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JAPANESE METHODS OF OYSTER CULTURE

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INTRODUCTION

Oyster culture in Japan dates back to the early history of the country. Food from the sea was extremely important because of huge populations concentrated along the narrow coastal plain. Here oyster culture has been tried in many ways and examples of the most primitive to very advanced methods are to be seen. The abundance of labor makes possible methods which would be unprofitable elsewhere, and yet in these methods may exist an idea which, if properly applied, would solve problems in other parts of the world.

Oysters are grown practically along the entire coast line of Japan, but the industry centers in the following favorable areas:

1. The great shallow bays among the Matsushima Islands near Sendai in northern Honshu are wonderfully adapted to oyster culture. These waters are rich in the foods needed by larval oysters making this area a center of seed production.
2. Thousands of acres of bottoms in Tokyo Bay produce oysters but never in sufficient quantity to meet the great demand.
3. The Inland Sea, including the waters in front of Hiroshima, is the oldest center of oyster culture in Japan. Warm protected waters and great expanses of tidelands combine to make this area a large producer of oysters.
4. Matoya Bay and the many other inlets near Nagoya are admirably suited to the culture of food oysters as well as pearl oysters.
5. Yatsushiro Bay in Kumamoto Prefecture on the island of Kyushu also produces many oysters.

Two general methods of oyster culture are used in Japan; those in which the oysters are placed upon the bottom, and those in which the oysters are suspended above the bottom. Each method has certain advantages and disadvantages as described below.

BOTTOM CULTURE

MATSUSHIMA ISLANDS: Among the Matsushima Islands in Miyagi Prefecture in northern Honshu, the tidal range averages about four feet and the depth at low tide is less than ten feet. Oysters are grown at the bottom from natural seed or from planted seed in the same manner as along our Atlantic Coast. Harvesting is done exclusively with small hand tongs. Few oysters are produced by this method principally because of the predations of oyster drills and starfish.

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Note: This report is based upon observations made while the author was in Japan in 1947 and 1948, representing the State of Washington Department of Fisheries and the Pacific Coast Oyster Growers Association in the inspection of seed oysters which were being exported to the United States.

TOKYO BAY AND INLAND SEA: In these areas the tidal range is greater than in Miyagi Prefecture, exposing large areas of tidelands at low tide. Seed oysters attached to scallop, oyster, abalone, or clam shells are placed upon the beach. Predators are hand picked from the beds and the oysters are moved from growing grounds to fattening grounds before marketing. Harvesting is done at low tide by hand. In many ways these methods correspond to those used along our Pacific Coast.

YATSUSHIRO BAY: The bottom of this bay in southern Kyushu is largely soft mud. During the summer, it is exposed to severe typhoons which make oyster culture very difficult. This area also has a greater tidal range than in northern Honshu.



FIGURE 1 - HARVESTING OYSTERS IN YATSUSHIRO BAY, KUMAMATO PREFECTURE.

Seed oysters are obtained here by placing round stones $2\frac{1}{2}$ to 4 inches in diameter on the bottom at the mouth of a small river where spatting is good during May. The stone cultch with the attached oysters is left in this protected location until the typhoon season is over and then taken by small boat to the growing grounds.

The stones are placed upon the bottom in parallel bands about five feet wide with a space of about six or seven feet between the rows. Years of placing the stones in the same bands has built up the level of the bottom and has left channels between the rows.

In September or October of the second year when the oysters have grown to marketable size, the Japanese oystermen bring small open boats through the channels and fill them with oysters, for transfer to fattening grounds. The growing grounds are at a medium tidal level, but fattening grounds are at a low level where oysters are exposed only at extreme low tide.

After 2 or 3 months, the oysters are harvested by raking them onto small wire-covered frames which are then agitated to wash the mud from the shells. The oystermen wear rubber waders and work in water as deep as three feet. (Figure 1.) This primitive method is very slow and laborious as the rocks are included with the oysters and must be handled many times. The stones are saved and are again placed in the water as cultch during the following summer.

