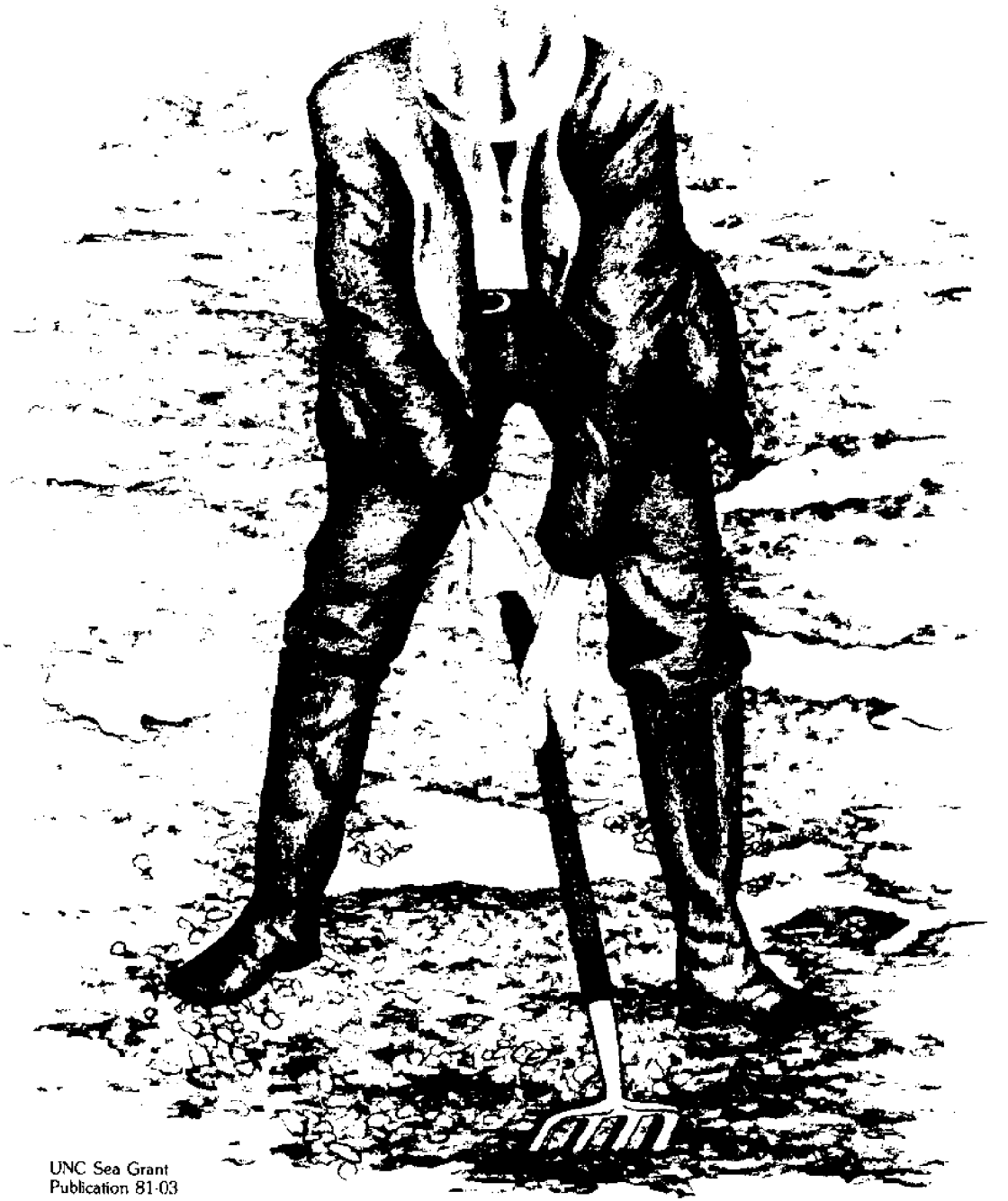
Clam Gardening



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Introduction

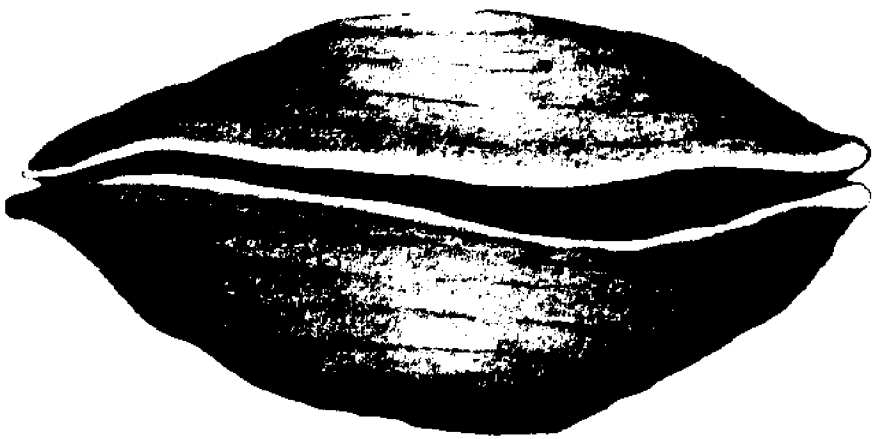
Like most types of aquaculture, clam farming began in the Orient. The Japanese have been raising clams for hundreds of years. Today, however, the relative importance and sophistication of clam aquaculture in the United States surpasses most other countries.

Most of this culture has historically been practiced in New England and Long Island. Usually, three to seven years are required to grow a marketable clam in New England. But, warmer waters and a longer growing season in North Carolina enable seed clams to reach market size in as little as two years. For this reason, commercial clam aquaculture has attracted interest in the southeastern states. This brief overview will help the potential clam grower evaluate his own situation, and receive additional information by contacting the sources listed in the appendix.

The hard clam (*Mercenaria mercenaria*), sometimes called the "quahog" (pronounced KO-hog), lives along the east coast of the United States. Increasing prices and decreasing harvests from natural clam beds have stimulated an interest in clam aquaculture in the coastal states, including North Carolina. Several relatively small-scale projects have been started to investigate the feasibility of clam farming in our waters. The University of North Carolina Sea Grant College Program has provided assistance to interested people since 1973. In addition to providing information and conducting trial seed plantings along the coast, methods for excluding predators have also been developed.

Most clam culture occurs on sand, shell, gravel or mud bottoms in sounds or bays. Methods have also been developed for culturing clams on floating rafts and in tanks on shore. Most coastal waters in North Carolina are considered too shallow and unprotected for raft or off-bottom culture using present technology and methods. Suitable clam-producing bottomland can be leased from the state provided certain stipulations are met.

