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SOFT AND HARD CLAMS OF THE ATLANTIC COAST OF THE UNITED STATES

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VALUE OF THE FISHERIES

Among the commercial mollusks of the Atlantic Coast of North America two species of clams occupy a position which is second in importance only to that occupied by the American oysters. These two mollusks are commonly known as the soft clam (Mya arenaria), and the hard clam (Venus mercenaria). The clam fisheries yield approximately 30 million pounds of meat annually valued at nearly $3,000,000 (Table 1). Only about 10 percent of the total catch is supplied from privately leased areas, while the rest comes from uncultivated public bottoms. If proper methods of clam cultivation were practiced in all the areas suitable for clam culture, it is estimated that the annual production of clams of both species could easily be increased to 50 or 60 million pounds or perhaps more, and steady employment and a good income would be assured to many persons engaged in clam farming.

Because of the differences in the distribution and habits of the two species of clams, it is more convenient to discuss them separately.

SOFT CLAM

Distribution and Habitat

The soft clams (Mya arenaria) are called also "soft-shelled clams," "long-necked clams," and "long-clams". Along our Atlantic Coast they are found from South Carolina to the Arctic Ocean. These animals are very abundant along the Coast of New England, especially in Maine and Massachusetts, but are rarely encountered south of Cape Hatteras (Table 1). This species is found also in some sections of our Pacific Coast, where it was introduced in the middle of the last century.

Soft clams live on tidal flats and beaches of harbors, inlets and bays. Usually their beds are confined between low and high water marks, but some deep-water colonies are known to exist. Clams live in various types of bottom soil, ranging from rocky gravel to soft mud. They stay in burrows beneath the surface of the soil, protruding their necks, or siphons, above the mud to feed upon minute plants and animals present in the water flowing over the mud flats.

Natural History

Reproduction. - The sexes in adult clams are separate, and males and females occur in approximately equal numbers. In New England waters most of the young clams are ready for their first spawning in the early summer, when they are about 1 year old. Some individuals, living in very favorable surroundings, may spawn when they are about 4 months old.

Soft clams begin spawning in the spring and early summer when the water temperature reaches 55.0 or 60.0°F. Along the New Jersey Coast this occurs during May and early June; in Long Island Sound and Narragansett Bay, in June; around Cape Cod, in June and July; and north of Boston, late in July. The spawning season lasts about 3 months in Massachusetts, and from 4 to 6 months in New Jersey.

Like many other mollusks of this group, the soft clam is very prolific, being capable of discharging millions of eggs each summer. The egg is white in color and spherical in outline. Its size is approximately 1/387 of an inch. Insemination of the egg takes place in the water outside the clam's body. Within 10 or 12 hours after insemination the egg develops into a small free-swimming animal, called a larva. In 10 to 14 days, depending on the temperature of the surrounding water, the free-swimming stage is completed, and the larva changes into a young clam, which settles down and attaches itself to various objects on the bottom, such as grains of sand, broken shells, or sea grass. This is known as clam set, and the young animals are called "seed clams". Later on, when the clam reaches the size of about three-quarters of an inch, it loses its organ of attachment and becomes capable of burrowing into the bottom soil which becomes its new habitat.

Growth. - The growth of clams depends upon an abundant supply of water, character of the bottom soil, and the temperature of the water. A fair circulation of water over the clam bed is needed to supply food organisms, such as algae and diatoms, and oxygen dissolved in the water which is necessary for the life of the clam. Tidal current also helps

to keep the bed clean by carrying away products of decomposition, thus preventing contamination of thickly populated beds. Clams grow in water, the salinity of which may range from 8 to 28 parts per thousand. Usually their tolerance to changes in salt content of the water is very great. The best soil for clams is a mixture of fine sand with some mud. However, these animals will live in every kind of soil, except very soft mud or shifting sand.

