Wm. Royce

FISH AND WILDLIFE SERVICE

CLAM INVESTIGATIONS

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By

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The Clam Investigations, which was sponsored by the Atlantic States Marine Fisheries Commission, was authorized by Public Law 556 of the 1948 Congress, which reads as follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, the Fish and Wildlife Service of the Department of the Interior is hereby authorized and directed to undertake, in cooperation with appropriate State and interstate agencies in accordance with the provisions of the Act of August 14, 1946 (60 Stat. 1080), comprehensive studies of the soft-shell clam, Mya arenaria, and the hard-shell clam, Venus mercenaria, with particular respect to the biology, propagation, and methods of cultivation of such clams. Such Service shall from time to time recommend appropriate measures for (1) arresting depletion in existing productive beds; (2) restoring to production beds formerly productive but now barren

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or unusable; (3) developing new areas which may be found suitable; (4) improving methods and techniques of digging, transplanting, and handling; and (5) otherwise increasing production and improving the quality of such clams for the benefit of both producers and consumers."

The first step in planning this five year investigation was a survey of the problems in each area along the entire Atlantic Coast. Conferences were held with representatives of the industry, state conservation departments, universities. Particular thanks are due the Clam Specialists Committee of the Atlantic States Marine Fisheries Commission for their valuable guidance in establishing this program. The results of this survey were used to establish a research program which would attack the most urgent problems in each area to provide the greatest benefit to the industry and to the agencies charged with the responsibility of conservation of this natural resource

For practical purposes the Investigation has been divided into two parts:

(1) Soft-shell Clam Investigation - north of Cape Cod;

(2) Hard-shell Clam Investigation - south of Cape Cod.

Apologies are hereby made to the Rhode Islanders who like to call their hard-shell clams quahaugs and to the Southerners who like to call their soft-shell clams "long necks'

or mannanoses."

SOFT CLAM INVESTIGATION:

The State of Maine has great quantities of soft-shell clams and an intense commercial fishery.

The principal problem of the State of Maine Sea and Shore Fisheries Commission is the management of this fishery so that it shall not become depleted. In places the digging can be greatly increased, in other places it must be curtailed if the industry is to continue.

FISH AND WILDLIFE SERVICE RESEARCH PROGRAM IN MAINE:

Boothbay Harbor has been selected as headquarters for the Clam Investigation as laboratory facilities are available there and also as it is about the center of the soft clam producing area. Three biologists are stationed there at the present time and two bays have been chosen for study to develop methods for management of the clam fishery. These two bays, Sagadahoc Bay and Robinhood Cove, are located at the south and north side, respectively, of Georgetown Island. Sagadahoc Bay is a wide, flat, sandy bay, facing the open ocean. Low tides expose an area of flats three-quarters of a mile long and half a mile wide. From six to twelve diggers work in this area during the Winter and twenty-to twenty-five

during the Summer. Robinhood Cove which opens at the north side of Georgetown Island is a long, narrow, deep bay with rather steep muddy banks. A relatively small area is exposed at low tide but the shore line is about seven miles long and clams are quite abundant. The same men dig in both Robinhood Cove and Sagadahoc Bay and sell their catch to one or two clam buyers. These buyers have kept daily records of the number of bushels each man has dug for the last three years. They will give us these records and will continue to keep them for us in the future which will enable us to determine catch per unit of effort, or bushels per man tide in both areas.

Each bay will be handled as a separate management problem to determine the amount of clams which can be removed each year without depleting the stock. To determine this we must first learn how fast the clams grow and how many clams are now present in the bay. We must determine how many young clams are added each year by setting and how many die of natural causes, such as predators, silting, freezing, disease, or old age. We have to know how many small clams are killed by the commercial digging and how many eggs are produced by clams of different ages and sizes.

Balancing all of these factors will tell us the amount of clams which can be removed safely each year. This figure will be compared with the actual production from records kept by the clam buyers. The clam population census will be taken twice each year to check the accuracy of our predictions. We may find, for example, that the diggers are removing fifteen thousand bushels per year when our estimate of sustained yield is ten thousand bushels per year. A decline in the abundance of clams over a period of several years would confirm our predictions that too many clams were being removed.

