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Abstract

Erratic reproduction of the introduced Japanese oyster (*Crassostrea gigas*) has created a need for spatfall predictions in British Columbia. An empirical method of determining time and approximate intensity of setting is described.

The Pacific oyster (*Crassostrea gigas*) is not indigenous to the Pacific Northwest where summer water temperatures are considerably lower than in its native habitat in Japan. Breeding is therefore uncertain except in a relatively few areas, where unique hydrographic conditions permit temperatures to attain required levels. Even here, due to variable summer weather in the Pacific Northwest, in some years breeding temperatures are not reached or maintained for long enough periods. Consequently there may be neither spawning nor setting. When spawning does occur, larval broods may not survive. In contrast to the long breeding period of *Crassostrea virginica* in Virginia and adjacent areas, larval broods on the west coast are generally discrete and setting is often restricted to a few days.

Since spatting is erratic and timing important to avoid fouling, blind cultching is both impractical and uneconomical. Therefore spatfall prediction is desirable and collection of oyster seed in Washington and British Columbia is based largely on spatfall forecasts.

In British Columbia, only in Ladysmith Harbour and Pendrell Sound, both relatively small areas, does setting occur with relative frequency and it is here that efforts to predict have been concentrated (Quayle 1955, 1949-57). The technique of prediction is essentially the same in both areas but hydrographic differences cause variation in both breeding and forecasting success.

Prediction Technique

Oyster spawning in British Columbia is usually sudden and complete, and is often observed visually. Therefore individual larval broods may be followed closely with respect to number and distribution of larvae, by means of both spot and running plankton samples.

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In Pendrell Sound, for example, in an area of five square miles, 14 spot samples of one to three cubic feet taken three feet below the surface at intervals of not more than three days, have been found to describe, adequately for prediction, trends in numbers of larvae. Although the number of advanced-stage larvae per unit volume of water is the ultimate basis for prediction, rate of reduction in number is also of importance. Trends in water temperature and weather conditions and their effect on final abundance of larvae must also be considered. Low water temperatures caused by rain or cloud cover frequently coincide with diminution of larval broods or even their decimation.

Spawnings are reported to the industry as soon as straight-hinged larvae are observed in the plankton. The number of larvae in the immediate vicinity of the spawning is used to make a preliminary estimate of the possibility of a commercial set. Reports are provided at about weekly intervals and information is made available through a regular Fisherman's Broadcast as well as by printed bulletins.

The larval period of the Pacific oyster may vary between 18 and 30 days depending on temperature and possibly other factors (Quayle 1954). By following size distribution of larvae and water temperature it is possible to modify predictions of date of beginning of setting. Prediction becomes more definite as the brood progresses and the final decision is given about a week before the expected date of the set.

It is apparent that the method of prediction is purely empirical. Each breeding area has its own characteristics and reliability of prediction is increased by experience.

Insufficient data have been accumulated to indicate accurately numbers of straight-hinged larvae required for a minimum commercial set under optimum conditions, but for Pendrell Sound it appears to be about 10 to 25 per gallon. In both areas, about one advanced-stage larva per gallon is required to produce a set of at least ten spat per shell.

Ladysmith Harbour

Ladysmith Harbour is a narrow, fairly-shallow bay, somewhat different from the usual fjord form of British Columbia inlets.

Summer salinities lie within the range 23 to 26 ppt and surface temperatures within the limits 60° to 68°F. Heating and cooling of tidal flats in the harbour contributes materially to rapid and considerable temperature changes. Temperature structure may also be quickly changed by wind mixing. A two-layered current system has been demonstrated, and a significant advection of phytoplankton into the inner harbour occurs (McAllister 1956). This type of circulation

no doubt aids in retention of oyster larval populations, all of which originate normally within the harbour.

Formerly, spawning in Ladysmith Harbour was quite irregular, and between 1930 and 1940 stimulation on a large scale was practiced (Elsey 1936), but more recently natural spawning has occurred quite regularly. There have been occasions, however, when extensive larval mortality occurred, in spite of what appeared to be satisfactory temperature conditions.

In Ladysmith Harbour, commercial spatfalls (a mean of 10 spat per shell) have occurred on floating cultch in only eight of the last 24 years. Spatfall predictions based on quantitative larval sampling have been made since 1949. The record of forecasting success has not been particularly good in Ladysmith Harbour for only six of ten forecasts may be considered satisfactory in respect to both time and extent of setting. Because of hydrographic conditions, Ladysmith Harbour will no doubt continue to be a difficult area in which to predict. More intensive sampling would probably increase efficiency.

In spite of the rather poor record from the biological point of view, forecasts in this area have been relatively satisfactory for growers who collect seed there, for timing has been right. On only one occasion has the prediction caused the industry to miss part of a set.

Pendrell Sound

Pendrell Sound is a typical fjord-type inlet with steep rocky shores and depths up to 1,000 feet. Natural oyster populations occur on the steep rocky walls of the sound. During early summer a layer of relatively fresh water (20 ppt) about 15 feet deep is formed over the main water mass of salinity about 30 ppt. It is in this thin surface layer, in which temperature may reach 75°F., that larval broods occur (Quayle 1957).

Surface currents are extremely weak and seldom exceed 1/4 knot. There is no sill at the entrance to this inlet to create turbulence, and main current action is along the bottom. Prevailing summer winds do not destroy stratification which disappears only with the advent of autumn storms.

In only one of nine years in which the area has been studied has the average spatfall on floating cultch been less than ten per shell and in four it has been well over 100 per shell. Of ten predictions made for this area up to 1956, one may be considered unsatisfactory.

Discussion

In Ladysmith Harbour where only local growers collect seed, ten spat per shell is considered the "commercial" level, although growers will cultch for less. In Pendrell Sound where operations are carried on by seed producers, the "commercial" level is about 25 spat per shell. Prediction is required to indicate whether these levels will be reached.

When weather is good, water temperatures average or above, and larval abundance high, there is little difficulty in predicting a commercial set. The difficulty is increased if larval numbers are low. When weather conditions are unfavorable (rain and cloud cover), prediction is difficult regardless of larval numbers.

The possibility of reducing prediction of Pacific oyster spatfalls in British Columbia to a mathematical basis is unlikely, for both initiation of spawning and larval survival appear to depend on water temperature which is largely a function of weather conditions in the breeding areas. Each larval brood must be considered as an individual case.

The plankton sampling and counting required in prediction studies involve considerable effort, but the return in efficiency of seed collection makes it well worth while in British Columbia.

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