Clams grow more rapidly in waters having a higher temperature. Therefore, their growth is more rapid along the coasts of New Jersey and southern New England than north of Boston. Nevertheless, in the latter zone, the animals may reach a marketable size of more than 2-1/2 inches in 1-1/2 or 2 years. Clams grown under favorable conditions in Massachusetts waters were known to reach an average size of 1.0, 3.3, 3.8, 4.1, and 4.5 inches at the end of the 1st, 2nd, 3rd, 4th, and 5th years respectively. In some localities clams grow during the entire year, but as a rule the most rapid increase in growth is noted in July, August, and September. The length of a clam's life is uncertain but is estimated to be at least 10 or 12 years.

Enemies. - The most destructive enemy of the clam in northern waters is the winkle or cockle (Neverita duplicata), which kills the clam by boring a hole through the shell. The lady crab (Ovalipes ocellatus) and the blue crab (Callinectes sapidus) kill and devour a large number of small clams. The horseshoe crab (Limulus polyphemus), which is found from Maine to Mexico, burrows through clam flats, uprooting the animals from the soil and eating a large number of them. Other varieties of crabs also attack and eat clams, especially young ones. Starfish and oyster drills are known to kill the young animals before they burrow into the ground. However, these two enemies cannot damage the buried clams.

Cultivation

At present little cultivation of clams is conducted along the Atlantic Coast. Nevertheless, limited attempts carried on in Massachusetts and Rhode Island demonstrated that the cultivation of clams, if properly practiced, will insure considerable return to persons engaged in this business. Because of the hardiness of the clams and their ability to withstand varied conditions, the cultivation of soft clams may be successfully undertaken in almost any protected areas situated north of New Jersey. Many areas, which at present are barren or devoid of these animals, can be converted to clam-growing farms with comparatively little effort. Utilization of such areas would result in an increased supply of clams for the market, and in the conversion of thousands of acres of unproductive bottoms to a source of revenue for clam cultivators. It is estimated that an acre of average clam flat, if properly cultivated, will bring a return of $500 per year, and some very productive grounds may yield as much as $800 per acre annually. Therefore, a man cultivating a small clam farm, between 1-1/2 and 2 acres in area, may expect to derive therefrom a gross income amounting to between $650 and $1,000 per year.

In establishing a clam farm foremost consideration should be given to the selection of the flats which are to be used for the cultivation. A good flat should have compact soil which, nevertheless, would permit

comparatively easy digging. A mixture of fine sand and mud in the ratio of 2 parts sand and 1 part mud is considered the most desirable soil. Care should be taken to note whether or not the soil of the flat is shifted by wave action. Areas where such shifting occurs should be avoided, because shifting sands would bury some of the clams too deep, while others would be washed out of their burrows. Since the growth of clams depends to a large extent upon the circulation of water, it is desirable to have the flat located where there is a good current. Soft clams should be planted at a level which affords a reasonable time between tides for digging the clams and cleaning the grounds. The clam farm should be far removed from any sources of domestic or industrial pollution.

The ground for a farm should be chosen near the areas where a natural set of young clams occurs. Such regions of heavy set are usually found in almost every kind of inlet or bay. Proximity of natural setting areas will eliminate the difficulties of transporting young clams a long distance. Because small clams are extremely fragile many of them may be damaged during transportation. Unfavorably high temperature also may cause considerable mortality among young animals. The best method of shipping seed clams is by packing them in boxes or barrels with damp seaweed. Pieces of ice placed on top of the barrel and covered with burlap will keep young clams in good healthy condition, assuring their survival.

Before the young animals are planted in their new surroundings care should be taken to prepare the ground for their arrival. Eelgrass and other thickly growing plants should be removed, and the grounds should be cleared of all clam enemies, such as cockles and horseshoe crabs. Sometimes it may be necessary to provide drainage of the flat to avoid the formation of small, stagnant pools. Raking the surface of the soil sometimes facilitates the burrowing of seed clams.

The planting of seed clams consists merely of sowing these animals upon the surface of the flat. When covered by the next tide, young clams will burrow rapidly into the soil and require no further attention. If it seems probable that the animals sown on the flats may be rolled by the wave action, it is advisable to plant them at half tide when the water is several feet deep, so that they will have enough time to burrow before the flat is exposed. The beds of growing clams should not be disturbed, unless they are too thickly planted and it becomes necessary to reduce the population. Only a limited number of individuals to the square foot of bottom can grow without competing with each other for food and space. Planted clams require little attention with the exception of protecting them from their natural enemies.

