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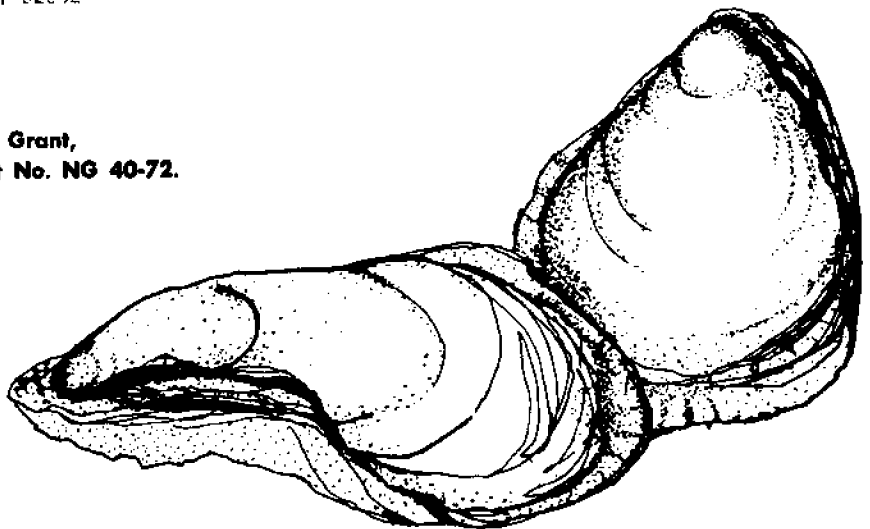
# COMMERCIAL OYSTER AQUACULTURE IN MAINE

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PREFACE

# Sea Grant Depository

This bulletin on Maine oyster aquaculture is designed to provide the prospective aquaculture entrepreneur with information concerning the present status of the field in Maine.

Many people and agencies have worked hard over the years to bring shellfish aquaculture to its present state of development. These include especially the Maine Department of Marine Resources, TRIGOM who held an important conference on New England aquaculture in 1970, and numerous interested private citizens and groups throughout the state. We at the University of Maine have been in aquacultural research with the Federal "Sea Grant Program" since 1971 and much of our progress draws on earlier groundwork provided by the people above.

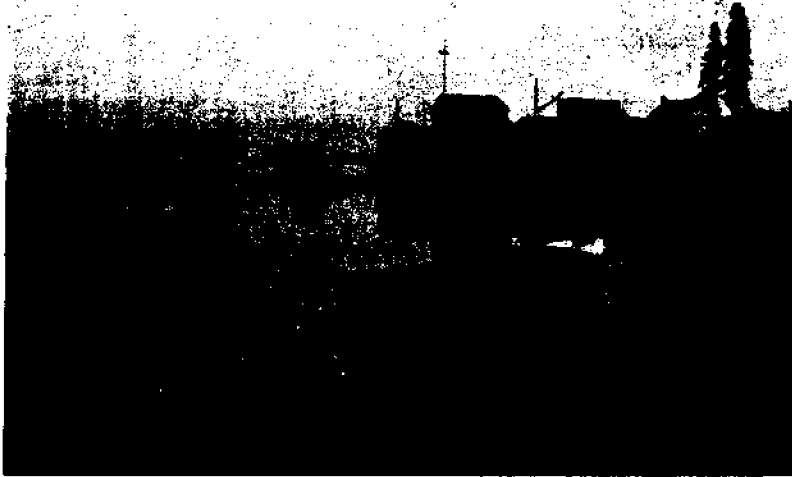
Considerable information is given on hatchery technique and field raft culture of oysters. Since the field is moving so rapidly, many recommendations made here will be modified as new information is developed. We plan to put out later editions of this manual as the situation warrants.

If a person plans to start an aquaculture venture, he/she should plan to visit the University of Maine's Darling Center at Walpole to obtain as much information and practical experience as possible. It is not possible to present all aspects of this field in a bulletin such as this, thus it is designed to supplement instruction received at the Darling Center. We would be very happy to demonstrate our techniques and, if space permits, to have the person work with us for a short period of time to learn the techniques first hand. Before starting, one is advised to contact the Maine Department of Marine Resources in Augusta for their advice, particularly with respect to legal matters.

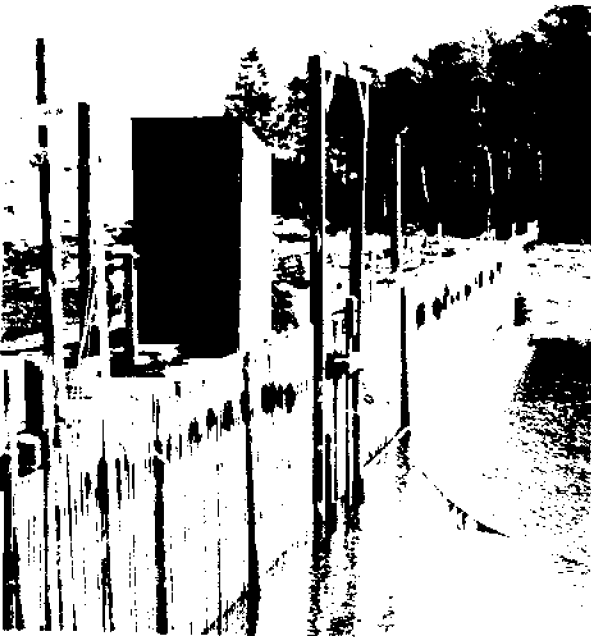
We are especially indebted to many persons for contribution to this bulletin. Miss Phyllis Coggins provided the illustrative material. Dr. David Dean has given much guidance to all of our studies. The University of Rhode Island Sea Grant Program's Dr. Paul Hargraves provided algal cultures for our aquaculture program. Mr. Robert Dow and Dana Wallace of the Maine Department of Marine Resources provided much advice throughout. Mr. William N. Shaw of NOAA added many helpful suggestions to the manuscript. Finally, Mr. Paul Ring and Mr. Harold Kimball were of great help in bringing this manuscript to print.

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With a wide variety of coastal environments and existing marine related structures, Maine could probably diversify into controlled shellfish culture.



SEA GRANT BULLETIN #2

Commercial Oyster Aquaculture in Maine

INTRODUCTION

With its extensive coastline and wide variety of marine habitats, Maine has produced significant oyster crops in the past, and with optimal development of the public and private fisheries, can be a very significant oyster producing area in the future.

Oyster production methods are conveniently divided into two types; natural on-bottom culture with various types of management and harvest control to assure maximum recruitment and harvest. The other is hatchery culture in which the life cycle is manipulated and controlled in the hatchery to eventually produce a marketable product. Significant efforts in natural production as part of the public fishery are being attempted by the Maine Department of Marine Resources (MDMR). Since natural seed collecting areas are scarce in Maine, the hatchery production method<sup>1</sup> looms as a very strong possibility as a seed source and as a method to produce a commercial crop. This report will provide preliminary information for persons interested in starting an intensive commercial hatchery venture in the State of Maine. An admixture of techniques, background, and other information is given; as the field is developed more fully in Maine we hope to treat specific subject areas in a more comprehensive fashion in future bulletins.

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<sup>1</sup>See Appendix II for status of world hatchery development.



Figure 1. Two species of oysters hold good potential for culture in Maine. American oysters (above) are native to the State and do well only in the warmed upper reaches of Maine's estuaries. European oysters (below) were stocked in Maine from Holland in 1949 and are adapted to colder water growing sites.





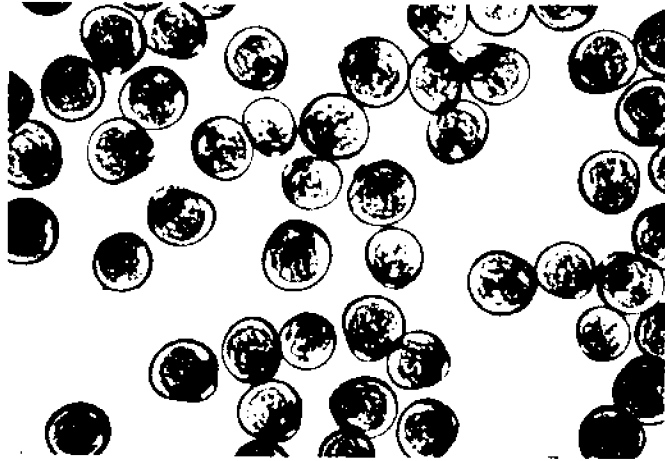
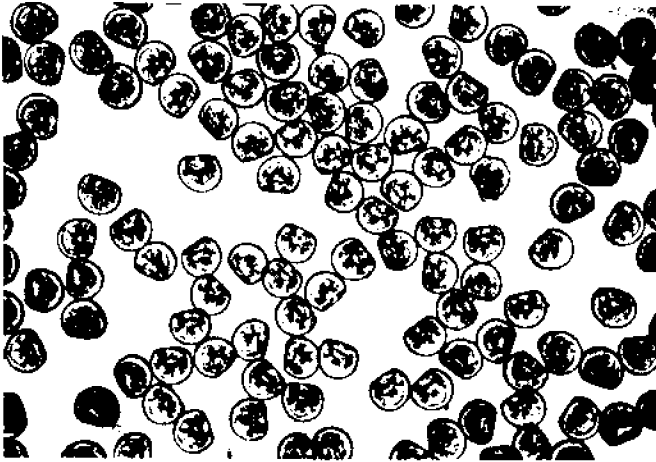


Figure 2. Free swimming veliger larvae of the American oyster greatly enlarged. Top view shows 2-day old "straight-hinge" larvae; middle view shows 1-week "late umbone" larvae and bottom view 2-week "mature" larvae. Mature larvae attach themselves to hard materials on the bottom and metamorphose into the adult form.

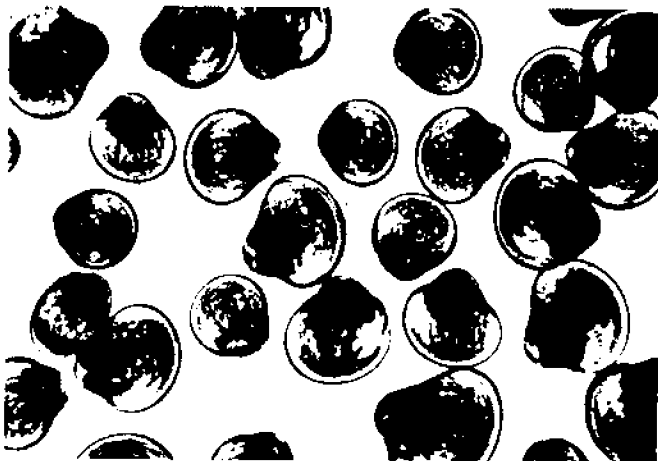
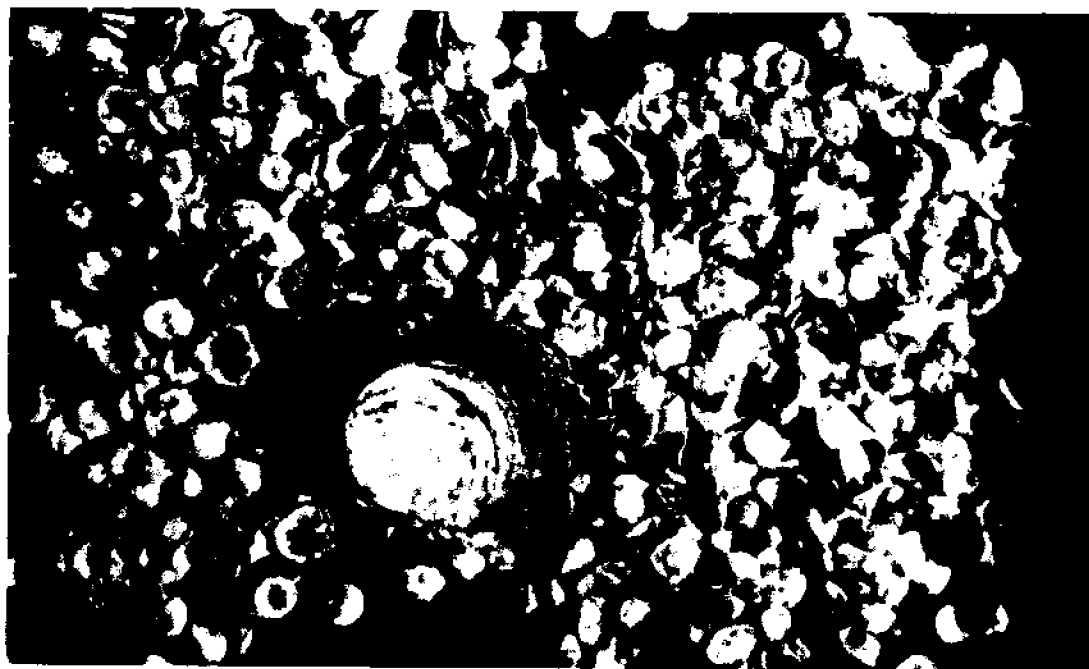




Figure 3. Juvenile oysters after setting in two growth forms. Above oysters are growing attached to the original cultch material. These oysters if not separated will grow in misshapen clumps producing an inferior market product. Below hatchery juvenile oysters have grown as "free single cultchless" oysters. Juvenile oysters are removed from the setting substrate a day or two after setting to give the free form. This new technique permits the efficient handling of a great number of oysters but requires newly developed culture technique to reach market size.



Oyster species. Two species of oysters have potential for intensive hatchery aquaculture in Maine. Each has its advantages depending on specific environmental conditions.

The American oyster, Crassostrea virginica -- This is the native oyster of Maine and eastern North America (Figure 1). It was once plentiful in the upper reaches of Maine's "arms of the sea" estuaries, particularly in the Sheepscot and Marsh River systems, and the upper Damariscotta River.

The American oyster supports a thriving industry to the south, Long Island Sound, Chesapeake Bay and the Gulf of Mexico, with prices ranging from 5 to 30 dollars per bushel depending upon quality. The more northern optimal sized oysters grown as singles command the best price for the restaurant half-shell trade.

The American oyster life cycle is typical of most bivalve mollusks. It must be considered a warm water animal with spring and summer water temperatures between 70 and 80°F necessary to produce gonad maturation and spawning in the northern races. This explains its natural occurrence being restricted to the upper areas of Maine's estuaries. When the oysters are sexually mature, there is a mass spawning on the oyster bed giving rise to a "brood" of free swimming "veliger" larvae (Figure 2) which live about 2 weeks in the plankton, feeding and growing on small algal forms less than 10 microns in size. When larvae become mature, they settle to the bottom, gluing themselves to any available hard substrate (Figure 3). There they transform to the adult form reaching a market size in 1 to 6 years depending on prevalent hydrographic conditions and food supply. When many American oysters set on a common surface, they will crowd each other as they grow and develop into a misshapen cluster, commanding a

poor market price. Those separated early or reared in the hatchery as singles should grow up as well cupped, rounded individuals which are high in demand when served raw on the half-shell.

In Maine's upper estuaries our results show that it is possible to raise a market half-shell American oyster in 2 to 3 years using rafting techniques. In thermally modified waters of power plants recent studies by MDMR indicate 1 year to market size may be possible.

The European oyster, Ostrea edulis -- Grown under the proper intensive conditions, the European oyster (Figure 1) is perhaps the world's highest quality table oyster. Grown intensively on the coast of France and finished in salt ponds to a pale green meat color, these oysters command a premium price in European cities.

The European oyster is different from the American oyster in several important respects. Of the genus Ostrea, it is a flat oyster with the upper shell being flat and the lower shell being quite rounded or cup-shaped. Shell shape is much less variable than the American oyster. The European oyster, in contrast to the American oyster, is a cold water animal, growing and reproducing at lower temperatures. Temperatures in the 50 to 75°F range are favorable for growth. With these temperatures, natural reproduction is achieved in the Boothbay region in late August and September. After spawning, the eggs are retained on the gills of the female and are released as half mature larvae approximately a week later. The masses of developing larvae on the gills give rise to the terms "white sick" and "black sick" and make these oysters unmarketable at this time because of appearance. This habit of holding larvae on the gills in summer has given rise to the belief that one cannot eat oysters in a month without the letter "R" in it. With the cooler water

temperatures in outer coastal regions, the intensive cultivation of European oysters could become a profitable enterprise in Maine.

