SUFFOLK COUNTY'S HARD CLAM INDUSTRY

AN OVERVIEW AND AN ANALYSIS

OF

MANAGEMENT ALTERNATIVES

A Selection of Sections[1]

From
The Preliminary Report of a Study
by the
Coastal Ocean Science and Management Alternatives (COSMA) Program

of the

Marine Sciences Research Center
State University of New York

30 April 1985

---

[1]The sections contained in this report were taken directly from the full report.

Working Paper No. 13

Reference 85-4

Approved for Distribution

J.R. Schubel

J.R. Schubel, Director

TABLE OF CONTENTS

LIST OF FIGURES

HARD CLAM MANAGEMENT ALTERNATIVES WORKING GROUP

J.R. Schubel, Chairman
Marine Sciences Research Center
State University of New York
Stony Brook, NY

Stuart Buckner
Town of Islip
Islip, NY

Harry Carter
Marine Sciences Research Center
State University of New York
Stony Brook, NY

Gordon Colvin
New York State
Department of Environmental Conservation
Stony Brook, NY

DeWitt Davies
Long Island Regional Planning Board
Hauppauge, NY

Kenneth Feustal
Town of Babylon
North Lindenhurst, NY

Jeffrey Kassner
Town of Brookhaven
Patchogue, NY

Lee Koppelman
Long Island Regional Planning Board
Hauppauge, NY

Robert Malouf
Marine Sciences Research Center
State University of New York
Stony Brook, NY

Bonnie J. McCay
Rutgers University
New Brunswick, NJ

J.L. McHugh
Marine Sciences Research Center
State University of New York
Stony Brook, NY

Scott Siddall
Marine Sciences Research Center
State University of New York
Stony Brook, NY

Lawrence Taylor
Lafayette College
Easton, PA

William Wise
New York Sea Grant Institute
Albany, NY

Pieter van Volkenburgh
New York State
Department of Environmental Conservation
Stony Brook, NY

Staff Officer

Nancy Helm
Marine Sciences Research Center
State University of New York
Stony Brook, NY

ACKNOWLEDGEMENTS

This report was prepared with support provided by Suffolk County, New York through the Suffolk County Planning Commission, and by the William H. Donner Foundation. During the course of the preparation many individuals and organizations assisted the members of the Working Group by providing data and information. We would like to thank all of of them for their time and effort. Valuable assistance was provided to us by: Stanley Czyzyk and other hatchery personnel of the Blue Points Company; David Relyea, F.M. Flowers & Son; Richard Koopman, Town of Huntington; John Plock Sr., Shelter Island Oyster Company (retired); The Huntington Historical Society; Huntington Public Library; Robert Nuzzi, Suffolk County Health Department; Al Johnson, Long Island Oyster Company; James Redman, New York State Department of Environmental Conservation; Edward Carpenter, Marine Sciences Research Center; Frank Hyland, Long Island State Park and Recreation Commission; Emil Usinger, President, Blue Points Company; The Islip Harbor Police; Judge Kenneth Rohl, Suffolk County Court; and the supervisors and bay management personnel of the Towns of Suffolk County. Special assistance in preparing sections of this report was provided by: Richard Ottersteadt, New York State Department of Environmental Conservation; Gail Critchlow; William Jenks, and Ronald Mendrick. Appendices A and B were prepared by Jon Conrad, Cornell University and Robert Cerrato, Marine Sciences Research Center.

Research assistance was provided by MSRC graduate students Paul Dube, Gregory Marshall, Robert Nyman, and Jack Sobel. Graphics services were performed by Marie Eisel, Marie Gladwish, and Vivian Rieger. The report was typed by Theresa Crescimanno and Lisa Mayer.

COSMA: An Overview

The Coastal Ocean Science and Management Alternatives (COSMA) Program was initiated by the Marine Sciences Research Center in 1982 with support from the William H. Donner Foundation. The goal of COSMA is to improve coastal management. COSMA concentrates on two different kinds of activities: on developing new and more effective ways of using scientific and technical information in environmental decision making, and on analyzing important coastal problems of regional, national, or international scope by bringing together scholars from different disciplines and from different institutions.

COSMA is a vehicle to bring together scholars to respond effectively to problems of coastal marine environments which result from society's uses of those environments. The Program is not intended to provide a home for scholars to select problems that interest them. The problems will be used to "select" the problem solvers rather than the reverse which is the way most academic institutions operate. To succeed, the Program must attain and sustain a good match between the problems and the problem solvers. This can be done only if there is great flexibility in the selection of problem solvers. The structure of COSMA ensures the potential to match problem solvers with problems. The most pressing environmental problems are interdisciplinary, and can be resolved only by teams of specialists working within their own disciplines but in close and carefully orchestrated coordination.

Several criteria are used in selecting problems for study through COSMA. Problems must be related to the coastal marine environment. They must be important problems whose solutions are truly interdisciplinary. The prospects should be good that the problems will be tractable with the resources in talent, time, and money that are available to the Program. Not all important problems are tractable. There will be no shortage of appropriate problems. The difficulty will be in selecting among them.

Once a problem has been chosen and the problem solvers selected, the next step will be to identify the full range of plausible alternative ways of dealing with it. Then a rigorous assessment will be made of the environmental, economic, socio-political and public health effects associated with each alternative. After this analysis is completed, the results will be cast in forms appropriate for decision making; forms that facilitate comparison of the advantages and disadvantages of each of the alternatives and selection of the most appropriate alternative.

MAJOR FINDINGS

- Hard clamming as a major industry has developed relatively recently in Great South Bay (GSB).

