THE BREEDING OF OYSTERS IN TANKS

By Edward Hughes, M.D., D.P.H.

(M.O.H. Dover, late Deputy M.O.H. City and Port of Plymouth)

(Text-fig. 1)

The following paper is a record of certain work which was carried out at the River Yealm during 1939. No claim is made for original work, but it may serve some useful purpose as a record.

Oysters from the River Yealm have been used in most of the experimental work carried out on the breeding of oysters at Conway. But, for some unknown reason, there has never been any relevant growth of native oysters in the Yealm. The beds are stocked every year with three-year-old Brittany oysters. These oysters thrive well in the Yealm and are of considerable commercial value.

Certain old tanks at the Fisheries have been altered and repaired for the purpose of cleansing prior to their despatch to the London market. These tanks are in use for this purpose approximately from the end of August until the beginning of May. Therefore they are unused for approximately four months during the breeding season.

Description of the Tanks

The accompanying diagram (Fig. 1) shows the lay-out of the tanks. Two old storage pits have been subdivided into three sections and rendered watertight. They may be described as A, B and C. Tank A is approximately 10 ft. deep and holds 32,000 gallons when filled to a depth of 8 ft. 6 in. The wall between A and B is 10 ft. high, and the wall between B and C is 8 ft. high. Tank B holds 9000 gallons at 3 ft. Tank C has a larger superficial area and the surrounding walls are 8 ft. high; it holds 32,000 gallons when filled to a depth of 5 ft.

Tanks B and C can be filled to the stated depth on the flowing tide via the sump marked in the diagram. The water in tank A is topped up to a depth of 8 ft. 6 in. by means of a petrol pump, except on very high tides.

The walls of the tanks are of brick rendered with concrete, and the floors are of concrete. All tanks are watertight. It will be noted that these tanks are considerably smaller than those in use at Conway.

It may be mentioned at this juncture that the owner, Mr J. Kingcome, made several attempts at oyster breeding in 1927, 1928 and 1929, in conjunction with the Experimental Station at Conway, but at that time the conditions necessary for ensuring a settlement of oysters in tanks were not known, and the attempts were unsuccessful.

Breeding

On June 1 1939 200 healthy four-year-old oysters from the river were placed in single layers on slatted frames on the floor of tank A. These frames were about 9 in. from the bottom, being supported by two widths of common brick. The oysters were covered by large slates, as advised by Cole (1938). All slates and bricks were treated with the prescribed mixture of sand and lime. Seventy bouquets of limed tiles were arranged round the floor of the

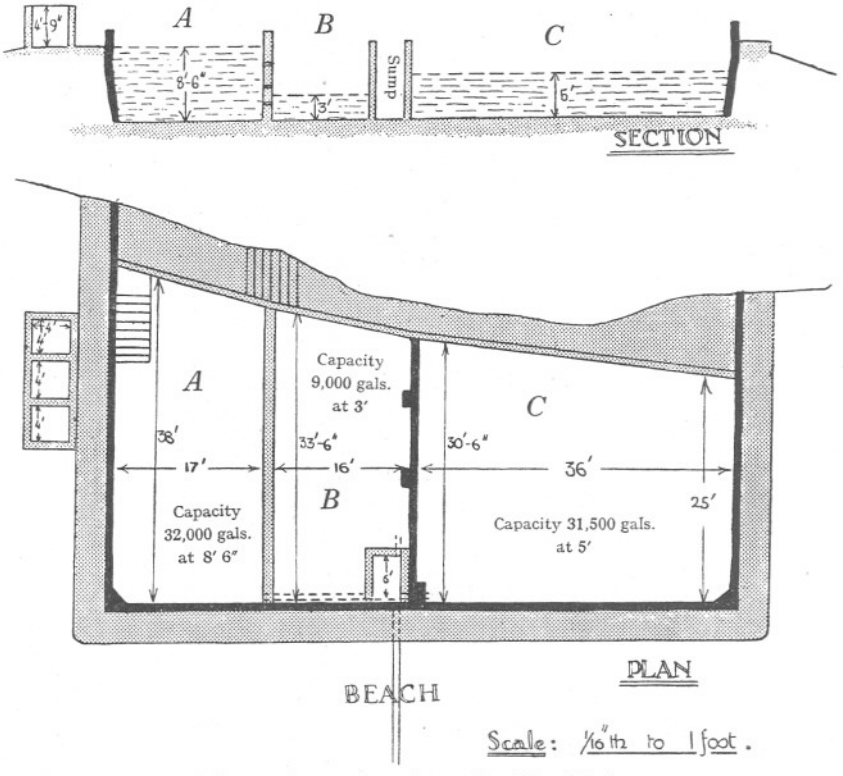

Fig. 1. Oyster cleansing tanks, River Yealm

tank. The tank was then filled to a depth of 8 ft. (30,000 gallons) on a high spring tide.

Enrichment of the water by crabmeat minced up with sand was then commenced. The sand was subjected to preliminary heating in order to kill any littoral organisms. The rate of enrichment was three medium minced crabs on alternate days.

About this juncture, Mr D. P. Wilson, of the Marine Biological Laboratory, Plymouth, very kindly examined a sample of tank water. He reported the presence of an abundance of suitable flagellates. Daily nettings were taken in order to ascertain the presence of free-swimming larvae. *p*H readings were

taken twice a week. With the exception of one reading of 8·5 (corrected) on June 21, the *p*H values appeared stationary at 8·3 (corrected). On June 23 free-swimming larvae were noted for the first time.

On June 24 a further eighty bouquets of tiles were lowered down the sides of the tank, to rest on the floor. At the same time a few oyster shells, in net bags, were lowered to a depth of 3 ft.

