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AN ASSESSMENT OF HUMAN IMPACT ON COASTAL ECOSYSTEMS AND LIVING RESOURCES OF THE NEW YORK BIGHT

by

Carl J. Sindermann, Director
Middle Atlantic Coastal Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U. S. Department of Commerce
Highlands, N. J. U.S.A.

It is generally recognized that the nearshore waters of the oceans cannot be considered simultaneously as stable sources of living resources and as waste disposal areas. The ecosystems of the sea are resilient up to a point, but man's rapid encroachment into and degradation of inshore waters lead to fears for the continued effective productivity and use of such waters.

Environmental degradation resulting from man's activities has readily observable effects on the inshore marine ecosystems, and on the living resources which are integral parts of that ecosystem. Such effects are often negative, resulting in reduction in quantity and quality of products derived from the degraded environment. While we may feel, intuitively, that harmful changes result from environmental contamination, it is necessary to develop a body of demonstrated facts to support or refute any suppositions we may make. Vital to this development is establishment of a baseline of present information about distribution and abundance of living resources; determination of rates of change, as derived from historical data, present surveys and future monitoring; and experimental verification of effects of environmental factors such as pollutants on living organisms. Of particular importance are assessments and analyses of changes and rates of changes in environmental factors such as abundance of food chain organisms, and in abundance and distribution of fish and shellfish -- as influenced by changing environmental conditions.

The New York Bight (Figure 1), an area of the world's oceans severely degraded by human activities, is an excellent location for intensive examination of the impact of environmental changes on living marine resources, since we may learn the most from waters that we have insulted the most. The Bight is a repository of wastes from some 20 million people and countless major industries. It is the focus of the world's largest continuing ocean dumping operation. In 1973 some 4.4 million cubic meters of sewage sludge, 2.85 million cubic meters of industrial wastes, and more than 5.0 million cubic meters of dredge spoils were dumped in the ocean waters of the Bight from 10 to more than 160 kilometers offshore. It has been estimated that 80% of all U. S. ocean disposal of municipal sludge and industrial wastes takes place in the New York Bight.

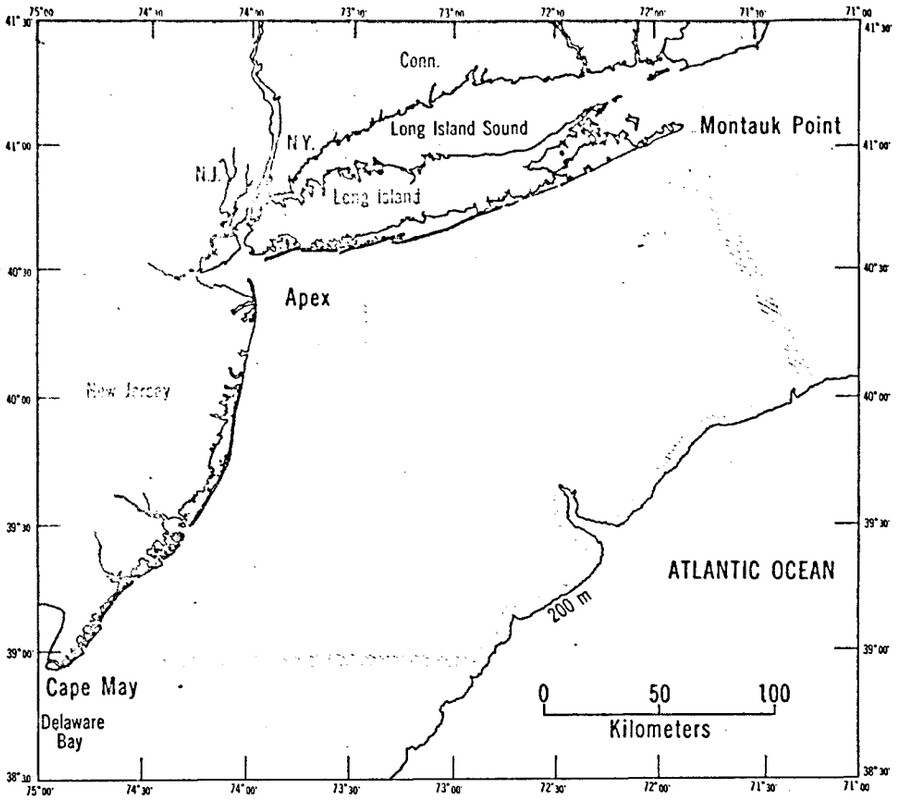


Figure 1. New York Bight

Interestingly, the New York Bight is much more than a dumping ground. Commercial and recreational fisheries are carried on in these waters. Part of the shore of the Bight apex is the location for the Gateway National Recreation Area project of the U. S. Department of Interior, which seeks to provide ocean-oriented recreation for millions of area residents. It was estimated, for example, that 4 million people visited New York ocean beaches on July 4, 1974. The New York Bight apex is also a major thoroughfare for marine commerce, crossed by some of the most heavily traveled shipping lanes in the world. The problems arising from the often conflicting present uses are severe enough, but the future is further complicated by a host of proposed major developments -- offshore nuclear power plants, offshore oil drilling, superports, deepwater oil terminals and artificial islands.

