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Temperature effect on mortality and growth of lobster (Homarus gammarus) in its first year of life.

by

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INTRODUCTION

This experiment is part of a project concerning the environmental effects of thermal effluents from nuclear power plants. The objective was to study the possible acute effect of raised temperatures on mortality of newly hatched lobster larvae. Later on a long term effect study on growth and mortality of the young lobster was incorporated in the experiment.

This paper is dealing with some of the results during the first ten months from August 1974 to June 1975. The experiment is supposed to continue for another two to three years.

MATERIAL AND METHODS

The lobster-larvae were hatched at a temperature of 14, 5°C. All the larvae originated from the same female. To get sufficient number of individuals larvae from 0 to 48 hours old were accepted.

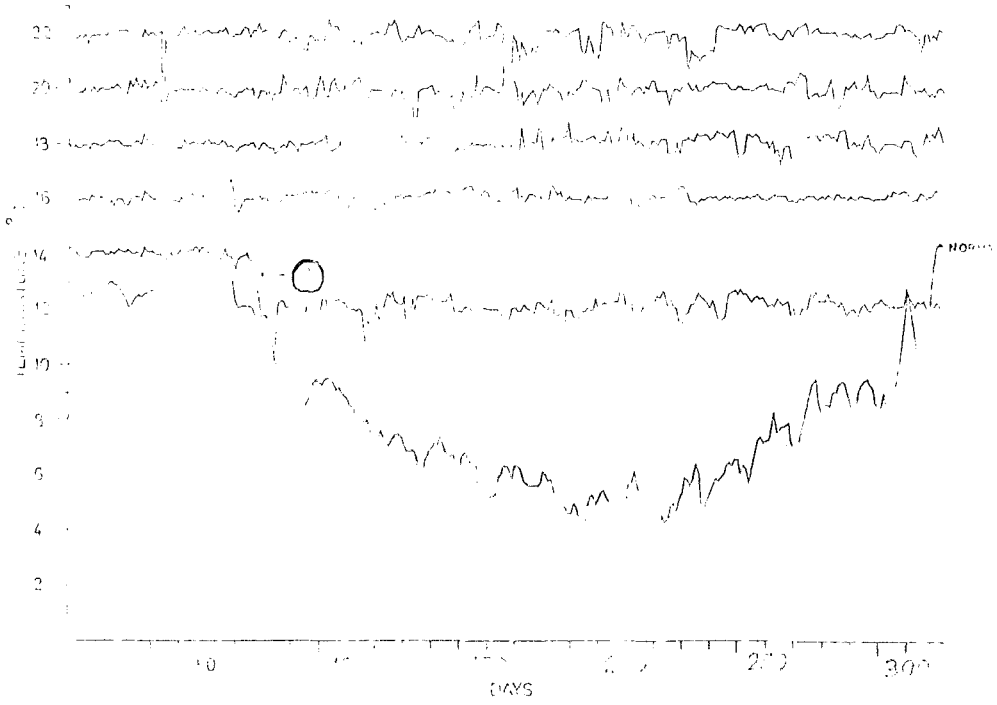

Fig. 1. The temperature recordings of the different experiments. 1 From this day the water temperature was changed from 14°C to the natural temperature conditions of the intake water at 20 m depth.

The experimental temperatures were 12°, 14°, 16°, 18°, 20° and 22°C (Fig. 1). About 70 days after start, the constant temperature on the 14°C series was exchanged with the natural temperature conditions of the 20 m intake water. The purpose was this way to obtain closed to natural growth and mortality rates for comparison (in the Figs. referred as normal). About 135 larvae were transferred from the hatchery directly to the aquaria of different experimental temperatures, where they were kept separately in small plastic boxes. The aquarium system is shown in Fig. 2. The temperature, mortality and moulting was observed every day. The length of the larvae, from the tip of the rostrum to the end of the telson, were measured to the nearest mm 14 days following each moulting. Such measurements were initiated from about the 150th day after start of the experiment. The larvae were fed in excess with small ox-liver pieces once a day (Dannevig 1928).