On July 5 settlement of spat was noticed on these shells, and on July 7 spat was visible on the tiles. Enrichment at the rate of three crabs on alternate days was continued.

On July 7 after perusal of the article by Cole & Jones (1939) forty bouquets were taken up from the floor of the tank and placed about 1 ft. below the surface of the water, being suspended from pieces of wood placed across the top of the tank A.

Tank B was filled to a depth of 3 ft. 6 in. on July 17 and allowed to warm by the heat of the sun.

On July 19 the temperature of the water in tanks A and B was the same, and forty bouquets of tiles which had been suspended in A were transferred to B. There was a heavy settlement of spat on these tiles. At the same time tank C was filled and the water allowed to warm in the sun.

The water in B was completely replaced by water from C on alternate days until July 23. Enrichment of B was continued with four medium crabs per day.

On July 23, tanks A and B were emptied at the same time and the walls well cleaned down. Seventy-five bouquets were placed in each of A and B and each tank was filled to a depth of 3 ft. 6 in. from C, in which the water had been warmed by the sun. At this period there was a difference of 10° F. between the temperature of the river water and that of the tanks. Up to this period, the air temperature was relatively low for the time of the year, and we were concerned lest a sudden change in water temperature would prove harmful to the young spat.

After July 23, there was a distinct improvement in the air temperature with a consequent increase of the temperature of the river. Thus, it was possible to effect several partial changes of the water in A and B direct from the river, and finally after August 1 it was possible to effect almost daily changes direct from the river. By this time the river temperature was only 5° below that of the tank water, and the spat had grown to the size of a sixpenny piece.

Enrichment of tanks A and B was continued at the rate of four minced crabs per day between July 23 and August 1.

On July 23 it was noticed that the spat on the forty bouquets which had been suspended in A and subsequently transferred to B and given partial changes of water, were appreciably larger than those which had remained on the floor of A without change of water until July 23.

Growth continued steadily, and there appeared to be a definite risk of overcrowding on the tiles. During the week August 7–14 a few of the larger

oysters, which were a little larger than a sixpenny piece, were detached from the tiles and placed in cages, lined with stiff muslin, inside the tanks. About 600 were detached in this way.

Mr Cole visited the tanks on August 14. On his advice the detachment of oysters was stopped on account of the danger of exposing patches of bare tile on to which the remaining oysters would be liable to grow. The subsequent detachment of such oysters without considerable damage presents great difficulty.

Owing to the necessity of utilizing tanks A and B for purification purposes, all the tiles were transferred to tank C on August 16. Here, they are given practically daily changes of tidal river water to a depth of 3 ft. 6 in. and at the time of writing (October 26 1939) they are making good progress. The tiles are covered with a heavy settlement of young oysters, many of which are the size of half a crown.

The spat which were detached from the tiles during the week August 7–14 were placed in the river estuary on August 16 and 17.

They were housed in suitable cages which are exposed on a low spring tide. At first, the growth of spat appeared to be slower than that on the tiles in tank C, but during the last two weeks they have improved, and at present are larger than those inside the tank.

Discussion

I understand that there are variations in the spatting of oysters, both in regard to the time of spatting and the abundance of spat. The year 1939 was considered a fair year for oyster breeding. The factors which contribute to these variations appear to be uncertain, but must be borne in mind when considering the success of this experiment in its first year.

The Yealm is a sheltered Devon river, free from gross sewage pollution and, so far, free from animal life which is inimical to oysters. The temperature of the water is relatively high, certainly higher than that at Conway. This factor in itself should favour successful attempts at oyster breeding. The following table gives the list of temperatures, taken at midday:

Date	Temperature °F.	Date	Temperature °F.
June 2	59	June 16	65
3	60	18	66
4	61	20	67
5	63	21	67
6	65	22	68
7	66	23	68
8	65	24	70
9	65	25	69
10	65	27	71
11	65	29	69
12	65	July 4	68
13	65	8	68
14	65	9	69
15	66	13	70

Cole (1938) has stated that he does not consider it practicable to breed oysters in tanks which are smaller in size and depth than those at Conway. It is interesting to note that the tanks at the Yealm in which the spat settled

are approximately one-third the size of those at Conway, although the depth of water is greater. The number of oysters and tiles used, and the rate of enrichment were "scaled down" from the Conway data.

Our experience confirms the view (see Cole & Jones, 1939) that the best results are obtained by suspending the tiles just below the surface of the water. The growth of spat on the tiles which were suspended in this manner was definitely superior to that on tiles which were left at the bottom of the tank. When the experiment is repeated next year, we shall place a few bouquets on the bottom of the tank, and suspend the remainder approximately a foot below the surface of the water about a week after free-swimming larvae are first noted.

Cole has stressed the importance of instituting several partial changes of water at an early date. Experience confirms the value of this procedure. Next year we propose to commence partial changes of water about a week after the spat has settled. In doing this we shall have to avoid the occurrence of a sudden drop in temperature of the water in the breeding tank. This can probably be effected by allowing for a preliminary period of warming for a day or two in the shallow tank C. As a working rule we propose to try to avoid a decrease in temperature of more than 5° F. In our work this year we have found that it is possible to allow for a change of about one-third of the volume of water by this method. Cole has suggested that spat should be placed in the river estuary about one month after settlement. Unfortunately, Mr Kingcome did not have sufficient cages to do this, but it is hoped to remedy this deficiency by next year. I have already reported the superior growth of the oysters which were placed in the estuary of the river.

Unfortunately, events will not allow the writer to continue his contact with this work next year, but it is hoped that this brief paper will serve as a record of work which can be done outside an experimental station. The absence of data which will interest the keen scientist is only too obvious.

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It is a pleasure to acknowledge the great help and co-operation of Mr J. Kingcome. His practical experience has played a great part in the success of this experiment.

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