  Justification: Until the 1930s the oyster industry was the major shellfishery in GSB. Environmental changes in the Bay caused oyster stocks to decline while hard clam stocks increased.

- Many current management practices and attitudes can be traced to the oyster fishery.

  Justification: The restriction of harvesting to hand operated equipment and the planting of adult brood stock both began in the oyster industry in the 19th century. The present attitude of baymen toward leasing can be traced to the 1890s when the fishery was dominated by a small number of large lease holders.

- Maximum hard clam harvest from GSB occurred in 1976. Since then landings and stocks have decreased.

- Possible reasons for the decline in hard clam abundance include: over-fishing, removal of clams from uncertified areas, harvest of seed clams, increase in Bay salinity, deteriorating water quality, and reduced reproductive success.

- During the period 1975-80, the hard clam resource in Great South Bay was overfished, i.e., harvested at a rate that exceeded recruitment.

  Justification: It has been shown that for the period 1975-80, harvesting mortality exceeded natural recruitment.

- Some mechanism is needed to control harvest if overfishing is to be prevented.

- A system of transferable quotas is one of a variety of mechanisms that could be used to control the total harvest and apportion it among harvesters.

- Water body-wide management would make sense from economic and ecological points of view.

- Hard clam harvest from Suffolk County's north shore bays and from the Peconic Bays is low relative to Great South Bay, but at its peak (1961-63) Huntington Bay provided nearly half of New York's total hard clam landings.

- The decline in harvest from Huntington Bay is due to a combination of factors including, but not necessarily limited to, large-scale harvest of seed clams in the early 1960s and increases in the area closed to shellfishing.

Justification: Recollections of baymen from the period and newspaper accounts indicate that large, illegal harvests of seed clams did take place in the early 1960s. Total closed area in Huntington Bay has increased since 1960 and some of the new closures were in very productive areas.

- Hard clam density in the Peconics is much lower than the average density in GSB.

  Justification: New York State Department of Environmental Conservation (DEC) surveys show hard clam densities as high as 1.6 clams/m^2 in only a few areas of the Peconics. Buckner's (1984) report shows an average density of 5 clams/m^2 in certified areas of Islip waters.

- The status of Moriches Inlet and runoff of wastes from duck farms have been major factors influencing hard clam production in Moriches Bay, although there never has been a major hard clam fishery there.

  Justification: During periods when the Inlet was closed (prior to 1931 and from 1951 to 1953) poor flushing allowed duck wastes to build up in the Bay. This led to the closure of large areas to shellfishing and poor quality of the clams even in open areas.

- The limited hard clam production in Moriches Bay, at present, may be the result of a lack of setting rather than in inability of the Bay to support growth of hard clams.

  Justification: Turner (1983) found that the growth rate of hard clams is greater in Moriches Bay than in GSB. Carter has hypothesized that the residence time in most of Moriches Bay is less than the length of the planktonic larval stage of hard clams (see Spawner Sanctuaries, this volume). The coves in Moriches Bay may have sufficient residence time, but their clam stocks are depleted.

- Prior to 1938 there was no hard clam fishery in Shinnecock Bay because salinity was too low as a result of the lack of an inlet between Shinnecock Bay and the Atlantic Ocean.

- Hard clam production in Shinnecock Bay at present is low relative to that of Great South Bay.

- Development of vacant and agricultural land coupled with population increases in Suffolk County projected for the next 35 years will place additional stress on the environment which could have ramifications for the County's shellfish resources.

  Justification: The impacts of development on water quality could affect adversely spawning, survival, and growth of hard clams. The number of potential recreational and commercial harvesters will increase. The

acreage closed to shellfishing in the County is likely to increase over the long-term, but it is not known by how much.

- Certain controls on the hard clam fishery are required even without any concern for the future of the fishery.

  Justification: To ensure compliance with Federal regulation of interstate shipment of shellfish, an adequate enforcement program is required to prevent harvest from uncertified areas.

- An appropriate minimum legal size limit should be determined and enforced to protect the spawning potential of natural stocks of hard clams. The addition of a maximum legal size would further enhance reproductive capacity.

  Justification: Small clams must be protected from harvesting to ensure that they reach reproductive age. An upper limit on the size would further enhance the reproductive capacity of the resource because cherrystones and chowders produce many more eggs than smaller clams.

- It is a virtual certainty that the hard clam fishery will not spontaneously rejuvenate. Without changes in existing management practices, it is unlikely that the fishery will recover and be stabilized.

  Justification: Under present circumstances the clam harvest, in the long run will continue to decline. The

decline will not be regular because setting will vary due to natural conditions. Since the industry is capable of exploiting a new set as soon as it reaches legal size occasional large sets will not contribute to a sustained population.

- Present regulations on hard clam harvesting have not restricted the total harvest to a level the resource can support.

  Justification: New York State production of hard clams, most of which come from Suffolk County, dropped from 9 million pounds of meats in 1977 to less than 3 million pounds in 1984

- Restricting the number of participants in the fishery (limited entry) and setting total catch quotas are two management measures that have not been used, but which could be used to control total catch of hard clams in Suffolk County waters.

- Implementation of any management strategies which would limit entry to the hard clam fishery would be controversial and would require courageous action by decision makers. Any limited entry program would require effective enforcement which would be costly.

  Justification: The prevailing sentiment among baymen is to oppose any attempt at limited entry. These baymen are a persuasive and politically powerful group. Additional problems would result from the

increased enforcement costs if a limited entry program were instituted.

- Any over-all fishery management program that does not maintain a healthy resource is a failure.

  Justification: If management programs do not ensure that stocks are maintained at levels which can sustain the harvests taken, the resource will decline, landings will fall, and the number of baymen who can expect to make a reasonable living will decrease.

