

It is a fact that foreign producers have designs to meet the long-standing shortages of the American market. Reports from Japan indicate that Japanese producers, and some Americans who have invested in Japanese oyster enterprises, are gearing for the American market. In at least one instance, a mass processing plant has been constructed to conform in operation to our standards of sanitation. A new technique for packaging and preserving frozen oysters for the American market has been developed. Once foreign oysters have entered the domestic market in quantity and obtained a competitive foothold, the domestic producer will be faced with another serious handicap.

Within the light of these circumstances, it is incumbent on oyster producers, utilizing findings from biological and technological research, to immediately and aggressively undertake to improve production and marketing methods, and increase production to meet market demands and competition from imported oysters.

The Future of the United States Oyster Industry From a Biologist's Viewpoint

JOHN B. GLUDE

*U.S. Bureau of Commercial Fisheries
Washington, D.C.*

OYSTERS ARE ONE OF OUR GREAT NATURAL RESOURCES and the oyster industry is one of the oldest in the United States. It is a variable industry, ranging from a wild fishery upon natural stocks of oysters to highly specialized farming carried out on private lands.

Many adversities face the oyster industry and cause speculation about the future of the resource and those individuals and companies engaged in it. The following discussion is an attempt to consider the biological aspects of the oyster industry; leaving to others the problems of processing, marketing, sociology, politics, and economics.

How can we predict the future of this sprawling industry which is spread over every coastal State, which uses many different methods, and has various local problems with little in common except the final product? Logically, we should examine the past to indicate trends. We should look closely at the present for today's problems are the best known, but with care lest we over-emphasize their importance. Finally, we should look to the future in the light of our experience in the past, the present status and the hopes and problems which we can foresee.

The Past

Production trends on the Atlantic coast have been downward from peaks which were reached many years ago; yet in other places the reverse is true. For example, the Pacific oyster industry, which began less than 30 years ago, now has a stabilized production of over 10 million pounds of oyster meats per year. Production in the Gulf States has varied from year to year but this area continues to produce a substantial share of the nation's oysters.

The Present

These present problems of the oyster industry appear to be almost insurmountable:

1. *Decrease in Areas Suitable for Oyster Production.* Narragansett Bay, Rhode Island, for example, was once a major center of oyster culture in New England. At the present time it produces no oysters despite repeated attempts to gather seed and to grow seed transplanted from other locations. Although the exact causes are not known, it must be concluded that this area is no longer suitable for oyster production. Development of coastal and estuarine areas for industry, recreation or residential purposes has already destroyed many areas which were suitable for oyster production. This trend will certainly continue.
2. *Oyster Predators.* Hordes of starfish from the dominant 1957 year class have almost destroyed the oyster industry of Long Island Sound. Oyster drills in Long Island Sound and the saltier part of the Delaware Bay and coastal bays of Maryland and Virginia are a serious deterrent to economic oyster culture. Other species of oyster drills in the Gulf of Mexico and in the Northwest likewise cause serious losses of small oysters.
3. *Mass Mortalities of Oysters in Delaware Bay, Coastal Delaware, Maryland and Virginia and Chesapeake Bay.* Major losses have occurred since 1957. Although cooperative research is under way, the exact cause of these mortalities has not been determined.
4. *Oyster Mortalities Caused by the Fungus Dermocystidium.* In the Gulf of Mexico and in the warmer waters of the Atlantic coast this parasite kills a large percentage of the oysters each year.
5. *Shortage of Seed Oysters.* North of Virginia the industry is limited by a shortage of seed oysters since reproduction is less dependable than it is in the South Atlantic and Gulf States.
6. *Control of Mud Shrimps in the Northwest.* Recent increases in abundance of mud shrimps *Callinassa* and *Upogebia* have caused the destruction of many acres of valuable oyster land in Washington. These pests burrow through the bottom, making it too soft for oyster culture and increasing the deposition of the silt over the oysters.
7. *Unexplained Oyster Mortalities in Washington and British Columbia.* Approximately ten instances of oyster mortalities are reported to the Washington State Department of Fisheries each summer. Similar oyster mortalities also are reported from British Columbia. Causative agents or factors are unknown.
8. *Economic Problems.* While the cost of producing Pacific oysters has increased, the selling price is the same or lower than it was ten years ago. In other areas prices are favorable but supplies of oysters are limited.
9. *Importation of Foreign Oysters.* Canned and smoked oysters from Japan are being imported in increasing quantities. A new plant at Hiroshima, Japan, is producing frozen oysters especially packaged for shipment to the United States.

