

# SURVEY OF THE SOUTH CAROLINA OYSTER FISHERY



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WILDLIFE AND MARINE RESOURCES DEPARTMENT  
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SURVEY OF THE  
SOUTH CAROLINA  
OYSTER FISHERY\*

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TECHNICAL REPORT NO. 3

from

OFFICE OF MARINE CONSERVATION, MANAGEMENT  
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1970-1971

R. C. Gracy and W. J. Keith

## ABSTRACT

The South Carolina oyster industry is currently beset with a wide range of problems; management, conservation, marketing, production and labor shortages plague the industry, keeping its efficiency low.

Examination of the history of the modern oyster industry reveals its downward trend in production since 1908. Basic to this trend are poor management, lack of suitable hand labor and the inability to procure adequate labor economically. Lack of mechanization forces dependency on hand labor. Other difficulties also inhibit the industry's stability. The lack of public commercial oyster grounds encourages poaching on private grounds. The problem is aggravated by not requiring a license which restricts a harvester to a specific lease. Only one plant in the State processes oysters; consequently, the total economic impact of the oyster industry is not fully realized.

Subtidal areas need to be developed to give a greater flexibility to the industry and release it from its dependency on intertidal shell stock.

Past methods of leasing have been complicated. Inventories of intertidal areas are difficult to maintain. Accurate listing of leases, lessees, acreages and lease locations which have been lacking in past years are now nearing completion. Public oyster recreational areas have been reorganized and information concerning their availability and locations is being prepared. A management program should be implemented in these areas.

In 1970 a feasibility study of intertidal oyster management, utilizing aerial photography, was initiated. Pilot photographs indicate that this method may hold promise.

Recommendations considered basic to the improvement of the industry have been enumerated for possible future action. Immediate steps must be taken to enhance the possibilities of a more vigorous oyster industry before its general decline reaches an irreversible point.

## INTRODUCTION

Oysters were utilized in South Carolina many years before the coming of the first European settlers. Indian shell middens attest to large scale usage and are found in the vicinity of most of the estuarine areas of the State. Some contain in excess of 100,000 U. S. bushels of oyster shells. Indian-made circular structures (Figure 1) composed mostly of oyster shells, range the coast between Sewee Bay, South Carolina, and Sapelo Island, Georgia. Some of the shell-rings are more than 100 feet in diameter and contain tens of thousands of bushels of shell. Although their purpose is not adequately explained, they have been dated by pottery types and radio-carbon techniques at about 2000 B. C. (Hemmings, 1970).



Figure 1. Prehistoric Indian-made Shell-ring Adjacent to Fig Island, North Edisto River.

Early colonists and explorers observed and utilized the vast quantities of oysters available. The English explorers left many written descriptions of their impressions of the country. Included in Thomas Ashe's description of Carolina in 1682 are his comments on the area's native intertidal oysters; . . . the Seas and Rivers of the same bounty equally participate in the Variety of excellent and wholesome Fish which it produces, Viz. . . . Oysters of an Oblong or Oval form; their number inexhaustible; a man may easily gather more in a day than he can well eat in a year; . . .". Also left to us is an earlier description by Robert Sanford in 1666; "It (Calibogue Sound) abounds besides with Oyster bankes and such heapes of shells as which noe time cann consume, butt this benefitt it hath but in common with all the Rivers between this and Harvey Haven (North Edisto River), which are stored

with this necessary material for lime for many ages, and lying soe conveniently that whatever neer River or Creeke you cann thinke fitt to sett a house there you may place your lime kill alsoe . . ." (Salley, 1911).

His reference to a "lime kill" denotes the utilization of oyster shells as a source of lime. The lime was used as a binder or cement and in many cases as the basis for a form-poured type of construction known as "Tabby" or sometimes as "Tapia". Beginning in the Colonial period and continuing into the nineteenth century, oyster shells provided the basic raw material for "hard" construction in a coastal area devoid of rock or practical substitutes. Apparently it was rather widely used and proved quite durable as evidenced by numerous forts, sea-walls, foundations and buildings which still stand.

Oyster shells were also extensively used for a number of years as a stabilization material for road construction. References exist pertaining to the shell road between Beaufort and Charleston (Carse, 1961), a distance of about 80 miles. In recent years the scarcity of raw shell has forced the curtailment of this practice.

Exactly when the South Carolina oyster industry began, in the modern sense, is difficult to determine. Probably its first beginnings were manifested in the taking of orders for the specific quantity desired before the actual harvesting was done. This, however, was home usage, and the supply was directly from the harvester to the consumer. During the last third of the nineteenth century a true industry, designed to supply a wider market and utilizing wholesale methods, began to develop.

By about 1886, oysters harvested in South Carolina were shipped in barrels by the Oemler Oyster Company of Savannah, Georgia, to Philadelphia. This same firm also canned subtidal oysters harvested in South Carolina and marketed them from Savannah under the trade name of "Colossus Brand" (Oemler, 1893). It is reported that sometime prior to this, an unnamed oyster company located at Beaufort, South Carolina, had an extensive operation in the Tea Kettle Creek region utilizing a steam-dredge. About this same time Elmo Cetchovitch is said to have started the first raw shucking house in the State. His operations were also in the Beaufort area, possibly in the vicinity of Daufuskie Island (Maggioni, 1970).

In 1889 the State legislature granted, by special act (the only method to then gain control of bottoms), a lease to Messrs. Hazard, Alexander and Donaldson in Winyah Bay and vicinity for the purpose of oyster cultivation. These prospective oystermen contracted John D. Battle to undertake a resource assessment which was completed by 1890. In 1890-1891, Battle completed an oyster study in South Carolina for the United States Fish Commission, entitled "An Investigation of the Coast Waters of South Carolina With Reference to Oyster-Culture" (Battle, 1890). This was an extensive survey undertaken after similar earlier studies had been conducted in Georgia and North Carolina. Apparently the major concerns of this study were to map intertidal oyster beds and attempt to find subtidal oyster beds and bottoms suitable for subtidal cultivation.

By 1890 the Bull Bay and Edisto Fish and Oyster Companies had cultivated subtidal oysters growing in Santee Pass Creek and in Bull Bay. According to Battle's study, the "wild" oysters of the region were usually superior to the planted subtidal ones. Both companies sold oysters to dealers in Charleston and may have also shipped to northern markets (Battle, 1890).

Also in the late 1880's or early 1890's, Henry Merritt had planted oysters in Lighthouse Creek. It is interesting to note that he claims: "A scarcity of reliable labor interferes with the increase of business . . ." (Battle, 1890), a problem which is probably more prevalent now. These oysters were probably sold in Charleston

John Griffin, in Bailey Creek near Edisto Island, had his business of cultivating subtidal oysters underway in the 1880's. He usually had about 20 acres under cultivation and sold his total yearly output of about 1,000 bushels in Charleston for 75¢ (1890) per bushel (Battle, 1890).

L. P. Maggioni & Co. operated on Daufuskie Island from about 1883 until 1902. They moved to Port Royal in 1903 and to Ladies Island (Figure 2) in 1918 where they are still located. This company bought and operated other oyster plants at various times. The von Platt cannery on Yonges Island in 1921; a cannery was built at Tom Fripp about 1927 and another at Sams Point in 1930. Some of their plants were numbered among the 16 steam canneries reputed to have been in operation between 1890 and 1905. Today the Ladies Island plant is the only oyster cannery in South Carolina still in operation. (Maggioni, 1970).

Before 1940, raw shucked oysters from South Carolina were distributed through much of the



Figure 2. Ocean, Lake and River Fish Company, Ladies Island. The Only Remaining Oyster Canning Plant in South Carolina.

midwest (Smith, 1943). During World War II there was a drain on the hand labor supply necessary for both harvesting and shucking. Production consequently suffered and has never recovered. Since about 1945 governmental, social, economic, and welfare policies have apparently contributed to a further decline in the availability of the hand labor supply which at this time is so necessary to the oyster industry. The creation of newer occupations which offer non-seasonal employment, more security, and sometimes higher pay have further drawn off manpower.