However, stone cultch has two advantages: it stays in place during typhoons, and it holds the oysters up above the mud.

RACK CULTURE

Oyster drills and starfish cause great mortalities among oysters grown upon the bottom. Others are smothered by silt.

To reduce these losses, the oysters are suspended from racks, or fences are built in the lower half of the intertidal zone. Most of these fences consist only of posts about eight feet apart with one horizontal pole placed on top.

The seed oysters are attached to old oyster shells which have a hole through the middle. These shells are strung on wire or tarred straw rope and held 6 to 8 inches apart by bamboo spacers or by twisting the strands of rope. The strings of seed are attached to the horizontal poles on the racks and must be short enough to clear the bottom by several inches. The oyster drills and starfish which crawl upon the bottom and cannot swim are thus kept away from the young oysters.

The principal difficulty with this type of culture is that these oysters become extremely heavy as they approach market size. This bends the poles and forces the posts deeper into the mud bottom. Soon the lowest oysters are touching bottom and predators are able to attack the oysters.

The advantage of rack culture is the rapid growth rate of the oysters placed above the bottom. The drills are mainly an enemy of the younger oysters so that rapid growth reduces the time during which they are attacked.

RAFT METHOD

In the protected bays among the Matsushima Islands of Miyagi Prefecture and in Matoya Bay near Nagoya and in other suitable locations, oysters are grown without ever touching bottom.

Seed oysters are obtained by punching holes in old oyster, scallop, or abalone shells and stringing them upon wires about 6 feet long. Scallop shells are usually preferred because of their large size. These strings of shells are draped over fences similar to those used in rack culture of oysters or suspended from rafts during the spawning season (Figure 2). Larval oysters attach to these shells in great numbers.

In the autumn, the strings of shells are removed from the rafts or racks and placed horizontally upon wide "hardening" racks built about 18

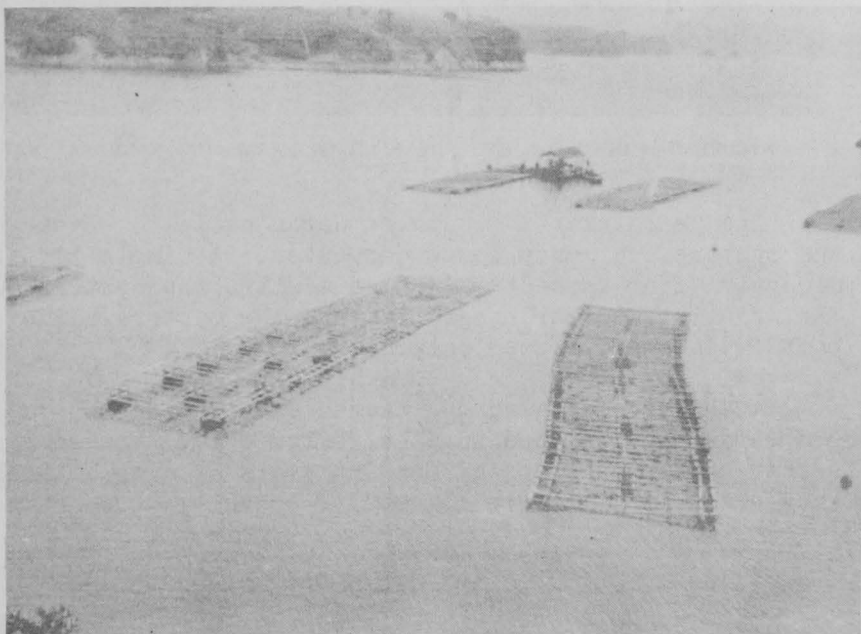


FIGURE 2 - OYSTER CULTURE RAFTS ARE ANCHORED IN DEEP PROTECTED BAYS.

inches above the beach in the intertidal zone (Figure 3). The seed oysters remain upon these racks until the following spring when they are taken ashore and shipped to the growing areas (see front cover page). Seed from Miyagi Prefecture is sent all over Japan by methods similar to those used in exporting seed to the United States.

