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PRESENT STATUS OF AN INTENSIVE COD LARVAE REARING EXPERIMENT AT AUSTEVOLL

BY

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ABSTRACT

Cod yolk sac larvae were attempted start fed on natural plankton in plastic pens. The majority of the larval groups were also hatched in these pens. None of the sampled larvae had ingested feed, and all groups died out within 16 days. The heaviest mortality occurred during the first week of development. Possible causes are discussed.

INTRODUCTION

The development program for intensive rearing of cod fry commensed at Austevoll Marine Aquaculture Station in 1979 (Jensen & al. 1979) and continued in 1980 (Huse & Jensen 1980). There are three main objectives within this program. - To develop methods for the production of large numbers of cod fry for release purposes. - To produce cod fry for the aquaculture industry. - To develop and enhance rearing methods for marine fishes.

Most emphasize has been put on the different aspects of start feeding as this is the bottleneck in the life history of the cod. In the present study, natural plankton is used, while paralell experiments with artificial diets are also carried out (Huse 1981).

Along with the production/development work this year, egg quality was monitored throughout the spawning season. Also the behaviour of the cod larvae in dense populations of zooplankton was studied.

MATERIAL AND METHODS

Spawning and egg monitoring

The brood stock consisted of 90 cod with a later supply of 17 wild cod. Six fish died late in the spawning season. The fish spawned naturally in the system discribed by Huse & Jensen (1980). Eggs were collected at least once every day. Total egg volume was measured and 20 eggs were examined to establish developmental stage, viability, and diameter.

Production and development.

Eggs were incubated in 15 m^3 plastic incubation/start feed pens floating inside one 175 m^3 and one 350 m^3 pen, 4 in the large pen and 2 in the smaller one. The incubation/start feed pens had an inner bag of 200 μ plankton gauze (fig. 1). This bag was removed 12 days after hatching. The purpose of

the bag was to increase the prey density of the larvae during the first phase of start feeding by keeping the larvae and the plankton in a small volume. It also facilated the removal of unvanted groups of eggs or larvae. All the incubation/start feed pens had plastic covering. This cover was opaque white in the first series of experiments, but as this caused a high production of diatoms in the pens the lids were later supplied with black plastic covering. The pens were continously supplied with water at the surface and were drained through surface and bottom outlets. Ca. 500 ml of eggs (ca. 300 000) were incubated in each pen.

Plankton from the collecting/consentrating system described by Jensen & al.(1979) and Huse & Jensen (1980) was distributed to the pens from 4 days after mean hatching. Samples were taken every day with a perspex tube. Each sample contained 1 per mille of the pen volume. The samples were filtered, the larvae picked out , and the plankton counted on a particle counter (HIAC PC-320).

Behaviour studies

The observation chamber was 35 x35 x 10 cm, vertically oriented, and illuminated by a dark red bulb over and to the left side of the chamber. Observations were done directly and also with recording video equipment. Water and larvae were introduced in the chamber 30 minutes before an observation period.

RESULTS AND DISCUSSION

Spawning and egg monitoring

The spawning season started at the end of January and lasted to 10th of April (fig. 2). A total of 229.6 l of eggs were collected during 72 days, giving a daily average of 3.2 l. With an estimated number of 600 000 eggs/l the average daily yield was 1.92 million eggs with a maximum of 7.14 million one day (12th of February) and a total of 138 million eggs for the whole season (fig. 2).

The temperature in the spawning pen decreased from 6°C in

late January to 4 °C in early April (fig. 2). There seemed to be no correlation between temperature changes and egg amount.

Fig. 2 shows the development of egg diameters throughout the spawning season. The regression line clearly indicates a decline in mean diameter during the season. A similar decline is described by Sivertsen (1935) and Dannevig (1921). Sivertsen's (1935) material seemed to indicate that there is no clear cut relationship between fish size and egg diameter. Snorre Tilseth (pers. comm.) has found an initial low egg diameter with an early increase and then a slow decrease lasting throughout the spawning season for individual fish. This should indicate that a large proportion of the brood stock participated in the spawning most of the season

In the daily egg samples a total of 1640 eggs were investigated. Of these 3.0% were not fertilized, while 4.8 % were dead or misdeveloping.

Production and development

Two egg groups were incubated 26th of February in the two incubation/start feed pens of the smaller production pen. The hatching results were very poor although there was no visible attack of fungi, which normally is the most frequent cause of mortality during incubation. Due to this heavy mortality the experiment was discontinued. Almost all the eggs had spikes of diatoms piercing the shell making them look like sea urchins. Whether this caused the mortality is, however, uncertain.

