion

How does all of this relate to the problem of clarifying what "social impacts" are all about? I have suggested that people are so busy trying to learn more about the floatable problem while working to improve response capabilities, that the question of target population gets lost in the shuffle. Why does this happen? I see a number of reasons.

To begin with, not much progress has been made in defining who or what "the public" is. Public involvement tends to be made up of the self-selected; that is, formally-organized efforts of interest groups which mainly represent their own constituencies. Since floatables are diffuse in origin and impacts, it is difficult to tie impact to people at clearly-delineated individual, community, or higher aggregate levels.

Besides confusion over how to accommodate and measure varying scales of impacts in different locations throughout the region, people are at a loss in knowing how to measure individuals' perceptions of risk, and how these perceptions may affect use of, or exposure to, marine resources and amenities. Again, the ubiquity and indeterminacy of the floatable problem deters possibilities for rigorous surveys of sample populations. With floatables, people cannot seem to focus, as they can when surveyed, for example, about their reaction to issues such as nuclear power plants or hazardous waste sites. Even sewage sludge, hardly as notoriously distinguished as floatables, has 12 and 106-mile dump sites where politicians, bureaucrats, and environmentalists can focus their attention. Floatables are everywhere and nowhere. Floatables do not lend themselves to policy analysis, because their regulation is not governed by any single policy framework.

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A General Overview of the Economic Impacts of Floatable Wastes on Fisheries, Tourism and Marine Recreation

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Introduction

The issue of ocean pollution received increasing attention in the late 1980's. While there is a broad consensus that the problem must be dealt with, there is far less consensus as to what specific steps should be taken. One of the reasons for this apparent asymmetry is that while the damages from ocean pollution are quite large, the costs of reducing ocean pollution are quite large as well. Since different areas of the coastal regions suffer different damages from ocean pollution, and would have different cost burdens associated with a clean-up, it is quite natural to find a lack of consensus on what to do about the problem.

Economic analysis can provide substantial insight into these issues and aid in the development of a consensus on policy. Broadly speaking, economists would argue that the policy that should be undertaken is the one that generates the greatest net economic benefit. Another way of describing the appropriate policy would be the policy which generates the biggest potential Pareto improvement, where a potential Pareto improvement results from a policy where the gainers gain by more than the losers lose. Since the gains and losses must be compared to determine the policy which generates the biggest differential, both the gains and losses must be measured in a common unit. Dollars represent an appropriate metric, not because everything that is important has a market price, but because people make trade-offs of unpriced goods for other goods. For example, beach houses in a clean coastal area will, *ceteris paribus*, rent for more than houses in a polluted area. Although one does not directly observe a market price for clean oceans, one can indirectly observe a willingness to pay for it.

The economic analysis of pollution problems such as these is fundamentally an exercise in valuation, or the development of dollar measures for both the damages associated with pollution and the costs associated with abating pollution. Economic analysis does not necessarily focus on the effects of pollution on regional income.

This paper looks at several issues associated with the economic analysis of ocean pollution in the New York Bight. The paper looks at both conceptual and empirical issues. The next three sections of the paper are primarily conceptual. In the second section, the use and abuse of economic information is discussed, the third section looks at the proper measurement of economic benefits while the fourth section examines the role of economic information in the formulation of ocean pollution policy. In the last three sections of the paper, empirical estimates are formed for the damages that ocean pollution generates in beach use, commercial fishing and recreational fishing. The conclusion discusses further research needs.

The use and abuse of economic information

When the floatable waste problem began to be discussed in the news media during the summers of 1987 and 1988, one of the key features of these news stories was the economic damages that the pollution events were causing. These reports focused on the effects on restaurants, tackle shops, hotels, cottages, and other industries that service coastal recreational activities. For example, The New York Times reported:

> The takeout line for ice cream at Nagle's Pharmacy used to stretch down to the curb on Main Avenue. There is rarely a line now, and pharmacy business overall is down by about 80 percent, according to the store's assistant manager, Tim Bermingham. (Schmitt)

These reports are good examples of the way both the public in general and policy makers misunderstand economic benefits, in the sense that they believe that the economic benefits of an environmental resource are equal to the cash that changes hands as a result of the use of the resource. The inadequacy of this measure can be illustrated by an example: little money is spent by recreationists or other potential users on activities involving interactions with species such as the bald eagle, the peregrine falcon, marine mammals or sea turtles. However, the consensus of many people is that the benefits to keeping these and other threatened and endangered species present on earth are extremely high. These benefits are well-recognized, and in fact are the rationale behind the Endangered Species Act.

The non-economist might look at the floatable waste problem and say, "What about the loss of business for seafood suppliers, vacation cottage owners, bait-and-tackle shops, and other businesses adversely affected by the pollution episodes? Aren't those real economic losses?" The answer to that question is that they are real losses for the individual establishments, but not for society as a whole. The reason for this is that the consumers still spend their money; they just spend it on something else, so that one firm's losses are another firm's gains. For example, if the pollution in the New York Bight lessened the demand for fish from New York or New Jersey waters, it would increase the demand for substitute products such as chicken, or fish from unpolluted waters. Thus, New York commercial fishermen and seafood processors lose, and New England commercial fishermen and Maryland chicken farmers gain. This redistribution of income is referred to as a transfer, and is regarded as neutral when computing economic benefits for society as a whole. Another example of such a transfer is when pollution causes recreational fishing activity to be transferred from saltwater to freshwater. Long Island tackle shops and charter captains get hurt by such a movement, but corresponding upstate New York businesses are better off. Of course, whether transfer should be ignored or factored into the analysis depends on the regional level of the decision-making. From a New York perspective, a transfer of activity from Long Island bluefish fishing to Catskill trout fishing should be regarded as neutral; however, a transfer from New York commercial fishermen to Maryland chicken farmers would be viewed as a cost. From a federal perspective, both would be viewed as neutral, whereas from a Suffolk County perspective, both would be viewed as a cost. As can be surmised, this can lead to substantial conflict in the development of policy to deal with the floatable waste problem, for which is the appropriate perspective? The answer to the question partially lies in who will be paying the costs of mitigating the ocean pollution problem. If it is taxpayers from the nation as a whole (through Environmental Protection Agency initiatives, for example), then all transfers should be regarded as neutral. However, if it is New York and New Jersey alone that will be financing the clean-up, then transfers out of the two states should be regarded as losses.

The measurement of economic benefits

The measure that economists employ to measure the economic benefits of a good, activity, or resource is the net economic benefit, which is equal to how much people value something, less the cost of providing it. There are three important classes of values associated with marine resources. The first of these is user value, which is the value that a person who directly uses the resource places on it. For example, beach use and recreational fishing have important user values. In addition, there are option and existence values. Option value implies that a person may value preserving the opportunity to use a resource in the future, while existence value means that the individual is made better off by the knowledge that the resource exists, even if he does not currently use it, or ever plan to use it.

All of these values can be described by the concept of willingness-to-pay. This simply measures how much an individual is willing to trade off other goods and services for the marine resources. As long as some of the goods and services have a dollar price, it is theoretically possible to derive a dollar measure of the value of a clean ocean (Freeman, 1979). The total willingness-to-pay can be measured as the area under the inverse demand curve (Figure 1), where the inverse demand curve represents the marginal willingness-to-pay function. If P represents the market price of the commodity, then Q represents the quantity of the commodity or activity that is being demanded. The total willingness-to-pay for the goods is the area of trapezoid ABQO. The total cost of the good (which is equal to total expenditures) is equal to the product of P and Q, or the area of rectangle PBQO. The net benefit of this commodity is area ABQO minus area PBQO, or the area of triangle ABP. This triangle is known as consumers' surplus. Note that the value or net social benefit is computed by subtracting out expenditures, rather than calling them benefits.

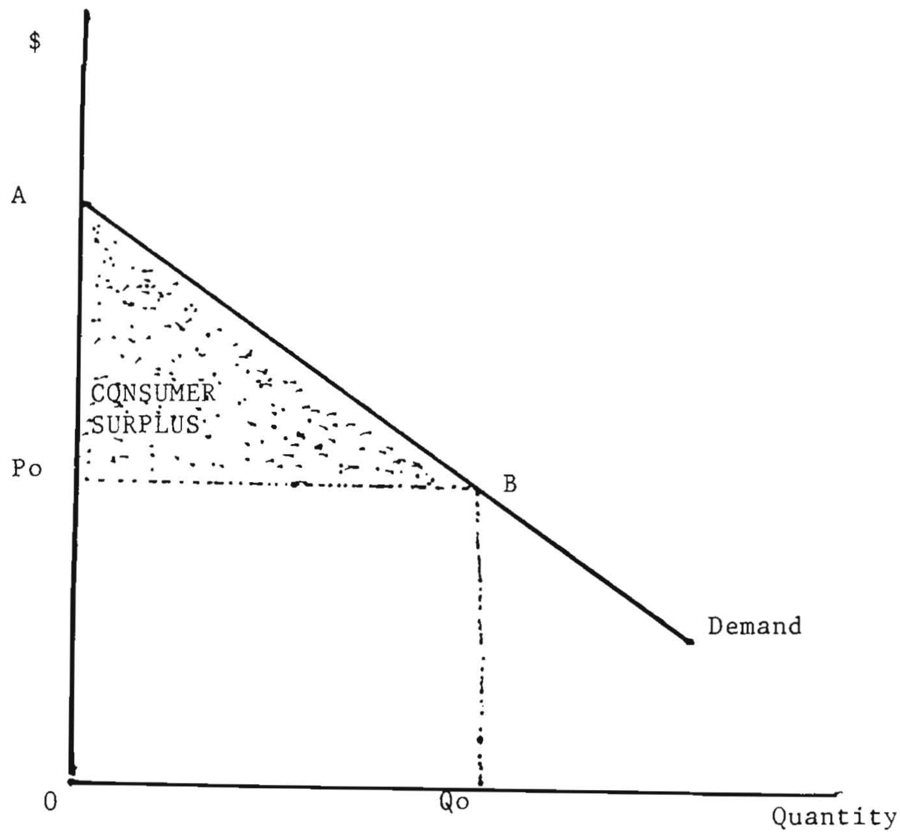

Figure 1. Inverse Demand Curve and Consumers' Surplus

Also note that any organism, ecosystem, or marine resource has a consumers' surplus associated with it, although it may be difficult to measure. Indeed, many of the above have no expenditures associated with them.

In many circumstances, there is an additional benefit which must be considered. If some inputs are more productive in the production of this good than in the production of alternative goods, this extra productivity is a benefit, not a cost, and should be included as part of the benefits. This benefit is known as economic rent or producers' surplus. Varying productivities of inputs imply an increasing marginal cost function. The net economic benefits under these circumstances would be represented by the area of triangle ABC in Figure 2, where consumers' surplus is equal to area ABP and producers' surplus is equal to the area of triangle PBC.

If one were looking at the demand and marginal cost of a marine resource-dependent good such as clams, an increase in pollution could have two effects. First, it could lower the demand curve (shift from D_0 to D_1), as consumers would now find clams less desirable. This would lead to a loss in net economic benefits of area ABEF in Figure 3. The pollution could also cause the marginal cost curve to shift up, as in Figure 4. This would lead to a loss in benefits of area ABCE.

The measures of value discussed above constitute a more satisfactory measure of benefits than direct expenditures. However, this does not mean that there is no need for information about how pollution affects direct expenditures in particular activities, or in particular localities. Although the measures of consumers' and producers' surplus are the correct measures for deriving efficient outcomes, direct expenditure measures are important for looking at equity and distributional issues. Additionally, direct expenditure is the measure of economic benefits which elected officials seem to respond to. All of these factors suggest that at times, indications of how pollution affects direct expenditures in resource-dependent activities may be useful. In the past, the author of this study has reported direct expenditures (Kahn, 1989). However, the present study is focused on those measures (consumers' and producers' surplus) which can be employed to help determine the optimal floatable pollution policy. Those who are interested in corresponding

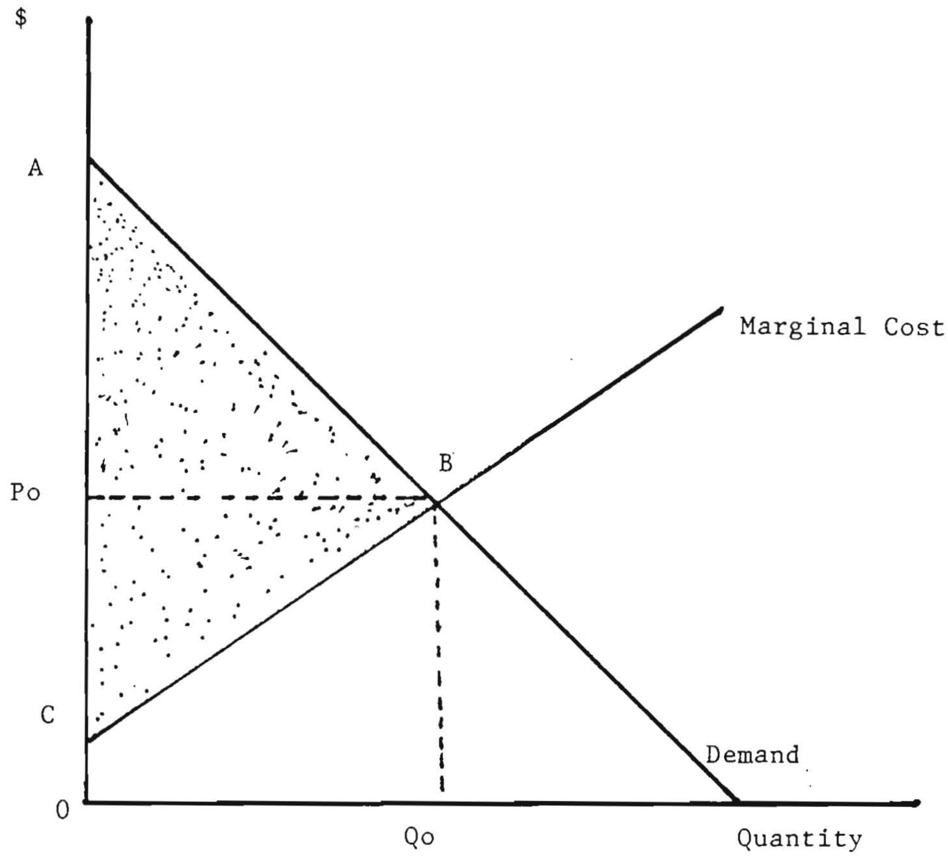

Figure 2. Inverse demand, marginal cost curves and net economic benefit.

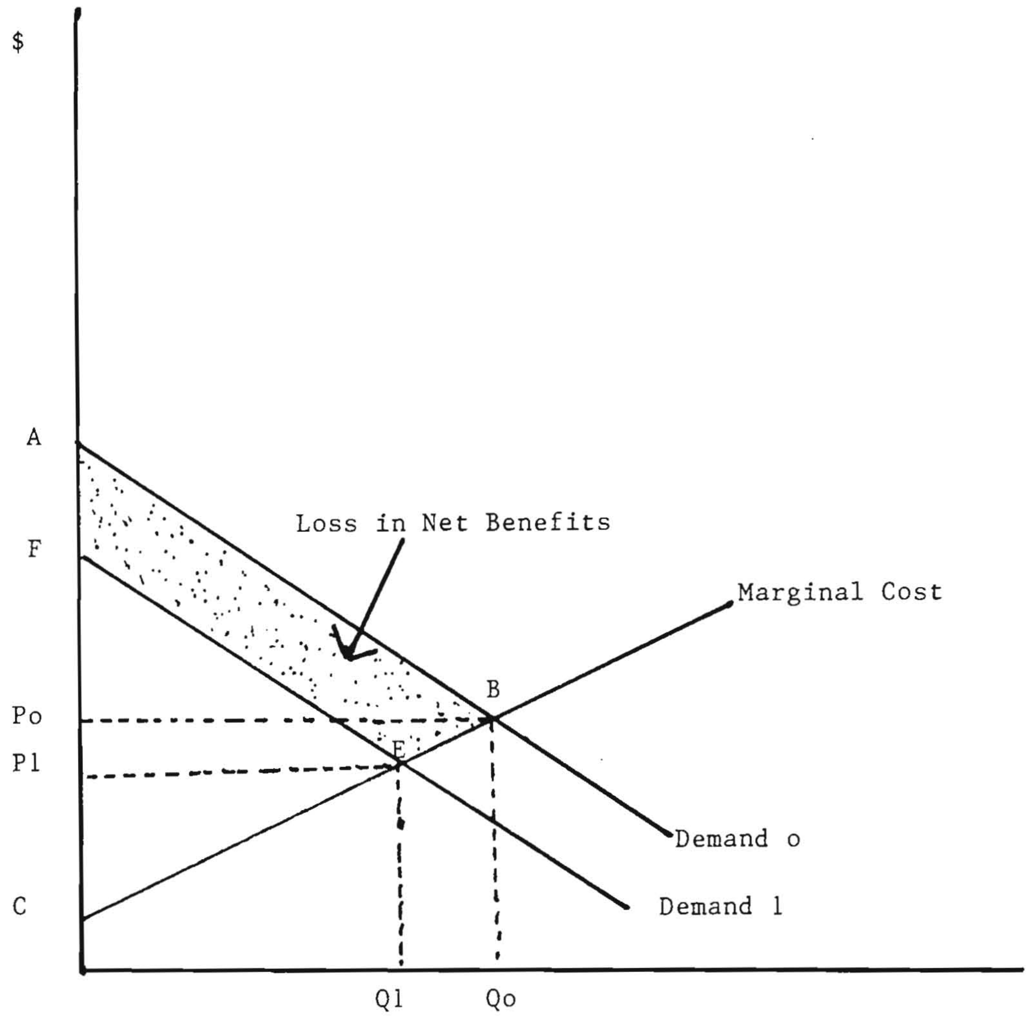

Figure 3. Loss in Benefits Associated with shift in demand.

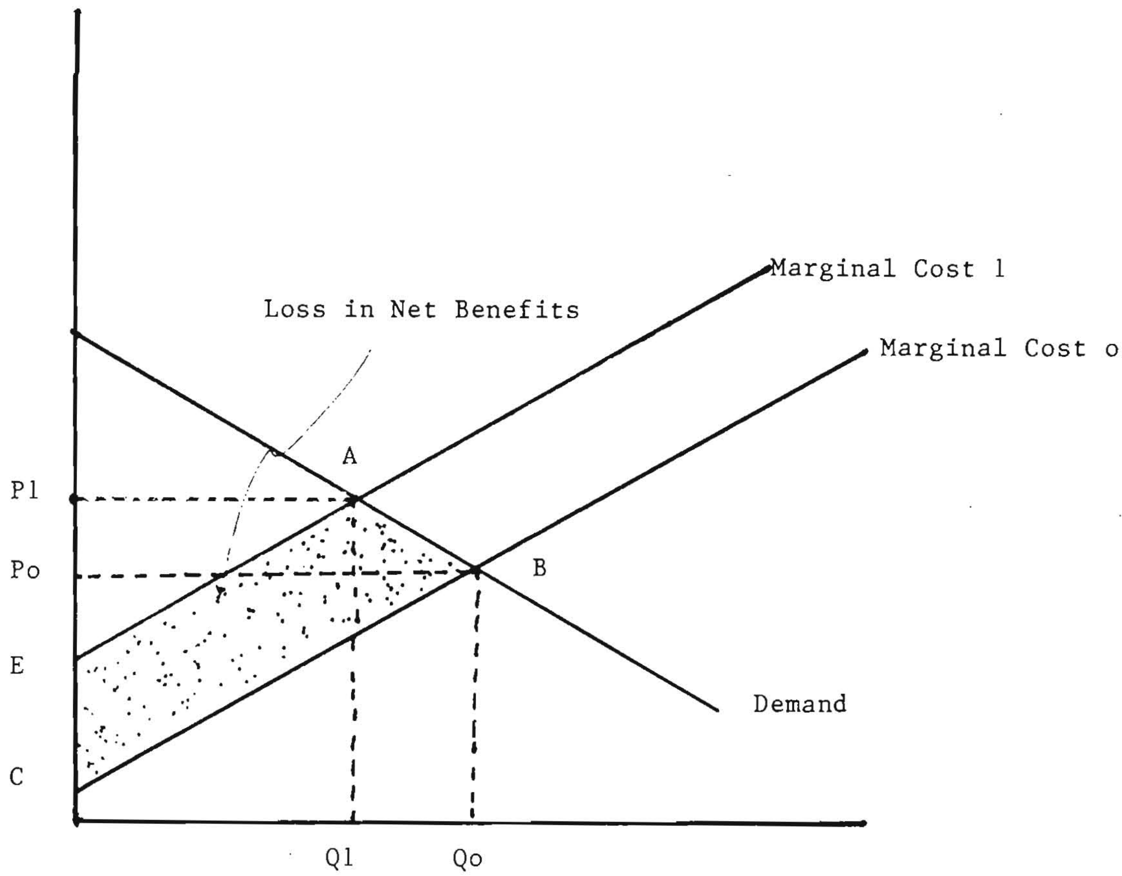

Figure 4. Loss in benefits associated with shift in marginal cost function.

measures of direct expenditures are referred to "Use Impairments and Ecosystem Impacts of the New York Bight" (Waste Management Institute, 1989).

Economic information and the formulation of ocean pollution policy

Economic benefit information is essential to the development of an ocean pollution policy which maximizes society's well-being. The information can be used in two types of analyses, cost-benefit analysis and marginal analysis. Cost-benefit is the appropriate decision-making tool to use when the decision choice is binary. For example, either a new sewage treatment plant is built, or it is not built; either medical wastes are subject to "cradle-to-grave" monitoring, or they are not. Marginal analysis is the tool to use when a continuum of choices is available. The appropriate size of a sewage treatment plant, or how many tons of sludge should be allowed to be dumped offshore--these are examples of situations in which a range of options exist.

Since most non-economists have a working knowledge of cost-benefit analysis, but not marginal analysis, the concepts of marginal analysis will be further discussed. Assume that the current level of floatable wastes in the New York Bight area is W1 cubic meters per square kilometer. Figure 5 shows the social costs associated with W1 and all other levels of floatable wastes, given the existing level. Note that at W1 marginal abatement costs are zero (this assumes no regulation of the problem has yet begun). As the level of floatable wastes is reduced below W1, the costs of reducing floatable wastes are initially small, but rise as the cheaper opportunities for reducing the wastes are first exhausted. The marginal damage function represents the damages from another unit of floatable wastes, given an existing level. The optimal level of floatable wastes would be W2, where the damages from an additional unit of floatable wastes are exactly equal to the costs of reducing them another unit. If one has perfect knowledge of the marginal damage and marginal abatement cost functions, then the optimal level of pollution can be identified with certainty. However, in practice, it may be extremely difficult to estimate these functions (Cumberland and Kahn, 1982), and the resulting estimated optimal level of pollution may have considerable uncertainty associated with it. Nonetheless, estimating these values can be

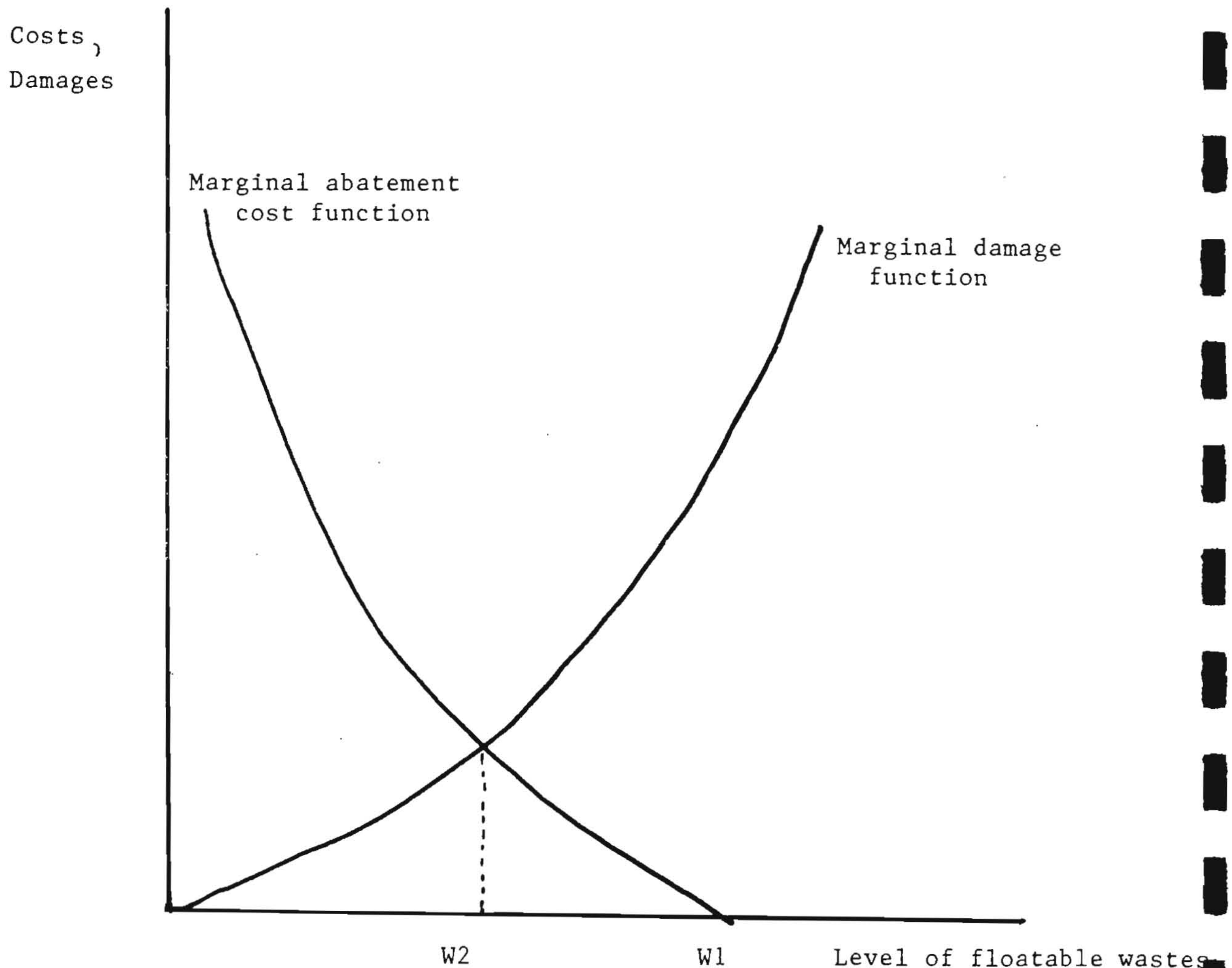

Figure 5. The optimal level of floatable wastes.

of considerable benefit in helping to set appropriate environmental standards.

Estimates of the economic value of beach use

The task of measuring the economic benefits which accrue to beach users and the beach industry is a very difficult task. The normal problems associated with measuring the effects of environmental change on non-market goods are exacerbated for two reasons. First, since pollution of the New York Bight has been an ongoing problem, it is difficult to establish an appropriate baseline from which to measure increases and decreases in the level of pollution and beach use. Secondly, two types of pollution affect beach use. These are chronic reductions in water quality (such as turbidity, odor, fecal coliform, etc.), and episodic pollution events such as the recent washup of medical wastes. The presence of the episodic pollution may make the effects of the chronic pollution more difficult to estimate, and vice-versa.

The ideal approach for determining the effects of pollution on beach use is to obtain data on total beach use in each year, and then use regression analysis to estimate a total participation function. The total participation function would give total number of user days as a function of regional population, average income, seasonal weather variation, levels of chronic pollution, and incidents of episodic pollution. It would then be possible to predict the reduction in beach use associated with increased pollution and the increase in beach use associated with reduced pollution. Unfortunately, data limitations prohibit the use of this methodology. Historical data on the pollution variables are only available for the most recent years, and data on total beach use are even spottier (1976 appears to be the only year for which this is available for the entire Atlantic Coast of New York). Therefore, there are simply insufficient degrees of freedom to allow such an estimation procedure.

As an alternative, one can assume that typical levels of beach use are on the order of the total level of beach use reported in the 1977 report entitled, "New York State and Outer Continental Shelf Development: An Assessment of Impacts" (hereafter referred to as the OCS report). The figures reported in Table 28 of the OCS report are reproduced in Table 1 of this report, with 1976 dollars converted to 1987 dollars. Table 1 reports annual beach visits, in "user days." The numbers in Table 1 are at variance with the number of beach visits reported in Heatwole and West's "Beach Use and Water Quality in New York City" (Table 2). In this report, they place the average number of visits to New York City beaches at 55 to 60 million in the pre-1969 period. The 55 million figure is 150% greater than the OCS figure of 22 million. This may be due to methodological differences in the two studies[1], but is more likely due to the episodic pollution (washup of sewage and other wastes) which occurred in 1976[2].

There exists other evidence which suggests that 1976 was an atypically low attendance year. Table 3 contains a time series of attendance at State Park Beaches in the area known as "The State Park Region." These data were made available by the Long Island State Park and Recreation Department. It is difficult to discern any trends in these series of data. The probable reason for this is that the variables which are random with respect to time (weather, episodic pollution, etc.) probably dominate the variables which vary systematically with time (income, regional population, etc.). Although a separate breakdown for attendance at Robert Moses, Jones Beach and Captree State Parks was not available for 1976, the aforementioned OCS report does give 1976 attendance for the State Park Region, which includes the town beaches between Jones Beach and Captree State Parks. This was 11 million, which is lower than virtually all the yearly totals in Table 2 (which does not include the town beach attendance). This is confirming evidence that the attendance figures cited in Table 1 do not represent a good baseline, representative of a typical year. Although we could find no additional estimates of attendance in typical years, an estimate can be formulated by multiplying the attendance figures in Table 1 by a factor of 2.5 (the ratio of the 55 million reported in Heatwole and West for New York City beaches and the 22 million reported in the OCS report). These figures are presented in Table 2, and can be viewed as an upper bound on the true attendance for a baseline year. The attendance figures in Table 1 will be viewed as a lower bound of the true attendance. Alternatively, one can look at the total attendance at state park beaches (these figures were available) and see that in the two years prior to 1976 and the two years after 1976, state park beach attendance averaged 13 percent higher

TABLE 1.

1976 BEACH USE

(lower bound attendance-from OCS report)

	Beach Visits and Tourism (annual user days)
New York City	22 million
Nassau-Suffolk	38 million
Total Atlantic Beaches	60 million

TABLE 2.

1976 BEACH USE

(upper bound attendance)

(extrapolated from Heatwole and West and OCS report)

	Beach Visits and Tourism (annual user days)
New York City	55 million
Nassau-Suffolk	95 million
Total Atlantic Beaches	150 million

TABLE 3. ATTENDANCE AT STATE PARK BEACHES in STATE PARK REGION

(millions of user days)

Park	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
R.Moses	2.74	2.59	1.7	2.45	2.25	2.34	2.5	2.3	2.6	2.7	3.1
Jones Beach & Captree	14.5	13.5	8.0	10.4	8.5	8.6	8.7	7.4	8.3	8.3	10.0
Total	17.24	16.1	9.7	12.85	10.8	10.9	11.2	9.7	10.9	11.0	13.1

than the 1976 figures. If this percentage were applied to total beach attendance, it would imply a baseline which is between the upper bound and lower bound, but much closer to the lower bound. This baseline is equal to 69 million.

The next step in the analysis was to compute the total economic benefits associated with the baseline attendance. The measure of economic benefits which is examined is consumers' surplus. As discussed above, consumers' surplus is defined as the difference between how much people value a good or activity, less the cost to them of obtaining that good or activity. Another way of explaining the consumers' surplus associated with beach use is that it represents the total that beach users would be willing to pay to continue to have the opportunity to engage in beach activities. Both measures of economic benefits will be employed in this study.

There is no existing measure of consumers' surplus available for New York beach users. To estimate the consumers' surplus one would need a data set which would allow the estimation of individual travel cost demand curves. Such a data set would contain data on the travel distance, number of trips, household income, education levels, family size and other socio-economic variables for a sample of individual beach users. Unfortunately, such a data set does not exist. However, it is possible to obtain some estimates of per-trip consumers' surplus from studies of other geographic areas.

The first of these is the Bell and Leeworthy study of Florida beaches (1986). They find residents' per-day consumers' surplus to equal approximately eleven dollars ($10.23 in 1984 dollars, converted to 1987 dollars). The corresponding figures for tourists were almost three times as high. For New York State, the consumers' surplus estimate which is relevant is the resident figure, as New York beach users are primarily downstate residents.

These results appear to be reasonable. Smith and Kaoru (1988) surveyed travel cost demand studies and analyzed seventy-seven published and unpublished studies. They report an average consumers' surplus per unit of use of $119 (1987 dollars) for coastal areas in general. One of the reasons that this figure is higher than the Bell and Leeworthy figure is that the unit of use in many of the studies is trips, rather than days. The range they report is $2.30 to $544.

Although this study can neither confirm nor reject the Bell and Leeworthy study as inappropriate for application to New York beaches. It does suggest that the Bell and Leeworthy results are at the low end of the spectrum of such estimates, and as such are more likely to be underestimates of the true value rather than over estimates.

The consumers' surplus estimates of Bell and Leeworthy, together with the estimates of total usage presented in Table 1, can be used to infer an aggregate demand curve for beach use. If the per-day consumers' surplus is assumed equal to the Bell and Leeworthy figure of eleven dollars, and there are 60 million days of beach use as reported in Table 1, then the total consumers' surplus is equal to 660 million dollars. A linear demand curve can be assumed, where the area between the unknown price line and the demand curve must equal 660 million dollars. In order for this to be true, the ordinate intercept must be $22 above the unknown price. Note that the magnitude of the unknown price is unimportant, as that does not affect economic value, which is the area between the price line and the demand curve.

If an increase in pollution reduced total beach use by 10%, then it could be assumed that the reduction took place because of a parallel downward shift of the demand curve, as in Figure 6. The loss in consumers' surplus would be equal to $125.4 million, which is a 19% reduction in consumers' surplus. This reduction in economic benefits is greater than the reduction in total use, because the remaining days of use are less highly valued, due to increased pollution. An alternative assumption is that the intercept remains unchanged and the demand curve rotates clockwise (Figure 7) to achieve the new level. In this case the reduction in consumers' surplus would be $66 million, which is exactly a 10% reduction. The actual change is likely to be somewhere between the estimates arrived at with the assumptions of a parallel shift and a rotation of the demand curve.

If the exact reduction in usage associated with particular changes in chronic or episodic pollution could be readily determined, it would be easy to value the benefits of pollution reductions or the costs of increases in pollution. However, this is the most problematic effect to determine and any attempt to forge this relationship with current levels of information would be

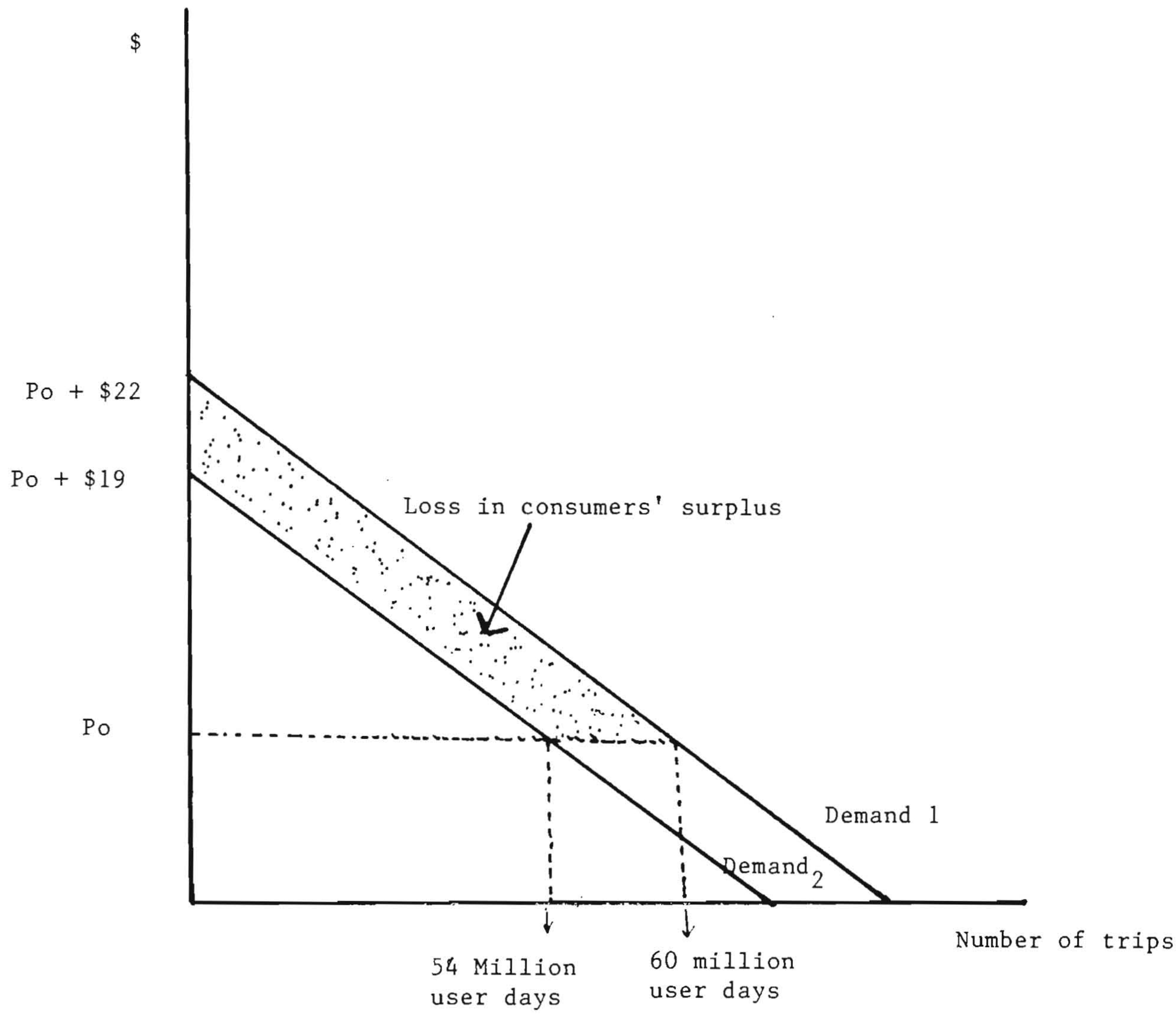

Figure 6. Parallel shift of demand for beach use - Loss in consumers' surplus associated with a pollution induced 10% reduction in beach use.

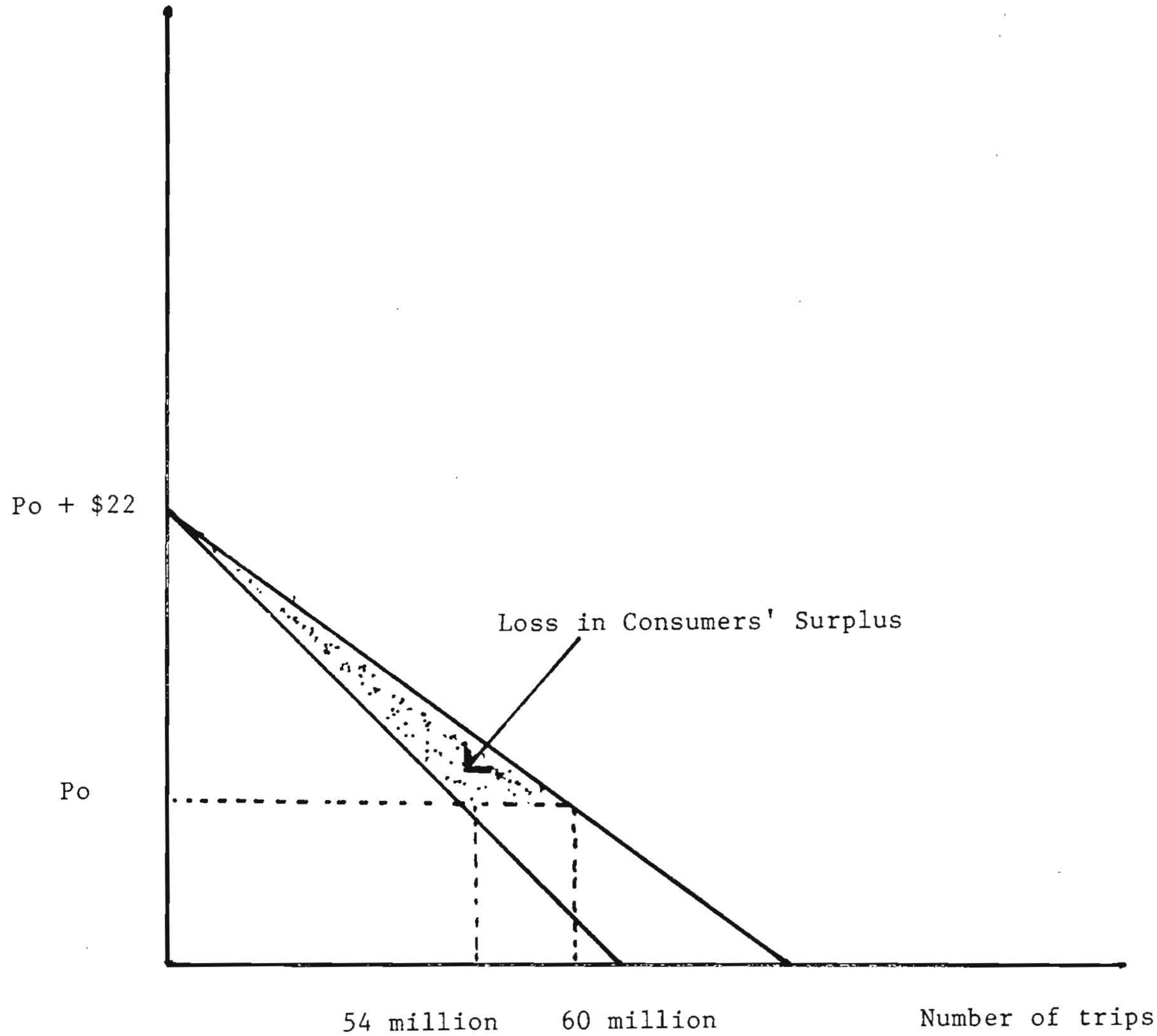

Figure 7. Rotation of demand for Beach Use -
Loss in consumers' surplus associated with
a pollution induced 10% reduction in beach use.

fraught with error. As an alternative to a direct attempt to forge this relationship, the losses in economic benefits associated with given declines in beach use, and the increases in economic benefits associated with given increases in beach use will be calculated. These are presented in Table 4 for lower bound baseline attendance. Corresponding measures for upper bound attendance are given in Table 5.

Since it is difficult to predict the reduction in beach use associated with changes in the levels of chronic pollution or changes in the frequency of episodic pollution, increases and decreases in economic benefits have been linked to percent changes in beach use (Tables 4, 5) so that the reader can make his own judgments as to the likely impacts of reductions or improvements in water quality of the New York Bight. It is possible, however, to make some estimates of the magnitude of the changes in beach use associated with changes in pollution by looking at the few studies which have been done on pollution and beach use.

In 1980, Heatwole and West published a Sea Grant-funded study entitled, "Beach Use and Water Quality in New York City." An interesting facet of this study is that they predicted that New York City beach facilities may not be sufficient to handle the increase in usage associated with the increase in water quality which they forecast was likely to occur during the 1980's. This scenario has not taken place, but it is still possible to gain some insights from this study. To begin with, this study shows that beach users are aware of poor quality and desire higher water quality. Secondly, the difference between attendance reported in the OCS report and that reported by Heatwole and West may be attributable to the washup of sewage and other wastes which occurred in the summer of 1976. If this is true, then the economic damages associated with this episodic pollution event are a loss in consumers' surplus of $990 million. However, these figures are somewhat on the high side and something representing a more conservative assumption of typical year beach usage might be more appropriate. Scaling the $990 million figure to an estimate inside a range of $300 million to $600 million would be more consistent with a baseline attendance figure between the upper and lower bounds which were previously discussed.

In an unpublished Cornell University master's thesis, Paul Fassinger looked at "Estimated

TABLE 4.

CHANGES IN ECONOMIC BENEFITS (consumers' surplus) ASSOCIATED WITH CHANGES IN LEVELS OF BEACH USAGE

(lower bound baseline attendance)

% Change in use	parallel shift of demand	rotation of demand
minus 1%	minus $13.1 million	minus $6.6 million
minus 5%	minus $64.4 million	minus $33 million
minus 10%	minus $125.4 million	minus $66 million
minus 15%	minus $183.2 million	minus $99 million
minus 25%	minus $288.8 million	minus $165 million
minus 50%	minus $495 million	minus $330 million
plus 1%	plus 13.3 million	plus $6.6 million
plus 5%	plus $67.7 million	plus $33 million
plus 10%	plus $138.6 million	plus $66 million
plus 15%	plus $212 million	plus $99 million
plus 25%	plus $371.4 million	plus $165 million
plus 50%	plus $825 million	plus $330 million

TABLE 5.

CHANGES IN ECONOMIC BENEFITS (consumers' surplus)
ASSOCIATED WITH CHANGES IN LEVELS OF BEACH USAGE
(upper bound baseline attendance)

% Change in use	parallel shift of demand	rotation of demand
minus 1%	minus $32.8 million	minus $16.5 million
minus 5%	minus $161 million	minus $82.5 million
minus 10%	minus $314 million	minus $165 million
minus 15%	minus $458 million	minus $248million
minus 25%	minus $722 million	minus $413 million
minus 50%	minus $ 1238million	minus $825 million
plus 1%	plus $33.2 million	plus $16.5 million
plus 5%	plus $169 million	plus $82.5 million
plus 10%	plus $347 million	plus $165 million
plus 15%	plus $532 million	plus $248 million
plus 25%	plus $928 million	plus $413 million
plus 50%	plus $2062 million	plus $825 million

Recreational Demand Due to Enhanced Water Quality at New York City Beaches." He calculated that a twenty percent decline in water pollution would increase the number of visitor days at New York City by between 264,644 and 870,265, which amount to changes of 0.4 percent and 1.5 percent. He also found that a forty percent decline in pollution would increase user days by between 873,644 and 2,584,918, which corresponds to changes of 1.6 percent and 4.7 percent. It should be noted that the survey upon which these estimates were based asked the respondents questions about their responses to changes of twenty percent and forty percent in water quality, without specifically defining what those changes would imply in terms of increased aesthetics, reduced health risks and so on. Ordinary beach users might not know how to properly interpret a hypothetical relative change of this nature.

Strand, Bockstael and Kling (1986) looked at public beach use and water quality in the Chesapeake Bay. While their results are not directly transferable to New York, they do provide some insights into beach users' attitudes towards pollution. They found the average beach user would be willing to pay between eleven and forty-three dollars per year to raise water quality from "unacceptable" to "acceptable." These results are difficult to project to New York, since the data are defined in terms of total days of beach visits, not total beach users. However, if one is willing to assume that the average New York beach user takes as many trips per year as the average Florida beach user (14.68) then there are between 4.1 and 10.2 million users of New York beaches. If they had the same willingness-to-pay as Chesapeake Bay beach users, this would correspond to between a 45.1 million and 438.6 million dollar willingness-to-pay for improved water quality. It is likely that the New York willingness-to-pay should be higher than the Chesapeake willingness-to-pay, since Maryland beach users have a relatively unpolluted Atlantic as an alternative to the Chesapeake (although it is two hours farther, by car, from the important population centers).

The effects of the chronic pollution may be as large or larger than the effects of episodic pollution; however, the author feels that this is not likely to be the case. Chronic pollution is less perceptible to the typical beach user, and does not elicit the same type of emotional response as raw sewage, grease balls, tampon applicators, or syringes. While the hypothesis that chronic pollution is just as impairing to beach use as episodic pollution cannot be rejected in any statistical sense, it is the author's opinion that chronic pollution does not have the same effect as episodic pollution. There are several logical arguments which support this contention. First, there is a west-to-east gradient of chronic pollution intensity, so beach users can normally obtain better water quality by traveling east. Second, since chronic pollution has increased gradually over time, individuals and society as a whole have had time to make adjustments, which lowers the cost of the pollution. Based on the data that have been described in this text, the best guess as to the economic costs of impairment from chronic pollution is a loss in consumers' surplus of $180 million.

Estimates of the economic value of commercial fishing

Kahn has developed a methodology for evaluating the effect of pollution on commercial fishing. In this paper, Kahn shows that pollution can shift the equilibrium growth function inward. This effect can be illustrated as the leftward shift of the locus of biological equilibrium in Figure 8, where the locus of biological equilibrium shows the one point on each supply curve that is a point of biological equilibrium. The inward shift of the locus of biological equilibrium leads to a shift of the bioeconomic equilibrium from point A to point B, and a reduction in economic benefits (consumers' plus producers' surplus) of area GIC less area ADC minus area GFH less area FEB. The measure is slightly more complicated than that which was discussed earlier due to the open-access nature of commercial fishing. Areas ADC and GIC represent the social losses from excess effort and must be subtracted to measure net social benefits (Kahn, 1987).

This type of effect of pollution can be seen as a supply-side effect, where the pollution causes reductions in the level of the fish stock, which ultimately shift the supply curve up and cause a loss in economic benefits. This can be done either through a direct effect of the pollution on the ability of the ecosystem to carry as large a biomass, or through the closure of some areas of the ecosystem to fishing activity, because of high levels of pollution.

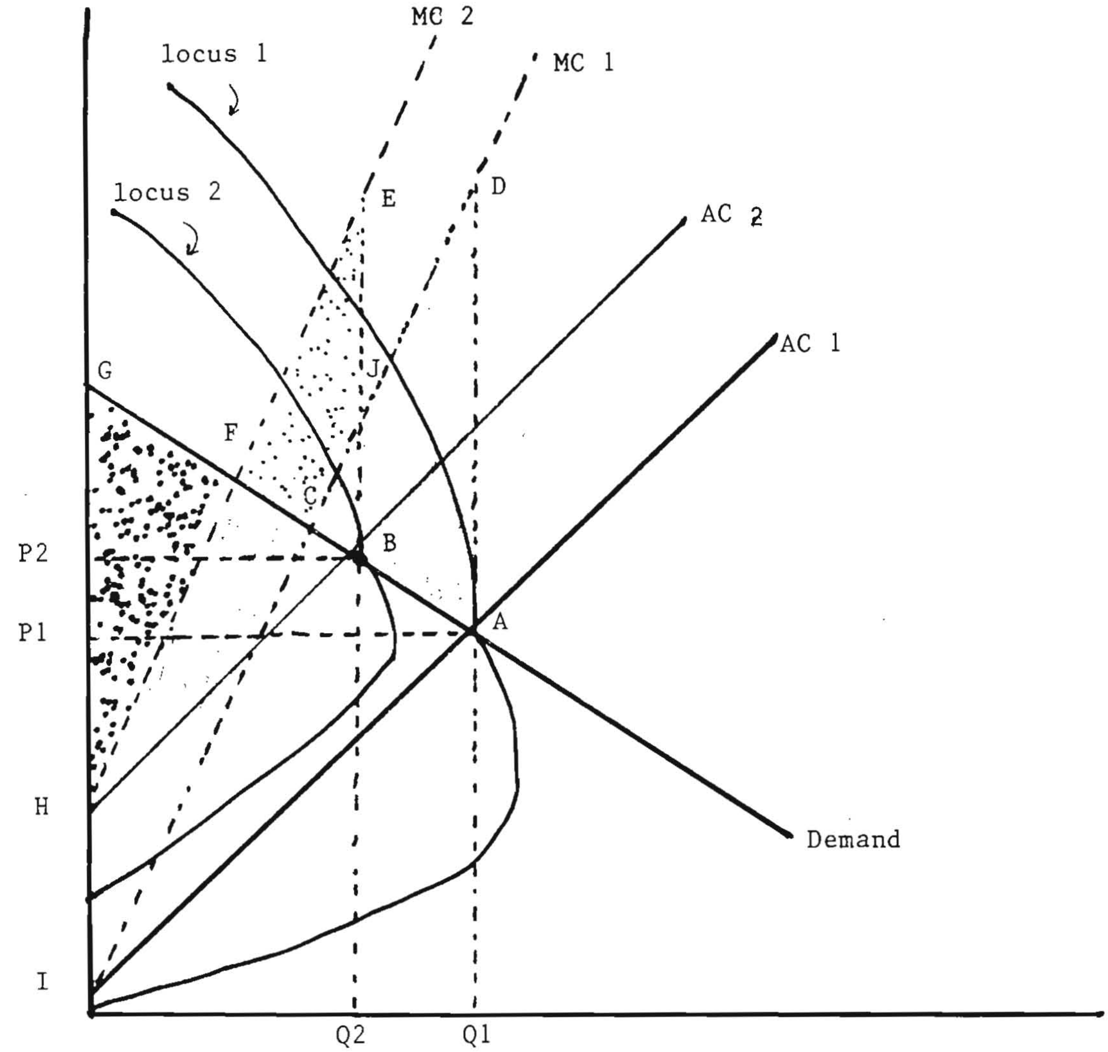

Figure 8. Loss in Net Benefits from pollution induced inward shift of locus of biological equilibria - Commercial Fishing.

In addition to the supply side-effect, pollution may affect the demand for fish and fish products. If pollution lowers the quality of fish by exposing the consumer to adverse health risks, then the demand curve will shift downward, as in Figure 9, shifting the equilibrium from point A to point B, and causing a loss of net economic benefits of area JDE less area ADC minus area FHG less area HBI. The same type of impact will occur even if the health risk is merely perceived, rather than real. Swartz and Strand (1981) showed this to be true for kepone, for which the James River spill reduced the demand for unaffected fish species through out the Chesapeake area. There is also considerable evidence (Grant, 1989; Scotti, 1989) that the demand for fresh fish, even offshore species, in the New York area has been dramatically affected by the washup of medical wastes.

Little has been published in the referenced economics literature concerning the effects of pollution on commercial fisheries. In addition to the aforementioned conceptual article by Kahn, there is an article by Kahn and Kemp (1985) which looks at pollution which damages submerged aquatic vegetation in the Chesapeake Bay. Strand and Lipton published a conceptual article showing the effect of fish diseases on net economic benefits and optimal fisheries management. Kahn and Kemp showed that the virtual elimination of submerged aquatic vegetation in the Chesapeake Bay and its tributaries during the late 1970s caused approximately 24 million dollars ($1987) of damage to commercial and sport fisheries, with roughly 17 million dollars of damage occurring in commercial fishing. Kahn and Rockel (1988) found that the elimination of Long Island bay scallops by brown tides would lead to annual losses of approximately two million dollars a year. Kahn and Buerger (1988) found that the New York fluke and flounder fisheries also yielded net annual benefits of approximately two million dollars. In another study, Kahn and Buerger (1989) found the post-1985 annual benefits associated with the striped bass harvest equal to approximately $273,000, while the value of the annual benefits of the striped bass harvest before the deterioration of Chesapeake stocks was approximately $669,000.

While the existing level of knowledge is not sufficient to place a precise value on the damages to commercial fishing from pollution, it is possible to gain some insights by looking at

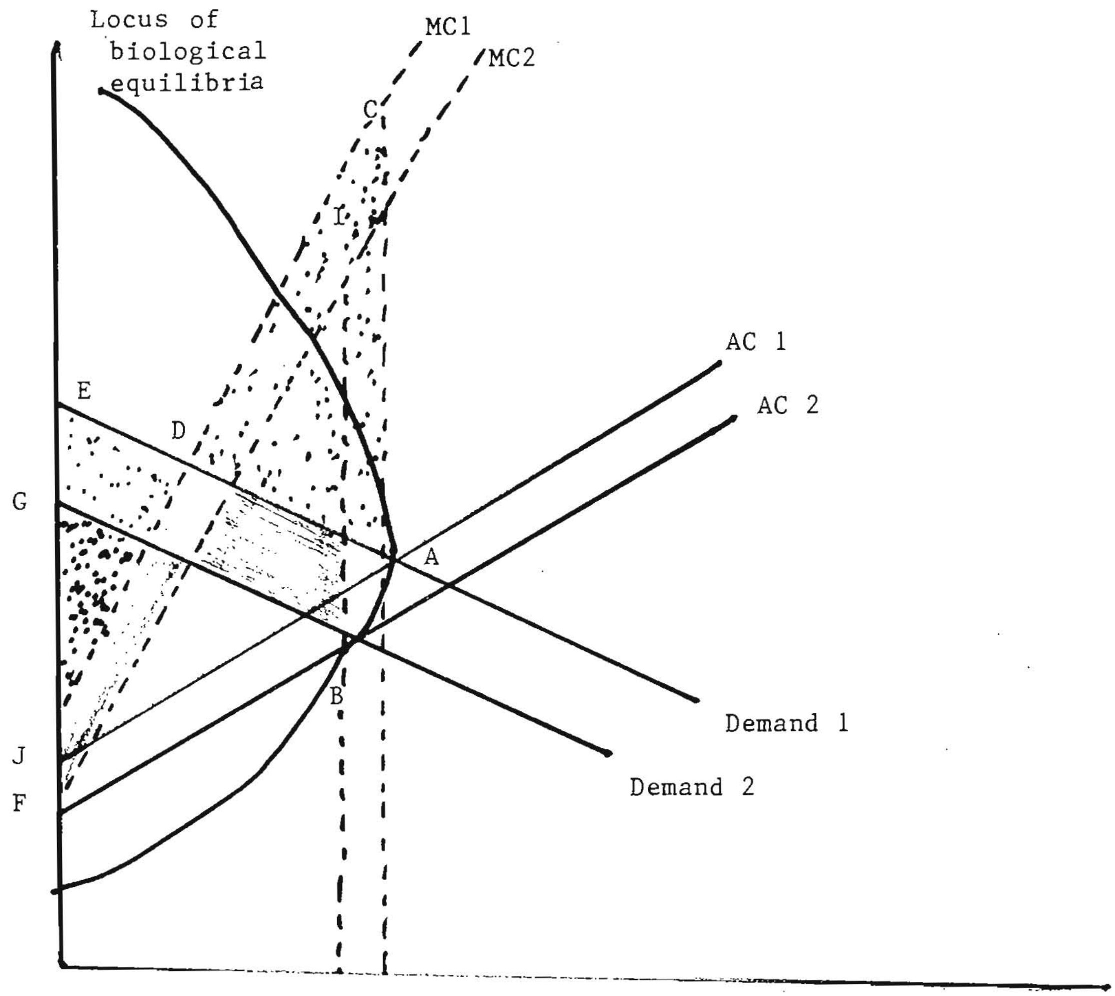

Figure 9. Loss in Net Benefits from pollution Induced downward shift of demand for commercial fishing.

the economic benefits associated with current (1986) levels of fish landings. Table 7 contains a summary of this information, which is based on NMFS landings data and several studies whose information is summarized in Table 6. The landings and the value of landings data are taken directly from the NMFS reports, with value of landings converted to 1987 dollars. The net economic benefits (NEB) are the total consumers' surplus and producers' surplus, and were computed by extrapolation using the following equations:

finfish: NEB = (1986 landings)* (1986 price) *($0.45)

(1986 price of flatfish)

shellfish: NEB = (1986 landings)* (1986 price) *($6.95)

(1984 price of bay scallops)

The rationale behind these equations is that net economic benefits are somehow proportional to quantity and quality. Since past studies have measured the net economic benefits associated with flatfish and bay scallops, these are used as standards. Net economic benefits per pound of the standard fish ($0.45 for flatfish and $6.95 for bay scallops) are then multiplied by landings to adjust for differences in quantity, and multiplied by the ratio of prices to adjust for differences in quality. This is admittedly an *ad hoc* technique, but it does allow for the construction of some value measures which are more meaningful than the NMFS value of landings, since the NMFS data do not consider consumers' and producers' surplus.