#### Commercial Oyster Culture Ventures

Several types of aquaculture ventures appear to be possible in Maine:

1. Production of Maine adapted seed oysters. With the growing interest from pilot commercial ventures and private coastal residents in raising oysters, there is an increasing need for Maine adapted hatchery grown seed oysters. Presently, hatchery seed oysters can be purchased from California<sup>2</sup>, however, these may not be the best for Maine conditions because the parent stocks may not be genetically adapted for acceptable survival and growth in these northern waters. We have research in progress to determine if differences in performance exist between the California purchased oysters and those produced in Maine from our natural stocks. Presently the University of Maine Sea Grant Program is supplying Maine grown seed oysters on a limited scale. Increasing demand will soon exceed our ability to supply seed oysters and at that time a commercial seed oyster hatchery will be needed in Maine.

The potential demand from private coastal residents who merely wish to raise a few thousand oysters, a marine kitchen garden if you will, should not be underestimated. The private business which could supply seed shellfish plus instructions and hardware to rear them might become very profitable. It is essential, however, that state laws restricting culture in polluted waters be adhered to.

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<sup>2</sup>Pacific Mariculture, Inc., Pescadero, California has available both American and European oyster seed.

2. Production of Maine grown half-shell oysters. Our studies indicate that it is possible to raise a market restaurant oyster in Maine in a period of 2 to 3 years. Either American oysters or European oysters are suitable depending on the specific environmental conditions; again the protected warmer upstream waters for the Americans and the cooler coastal waters for European oysters.

3. American oyster holding industry. American oysters when they are held in cold Maine waters retard their reproductive cycle so that they may retain a fat marketable condition throughout the summer months. This is in contrast to the situation on the natural oyster grounds in Long Island Sound and the Chesapeake Bay region where oysters become unmarketable in summer months due to their reproductive activities in the warm waters.

The same would be true of American oysters grown in Maine's warmed protected upper estuaries. If these oysters, which have grown to a market size in the warm waters, could be moved to Maine's cooler waters for summer conditioning then one could provide prime oysters for the summer trade. Markets to the south would be receptive, again because the natural sources of supply cannot provide quality oysters during the summer period. An attractive possibility, if Maine marine law can accommodate, is to grow American oysters in warm upstream polluted waters and move them to colder waters for depuration and summer conditioning..

4. Lobster pounds and aquaculture. Possibly a good place to begin the first two types of oyster aquaculture would be in the approximately 70 active and inactive lobster pounds in Maine. Of all of our cooperative growth sites in the past 2 years, oysters have performed best in lobster pounds. These sites would seem to offer several important advantages;

excellent control over any aquaculture crop; the impounded waters which are enriched by lobster excretion might especially be suited for all phases of hatchery operation, including feeding of the delicate larval phase; and the types of structures that are required for oyster aquaculture may already be present at most lobster pounds. Considerable research work must be accomplished to learn if oyster aquaculture and lobster holding are 100% compatible and to learn of the real potential of these sites in oyster aquaculture. However, we know enough now to encourage people to go ahead on a modest pilot scale.

#### METHODS

We will limit ourselves to techniques and equipment which will be applicable to our Maine situation. Hatchery oyster culture may be conveniently divided into several areas.

#### PROCUREMENT OF BROOD STOCK

A prerequisite in any hatchery is of course a high quality brood stock which will produce progeny that will be adaptable for Maine conditions. It would be well to have as many adult oysters as possible as a brood stock to provide for sufficient genetic variability in offspring for best performance and later selection of future brood stock. Brood animals might be selected for fast growth, desirable shell morphology, and winter hardiness. Oysters for a brood stock may be procured from several Maine sources.

1. Maine Department of Marine Resources -- The Department has managed American oysters in Maine for years and it may be possible to procure oysters through their area biologists or the main office in Augusta. Notable sources are the Piscataqua River and Spinney Creek on the New Hampshire border and the New Meadows aquaculture project which

is a cooperative program between MDMR and the town of Brunswick. In 1972, they harvested their first crop of market half-shell oysters. These oysters are all from natural Maine set, thus would be adapted to this northern environment. No doubt a limited amount of brood oysters could be purchased from the New Meadows project in future years.

2. University of Maine, Ira C. Darling Center, Walpole, Maine -- We have been in a Federal Sea Grant aquaculture program since 1971 and are building up selected brood stock reserves of American and European oysters. We have yearling progeny of the Boothbay European introductions and these would be the logical choice in Maine for this species. Similarly we are building up selected hatchery stocks of American oysters from various Maine sources. These will be available in limited numbers for hatchery brood stock for those that might want them.

3. Out-of-State sources -- All oysters, in fact, any marine species, imported into the State of Maine to be placed in the marine environment must have prior clearance from the MDMR. This is to eliminate the possibility of importing shellfish diseases and undesirable other species that might be carried along on the shells of the oyster.

In importing oysters for brood stock there are several risks. First is the possibility of importing a disease, predator or competitor, which could become endemic and a potential disaster to future culture efforts and other brood stock. Of concern to us is the importation of MSX oyster disease which has decimated oyster populations in the Chesapeake - Delaware Bay regions. Incidences of this disease have been reported as far north as Cape Cod. The northern occurrences are no doubt the result of movement of commercial stocks from one region to another. Additionally, imported brood stock and their progeny may not be able to adapt to environmental



conditions in Maine.

Considering these limitations there are sources of out-of-state brood stock for Maine aquaculture. Pacific Mariculture of Pescadero, California, produces cultchless hatchery American and European oysters of northern stocks. With MDMR clearance, these can be received by air freight and reared to a brood stock size in two to three years. American oysters also might be procured from Great Bay, New Hampshire, or perhaps the Bras-de-Or Lakes in Canada; but again there must be MDMR clearance.

#### CONDITIONING AND SPAWNING

To obtain hatchery progeny it is essential to have an artificially heated sea water supply to condition and spawn the brood stock. Of course both species are in a spawnable condition during their natural summer reproductive season (July and August, depending on site). However, it is extremely desirable to advance this season to allow new progeny to take advantage of the spring growth period.

#### American oysters

Conditioning regimes for Long Island Sound oysters have been well worked out (Loosanoff and Davis, 1963), i.e., a winter oyster can be brought into spawning condition in 3 to 4 weeks in heated running sea water at 70-75°F. But it has been suspected (Stauber, 1950) that American oysters may exist in a series of geographical races with different temperatures necessary to produce gonad maturation.

In Maine we can assume that our stocks are not significantly different from Long Island Sound stocks, hence, the conditioning regimes described by Loosanoff and Davis (1963) are no doubt valid for use here. Our experience in Maine indicates that it is very difficult to condition an American oyster to spawn from January to March without extensive

supplemental feeding. Artificially warmed waters with the lack of phytoplankton in the early months will make the oysters use stored reserves for body maintenance rather than gonad production. Later in the season after March, American oysters can be conditioned in most areas to spawn in running heated sea water without supplemental feeding.

Properly conditioned American oysters are readily spawned by combinations of thermal and chemical stimulation (stripped gonad) described by Loosanoff and Davis (1963). A running water heated (80-85°F) bath should be substituted for the standing baths described by Loosanoff for more effective spawning. Periodically the water is stopped, the culture gently drained and stripped gonad added in dense suspension to stimulate spawning. Spawning oysters from the mass bath are then gently lifted individually to separate containers with water filtered to 1 to 3 microns for collection of clean eggs which then can be fertilized in a controlled manner. The greater effectiveness of running heated baths in stimulating spawning leads one to suspect that high dissolved oxygen levels are important in gamete release. The stripping of eggs from sacrificed animals has been utilized successfully by some laboratories (Virginia Institute of Marine Science). However, this involves loss of parent stocks and may result in the development of larvae which are not as vigorous as those produced from naturally spawned eggs.

#### European oysters

Different techniques are required for conditioning and spawning the incubatory European oyster and you are referred to the writings of especially Walne (1966) for description of European methods. In Maine, with the introduced Boothbay Harbor stocks (Welch, 1963), we have very little trouble obtaining larvae between February and September. Early in the year

we have the best luck with standing aerated 15 gallon cultures containing six oysters. Water is heated to (66 to 72°F) and is renewed daily. Cultured algae, Phaeodactylum sp. or Dunaliella sp., is dripped into cultures commensurate with clearing rates.

Walne (1966) has observed release of larvae 30-40 days after placing winter oysters into 70°F water and we have observed the same with Maine's Dutch stock of European oysters (Figure 4). We have never attempted stimulation of spawning since spontaneous spawning regularly occurs as the gonad becomes mature. Spawning of female oysters is indicated by piles of excess eggs around the shell margins. The progress of the incubating female can be readily monitored by rapidly squeezing the valves together obtaining several drops of extra-pallial fluid for microscopic observation of prematurely released larvae.

After February, when phytoplankton becomes apparent in most areas, European oysters can be successfully conditioned and spawned by placing them in heated (66-70°F) running water baths without supplemental feeding. A sea water system with heat exchange capacity is a necessity. Periodically, oyster extra-pallial fluid is procured as above and those oysters identified as incubating individuals are placed in standing water to await larval release. With some experience in observation, the time of release can be predicted within a day or two.

The natural spawning season in Maine extends from August to September, but in warmer areas it may be a longer period. We are sure that large quantities of veliger larvae could be obtained from field rafted populations by the technique of rapidly squeezing valves together to find the incubating oysters. Incubating oysters could then be isolated in standing water for subsequent release of veligers as above.

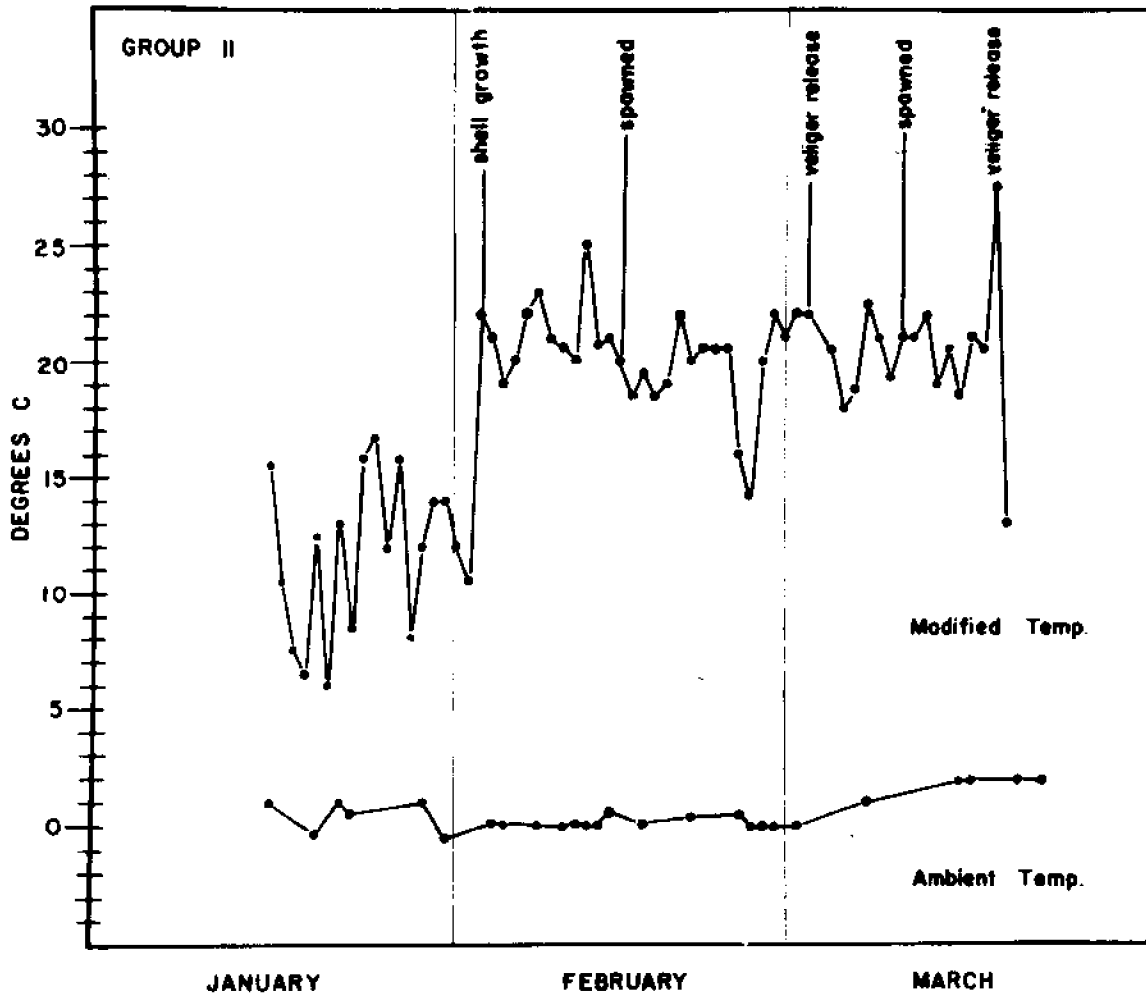


Figure 4. Spawning and larval release in European oysters in response to modified seawater temperatures in early season. Oysters were held in standing water aerated cultures charged daily with the addition of cultured algae.

### LARVAL CULTURE

With both species, one should be aware of the two methods used to obtain algae to feed the larvae, i.e., cultured vs. natural algal feeding. Feeding by natural algae offers great economy; however, it must depend on an area with suitable species and density of natural phytoplankton. The cultured algal feeding method offers reliability but is expensive to maintain.

The cultured algal feeding method originated in Great Britain and has achieved its greatest development at the National Marine Fisheries Service Shellfish Laboratory, Milford, Connecticut. Good descriptions of techniques involved are contained in Loosanoff and Davis (1963) and Mathiessen and Toner (1966) so that it will be redundant to repeat these here.

Feeding of larvae by natural algae can be extremely valuable for rearing shellfish both on a commercial scale and for an intensive experimental application. Wells and Glancy (Wells, 1920) produced algal blooms for larval food by holding centrifuged sea water in sunlight in their pioneer commercial hatchery operation on Great South Bay, Long Island, New York. In recent times excellent success has been obtained with natural algal feeding in hatchery efforts associated with MSX oyster disease rehabilitation efforts in the Mid-Atlantic region and in Sea Grant programs in many areas.

Most systems are rather simple as in the following procedure that we used with American oysters at the New Jersey Oyster Research Laboratory at Cape May and the Chesapeake Biological Laboratory at Solomons, Maryland:

(a) Fertilized egg to 2-day veliger larvae -- Fertilized eggs are placed in polyethylene containers at densities of 15-30 per ml for 2 days

at a temperature of 76°F. Laboratory system sea water should be filtered to 1 micron<sup>3</sup> with no contamination by metals. No supplementary feeding during this period is necessary. Methods should follow those outlined by Loosanoff and Davis (1963).

(b) Two-day larvae to setting larvae --

(1) Environmental conditions

Start initially with densities of larvae at 5-10 per ml in polyethylene or other nontoxic culture containers with capacity of at least 5 gallons. Large volume cultures of 100 gallons or more have given excellent results (Figure 5) Optimum culture temperatures should range between 76-86°F for American oysters with some disadvantage at either extreme. At 76°F, larval growth is slower (15 to 20 days to setting). However, there is less chance of loss through starvation and bacterial action. At 86°F, larval growth rates are optimal; however, closer control is required to provide sufficient food and eliminate bacterial effects.

(2) Change procedure

Change procedures with natural algal feeding are necessarily more elaborate than with cultured algal systems. Not only do proper amounts of wild algal populations have to be maintained, but there must be control of competitive zooplankton that comes along with the algae. It is difficult to differentially remove all zooplankton, especially copepod immature stages. Rather than complete removal of zooplankton success depends upon a proper control of zooplankton

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<sup>3</sup>CUNO MICRO-KLEAN Filters, American Machine and Foundry Co., Meridan, Connecticut 06450



Figure 5. Large volume (100 gal.) polyethylene tanks with light aeration  
• provide a superior environment for rearing larval shellfish.

numbers by differential screening of the larval culture at each change.

