AN EFFECT OF WATER QUALITY ON THE GROWTH OF CULTURED LARVAE OF THE OYSTER *Ostrea edulis* L.

By

R. H. MILLAR and J. M. SCOTT

Marine Station, Millport, Isle of Cumbrae, Scotland

Larvae of the oyster sometimes fail to grow satisfactorily when cultured in standard conditions. When the water was pre-treated with adsorbing agents, and when artificial seawater was used, the larvae grew faster, indicating the presence of harmful substances in solution in the natural seawater, which could be removed by adsorption.

INTRODUCTION

In routine culturing experiments with oyster larvae at Millport it has been found that repeated failure may occur at some period in summer, using the same standard procedure which is successful during the remainder of the year. KNOWLES (personal communication) has found similar difficulty during part of the summer, at the Seed Oyster Unit of the White Fish Authority. WALNE (1966) reported a similar occurrence, and suggested that it may have resulted from a combination of high organic content in the seawater and the use of polythene vessels, leading to a large increase of bacteria. These failures, however, may have resulted from the presence of harmful substances in solution in the seawater, possibly originating as breakdown products or as external metabolites from previous populations of plankton. Preliminary experiments were therefore made to investigate this effect, which can be of practical importance in molluscan hatcheries, and is also of more general interest in marine ecology.

ADSORPTION EXPERIMENTS

These experiments were made to discover if seawater which had first been treated with an adsorbing agent gave better larval growth than untreated water. Of several agents tried only Fuller's Earth and magnesium trisilicate, when used to treat the water, permitted larval survival and growth.