The same two pens were started up again with new egg groups 19th of March. Before incubation the pens were emptied,hosed down, and supplied with black lids to avoid algal growth. Hatching results were good (> 50%). The average myotome heights of the newly hatched larvae were 0.20 and 0.24 mm. Natural plankton was pumped into the pens from day 4 after hatching. Densities of prey between 100 and 200 µ were > 1000 per l at day 7 (data not fully processed yet). The samples showed that no larvae had ingested feed at all,

and after 14 days all larvae were dead.

To investigate whether the mortality was caused by poisonous components in the water several thousand larvae hatced in indoor incubators were released in both of the two pens. The larvae were found in decreasing numbers in the samples, and after 5 hours no live larvae were traceable. To verify this result a 10 l container of the pen water was brought to the lab. A similar container with surface water acted as control. Two hundred larvae were released in each container. Fourteen hours later all larvae were dead in the pen water container while no mortality was observed in the control group. The pen water is now being analyzed.

Egg groups were incubated in two of the four incubation/start feed pens in the large production pen (fig. 1) 30th of March and 7th of April. The other two pens were supplied with larvae from the indoor incubators hatced 15th and 17 th of April respectively. Mortality patterns of these groups are given in fig. 3. The mortality patterns are very untypical as the mortality rates were higher the first days than at the expected time of mass mortality due to starvation.

No larvae sampled had stomack content in spite of prey densities of between 1000 and 4000 per l in the pens. These results are bound to have a complex causation as no single treatment is likely to have this effect alone. The following suggestions might be offered:

- Interaction larvae - larvae. The group with the higest larval density has the higest initial mortality and is levelled down with the other groups after a few days.
- Interaction larvae - plankton. Too high densities of lively prey, and also coarser plankton, might disturb the feeding behaviour of the larvae and also cause exstra stress. This will be verified later in this paper.
- Mechanical damage. The larvae had a tendency to adhere to the walls of the inner bag of plankton gauze. This effect was partly due to a surface current created by the injection of plankton and water, which might itself also disturb or harm the larvae.

These possibilities are all related to the use of the plankton

gauze bags as densities and also mechanical stress would be less without them. Last year's, in comparison, successful results were obtained without inner bags.

Other possible explanations might be:
- Poisoning (under investigation).
- Diseases.

Behaviour studies

The behaviour studies carried out this season were preparatory and the main objectives were to establish procedures, equipment and techniques for futher work. However, the results with a group of starving larvae supported the results of Tilseth and Strømme (1976), showing an active period from day 2 to day 11, although within this period there seemed to be a more marked activity peak around days 6 and 7.

A small experiment was also carried out with both larvae and plankton.With no plankton present the darkest corner of the observation chamber held the largest part of the larvae. When, however, living plankton from the pumping system was released together with the larvae this corner was occupied by the plankton. Copepods also on several occasions caused violent avoidance reactions of the larvae. This segregatory behaviour might create very high densities of larvae and subsequent disturbance of feeding behaviour in a restricted volume.

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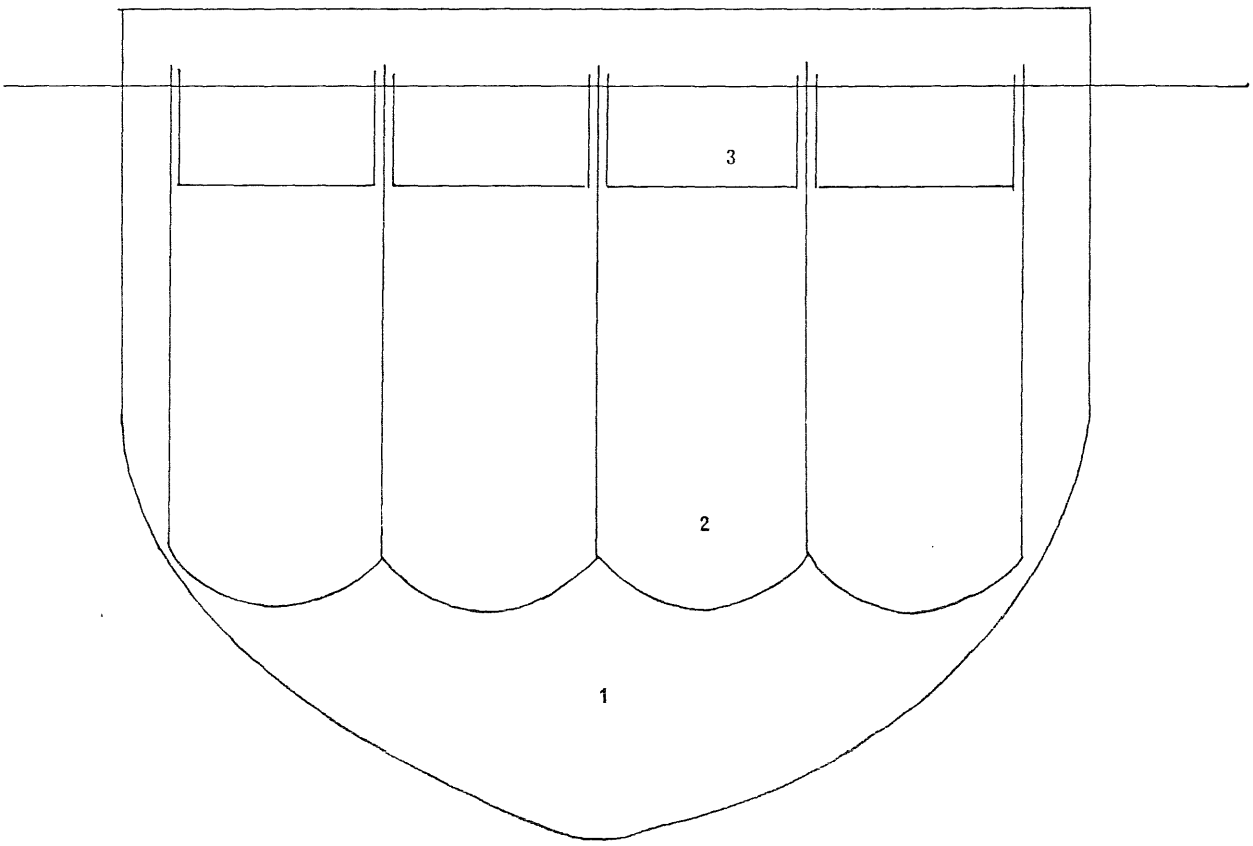