Experimental and practical work showed that artificial methods of seed-clam collecting rarely justify themselves. Usually the natural set is quite sufficient to supply planters with seed clams. The following methods may be recommended for the gathering of seed clams in the areas of heavy natural set: Digging the set in shallow water in such a manner that the clams will be washed out of the soil by the tide; making trenches across thickly set flats into which the clams will be washed by the action of the tide and wind; in extremely heavy setting areas, gathering both soil and clams and transporting to the planting grounds; sifting the clams from the sand by using wire mesh of a sufficiently large size to retain

the clam but allow the particles of sand and mud to go through. Digging the flats just prior to the setting of clams very often proves helpful in catching better clam sets.

The time for harvesting clams depends upon the size of the animal and the existing demand. Since the greatest growth of clams takes place during the summer months, it may be profitable not to disturb the bed during that period, but to start harvesting in the fall. An additional advantage of this method is that small clams set in the summer will, by the time of harvesting, burrow into the soil and be somewhat protected from being trampled on by men digging the flats.

HARD CLAM

Distribution and Habitat

The hard clams (Venus mercenaria) are found from Maine to Florida, being most abundant along the shores of Massachusetts, Rhode Island, New York, New Jersey, and Virginia. Clam fisheries of considerable extent exist also in North Carolina and Florida (Table 1). In the New England States these clams are called "quahaugs" or "quohogs," while in New York and in the South they are known as "hard clams," "hard-shelled clams," "round clams" or "little necks". They live in the zone extending from almost high-tide level to a depth of over 50 feet, being most common on flats located several feet below the low-water line. Because of their ability to exist on almost every kind of bottom and within a very wide depth range, the possibilities of developing extensive hard-clam farming are very promising. The proper utilization of vast shore areas suitable for the cultivation of clams would result in a much greater production of these shellfish.

Natural History

Reproduction. - In hard clams the adults are, with few exceptions, of separate sexes, and males and females are represented in virtually equal numbers. Almost all young clams first develop as males, but later, usually during the second year of life, approximately half of their number becomes female. Some young animals may spawn at the age of 3 or 4 months, but the majority spawn when 1 year old.

Hard clams begin spawning in the summer when the water temperature reaches about 73°F. In southern waters this happens earlier, and the spawning season is of longer duration than in northern States. Millions of eggs can be discharged by a single female clam in one season. The eggs are slightly larger than those of the soft clam, being 1/325 of an inch in diameter. The early development closely resembles that described for the soft clam. Setting occurs at the end of 10 or 14 days, depending upon the temperature of the surrounding water. Upon reaching a size of 1/8 to 1/4 of an inch the young clams burrow into the bottom soil. Although the clam possesses the power of crawling through the sand, it moves but little, and may be regarded as a stationary animal.

Growth. - The rate of growth of the clam is considerably affected by the types of current, depth, salinity and temperature of water, and composition of bottom soil. As mentioned in the case of the soft clam, a good current of water is needed to provide clams with food and oxygen, and keep the beds clean. Hard clams can feed only when covered with water. Clams living near a high-tide level are exposed daily for long periods, during which time they do not feed. Retardation in growth, due to loss of feeding time, is the usual result. The natural clam beds are found in brackish water the salinity of which ranges from about 10 to 28 parts per thousand. Clams are well adapted to tolerate daily fluctuations in salinity which usually occur in the water covering the beds located near river mouths, or in bays and harbors.