- Sustainable yield is defined to be the level of harvest that the stock can support over an extended period. Reliable estimates of the sustainable yields of hard clams are unavailable for any of Suffolk County's bays. Only for the Town of Islip is such an estimate available.

  Justification: Estimates of sustainable yields have been made for Great South Bay but the information upon which they are based is inadequate for that purpose. Stock assessments carried out by the Town of Islip offer an empirical basis for determining sustainable yields for that Town's waters.

- Individual towns could institute limited entry programs for hard clam fisheries in town waters by themselves or in cooperation with the State Department of Environmental Conservation. In either

case, the question of issuing permits to harvest other species of shellfish would have to be resolved.

- Seed planting programs are popular among baymen and most town officials as a hard clam management alternative.

- Although seed planting may not be practical as a method for producing a substantial increase in the number of clams available for harvest, it may be useful in enhancing and maintaining recreational fisheries in small areas, and under certain conditions, in rehabilitating stocks for commercial harvest in selected and restricted areas.

  Justification: If specific criteria are met, seed planting could be used to rehabilitate an area in which stocks have been reduced below harvestable density. Such an area should have--in addition to reduced stocks--a combination of biological and physical factors which make successful recruitment infrequent, and characteristics which permit a survival rate of at least 10% from 25 mm to littleneck size.

- A rigorous assessment has never been made, for any relatively large-scale town program, of the survival of planted seed clams and their overall contribution to harvestable stocks.

- It is very unlikely that seed planting programs of the scale now carried out can contribute in any significant way to total harvest. Typical town seeding programs would have to be increased by at least ten-fold, and perhaps by as much as one hundred-fold, to make a significant contribution to total harvest.

  Justification: Total annual hard clam harvest for a town on Great South Bay is currently about 100,000 bushels. A typical town seed planting program would plant about 2 million seed clams at 25 mm. Even if 100% of the seed planted were harvested as littlenecks, the town's annual harvest would be increased by only 4%. A more realistic survival rate would be 15% which would result in an increase in landings of less than 1%.

- Seed planting should be evaluated rigorously as a hard clam management alternative. The evaluation must include three primary criteria: the effectiveness in achieving the goals of the program, the scale of the program, and the costs of the program.

- The spawner sanctuary concept is a refinement of the spawner transplant program. A spawner sanctuary is an area stocked with large, fecund hard clams to enhance fertilization of eggs, and which is located so that it will enhance the set of sanctuary produced larvae in preselected areas which are capable of sustaining good growth and high densities.

- The recent development of numerical (computer) models to simulate the flow fields of coastal embayments makes it possible to select sites for establishment of spawner sanctuaries which will supply larvae to preselected target areas with an accuracy not previously possible.

- The evaluation of the spawner sanctuary management alternative should be based on its contributions to standing stocks in, or harvests from, the target areas over a period of at least five years.

  Justification: Once stocked, and if poaching is not excessive, the original brood stock should remain fecund for five years, on the average (based on current knowledge of survivorship and fecundity), during which it should contribute to standing stocks.

- It is unlikely that any of the north shore bays is a good candidate for spawner sanctuaries, although information needed for a rigorous assessment is not available.

  Justification: The large tidal exchange between the north shore bays and Long Island Sound, relative to the volumes of these bays, indicates that the residence time of water is probably 7-8 days rather than the 20+ days needed for establishment of an effective sanctuary. Residence times of these bays could be determined with dye release studies.

- Shinnecock and Moriches Bays probably are more appropriate for establishment of spawner sanctuaries than the north shore bays, but less suitable than Great South Bay.

  Justification: Because the residence times of water of Moriches and Shinnecock Bays are greater than those of north shore bays, the former are more suitable for establishment of spawner sanctuaries than the latter. Moriches and Shinnecock Bay are somewhat less appropriate for establishment of spawner sanctuaries than Great South Bay because they are smaller and have shorter residence times. A suitable model and data base exist to evaluate the potential of Moriches Bay for spawner sanctuaries and might also be used to evaluate Shinnecock Bay because the two bays are similar.

- There are four basic selective closure strategies: (1) closing areas until most small clams reach harvestable size; (2) closing areas after some prescribed optimum yield has been reached; (3) closing areas until the harvestable population reaches some minimum threshold level, and (4) closing nearshore areas to ensure a winter grounds for harvest during inclement weather.

- The choice among selective closure alternatives will depend upon the goal of the management plan. Selected closure can be used alone or in combination with other management alternatives.

- All types of selective closure need to be combined with population assessments as an integral part of the management program.

  Justification: Population surveys must be conducted prior to closing to determine stock size plus recruitment and mortality rates. Additional (annual) surveys are needed to monitor the rate at which stock rebuilds. Even closures to maintain winter harvest grounds require stock assessment for proper management, since the area must have an existing stock of harvestable density.

- To be optimally effective, selective closure should be combined with some type of program of limited entry, limited catch, or both.

  Justification: Maintenance of some minimum stock size in an area may be necessary for successful recruitment. If this is true, then limited harvest needs to be implemented during the period when an area is open. Limited catch might also be implemented to prevent overharvesting of areas which remain open, and to prevent uncontrolled harvest on newly reopened areas.

- Protection of clams in relatively small areas against predators may be feasible using available methods, but protection over large areas is not practical at present. Relatively little is known about hard clam predator controls. It would be useful to obtain

the information necessary to rank predators in terms of their importance on a water body-wide basis, and to understand how their importance varies under different environmental conditions.