Usually, small seed clams are obtained from a hatchery, then "planted" on a leased area. Protection from predators, currents and vandals as well as periodic maintenance, are provided by the leaseholder. In North Carolina, it is legal to harvest clams over one-inch thick. These littleneck clams should be ready to harvest and market after two to three years.



Obtaining Seed Clams

If clams are to be grown on a leased area where clams already grow, some seed (baby clams) will probably set naturally. But, for optimum stocking densities, hatchery-raised seed will probably be required. Hatchery techniques are relatively simple, but the biological principles involved are quite complex. Thorough investigation and study are required before a costly hatchery begins operation. Therefore, most growers will probably purchase their seed clams from a commercial hatchery.

Through careful temperature manipulation, clams can often be induced to spawn at most times of the year. Basically, sexually mature clams exhibiting good size, growth and shape characteristics are chosen for brood stock. Then, the water temperature is gradually raised to between 18° and 22°C (65°-72°F). Depending upon the time of year, the clams are held at this temperature from two to six weeks. Following this conditioning period, spawning is induced by raising the temperature to 25°C (77°F).

After successful spawning occurs, the fertilized eggs are transferred to rearing tanks where they hatch, and the larvae are graded through screens. The largest larvae are transferred to other tanks receiving a flow of seawater containing high concentrations of suitable algae for food. After approximately 10 days, larvae are observed under a microscope to determine when they begin to set. The very tiny clams, now called spat, are dispersed in tanks receiving algae-enriched seawater. The tanks must be periodically cleaned, and diseases and predators must be controlled as the spat grow to the various seed sizes.

Water quality is of the utmost importance. All pollution, toxic algae blooms and heavy silt loads must be avoided. The salinity, or the salt content of the water, must remain above 22 parts per thousand (ppt) and preferably about 28 ppt if the spat are to survive to seed size. Details about these techniques may be obtained from "Rearing of Bivalve Mollusks" by V. Loosanoff and H. Davis (listed in appendix).