Faced with problems and opportunities for understanding of such awesome proportions, the National Oceanic and Atmospheric Administration (NOAA) of the U. S. Department of Commerce began in 1973 an ambitious program called MESA (Marine Ecosystems Analysis), with initial emphasis on the New York Bight. Other coastal areas were identified for future projects of similar scope. Objectives of the New York Bight Project were identified as follows:

1. Determine the fate and effect of pollutants on the New York Bight ecosystem, with particular emphasis on ocean dumping.

2. Quantify on a broad scale the environmental factors involved in the location, design, construction and operation of major offshore facilities.

3. Identify and describe the important subsystems, processes and driving forces operating in the New York Bight as a whole, defining their interrelationships and rates of change.

NOAA, as the federal agency concerned with the quality, quantity, and effective management of living marine resources, must address itself specifically to those environmental factors such as pollution which affect the resources negatively. On the other hand, there may be positive effects of man's activities on ocean resources (such as increased growth rates or increased productivity) which must also be examined. The intimate relation of ocean ecosystems with production of food makes it imperative that a broad approach to marine environmental problems be maintained.

The National Marine Fisheries Service, one of the principal operating units of NOAA, has had substantial ongoing research in the New York Bight, and has been given primary responsibility for development of biological data relevant to the general objectives. The biological program for the New York Bight contains the following principal elements:

(1) Establishment of biological baselines by an intensive examination of distribution and abundance of resource and food chain organisms; and determination of rates of change in populations by compilation and analysis of existing historical data, as well as data obtained by ongoing and planned surveys;

(2) Description of the present levels of principal pollutants in water, sediments, and living organisms; and

(3) Determination by controlled laboratory experiments of the effects of pollutants in various concentrations on living resources, at many stages in their life histories and during various exposure times.

Studies now underway are part of the ongoing research of the National Marine Fisheries Service, part of which is done through research contracts with a number of universities.

Principal areas of biological investigation include:

1. Statistical design of sampling stations and procedures for benthic organisms, related sediments, and demersal fish;

2. Benthic respirometry, measuring seabed oxygen consumption and mapping present rates of decomposition of organic wastes occurring as a result of biological and non-biological processes;

3. Detailed surveys of benthic macrofauna and meiofauna, to provide data on species abundance, diversity, and biomass;

4. Microbiological studies, concentrating on abundance of bacterial populations as related to organic content of sediments, and on bacteriological aspects of fin rot disease of fish;

5. Plankton and primary productivity studies, emphasizing comparisons of impacted versus unimpacted zones;

6. Resource surveys (fish and shellfish) concentrating on relative distribution and abundance of economic species;

7. Distribution and abundance of contaminants (especially heavy metals) in sediments, food chain organisms, and resource species;

8. Field and experimental studies of mutagenesis as possibly affected by environmental contaminants; and

9. Experimental studies and field observations of the effects of contaminant stress on the behavior of fish.

Data acquired in the first year of the work, as well as that developed in numerous but less intensive studies in the past, have already pointed to some preliminary biological conclusions of significance:

1. Benthic communities in the dumping zones and adjacent areas have been drastically reduced in species diversity and biomass, as compared with more peripheral areas.

2. Meiofaunal indicators of environmental degradation (amoebae, ciliates, foraminifera, nematodes) have been recognized, and interesting trophic relationships (especially with ciliates) discovered.

3. Antibiotic and heavy metal resistance in pollution bacteria, and indications of transfer of resistance to marine bacteria have been recognized.