One can not use the net economic benefits reported in Table 7 to undertake an analysis similar to that used in the beach use section of the report because the response to pollution is much more complex than in the beach use case. In the beach use case, the response to pollution is a downward shift of the demand curve. However, with fisheries, pollution may cause both the demand and supply functions to shift, as well as the locii of biological equilibria. It is therefore relatively difficult to place upper and lower bounds on the change in value associated with a change in landings, and virtually impossible to measure the change in value associated with a change in fish stocks. In the absence of any better information, it would be reasonable (although subject to a potentially large standard error) to assume that a given percent reduction in fish

TABLE 6.

Net Economic Benefits (Consumers' and Producers' Surplus) and Value of Landings for Available Species

species	year	catch (1000 lbs)	price $	value $1000	NEB 1987	NEB per lb $1000
bay scallops *	1984	297	4.95	1470	2000	6.73
fluke # flounder	1986	4436	0.82	3637	2000	0.45
striped bass †	1975	1409	0.74	1043	669	0.47
striped bass +	1984	540	2.40	1296	273	0.51

sources:

* Kahn and Rockel

Buerger and Kahn

† Buerger and Kahn

Landings and Value data from NMFS, New York Landings

Table 7. Value of Landings and Inferred Net Economic Benefits for Major New York Species (1986 landings, 1987 dollars)

Species	catch 1000 of lbs	value 1000 of $	inferred NEB
bluefish	1616	462	254
butterfish	824	427	234
cod	459	470	257
blbck flounder	898	690	378
fluke	2727	4269	2342
ywtl flounder	533	490	269
scup	1969	1971	1081
swordfish	580	2031	1138
tilefish	2371	3069	1684
tuna (all)	1254	3485	1913
all finfish	**19546**	**20377**	**11183**
lobster	1407	4265	5798
all clams	14633	16643	22628
oyster meats	264	1266	1721
sea scallops	174	922	1254
squid	6420	2722	3701
all shellfish	**23308**	**26219**	**35647**
all fish	*42854*	*46596*	*46830*

stocks reduces both fish landings and economic benefits by the same percentage.

In summary, finfish generate approximately 11 million dollars in net economic benefits, and shellfish generate an additional 35.6 million dollars in net economic benefits. It is thus apparent that even relatively small damages to these fisheries could have important economic consequences. Although it is extremely difficult to fine-tune an estimate, it is apparent that pollution impairs commercial fishing in a fashion that would be measured in tens of millions of dollars, with possibilities of it reaching over one hundred million dollars per year when multiplier effects are considered.

Recreational fishing

The analysis of recreational fishing proceeds along the same lines as the analysis of beach use, with the exception that the author has conducted original research on the economic value of recreational fishing in the New York marine district. (Kahn and Buerger, 1988, 1989; Kahn, 1989) This work, funded by the New York Sea Grant Institute and The New York Department of Environmental Conservation, was based on both intercept surveys and random telephone surveys. The intercept surveys were conducted at fishing areas such as marinas, piers and shore fishing areas, and were designed to collect information on the fishing activity of anglers. The random telephone surveys were designed to collect information on the level of participation.

The information on fishing activity was used to estimate travel cost demand curves. Regression analysis was used to relate the number of trips to a vector of explanatory variables, such as travel cost (including charter or party boat fare, if applicable), family income, age, education, sex, and years of experience in coastal fishing. Consumers' surplus was then derived from the travel cost demand curves. The per-person consumers' surplus was estimated to be between $300 and $1,000 per year. The range on the estimates was due to the fact that no single estimate was formulated for the fishery as a whole; rather, estimates were generated for different components of the fishery (species and mode of fishing). Unfortunately, the data set did not contain sufficient information to determine consumers' surplus as a function of the level of floatable waste or pollution in general. See Kahn (1989) for a complete discussion of the research methodologies.

The participation function was estimated as a probability of participation function using a probit regression. The dependent variable was binary (one if someone in the household participated in saltwater fishing in 1986, and zero if no one in the household participated in 1986). The explanatory variables included a vector of socio-economic variables, and the location (borough or county) of the household. A mean aggregate participation rate was calculated and applied to the number of households in metropolitan New York and Long Island. This yielded an approximate number of one million recreational fishermen.

Based on an upper bound consumers' surplus estimate of $1,000 per person, a lower bound estimate of $300, a fishery-wide average number of trips of ten, and a fishery-wide average travel cost of about twenty dollars, an analysis similar to that which was applied to beach use was conducted. Tables 8 and 9 contain information on the potential losses in recreational fishing due to floatable wastes.

Conclusion

The development of policy to deal with the floatable waste problem requires information on how people value the reduction of waste. The measure of net economic benefit (consumers' and producers' surplus) was discussed as being the most appropriate measure in this context.

Unfortunately, there are not sufficient data to completely specify the relationship between changes in the level of pollution and changes in economic value, although some likely scenarios have been specified in this study. Because of the difficulty in establishing this relationship, the study has developed an alternative approach which yields some insight into the relationship. This is done by looking at three activities (commercial fishing, recreational fishing and beach use) and measuring how extensive the change in benefits would be if pollution changed the level of activity by given percent reductions. These results, which were presented for each activity in the preceding sections, are aggregated and presented in Table 10 and Figure 9.

TABLE 8.

CHANGES IN ECONOMIC BENEFITS (consumers' surplus) ASSOCIATED WITH CHANGES IN LEVELS OF RECREATIONAL FISHING ACTIVITY

(lower bound estimates of individual consumers' surplus)

% Change in use	parallel shift of demand	rotation of demand
minus 1%	minus $7 million	minus $3 million
minus 5%	minus $34.2 million	minus $15 million
minus 10%	minus $66.5 million	minus $30 million
minus 15%	minus $96.6 million	minus $45 million
minus 25%	minus $151 million	minus $75 million
minus 50%	minus $251 million	minus $150 million
plus 1%	plus 7.1 million	plus $3 million
plus 5%	plus $36.3 million	plus $15 million
plus 10%	plus $74.6 million	plus $30 million
plus 15%	plus $115 million	plus $45 million
plus 25%	plus $202 million	plus $75 million
plus 50%	plus $454 million	plus $150 million

TABLE 9.

CHANGES IN ECONOMIC BENEFITS (consumers' surplus) ASSOCIATED WITH CHANGES IN LEVELS OF RECREATIONAL FISHING ACTIVITY

(upper bound estimate of individual consumers' surplus)

% Change in use	parallel shift of demand	rotation of demand
minus 1%	minus $20.9 million	minus $10 million
minus 5%	minus $102.4 million	minus $50 million
minus 10%	minus $199 million	minus $100 million
minus 15%	minus $291 million	minus $150million
minus 25%	minus $457 million	minus $250 million
minus 50%	minus $1238 million	minus $500 million
plus 1%	plus $21.1 million	plus $10 million
plus 5%	plus $108 million	plus $50 million
plus 10%	plus $222 million	plus $100 million
plus 15%	plus $340 million	plus $150 million
plus 25%	plus $595 million	plus $250 million
plus 50%	plus $1328 million	plus $500 million

TABLE 10.

CHANGES IN ECONOMIC BENEFITS

(consumers' and producers' surplus)

ASSOCIATED WITH POLLUTION INDUCED CHANGES IN LEVELS OF RECREATIONAL FISHING, BEACH USE AND COMMERCIAL FISHING ACTIVITIES

% Change in use	lower bound	upper bound
minus 1%	minus $10 million	minus $54 million
minus 5%	minus $50 million	minus $266 million
minus 10%	minus $101 million	minus $518 million
minus 15%	minus $152 million	minus $756 million
minus 25%	minus $252 million	minus $1190 million
minus 50%	minus $503 million	minus $2499 million
plus 1%	plus $10 million	plus $55 million
plus 5%	plus $50 million	plus $279 million
plus 10%	plus $101 million	plus $573 million
plus 15%	plus $152 million	plus $879 million
plus 25%	plus $252 million	plus $1535 million
plus 50%	plus $503 million	plus $3413 million

In Table 10 it can be seen that if pollution were severe enough to generate a 25 percent reduction in the levels of recreational fishing (through a downward shift in demand), beach use (through a downward shift in demand) and commercial fishing (through a downward shift in demand or an inward shift in the locus of biological equilibria), the loss of economic benefits from those activities in New York is between $252 million and $1.19 billion. The evidence presented in this paper and others in this volume suggests that it is very likely that the floatable waste episodes of 1988 reduced these activities by at least 25 percent. If losses in New Jersey were similar (see Ofiara, this volume), then it is very likely that regional losses in these three activities exceeded one billion dollars.

Acknowledgments

This research was partially funded by the U.S. Environmental Protection Agency and the Dynamac Corporation. The recreational fishing portion of the study was based on previous work, funded by the National Oceanic and Atmospheric Administration (New York Sea Grant Institute) and the New York Department of Environmental Conservation. These agencies are not responsible for the viewpoints or conclusions of this study. I would like to thank Larry Swanson and the Waste Management Institute for giving me the opportunity to participate in this study, and acknowledge the helpful comments provided by Larry Swanson, Trudy Bell, Nick Fisher and Doug Ofiara.

Notes

1. Although the methodologies used in these two studies are not described in reports, two types of methodologies can be contrasted. One is a daily count and the other is when attendance on a "typical weekday," "typical weekend," and "typical holiday" are estimated, then multiplied by the appropriate number of days in each category. Since beach managers invariably will choose good weather days on which to base their typical counts, this methodology can drastically overestimate the seasonal attendance.

2. See report to Governor Hugh L. Carey, on the 1976 fouling of Long Island beaches.

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The Effects of Recent Marine Pollution Events on New Jersey's Commercial Fisheries

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Introduction

Marine pollution can impact commercial fisheries in many ways. Some are supply effects resulting from fish stock reductions, loss of fish habitat and spawning grounds, and decreases in recruitment and fish weight gain. In general, supply reductions will force an increase in market price. Demand can also be influenced if marine pollution affects quality (color, taste, texture of flesh), and causes detrimental health effects. In addition, demand can be affected by consumers' perceptions of quality and/or health effects. If marine pollution has adverse effects on all of these, not just health effects, then demand will fall relative to supply, generally resulting in lower prices.

Consider the above supply effects. A reduction in fish biomass will result in lower catch rates per unit of effort, higher costs per unit of effort, and lower industry profits in the short-run; all of which cause vessels to exit the fishery. Providing that demand remains unaffected relative to a supply decrease, market price will increase, and, depending on price margins of fish wholesalers, the ex-vessel price to the fisherman will also increase. If the higher prices offset the previous increases in cost per effort, then industry profits will rise also. If left unregulated, this sequence will attract more effort per vessels to the fishery until revenues equal costs (Anderson, 1986).

Consider possible demand effects as a result of marine pollution. Lower market prices due to depressed demand conditions will result in lower prices, lower revenues, and lower profits to fishermen. This effect will cause unprofitable or less-efficient vessels to exit the fishery until all vessels in the fishery just achieve the break-even point.

Economic impacts from polychlorinated biphenyl (PCB) contamination in New Bedford Harbor to local commercial lobstermen were investigated by McConnell and Morrison (1986). Since 1979, waters in the New Bedford Harbor area have been closed to the harvest of lobsters because of PCB contamination. As a result, New Bedford inshore lobstermen have been forced to travel to more distant fishing grounds, or have discontinued lobstering. By reallocating efforts to grounds outside the closed areas, lobstermen incur increased costs of time, fuel, vessel maintenance, and gear replacement. The increase in costs is estimated annually at $1,093 per lobsterman (1985$) and represents economic damages that accrue from harvest closures because of PCB contamination. Total damages are estimated at $53,557 per year (1985$) and the present value of the economic damages is $2 million (1985$). An obvious economic impact that McConnell and Morrison do not address is the effect the advisory and subsequent closure have had on local demand and price for lobsters. This effect would be to decrease revenues as a result of falling prices, assuming consumers are risk-averse and choose to avoid contaminated seafood products that result in adverse health effects. Thus, the estimated damages may underestimate the true damage. Several studies (Swartz and Strand, 1981; Capps et al., 1984) demonstrate that significant negative short-term impacts have resulted from health advisories and news reportings of these in the local seafood markets. In one case, the U.S. Food and Drug Administration (U.S. FDA) warnings and news of these warnings about mercury contamination in swordfish resulted in a significant fall in U.S. demand and depressed per capita consumption for 12 years following the warning (Lipton, 1986).

New Jersey's commercial fishery

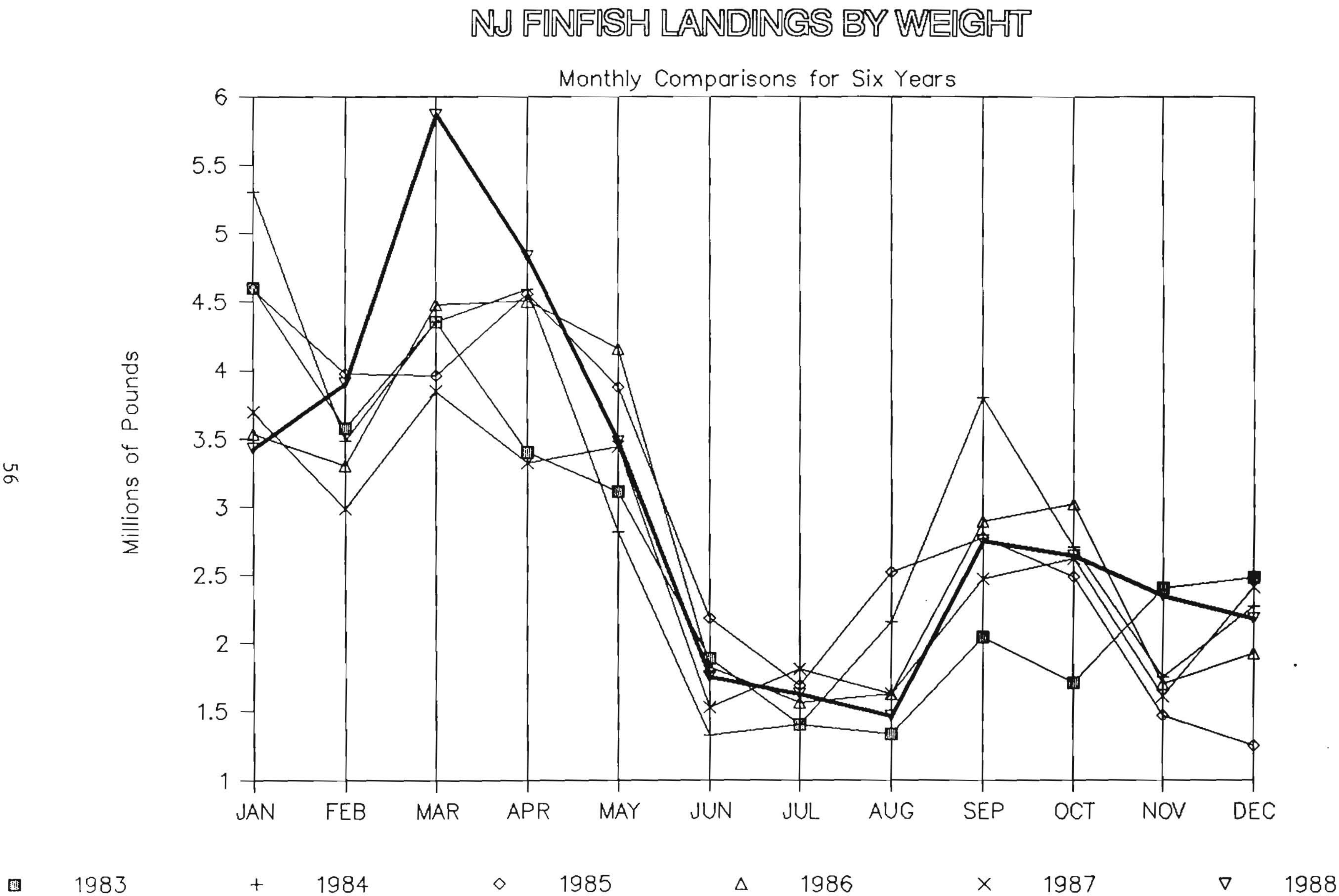
The dockside value of New Jersey's commercial landings in 1988 was $72 million. Much of the harvest was processed at dockside, creating additional income in the communities in which the fish were landed. Thus, the commercial fishery in the waters off New Jersey's coast provides a substantial income to the residents of the state and can be of critical importance in small coastal communities.

The question addressed here is whether the well-publicized pollution incidents of 1988 had discernible effects on commercial fishing landings and value. Data examined are from the National Marine Fisheries Service (NMFS). Figures 1-6 provide monthly data for commercial landings in New Jersey ports for the years 1983-1988. For ease of comparison, 1988 data are indicated by a heavier line. Figure 7 depicts yearly bluefish landings (a species emphasized in reports relating to PCB's) for the period 1974-1988, and Figure 10 shows total state landings for the same time period. Figures 8 and 9 contain data on landings in the state's three principal fishery counties. Data tables accompany the figures.

Effects on landings

Figure 1 (Table 1), *New Jersey Finfish Landings by Weight*, shows that 1988 is neither the best nor the worst of the last five years. A month-by-month comparison gives no indication that a significant event occurred which affected the quantity landed. Landings were strong prior to the 1988 summer pollution reports; were about average during the 1988 summer months, in comparison to preceding years; and ended the year with a strong showing. Figure 2 (Table 2), *New Jersey Shellfish Landings by Weight*, in fact, shows 1988 to be a somewhat better-than-average year in the summer months and after. (Shellfish landings do not have the seasonality of finfish.) In any event, current commercial landings statistics do not show any evidence of a differential negative impact of pollution on the fishing industry during this period.

Figure 1


NJ FINFISH LANDINGS BY WEIGHT
Monthly Comparisons for Six Years
Millions of Pounds
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
JAN
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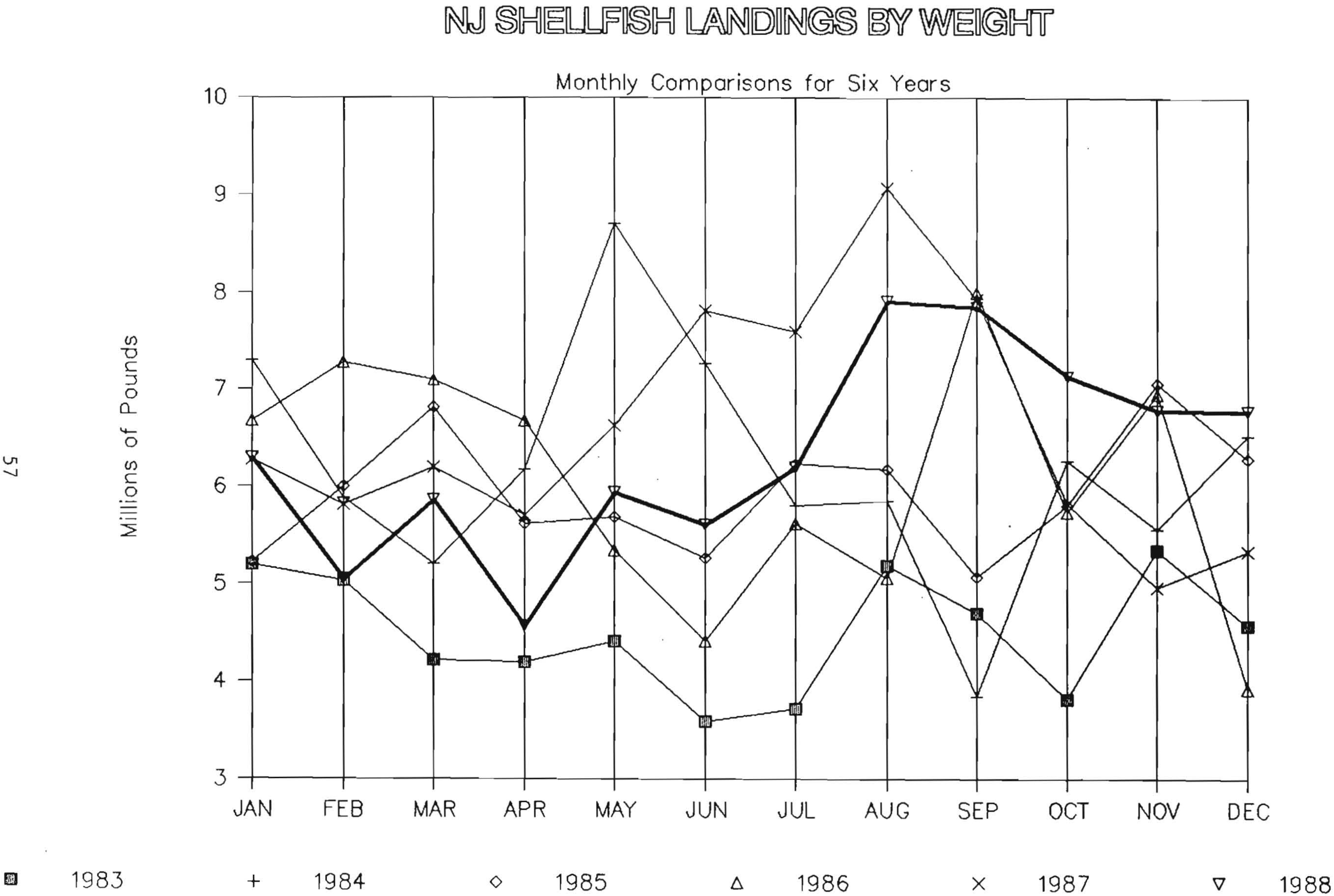
1983
1984
1985
1986
1987
1988

Figure 2


NJ SHELLFISH LANDINGS BY WEIGHT
Monthly Comparisons for Six Years
Millions of Pounds
10
9
8
7
6
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JAN
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Table 1
NJ Finfish Landings by Weight (Pounds)

	1983	1984	1985	1986	1987	1988
JAN	4,601,827	5,304,100	4,590,065	3,529,866	3,690,963	3,429,370
FEB	3,574,365	3,484,765	3,977,205	3,301,180	2,984,421	3,900,936
MAR	4,353,110	4,349,754	3,961,236	4,484,175	3,846,590	5,868,448
APR	3,402,067	4,591,869	4,556,484	4,506,910	3,324,173	4,831,813
MAY	3,111,227	2,818,602	3,878,875	4,159,607	3,444,937	3,478,376
JUN	1,891,142	1,325,954	2,185,658	1,826,959	1,534,738	1,756,115
JUL	1,402,747	1,402,992	1,690,550	1,566,254	1,808,131	1,630,628
AUG	1,335,827	2,154,774	2,521,485	1,626,709	1,625,029	1,467,123
SEP	2,043,886	3,801,221	2,775,019	2,896,599	2,468,719	2,753,298
OCT	1,705,208	2,702,492	2,483,282	3,019,854	2,619,520	2,643,152
NOV	2,401,021	1,747,598	1,468,260	1,702,462	1,610,870	2,348,610
DEC	2,478,024	2,269,701	1,246,054	1,921,015	2,410,391	2,180,745

Table 2
NJ Shellfish Landings by Weight (Pounds)

	1983	1984	1985	1986	1987	1988
JAN	5,198,542	7,298,633	5,231,505	6,679,685	6,277,878	6,301,986
FEB	5,032,798	5,891,632	6,004,200	7,287,447	5,817,984	5,052,606
MAR	4,212,702	5,209,768	6,822,992	7,102,074	6,206,416	5,866,383
APR	4,189,686	6,183,629	5,621,915	6,681,392	5,704,303	4,565,445
MAY	4,415,092	8,710,575	5,685,063	5,349,663	6,629,221	5,950,754
JUN	3,591,624	7,269,742	5,264,108	4,416,209	7,814,460	5,611,848
JUL	3,713,232	5,802,450	6,237,530	5,621,856	7,595,686	6,196,987
AUG	5,187,031	5,859,816	6,180,158	5,059,226	9,076,548	7,910,550
SEP	4,697,659	3,837,025	5,068,747	8,002,078	7,933,719	7,852,305
OCT	3,808,854	6,266,564	5,802,141	5,736,089	5,829,009	7,140,764
NOV	5,342,556	5,558,458	7,061,413	6,957,747	4,966,871	6,788,094
DEC	4,574,607	6,523,804	6,288,667	3,924,872	5,334,447	6,777,314

Table 3
Value of NJ Finfish Landings

	1983	1984	1985	1986	1987	1988
JAN	$1,694,657	$1,724,120	$1,556,649	$1,835,064	$1,978,760	$2,296,818
FEB	$1,696,731	$1,702,604	$1,606,470	$1,726,170	$2,122,850	$2,408,818
MAR	$1,946,915	$1,621,559	$1,784,055	$1,783,892	$2,334,310	$2,335,622
APR	$1,305,067	$1,398,086	$1,443,764	$1,416,791	$1,965,181	$1,610,344
MAY	$1,155,127	$934,862	$1,245,963	$1,526,995	$1,452,073	$1,438,589
JUN	$806,024	$779,048	$887,773	$999,867	$1,270,758	$1,254,274
JUL	$740,345	$748,630	$896,624	$1,090,420	$1,526,611	$1,070,142
AUG	$769,875	$1,431,446	$1,594,059	$1,142,713	$1,307,901	$1,584,892
SEP	$1,061,853	$2,273,259	$1,564,194	$2,312,644	$1,996,733	$2,797,501
OCT	$1,097,219	$1,542,472	$1,614,194	$1,780,768	$2,066,588	$1,726,175
NOV	$1,477,194	$1,338,123	$993,607	$1,202,228	$1,390,707	$1,638,403
DEC	$1,056,476	$1,000,183	$842,134	$1,172,204	$1,926,010	$1,592,386

Source: National Marine Fisheries Service

Figures 3 and 4 (Tables 3, 4) report the same data; however, the variable compared is dollar value of landings. The general price rise over this five-year period results in a better-than-average performance for 1988, but discounting this effect again leaves one with the impression that 1988 was not a year that showed significant deviations from the patterns of previous years.

As depicted in Figure 5 (Table 5), finfish ex-vessel prices for 1988 are higher than in preceding years in the late summer-early fall months, precisely when negative aspects of pollution should have caused a price decline. Shellfish dockside prices (Figure 6, Table 6) for 1988, on the other hand, are close to the five-year average, but consistently higher than in the previous year. The information in these two figures gives little support to hypotheses that pollution reports of the summer of 1988 had a negative effect on the market for seafood landed in New Jersey.

Landings and bluefish values were examined because of special concern relative to the presence of PCB's in bluefish, with the subsequent restrictions on the consumption of this fish. A health advisory was issued in December, 1982, and the spring of 1988 saw a series of newspaper articles stressing the presence of PCB's in bluefish caught off the New Jersey coast. Landings declined in 1983 and 1984, and value declined in 1983, but rose in 1984, resulting from a rise in price--probably caused by decreasing supply (Figure 7, Table 7). In 1985 and 1986 landings increased significantly, followed by a relatively small decline in 1987, and a further decline in 1988. The value of landings rose through 1987 but fell in 1988. As can be seen in the table, prices fell in 1983 after reaching a high point the previous year, and they fell once again in 1988 after the extraordinarily high prices of 1987 (the latter accompanied by a decrease in supply). In 1982 the health advisory occurred in December, and so could not affect that year's market, whereas in 1988 the adverse publicity came early in the summer and so could have had a significant effect--which it did, on the 1988 market. While the health advisory of 1982 did not produce a long-term detrimental economic impact on the commercial bluefish fishery, it is still too

Figure 3

VALUE OF NJ FINFISH LANDINGS

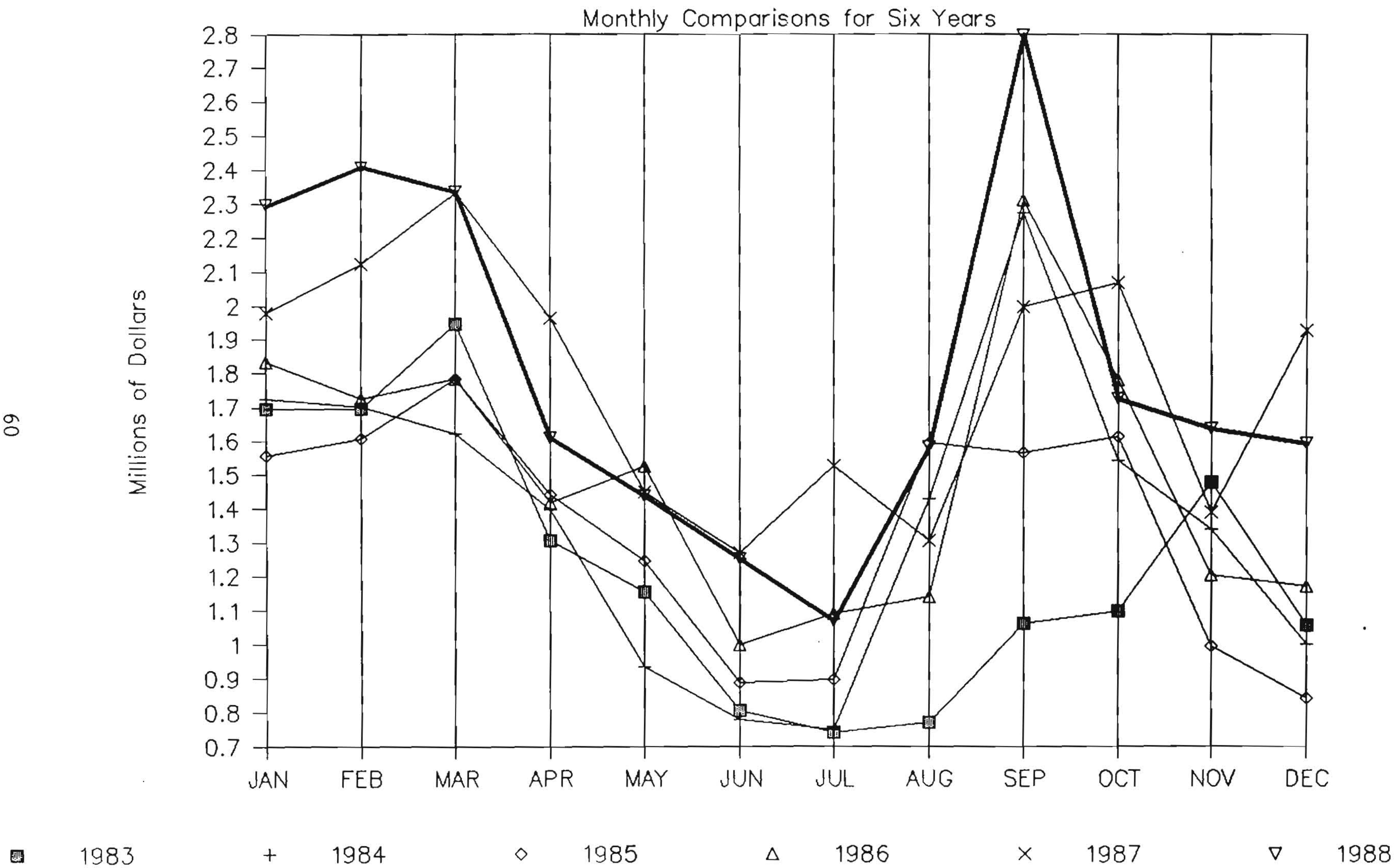

Figure 4

VALUE OF NJ SHELLFISH LANDINGS

Monthly Comparisons for Six Years

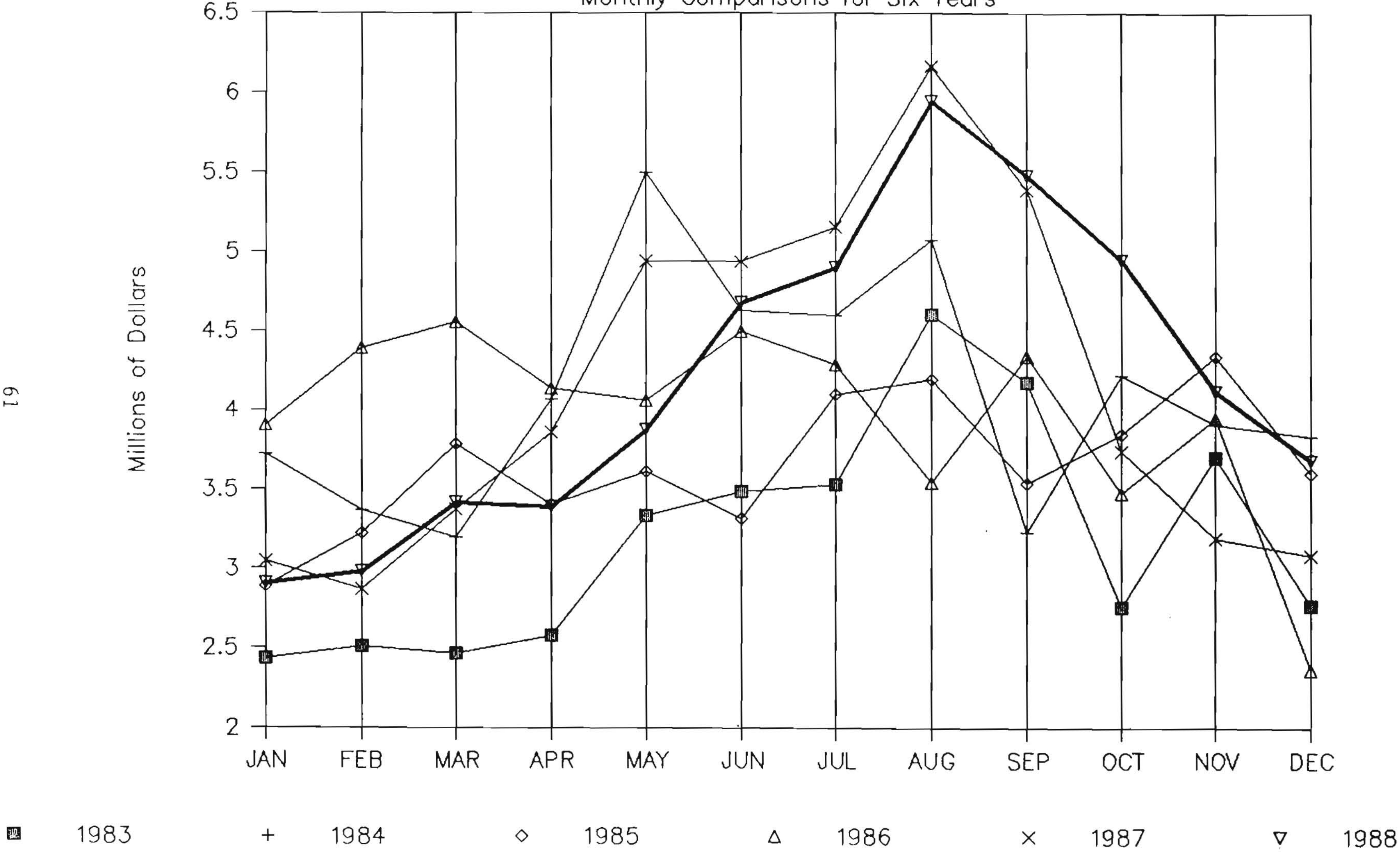

Figure 5

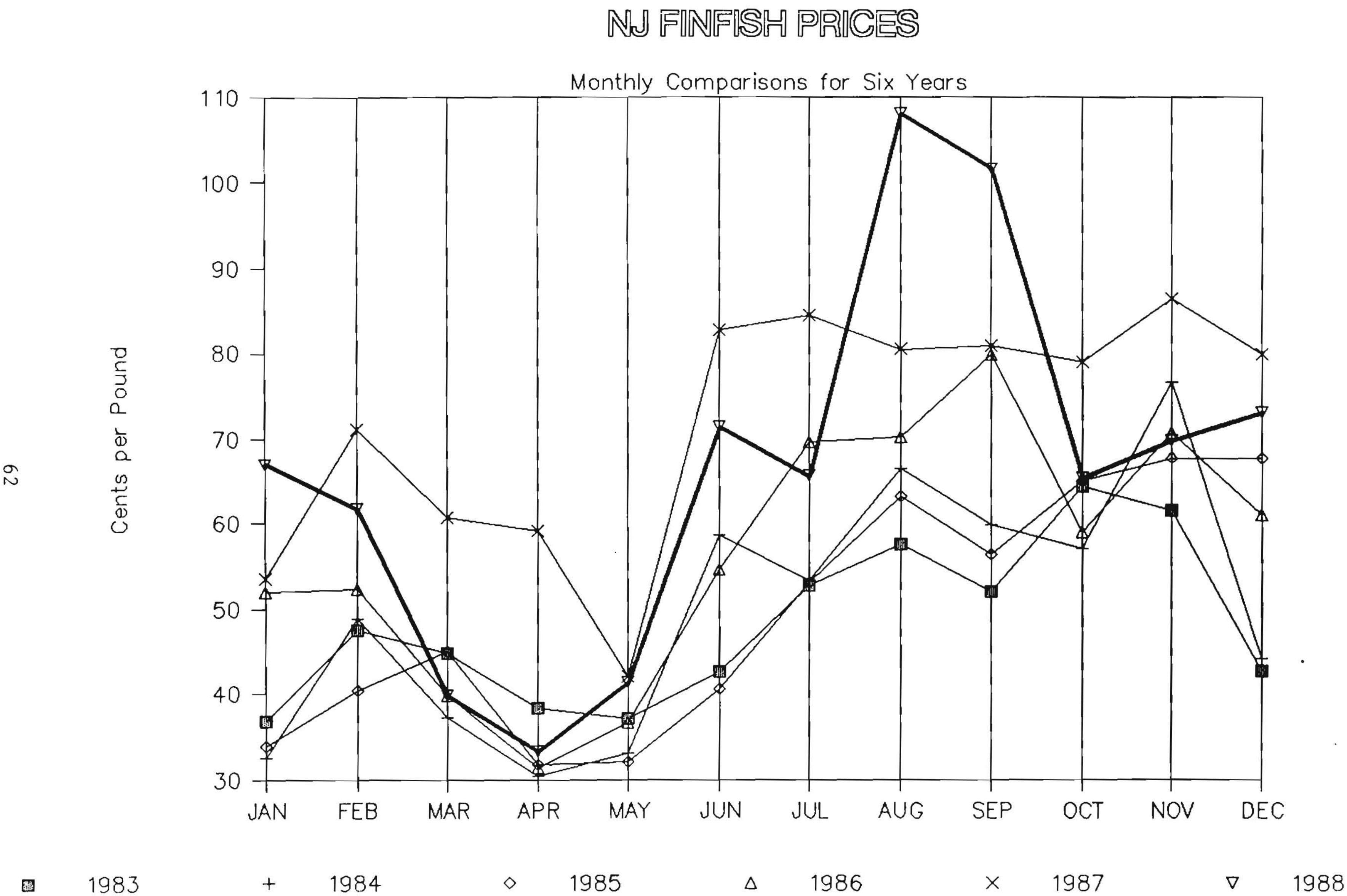
NJ FINFISH PRICES
Monthly Comparisons for Six Years
Cents per Pound
110
100
90
80
70
60
50
40
30
JAN
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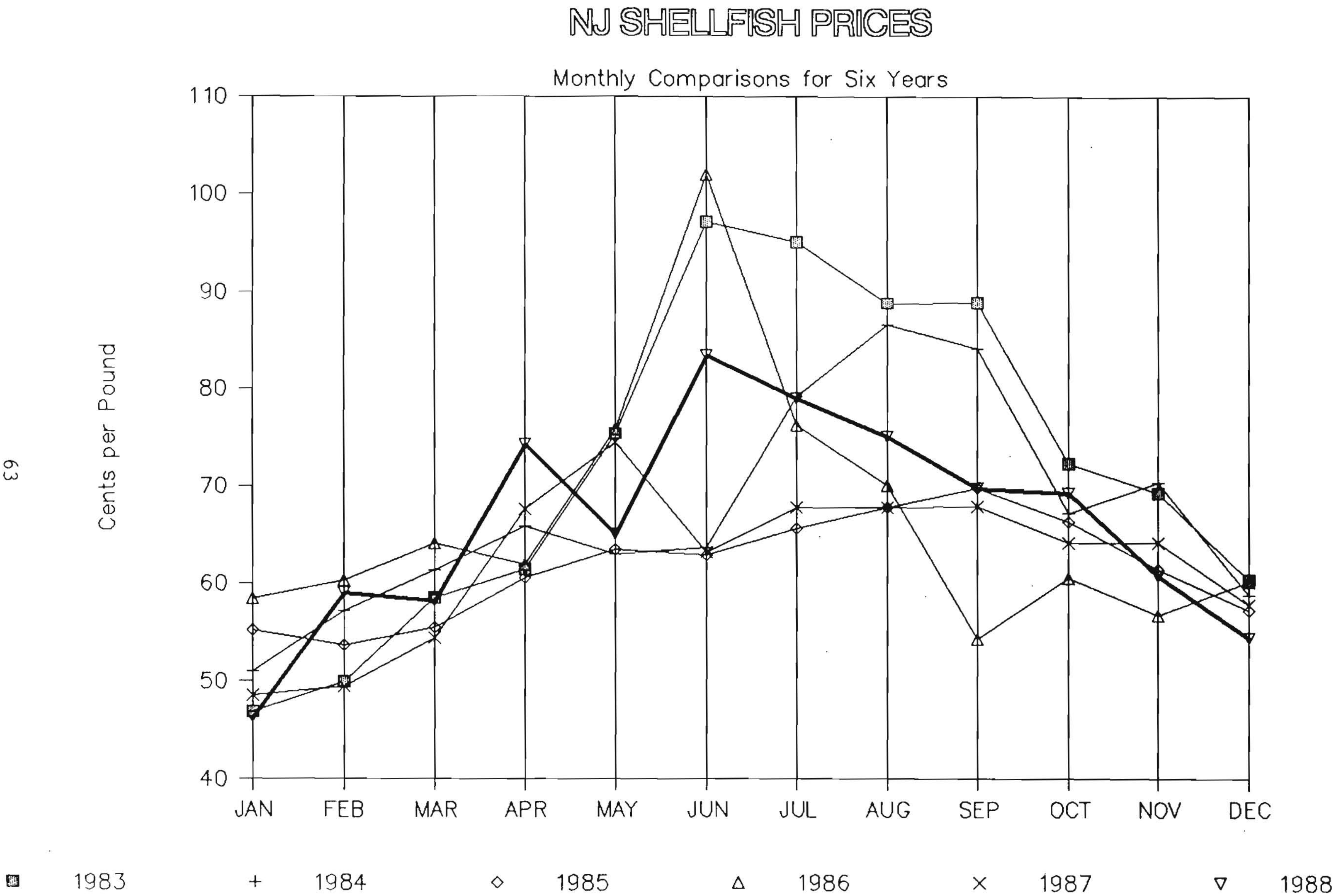
Figure 6


NJ SHELLFISH PRICES
Monthly Comparisons for Six Years
Cents per Pound
110
100
90
80
70
60
50
40
JAN
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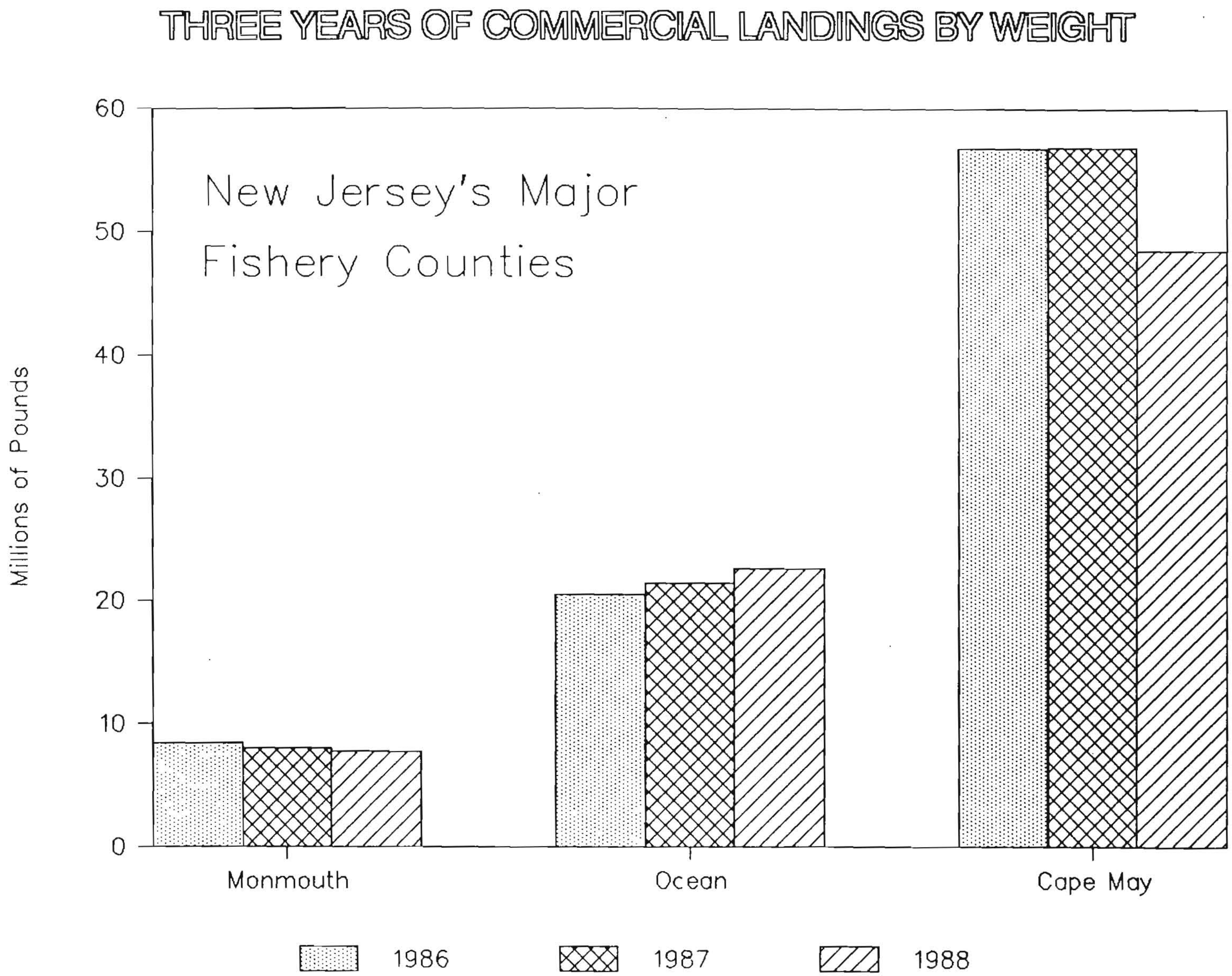
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1983
1984
1985
1986
1987
1988

early to determine the final effects of the press coverage of. the summer of 1988. However, on the basis of previous work (Swartz and Strand, 1981; Capps et al., 1984; Lipton, 1986) we believe short-term welfare losses did occur in the period following the release of the advisory, and in the period following press coverage of bluefish-PCB health advisories during the summer of 1988. In New Jersey, this has been of particular importance because bluefish have been the principal target species in the party and charter boat industry. It is in these fisheries, rather than in the commercial fishery, that economic losses were felt--both in terms of producer and consumer welfare.

Figures 8 and 9 (Table 8) contain data for Monmouth, Ocean and Cape May Counties, where New Jersey's major commercial fishery ports are located. In 1988, these three counties accounted for 70.7 percent of total landings by weight, and 75.4 percent of landings by value. The one county that did show a significant decline in landings in 1988 over the two previous years was Cape May County, which is located outside the area that experienced the pollution incidents of the summer of 1988, and whose tourist industry distanced itself from the events in the northern part of the state. However, a compensating factor was a large increase in price per pound landed. Monmouth County, which is home port for the state's largest fishermen's cooperative, likewise experienced a large price increase, but this was accompanied by only a slight decrease in landings over the previous year.

In Ocean County, home of the ports of Point Pleasant and Barnegat Light, landings increased but the dollar value of the catch decreased. It is difficult to assign a single cause to this. The species that fell most in price per pound--swordfish--nevertheless had both weight and dollar value higher in 1988 than in 1987. The species that lost the most in total value of landings in 1988, compared to 1987, were tilefish, weakfish, and tuna; however, only weakfish experienced a decline in price per pound. One would be hard-pressed to defend the hypothesis that pollution was the sole or even primary cause of this anomaly in Ocean County.

Figure 8



THREE YEARS OF COMMERCIAL LANDINGS BY WEIGHT
New Jersey's Major
Fishery Counties
Millions of Pounds
0
10
20
30
40
50
60
Monmouth
Ocean
Cape May
1986
1987
1988

Table 1. **Tourist/Convention Expenditures**

1978	$1.262 Billion
1981	$2.510 Billion
1983	$4.658 Billion

Table 2. **Long Island Tourist/Convention Expenditures for 1987 & 1988**

	1987	1988	Change
Tourist/Convention Visitors (millions)	25.5	20.9	-4.6
Expenditures (millions$)			
-Lodging (*1*)(*2*)	368.9	332.2	-36.7
-Food (*3*)	1,147.5	1,003.2	-144.3
-Transportation (*4*)	255.0	219.5	-35.5
-Entertainment	561.1	505.3	-55.8
-Other (*5*)	1,009.2	908.8	-100.4
Total	3,341.7	2,969.0	-372.7
Annual Total Impact (millions$)	7,685.9	6,828.7	-857.2
Other Direct Summer Activity (millions$) (*6*)	589.0	525.0	-64.0
Industry Total (millions$)	**8,274.9**	**7,353.7**	**-921.2**

Notes:
1) Based on 14,000 Rooms
2) Average Lodging Rate (1987=$95/Night); (1988=$100/Night)
3) Average $45/day in 1987 & $48/day in 1988
4) Includes day trips
5) Other = retail sales, etc.
6) Visitors to summer home owners

Table 3. **Estimated Loss of Revenues in 1988**

Year	**Industry Estimates (millions $)**
1987 (Actual)	$8,274.9
1988 (Estimated)	$8,738.3
1988 (Actual)	$7,353.7
Net Impact Loss	$1,384.6

The Effect of Floatable Waste on the 1988 Charter and Open Boat Business in New York City and Long Island

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Introduction

One hundred and ninety-five New York City and Long Island charter and open boat owners were surveyed by use of a mail questionnaire (Appendix 1). The surveys were undertaken to document the occurrence, extent, and regionality of an alleged decline in business since mid-summer, 1988. An attempt was also made to determine the reasons for any decline that was discovered.

Sixty businesses (30%) returned usable data with regard to number of vessel trips and numbers of passengers carried. Information from twenty-seven vessels licensed to carry more than six passengers for hire indicated a decline of twenty-three percent in passengers carried per year in 1988, as compared to the period 1985-1987. A thirty percent decline in the number of vessel trips conducted by six-person-or-less charter boats was calculated from the information provided by thirty-three businesses which operate six-person charter boats. Regional differences in trip or passenger data were not calculated, due to the poor response rate in some areas.

Of the captains operating vessels in the class carrying more than six persons for hire (open boats and/or larger charter boats) sixty percent indicated that floatables (including medical wastes) were the most important issue affecting their businesses in 1988. Other issues cited by respondents to be threatening the profitability of the industry included fish stock abundance, stock allocation, and the increasing costs of fixed business expenses (i.e., insurance, docking fees, fuel, etc.).

During the latter half of 1988, many charter and open boat owners reported a decline in their businesses. No effort had been made to document this decline. This lack of information made it difficult for organizations and agencies whose job it is to promote the sport fishing

1989 LONG ISLAND-NYC PARTY/CHARTER FISHING BUSINESS QUESTIONNAIRE

1. Please check the blank next to the phrase that best describes your business.

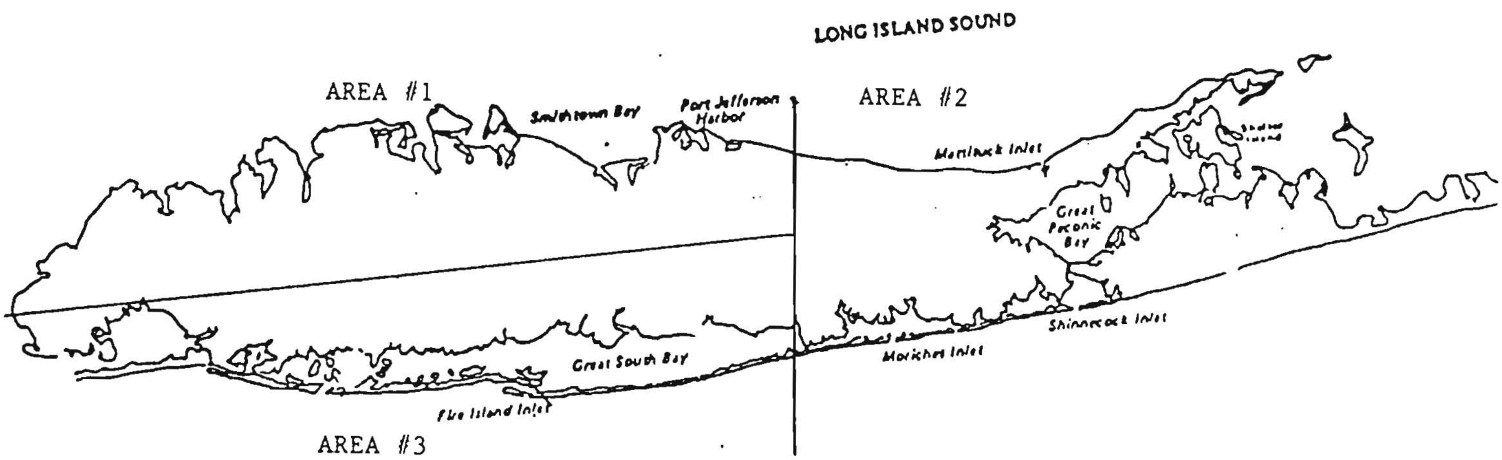
   ________ Charter Boat - 6 passenger or less

   ________ Charter Boat - 7 passenger or more

   ________ Party Boat

2. Using the map below, please indicate from what part of NY coastal waters your vessel is based.

   ________Area 1 ________Area 2 ________Area 3



3. In the boxes below, please fill in the number of trips your vessel(s) made during each season for the years 1985-1988.

	Winter (Jan/Feb/Mar)	Spring (Apr/May/June)	Summer (Jul/Aug/Sept)	Fall (Oct/Nov/Dec)
1985				
1986				
1987				
1988				

4. In the boxes below, please fill in the number of passengers carried in your vessel(s) during each season for the years 1985-1988. (Note: Taken together, questions 3 & 4 will provide a measure of both the charter and party boat industries - please provide as much information as possible to both questions.)

	Winter (Jan/Feb/Mar)	Spring (Apr/May/June)	Summer (Jul/Aug/Sept)	Fall (Oct/Nov/Dec)
1985				
1986				
1987				
1988				

5. Several factors have been mentioned as having great influence on charter/party business activity levels in 1988. Please rank the following factors in decreasing order of importance in terms of their impact on your business. (Number 1 next to most important issue, 2 next to second most important issue and so on through number 4.)

_________ Weather/Sea Conditions _________ Seafood Safety

_________ Fish Abundance _________ Floatable Wastes (including medical wastes)

6. To what extent did media coverage of the factors listed in question #5 influence your business in 1988? (circle one)

No influence Moderate influence Great influence

7. (For charter businesses only) - Are the number of charter reservations you received during the period January 1, 1989 to date of receipt of this survey: Equal To; Greater Than; Less Than; the numer of reservations received during the same period in 1988? (Circle one)

8. Please indicate your gross receipts for each year listed below*

1985	1986	1987	1988
_________	_________	_________	_________

*We realize the reluctance of businesses to provide this type of information. This question is included because it will provide the truest measure of business activity. As noted in the letter the anonymity of this information is assured.

9. In your opinion, how do you feel about the future of the charter/party industry. (Use back of paper if necessary.)

____

____

____

____

____

____

industry. Thus, this survey was developed in an attempt to answer the following questions:

1) Was there a change in business (open/charter boat) in 1988 as compared to previous years?
2) If so, what was the extent of that change?
3) If a change occurred, were some areas affected more than others?
4) What, in the opinion of the surveyed captains, were the major reasons for this change?

Methods

A survey list was compiled from publications which normally run open and charter vessel ads and from several captains' associations lists on file with the New York Sea Grant Extension office in Riverhead, New York.

In February, 1989, a cover letter indicating the survey objectives along with a questionnaire were mailed to 195 charter and open boat businesses. A second mailing ten days later served as both a "thank you" to respondents and as a reminder to non-respondents. The cover letter and follow-up mailing were seen as necessary to ensure an acceptable rate of response (Warwick and Lininger, 1975).

Sixty usable, completed surveys were returned as follows: nineteen from open boat captains, eight from large charter boats (more than six passengers), and thirty-three from smaller charter boats. For the purposes of data analysis, the results from open and large charter boats were combined, whereas the data from the small charter boats were studied separately.