Harvesting techniques have changed very little since the beginnings of the industry. The oystermen still walk on the intertidal oyster banks, either filling a container to be emptied into a small boat or loading directly into a wide flat bottom boat, known locally as a "batteau", for transfer either directly to the dock or perhaps to a barge or self-propelled scow of larger capacity. This procedure is time consuming, requires many workers in relation to the quantities produced, and is inefficient from the standpoint of properly harvesting an area, since only the most accessible areas are picked. This tends to almost denude some shores while leaving others overpopulated.

The South Carolina oyster industry is confronted with many problems; overly restrictive and inadequate laws and traditional attitudes have helped to circumvent the establishment of a healthy, efficient oyster industry. Basic production is directly proportional to the labor supply.

Today the industry needs assistance to encourage development and modernization. Changes must be made in the areas of resource management, harvesting, processing and marketing if the industry is to survive.



## METHODS AND PROCEDURES

This study of the South Carolina oyster industry was initiated on 1 January 1970. It was divided into four distinct phases or "Jobs". Each phase was interdependent and work was simultaneously initiated on all phases.

Job 1, "Compilation and Evaluation of Existing Statistical and Economic Data on the South Carolina Oyster Industry", was primarily a study of South Carolina Marine Resources Division records and records of the South Carolina Division of Commercial Fisheries, predecessor of the Marine Resources Division. South Carolina shellfish tax records were also studied to obtain production figures. National Marine Fisheries Service figures were examined, but because of their broad categories they lacked the more useful detail of the State records. Evaluation was based on whether existing data met the present needs of the oyster industry and of the State's administrative sections.

To obtain basic knowledge of the industry and its problems, Job 2, "Field Survey of the Oyster Industry", was begun by contacting all of the major and most of the minor oystermen and oyster dealers in the State. Most were visited numerous times during the course of the study in an effort to establish rapport and gain basic information on current production methods and problems. Oyster plants, shucking-houses, docks and homes were visited as were their harvesting and planting operations in the field. The general condition and distribution of the intertidal and subtidal oyster beds were observed, by boat, in all six coastal counties. To determine the extent of intertidal oysters in selected areas, aircraft were utilized to a limited degree. Aerial infra-red photography was undertaken first through the cooperation of the United States Air Force and later by contract with several private agencies

equipped to conduct such a survey. This feasibility study is still in progress.

Job 3, "Evaluation of Existing Biological and Ecological Information Pertinent to Future Research and Management Activities", involved additional study of the Marine Resources Division records, former Division of Commercial Fisheries records, Bears Bluff Laboratories, Inc., papers, and assorted pre-World War II private and Federal studies, copies of which were largely supplied by the Department of the Interior Library Service. Of particular value, in the period from 1946 to 1969, were published and unpublished Bears Bluff Laboratories oyster investigations. However, many of the unpublished records exist only as uncatalogued reports which necessitated extensive reading of unbound, and in some cases handwritten, file sheets.

In Job 4, "Survey of Existing Management and Regulatory Systems", the amended Code of Laws of South Carolina, 1962, was studied and compared with the statutes and regulations of other East and Gulf Coast oyster producing States. In an effort to gather pertinent background information on oyster management and applicable shellfish rules and regulations, several East and Gulf Coast states were visited and their marine fisheries personnel interviewed.

Old South Carolina fisheries laws and data obtained in South Carolina oyster surveys as early as 1890 were consulted in an effort to evaluate regulations or ideas which have fallen into disuse that may now be suitable for present-day application.

After all information had been reviewed and digested by Marine Resources Division personnel, a tabulated list of recommendations, considered necessary for improvement of the South Carolina oyster industry, was compiled.

### **JOB 1: COMPILATION AND EVALUATION OF EXISTING STATISTICAL AND ECONOMIC DATA ON THE SOUTH CAROLINA OYSTER FISHERY.**

The South Carolina oyster fishery is centered wholly around the American oyster, *Crassostrea virginica*. The value of oyster landings amounted to approximately \$484,857.00 in 1970. According to the United States Bureau of Commercial Fisheries records, South Carolina's oyster industry reached its peak production in 1908 with 3,220,779

U. S. bushels harvested. By 1970 this has decreased to 267,928 U. S. bushels. This 2,952,851 bushel decrease in State oyster production probably can be attributed largely to drastic declines in the availability of hand picking and shucking labor, as well as to inadequate regulatory practices and poor management in some quarters,

which occurs primarily in the forms of over-harvesting and partial or complete lack of shell or seed planting.

Although methods of labor procurement were not within the scope of this project, it must be clearly stated that this is one of the major problems of the industry and, as such, solutions must be actively sought. Perhaps the most practical approach to this problem is for the State and Federal governments to encourage the application of present technology to the problem and attempt to at least partially rectify the shortage of labor by developing new and improved methods of mechanical harvesting and shucking.

Intertidal oysters (Fig. 3) grow in the zone between high and low tides. In South Carolina the average tidal range is almost five feet at the



Figure 3. Mud Flat Where Oysters Growing on the Firm Mud on Top of Mounds Give the Appearance of Total Coverage at Low Tide.

North Carolina border and increases to about seven feet in the Beaufort-Port Royal area. Spring or storm tides can increase these averages two

feet or more. Approximately 95% of South Carolina's oysters grow in this intertidal area with the remainder occurring in the subtidal area.

South Carolina's tidelands contain over 638,000 acres of productive habitat for marine and estuarine life. At present the major portions of intertidal oyster producing grounds are either leased, privately owned, contained in public recreational grounds or polluted. Seldom does additional acreage become available for lease. There are now 7,013 acres contained in 97 separate leases. South Carolina has 20 public oyster grounds set aside for recreational harvesting of oysters, clams and other shellfish suitable for human consumption. These 20 areas contain a total of only 25.75 acres of oyster producing ground and 20.46 acres of potential oyster producing bottoms. There are several thousand acres of tidelands which do not now produce oysters, but could possibly do so with proper cultivation. These include not only intertidal grounds, but also some subtidal bottoms.

The South Carolina Marine Resources Division tax records indicate that the commercial oyster harvest in fiscal year 1970-71 was 344,255 S. C. bushels\*. Production by the oyster industry can be broken down into four basic phases. The first is the in-state shipment of shell stock oysters which amounted to 49,733 S. C. bushels in 1970-71. This is compared to the second phase of 24,118 S. C. bushels shipped out-of-state in the shell. The third phase, raw shucked oysters, amounted to 54,443 S. C. bushels during this period. The fourth phase of production amounted to 195,961 S. C. bushels canned by the only steam canning oyster plant actively operating in South Carolina in 1970-71. This phase increased from 40% of the State's total production in 1965-66 to 57% in 1970-71.

\* Conversion to U. S. bushels: Multiply by 1.893.

Table 1. Basic Phases of South Carolina Oyster Production by Fiscal Year (July through June) in South Carolina Bushels.

IN STATE	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Shell stock .....	86,961	69,310	63,122	60,307	59,152	49,733
Canning .....	244,575	242,252	256,559	180,510	154,799	195,961
Raw shucked .....	179,010	182,437	117,092	97,763	62,711	54,443
EXPORT	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Shell stock .....	94,520	67,310	75,952	38,271	40,467	34,118
<b>GRAND TOTAL</b> .....	<b>605,066</b>	<b>561,309</b>	<b>572,725</b>	<b>376,851</b>	<b>317,129</b>	<b>344,255</b>

1965-66 to 1970-71 Average = 462,889 S. C. bushels.

Range: 317,129 in 1969-70 to 605,066 in 1965-66.

The primary sources of statistical and economic information for this State's oyster production have been the Marine Resources Division, formerly Division of Commercial Fisheries, of the South Carolina Wildlife Resources Department, and those of the National Marine Fisheries Service.