For each of the problems listed above, solutions can be found. The decrease in areas suitable for oyster production is part of the general "estuarine problem." The Gulf State Marine Fisheries Commission and the Atlantic States Marine Fisheries Commission have recognized the importance of this problem.

States and Federal agencies are expanding research to find ways of preserving essential coastal bays and estuaries and replacing those which are lost.

The control of predators appears much more promising than it did several years ago. Recent research has disclosed chemical and physical methods which after thorough testing should be available for commercial use.

Cooperative research by State and Federal scientists to determine the causes of mass mortalities in the Middle Atlantic area has increased greatly during the past two years. An organism suspected as the causative agent has been discovered but not yet identified. The 1958 and 1959 year classes of oysters in Delaware Bay have survived better than earlier groups which may indicate that a resistant strain is being developed.

The fungus parasite *Dermocystidium* cannot be controlled as yet; however, certain measures can be taken to alleviate its effects. Oysters can be marketed at a younger age or transplanted to areas where this fungus is less common.

Seed shortages can be overcome by utilizing certain areas where reproduction is dependable to produce seed for other areas. This is already being done in certain places but private collection of seed could be expanded. Artificial propagation of seed oysters is now possible and may provide economic sources of seed in the near future.

Recent advances in our knowledge of chemicals may make it possible to control the mud shrimp in the Northwest. Preliminary experiments show that these species are easy to kill but further testing is required before control methods can be advocated.

Although causes of the oyster mortalities in the Northwest are not known at this time, it appears likely that the problem can be solved with sufficient effort.

While other problems such as high costs, low prices, and imports cannot be solved by biological research, production costs might be decreased by better growing, harvesting or processing techniques.

The Future

If we can look far enough ahead we can see a bright future for the oyster industry after today's problems are solved. This will not be the oyster industry which we know at present for it will use new methods and techniques and new areas for oyster production. Consider the future in four phases without setting a timetable for each phase.

First Phase

Oyster culture in the United States could be vastly improved if the best commercial practices in use today and the present scientific knowledge were applied throughout the industry. Production could be increased, quality could be improved, and costs could be lowered. The need for food for an expanding population should maintain high consumer demand for oysters.

During this period antiquated laws which hamper private enterprise would be corrected. Experience in Long Island Sound, Chesapeake Bay, and the Pacific Northwest has demonstrated the tremendous increase in production which can be achieved through private cultivation of oysters as compared with public management. During this period nearly all oyster-growing areas would be placed under private control but some seed areas might still be managed as a public resource.

Most predator control problems should be solved during this period by measures which, though expensive, could be used economically by private oyster farmers.

Causes of mass mortality would be discovered during this period and some control measures would be developed. It is unlikely that this problem could be completely solved during this period.

The oyster industry will face several serious problems during this period. Foreign competition will undoubtedly increase. The quantity and quality of oystering areas will decrease and production costs will continue to rise. The oystermen will be challenged to produce a product more acceptable to the consumer, more attractively packaged, of higher quality but without an undue increase in price.

Second Phase

Industrial development and increase in population in coastal areas will cause a continued decline in the quantity and quality of suitable environments for oyster culture during this second phase. The runoff of fresh water will decrease and the load of silt, domestic and industrial wastes carried by the rivers will increase. These factors will make it necessary to relocate that part of the oyster industry which is close to centers of population.