These studies will also enable us to determine the extent of natural fluctuations in abundance which can then be compared with the changes in abundance caused by digging. These investigations are being conducted jointly by the State of Maine Sea and Shore Fisheries Commission and the Fish and Wildlife Service as pilot plant studies of the management problem. When methods have been perfected the State of Maine will be able to apply these techniques to all of her coast line.

In addition to the management studies at Sagadahoc Bay and Robinhood Cove other problems of mutual interest to the industry, the State, and the Service will be in-

vestigated, such as methods of clam farming, cause of "water belly", effect of thinning stunted clams, methods of catching seed clams, best time and methods of transplanting seed, etc.

NEW HAMPSHIRE AND MASSACHUSETTS:

The story of the disappearance of the soft clam in New Hampshire and Massachusetts has received much publicity and is responsible in a large measure for the present investigation. Flats which formerly supported three hundred fifty to four hundred diggers now support thirty-five. Areas which were once productive are now barren. Sewage pollution has closed many of the best areas. The problems in Massachusetts are varied because of the different environmental conditions. Management of the fishery by closed areas and seasons and catch limits seems ineffectual where depletion has become so serious. Farming of soft clams, using methods similar to those developed in Japan, may be a partial answer. Town planting programs may provide enough clams for tourist digging. Perhaps eventually a combination of private farming, town planting for tourist digging, and a managed commercial fishery will solve the problem.

FISH AND WILDLIFE SERVICE MASSACHUSETTS PROJECT:

The Parker River Wildlife Refuge near Newburyport has been chosen for the location of clam research in this State. Plum Island Sound, resulting from the estuaries of the Ipswich, Parker and Plum Island Rivers, was once a center of clam production and still has great potentialities. Most of this area is free from pollution and lies within the Refuge where experimental plots are easily protected.

An office has been established at Newburyport and three biologists are stationed there. Arrangements have also been made for cooperative studies with Harvard University in this area.

The Newburyport Unit will establish experimental clam farms and determine their commercial practicability. Spawning and setting of the larvae will be followed to develop methods of obtaining seed clams. Growth rates and mortality of the young clams will be determined. The effects of predators and means for their control will be studied.

In addition, investigations will be made to establish the reasons for the decline in abundance of clams. Past catch records from the town shellfish wardens and the diggers themselves will be obtained to determine if overdigging can account

for the decrease or if it could be a periodic fluctuation as some believe. Observations of areas closed because of sewage pollution should yield some valuable information concerning changes in abundance where there is no commercial fishery. The Joppa Flats, at the mouth of the Merrimack River, are full of large clams but have no small ones. This may indicate that no setting has occurred during the last three years or that some unfavorable condition has killed the smaller clams. Spawning and setting will be studied here during this summer to determine if reproduction is normal.

All of this work will be in close cooperation with the Woods Hole Oceanographic Institution project at Barnstable and the Shellfish Program of the Marine Fisheries Division of the Massachusetts Department of Conservation.

HARD CLAM INVESTIGATIONS:

The great range of *Venus mercenaria* from New England to Florida and the variety of conditions under which it exists makes the selection of sites for research very difficult. Eleven states are involved and each would like to have a project located within its borders. The limited appropriation makes it necessary to concentrate the work in a few representative areas where the most valuable results can be obtained. Cooperative studies with State Conservation Departments and

universities are planned to utilize existing research facilities as much as possible.

NEW JERSEY:

The extensive hard clam fishery of New Jersey, plus the research project of Dr. Thurlow Nelson and his group at Rutgers University, present many opportunities for joint studies. A cooperative agreement has been established between Rutgers University and the Fish and Wildlife Service to facilitate research on quahaugs in this State. During the Summer of 1949 two graduate students will be assigned to work with Dr. Nelson's group on certain phases of the problem. (1) One man will try to develop methods of obtaining seed quahaugs from natural reproduction. We know that clean shells placed in the water at the proper time will catch oyster spat, but how can we catch clam spat? Until methods of obtaining seed clams are developed commercial clam farming can never be feasible. In Japan loosely woven palm fiber matting is hung in the water and the arksheil clams attach as heavily as fifteen hundred per square foot. Maybe similar methods will be successful here with the hard shell clam. Perhaps changing the character of the bottom in certain places like the Woods Hole Oceanographic Institution is doing at Barnstable will induce setting of quahaugs also. It may be possible to locate areas

where natural setting is very heavy and where seed clams can be strained from the sand. These are the possibilities that one of the biologists at Rutgers will explore this Summer.