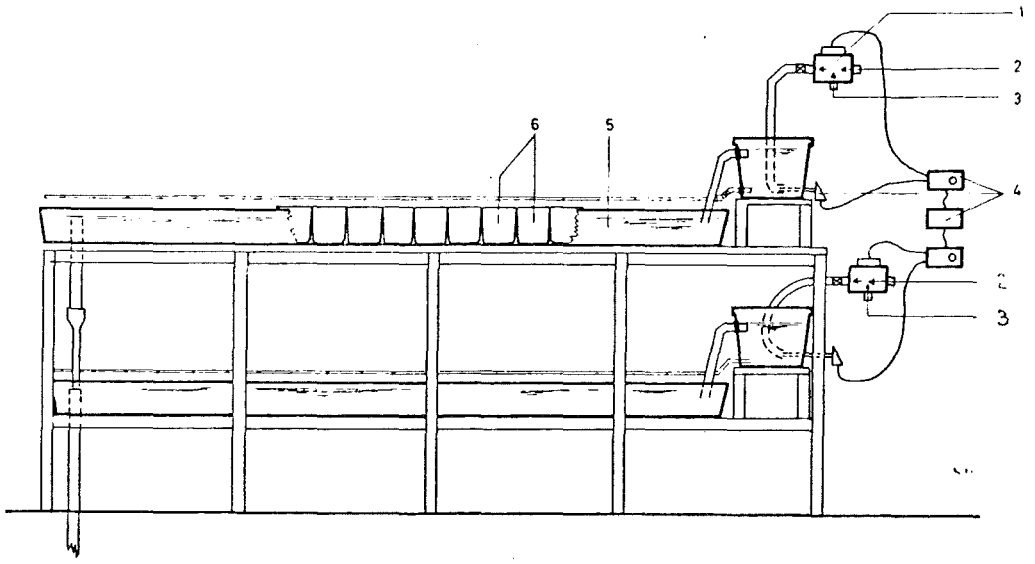

Fig. 2. The experimental set up. 1. The magnetic valve 2. Cold water 3. Warm water 4. The automatic system for controlling the valve 5. Water bath 6. Aquarium boxes.

RESULTS AND DISCUSSION

Fig. 3 shows the cumulative mortality at the different temperatures during the experimental period. The immediate mortality caused by the temperature shock in transferring the larvae from the hatchery to the experiments appeared to be relatively small. During the first 40 days a relatively high mortality appeared in all the experiments. Except for the 20°C series, the differences between the series were rather small. The higher mortality in this series cannot be explained by the temperature itself, because of the lower mortality in the 22°C series. After 40 to 80 days depending on temperature, the mortality decreased and stabilized at a low value. Under the winter conditions (temperature below ca. 6°C and after about 150 days) the mortality in the natural temperature experiment increased to a higher level than the others. Smith (1935) did not observe any increased mortality during winter conditions in his ecperiment with lobsters of the same age. However, in his experiment the winter temperature did not descend 6°C. It thus seems likely that a temperature below 6°C is unfavourable for the small lobsters.

An observed increased mortality in the 16°C experiment after about 160 days was attributed to the slippery bottom of some new plastic aquarium-boxes. These new boxes seemed to cause problems for the lobsters in moulting, and the observed mortality in this series is probably significantly affected by this special problem. Apart from the latter result the general trend is an increasing mortality with decreasing temperature conditions.