Results and discussion

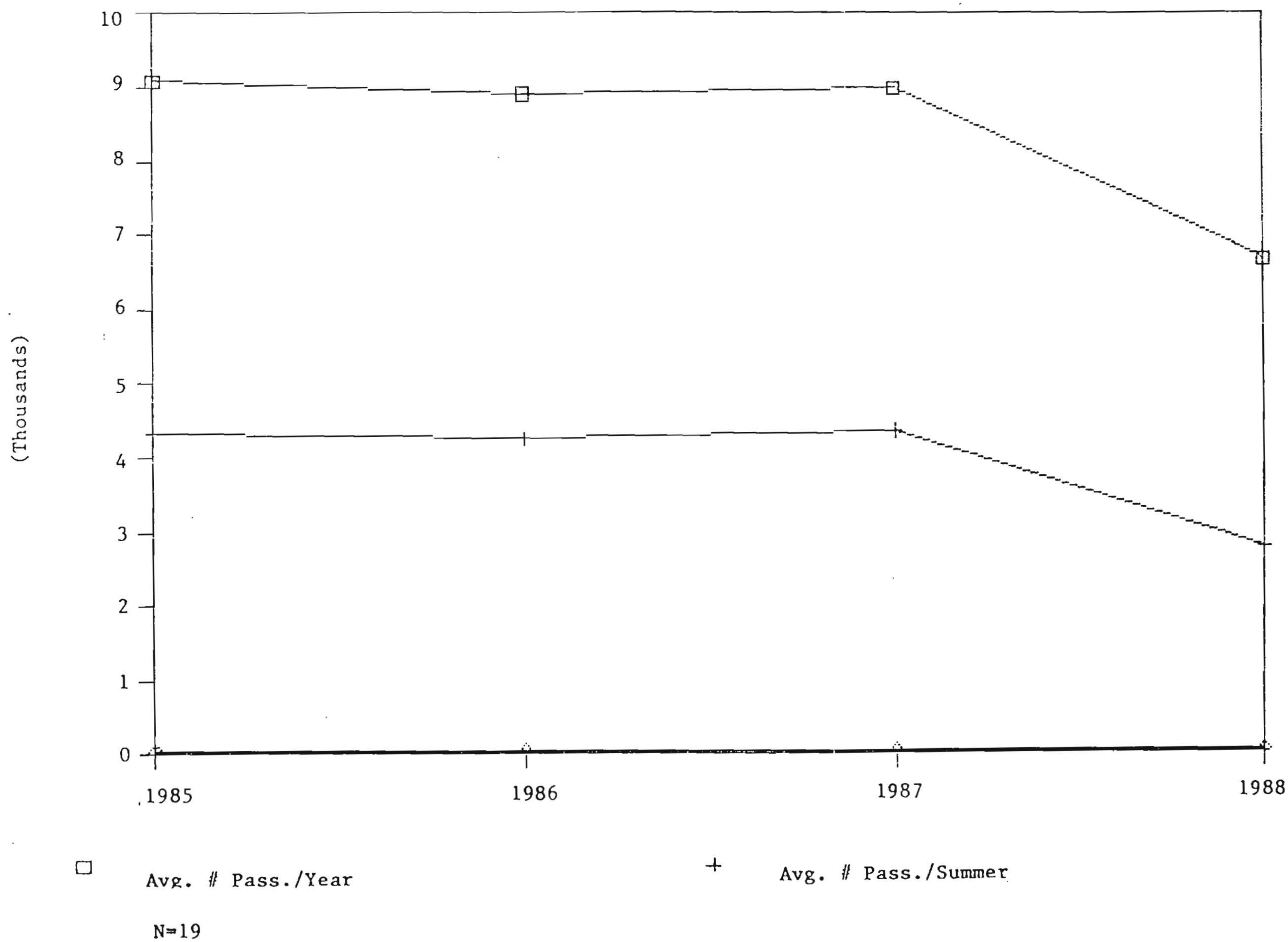
Although the thirty percent response rate suggests tenuous conclusions, there is sufficient documentation to indicate that a marked decline took place in the open, large charter and six-person charter boat industry during 1988, as compared with the period 1985-87. For example, those party boat and large charter boat businesses responding to the survey experienced a decline in the average annual number of passengers, from 8,438 per year for the period 1985-87, to 6,521 per year in 1988 (Figure 1).

Figure 2 indicates that prior to July, the 1988 season exhibited a normal pattern of

FIGURE 1

PARTY BOATS -- 1989 SURVEY

Mean Numbers of Passengers



1989 Sea Grant Long Island/New York City Charter/Party Boat Survey

FIGURE 3

SIX PERSON CHARTER BOATS

Mean # Trips Per Year (all areas)

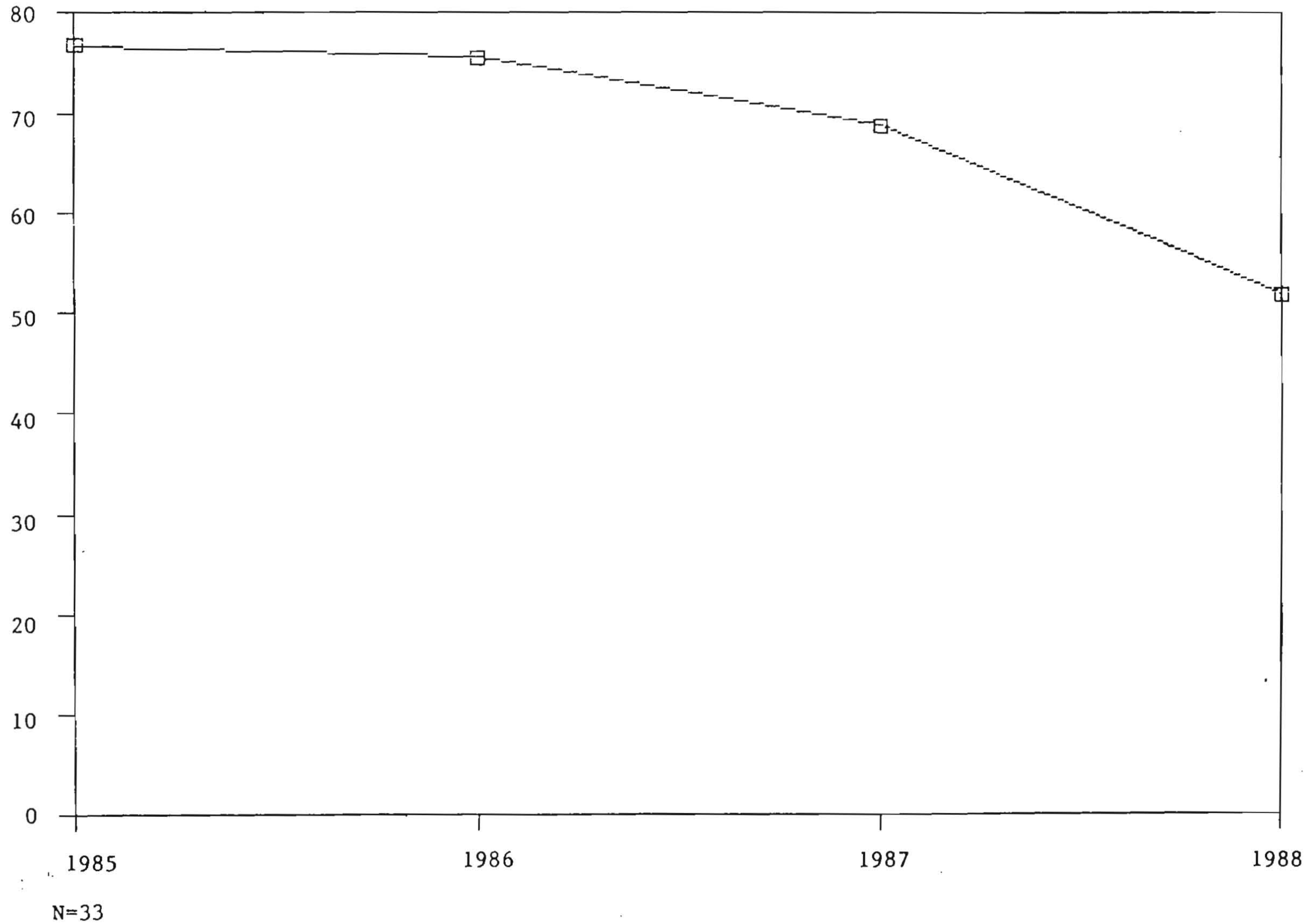
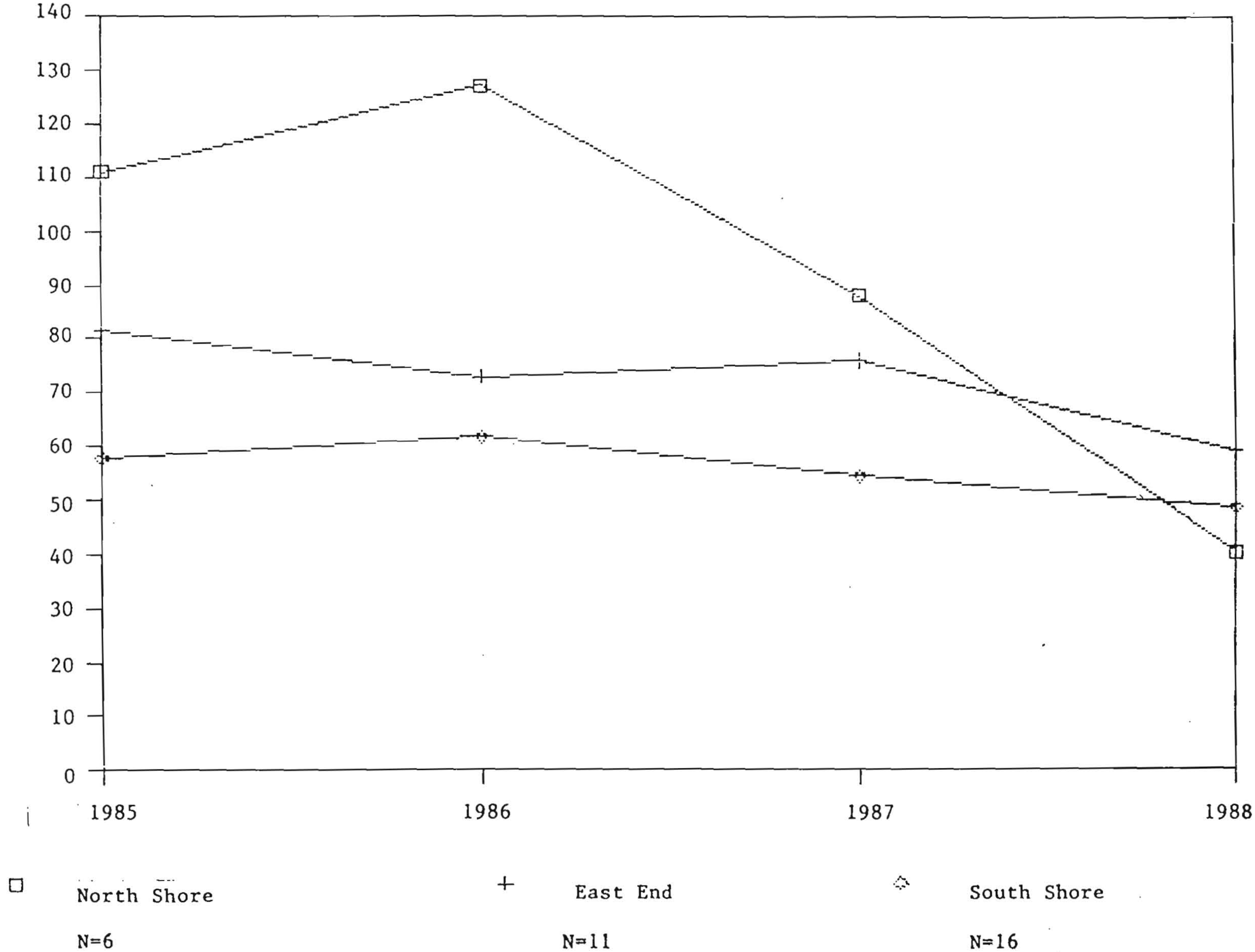


FIGURE 4

SIX PERSON CHARTER BOATS

Mean # Per Year (by area)



1989 Sea Grant Long Island/New York City Charter/Party Boat Survey

TABLE 1

Ranking of Factors Influencing Party Boat Business Volume in 1988
(as perceived by Captains/Owners)

	Most Important	Important	Somewhat Important	Least Important
	Percent			
Floatables (including medical wastes)	60	33	7	0
Seafood Safety	13	60	27	0
Weather/Sea Conditions	0	7	33	60
Fish Abundance	27	0	7	40

Note: Percentages do not add to 100% due to rounding.

TABLE 2

Ranking of Factors Influencing Six Person Charter Boat Business Volume in 1988
(as perceived by Captains/Owners)

	Most Important	Important	Somewhat Important	Least Important
	Percent			
Floatables (including medical wastes)	19	34	23	22
Seafood Safety	28	16	89	28
Weather/Sea Conditions	16	25	23	28
Fish Abundance	36	25	26	17

Note: Percentages do not add to 100% due to rounding.

Conclusion

It is apparent that the open/charter boat industry suffered a setback during the latter half of 1988. The authors feel these data to be representative of the industry as a whole. Although a higher response rate would likely have permitted more definitive conclusions and greater analysis, it should be noted that a response rate of thirty percent probably represents the best data set likely to be provided by this industry.

References

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Murray, J.D. 1976. The Charter Boat Industry of New York State. State University of New York, College of Environmental Science and Forestry, Syracuse, NY.

Warwick, D.P. and C.A. Lininger. 1975. The Sample Survey: Theory and Practice. McGraw Hill, New York.

The Economic Impact on the Long Island Seafood Industry as a Result of Ocean Floatables and Marine Pollution

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Introduction

Ocean floatables and marine pollution along the entire Eastern seaboard have received enormous publicity for the past two years. These environmental concerns have created substantial public discussion regarding the wholesomeness of seafood in general. Reportedly, dockside prices paid to fishermen have plunged dramatically because of consumer perceptions that all fish and shellfish are contaminated. And, according to some accounts, some seafood products have been practically unsaleable. The November issue of Marine Fish Management indicated that fishermen have been receiving between thirty to forty percent below last year's prices, and wholesale prices are off a reported thirty-five percent. These comments were provided by William Gordon, the former head of the National Marine Fisheries Service and the present Deputy Chief of the New Jersey Marine Sciences Consortium. In a recent Newsday article, it was reported that retail seafood sales on Long Island were off by thirty percent, with several seafood retailers closing as a result. These examples are typical of the kind of information that has been included in industry and media presentations, in print as well as television.

It is important to try to quantify the economic impacts of ocean floatables and marine pollution on specific segments of the seafood industry within New York. The information presented includes:

- Unadjusted monthly price comparison by key species: An analysis of monthly dockside prices for key species harvested and landed by New York commercial fishermen for the years 1985 through 1988.
- Case study review of annual sales for Long Island retailer(s): A comparison of gross sales by month for the years 1987 and 1988.
- Dockside landing price index for key New York commercial species: The collective

analysis will show average dockside landing price index for important species landed by commercial fishermen in New York. Again, the average price index will be for the years 1985 through 1988.

Economic impacts

Unadjusted monthly price comparison by key species:

This information, covering the years 1985-1988, identifies the average monthly dockside price per pound for each species. The month-by-month comparison does not factor in the quantity from either New York or other areas. Quantity is an important price determinant; particularly since most of these products are primarily sold on the fresh market. However, the month-to-month changes inherently reflect supply and demand. Any radical changes may be attributed to some outside factor(s). The focus of attention involves 1988; and, in particular, the late spring, summer and fall of that year, which corresponded to reports of ocean floatables and beach washups.

The actual effect on individual fishermen relates to their dependence on a particular species or fishery. For instance, a directed fishery such as the lobster or hard clam fishery may be very affected by any market condition, especially of the magnitude of the associated ocean floatables and beach washups. On the other hand, the impact on multi-fishery efforts such as some trawling and bay fishing activities may be mitigated by the fact that all species may not suffer a negative market condition. Also, the option of targeting other species exists.

The following is a species-by-species analysis:

Figure 1. Bluefish - Multi Fishery Trawl Target. Fairly consistent prices for 1988; slightly higher from mid-June through November as compared to previous year, considering the PCB advisories associated with bluefish. Surprisingly, it appears that the market experienced no appreciable change. The comparative average annual price index is relatively consistent with price and supply factors.

Figure 2. Flounders - Multi Fishery Trawl Target. Again, consistent prices with increases shown through 1987; an irregular 1988 pattern may be more related to supply. The comparative annual price index is relatively consistent with price and supply factors.

Figure 3. Lobsters. The lobster fishery is a directed, fixed-gear fishery with peak fishing efforts in April through December. 1988 monthly prices appear consistently below 1987,

particularly during the beach washup reporting period. Ocean floatables and beach washups could have been an important factor. The comparative annual price index does not show a decline in price in 1988.

Figures 4A & 4B. Hard Clams. This is a hand harvest/mechanical transplant directed fishery. Prices shown are monthly for 1988, and weekly for 1986/1987. Little Neck wholesale prices are from Green Sheets. 1988 wholesale prices show evidence of an impacted market.

Figure 5. Loligo Squid - Multi-Fishery Trawl Target. It is not likely that ocean floatables and beach washups affected squid prices. The domestic market, while broadening, is still dependent on key ethnic consumption. Processing for both the export and domestic markets is significant. The price is more likely to reflect supply and demand, in addition to processing capacity. The comparative average annual price index is consistent with known market conditions.

Figure 6. Scup - Multi-Fishery Trawl Target. 1988 prices reflect lower value prior to the high impact May-December period. 1988 overall prices are lower, except for late fall prices. The comparative average annual price index shows lower landings and price for 1988.

Figure 7. Tilefish - Longline-directed fishery. 1988 prices consistently above previous year. Increasing price may reflect substitution for striped bass in restaurants. The comparative average annual price index is consistent with price and supply (decline) factors.

Figure 8. Tuna and Swordfish - Longline/handline-, harpoon-directed fishery. It is possible that prices shown for 1988 have been affected by ocean floatables and beach washups. Other factors include export marketing and specific species' availability. The comparative average annual price index is consistent with price and supply factors.

Figure 9. Whiting - Multi-Fishery Trawl Target. The 1988 monthly price is consistently below 1987 and 1988 prices. Ocean floatables' impact may be a factor. The comparative average annual price index indicates a sharp decline in 1988 which may be associated with a unique market condition.

Figure 10. Dockside Landing Price Index for important New York commercial fisheries species. The first important observation is that for 1988 versus 1987, the average price for these species actually increased (slightly). More importantly, when compared to the changes that occurred in the years 1985 through 1986, the amount of change is insignificant. The amount of change in 1988 is not only insignificant, but indicates an important trend

reversal. The most significant increase occurred between 1985 and 1986, with a 20 cents per pound change, resulting in a twenty-four percent per pound increase. The change in 1987 over 1986 was minus 1 cent; when added to the change in 1986, a total change of twenty-three percent occurred over the 1985 price, with a less-than-one percent negative change over 1986.

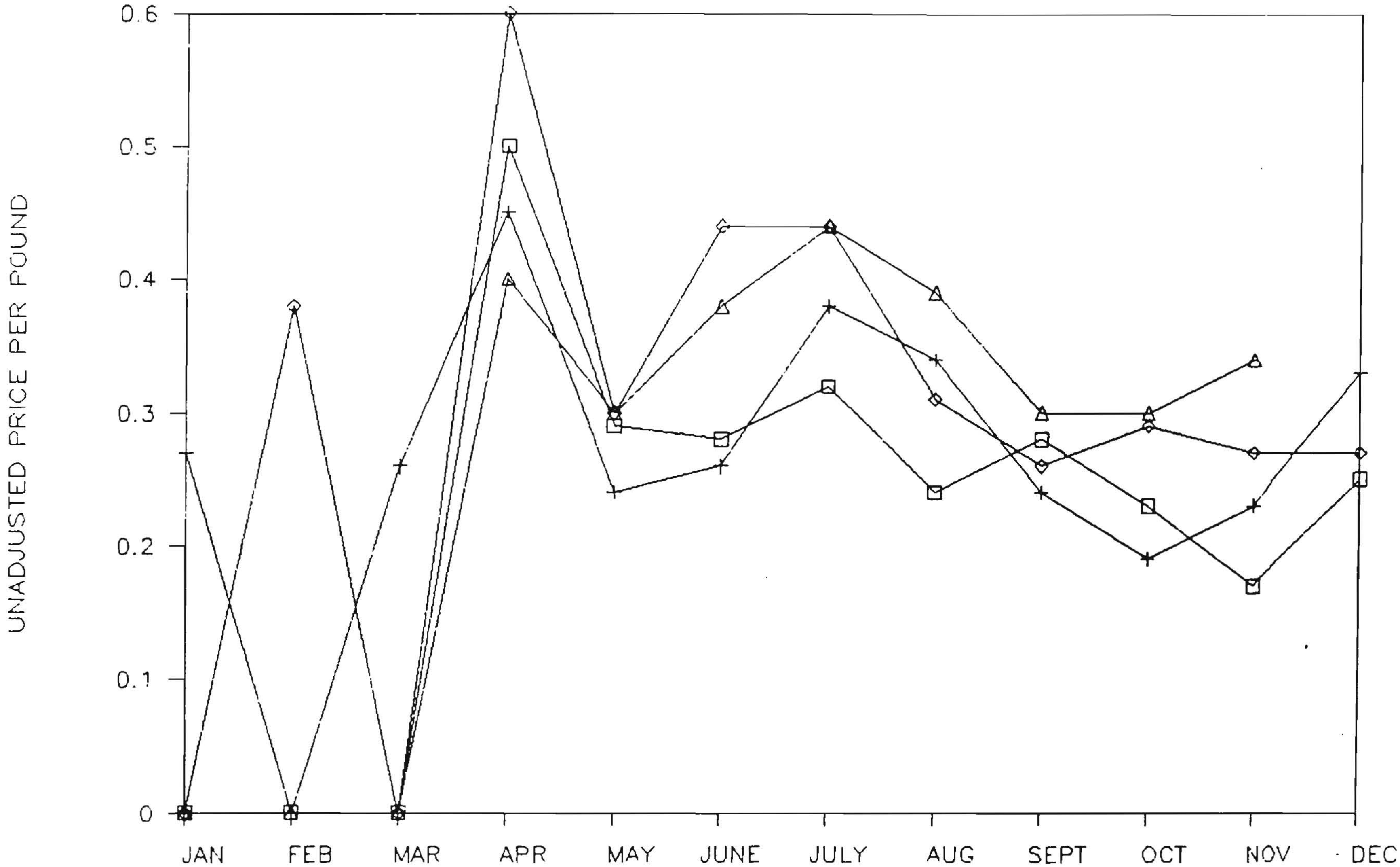
Coincidentally, beginning in 1985, a significant change in per capita consumption of seafood occurred and, in fact, the average per capita consumption was reported to be 15.4 pounds, up from the previous level of approximately 13 pounds, where it had hovered for years. This growth was attributed to the health and dietary benefits widely proclaimed and associated with increasing seafood consumption. Interestingly, it appears that in 1987 a leveling-off of sorts occurred, predating the ocean pollution/beach wash-up dilemma of 1988. Some possible explanations include a leveling-off after a significant growth spurt (price increase), as well as a reaction to the perception of higher and increasing costs for seafood in general.

Conclusion

It is clear from the information presented that a leveling-off and a significant decrease in the rate of price increases has occurred. One may hypothesize that ocean pollution in the form of floatables and beach washups played a role. In the case of directed fisheries, such as the lobster and hard clam fisheries, it can be shown that a more significant impact did occur. Information about the impacts on other segments of the fishing industry are not complete enough to determine the associated impacts. Further detailed review is needed before any determination is possible. This information is important so that the industry can accurately keep the public informed.

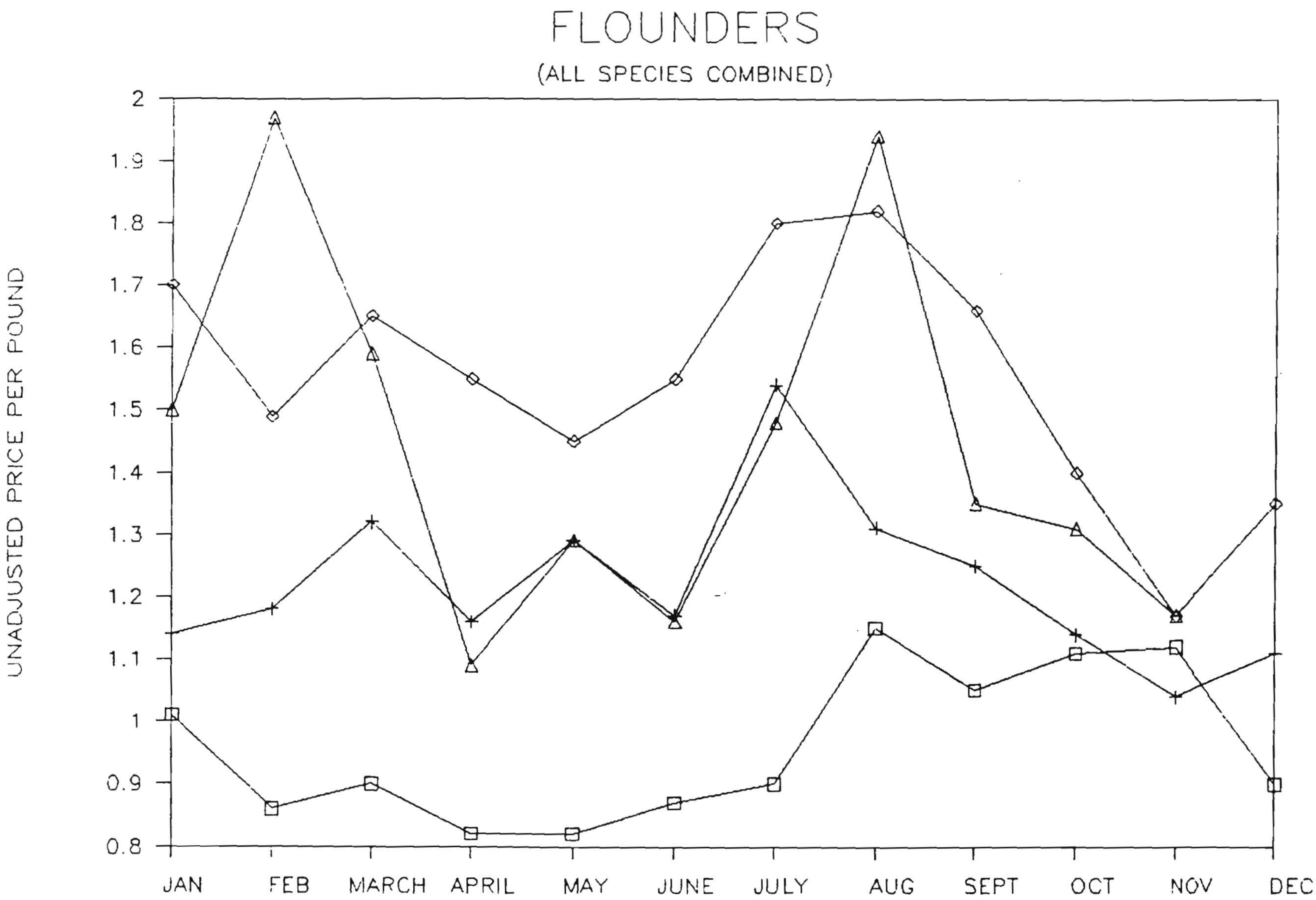
Figure #1

BLUEFISH



□ 1985	+ 1986	◇ 1987	Δ 1988
LBS. = 2,133,140	LBS. = 1,617,300	LBS. = 1,564,600	LBS. = 1,125,444
VALUE = $ 535,369	VALUE = $ 446,327	VALUE = $ 523,872	VALUE = $ 406,979
$/LB. = $.25	$/LB. = $.28	$/LB. = $.33	$/LB. = $.36

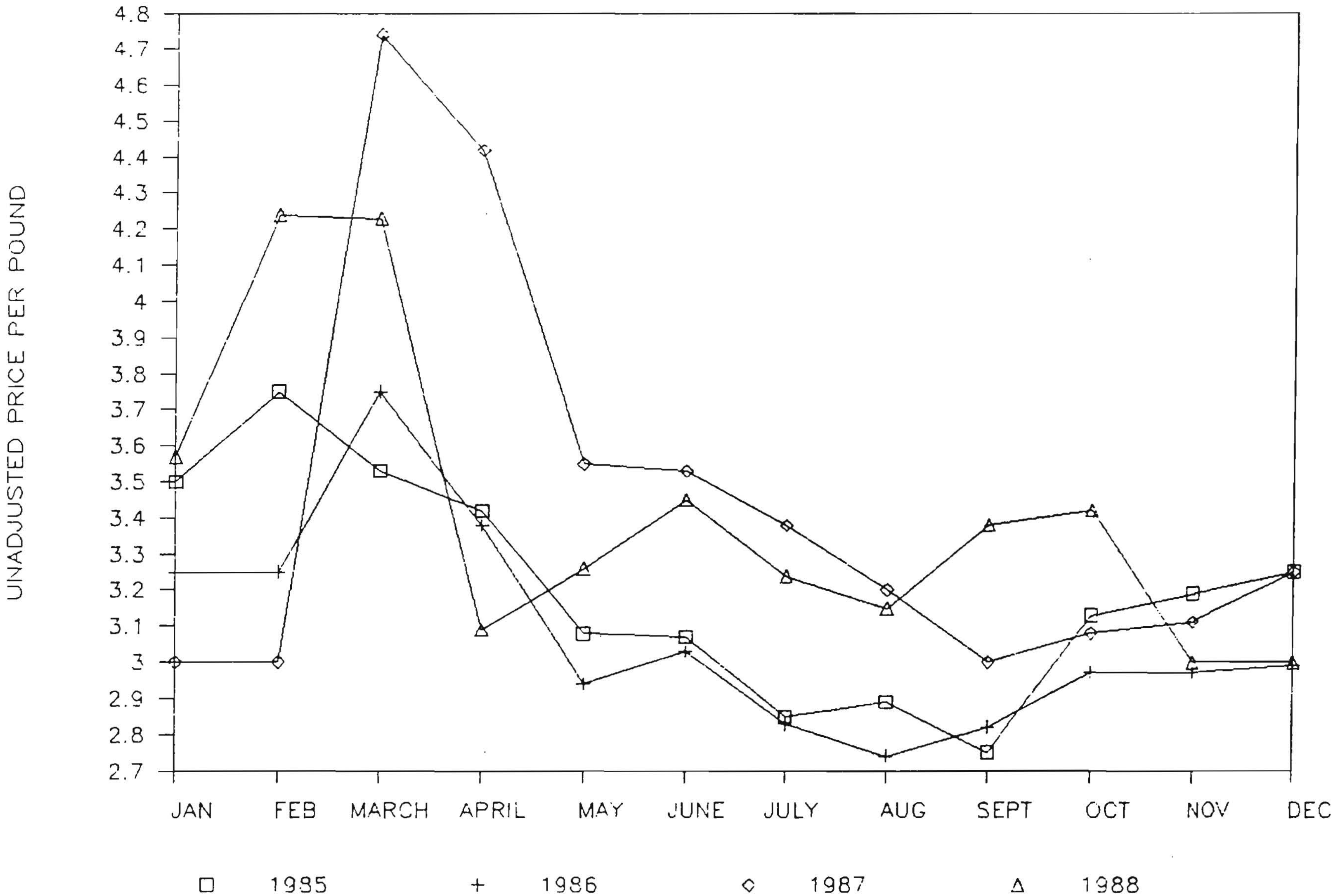
Figure #2



□ 1985	+ 1986	◇ 1987	Δ 1988
LBS. = 4,857,600	LBS. = 4,291,800	LBS. = 4,379,300	LBS. = 5,328,730
VALUE = $4,466,867	VALUE = $5,316,649	VALUE = $6,784,167	VALUE = $7,577,479
$/LB. = $.92	$/LB. = $1.24	$/LB. = $1.55	$/LB. = $1.42

Figure #3

LOBSTERS



1985	1986	1987	1988
LBS. = 1,240,900	LBS. = 1,407,100	LBS. = 1,146,700	LBS. = 1,486,558
VALUE = $3,709,714	VALUE = $4,113,787	VALUE = $3,773,946	VALUE = $4,921,996
$/LB. = $3.00	$/LB. = $2.90	$/LB. = $3.29	$/LB. = $3.31

Figure #4A

HARD CLAMS — NECKS ONLY

AVE. WHOLESALE PRICE

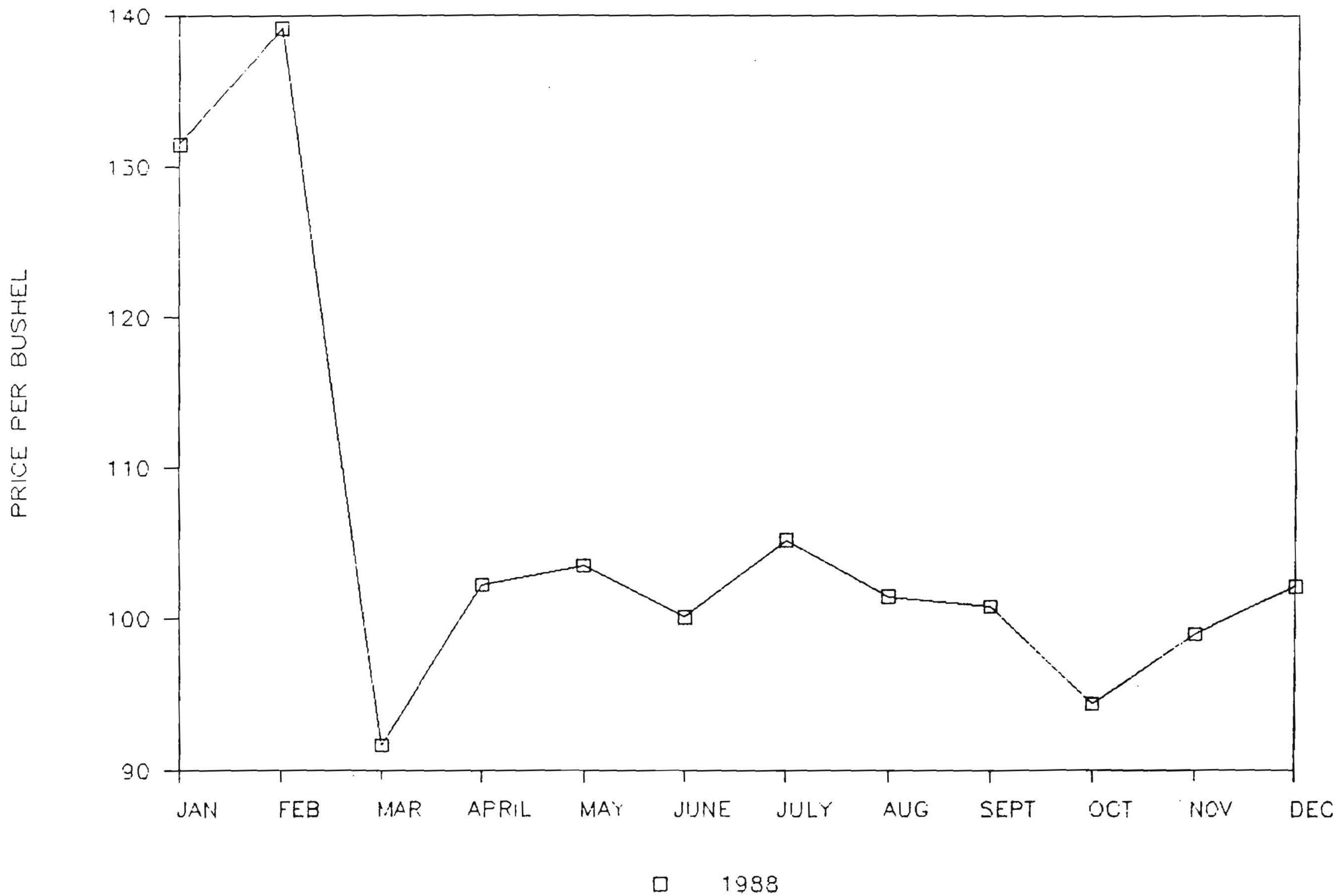
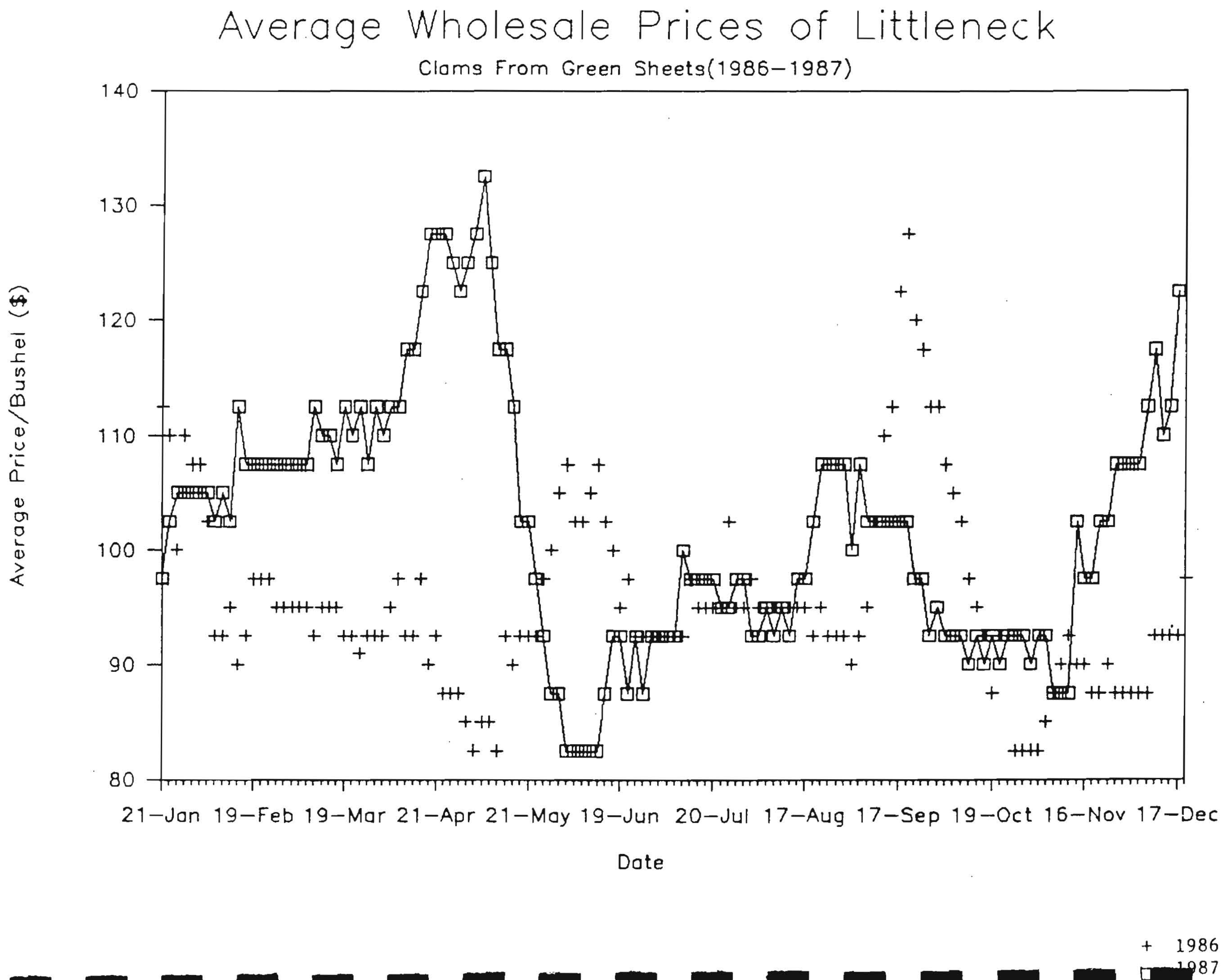
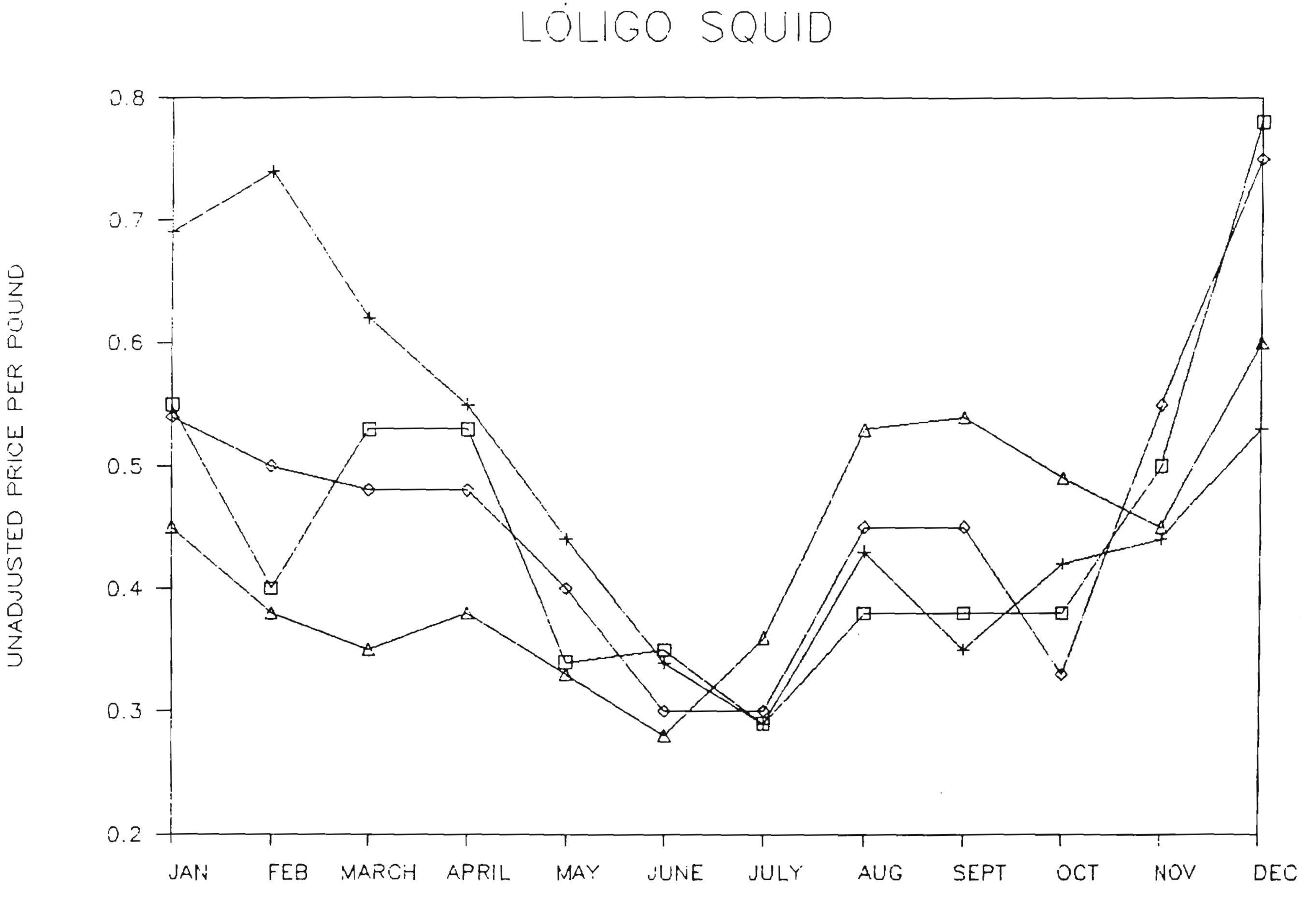


Figure #4B



Average Wholesale Prices of Littleneck
Clams From Green Sheets(1986–1987)
Average Price/Bushel ($)
140
130
120
110
100
90
80
21–Jan 19–Feb 19–Mar 21–Apr 21–May 19–Jun 20–Jul 17–Aug 17–Sep 19–Oct 16–Nov 17–Dec
Date
+ 1986

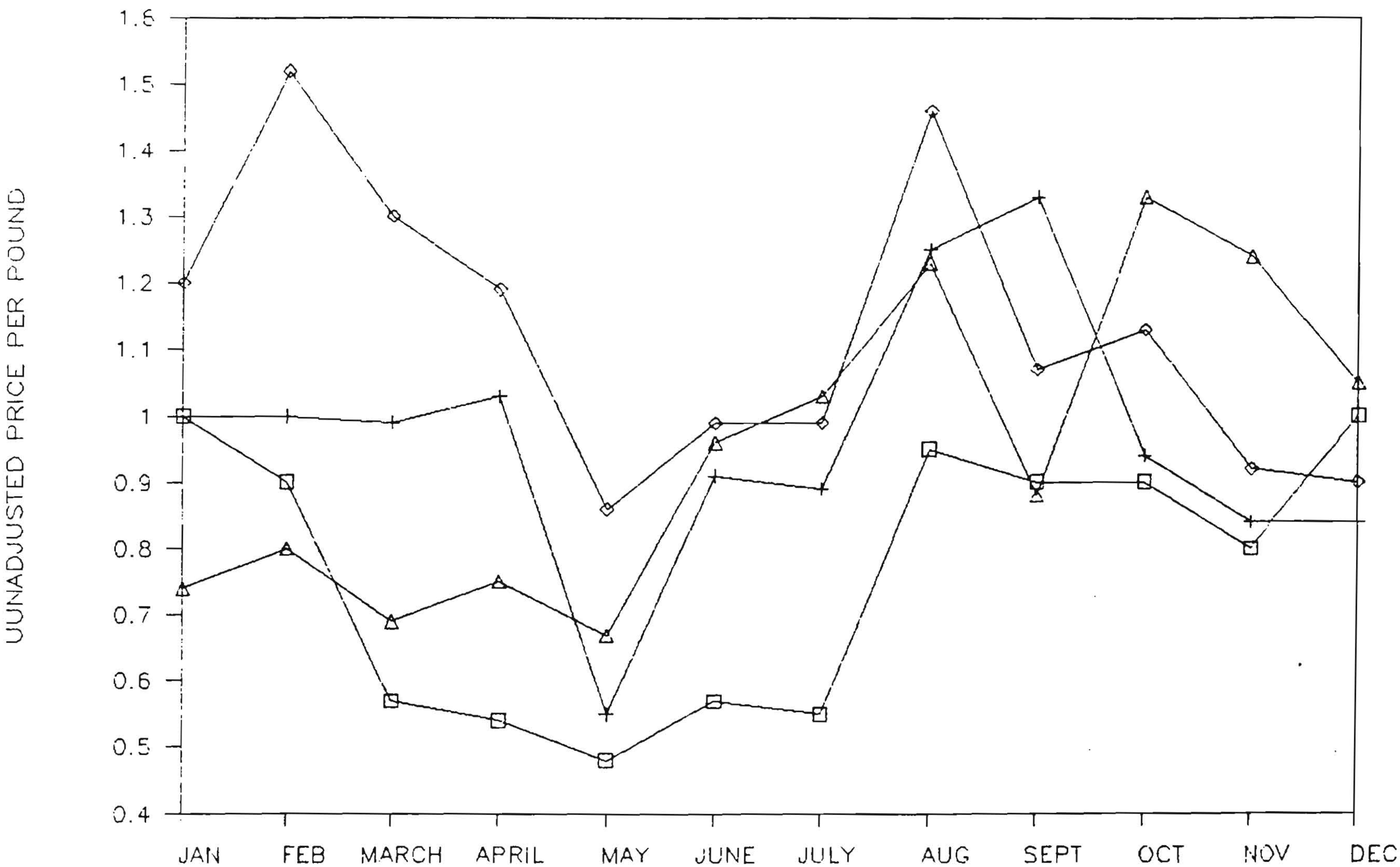
Figure #5



1985	1986	1987	1988
LBS. = 4,738,800	LBS. = 6,420,300	LBS. = 7,819,900	LBS. = 8,023,634
VALUE = $1,754,014	VALUE = $2,625,423	VALUE = $3,060,096	VALUE = $3,016,802
$/LB. = $.37	$/LB. = $.41	$/LB. = $.39	$/LB. = $.38

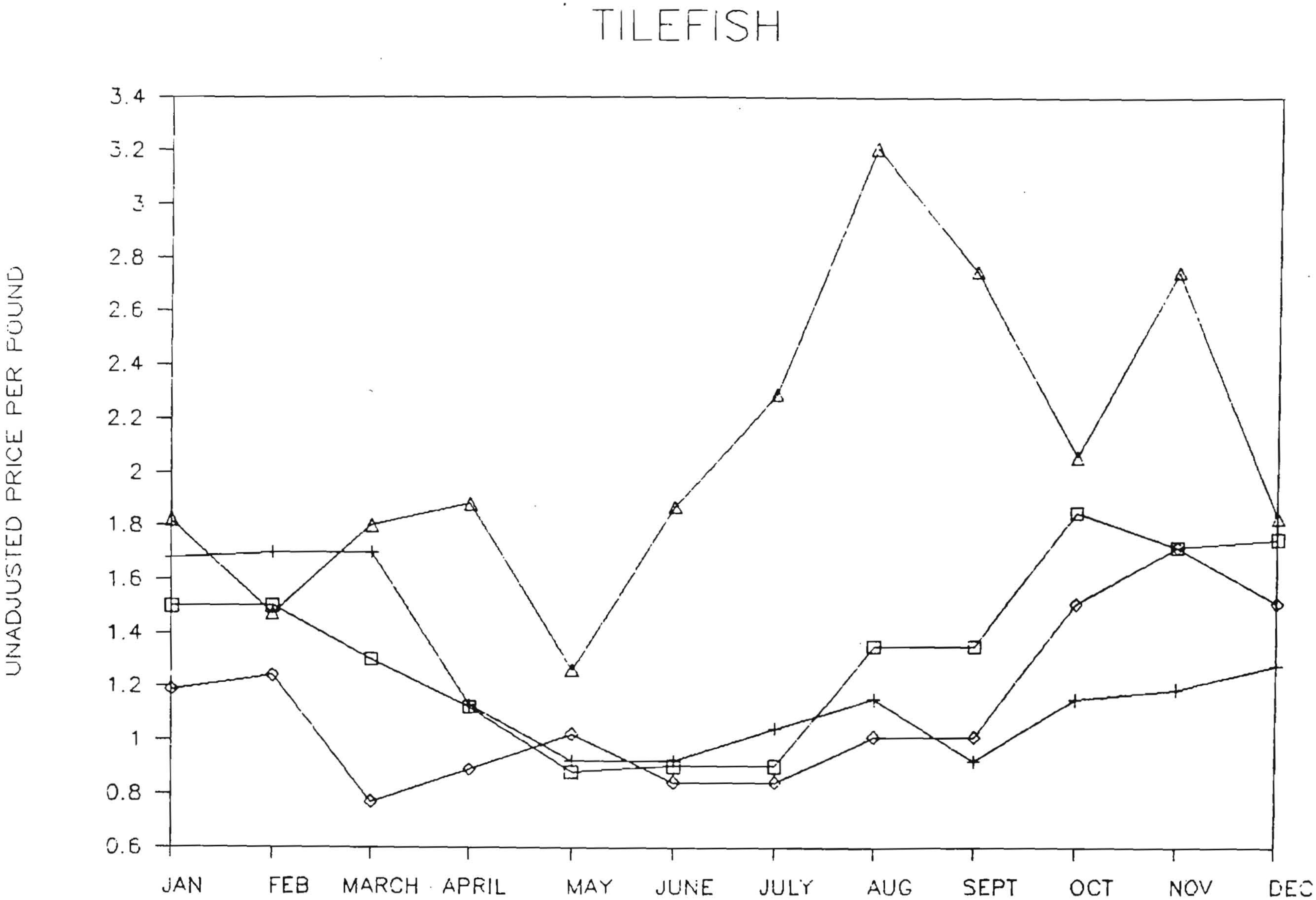
Figure #6

SCUP



□ 1985	+ 1986	◇ 1987	Δ 1988
LBS. = 1,897,600	LBS. = 1,969,800	LBS. = 2,008,300	LBS. = 1,514,073
VALUE = $1,547,089	VALUE = $1,900,843	VALUE = $2,066,555	VALUE = $1,375,174
$/LB. = $.82	$/LB. = $.96	$/LB. = $1.03	$/LB. = $.91

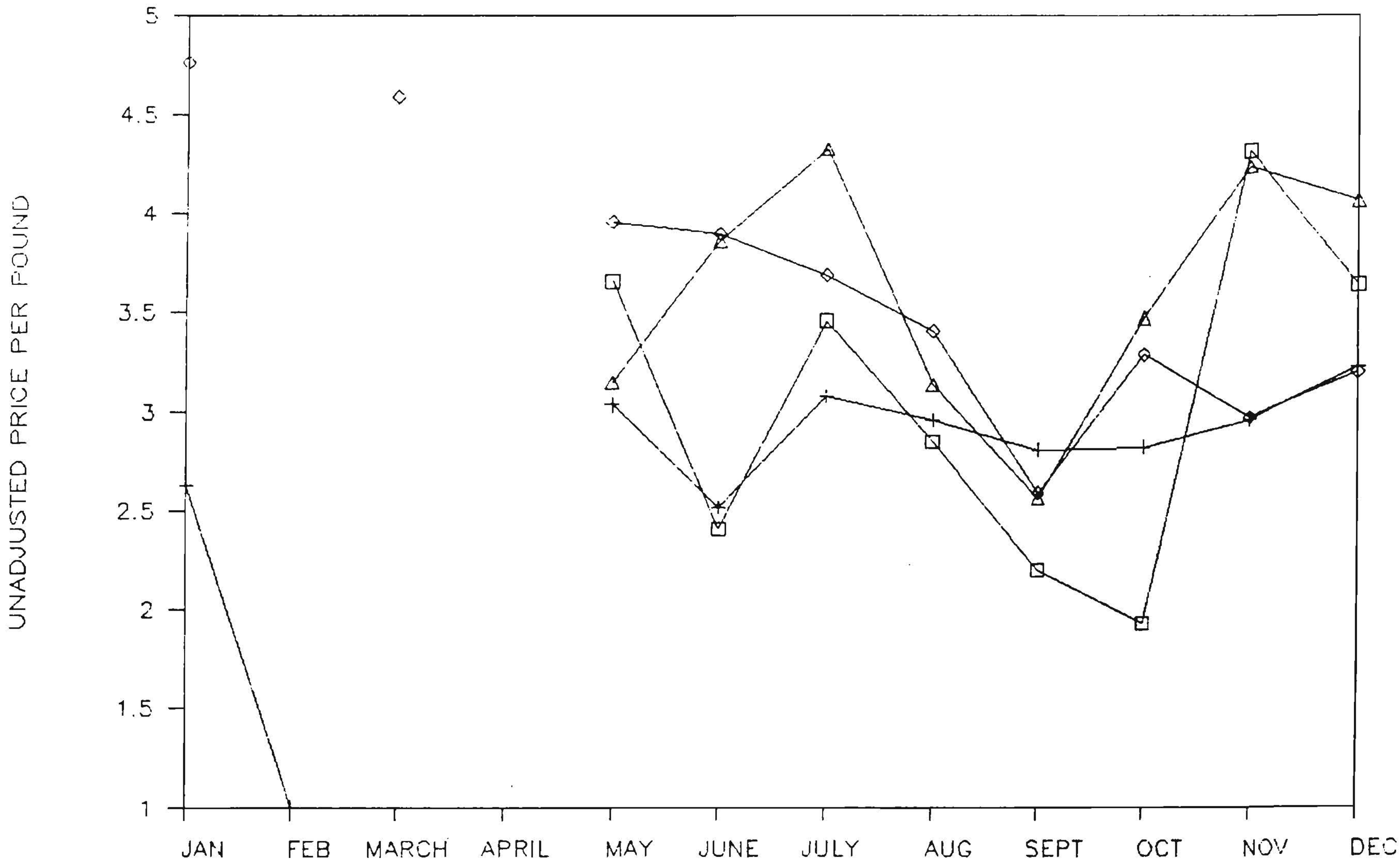
Figure #7



□ 1985	+ 1986	◇ 1987	Δ 1988
LBS. = 1,938,100	LBS. = 2,371,300	LBS. = 4,401,200	LBS. = 1,913,582
VALUE = $2,497,391	VALUE = $2,961,046	VALUE = $4,815,392	VALUE = $3,536,884
$/LB. = $1.29	$/LB. = $1.25	$/LB. = $1.10	$/LB. = $1.85

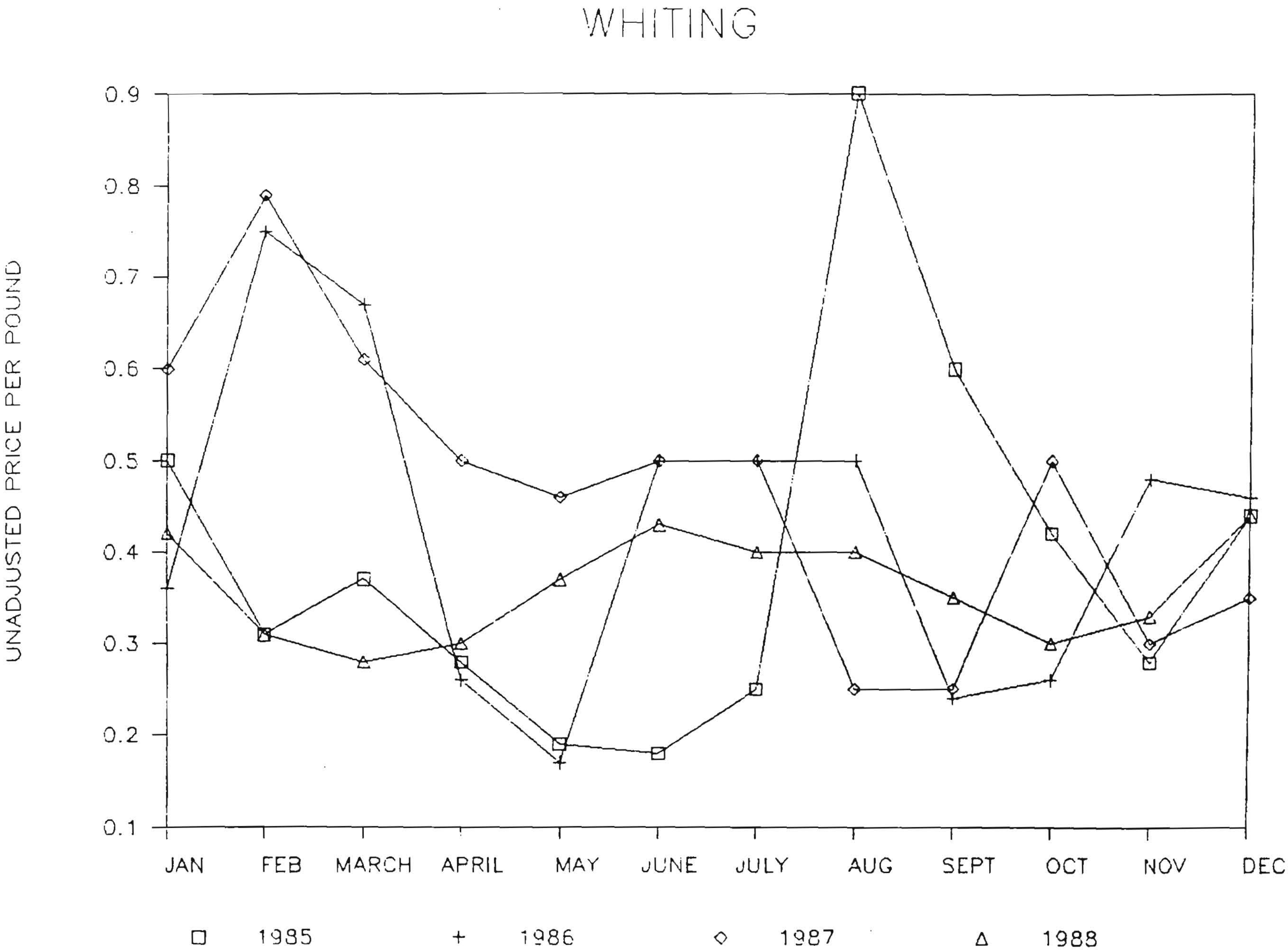
Figure #8

TUNAS (ALL SPECIES) AND SWORDFISH



□ 1985	+ 1986	◇ 1987	Δ 1988
LBS. = 1,076,300	LBS. = 1,834,600	LBS. = 1,864,160	LBS. = 1,475,440
VALUE = $2,819,276	VALUE = $5,322,555	VALUE = $5,718,891	VALUE = $4,964,335
$/LB. = $2.62	$/LB. = $2.90	$/LB. = $3.07	$/LB. = $3.36

Figure #9



1985	1986	1987	1988
LBS. = 4,402,900	LBS. = 2,363,900	LBS. = 4,523,500	LBS. = 4,189,386
VALUE = $1,411,779	VALUE = $ 955,078	VALUE = $2,320,584	VALUE = $1,441,014
$/LB. = $.32	$/LB. = $.40	$/LB. = $.51	$/LB. = $.34

Figure #10

DOCKSIDE LANDING PRICE INDEX

SPECIES INCLUDED:

Bluefish	Flounder	Tilefish	Scup
Lobster	Whiting	Tuna/Swordfish	Squid, Long-Finned

YEAR	TOTAL LBS.	TOTAL VALUE	AVERAGE $/LBS.	%/CHANGE
1985	22,285,340	$18,741,499	$ .84	--
1986	22,276,100	$23,195,381	$1.04	24%
1987	28,173,700	$29,063,503	$1.03	23% (1%)
1988	25,425,708	$27,240,663	$1.07	27% (4%)

Floatable Wastes in Marine Waters

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Introduction

In September 1988, another summer beach season came to a close and like the summers of 1976 and 1987 on Long Island (Figure 1), the summer of 1988 will be remembered for the beach closures, the faltering tourist trade and, perhaps, reduced sales at the fisheries markets. For the most part, buoyant waterborne waste materials and debris euphemistically called floatables were the root of the problem.