Justification: The primary reason for considering predator control is that predation may be the most important factor controlling recruitment, although not the only one. Conditions under which predator control is not feasible or cost-effective should be known. Effective predator control will require a knowledge of each predator's life cycle, and of key or limiting factors that control predator distribution and abundance. Size-specific predation rates also should be known.

- Potential predators of hard clams are many, and vary with the size of clams. The life stages most vulnerable to predation in nature are post-set clams up to about 25 mm in length. If clams in nature are to be protected against predators, the life stage to concentrate on is early post-set clams between 4 and 25 mm in length.

  Justification: Larval and early post-set clams up to about 4 mm cannot be protected economically in the field. Once clams reach about 25 mm length they usually are much less vulnerable to predation.

- Five general methods of hard clam predator control in the wild fishery have been identified: (1) chemical methods, (2) gravel or shell (aggregate), (3) mechanical methods to collect predators, (4) fences, and (5) ecological approaches.

- Unless predation can be controlled, it is unlikely that other management approaches will be effective in increasing and sustaining enhanced stocks and catches of clams in the Peconics estuarine system. Predator control is necessary but may not be sufficient to enhance the resource in this area.

  Justification: Density of hard clams in Great South Bay appears to be about ten times that in the Peconics. There are more whelks and starfish in the Peconics then in Great South Bay. The lower abundance of clams is assumed to be related to the greater abundance of large predators.

- Of Suffolk County's north shore bays, Huntington Bay supports by far the largest hard clam fishery. Landings from north shore bays are far below their peak values but provide an important contribution to total Suffolk County hard clam landings.

- Mariculture is the manipulation of all or part of the life cycle of a marine organism to enhance its production. Mariculture may be public or private in its orientation. The goal of public mariculture is to enhance natural stocks in a public fishery. The goal of private mariculture is to turn a profit. Public

mariculture to enhance stocks of hard clams for the catch fishery is encouraged by baymen and is facilitated by town, county and State governments. The development of private mariculture is discouraged by baymen and impeded by existing attitudes and regulations.

- Private mariculture is not a management alternative for rehabilitating and sustaining the wild harvest, but may play an important role in the future of hard clam production and in preservation of the traditional lifestyle of baymen.

- The environment may be manipulated to enhance hard clam production either by making conditions more favorable for the hard clam or less favorable for its predators.

- Private mariculture requires the allocation and exclusive use of segments of the sea floor. If publicly-held lands are allocated, private mariculture will compete with public sector users.

- The practices of private and public mariculture are not mutually exclusive. Public mariculture activities rely upon private mariculturists, on Long Island and elsewhere, for seed clams to augment natural stocks.

- The economic viability of hard clam culture on Long Island has not been demonstrated convincingly.

- Development of private mariculture will require a change in attitudes by government and public alike and the implementation of management plans which allocate specific areas of the marine environment among competing uses.

  Justification: The development of new private mariculture ventures in Suffolk County's coastal zone is limited by the ability of the culturist to acquire ownership, lease, or guaranteed access to coastal waters and underwater lands suitable for the enterprise. Lack of action by State and local governments and negative attitudes toward mariculture on the part of commercial fishermen, recreational boaters, and shoreline residents have tended to discourage potential mariculture developers.

- The development of private mariculture on Long Island will require guaranteed long-term access to underwater lands and/or overlying waters.

  Justification: Successful private mariculture requires guaranteed long-term access to underwater lands through sales, leases, or other mechanisms to justify the initial investment required for a private mariculture venture.

- The economic outlook for private mariculture hinges on the development of technical advances which improve growth and survival during growout, and recovery at harvest.

Justification: The profitability of hard clam mariculture primarily depends upon the cost of seed clams and the recovery of market size clams. At the current retail price for littlenecks, 15-20% of the planted seed must be recovered after 2-3 years of growout just to cover the costs of seed production. Higher rates of survival to harvest must be achieved to cover all costs and provide a profit, yet documented estimates of survival to 50 mm rarely exceed 15% and often are less than 1%.

Development and maintenance of effective mariculture programs--public and private--will require substantial and sustained research and development efforts comparable to those provided to the agriculture industry through agriculture experiment stations.

A SELECTION OF MANAGEMENT ALTERNATIVES

FOR INDIVIDUAL WATER BODIES

INTRODUCTION

The primary goal of this report is to provide a technical assessment of the full range of plausible management alternatives which could be used individually, or in various combinations, to revitalize and stabilize Suffolk County's hard clam industry. This industry could take a variety of forms. We have concentrated our efforts on one part of the industry, the commercial wild fishery, and have touched only relatively lightly on the recreational hard clam fishery and on the potential for the development of a hard clam mariculture industry. Our analysis has been restricted largely to a consideration of the technical and scientific aspects of the various management alternatives. We have assessed the scientific evidence to determine the extent to which these management alternatives could contribute to the revitalization and stabilization of Suffolk County's hard clam fishery, if they were applied. We have given only cursory attention to the very important socio-cultural factors which must be considered in determining which alternatives should be applied.

This choice was deliberate. Our objective has been to provide the best technical assessment we could. We have not attempted to set societal goals as to what kind of hard clam industry is most desirable, or most appropriate, for Suffolk County. That was not our task; had it been, a quite different working group would have been required. Few of the present members are qualified to express expert opinions on such matters. As Lewis Thomas points out "There are some things about which it is not true to say that every man has a right to his own opinion." The opinions expressed in this report on technical

matters, however, should be given proper consideration. They carry the force of knowledge and were arrived at only after considerable deliberation. As knowledge increases, the choices may change. The likelihood of selecting the best--most appropriate and effective--management strategies could be increased by conducting studies designed to fill important data and information needs outlined elsewhere in this report.

