Rehabilitation of Disease-Depleted Oyster Populations in Eastern Canada

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INTRODUCTION

In Eastern Canada, oysters, *Crassostrea virginica*, Gmelin, occur in those portions of the provinces of Prince Edward Island, New Brunswick and Nova Scotia bordering the southwestern Gulf of St. Lawrence.

In 1915 oysters started dying in large numbers in Malpeque Bay, Prince Edward Island. Mortalities fanned out from an apparent epidemic centre and soon involved Cascumpeque and Bedeque Bays. By 1920 the fishery of these waters was prostrate. Subsequent investigation, ten or more years after the subsidence of spectacular mortality, suggested:

(1) that in infectious, epidemic disease was involved;

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(2) that mortalities exceeded 90 per cent of pre-epidemic stock;

(3) that survivors were wholly or partly resistant and bred similar progeny;

(4) that the progeny became fully resistant (i.e., less than 10 per cent per year died) in about thirteen years from the first disease mortalities.

In the next twenty-five years this disease destroyed all the oyster fisheries of Prince Edward Island. Perhaps the most interesting outbreak was the one affecting Hillsborough Bay and it tributary rivers, commencing in 1935, because it was observed from its onset and because resistance was studied and attempts were made at rehabilitation. Observations disclosed a spreading epidemic of much the same nature as in Malpeque Bay, except that mortalities reached or exceeded 95 per cent. In Johnston River, a small tributary, a relatively large number of resistant Malpeque adults were planted to act as brood stock in assisting rehabilitation. This had no apparent effect, the development of full resistance taking thirteen years, as in Malpeque Bay. In a further effort at rehabilitation, resistant Malpeque Bay spat were sold, in comparatively small numbers, to growers in Hillsborough Bay and the principal tributaries. The fishery recovered to its pre-epidemic level in ten to twelve years, as compared to the twenty years required in Malpeque Bay. It is uncertain whether this was accomplished by direct survival of these spat to market size or by their spawning of resistant young or by a combination of these two.

The causative organism of these epidemics was not discovered.

Pertinent papers are those of Needler (1931, 1936 and 1941), Homans (1937, 1938 and 1939), Fraser (1938), Richardson (1938), Needler and Logie (1947) and Logie (1958). The last two are the most comprehensive.

From 1947-50 and again from 1953-55, the senior author studied model or miniature epidemics in small lots of mainland oysters placed in the waters of Bideford River, tributary to Malepeque Bay. From these experiments it appeared:

(1) that the causative organism was still present in Malpeque Bay waters;

(2) that mainland oysters were susceptible;

(3) that, with few exceptions, mortalities followed a characteristic pattern of a one-year lag, presumably for development of the disease in the oyster, followed by heavy mortality reaching 95 per cent of the original number in three years and a probable terminal value of 99 per cent; the heaviest rate of mortality occurred in the third year of exposure and reached 75-80 per cent.

It is probable that all Prince Edward Island epidemics conformed closely to this description. The apparently increasing mortality in successive outbreaks was more probably the result of closer observation than of increasing death rate.

In 1955, oysters commenced dying in mass numbers in various waters of New Brunswick and Nova Scotia. This epidemic is still advancing, the sole area of any importance not yet clearly involved being Bras d'Or Lake, N. S. Mortalities follow the same pattern and reach the same intensity as described for Prince Edward Island.

The normal oyster fishery of the mainland is relatively large, that of New Brunswick in particular being two to three times that of Prince Edward Island. Rehabilitation of the fishery in these provinces was therefore a pressing problem. The urgency was increased by another consideration. Returns from the oyster fishery provided in many cases an essential segment of the income of people

in a chronically precarious financial state. Rapid restoration of the fishery was therefore an urgent socio-economic measure.

Even considering its poor success in Johnston River, the most promising technique at the time was the transfer of resistant Prince Edward Island adults to disease-depleted mainland waters to act as brood stock. In orderly scientific procedure it would have been necessary to discover the answers to the following questions before massive transfers took place:

(1) Was this the same disease as in Prince Edward Island?
(2) Would Prince Edward Island adults survive in the mainland waters?
(3) Would they spawn?
(4) Would their progeny be resistant?

However, because of the urgency of the socio-economic problem, preliminary search for these answers and large-scale rehabilitation transfers went on almost concurrently.

MATERIALS AND METHODS

Commencing in 1956 and continuing every year thereafter, two lots of 300 Prince Edward Island oysters were held in trays in several locations in mainland waters. Mortalities were regularly observed in these and in comparable lots of native and of Bras d'Or Lake oysters held as controls.