Clam growers will find that the prices for seed vary considerably. Recently, prices have ranged from $10 to $15 per thousand seed depending upon the size purchased. One-eighth- to one-quarter-inch seed is less expensive, but is more vulnerable to predation. Also, seed this small may wash away in currents strong enough to disturb the bottom. Though considerably more expensive, three-eighths- to one-half-inch seed will probably provide better survival. One clam grower recommends about 200 seed per square foot.

Leasing and Permits

With the exception of some grants, virtually all coastal bottomlands underlying commercial waters in North Carolina are public. Therefore, a lease must be obtained from the state to establish responsibility for the planted area. Permits may also be required for any system utilizing a hatchery, holding tanks, pumped water or discharged water. Simply planting seed clams on granted or leased bottomland does not require a permit.

In North Carolina, the Marine Fisheries Commission is responsible for issuing leases and regulating leased bottomland. No lease will be granted on an area containing a natural oyster or clam bed. No less than one acre nor more than 50 acres can be leased, except in areas of Pamlico Sound which are more than two miles from shore. In those areas, leases must be at least five acres and less than 200 acres.

Granted to residents of North Carolina only, the leases can be renewed for a period of 10 years. A $25 filing fee and standard boundary survey of the proposed area are required of the applicant. Public notices are issued by the Commission, and the area is investigated by state and county officials to establish the absence of natural beds. If no public protests are filed, the Marine Fisheries Commission may grant the lease at its quarterly meeting.

The lease must be for commercial purposes with the lessee harvesting and marketing at least 25 bushels of clams and/or oysters per acre per year. The leased area must be reasonably marked, and the markers must be maintained. Currently, leaseholders are charged $5 per acre per year for rent. Noncompliance with the requirements may result in termination of the lease.

Prior to filing an application, interested persons should contact members of the Shellfish Management staff of the North Carolina Division of Marine

Fisheries (address in appendix). Such contact can determine public utilization and long-range management plans for the proposed area. This may save time and effort by preventing the filing for bottomland that cannot be leased. Normally, from three to six months are required to obtain a lease. Presently, about 370 leases covering around 3,000 acres have been issued.

Activities which may degrade the sensitive nature of the coastal environment require permits. Any type of discharge into the water requires a National Pollutant Discharge Elimination System (NPDES) permit. Limits will be imposed if the discharge adversely affects natural water quality. Any construction or land alteration will require a permit from the Army Corps of Engineers and the Coastal Resources Commission. The North Carolina Division of Environmental Management in the Department of Natural Resources and Community Development (address in appendix) can provide assistance.

Location Suitability

As with any form of aquaculture, the selection of a site is of primary importance. Several factors, including the salinity, temperature and dissolved oxygen of the water, as well as pollution, currents bottom type and accessibility determine the suitability of a site. If an area has a natural clam population, that area is probably suitable for farming clams. (In North Carolina, however, leases aren't granted for areas containing a natural clam or oyster bed.) Surges of fresh water should be avoided. Clams require relatively salty water for good survival and growth. Normal clam grow-out requires at least 20 to 30 ppt salinity (about two-thirds the salt content of the ocean). The salinity is more consistent in areas with active tidal flushing and a relatively small watershed. Creeks or rivers draining a large watershed are more likely to produce damaging freshwater influxes. Also, fresh water leaves a large watershed more slowly and prolongs the exposure to low salinities. Adequate tidal flushing ensures mixing of the water, delivers food, removes wastes, and stabilizes the salinity. In general, clams are less tolerant of salinity change than oysters.

The experts generally believe that clams begin feeding when the water temperature rises to 10°C (50°F) in the spring, and stop feeding when temperatures drop past 10°C in the fall. They will grow in temperatures ranging from 18° to 30°C (65° to 85°F). Faster growth occurs in warm water. Hard clams can withstand full sun in summer

and freezing cold in winter for short periods of time. But, keeping clams submerged will eliminate the stress caused by these extremes and probably improve growth. Planting and harvesting, however, may be much easier in an area just above the low tide.

Clams can withstand relatively low dissolved oxygen levels in water, but growth will be poor. At low oxygen levels, the animal must expend more energy for pumping more water through its body to get the necessary oxygen. Therefore, less energy is available for growth. Water will generally contain more dissolved oxygen in an area thoroughly mixed by tides, currents or the wind.

Polluted water should definitely be avoided. Therefore, never attempt to grow clams in water receiving direct discharge from industries, power plants, marinas, sewage plants, refineries or boat works. Bacteria, viruses, chemicals or heavy metals may contaminate the site. Water containing chemicals, such as insecticides or herbicides from farm runoff, should also be avoided. The Division of Environmental Management will provide information about existing discharges into the proposed watershed.