J. Cons. perm. int. Explor. Mer | 32 | No. 1 | 123-30 | Copenhague, Juillet 1968

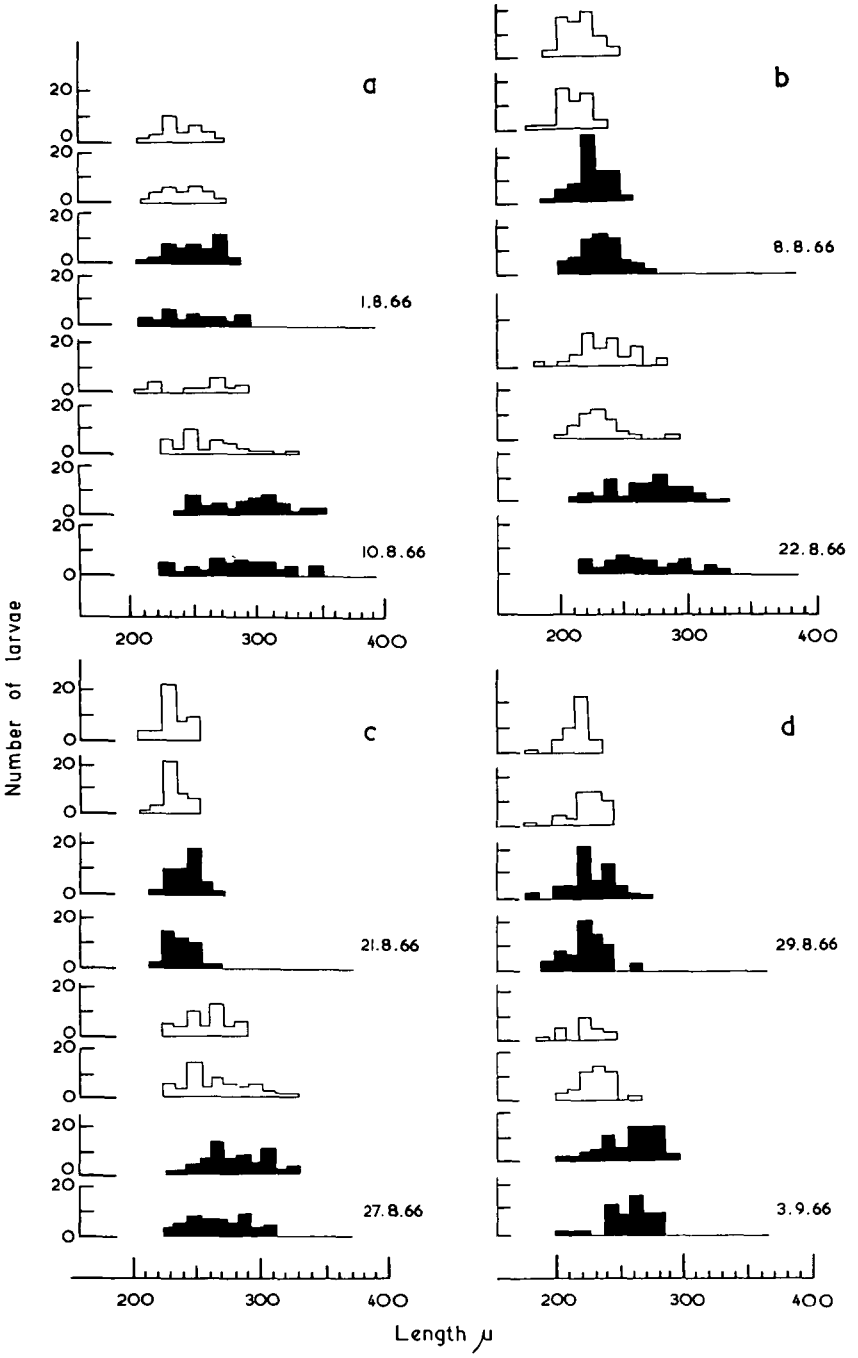

Figure 1. Size distribution of larvae, at a day during experiment, and at end of experiment, in releases: a, 66/18; b, 66/20; c, 66/21; d, 66/23. Open histograms, untreated seawater; filled histograms, seawater pre-treated with Fuller's earth.