Typical anthropogenic materials classified as floatables include wood, refuse, sewage-related debris (materials acknowledged to regularly reach sewage treatment systems such as condoms, sanitary napkins, tampon applicators, diaper liners, grease balls, etc.) tar balls, fecal material, and fishing gear. A different category of floatables these past few summers is that of medical wastes (hypodermic needles, syringes, bandages, red bags, enema bottles).

Floatables have been a concern in New York and New Jersey coastal waters for well over a century. They contributed to New York City's image as one of the filthiest urban centers of the 1800's. Among other offensive materials, tanneries, slaughter houses, and butchers disposed of their waste water including "hair, bone, blood and other animal byproducts" in the Hudson River. Along with other wastes, floatables were legally dumped at various locations off the coast for the period 1888-1932. The Supreme Court halted the dumping of refuse at sea, and the last barge sailed on June 28, 1934.

Over the last century, the character of floatable waste has changed considerably, as have our sensibilities to it. Late in the last century and until the 1930's, refuse, largely in the form of garbage, paper, bottles, degradable metal containers, and dead animals, was dumped at the designated refuse and floatable sites. Untreated sewage and associated materials such as condoms entered the harbor waters through the sewerage system.

By the mid-1950's, America had become the throwaway society. Life magazine documented the phenomenon with its August 1, 1955, story on "Throwaway Living." The volume of floatables had increased, but perhaps more importantly, by the mid-1960's, the character of floatables had changed. The styrofoam cup and disposable diapers were part of daily life. Late in 1969, one of the major manufacturers of feminine hygiene products introduced the plastic tampon applicator. Perhaps by the summer of 1970, these infamous "beach whistles" began to wash ashore, kindling a renewed concern about floatable waste--but this time centered primarily around sewage-related items. Even more noticeable in the context of the floatable problem was the introduction of the 1-liter PET (polyethylene terephthalate) soda pop bottle in 1977.

The beach closures along coastal New Jersey in 1987 and the south shore of Long Island in 1988 have focused on a totally different set of waste products--hospital or infectious waste. Their volume is relatively small, but as with sewage wastes, concern centers around the issue of public health. Why these wastes are appearing more frequently is not certain. However, there are several possible contributing factors. Among these are:

- A marked increase in disposable medical care materials;
- An increase in the use of medically-associated equipment on the streets, as drug paraphernalia; and
- An increase in illegal disposal of medical wastes as a consequence of the increased costs of disposal.

Regardless of the source of the waste, plastics are becoming a much greater share of the total floatable load, particularly in terms of volume. Table 1 shows the change in population along coastal New York and New Jersey, the national increase in the amount of garbage and trash generated per person, per capita, per year, and also the annual per capita plastic discarded over the period 1970-1985. The local increase in plastic discards for this period is 511×10^3

metric tons. This suggests that a much greater percentage of potential floatable material may be made of plastic.

Sources and transport of floatable wastes to coastal waters

The bulk of noxious materials continues to reach New York Bight waters and beaches, from the same sources in 1988 as in 1976. Major sources of floatables to the New York Bight include combined sewer outfalls (CSO's), wastewater discharges, solid waste handling, commercial ships, fishing vessels and recreational boaters, and beach users.

The Hudson-Raritan Estuary serves as the greatest general source of floatable waste to the Bight, since the bulk of the individual sources are located around the periphery of the estuary. Floatables are effectively flushed from the estuary during the time of the spring freshet, typically from March to May in the upper Hudson. The impact of the freshet on the Bight lags this by about one month, so that large quantities of floatables can be expected to be flushed into coastal waters at or near the time of the commencement of the summer beach season. Other than at the time of the spring freshet, the floatable load at any one time in the estuarine plume is largely a consequence of the relatively recent rainfall history. A heavy rain following an extended dry period such as occurred in late July, 1988, will most likely produce the heaviest volume of floatable material; streets will be cleansed, sewage treatment plants bypassed, and the garbage transfer points and landfills flushed by runoff and perhaps higher storm high waters. Occasionally, accidental spills and illegal discharges will add to the normal heavy floatable load.

Once floatable materials are flushed into the Bight, they are subject to the physical oceanographic and meteorological processes operating on Bight waters. Most frequently they will be carried with the Hudson-Raritan estuarine plume along the New Jersey coast. This is why the beaches at Sandy Hook are so often cluttered with undesirable materials.

The general flow of surface waters over the continental shelf is from the northeast to the southwest, parallel to the trend of the coast. Floatable materials in the surface layers are transported with these currents, but are also influenced by wind-driven transport.

During the summer months, prevailing winds have a pronounced effect on the distribution and fate of floatables. Typically the prevailing wind is from the south to southwest, but intermittently shifts to other directions. These winds tend to transport the floatables to the north and east. Thus, floatable materials will generally be well disbursed--some lost at sea, others creating the general clutter that we have objected to on both New Jersey and Long Island beaches.

Floatable material will tend to be concentrated at zones of convergence, such as at the edge of the Hudson River plume. Thus streaks of floatable material are often observed. They are modified by currents near the shore so that they become more coast parallel and are often described as washing ashore in waves. Once floatables are accumulated in this way and driven close to the coast, sea breezes are probably a predominant factor in moving them ashore.

In 1976, the prevailing summer wind field intensified from the south and was extremely persistent (no wind shifts) for a period of two weeks (June 9-25), driving the floatable material northward and eastward and eventually ashore on Long Island. The winds were much more variable when on a number of occasions they blew from the east, coinciding with the washup of floatables on New Jersey beaches.

With regard to transport in the coastal waters off New York and New Jersey, it has been found that they move slightly to the right or left of the wind depending upon the localized surface currents, and between 4-4.5 percent of the wind speed.

Floatables and particularly plastics, however, have become a global oceanic problem. While much of the flotsam in the ocean degrades and sinks, plastics persevere. Plastics are thought to be the most frequently sighted man-made objects in the ocean.

Plastics and floatables in the ocean generally can be found in areas frequented by mankind--along shipping routes, and in regions with heavy population centers. Areas such as the Caribbean Sea, which reflect a relatively high population along with major shipping lanes and a high density of recreational boaters, are particularly vulnerable. The problem is further exacerbated by the fact that the prevailing ocean currents concentrate materials brought in from the eastern North Atlantic.

The northern Sargasso Sea appears to be the ultimate repository for much of the plastic material entering the North Atlantic. The clockwise gyre of the North Atlantic circulation system with its intensification in the western North Atlantic apparently favors this fate. Observations indicate that not only is the concentration of plastics greater there, but that the plastics found appear to be of greater age than elsewhere in the North Atlantic.

There is much less information available regarding plastics in the Pacific Ocean, but concentrations appear to be most heavy in the central subtropical and western North Pacific.

Effects

Floatable wastes generally are considered to cause the following classes of problems:

1. Aesthetic degradation of beaches and coastal waters;
2. Navigational hazards;
3. Public safety effects and the fear of public health effects from physical contact;
4. Detrimental impacts on marine birds, turtles, fishes and other marine organisms; and
5. Monetary costs of cleanup and of lost revenue by beach-related industry.

Perhaps the greatest impact of floatable wastes is that associated with the lost opportunity to recreate and the disdain that people have regarding the use of coastal resources. This is apparent when one considers the decline in beach attendance at area beaches over the past two decades. People are repulsed by the idea of possibly coming in contact with sewage-related items or medically-related waste, no matter what public health officials claim with regard to health risks. Further, the presence of floatables in many ways is considered an indicator of what can't be seen--the toxics, carcinogens, etc.

Plastic floatables are particularly troublesome, and are often navigational hazards to the commercial and recreational boating community. Ghost fishing nets (nets that have broken free or are abandoned that continue to drift and continue to fish), natural and synthetic line, and strapping materials are known to foul propellers and rudders in some cases, disabling the vessel percent of hospital waste is plastic, compared to 3 to 6 percent for municipal solid waste.

Educational programs should be designed to encourage beach users and recreational boaters and marina operators to be more conscientious concerning proper waste disposal. Expanded disposal facilities should be available at all beaches and marinas, and the frequency of trash removal increased. Governments and businesses can perhaps work together to create incentive programs to reduce beach littering and over-the-side disposal. The State of New Jersey is already instituting these types of programs.

There have been some improvements in the overall floatable waste problem in recent years. Specifically, the volume of raw sewage discharged in the metropolitan area has been reduced by over an order of magnitude. There is also the rudiments of a program to control CSO's.

There are, however, technological improvements that should continue to be explored in order to further reduce the volume of floatable wastes reaching area beaches. Some of these are:

1. Improve operation and maintenance of sewage treatment plants, and reinstitute emergency power supplies to reduce bypassing during power shortages;
2. Strive to reduce or eliminate CSO's;
3. More thoroughly explore alternatives for isolating material released to the marine environment by CSO's;
4. Continue to improve the process of removing litter and floatable debris from streets and other paved areas served by combined sewer systems;
5. Improve solid waste handling practices aimed toward recycling and the use of wastes as an energy source; and
6. Improve the process of transferring materials to landfills, and reduce the volume of materials escaping to marine water from landfills.

Short of these improvements, we must be prepared to suffer the consequences of floatable beach pollution and associated beach closures.

Climatic conditions just before and during summer including high spring river runoff, intense thunderstorms, and high stages of monthly mean sea level in the metropolitan area lead to large floatable loads in the harbor. Power outages of brownouts caused by electrical storms and summer heat increase the likelihood for sewage treatment plant breakdowns and bypassing, thus potentially adding to the already large floatable burden.

Unfortunately, both Long Island and New Jersey beaches are vulnerable to the washup of floatables. The Hudson River plume will continue to transport its floatable load along the northern New Jersey coast where it can periodically be transported shoreward.

Long Island is particularly vulnerable because of the normal southerly wind field during the summer months. The daily onshore sea breeze intensifies the mean flow.

Until fewer potential floatables are manufactured, controlling their dispersal will be increasingly costly and uncertain. Until source control is more effective, intensive beach cleaning efforts are the remaining solution. Further, existing levels of source control may well reduce the usage of beaches nearest most of the metropolitan region's users, resulting in unprecedented pressures upon beaches further to the east and south, and heightening frustrations of those unable to reach the most distant beaches.

On Labor Day, 1976, we put the floatable problem out of our minds hoping that it would disappear. It is important not to let the passage of the summer of 1988 dim our actions to reduce the problem. We must also realize that these improvements will be costly.

The Importance and Effectiveness of a Manifest System for Medical Waste

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Introduction

In 1988, the washup of medical wastes on beaches, including syringes, needles, bandages, colostomy bags, catheter and intravenous tubing, blood vials, and surgical gloves, drew the public's attention to glaring deficiencies in the systems for managing and disposing of medical waste. While most of the attention focused on beach closures, the wastes on the shores were symptoms of more far-reaching problems.

There is sufficient evidence to justify the controls on the handling and disposal of medical wastes that are in place. As of 1989, the New York State Department of Environmental Conservation (NYSDEC) had prosecuted more than 30 cases involving the illegal handling and disposal of medical wastes during the three-year period from 1987-1989. Approximately one-half of the cases, including four in 1988, cited hospitals and other medical facilities for "illegally relinquishing infectious waste to unpermitted haulers." (NYSDEC, 1988).

In other reported New York State incidents, thousands of abandoned "red bags" were discovered at warehouses and hundreds of blood vials were dumped on land and into water (NYSDEC, 1988). Wastes were also found dumped near playgrounds, by passing trucks. In addition, garbage trucks servicing hospitals collected medical wastes that were improperly mixed with normal wastes (NYSDEC, 1988). Finally, in what appears to be a growing practice, medical wastes and other wastes have been transported in the same refrigerated trucks used to ship food products (Newsday, 1987). These incidents of medical waste mismanagement suggest a problem of greater magnitude and severity than was mentioned in the press and other forums.

The full extent to which medical wastes are improperly or carelessly handled is unknown. The U.S. Office of Technology Assessment (OTA) reported in Issues in Medical Waste Management that "Basic information on sources, amounts, composition, and treatment/disposal of medical waste is not known in any useful detail." (OTA, 1988). The OTA (1988) also reports that it was unclear if health care workers and others were adequately informed of recommended procedures and were properly trained in basic management practices for handling medical wastes. Similarly, the U.S. Environmental Protection Agency (U.S. EPA, 1988) reports that "The total number and capacity of hospital incinerators is uncertain." Finally, the 1986 report "Hemorrhage from the Hospitals: Mismanagement of Infectious Waste in New York State" (NYSLCSW, 1986), which provided much of the basis for New York State's legislation on medical waste, concluded "If [a] facility does not incinerate on-site all of its wastes, the [New York State Department of Health] simply does not know where it goes."

There is a void in available information on the particularly sensitive and potentially dangerous issue of medical waste disposal. Lack of control on the segregation, packaging, labeling, transportation, tracking, treatment, and disposal of medical waste has been exacerbated in the past as a result of the absence of a federal program ensuring minimum, uniform requirements. The need for such a federal program was never more evident than during the summer of 1988.

The following discussion reviews the federal and state actions taken as of March, 1989, to address these deficiencies. The discussion also attempts to provide an understanding of the need for such actions, an examination of the potential effectiveness for controlling the disposal of medical wastes, and ideally, to prevent future washups of medical debris, such as those experienced during the summers of 1987 and 1988.

Legal background

The roles of the federal government and the U.S. EPA in medical waste management have been equivocal. The U.S. EPA has had the authority to regulate medical waste since 1976 (Resource Conservation & Recovery Act [RCRA], 1976), but as of March, 1989, had exercised it only to produce a nonenforceable guide (U.S. EPA, 1986). In response to public outrage during the 1988 summer washup events, the U.S. Congress moved with unusual speed in enacting the Medical Waste Tracking Act (MWTA); legislation directing the U.S. EPA to track medical wastes and prohibiting ocean disposal of medical wastes (MWTA, 1988).

Although it is only a two-year demonstration program, the MWTA, enacted by Congress in November, 1988, as Subtitle J of the Resource Conservation and Recovery Act (RCRA), represents a sincere effort to ensure minimum, uniform federal requirements for managing medical wastes. In addition to public health concerns, the statute recognizes the aesthetic and environmental values violated by medical waste washups, and such values are protected by the scope and provisions of the law (MWTA, 1988). The cornerstone of the MWTA is the establishment of a tracking program and a manifest system for wastes moving off-site for treatment and disposal (MWTA, 1988). The U.S. EPA is required to define the categories of waste covered by the tracking program and a category scheme is included in the law. The U.S. EPA Administrator is given the discretion to narrow certain categories "[w]hich he determines do not pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed." (MWTA, 1988).

The tracking provisions include specific requirements for segregation, packaging, and labeling of medical waste (MWTA, 1988). Different record-keeping requirements apply to wastes treated onsite (MWTA, 1988). The MWTA also makes violations felonies, and imposes stringent civil and criminal penalties. In addition to regulating handling and transportation of medical waste on land, the U.S. Congress identified the particularly sensitive issue of ocean dumping. Ocean dumping of medical wastes by private individuals is prohibited, and restricted to very limited circumstances for public vessels.

Various states have also moved to strengthen their own programs for managing medical wastes. For example, amendments to the New York State Environmental Conservation and Public Health Laws require the development of a state tracking program and plan for the management and disposal of infectious medical wastes. Other states impacted by medical waste dumping, such as New Jersey, Florida, and Ohio, have also enacted legislation and regulations. Despite these important efforts on the state level, the Natural Resources Defense Council (NRDC) has supported controls on the federal level because medical wastes are frequently transported out-of-state for treatment and disposal, and potential health and environmental impacts from improper management do not respect state boundaries. It is also important to protect certain states from becoming dumping grounds for out-of-state waste.

Manifest tracking system

A manifest tracking system is one approach designed to ensure that specific requirements for the handling and transportation of medical wastes are met. The federal demonstration tracking program for medical waste is a modified version of the RCRA hazardous waste law. The waste tracking forms create paper trails that allow federal and state agencies to follow medical wastes from the point of generation to the point of treatment and disposal.

Effectiveness of the manifest tracking system

The completion of the medical waste manifest by medical waste generators, haulers, and operators or owners of disposal facilities is an integral part of the federal government's, New York State's, and New Jersey's program for the control of medical wastes. There is no question that tracking requirements, with stringent civil and criminal penalties, serve as strong deterrents to illegal dumping. The manifest system, which identifies the generator, hauler, and point of treatment and disposal, addresses the very types of abuses mentioned earlier. The rules essentially codify what should be the best possible management practices, and cover aspects of the health care profession that were previously unregulated, such as private practitioners and other small offices. Additionally, the rules could significantly reduce the amount of medical waste hospitals frequently combine with solid waste, because administrators and doctors are aware that they can be liable if illegally-disposed waste is traced back to them.

The NRDC strongly believes that the federal government, and particularly the U.S. EPA, must play a major role in regulating medical waste and in enforcing regulations. The U.S. EPA is directed by the U.S. Congress to promulgate rules pursuant to the MWTA, and must depart from its prior passive role of merely providing guidance and education in this area. After more than a decade's delay in establishing controls for medical waste management at the federal level, the U.S. EPA must assume a leadership role in this area.

The MWTA, however, is not a panacea. Indeed, it has a number of weaknesses that could potentially affect the demonstration program. The most significant weakness is that the MWTA covers only ten states, including New York, New Jersey, Connecticut, and the Great Lakes states. The system should be extended to all fifty states because the problem is national in scope. Medical wastes have washed up on beaches and/or been improperly disposed of in approximately twenty states (Appendix A).

Unlike the requirements applicable to New York, New Jersey, and Connecticut, the participation of the additional seven Great Lakes states is not mandatory. The Great Lake states may opt out of the program for any reason (MWTA, 1988), while the former three can leave the program only upon showing they have implemented a medical waste tracking program no less stringent than the required federal program.

The MWTA also contains a provision that allows additional states, concerned about the management and disposal of medical waste, to join the federal tracking program. The Governor of a concerned state may petition the U.S. EPA to be included in the program within 30 days of the

Appendix A

Listing of States with Incidents of Medical Waste Pollution

California

Connecticut

Delaware

Florida

Indiana

Maine

Maryland

Massachusetts

Michigan

New Jersey

New York

North Carolina

Ohio

Oregon

Pennsylvania

Rhode Island

South Carolina

Texas

Wisconsin

promulgation of the MWTA's regulations (MWTA, 1988). However, the inclusion of this additional provision is unlikely to substantially increase the number of participating states for two reasons: lack of federal funding to support state inclusion, and the short duration of the program. Additionally, state officials are reluctant to commit their own resources because of the possibility that medical waste regulations could be changed after just two years.

The MWTA does not address the principal treatment and disposal practices for medical waste: incineration, steam sterilization, landfilling, and sewage disposal. The statute requires only that the U.S. EPA study these practices, although the treatment and disposal of medical waste through these four waste treatment and disposal practices pose other, possibly more serious, threats to human health and the environment (MWTA, 1988). If left unregulated, potential impacts from air emissions, ash management, sewer discharges, and landfills could contribute to the further degradation of coastal areas and waters.

Finally, the U.S. EPA's exercise of discretion in issuing the rules required by the MWTA may also weaken the program's viability and effectiveness. For example, the U.S. EPA has excluded or limited whole categories of wastes that the U.S. Congress included in the statutory definition. Clearly, the MWTA (1988) provides the U.S. EPA with the discretion to exclude from regulation wastes from surgery, autopsy, laboratory, and dialysis, and discarded medical equipment and parts, if the U.S. EPA determines such wastes do not pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Exercise of this discretion, however, requires the U.S. EPA to make a "no hazard" finding before excluding any medical waste from the definition (MWTA, 1988). The NRDC does not believe that data exist to support such a finding, or that the MWTA's requirements can be satisfied by reference to a lack of information regarding proposed excludable wastes. Moreover, it appears that the U.S. EPA's decision to exclude these wastes from the tracking program may be based, in large part, on the costs of disposal associated with stringent handling and tracking requirements. It should be noted, however, that the U.S. EPA was not authorized to consider cost factors in developing the regulations.

The U.S. EPA's proposal to exclude certain wastes that are contained in the statutory definition of medical waste, and therefore subject to stringent handling and transportation requirements, is certain to create confusion in at least three important areas. First, the proposed changes in definition will undermine state efforts that are already underway to conform with federal requirements, and will create confusion between existing state regulations and the federal program. For example, changes to the New York State infectious waste generator requirements and manifest system adopt the full statutory definition of regulated medical waste provided by the U.S. Congress.

Second, the exclusion of certain wastes pose enforcement difficulties. If similar wastes are subject to different controls, regulatory efforts will be undermined. Interestingly, the exclusions may also undermine the enforcement of other federal statutes, including the prohibition of medical waste ocean dumping, because amendments to the Ocean Dumping Act and Clean Water Act adopt the broader definition of medical waste.

Finally, the exclusion of certain wastes from the tracking requirements will have a significant impact of the U.S. EPA's ability to collect data on those wastes. In fact, there will be no information collected at all, because the reporting and record keeping requirements apply only to wastes included in the definition of medical waste.

One of the major purposes of the two-year demonstration program is to provide the U.S. EPA with extensive data on the generation, handling, transportation, and disposal of medical wastes. The U.S. Congress intended that data be collected to assist in determining the need for additional legislation to control medical waste. It is no coincidence that the first area that the U.S. EPA was required to report on is "the types, number, and size of generators of medical waste (including small quantity generators) in the United States, the types and amounts of medical waste generated, and the on-site and off-site methods currently used to handle, store, transport, treat, and dispose of the medical waste, including the extent to which such waste is disposed of in sewer systems (MWTA, 1988).

As previously discussed, comprehensive data on medical wastes is not available. Thus, not only has the U.S. EPA removed certain categories of wastes from the federal tracking program, but the narrowing of the definition jeopardizes future regulatory efforts. It is the NRDC's understanding that in the proposed regulation the U.S. EPA decided against categorizing data by waste type, and only examines the total generation of waste. This decision may hamper future efforts to advise medical facilities of the best treatment practices for the different categories of waste because, again, specific information on utilized methods is not available. Finally, tracking measures, under Section 11003(a) 42 U.S.C. 6992b(a) of the MWTA (1988), are limited to the manifest system. The NRDC believes other tracking mechanisms should be explored and considered, and has recommended that a second system be developed to require the use of imprinted lot numbers on medical supplies. The imprinted code should be sufficiently resistant to exposure to sea water and other elements to prevent obscuring the product's identity. The effectiveness of requiring lot numbers or similar markings has already been demonstrated. Additionally, because many wastes found on regional beaches in 1988 appeared as individual items, and were therefore untraceable (NYSDEC, 1988), the use of such markings would provide an effective method for distinguishing commercial medical wastes from supplies discarded by private individuals.

Conclusion

An important question is whether the new tracking rules will prevent future washups of medical wastes, and beach closings. The long-term issue, however, concerns the degree to which the MWTA will serve as the basis for a more permanent national program. The tracking rules can help to control the disposal of medical wastes; however, the tracking requirements will not prevent all waste from possibly washing ashore, for three reasons. First, as discussed above, the federal program does not cover all fifty states, and state regulations cannot address the interstate aspects of the problem. Second, in 1988 medical wastes accounted for only 1-10 percent of all wastes found on New York beaches, although specific figures vary among different agencies and were site-specific (NYSDEC, 1988). Thus, the majority of wastes remain uncontrolled. Third, with the exception of New York City's decision to cover its marine garbage barges, as required by the Shore Protection Act, other significant sources of medical wastes and, particularly, combined sewer overflows, remain unabated.

In terms of medical wastes, the tracking provisions are clearly only the first step in bringing medical wastes under comprehensive controls. The effectiveness of such controls is not fully known; however, the interim reports required by the MWTA (1988) may provide relevant information. There are important lessons for better controlling the solid waste stream to be gained from the attention given to medical waste. In fact, the U.S. EPA is required to make a determination on the need for similar controls for municipal solid waste.

Medical wastes have focused attention on the severe impacts on marine and coastal environments in ways that other issues have been unable to do. It is important to go beyond the steps taken in 1988 to further address ocean pollution issues.

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Have We Addressed the Causes of the Problems or the Symptoms of the Beach Washups?

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Introduction

While playing tennis last Wednesday evening, I tried to reach for a dropped shot near the net, and I must have injured a muscle in the upper thigh of my right leg. As a result of my constant complaining about the pain, my wife insisted that I see a doctor. The next day I visited my doctor at Stony Brook University Hospital and after telling me that at my age I should let the ball come to me, the doctor told me to go home and put a cold compress on the injured area. When I did so that evening, my wife told me that I really should use a hot compress. I did so, and lo and behold, the pain disappeared. The next day I called the doctor and told him that my wife had told me that a hot compress was the way to go and it seemed to have worked. The doctor listened and said, "That's funny, my wife told me to use a cold compress." Sometimes I think this is the way the public perceives how government addresses its problems.

I have been asked to attempt to answer the question, "Are we addressing the causes of the problem or only the symptoms of the problem of beach washups?" To answer this question, one should, obviously, delineate the symptoms and causes of beach washups.

The 1988 beach washup events were dramatized by the media when the New York State Department of Environmental Conservation (NYSDEC) Commissioner Thomas Jorling was asked to rush to Lido Beach to witness the wash-up of medical debris, while attending a media event in Massapequa, New York, pertaining to air pollution at gasoline stations. It is not necessary to repeat the events that followed. The media finally had a subject that virtually matched the saga of the "Mobro" garbage barge. The "death of the beaches" was in every newspaper and television show on an almost-daily basis during the summer of 1988. Headlines, newspaper articles, and editorials deplored the condition of Long Island beaches.

Actually, the total amount of medical waste found on area beaches during the period from July 6, 1988, through August 6, 1988, probably only filled one shopping bag. Only two New York State beaches closed as a result, for a total of not more than seven hours. All the above elements suggest that the 1988 beach washup events did not warrant the excessive media coverage they received.

The symptom that created the initial "event" was the discovery of hypodermic needles among the stranded floatable materials, ostensibly from diabetics or intravenous drug abusers. While these discoveries were the highlights of the media events, various beach closings resulting from other more normal events, such as sewage treatment facility failures, added to public concern. Sewage treatment facility failures have been common occurrences on Long Island and other waterfront communities in New York State.

The tremendous economic losses resulting from the failure of the public to resume normal beach activities during the summer of 1988 brought every layer of government to attempt to eliminate the symptoms and, in some cases, to attack the causes of floatable washups. The U.S. Environmental Protection Agency (U.S. EPA), the U.S. Army Corps of Engineers (U.S. ACE), and the U.S. Coast Guard (USCG) developed and implemented a program to locate and remove debris in the many nooks and crannies of the New York/New Jersey Harbor. Over 441 tons of floatable materials were removed during new and full moon tides and during heavy rainfalls in 1988 (U.S. ACE, 1989). By volume, this material consisted of 90% wood and 10% plastic, paper, metal, and other similar materials (Caspe and Molinari, 1990). Using helicopters, these agencies warned state and local facilities of impending floatable washups.

New York State, through the NYSDEC, Department of Parks, Recreation, and Historic Preservation (NYSDPRHP), and the Department of Health (NYSDOH) coordinated several programs to educate the public, utilizing hotlines and literature, of problems at the beaches, the nature of the materials involved, and how to handle suspected medical waste items. In 1988 the NYSDPRHP purchased expensive beach cleaning equipment to remove beach washup debris on a daily basis. The NYSDEC hired two new officers and purchased two boats expressly for the purpose of patrolling beaches to locate potential sources of beach washups. Nassau and Suffolk Counties, in conjunction with the New York State Water Pollution Control Federation, developed and implemented a program to educate the public regarding the disposition of medical debris removed from area beaches.

While many of these fine efforts addressed the symptoms of the problem, such as needles on the beach, what was being done to address the causes of the floatables problem? Why did these floatable materials get into coastal waters so that they ended up on area beaches?

A thorough study by the NYSDEC (1988) documented the causes of the 1988 beach washups. They are:

- Poor housekeeping at the Fresh Kills Landfill and the New York City marine transfer stations;
- The many combined sewer overflows (CSO's) in the New York Metropolitan Area; and
- Improper waste disposal from commercial and recreational vessels.

I would like to suggest that there were other causes:

- Inadequate education of proper medical waste handling and disposal procedures to the medical profession and individual drug users and diabetics; and
- High costs for disposal of medical wastes resulting from insufficient facilities on Long Island.

What has been done or what is being planned to address these causes?

1. As a result of a New York City Department of Environmental Conservation (NYSDEC) consent order, housekeeping at the Fresh Kills Landfill and New York City marine transfer stations has improved tremendously. Improvement in general procedures, rules limiting barge volumes, covers on barges, improved boom procedures, and increased boat surveillance, etc., have resulted in the reduction of debris washups resulting from these facilities.

2. The upgrading of the New York City combined sewer overflows (CSO's) is currently in progress. While $10 billion has been budgeted to accomplish this task, this project is destined to take 10 years to accomplish.

3. It has been suggested that the improper waste disposal practices of recreational boaters can and should be remedied by increased pump out stations. A recent study, however, indicated that there are sufficient pump out stations presently available to boaters in New York's marine districts but that costs, possibly poor locations, and inadequate boating education, have limited proper use of these facilities. Accordingly, no decision to increase building of pump out stations has been made.

4. With regard to educating the medical profession about proper waste disposal, I believe that the increased penalties for improper disposal combined with NYSDEC's successful enforcement actions against some facilities has resulted in educating the medical community. No

doctor or hospital wants to receive negative publicity in this regard and we are convinced that legitimate medical professionals will not be future offenders. The medical waste manifest system has to remind all people in the medical industry of their obligations.

Individual diabetics will continue to be a problem. It is imperative that the NYSDOH, local health departments, and medical professionals emphasize to the individual diabetic that there is a right and wrong way to dispose of needles. If the majority of diabetics in the New York Metropolitan Area (in 1988, this figure was estimated at between 60,000-112,000 individuals) could be made to change their ways and to dispose of their needles in proper containers, a major part of the medical waste problem could be eliminated.

Of course, the problems associated with intravenous drug abusers will be with society for a long time. Until the problem of illicit drug use is solved or minimized the public can expect to find used drug paraphernalia on the beaches.

5. One of the root causes of the medical waste disposal problem is the lack of adequate disposal facilities. Most knowledgeable people agree the best method of infectious waste disposal is incineration. There is, however, inadequate incineration capacity on Long Island and accordingly, these waste materials must be shipped long distances for disposal. Medical waste disposal costs ranging from $0.35-$1.00 (1988 dollars) per pound are not abnormal.

To ensure, therefore, that these wastes do not appear on area beaches, in plastic bags on the sides of our highways, or in other undesirable locations, people must be able to properly dispose of these items regionally. An environmentally sound incinerator must be built on Long Island for this purpose. Efforts are being made to site and construct such an incinerator and it is imperative that Long Island decision-makers support this important project.

Conclusion

Finally, let me say that while I believe that all levels of government working together have done a superb job in addressing the floatable problem, the solution to beach washups and the appearance of area beaches continues to remain in the power of the beach user. I have seen the appearance of a state beach in the early morning and the disaster that is evident by the end of the day. Hundreds and thousands of trash containers never seem to be sufficient to prevent the initially pristine shoreline from looking like a municipal landfill. When people stop throwing their waste onto the beaches I assure you the beaches will be clean.

Hindcast of Medical Waste Trajectories in Southern New England Waters

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Introduction

In early June, 1988, medical wastes including syringes, needles, rubber tubing and gloves, vials, plastic catheters, and other such items were found along the Island State Park and Ortley Beach of the New Jersey shoreline. By July 14-19, 1988, similar types of waste were observed along the Connecticut, Rhode Island and southern Massachusetts (and offshore islands) shorelines. The origin of the wastes remains unclear, although there is circumstantial evidence to suggest that the material may have been discharged in the New York Bight area and transported to southern New England shores by the prevailing winds and currents. Health officials, environmental managers, public safety personnel, and news media in Rhode Island and the general southern New England region took an active interest in the strandings of these wastes, because of the potential public health risks involved. In 1988, Rhode Island Governor Edward DiPrete established a task force to advise him on the health/environmental risks associated with the strandings, and to determine whether the debris is connected to recent similar discoveries in Connecticut, New Jersey, and New York. These releases may also be related to illegal offshore dumping.

On Wednesday, July 20, 1988, Mr. Robert Bendick, Jr., Director of the Rhode Island Department of Environmental Management (DEM), contacted Applied Science Associates, Inc. (ASA) on behalf of the Governor's medical waste task force, and requested that ASA provide assistance in determining the origin of the waste release through numerical model simulation techniques.

The objective of this study was to hindcast medical waste trajectories using existing information on the waste stranding locations and times, and oceanic currents and winds to determine the origin of the release. ASA was requested to complete the simulations as quickly as possible. Given the time constraints, the selection of environmental data necessary to perform the simulations was based more on ready availability than on quality. The data sets selected are, however, reasonably representative of conditions in the area.

Table 1 presents a summary of the medical wastes collected along the coastlines of New Jersey, New York, Connecticut, Rhode Island, and Massachusetts for June and July, 1988. The table gives the stranding date, location (latitude, longitude), and description of the waste. The table is divided into two sections. The first section presents data summarized by the Rhode Island Department of Health (DOH) and represents material actually recovered and thought to be related to the medical waste release problem. Sitings are for Rhode Island waters only. These data were provided by Roger Greene of the Department of Environmental Management, and Charles Hachadorian, Jr., from the DOH Health and Drug Control Division. The list was current as of July 25, 1988. The second portion of the table summarizes other observations in the general area. These data are unconfirmed, and have generally been extracted from television and radio news, and newspaper accounts of the incident. Any overlap between the DEM/DOH confirmed sitings and those in the newspaper reports has been eliminated whenever possible. There may well still be some double-reporting or errors in the recording of information.

Figure 1 shows the stranding locations on a map of the region. The DOH and other sitings are noted by separate symbols. A review of Table 1 and Figure 1 clearly shows that strandings began in early June along the New Jersey coast, progressed to the southern Long Island shoreline by early July, and by mid-July reached Rhode Island waters. By July 17-20, the beachings had reached the Massachusetts coast, with sitings as far north as the southern end of Cape Cod at Monomoy Island. These sitings are consistent with a waste release in the New York Bight in mid-June, and its subsequent transport by wind and currents toward the northeast over the next month-and-a-half.

The results of the numerical hindcasting efforts are presented in this paper. The second section summarizes the methodology used to perform the trajectory simulations. Application of the technique to the study area is described in the third section. Study conclusions are presented in the final section.

Trajectory calculation methodology

Following the extensive research in oil spill trajectory modeling (Huang and Monastero, 1982; Spaulding, 1988), and based on the observation that medical waste floats at or very near the

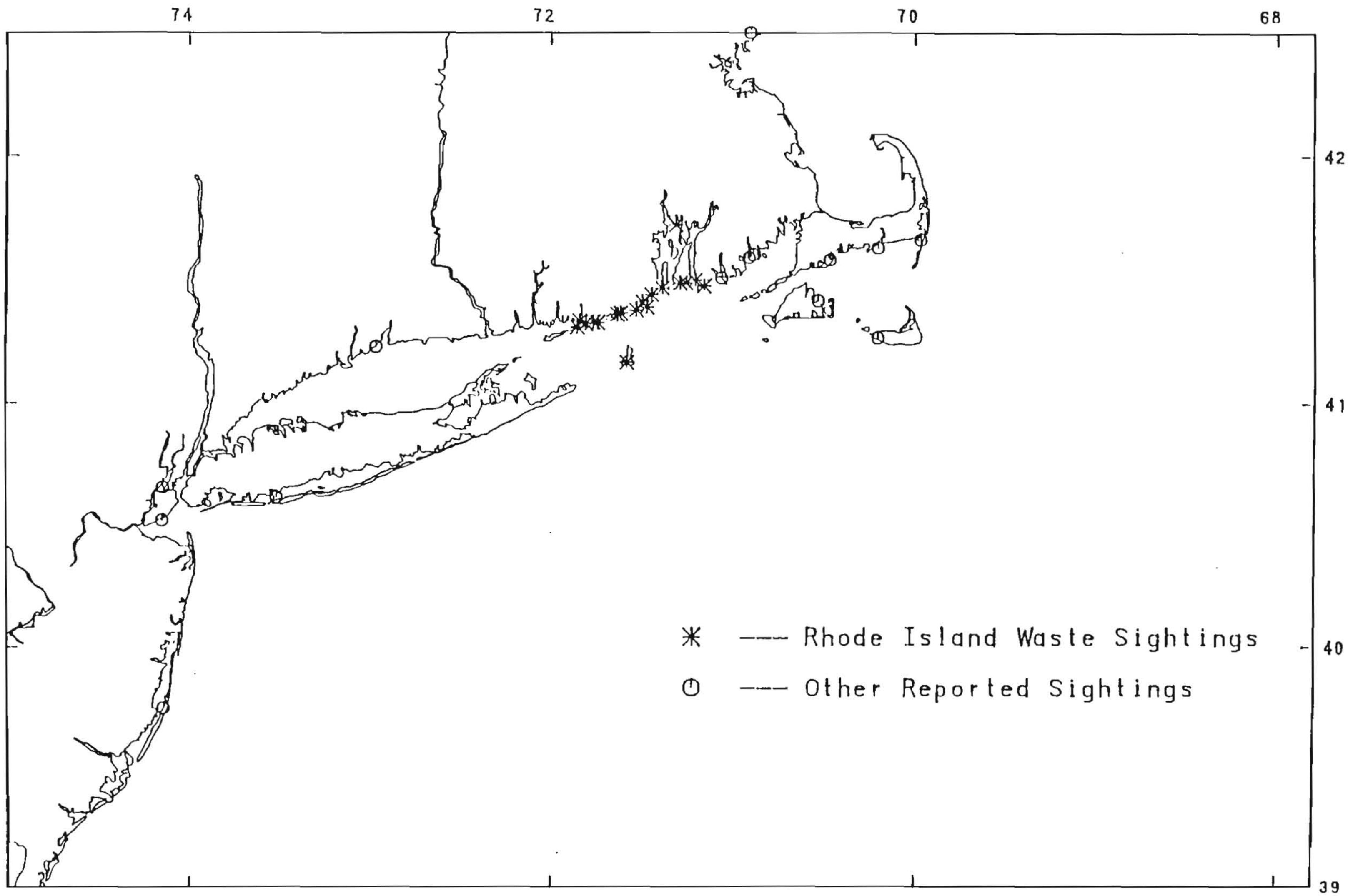

Figure 1 Study area showing the observed stranding sites for medical debris. A description of the material, stranding location (latitude, longitude) and date are given in Table 1.

TABLE 1 DESCRIPTION, LOCATION, AND DATES OF MEDICAL WASTE STRANDINGS ON THE NEW JERSEY, NEW YORK AND SOUTHERN NEW ENGLAND SHORELINE, JUNE-JULY 1988.

OBS. NUMBER	LOCATION	LAT./LONG.	DATE FOUND	ITEM(S) FOUND
RHODE ISLAND SIGHTINGS				
1	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/19/88	PLAST-O-FLAC 1000ML
2	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/19/88	NYLON VALVE, 4 TUBES, ORANGE NYLON FASTENER
3	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/21/88	PLASTIC BAG W/ BLUE MARKINGS
4	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/21/88	PLASTIC CATHETER END
5	GREEN HILL BEACH	41.36/71.61	N. A.	4 RED NEEDLE PROTECTORS
6	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/20/88	HYDROGEN PEROXIDE BOTTLE, 3 PLASTIC CAPS, PLASTIC BAG
7	FIRST BEACH, MIDDLETOWN	41.48/71.29	07/19/88	B-D TUBE HOLDER W/ 3 TEST VIALS AND DROPPER
8	SCARBOROUGH BEACH, NARRAGANSETT	41.38/71.47	07/20/88	1 LARGE PLASTIC TUBE, RED NEEDLE COVER, SYRINGE
9	SEASIDE BEACH, WESTERLY	41.32/71.76	07/19/88	2 TSP. DOSAGE SPOON
10	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/20/88	1 SURGICAL GLOVE
11	WATCH HILL BEACH, WESTERLY	41.30/71.85	07/18/88	RESPIRATOR PART, PLASTIC BAG
12	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/21/88	BABY BOTTLE TOP, MICROFOAM SURGICAL TOP
13	HARBOR ISLAND, SOUTH KINGSTOWN	41.41/71.49	07/19/88	NEEDLE AND SYRINGE, INSULIN SYRINGE
14	HULL COVE BEACH, JAMESTOWN	41.46/71.38	07/21/88	SURGICAL MASK
15	WEEKAPAUG BEACH, WESTERLY	41.32/71.74	07/18/88	INSULIN SYRINGE
16	WEEKAPAUG BEACH, WESTERLY	41.32/71.74	07/17/88	SURGICAL GLOVE
17	WATCH HILL, WESTERLY	41.30/71.85	07/18/88	CATHETER END
18	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/19/88	RUBBER TUBING, INTUBATION PRODUCT, CATHETER BAG
19	SCARBOROUGH BEACH, NARRAGANSETT	41.38/71.47	07/21/88	PLASTIC CYLINDER MARKED "UNISOL COOPERVISION"
20	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/17/88	NEEDLE AND SYRINGE
21	BLOCK ISLAND	41.16/71.58	07/19/88	NEEDLE AND SYRINGE
22	LITTLE COMPTON	41.49/71.20	07/18/88	NEEDLE AND SYRINGE
23	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/11/88	TEST TUBE
24	GOOSE WING, LITTLE COMPTON	41.47/71.15	07/20/88	NEEDLES (UNRECOVERED)
25	SEASIDE BEACH, WESTERLY	41.32/71.76	07/20/88	1 QUART PLASTIC IV, 3 PLASTIC TUBES, SPOON
26	EAST MATUNUCK STATE BEACH	41.37/71.53	07/22/88	1 PLASTIC BAG
27	SEASIDE BEACH CLUB WESTERLY	41.32/71.76	07/22/88	NEEDLE AND SYRINGE, TABLET BOTTLE
28	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/22/88	RESPERATOR HOSE
29	SECOND BEACH MIDDLETOWN	41.48/71.25	07/23/88	NEEDLE
30	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/23/88	ORTHODONTIC ELASTICS
31	PAWCATUCK RIVER WESTERLY	41.33/71.84	07/23/88	NEEDLE AND SYRINGE
32	WEEKAPAUG BEACH WESTERLY	41.32/71.74	07/23/88	LEG OR ARM CAST
33	MISQUAMICUT BEACH, WESTERLY	41.32/71.80	07/23/88	RUBBER GLOVE AND SURGICAL GLOVE
34	BARRINGTON BEACH	41.72/71.31	07/23/88	SYRINGE
35	DUNES CLUB, NARRAGANSETT	41.43/71.44	07/23/88	SYRINGE
36	CHARLESTOWN BEACH	41.35/71.63	07/23/88	SYRINGE CAP
37	GREEN HILL BEACH	41.36/71.61	07/23/88	WHITE SURGICAL GLOVE, PLASTIC CONTAINER
38	EAST MATUNUK STATE BEACH	41.37/71.53	07/23/88	SEALED VIAL OF LIQUID
39	EAST MATUNUK STATE BEACH	41.37/71.53	07/24/88	RUBBER GLOVE, PLASTIC BOTTLE

OTHER SIGHTINGS (PROVIDENCE JOURNAL)

1	ISLAND STATE PARK, ORTLEY BEACH, NJ	39.75/74.14	06/03/88	4 VIALS OF BLOOD
2	BAYONNE MUDFLATS AND NEWARK BAY, NJ	40.65/74.14	07/02/88	141 VIALS OF BLOOD
3	MIDLAND, SOUTH, GREAT KILL BEACHES, NY	40.52/74.14	07/13/88	2 VIALS OF BLOOD
4	LIGHTHOUSE POINT PARK BEACH, CT	41.23/72.97	07/14/88	SYRINGES
5	JONES, LIDO AND LONG BEACHES, NY	40.61/73.51	07/06/88	3 VIALS OF BLOOD
6	SOUTH BEACH EDGARTOWN, MA	41.41/70.53	07/17/88	VIALS, SYRINGES AND NEEDLE GUARDS

MASSACHUSETTS SIGHTINGS (MASS. DEPT. OF HEALTH)

1	CHATHAM	41.66/69.96	07/21/88	2 SYRINGES
2	WESTPORT	41.51/71.06	07/21/88	2 NEEDLE COVERS
3	EDGARTOWN	41.42/70.53	07/21/88	4 SYRINGES, SEVERAL INJECTABLE MEDICATION VIALS
4	FAIRHAVEN	41.60/70.89	07/21/88	2 SYRINGES
5	MASHPEE	41.58/70.46	07/21/88	SYRINGE
6	NANTUCKET	41.26/70.20	07/21/88	SYRINGE, ECG PAD
7	NEW BEDFORD	41.59/70.91	07/21/88	HOSPITAL WRIST BAND, HYDROGEN PEROXIDE BOTTLE
8	CHATHAM	41.66/69.96	07/22/88	3 SYRINGES
9	FAIRHAVEN	41.60/70.88	07/22/88	SYRINGE (APPEARS NEW)
10	WESTPORT	41.51/71.06	07/22/88	CATHERIZATION TUBE
11	YARMOUTH	41.63/70.20	07/22/88	MULTI-TRAUMA DRESSING PACK
12	NANTUCKET	41.26/70.20	07/22/88	MEDICATION BOTTLE, SYRINGE, MISC. DEBRIS
13	MARBLEHEAD	42.50/70.90	07/22/88	3 SYRINGES (APPEAR NEW)

sea surface, the drift of the waste was approximated as the vector sum of the mean ocean currents, and a wind-induced drift represented as 3 percent of the wind speed. The wind-induced drift has a variable drift angle with respect to the wind direction, following Samuel et al. (1982). The angle, measured clockwise to the right of the wind vector in the northern hemisphere, is typically 15° for moderate wind speeds.

In the present calculation, the contributions of tidal currents are ignored because of project time constraints and because they have little effect on net trajectory motions over periods of 30 days or longer. These time scales are typical of the proposed simulation time periods in the present analysis.

The trajectory calculations can be performed in both forward and backward modes. In the forward mode, wastes are released at given launch points at specified times, and the trajectory paths are predicted into the future. In the backward mode, the release point is assumed to be the presently observed location of the waste (e.g., a beach stranding) and the model calculation is run backwards to predict where the material was in the past. Calculations in the forward and backward modes can be performed as long as desired, provided reliable data are available on winds and ocean currents.

In practice, forward and backward trajectory calculations are limited to 30-60 days. As trajectory simulations proceed, errors in the estimate of position increase. For simulation periods greater than 60 days, trajectory calculations may be significantly in error.

Application of trajectory model to study area

The trajectory model described in the previous section was applied to the study area extending from 39-42.5° N latitude and 68-75° W longitude. The following sections describe the current and wind data used in the model. Hindcasts to determine the waste release points are presented, along with simulations of trajectories.

The basic data source for surface currents is the series of atlases of ship drift observations produced by the Naval Oceanographic Office (1977). Current ocean drifter data summaries (e.g., Bumpus and Lauzier, 1965), and other data have also been incorporated whenever possible. Although extensive numerical hydrodynamic model predictions are available for the area (Kantha et al., 1986), these were not used since they do not agree with the existing observational data base. For the southern New England shelf the seasonal and mean surface currents predicted by this model are totally unrealistic, showing extremely strong (>0.5 m/sec) onshore/offshore flow. This area is of primary concern in the present study.

The current data, interpolated onto a 5 kilometer square grid, are shown in Figure 2. This surface current field is in general agreement with our understanding of the mean circulation in the area, and shows:

- An along-shelf flow generally directed to the west/southwest on the southern New England shelf;
- A weak clockwise eddy in the apex of the New York Bight, with eastward-directed flow along the western Long Island shoreline;
- Generally weak flows off the shelf. (The data do not accurately reflect the passage of Gulf Stream rings that are known to propagate southwestward along the shelf break, after being spawned by the Gulf Stream);
- A general clockwise gyre in the Gulf of Maine; and
- A geographic barrier clearly delineated by Nantucket Shoals, isolating the circulation in the Gulf of Maine from that in the southern New England and New York Bights.

For comparison, Figure 3 shows a summary of current meter observations in the general area taken from Beardsley et al. (1976). Current speeds near the surface are typically 3-8 cm/sec. Summer winds are generally from the southwest in the area (Turner, 1984), with offshore winds typically much stronger than their nearshore counterparts (Godshall et al., 1980). The winds are also known to display spatial variations over the shelf, on length scales of 100 kilometers, particularly for the higher frequency spatial variations (hourly-daily). The low frequency variations are typically small.

Unfortunately, due to time constraints, it was not possible to obtain wind data from the operational network of offshore meteorological buoys maintained by the National Oceanic Atmospheric Association (NOAA) National Data Buoy Center (Gilhousen et al., 1983). Wind data for June 1988 were available, but processing times and delivery of the data required several weeks. Thus wind data from Green Airport in Warwick, Rhode Island, were used for the model. Data were collected and digitized at hourly intervals from the Green Airport NOAA/National Weather Service (NWS) Station. The wind record covers the period from June 1, 1988 to July 20, 1988.

To visualize wind flow a progressive vector plot is used. The raw data for east/west and north/south wind speeds are multiplied by the time interval to establish a pseudo-displacement of

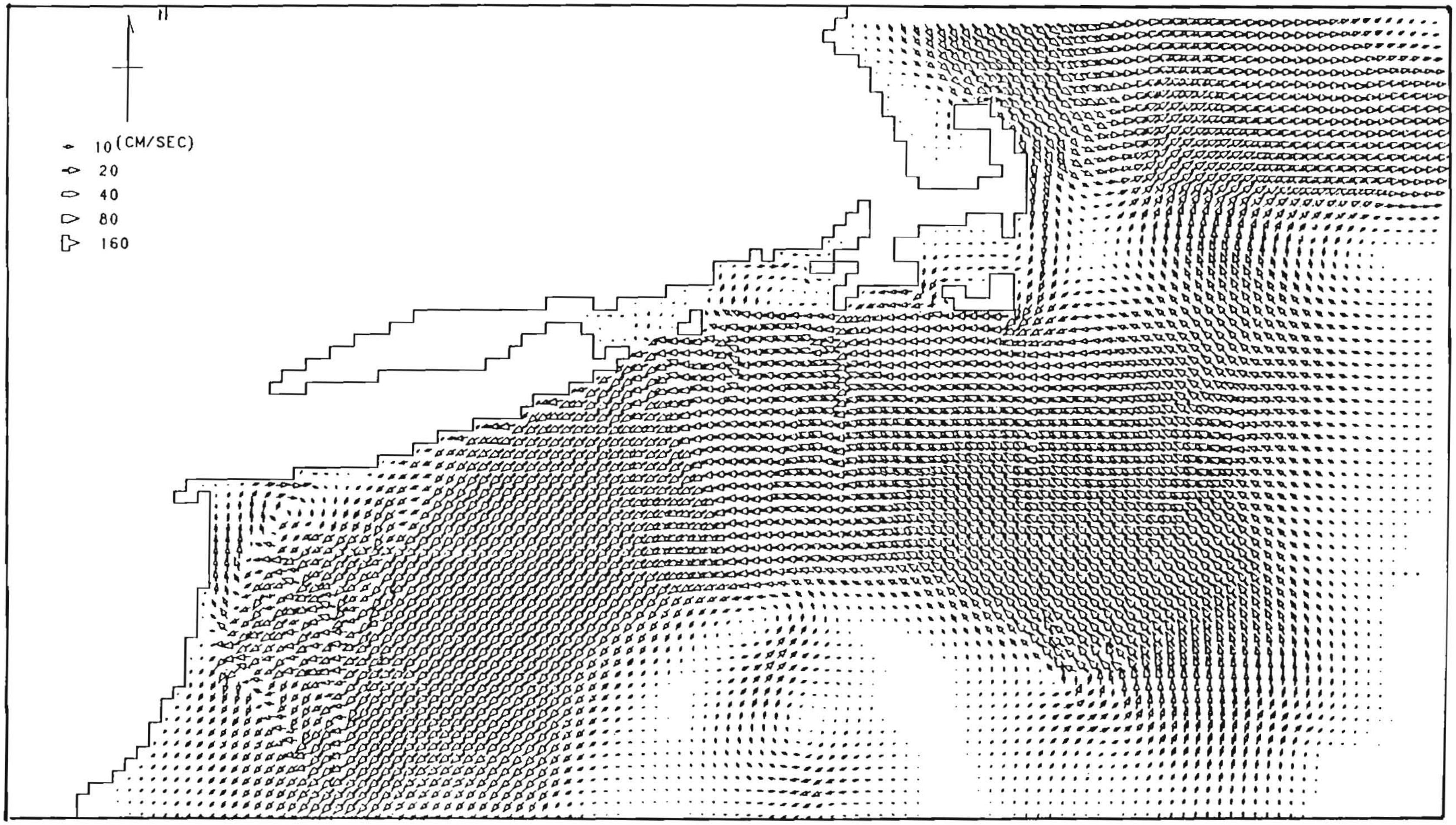

Figure 2 Mean observed ocean surface currents in the New York and southern New England Bights. Data are obtained from Naval Oceanographic Office (1977) surface current charts and Bumpus and Lauzier's (1965) summary of surface drifter data.

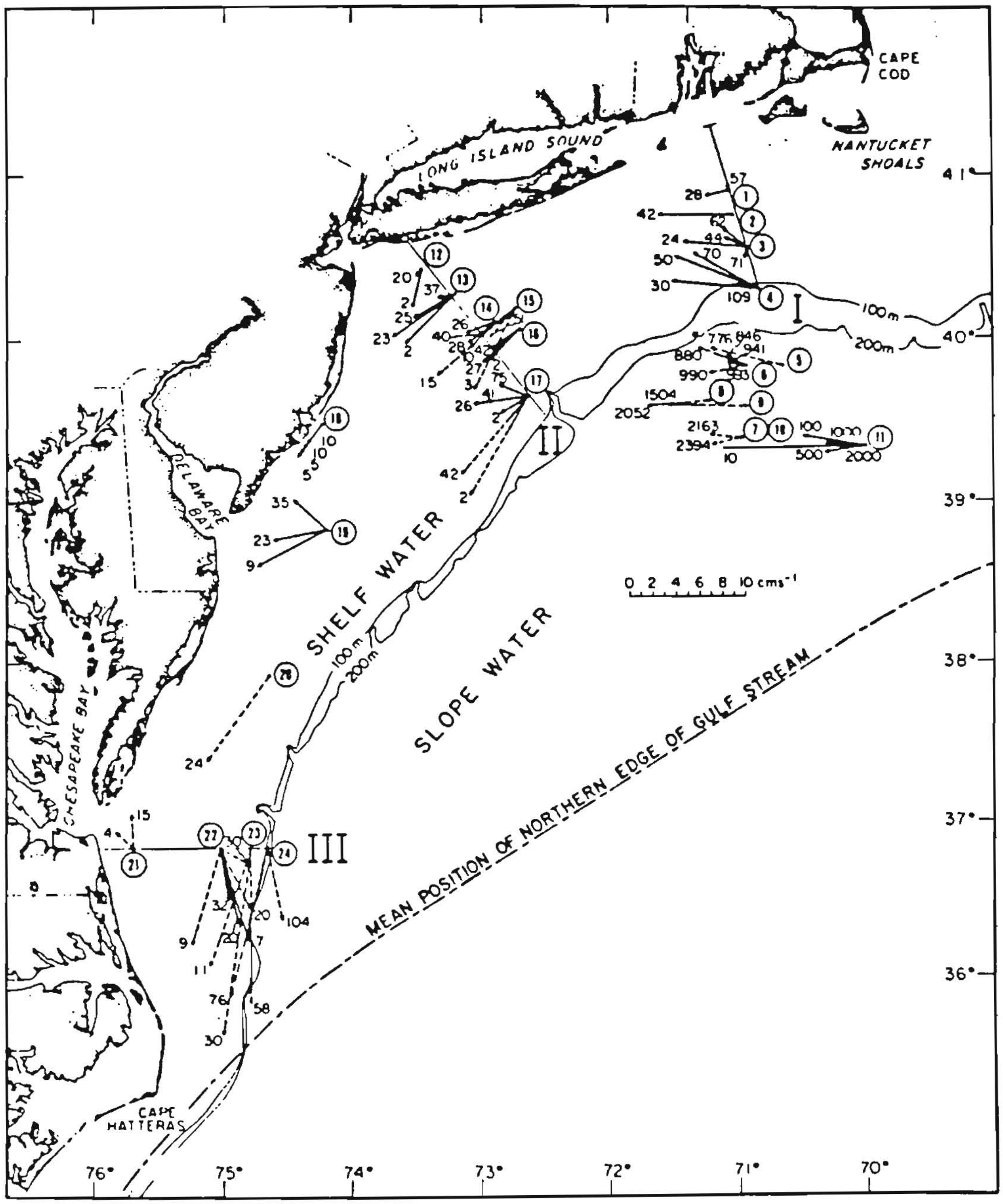

Figure 3 Mean velocities as measured by moored current meters in the Middle Atlantic Bight region. Winter measurements are indicated by solid arrows, summer velocities by dashed arrows. Individual stations are circled. Measurement depths (in meters) are shown near the head of the arrows (Beardsley et al, 1976).

a particle passing through the observation station in that interval. These positions are accumulated in the progressive vector plot to give a picture of overall integrated motions associated with that observation. These positions, of course, do not represent actual motions or pathlines of real particles. They illustrate mean motions at a point.