An area for growing clams must have sufficient water exchange to carry wastes away and to bring food in. Too much water flow may scour the bottom and wash the clams away; too little current may result in the deposition of silt which will smother the clams.

Most soils are suitable for clam aquaculture if they are not too acid. The ideal soil is firm, but loose enough for raking. Avoid locations where silt accumulates. Naturally occurring seaweed is harmful only when it reduces water circulation or smothers the clams.

The clam garden site should also be readily accessible. Being able to drive to the leased area is an advantage, but many areas can be reached only by boat. Poaching, vandalism and damage to the site can be minimized by adequate surveillance. If the site can be watched from the home, surveillance is much easier. The bed should never be ignored. If the leased area is checked often, needed repairs can be made and potential problems will be noticed.

Managing the clam garden

Successful clam culture depends upon proper management. Predator control is mandatory for bottom culture in North Carolina. Skates and rays, ducks, geese, toadfish, whelks, mud crabs and especially blue crabs will eat small, unprotected clams. Where practical, crushed oyster shell, pea gravel or crushed stone spread at least four inches thick over the area to be planted will offer some protection because the seed clams will burrow into the material. Rays, however, can use their "wings" to swirl the material off the clams.

Small mesh (one-quarter inch) plastic netting can be erected around or over the bed. The fence must be kept clean to prevent fouling since clogged fencing will reduce water flow through the site. Some crabs will get into the area and must be periodically removed. A protection method should be suited to the chosen location. For example, gravel needs little maintenance and may be the only choice on deeper, constantly submerged beds. But, in many areas, it may be prohibitively expensive or hinder harvesting.

The University of North Carolina Sea Grant Marine Advisory Services agents have tried several methods of protecting growing clams from predators, with emphasis on controlling blue crabs. The most successful method has been plastic mesh covers attached to a frame made from three-eighth-inch concrete reinforcing rods. One-quarter-inch mesh Conwed or Vexar plastic mesh (addresses of sources in appendix) is tied to the welded, rectangular frame. The mesh overlaps the sides of the frame about six inches on each side, providing a skirt. The frame (with mesh attached) is placed on the bottom over the planted clams, with overlapping skirt buried in a trench in the soil around the frame. Several floats can be placed under the cover to keep it off the clams.

Some protected locations may be suitable for raft culture of clams. Apparently, predators are less of a problem and growth is faster in a raft. Clams are planted in trays filled with about four inches of sand or gravel, and the trays are suspended below a floating raft. Similarly, attempts are being made at growing clams in onshore tanks containing sand or gravel. Filtered salt water is pumped through the tanks to provide food and remove waste products.

As stated previously, an area with a natural clam population is probably suitable for clam culture. Try to observe native clams from the proposed growing area to determine if they show favorable growth characteristics. Look for a sharp growth edge. Blunt edges and thick shells are indicative of slow growth.

If no natural clams are present, but conditions appear suitable, you may want to establish a trial planting or a pilot project. An area about four feet by eight feet should be planted with 6,000 to 7,000 seed clams to determine survival and growth rates. The trial planting can also test the predator control method you plan to use. After about two years, the suitability of the site should be evident. The two years involved in the trial growout will provide practical experience managing the clam garden, time for additional study of clam aquaculture, and time to determine and develop markets.

Harvesting and marketing the clam crop are two final considerations required for determining the suitability of a site. The location must be harvestable by means available to you. Most clam beds can be raked, but other harvesting methods, including dredging, may be necessary in some locations. Markets or buyers should be located reasonably close to the site. Because the clam garden contains a captive supply, clam farmers have a marketing advantage over commercial clam fishermen. The clams can be held until prices are high before they are sold. Growers should compare local prices with prices paid by buyers in the northeastern states. If prices are justifiably higher, growers may want to ship their clams to another market for sale. Sea Grant Marine Advisory Services agents (names and addresses in appendix) can provide more specific information about markets.

Appendix

Sources of additional information

The chances for successful clam growing are enhanced by obtaining as much information as possible. Visiting growers, contacting extension personnel, and talking to people in the business provide the most information. Reading and studying can only prepare the prospective grower for actual knowledge obtained through experience. A trial planting of clams will require one-and-a-half to two years to become harvestable. That time can be used to study the subject and determine its feasibility. Listed below are some sources for additional information.

