International Council for
the Exploration of the Sea

C.M. 1985/F:22
Mariculture Commitee.

PILOT SCALE STUDIES OF INTENSIVE COD FARMING IN NORWAY

by

P.G.Kvenseth, B.R.Braaten + and S.L.Gokstad.

Insitute of Marine Research,
Austevoll Marine Aquaculture Station, N-5392 Storebø, Norway

+
present adress: NIVA, P.Box 333 , Blindern
N - 0314 Oslo 3, Norway

ABSTRACT

Cod fry produced in a seawater pond at Austevoll, Norway were used in a farming experiment. Cod larvae were start fed on the natural plankton in the pond. Additional feeding with dry pellet started when the fry were 60 days old. The mean weights were 2,5 g when 5.000 cod fry were transferred from the pond to farming facilities at the Aquaculture Station in late May. Small fish were kept in tanks. As the fish grew larger, they were transferred to net pens. Small fish were fed dry pellet, while larger fish were fed moist pellet. Weight of different groups varied between 0,5 kg and 1,0 kg after 21 months. Total survival was less than 20%, losses were caused by cannibalism, vibriosis, predation and accidental holes in the netpens.

INTRODUCTION

Successful production of cod fry in the Hyltro pond in 1983 gave the opportunity to initiate farming experiments where the whole life cycle of the cod could be controlled in captivity. The fact that reared cod fry are available in great numbers have several advantages for farming experiments. The experimental fish can be sorted out from large groups giving homogenous size groups, in addition exact age and background of fish are known.

MATERIALS AND METHODS

Cod larvae were start fed in the pond (Øiestad et al. 1985). The fry were caught in the pond by the use of dipnets in the period June 23th to July 1th 1983. The fry were transported to Austevoll Marine Aquaculture Station in containers. The fish were graded and the intermediate group (between smolt grid 6 and 7) were distributed in two groups each with 2500 fish in 1.7 m3 circular tanks. The tanks had continously water exchange, and were supplied with deep water (55 m). The first part of the experiment was run from July to December. One of the groups was transferred to a 50 m3 net pen in early September.

Both groups have been counted and measured monthly. The fish were fed dry pellets, from automatic feeders during their first month in captivity and by hand three times a day the rest of the experimental period. During outburst of vibriosis the fish have successfully been treated with oxytetracyclin mixed in the feed.

In December the cod fry were graded in three groups, and set up in an ongrowing experiment. Group small (< 20 g), group medium (20 - 50 g) and group large (> 50g). Group medium and large were kept in 50 m3 net pens the whole experimental period, until December 1984. Group small was kept in tank until October 1984 when it was transferred to a 50 m3 net pen.

Due to stop in the water supply the small group died and a new small group was established in February 1984. All groups were fed ad libitum every day except Sundays. The diet was changed 10.04.84 from dry to moist pellet (45% acid conserved caplin, 55 % pellet meal) and again on the 14.05.84 to a diet with better consistence : 10% caplin, 40 % frozen caplin, 40 % caplin meal, 10 % pellet meal. All groups were counted monthly and a sample of fish weighted. In calculating the conversion efficiency factor (CF) in a period t(1) - t(2) we used:

$$CF = I/((W2 - W1)(N1 + N2)/2)$$

Where I is intake of food
W is mean weight
N is number of fish alive.

For loss of fish we used two categories:

1) Dead, found dead in tank/pen
2) Disappeared, lost but not found dead.

Before weighting, the fish were starved for 24 hours and then anaesthetized with benzocain soluted in alcohol. Temperature in farming facilities were measured daily. Net pens were changed monthly during the summertime because of heavy fouling from alga.

RESULTS AND DISCUSSION

Period June 83 to December 84

The fish in both groups increased their mean weigth from 2.5 g in June to 30 g in December. The temperature varied between 7^0C and 13^0C. Total loss of fish were respectively 46% for the tank group and 57% for the tank/pen group.

Out of these 28 % of the fish in each group disappeared without beeing found in the tank/pen. The reasons for this may be several: cannibalism, in addition small fish (2.5 - 5 g) quickly disintergrate at summer temperature and can escape through bottom sieve in experimental tank or through mesh in net pen. Escape through holes in the net pen as well as predations from birds or minks can not bee excluded.

Ongrowing period, December 83 to December 84

The temperature in the tank (Fig. 1a) increased from 6^{0}C in March - April to 9^{0}C in September. The pen temperature decreased from 8^{0}C in December to 4^{0}C in March, and increased again during spring and summer to 13 - 14^{0}C. The number of fish in the net pens were heavily reduced during the winter and spring.

