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STATUS OF AN INTENSIVE COD REARING PROJECT IN NORWAY

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ABSTRACT

Cod yolk sac larvae were start fed with natural plancton in plastic pens. Eggs were obtained from a plastic spawning pen where cod spawned naturally. An attempt to incubate eggs directly in the start feed pens failed. Planctonts were collected with two propeller pumps coupled to double gauze cones. Hoses led the plancton to a collecting bag from where it was distributed to the pens by an automatic pump. Survival through start feeding was 2,5 - 5%. A yet unexplained heavy mortality occurred 70-100 days after hatching.

INTRODUCTION

Substantial research concerning the production and release of large numbers of marine larvae has been carried out in Norway during the last 80 years (Dannevig 1895, Rollefsen 1940, Dannevig and Dannevig 1950, Dannevig and Hansen 1952, Øiestad et al.1975). Special emphasize has been put on cod as it is the most important species in Norwegian fisheries.

Although the effort has been great, the progress towards a successful release programme has been slow. This indicates that the problem is complicated, but that a proper solution will make the struggle worthwhile.

Rearing of cod fry in floating PVC-coated fabric pens commenced at Austevoll in 1979 (Jensen et al.1979). The initial 60 000 yolk sac larvae of this experiment yielded a 1% crop of 60 mm young cod. This rather promising result led to an increased effort along the same lines in this year's experiments.

MATERIAL AND METHODS

The general set-up of both pens and plancton collecting pumps is described by Jensen et al. (1979). In 1980 a 350 m^3 production pen was used, with four 15 m^3 incubation/start feed pens floating inside it. Eggs were collected from a spawning pen of 175 m^3 (Fig. 1) where a brood stock of approximately 100 coastal cod spawned naturally. The water column in the spawning pen was rotated both horizontally and vertically by means of water nozzles to make the eggs available for the collecting net. The overflow filter had a mesh size greater than the egg size to avoid clogging and to get rid of eggs which were not stopped by the collecting net. This also assured homogenity in the egg groups. The water introduced through the nozzles was taken from 55 m depth to maintain stable temperature and high salinity.

Eggs were first incubated directly in the start feed pens, but most eggs failed to hatch, and the few hatched larvae suffered a very high mortality. The experiment was therefore discontinued.

By that time, however, the spawners were spent and eggs had to be obtained from Flødevigen, Arendal. These eggs were incubated in the indoor incubating system described by Jensen et al. (1979). About 150 000 3-day old larvae were transferred to three of the 15 m^3 pens 10th to 15th of May.

The plancton collecting system consisted of two propeller pumps (Jensen et al. 1979) with double plancton net cones. From the ends of the cones a hose led the plancton to a floating gauze bag, and from this bag it was distributed to the rearing pens with a pump monitored by an interval switch. The plancton fraction used for start feeding (120 - 350μ) mainly consisted of copepod nauplii and small copepodites. A particle counter (HIAC PC - 320) was used as an aid to determine zooplancton densities both in the pens and in the sea. Sampling in the pens was carried out with a Ø 65 mm "Perspex" tube with a length corresponding to the depth of the pens (5,5 m).

In the middle of June the three 15 m^3 pens were emptied out into the 350 m^3 pen where the young cod now were fed with grown copepods from the plancton pumps. Here the fish stayed until the middle of July when it was moved to a net pen.

RESULTS AND DISCUSSION

Spawning

In the 1979 experiment the spawners were stripped. This method gave unpredictable results both with regard to egg qualities and fertilization rates. The natural spawning in the spawning pen (Fig. 1) of this year's experiment gave very good results in all respects. Fertilization rates were high (>90%) and technical operation of the system was very simple. Egg quantities and temperatures are given in fig. 2. During the spawning season a total of 108,3 l of eggs were collected, averaging 2,8 l per day. With an estimated amount of at least 600 000 eggs per liter the total yield was 65 million eggs averaging 1,7 million per day with a maximum of 4,8 million in one day.

Dannevig (1930) and Sivertsen (1935) showed a clear correlation

between spawning intensity and temperature. Fig. 2 confirms these findings. Before the 29th of March the spawners responded to changes in temperature while after this date the fish were mostly spent and thus unable to respond.

Altogether this system seems a likely solution to the problem of obtaining large groups of good eggs over a long period with a minimum of effort.

Incubation and hatching

The initial attempt to incubate eggs directly in the pens under stagnant conditions failed. Other similar experiments have suffered the same fate (Solemdal, Tilseth, Øiestad, pers.comm.). A variety of explainations may be offered: There definitely were signs of fungi on the eggs. The pens were not covered, thus allowing UV-radiation to enter. The eggs and larvae might have been poisoned by components contained in the coating of the pen fabric. A small experiment with yolk sac larvae in a 100 l bag of the same material supports this theory. Most likely the total result is a cumulative effect of the mentioned causes. With these factors under control, however, fatal environmental differences between the pens and the indoor incubators are not readily seen.