Figure 4 shows a progressive vector diagram of the Green Airport wind from June 1-July 20, 1988. Symbols, with the day marked next to them, are given at weekly intervals. For the first two weeks of the record, the wind is consistently toward the southeast. From June 15-July 20, however, the winds blow toward the northeast (from the southwest), which is typical for this time of year (Turner, 1984). Although generally from the southwest, the wind is variable for the last week in June and the first week in July. From July 6-20, however, the wind is persistently from the southwest. From June 15-July 15, the mean wind speed is 2.5 m/sec (5 knots).

The offshore wind speeds in the area of interest are significantly stronger than those measured at land-based stations (such as at the NOAA/NWS Station at Green Airport). Following the analysis of Godshall et al. (1980), and comparing the observed winds at Green Airport to the climatic summaries for the NOAA offshore data buoys (Gilhousen et al., 1983), the Green Airport winds were multiplied by a factor of two to represent offshore wind conditions. Lacking additional data, the wind is assumed to be spatially uniform.

In an attempt to determine the origin of the medical wastes that stranded on Rhode Island and nearby Connecticut and Massachusetts shorelines, the trajectory models employing the above-described current and wind data were employed in the backward mode. Waste material was launched from the observed stranding sites given in Table 1, at 1200 hours (noon) on the observed dates. These start times may well be in error, because the material may have been beached some time before it was found. They are, however, selected in lieu of any better alternative.

Trajectory calculations were run backwards until June 1, 1988, or until the trajectory intercepted land. The trajectory predictions for the medical wastes are shown in Figure 5. Due to the model's inability to resolve fine-scale, nearshore features, most of the trajectories from the western Rhode Island shoreline hit Montauk Point, Long Island, in the backward calculation. However, trajectories launched from stranding sites further to the east passed around eastern Long Island and continued until they hit land. These trajectories typically take 35-40 days to travel from Rhode Island to New York or New Jersey shorelines. The trajectory paths suggest that most of the waste material originated in the New York Bight, with the focal point appearing

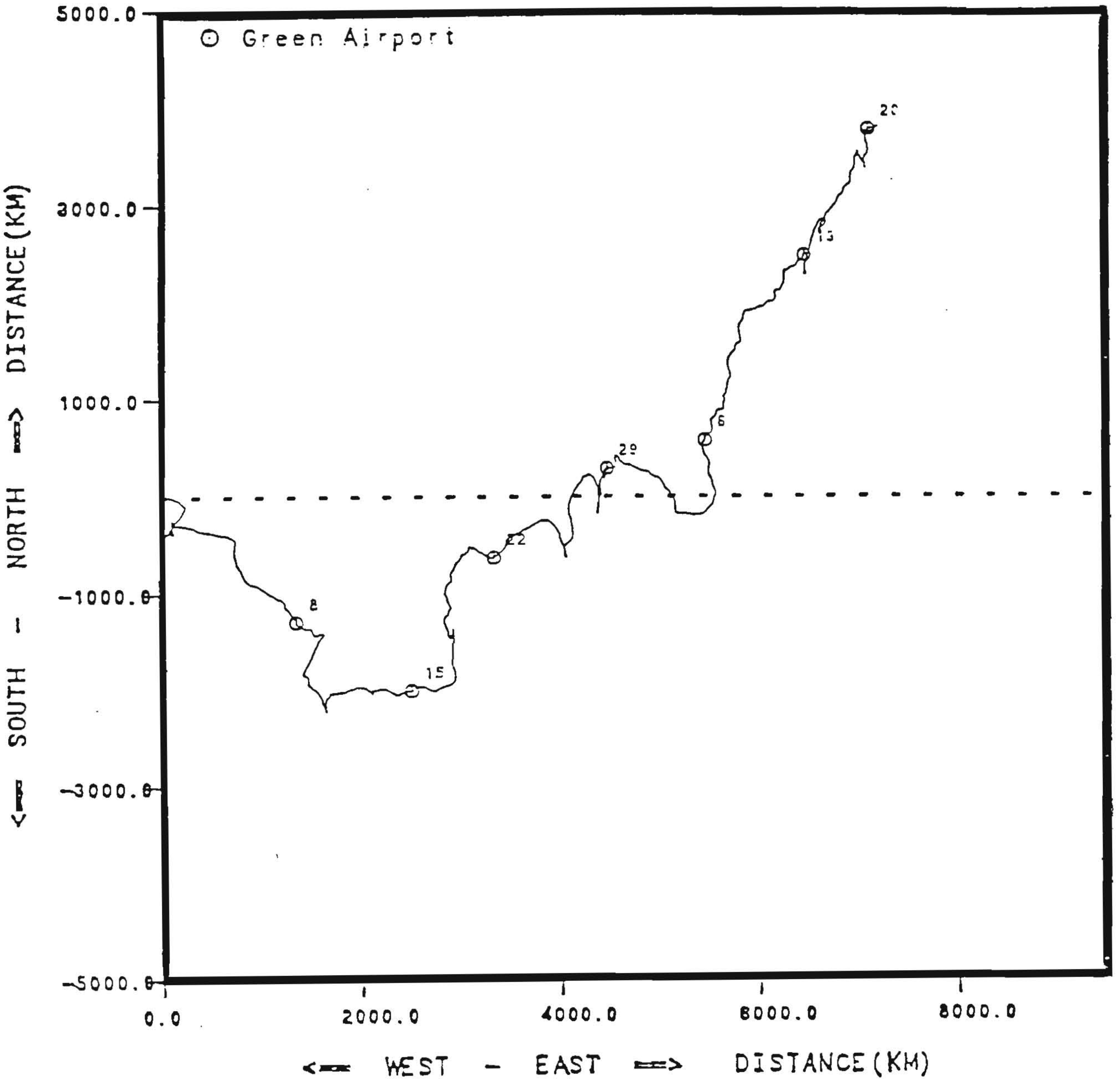

Figure 4 Progressive vector diagram of wind observations at Green Airport, Warwick, Rhode Island, Symbols are noted at 7-day intervals. (1000 km/7 days = 1.65 m/sec).

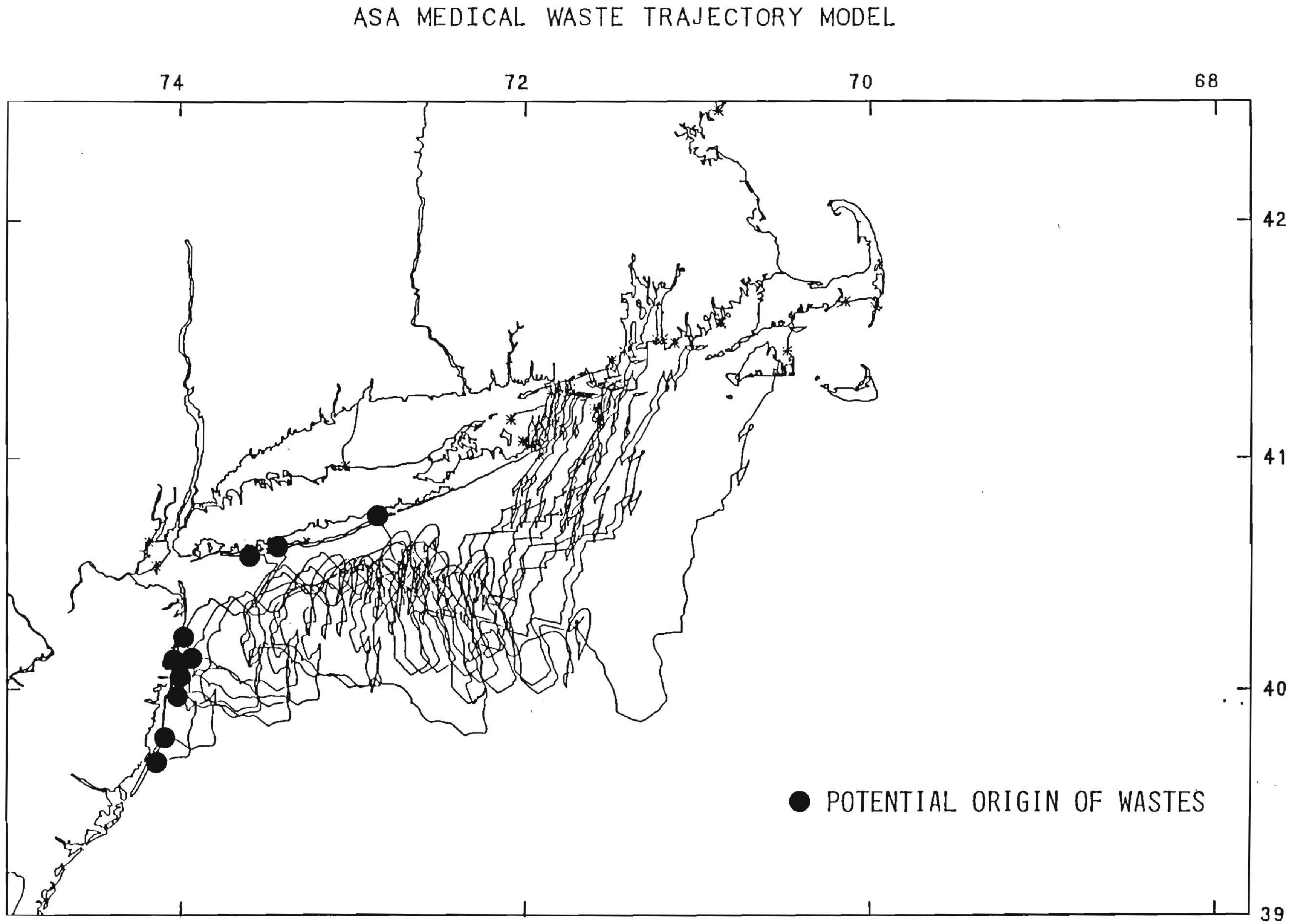

Figure 5 Medical waste trajectories, launching the wastes at the observed beaching locations (Table 1) and calculating backward to determine their potential origin.

to be near the Bight Apex. The release time (if indeed the release was instantaneous) seems to have been in mid-June.

To check the consistency and reasonableness of the backward calculations performed, forward simulations were made for release locations in the New York Bight Apex at various release times. The release sites were selected to encompass probable sources of prior medical waste beaching in the New York-New Jersey area. The possible release sources include:

- Illegal nearshore dumping;
- Material trapped in intertidal areas in N.Y. Harbor and the surrounding region;
- Releases from barge loading and unloading at the N.Y.C. Sanitation Department facilities;
- Combined Sewer Overflow (CSO) discharges; and
- Releases from pleasure and commercial craft.

Figures 6-9 show 40-day model-predicted trajectories for waste releases assumed to have occurred on June 1, 6, 11 and 16, respectively. These release times were selected since they bracketed a reasonable estimate of when releases actually occurred, and are consistent with the observed beaching incidents and patterns. The release locations are exactly the same in each case, and are distributed uniformly on a square grid in the vicinity of the Bight Apex. One trajectory is simulated for each release site, beginning at noon on the release day. For releases that occurred early in June (Figures 6 and 7), the wastes are predicted to be transported offshore; first in a southeasterly direction, and then to the northeast. This pattern corresponds to the changing wind pattern depicted in Figure 4. When released on June 11 (Figure 8) the model predicts the waste is transported to the southern Massachusetts shoreline. Wastes are also observed to impact the southern Long Island shoreline, particularly the western half. If the release date is advanced to June 16, 1988 (Figure 9), eight of the nine trajectories strand on the western end of the southern Long Island shoreline. Assuming an instantaneous release, this analysis suggests that the waste release date was probably between June 11 and 15, 1988.

A review of the progressive vector diagram for the winds explains the trajectory predictions given above. For release times early in June, the southeasterly-directed winds transport the waste offshore. When the winds reverse and blow to the east and northeast, the waste is transported off- or along-shore, respectively. When the release date is near the middle of the month, the debris is transported in an easterly direction first; and, when the wind switches direction, to the northeast. If the release occurred later than June 15, the waste transport was toward the northeast, with impacts only observed along the western end of Long Island.

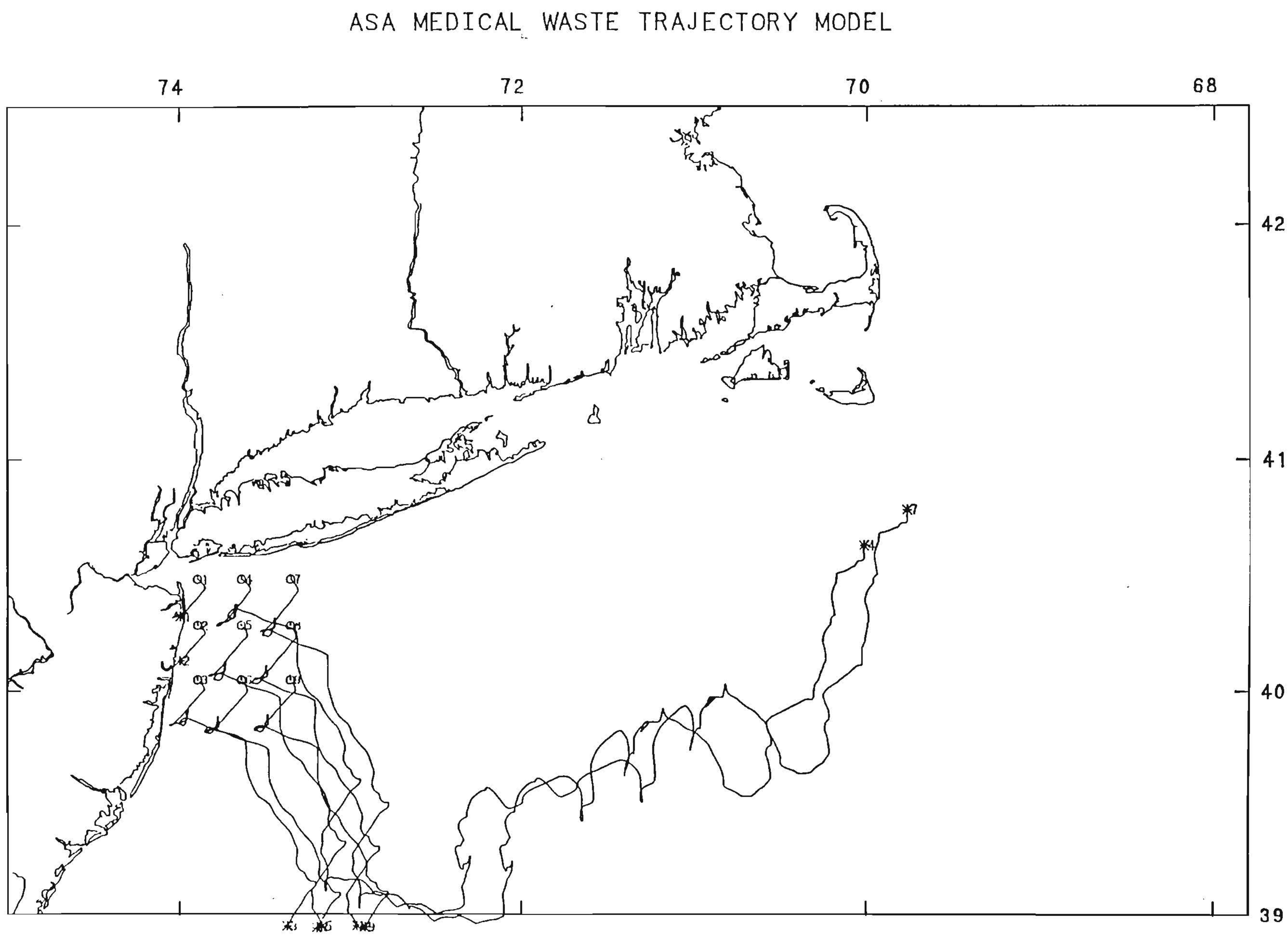

Figure 6 Medical waste trajectories assuming a release location in the New York Bight apex and releases on 1 June 1988.

ASA MEDICAL WASTE TRAJECTORY MODEL

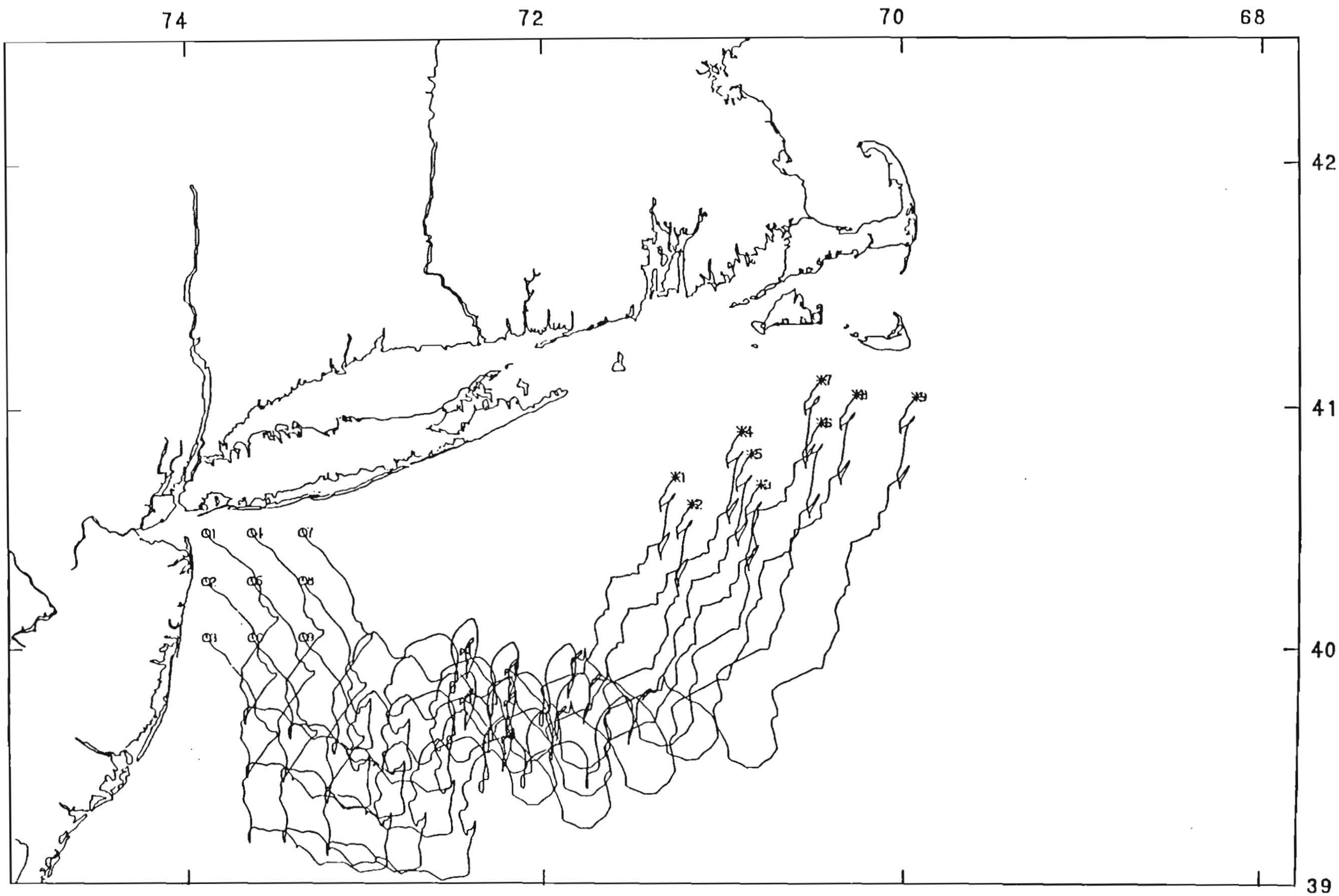

Figure 7 Medical waste trajectories assuming a release location in the New York Bight apex and releases on 6 June 1988.

ASA MEDICAL WASTE TRAJECTORY MODEL

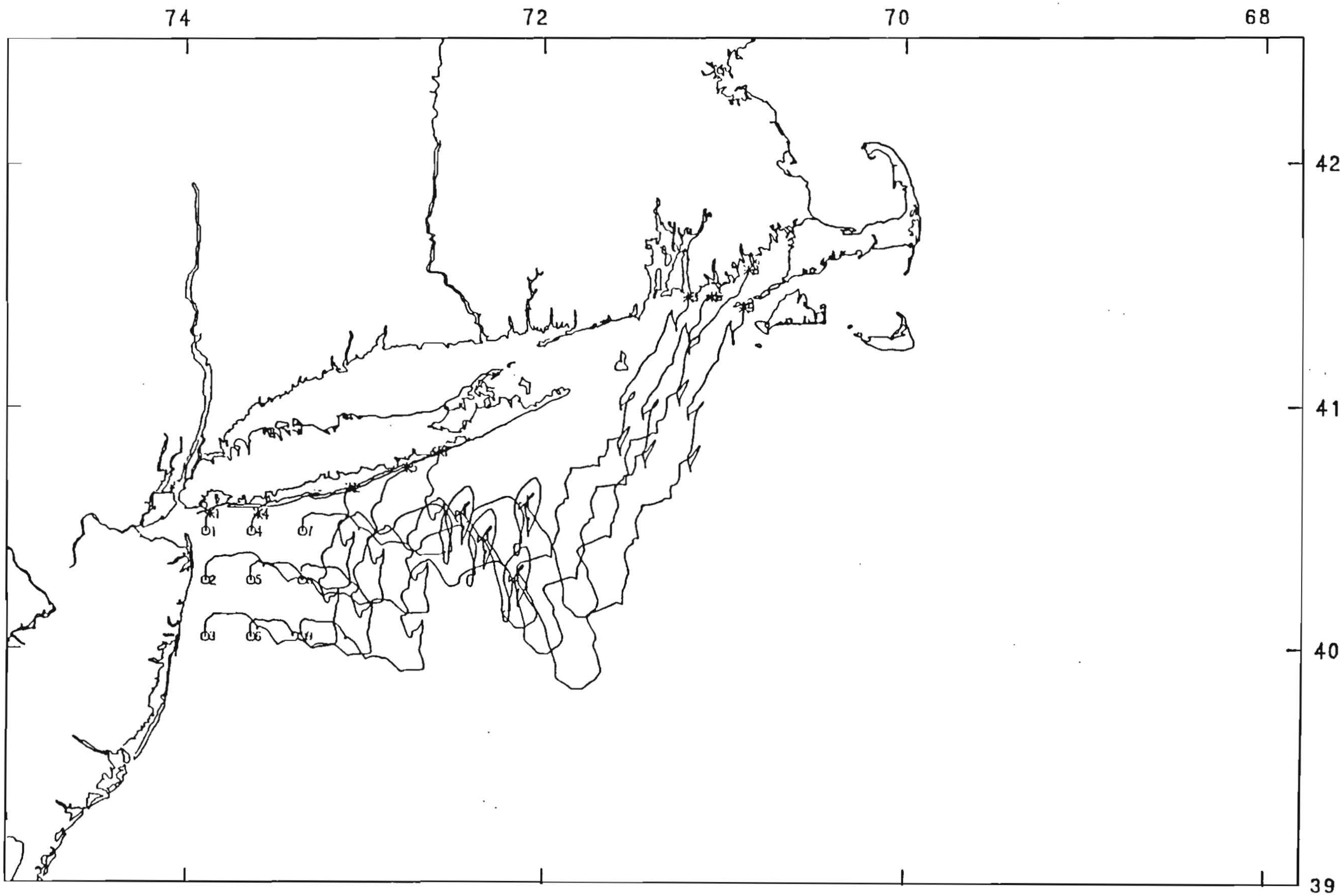

Figure 8 Medical waste trajectories assuming a release location in the New York Bight apex and releases on 11 June 1988.

ASA MEDICAL WASTE TRAJECTORY MODEL

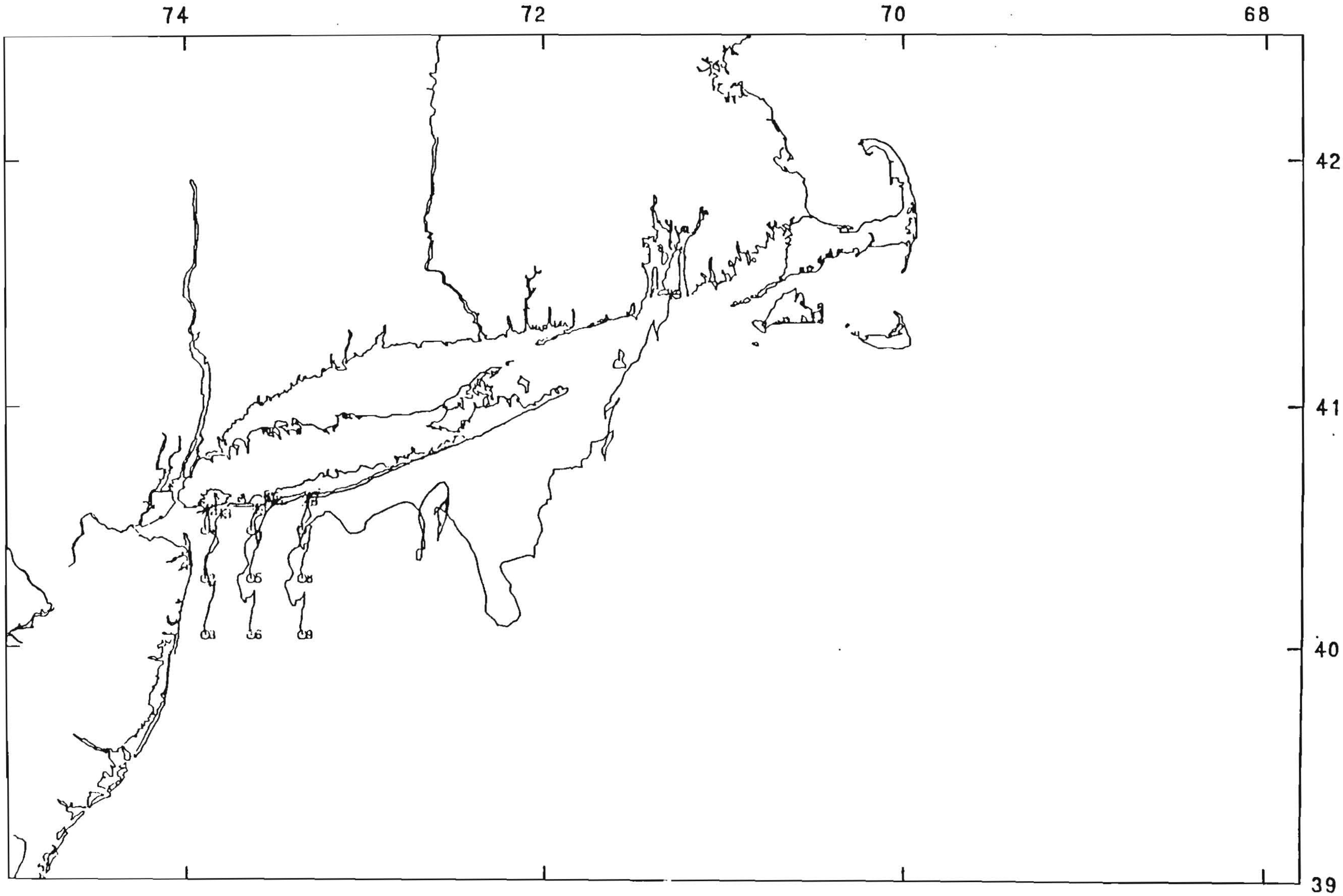

Figure 9 Medical waste trajectories assuming a release location in the New York Bight apex and releases on 16 June 1988.

This analysis suggests that the timing of waste release relative to the meteorological conditions is critical to the observed stranding of material on the southern Rhode Island coastline. This may explain why strandings have been observed at this time but not at other times, even though the New York and New Jersey coastlines were impacted (New Jersey and New York Departments of Environmental Conservation, 1988).

It is interesting to note that in the fall, spring, and winter, chances of medical debris impacting the Rhode Island shoreline from releases in the New York Bight Apex are probably minimal. This is because the mean winds during these times are generally from the west or northwest (Gilhousen et al., 1983). Combining this with the observed southwesterly mean shelf flows leads to eastward (offshore) or southwestward (alongshore) transport. In summer the mean winds are from the southwest; hence, the mean ocean currents and winds are generally opposed. Since the wind-induced flows are usually stronger than the mean ocean currents, the net transport of surface debris would be to the northeast. This analysis suggests that the likelihood of debris stranding is highest in the summer months, assuming material is released.

Conclusion

Based on the preliminary model calculations the following conclusions may be drawn: The most probable source of the medical waste observed to be stranding on the southern Rhode Island coastline in July, 1988, is the New York Bight Apex. It is impossible to be more specific about the location or the actual sources with the environmental data used for the analyses. Calculations suggest that the waste material drifts for 32-44 days between the time of release and when the material is stranded due to ocean and wind currents. The predictions indicate an approximate mid-June release date, in order for medical waste to arrive on Rhode Island shorelines by July 19-22.

Calculations using the trajectory model in the forward mode are consistent with the backward mode estimates described above. They further demonstrate that the timing of the waste release relative to the meteorological conditions was critical in transporting the debris to the Rhode Island shoreline. If the waste release occurred early in June, the debris could have been transported offshore, later in June, the material would have impacted the southern Long Island shoreline. A principal assumption here is that the release occurred over a very short period of time, such as a day.

The calculations and analyses of this study were performed under very rigid time constraints in an attempt to provide timely information to the Rhode Island Governor's medical waste task force. As such, the analyses and data sources used were selected more for ready availability than for quality. Suggested model improvements include the following:

1. Obtain wind data for offshore areas from the NOAA/National Data Buoy Center for May-July, 1988. These wind data will be more representative of actual offshore conditions, and with multiple observation points will allow some representation of the wind's spatial structure.
2. Increase the number of launch points used in the backward mode calculation. The present analysis has primarily used data from Rhode Island beach strandings as input to hindcast calculations. The data set should be expanded to include additional sightings from New Jersey, New York, Connecticut, and Massachusetts.
3. Tidal currents have been ignored in the present calculations, due to their limited contribution to offshore trajectory motions. In nearshore areas, particularly Long Island, Block Island, and Rhode Island Sounds, the tides play a more critical role in determining waste trajectories. The current data set should be augmented to include tidal circulation effects.
4. The historical offshore buoy wind records should be analyzed to determine how often the meteorological conditions necessary to transport medical wastes from the New York Bight to Rhode Island shoreline occur. Is what has recently been experienced a common or rare event?
5. A detailed comparison of trajectory model predictions with observations and with improvements in the current and wind data base will allow an improved estimate of probable release time and location. A sensitivity study could also be performed to assess the probable errors in the source location and release time.
6. For the lack of a better immediate approach, a simple wind drift calculation methodology based on oil spill modeling research was used. The literature should be searched and reviewed to assess the suitably of this approach for medical debris trajectory modeling.

Acknowledgments

In responding rapidly to a request for an analysis of this problem, ASA relied on a network of friends and colleagues who assisted us in completing the study. We gratefully acknowledge the help of: Hal Walker, EPA, Narragansett Marine Water Quality Laboratory, who provided us with the names of key information sources in New York and New Jersey; Terri Paluskiewicz and Robert LaBelle, Minerals Management Service, Branch of Environmental Modeling, who prepared and sent to us their current climatology for the area on extremely short notice; Roger Greene, Rhode Island Department of Environmental Management, who kept us up-to-date on waste material strandings; and Eric A. Meindl of the NOAA/National Data Buoy Center who prepared a summary of the offshore meteorological data. The cheerful assistance of ASA's secretarial staff under rigid time constraints is, as always, appreciated. This study was sponsored by the Rhode Island Department of Environmental Management, under the direction of Mr. Robert Bendick, Jr.

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The Medical Waste Dilemma

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Introduction

In recent years, advances in medical science have significantly improved the U.S. health care system. One of the greatest accomplishments has been the reduction and control of hospital-acquired (nosocomial) infections. Thanks to the development of stringent infection control procedures and the use of disposable medical supplies, the risk of acquiring a secondary disease while receiving treatment in a health care facility has dropped dramatically.

Yet, our health care system still has many serious challenges ahead of it. The AIDS epidemic, the aging of our citizens, the devastating effects of illegal drugs, and the safe disposal of medical waste--all place increasing demands on our health care system, at a time when government has less to spend. While it appears that Americans will struggle with these serious ills for some time to come, one major problem can be corrected immediately--our medical waste disposal crisis can be solved!

Some people have suggested that we return to the days of reusable medical supplies, in order to reduce the volume of medical waste. However, the added protection afforded our patients by utilizing sterile disposable supplies, such as syringes, virtually eliminates this option. Furthermore, extensive manpower shortages coupled with fewer health care dollars prevent a return to the days of labor-intensive re-sterilizing techniques.

As of December, 1990, Long Island's landfills will be closed for business. This harsh reality has already affected our hospitals' waste disposal plans. A majority of our region's health care providers are forced to transport their infectious waste to sites as far away as South Carolina, Wisconsin, and Canada, at a cost of $1,000 per ton. It is certain that these existing incinerators and landfills will eventually be closed to outside use.

The primary response of federal, state, and local government officials to the medical waste disposal issue has been the promulgation of a series of regulations designed to control the handling of waste as it makes its way to the final disposal location. While the basis of these rules is well-intended, the effect may be just the reverse. Financial incentives drive transporters and handlers of this waste to take shortcuts, as the cost of complying with these laws drives the price of waste removal to new heights. Unfortunately, we can't continue to look to others to solve Long Island's problems

Thus, the residents of Long Island will soon need to make some difficult decisions regarding the disposal of medical waste. While our public officials will do everything in their power to strictly control the handling and transportation of our health care system's by-products, it will take a strong public mandate to find a permanent solution to this growing problem.

The choices are relatively simple. Recycling is inappropriate for most medical waste products. The closure of our regional landfills is imminent, and shipping our waste across the country is not an alternative. In fact, it contributes to the improper disposal of medical waste. We cannot expect other states and countries to endure the additional burden of arranging for the final disposition of our waste products. The carting of medical waste across the country at astronomical prices increases the chance of accident, and raises the ante for circumventing the law

Furthermore, very few of our hospitals have incinerators, and those that exist will require costly renovations to meet New York State's new air emissions standards by 1992. Municipal resource recovery plants do not have the capacity or the legal ability to add infectious medical waste to their garbage handling systems.

The only realistic solution for medical waste disposal is a centralized, state-of-the-art, waste-to-energy incinerator that can handle all medical waste produced by hospitals, nursing homes, laboratories, clinics and physicians' offices. This way our health care providers will be able to permanently retire fifteen individual incinerators, and eliminate the need to haul our medical waste to distant disposal sites that may shut their doors at any time. Additionally, millions of dollars would be saved and the public would be assured that our medical experts would apply their stringent infection control standards throughout the entire medical waste disposal process.

Here is an opportunity for Long Island to set an example to the rest of the nation. Instead of grabbing headlines due to events such as the Islip garbage barge odyssey and closure of our beaches, we can gain respect by solving our own problems. The presence of medical waste is inevitable. The solution for safely disposing of it is available. All that is required is leadership from our elected officials, and the public's commitment to making Long Island a cleaner, safer place in which to live.

Manifest Waste: Will the Regulation of "Medical Waste" Disposal Promote Public Health and Protect the Public Shores?

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Introduction

The appearance of large amounts of debris on New York and New Jersey shorelines during the summers of 1987 and 1988, along with bacterial pollution of inshore waters of New Jersey in 1987, resulted in extensive beach closings at the height of the tourist seasons. The local fiscal and social impacts, as well as the public's perceptions of these events, are extensively discussed within the pages of these proceedings. One legal outcome related to the washup of debris during the summers of 1987 and 1988 (which may have longterm economic consequences throughout the United States) was the passage of the Medical Waste Tracking Act (MWTA) by the U.S. Congress in late 1988. The MWTA was drafted in response to the presence, amidst the rest of the summer washups, of small amounts of "medical waste" widely reported in the press as issuing from hospitals.

The nearly-hysterical atmosphere of the general public that surrounded the reporting of these phenomena in 1988 was conditioned by several factors: 1) the large number of beach closures; 2) the repetitive effect of media reporting, suggesting that the volume of medical waste was large; 3) the use of the term "hospital waste" and the mis-labeling of non-medical items as coming from medical sources, suggesting that institutional providers of medical care had skirted their current regulations and laws to dump medical waste into public waters; 4) the well-known communicability of the Acquired Immune Deficiency Syndrome (AIDS) via blood exposure and needle-stick injury, bringing the entire issue of "medical waste" on the shores; and, 5) the absence of known disease transmission by medical waste, which led to an apathy towards, and a paucity of studies on, the survivability of medically important microbes, especially hepatitis B and Human

Immunodeficiency Virus (HIV), under the particular circumstances encountered. These factors, in turn, led public health officials to qualify their remarks concerning the risk of disease transmission by needle-stick or blood exposure on the beach. The natural conclusion drawn from these factors was that hospitals and other medical care facilities were breaking the law by dumping wide varieties and large quantities of medical waste into the water (surpassing prior years) and, thereby, soiling the environment, offending people's sensibilities, and, most importantly, endangering public health.

The legislative response to this situation was the passage of the MWTA. The MWTA defines and affects "regulated medical waste" and its universe of both small and large generators. It imposes conditions on the packaging, transport, and disposal of medical waste; notably, a four-part manifest system for tracking waste from cradle-to-grave. The MWTA also prescribes very large fines and sentences on those who break the law, knowingly or otherwise. New York, New Jersey, Connecticut, Rhode Island, and Puerto Rico are in compliance with the MWTA, the latter two voluntarily. Although the MWTA has been described as a demonstration project, it is likely that some variant of this program will be applied nationally, perhaps even before the results of the two-year project are known in late 1991.

This author believes the MWTA is seriously flawed because it responds to a misidentified source of wastes and an ill-defined problem concerning the transmission of infectious diseases from these wastes. Even if Congress refrains from early passage of the MWTA as national legislation, it is unclear whether the MWTA could ever be judged unnecessary or inappropriate. It is also unclear what criteria can be used to judge its failure or success, since it is uncertain if the problem which it was designed to correct (e.g. beach washups) has any relationship to the actions mandated by the MWTA.

It has been documented that on Long Island, during the summer of 1988, the entire volume of waste labeled "medical waste" could fit into one trash bag. Furthermore, much of what was identified as "medical" in origin was actually household items, or had environmental sources. Perhaps the greatest misperception was the belief that much of the truly "medical" material emanated from legitimate medical sources, notably hospitals. Although hospitals do generate 85-90% of all medical waste in New York and New Jersey (U.S. EPA, 1989), no hospital source for any of Long Island's 1988 floatable waste was ever identified. An examination of the actual nature of the waste revealed that most of it was one-cc syringes, so-called "tuberculin" or insulin syringes, which are much more commonly used by diabetics at home or intravenous drug abusers in the community than by medical personnel for inpatients. As Dr. Swanson's paper in this volume suggests, the most likely sources of these items are from combined sewer overflows (CSO's) and from spillage of residential waste into the New York Bight. These wastes were then driven ashore by unusual wind patterns in New Jersey in 1987 and in New England in 1988.

The above explains much of the appearance of medical-type waste on the shores of these states at that time, yet it leaves the issue of public health risk unresolved. As noted earlier, it is almost certainly the threat of AIDS that elevated the pitch and lowered the quality of the debate concerning floatable pollution in 1988. Rather than merely discussing the environmental and aesthetic aspects of the debris which washed up on the beaches, emphasis by the press and the public focused on infectious aspects. This feature was worsened by the nature of the infectious hazard, i.e., AIDS with its attendant stigmata and ultimate mortality, and the difficulty faced by scientists when trying to prove that transmission cannot occur through exposure on the beach. This difficulty was magnified by the inability of public health officials and physicians to reference reliable data on the survivability of HIV and other human pathogens in the sunlight, water, temperature, and time conditions of beached sewage. In addition, there was inadequate communication between the public, the medical, and the scientific communities regarding the complex chain of events that must occur for an environmental microbe to cause disease in a human.

The series of events, known as the chain of transmission, involve various properties of the organism, the exposed host, and especially, their interaction. The organism must be present and capable of causing infection in humans and it must be present in sufficient numbers to cause both infection and disease. For HIV, information on virus survival outside the human body is limited (Resnick et al., 1986); however, it is clear that the virus is fragile and present in relatively small numbers (compared to, for example, hepatitis B virus) in human blood, with rapid inactivation once outside the body. Its precise longevity in salt water, sunlight, and surface temperatures is, however, unknown. Nevertheless, the communicability of HIV under these circumstances, if it exists, would likely be orders of magnitude less than the 0.4 percent risk of infection encountered by health care workers after injury from a needle freshly withdrawn from an AIDS patient's vein. In addition, to contract illness from an infectious agent a person must be susceptible to the agent (for HIV, probably all persons are) and exposed to it by a route that can cause infection. Merely seeing a needle and syringe with blood in it or even swimming in the same water with "medical waste" does not result in infection transmission. Similarly, even fresh AIDS-contaminated blood on intact or even abraded skin almost never results in infection. Rather, for a 0.4 percent rate of infection, fresh blood must be physically injected under the skin during the puncture. If one puts all of these improbable features together, the likelihood of developing HIV infection from washed-up needles and syringes is obviously minuscule, if not zero. Nevertheless, the public, demanding zero risk and a degree of certainty that can rarely be met in medicine, has not been reassured by the hedged pronouncements warranted by current knowledge and supposition.

Conclusion

The misidentification of the source, extent, and threat of "medical waste" that was encountered during the summers of 1987 and 1988 has resulted in legislation targeting the health care industry. Although waste disposal costs are normally borne by hospitals, physicians, dentists and the like, ultimately, the public pays for these costs. When the argument on behalf of the legislation is framed in such a way that the perceived benefit is prevention of HIV infection and AIDS, it is hard to disagree with it. However, it is less clear whether the public and regulators would so quickly accept a burden of $6-$7 per patient per day ($1988) with: 1) little or no likelihood of decreasing beach washups; and 2) no real benefit in the prevention of human disease. It is not clear whether the cost would be readily maintained solely for the aesthetic impact of the MWTA. In addition, it is uncertain if such an economic impact would truly be felt. There is no doubt that illegal dumping occurs and there is no denying the revulsion felt by all who encounter such material in what is supposed to be the pristine environment of the beach. But the discussion needs to be framed in these terms, and not in the form of its health benefits. Finally, all of the debate and activity associated with the MWTA and all of the money expended to be in conformity with the MWTA ignores the more pressing, and almost certainly more beneficial, programs dealing with municipal solid waste and sewage waste disposal, and the prevention and treatment of intravenous drug abuse.

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The Public Health Implications of Floatable Wastes in the Ocean

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Introduction

This paper focuses on three areas: the public health implications of floatable marine debris and medically-related waste; the actions undertaken by the Suffolk County Department of Health Services (SCDHS) to address the floatable waste problem; and the safety of Suffolk County's bathing waters and shellfish.

In this respect, it is important to reflect upon the experiences of the SCDHS in handling the massive pollution problems of 1976 and the floatable episodes in 1988. On June 14, 1976, the SCDHS became aware of massive deposits of sludge-like materials and marine debris on the beaches of Fire Island, New York, and the south shore of Long Island. Inspection revealed that the following materials were deposited over a 20-mile stretch of shoreline: thousands of sludge- or tar-like grease balls; personal hygiene items; burnt wood; and miscellaneous garbage items.

The operators of these beaches were informed of these findings and asked to prohibit swimming at all beaches. In the meantime, samples of the deposited tar balls and adjacent seawater were sent to the public health laboratories for testing. Bacteriological examination was performed by Suffolk County, New York State, and the U.S. Environmental Protection Agency (U.S. EPA) laboratories.

As is known, coliform organisms can be found in humans, animals, and plants. It is estimated that between 10-15 percent of all coliforms originate in the gastrointestinal tract of humans and animals. For this reason, coliforms are often indicative of fecal contamination. Examination of the sludge-like material revealed extremely high coliform counts, in the millions. However, the seawater from the various beaches, exclusive of the sludge-like material, was actually within the recommended standards of the New York State Sanitary Code. Based on these findings, the SCDHS indicated to the beach operators that waters were bacteriologically safe for swimming, and the opening of the beaches was contingent on their clearing and raking of the beach areas.

The federal and state agencies were actively involved in determining the source of pollution and the route of transmission. A comprehensive report of Long Island beach pollution was published in 1977 by the National Oceanic and Atmospheric Administration (NOAA), in cooperation with the U.S. EPA and the U.S. Coast Guard (USCG).

Regarding the 1988 deposits of medically-related debris on Long Island beaches, it should be emphasized that the likelihood of disease transmission from syringes or needles is extremely remote for the following reasons:

- The biological samples may be free of pathogenic organisms;
- If the biological samples were contaminated, the physical and chemical stresses to which these organisms might have been subjected during transfer would most probably kill the infecting pathogens;
- The dilution effect and the movement of the seawater would drastically reduce the infective dose.

It should be noted that epidemiologic surveillance during the 1976 and 1988 pollution episodes did not reveal any increase in the incidence of Hepatitis A or any gastroenteric infections which could be attributed to the beach pollution.

Shellfish sanitation study

Of importance is the SCDHS study of shellfish sanitation, conducted in cooperation with the U.S. EPA in the Great South Bay. In the late 1970's, several areas in the Great South Bay were closed to clamming because they did not meet the recommended standards. Recognizing the economic threat to the shellfish industry, local baymen prevailed upon neighboring towns to challenge, in court, the validity of the present criteria as enforced by the State of New York and the federal government.

The Suffolk County Legislature and the County Executive, in turn, asked the SCDHS to review the shellfish sanitation program criteria, the enforcement procedures, and to study the health effects resulting from the consumption of raw shellfish.

In no way was the study intended to challenge the current standards or to validate present enforcement procedures. Rather, it was intended to explore several microbiological, epidemiological, and public health components in the shellfish sanitation program. The study began in 1978 and continued for several years as a joint project between the SCDHS and the Marine Health Research Field Station of the U.S. EPA in West Kingston, Rhode Island. The objectives of the investigation were:

1. To study the bacterial contaminants in the seawater samples collected from selected, approved, conditional, and unapproved areas in the Great South Bay;
2. To study the bacterial and viral contaminants of shellfish samples collected from the same areas;
3. To compare the bacterial contaminants of surface and bottom seawater samples;
4. To study the correlation between the bacterial indicators in the seawater and the bacteriological status of shellfish samples collected from the same areas;
5. To study the effect of several variables, including temperature, rainfall, time, day, season, and others, on several of the bacterial indicators; and
6. To compare the health effects resulting from the consumption of raw clams dug from approved waters with varying bacterial counts to those effects resulting from the consumption of clam chowder by a control group.

Study design

Three areas were selected for testing in the Great South Bay. One area was closed for clamming because of its proximity to major sources of contamination; namely, point sources from sewage treatment facilities and storm runoff drains. Another area, not directly contaminated from point sources and periodically open for clamming, was selected to represent the conditionally open areas. A third area known for its low level of contamination was chosen to represent the open areas.

Seawater samples were taken at approximately 300 meter intervals on a grid system. Seawater samples were taken at approximately 15 centimeters (cm) below the surface, and above the sediments Shellfish samples were collected from the same areas at the same time, and were examined for the same organisms as the seawater samples.

Bacteriological testing was performed in the U.S. EPA Laboratory in West Kingston, Rhode Island, and in the Suffolk County Public Health Laboratory in Hauppauge, New York. Monitoring of the total and fecal coliforms in selected open water areas indicated that the bacterial counts for both the total and fecal coliforms remained below recommended guidelines for open areas.

The traditional guidelines were utilized. The current regulations require that the bacteriological quality of the overlying shellfish water meet one of the following criteria:

1. The coliform median of the samples shall not exceed 70 per 100 milliliters (mls) of seawater, and not more than 10 percent of the samples exceed 230 per 100 mls.
2. The fecal coliform median of the samples shall not exceed 14 per 100 mls, and not more than 10 percent of the samples exceed 43 per 100 mls.

Microbiological testing was also performed for the identification of the following organisms (qualitatively, and, whenever possible, quantitatively):

1. Aerobic plate count
2. Total coliforms

3. Fecal coliforms

4. *Escherichia coli*

5. *Aeromonas*

6. *Clostridium perfringens*

7. *Vibrio parahaemolyticus*

8. Vibrio species

9. Enterococci: *Streptococcus faecalis, Streptococcus faecium, Streptococcus bovis, Streptococcus avium*

10. Bifido bacteria

11. *Candida albicans*

12. Salmonella

Comparisons were made between the bacterial counts in the closed, conditional, and approved areas; between surface and bottom seawater samples; and between the bacterial counts in the seawater samples and the clams collected from the same areas. In excess of 1,000 seawater and shellfish samples were collected and examined for bacterial contaminants. A subsample of shellfish was examined for viral contaminants by Dr. Joseph Metcalf, of the University of New Hampshire.

The following tables compare the bacterial counts in the approved and unapproved areas for both surface and bottom seawater samples, and also for clams dug from the same areas.

Monitoring of the total and fecal coliforms in selected open, conditional, and closed areas indicated that the bacterial counts for both the total and fecal coliforms remained below the recommended guidelines for open areas. For conditional areas, and to a great extent for closed areas, the levels were below the recommended levels for extended periods, with the exception of an occasional spike. In some closed areas, both total and fecal coliforms were far below the recommended levels, especially during the latter part of the summer and early fall, 1988.

Using the guidelines recommended previously by the U.S. Food and Drug Administration of a maximum aerobic plate count of 500,000/G and a maximum fecal coliform count of 230/100G, it was found that 99.3 percent of the clam samples obtained from approved areas and 100 percent of the clam samples obtained from unapproved areas met the aerobic plate count limit. The corresponding figures for the fecal coliform limits in approved and unapproved areas were 95.8 percent and 97.2 percent, respectively.

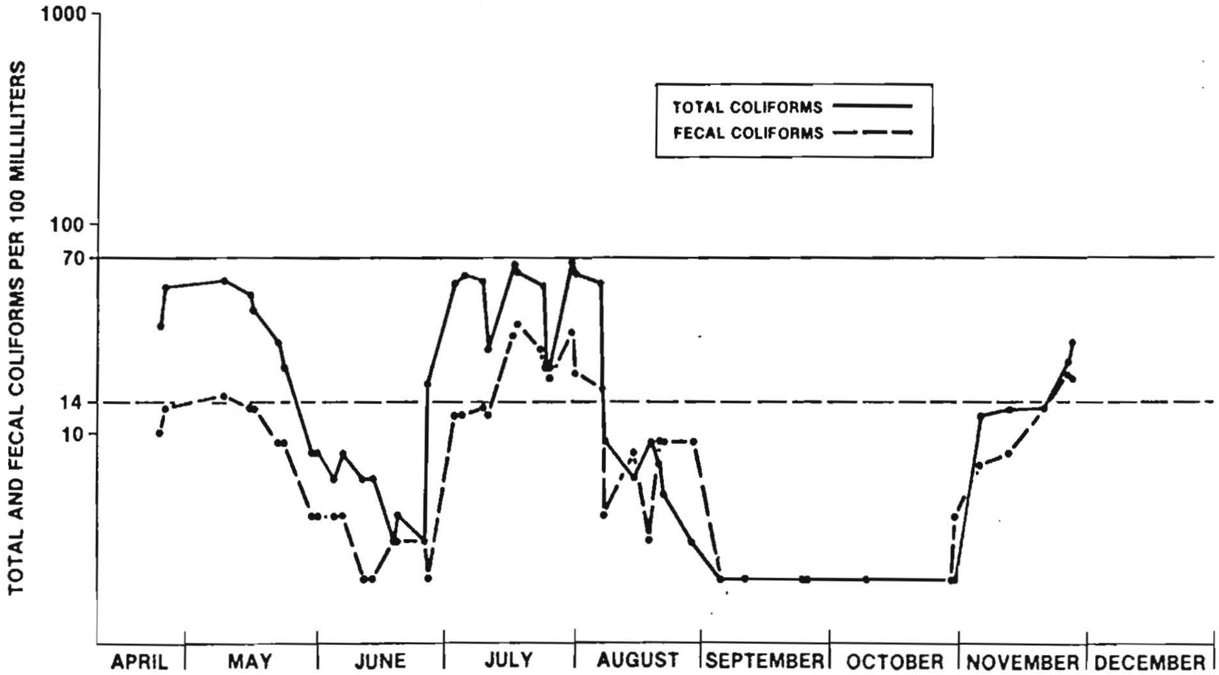
Although the seawater samples from the approved areas seemed to be less contaminated than those from unapproved areas, the clams did not follow the same pattern. As a matter of fact, the comparison of bacterial counts in the clams dug from approved and unapproved areas was rather striking. In addition, the investigation included a study of the health effects resulting from the consumption of shellfish with varying bacterial counts.

Many of the microbiological standards that have been adopted or proposed for recreational waters, perishable foods, or shellfish have not been fully supported by epidemiologic studies of the health effects on human populations. Some standards were based on risk factors or criteria that were applicable several decades ago, and are antiquated. The lack of health effects studies precipitated the frequent challenges of the validity of the current standards or guidelines.

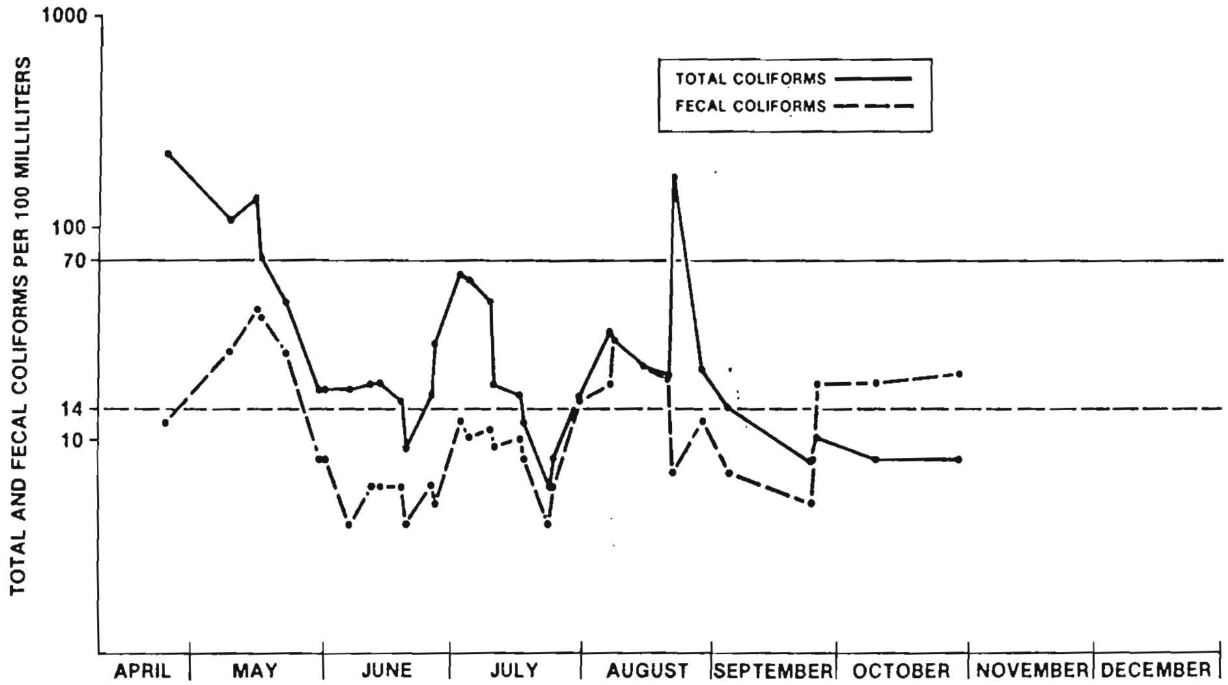
The ideal study design in a situation such as this would be to take several hundred volunteers, divide them at random into several groups or strata, and have them eat clams collected from waters with different coliform counts or other bacterial indicators. Volunteers would be followed for a pre-determined period, and any health effects recorded. A decision would then be made of the count or counts that would provide a reasonable degree of protection.

Needless to say, the various ethical and legal problems that might have been involved in this study design made this type of approach impossible. The only reasonable alternative was to collect clams from certified areas, examine them for various indicators, and compare the health effects in volunteers following the consumption of these clams with those in another group of volunteers, asked to eat clam chowder and serve as controls.