I. Additional reading

A. Books

1. *Practical Shellfish Farming*, P. Schwind, 1977. International Marine Publishing Company, Camden, ME 04843. 91 pp.
2. *Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms*, J. Bardach, J. Ryther, and W. McLarney, 1972. John Wiley and Sons, Inc. New York, NY 10022 868 pp.
3. *Fish and Shellfish Farming in Coastal Waters*, P. H. Milne, 1972. Fishing News (Books) Ltd., 1 Long Garden Walk, Farnham, Surrey, England. 208 pp.

B. Pamphlets and papers

1. Hall, W. R., Jr. (no date). The hard clam. Bulletin No. 12. Sea Grant Communications Office, College of Marine Studies, University of Delaware, Newark, DE 19711. 5 pp.
2. Cook, D. 1978. Culturing the clam—a Virginia innovation. Marine Resource Bulletin, *10*(4). Sea Grant Advisory Service, Virginia Institute of Marine Science, Gloucester Point, VA 23062. 4 pp.
3. Kraeuter, J. and M. Castagna. (No date). An analysis of gravel, pens, crab traps and current baffles as protection for juvenile hard clams (*Mercenaria mercenaria*). Contribution number 832. Virginia Institute of Marine Science, Wachapreague, VA 23480. 12 pp.
4. Loosanoff, V. and H. Davis. 1963. Rearing of bivalve mollusks: Advances in Marine Biology, 1:1-136. Academic Press. New York, NY 10022.
5. MacKenzie, Jr. 1979. "Management for Increasing Clam Abundance" Marine Fisheries Review *41*(10):10-22.

II. Additional personal contacts

A. General clam culture information in North Carolina

1. North Carolina Division of Marine Fisheries, Division of Shellfish Management, P.O. Box 769, Morehead City, NC 28557. (919) 726-7021.
2. UNC Sea Grant Aquaculture advisory service: John Foster, Aquaculture Demonstration Project, Rt. 2, Box 305, Aurora, NC 27806 (919) 322-4054.

3. Central coastal region: Bob Hines, Marine Advisory Services, Marine Resources Center/Bogue Banks, P.O. Box 896, Atlantic Beach, NC 28512. (919) 726-0125.

4. Southern coastal region: Jim Bahen, Marine Advisory Services, Marine Resources Center/Fort Fisher, General Delivery, Kure Beach, NC 28449. (919) 458-5498.

5. Northern coastal region: Hughes Tillett, Marine Advisory Services, Marine Resources Center/Roanoke Island, P.O. Box 699, Manteo, NC 27954. (919) 473-3937.

B. General clam culture information outside of North Carolina.

1. Other coastal states also provide marine advisory service through the Sea Grant Program or the Cooperative Extension Service.

2. A clam production short-course is conducted each year by the Virginia Institute of Marine Science, Wachapreague, VA 23480. It is coordinated by Michael Castagna.

C. Bottom leasing information in North Carolina. Division of Shellfish Management, North Carolina Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557. (919) 726-7021.

D. Permit requirement information in North Carolina. Division of Environmental Management North Carolina Department of Natural Resources and Community Development, P.O. Box 27687, Raleigh, NC 27611. (919) 733-7051.

III. Material suppliers

A. Clam seed suppliers

1. North Carolina Shellfish Enterprises, Mr. Joe Fulcher, Box 277, Harkers Island, NC 28531. (919) 728-2160.

2. Mr. Alton Chadwick, Box 101, Marshallberg, NC 28553. (919) 729-9391.

3. Aquacultural Research Corporation, Mr. Richard Loring, P.O. Box 597, Dennis, MA 02638. (617) 385-3933.

4. Shellfish, Inc., West Sayville, NY 11796. (516) 589-5770.

5. International Shellfish Enterprises, Inc., P.O. Box 201, Moss Landing, CA 95039. (408) 633-3063.

6. Sea Plantations, Inc., 29 Congress Street, Salem, MA 01970. (617) 745-4560.

7. LeBleu Enterprises, 844 17th Avenue, Santa Cruz, CA 95062. (408) 476-9497.

8. Shelter Island Oyster Company, Sterling Avenue, Greenport, NY 11944. (516) 472-1170.

B. Plastic mesh (one-quarter-inch) for predator control

1. Conwed Corporation, P.O. Box 43237, St. Paul, MN 55164. (612) 221-1100.

2. DuPont Company (Vexar netting), 724 Bank of Delaware Building, Wilmington, DE 19898. (302) 774-4758.

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