The medium group was reduced with 80% in the period: December to June. In the same period the large group was reduced with 40%. The number of fish in the small group (in tank) in the period February to June remained nearly constant (Fig. 1c).

Most of the reduction were caused by fish that disappeared, (medium 77%, large 32%), (Fig. 2c, 3c and 4c), the reasons for this reduction may be several. One possible explanation is cannibalism, this have been observed several times in tank experiments with cod, even with well graded fish.

Assumebly the cannibalism would be the greatest problem in the small and large group because of the grading and less in the medium group because this contains the most homogenous sized cod.

When the disappearance is greatest in the medium group and almost lacking in the small group (in tank) where the fish density in addition was higher, cannibalism can hardly be the explanation. Some of the reasons can be found in the level of control with the different rearing systems. The only way for a fish, this

size to disappear from the tank is by cannibalism. From a net pen the fish have several possibilities to disappear. The cod have a different behaviour in the pen, compared to salmon and trout. It swims along the net walls and bottom and finds easily holes. Predation mostly from herons and mink have also been observed.

The three size groups of cod reached a mean weight 21 months after hatching of respectively 500 g, 800 g, 1000 g (Fig. 2a, 3a, and 4a).

Conversion efficiency varied during the experimental period (Fig. 2b, 3b and 4b). Generally the conversion efficiency was below 1.5 during spring but increased to 2.0 - 3.0 during summer and fall.

Intensive farming of cod in Norway are now possible. The whole life cycle can be controlled in captivity. The growth and conversion efficiency are acceptable, but to develop a profitable cod farming, the heavy disappearance of fish must come under control.

ACKNOWLEDGEMENTS

This study was made possible by funds granted by ELF Aquitaine Norge A/S.

LITTERATURE

ØIESTAD, V., Kvenseth, P.G. and Folkvord, A., 1985. Mass-production of cod fry in a pond in Western Norway, with additional feeding post metamorphosis. Trans. Amer. Fish. Soc. (In press).

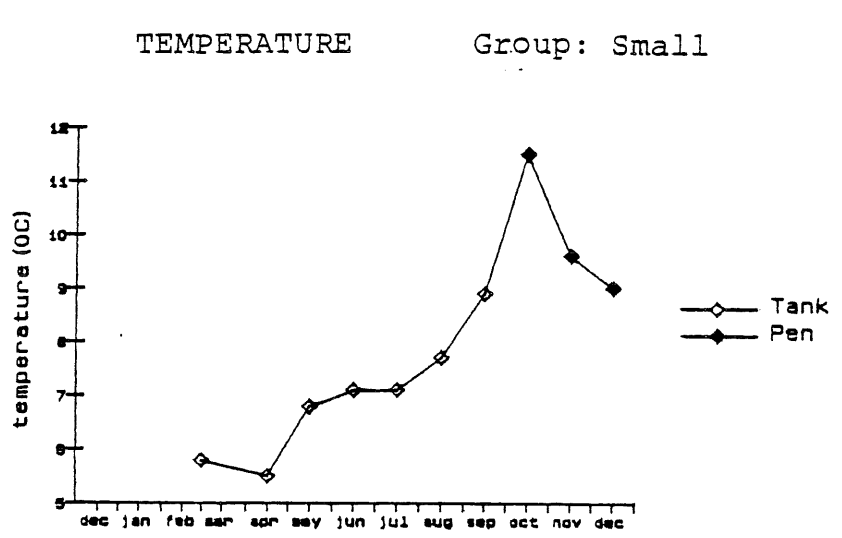

Fig. 1a Temperature during the ongrowing period measured in the tank (group: small).

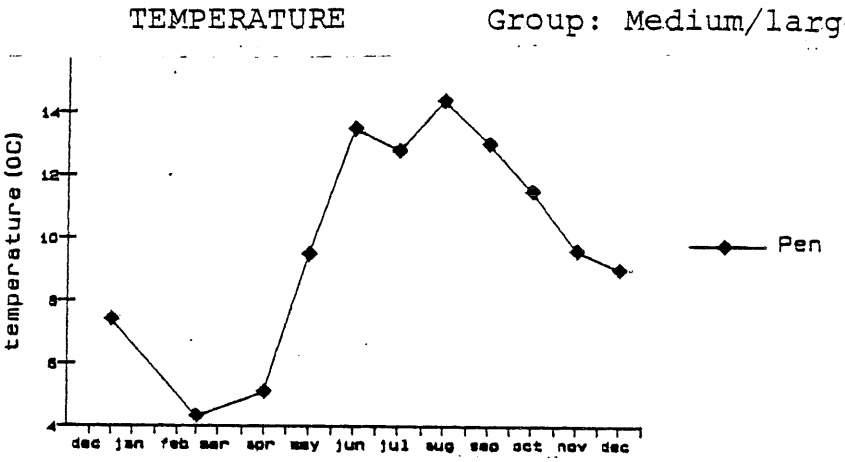

Fig. 1b Temperature during the ongrowing period measured at 2 m depth in the pen (group: medium and large).