The hatching persentage in the indoor incubators was around 50. This rather poor result was caused by an attack of fungi in two of the groups.

Mainly due to the rather long incubation period of cod eggs the control of fungi seems to be a vital point in mass rearing of cod larvae.

Start feeding

The failure of the first incubation caused the eventual start feeding of the larvae to take place at a rather unfavourable time with regard to the availability of suitable prey organisms. The first cohort of Calamus finmarchicus had already grown out of the ideal size range, and the second cohort had yet to be hatched. The plancton consisted mainly of copepodites and bivalve

larvae. The latter are believed to be undigestable for cod larvae (Tilseth, pers.comm.).

The first day after the release of yolk sac larvae in the pens the sampling showed a stable number per volume. There might, however, have been an initial mortality in connection with the transport and release as a stock estimate on the samples only amounted to half the number released. Avoidance might have played a role but could hardly have accounted for such a discrepancy. 70% of the start feeders had stomack content from 2 days after the release. A faulty sampling tube caused a pause in the sampling, and during this period the expected starvation mortality occurred. 17 days after mean hatching a stock estimate based on sampling showed a 2,5% survival from the number released. Compared with the estimate from the day after release, however, the survival was 5%.

Postlarval mortality

The 15 m^3 pens were emptied out into the 350 m^3 pen 37 days after mean hatching. The postlarvae were not counted to avoid handling, but a rough visual estimate indicated a number in the order of magnitude of 3 000. The fish were now fed plancton between 350 and 4 500 μ.

15th of July the now 70 day old fish were transferred to a net pen and counted and measured. The total number was 1 075 fish with a mean length of 54 mm and a mean weight of 1,5 g.

A later count 12th of August gave a total number of 360 fish. The cause of this rather unexpected mortality is under investigation. Mean length had now increased to 89 mm while mean weight was 6,4 g.