(2) The other graduate student working with Dr. Nelson's group will investigate the basic problem of identifying the organisms used as food by hard clams in New Jersey waters. This information is necessary for a complete understanding of the growth rates in different areas.

VIRGINIA:

A preliminary survey of the clam fisheries of Virginia has been made and conferences have been held with the biologists of the State Fisheries Laboratory. Cooperative studies are planned for the future and it is expected that the results of clam farming experiments can be adapted for use along the Eastern Shore.

NORTH CAROLINA:

A preliminary survey of the clam fisheries of North Carolina was made during February. Plans have been made to base Southern Clam Research at the Beaufort Laboratory of the Fish and Wildlife Service. A fairly good clam industry is located in the vicinity of Beaufort and a great variety of environment conditions are to be found.

Fundamental studies of the rate of growth, age at maturity, and salinity tolerance, as well as development of practical methods for increasing and managing the fishery will be conducted here. It may be possible to develop methods of commercial clam farming near Beaufort which will be applicable to the southern part of the Atlantic Coast.

SOUTH CAROLINA:

The problem of developing the fishery is important in South Carolina as in North Carolina. Clams are present in some abundance along most of the coastline, but the fishery is limited by economic factors.

The development of hard clam farming may offer an opportunity for increasing production at some future date, but the demand must increase before farming can become profitable.

FLORIDA:

A survey of the clam fisheries of Florida was made during February with interviews of representatives of the industry and research agencies. The present fishery is very limited although great quantities of clams were once taken by dredge in the Ten Thousand Islands. The cannery at Naples is now closed and the dredge has sunk. The beds among the islands still contain many clams and it is important to know the true extent of this resource for proper management and development of the fishery.

CONNECTICUT:

The quahaug fishery of Connecticut is small but might be expanded by farming in connection with the oyster industry in Long Island Sound.

No field work is anticipated here at present but funds have been allocated to Dr. Loosanoff at the Fish and Wildlife Service Shellfish Laboratory at Milford to develop methods of artificial propagation. This work will explore the possibility of producing seed clams in hatcheries while the field units in Rhode Island and New Jersey investigate seed production from natural spawning and setting.

RHODE ISLAND:

An intensive quahaug fishery by tonging, raking and power dredging methods is located in Rhode Island. Tonging is conducted the year around in every clean part of Narragansett Bay by about thirteen hundred diggers. Power dredging is permitted only in part of the Sakonnet River from December 1st to March 31st and supports less than thirty-five boats. A serious controversy has developed over the relative merits of these two methods and the Fish and Wildlife Service has been asked by the industry and the State Conservation Department to settle it. Tongers claim that power dredges tear up the bottom killing the seed and breaking many of the marketable sized clams.

Dredgers claim their operations cultivate the bottom preventing silting and increasing setting. Dredgers want additional beds which are too deep for hand tongers opened for the use of power dredges.

Two biologists are now stationed at Wickford, R. I., and have just completed a survey of the quahaug population throughout the Bay in cooperation with the Narragansett Marine Laboratory of the Rhode Island State College. This information will be used to select a representative area for experiments to test the effect of hand vs. power methods on adult clams, juvenile clams, setting, and related bottom forms such as fish and scallops.

Part of the test area will be hand tonged or raked and another part will be dredged. Equal amounts of hard clams will be removed from each plot. Periodic examinations will show the effect of each method.

The results of this experiment will find application all along the coast wherever controversies exist between hand and power methods of clam fishing.

Seed production from natural spawning will be investigated this Summer by the Rhode Island unit as a beginning of quahaug farming studies. Although clam farming is not permitted in Rhode Island at present, the methods developed here should

apply in other places.

A management study area is also planned for Narragansett Bay. One part of the bay which supports a small fishery will be observed and records will be kept of actual catch. Methods similar to those described for the soft clam studies in Sagadahoc Bay and Robinhood Cove in Maine will be used to arrive at an estimate of the sustained yield. This estimate will then be compared with actual production and correlated with quahaug population trends in the bay.