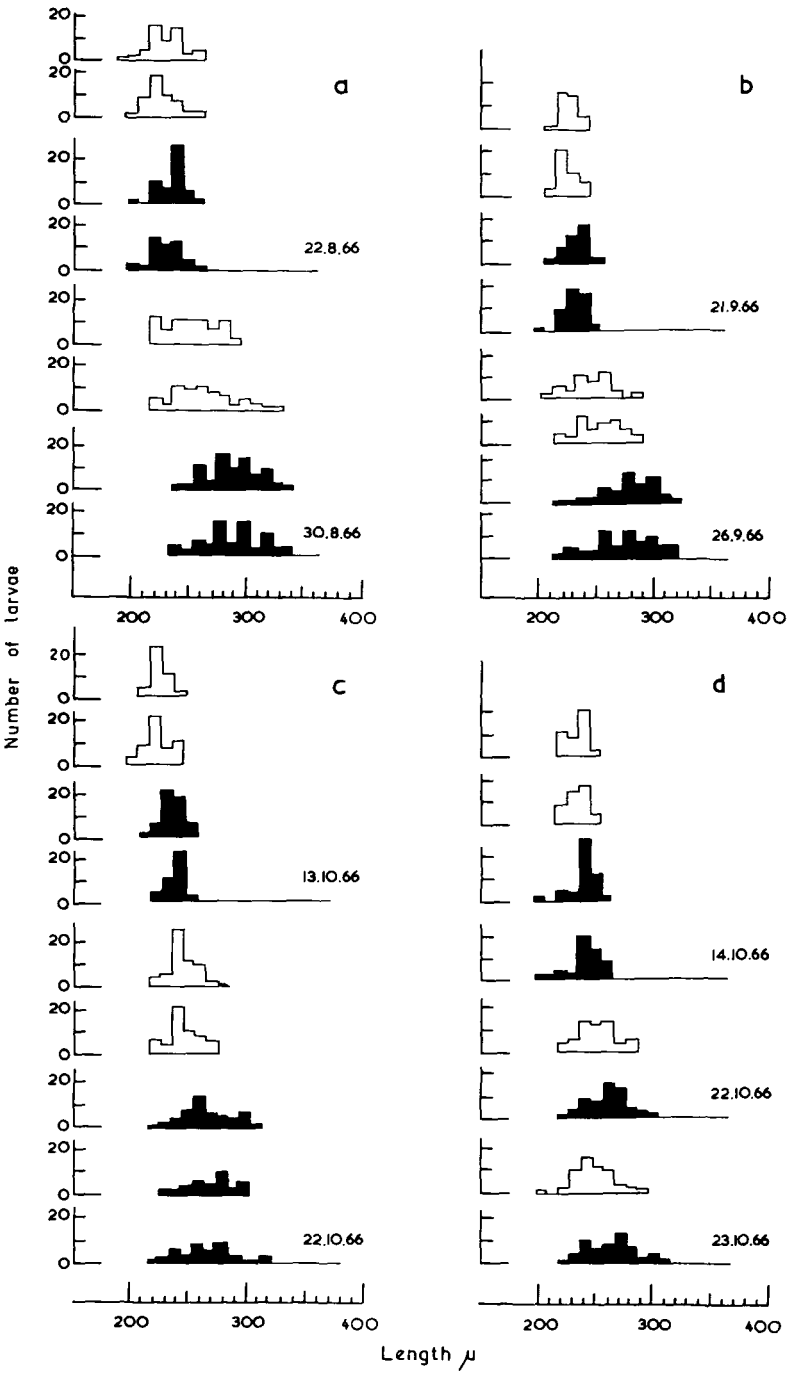

Figure 2. Size distribution of larvae, at a day during experiment, and at end of experiment, in releases: a, 66/21; b, 66/25; c, 66/27; d, 66/27. Open histograms, untreated seawater; filled histograms, seawater pre-treated with magnesium trisilicate. In d, antibiotics were added to both untreated seawater and seawater pre-treated with magnesium trisilicate.

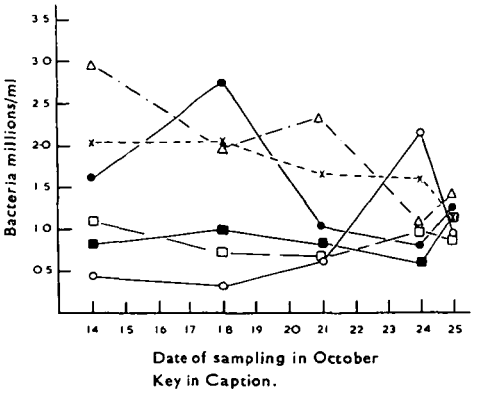

Figure 3. Numbers of bacteria in larval culture water (release 66/27). ●, untreated seawater; △, seawater pre-treated with magnesium trisilicate; ○, untreated seawater with antibiotics; ×, seawater pre-treated with magnesium trisilicate, with antibiotics; □, artificial seawater; ■, artificial seawater with antibiotics.

(A) FULLER'S EARTH

The culture vessels were 250 ml Pyrex beakers, each containing about 200 ml of water and about 200 newly released oyster larvae. In one pair of beakers, which acted as controls, the seawater had been filtered through glass-fibre paper. In the other pair the water was first passed through a similar glass-fibre paper, then repeatedly shaken with Fuller's Earth for at least 30 minutes and cleared by further filtering through glass-fibre paper. A culture of *Monochrysis lutheri* Droop was centrifuged, the liquid discarded to remove excess nutrients and bacteria, and the precipitated cells suspended in filtered seawater. This *Monochrysis* was then added to all beakers to give about 50 cells per c. mm. No antibiotics were used. The water in all beakers was changed once each day and at each change the whole experiment was set up as initially. Larvae from four releases were used, each experiment with larvae from a single release.

Larval growth is indicated by the rightwards horizontal shift of histograms of shell length (Figure 1). In experiment 66/21 no difference in growth rates is apparent, but in 66/18, 66/20 and 66/23 there are strong indications of faster growth in the experimental larvae, than in the controls.

(B) MAGNESIUM TRISILICATE

A second series of experiments was set up, using three releases of larvae. Conditions were the same as in the first series except that magnesium trisilicate was used in place of Fuller's Earth. The increase in growth rates of larvae in treated water over those in untreated water is even more obvious than in experiments with Fuller's Earth (Figure 2, a–c). A harmful substance has apparently been removed from the seawater by adsorption. The substance might have been slightly toxic and have directly retarded larval growth. Another possible explanation is that the substance was itself non-toxic, but, being organic, promoted bacterial growth, which is known often to retard or kill larvae in cultures.

(c) MAGNESIUM TRISILICATE AND ANTIBIOTICS

In order to indicate which of these explanations is more likely a further experiment was made, as already described with magnesium trisilicate but with the addition of antibiotics (penicillin and streptomycin each at 50 mg/l) in each beaker to control bacterial growth. The result (Figure 2, d) again shows faster growth in treated water, suggesting that growth in untreated water was retarded by the direct action of some substance and not by any increase in bacterial numbers.