In the development of a comprehensive management plan, which is to be accomplished in Phase II of this study, the technical analysis will have to be combined with a socio-economic analysis and presented in the context of societal objectives and goals for Suffolk County's hard clam industry. The technical analysis provides the basis for selecting management strategies to maximize the likelihood of achieving those goals once selected.

In this section, we present for individual water bodies in Suffolk County a list of those management strategies which, based on our technical analyses, we believe in the aggregate would be most likely to be successful in maximizing, on a continuing basis, the yield of hard clams from that water body. The reason for selecting the goal of Maximum Sustainable Yield for management is that one must choose some goal and by maximizing the sustainable yield of hard clams, one maximizes the number of possible choices of societal objectives and goals which are attainable for a hard clam industry. While some management strategies are common to programs for all water bodies, other are not.

An integral part of any management program should be a mechanism to provide an on-going evaluation of the effectiveness of the over-all

program and the extent to which each individual management component contributes to the success (effectiveness) of the over-all program. Such evaluation is required for the programs outlined on the following pages.

- Conduct stock assessments throughout the Bay designed to provide reliable information on the population dynamics of the resource.

- Establish spawner sanctuaries free of the constraints of town boundaries.

- Develop a plan of alternate openings and closing of harvest grounds to limit total harvest and to spread the harvest out over the year.

- Establish a maximum legal size and retain, or increase, the present minimum legal size to ensure maximum protection of the spawning stock.

- Enhance the enforcement of hard clam laws by increasing patrols and by intensifying the prosecution of violators.

- Utilize clams in uncertified areas as a renewable resource for maintaining the spawning stock.

- Set aside a small percentage of the Bay (<10%) for controlled culture and harvest of hard clams and other species by individuals or groups.

- Encourage the formation of baymen's cooperatives to increase economic returns to baymen.

- Monitor salinity over the long-term at a small number of stations at key locations throughout the Bay to establish long-term trends which may provide insights into how changes in salinity affect standing stocks of hard clams.

- Take steps to ensure that there is no further alteration in water quality which could decrease standing stocks of hard clams or increase the areas closed to harvesting.

PECONIC BAY SYSTEM

- Conduct a research program to determine if the standing stock of hard clams is limited significantly by predation. If it is, determine whether, or not, it is possible to effectively control predation and if so, where, by what means, and at what cost.

- Conduct stock assessment throughout the Bay to provide reliable information on the population dynamics of the resource.

- Establish a maximum legal size and retain or increase the present minimum legal size to ensure maximum protection of spawning stock.

- Enhance the enforcement of hard clam laws by increasing patrols and by intensifying the prosecution of violators.

- Utilize clams in uncertified areas as a renewable resource for maintenance of spawning stock.

- Encourage the formation of baymen's cooperatives.

- Evaluate land use decisions on the basis of their potential impacts on water quality and living marine resources.

- Set aside an appropriate percentage of the Bay for controlled culture and harvest of hard clams and other species by individuals and groups. If predation limits stocks and can be controlled, an appropriate percentage might be 10% of the total area. If predation can not be controlled effectively, the percentage should be increased.

- Evaluate the impact of improvements in sewage treatment and disposal on certification of shellfish growing areas.

- Take steps to ensure that there is no further alteration in water quality which could decrease standing stocks of living marine resources or increase areas closed to harvesting.

The Peconic estuarine system contains highly variable environments, especially within the many small embayments along the margins. The efficacy of the recommended plan will change from place to place and the components of the plan will need to be evaluated separately, and in different combinations, for the various sub-environments. The strategies listed are for a commercial wild fishery. Other strategies would be selected to create and sustain a localized resource to support a recreational fishery.

MORICHES AND SHINNECOCK BAYS

- Conduct a research program to determine if the resource is limited significantly by predation, or by natural physical factors which limit setting of hard clams within the bay. If the answer to either of these questions is yes and if the factors affecting predation and/or setting cannot be controlled effectively at acceptable cost, the area allocated to mariculture should be increased above the nominal 10% recommended for Great South Bay.

- Conduct stock assessments throughout the Bay to provide reliable information on the population dynamics of the resource.

- Establish a maximum legal size and retain or increase the present minimum legal size to ensure maximum protection of the spawning stock.

- Enhance the enforcement of hard clam laws by increasing patrols and by intensifying the prosecution of violators.

- Utilize clams in uncertified areas as a renewable resource for maintenance of spawning stock. (This applies only to Moriches Bay since there are not substantial closed areas in Shinnecock Bay.)

- Encourage the formation of baymen's cooperatives.

- Evaluate land use decisions on the basis of their potential impacts on water quality and living marine resources.

- Evaluate proposals for modification and stablization of inlets on the basis of their potential impacts on water quality and living marine resources.

- Evaluate the potential of these Bays for the establishment of spawner sanctuaries.

- Monitor salinity over the long-term at a small number of stations at key locations throughout the Bays to establish long-term trends which may provide insight into how changes in salinity affect standing stocks of hard clams.

NORTH SHORE BAYS: (HUNTINGTON BAY, SMITHTOWN BAY, PORT JEFFERSON HARBOR, MT. SINAI HARBOR)

- Conduct a research program to determine if the resource is limited significantly by natural physical factors which limit setting of hard clams within these Bays. If it is and if the factors affecting setting cannot be effectively controlled at acceptable cost, the areas allocated to mariculture should be increased above the nominal 10%.

- Conduct stock assessments throughout the Bay designed to provide reliable information on the population dynamics of the resource.

- Establish a maximum legal size and retain, or increase, the present minimum legal size to ensure maximum protection of the spawning stock.