Larval cultures should have water renewed at least once daily. The following are sequences of screening operations that we have used with good result:

(a) Removal of larvae from culture water -- Use coarsest screen<sup>4</sup> that will retain all oyster larvae so that most small competitors can be eliminated. All screens can be washed into a single container to provide a continuous screening operation. The result of this should be a container of highly concentrated pooled larvae.

(b) Removal of larger competitors, i.e., copepods -- Re-screen concentrated larvae. Use finest screen that will just allow passage of all larvae and thus retain larger competitive organisms. Obviously, competitors which are the same size as the larvae will remain with the larvae. However, larvae will not be significantly harmed by these. As competitors, especially copepods, grow larger than the oyster larvae, they can and must be removed from cultures. Result of (b) should be a pooled culture of larvae which are as free as possible from competitive zooplankton.

(c) Complete removal of all water from pooled larvae and grading of larvae -- All old water must be removed to lessen bacterial contamination in new cultures. Larvae should be graded to permit discard of slower growing individuals which

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<sup>4</sup>Use either stainless steel sieve series of 325, 250, 200, 150, 100, 80, and 60 mesh per inch (Newark Cloth Company, Newark, New Jersey) or hand-manufactured screens of nylon "Nytex" mesh (Tobler, Ernst and Traber, Inc., 71 Murray St., New York, New York).



may cause increase of pathogenic bacteria and protozoa. Select a screen series which will effectively grade the larval population into 2 or 3 groups. The finest screen in the stack should collect even the smallest larvae. Examine the smaller graded samples under a 100X magnification microscope for signs of mortality and weak larvae. If any gross differences are apparent between these and larger size groups, discard or separate the smaller larvae. Even though slow-growing larvae may eventually set if retained, there is no particular advantage to their retention. Newly spawned groups can be raised to setting much quicker without the risk of disease loss.

(d) Renewal of daily food supplies and new culture conditions -- Make a stock culture with all healthy larvae from (c) with about 5 gallons per million larvae. (No old culture water should contaminate this.) Aliquot larvae into culture containers and renew water supplies. Incoming laboratory culture water should be filtered with felt bags.<sup>5</sup>

The above procedure has given the most positive results and has come about through much trial and error effort. The key to any success, of course, is to include enough variation in initial technique so that the most workable method can be found. Occasionally, an overly dense algal bloom has been detrimental to larval success. A good rule of thumb is to regulate larval density and algal density in such a way that larvae noticeably clear the water within the change cycle. Sufficient algae should be present to show some turbidity over most of the change cycle. With new

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<sup>5</sup>AFCO SNAP-RING Calibrated Filter Bag 5-25 micron opening, AFCO Filter Products Company, Glenville, Connecticut.

cultures (2 to 6-day larvae with low clearing rate) larval concentrations can be quite high (up to 30 per ml) with a very modest algal density. With older larvae and heavier feeding rates, either the density of larvae must be reduced or algal concentrations increased. It is difficult to substantially increase natural algal counts except by centrifugation and greenhouse aging of water supply, so that densities of larvae must be adjusted to allow optimal feeding conditions. If algae are too dense, then a fine filtration system<sup>6</sup> is in order. All of the techniques need a bit of experience on the part of the operator to be successful. An open eye and much experimentation at each site are necessary ingredients to success.

With European oysters the same techniques are applicable although lower temperatures will produce satisfactory growth (66-72°F). Large volume cultures (100 gallons) appear to be preferable to small volumes (5 gallons) for unknown reasons. In Maine in 1971 we lost most of our European oyster larval broods with small volume cultures; in 1972 with large volumes and light aeration<sup>7</sup> we rarely lost larvae. With proper sanitation we have not encountered mortalities that might be attributed to pathogenic organisms and in recent times we have used no antibiotics.

A wide variety of marine areas appear to be suitable for natural algal feeding in the mid-Atlantic region ranging from the upper Chesapeake Bay with salinities of 10 to 15‰, to coastal lagoons such as Chincoteague Bay with full sea salinities. There have been some exceptions to this rule; for example, Virginia Institute of Marine Science at Gloucester

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<sup>6</sup>Use either fine sand filters or MICRO-KLEAN filters or other similar product.

<sup>7</sup>Silent Giant aquarium air pump, Aquarium Pump Supply, Inc., Prescott, Arizona.

Point, Virginia, and the National Marine Fisheries Service at Milford, Connecticut, have not utilized natural algal feeding to any great extent. Important factors appear to be the presence or absence of algal species that are the correct size and physical and biochemical makeup which can be utilized by the larvae. All natural algal feeding techniques have been derived by trial and error and suitable areas for natural feeding found by chance. Obviously, much must be accomplished experimentally to allow us to fully understand this situation and to allow us to predict in advance optimal areas for hatchery location. In Maine, our preliminary work indicates that the protected upper estuaries may be the preferred locations for natural algal feeding. A new hatchery in Maine should be aware of the cultured and natural algal feeding options. If natural algal feeding is workable, then great advantage in economy will be achieved.

#### SETTING AND JUVENILE REARING

In setting, we have been aided a great deal by the gregarious setting response originally discovered by Cole and Knight-Jones (1949). We have found that mature larvae are stimulated to set in the presence of "shell liquor" or merely water in which adult oysters have pumped. Normally, setting will occur sporadically over a period of several days but by adding adult oyster waste water to setting larvae we can obtain very heavy sets in  $\frac{1}{2}$  to two hours. This permits an efficient manipulation of cultch surfaces allowing optimal setting densities thus increasing efficiency of conversion of larvae to viable spat. The response appears to be inter-specific. Metabolites from either species can stimulate the response in European oysters and possibly the same is true for

American oysters. Presently we are at work to identify the substance which is responsible for the response.

With recent developments, we now have the option to set oysters using either the traditional shell cultch or the new cultchless techniques (Figure 3). The cultchless methods are now making hatcheries quite commercially attractive in that they allow very efficient culture of large numbers of shellfish in the early juvenile stages. However, since the technique is relatively new, the optimal methods of rearing cultchless oysters to harvest are still in the developmental stage.

The present legal status of cultchless setting relating to patent rights is not entirely clear. The idea of obtaining free single hatchery developed oysters was brought out by Pacific Mariculture of California and at least two techniques have been patented (Pacific Mariculture, 1967 and Long Island Oyster Farms, 1970). However, Dupuy (1972) of VIMS has offered two methods; that of removing new spat by water jets a few hours after setting and setting on "Mylar" sheets with subsequent removal by flexing.

Newly removed cultchless oysters must be properly handled to allow acceptable survival and growth. We have had good luck in placing the newly freed oysters in screened boxes with closed system water changed daily with the addition of cultured Isochrysis galbana or Phaeodactylum sp. If new spat are obtained in the spring or summer months, it should be possible to rear them in closed systems with the water changed periodically without the addition of cultured foods although we have not tried this method. Circulation must be provided either by an airlift system (Figure 6) or nontoxic pump. This type of system can be modified to any size, of course, but the essential element is plastic screens of varied sizes to allow good water and food circulation through the free oysters. Screen size is

increased with larger oysters to provide easier cleaning. Cultchless oysters can be very easily reared to a  $\frac{1}{4}$ " size in the hatchery in this manner and to larger sizes by holding them in screened boxes in running water.

We have expanded our closed system culture apparatus to a 100 gallon size by using fiberglass-lined plywood tanks in conjunction with non-toxic plastic-lined pumps<sup>8</sup> (Figure 6). Water is dropped from these vessels daily and cultured algae added commensurate with oyster clearing rates. Temperatures of 66-70°F are adequate for growth of European oysters, but higher temperatures of 72-78°F may be required for American oysters.

There are two quite vexing problems with early cultchless oysters that one must be aware of: gas bubble disease and mortality due to protozoan ciliate facultative invaders. What appears to be a gas bubble problem occurs when early spat are placed in heated running seawater. Warmed water is able to retain less dissolved gases, so upon heating the excess gases come off as bubbles. Young oysters are observed to carry increasingly larger bubbles between the shells. They are unable to void the larger bubbles and this apparently interferes with feeding and results in mortality. This phenomenon has also been noted at the University of Delaware (Malouf, 1972). We have not observed the problem with a single daily change of heated seawater, but with running heated systems the problem becomes evident quickly, especially with a large heating differential. This problem will probably be corrected with installation of a water degasser, and our further research will be focused on solutions to the problem.

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<sup>8</sup>Little Giant Plastic Pump, U.S. Plastics Corp., Lima Ohio.

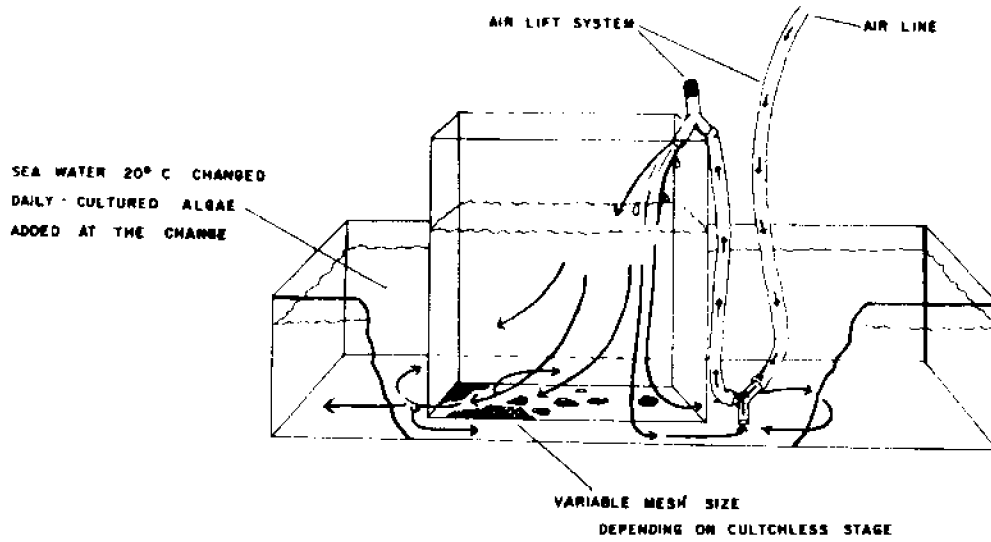
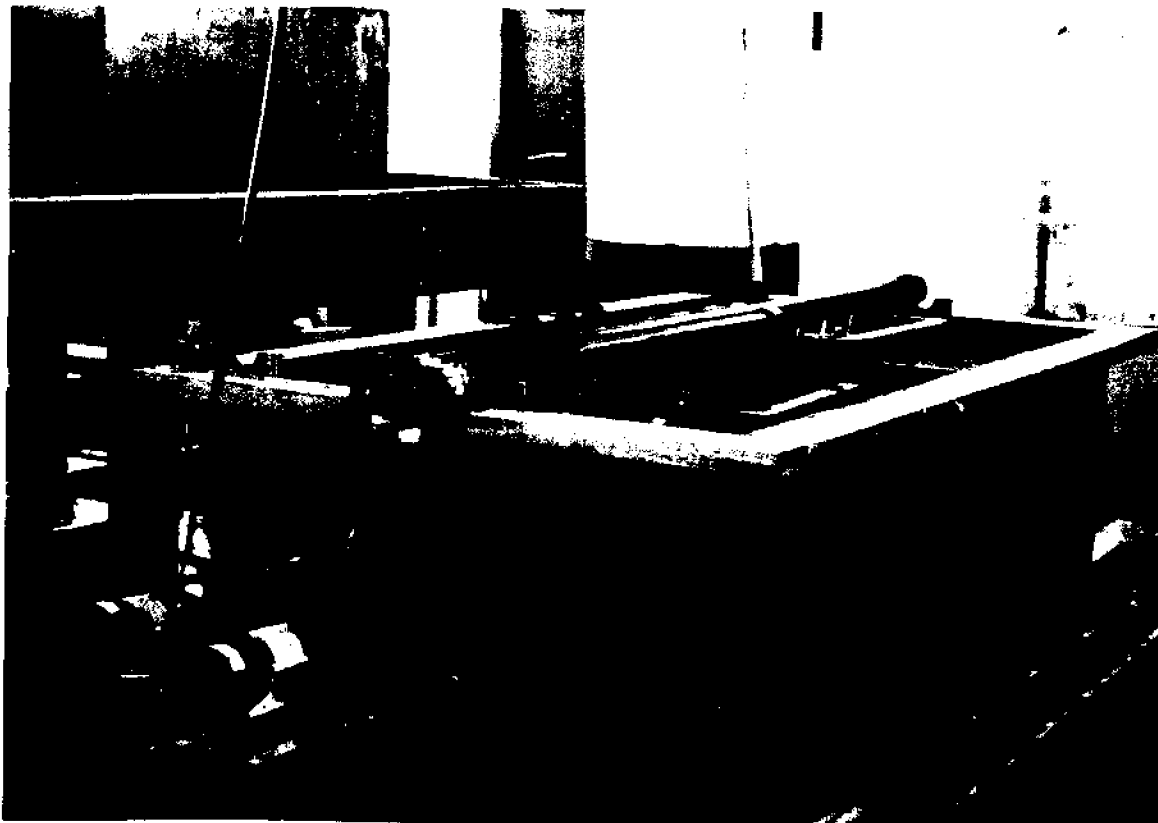


Figure 6. Two types of semi-closed systems which have been successful in rearing newly obtained cultchless oysters. Above is an air lift system and below a larger dual bath with circulation by non-toxic plastic pumps (Little Giant). In each system spat are maintained on stacked screens with closed system water changed daily. Cultured algae is added commensurate with clearing rates.



Protozoan ciliate invaders are a particular problem with new cultchless oysters. These appear to be facultative invaders, not true parasites, attacking first the oysters which were damaged in the cultchless removal process. Normally ciliates are controlled by a daily change of water and washing of the screened oysters to force the small ciliates through the screen. The first 3 days of cultchless rearing are the most critical and with proper sanitation, as above, the ciliate invasion should run its course through the damaged oysters. On one occasion, however, (August, 1973), ciliate protozoan invasion destroyed about 95% of a brood of new cultchless American oysters at our laboratory. We must learn more about the chemical control of protozoan invaders to make the hatchery a more reliable operation in the future.

#### NURSERY CULTURE

This phase is defined as culture of oysters from a 5-10 mm (hatchery size to harvest). We will restrict our comments to hatchery cultchless oysters. As stated earlier, this phase is developmental; thus, we can only offer tentative recommendations and suggestions at this point.

#### Early field placement

After cultchless spat achieve a 4 to 5 mm size in closed systems, they can be placed in natural waters in screened cages if environmental temperatures are adequate. Small European oysters will survive temperatures as low as 50°F but small American oysters probably should not be placed out until waters are over 60°F.

#### Later field placement

Since the rearing of cultchless oysters from a 1" size to harvest is largely developmental at this point, we can only offer a series of suggestions for culture apparatus and tray design. The most suitable apparatus can only be derived after experimenting at each specific

site. As our work progresses we hope to make more specific recommendations.

With field rearing there are, of course, two general alternatives: on-bottom planting and rafting (the suspending of the shellfish crop in the water in some sort of enclosure for growth to harvest). On-bottom planting of cultchless seed has not been tried extensively in Maine or any other region for that matter. If cultchless oysters survived and grew on the bottom, and the entrepreneur could be reasonably sure of protecting his crop legally, this might be a likely alternative. We do not have the experimental evidence necessary to make recommendations for on-bottom planting. Each operator should experiment with this type of culture on a pilot scale if his growth area seems suitable.

In rafting, the shellfish are suspended directly in the water column off the bottom. This system, if economically workable, will provide the fastest shellfish growth because the more rapid current velocities above the bottom allow more food particles to be intercepted by the shellfish. The biological and hydrographic reasons for this have been explained by Ryther (1969).

We will list pictorially the type of rafting systems (Appendix V) that are presently under consideration in the State of Maine, without making a strong value judgement at this point. Appendix III lists suppliers of hardware and preconstructed trays that should be adaptable for raft culture in Maine.