At the destination, the shells with spat attached are strung on wires about 10 feet long with a 6- to 8-inch bamboo spacer between each shell.

Rafts are supported by tarred wooden barrels or old oil drums held in place by an open pole framework. The strings of seed are attached to the rafts at about two foot intervals and the rafts are anchored in deep enough water so that the oysters will never touch bottom. (Figure 5)

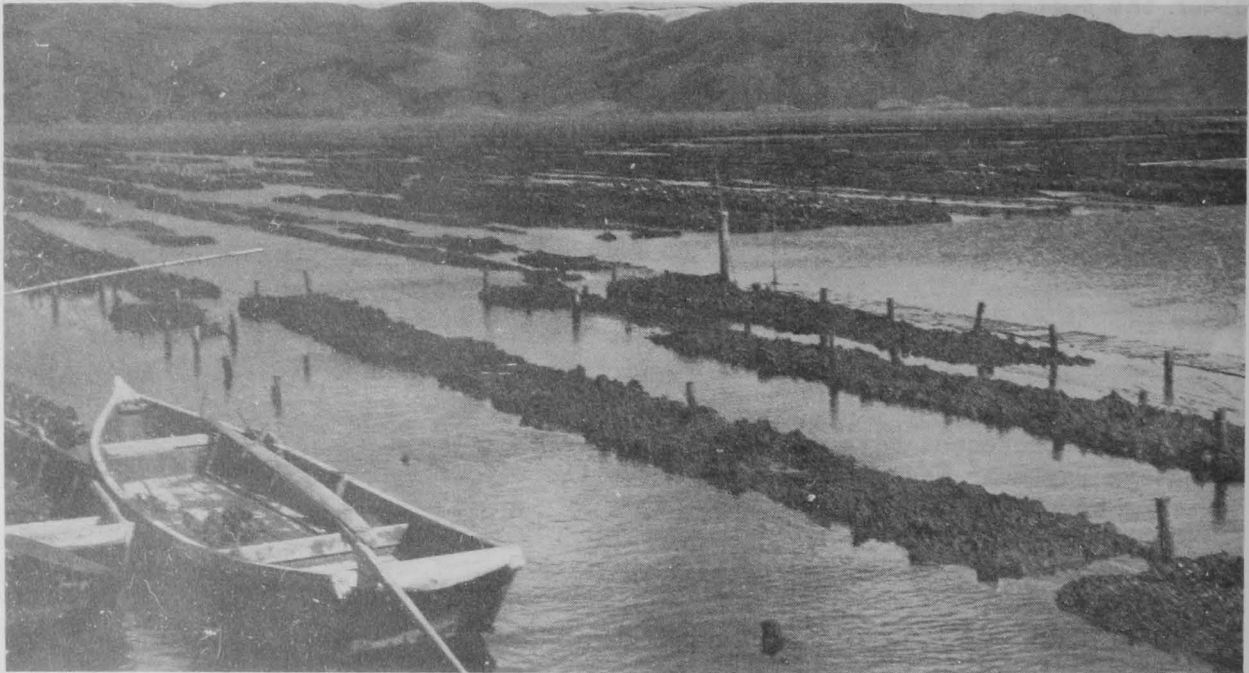


FIGURE 3 - SEED OYSTERS ARE HELD ON HARDENING RACKS AT WATANOHA THROUGH THE WINTER.

One year later in southern Japan or $1\frac{1}{2}$ to 2 years later in northern Japan, the oysters are ready to be harvested. A simple "A" frame is placed on a boat or directly upon the rafts and used to lift the oysters out of the water. (Figure 6). The wire is cut near the bottom and the oysters slide into the boat. Wires and bamboo spacers are used only once.

A shortage of wire has caused many growers to substitute two strands of tarred straw rope twisted together (Figure 4). The shells bearing the spat are inserted between the strands at intervals of 6 to 12 inches and as the oysters grow they are held firmly in place.