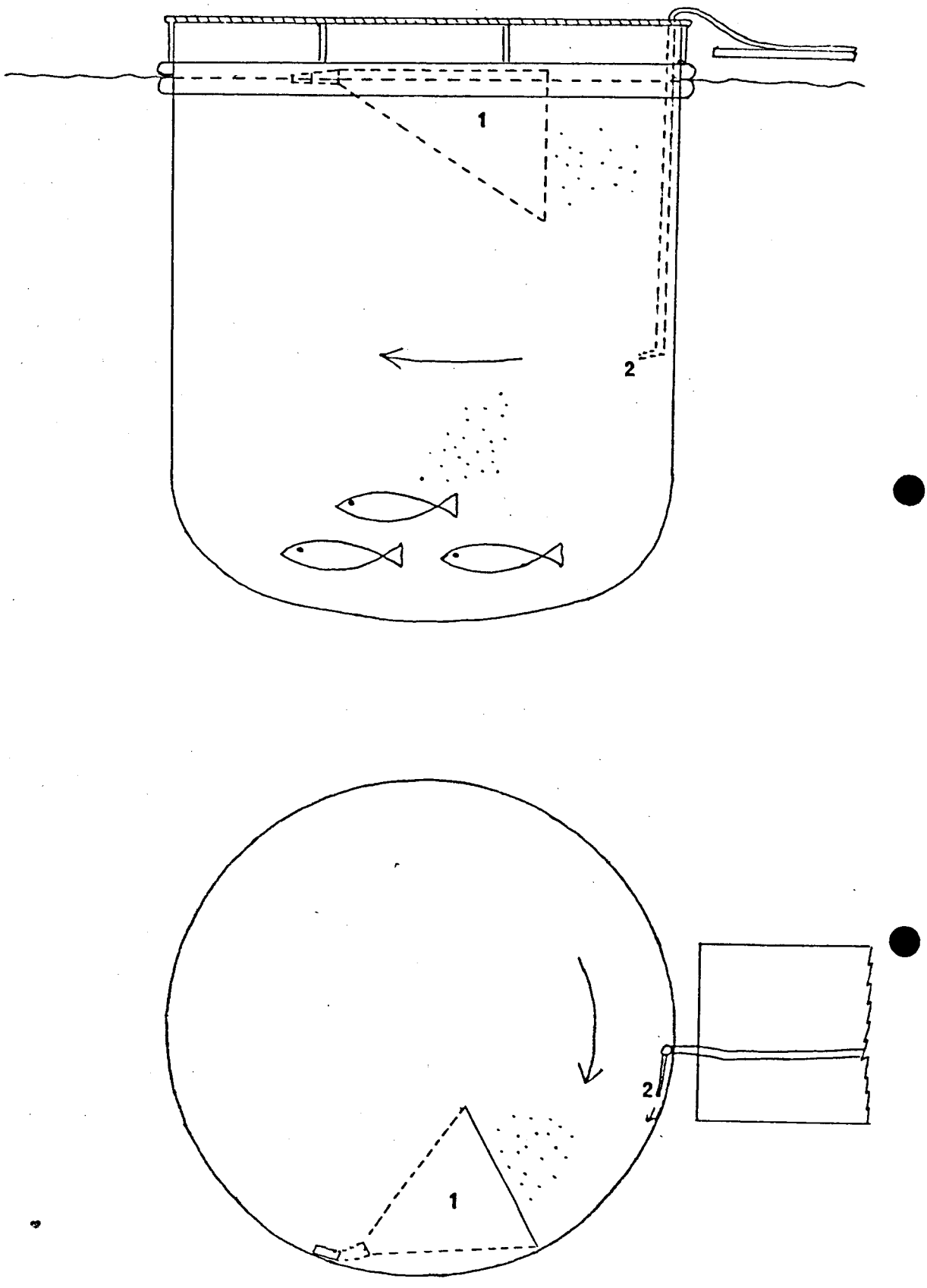

Fig. 1. Spawning pen arrangements.
1) Collecting net
2) Horizontal water nozzle

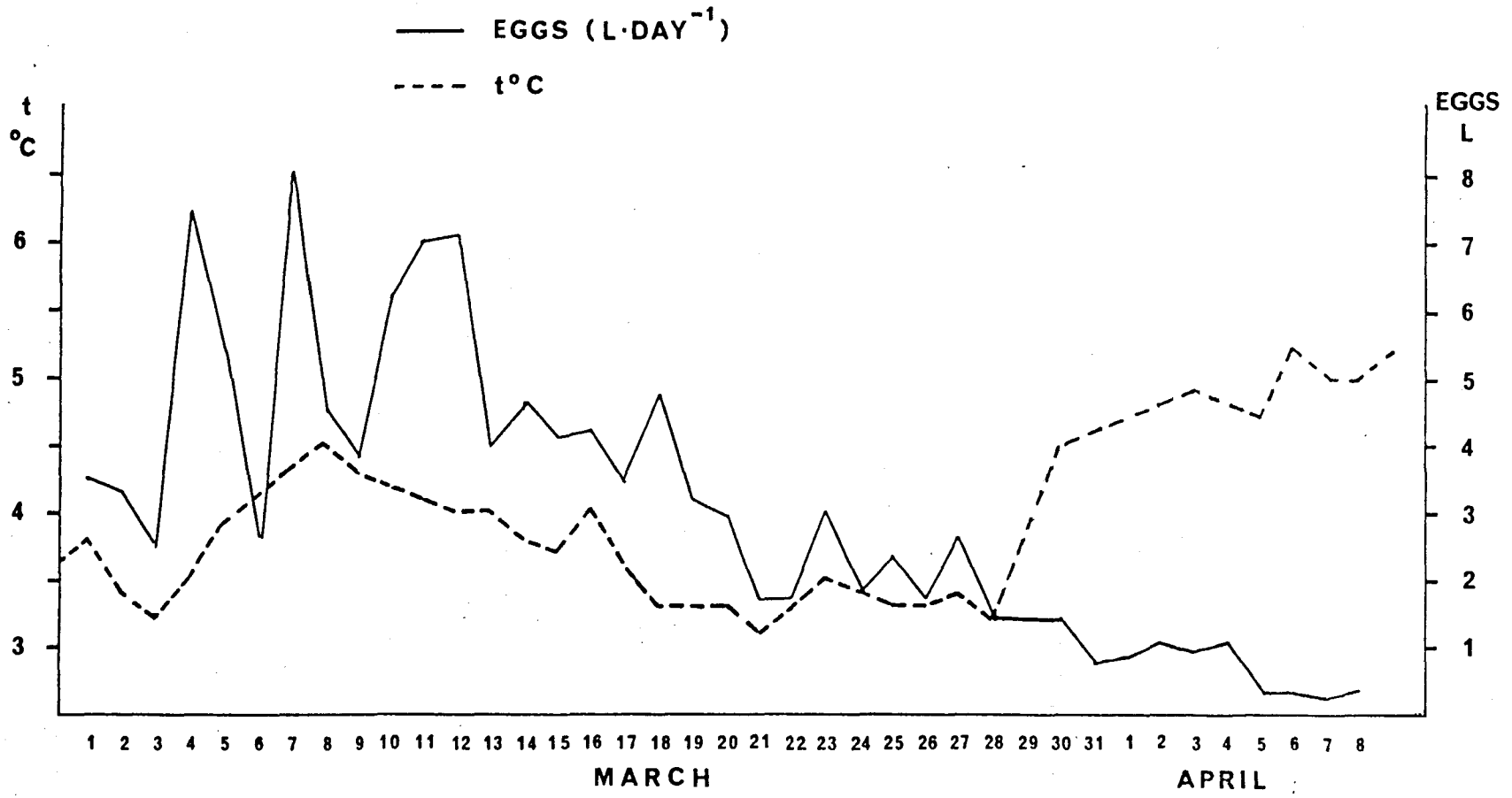

Fig. 2. Daily egg amounts and temperatures during the 1980 spawning season.

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