#### Factors influencing shellfish rafting

##### Fouling

This refers to the attachment of other species of marine animals and plants to the oysters or traying structures. Fouling impedes oyster growth or causes mortality through smothering or competition for food



supply. Especially troublesome are barnacles, sea squirts (Molgula sp.), sea strawberries (Tubularia sp.) and various forms of filamentous attached algae.

If fouling becomes a problem, methods must be developed to overcome it in the most efficient manner. The method must involve the mass handling of oysters rather than any hand picking method involving removal of fouling organisms from individual oysters. We haven't done much work on the control of fouling but several publications may point the way to successful control:

1. Dichlorophene<sup>9</sup> control of sea squirts -- (Tubiash, 1967), reports that a 4-6 hour dip of 10 ppm Dichlorophene is lethal to sea squirts and not to a variety of bivalve shellfish including oysters. Squirts are observed to disintegrate several days after treatment. Some experimentation with this treatment no doubt will lead to a very effective control of many fouling organisms.

2. Salt dips as a control of a variety of oyster competitors -- Shearer and Mackenzie (1961) report that "sponges", sea squirts (Molgula) and starfish are killed by 10-20 minute dips into saturated salt solution, whereas oysters are not harmed. Mackenzie and Shearer (1961) report up to 98% kill of mud blister worms (Polydora sp.) when the brine dip is followed by 15 or more minutes of air drying. Our limited experience with salt dips indicates they may be harmful to smaller cultchless oysters, so an experimental approach is advised.

4. Copper sulfate -- 1-2% for short periods of time plus several hours of air drying kills most mussels but not oysters over 1 year old

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<sup>9</sup>Preventol GD, GAF Corporation, 140 West 51st Street, New York, New York 10020.

(Mackenzie, 1961).

4. Air drying -- The MDMR Brunswick Aquaculture project has reported that periodic air drying of trayed oysters is beneficial in removing fouling. An experimental regime should be followed to develop optimal times of exposure to remove competitors without harming the shellfish.

#### Overwintering

To be successfully reared to market size, oysters must be once and possibly twice overwintered. We have experiments in progress to derive the optimal methods; for now the following factors appear to be important:

1. Origin of stock -- With European oysters we have some preliminary indication that progeny of the Boothbay stocks may overwinter with less mortality than California purchased groups. It is possible that 20+ years of natural selection to prolonged winter cold water temperatures in the Boothbay stocks may have given rise to a very hardy race of European oysters. We are at work now with comparative overwintering experiments to see if this might be the case. If the Maine stocks of European oysters are indeed more hardy, then we will have a strong rationale for a Maine based hatchery.

2. Condition of stock -- Our experiments on the Damariscotta River indicate that young European oysters going into the winter with high stored food (glycogen) levels will come through the winter with lower mortality than stocks in poorer condition. Late winter losses in many cases appear to be related to depletion of stored food reserves.

3. Handling Methods -- Several factors appear to be important here. First, oysters should be stored for the winter away from wave action that might erode the shell margin and allow entry of small animals. It

is best to prepare oysters for overwintering prior to the time that they stop seasonal growth. This would allow oysters to repair damage to shells in handling. In Maine, oysters should be prepared for overwintering during October. The method of holding should allow periodic inspection on warm winter days. Oysters should be inspected for siltation and presence of predators such as starfish. At no time should oysters be subjected to subfreezing air temperatures.

Table 1 shows some of our results to date with overwintering at various sites. Results have ranged from 0 to 100% mortality. It is obvious that proper overwintering is one of the most crucial aspects of oyster culture in Maine. A commercial operation should have this factor well researched on a pilot scale before expanding to a large production scale. Efforts in winter 1973-74 will concentrate on proper overwintering of stock so our future recommendations should be more definite.

Table 1. Overwinter (1972-73) mortality of American and European oyster cultchless seed (1/2" - 1") at several sites on the Maine coast.

Location	% Mortalities	
	European Oysters	American Oysters
Clark's Cove, Walpole	0 of 34 = 0%	1 of 25 = 4%
Plummer Point, South Bristol	1 of 36 = 2.8%	0 of 22 = 0%
Bucks Harbor	5 of 24 = 20.8%	0 of 13 = 0%
South Blue Hill	20 of 24 = 83.3%	1 of 18 = 5.5%
North Brooklin	13 of 58 = 22.4%	3 of 65 = 4.6%
Roque Bluffs		16 of 16 = 100%
Squid Cove, Mt. Desert	7 of 28 = 25%	8 of 8 = 100%
Smith Cove, So. Brooksville	6 of 25 = 24%	13 of 25 = 52%
East Belfast	30 of 31 = 96.8%	25 of 31 = 80.6%
The Gut, So. Bristol	0 of 24 = 0%	
Steuben	8 of 27 = 29.6%	0 of 92 = 0%
Total	90 of 311 = 28.9%	67 of 315 = 21.3%

Appendix I Pertinent References

Most of the following are available in the library at the Darling Center, Walpole, Maine

- Ansell, A. D., et al. 1963. Studies on the mass culture of Phaeodactylum.  
II. The Growth of Phaeodactylum and other species in outdoor tanks.  
*Limnol. & Oceanogr.*, 8: 184-206.

Techniques applicable to a hatchery operation.

- Baughmann, J. L. 1948. An annotated bibliography of oysters with pertinent material on mussels and other shellfish and an appendix on pollution. Texas A. & M. Res. Found., College Sta., 794 pp.

The standard work of oyster related references to 1948.  
Out of print, but available from University Microfilms,  
Ann Arbor, Michigan.

- Cole, H. A. and E. W. Knight-Jones. 1949. The setting of larvae of the European oyster Ostrea edulis L. and its influence on methods of cultivation and spat collection. *Fish Invest.*, Min. Agric. Fish., London, Ser. II 17(3): 1-39.

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- Dupuy, J. L. and S. Rivkin. 1972. The development of laboratory techniques for the production of cultch-free spat of the oyster, Crassostrea virginica. *Ches. Sci.*, 13(1): 45-52.

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Out of print, but the standard work on the biology of the American oyster. Available at Darling Center library, Walpole, Maine.

- Gaucher, T. A. 1971. Aquaculture: A New England Perspective. TRIGOM, 96 Falmouth Street, Portland, Maine. 119 pp.

The proceedings of the 1970 TRIGOM conference on aquaculture at the University of New Hampshire gives a good biological, economic and legal perspective to the field in New England.

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Hidu, H. and D. Dean. 1972. A working bibliography of Maine aquaculture. University of Maine, Ira C. Darling Center Ref. # 72-10, Walpole, Maine.

A non-published list of several hundred aquaculture-related titles available at the University of Maine, Darling Center, Walpole, Maine.

Iverson, E. S. 1968. Farming the edge of the sea. Fishing News (Books), Ltd., London. 301 pp.

Lasker, R. and L. L. Vlymen. 1969. Experimental Sea-water Aquarium. U.S. Fish and Wildlife Serv., Circ. 334, 14 pp.

Describes construction of sea-water systems that would have applicability in oyster aquaculture.

Long Island Oyster Farms, Inc. 1970. Artificial rearing of oysters. U. S. Patent #3,495,573.

Patented methods of obtaining cultchless oysters.

Loosanoff, V. L. 1951. Culturing phytoplankton on a large scale. Ecology, 32(4): 748-750.

Loosanoff, V. L. 1962. Gametogenesis and Spawning of the European Oyster, O. edulis in Waters of Maine. Biol. Bull., 122(1): 86-94.

Loosanoff, V. L. and H. C. Davis. 1963. Rearing of bivalve mollusks. In: F. S. Russel (ed.), Advances in Marine Biology, Academic Press, London, 1: 1-136.

The standard text of techniques of rearing bivalve larvae by the USBCF Milford cultured algal feeding method.

Mackenzie, C. L., Jr and L. W. Shearer. 1961. Chemical control of Polydora websteri and other Annelids inhabiting oyster shells. Proc. Natl. Shellfish Ass., 105-111.

Mackenzie, C. L., Jr. 1961. A practical chemical method for killing mussels and other oyster competitors. Comm. Fish. Rev., March, 1961: 15-19.

Malouf, R., et al. 1972. Occurrence of gas bubble disease in three species of bivalve molluscs. J. Fish. Res. Bd. Canada, 29(5): 588.

Mathiessen, G. C., and R. C. Toner. 1966. Possible methods of improving the shellfish industry of Martha's Vineyard, Dukes County, Mass. Mar. Res. Found., Inc., Edgartown, Mass. 138pp.

Gives recommendations for technique and equipment necessary for a commercial shellfish hatchery with a cost analysis.

Morse, H. H. 1971. An economic study of the oyster fishery of the Maritime Provinces. Fish. Res. Bd. Canada. Bull. 75, Ottawa, Can.

An excellent study of oyster production economics and marketing which has some direct application to the Maine situation.

Maine State Planning Office. 1971. Maine Coastal Resources Renewal (2 booklets). Augusta, Maine. July 1971.

Maine aquaculture is discussed in these 2 booklets. Book #2 (Appendix) contains a summary of marine laws applicable to aquaculture in Maine.

Pacific Mariculture, Inc. 1967. Method and apparatus for growing free oyster spat. U.S. Patent #3,526,209.

Price, K.S. and D. L. Maurer (ed.). 1969. Proceedings of the Conference on Artificial Propagation of Commercially Valuable Shellfish. College of Marine Studies, University of Delaware, Newark, Dela. 212 pp.

Many aspects of hatchery culture discussed in a 2 day conference. Principles and techniques are largely applicable to Maine.

Riley, J. G., R. J. Rowe, and H. Hidu. 1972. Oysters: reattachment as a method of rearing cultchless hatchery oysters. Comm. Fish. Rev., May-June, 1972: 41-43.

Ryther, J. H. 1969. The potential of the estuary for shellfish production. Proc. Nat. Shellfish Ass., 59: 18-22.

Provides the theory behind successful rafting of shellfish as opposed to on-bottom culture.

Shaw, W. H. 1969. The past and present status of off-bottom culture in North America. Trans, Amer. Fish. Soc., 98(4): 755-761.

Shearer, L. W. and C. L. Mackenzie, Jr. 1961. The effects of salt solutions of different strengths on oyster enemies. Proc. Nat. Shellfish Ass., So, 97-103.

Sindermann, C. J. and A. Rosenfield. 1968. Principal diseases of commercially important marine bivalve Mollusca and Crustacea. Fish. Bull., U.S. Fish & Wildlife Serv., 66: 335-385.

Stauber, L. A. 1950. The problem of physiological species with special reference to oysters and oyster drills. Ecology, 31: 109-118.

Tubiash, H. S. and A. E. Farrin. 1967. Dichlorophene for control of tunicates in cultures of artificially reared bivalve mollusks. Prog. Fish-Culturist. 29(4): 235-237.

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- Welch, W. R. 1963. The European oyster Ostrea edulis, in Maine. Proc. Nat. Shellfish Ass., 54: 7-23.
- Wells, W. F. 1920. Growing oysters artificially. Conservationist, 3: 151.



Appendix II

Hatchery Perspective

At this date, world shellfish hatcheries must still be classified as developmental, with several areas achieving early commercial status within the past 10 years. An additional 10 to 20 years of proven commercial success will place them on a firm economic basis.

The present technological stage of development can be summarized by considering the different oyster life stages and the options open for culture (Figure 7.). For example, once fertilized eggs are procured, there is little difficulty in obtaining an abundance of viable 2-day veliger larvae by techniques of Loosanoff and Davis (1963). There are then at least two options for rearing new veligers to mature veligers with relatively low mortality factors. The cultured algae system (mentioned earlier) is quite reliable and independent of season; however, maintaining algal cultures is expensive. Feeding of larvae by natural algae has been workable in many areas and would offer great economy. It is, however, entirely dependent on the quantitative and qualitative nature of the plankton within specific areas, and is quite seasonally dependent.

With setting or metamorphosis of larvae to the adult form, there is also a dual option. Larvae can be set and left on cultch shells producing, as in nature, many oyster spat permanently attached to cultch. All hatcheries achieved this product until the mid 1960's. The disadvantage of this method, although cultched juvenile oysters survive well on on-bottom planting, is that there is extreme loss of early spat through crowding effects on the shells. It is difficult to make larvae settle on shells at optimal densities. Thus, it has, in the past, cost a commercial

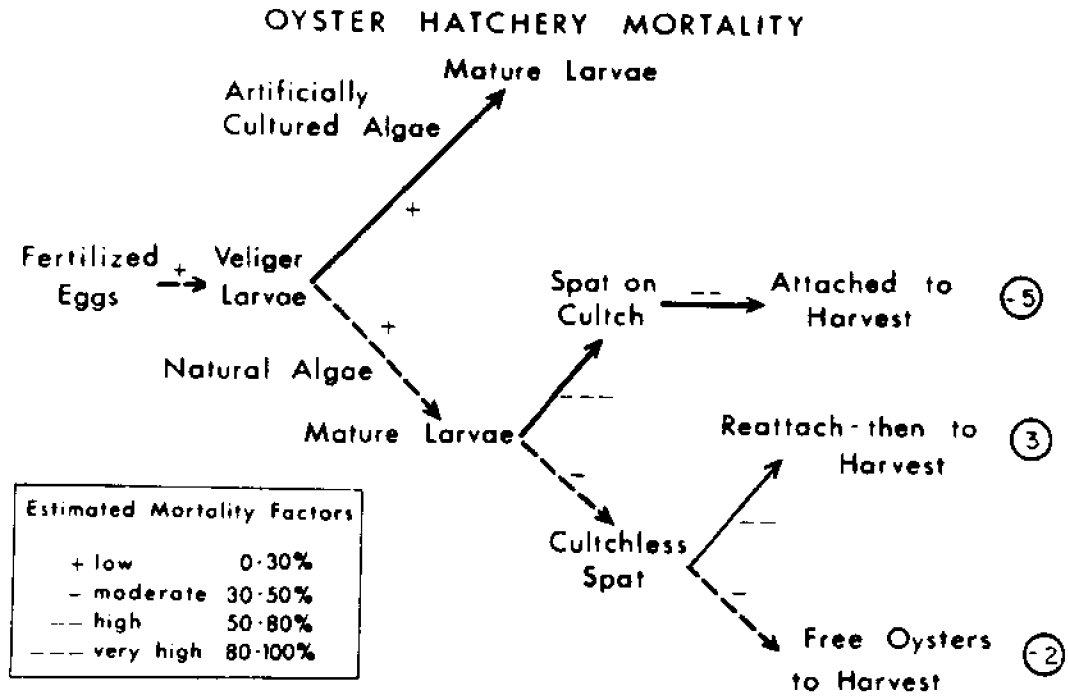


Figure 7. Present culture options in the oyster hatchery with estimates of mortality at each option. Dotted lines indicate the most economically workable route with present stage of development.

hatchery \$5 to \$15 to produce a bushel of spatting cultch. Costs would have to come down to \$1 to \$4 per bushel to make the method practical.

The newer option is cultchless setting in which the larvae are allowed to attach to a substrate, but are removed a day or two later to produce a free, single, juvenile oyster. Although this process might cause considerable mortalities of metamorphosing larvae, the losses of early spat are significantly lower than in a cultch method. There is then a great advantage in rearing cultchless oysters in the hatchery, first in closed systems, and later in flowing water systems. Since the hatchery cultchless system is only 5 to 7 years old, the greatest unknowns remain in the most efficient method of rearing cultchless oysters to a harvest. Several research efforts are presently trying to work out the problem. Certainly cultchless oysters can be reared to a 1" size in trays, either in the hatchery or in suspended rafts. After that point we are in some doubt concerning optimal methods. We have tried artificial reattachment to flat substrates (Rowe, Riley and Haidu, 1972), and although shellfish readily respond to the reattachment by forming a permanent attachment with the growth edge, the method appears not to be workable economically.

At this date, it would seem that cultchless oysters should be reared in suspended trays to harvest; although, again, we are still at work determining the optimal ways of doing this. See Appendix V.

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Appendix III

Companies Supplying Aquaculture-Related Materials

AMF CUNO Division  
950 Watertown Street  
West Newton, Massachusetts 02165

Manufacture core filters necessary in filtering seawater for algal production and larval rearing.

Aquafine Corporation  
1230 Sunset Boulevard  
Los Angeles, California 90026

Produce ultraviolet sterilizers useful in algal rearing.