Like many other mollusks of the same group, hard clams grow more rapidly in warmer regions than in the North where the water temperature drops almost to the freezing point during the winter months. The majority of clams enter into the inactive stage in the fall, when the temperature decreases to about 42°F. and remains in such a state until the next spring. Therefore, in northern waters the animal grows only from May to the middle of November. The fastest growth is achieved during the second part of July, in August, and in September. The rate of growth varies in different localities, but is, as a rule, slower than that of oysters or soft clams. In New England waters the average size of hard clams, attained at the end of their first growing period, is usually less than a quarter of an inch. Their size increases to about 1.1, 2.0, 2.5, 3.0, and 3.2 inches at the ages of 1 1/2, 2 1/2, 3 1/2, 4 1/2, and 5 1/2 years respectively. Hard clams measuring 5 1/2 inches in size occasionally are found. The age of such large animals is estimated to be between 20 and 25 years.

Enemies. - The cockles (Neverita duplicata and Polinices heros), and the conches (Fulgur caniculatus and F. carica) are the chief enemies of hard clams. Cockles attack the clam by perforating its shell in the region of the umbo, the part which may sometimes be projecting over the mud. The conches are capable of breaking the shells of the clam. When an appreciable crack is formed the conch inserts its long tongue into the shell and eats the clam. Starfish readily attack and devour clams that are lying on the bottom, but are not dangerous if the clams are in their burrows. Young clams may be destroyed in large numbers by water fowl, and possibly by some bottom-feeding fish.

Cultivation

The present supply of hard clams that reaches consumers is considerably less than our coastal waters can produce. The ever existing demand and the high prices paid for them testify that the supply of clams for the market should be materially increased. Such an increase can be achieved by the application of cultural methods on a very broad scale.

The cultivation of hard-shell clams may be rendered a very profitable and dependable business, provided some fundamental rules are observed in selecting the ground for the farm and in taking proper care of it. It has been estimated that a hard clam farm can yield as much as 600 bushels of 2 1/2-inch clams per acre annually. At the current price of $3 to $4 per bushel the yield would be sold for a sum ranging from

$1800 to $2400. The original investment in the hard-clam farm, and the labor necessary for the cultivation and gathering of the clams for the market, is comparatively small. The clam farm requires much less care than the agricultural farm but offers far more profit.

In choosing the location for the farm the planter should select one where good circulation of water persists, and where the nature of the bottom soil is such that it will support the clams. A farm located between the tidal lines or close to the low-water mark is an uncertain investment as there is always danger of the destruction of clams during a severe winter. It is preferred, therefore, to plant clams on flats which are covered with at least 3 feet of water at low tide. The farm should be located away from all sources of industrial or domestic pollution. Well protected areas are preferable to open water because, in the latter case, the wind and rough water may result in loss of stock and will considerably increase the amount of labor involved. If possible, the farm should be located near regions where seed clams may be readily obtained.

Although the set of hard clams is usually less abundant than that of soft ones, it may be gathered and transported in large quantities by using the methods described for the soft clam. The planter can also catch a considerable number of seed clams on his own grounds by simulating the natural conditions of the areas where the setting of clams usually occurs.

Little work is needed to prepare the ground for planting. It consists of the removal of thick grass, stones, and other debris which would interfere with the raking of clams, and of the destruction of the enemies, such as cockles, conches and starfish. The young clams may be scattered evenly from a boat by shovels. Usually young clams will burrow in the sand a short time after they have settled to the bottom. As clams are not active at low temperature, it is not advisable to plant them in cold weather when, instead of burrowing, they will lie on the surface exposed to attack by their enemies. The number of seed clams that can be planted on any given area will depend upon the natural conditions, chiefly the current. When circulation of the water is good, as many as 25 seed clams can be planted per square foot of the bottom. Little labor will be required to take care of the farm after the seed clams are planted. If left undisturbed, they will grow until they attain a marketable size. At times, however, it may be necessary to clean the grounds of seaweeds and destroy the enemies.

It may be convenient to divide the clam farm into sections according to the size of the planted seed. By dividing the ground and planting seed clams of different sizes the planter can maintain a well organized farm which will permit him to place clams of a uniform size on the market without culling his catch.

Food Value of Clams

The edible portion of soft clams constitutes from 33 to 36 percent of the total weight, and that of hard clams is from 16 to 19 percent. In this respect both species of clams compare favorably with the oyster, the meat portion of which constitutes 6 to 13 percent of the total weight.