South Carolina records were used to obtain production, shipping, seed planting and shell planting figures, since National Marine Fisheries Service records are not compiled in these categories. For consistency, South Carolina harvesting figures are also cited.

The major oystermen and many of the minor ones have been contacted concerning harvesting, marketing, processing, types of equipment used and numbers of kinds of vessels employed in their operations. An inventory (1970-71) of oyster leases, lessees, acreages and locations has been compiled. This data is available but not included.

A summation of the basic statistical and economic data which have been collected is given below. The industry's investment has been increased since 1970 only by the recent introduction of an experimental mechanical harvester.

**Table 2. Capital Equipment and Personnel for the 23 Major South Carolina Oyster Producers, 1971.**

EQUIPMENT		PERSONNEL	
Canning Plants	1	Boat operators	15
Docks	24	Misc. personnel	51
Gathering boats	179	Pickers	150
Mechanical harvester	1	Shuckers	101
Outboard motors	101		
Shucking houses	19		
Tow boats	21		
Vehicles	34		
ESTIMATE OF TOTAL INVESTMENT			\$ 3,290,000.00

## JOB 2: FIELD SURVEY OF THE OYSTER INDUSTRY

During the spring and summer of 1970 and 1971, various shell stock piles were photographed and some were measured. Part of the shell planting in the leased areas was observed (Figure 4) by biologists and State conservation officers. All shell planting could not be observed in either year since most oystermen desire to plant seed and shell just as soon as the harvesting season ends. There were not enough personnel available to witness the several shell plantings being conducted at the same time.

Seed transplanting activities were monitored closely in 1969-70, since only 17 oystermen applied to move seed oysters. In 1970-71, 15 oystermen applied for seed moving permits. Several transfers of seed were observed (Figure 5) by biologists.



**Figure 4. Conservation Officer Inspecting Shell Planting Near McClellanville.**

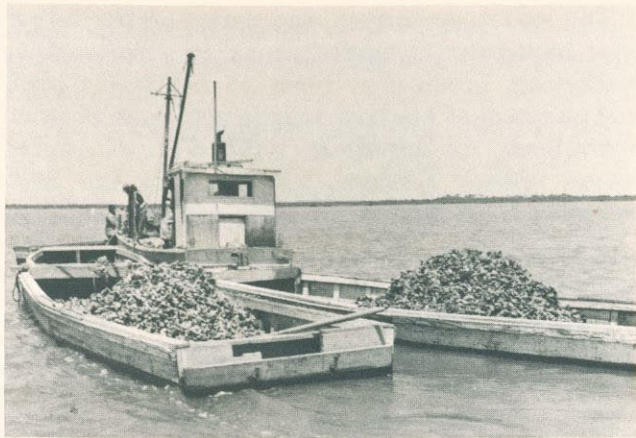


Figure 5. Seed Oyster Planting in Casino Creek.

The non-fulfilling of seed and shell planting quotas has been one of the foremost problems of the industry. It is believed that the majority of commercial oystermen have not been accurate in their shell and seed planting reports. It is felt that oystermen generally have turned in reports totaling their required shell or seed quotas of 65 S. C. bushels of shell per acre of bottom leased and not what they actually planted. In 1969, only 599,620 U. S. bushels of oysters were harvested; yet Marine Resources Division records also show that credit was given to oystermen, on their claims, for planting 1,290,487 U. S. bushels of shell and 17,699 bushels of seed. Approximately the same situation occurred in 1970, when the oyster harvest totaled 267,928 U. S. bushels and credits were given for planting 263,557 bushels of shell and 61,205 of seed. The figure for shell planted was more realistic for 1970 than for 1969, but still apparently not correct.

Since there was, with one exception (Figure 6), no significant stockpile of shell available, it is highly improbable that planting has been carried out on such a scale. It is felt that the official figures for harvesting and shell planting are not correct. The figures claimed for shell planting are probably several times the amount actually planted. Much of the claimed production, particularly by smaller operators, is stated lower than is actually produced. However, the incorrectness of the planting claims greatly exceeds the incorrectness of the harvesting claims.

There has been a need for a much better statistical system for the Marine Resources Division for some time. In 1971 a statistical section was established and a full time statistician employed. Also in 1971, a full time leasing and licensing supervisor was obtained. Through his office leases

are kept current and up-to-date files are maintained on producers and shippers of shellfish.

In the spring of 1970 a memorandum was issued stating that no oysterman would be given shell or seed planting credit if arrangements were not made in advance with the Marine Resources Division. The purpose was to provide for better supervision, monitoring and inspection of planting. This memorandum helped, but did not by any means correct the existing deficiencies. Some of the oystermen simply did not turn in any shell or seed planting reports at all or chose to ignore the directive and sent their reports in after planting was over. Substantially the same notice was sent in the spring of 1971 and, as before, positive response was lacking. Although probably about the same amount of planting was done in 1970 as in 1971, fewer oystermen in 1971 complied with the requirement that arrangements for planting be made in advance.

Many oystermen depend on the "wild harvest" and do as little cultivation as possible; therefore, the average oysterman wants as much area as can be leased. There are, of course, exceptions to this, but the general trend is toward large acreage and minimum cultivation. This trend needs to be reversed, with more cultivation required and less acreage available to those not sufficiently inclined to adequately manage it. Some commercial oystermen are fairly well capitalized and capable of much better management and cultivation than they now practice.

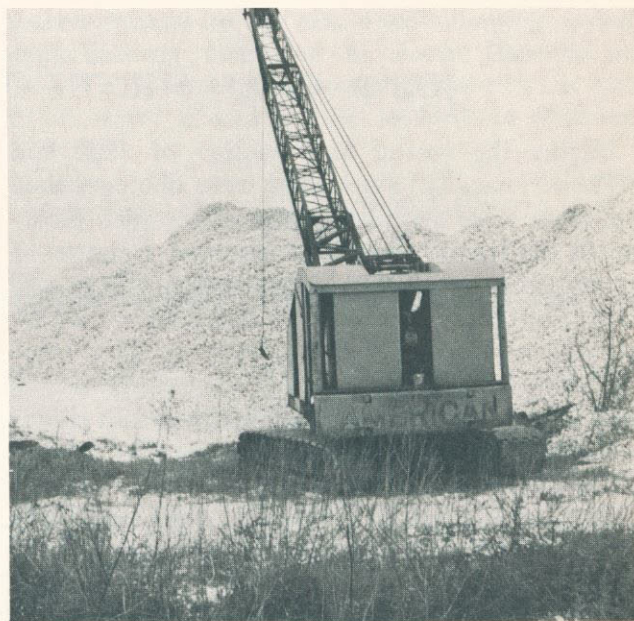


Figure 6. South Carolina's Largest Shell Stockpile. Located at the Ladies Island Canning Plant.

Possibly the primary common denominator in the declining production of the South Carolina oyster industry is the acute shortage of labor for planting, harvesting and shuckling operations. This labor force is comprised mostly of Negroes. As the "old timers" die or retire, potential younger workers are not taking up the trade. Current governmental welfare practices may hinder the successful recruitment of labor. If full time employment could be provided, then perhaps the industry would appear more attractive to the potential employees. The inability to attract workers has hindered the production of the only canning factory left in the State. The once active other canneries (Figure 7) have closed due largely to the inavailability of a sufficient hand labor force.



Figure 7. Yonges Island Canning Plant Closed for Several Years Due to a Lack of Labor.

The usual method in South Carolina of gathering oysters is by hand, utilizing a pair of "nail grabs" which are worked in the manner of small tongs. Dredging is sometimes done on a very small scale on subtidal beds, but the total area of subtidal coverage is not large and the dredging methods usually employed are illegal. One mechanical harvester (Figure 8) for picking intertidal oysters is currently under development by the Ocean, Lake and River Fish Company of Ladies Island, South Carolina. Experimental harvesting operations began in the Beaufort-St. Helena area in 1971. Some difficulties have been encountered, as is expected with any new mechanical device, and modifications are being made. While the operators are gaining experience, sufficient oysters are being harvested to be utilized in canning operations. Perfection of this type of machine is necessary if the prohibitive cost and general non-availability of hand labor are to be overcome.