Beckman Instruments, Inc.  
599 North Avenue  
Wakefield, Massachusetts 01880

Manufacture the RS5-3 portable salinometer which automatically reads salinity and temperatures.

Brosites Industries, Inc.  
P.O. Box 6  
Pemaquid Harbor, Maine 04560

Custom manufacturers of fiberglass trays and other plastic vessels for hatchery application.

Conwed Corporation  
Plastics Division  
742 29th Avenue, S.E.  
Minneapolis, Minnesota 55414

Manufacture a variety of plastic screens suitable for field rearing of cultchless oysters.

FDC Packaging  
Pope Road  
Holliston, Massachusetts 01746

Specialize in packaging for shipping fisheries products.

Fiberglass Specialities, Inc.  
Bullock Road  
E. Freetown, Massachusetts

Custom manufacture fiberglass trays and tanks for marine laboratories.

Fluid Power Products, Inc.  
19 Kearney Road  
Needham Heights, Massachusetts 02194

Handle DuPont high capacity teflon heat exchangers suitable for sea-water application.

GAF Corporation  
140 West 51st Street  
New York, New York 10020

Manufacture Snap-Ring Filter Bag System which is necessary in larval rearing in the hatchery.

G. B. Lewis Co.  
426 Montgomery Street  
Watertown, Wisconsin 53094

Makers of fiberglass industrial trays which are useful in hatcheries. (Stack-N-Nest Trays)

Goodwin Hydrodynamics  
P.O. Box 277  
Weirs Beach, New Hampshire 13246

Handle a variety of apparatus useful in a hatchery including the Bauer Centri-Cleaner Liquid Cyclones useful in removing silt and zooplankton from seawater.

Koppers Company, Inc.  
Organic Materials Division  
430 Park Avenue  
New York, New York 10022

Manufacture a variety of paints useful in a salt water hatchery.

Marcrafts Incorporated  
Flying Point Road  
Freeport, Maine 04532  
Harold Arndt, Prop.

Company specializes in custom made hardware for aquacultural enterprise; especially aluminized steel traying systems.

Marlboro Wire Goods Co.  
406 Lincoln Street  
Marlboro, Massachusetts 01752

Manufacture vinyl coated wire baskets useful in shellfish rafting.

Marlow Pumps  
Midland Park, New Jersey

Makers of variety of pumps suitable for salt water application.

Nestier Division  
Vanguard Industries, Inc.  
10605 Chester Road  
Cincinnati, Ohio 45215

Makers of plastic shellfish grow-out trays suitable for cultchless oysters from 2 mm to 1" size.

Newark Wire Cloth Company  
351 Verona Avenue  
Newark, New Jersey 07104

Manufacture stainless steel screens useful for culture of bivalve larvae; more expensive than Nitex screens, but more durable.

O'Connor Associates  
21 Center Street  
Weston, Massachusetts 02193

Handle Sethco Pumps suitable for salt water application; also large fiberglass tanks.

R. Murphy Company, Inc.  
Ayer, Massachusetts 01432

Manufacture a variety of shellfish knives.

Tobler, Ernst & Traber, Inc.  
71 Murray Street  
New York, New York 10007

Manufacture Nitex nylon monofilament screen which is used to culture bivalve larvae. A necessary item in the hatchery.

United States Plastics Corp.  
1550 Elida Road  
Lima, Ohio 45805

Handle a variety of plastic ware including "Little Giant" plastic pumps suitable for closed system culture of juvenile shellfish.

Unitron Instrument Co.  
Microscope Sales Division  
66 Needham Street  
Newton Highlands, Massachusetts 02161

Handle the Unitron Model BMLU-3 microscope which is of good quality and low price, suitable for observation of shellfish larvae.

"Vexar" Sales  
E. I. DuPont De Nemours and Co.  
River Road  
Buffalo, New York 14207

Manufacture and supply "Vexar" plastic netting useful in shellfish culture.

W. L. Blake and Company  
Portland, Maine 04112

Dealers in pumps and plastic pipes for hatchery application.  
Design water systems for lobster pounds.

Appendix IV

Persons and Agencies Active in Maine Aquaculture

This is a compilation of private persons, corporations, and public agencies which are active in Maine oyster aquaculture. The list is incomplete however it may serve to allow needed communication between interested persons.

Mr. Spencer Apollonio - Commissioner  
Maine Department of Marine Resources  
Augusta, Maine 04330

MDMR has conducted extensive aquaculture research especially at Spinney Creek, New Meadows River and Mason Station Power Plant at Wiscasset.

Mr. Harold Arndt  
Marcrafts, Inc.  
Freeport, Maine

Pilot scale commercial culture of oysters on the New Meadows River plus manufacturer of aquaculture related hardware.

Mr. Robert Mant  
Mr. Fred Beck  
Maine Sea Farms  
Harborside, Maine 04642

Extensive commercial culture of Coho salmon and pilot commercial culture of oysters at Cape Rosier, Penobscot Bay.



Mr. Ralph E. Becker  
Mr. Robert Knecht  
Robinhood Marina Inc.  
Robinhood, Maine

Experimental culture of oysters in  
the Sassanoa River.

Booth Fisheries  
Borthwick Industrial Park  
Portsmouth, New Hampshire

Company expresses interest in market-  
ing Maine produced oysters.

Mr. Winthrop L. Brown  
Mr. Montescue T. Moree  
57 Winter Street  
Topsham, Maine 04086

Pilot scale commercial culture of  
oysters in the Cundy's Harbor area.

Mr. Dennis Farrin  
Thompson Inn Road  
South Bristol, Maine 04568

Experimental scale culture of  
oysters in the Johns Bay area.

Mr. Westley Ford  
Hancock, Maine

Experimental culture of oysters  
in a lobster pound.

Mr. Donald S. Gilpatric, President  
Mr. John Williams  
Acadia Aquacultural Enterprises, Inc.  
Box 232  
Mount Desert, Maine 04660

Pilot commercial culture of oysters  
and other shellfish in the Mount  
Desert Region.

Mr. Gary Higginbottom  
Coastal Planning Office  
218-1/2 Water Street  
Augusta, Maine 04330

Agency concerned with integrating  
coastal uses into compatible regional  
plans.

Mr. Rodd L. Hopper  
Cross Point Road  
North Edgecomb, Maine 04556

Experimental scale culture of  
oysters on the Sheepscot River.

Mr. F. Eugene Newbold  
Mr. Harold Billings  
Tern Rock Ocean Products, Inc.  
Bass Harbor, Maine

Pilot commercial culture of oysters  
in the Mount Desert Region.

Mr. John Printy  
Reachwood, Inc.  
Newcastle, Maine 04553

Cooperative developmental shell-  
fish experiments with the Univer-  
sity of Maine on the Marsh River.

Mr. Ingram Richardson  
South Bristol, Maine 04568

Cooperative developmental experi-  
ments with the University of Maine  
on the lower Damariscotta River.

Mr. Mark S. Richmond  
Mr. Deane A. Richmond  
Maine Coast Oyster Corporation  
P.O. Box 171  
Blue Hill, Maine 04614

Pilot commercial production of  
oysters in the Blue Hill Region.

Mr. Lawrence M. C. Smith  
Wolfe's Neck  
Freeport, Maine 04032

Marketer of specialty food products  
expresses interest in marketing  
Maine produced oysters.

University of Maine  
Ira C. Darling Center, Walpole  
Dept. of Agricultural Engineering  
Dept. of Mechanical Engineering  
Dept. of Agricultural & Resource Economics  
Dept. of Zoology  
Cooperative Extension Service  
Orono, Maine 04473

Since 1971 involved in Federal "Sea Grant" program to bring on commercial oyster aquaculture in Maine. Program develops scientific information in several fields plus cooperates with promising pilot commercial ventures in developing methodology.

Appendix V

Apparatus and costs in commercial shellfish rafting

Presently we do not have the final answers for economic commercial shellfish rafting. The material offered here is that which have given good shellfish performance on a limited pilot scale. We suspect that there will be evolution of techniques to produce a final optimization of systems.

A. Shellfish Seed

Mr. William W. Budge  
Pacific Mariculture, Inc.  
Pigeon Point  
Pescadero, California 94060

Type of seed offered: Crassostrea virginica (American oyster) and Ostrea edulis (European oyster). Several species of clam seed have been produced on special order. Oyster of both species are shipped in the 2-3 mm size range. 1972 price quotes.

QUANTITY	PRICE
3,000	\$ 60.00
5,000	\$ 80.00
10,000	\$100.00
20,000	\$150.00
50,000	\$200.00
100,000	\$330.00
100,000 - 1M	\$3.00/1,000
1M-3M	\$2.75/1,000
3M-5M	\$2.50/1,000
5M-10M	\$2.25/1,000
10M and over	\$2.00/1,000

B. Marine supplies and related hardware for raft construction

Most items in the following list may be found at hardware stores. The prices given are local ones at full retail level excluding Maine sales tax. Items not available at local stores have been identified and the address of a producer given. August, 1973, typical prices.

DESCRIPTION	DIMENSION	PRICE
styrofoam log	7" x 20" x 9'	\$12.95
styrofoam log	10" x 20" x 9'	17.95
fiberglass window-screen, roll	36" x 100'	23.95
galv. hardware cloth, roll	1/8" mesh 36" x 100'	70.00
galv. hardware cloth, roll	1/4" mesh 36" x 100'	70.00
galv. hardware cloth, roll	1/2" mesh 36" x 100'	75.00
galv. flat-head screws, box of 100	1-1/4" x #10	2.39
galv. flat-head screws, box of 100	2" x #10	3.49
galv. eye-bolt	1/2" x 12"	2.00
galv. shackle	1/4"	.83
galv. thimble	1/2"	.23
spruce 2 x 4	2" x 4" x 12'	1.76
pine strapping	1" x 3" x 12'	.60
cement coated staples, box of 1000	9/16"	.85
nylon line, per foot	1/2"	.25
concrete, delivered	1 yd <sup>3</sup>	20.00
steel nut	3/8"	0.015
steel washer	3/8"	0.006
steel rod with welded eye and threaded end	3/8" x 60"	2.00
PVC cold water pipe, per foot	3/4"	.29
PVC schedule 40 pipe, per foot	2"	.32

Mr. Harold E. Arndt, President  
 Marcrafts Incorporated  
 Freeport, Maine 04032

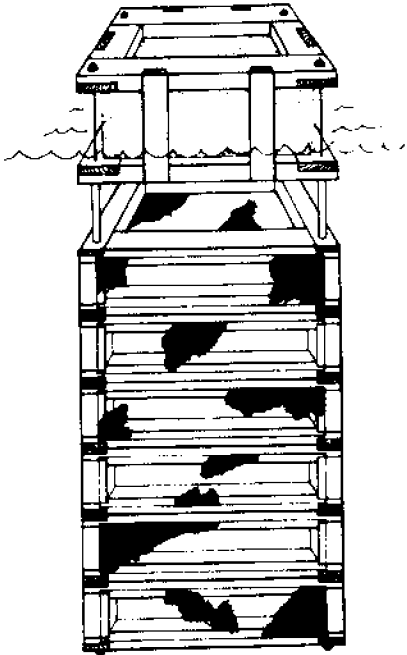
aluminized steel grow-out tray, vinyl dipped	1/4" mesh 3" x 2' x 4'	17.30
aluminized steel grow-out tray, with cover	1/4" mesh 3" x 2' x 4'	20.00
aluminized steel grow-out tray	1/2" mesh 3" x 2' x 4'	8.40
aluminized steel grow-out tray, with cover	1/2" mesh 3" x 2' x 4'	9.80
aluminized steel grow-out tray, vinyl dipped	1/2" mesh 3" x 2' x 4'	12.15
aluminized steel grow-out tray, with cover	1/2" mesh 3" x 2' x 4'	14.55

aluminized steel grow-out tray	1" mesh 3" x 2' x 4'	\$ 6.50
aluminized steel grow-out tray, with cover	1" mesh 3" x 2' x 4'	7.68
aluminized steel grow-out tray, vinyl dipped	1" mesh 3" x 2' x 4'	10.15
aluminized steel grow-out tray, with cover	1" mesh 3" x 2' x 4'	12.15

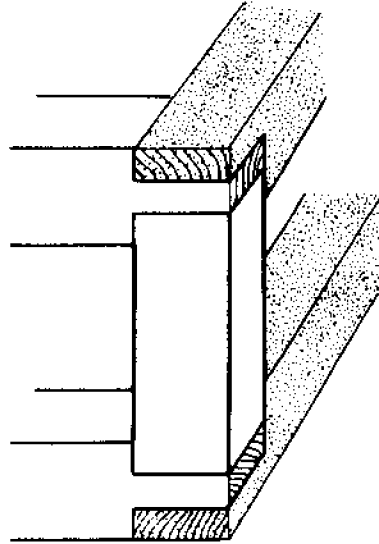
C. Suggested floating tray configurations (Figures 8 and 9).

Several variations of stacked trays which are suitable for rearing cultchless oysters. All contain wood-styrofoam flotation heads with disassemblable metal rods for tray cleaning and oyster maintenance.

- a) Richmond growout trays with wood culture frames and fiberglass screening; stack of 6 trays (1' x 2' x 6") will hold 15,000 1/8" oysters; cost approx. \$72.
- b) with "Nestier" stacked plastic trays and 2mm plastic liners (2' x 2' x 2"), 4 trays will hold 15,000 1/8" oysters; cost approx. \$77.
- c) Marcrafts aluminized steel growout trays (2' x 4' x 3"), 6 trays will hold 6,000 1/4" to 1/2" oysters and allow for further growth without number reduction; cost approx. \$176.
- d) "Nestier" growout trays, nineteen unit stack will hold 1800 market sized oysters, cost approx. \$126.
- e) Modified Maine lobster car suitable for holding Marcrafts aluminized steel growout trays.