GROWTH RATE AND REDUCTION

The Japanese claim that oysters grow much more rapidly suspended from rafts than they do on the bottom even when they are covered by water at all times.

Ordinarily oysters raised on the bottom in Miyagi Prefecture reached marketable size in 3 years. Raft-cultured oysters, however, are harvested after $1\frac{1}{2}$ to

2 years. Seed oysters are caught in July and August and are hung from rafts the next April. By the following December to May, the oysters are ready to market.

In southern Japan similar Miyagi seed, hung from rafts in April, is harvested the following November. Local seed caught in Matoya Bay in July and suspended from rafts immediately is harvested the following May.

Oysters are marketed when about 3 inches long and are usually shucked and sold fresh. Lack of transportation facilities limit the fresh oyster market to the vicinity of the beds and some oysters are salted, dried, or smoked.

Production per-unit-area of the raft method of oyster culture is extremely high. Each 10-foot string produces about $\frac{3}{4}$ bushel of marketable oysters. Strings are spaced on 2-foot centers and rafts are tied end to end. Production on this basis can exceed 8,000 bushels per acre per year. This immense production is accomplished by utilizing the third dimension of depth.

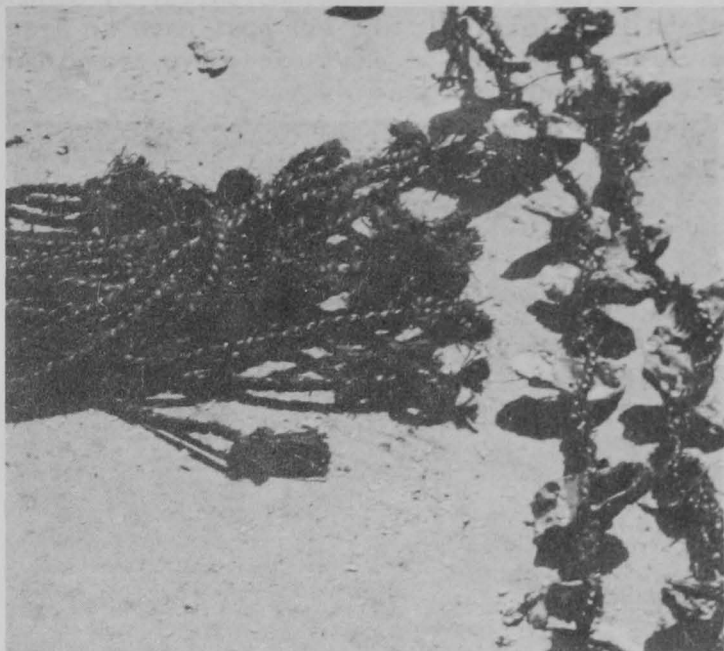


FIGURE 4 - OYSTER SHELLS BEARING THE SPAT ARE INSERTED BETWEEN STRANDS OF TARRED STRAW ROPE.



FIGURE 5 - STRINGS OF SEED OYSTERS ARE SUSPENDED BELOW RAFTS AND NEVER TOUCH BOTTOM.

ADVANTAGES AND DISADVANTAGES: In Japan where space is at a premium and labor costs are low, the raft method is very successful. Predations from crawling snails and starfish are eliminated, mortality by smothering of spat on the under side of cultch is eliminated, and all spat have an even chance to grow. More oysters can be raised per shell without excessive crowding because they can grow downward as well as outward and upward.