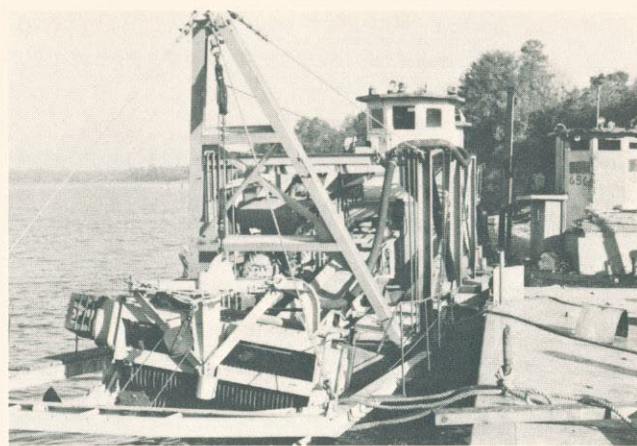


Figure 8. Mechanical Intertidal Oyster Harvester Currently Under Development near Beaufort.

The only pair of "patent-tongs" (Figure 9) to be used in South Carolina in recent years began operation in the McClellanville area in November of 1970. Use was again made of them in 1971 in the same general area. They were used both for subtidal oysters and hard clams. No appreciable bottom damage seems to result if reasonable care is taken, and their use confined to firm bottom.

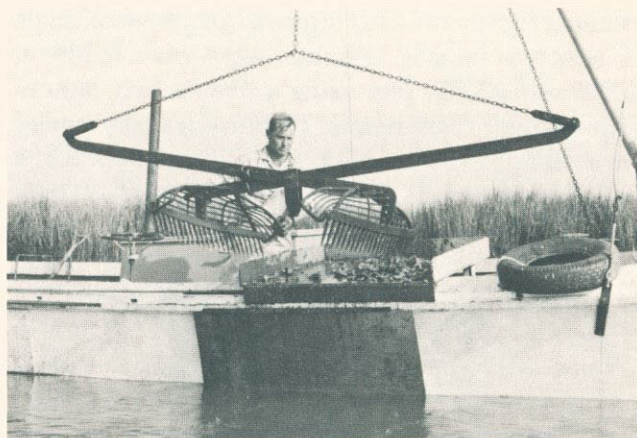


Figure 9. Patent-Tongs in Operation in Alligator Creek.

In some areas of natural subtidal oyster growth, as in the Santee Rivers where oysters grow very thickly, their use should be an aid to thinning the crop to encourage better growth. The future use of these tongs will be encouraged in order to continue to observe their effects on oyster bottoms.

In an effort to obtain more accurate figures on the total acreage of intertidal oysters, acres within each lease or "block", and to facilitate better oyster management and total tideland management, a pilot aerial photographic survey was initiated in the spring of 1970.

Several aerial mapping companies were contacted and offered the opportunity to submit proposals for a pilot program of the character desired. MAPCO of Ormond Beach, Florida, and Photo Sciences of Gaithersburg, Maryland, were two of the organizations contacted capable of doing the type of required photography. Several meetings were held with each of these companies. Both indicated that they could do the required work.

After due consideration of the commercial firm's proposal, the decision was made to contact a Federal agency in an effort to save funds. A pilot study was planned and an area was selected near Charleston for photographing. Processed positive transparency film was available the same week that it was taken.

Ektachrome color and Ektachrome "camouflage detection" film (color infrared) were used on high and low tides. The tide and times were selected and furnished by the Marine Resources Division. All photographic flights of this pilot project were completed in 1970. The flights were flown at 3,000, 4,500, 6,000 and 10,000 feet using a camera with a 6-inch focal length lens giving a 4.5 inch format. The film was left as positive transparencies and only limited prints were made of selected frames. Flights were also made at 15,000 and 18,000 feet using a double lens camera with a longer focal length. Positive transparencies were also produced with this film, but with a 9 x 18 inch format. The film was viewed in 1970 and tentatively evaluated in 1971. From these preliminary evaluations it is apparent that intertidal oysters as well as delineation of vegetation is possible using color infrared film. Overlays (Figure 10) can be accurately drawn. It is evident that in order to make accurate calculations from such photography, the photographs must be professionally taken, the film handled with utmost care, the exposed film processed with care, ground truth and control be adequately provided, and aircraft and equipment be capable of performing the job demanded of it. The first photographs provided very useful data in the initial stages of attempting to plan a program within South Carolina. After due consideration, it was proposed to enter into an agreement with the South Carolina Water Resources Commission to contract a more detailed second study of a selected area with a firm already engaged in, or familiar with, the type of photography required. Special funds were acquired and a subcontract, amounting to about

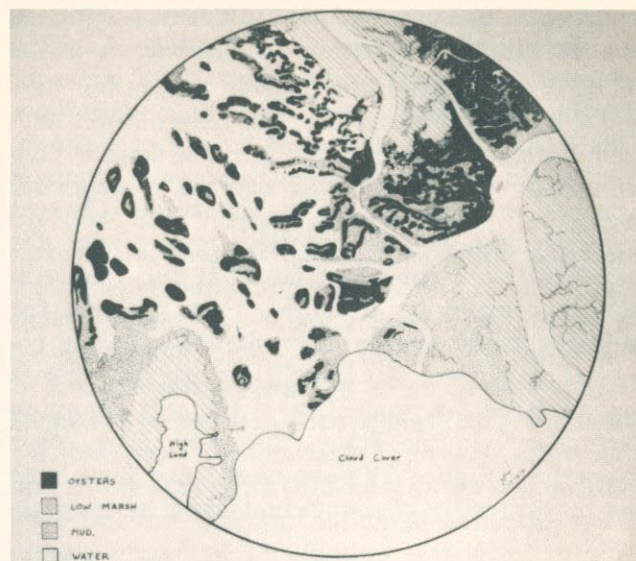


Figure 10. Intertidal Oyster Overlay Compiled from Aerial Infrared Transparency.

\$47,000.00, was let to Lockwood, Kessler & Bartlett of Syosset, New York.

The basic content of this contract is to conduct "A Pilot Study of Feasibility of Use of Aerial Photography and Professional Photo Interpretation for Delineation of Physical Features of Tidelands and Estuarine Areas in Beaufort County, South Carolina." Of greatest interest is the interpretation of valuable oyster beds and delineation of marsh grasses used to interpret the mean high water mark. A completion report will be due the first half of 1972.

In the spring of 1971 the South Carolina Marine Resources Division entered into a contract with the U. S. Army Corps of Engineers for the purpose of a "Study of Charleston Harbor." This was the third effort utilizing infrared photography. The Marine Resources Division's portion of the contract included an inventory of the marshlands and a survey of the offshore dumping grounds. The Corps of Engineers was to supply color infrared photography for the study and the Marine Resources Division was to supply the interpretation. The area finally photographed amounted to about 130.9 square miles or approximately 83,648 square acres. This includes a large part of the State's polluted oyster grounds.

A KC-IB camera, 3443 "camouflage detection" film with an infrared filter, was used. The processed film was left as 9 x 9 inch color positive transparencies. Extreme care was given to the film before and during processing. For the most part the quality of the photographs was good. Inter-

pretation is still in progress and several additional months will be required for completion.

The intertidal oysters growing on the open mud flats show up very well. The creek and river-bank beds are more difficult to identify and extensive ground truth is needed before they can be properly defined. With proper ground truth and detailed viewing of the transparencies, the marsh grasses can be identified fairly readily.

It is anticipated that among the many things that can be accomplished from the successful completion of an aerial photographic survey using the proper film and procedures, are recording oyster acreage, for inter-tidal beds from which maps or overlays to be compiled. This should be of benefit not only in providing an accurate inventory, but also in establishing long term trends if the entire coastal area of the State, or a large portion of it, can be accurately photographed.