Management methods developed here can be applied wherever a State Conservation agency has the responsibility of regulating the fishery.

Dr. Royce

A N N U A L R E P O R T

CLAM INVESTIGATIONS

FISCAL YEAR 1949

JOHN B. GLUD, CHIEF

WOODS HOLE
MASSACHUSETTS

ANNUAL REPORT

CLAM INVESTIGATIONS

FISCAL YEAR 1949

I. INTRODUCTION:

Public Law No. 556 authorizes and directs the Fish and Wildlife Service to undertake a comprehensive and continuing study of the hard and soft-shell clam fisheries over a period of five years in order to stop the depletion of these valuable natural resources and to restore them to their maximum yield.

Work on this project began October 4, 1948, when Mr. John B. Glud, Chief of the Investigations, reported for duty at Woods Hole, Massachusetts.

During October and November a survey of the clam problems in the states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut and New Jersey was made.

The results of this survey were used to formulate a program for the investigation which was presented to the Clam Specialists Committee of the Atlantic States Marine Fisheries Commission on December 20.

The Clam Specialists Committee approved the program as presented.

The survey of clam problems along the Atlantic Coast was continued during January, February and March through conferences with industry, state conservation departments and universities in the states of Virginia, North Carolina, South Carolina and Florida. This preliminary survey indicated that development of the commercial fishery, improvement of marketing procedures, exploration of extent of clam beds and development of better fishing methods are important. Basic biological factors concerning clams, such as growth rate, fecundity versus age, salinity and temperature tolerance and effect of predators have never been determined for most of the south. This information must be obtained for efficient regulation of the fishery especially if it should expand greatly.

It is planned that one research unit will be established at Beaufort, North Carolina during the next fiscal year.

Four research projects have been established at strategic locations to attack the problems disclosed by the surveys described above. In each case the site was chosen to utilize existing facilities to minimize expenditures.

II. BOOTHBAY HARBOR, MAINE UNIT.

The principal soft shell clam problem in Maine according

to the State Sea and Shore Fisheries Commission is the management of the commercial fishery to maintain the greatest production without depleting the supply.

Two representative bays have been chosen for pilot plant studies to develop methods for management of Maine's clam resources. The three biologists stationed at Boothbay Harbor have completed the first population survey in each of these bays and this will be repeated semi-annually. Catch records per man day for the past three years have been obtained from local clam buyers and are being analyzed. Arrangements have been made for obtaining these records from now on from the buyers. Additional studies of growth rate, reproduction, natural and digging mortality have been initiated.

When enough information has been obtained an estimate will be made of the amount of clams which can be removed each year without depletion. This will be compared with actual production and correlated with population trends to establish validity of these methods. These studies will determine the relative effect on the population of natural fluctuations and digging.

Other cooperative projects with Maine Sea and Shore Fisheries Commission include:

1) Thinning experiment: In many places clams are overcrowded and stunted. This experiment will check growth rates in plots which have been commercially dug to reduce the number of clams in comparison with control plots.

2) Transplanting experiments will determine at which size clams can best be transplanted and at which time of the year.

3) Seed gathering experiments: In some places in Maine soft clams set in great numbers with concentrations exceeding 600 per square foot. Various mechanical methods are being tried to remove these one-quarter inch to one inch clams from the ground for transplanting.

4) Exposure experiments will determine the mortality of clams left on the surface after commercial digging during each part of the year.

5) Adaptation of clams to laboratory conditions. These tests indicate that clams can be successfully held in tanks at Boothbay Harbor for experimentation.

III. NEWBURYPORT UNIT.

In Massachusetts soft clams have become so scarce that the usual methods of controlling seasons and catch seem ineffectual in restoring their abundance. Three approaches to this problem are being taken:

1) Developing methods of private clam farming.

2) Developing methods for town plantings.

3) Determining reasons for the present decline in abundance and recommending measures for restoring the fishery.