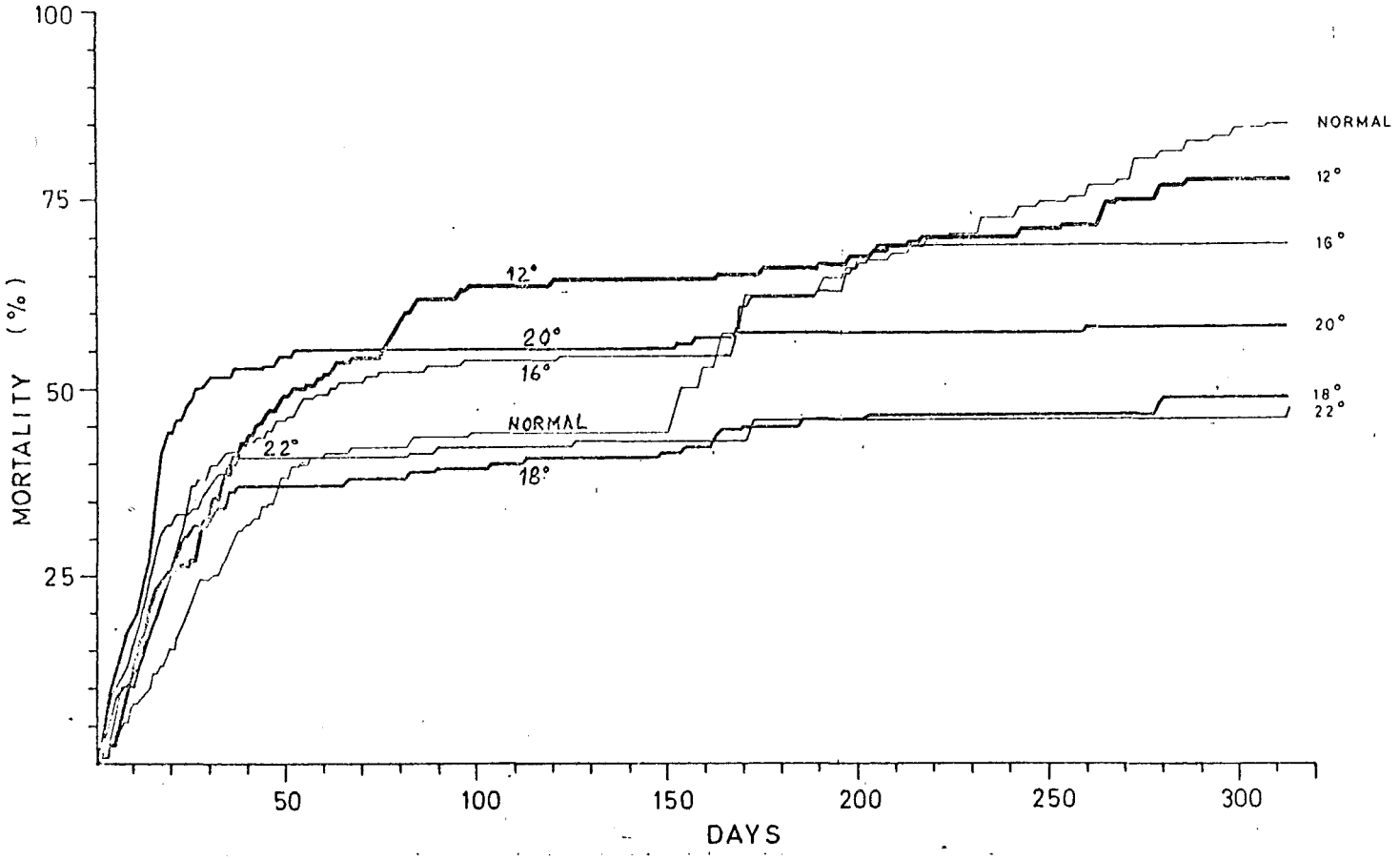

Fig. 3. The cumulative mortality of the lobsters in the different stages in the experiments.

Fig. 4 shows the mean number of days to reach the different stages of development. With higher temperatures the moulting frequency increased. Under natural temperature conditions the time between the 6th and 7th stage is very long (more than 220 days), obviously due to the low winter temperatures, which were too low to allow moulting.

Smith (1933) showed for larvae at this age that moulting ceased at temperatures under about 8°C. The mean number of days to reach the 4th stage in the six experiments were statistically significant different.