Figure 1. Pen arrangement. 1) Large production pen. 2) Incubation/start feed pen. 3) Plankton gauze bag.

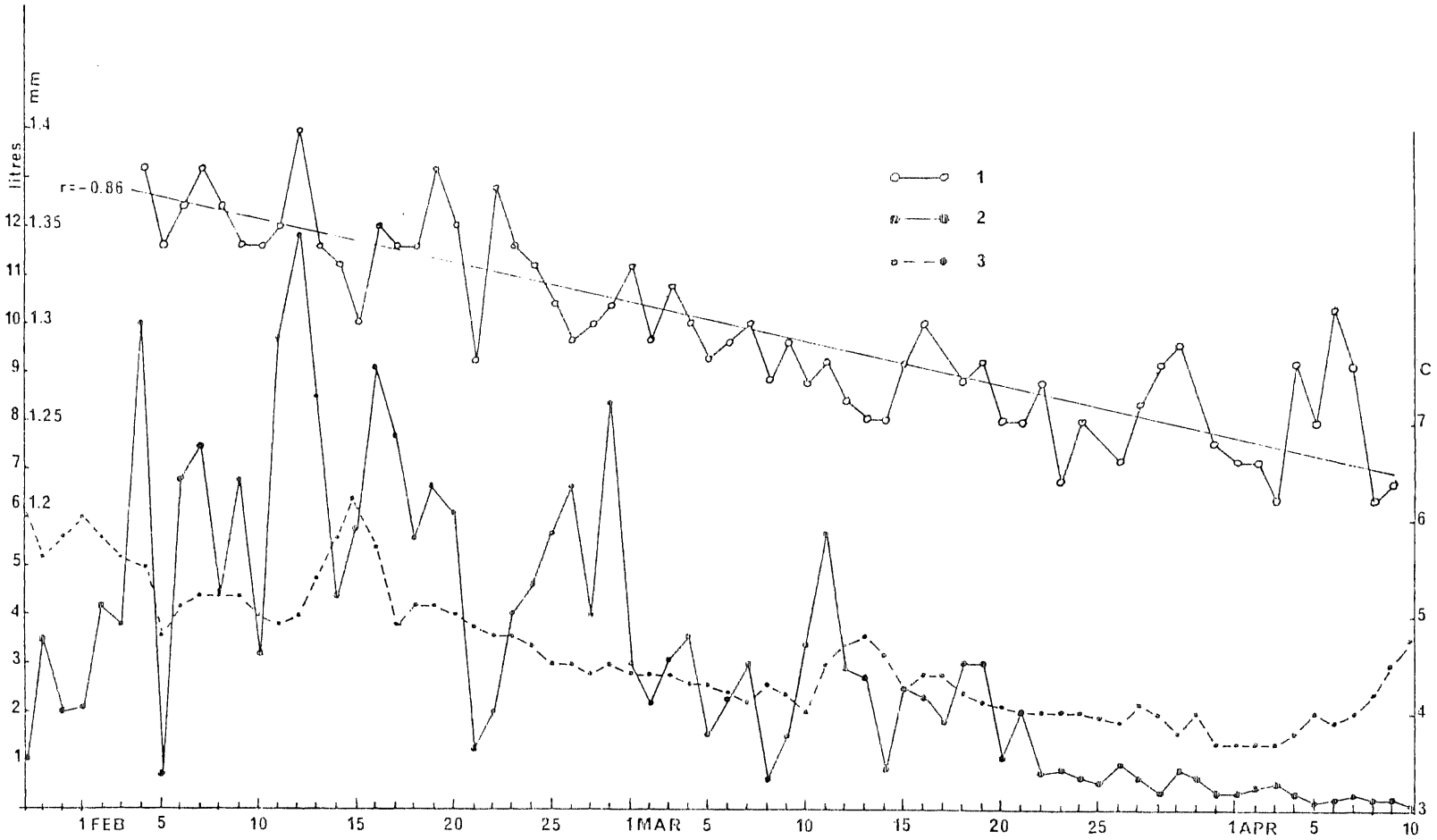

Figure 2. Egg amount, temperature and egg diameters. 