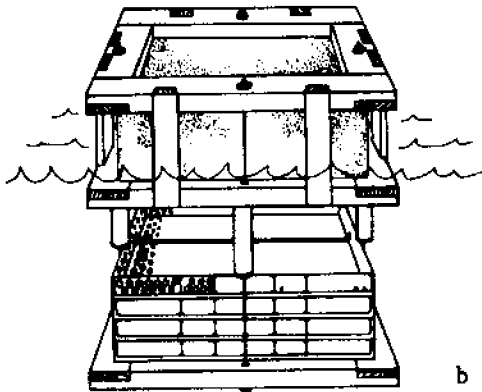


a

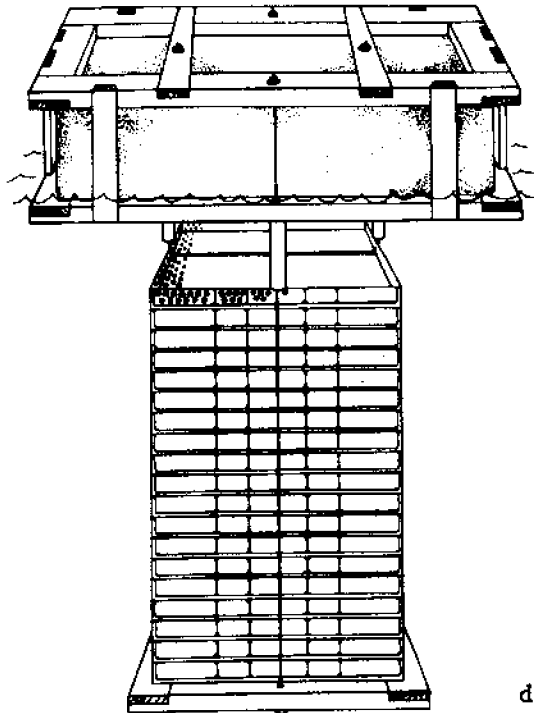


CORNER OF RICHMOND  
GROW-OUT TRAY

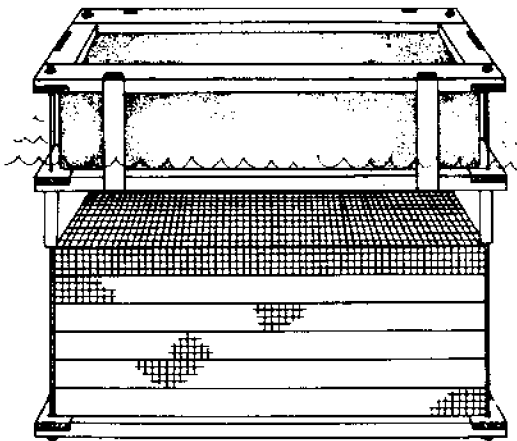
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b

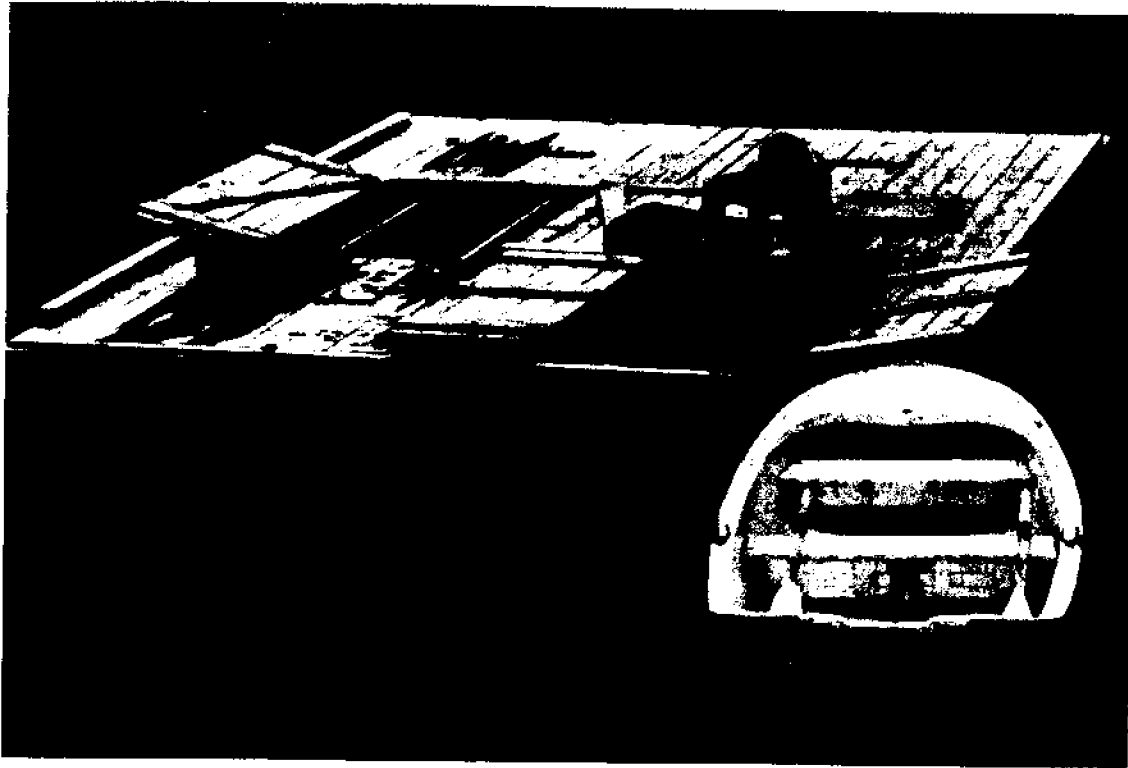


d



c

Figure 8. Suggested shellfish growout tray configurations (see text).



e

Figure 9. Modified Maine lobster car suitable for culture of first year cultchless oysters. We have placed window screen sized oysters in floating boxes inside the car. Later, oysters are transferred to aluminized steel trays secured to crosspieces at the bottom of the car. It is essential to secure trays to the base of the car to minimize effects of waves in abraiding oysters in the trays.



Appendix VI

Marine Law Applicable to Aquaculture in Maine

The following are Maine laws or parts of laws applicable to shellfish aquaculture which have been extracted from the Maine Marine Resources Laws and Regulations (revised to October 3, 1973). You are referred to that handbook from the Maine Department of Marine Resources for a full listing of these and other laws relating to shellfish culture activity.

**Chapter 401**

**General Provisions**

Sec.

- 3401. Definitions.
- 3402. Rules of construction.
- 3403. Application of general laws to domestic and foreign marine species.
- 3404. Regulations of commissioner and salmon commission.
- 3405. Concurrent jurisdiction.

**§ 3401. Definitions**

Each word or term defined in this section has the meaning indicated in this section for the purposes of chapters 401 to 417, unless a different meaning is plainly provided by the context.

- 1. **Angling.** "Angling" means fishing with handline or rod with a live or artificially baited hook.
- 2. **Atlantic salmon.** "Atlantic salmon" means Atlantic sea run salmon.
- 3. **Can, the verb.** The verb "to can" means in all its moods and tenses to process or preserve food in hermetically sealed containers.
- 4. **Coastal waters.** "Coastal waters" means all waters of the State within the rise and fall of the tide and the marine limits of the jurisdiction of the State; but it does not include waters within or above any fishway or dam when that fishway or dam is normally the dividing line between tidewater and fresh water, nor does it include waters above any tidal bound that has been legally established in streams flowing into the sea.
- 5. **Commissioner.** "Commissioner" means Commissioner of Sea and Shore Fisheries.
- 6-A. **Conservation.** "Conservation" means providing for the development and wise utilization of Maine's marine resources or protecting the ultimate supply for present and future generations or preventing waste or for implementing sound management programs.
- 6. **Clam.** "Clam" means a marine mollusk or shellfish commonly called a soft-shell clam.
- 7. **Closed season.** "Closed season" means the time during which a particular species may not be caught or taken.
- 8. **Crawfish.** "Crawfish" means those species of the family Palinuridae, including the representative genera *Panulirus*, *Jaesus* and *Palenurus* which have been sometimes called by such terms as rock lobster, spiny lobster, sea crawfish, red lobster, thorny lobster, langoust, crayfish, Sidney crawfish, kreef, Cuban rock lobster or African lobster or African crawfish.
- 8-A. **Cultivation.** "Cultivation" means the artificial control or manipulation by man of any marine species at some stage of its life history for the purpose of increasing yield or improving quality.

9. **Dealer.** "Dealer" means any person who buys and sells or distributes any marine species.

10. **Department.** "Department" means Department of Sea and Shore Fisheries.

11. **Division.** "Division," when by the context it refers to part of chapters 401 to 417, means a part of a subparagraph. It is next in importance to a subparagraph. It is designated by a small letter in parenthesis.

11-A. **Fish, the noun.** "Fish" means all marine animals.

12. **Fish, the verb.** The verb "to fish" in all of its moods and tenses means to take or attempt to take fish or other marine species by any method or means, whether or not the method or means results in their capture.

13. **Fresh fish.** "Fresh fish" means any fish which has not been smoked, pickled, cooked, canned or quick frozen.

14. **Hard-shell clam.** "Hard-shell clam" means that species of shellfish which is sometimes called a quahog.

15. **Hermetically sealed.** "Hermetically sealed" means a container which has been made airtight by or as by fusion so that no air, gas or spirits can either enter or escape, whether or not the can is sterilized by heat, but does not include friction cover containers.

16. **Lobster car.** "Lobster car" means a box or other contrivance used in coastal waters, whether floating or sunken which is used for keeping lobsters which are alive.

16-B. **Marine and estuarine resources.** "Marine and estuarine resources" or "marine resources" means all renewable marine organisms, including fish, shellfish and marine plants, and the entire ecology and habitat supporting such marine organisms, unless otherwise provided by law.

17. **Marine species.** "Marine species" includes all fish which usually inhabit salt water, all shellfish, lobsters, crabs, shrimps and marine worms, but is limited to the number and type of those species indicated by the context of the particular section where it is used.

18. **Marine worms.** "Marine worms" means clam, sand and blood worms.

19. **Open season.** "Open season" means that time during which a particular species may lawfully be taken.

19-A. **Organism.** "Organism" means all fish, marine plants and other marine life.

20. **Paragraph.** "Paragraph," when by the context it refers to part of chapters 401 to 417, means a part of a subsection as defined in this section. It is next in importance to a subsection. It is designated by a capital letter. It includes all subparagraphs, as defined in this section, which are directly under it.

**21. Quahog.** "Quahog" means a species of shellfish which is often called a hard shell clam.

**22. Resident and residence.** "Resident and residence" each refer to domicile.

**23. Salmon commission.** "Salmon commission" means Atlantic Sea Run Salmon Commission.

**24. Seed clam.** "Seed clam" means a soft-shell clam which is less than 2 inches long in its longest diameter.

**25. Seed quahog.** "Seed quahog" means a hard-shell clam which is less than 2 inches long in its longest diameter.

**26. Shellfish.** "Shellfish" means all marine mollusks except lobsters, crabs and shrimps.

**26-A. Species.** "Species" means the scientific name used in the classification of marine organisms.

**27. Ship, the verb.** The verb, "to ship" in any of its moods and tenses means to send by a common carrier.

**28. Soft-shell clam.** "Soft-shell clam" means that species of shellfish which is often called a clam, and it does not include a quahog.

**28-A. Species.** "Species" means, as used in the laws and regulations administered by the Department of Sea and Shore Fisheries, the scientific name used in the classification of marine organisms.

**28-A. Species.** "Species" as used in the laws administered by the Department of Sea and Shore Fisheries means the scientific name used in the classification of marine organisms.

**29. Subparagraph.** "Subparagraph," when by the context it refers to part of chapters 401 to 417, means a part of a paragraph as defined in this section. It is next in importance to a paragraph. It is designated by an Arabic numeral in parenthesis. It includes all divisions, as defined in this section which are directly under it.

**30. Subsection.** "Subsection," when by the context it refers to part of chapters 401 to 417, means a part of a section. It is next in importance to a section. It is designated by an Arabic numeral. It includes all paragraphs, as defined in this section, which are directly under it.

**30-A. Take, the verb.** The verb, "to take" means to fish for, hunt for, pursue, capture or kill, or attempt to do any of those acts. It does not include harvesting of marine species that are cultivated by the commissioner or persons authorized by him to cultivate pursuant to chapters 401 to 417.

**31. Territorial waters.** "Territorial waters" means coastal waters as defined in this section.

**32. Tidal waters.** "Tidal waters" means coastal waters as defined in this section.

**33. Transport, the verb.** "The verb "to transport" in all its moods and tenses means to move an object from one place to another by any means other than to ship as defined in this section.

**34. Tuna.** "Tuna" includes all species of fish known as tuna and includes that fish commonly called a horse mackerel.

**35. Warden service.** "Warden service" means coastal warden service which includes all coastal wardens regardless of rank, grade or position.

1973, c. 432, § 1, c. 462, § 1, c. 513, § 1.

#### § 3452. Taking of polluted shellfish

The commissioner may authorize individuals, concerns or entities to take shellfish from polluted flats or waters for the purpose of deparating them in accordance with the requirements set forth in section 4302-B and the regulations promulgated thereunder.

**1. Experiments to effectuate this section.** The department shall be authorized to conduct experiments which will effectuate this section, to seek and expend funds necessary for such experiments, to cooperate with concerns, individuals and entities or other agencies in matters relating to deparation, and shall set rules and regulations controlling such experiments or processes.

**2. Authorizations.** All authorizations granted by the commissioner under this section shall be in writing, shall be dated and shall include all information required to define boundaries, establish limits, set forth rights and any other provisions required to assure safety or process and product.

**3. Sale of deparated shellfish.** Deparated shellfish may be sold in accordance with section 4302-B and the regulations promulgated thereunder.

**4. Penalty.** Whoever violates any provision of this section shall be punished by a fine of not less than \$100, nor more than \$300, for each offense, or by imprisonment for not more than 90 days, or by both.

NOTE: (Effective March 22, 1973)

1973, c. 110

#### § 3703. Research by private interests

Any person or corporation interested in scientific research relating to shellfish, or other fish over which the commissioner has supervision, or in the cultivation and development of the shellfish industry or the seaweeds, including but not limited to Irish moss, for economic purposes, may apply to the commissioner setting forth the desire to make experiments relative to the cultivation, conservation and harvesting of particular marine species or seaweeds. Upon receipt of the application by the commissioner, the following procedure must be followed:

**1. Commissioner to be satisfied certain requirements are met before notice of hearing.** The commissioner shall give notice of a hearing on the application if he is satisfied that all the following provisions are met:

**A.** That the application contains sufficient information to show that the applicant is entitled to the certificate provided in this section;

**B.** That information contained in the application is true;

**C.** That the applicant either owns, or has consent, so far as the same can be granted, from the owner of the flats, shore rights or waters where the work is to be undertaken; and

**D.** That the granting of the certificate provided in this section will not unreasonably interfere with navigation.

**2. Notice of hearing; how; contents.** The commissioner shall then give notice of the hearing as follows:

**A.** The commissioner shall cause the notice to be published once a week for 2 consecutive weeks in some newspaper published in the county where the proposed location is situated.

**B.** The commissioner shall state in the notice, the time and place of the hearing, the name of the applicant and the general area where the work is to be undertaken.

**3. Commissioner may issue certificate to set area apart upon hearing.** If, upon hearing, the commissioner is satisfied that the interests of the State will be promoted by the experiments, he shall issue a certificate setting apart so much of such shores, flats and water privileges, not exceeding one acre in extent to any one applicant, for such length of time, not exceeding a period of 6 years, as in his judgment may be necessary and proper to accomplish the ends sought. The commissioner may set aside areas on the submerged lands or reefs within the jurisdiction of the State, for experiments with the cultivation, conservation and harvesting of seaweeds, including Irish moss. No one applicant shall be entitled to more than 3 such areas and no single area shall exceed more than one square mile, but any areas so set aside shall not be closer to the low water mark on the adjacent shore than 25 feet, and all of said areas for such experiments shall be east of 69° 45' west longitude. The total area set aside for all applicants for experiments with seaweed shall not exceed, at any one time outstanding, 10 square miles; width of any area shall be not less than ¼ mile.

**4. Applicant to record certificate.** The applicant shall record the certificate in the registry of deeds of each county where the flats or waters are located.

**5. Applicant to give public notice of certificate.** The applicant shall cause public notice of the issuance of the certificate by publishing the certificate once in a daily newspaper of general circulation in the county and once in a weekly newspaper of general circulation in the county where the area to be used is located, by posting a copy of the certificate in a conspicuous place near the area and by recording a copy of the certificate with the clerk of the municipality where the area is located.

6. **Applicant to mark area.** The applicant shall place stakes or other monuments upon the adjoining upland so as to designate the area set apart as specified by the commissioner in the certificate.

7. **Revocation.** The commissioner may revoke the certificate so granted, after notice and hearing to the holder thereof, for the following reasons: The holder has not within the year last passed conducted any experiments in said area or the experiments conducted have been injurious to the marine species in said area.

1968, c. 527, § 1.

§ 3703-A. **Special License**

The Commissioner of Sea and Shore Fisheries is authorized to issue special licenses exempting the holder from certain laws administered by the department as to the time, place, size, condition, amount and manner of taking fish or shellfish.

1. **Requirements.** To qualify for such a license an applicant must:

A. Prove to the satisfaction of the commissioner that he will be conducting scientific research; or that he is prepared to engage in cultivation of marine species which would require management and harvesting techniques not authorized under present statutes;

B. File a description of the proposed project with the commissioner describing the objectives, the location, the estimated time of completion and the section or sections of the fishery laws that need to be suspended to carry out the project;

C. Payment of a filing fee of \$50. The fee may be waived for research activity by institutions or organizations financed in whole or in part by state funding.

2. **Special licenses granted.** The commissioner may grant such a license subject to such conditions as he deems advisable to protect fishery resources and assure compliance with health requirements. Such license may be issued for a year subject to renewal for a period of 4 more years without refileing an application providing that conditions attached to such license have been met.

A. Any person that is engaged in handling or harvesting fish in any research or cultivation project sanctioned by a special license must be registered with the department and listed in the license.

B. The fee for a special license is \$15 for the applicant and \$10 for each additional person who is registered with the department and listed on the license as authorized to work on the project.