It is envisioned that the most economical and practical method to accomplish such a project on a coast-wide basis is to evolve a multi-purpose, multi-agency use survey encompassing a variety of purposes. Due to the technical considerations involved, total scope and time required for accurate interpretation and compilation of data, it is suggested that such a study should be a project in itself so that personnel assigned to it may give their fullest attention or, perhaps preferably, that such photography, interpretation and compilation be contracted to a private firm with State personnel providing the necessary assistance, support and coordination.

In South Carolina pollution is a primary concern, having closed to harvesting a significant percentage of some of the most productive oyster areas of the State. For example, Clark's Sound, adjacent to the southern portion of the South Carolina Marine Resources Science Center, produces excellent intertidal oysters and contains extensive acreage, but has been closed to shell-fishing for about ten years due to pollution emanating from Charleston Harbor.

Poor management, especially in over-harvesting (Figure 11) and partial or total lack of shell planting have resulted in a general depletion of large areas of the oyster population in this State.

"The National Register of Shellfish Producing Areas (Houser and Silva, 1966), states that South Carolina has 183,100 intertidal and subtidal acres of active oyster producing water, with 32,000 acres, or about 18% of this water closed by pollution (Figure 12). In 1970 South Carolina had 7,059 acres leased or in public oyster grounds,



Figure 11. Lease in Price Inlet Area Showing Mismanagement Through Overharvesting.

which represents the total acres of producing oyster ground not polluted. Thus there are about 1,721 polluted acres of producing oyster grounds in South Carolina, with no alleviation in sight for the near future.

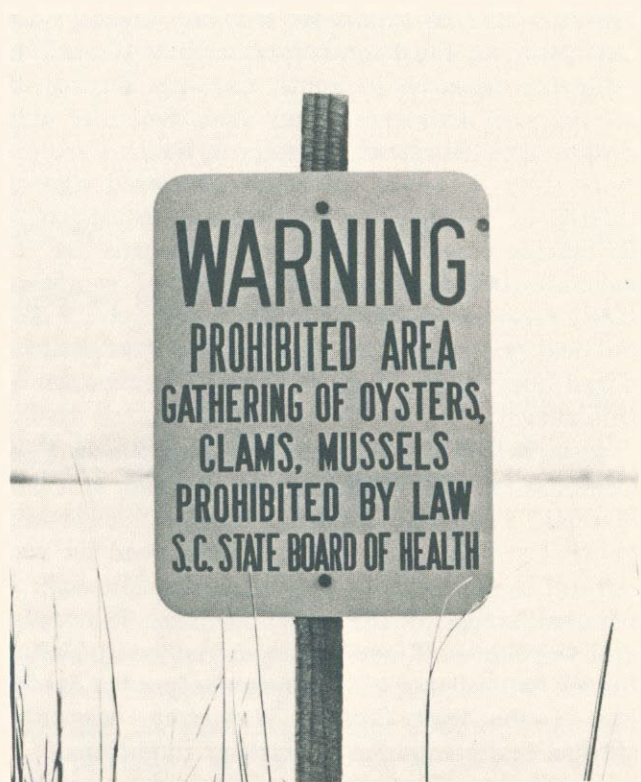


Figure 12. Boundary Sign of Polluted Oyster Grounds.

### JOB 3: EVALUATION OF EXISTING BIOLOGICAL AND ECOLOGICAL INFORMATION PERTINENT TO FUTURE RESEARCH AND MANAGEMENT ACTIVITIES.

In order to evaluate the existing biological, ecological and legislative information pertinent to future research and management activities, a literature survey of published and unpublished information and data relating to the oyster and the oyster industry in South Carolina was conducted. Extensive efforts were made to gain historical materials relating to the industry and oyster usage in an effort to gain insight into earlier problems and observations which would afford some basis of comparison to present conditions.

The primary in-state source of current written information concerning oysters in South Carolina has been the records and various "Contributions" of Bears Bluff Laboratories, Incorporated, of Wadmalaw Island, South Carolina. Upon termination of their work for the South Carolina Wildlife Resources Department in 1969, the majority of their records, files and Laboratory publications were acquired by the then newly created South Carolina Marine Resources Division. Bears Bluff Laboratories, Incorporated, contributed much to estuarine research in South Carolina during its 24 years of existence. They had done the only field studies concerning oysters in South Carolina since July 4, 1945. No State-sponsored agency existed in South Carolina that was equipped to do marine research; hence, their records are invaluable and for background data of comparatively recent years were heavily relied upon. Their publications as well as their unbound and unindexed files were studied during the course of this survey.

Assorted pre-World War II United States Fish Commission and United States Bureau of Commercial Fisheries reports, mostly concerning South Carolina and Georgia, were read as was some of the material of the Charleston Museum. A detailed study of the area between Charleston and the Santee Rivers, sponsored by the United States Army Corps of Engineers before the dredging of the Intra-Coastal Waterway, was also studied and compared to existing conditions.

Evaluation of available existing data coupled with personal observations revealed a number of

different conditions wholly or partially peculiar to South Carolina.

In attempting to make comparisons with other States, possibly the absence of large lunar tides along the Gulf Coast makes a part of their biological data unsuitable to South Carolina oyster biological requirements. Deep-water oysters, such as are common to Maryland, Virginia and North Carolina, occur infrequently in South Carolina, making some of the studies of these three states inapplicable to South Carolina requirements.

The reasons little or no set of oyster spat occurs in subtidal bottoms of the South Carolina and Georgia coasts has not been adequately determined. The absence of a deep-water spat set in these regions was recognized at least by the last half of the nineteenth century and commented upon in early studies. Several plausible suggestions have been presented concerning this lack of set; however, none have been adequately proven and no possible method to alleviate this situation has yet been presented.

There are only a few natural subtidal oyster beds in the State, and the majority of these are suitable only for seed. Verbal reports indicate that perhaps 30 or 40 years ago there were several more extensive subtidal beds, but for various undetermined reasons, the majority of them were apparently destroyed. Early Indian shell-middens and shell-rings often contain oyster shells of good size and shape (Figure 13) which evidently came from subtidal beds, although today there are no subtidal beds to be found in adjacent areas.

Deep-water oyster cultivation has been historically successful only in limited selected areas of South Carolina; however, this success has been true only in the transplanting of seed from natural areas of subtidal establishment to other subtidal areas for growing. The planting of deep water cultch material has not been successful (Oemler, 1893). Today only about 5% of the oyster production is from planted subtidal areas. These were all planted with deep-water seed from distances of up to 30 miles from the areas of the





Figure 13. The Shape of Indian Utilized Oysters from Fig Island Shell-Ring Indicate Subtidal Growth.

natural seed beds. In some instances the growth of these transplants has been phenomenal, the seed reaching a marketable size in about 12 months. The demand for these quality oysters far exceeds the supply, and efforts should be made to encourage expansion of this phase of the industry.

One of the few natural subtidal oyster growing areas, Alligator Creek, was planted experimentally by the South Carolina Marine Resources Division in the spring of 1971. Approximately 2,600 U. S. bushels of seed oysters were transplanted from the Wando River. This area was closed to all harvesting, and although harvesting has not yet been allowed, the transplanting appears to be successful. Mortality has not been in excess of 15%, and growth of approximately  $\frac{3}{4}$  inch has been attained in ten months (Figure 14). If it does prove successful, consideration should be given to other State-initiated subtidal seed plantings.

Several basic actions could be taken to encourage subtidal oyster cultivation, two of which would be of a legislative nature. First, some provision should be made for leasing or otherwise controlling defined portions of bottoms for specific periods with fixed responsibilities for both the State and the lessee. Secondly, the current laws curtailing the use of dredges should be modified to allow the use of mechanical harvesting or dredging in designated areas under certain stipulated conditions and regulations. The cost of planting seed by hand and recovering the marketable oyster by hand is now too expensive to justify the expansion of subtidal producing areas.