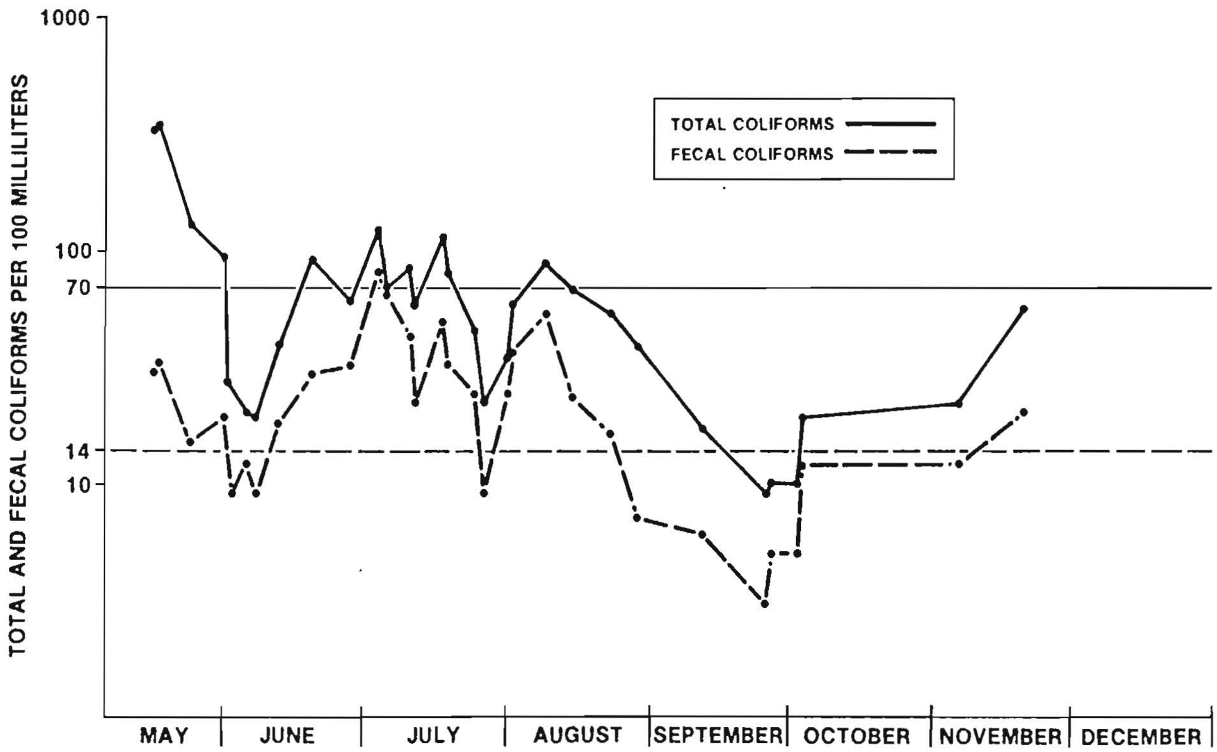
OPEN AREAS
TOTAL AND FECAL COLIFORMS IN SURFACE WATER

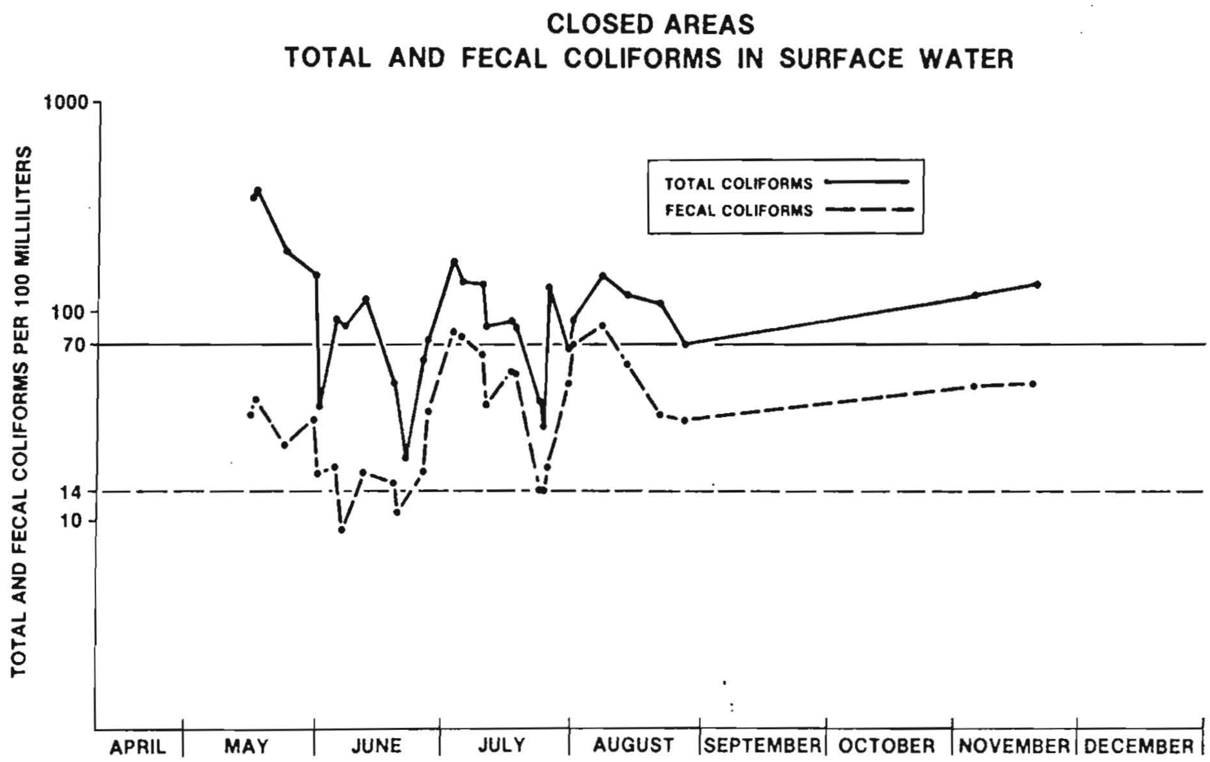


CONDITIONAL AREAS
TOTAL AND FECAL COLIFORMS IN SURFACE WATER

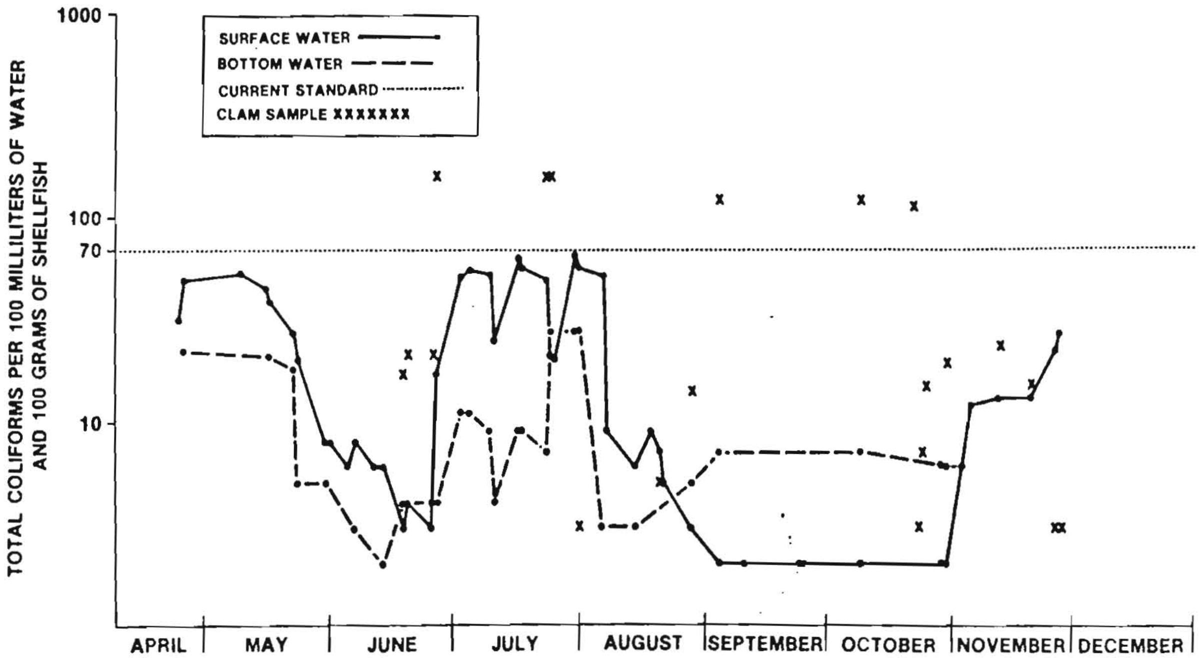


AREA E1 (CLOSED)
TOTAL AND FECAL COLIFORMS IN SURFACE WATER

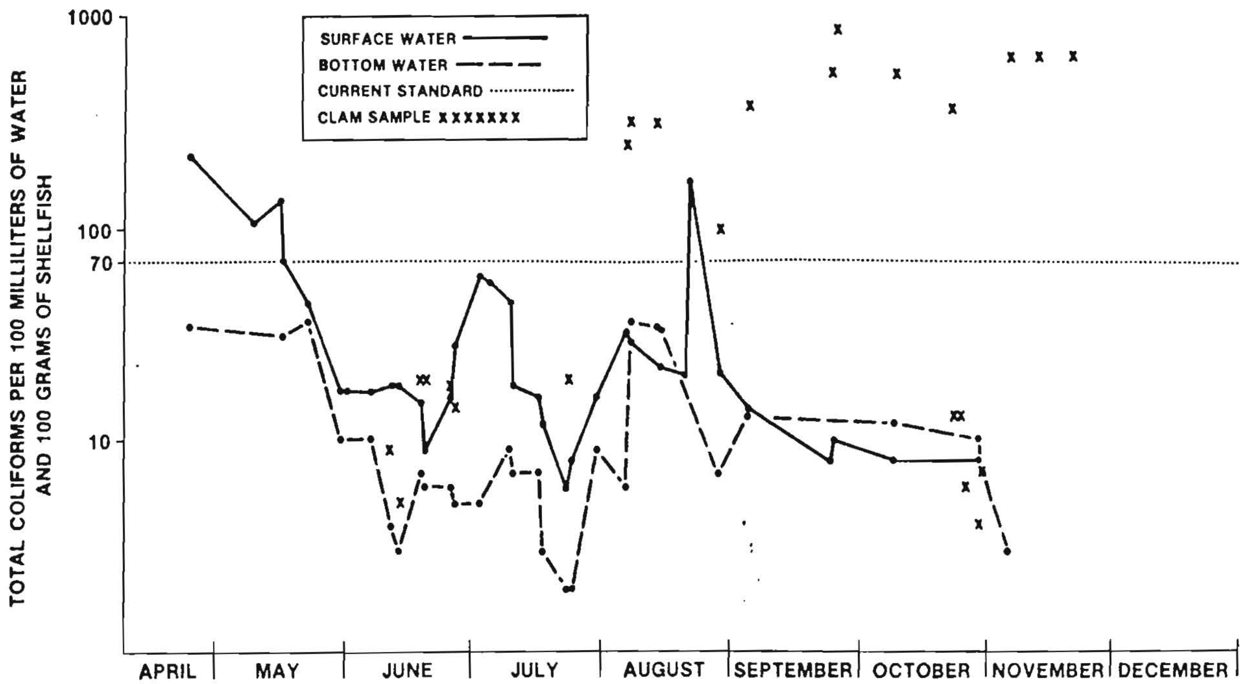



CLOSED AREAS
TOTAL AND FECAL COLIFORMS IN SURFACE WATER
TOTAL AND FECAL COLIFORMS PER 100 MILLILITERS
1000
100
70
14
10
TOTAL COLIFORMS
FECAL COLIFORMS
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

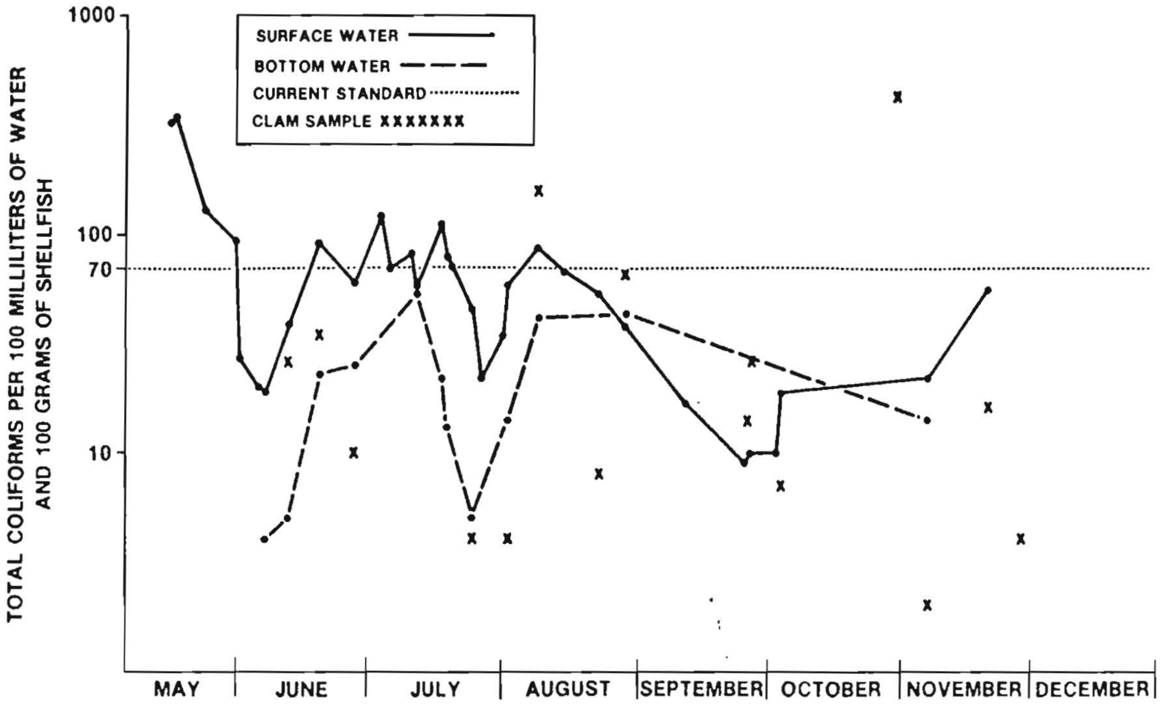
APPROVED AREAS
TOTAL COLIFORM COUNTS IN SURFACE AND BOTTOM WATER SAMPLES AND IN SHELLFISH



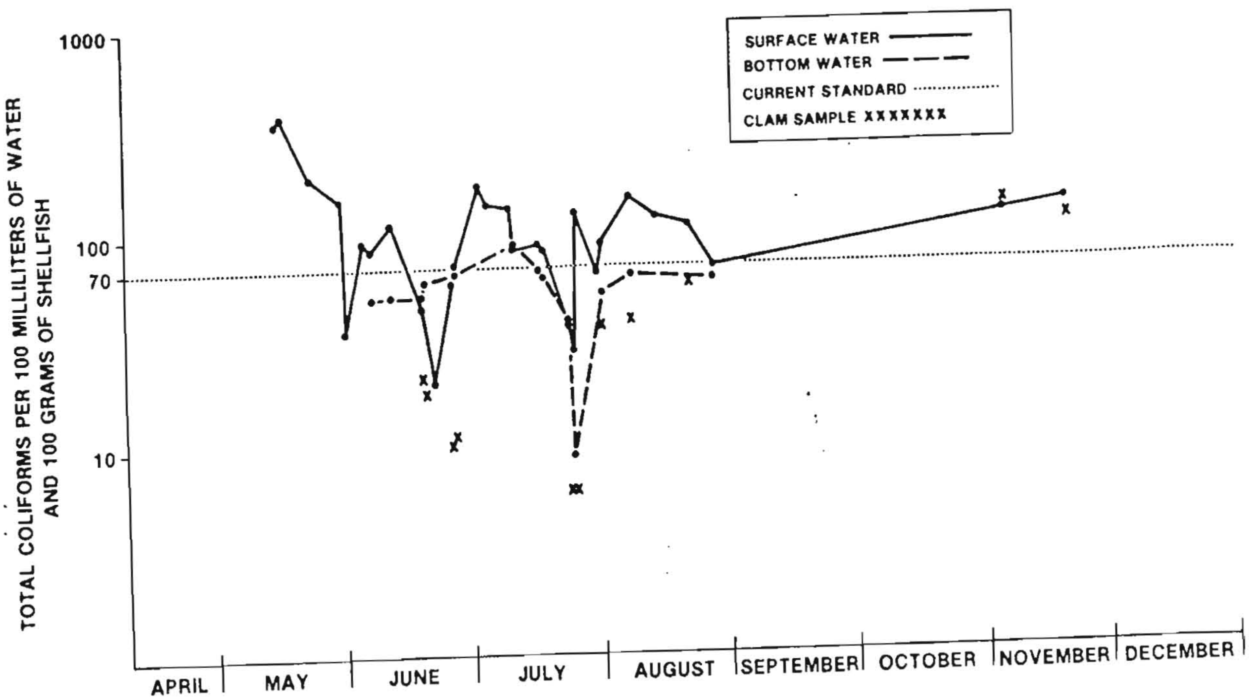
CONDITIONAL AREAS
TOTAL COLIFORM COUNTS IN SURFACE AND BOTTOM WATER SAMPLES AND IN SHELLFISH



AREA E1 (CLOSED)
TOTAL COLIFORM COUNTS IN SURFACE AND BOTTOM WATER SAMPLES AND IN SHELLFISH



CLOSED AREAS
TOTAL COLIFORM COUNTS IN SURFACE AND BOTTOM WATER SAMPLES AND IN SHELLFISH



COMPARISON OF THE AEROBIC PLATE COUNT BETWEEN THE APPROVED AND THE UNAPPROVED AREAS*

BACTERIAL COUNT **	SURFACE WATER		BOTTOM WATER		CLAMS	
	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED
LESS THAN 10.000	80.3	88.4	86.3	93.2	93.5	90.5
10,000–	100	99.6	98.0	98.6	100	98.5
100,000–		100		100		99.3
500,000+			100			100

* THIS COMPARISON IS BASED ON 677 SAMPLES. FIGURES INCLUDED IN THE TABLE ARE CUMMULATIVE RELATIVE FREQUENCIES.

** BACTERIAL COUNTS ARE PER 100 ML OF WATER OR 100 GM OF CLAMS.

COMPARISON OF THE TOTAL COLIFORMS
BETWEEN THE APPROVED AND THE UNAPPROVED AREAS*

BACTERIAL ** COUNT	SURFACE WATER		BOTTOM WATER		CLAMS	
	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED
0-14	37.1	66.9	53.4	81.6	42.2	48.2
15-43	57.8	85.8	69.0	93.1	64.0	69.4
44-70	61.2	88.2	75.9	93.1	80.0	78.8
71-230	82.8	94.9	91.4	97.7	88.9	82.9
231-1100	97.4	98.5	96.6	100	93.3	89.4
> 1100	100	100	100		100	100

* THIS COMPARISON IS BASED ON 971 SAMPLES. FIGURES INCLUDED ARE CUMMULATIVE RELATIVE FREQUENCIES.

** BACTERIAL COUNTS ARE PER 100 ML OF WATER OR 100 GM OF CLAMS.

COMPARISON OF THE FECAL COLIFORMS BETWEEN THE APPROVED AND THE UNAPPROVED AREAS*

BACTERIAL COUNT **	SURFACE WATER		BOTTOM WATER		CLAMS	
	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED
0-14	52.2	84.2	72.4	96.6	73.3	71.4
15-43	75.7	95.1	86.2	97.1	82.2	89.9
44-70	80.9	96.8	91.4	98.3	93.3	91.7
71-230	92.2	99.3	100.0	99.4	97.7	95.8
231-1100	100.0	100.0		100.0	100.0	100.0

* THIS COMPARISON IS BASED ON 971 SAMPLES. FIGURES INCLUDED ARE CUMMULATIVE RELATIVE FREQUENCIES.

** BACTERIAL COUNTS ARE PER 100 ML OF WATER OR 100 GM OF CLAMS.

COMPARISON OF THE ESCHERICHIA COLI BETWEEN THE APPROVED AND THE UNAPPROVED AREAS*

BACTERIAL COUNT**	SURFACE WATER		BOTTOM WATER	
	UNAPPROVED	APPROVED	UNAPPROVED	APPROVED
0–14	59.7	88.3	70.9	88.3
15–43	81.8	97.4	92.7	98.2
44–70	87.0	98.5	98.2	98.8
71–230	98.7	99.6	100	100
240–420	100	100		

* THIS COMPARISON IS BASED ON 568 SAMPLES. FIGURES INCLUDED ARE CUMMULATIVE RELATIVE FREQUENCIES.

** BACTERIAL COUNTS ARE PER 100 ML OF WATER.

Selection of volunteers

The main criteria for volunteer selection was to recruit individuals who could be reached in large numbers, in a few sites, and who would be amenable to follow-up. For this reason, several colleges, various municipal agencies, and a few industrial plants were contacted and informed of the purpose of the study. Administrative approvals were requested, and the study was approved by the Human Research Review Committee. The acceptability of volunteers in the study was contingent upon their willingness to eat raw clams or clam chowder, on the absence of history of allergic reactions to clam consumption, on their willingness to report any sickness during a follow-up period of two months, and, if need be, to provide biological samples.

Volunteers were divided at random into two groups:

- The first group was fed clams harvested from approved growing areas which meet the current federal shellfish guidelines;
- The second group was fed commercially-canned clam chowder and was used as a control.

In order to encourage participation in the study, several articles appeared in newspapers, and notices and official memoranda were distributed. The first group of participants, consisting chiefly of New York State and Suffolk County employees, were fed at two locations, the New York State Office Building in Hauppauge, and the County Center in Riverhead. The second and third feedings at the Suffolk County Community College and the State University of New York at Stony Brook consisted of college and medical school students, and teaching and administrative staff.

Clams for the feeding programs were harvested under the supervision of New York State Department of Environmental Conservation (NYSDEC) officers, to ensure adherence within the boundaries of designated, approved growing areas. The shellfish were subsequently transported by SCDHS staff to a refrigerated storage facility where monitoring by the Department continued until preparation for serving.

The clams, "Cherrystones" and "Little Necks," were removed from refrigerated storage, rinsed with running water, and placed on potable chopped ice. Experienced clam openers selected from the SCDHS staff and other agencies followed the normal, acceptable practices in the preparation of the shellfish for human consumption without cooking. The clams were opened with clam knives that were stored in a sanitizing solution. After opening, the clams were placed on the-half-shell on metal trays from which serving plates were filled.

The clam feeding consisted of six to eight raw clams served as an appetizer on a single-service plate, with an individual serving of commercially-prepared cocktail sauce and a wedge of lemon. For the control group, eight ounces of heated, commercially-prepared clam chowder was served in a single-service cup.

In order to receive a plate of clams or a container of chowder, the participant was first asked to submit a signed consent form and to complete a pre-feeding questionnaire for background health information The purpose of the questionnaire was to determine the participant's past and recent medical history, with emphasis on allergies, gastrointestinal problems, and viral hepatitis

When served, the participant was also given a post-feeding questionnaire to be filled out after seventy-two hours. The questionnaire was designed to confirm the number of clams actually eaten by the individual, and to determine the incidence of gastrointestinal symptoms among participants during the seventy-two hour post-feeding period.

Arrangements were made to facilitate the collection of the follow-up questionnaires at the locations where the individuals were fed. In addition, telephone calls were made to those who did not return the follow-up questionnaire. A final eight-week post-feeding questionnaire was mailed out to determine the incidence of hepatitis or any other related disease.

Results of the study

Of the 929 volunteers who were fed raw clams, 572 (61.6%) completed and returned the seventy-two hour follow-up questionnaire, as compared with 145 (46.6%) of the 311 control individuals who ate clam chowder. The incidence of illness among the experimental group was 4.4%, as compared with 9.0% among the control group. The most frequently encountered symptoms reported by those who ate raw clams were, in descending order: upset stomach, cramps, diarrhea, nausea, and fever. In the control group, diarrhea was the most common symptom, with cramps and nausea accounting equally for the remainder.

Of the 379 (40.8%) of the experimental group who returned the eight-week follow-up questionnaire, 39 (10.3%) reported a gastrointestinal illness during the period. Of the 83 (26.7%) of the control group who returned the eight-week questionnaire, 9 (10.8%), reported a gastrointestinal illness. No cases of Hepatitis A occurred among either group.

Quantitative bacteriological examination of the clams from the various bushels revealed that the coliform counts were quite low, with the exception of four. Two lots contained 260 and in excess of 4800 total coliforms per 100 gm, and two had fecal coliform counts of 16 and 26 per 100 gm of clams. No correlation was found between the bacterial counts of clam samples collected from individual bushels at the time of feeding and the incidence of illness among people who ate clams from those bushels.

Of the 40 volunteers who consumed raw clams from the bushel with total coliforms in excess of 4800, only 1 (2.5%) experienced gastrointestinal symptoms, while 3 of the 95 (3%) who ate clams with total coliforms of 260/100 gm became ill within the seventy-two hour follow-up period. In other words, the incidence of gastrointestinal illness was practically the same whether the coliform count was 260 or in excess of 4800/100 gm of clams. Among the volunteers who ate clams which had 16 fecal coliforms per 100 gm, 1 of 49 (2.0%) developed symptoms as compared with 3 of 61 (4.9%) among those who ate clams with fecal coliform counts of 26/100 gm.

Conclusion

It is important to answer a frequently addressed question: "Are Suffolk County beaches and the shellfish industry safe?" As long as the SCDHS surveillance and testing programs are not compromised, my answer as a public health official is an absolute and unquestionable yes.

CLAM FEEDING STUDY

72 HOUR FOLLOW-UP

	NO. OF PARTICIPANTS	RETURNED FORM	SICK	ATTACK RATE
CLAMS	929	572 (61.6%)	25	4.4%
CONTROLS	311	145 (46.6%)	13	9.0%

CLAM FEEDING STUDY

8 WEEK FOLLOW UP

	NUMBER OF PARTICIPANTS	RETURNED FORM	SICK	ATTACK RATE
CLAMS	929	379 (40.8%)	39	10.3
CONTROLS	311	83 (26.7%)	9	10.8

New York City Department of Environmental Protection Water Quality and CSO Abatement Program

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Introduction

The New York City Department of Environmental Protection (NYCDEP) is responsible for the quality of the water supply, waste water collection, and waste water treatment for the approximately seven million people living in the five boroughs of New York City. The Department owns and operates 14 sewage treatment plants throughout New York City and assesses the effectiveness of its water pollution control activities each year by measuring pollutant concentrations in the New York Harbor. This pollution assessment program is called the New York Harbor Water Quality Survey (NYHWQS), and has been performed yearly since 1909. This program demonstrates that agencies, responsible for protection of public health since the turn of the century, were cognizant of the fact that water quality needs to be studied and the condition of area water requires close observation.

The NYCDEP is very fortunate to have inherited the NYHWQS database of water quality parameters compiled since 1909. A new report is assembled each year to document the year's findings, long-term trends, and levels of compliance with the New York State Department of Environmental Conservation (NYSDEC) water quality standards. The NYHWQS, in conjunction with the Plant Operations Report, details how water quality, as measured by conventional parameters, has changed as a result of NYCDEP operations pursuing the goals of the Water

Pollution Control Act (WPCA). Additional benefits of the program include a potential public health warning system and a predictive basis on which to adjust future operations. Project data are also used in assessing the attainability of present or proposed regulations and standards.

Figure 1 shows the Hudson-Raritan Estuary, the locations of the area water pollution control plants, and the 52 water quality monitoring stations in the Harbor. The Harbor is a complex and fascinating body of water consisting of interaction between the fresh water of the Hudson River, the tidal salt front of the Atlantic Ocean, and the exchange with the Long Island Sound. Bodies of water are classified by the NYCDEC, which sets water quality standards according to usage classifications. Two important parameters are dissolved oxygen (DO) and coliform bacteria. Oxygen is essential to aquatic life and for the aesthetic well-being of the water, while coliform bacteria standards are set as indicators to protect public health for contact recreation and the seafood consumption.

Figure 2 presents historical data from 1909-1986 for the branches of the East River. The data plotted represent average summer percent saturation levels of DO in the water column. It is evident that there was a decline in water quality throughout the mid-century, with less than 50% saturation levels. Significant upward trends in saturation levels are observed since the 1970's, corresponding to a major program of construction and upgrading of Water Pollution Control Plants (WPCPs) to secondary treatment.

A more detailed presentation for DO and coliform data from 1970-1989 is shown in Figures 3, 4 and 5. The improvement in harborwide water quality is evident in increasing oxygen levels and decreasing coliform bacteria levels. The NYSDEC standards are indicated for comparison. Eventually all harbor water may be required to meet primary contact levels, which correspond to the "swimmable and fishable" goals of the WPCA. In 1988, 63% of the 52 sampling stations had average top and bottom DO levels which met the NYSDEC standards. Harborwide, 87% and 98% of all stations were in compliance with both the average and chronic stipulations of the New York State standards for total and fecal coliform, respectively. Significant improvements in coliform levels in the Hudson River and lower East River resulted from the start

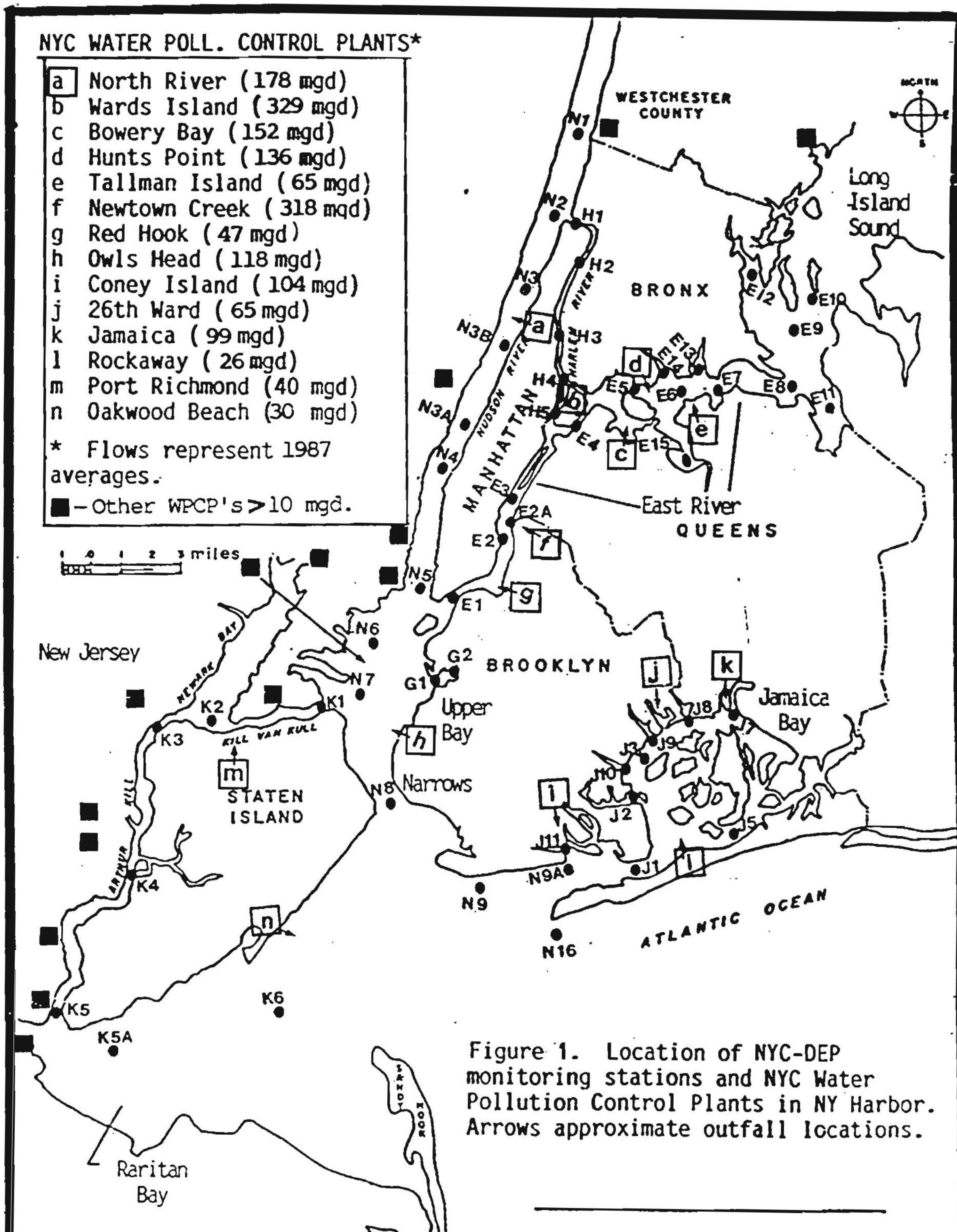


Figure 1. Location of NYC-DEP monitoring stations and NYC Water Pollution Control Plants in NY Harbor. Arrows approximate outfall locations.

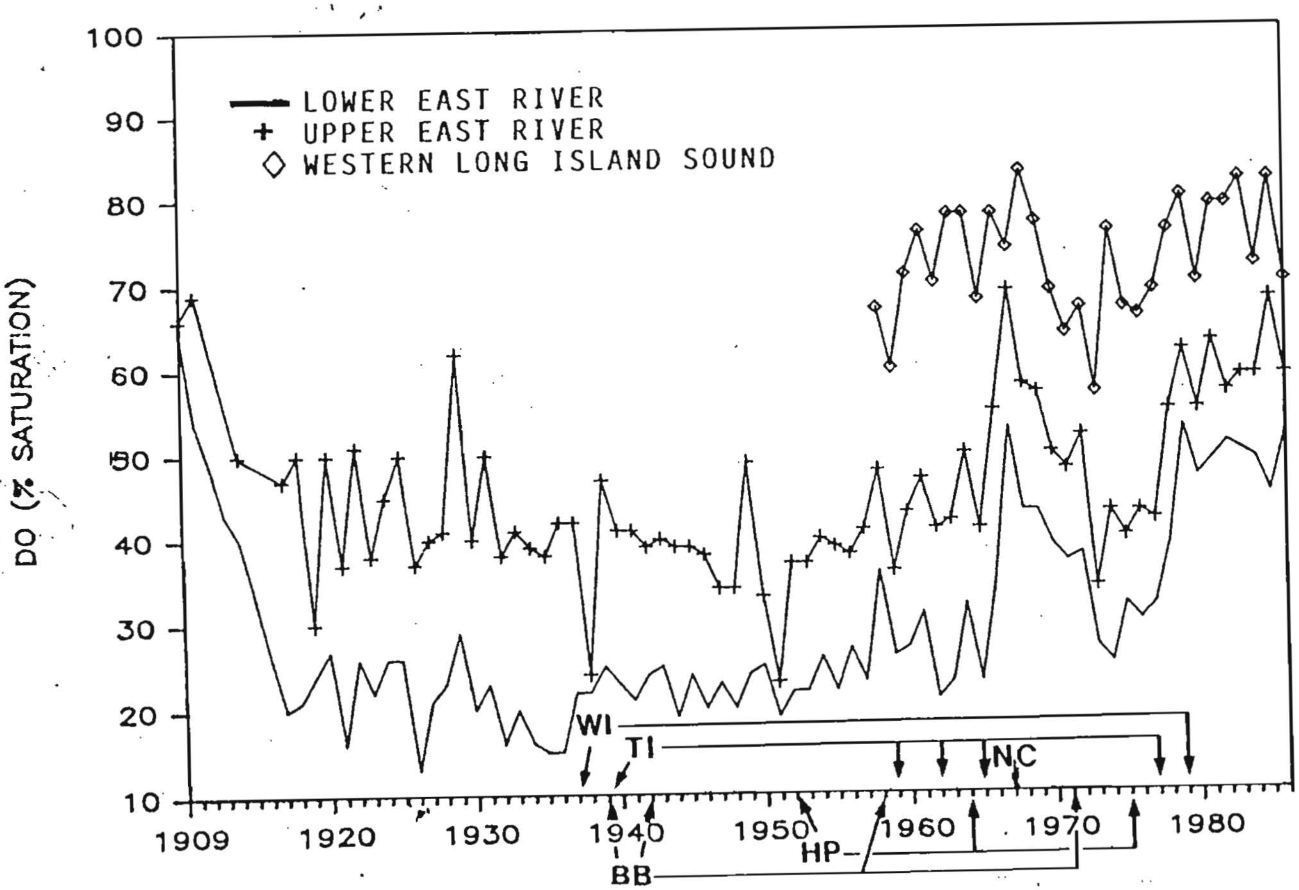


Figure 2. Average summer dissolved oxygen percent saturation for three Harbor branches, from 1909 through 1986. Construction of and significant upgrades to NYC WPCP's on the East River are also depicted: WI=Wards Island, TI=Tallman Island, BB=Bowery Bay, HP=Hunts Point, and NC=Newtown Creek.

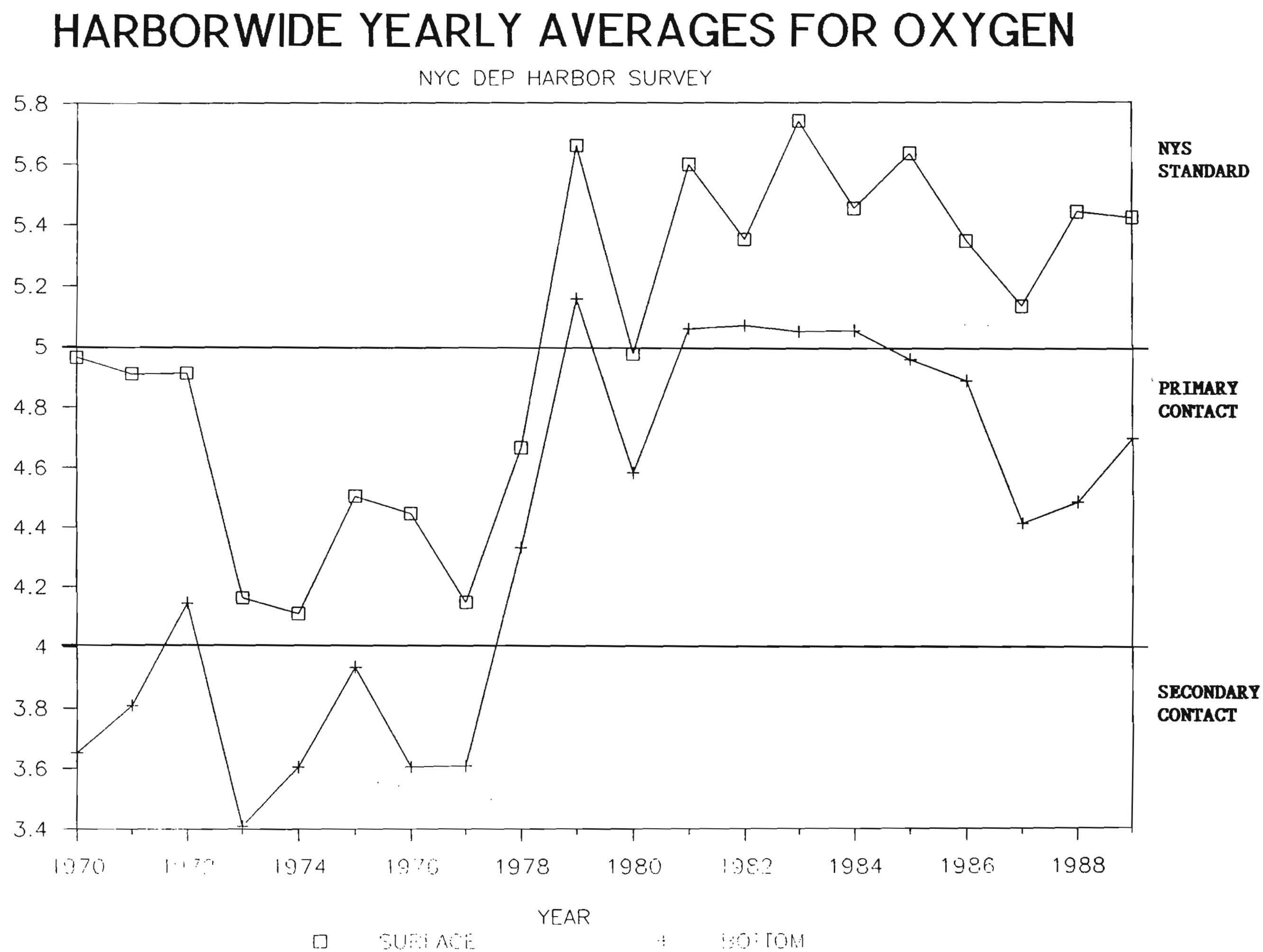

HARBORWIDE YEARLY AVERAGES FOR OXYGEN
NYC DEP HARBOR SURVEY
DISS.OXYGEN (MG/L)
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
1970
1974
1978
1980
1984
1986
1988
YEAR
NYS STANDARD
PRIMARY CONTACT
SECONDARY CONTACT

Figure 3.

HARBORWIDE AVERAGE TOTAL COLIFORMS

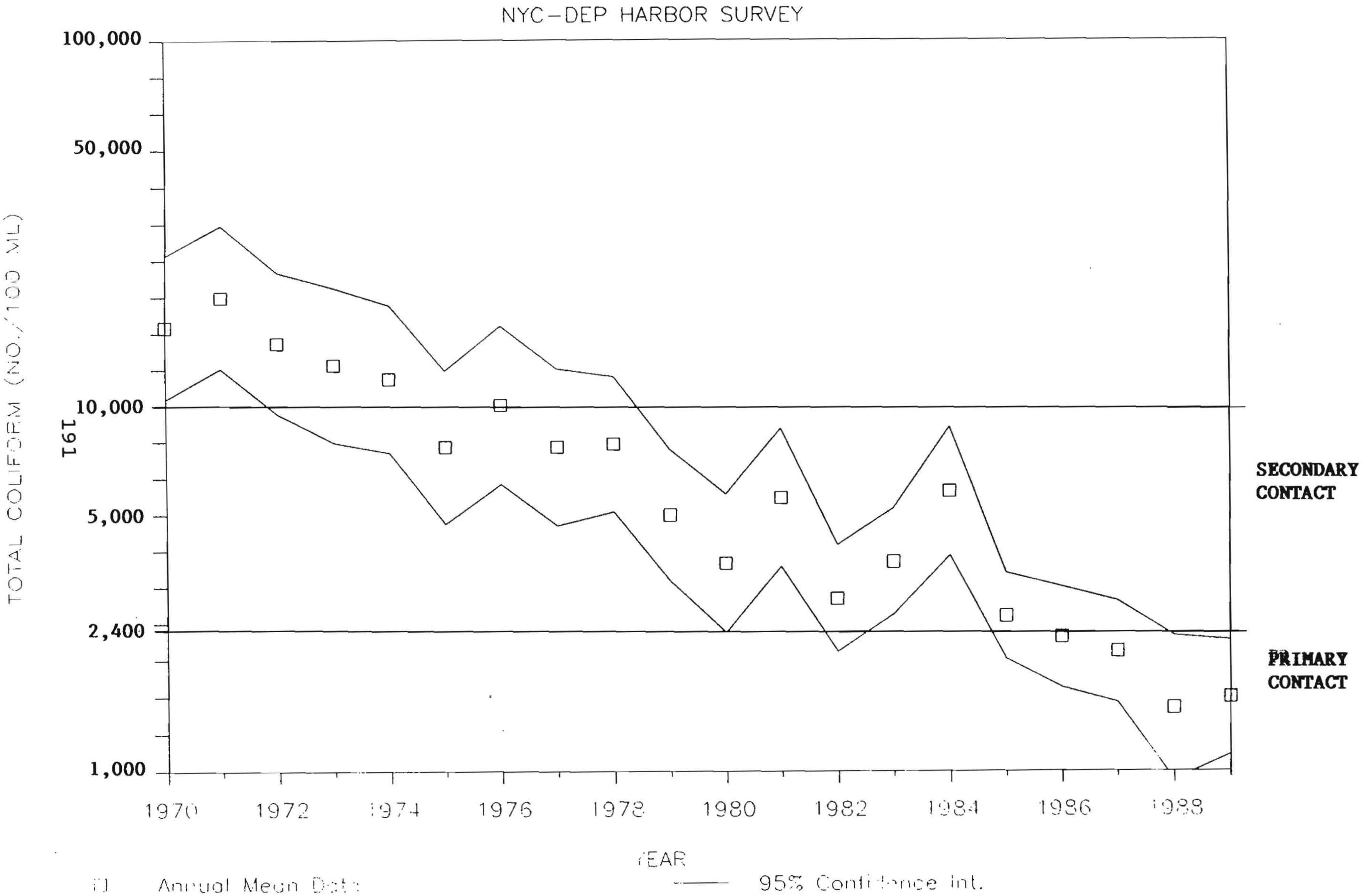


Figure 4./

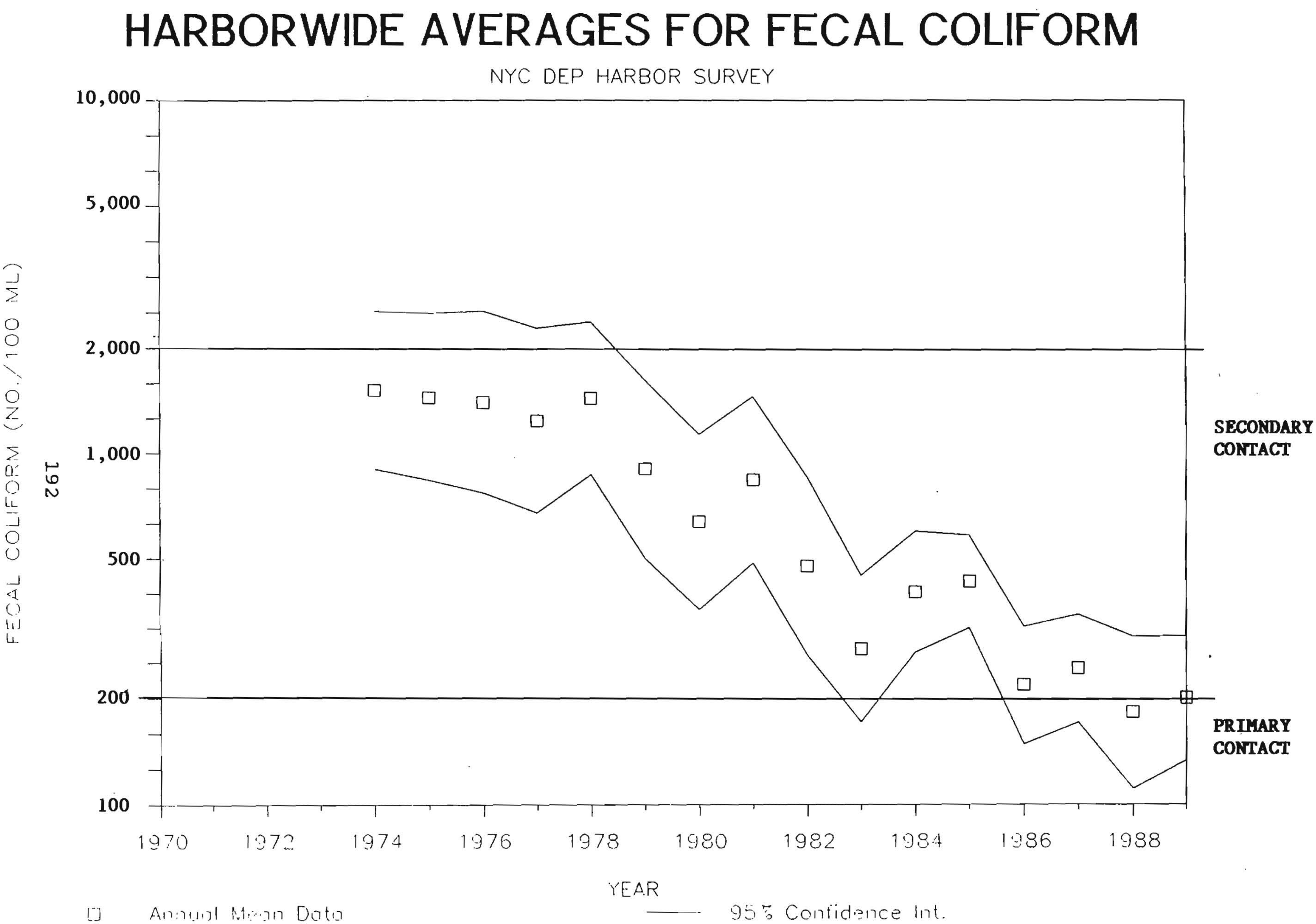
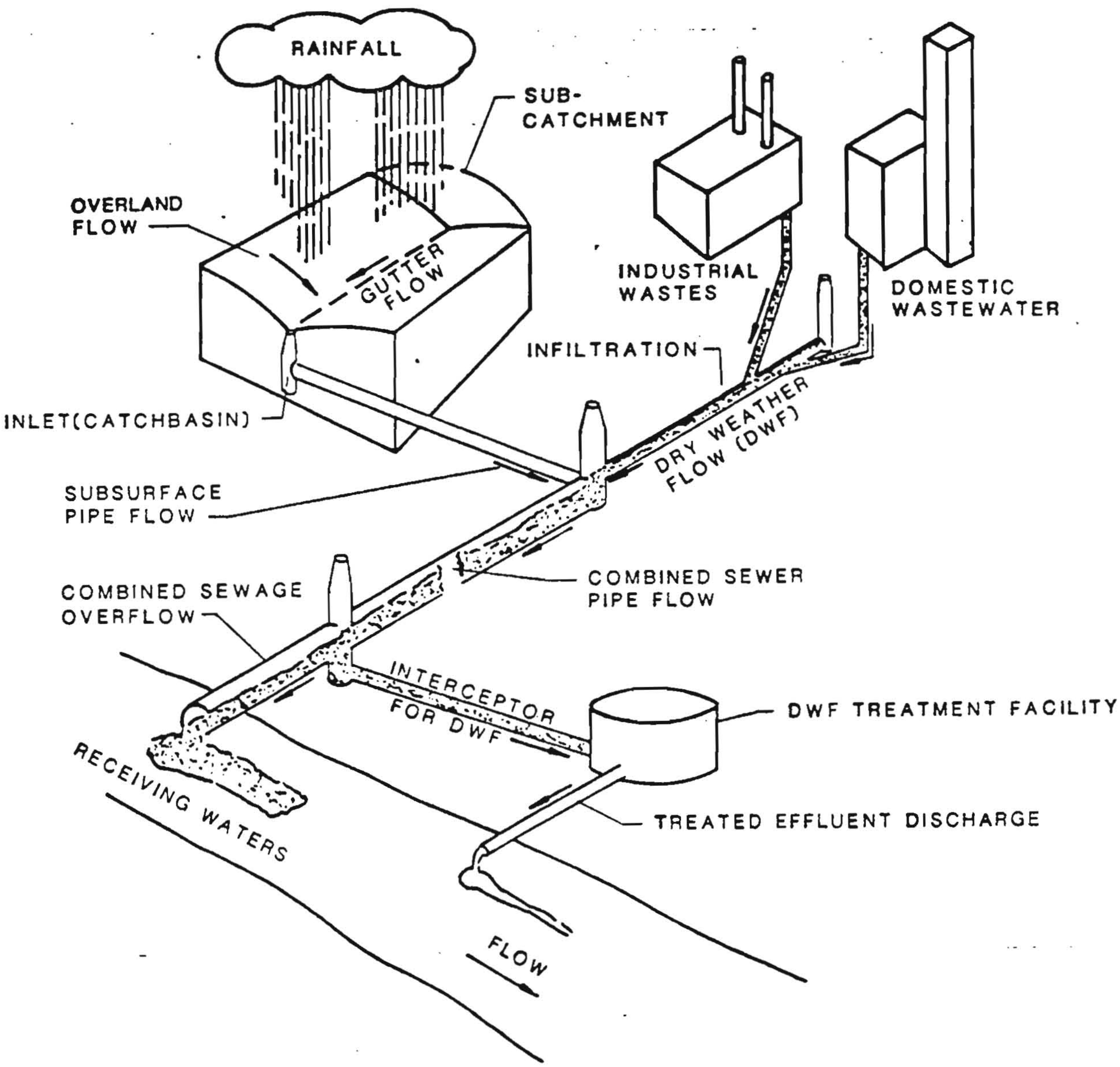

HARBORWIDE AVERAGES FOR FECAL COLIFORM
NYC DEP HARBOR SURVEY
FECAL COLIFORM (NO./100 ML)
10,000
5,000
2,000
1,000
500
200
100
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
YEAR
SECONDARY CONTACT
PRIMARY CONTACT
Annual Mean Data
95% Confidence Int.

Figure 5.

Figure 6.



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SCHEMATIC OF RAINFALL-RUNOFF-COMBINED SEWER OVERFLOW indicated is largely a matter of judgment about the estimated relative risk of disease transmission. This is necessary, since there are no reasonable tests to allow objective identification of infective waste. Aesthetic and emotional considerations, or perceived health risks, may override the actual risk of disease transmission. The most practical approach to infective waste management is to identify those wastes that are judged to represent a sufficient potential risk of causing infection during handling and disposal and for which some special precautions appear prudent. Health care-related wastes for which special precautions appear prudent include microbiology laboratory waste, pathology waste, and blood specimens or blood products. Moreover, the risk of either injury or infection associated with the disposal of certain sharp items (e.g., needles and scalpel blades) contaminated with blood also needs to be considered. While any item that has had contact with blood, exudates, or secretions may be potentially be infective, it is not normally considered practical or necessary to treat all such waste as infective.

Universal precautions

Prior to discussing "universal precautions" in the context of medical waste management, it is necessary to define what they are. Since medical history and examination cannot reliably identify all patients infected with HIV or other blood-borne pathogens, blood and body fluid precautions should consistently be used for all patients. This is especially true for emergency-care settings, where the risk of blood exposure is increased and the infection status of the patient is usually unknown. Universal precautions include the following recommendations, intended to decrease the probability of infection of health care workers:

- All health care workers should use appropriate barrier precautions to prevent skin or mucous membrane exposures. Barrier protection includes gloves, masks, gowns, aprons, and eye protection devices.
- Hands and other skin surfaces should be washed immediately if contaminated with blood or other body fluids.
- All health care workers should take precautions to avoid injuries caused by needles, scalpels and other sharp instruments during all procedures involving these devices. Needles should not be recapped, purposely bent, or manipulated by hand. All sharps should be disposed of in a puncture-resistant container, capable of decontamination without further handling of the sharps.
- Resuscitation bags or mouthpieces should be used for mouth-to-mouth resuscitation

whenever possible.

- Health care workers with exudative lesions or weeping dermatitis should refrain from all direct patient care and from handling patient care equipment until the condition is resolved.

Universal precautions are meant to apply to blood, semen, and vaginal secretions as well as to cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid and amniotic fluid. Universal precautions do not apply to feces, nasal secretions, sputum, sweat, tears, urine, and vomitus unless they contain visible blood. A more detailed description of these precautions can be found in the references (CDC, 1987, 1988).

Medical waste

As defined in the Medical Waste Tracking Act of 1988, medical waste is "any solid waste which is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals." Although there may be other, slightly different definitions of "medical waste" or "infective waste," each medical institution must develop a plan to deal with waste generated by such a facility.

Recommended program

CDC recommends that health care facilities establish an infective waste disposal plan. An integral part of an effective waste disposal plan is the designation of the person or persons responsible for establishing, monitoring, and periodically reviewing the plan. Such plans should consider three basic elements for infective waste:

- Identification of potentially infective material;
- Proper handling, transportation, and storage; and
- Appropriate processing and disposal.

Identification of potentially-infective waste

CDC suggests that microbiology and pathology wastes, blood and blood products, and sharp items--especially needles--should be considered as potentially infective, and should be handled and disposed of with special precautions. Other items may be designated for special handling based upon local and state ordinances. The most practical approach to infective waste management starts with identifying those wastes that are judged to represent sufficient potential risk of causing infection during handling and disposal, and for which some special precautions would appear prudent. This identification process is very important because the separation of the waste stream that develops from it will have a perceived effect on the health and safety of the employees, and a substantial effect on the cost of disposal. Items defined as infectious need to be identified at the source, segregated, and prepared for special handling. At the same time, it is important to eliminate non-infective waste from the special waste stream so as to keep disposal costs at a minimum. This step is sometimes difficult to implement because of the reticence of some staff to take the extra time to segregate waste material. Some infection control people have taken the position of designating most, if not all, waste from certain locations (e.g., the operating room) for special handling, so as to minimize distractions. On the other hand, we have heard of some hospitals designating all of their waste as infectious, a practice that comes under scrutiny soon after the first disposal bill arrives. A related circumstance was reported by a colleague who visited an infectious waste incinerator that was found to be malfunctioning, because it was filled with computer printouts.

Handling, transport, and storage of potentially-infective waste

Persons involved in the handling, transportation, and storage of infective waste should be informed of the potential health and safety hazards, and trained in appropriate handling and disposal methods. These employees should also be provided with appropriate personal protective equipment and trained in how to use it. If processing or disposal facilities are not available at the site of generation of infective waste, it may be safely transported in sealed impervious containers to another area, or to another facility for appropriate treatment. To minimize the potential risk for accidental transmission of disease or injury, infective waste awaiting terminal processing should be stored in an area accessible only to personnel involved in the disposal process.

Processing and disposal of potentially-infective waste

Waste that has been designated as infective should either be incinerated or should be decontaminated before disposal in sanitary landfill. Acceptable decontamination methods include autoclaving, chemical disinfection, and exposure to gamma radiation. Disposable syringes with needles still attached, scalpel blades, broken glass and other sharp items capable of causing injury should be placed intact into puncture-resistant containers, and located as close as is practical to the site of origin. If the filled containers are to be autoclaved before disposal, they should be made of material that will maintain its impermeability after autoclaving, in order to prevent subsequent injuries. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer. Sanitary sewers may also be used for the disposal of other infectious wastes, provided they can be ground and flushed into the sewer.

Universal precautions applied to infective waste

The concept of universal precautions, i.e., that blood and body-fluid precautions should be consistently used for all patients, does not alter the application of any of the preceding recommendations (CDC, 1988). Universal precautions are meant to supplement an infection control program, not replace it. As an example, isolation procedures would not change, and only waste material identified as potentially infectious, e.g., bulk blood and sharps, would be segregated for special handling. This would mean, of course, that not all of the waste from an isolation room would be designated as potentially infectious.

Non-traditional health care providers

CDC believes that our recommendations should apply to all health care facilities, regardless of size. For example, strategies for the disposal of blood or sharps would apply both to large acute hospitals as well as to small clinics. Obviously, there should be some judgment based on local and state ordinances.

Summary

We are not aware of any significant public health problem posed by the disposal of infectious waste in the United States. In recent years there appears to have been improper disposal of some medical waste in some areas along the Eastern Seaboard. We believe that these problems can be addressed by state and local agencies. Procedures suggested by the EPA under the Medical Waste Tracking Act of 1988 should focus attention on the problem of proper disposal of medical waste. It may not be necessary to handle infective waste with the same degree of management caution as, for example, hazardous chemical or radioactive waste. However, it may be advisable for local communities to develop means of handling medical waste using the Medical

Waste Tracking Act as a guideline.

We believe that the most frequent problem encountered in health care facilities concerns the definition of infectious waste. When the definition is too broad and virtually all waste is considered infective, waste management becomes oppressive and expensive, and adds to the public's misconception that such waste is a significant health hazard.

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Center for Disease Control. Update: Universal Precautions for Prevention of Transmission of Human Immunodeficiency Virus, Hepatitis B Virus, and Other Blood-borne Pathogens in Health Care Settings. MMWR 1988;36:377-388.

Abstract: Do Floatables Contaminate Fishery Products?

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There is neither evidence for floatable contamination of fishery products, nor is there a plausible mechanism for contamination of finfish or shellfish. It is true that lack of evidence, alone, is not very reassuring. Finfish and shellfish near industrialized and densely population areas are already contaminated by human pathogens and toxic chemicals. We know the major sources of this contamination in every industrialized estuary--industrial and sewage effluents and inputs of some pollutants come from agricultural runoff, the atmosphere, and a few other sources. Given the magnitude of these sources, and the degree to which nearby fish and shellfish are already contaminated, contamination by small pollutant sources would be very hard to detect. To my knowledge floatables have not even been hypothesized seriously as contaminating specific fish or shellfish resources.

Still, despite the understandable lack of evidence, we might ask if there is a plausible mechanism for floatable contamination of fishery products. We do understand rather well the physical and chemical processes that determine the distribution of pathogens and chemical pollutants in sea water and sediments. Also, we understand much about the behavioral and physiological processes by which fish and shellfish take up these pollutants and become contaminated. There are a great many processes not yet understood, of course, but the dominant processes of fish and shellfish contamination are understood

We know that finfish and shellfish can accumulate chemical toxicants and carcinogens in their organs and tissues, either through their food or from contaminated water which passes across their gills or skin. We know that the effectiveness of uptake varies substantially from species to species, with age of the organism, and from chemical to chemical. At least broadly, we can estimate the environmental concentrations of particular chemicals that will seriously contaminate particular resources species in terms of public health.

We also know that finfish and shellfish can be contaminated with human pathogens, both bacteria and viruses. As with chemicals, the processes of pathogen contamination are rather well known. A plausible mechanism for floatable contamination of fishery products would require dispersal of a chemical or a pathogen in concentrations high enough to influence concentrations in resource species. To my knowledge, any plausible floatable discharge can not even approach the concentrations required.