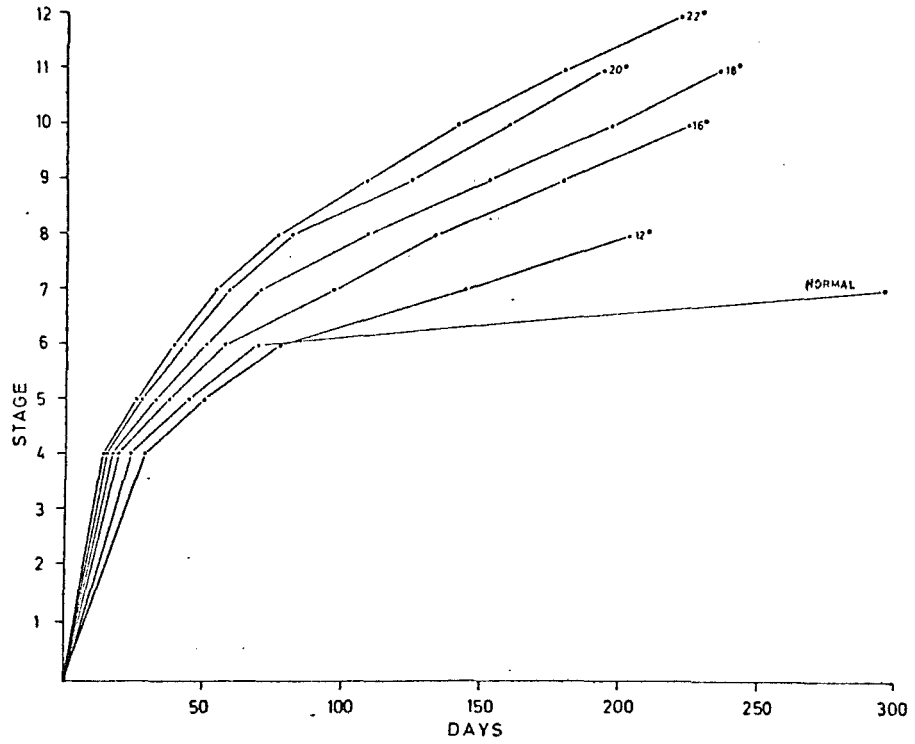

Fig. 4. The mean number of days to reach the different stages in the experiments.

Fig. 5 gives the mean total length of the different stages. The figure demonstrates clearly that for the lower stages the average length of the same stages are less in the 12°C series than in the higher. At higher stages the 22°C series demonstrate also lower average lengths than for the intermediate series. The experiment thus indicate that the optimum growth rates occur within these outer limits.

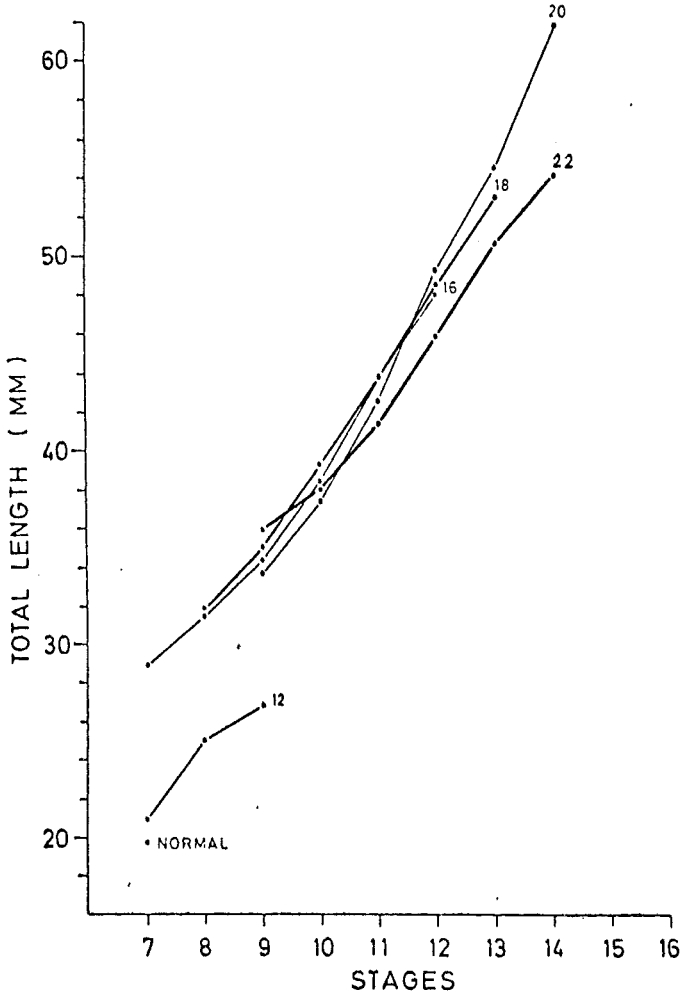

Fig. 5. The mean total length of the lobsters in the stages 7-14 in the experiments.

SUMMARY

1. Experiments with newly hatched lobster larvae have been carried out in the temperatures 12°, 16°, 18°, 20°, 22°C and at normal temperature conditions at the intake water from 20 m depth outside the biological station. The larvae were transferred directly into the different experimental series.

2. The temperature shock did not give any special increase in mortality during the first few days.

3. The highest long term mortality appeared in the 12°C experiment and in the normal temperature experiment.

4. The time from hatching to the 4th stage of development was significantly different in the six series.

5. The optimum growth rate was observed in the intermediate temperature series.

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