The literature of the subtidal oyster-producing



Figure 14. Wando River Seed Oyster (bottom). Alligator Creek transplants after Ten Months of Growth (top).

States has been researched to the extent considered necessary to profit from their experience in management, conservation and regulatory practices.

Transplanting of intertidal oysters to subtidal areas has been attempted, but often has not been successful. There is little setting of spat much below mean low water, and the survival is very small when compared with intertidal spat survival. The only practical method of cultivation of subtidal oysters has been the transplanting of subtidal seed from low salinity natural seed areas (Table 3) to locations of much higher salinity.

Table 3. Subtidal Oyster Seed Bed Locations in South Carolina

NAME	LOCATION	ACRES
Ashepoo River	In and below Intra-Coastal Waterway	36
North Santee River	Below Intra-Coastal Waterway to mouth	298
South Santee River		
Wando River	Beresford Creek to Paradise Island	390

Conditions prevailing in most high salinity areas promote rapid growth, if the bottom is of adequate supporting firmness, but at the same time encourages a great abundance of natural enemies. At least nine major fouling organisms and predators are recognized to plague subtidal oysters in South Carolina (Table 4), making it difficult for them to become established and survive.

Table 4. Common South Carolina Oyster Pests.

1. Barnacle	( <i>Balanus eburneus</i> )
2. Blue crab	( <i>Callinectes sapidus</i> )
3. Boring sponge	( <i>Cliona</i> sp.)
4. Drilling snail	( <i>Urosalpinx cinerica</i> )
5. Encrusting bryozoan	( <i>Membranipora</i> sp.)
6. Hooked mussel	( <i>Brachiadontes recurvus</i> )
7. Mudworm	( <i>Polydora websteri</i> )
8. Starfish	( <i>Asterias forbesi</i> )
9. Stone crab	( <i>Menippe</i> sp.)

South Carolina has a unique combination of environmental conditions inducing the majority of all South Carolina oysters to establish and grow in the intertidal zone (Galtsoff and Prytherch, 1927). Due to the almost continuous intertidal spat-set from May through October, along with an apparently high rate of survival, it is extremely difficult to produce any oysters except clusters of closely bunched, elongated individuals locally known as "coon oysters". Generally, the intertidal oyster is suitable primarily to raw shucking or steam canning. No effective method of mechanical harvesting of these oysters has been perfected, although a harvester is under development and in limited operation.

The profusion of oysters growing one upon another, due to successive sets on the older individuals, sometimes produces elongated clusters, often attaching to solid objects and growing in height to 18 inches or more. Usually only the outermost ones remain alive, and they are generally of poor configuration (Figure 15).



Figure 15. Successive Yearly Sets Frequently Produce Oyster Clusters Growing to Heights of 18" or More.

#### JOB 4: SURVEY TO EXISTING MANAGEMENT AND REGULATORY SYSTEMS.

In South Carolina oyster production has been on a downward trend since 1908. Since 1963 this decline has been more pronounced. In part it can be attributed to unwise and unduly restrictive regulatory policies governing oyster management and harvesting in this State.

Among some of the problems encountered are those engendered by the current leasing system. Since the vast majority of tidelands in South Carolina are State owned, it is necessary to provide the oyster producer with some type of exclusive protection in a given area. At the turn of the century, this could be done only through a special act of the State Legislature (Battle, 1890). Granting bottom rights in this manner was time consuming and probably tended to promote favoritism. Later, probably about the time of the First World War, a more equitable method was adopted by which rent was paid on prescribed areas of grounds producing or capable of producing oysters. This was done through a leasing system

which, while better than the previous arrangement, tends to promote a multitude of small leases with meandering, ill-defined boundaries. Many times areas will be found where a lease is entirely surrounded by one or more different leases. Boundaries, almost without exception, are difficult to locate. In some areas oystermen working for one lessee have to cross the boundaries of another's lease. In certain locations this situation encourages poaching of epidemic proportions. Enforcement personnel have an impossible task in attempting to control these poorly delineated areas. Some areas have been taken out of production by the rightful owner because the cultivation of these areas brings no return. The stolen oysters are either retailed directly to the consumer by the poacher or, if the quantity is great, sold to a dealer who probably knows where the oysters came from, but who condones, and in some cases encourages, the practice.

In an effort to alleviate some of the problems generated by the present inherently complicated leasing method, a new system of "block-leasing" was initiated in 1970 at the suggestion of Project personnel. Basically it involved utilization of natural boundaries instead of artificial ones and confines one lease to a single geographic area. The lease also now carries one identification number instead of many. This helps lessen the burden on administrative and enforcement personnel as well as the lessee himself, for in many cases the lessee, while physically on his lease, was not able to point out its boundaries. A pilot "block-leasing" system was implemented and completed in the Murrells Inlet area in 1970. This necessitated the rearranging of the public recreational grounds in this location, but generally both the public and the commercial oystermen seem pleased with the results.

In 1971 "block-leasing" was initiated in the area between Alligator Creek and the north shore of Charleston Harbor. Considering the acreage and number of lessees involved, this was perhaps the most problem-plagued area in the State. Much trading of ground was necessary among lessees in order to confine their leases to a single, well-defined geographical area. With the many personalities involved, this swapping process became quite time consuming, necessitating many meetings between Marine Resources Division personnel and individual oystermen as well as large meetings of all those affected.

Meetings and proceedings were conducted by Marine Resources Division personnel. At the end of 1971 "block-leasing" was approximately 90% completed in this area. Much effort and time was necessary to achieve this completion; however, it is expected that this more efficient system will prove its value within the next several years. The number of leases has been reduced from 145 in 1970 to 97 in 1971. Total acreage of leased bottoms remains approximately the same.

Current regulations require the planting of 65 South Carolina bushels of shell or seed per acre under lease. It can easily be demonstrated that the amount of shell multiplied by the acres of leased bottom usually exceeds the total shell production reported for the entire State in any recent year. Therefore, the oystermen should plant the remainder of their quota in seed. Only a few producers even try to comply with this regulation—fewer still are successful. Most oystermen have no mechanical facilities for planting shell or seed. The shovel and batteau or barge are depended upon. Using shovels to plant seed

or shell requires some degree of judgment, since carelessness can cause planting to occur in stacks, or distribution to occur unevenly or in deeper water where the shell catch no spat. Only the steam cannery barges have hydraulic capabilities (Figure 16) and while they plant for a number of different oystermen, their activities are confined to the areas south of Charleston and usually along the lower third of the coast.

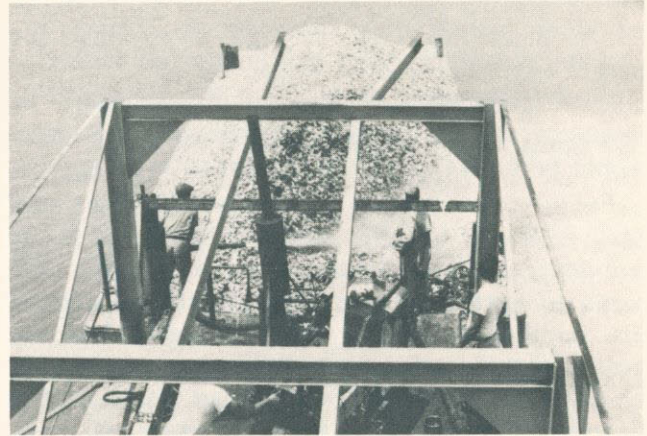


Figure 16. Oyster Shell Being Planted Intertidally at High Tide by Hydraulic Pumps. This Type of Planting is Practiced by Only One Operator in South Carolina.

Personal visits to the States of Virginia, North Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana have been made in an effort to study their handling of problems which would be applicable to those encountered in South Carolina. During these visits it soon became apparent that the one outstanding financial disadvantage that South Carolina possesses is that, unlike the last four States named, there are no known large, seemingly inexhaustible, prehistoric dead shell deposits available, through the sale of which funds can be derived to finance fisheries assistance operations or otherwise used to aid oystermen through such activities as State initiated shell planting.