The small quantities of chemicals in floatable wastes that can contaminate resources would not seem to measurably influence sea water contaminant concentrations. Most bacterial and viral pathogens of man are killed or inactivated by sea water within hours to days So, even the very small numbers of pathogens presumably in medical floatable wastes do not accumulate in sea water.

Therefore, I have heard of no plausible way in which floatable wastes could contaminate fishery products. I suggest that this issue be dismissed as simply implausible. It can only distract attention from the several real impacts of floatable wastes.

Our Environment: A Look at Earth's Vital Signs and Their Impact on Our Quality of Life

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Introduction

I am sure that each of us at one time or another has received a thorough physical examination. After your checkup you generally received good news. Hopefully, you were in good health with systems working. You went home feeling good about yourself and your future.

First, I want to take stock of our environment in a complex, global perspective. From the beginning, I can tell you I have little good news about our patient, the planet on which we depend. The read-outs from all tests are not reassuring:

- The planet's forests are shrinking;
- The planet's deserts are expanding;
- The planet's soils are eroding at record rates;
- The planet's waterways, estuaries and oceans are being polluted;
- The planet's safe fresh water supplies are diminishing;
- The planet's plant and animal species are disappearing--some before they are named and cataloged;
- Man-produced wastes are growing rapidly, increasingly spreading over the ocean;
- The ozone layer in the upper atmosphere, that protects us from ultraviolet radiation, is thinning;
- The temperature of the earth appears to be rising, threatening to melt glacial ice and raise sea levels, and poses a threat to virtually all the support systems on which we depend.

Of all human activities, two are disproportionately important. These are population growth and waste management.

Population growth

The world's population grew by about 83 million in 1988, reaching five billion. With continued health programs, the number of births over deaths is expected to grow to 90 million in the 1990's, before moderating early in the next century. At this rate, the earth's population will at least double by the year 2040.

Much of this growth has and will continue to occur in the Third World, where human demands often already overtax local life support systems. When annual population increments are coupled with heightened stress on local systems, shortages of food, fuel, and fodder emerge almost overnight. Waste disposal problems, already acute, become a nightmare. We must begin to recognize the relationship between population size and the sustainable yield of local forests, grasslands, water bodies, and croplands, in addition to the ability of technology to utilize these resources while at the same time dealing safely with waste management.

If the demands of a local population exceed sustainable yields, the system will continue to deteriorate even if population growth stops. In the Third World continuous population growth and biased land distribution drive farmers onto marginal land incapable of sustaining long term cultivation. Perhaps worse still, these crowded peoples seek opportunities in other countries, sometimes adding to the adopted country's overtaxed systems.

What has happened in the U.S. gives one little hope for U.S. visionary leadership in the area of population growth. In 1973, a blue-ribbon Commission on Population Growth and the American Future, chaired by John D. Rockefeller, 3rd, concluded, "The gradual stabilization of our population would contribute significantly to the Nation's ability to solve its problems."

Years before, then-President Nixon in 1969 observed, "One of the most serious challenges to human destiny in the last third of this century will be the growth of the population. Whether man's response to that challenge will be a cause for pride or for despair in the year 2000 will depend very much on what we do today." Population growth forces upon us slow but irreversible lifestyle changes. We Americans have embedded in our traditions values that constitute the American way of life. They are freedom from public regulation; free use of water; freedom to access uncongested, well-regulated roadways; freedom from permits and licenses; freedom to fish, swim, and camp where and when we will; and freedom from fees, red tape, and bureaucrats. Although we in the New York/New Jersey area cannot live this way now, in 2020 we may look back with envy on what will then be viewed as the unfettered way of life of the 1990's.

The Rockefeller Commission's report, although issued more than 15 years ago, has had little impact. The planet's population is up from 3.5 billion in 1970 to over 5 billion today, and continues to climb. The population of the U.S. is up from 205 million in 1970 to over 242 million today, and our present population trajectory will put our nation's population at 270-300 million by the year 2000. Think about the impacts and burdens on societal systems occurring during this growth period.

Demographic experts predict that during this same period 75 percent of our population will live within 75 miles of a coastline. If these estimates are true, 225 million Americans will be living along our coastlines by the year 2000, most of them in our already crowded metropolitan regions, and all of them requiring housing, food, transportation, energy, jobs, waste disposal, and places for recreation. By the year 2000, the New York metropolitan area is predicted to grow to 20.6 million. The American public, I believe, is woefully ignorant of these demographic realities.

There is no escaping the fact that our population is growing rapidly, on both a global and national scale, that more people mean more waste, less room and fewer resources for each of us, and less ecological diversity and productivity to pass on to future generations. Population growth is an environmental issue, and it is irrefutable that the every-day behavior of the individual is a major contributor to the floatable waste issue.

Energy trends are also an important indicator of the world's economic and ecological health. Trends since 1986 point to a resurgence in oil consumption and continued growth in coal consumption. The oil sheiks and coal barons may be cheered by these events; however, it does not bode well for the planet. The growing demand for energy will only add to the dangerous game of chemistry we are conducting with the earth's atmosphere. Lakes, streams, oceans, forests, farm productivity, human health, and human life are now at risk.

Segregation of waste materials is not new or unique to a hospital environment. Table 2 clearly reveals the separation requirements and waste stream divisions of a hospital such as MGH. The largest portion of hospital waste is classified as solid waste, and is carried out of hospital dumpsters to either landfills or incinerators. Included are materials from the hospital's business functions, food production, patient care--including testing and treatment, and normal residues usually associated with the daily living requirements of any large operation or residential household. In addition to solid wastes, a number of other waste materials are segregated. Discarded equipment such as intravenous poles, wheelchairs, stretchers, and other movable pieces of hospital apparatus are separated from the normal disposal stream. Structural residues from hospital construction or renovation projects are also separated from other waste streams.

TABLE 2:	**ANATOMY OF HOSPITAL WASTE**
	Solid waste
	Equipment
	Construction waste
	Infectious waste
	Radioactive waste
	Hazardous waste
	Waste gases
	Pathological waste
	Animal waste
	Municipal sewage wastes

Separation of infectious waste materials has, for years, been a recognized need. Long before the public expressed concern about infectious materials, hospitals had their own internal practices to protect both patients and personnel from the dangers of cross infection. Patients known to have communicable diseases or produce infectious materials were segregated, and their wastes removed from the normal waste stream to a location within the hospital where the materials were autoclaved or sterilized to reduce the danger of contamination to others. Once autoclaved, these materials were then discharged into the normal waste stream. Aside from infectious wastes, hospitals have handled radioactive materials separately from other wastes, and have had special collection procedures for hazardous chemical wastes and other toxic substances. In addition, hospitals have had special concerns regarding waste gases emanating from operative procedures, and anatomical wastes were separated from all other wastes and sent to a different collection point and incinerated. Animal wastes and carcasses resulting from research activities have also been handled separately. This system of waste disposal was in compliance with all applicable public health laws and Massachusetts Environmental Protection Agency (EPA) requirements.

During the week of January 6, 1987, an abrupt change occurred in the waste disposal practices in the Boston area. As a result of certain capacity limitations in community-owned landfills and a restricted-use decision on the part of regional incinerator management to decline medical waste materials, hospitals found themselves in the untenable position of having their wastes refused at disposal sites. This became "The Boston Trash Crisis," which was exacerbated by public fears and concerns regarding infectious hospital wastes. Surveys and published reports indicated that this was happening not only in the Boston area, but also in other metropolitan cities around the country. The problem continued to grow, and culminated during the summers of 1987 and 1988, with incidences of medical wastes washing up on East Coast shores.

Starting with public concerns and industry pressures to remove what was believed to be infectious materials from the waste stream, hearings and regulations were promulgated by a number of states, with increased pressure placed on the federal government to step in and take strong action, on a national basis. As a template of what was occurring nationally during 1987, one can review the changes that took place in the Massachusetts' public health regulations as an example of the tightening controls.

Table 3 describes the Massachusetts infectious waste regulations in existence prior to 1987, and Table 4 shows the changes in the regulations that occurred after public hearings. Note that the definition for the regulation of infectious wastes did not change, but new definitions were promulgated which described in detail the sources of infectious wastes. The impact of this change was subtle, but significant. What this meant was the elimination of the health care industry's ability to determine what was infectious, as Massachusetts became more explicit in defining broad categories of materials that were to be handled as either infectious or potentially infectious. Also significant was an attitude that was evolving for the handling of medical wastes in terms of, and equating infectious regulations with, the regulations defined by the Resource Recovery and Conservation Act (RRCA) for hazardous materials.

TABLE 3:	**REGULATIONS FOR INFECTIOUS WASTE** Massachusetts Department of Public Health *(Prior to April 1987)* <u>Definition</u>: Waste, which because of its infectious characteristics, may cause or significantly contribute to an increase in serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. <u>Sources</u>: Strict or wound and skin isolation wastes Pathology waste Blood and body fluids sent to laboratories Microbially infected animals Materials contaminated with above

TABLE 4:	**REGULATIONS FOR INFECTIOUS WASTE** Massachusetts Department of Public Health *(After April 1987)* <u>Definition</u>: Waste which because of its infectious characteristics may cause or significantly contribute to an increase in serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. <u>Sources</u>: Isolation precaution wastes Cultures and stocks of infectious agents and biologicals Blood and blood products Pathological wastes Sharps Animal carcasses, body parts, bedding Surgery, autopsy, patient care wastes Contaminated laboratory wastes Contaminated equipment Other

Although many feel infectious materials and hazardous wastes are essentially the same, there are different characteristics which describe each category and make them distinct. A review of the characteristics of hazardous material indicates that this material can be categorized by four different measurements (Table 5). This material is so classified because of certain properties that cause the substance to be either flammable, caustic, explosive, or to have certain chemical concentrations determined by an environmental protection (EP) toxicity test described in federal regulations. These characteristics are important in defining the classification of a material as hazardous. If any one of the properties or characteristics of the substances change, thus rendering them non-explosive, non-flammable, non-toxic, or reduced in EP toxicity value, the material is no longer considered harmful or hazardous, and may be disposed of with other normal wastes.

TABLE 5:	**HAZARDOUS MATERIAL CHARACTERISTICS**
	Ignitability
	Corrosivity
	Reactivity
	EP toxicity

It can be seen from Table 6 that a different set of parameters is used for infectious materials. First, it is important to understand that when discussing infectious material, one is talking about microorganisms that are extremely varied and can be scientifically classed in, perhaps, several hundred ways. These organisms are also very fragile and need specific life-supporting conditions in order to survive. Understanding this, one then begins to classify the characteristics of infection in six important categories that become the epidemiological processes for the transfer of infection. First, there must be a bacteriologic agent or virus present, and this agent needs to live in a reservoir that maintains its life-support system. This life-support system is sensitive to temperature, pressure, moisture, and aerobic or anaerobic conditions. In simple terms, these organisms usually thrive best in warm, dark places. In order for an infection to transfer, microorganisms need to travel from one host to another, they need a mode of escape, and they need a method of transmission or transportation in order to travel from one host to another. Each microorganism must have an exact mode of entry into a host, and that host must be susceptible to the new microorganism. If any one of the elements in this chain is broken, the infectious process is interrupted and, in most cases, the microorganism will not survive. Understanding this process, public health regulations have allowed for certain treatments that would effectively destroy microorganisms and render the waste materials non-infectious.

TABLE 6:	**CHARACTERISTICS OF INFECTIOUS PROCESS**
	Causative etiological agent Reservoir Mode of escape Mode of transmission Mode of entry Susceptible host

Table 7 provides a comparison between the allowed methods of treatment for infectious waste handling, both prior to 1987 and after 1987, when new state regulations were issued in the Commonwealth of Massachusetts. This comparison shows that many of the pre-1987 treatments continued to be effective in the post-1987 regulations, with some redefinition. Steam sterilization was still allowed; gas sterilization was still found to be effective; chemical sterilization was changed to a more accurate description of the process; namely, chemical disinfection; incineration was categorized into one treatment process, whether it be on- or off-site; and discharge into the municipal sewerage was still permitted.

TABLE 7:	**INFECTIOUS WASTE HANDLING**
Prior to 1987:	Steam sterilization Gas sterilization Chemical sterilization Pathological sterilization Municipal sewerage (liquid and semi-liquid) Off site incineration
Since 1987:	Steam sterilization Gas sterilization Chemical disinfection Incineration Municipal sewerage

Most important in this process is the establishment of assigned responsibility to a single individual. What should be considered within the scope of this responsibility is not only the collection of infectious wastes, but total responsibility for all categories of materials that need to be disposed of by the institution. The next step is the establishment and identification of waste materials which need to be collected, and the disposal disposition. This includes not only the type of material, but also the location of use within the hospital. This then requires a collection protocol that is fairly specific and is developed according to the methods of separation needed. I will outline several methods used by the MGH in collection procedures. As companion to the collection process itself, policy manuals, specific job descriptions, and training programs need to be developed as the program is established. Record keeping requirements are needed for all items governed by state or federal regulations, and in all cases there needs to be a high degree of reliability between the hospital staff and waste collection personnel in order to satisfy public concerns and specific requirements of haulers and site operators.

The collection methods themselves are straightforward once the waste products are identified. Although the practices and procedures in each hospital may be different, there seems to be common use of the red bag as the distinguishing feature for infectious wastes. These red bags, in their appropriate containers, need to be placed strategically in the institution to facilitate disposal for hospital personnel, practically and simply. Containers vary in size according to the area in which they are located and the volume of materials that are to be disposed of in each container. Laboratories tend to need a larger number of stand-alone, rigid containers for glass tubes and pipette materials; patient care units require strategically located red bag waste paper-type containers located throughout utility rooms and other treatment sites.

Beyond the red bag containers there must be an independent collection system for needles and attached syringes. Massachusetts General has used a variety of methods over the years, from the grinding of needles and syringes to the current method of incineration. Each containment and collection system needs to consider the staff practices involved with patient care. Needle containers also need to be strategically located to make disposal as simple as possible. This increases the volume of containers used, but avoids the occasional error of unwanted needles going into the regular waste stream. Education and enforcement become more difficult if the medical staff and allied health personnel have to search throughout a unit to find the appropriate container to dispose of infectious or medical waste materials.

In the effort to make collection convenient for the staff, the hospital needs to be prepared for the increased volume of materials going into the infectious waste collection system. It is unrealistic to think that staff nurses or physicians will separate normal wastes from infectious wastes. It is more likely that they will opt for disposing of most materials they have used at a patient bedside into the red bag waste stream, thereby increasing the volume of materials that must be disposed of by incineration. It is best to have all waste separation begin at the patient level and move down to the trash receiving area of each hospital in the container in which it is to be shipped from the hospital to the disposal site. Whatever collection methods are used in infectious disease capture, the hospital needs to pay attention to inadvertent incidences of medical waste materials going into the general hospital waste stream. In this regard, personnel assigned to waste removal, in their routine collection practices, should be on the lookout for improper materials entering the general waste stream. In order for the hospital to be protected against claims of disregarding regulations or improperly disposing of infectious waste materials, a final check should be made at the hospital's centralized trash collection area before any material is taken away. No matter how small the item, or infrequent the occurrence, public and media perceptions will magnify any error in waste handling to appear as though all hospital wastes are being disposed of in an improper manner.

The final step in a waste management program is the development of training programs with supporting policy and procedure manuals. These need to specify job responsibilities and departments throughout the institution. Other requirements to be considered are the record keeping responsibilities for manifests and other public records. Manifesting for infectious wastes follows the same procedural guidelines as those required for hazardous wastes. Although the principles are the same, the outcomes tend to be much different. Hazardous waste manifesting enables the hauler and site operator to know the contents and characteristics of the materials in each container Infectious waste manifesting lists only the generic category of the material, which is biohazardous, and then goes on to describe the contents of the container by its weight. Given the wide range of biologic and microbial organisms possibly contained within the waste, there is no record, understanding, or specificity in the manifest document by which an outsider could identify the contents without taking specific scientific action to identify the waste materials. Nor does the outside of the container, through the manifesting system, list the contents. It is, for all intents and purposes, a box with a generic dump of material.

As a review of the infectious waste management plan, Table 9 summarizes the institutional plan of action to be considered for effectively safeguarding both the employee and the public

Each institution should first have available a survey of materials that fall not only into the infectious waste category, but also other waste groups that include hazardous waste materials, radioactive waste materials, and other special categories of wastes such as asbestos wastes.

TABLE 9:	ACTION PLAN
	Survey
	Understand requirements
	Fix responsibilities
	Disposal options
	Plan and recovery methods
	Reliability
	Education

Next, each institution should understand its regulatory requirements as promulgated by state and local Departments of Health, Environmental Protection Agencies, and other regulating bodies within each state. The institution should delegate the authority for waste collection to a single individual within the institution. This individual should be given the responsibility and the delegated power to effectively carry out his or her duties.

One should have a firm understanding of the disposal options available to handle the waste stream, depending on the area in which each institution is located, and what steps must be taken by the institution in order to prepare the waste materials for landfill or incineration.

Next, there should be a plan for the collection and recovery logistics of the identified waste materials. As a part of this plan, in order to facilitate waste collection in the institution, hospital staff practices and behaviors must be known. For all waste collected, there must be a high degree of reliability on the parts of the institution, the hauler, and the disposal site operator. Internally, the institution must assure the wastes have been properly separated and packaged. Externally, the institution must know it is working with a legitimate vendor who is handling the materials according to the external regulations for moving biohazardous materials to approved sites and disposing of those materials properly.

Finally, what is important in any program is education. In this case, education needs to include not only the staff within the institution, but also the vendors who are supplying materials that may be categorized as biohazardous, the members of the waste disposal industry through both haulers and site operators, and finally the public at large.

Once the institution has installed a formal program for handling its infectious wastes, attention needs to be focused on the increased costs of such a program. As indicated in Table 10, a variety of new operating expenses will impact the hospital. First and foremost is the increased cost of waste handling. New personnel will be added in areas such as waste handling or infection control. There will be required upgrades of existing personnel that take into account new sets of duties. There will also be some practice inefficiencies because of new methods required in separation techniques and handling procedures as waste materials move through the institution.

TABLE 10:	OPERATING EXPENSES IMPACTED
	Waste handling
	Personnel
	Needle boxes
	Precaution supplies
	New patient care items

An example of such a product change at MGH is the way in which blood specimens, which had previously traveled through the institution with requisitions wrapped around glass tubes, have been changed to a procedure which now puts each specimen into a plastic bag. Such change, simple in outward appearance, would seem to add only a few seconds to a technician's workload for the unwrapping of each of these specimens. However, when one multiples the thousands of tubes and specimens that come into an institution's laboratories each day, the impact of such a small, incremental change has a very dramatic cumulative effect on an individual's workload. There has also been a change in MGH's needle collection system. In addition, there has been a dramatic impact in the volume of material now classified as infectious waste because of such changes as universal precautions. Finally, concerns regarding biologic hazards have produced a whole new series of products for the hospital marketplace. One such change is exemplified in Table 11, which indicates the percentage of increased cost that the regulation for universal precautions has had on MGH.

Another example of supply changes in MGH includes the change in chest and gastric suction apparatus. In the past several years, MGH has switched from reusable glass bottles to plastic, disposable equipment. In the public arena, where we hope to solve the waste crisis by eliminating disposable items, the hospital industry is moving in the opposite direction with concomitant increases in both acquisition and waste disposal costs. For example, in switching gastric suction systems, MGH increased its expected budget from some $27,000 to over $65,000 on an annual basis.

TABLE 11: OVERALL SUPPLY EXPENSE INCREASES RELATED TO UNIVERSAL PRECAUTIONS

Base Year	percent
1985	0.00
1986	36.42
1987	72.03
1988	101.62

Table 12 outlines the changes in the actual cost of waste disposal since 1985. Massachusetts General's solid waste disposal costs have risen from a $50/ton expense in 1985 to an expected high of $100/ton in 1988 or 1989. It is important to note that although the increase in cost appears to be higher than that expected for inflation, it represents, in reality, much less profitability. The hauler, because of material being shifted to the infectious waste stream, sees a reduced volume of business and incurs higher costs as a result of limitations in disposal site capacity. It is because of this volume shift that the line item in Table 12 showing the cost of infectious waste disposal had an opposite effect on hospital costs than what the reduced prices indicate. Although the cost per pound dropped between 1985-1988, the volumes of waste rose at a steeper rate, causing the line expense item to increase dramatically. The profitability in the handling of infectious material for business is growing, not only because of this volume change within hospitals, but also because of the added attention given to other health provider sites and their medical wastes.

The last cost indicated in Table 12 is the needle disposal and collection method employed in the hospital. As shown, this system begins with MGH in 1985 with 350 fixed needle containers that were permanently installed at a cost of $58 per unit. The collection system between 1987 and 1988 was altered because of a dramatic increase in the number of collection stations, thus making it easier for staff to dispose of needles and syringes in properly-identified, rigid, disposable containers. These containers ranged in cost from $1.89 to $4.00 each, depending on container volume and the purchase contract. The yearly cost of such a needle collection method is difficult to calculate, since the number of times a container needs to be replaced depends on its use and time elapsed between collection intervals. It can be estimated, though, that costs will range in the tens of thousands of dollars.

TABLE 12: COST CONSIDERATIONS

	1985	1986	1987	1988
Solid waste disposal	$50	$60	$80	$100
Infectious waste	0	$0.50	$0.42	$0.38
volume	1%	7%	11%	14%
Needle collection				
locations	350	--	900	1,390
unit costs	$58 fixed	--	$1.89	$4.00

In total, MGH's experience with the handling of its medical wastes as biohazardous materials has raised the cost of disposal from approximately $125,000 in 1985 to over $1,000,000 in 1988. It also requires, because of separation and packaging techniques, more man-hours to accomplish the mechanics of waste disposal. Some may argue this cost is inconsequential in comparison to a total hospital budget. In an institution that has fixed controls on its revenue, such costs are not inconsequential, I can assure you.

What has been summarized in this presentation are the practical impacts and cost considerations associated with an effective infectious waste handling system. It is important to note that if there is public concern about infectious materials entering the general waste stream, hospitals are not the only generators of such materials. As Table 13 indicates, there are a number of other sites and delivery centers in which infectious or potentially infectious materials are generated. They include readily identifiable sources such as nursing homes, laboratories, physician offices, and others. I would like to draw some greater attention to the last generator listed in Table 13, the household.

TABLE 13:	MEDICAL WASTE GENERATORS
	Nursing homes
	Private medical laboratories
	Physician offices and clinics
	Health maintenance organizations
	Surgi-centers
	Dental offices
	Funeral homes
	Veterinary clinics
	Home health care services
	Households

Households may, in fact, be one of the largest sources of infectious materials, no matter how disparate the sites may be. Hospitals may be a more popular site in the public fancy because of the medical products they use, but in reality they are not the great reservoirs of potential biologic disease. In fact, a study conducted in Germany (Kalnowski, et al., 1983) found that bacteriologic counts of general household wastes were higher than the same survey counts done for hospital wastes. Hospitals tend to identify, segregate, and treat their patients known to have communicable diseases, for the protection of the employees and staff in the hospital, as well as for other patients. It is not unreasonable, therefore, to assume that such material entering the hospital's waste stream is treated waste, while material from other site contributors may not be identified or treated prior to disposal.

This point can be demonstrated in Table 14, which shows in the Commonwealth of Massachusetts in 1988 there were 22,500 reported diabetics using insulin by injection and 40,000 reported intravenous drug abusers. In addition, in October, 1988, a count revealed 830 people were reported, living AIDS patients.

TABLE 14:

Diabetes	22,500*	Type I
Drug abuse	40,000*	
AIDS	830*	(4.9/100,000)

**Massachusetts Department of Public Health*

In many discussions involving medical waste disposal, the issue that provokes the most public fear and reaction is the spread of AIDS. The public simply assumes that hospitals and AIDS patients are bound together in a closed loop continuum. The experiences of MGH have indicated, however, that this is not the case. Statistics reveal that fully 90% of the people with AIDS lived in private households rather than hospitals, at the time of the study, and in other treatment sites that eluded public health regulations. Table 15 takes a dissected view of this relationship In a statistical accounting of patients with the reportable disease AIDS, Massachusetts listed 1,599 individuals reported to have had the disease as of October, 1988. Of this 1,599 patients, 830 were still alive and living in the Commonwealth. A 1988 hospital admissions survey concluded that the percent of patients listed as part of the hospital's diagnostic profile range from a high of two percent in one institution, which is an AIDS treatment center, to zero percent in most institutions. This produces a statistical average of 0.1 percent of a total hospital patient population who may have the HIV virus. In comparing this number to the total number of reported patients with AIDS, there were on average on a given day approximately 83 patients being treated in hospitals throughout Massachusetts with AIDS. This accounts for about one-tenth of the total patients reported with the disease. The rest of the patients, 747, were being treated on an ambulatory basis. Thus, fully ninety percent of the people with the disease that the public is most concerned about were in households and other treatment sites that eluded 1988 regulations.

TABLE 15: AMBULATORY PREVALENCE OF AIDS

Total patients diagnosed	1,599
Patients under treatment	830
Percent of total admissions	2-0% (0.1% avg)
Rate of hospitalization	83 (10%)
Ambulatory	747

Conclusion

In conclusion, I do not want to appear defensive, although I believe hospitals do have a right to articulate that position. The point I wish to end with is it is important to focus on the problem which the public has a right to be concerned about, and that problem is whether or not hospital wastes are a reservoir of infectious materials that pose a biologic hazard to society. Hospitals are large, concentrated centers that dispose of waste materials that are both aesthetically unpleasant and unfamiliar to the public. Also, physical hazards exist in a hospital waste stream that are more of a danger to hospital workers than they pose to the outside environment. Although hospital workers are more likely to acquire such illnesses as hepatitis as occupational hazards of their work, there is little, if any, documented evidence that reveals that hospital workers acquire more communicable diseases than other vocational groupings. This is logical, since hospital employees work with biologic agents in their most viable and virulent stages.

Although hospitals are receptacles of disease, they are not by interpretation reservoirs of communicable disease. The twentieth century hospital is a center for disease diagnosis; it is a center for intervention in life-threatening diseases; it is a center for surgical repair of anatomical problems; it is a treatment center for diseases of poor diet, lack of physical exercise, and environmental maladies of pollution; and the hospital is a restoration center for injuries from accidents and trauma

A quote from the World Health Organization shows a shift in the definition of health in the industrialized world that is a clear reflection of this point: "In the place of death and disability from infectious disease, the major problems in the developed countries are the chronic, non-communicable disorders."

If concerns over infectious material in the waste stream exist, let us deal with them in a generic fashion. Let us use scientific and quantified information rather than sporadic, directed attacks on organizations based on opinion and media-generated hysteria.

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Public Safety: Perceptions, Effects and the Future

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Introduction

The mission of the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP) is to provide safe and enjoyable recreational and interpretive opportunities for all New York State residents and visitors, and to be responsible stewards of valuable natural, historic, and cultural resources (Lehman, 1986). In people's minds an umbrella of safety exists when they enter a park. Beginning July 6, 1988, and continuing through July 10, 1988, the NYSOPRHP was unable to satisfy that mission at its Long Island State Park beaches. Although for years a multitude of debris has been washing onto the shores of Long Island, the above dates signified a new concentration of debris, termed medical waste. Vials of blood and over one hundred syringes of varying sizes appeared on State Park beaches where such material had previously been rare. The unknown dangers to public health and public safety associated with this debris caused beach operators to close public use facilities along the south shore of Long Island at an alarming rate during the summer of 1988. Precautionary closings occurred at Jones Beach and Robert Moses Parks on the afternoon of July 6, 1988, followed by intermittent openings and closings over the next two days. Adding to the alarm was the misidentification of fireworks casings, frozen fruit snack containers, dust masks, and many other items believed to be medical debris.

Swimmers and sunbathers found and turned in syringes, vials, and other offensive debris. This meant that State Park personnel, through no fault of their own, were not providing safe and enjoyable recreational opportunities. The beaches were unpleasant places to be. In the midst of these three days, health officials concluded that the likelihood of disease transmission by these floatable materials was so minimal that there was no real public health threat to beach users.

Beach operators were left, however, with the threat of public safety degradation and aesthetic damage to the facilities they work diligently to keep clean. Thoughts of patrons suffering punctures from syringes and lacerations from broken vials they might have encountered in the sand were reason enough in the minds of many to keep the beaches closed. The sight, on several occasions, of children playing with syringes found in the sand served to reinforce the idea of protecting the public by keeping the beaches closed. "Jason Schwartz, 10, with bright green pail in hand, calmly strolled up to a lifeguard at Tobay Beach in Oyster Bay and delivered two syringes, a rubber glove, seagull feathers and four broken shells. 'None of this looks bad but maybe you want to investigate it,' Jason said. 'My mother wants me to give this to you. She said I shouldn't have it.'" (Hanrahan and Benson, 1988).

Although there were no staff layoffs or duty changes as a result of reduced park attendance, great concern existed for the employees who were cleaning the beaches manually. Public employee unions, such as the Civil Service Employees Association, as well as managers and parents of State Park employees, all expressed concern over the issue that there were no clear instructions for the proper handling of medical waste items. In addition, there were no distinct guidelines available regarding the handling of items that could possibly provide evidentiary value for the investigators attempting to identify the sources of the wastes. As a result, the New York State Department of Environmental Conservation (NYSDEC) collected and preserved all medically-related debris.

The perception that there was an extremely dangerous situation occurring at area beaches was fueled by continuous, alarming headlines in New York metropolitan area newspapers and television reports. Editorial cartoons further heightened the perception of danger. The majority of the television and newspaper coverage included the statements of health officials that health threats were negligible, but these more reassuring comments were saved for insignificant positions within the newspapers. Certainly, the media have a responsibility to inform readers, viewers, and listeners of actual happenings in their area; however, is it responsible or fair to become overly dramatic in the headlining of reports that include less-dramatic, but more accurate facts that people may never read?

Although there were an equal number of responsible, well-researched articles and news broadcasts during the summer of 1988, the perception was created that beach visitors were taking their lives in their hands by partaking in their favorite pastime. It was difficult for Long Island State Park officials to ascertain, as telephone calls started coming in from the public, whether people were more concerned with disease transmission or the possibility of becoming injured by stepping on a piece of debris, which is always a possibility. The aesthetic quality and public safety standard of the beaches remained a great concern of beach operators even after public health threats had been clearly established as minimal.

What were the effects?

In light of the perception that there was serious danger inherent in a visit to the beach during the summer of 1988, individuals and groups began staying away from some of the finest beaches in the nation. Day camp operators called Long Island Regional State Park Headquarters for assurances that any danger had passed. Jones Beach information offices were deluged with calls for the status of not only that park, but all other beaches on Long Island. Comprehensive information was simply not available at that location or any other single location. Although letters were written to day camps stating the opinions of health officials and other government experts, it was found that even those who had taken the time to learn the true nature of the debris problem were refusing to visit beaches for camp day trips. The transference of recreation seekers from beaches to other activities became so significant during the summer of 1988 that New York State Troopers from upstate zones were telephoning regarding the status of Long Island beaches in order to make patrol schedule changes to deal with increased traffic.

The decrease in attendance at the Jones Beach Complex, including Captree, Robert Moses, and Jones Beach State Parks, was dramatic. Table 1 shows the annual attendance figures for those facilities from April 1, 1988 through December 31, 1988, as compared with the same period in 1987, which had been a good year for attendance given historical attendance trends. The decrease in attendance of approximately 2.4 million people resulted in a severe loss of revenue for New York State, in a year when fiscal problems became the theme for the remaining months of 1988. Table 2 shows the impact of decreased attendance on revenue during the traditional swimming season from Memorial Day through Labor Day 1988. The parking revenue shown represents the park entry fee, while the category entitled General shows all other revenue including fees for games, miniature golf, and pitch-putt golf. The loss of more than one million dollars in revenue in 1988 was significant to Long Island State Parks. Figure 1 graphically illustrates the differences between 1987 and 1988 attendance and revenue for the month of July in both years. As the 1988 season commenced on Memorial Day weekend, the general consensus was that attendance in 1988 would be even greater than it had been in 1987. Figures 2 and 3 show early season growth in both attendance and revenue in 1988. Given this trend, and that the remainder of July was hotter and drier with less precipitation than usual, New York State's actual loss of revenue was certainly greater than and may have exceeded by more than double the one million dollars shown on the record.

Several factors influenced the trend of reduced beach visits by the public. After July 24, 1988, poor or marginal weather patterns consisting of fog, rain, and at times cool weather on weekends, discouraged outdoor activities. Of much greater impact seemed to be the reality that although Long Island had not closed beaches because of debris washups since July 10, many New York City beaches and other beaches were closing daily as a result of raw sewage problems and continued medical debris pollution. The public perception in these cases appeared to be that if one beach was closed, no matter where, all beaches must be affected by the same problem. People seemed to have no geographical sense of the negatively-impacted facilities close to New York City versus clean beaches further east on Long Island.

Table 1. ANNUAL ATTENDENCE FIGURES-- JONES BEACH COMPLEX

1988 - 1989 FISCAL YEAR	DECEMBER	FISCAL YEAR THROUGH DECEMBER
Jones Beach via car	119,164	5,550,861
Robert Moses via car	63,583	2,494,236
Captree via car	63,102	1,517,597
	245,849	9,562,694

1987 - 1988 FISCAL YEAR	DECEMBER	FISCAL YEAR THROUGH DECEMBER
Jones Beach via car	196,633	7,709,566
Robert Moses via car	49,674	2,783,281
Captree via car	60,377	1,451,711
	306,684	11,944,558

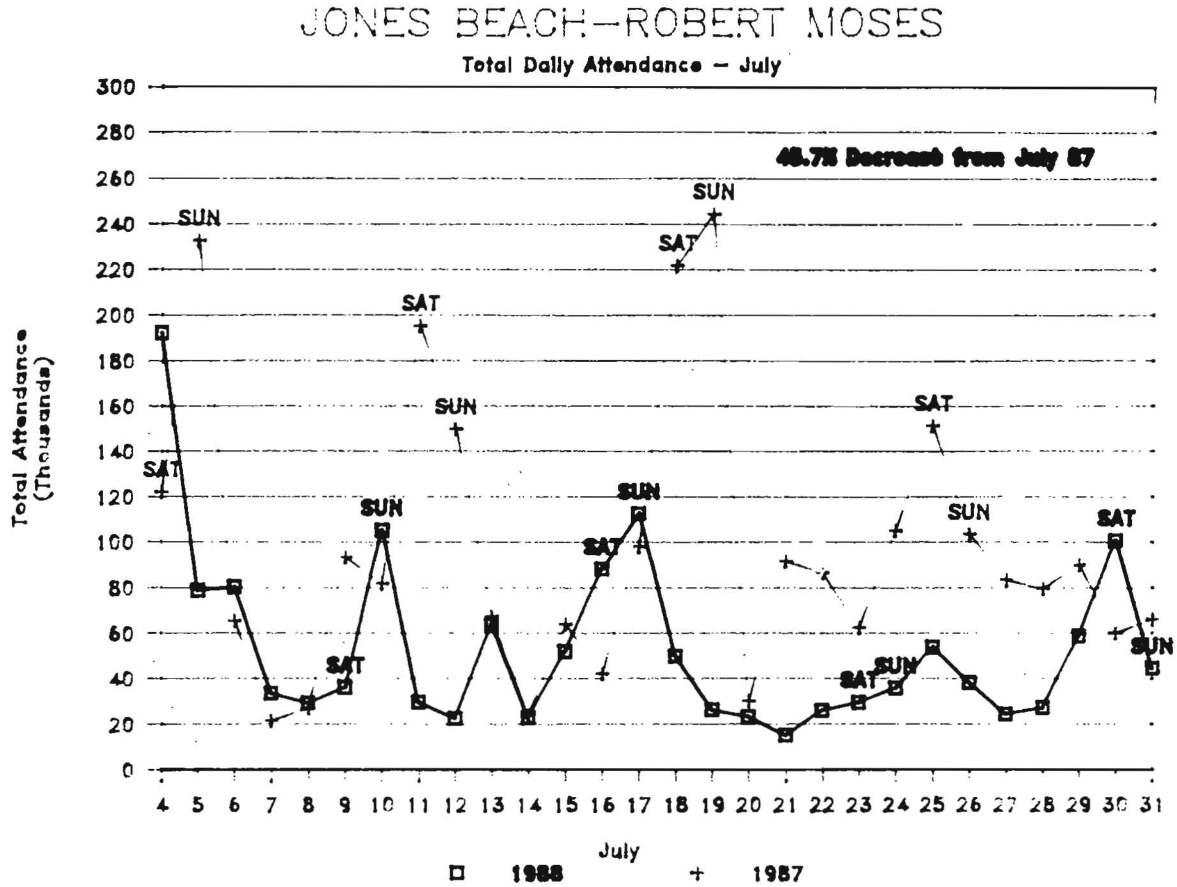
Table 2.

REVENUE - JONES BEACH COMPLEX

5/23/87 - 9/7/87

	1987		1988	
	Parking	General	Parking	General
Jones Beach		$836,551.82		$676,361.53
Robert Moses		186,673.23		179,930.03
Captree		50,335.31		59,889.15
Meadowbrook	1,211,007.64		837,568.95	
Wantagh	632,152.10		361,552.85	
Robert Moses	1,019,898.55		746,577.11	
Captree	98,499.43		99,689.68	
Sub-Total	2,961,557.72		2,045,388.59	
Total Revenue	$4,035,118.08		$2,961,569.30	

Figure 1.


JONES BEACH—ROBERT MOSES
Total Daily Attendance — July
46.7% Decrease from July 87
Total Attendance (Thousands)
July
1988
1987

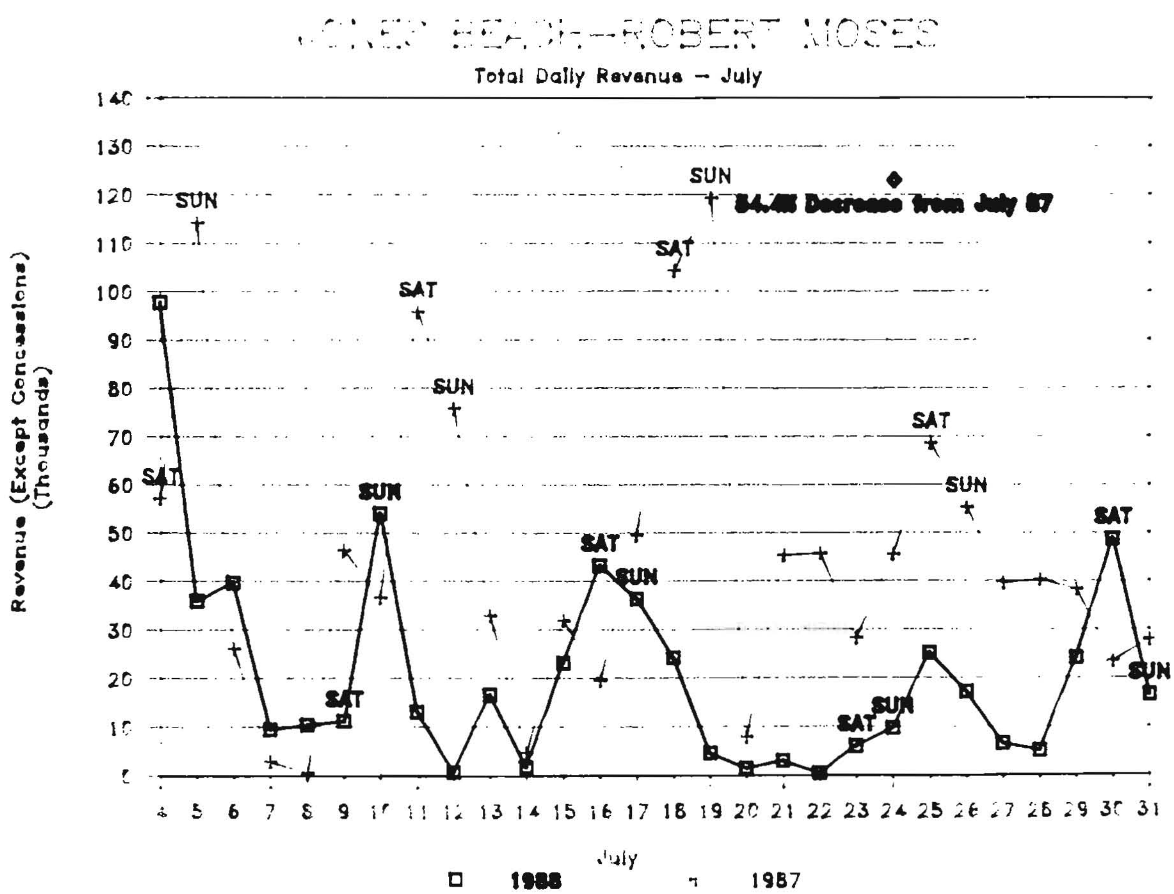
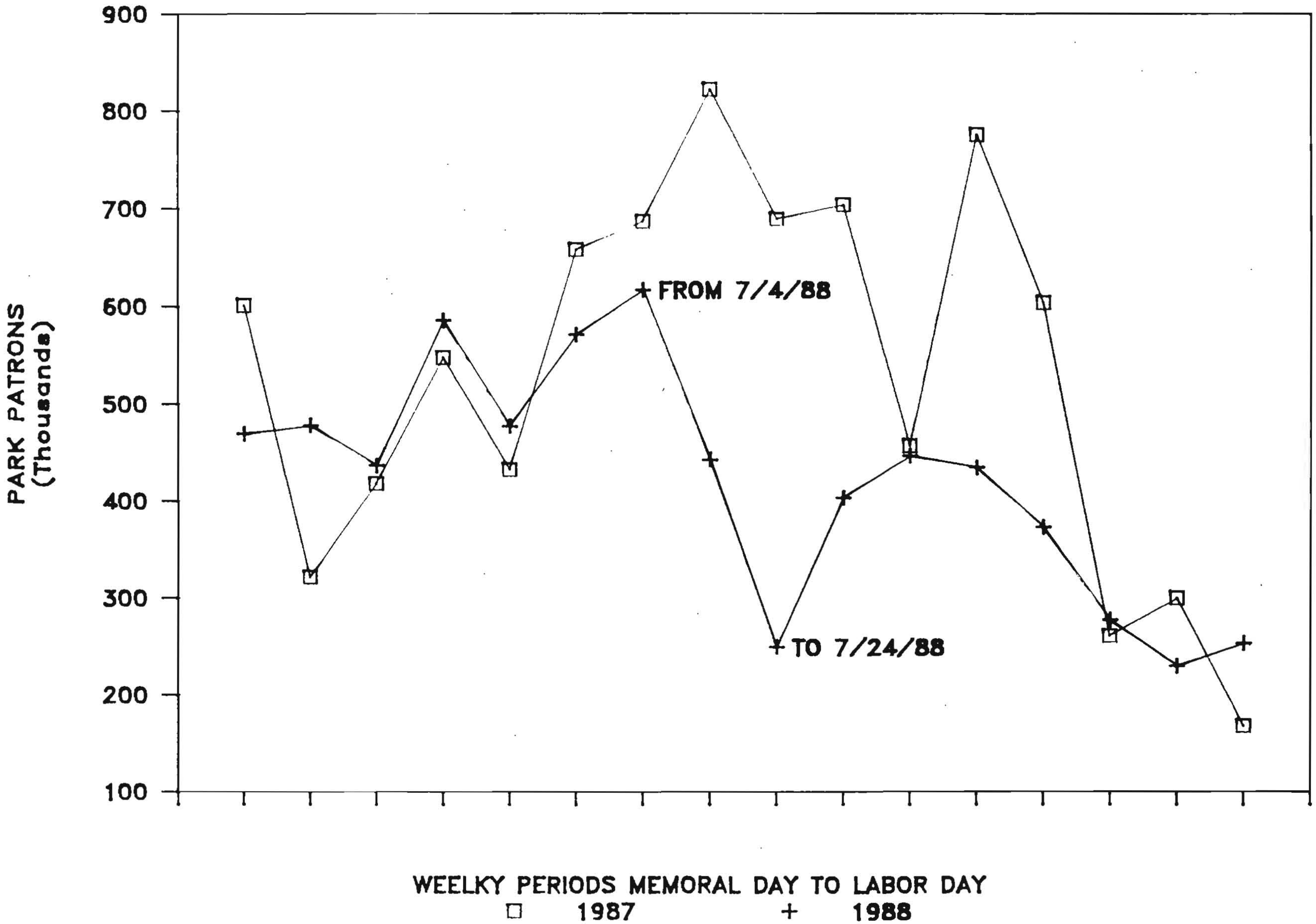

Total Daily Revenue — July
54.4% Decrease from July 87
Revenue (Except Concessions) (Thousands)
July
1988
1987

Figure 2.

JONES BEACH STATE PARK COMPLEX

PARK ATTENDANCE – SUMMERS 1987 & 1988



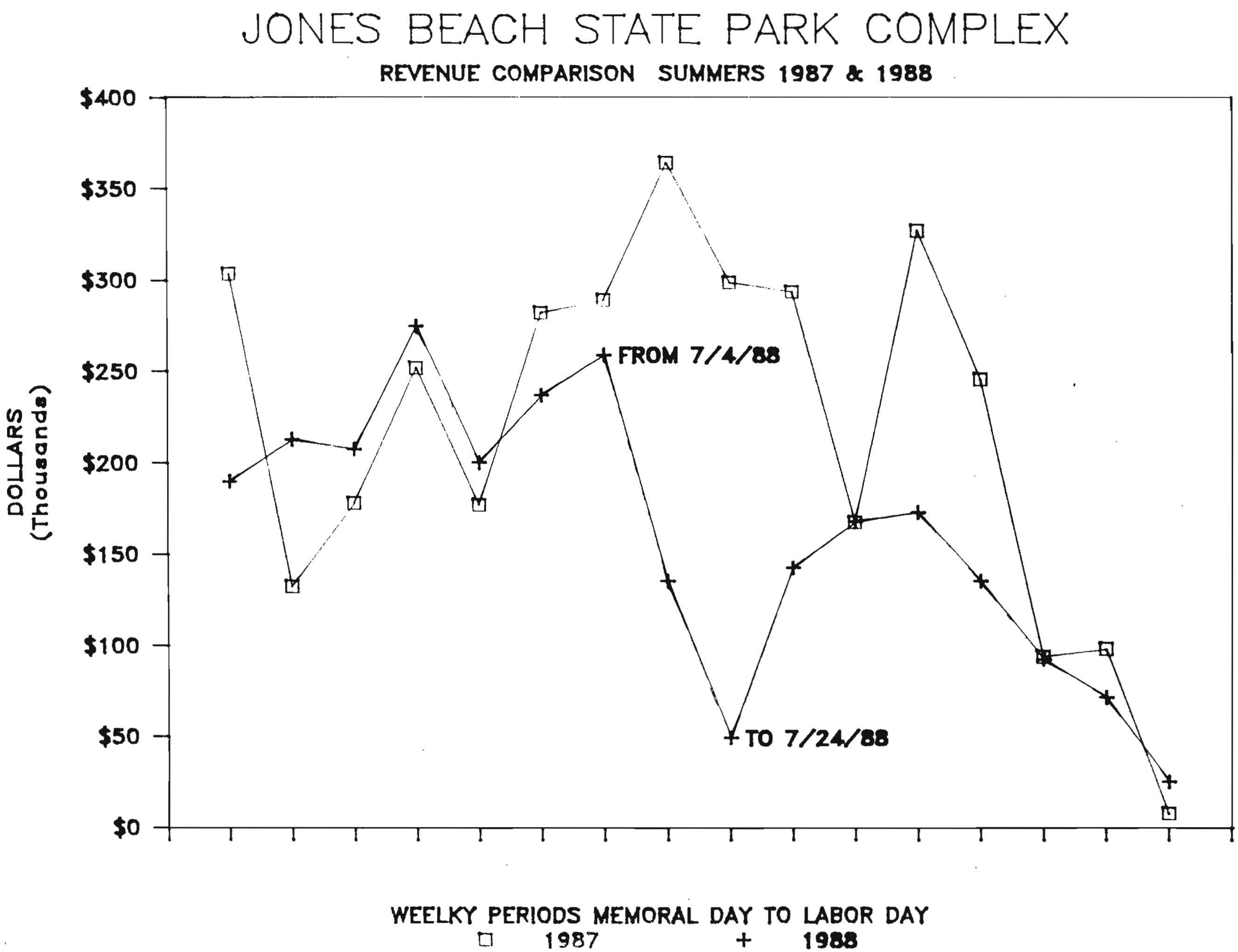

JONES BEACH STATE PARK COMPLEX
REVENUE COMPARISON SUMMERS 1987 & 1988
$400
$350
$300
$250
$200
$150
$100
$50
$0
DOLLARS
(Thousands)
FROM 7/4/88
TO 7/24/88
WEELKY PERIODS MEMORAL DAY TO LABOR DAY
□ 1987 + 1988

Figure 3.

The three instances of actual physical injury related to accidental contact with syringes were hardly noticed by the media. None of the victims were severely injured and there was no evidence that the injuries were followed by illness, making these events public safety issues or aesthetic concerns, rather than public health issues. One victim, however, served a notice of intent to file a claim against the State of New York citing "Negligence and gross negligence in keeping a State Park open when a clear danger was present with the knowledge of the State." The umbrella of safety had a hole in it. All the injuries had occurred well after the last beach closing on July 10, 1988.

The unacceptable presence of syringes and vials of blood on public beaches, regardless of minimal health risks and slight public safety concerns, created a perception encouraged by media reports that beach facilities were undesirable places to seek recreational opportunities. It is well established that the public will seek recreation at places where there is less perceived danger or where the dangers are less well-known, rather than subject themselves to a possible threat, the magnitude of which is uncertain and beyond their personal control. The public is attracted to aesthetically pleasing beaches and in 1988, beach standards were not met.

What does the future hold?

To measure the possible success of the future, one should review history to determine whether anything has been learned from past events. "Although the initial impact of these [floatable] events has been spent, the incidents of beach soiling and waste deposition continue sporadically. The staff of New York State Parks and of the Long Island State Park and Recreation Commission are attempting to "live" with the situation and cope with the problem of operating a complex recreational resource under strong uncertainty. The visitors to our beaches should not be subjected to the harsh realities of cultural eutrophication on a routine basis; the recreational component of the Bight's coastal resources must become a primary factor in the development of a decontamination program for the New York Bight. There appears to be no specific agency at any level whose primary duty is to deal with all the various types of elements of a disaster of this type. Indeed there seems to be some disagreement on the fact that this was a disaster at all." These words, a portion of the testimony given by Dr. Peter Buttner at Joint Hearings before the Subcommittee on Fisheries and Wildlife, Conservation and the Environment and the Subcommittee on Oceanography on July 24, 1976, would have been as appropriate in August, 1988, as they were then. Although people today are not resigned to "live" with unpleasant debris on local beaches, in 1988 beach operators were no better prepared to deal with medical debris washups than were those who had to deal with heavy sewage pollution on the same beaches in 1976. At the level of beach operators, we were no better able to measure the magnitude and movement of the debris in the water, to communicate with each other effectively or to identify the source of the problem.

In 1988 there was no clear understanding of which agencies were responsible for coordinating a response, tracking a problem, or predicting what might happen next. Beach operators were not equipped, except in a few cases, to perform cleanups in any fashion other than manually. Only a few operators knew the appropriate procedures for handling items that might have had some value as evidence in subsequent investigations or legal cases. In 1988, investigative staff had to be brought from other areas of New York State to begin the search for violators of dumping laws or some other source of medical debris appearing on the beaches. Testing of the fluids found in vials was slow to occur and there was some debate over whether testing was an advisable action to take, given the small amount of fluid available and the questionable integrity of such tests with regard to the age and condition of the samples.

By July 11, 1988, many of the aforementioned problems had become obvious and were included in several reports from various agencies to New York State's Governor Mario Cuomo. The Governor asked for, and the New York State Legislature later approved, an emergency appropriation of $2 million to increase law enforcement and investigation of illegal pollution sources and to improve cleanup capabilities. Expenditure of the funds made available through that appropriation will enable State Parks staff to perform beach cleaning operations nearly six times faster than they could in 1988. A centralized, computerized information system will be available for exchange of accurate, first-hand information among beach operators, regardless of jurisdictional boundaries. The enhancement of communications should help to avoid beach closures based on speculation or reaction to inaccurate information. Although this system will not be set up to handle public and media inquiries, a toll-free telephone number will be made available by the New York State Department of Economic Development for those types of inquiries. Investigation of offshore waters, made possible by the purchase of marine equipment, will help in identifying the scope and location of debris that might affect beach operations. Information obtained in this manner will be included in the centralized data collection system to track the volume, type, and direction of floating debris. The ability to move staff and equipment is being enhanced by adding suitable equipment to the State Park fleet. A multiple agency approach has been taken to developing guidelines applicable to all phases of handling of floatable debris. Drafts of these guidelines were presented at a conference of beach operators on March 17, 1989, to allow for operator input before finalizing them as uniform guidelines for anyone involved in collecting, preserving as evidence, and disposing of materials found on public beaches. Recommended standards for the closing and reopening of beaches will be included in the documents.

Conclusion

Since the summer of 1988, significant progress has been made toward assuring a quicker, more effective response to washups of floating debris on Long Island's beaches, but the only effective cure for this most unpleasant situation is to identify and control the sources of floatable pollution. Persistent winds from the southwest bring floatables from the New York Bight to Long Island. The only difference between prior floatable events and the 1988 events was the increased occurrence of and concern for medical waste. Unusual, persistent weather conditions will cause the floatable events of 1988 to be repeated if floatable trash remains in offshore waters. Beach managers must be prepared for these problems and strive to eliminate floatable wastes from the ocean. Beach operators, in the foreseeable future, will be forced to correct a problem not of their own making, but one which seriously impacts their ability to deliver a public service for which Long Island has become world-famous.

Vigilance along the shoreline must now and in the future be a key part of the daily routine of beach managers. No one can afford to forget the historical lessons of the pollution episodes that occurred in 1976 and 1988. The needed education, operating guidelines, safety procedures, coordination, and equipment will be available in 1989 to allow beach operators to provide optimum public service, but as managers we must not become complacent to the need for these resources in the future

The public's safety remains a high priority of beach managers. Aesthetic degradation is one impact of the medical debris problem that was not overstated or misinterpreted, and will continue to affect the public's desire to visit a beach. Syringes on a beach are unsightly, offensive, and scary. The ability to quickly and effectively clean beaches helps to create a more aesthetically pleasing beach environment. The future holds cleaner beaches, well-informed decisions, and fewer closings than were experienced in 1988 because beach operators are more knowledgeable and better able to respond to floatable wastes, but the problems associated with ocean-borne debris will not be eliminated until such pollutants are curtailed at their sources. The media have the power to help restore the public's confidence in beach operators' abilities to maintain the quality of recreational facilities people have come to expect. The media must become educated with regard to the true implications of the floatable problem and of the impacts that their reporting style has on society. Media cooperation can be expected only when we become truly responsible stewards of our valuable natural resource.

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Acknowledgments

The author appreciates the assistance of John Keenan in preparing the graphic presentations, John Prenderville and Joseph Lescinski for revising the document and Barbara Fernandez for editing and typing.

Basis for Local Beach Management Decisions During the Summer of 1988

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Introduction

The public is well aware of what happened repeatedly during the summer of 1988, beginning on July 6th and 7th; however, local beach operators viewed the floatable situation in a different perspective than did the community. Beach operators observed the quality, type, and degree of freshness of the floatable materials, and compared them to those collected during the previous fifteen years. Floatable materials have been stranded on Long Island beaches prior to 1988, and they continue to wash up on beaches. The summer of 1988 was different, however, most notably because of the presence of medically-related waste. Only on one previous occasion did any type of medical waste strand on area beaches. This occurred in August, 1987, on a small section of East Atlantic Beach, Fire Island. Previous to this incident, the daily, local beach stranding inventories had only recorded sewage-related floatables and other debris.

Quite naturally, the response of local beach operators in 1988 was immediately biased by the presence of medically-related waste. Concern for public health overshadowed a well-seasoned response that had developed over the previous fourteen years. With a sea of sewage and trash rolling up onto their beaches, local officials did not hesitate to immediately close the affected beaches, without consulting Nassau County health officials.

There were times during the summer of 1988 when many beach operators closed their beaches to bathing as a result of finding one or several syringes along the shore; however, when the Town of Hempstead closed its beaches in 1988, it was because of enormous or continuous strandings of floatable materials. It is important to mention the tremendous amount of media pressure exerted on local beach operators during these floatable episodes. Media personnel demanded that Town of Hempstead officials explain why they had not closed local beaches since there were washups of floatable materials along parts of the Rockaway shorelines. When Town officials tried to explain that area beaches were clean and had not experienced washups of floatables, beach operators were accused of concealing floatable evidence from the press. Conversely, when Town officials closed beaches as the result of an impending lightning storm, media personnel demanded to see the floatables responsible for the closings. The summer of 1988 was a very hectic period for local decision-makers, to say the least.

Town of Hempstead officials did notice several differences between the floatable events of 1988 and those of prior years. In addition to the medically-related waste within the 1988 floatable load, the amount and condition of the sewage floatables contrasted with those observed in prior years. The 1988 floatable materials appeared to be fresh. Fat and grease balls were soft, while in the past they were primarily hard and old in appearance. The plastics associated with the 1988 slicks did not have coatings of tar or fat around them as in previous years. Lastly, the water quality associated with these stranding slicks was remarkably degraded when compared to samples taken in the past. Examination of water samples from within the 1988 slicks repeatedly produced total fecal coliform values of greater than 24,000+. Follow-up samples taken after beach cleanups or on the subsequent tide revealed a marked reduction in coliform values associated with these slicks This suggested that the waste materials were from a recent discharge of unknown origin, ushered to local beaches rapidly by the combined effects of currents and winds which persisted throughout the 1988 summer season. The water quality degradation associated with the 1988 slicks was of short duration, dissipating after only a few hours. Most of the strandings, except for three or four multi-mile long slicks, were isolated in localized sections of Town beaches. Such slicks could have been associated with a specific lens of low-salinity water and debris which, upon entering the surf zone, fragmented and could not be located after each stranding incident.

When large floatable incidents occurred during the summer of 1988, another difference in strandings was also noted. In contrast to prior incidents, these strandings occurred throughout the tidal cycle, not only on the high tide line. In 1988, debris could be found from high to low tide marks, as well as out in the surf.

Since November, 1988, reports have been presented on a weekly basis in an attempt to designate where the floatable materials came from, what portions of the floatable materials were medically-related, and what agencies have been doing to relieve the floatable problem. Various quantitative estimates have been presented regarding the discharges of solid waste, hazardous waste, infectious waste, raw sewage, partially-treated sewage, and combined sewage, during day/night and wet/dry conditions. Specifically with respect to the medically-related components of the waste stream, estimates of the amounts of floatables retrieved during the summer of 1988 ranged from a shopping bag-full to an area covering several cubic yards. Once the issue of AIDS became associated with floatable wastes, no quantity estimates could overcome public opinions regarding the safety of area beaches.