New culture methods such as the use of rafts placed in deep water away from cities will more than replace the areas which are no longer suitable for oystering. Handling, shucking and processing techniques will be improved to reduce costs. Already the Japanese raft culture technique produces 600 to 1,000 gallons of oyster meat on a raft 24 feet by 60 feet in eight months. This principle improved by modern materials and American mechanization will make it possible to compete economically with foreign imports.

Improved techniques for purifying oysters will be in common use to guarantee highest quality to the consumer.

Third Phase

A further decrease in natural areas suitable for oyster culture will make it necessary to grow oysters in ponds. Research on pond culture of oysters is already under way and methods should be perfected by this time. Seed oysters would be produced in private, commercial hatcheries following techniques which have recently been developed and which will be improved before this period. Our knowledge of nutrition will be advanced to the point that producing food for oysters will be possible and economically practicable. Selective breeding will increase growth rates, reduce disease, and improve flavor and other characteristics. Predators will be excluded and most diseases will be controlled.

Fourth Phase

The ultimate in oyster culture would be artificial propagation not dependent upon naturally clean sea water or natural food. The oysters might be grown under completely controlled environmental conditions in a few months. It is already possible to produce a continuous supply of phytoplankton under closely controlled conditions, and this method might be used to produce the oyster's favorite food. Perhaps "oyster pellets" or "instant oyster food" will be commercially available. Even now larval clams can be raised on dried foods at the U. S. Bureau of Commercial Fisheries Laboratory at Milford, Connecticut.

The water used in oyster culture might be taken from the ocean, diluted

to the correct salinity and sterilized by ultraviolet light. Inland oyster farms might use artificial sea water which would be filtered, purified, and recirculated to maintain a perfect environment.

Oysters and other molluscs are among the most efficient sources of animal food since they feed directly upon plants. Their growth is rapid if food supplies are adequate and environmental conditions are satisfactory. Furthermore, the product is nutritious, well accepted and easily marketed. The prospects of increasing production of shellfish are extremely good; much better than the prospects of increasing quantities of other marine fishery products. Surely "Farming of the Sea" which we hold to be the solution to the food supply problem of the future will begin with culture of oysters and clams.

Predictions presented here are based on incomplete evidence and some unproven assumptions, but with faith in the ability of American scientists and the resourcefulness of American industry. Present problems can be solved and the future can be bright, but only if we obtain the knowledge which will be needed in the future.

Industry's Appraisal Of The Future of the Oyster Industry

DAVID H. WALLACE

*Oyster Institute of North America
Annapolis, Maryland*

THOUGHTFUL LEADERS IN THE OYSTER INDUSTRY are seriously concerned with the future of their business. If our production continues to decline at the same rate as it has since 1954, less than 40,000,000 pounds will be made available to the consumer in 1970.

Some towns along the middle Atlantic Coast have become almost "ghost" towns already. More areas are feeling the pressure of a declining economy every day. The Eastern oyster, which was a staple part of the diet of our early settlers along the north and middle Atlantic Coast, is fast disappearing from the American scene.

Most of this discussion will be confined to the East coast from Maine to North Carolina, since in recent years this area has suffered the greatest losses of oysters and consequent decline in production.

Long Island, Delaware Bay and Chesapeake Bay have been recognized as the major oyster centers in the United States. Long Island was noted especially for its ability to grow excellent quality of oysters both for the half shell trade and the shucking industry, Delaware Bay produced excellent shucked oysters, but because of the vast acreage suitable for oysters, the Chesapeake yielded more than both of these plus all the other oyster areas in the United States.

The bulk of the oysters grown in these Eastern states, except Maryland, are cultivated on private grounds.

Since 1950 Long Island oystermen have sustained tremendous losses from hurricanes, starfish and drills, an unexplained mortality in 1953, and no commercial set until 1958. Delaware Bay growers in the same period have been