Information gained from these States seems to indicate that South Carolina's rampant poaching problem might be alleviated by providing potential poachers with a place to harvest oysters other than privately leased grounds belonging to someone else. This possibly could be accomplished by selecting certain areas to be managed by the State as public commercial oyster grounds. A study has been conducted along these lines, and the creation of such commercial grounds seems entirely feasible if suitable grounds can be lo-

cated and are made available for this purpose and if some type of funding for planting, maintenance and control can be found.

It seems likely that grounds for public commercial use would have to be donated by current lease holders. They may be willing to do this if it can be shown that establishment of such areas would help to control the serious poaching problem. Funds would have to be derived, at least in part, from a special license and from a per bushel tax or picking fee. Caution will have to be used not to place these fees so high as to make the practice of poaching as attractive as it is now. Once established, such grounds should ideally be managed and cultivated to the extent that they would become a model to the industry.

Public recreational oyster grounds were created in South Carolina several years ago. They are generally well marked, with prominent metal signs (Figure 17) around their boundaries. Some are readily accessible; some are not. Until recently, their locations were not known to the public at large, but with the proposed issuance of a descriptive brochure with maps early in 1972, their existence and locations will be known. The recreational grounds, however, need a firm man-



Figure 17. Boundary Sign of Public Recreational Oyster Grounds.

agement policy to include the planting of both shell and seed. Although the shucking houses are required to plant 5% of their shell production on the public grounds, this provision has generally been ignored. Planting has been inadequate on these grounds in the past five to ten years. As with the proposed public commercial grounds, these public recreational grounds should become model areas of conservation and management.

## RECOMMENDATIONS AND CONCLUSIONS

As a result of this survey, the following recommendations are considered to be necessary to aid the development and more successful management of the South Carolina oyster industry. The oyster industry, even considering its many problems, is a valuable resource. Oysters are sessile and are one of the few marine resources that can be totally managed on a year-around basis. The South Carolina oyster industry once produced in excess of three million bushels of oysters a year. It has been in a state of decline for many years, and a concerted effort must be made now to reverse this trend if the industry is to survive.

The following recommendations have been developed for submission to the Marine Resources Division of the South Carolina Wildlife Resources Department:

(1) The Marine Resources Division's Office of Conservation, Management and Services should establish a permanent section to be known as the "Shellfish Section" for the purpose of developing and carrying out shellfish management practices which may be deemed appropriate.

(2) Rearrangement of current oyster leases into a "block-leasing" system utilizing natural boundaries. Blocking was initiated in 1970 and has been accomplished from Charleston northward. This has to date removed 48 leases from the files, resulting in the lessening of the workload for both the lessee and Marine Resources Division personnel. Additional benefits are expected from this system. This should be continued until all leased areas are brought under this system.

(3) Lease acreage should be dependent on the capabilities of the lessee to manage his grounds. The oystermen who exhibit the most capabilities should be considered first when additional acreage for lease becomes available. New persons and those who show less capability should be given secondary consideration.

(4) Numbering oyster vessels and issuance of permits to pickers for purposes of controlling poaching should be accomplished at an early date. In some areas poaching has reached epidemic proportions, and some control is needed. Each

picker should have to obtain a permit, restricting him to a specific lease or leases. Each picker working on State grounds should also be required to obtain a permit. Conservation officers need to have the authority to cite anyone who is engaged in the commercial harvesting of oysters without a permit.

(5) Steps need to be initiated to make arrangements to lease or otherwise give restricted title to subtidal grounds for limited periods of time for the propagation of oysters. South Carolina, along with possibly one other State on the Eastern seaboard, has no provisions to lease subtidal grounds for oyster culture. Our oyster industry is based almost entirely on the intertidal oyster. Per bushel, this oyster brings a lower price than the subtidal oyster. It would be of benefit, especially to the smaller producer, to upgrade this portion of our oyster industry by leasing subtidal areas and encouraging the oystermen to plant more subtidal seed oysters which, when mature, would bring a better price in the shell stock trade. A system should be devised to allow "planted" subtidal oysters to be harvested throughout the year. If the oystermen were allowed to harvest their planted subtidal oysters at any time, this would allow them to retain their customers and would at the same time encourage additional subtidal cultivation. The harvester would also be in a position to utilize his labor force throughout the year.

(6) Permit subtidal dredging to be done in certain areas and under certain conditions. If the South Carolina oyster industry is to progress, it is imperative that the laws be changed to allow dredging in less than 12 feet of water at low tide as is currently required. Oysters can be dredged from polluted waters and successfully transplanted to selected subtidal areas for fast growth and superior configuration to produce a higher-priced oyster. At the same time, the oystermen need to be able to legally dredge these same oysters for the market. Dredging is currently the only profitable method by which this can be accomplished.

(7) Upgrade the public recreational oyster grounds.

(a) It should be required of all lease holders to plant at least 5% of their yearly requirement of shell or seed on the public recreational grounds. At present these grounds are neglected as far as management is concerned. The law now requires that canneries and raw shuck houses may be required to plant 5% of their annual quota on these grounds; however, since

many of the raw-shucking houses and most of the canneries have gone out of business, this is inadequate.

(b) Enlarge or establish new public recreational oyster grounds. There has recently been an appreciable upward trend in recreational oyster harvesting, which has created a greater demand on the public beds. The State should keep abreast of this demand and practice advanced planting and conservation methods on these grounds. An "Oyster Guide" to the recreational grounds will be published early in 1972 at the suggestion of Shellfish personnel to familiarize the public with these grounds.

(8) Establish State-managed oyster areas for management and scientific research. Under certain conditions these areas could be opened as public commercial oyster grounds for controlled harvesting. There is no area, other than polluted grounds, that experimental work, either in management or research, can be carried out.

(9) Encourage the utilization of currently polluted grounds for use as public seed grounds and utilization of harvestable size oysters for depuration. The polluted grounds have been neglected in reference to oyster culture. From a lack of harvesting they are mostly overgrown with oysters. It is recommended that the polluted oyster grounds be used as a source of seed for commercial operators and to encourage persons unable to obtain leases to utilize harvestable size oysters in a depuration area. Efforts along these lines would have to be a joint operation between the Marine Resources Division and the South Carolina State Board of Health, Shellfish Sanitation Laboratory.

(10) Enforce the 65-bushel-per-acre required planting of seed or shell. Close supervision with positive confirmation of planting should be required. Too much planting has been done on "paper" and not enough on oyster beds. All planting should be supervised by conservation officers or Marine Resources Division biologists to provide confirmation of amount and area planted.

Sixty-five bushels of seed or shell per acre is actually inadequate when consideration is given to the limited area of ground this amount covers. It is recommended that while the current planting should be enforced additional study should be conducted to discover methods to obtain additional seed or cultch material with the future possibility of increasing the planting quota.

(11) Lend all possible support to the development of a method of safely harvesting, by me-

chanical means, intertidal oysters. In 1670 when English colonists first landed at Charleston, they picked oysters by hand. Three hundred and one years later people are still picking oysters by hand. In past years, when hand labor was plentiful, the South Carolina oyster industry flourished, but as the hand labor supply dwindled, so did oyster production. If the decline of the oyster industry is to be halted, then it must be done in part with modern mechanized equipment.

(12) Actively encourage the development of seafood processing plants and better methods of sales and distribution of all seafood to include oysters.

(13) A more detailed study into the use of infrared photographs or thermal scanning as tools for marine resources management to include intertidal shellfish needs. In recent South Carolina pilot studies using infrared photography it has shown promise as an aid in shellfish management.

(14) Active assessment of other shellfish resources such as clams, in which the industry manifests a high interest. Exploratory operations need to be conducted concerning the availability of scallops and other shellfish on the continental shelf of the South Carolina coast.