One plan, which may have a major impact on public opinion regarding floatables, is the New York Harbor skimming proposal undertaken by the U.S. Environmental Protection Agency (U.S. EPA) to remove floatables before they exit New York Harbor. That effort, however, should be expanded to run on a daily basis, and not just after major rainfalls and lunar tides. The floatables discharged daily from combined sewer overflows and overburdened sewage treatment plants need to be removed daily.

It was not made very clear in the Newsday article "Gunk Busters: Authorities Say Beach Pollution Won't Be Solved This Summer, But Will be Contained," (McIntyre, 1988) that Long Island beach operators were equipped with sufficient debris removal equipment to handle the washups of floatable materials. The article also failed to express to the public that these same beach operators have been handling vast amounts of debris- and sewage- related floatables on Long Island beaches for the last fifteen years. Town of Hempstead beach cleanup operations take place every morning and night during the summer seasons, unbeknownst to the majority of the public who use beach facilities. This is why I take issue with the U.S. EPA's position that floatable trash possibly originates from beach users, and just gets re-suspended by winds and tides. Materials that wash up onto local beaches or are discarded during public hours are removed by dedicated employees every day. For years, the Town of Hempstead Parks Department has had a midnight garbage pickup to remove the trash from its beaches.

Each of the Town of Hempstead beach facilities are visually inspected each morning before cleanups are undertaken by Town Park or Conservation personnel. Both the quantity and the type of floatable material collected or observed is entered into a daily stranding report. If any medically-related debris is found along the strawline or within the general beach area, those objects are carefully sorted and placed in an approved container for further investigation by the New York State Department of Environmental Conservation (NYSDEC) or the Nassau County Department of Health. The beach is then be cleaned. It is not the Town of Hempstead's intent to close any beach as a result of one or two syringes. Throughout the day lifeguards and park personnel partake in periodic inspections of incoming and outgoing material strandings. In the event of a large floatable slick of sewage or garbage-related material approaching the bathing area or stranding onto the beach, park personnel call for the immediate closure of that beach facility, or the part of the facility affected. The area remains closed until the floatable material has either stranded or has been moved out of the bathing area by the tides. Coliform samples are taken from within the stranding slick at that time and then again, after the next high tide. As in the past, the examination and documentation of stranded floatable materials is carried out to determine the type and the amount of waste, as well as to observe the presence of medically-related waste. Notification of floatable strandings is made to the Nassau County Department of Health (NCDOH) or to the NYSDEC, in the event of substantial evidence of medical waste.

Medically-related materials collected and documented by Town of Hempstead personnel are carefully marked and held in a secure location within the park until representatives from either the NCDOH or the NYSDEC Division of Law Enforcement can inspect the waste material. After inspection, the materials are disposed of at Nassau County or New York State facilities.

Media coverage of these 1988 actions received little or no attention; however, their results were noticed immediately by the public. The summer of 1988 was a learning experience for the community and as a result of the attention the floatables commanded, answers, guidelines, and procedures will continue to be forthcoming to insure each beach operator has the necessary information, support, and resources to handle any future situations involving the stranding of floatable wastes.

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Responsibility, the Media and Public Perception

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Introduction

A wondrous story has unfolded. This conference has displayed the vast gulf between reality and perception, between what actually happened as a result of floatable wastes and what has become the public reality of what happened. *The New Yorker* (1989) observed that people live their lives in a Newtonian world where things operate according to understood laws because people experience them This is a comfortable world. But people also live in a world of nuclear physics that has dimensions that bracket human experience but are not part of it. People have no instinctive experience with that nuclear world to guide reactions and decisions. This is a fearful world.

In a sense, people have reached a similar state in the environmental realm. Our polluted planet was, in recent memory, one that could be related to the human, individual experience. One sensed that people could clean up this planet up if they really wanted to. Within recent years, though, there have occurred events which seem to lie outside the dimensions of individual control, being both a part of and beyond intuitive experiences of how the world works. This, too, is a fearful world.

The official person contemplates nuclear danger in front of a map of the world and relates that danger to the web of other global, political dangers. But the private person experiences that danger locally. Nuclear danger contemplated in a purely private way is intimate, something people experience so subjectively that it is difficult to share their feelings or even to find a language for them.

People reacted similarly to the pollution episodes of 1987 and 1988. The public person has a map of this world of sources, sinks, and fates; but the private person lacks such a map and experiences this world as it interacts with usual experiences and customary behavior. Often the private person barely understands the greenhouse effect, the hole in the ozone layer, or the sudden appearance of floating wastes on summer beaches. The fears engendered by the absence of an adequate map with which to guide reaction are easily exploited. Thus, society was socially enriched from the media's treatment of the pollution episodes of the mid-1970's and from washup events of 1988, including medical wastes laden with overtones of AIDS. These creations of horror are beyond our comprehension and the realm of our private experiences. Reactions upon confronting these episodes are ones of outrage, of fear that things are beyond our control. These fears are often shamelessly exploited by others for their own gain. Political and economic posturing in the face of public apprehension is not pleasant to observe.

Perception

Perception is defined as a mental image of something acquired through the senses. The public's perception of the quality of the coastal environment, acquired through people's experiences of the summer of 1988, must be disturbing, or a conference such as this would not be necessary. How does the public form its perception of the coastal environment? The principal sources are, in order of importance: direct personal contact, the experiences of significant others, the "sensational" media, and, lagging behind badly, the "thoughtful" media. It is known from many studies that pollution of water bodies is often judged by the presence or absence of floating materials. It is known from many studies that people accept information more readily in verbal form than in written form. And it is known, at least intuitively, that information is transferred more readily by television and headlines than it is by written materials such as articles or educational tracts. For example, a study done for the American Association for the Advancement of Science's Public Understanding of Science Committee suggested that ninety-six percent of the public derived most of their science information from the nutritional labeling on food packages. It is against such an intellectual and informational gradient that our science writers labor.

Public perception in this fearful world of mysterious, unexplained disruptions of personal experience is disturbing. It is, I suggest, expressed by a sense of despair of the situation, of conflict already lost. Anastasia Toufexis, writing in *Time Magazine* (1988), stated:

> "The oceans are broadcasting an increasingly urgent SOS. Since June 1987 at least 750 dolphins have died mysteriously. . .harbor seals have the highest pesticide levels of any U.S. mammals. . .fisherman are hauling up lobsters and crabs with gaping holes in their shells, and fish with rotted fins and ulcerous lesions. . .the oyster haul from Chesapeake Bay was the worst ever. . ."

The Media

Television has come to be the action media: people doing something. It is short and condensed--the sound byte. Print media like to be known as the in-depth media, producing information available for analysis. In reviewing media coverage of the past medical waste events, I have concentrated on the print, as reviewing television or radio is more difficult for one not experienced in such a task. I will simply assert that electronic media are more immediate, more aggressive, and far more effective in mass communication than print media. I found that in the print media's coverage of medical waste events the general tenor of the headlines was poor, but texts were excellent. In-depth analyses of the floatables problem, probable sources and origins of materials, and hazards to the public presented by the event were all treated well. Interviews with responsible, informed persons were commonplace--but only in the texts.

To understand the disparity between headline and copy, one must have some insight into the workings of a newspaper. A breaking story is assigned to a reporter. A floating debris story is usually referred to an environmental reporter. The story, when written, is reviewed by the news desk staff, where the headline is written. The editor of the newspaper sets the location of the story in the publication and determines the general policy of the paper toward the story. In a continuing story, as in the medical wastes coverage, second-line reporters may be later assigned to the follow-up stories. These reporters utilize both new information and previously written stories in their reporting. Headlines were written by news desk staff during the summer of 1988, and belie the quality of the stories beneath the titles. Headlines are meant to catch the reader's attention and sell papers. The location of the story in the newspaper is also meant to sell newspapers. Juxtapositions of articles, sometimes highly unfortunate in their connotations, are a matter of editorial policy, with sales in mind. We in the knowledgeable and concerned community must always go beyond the headlines.

Responsibility

Who is at fault? No one and everyone. Paul Vitello in *Newsday* (1988) wrote:

> "It's the kind of a crisis that makes people angry, partly because they don't like to be made afraid to go in the water, but also because it's the kind of crisis that for them sums up a general feeling that things are getting out of hand. The bridges are falling down, the highways are collapsing...where is all the money going?"

Were the innocent injured? Certainly. Marian Burros, in *Eating Well, (New York Times,* 1988), stated "There appears to be an indiscriminate rejection of all fish [as food], a rejection health officials say is unwarranted."

Can we effect change in behavior? Possibly, but it will take time.

> "The problems were compounded by misunderstanding and what officials called understandable hyperbole. The sensitivity is there, the electronic media hype is there and you get people interviewing state police and lifeguards and people on the beaches. . .state park people are not familiar with this type of material. They get caught up in the hype too." (Philip Gutis, New York Times, 1988)

Recommendations for action

The science and regulatory/management communities, including health officials, academics, regulators, etc., must continue to work with the press. One must not become angry or discouraged. Emphasize contacts with editors and producers. Put together background materials that show both sides of the story and that analyze information. Recognize that once a problem is solved, it is no longer a story: a clean beach gets no headlines.

Teachers throughout the educational system must try to have students analyze information they receive from all sources in order to place events in a context beyond personal experience. They must convey the thought that the world cannot be comprehended in 15 minutes.

Attempt to develop the concepts of risk, both real and perceived, avoidable and unavoidable. These are difficult concepts, but ones which allow for more rational, less emotional discussion

Accept that medical waste episodes are now a part of the folklore fabric of the community. We cannot make them go away. We must prepare for the future. We must expect more medical waste events and prepare accordingly. Information must be prepared and distributed now that will permit future summers to be placed in context. We must show that we learned from the past experiences

In order to balance the negative, positive information must be made available to the media. Recognize that for the media negative events are "pressing" events, positive events are not "pressing," and therefore do not attract much coverage.

Whenever possible, work with those who are most likely to be influenced by the electronic media hype. Help prepare people, such as lifeguards, park employees, and police, who will be interviewed, especially by television personnel, to develop a balanced response to emergencies such as medical waste events Being on television still ranks as a highlight in the lives of most people, and recognize that their responses will be a valued by the public as those of experts.

It is good to recall the axiom "Don't bother me with facts, I've already made up my mind."

Acknowledgments

Thanks are extended to the following environmental reporters for useful and constructive discussions: Bob Hamilton, *New London Day;* Mark McIntyre, *Newsday;* and Todd Bates, *Asbury Park Press.* I had hoped to utilize polling studies from the Roper Center and Institute of Public Policy, University of Connecticut, in the preparation of this paper, but there were none related to medical waste episodes. Tod Bates is undertaking a content analysis of newspaper coverage of the medical waste coverage, but this was not complete for presentation at this conference.

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New York Bight Floatables Action Plan

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Introduction

Floating material in our waterways has once again become a prevalent sight in the past decade. However, it wasn't until the summer of 1987 that the public witnessed a significant number of washups of floating debris, including wood, plastic and small amounts of medically-related waste on beaches in New Jersey and New York. Beginning in early June of 1988, the appearance of these materials resulted in the closings of beaches on Long Island, New York City and New Jersey.

After the 1987 washups, the U.S. Environmental Protection Agency (U.S. EPA) Region II undertook three months of helicopter surveillance and on-site investigations of floatables accumulations in the New York/New Jersey Harbor. From November, 1987, through January, 1988, EPA scientists mapped the estuaries and shorelines that were most heavily impacted by floatables and looked at the possible sources and dynamics of the materials.

The U.S. EPA mapping efforts revealed the following:

- The most heavily impacted areas were the Arthur Kill, Pralls Island, the Island of Meadows, and various locations on the shoreline of Staten Island.
- The further south and east of the New York Metropolitan area, the cleaner the shorelines.
- Minimal floatables pollution was found along the most developed shorelines.

Sources of floatable materials identified included combined sewer overflows (CSOs), stormwater runoff, beach and pleasure vessel litter, marine transfer operation of solid waste, wood from decaying piers and vessels, and the resuspension of materials already deposited on the shoreline. The U.S. EPA's investigation into the dynamics of floatables pollution determined that slicks were most prevalent during the high lunar tides associated with a new or full moon, and after heavy rains that resulted in heavy CSO loads.

To further the U.S. EPA's understanding of floating debris in the New York Bight area, its ocean survey vessel *Peter W. Anderson* was utilized to collect debris along different transects within the New York/New Jersey Harbor complex and perpendicular to the New Jersey and Long Island shorelines. The survey was conducted from August 29, through September 1, 1988, following severe thunderstorms and a full moon. This sampling survey revealed that floatables were most heavily concentrated in the Harbor, and the collected material included plastic bags, wood, cigarette butts, paper products, tar balls, grease balls, and sewage-related items such as condoms and tampon applicators. The sampling of the Long Island and New Jersey transects recovered only a small amount of floatables, consisting mainly of small pieces of plastics and pellets.

Floatables Action Plan

In August, 1988, an interagency work group was formed to develop a Floatables Action Plan as part of the New York Bight Restoration Plan. Members of the work group included the U.S. EPA (chair), New Jersey Department of Environmental Protection and Energy (NJDEPE), New York State Department of Environmental Conservation (NYDEC), New Jersey Authorities Association (NJAA), National Oceanic and Atmospheric Administration (NOAA), United States Coast Guard (U.S. CG), United States Army Corps of Engineers (U.S. ACE), Interstate Sanitation Commission (ISC), the Waste Management Institute of SUNY at Stony Brook (WMI), New York City Department of Environmental Protection (NYCDEP), and the New York City Department of Sanitation (NYCDS). The work group developed this plan to ameliorate the problem to the greatest degree possible during the summer of 1989. This plan was approved by all involved agencies and was announced on March 7, 1989.

The Action Plan was implemented in the summer of 1989 to address the problem of floatables within the New York/New Jersey Harbor. The plan consisted of surveillance, regular cleanups at established key locations, non-routine cleanups, and a communications network.

As discussed above, most floatable debris slicks that impacted the shorelines of New Jersey and New York were known to originate in the New York/New Jersey Harbor. Major slicks were primarily observed in the Upper Harbor, the Lower Harbor in the Arthur Kill, and Hudson River (Figure 1). The surveillance plan, implemented in 1989 from May 15 to September 15, concentrated on detecting floatable debris slicks within the Harbor, but still provided monitoring of the Long Island and New Jersey shorelines.

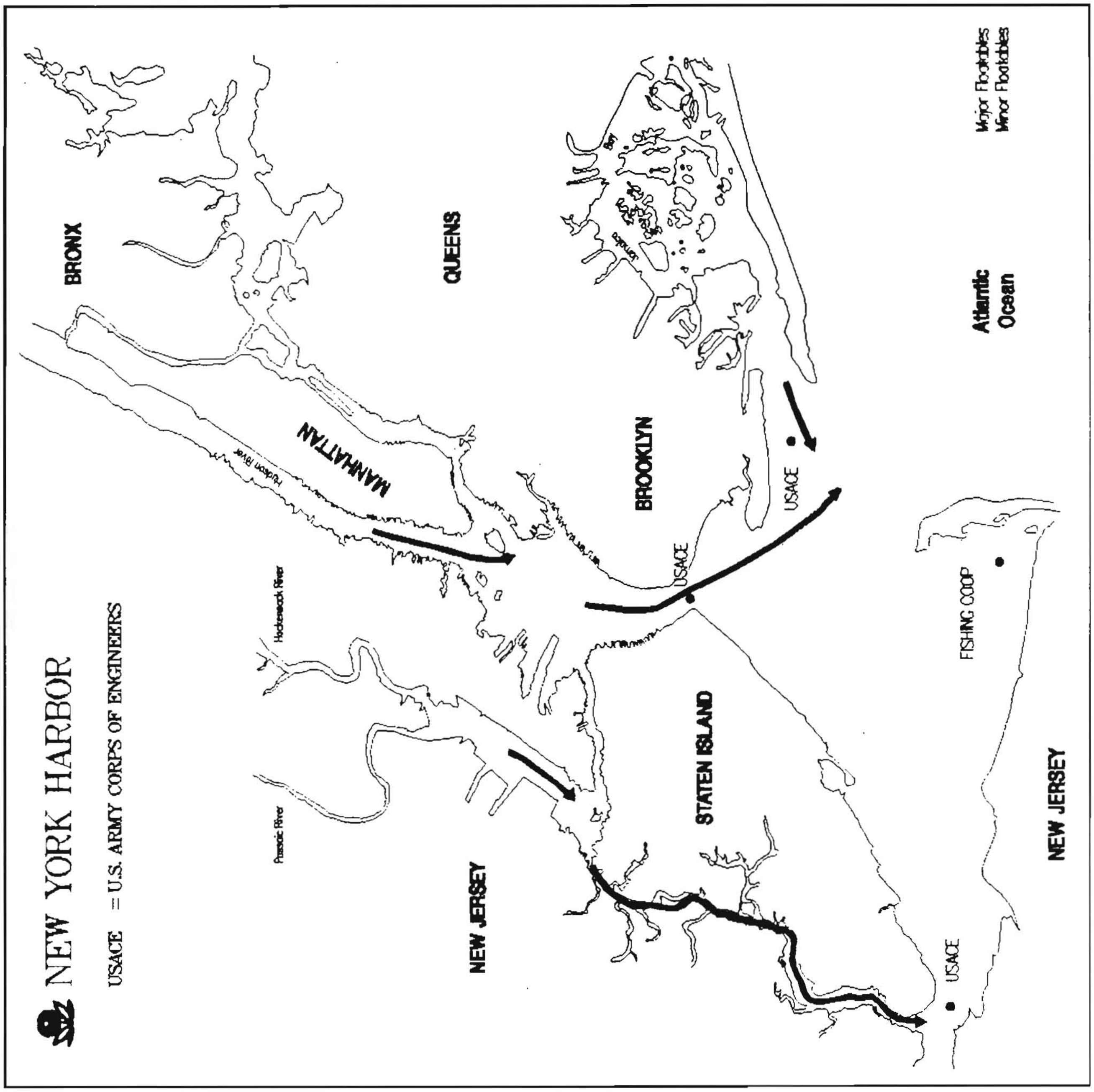

FIGURE 1 - Potential Cleanup Sites

Provided surveillance included:

NJDEPE

Helicopter: Daily surveillance of New Jersey shoreline and Lower New York Harbor. Monday through Sunday, except Wednesday.

U.S. EPA

Helicopter: Daily Surveillance of the Harbor, and surveillance of New Jersey and Long Island shorelines as part of the normal water quality monitoring program. Monday through Saturday.

Research Vessel Clean Waters: Patrol of New York Harbor twice weekly, manned by U.S. EPA and NYSDEC staff.

U.S. CG

Helicopter: Routine patrols three days per week.

Patrol Vessel: Daily, routine patrol in the Harbor; weekly patrol of the New York Bight.

An integral part of the Action Plan included the regular cleanup of the Harbor at established key locations. These locations were the Verrazano Narrows and the outflow of the Arthur Kill into the Lower Harbor. The U.S. ACE performed the cleanups with their drift vessels utilizing specially-designed nets (effective openings of less than 1 3/4 inches). To dispose of the collected debris, the NYCDS supplied barges, or permitted the U.S. ACE access to the Marine Transfer Stations.

Regularly scheduled cleanups occurred on the day before, day of, and day after the full and new moon high tides. These operations were performed only during daylight hours. In 1989, during the period of May 15 to September 15, twenty-six days of cleanup occurred. Additionally, the U.S. ACE conducted cleanups at the key locations following significant storm events that caused combined sewer overflows.

The plan focused on the capturing of debris slicks that were spotted within New York/New Jersey Harbor. The U.S. ACE vessels and a fishing cooperative, vessels under contract with NJDEPE, conducted cleanup operations. For slicks observed beyond the Sandy Hook-Rockaway Point transect, a NOAA/U.S. CG model was used to predict potentially-impacted areas. Individual state floatables coordinators were informed of the potential slick washups. The state coordinators notified the local authorities when necessary.

To administer the plan, a communication network (Figure 2) was established for reported sightings of floatable debris. The U.S. EPA floatables coordinator functioned as the center of the reporting network and coordinated cleanups activities. All agencies involved in the surveillance and cleanup operations were available 24 hours/day through the use of hotline numbers and paging systems.

Conclusion

The Floatables Action Plan for the summer of 1989 was developed as a short-term measure to improve the floatables problem to the greatest degree possible. The successful operation of the Plan does not guarantee that washups of marine debris will not occur in the future. Floatable washups will not cease until all sources of marine debris are controlled.

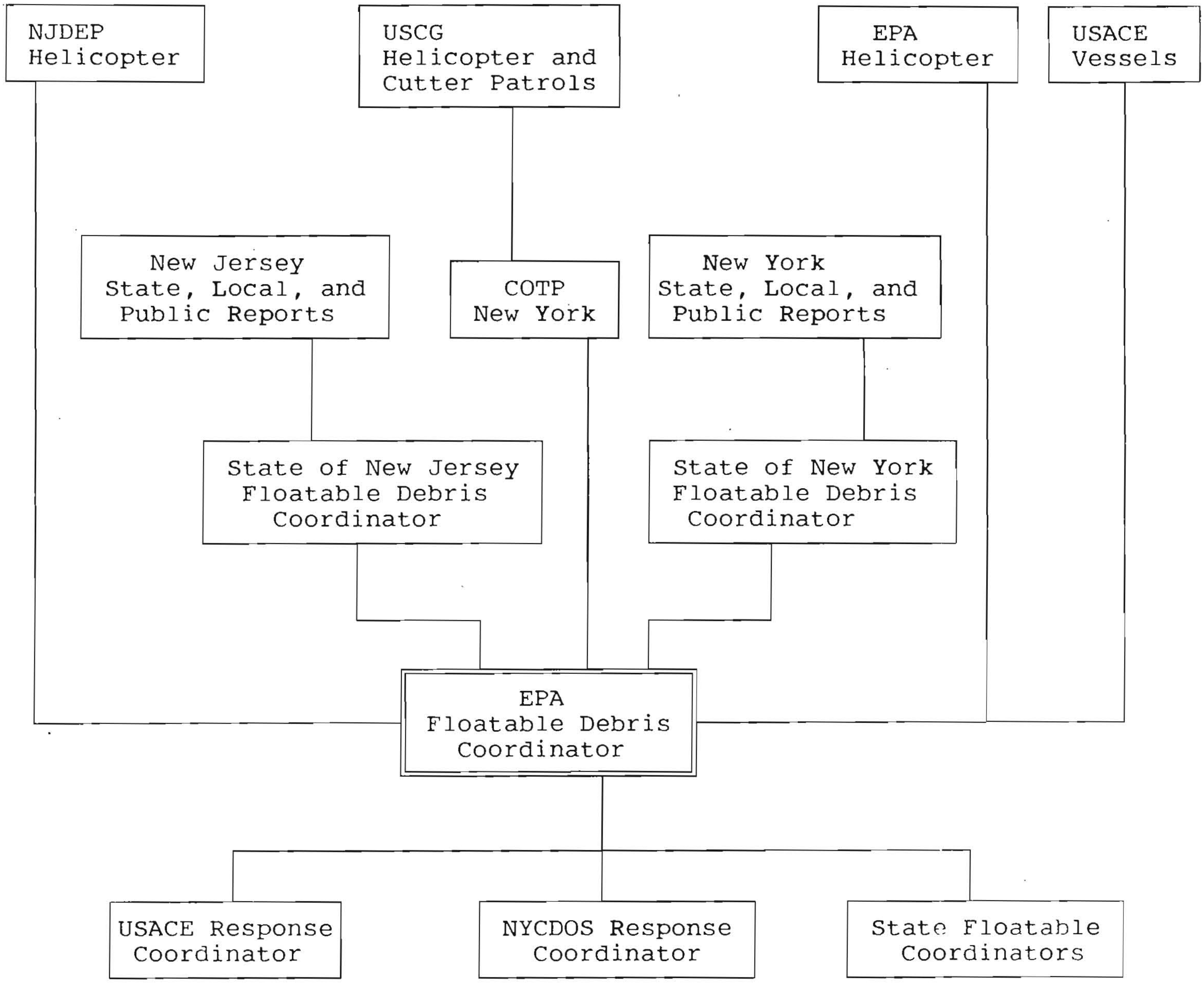

FIGURE 2 - COMMUNICATIONS NETWORK FOR REPORTING AND RESPONDING TO FLOATABLE DEBRIS SLICKS.

Prevention and Response: New York State Actions

Roberta E. Weisbrod
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Introduction

At this conference, there have been discussions regarding various aspects of New York State actions addressing floatable waste issues. Harold Berger, Regional Director of the New York State Department of Environmental Conservation (NYSDEC), has already made specific analyses of the sources of floatable wastes on beaches; David Markell, Director of the NYSDEC Division of Environmental Enforcement, has discussed the sources of infectious wastes and how New York State handles these materials; and Langdon Marsh, Executive Deputy Commissioner of the NYSDEC, has given the long-term overview of waste management in New York State.

"I feel like the sixth wife of Henry VIII," as Phil Weinberg, great commentator of the New York State Environmental Conservation League, once said. "I know what to do and how to do it; the trick is to make it interesting." What I would like to accomplish at this conference is to elaborate on the NYSDEC's plans to prevent and respond to future washups of floatable debris.

Prevention

For each of the potential sources of floatable wastes, the NYSDEC has implemented a program. In addition to legitimate sources of floatable marine debris, such as those controlled by the regulatory/enforcement community, there are also public sources, such as those cited by former NYSDEC Commissioner Dewling. These public sources include combined sewer overflows (CSO's), sewage bypasses, marine transfer operations, stormwater runoff, illegal dumping, and refuse from commercial ships, recreational boaters, and beach users.

Combined sewer overflows

In 1982, in order to decrease the use of CSO's, the NYSDEC mandated (through its State Pollutant Discharge Elimination System (SPDES) that New York City begin an abatement program. The 1988 NYSDEC SPDES permits enforced that requirement. In 1989, the program was at the facility planning and preliminary design stage in most of New York State's tributaries and major bays, and New York City had committed $1.5 billion in its 10-year capital budget for this program. As New York City completes the major overflow areas, the mode and speed of control of the smaller overflow points will be of concern.

In addition, the SPDES permits for New York City, including Wards Island, limit CSO flows to the stated capacities. The reason for this restriction is related to the way sewage treatment plants (STP's) operate. If flows are 150 percent above stated capacity then secondary treatment conditions prevail, but at up to 200 percent capacity, primary treatment is affected. Above 200 percent capacity, the level of flow is bypassed. This phased-in moratorium will preserve CSO capacity.

Sewage bypasses

The New York City SPDES permits require remedial corrections to sewage bypasses to be performed on a 24-hour, 7 day per week basis in New York City.

Marine transfer of solid waste

Harold Berger discussed marine transfer of municipal solid waste (MSW) in some detail during the first day of this conference. Several problems of considerable magnitude are associated with the marine transfer of MSW. In 1989, approximately 28,000 tons of MSW were handled by the New York City Department of Sanitation (NYCDS) on a daily basis. Half of that waste was barge-fed to the Fresh Kills Landfill, Staten Island. In 1989, this transfer of MSW required approximately 19 barges per day. Each barge handled roughly 700 tons and 3-4 barges were convoyed by one tugboat. Considering this large amount of refuse, a waste loss of 0.01 percent would release one ton of garbage into the marine environment each day. In light of this situation, the controls the NYCDS placed--including enhanced booms at the landfill, booms and skimmers at the transfer stations, and covers on barges--were clearly called for. These procedures were put in place by the required permit conditions.

Stormwater runoff

Stormwater runoff sources are related to street litter. Both New York City and New Jersey consider regulating the amount of street litter an important element in controlling marine debris.

Litter from commercial and cruise ships

A study by Price and Thomas (1987) for the New Jersey Department of Environmental Protection (NJDEP) indicated that litter from commercial vessels was not quantitatively significant. The 1988 implementation of the international treaty, the Mar Pol Annex V, reduced litter from commercial vessel sources

Recreational boaters

In addition to other functions, the Mar Pol Annex V was used to reduce the input of another source of debris that many people in New York State considered significant: litter from the boating public. The proposed rules of the Mar Pol Annex V specified that marinas with dockage space for ten or more vessels should have port-side waste receptacles. As part of the Long Island Sound Estuary Program Floatables Work Group, the NYSDEC was briefed regarding areas the U.S. Coast Guard (U.S. CG) deemed necessary, in view of existing compliance prior to the Mar Pol Annex V. Officials in New York State, recognizing there was a flotilla of recreational vessels in marine waters (an estimated 250,000 in the New York Bight area, and somewhat fewer in the Long Island Sound), began a public education campaign. Working with the Marina Trades Association, the NYSDEC produced a poster that exhorted *Stow It, Don't Throw It*. The Marina Trades Association distributed it to member marinas and at boat shows.

The NYSDEC also initiated the production of a brochure, *If You See It Report It*, with the New York State Sea Grant Institute, listing reportable marine incidents including oil spills, dumping, disposal in impermissible areas, and debris slicks, along with the appropriate telephone numbers to call.

Beach users' litter, street litter, and shoreside dumping

Each September, from 1987-1989, the NYSDEC has sponsored Beach Cleanup Days. The purpose was threefold: to enhance commitment among the choir (as in "preaching to the choir"); for media value; and for informational purposes. The documented information resulting from Beach Cleanup Day activities enables the NYSDEC to estimate the volumes of floatable materials that wash up, what these materials are composed of, and probable waste sources and distribution patterns. Of particular interest is the beach cleanup that took place on Columbus Day weekend, 1988, when 33 syringes were found on 4.2 miles of beach (over nine beaches). This figure represents as close as the NYSDEC can get to a background number for 1988, and it is approximately what the State of Texas recovered in its cleanup in 1987. It was very clear that a large part of the material found on each of the beaches was left by beach users. Much of the fast-food accouterments on Coney Island came from the local fast-food purveyor.

Therefore, the NYSDEC is convinced that the next public education push must be widespread, and has to have an immediate impact on the public. The NYSDEC believes public education efforts, such as exhibits, are effective, particularly at sites which are appropriate to that end. For example, exhibits at Beach Environment Awareness Day, May 20, 1989, will focus on efforts to prevent beach washups.

The NYSDEC would like to see permanent or semi-permanent exhibits become an integral part of the beach or shore recreational experience, just as similar exhibits are part of the National Park experience. We have prepared a grant proposal to that end.

Enforcement

During the first day of this conference, Dave Markell spoke about a new manifest system, fines, and penalties. The NYSDEC enforcement staff, Environmental Conservation Officers, investigators, and attorneys continue to investigate solid waste violations, including medical wastes and illicit disposal activities, and have developed significant cases. There are, as well, new regulations for construction and demolition debris with tighter controls, so that medical wastes and putrescible wastes cannot be slipped in with construction debris.

With the $2 million that New York State's Governor Mario Cuomo asked the legislature to appropriate in 1989, the New York State Department of Health (NYSDOH) hired eleven staff, the New York State Office of Parks, Restoration, and Historic Preservation (NYSOPRHP) purchased six beach cleaning machines, trucks, and vessels; and the NYSDEC hired six Environmental Conservation Officers, two investigators, two solid waste specialists, and purchased three vessels and trucks.

In 1990, in addition to other enforcement and investigation activities, the NYSDEC will be sending inspectors out on a regular basis aboard the *R/V Clean Waters*. This U.S. Environmental Protection Agency (U.S. EPA) vessel was in dry dock until New York and New Jersey contributed funds for the vessel's repair and operation in 1988 and 1989. In 1989, in a cooperative arrangement with U.S. EPA, NYSDEC inspectors viewed operations of permitted facilities from the water and looked for evidence of unpermitted facilities. Finally, New York State participated fully in an outstanding interagency effort to develop the Floatables Action Plan under the leadership of Paul Molinari, who described this effort today.

Response

In 1989, the NYSDEC developed a plan to ensure a rapid and efficient response to floatable events. NYDEC Environmental Conservation Officers were to take the lead in responding to medical waste washups. The NYSDEC, thanks to the efforts of Ron Foley, Long Island Regional Director of NYSOPRHP, met directly with beach operators to convey the NYSDEC response scheme. Furthermore, working together with the State Department of Health, NYSDEC has provided guidelines regarding what is and is not medical waste and how to handle and dispose of it, along with suggestions and criteria for beach closings and reopenings.

In summary, the NYSDEC is doing its best to make future summers the best they can be in New York State

Floatables: The New Jersey Experience

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Introduction

Floatables in the marine environment have been recognized as an issue of concern by New Jersey coastal residents for over one hundred years. Responding to public concerns over strandings of floatable wastes in 1986, the New Jersey Department of Environmental Protection (NJDEP) formed a floatables work group to develop a strategy to address this issue. The strategy, developed in the fall of 1986, focused on three major activities: a) assessing the magnitude of the floatables problem considering quantitative, qualitative, and areal extent aspects; b) identifying and evaluating potential sources of floatable wastes impacting New Jersey's coastal environment; and c) initiating appropriate control measures to minimize floatable strandings on New Jersey beaches.

To implement the work group activities, New Jersey initiated a Floatables Study in the spring of 1987 (NJDEP, 1987). As part of this survey, a beach indexing phase determined the distribution of floatable materials on fifteen representative segments of beach, on three separate dates (Figure 1). Floatables were categorized and counted and results of this Study indicated that New Jersey's northernmost coastal beaches and Raritan Bay beaches contained the greatest number of floatable items (NJDEP, 1987).

The northern beach impacts and the type of materials found on the beaches led to the presumption of a northern New York/New Jersey Harbor source. In the summer of 1987, New Jersey was the recipient of several floatable stranding events which received widespread media coverage. Although the areal extent of the washups was over most of the New Jersey shoreline, the actual volume of the material was not great. The NJDEP designed a drifter study in 1987 which conclusively demonstrated that floatable materials released in the Harbor area could be found on New Jersey and New York beaches within two weeks of their release, with the specific stranding location dependent upon prevailing wind conditions.

Based upon evidence collected in several washup and drifter study results, New Jersey initiated several actions to address the floatables problem in 1988. The *New Jersey Shore--Keep it Perfect* anti-litter campaign was initiated to prevent beach litter and recreational boating contributions to the floatables load. A public service twenty-four-hour, toll-free telephone service was available for the public to receive updated beach water quality conditions and to report incidents of coastal water pollution. An interagency floatables response protocol was developed to insure credible observation, notification, verification, and response activities for each reported incident. Daily helicopter surveillance flights were conducted throughout the summer of 1988 to provide advance notification of floatables' locations and potential strandings. In addition, a pilot study was conducted to assess the feasibility of using commercial fishing vessels to recover accumulated floatables slicks from Harbor waters. The protocol worked very well, and was incorporated into the floatables response protocol under the New York Bight Restoration Plan. Heightened public awareness resulted in 753 phone reports of incidents during the summer of 1988. Six ocean and fifteen Raritan Bay beach closures were instituted as a result of floatable washups.

Helicopter surveillance during 1988 revealed a large reservoir of floatables on Harbor shorelines that could have been resuspended during storm or lunar cycle high tides. The NJDEP initiated "Operation Clean Shores," a shoreline cleanup project to remove floatables from forty-five miles of New Jersey shoreline prior to the 1989 bathing season. The NJDEP also contracted fishing vessels to remove floatable slicks during full moon tides and following summer storms, throughout the 1989 bathing season. Thus the New Jersey Department of Environmental Protection actions assisted in minimizing the number of floatable incidents on New Jersey shores.

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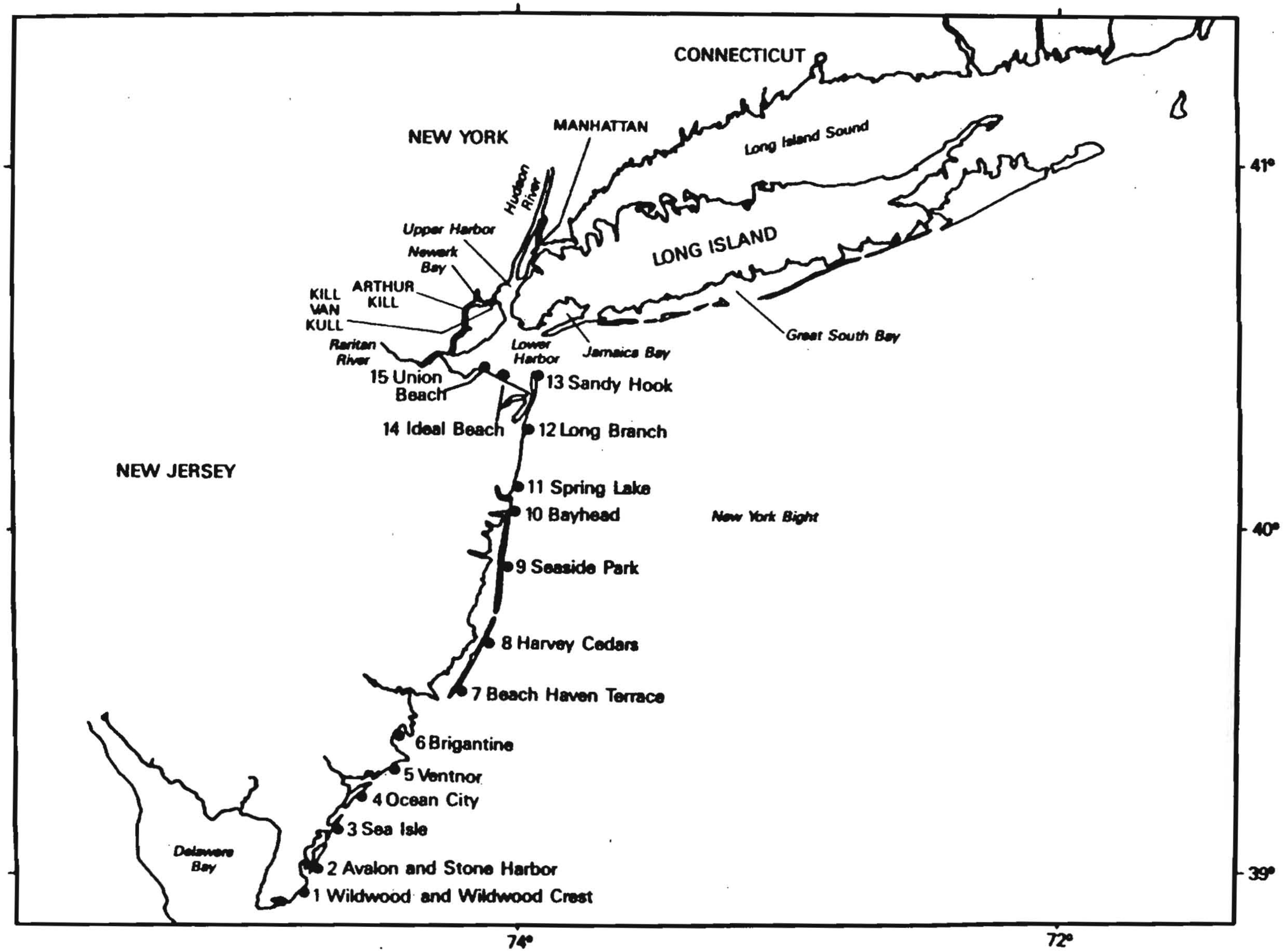

Figure 1 Locations of beaches sampled during NJDEP beach survey

Solid Waste Management

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Introduction

This paper discusses the 1989 operations and future plans of the New York City Department of Sanitation (NYCDS) in its efforts to reduce materials from entering the perpetually-increasing waste stream. In May of 1988, the NYCDS announced the expansion of citywide recycling programs to be offered to all New Yorkers by 1992. This five-year plan summarized pilot recycling programs implemented by the Department since 1984, and proposed an ambitious plan for future expansion. Most recyclable materials will be collected directly by the NYCDS or indirectly through contract with organizations providing recycling services to governmental agencies and tax-exempt institutions.

The proposed recycling law, Intro 952-A, was passed by the NYC Council Environmental Committee in 1988, and is expected to be passed by the full council and signed into law by the Mayor of New York City. This important law will effectively reduce the amount of waste materials landfilled by five percent per year over the next five years. The NYCDS ultimately expects to see a twenty-five percent reduction in the total volume of waste collected for disposal. In keeping with this commitment, and anticipating passage of mandatory legislation, the Department received an expense budget of \$19.5 million for Fiscal Year 1989, and a projected expense budget of \$47 million for Fiscal Year 1990. In addition, a ten-year capital plan includes \$167 million to purchase collection vehicles and to construct processing facilities. All monies will be used to implement the five-year recycling plan.

The pilot program, implemented in eight NYC communities during 1989, recycled material from 360,000 households and removed approximately 150 tons of material per day out of the waste stream. By the fifth year, the Department expects this figure to be 7,180 tons per day, which equates to approximately 12 barges of material less per day . Each barge generally contains nearly 600 tons of waste material destined for the landfill in Fresh Kills, Staten Island.

Another important component in the management of municipal solid waste (MSW) is the building of multiple resource recovery plants. Waste-to-energy has proven to be a safe and effective method for the disposal of MSW. It requires relatively little land area, compared to other alternatives, and can reliably process large volumes of MSW. These characteristics make incineration particularly attractive for urban areas that have large amounts of waste materials and a limited availability of land. These plants, planned for each borough, will reduce the need for transporting raw waste long distances to remote disposal sites. As existing landfill capacity is exhausted and obsolete disposal sites close, resource recovery will play an even more important role in how local governments meet their daily disposal needs.

In addition, is necessary to clear up a frequent misconception. It is a commonly-held belief that the NYCDS continues to dispose of its refuse at sea. This misconception was evident during the infamous *Mobro* garbage barge crisis of 1987. The international tour of this now famous barge with its unwanted cargo of quite ordinary waste became a symbol of the current disposal crisis. When an inquiring reporter, affiliated with a New York newspaper, asked six people where they thought the waste material taken from their homes ended up, four thought it was dumped at sea, and the other two did not know. In fact, a federal law passed in 1934 made it illegal to dispose of refuse at sea. This law became effective in 1935, some fifty-four years ago.

Bureau of Waste Disposal Marine Operation

In 1989, the Department's Bureau of Waste Disposal handled approximately 25,000 tons of refuse per day, or 7.5 million tons per year. Daily, 13,000 tons of collected waste material was hauled by barge to the world's largest landfill, Fresh Kills, Staten Island. This process requires the use of 103 Hopper-type barges, each holding approximately 600 tons of material. It is hard to envision the sight of 13,000 tons of waste unless one spends a day observing this massive operation. The NYCDS marine system, which handles this incredible waste load, is comprised of three interconnected, yet distinct, operations. They are marine transfer stations, marine transportation, and marine unloading.

Marine transfer stations

Waste loading processes are handled by eight marine transfer stations (MTS's) strategically located throughout NYC: three in Manhattan; one in Queens; three in Brooklyn; and one in the Bronx. The procedures for accepting material at all of the MTS's are essentially the same. The trucks enter the MTS by ramp onto a tipping floor, and stop at a scale where they are weighed. They then proceed directly to a cubicle situated above the barge. From this unloading bay, the trucks discharge their load directly into the barge. During the loading process, the barge is repositioned slightly in the slip, in order to even out the load and avoid high peaks.

After the barge is loaded, sanitation personnel clean the decks and deposit any loose material back into the barge. The Department has found that litter blowing from the decks during transit is one of the few ways water cleanliness can be affected; therefore, the cleaning process is carefully monitored before the barge leaves the facility. As the barge departs the slip, sanitation personnel specially trained for this assignment activate a net applicator. This device spreads a net completely over the length and width of the barge. This net cover stays on the barge during transit and is removed at the Fresh Kills Landfill during the unloading process. The Department had been studying various methods of covering barges for over a year, including the use of sprays; however, in November of 1988, the Department received a mandate to cover all barges in transit with nets by January 17, 1989. This required procedure was one result of a federal regulation, the Shore Protection Act of 1988.

Marine transportation

When the barges are fully loaded they are pushed by tug boats over the entire, or a portion of, the 27-mile route to the final disposal site, at Fresh Kills, Staten Island. Interestingly, during the *Mobro* garbage crisis, the NYCDS had reports of its barges being seen as far south as Cape May, New Jersey; however, the Department had marine dispatchers in constant communication with the tugs hauling the waste material. The dispatchers were also in constant contact with the eight MTS's and the NYCDS headquarters operation control office. All of these offices work twenty-four hours per day, seven days per week.

For the purpose of coordination, the marine dispatcher oversees the entire marine operation. At any given time the dispatcher knows the location of a barge, whether it is moored or traveling, loaded or empty. This communication network provides the Department with the location of all barges at all times. Once the barge arrives at the marine unloading plant at the Fresh Kills landfill it must pass through a series of booms to enter the actual unloading area. The booms are floating devices, which extend from one shoreline to another in the narrow waterways of Fresh Kills. Each boom has a fifteen-foot net (skirt) attached to it, which releases below the waterline to prevent floatables from escaping from the facility into the waterways outside of the controlled unloading area.

The Department has a carefully monitored "lock" system for controlling the opening and closing these booms to ensure that no two booms are ever opened at the same time. By operating in this manner, the Department has found the booms effectively contain litter in a specific area for immediate clean-up by our sweeper boats.

Marine unloading

At the unloading area, extensive efforts are in place to keep the waterways clean. To ensure material does not enter the water, the Department has designed and constructed special devices, referred to as gangplanks, which bridge the small gap between the bulkhead and the barge. This device successfully catches material falling from the crane's bucket as the material is passed from the barges to the land-based Athey wagons that haul waste material to the active bank. The Athey wagons are placed a minimum of thirty feet behind the bulkhead to prevent material from blowing into the water during the unloading process. This unloading operation may be completely stopped several times during the day to ensure the operation is completed in the cleanest manner possible. Still further, the Department deploys a minimum of three sweeper boats, twenty-four hours per day, to retrieve small quantities of litter which may have entered the water during the unloading process. A separate work boat is utilized to open and close the boom "lock" system as required for barge movement.

Future unloading techniques

The Department is currently evaluating two new methods of unloading barges: using hydraulic-type cranes, and using rubber tire vehicles or dump trucks. The new operating methods may demonstrate that the hydraulic crane has improved bucket control, and this may result in less waste material loss during the unloading process. Tests on the productivity aspects of this type of crane were in the early testing stages in 1989. The Department is also evaluating the possible use of heavy-duty rubber tire vehicles in place of hauling vehicles pulled by tractors and designed to travel unpaved roadways. The proposed new rubber tire vehicle requires that the Department build hard surface roads for travel to the active banks. The Department has already found considerably less litter falls off these trucks en route to the active bank, as material falling off a vehicle has the potential to eventually find its way into the water.

It is a pleasure to report that three separate groups, the New York State Department of Environmental Conservation (NYSDEC), an independent monitor, and the NYCDS's own water-quality monitoring team stated that the Department has taken many positive steps which have proven effective to both prevent and mitigate water-borne litter. The Department realizes it must do even more; therefore, continuing efforts are being carefully monitored to ensure full compliance with the NYCDS's extensive water cleaning efforts.

Other potential sources of floatables

There are other potential sources of floatable wastes that should be addressed individually. The New Jersey Floatables Study: Possible Sources, Transport, and Beach Survey Results, prepared by the New Jersey Department of Environmental Conservation (NJDEC) in November, 1987, stated "[b]each litter is not always found on the beach where it was left. High tides can remove litter from one beach and ocean currents can carry it to other nearby or distant beaches."

Sewage discharges. A large amount of the material that ended up on New York and New Jersey beaches consisted of items typically flushed down a toilet such as condoms, tampon applicators, and needles. It is reasonable to assume that sewage items could also be a source of floatables.

Storm drains. Storm drains collect runoff from rain or snow and discharge stormwater directly into waterways. Intense storms can pick up refuse from the streets, such as plastic, paper, and glass containers and packaging material.

Combined sewer overflows. In NYC and New Jersey, street runoff is passed through a combined sewer that carries municipal and industrial waste to sewage treatment plants. Again, heavy rains may cause the sewers to exceed their capacity and carry floatables into the waterways; therefore, combined sewer overflows (CSO's) are a feasible source of floatable wastes.

Commercial shipping and recreational boating. The NJDEC (1987) report indicates that commercial vessels ". . .represent a relatively constant source of floatables. Commercial and recreational vessels can be a source of floatable litter, dunnage (material used to hold cargo in place) and kitchen and sanitary waste." The report also concludes that recreational boaters contribute more to the floatable problem than commercial vessels during the summer months because of the vast numbers of recreational boaters in the region at that time. In addition, recreational boaters dump wastes closer to the shoreline; therefore, materials are more apt to reach the land mass.

Illegal discharges and dumping. The NJDEC (1987) report admits it is difficult to pinpoint illegal dumping as a major cause of floatables, as a result of insufficient documentation. The report does state, however, that part of the problem in apprehending illegal dumpers is that there are so many places, both in New York and New Jersey, where one could dump illegally.

Marine municipal refuse transfer facilities. When the NJDEC (1987) floatable study refers to the NYCDS marine system, it identifies the Department as a potential source of floatable materials, rather than a definite contributing source. It is probably because the NJDEC has considered the many safeguards the NYCDS has in place. It is important to mention that the NJDEC report was issued in November, 1987, which was before the NYCDS had gangplanks, nets, and many of the other innovative procedures since put in place.

Ocean dumping and wood burning. There is little evidence that the dumping of sludge contributes to floatables. Floating wood is burned to control the amount of floatables in the New York-New Jersey Harbor. Permits require wood burners to retrieve wood materials lost from their barges, and this policy reduces the amount of wooden floatables that may have previously come from wood burning sites.

There is sufficient evidence to identify each of the above-mentioned sources as contributors to the floatables problem; however, no individual source can be identified as the primary source of the problem. The NYSDEC (1988) report Investigation: Sources of Beach Wash-ups in 1988, reached the same conclusion--that no single source can be considered the exclusive source for the washups of 1988.

Medical waste materials

The needles and other potentially infectious wastes that washed up on New York and New Jersey beaches during the summer of 1988 were of national concern. However, only a small amount of the material, approximately ten percent, was considered medical waste. In addition, effective January 1, 1986, an amendment to local Law 57 prohibited any and all material emanating from a hospital to be disposed of at any New York City landfill. All materials, including cafeteria and paper waste from administrative offices, must be incinerated in a municipal incinerator.

Since this amendment was instituted, NYC has processed more than 120 cases of medical waste violations at NYCDS incinerators, but not one was the result of material found at the marine unloading plant. As of 1989, adjudicated penalties to violators have resulted in approximately $700,000 in fines. In addition to imposing fines, the Department suspends collection and disposal services to the offending hospital.

Conclusion

The NYCDS has taken, and will continue to take, immediate steps to reduce the possibility of contributing to the problem of floatable wastes in the oceans. As discussed, the NYCDS has made a substantial investment in new technology, personnel and equipment to address and remedy this critical environmental concern. The public certainly does not want to see a repeat of the 1987 and 1988 incidents that closed the beautiful New York and New Jersey beaches for the summer.

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Impact of Environmental Issues on Tourism

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Introduction

I have lived on Long Island all my life--enjoying all aspects of its marine environment to the fullest. I've devoted most of my adult life to promoting Long Island and its quality of life as a "product" for economic development and in recent years, for tourism. Yet, I must admit I have learned more about this fragile environment, and what it requires to keep it functioning in the past eight months. Yesterday and today, I also learned that these needs can be met. If this conference issues no other message to the public, that is the message which must be broadcast loud and clear.

The public is frightened--not only for its own health and safety, but for the marine environment which surrounds us. . .frightened that government will not respond with adequate, effective measures. . .frightened that irreversible damage has been done. I want to thank Larry Swanson and the Waste Management Institute for providing this conference enabling speakers to give evidence that we are meeting the challenge. I want to thank the speakers for their frank and thoughtful presentation.

Most importantly, I hope I will be able to thank the media for providing full, enthusiastic, factual, encouraging and accurate coverage of these proceedings. The media, after all, have done more to contribute to the fears of the public than was produced by any bag-full of medical debris or any temporary closing of a beach facility in 1988.

My hope for the media is that those who report on conditions in our environment or even single incidents of materials washing ashore will recognize, as I have come to recognize, that anything which affects our marine resources has a direct effect on all elements, all aspects. . .all activities which occur or relate to Long Island. Every word which is written or spoken has a direct impact upon our quality of life, our economy, and, to a large extent, our ability to address these challenges.

My specific area of concern is tourism. It is measured by the movement of people and their expenditures. Currently, tourism represents twelve percent of the world economy--and it's growing. On Long Island, tourism had been projected to become the largest contributing economic activity in 1988, expected to produce an impact of over $8 billion in the bi-county economy and to provide more than $100 million in related sales taxes for Nassau and Suffolk Counties. Based on a healthy ten-year growth rate and unusually high pre-summer requests and reservations, predictions of a record year were reasonable indeed.

Instead, Long Island suffered its first decline in a decade and recorded tourism activity for 1988 that was 18% lower than that of 1987. Like the environment, tourism is fragile, dependent on outside influences and unrelated circumstances. Yesterday's inventory of hotel rooms, airline seats, unchartered buses and limousines, restaurant and theater seats cannot be sold tomorrow. These are the most perishable commodities in the marketplace. Left unsold and empty, they must be recorded as "lost." To a business which depends on tourism, each day provides a new inventory which must be marketed, sold and serviced. The unsold and unused portion is a business loss, and represents an economic loss to the region which cannot be regained.

Long Island and its visitor industry businesses suffered extreme losses in 1988. Lodging was down, concessions were down, restaurants were down. Some in the recreational fishing fleet reported losses as great as eighty-seven percent. Area attractions which have not direct affiliation to the shoreline or the beaches reported business at "fifty percent of normal."

The majority of the businesses associated with tourism are small firms, not-for-profit organizations and municipally-supported entities. All are ill-equipped to deal with the onslaught of media coverage of a "crisis" such as we experienced in 1988. These are the hoteliers, charter captains, and others who "know" that if a bad weekend weather report is broadcast on Wednesday, bookings for the coming weekend, which they have had reserved for months, will cancel.

A cloud in the sky on a summer weekend can discourage business; temperatures which are too hot or too cold can influence tourism activity. What, then, will the image of garbage floating up on the region's beaches do during the all-too-short summer visitor season? There is no question of the impact it had--and some five million visitors proved that point in 1988 by turning elsewhere for their recreational/vacation pursuits.

Anything which pollutes the sea around us is an environmental concern. Whether garbage or an oil slick; coliform levels or oxygen levels; unexplained algae or the sighting of an unusually high number of dead and dying sea creatures--there is indisputable evidence that our marine environment demands our attention.

That concern for the environment, however, is mated with an equal concern for the economic realities of society. Failure to maintain the facilities which attract and serve the visiting public would--and should--attract an outcry of dismay and indignation. If our beaches were not well-maintained, our golf courses not well-manicured, our museums and our theaters not professionally staffed and directed, our hotels and resorts not carefully managed in a style expressing hospitality and comfort, the traveling public would have every right to complain and to justifiably avoid Long Island as a destination. The opposite is the case, however, and the traveling public has identified Long Island as the destination of choice.

What drove visitors away in 1988 was not merely the appearance of garbage on the beaches, but fear of what that garbage might contain. What the public reacted to were reports that the garbage included medical wastes and an occasional syringe, and the suggestion that the syringes might be infected with the AIDS virus. Few if any reports pointed out that the total volume of floatable material coming ashore was less than in previous years. To my knowledge, none reported on the actual number of syringes, or differentiated between medical waste and other debris discovered along the seashore. As the summer moved on, most reports, in fact, failed to point out the wide variety of reasons for individual decisions to close various beaches to swimmers. That was left to the public's own imagination, and the public chose to believe the worst.

The public beaches which are traditionally populated by visitors through the summer months were closed for only a few days during the entire summer. The media offered the public no accurate perspective. Whether it was five miles of New Jersey's 127 miles of shoreline which were closed for two weeks, or six miles of Long Island's 1100 miles of shore which were closed for a brief period--little distinction was provided by the media. The message was clear. It was: "Don't go near the water!" Reports of beach closings failed to indicate whether it was town beaches, village beaches or private beach being closed, thus the public believed that all beaches were unsafe.

The reaction went further. The public came to believe that anything associated with the waters which surround us must be unsafe. They not only stopped fishing; they stopped eating fish. They not only avoided the seaside pavilions; they stayed away from the golf courses on the bluffs.

Ocean dumping must be controlled and strictly limited. Waste disposal of all types must be carefully monitored and regulations scrupulously enforced. Our ocean environment must be preserved and protected. Long Island's natural shorefront attractions must be maintained for their beauty and their recreational benefits.

At the same time, communication to the public on environmental issues must be factual and balanced, and must demonstrate a concern for the public as well as for the environment. In column upon column of newsprint devoted to the "closing" of a single beach on any given day in the summer of 1988, there was never a report offering readers information on alternate beaches which were open. There was never a report on the scores of beaches which never closed. Media spokespersons have indicated that providing such information not their job. I disagree.

There is no question that the environmental threat was the issue, and there is, perhaps, some justification for the reports of potential dangers to health and safety (although none were ever confirmed by health officials). Such reports, however, have an obligation to the public to express the extent of the problem in no uncertain terms. If all beaches are affected, that should be reported. If all 1100 miles of Long Island's shoreline is affected, alert the public. But if one or two beaches among the hundreds of miles of public beach are closed due to floatable wastes washing up from the ocean, the public should be informed of those specific closings--and the media have a responsibility to report on available beach alternatives.

The reason for the phobia which set in last summer was the public's belief that there were no options, no alternatives. They were led to believe that it was unsafe to go near the water--any water. That was simply untrue. The public's disdain for seafood was, similarly, a response to overzealous and overstated media reports which suggested that all fish were unsafe to eat. That is simply untrue.

Early indications for the coming season suggest the traveling public is aware of these untruths. Substantial advance reservations are reported in Long Island's resort areas--earlier, in fact, than has traditionally been experienced. The summer visitor is returning, encouraged by heightened efforts to protect the marine environment for his enjoyment and for the safety and protection of all who reside on this island.

The tourism industry has stepped up its promotional efforts for the coming season. In partnership with communities and industry groups throughout Long Island we will be communicating a positive, cordial invitation to the world, to come and enjoy all of our attractions, including our beaches and our fishing and other marine recreation. In partnership with various State agencies, we will be providing more extensive sources of information to enable the traveling public to be aware of beach alternatives if necessary, and to provide timely and accurate information at all times.

Other agencies have the responsibility to protect our environment, to correct shortcomings in waste management where they may exist, to monitor and safely dispose of hospital wastes, to protect the public health and safety. Those responsibilities are being met.

Our responsibility is to restore the public confidence through every possible avenue of communication and to put Long Island back on line as a highly-desired visitor destination. We are prepared and determined to fulfill that responsibility.

Rumor has it that some of the exploitative, inaccurate, misleading media reports of 1988 are currently being considered as candidates for Pulitzer Prizes. As one who began his career in journalism, I find that frightening. The media coverage has provided a positive contribution. It has focused necessary attention on a crucial issue, and has been singly responsible for brining all forces together to address and resolve this environmental crisis. For that, the media must be commended.

Its responsibility does not end there, however. We look forward to continued coverage in the media. We seek the assistance of all the media in communicating full, accurate and balanced information to the public in order that the public may be enlisted in efforts to both protect and enjoy our marine environment.