1)Egg diameter(mm). 2)Egg volume(l). 3)Temperature(^{O}C).

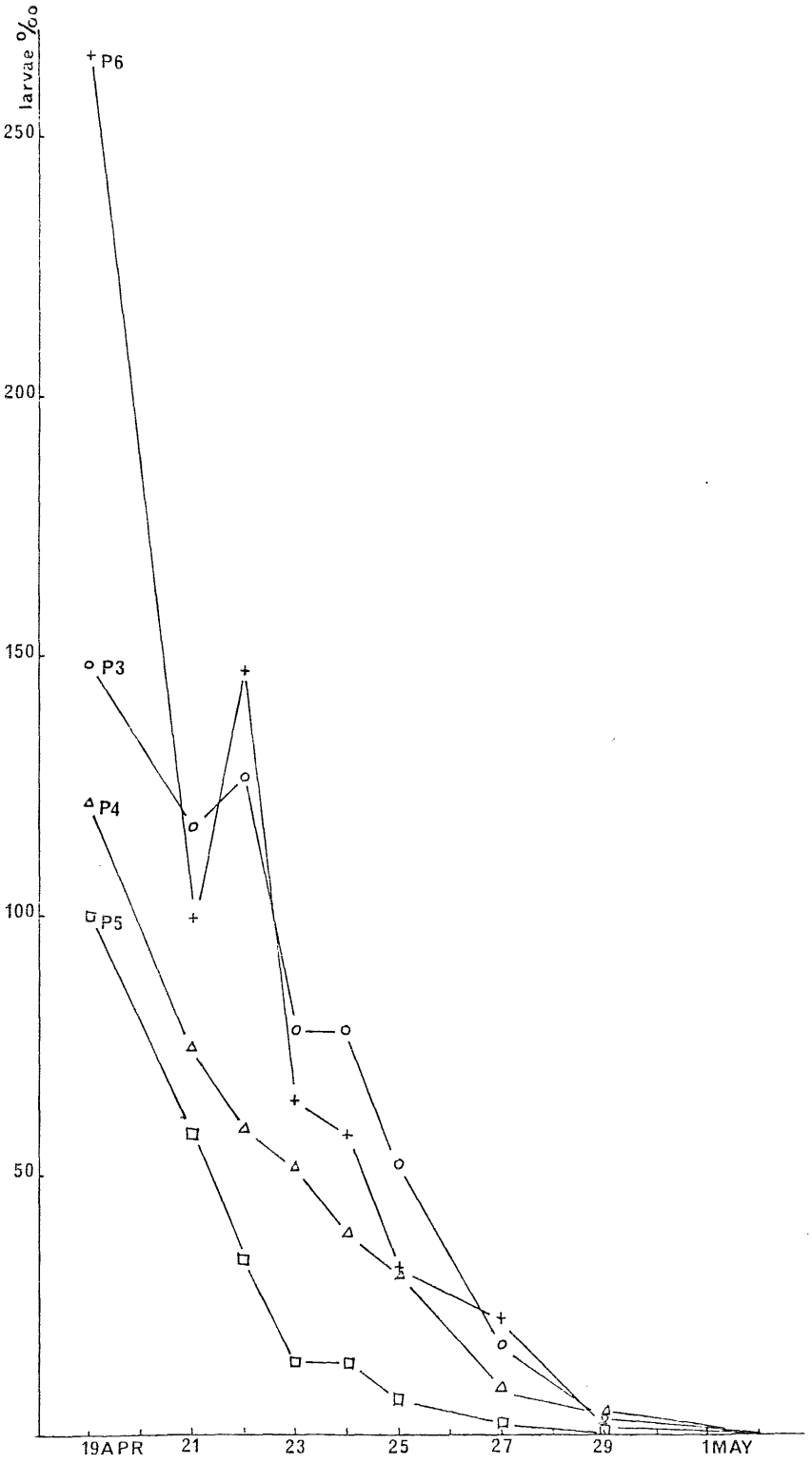

figure 3. Mortality patterns for different larval groups.