Table 1.- Catch of hard and soft clams of the Atlantic Coast States, 1940

State	Soft Clam				Hard Clam			
	Public		Private		Public		Private	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Pounds
Maine	6,278,500	$ 266,571	-	-	5,000	$ 425	-	-
New Hampshire	403,200	50,720	-	-	-	-	-	-
Massachusetts	8,412,100	811,563	186,000	$20,575	2,411,100	336,251	-	-
Rhode Island	75,000	6,105	-	-	1,537,000	197,308	441,000	$ 40,003
Connecticut	28,200	4,580	-	-	59,000	9,734	-	-
New York	436,900	36,495	-	-	2,171,400	391,510	636,300	87,290
New Jersey	780,400	47,357	-	-	2,150,200	308,504	216,100	31,597
Delaware	-	-	-	-	24,000	3,075	9,400	1,305
Maryland	-	-	-	-	78,900	17,250	-	-
Virginia	-	-	-	-	1,704,100	343,460	60,000	9,000
North Carolina	-	-	-	-	530,200	45,067	-	-
South Carolina	-	-	-	-	2,900	203	-	-
Florida	-	-	-	-	707,800	67,368	-	-
Total	16,414,300	1,223,391	186,000	20,575	11,381,600	1,720,155	1,362,800	169,195

	Pounds	Value
Total, soft clam	16,600,300	$1,243,966
Total, hard clam	12,744,400	2,249,350
Total, both species	29,344,700	3,493,316

A bushel of soft clams in the shell yields about 16 pints of clam meats. The yield of hard clams is approximately 12 pints per bushel, while a bushel of good oysters yields only 8 pints. A bushel of sea mussels yields 15 pints of meat.

Like all mollusks of this group, the two species of clams contain large quantities of nutritive substances necessary for a balanced diet. The content of proteins, carbohydrates and minerals is considerably higher in clam meats than in the oyster, which is considered a very nutritious food. The meat of clams contains iodine, which is necessary for the normal activities of the thyroid gland. Other elements found in the clam meats, such as iron and copper, are needed for the proper composition of the blood. Because of this, clams are often prescribed for anemia and other disorders. Although the exact vitamin content of clam meats has not been determined, it is believed that they, like the oyster, contain most of the essential vitamins, such as A, B, C, D, and G. They also contain relatively high quantities of phosphorus and calcium, which are necessary for normal development and growth of the human bones. Clams are sold in a fresh condition, or are canned as whole or minced clams, or as chowder or clam cocktail.

Sanitary Control

Clams, like all other shellfish that can be eaten raw, are subjected to rigid sanitary regulations and inspection exercised by the Federal and State health authorities. The laws prohibit the removal of clams from areas which do not meet definite standards of purity. Clams gathered from certified areas and opened at shucking houses are again examined, and must comply with bacteriological and chemical standards set forth by the health authorities. Employees of the shucking houses must undergo frequent medical examination. Persons found suffering from contagious diseases are not permitted to handle fresh clams. The shucking houses and their equipment also are inspected periodically by municipal and State sanitary authorities.

Regulation of the Clam Fisheries

The virtual lack of cultivation of both species of clams can be ascribed directly to obsolete State and town regulations and laws, which neither permit the leasing of many intertidal and shallow water areas to private interests, nor offer sufficient protection to the clam farmers. The principles upon which shellfishery laws are founded are somewhat different in each State. In general, however, these laws recognize the so-called free fishing rights of the public, according to which the right of gathering shellfish in an intertidal zone and even in deep water within the geographic limits of townships is open to any inhabitant of the State or town. Under such conditions leasing of flats in intertidal zones and shallow water becomes impossible. Obviously clam culture can never be developed on a very large scale until the laws are changed to permit leasing of bottoms suitable for clam cultivation, and clam planter's beds are protected from trespassers.

Nevertheless, regardless of unfavorable laws, in almost each State there are limited possibilities for leasing certain bottom areas which may be suitable for clam culture. Persons interested in obtaining such leases should write for information to the State authorities in charge of shellfisheries.

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