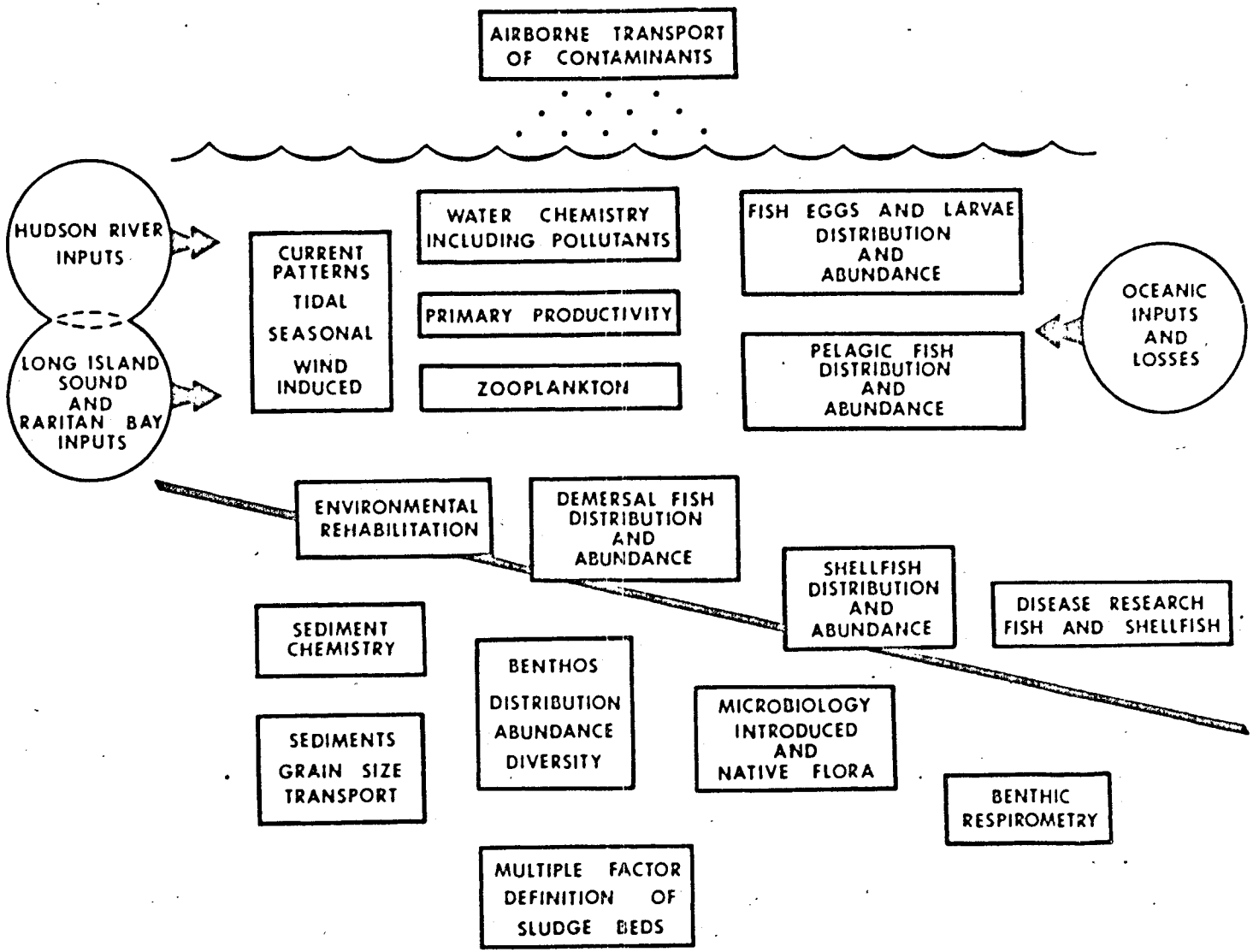
4. The occurrence of "fin rot" in fish, and of gill abnormalities in crustaceans has been described, and quantitative surveys have indicated that the prevalence of fin rot is significantly higher in the Bight apex than in adjacent continental shelf areas.

5. Trawling surveys in the Middle Atlantic Bight have provided preliminary indications of lower fish biomass in the apex area as compared with adjacent shelf areas of comparable size.

When biological information is combined with that developed by other NOAA components -- physical and chemical oceanography, sediment analyses, etc. -- it should be possible to (1) provide greater understanding of the impact of existing man-induced changes on living marine resources; (2) describe the effects of particular contaminants singly or in combination on living organisms including specific aspects of disease; and (3) develop an initial predictive model for use in the Bight and elsewhere of the impact of pollutants on marine ecosystems.

Other federal agencies (Environmental Protection Agency, Food and Drug Administration of the Department of Health, Education and Welfare, U. S. Army Corps of Engineers, Atomic Energy Commission) are conducting (or are supporting by contract) specialized research in the Bight. The composite effort should make it possible to correlate all existing data and to add significantly to it, to provide a much clearer understanding of man's impact on the nearshore environment and its resources. Information should be of significant value to many user groups, including ocean industries of all kinds, sewage treatment districts and engineers; municipal and regional land and water use planners, Environmental Protection Agency (EPA), Food and Drug Administration (FDA), Corps of Engineers, River Basins Commissions, state fisheries and environmental management departments, citizen conservation groups, fishermen and fishery industries, and groups concerned with developing predictive models of ocean systems.

NEW YORK BIGHT — — RESEARCH REQUIREMENTS



PRINCIPAL HUMAN POLLUTANT INPUTS NEW YORK BIGHT