3. **Transportation permit.** Any person engaged in the cultivation of fish or shellfish under a special license may ship, transport or sell such fish, provided that, in addition to compliance with state or federal health requirements and regulations, a permit be obtained from the department and that all fish shipped, transported or sold shall be tagged with the name and address of the cultivator and the number of the license under which the exemption from the fishery laws was granted. The permit may be renewed annually provided that the applicant has retained his special license.

1973, c. 432, § 5.

§ 3704. **Interference or unlawful taking**

It is unlawful for any person, during the period that any shores, flats or waters are taken or used under this chapter, for scientific research relating to shellfish or other fish, to take, dig, fish or in any manner destroy any marine species within the area used or taken, or to interfere with the shores, flats and waters so used or taken.

It shall be unlawful for any person, during the period that any shores, flats or waters are taken or used under this chapter for the cultivation, conservation or harvesting of seaweeds, to take, dig or sever or in any manner destroy any seaweeds, within the area used or taken, but it shall be lawful for any person to take, dig, fish or in other manner take marine species, in said area, provided it is lawful to do so.

1. **Penalty.** Whoever violates any provision of this section shall be punished by a fine of not less than \$50 nor more than \$100 for each offense, or by imprisonment for not more than 90 days.

1968, c. 527, § 2.

§ 3705. **Marine resources research**

The department under the direction of the commissioner is authorized to conduct or sponsor a program or programs for research and development of commercial fishery resources and other marine resources of the State which may include, but not be limited to, biological, chemical, technological, hydrological, processing, marketing, financial, economic and promotional research and development. The department may carry out such a program or programs within the department, in cooperation with other state agencies, and federal, regional and local governmental entities, or with private institutions or persons. The department is authorized to receive funding and to undertake programs in conformity with Federal Public Law 88-309 and other federal programs concerned with marine resources and public health programs associated with marine resources; to seek and expend matching federal funds for the purposes of this section; and to seek and receive funding or accept donations from other public or private sources for the purposes of this section.

Chapter 414

Leasing of Areas for Cultivation of Marine

Resources

Sec	
3721	Areas that can be leased
3722	Application.
3723	Satisfaction of certain requirements before notice of hearing.
3724	Notice.
3725	Lease.
3725 A.	To record lease.
3726	Area to be marked.
3727	Grievance procedure.
3728	Revocation of the lease.
3729	Rights.
3730	Renewal of lease.
3731	Interference or unlawful taking.

§ 3721. **Areas that can be leased**

The Commissioner of Sea and Shore Fisheries, with the consent of the advisory council, and if not in conflict with the Maine Coastal Plan and any applicable coastal zoning ordinances, may lease to a qualified person, persons or corporation areas in and on Maine coastal waters, public lands under Maine's coastal waters and portions of the intertidal zone for the harvesting and cultivation of fish or shellfish. The commissioner may grant a lease upon such terms and conditions as he may deem proper, but not for a term longer than 10 years or shorter than 5 years. No tract leased by the commissioner shall cover more than 5 acres. A person may lease as many tracts as the commissioner may grant providing that no one person or corporation shall be entitled to a total area of more than 200 acres.

§ 3722. **Application**

A person or corporation desiring to obtain a lease for the use of a tract of Maine's coastal water areas, public land under Maine's coastal waters, or land in the intertidal zone must make application in writing to the Commissioner of Sea and Shore Fisheries containing the following information:

1. **Description.** Location and description of the area by metes and bounds or coordinates as appropriate;
2. **Species.** The specie or species to be managed or cultivated;
3. **Project.** A description of the proposed management or cultivation project in sufficient detail to enable the commissioner to determine:
  - A. The compatibility of the project with other present or potential uses of the requested area; and
  - B. Degree of exclusive use of the area essential to the proposed project;
4. **Owner's permission.** That the applicant either owns or has written permission from the owner to use whatever land above high water mark and to exercise any riparian right on the flats necessary to successfully carry out the proposed project.

**§ 3723. Satisfaction of certain requirements before notice of hearing**

The commissioner shall give notice of a hearing on the application, if he is satisfied that all the following provisions are met:

1. **Information.** That the application contains sufficient information to show that the applicant is entitled to the lease provided in this chapter;
2. - **true.** That information contained in the application is true.
3. **Riparian owners.** That granting of the lease will not unreasonably interfere with the egress or ingress of any riparian owners;
4. **Navigation.** That the granting of the lease will not unreasonably interfere with navigation;
5. **Preexisting uses.** That granting of the lease not in conflict with the Maine Coastal Plan, applicable coastal zoning ordinances and does not unreasonably interfere with preexisting uses.

**§ 3724. Notice**

The commissioner shall give notice of hearings as follows:

1. **Publication.** The commissioner shall cause notice to be published once a week for 2 consecutive weeks 2 weeks prior to the hearing in some newspaper of general circulation in the county where the proposed location is situated, and notice posted in 2 public places 2 weeks prior to the hearing, in the municipality or municipalities where the waters or flats are situated or to which they are adjacent.
2. **Time and place of hearing.** The commissioner shall state in the notice, the time and place of hearing, the names of the applicants and the general area where work is to be undertaken.

**§ 3725. Lease**

The commissioner may grant the lease, if after the hearings, he is satisfied that all conditions are met and that the interests of the State will be promoted by cultivation or planting in the requested area.

1. **Preference.** In the case of more than one applicant for the lease of a given area, preference shall be given as follows:

- A. On the flats, preference shall be given to the riparian owner;
- B. In coastal water areas or public land under coastal waters, preference shall be given to:
  - (1) Fishermen who have traditionally and effectively fished in the area;
  - (2) The owner of an area above ordinary low water mark, if the lease is granted within 100 feet of ordinary low water mark.

2. **Rents.** The commissioner shall set the rents for the areas so leased.

**§ 3725-A. To record lease**

The applicant shall record the lease in the registry of deeds of each county where the flats, public land under coastal waters or coastal water areas are located. The applicant shall cause public notice of the issuance of the lease, a description of the area and an enumeration of all restrictions of activity in the area, by publishing information as to the location and nature of the lease once in a daily newspaper of general circulation in the county where the area to be used is located.

**§ 3726. Area to be marked**

The applicant shall mark the leased area in a manner prescribed by the commissioner.

**§ 3727. Grievance procedure**

Any person aggrieved by a decision of the Commissioner of Sea and Shore Fisheries upon an application for a cultivation or management lease under this section may petition directly to the Superior Court for a reversal or modification of such a decision, provided that:

1. **Objections.** The objections were raised at the hearing required by this chapter; and

2. **Evidence.** The evidence of law or facts to substantiate such objections were presented at such hearing;

3. **Decision detrimental.** Decisions made by the commissioner pertaining to enforcement of health regulations or a determination that cultivation of a particular species would be detrimental to marine fishery resources are not appealable.

**§ 3728. Revocation of the lease**

The commissioner may revoke any lease so granted, after notice and hearing, in accordance with section 3725, to the holder thereof, if no cultivation or management project is carried out within the year after the lease is granted, or such cultivation has been injurious to marine species in the area, or that conditions stipulated in the lease have not been met.

**§ 3729. Rights**

A holder of a lease under section 3725 shall have the exclusive right to cultivate and harvest the species stipulated in his lease. Holders of leases for cultivation of any species on flats or land under coastal waters are entitled to take all of that species in the specified leased area.

A holder of a lease under section 3725 must also obtain a special license under section 3703, subsection 1, paragraph A, if a variance is sought in the applicability of the fishery laws and regulations administered by the Commissioner of Sea and Shore Fisheries.

**§ 3730. Renewal of lease**

Any holder of a lease granted under sections 3721 and 3725 shall, upon expiration of the lease, have preference in the reletting of the area unless the former lessee shall be in arrears for rent. An application for renewal shall be granted without notice or public hearing provided that no renewal shall be granted when the Commissioner of Sea and Shore Fisheries shall, for interests of the State, cease to lease said area.

**§ 3731. Interference or unlawful taking**

Any person who interferes with, annoys or molests another in the enjoyment of any lease authorized under this chapter shall be subject to a fine of not less than \$100 nor more than \$500 for each offense, or by imprisonment for not more than 90 days.

1973, c. 462, §2.

**§ 4211. Importing marine species**

No person shall introduce or import for introduction into any of the coastal waters of this State any live marine species, either fish, shellfish, crustacea or aquatic plant life, or the eggs from any of said species, or have in possession any such fish, eggs or marine species so introduced or imported without written permission of the Commissioner of Sea and Shore Fisheries. The commissioner may grant permits and establish rules and regulations for the importation of live marine species, fish, eggs or aquatic plants into the State. Importers shall, when requesting a permit, provide the commissioner with information as to the number and species to be imported, the name and address of the source and a statement from a recognized pathologist or biologist, either of a state conservation department, the National Marine Fisheries Service or United States Fish and Wildlife Service, certifying the particular species to be imported are free from bacteria, fungus, virus or any other infectious or contagious disease, or parasites, predators or other organisms that might be dangerous to indigenous marine life or the environment. Such statement shall accompany each request for permission to import any marine species, the eggs thereof or any aquatic plant.

A violation of this section shall be punishable by a fine of not less than \$100 or by imprisonment for not more than 90 days, or by both.

1971, c. 249.

**§ 4253. Cultivation of oysters**

Any inhabitants of the State, with the consent of the adjacent riparian proprietors, may plant oysters below low water mark in any navigable water in any place where there is no natural oyster bed, subject to this section:

**1. Planter's duties** Any person who wishes to take advantage of this section shall do the following:

**A.** He shall mark the area as follows:

(1) He shall enclose the area with stakes extending at least 2 feet above high water mark, but so as not to obstruct the free navigation of the waters.

(2) He shall place notices that the area is used for the planting of oysters on the banks of shores adjacent to the protected area, not more than 10 feet nor less than 6 feet above the ground in conspicuous positions. The notices must be painted on wood in black capital Roman letters, not less than 2 inches in height and not less than 1/2 inch in breadth, so that the letters are plainly legible. He shall maintain the notices during the time that he wishes to have the advantages of this section.

**B.** He shall describe the area by metes and bounds in a written statement which must state that he is using the area for the purposes of this section and must include the written consent of the adjacent riparian proprietors. He shall record this written statement with the town clerk of the municipality where the area is located and with the commissioner.

**2. Permittee has exclusive rights; penalty.** After he has complied with all the provisions of subsection 1 he is permitted to plant oysters and has the exclusive right to the taking of the oysters within the specified area.

**A.** It is unlawful for any person, without the consent of the permittee, to trespass within the area or to injure the area where the oysters have been planted, and whoever does so shall be liable to the permittee in a civil action for any damages.

(1) And in addition, if any person, without the consent of the permittee, takes any oysters or any shellfish from within the area, he shall be punished by a fine of not less than \$20 nor more than \$50, or by imprisonment for not more than 3 months.

**§ 4304. Cultivation of clams and mussels**

The municipal officers of any municipality, and the commissioner in the event that the municipality has been deorganized by Act of the Legislature, are authorized to grant written licenses for the purpose of planting and cultivating clams, quahogs or mussels upon the flats and creeks of their respective jurisdictions, subject to this section:

**1. Survey and plan must first be made; filing.** Before granting any license, the municipal officers of a municipality, or the commissioner in the case of a deorganized municipality, shall cause a survey and plan to be made of the territory within which licenses are to be granted.

**A.** The plan is to be kept in the office of the clerk of municipality, or in the office of the department if the municipality is deorganized.

**2. Total area under cultivation limited.** The total area under licensed cultivation may not exceed 1/4 of the total area of all the flats and tidal creeks within the municipality.

**3. Term of license.** The term of the license may not be less than 5 years nor more than 10 years.

**A.** The municipal officers shall fix the exact term within those limits in event the legislative body of the municipality fails to do so.

**B.** The commissioner shall fix the term within the 5 to 10 year limits for deorganized municipalities.

**4. Annual license fee.** The licensee shall pay an annual license fee to the municipality, or to the department if the municipality is deorganized.

**A.** The municipal fee may not be less than \$1 nor more than \$5 per acre annually.

(1) The municipal officers shall fix the exact fee within those limits if the legislative body of the municipality fails to do so.

**B.** The fee for a license in a deorganized municipality is \$5 per acre annually.

**5. Persons qualified for license.** A license may be granted only to a person who has resided in the State for at least one year next preceding the date of his application, or who has been a taxpayer in the municipality for at least one year next preceding the date of his application.

**6. May not obstruct navigable water.** No license may be granted if the exercise thereof would materially obstruct navigable water.

**7. Preference given in certain cases.** The granting of authority shall give preference to a riparian proprietor of adjacent property when there are 2 or more applicants for the same area, and an adjacent riparian proprietor is one of them.

**8. Authority to pass ordinances.** A municipality may enact municipal ordinances, which do not conflict with this section and sections 4305 and 4351, to further regulate the licenses authorized by this section.

**9. Procedure in § 4305 to be followed.** The municipal officers and the commissioner shall follow the procedure provided in section 4305 in granting licenses authorized by this section.

**§ 4305. Procedure for licenses authorized by § 4304.**

The procedure for granting, assigning and holding the licenses authorized by section 4304 is as follows:

**1. License application.** Any person interested in obtaining a license shall apply in writing to the municipal officers of the municipality wherein the flats or creeks to be under license are located, or to the commissioner if the municipality is deorganized.

**A.** The application must state a description of the exact area applied for.

**B.** The application must state that the applicant has resided in the State at least one year next preceding the date of application, or that the applicant has been a taxpayer in the municipality for at least one year next preceding the date of application.

**2. Notice of hearing.** Upon receipt of an application properly completed, the municipal officers, or the commissioner if the municipality is deorganized, shall order notice of a public hearing on the application.

**A.** The notice must state the name of the applicant, the date of the application, a description of the exact area applied for and the time and place of the hearing.

**B.** The notice must be posted in at least 3 public places in the municipality and published once in a newspaper published in the municipality, all at least 10 days before the date of hearing.

(1) If there is no newspaper published in the municipality, then notice must be published in a newspaper having general circulation in the municipality.

**3. Hearing.** The municipal officers, or the commissioner if the municipality is deorganized, shall hold a public hearing at the time and place designated in the notice.

**A.** Any interested person may give relevant evidence at the hearing.

**4. Granting license.** After the hearing the municipal officers, or the commissioner if the municipality is deorganized, may grant the license within the area specified in the application, subject to the following provisions:

**A.** All the requirements of section 4304 have been fulfilled.

**B.** The applicant pays the license fee for the first year.

**C.** The license specifies the name of the applicant and describes the exact area under license by metes and bounds.

**5. Area licensed to be marked on plan; recording.** Immediately after granting the license the municipal officers, or the commissioner if the municipality is deorganized, shall mark the area licensed on the plan provided for in section 4304.

**A.** The municipal officers shall record any license issued by them with the clerk of the municipality, and shall record the license with the commissioner.

**6. Duties of licensee; marking area; notice.** Immediately after receiving his license, the licensee has the following duties:

**A.** He shall cause the area covered by his license to be plainly marked by stakes, buoys, ranges or monuments which he shall maintain during the entire term of his license.

**B.** He shall place notices that the area is licensed on the banks or shores adjacent to the protected area not more than 10 feet nor less than 6 feet above the ground in conspicuous positions. The notices must be painted on wood in black Roman letters not less than 2 inches in height and not less than 1/4 inch in breadth so that the letters are plainly legible. He shall maintain the notices during the term of his license.

**7. License recorded before effective; revocation.** No license becomes effective until the recording provisions of subsection 5 are fulfilled, and failure to place and maintain the markers and notices provided by subsection 6 is sufficient cause for the revocation of the license by the authority granting the license.

**8. Licensee to give annual report.** Every person licensed shall submit a written report on oath, on or before the first day of January of each year, to the authority who granted his license. The report must state the total number of bushels of each kind of shellfish produced or marketed from the area licensed during the preceding year, and an estimate of the total number of bushels of each kind of shellfish planted or growing on the licensed area at the time of the report.

**9. Forfeiture if area does not produce.** The granting authority shall determine the market value of all the shellfish reported in the report provided in subsection 8.

**A.** If the total amount on any one report falls below the market value, as thus determined, of \$25 per acre within the first 2 years of the term of the license, or below the market value, as thus determined, of \$50 per acre for any 3 consecutive years thereafter, then the authority which granted the license may declare it forfeited.