- Enhance the enforcement of hard clam laws by increasing patrols and by intensifying the prosecution of violators.

- Utilize the clams in areas which are uncertified as a renewable resource for maintenance of spawning stock.

- Encourage the formation of baymen's cooperatives.

- Evaluate the potential of these Bays for the establishment of spawner sanctuaries.

- Develop a plan of alternate openings and closings of harvest grounds to limit total harvest and spread the harvest out over the year. (This strategy probably should be limited to Huntington Bay.)

- Evaluate the impact of improvements in sewage treatment and disposal on certification of shellfish growing areas.

- Evaluate land use decisions on the basis of their potential impacts on water quality and living marine resources.

INFORMATION PRIORITIES

Significant improvements in the efficiency and effectiveness of management of Suffolk County's hard clam industry will come only through knowledge; through the utilization of existing knowledge and the development of new knowledge--new information. In a professional context information often is used as a synonym for knowledge, at least for selected knowledge. Information differs from data, from facts, in that it connotes structure or orderliness, especially of the kind that makes possible the formulation and transmission of a meaningful message. While existing information has not been utilized fully in selecting and implementing management strategies, new information is required. According to P.D. Medewar's Law of Conservation of Information "No process of logical reasoning--no mere act of computer-programmable operation--can enlarge the information content of the axioms and premises or observation statements from which it proceeds." Since information is the refined product of research, additional research is needed to significantly improve our ability to rehabilitate and to sustain--to manage--Suffolk County's hard clam industry.

The information gaps listed below are those which we believe should be given the highest priority. The criterion for selection is the potential contribution each could make to improved management for each dollar invested. In some cases, constriction or closure of these information gaps requires additional research; other cases do not. The individual items are not ranked.

SOME IMPORTANT INFORMATION GAPS
WHICH CAN BE FILLED WITHOUT ADDITIONAL RESEARCH

- Evaluation of existing information is needed to select an appropriate maximum legal size, and a re-evaluation of the present minimum size is needed to provide further protection for the spawning stock (This evaluation should include social and economic, as well as biological considerations).
- A rigorous evaluation is needed of the options available for allocating public bay bottom to mariculture and the potential returns to the region of such allocation.

SOME IMPORTANT INFORMATION GAPS
WHICH CANNOT BE FILLED WITHOUT ADDITIONAL RESEARCH

- Stock assessments are needed which will provide reliable estimates of sustainable yields for Great South Bay and possibly other Suffolk County waterbodies.
- Research is needed to improve the knowledge of predator/prey relationships for hard clam populations in Suffolk County waters. These studies should include, but not necessarily be limited to, the effect of predation on hard clam recruitment, and life histories of major predators.
- Research is needed to improve methods of predator control.
- Research is needed to determine if there is a minimum density of adult clams necessary to encourage set of larvae in an area.
- Research is needed to assess the effects of disturbance and modification of the bay bottom on hard clam sets and survival.
- Research is needed on hard clam mariculture in the nursery and growout phases to improve the ability of nursery systems to produce large seed clams and to increase survival during growout.

- A rigorous evaluation of a large scale seeding program is needed to assess the survival rate of planted seed clams and their overall contribution to recruitment and standing stock.
- A rigorous evaluation is needed of one or more spawner sanctuaries to assess their overall contribution to recruitment and to standing stocks.
- Research is needed to determine the effects of salinity changes and long-term salinity trends on the hard clam resource.
- Research is needed to evaluate the suitability of Moriches and Shinnecock Bays (using an existing model) for the establishment of spawner sanctuaries.
- Research (using a dye release) is needed to evaluate one, or more, north shore bays to determine their potential for establishment of spawner sanctuaries.
- Research is needed to identify the relationships among population growth, land use, marine water quality, and living marine resources.
- Research is needed on toxic and pathogenic agents and substances, which may occur in hard clams as a result of marine pollution, and the threat they pose to public health.
- Research is needed to provide detailed socio-cultural information on the fishermen and the fishing industry for use in devising and implementing appropriate management programs.
- Research is needed which will lead to the development of an information system for the hard clam industry which would include biological, economical, social, cultural, and environmental information.

THE HARD CLAM FISHERY

AN OVERVIEW OF ITS PAST, ITS PRESENT CONDITION, AND ITS PROSPECTS FOR THE FUTURE

Brief History of New York Hard Clam Fishery

Prior to World War II hard clams were of secondary importance to oysters in New York. In the early days they were looked upon, for the most part, as a standby food for hard times, a food not in keeping with American culture and affluence. Even before World War II this began to change. Following a brief and rather sharp rise in prices during the later War years, and then an equally abrupt fall, hard clam landings and prices in New York began to rise rapidly in the early 1950s (Figure 1). The peak of landings was reached in 1947, when more than 10 million pounds of meats were landed. Landings fell off thereafter until in 1954 only about 2.5 million pounds were produced. They began to rise again as good sets were experienced in Great South Bay, and rose to a secondary maximum in 1976 of about nine million pounds of meats. Prices rose also, as clams became more popular, so that by 1976 the price had risen to about $1.18 per pound from a low of about $0.45 per pound in 1948 (prices expressed in standard dollars with 1967 = 100 as a base). Since 1976, production has fallen off rather steadily, so that by 1984 only about 2.7 million pounds of meats were landed.