Commencing in 1957 and continuing into 1960, large numbers of adult Prince Edward Island oysters were transplanted to the principal diseased areas of the mainland to serve as brood stock. In all, some 4 to 5 million oysters were so transplanted.

Commencing in 1957, mortalities in tray lots of spat annually produced in diseased areas were observed. Since 1958 two controls have been employed:

(1) Malpeque Bay spat (presumably resistant);
(2) Bras d'Or Lake spat (presumably susceptible).

In addition general observations have been made of the numbers of spat and small oysters appearing on natural and artificial cultch in the diseased areas.

RESULTS

As already stated, the pattern of mortalities in mainland epidemics conformed in virtually every case and every particular with that established as characteristic of epidemic disease in Prince Edward Island.

The introduced oysters did live and did exhibit the same degree of resistance as in Prince Edward Island.

They did spawn. It should be stated that 1958, 1959 and 1960 were good spawning years and that 1959 was phenomenally so.

Large numbers of spat and of year-old oysters appeared in the diseased areas, but spat caught on artificial cultch and held on trays in these areas has died heavily, showing no clear disease resistance whatever. Similarly spat and small oysters picked up from around the shores died when held on trays.

DISCUSSION

The identity of mainland and of Prince Edward Island oyster diseases cannot be established by reference to the causative organism, since this has not yet been clearly identified. However, adherence to the characteristic mortality pattern everywhere and the similar resistance of Prince Edward Island oysters in Prince Edward Island and in mainland waters are together taken as the best

available evidence that all epidemics are due to the same cause. It should be pointed out though that this is an inference from the data rather than a definitive statement (Logie, 1958).

The lack of resistance in spat produced in mainland waters after transfer of Prince Edward Island brood stock is disconcerting to the whole concept of rehabilitation by this method, although it has been pointed out by Drinnan and Henderson (1959) and by Drinnan (1960) that it conforms to the precedent established in Johnston River in 1939 et seq.

No completely satisfactory explanation of this phenomenon can be advanced, but Drinnan (1960) has speculated about it. Spat produced locally on the mainland now could be a mixture of three crosses:

(1) native x native;

(2) native x P.E.I. transplants;

(3) P.E.I. transplant x P.E.I. transplant.

Good reasons exist for suggesting that the first two of these should be highly susceptible and that the third should be highly resistant. Because of the paucity of surviving native adults demonstrated by searches so far, it was considered that progeny produced after rehabilitation transfers would be dominated by the third parentage listed above. In view of the data now at hand, it appears probable that somewhere in the diseased areas large enough stocks of surviving natives exist to exert a dominant influence on the genetic composition of the spat. This thesis is barely tenable in some cases, but it is nevertheless the only one consistent with the facts. Its authenticity should be tested by:

(1) searching for the postulated stocks of native parents;

(2) destroying them when found;

(3) saturating further with P.E.I. parents;

(4) continuing trials of spat survival, both in trays and on natural cultch.

In the meantime, judgment of this method of rehabilitation should be withheld.

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Recent Advances in the Control of Shellfish Predators and Competitors

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THE PURPOSE OF THIS ARTICLE is to describe briefly several methods of control of shellfish enemies that either came into practical use during recent years or are on the threshold of being employed on a large scale by shellfish industries.

As is well known, the methods of controlling shellfish predators and competitors may be of three basic types, namely, biological, mechanical or chemical. Biological methods, being more natural than those of the other two categories, are preferable in many respects. However, in aquatic environments they are difficult to develop and, perhaps, even more difficult to execute. An example of this was when a ciliate, *Orchitophyra stellarum*, was discovered in gonads of male starfish, *Asterias forbesi*, which were made sterile by the activities of this parasite (Piatt, 1935). Unfortunately, regardless of persistent efforts, we failed to spread the infection among starfish kept in the laboratory aquaria and tanks or in Long Island Sound.

Mechanical methods have been mainstays of shellfish cultivators for many years. Most of us are familiar with starfish mops and dredges, drill traps and, more recently, suction dredges that are in use in this country. The principles of these methods have already been described (Galtsoff *et al.*, 1937; Galtsoff and Loosanoff, 1939). In Europe, for over a century, several types of fences have been in use against crabs and rays. All these methods are partially helpful but none is adequate in itself. As a result, to cite one example, the recent prevalence of drills in Long Island Sound compelled the oyster industry to give