**10. Assignment of license.** A licensee may assign his license to any person who has resided in the State for at least one year next preceding the date of the assignment, or who has been a taxpayer in the municipality where the licensed area is located for at least one year next preceding the date of the assignment, provided the granting authority gives written consent to the assignment.

**A.** Once the license is assigned, and the assignment has been approved by the granting authority, the assignee has all the privileges and duties of the original licensee and is subject to all the provisions of law as though he were the original licensee.

#### **§ 4308. Transplanting of seed clams and quahogs**

The commissioner is authorized to issue permits to dig and transplant sea quahogs or seed clams to any person licensed to cultivate shellfish under the authority of section 4304, subject to this section.

**1. Application for permit.** Any person so qualified shall apply to the commissioner through the municipal officers of the municipality where the seed quahogs or seed clams to be transplanted are located, or directly to the commissioner if the seed quahogs or seed clams to be transplanted are located in a municipality which has been deorganized by Act of the Legislature.

**A.** The application must state all the following information:

**(1)** A description of the exact area where the seed quahogs or seed clams are to be obtained;

**(2)** A description of the means by which seed quahogs or seed clams are to be harvested for transplanting purposes;

**(3)** The method of transplanting the seed quahogs or seed clams;

**(4)** A description of the area where they will be planted.

**2. Notice of hearing.** Upon receipt of an application properly completed, the municipal officers of the municipality where the seed quahogs or seed clams are to be obtained, or the commissioner if that municipality is deorganized, shall order notice of a public hearing on the application.

**A.** The notice must state the name and address of the applicant, the date of application, a description of the exact area where the seed quahogs or seed clams are to be obtained and the time and place of the hearing.

**B.** The notice must be posted in at least 3 public places in the municipality, and published once in a newspaper published in the municipality, all at least 10 days before the date of hearing.

**(1)** If there is no newspaper published in the municipality, then notice must be published in a newspaper having general circulation in that municipality.

**C.** Notice of the hearing must be given the commissioner, unless the municipality from which the seed quahogs or seed clams are to be obtained is deorganized.

**3. Disapproval; appeal; denial.** After the hearing the municipal officers may disapprove the application, in which case the applicant may appeal to the commissioner whose decision is final.

**A.** If the municipality is deorganized, the commissioner may deny the application and that denial is final.

**4. Approval of application.** After the hearing the municipal officers may approve the application if all the provisions of this section are met, and the applicant shall then forward a copy of the application and approval to the commissioner.

**5. Granting of permit.** After receipt of the copy of the application and approval, or after the hearing if the seed quahogs or seed clams are located in a deorganized municipality, the commissioner may grant the permit, subject to the following provisions:

**A.** The commissioner shall appraise himself of the conditions under which the transplanting will take place before issuing a permit.

**B.** The seed quahogs or seed clams may be planted only in flats located in this State.

**C.** The permit must contain a specific expiration date, and a specified maximum volume of seed quahogs or seed clams which may be transplanted within the permitted time.

**(1)** The maximum volume of seed quahogs or seed clams to be transplanted under all permits may not exceed 25% of the estimated seed quahog or seed clam population in any given area, and the maximum volume granted to any one permit holder may not exceed 5% of the estimated seed quahog or seed clam population in the area specified in the application.

**(a)** Research personnel of the department shall determine the seed quahog or seed clam population by utilizing accepted survey methods.

**6. Rights of permittee.** The holder of a permit may remove seed quahogs or seed clams, whichever is specified in the permit, from the area specified in the permit, transport them to and transplant them in the area specified in his permit, provided he does not exceed the maximum volume specified in his permit.

#### **§ 4309. Certificate to ship shellfish out of state**

It is unlawful for any person, firm or corporation to ship beyond the limits of this State any soft-shell clams, quahogs, oysters or mussels, whether the same have been removed from the shell or not, or to sell such shellfish to another for shipment or transportation beyond the limits of the State, or to cause the same to be done, without having a current shellfish certificate from the commissioner as provided in this section.

### **Article 3. Prohibited Acts**

#### **§ 4351. Violations regarding shellfish cultivation; local enforcement**

The following provisions apply to areas under the licenses authorized by section 4304.

**1. Taking shellfish without consent of licensee; penalty.** It is unlawful for any person, except the licensee, his employees, heirs or assignees, to dig or take clams, quahogs or mussels, or clam, quahog or mussel seed from the area licensed. The licensee, his heirs or assignees have exclusive use of the shellfish in the area described in the license during the term of the license.

A. The licensee, his heirs or assignees may in a civil action recover treble damages and costs of any person who, without his or their consent, digs or takes any clams, quahogs, mussels or other shellfish from the area covered by the license.

B. Whoever so digs or takes clams, quahogs or other shellfish shall, in addition, be punished by a fine of \$20 for each offense, or by imprisonment for not more than 30 days, or by both.

**3. Molesting shellfish without consent of licensee; penalty.** It is unlawful for any person, without the consent of the licensee, his heirs or assignees, to do any of the following acts, and whoever does so shall be punished for the first offense by a fine of not more than \$20 or by imprisonment for not more than one month, and for a subsequent offense by a fine of not more than \$50 or by imprisonment for not more than 6 months:

A. To work a dredge, tonga, rake or other implement for the taking of shellfish or any description, for any purpose whatever, upon or over the area covered by the license;

B. To disturb the growth of shellfish upon the area covered by the license in any manner;

C. To discharge any substance upon the area covered by the license which may directly or indirectly injure the shellfish thereon.

**3. Molesting markers; penalty.** It is unlawful for any person to willfully do any of the following acts, and whoever does so shall be punished by a fine of not more than \$20, or by imprisonment for not more than 30 days, and in addition shall be liable in a civil action to the licensee, his heirs or assignees in treble damages and costs:

A. To willfully injure, deface, destroy, move or remove any mark or bound used to define the extent of any area covered by a license;

B. To willfully place any unauthorized mark or bound on the area covered by a license;

C. To willfully fasten any boat or vessel to any mark or bound used to define the extent of the area covered by the license;

D. To willfully injure, deface, destroy, move or remove any notice required by section 4305.

**4. Local enforcement.** It is the responsibility of the municipality, or the commissioner if the municipality is deorganized, to enforce all provisions relating to licenses issued under the authority of section 4304.

**§ 4552. Method of taking clams or marine worms**

It is unlawful to take or dig clams or marine worms in the State of Maine contrary to this section.

**1. Hand powered devices only.** It is unlawful to take or dig any clams or marine worms, except by devices or instruments operated solely by hand power

**2. Boats and hydraulic dredges.** It is unlawful for the purpose of taking clams or marine worms to dig, rake, loosen or disturb the flats with the propeller or with any other part of any boat or hydraulic dredge.

**3. Department equipment excepted.** This section does not apply to equipment operated by the Department of Sea and Shore Fisheries.

**4. Maryland dredges excepted in Hancock County.** This section does not apply to any Maryland type dredge operated solely within the limits of Hancock County, provided permission to operate the dredge is obtained from the municipal officers of the municipality where the dredge is operated, and provided no marine worms taken by these machines may be marketed in any form or manner.

**5. Hydraulic or mechanical dredges excepted in Town of Phippsburg.** This section does not apply to any hydraulic or mechanical dredge operated solely within the Town of Phippsburg, provided that the operation is a part of the town shellfish management program and provided permission to operate the dredge is obtained at a special or annual town meeting of the Town of Phippsburg. The town shall be authorized to charge a fee of \$20 for a license to operate said unit and assess a tax of 10¢ per bushel of soft shell clams harvested during the period of a state-approved management program.

**6. - between Cape Elizabeth and Pemaquid Point.** This section does not apply to the operation of any hydraulic or mechanical clam dredge approved by the Department of Sea and Shore Fisheries operated below low water within an area between Cape Elizabeth and Pemaquid Point, provided that such operation is not used for taking marine worms, lobsters or other crustaceans and is done with the approval of the Department of Sea and Shore Fisheries. The Department is authorized to charge an annual fee of \$50 to license each hydraulic or mechanical dredge and to collect a tax of 10¢ per bushel of soft-shell clams taken by such dredges and no more than 50 dredges shall be licensed in any calendar year.

A. All license fees and revenues derived under this subsection shall be used by the Department of Sea and Shore Fisheries for the purpose of studying the aftereffects on the aquatic growth and fish life in the dredged area

(1) All information gathered as a result of the above study or studies shall be made available to the Department of Inland Fisheries and Game.

B. Each dredge operator shall keep a daily report of the area in which he operated and these reports shall be given to the Department of Sea and Shore Fisheries on or before the 15th day of each month for the preceding month.

1965, c. 105; 1969, c. 250.

**§ 4553. Seizure and disposition of equipment and species**

All fish, shellfish, lobsters and other marine species, and parts thereof, which are taken, caught, bought, sold, shipped, transported or found in the possession of any person in violation of any provision of chapters 401 to 417, or in violation of any regulation authorized by chapters 401 to 417, is contraband and is subject to forfeiture to the State in accordance with this section and section 4510. All equipment used or possessed in violation of any provision of chapters 401 to 417, or in violation of any regulation authorized by chapters 401 to 417, is likewise contraband and so subject to forfeiture.

**1. May be seized without warrant; warden's duty to libel; contents of libel.** Whenever a constable warden seizes any of the above items and does not return them to the owner, except as provided in subsection 2, he shall within a reasonable time file a libel with a judge. He shall insert the following information in the libel:

A. The description of the items seized by him;

B. A statement that they were seized by him on a certain day in a certain municipality;

C. A statement that the items seized were either taken, caught, bought, sold, shipped, transported, possessed or used in violation of a provision of chapters 401 to 417, or a regulation authorized by chapters 401 to 417, whichever is applicable;

D. A prayer for a decree of forfeiture of those items.

**2. Items which need not be libeled.** The following items need not be libeled:

A. If the aggregate value of all items seized is less than \$10, unless there is reasonable doubt as to their ownership;

B. All marine species of illegal size, shellfish taken from polluted areas, female egg-bearing lobsters, V-notched female lobsters, lobsters which have been mutilated so that their size cannot be determined, female lobsters which have been mutilated so as to obliterate a V-notch, and any other marine species, the possession of which is unlawful throughout the State.

**3. Order of notice; contents.** The judge to whom the libel is directed shall fix a time for the hearing of the libel. He shall issue an order of notice to all persons interested, in which order or notice he shall insert the following:

A. A citation to all persons interested to appear at the time and place appointed for the hearing and show cause, if any they have, why the items described in the libel should not be declared forfeited to the State;

B. The time and the place fixed for the hearing;

C. An order that a true copy of the libel and the order of the notice, attested by a coastal warden, be posted in 2 conspicuous places in the municipality, or place where the items were seized, at least 10 days before the day set for the hearing;

D. In event that the items were seized from the possession of a common carrier, he shall order the common carrier served with a true copy of the libel and the order of court, attested by a coastal warden, by leaving the same at his place of business nearest to the place where the items were seized, at least 10 days before the day set for hearing.

4. **Sale or other disposition prior to hearing.** If after receipt of the libel and before the hearing, the judge finds that the items seized will be unsuitable for food, or other use, at the day of hearing, he shall order the officer who made the seizure to dispose of the same.

A. The officer may then dispose of the items at public or private sale or otherwise dispose of such property.

B. If the items are disposed of by sale, the officer shall hold the proceeds of the sale subject to the decision of the court as to final disposition of them.

5. **Items or proceeds forfeited if no court appearance; proceeds disposed of in same manner as fines.** If no claimant appears at the hearing on the libel at the time specified in the order of notice, on return of service of the officer in compliance with the order of notice, the judge shall declare the items forfeited to the State.

A. If the items have been sold in accordance with subsection 4, the officer shall turn the proceeds over to the judge who shall dispose of them in the same manner that he disposes of fines collected under chapters 401 to 417.

6. **Duty of claimant to file written claim on or before hearing day; contents.** If any person appears at the time of the hearing on the libel as specified in the order of notice, and claims title to any item listed in the libel, or claims the right to possession of any item, he shall file a written claim with the judge on or before the day set for hearing. The claim must contain the following:

A. A statement of his title or right so claimed and the foundation thereof;

B. A statement of the specific items claimed;

C. A statement of the time and the place of the seizure, and the name of the officer by whom they were seized;

D. A statement that the items claimed were not held in possession or use, with his knowledge or consent, in violation of any provision of chapters 401 to 417, or in violation of any regulation authorized by chapters 401 to 417;

E. He shall state his business and his place of residence;

F. He shall sign and make oath to the claim before the judge.

7. **Claimant admitted as party; hearing.** If any person, firm or corporation makes a written claim as provided in subsection 6, the judge shall admit him as a party to the process, shall proceed to determine the truth of the allegations in the claim and libel and shall hear any relevant evidence offered by the libellant or the claimant.

8. **Court order if claimant found entitled to any item claimed.** If the judge upon hearing is satisfied that any item listed in the claimant's claim was not, with the claimant's knowledge or consent, used or possessed in violation of any provision of chapters 401 to 417, or any regulation authorized by chapters 401 to 417, and that the claimant has title or is entitled to possession of that item, he shall give the claimant an order in writing. The judge shall direct the order to the libellant commanding him to deliver that item to the claimant, or, if the item has been sold, to deliver the proceeds of the sale to the claimant within 48 hours after the demand.

9. **Forfeiture; executions for cost; appeal; recognizance.** If the judge finds that the claimant is not entitled to any item claimed, the judge shall render judgment against the claimant for the State for costs to be taxed as in civil cases before the judge. The judge shall issue an execution for the costs as in civil cases. The judge shall declare the articles forfeited to the State. If the items have been sold in accordance with subsection 4, the officer shall turn the proceeds of the sale over to the judge who shall dispose of them in the same manner he disposes of fines collected under chapters 401 to 417.

A. The claimant may appeal to the Superior Court next to be held within the county where the judge's court is located, and, if he appeals, the judge may order the claimant to recognize with sureties as on appeals in civil cases from the judge.

B. The judge may order that the items or proceeds of sale remain in the custody of the officer pending the appeal.

10. **Disposition of forfeited items.** The officer shall turn over any articles declared forfeited to the commissioner who shall dispose of the same.

1965, c. 431, § 9

§ 4553. Report to commissioner

The coastal warden making any seizure under section 4552 shall within 10 days thereafter report all the particulars of the seizure, the sale or other disposition, the court action taken and all expenses involved to the commissioner.

§ 4554. Repealed by P.L. 1965, c. 431, § 10.



MAINE SEA GRANT PUBLICATIONS

Information Leaflets

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Technical Reports

MSG-TR-1-72	Riley, John G., Richard J. Rowe, and Herbert Hidu. Oysters: Reattachment As Method of Rearing Cultchless Hatchery Oysters. Comm. Fish. Rev. 34(5-6): 41-43.	\$ .50
MSG-TR-2-72	Riley, John G. A Mechanized System For Oyster Production. Amer. Soc. of Agr. Eng. Paper NA 72-106.	\$ .50
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MSG-TR-5-73	Blamberg, Donald L., David C. O'Meara, Richard W. Gerry, Paul C. Harris, and Thomas A. Bryan. Preliminary Observations Concerning the Nutritive Value of Dehydrated Scallop Viscera as a Component of Poultry Rations. Univ. of Maine Life Sci. and Agr. Expt. Sta. Misc. Rept. 129.	\$ .50

Miscellaneous Publications

MSG-M-1-71	A Proposal to Initiate the University of Maine's Coherent Project Sea Grant Program, Culture of Resources in a Cold Water Marine Environment.	OP*
MSG-M-2-71	A Proposal to Renew the University of Maine's Coherent Project Sea Grant Program, Vol. I and II, December 1971.	OP
MSG-M-3-72	A Report on the University of Maine's Sea Grant Program for 1 May 1971 to 30 April 1972.	OP
MSG-M-4-73	A Proposal to Renew the University of Maine's Coherent Project Sea Grant Program, Vol. I and II, January 1973.	Free
MSG-M-5-73	University of Maine Coherent Project Sea Grant Program Annual Report for the Year Ended April 30, 1973.	Free

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\*OP = Out of Print