BACTERIAL NUMBERS

That better growth in treated water was not due to lower bacterial numbers was also shown by counts of bacteria in the water, in experiments using magnesium trisilicate, both with and without antibiotics. The counts are total numbers, obtained by a direct counting technique of bacteria retained on a membrane (MILLAR and SCOTT, 1965). Bacterial numbers were not significantly different ($p = 0{\cdot}05$) in treated and untreated water, in the absence of antibiotics (Figure 3). In the presence of antibiotics, the numbers (Figure 3), although scarcely significantly different in treated and untreated water, tended to be higher in treated water. The evidence is clear, therefore, that faster larval growth did not result from lower bacterial numbers.

EXPERIMENTS WITH ARTIFICIAL SEAWATER

Indirect evidence may also be gained from a comparison of growth in natural seawater and artificial seawater which contains no organic substances except as impurities in the inorganic chemicals. Seven experiments were set up, using 6 releases of larvae. In each experiment, 2 controls had natural seawater filtered through glass-fibre paper, and 2 or 3 beakers had artificial seawater made to the formula given by WOOD (1961). In no case was growth slower in artificial water, and in 6 out of 7 experiments it was faster. The results of four experiments are shown in Figure 4. In one of the experiments membrane counts were made (Figure 3), and numbers of bacteria in control and artificial seawater were not significantly different ($p = 0{\cdot}05$). This was true whether or not antibiotics were used. Larvae in this experiment (Figure 5) showed no obvious improvement in growth rate.

DISCUSSION

These results taken as a whole suggest, but do not prove, the presence of dissolved matter in seawater which directly retarded the growth of oyster larvae. It is beyond the scope of the present work to investigate the nature of this harmful substance, but it might be organic. Organic substances are known to affect marine plants and animals either beneficially or adversely (LUCAS, 1955; SAUNDERS, 1957; JEFFREY and HOOD, 1958), and something is known of the effects on bivalve larvae. LOOSANOFF (1954) and DAVIS and GUILLARD (1958) showed that certain flagellates produce metabolites which are toxic to the larvae of oysters and clams, and DAVIS (1953) found that seawater at certain times could kill oyster larvae in cultures, or retard their growth. DAVIS (1960) noted a slight increase in the growth rate of the larvae of the clam *Venus* (*Mercenaria*) *mercenaria* Linnaeus in the presence of small amounts of suspended silt, clay,