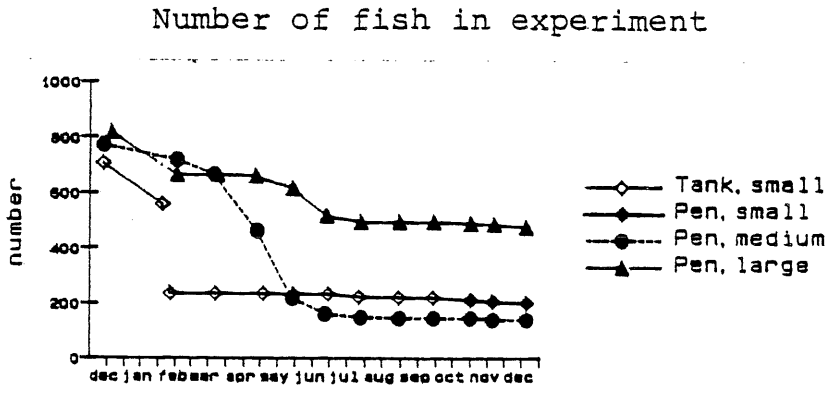

Fig. 1c Survival curve for fish in the experiment, from December 83 to December 84.

DATA FOR GROUP: SMALL

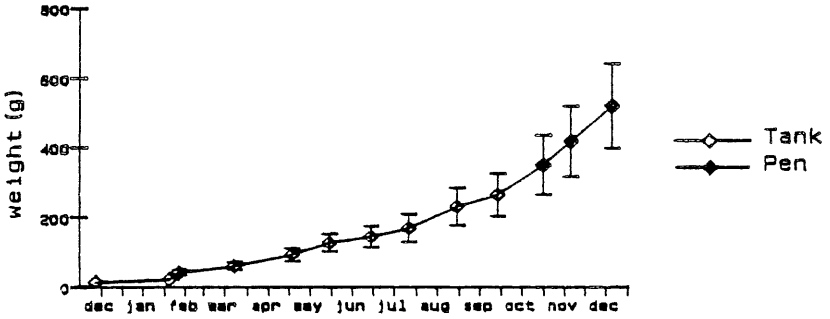

Fig. 2a Growth of fish in the experiment, mean monthly weight (g) SD.

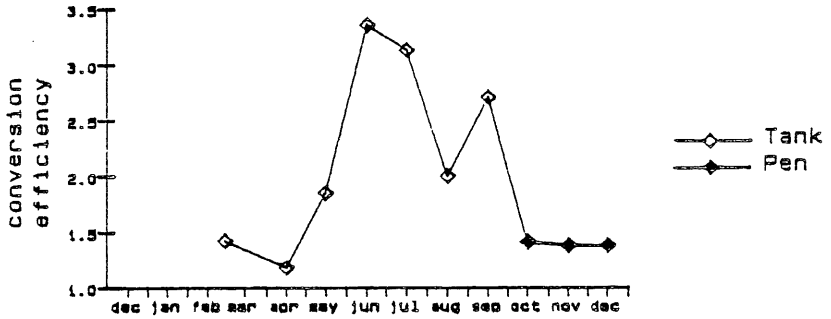

Fig. 2b Growth conversion efficiency on a wet basis, calculated for each month during the experimental period.