Prices continued to rise until 1980, but thereafter, despite the substantial drop in production, prices fell. This was probably caused partially by competition from other states, but also was due to a drop in consumer confidence caused by a pollution scare in 1982 and early 1983. From the peak in 1947 to the low in 1984, hard clams have

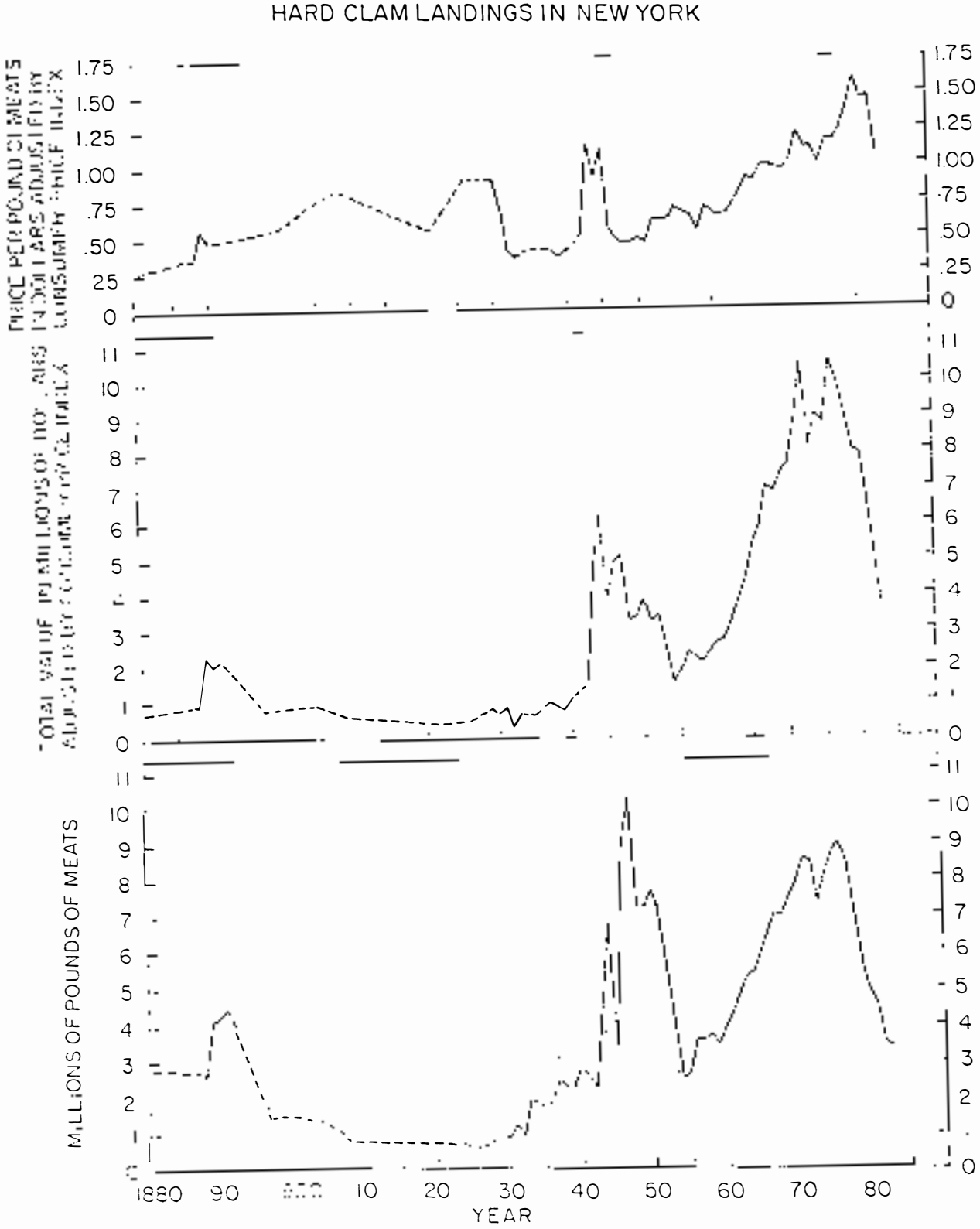

Figure 1. New York State annual hard clam landings and value

declined to about one-third of their former level, while prices have risen from about $0.45 to about $1.62 per pound (in standard dollars) at their peak in 1980.

The relative importance of landings from different areas has changed over time. In the early days many hard clams came from Raritan Bay and nearshore waters of the western end of Long Island. Some time between 1904 and 1921 the supply of hard clams available for harvest around the western end of Long Island dropped sharply, and Suffolk County became the source of 80 percent, or more, of the total harvest of hard clams in New York. The precise time of the change is not certain, because statistics were not recorded every year before 1929. The north shore of Long Island was quite productive for a while, and in 1962 and 1963 the north shore and the Peconic Bays together yielded over 2 million pounds of meats. Landings from these areas dropped off sharply soon after, and Great South Bay became the major supplier.

PRESENT CONDITION OF THE FISHERY

Overharvesting of the Resource

There is a justifiable need for concern about the fishery. No only have total landings in New York dropped to about one-quarter of their maximum, but the total value of the resource harvested has dropped even further (Figure 1), from a maximum of about $10.6 million in 1976 (1967 dollars - about $18.1 million in 1976 dollars) to a low of about $3.1 million in 1984 (in 1967 dollars; about $9.4 million in 1984 dollars). This was caused partly by the drop in landings, and perhaps also by competition from elsewhere. It apparently was enhanced by degradation of water quality. The unit price continued to

price continued to rise at an even higher rate after the peak in landings was reached in 1976, but after 1980 the effects of water pollution caused the unit price to drop even though landings dropped also. There is little doubt that the drop in landings was caused at least partly by overfishing.