Parker River Wildlife Refuge has been chosen as a base for soft clam investigations in Massachusetts and New Hampshire and three biologists have been stationed at Newburyport, Massachusetts. Flats have been surveyed to locate areas which will be suitable for experimental clam farming. Three experimental plantings of seed from Sam's Cove, Maine, have been made and Winter survival has been satisfactory.

(a) Farming. Seed clams about 1¼" in length were obtained from Quincy flats in May and June and planted in twelve experimental beds on Newbury flats. These seed clams were planted by three methods.:

1) Plowing in with a hand plow.

2) Broadcasting over a bottom previously plowed.

3) Broadcasting over untouched bottom.

Preliminary observations of clam holes indicate method 3 is just a s successful as the other two and is much cheaper.

Various concentrations from 10 to 50 clams per square foot were tried and the effect on growth and production will be de-

termined by future digging.

Cost records of each operation are being kept and will be used to determine the commercial practicability of clam farming.

(b) Town planting methods are being developed through the experiments at Newbury. Accurate records of cost, survival, and growth of transplanted clams will assist the towns in evaluating their own planting efforts. This part of the work is in close cooperation with the Marine Fisheries Division of the Massachusetts Department of Conservation.

(c) Program for determining reasons for the present decline in abundance. A sampling program has been started to determine clam population by age groups for the flats in Plum Island Sound. Last year's good set will be compared with the extremely low concentration of adult clams to indicate how many spawning clams are required to seed the flats adequately.

Commercial catch records are being obtained to determine production trends as a clue to the reasons for the present scarcity of clams.

Biological investigations of natural mortality, effect and control of predators and diseases, spawning and setting are being undertaken in cooperation with Woods Hole Oceanographic Institution which is conducting similar studies at Barnstable, Massachusetts.

IV. NARRAGANSETT BAY UNIT.

Narragansett Bay has been selected for hard-shell or quahaug investigations in cooperation with Rhode Island State College. Two biologists have been stationed at the State lobster hatchery at Wickford, Rhode Island and are working on the following phases of the problem:

(A) Effect of raking versus power dredging on adult and young quahaugs, setting, and related bottom forms. A serious controversy now exists among the fishermen using each method and between dredgers and the State Conservation Department.

1) A survey of the bay to select a representative area for test plots has been completed.

2) Conferences have been held with rakers, dredgers and State Conservation officials and all approve the choice of this location. Rakers are being employed to fish one part of the area. Another part will be dredged with a standard commercial dredge and the third part will be kept as a control plot. Fishing will continue through July, August and part of September and the relative effect of each method will be determined.

(B) Management of the Commercial fishery. It is planned that a portion of Narragansett Bay will be established as a management study area this summer to develop methods for use by the

various State Conservation Departments. This project will be similar to the two soft clam management studies in Maine.

(C) Seed quahaugs from natural reproduction. Spawning and setting are being followed to develop methods of catching seed quahaugs which might be used for farming or reseeding of deplated areas.

(D) Quahaug farming will be attempted in experimental areas set aside by the State to develop methods and to determine commercial practicability.

V. NEW JERSEY UNIT. Through a cooperative agreement two biologists have been employed for the summer to work with Dr. Thurlow Nelson of Rutgers University who is conducting a quahaug investigation on a grant from a commercial company.

One biologist is stationed at Tuckerton, New Jersey where he is exploring methods of obtaining seed quahaugs from natural reproduction.

The other man is located near Cape May, New Jersey and is attempting to determine the food organisms utilized by hard-shell clams.

VI. MILFORD SHELLFISH LABORATORY.

Part of the clam appropriation was allocated to the Milford Laboratory for studies of artificial or hatchery propaga-

tion of hard and soft clams to supply seed for farming or stocking depleted area. Considerable progress has been made in this work as will be described in Dr. Loosanoff's report.

Additional studies of physiological requirements of clam larvae are also under way at this station.

VII. WOODS HOLE OFFICE. Headquarters of the Clam Investigations have been located at Woods Hole pending transfer to Boothbay Harbor, Maine.

Observations on the feeding of soft shell clams has been continued at Woods Hole Oceanographic Institution by John Barlow as a cooperative project with Harvard University. During the summer Mr. Barlow is investigating the effect of different types of bottoms upon setting and early growth of soft shell clams in Barnstable Harbor.