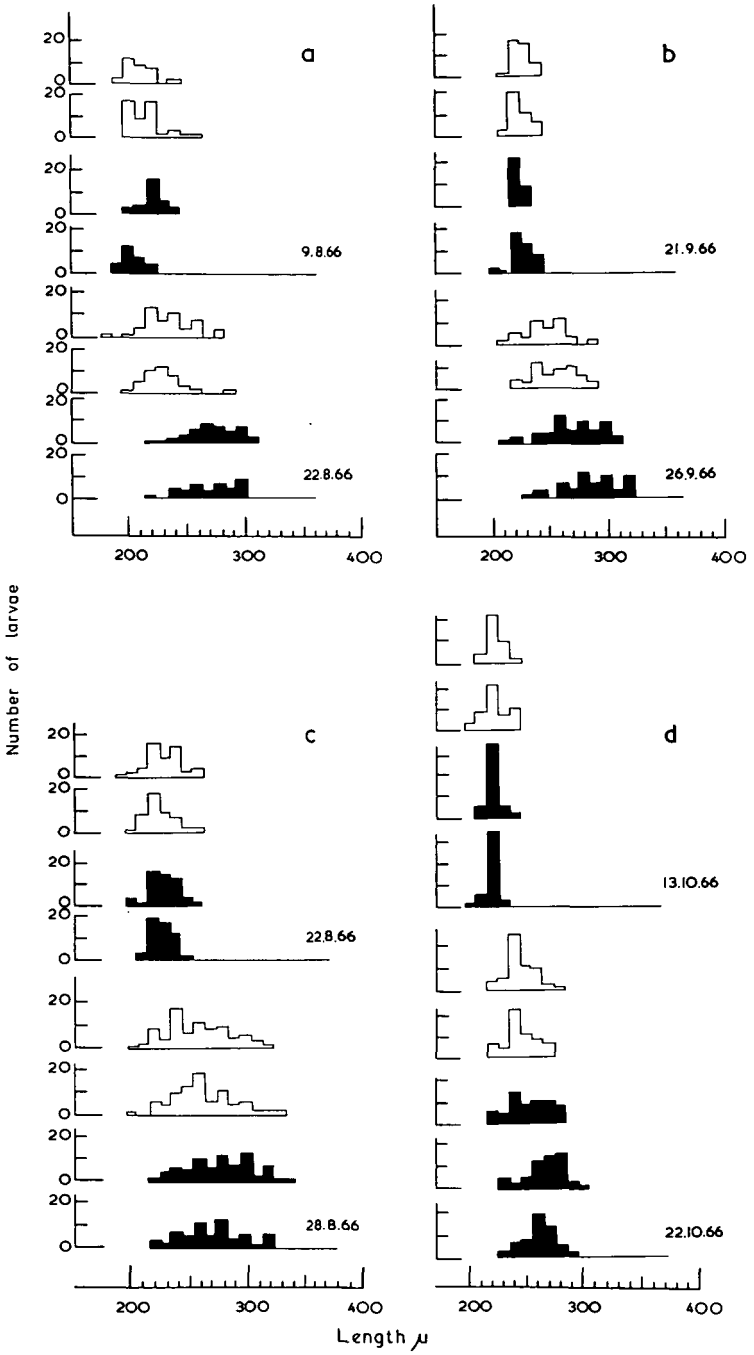

Figure 4. Size distribution of larvae, at a day during experiment and at end of experiment, in releases: a, 66/20; b, 66/25; c, 66/21; d, 66/27. Open histograms, natural seawater; filled histograms, artificial seawater.

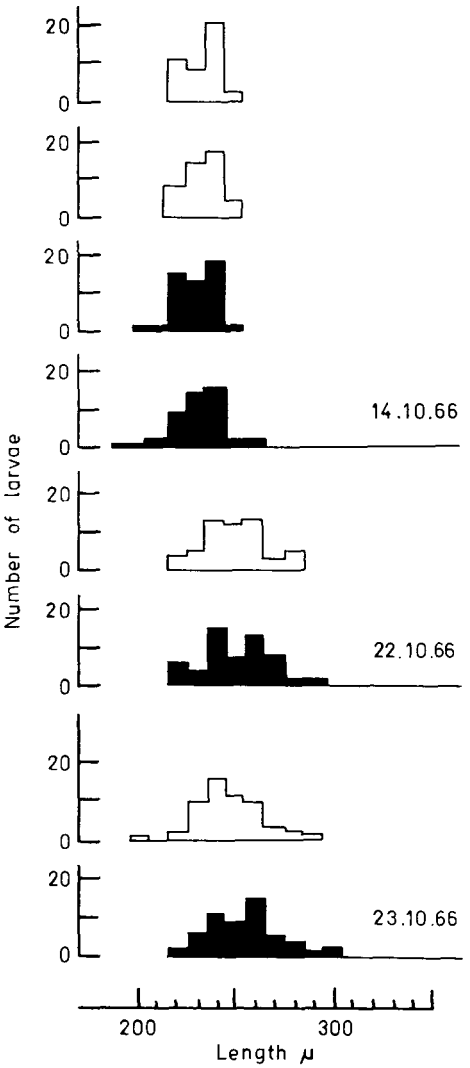

Figure 5. Size distribution of larvae, during and at end of experiment, in release 66/27. Open histograms, natural seawater with antibiotics; filled histograms, artificial seawater with antibiotics.

and Fuller's Earth. He suggested that this may have resulted from the chelation of toxic substances and the addition of positive growth factors. Our results indicate that a toxic substance is present and can be removed by adsorption, and that the harmful effect is direct rather than through the mediation of bacteria. It is suggested that a substance of this kind is responsible, at least in part and on occasions, for the failure of oyster larvae to grow in laboratory and hatchery culture, at certain periods of the year.

SUMMARY

Oyster larvae grew more slowly in untreated seawater than in seawater previously treated with the adsorbing agents Fuller's Earth or magnesium trisilicate, or in artificial seawater containing no organic matter. Bacterial numbers were not significantly different. The results suggest that a harmful substance, possibly organic, was responsible for the slower growth in the experiments, and a similar effect may partly account for the failure of larval cultures at certain periods of the summer.

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