Buckner (1984) showed that in Islip waters of Great South Bay, among adult clams mortality caused by harvesting was double the mortality from natural causes in uncertified areas, and in certified areas was five times as great. That the intensity of fishing had increased in areas formerly leased to private operators was shown by a reduction in the proportion of large clams and a corresponding increase in the proportion of small clams. In the certified areas the relative proportions of littlenecks, cherrystones, and chowder clams were stable from one year to the next, demonstrating that there had been little change in harvesting intensity. Intense fishing in both certified and leased areas was clearly demonstrated by the average harvest mortality rates, 0.43 percent in certified areas and 0.63 percent in leased areas. Differences in survivorship rates between those based on natural mortality and those based on total mortality also indicated that the stocks of clams were being reduced at an alarming rate, clearly in excess of net natural reproduction. The intense rate of harvesting caused a 54 percent decline in reported landings between 1979 and 1982.

Using the 1978 density of clams in Bay Shore Cove (26.4 clams per square meter) as an estimate of maximum population size in an uncertified area, it can be seen that certified areas, with an average of only 5.1 clams per square meter, and leased areas, with an average

of only 3.1 clams per square meter, had been seriously reduced in stock. These reductions were accompanied by a decrease in catch. Since a substantial amount of illegal harvesting takes place in the uncertified areas (Becker 1983), it is clear that the estimated percentages of maximum population size in certified and leased areas are conservative, and therefore actually substantially lower than actual expected maximum concentrations.

Further evidence of overfishing (Buckner 1984) was obtained from observations of changes in age structure of the fished stocks. Decreased average size of clams in the population throughout the fishery demonstrated a decrease in average longevity. This might, however, mean only heavy fishing and not necessarily overfishing. However, survivorship curves obtained in this study were characteristic of an overfished population, for decreased survival of older clams was not compensated for by increased survival of younger clams. Clearly, the symptoms associated with an overfished stock were evident in the size and age composition of clams in the Great South Bay fishery.

Water Quality Problems

From time to time, outbreaks of several types of bacterial and viral enteric diseases such as typhoid, gastroenteritis and infectious hepatitis, sometimes referred to by the vague term food poisoning, have been attributed to consumption of raw shellfish. Major outbreaks have occurred in the New York and New Jersey regions in 1924-26, 1961, 1964, and most recently in 1982-83. Occurrences have been sporadic, and may not always be reported. Violations of shellfish sanitary control regulations are frequent. It has been reported that up to 50

percent of clam diggers may work in uncertified waters at times (Mirchel 1980). Buckner (1984) has estimated the quantities of clams harvested from uncertified areas to be significant. Human disease outbreaks will continue, and the future of the industry may depend in part on the need for greater accountability and quality control. At present, enforcement of harvesting regulations relies largely upon the integrity of diggers, but traditionally it has been to the diggers' advantage economically, at least in the short term, to exploit the clam resource illegally by digging in uncertified waters. The chances of a particular digger being caught, or receiving a large penalty if caught, have been small. The potential for outbreaks of bacterial and viral enteric diseases attributed to the consumption of raw hard clams probably will increase as the population of Long Island increases, and as the populations of clams in certified areas decreases. Not all outbreaks have been positively traced to clams harvested from Great South Bay or other areas on Long Island, but if consumer confidence is affected, and the price of clams drops, it does not matter very much whether Long Island is directly implicated or not.

Declining Economic Value

The declining economic value of the hard clam fishery has been substantial since its peak in 1976. It has dropped in real dollars (1967 base) from about $10.6 million in 1976 to about $3.1 million in 1984 (Figure 1). This decline may continue, and is unlikely to rise very much, unless some way to control poaching of clams from beds closed by poor water quality is found. Poaching is likely to increase if stocks on certified grounds continue to remain low from over-fishing. New York's share of the hard clam market has declined in

recent years, and this probably has had some effect upon prices paid. Moreover, as has already been said, the fear of consumers caused by pollution scares, real or imagined, can affect the price adversely, also.

PROSPECTS FOR THE FUTURE

Continued Environmental Pressure

Pressure on the coastal marine environment is likely to continue Long Island's population continues to grow. Some areas may be close to saturation now, but others still have room for growth. Increased discharges of sewage, treated or otherwise; increased industrial wastes; and increased pollution from non-point sources are bound to lead to decreased water quality, especially at the eastern end of Long Island. This will tend to increase the area of coastal waters uncertified for harvesting of shellfish. The result will be increased harvesting from uncertified areas as the areas open to shellfishing shrink, and probably more frequent outbreaks of disease attributed to consumption of raw shellfish. This may further erode public confidence in clams, causing prices to decrease further, and make it increasingly difficult for baymen to make a decent living.

Increased Fishing Pressure

Increased fishing pressure in certified areas will, unless checked in one way or another, lead to further declines in standing stock, again reducing the chances for baymen to make a living. Some baymen undoubtedly will drop out of the fishery, but continued attrition is likely to hold the stocks down to low levels. The future is not bright for the hard clam industry in Suffolk County unless

significant steps are taken promptly to correct the major problems. The management alternatives for rehabilitation and sustaining the hard clam fishery are the focus of this report.

LITERATURE CITED

Becker, Margaret. 1983. The 1982 shellfish-related disease outbreak in New York State: Agency response and interaction. Rockefeller Inst. Working Paper No. 5, State University of New York, 39 pp.

Buckner, Stuart. 1984. Population dynamics of the hard clam, *Mercenaria mercenaria*, in Great South Bay, New York. Ph.D. Thesis, Marine Sciences Research Center, State University of New York at Stony Brook, xiii + 217 pp.

Mirchel, Andrew Christian Francis. 1980. Enforcement of hard clam laws on Great South Bay, New York. Masters Thesis, Marine Sciences Research Center, State University of New York at Stony Brook, xi + 135 p.