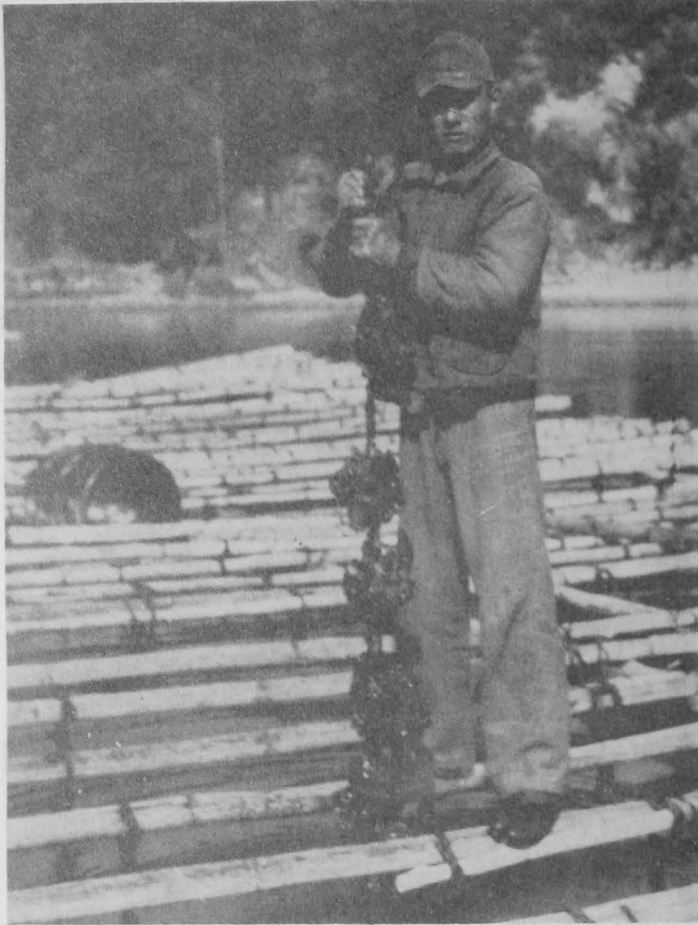


FIGURE 6 - AT THE END OF 1 OR $1\frac{1}{2}$ YEARS, THE RAFT-CULTURED OYSTERS ARE READY FOR MARKET.

Oysters are held in warmer, less saline, and more nutritive layers of water close to the surface and growth is very rapid. Harvesting is simplified and can be done at any tidal stage.

Barrel floats for the rafts which are removed and tarred each spring will usually last 3 or 4 years. The pole framework is not underwater and lasts for many years. Poles are easily obtained on the hills adjacent to the oyster growing areas with low-priced labor.

The principal disadvantage to this method of oyster culture in Japan is that severe storms will break apart the rafts. A recent tidal wave smashed over 50 rafts in one bay and, therefore, raft culture is confined to the deep protected inlets along the coast.

APPLICATION IN UNITED STATES: In the United States raft culture of oysters is being experimented with near

Vaughn, Washington. Vaughn Bay is a narrow branch of Puget Sound which is protected from storms. The rafts are constructed of a fir-pole framework and supported by oil drums. Strings of oysters are suspended from horizontal monel metal wires which are stretched across the rafts. Seed shells are strung on #12 galvanized wires about 8 feet long.

Instead of using bamboo spacers between the seed shells, one complete loop of the wire is made at 6-inch intervals, which separates the shells (Figure 7).

The seed oysters used in this experiment were imported from Kumamoto Prefecture on the Island of Kyushu, and produce smaller oysters than seed from northern Japan. These tasty oysters, which have been named the "Washington Oyster", are expected to fill the demand for a small white oyster for the cocktail or half-shell trade. They become fat and marketable at a diameter of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches and because of their deeply capped shells, produce more meat than northern Japanese oysters of similar diameter.

Since the "Washington Oysters" are a specialty product, it is expected that raft culture will be profitable in spite of the extensive hand labor involved.

Further commercial application of the raft method of oyster culture on the West Coast will probably be confined to specialty products for the present.

At some future date when all of the tidelands and shallow bottoms are utilized to the maximum, it will still be possible to increase production by anchoring oyster rafts offshore. Many small protected bays in Puget Sound have steep beaches and therefore only a small acreage of oyster lands. These productive inlets are admirably suited to the raft method of oyster culture.

It is also possible that the ingenuity of the American oyster industry will develop better and more economical methods so that floating oyster culture can compete with conventional procedures.



FIGURE 7 - EXPERIMENTS WITH RAFT CULTURE AT VAUGHN, WASH.