(15) Recommend removing the per bushel tax from oysters harvested. The tax is not an incentive to report accurate harvest figures. If this tax were removed, a higher rent, approximately \$3.00 per leased acre, could make up for the monetary difference. The harvest records could then be collected in a more accurate manner by the National Marine Fisheries Service. Records compiled by this organization can not be used by any tax collecting office.

(16) The subtidal oyster seed beds of the State have never been the subject of a scientific management program. Also, these seed beds have not been thoroughly assessed since 1967. The areas involved should be resurveyed, current volume and acreage determined, and appropriate maps delineating the oyster beds should be compiled. Recruitment data and other information considered pertinent to such a study should be collected in more detail than previously. Transplanting experiments have proven that successful subtidal seed planting can be made in carefully selected areas. In an effort to expand previously discovered growing sites and to find new ones, controlled experimental transplanting should continue to be made from these beds.

(17) Change the right of the lessee to enter into mutual use agreements with other lessees and require these agreements to be recorded with the Office of Marine Conservation, Management and Services. This change is not to be considered sub-leasing, but truly mutual use, such as a cannery picking cluster oysters on one lease and a raw shucking house picking single oysters on the same lease. Sub-leasing, selling or speculating and acquiring a lease in order to collect a royalty on oysters harvested from this lease should not be condoned.

(18) Several additional conservation officers need to be added primarily to marine law enforcement to effectively monitor oyster shell and seed planting, enforce permit requirements for harvesters and control poaching. The law enforcement section presently contains nine men and one supervisor. This force is expected to enforce all marine, game and boating laws along 190 miles of coastline encompassing 638,000 acres of marsh and inland waterways plus all waters to sea within three nautical miles of shore. At this time it is often necessary for an officer to postpone one job in order to complete another. Additional patrols could be used as a preventive measure. Fines for shellfish violations should be increased from the present \$25.00 to about \$100.00 per offense.

(19) The acquisition of an aircraft with amphibious capabilities by the Marine Resources Division would greatly increase the Division's flexibility. Such an aircraft could always be used in a variety of shellfish programs such as intertidal oyster surveys, control of poaching, checking of shell and seed planting, and aerial photographic studies. It could be further utilized in other areas of marine management and law enforcement by Division personnel.

(20) Additional scientific studies and other research is necessary to enhance future shellfish management activities. Fields of endeavor might include the following:

- (a) Biological studies of the intertidal oyster.
- (b) Oyster spat set investigations (intertidal and subtidal).
- (c) Experimental transplanting of subtidal seed oysters.
- (d) Investigation of oyster culture in ponds.
- (e) Cultch material investigations.
- (f) Mechanical harvesting applications.
- (g) Cultchless seed oyster experiments.
- (h) Studies of oyster diseases.

- (i) Studies concerning oyster depuration.
- (j) Survey and study of the major subtidal seed oyster beds.
- (k) Investigations of commercial potential of other shellfish.

The results of this study leave little doubt that immediate action is needed to reverse the downward trend of the oyster industry. Further laboratory and field research are needed to better understand the biology and ecology of the intertidal oyster and to aid in better management of the fishery. At the same time, additional research

is needed in subtidal seed transplanting and leasing of subtidal bottoms and some type of mechanical harvesting for intertidal bottoms.

The currently polluted oyster grounds need to be utilized both for seed and possibly for depuration stock.

As more pressure is applied to the public recreational oyster grounds, it is imperative that they be maintained and plans be instigated for expansion.

To further enhance our commercial fishery, an all-purpose seafood processing plant is needed.

## SUMMARY

All types of shellfish, including oysters, were used thousands of years before the coming of European settlers. Large shell middens still survive to attest to Indian community usage.

Historically, the first explorers and settlers were quick to discover and use the large quantities of oysters they found. The meats were used as food and the shell was burned to produce lime for building purposes. The English in particular, beginning about 1666, left numerous written accounts describing oysters.

Apparently until about the last third of the nineteenth century, there was no oyster industry as it is known today. Until its beginnings in the late 1800's, there was little or no wholesale distribution of shellfish. By 1886, South Carolina harvested oysters were being shipped as far north as Philadelphia. By 1890 such companies as the Bull Bay and Edisto Fish and Oyster Companies were cultivating subtidal oysters and wholesaling their products in South Carolina as well as shipping some northward. Shortly after the turn of the century, as many as 16 plants were steam-canning oysters in the State. Due to various reasons, apparently mostly management and labor problems, production, according to available records, began a steady decline in 1908. Today the industry must find ways to circumvent the critical labor shortage and also must begin at once to practice proper management and conservation.

Four studies or jobs were considered necessary during the survey in order to make recommendations to upgrade the industry to a higher efficiency and productivity.

### **JOB 1: COMPILATION AND EVALUATION OF EXISTING STATISTICAL AND ECONOMIC DATA ON THE SOUTH CAROLINA OYSTER FISHERY.**

An inventory has been compiled of oyster leases, lessees, lease acreages and locations. Canned, raw shucked, in-shell local and export oyster production for 1965 through 1970 has been compiled, along with information relating to harvesting, marketing and processing. The number and types of vessels, equipment and gear have been tabulated and are included in Table 2.

### **JOB 2: FIELD SURVEY OF THE OYSTER INDUSTRY.**

In 1970 all the State oyster producing grounds, leased, polluted and public, were surveyed by boat and aircraft. In 1971 selected portions of these grounds or those previously missed were again studied. All commercial oystermen have been interviewed and their operations studied with respect to proper management and utilization of this natural resource. Information has been gathered relating to investment, facilities and labor supply and summarized in Table 2. Only portions of the shell plantings and seed transplanting operations were monitored by biological personnel and conservation officers.

An aerial infrared pilot survey of South Carolina tidelands was initiated in 1970. Throughout 1971 feasibility studies continued to determine if this method would be adequate to compile more adequate charts of the oyster grounds, delineate polluted areas, accurately map acreages of inter-

tidal oysters, both mud flat and river bank beds, determine marshland zonation and generally become an important part of overall enhancement of tideland management.

**JOB 3: EVALUATION OF EXISTING BIOLOGICAL AND ECOLOGICAL INFORMATION PERTINENT TO FUTURE RESEARCH AND MANAGEMENT ACTIVITIES.**

All available published and unpublished information relating to both biology and ecology of the South Carolina intertidal and subtidal oyster has been reviewed. Except for some historic background material, this was completed by the first half of 1971.

South Carolina has a unique combination of biological conditions which influence the majority of oysters to grow in the intertidal zone. Due to the almost continuous spat-fall from May through October and an apparently high survival rate, it is difficult to produce any but cluster oysters which are generally suitable only for raw-shucking or steam canning.

Subtidal oysters grow naturally in only a few limited areas. These occur primarily as seed. Areas of harvestable quantity natural subtidal oysters are extremely limited, although some degree of success has been achieved with seed transplants.

No widespread mortality of intertidal oysters has been attributed to oyster predators; how-

ever, subtidal beds are seriously affected by common oyster pests, especially boring sponge. Table 4 contains a list of common South Carolina oyster pests and predators.

**JOB 4: SURVEY OF EXISTING MANAGEMENT AND REGULATORY SYSTEMS.**

Rules and regulations governing shellfish have been obtained from most East and Gulf Coast oyster-producing States. Louisiana, Mississippi, Alabama, Florida, Georgia, North Carolina and Virginia have been visited with reference to their oyster management, conservation and regulatory policies. Many of their management and regulatory policies are inapplicable to South Carolina because their oysters are mostly subtidal, whereas the majority of South Carolina oysters are intertidally grown. Table 3 lists natural subtidal seed areas in South Carolina.

The first four mentioned States have a seemingly inexhaustible supply of submerged dead shell deposits, from which they can derive most of their shellfish resources planting and enforcement capital.

The rearrangement of current oyster leases into areas confined within natural boundaries is one of the most effective management practices to have been implemented in South Carolina in recent years.

Poaching and exacting compliance with current shell-seed planting regulations are among the current enforcement problems which require further attention.



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