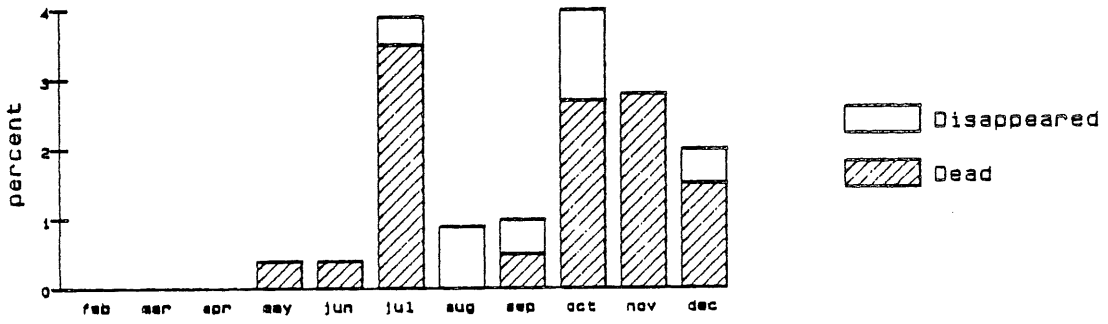

Fig. 2c Dead and disappeared fish on a monthly basis, given as percentage of the number alive previous month.

DATA FOR GROUP: MEDIUM

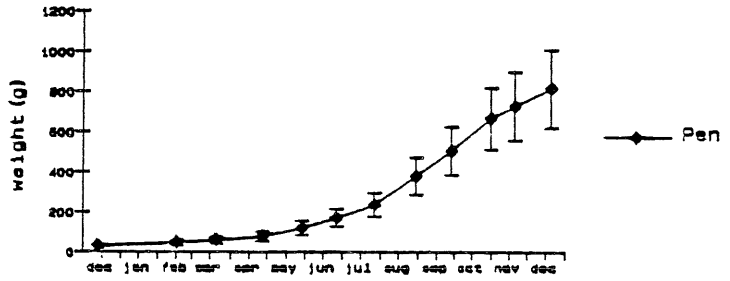

Fig. 3a Growth of fish in the experiment, mean monthly weight (g) SD.

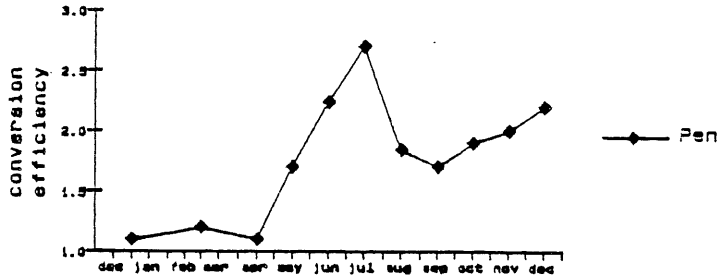

Fig. 3b Growth conversion effiency on a wet basis, calculated for each month during the experimental period.

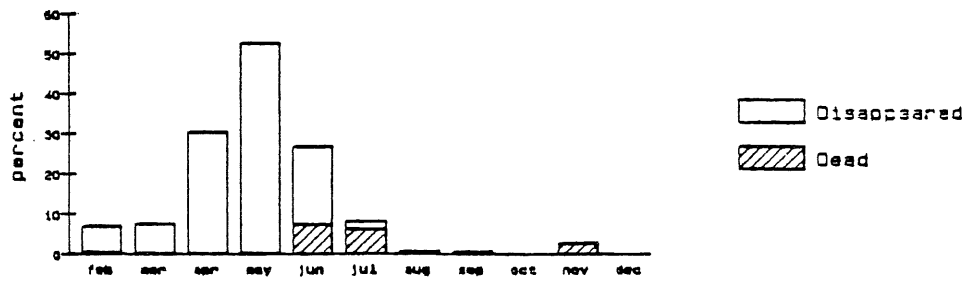

Fig. 3c Dead and disappeared fish on a monthly basis, given as percentage of the number alive previous month.

DATA FOR GROUP: LARGE

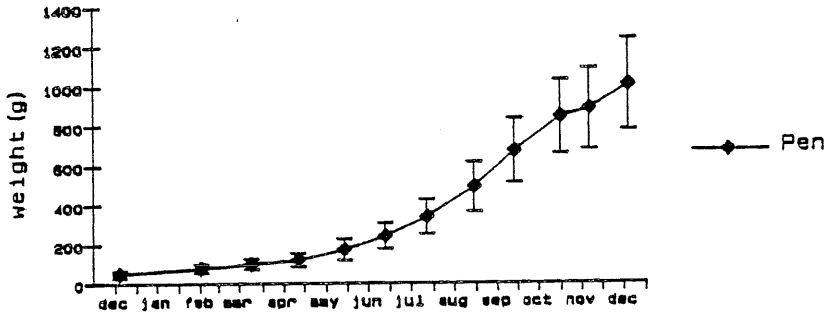

Fig. 4a Growth of fish in the experiment, mean monthly weight (g) SD.

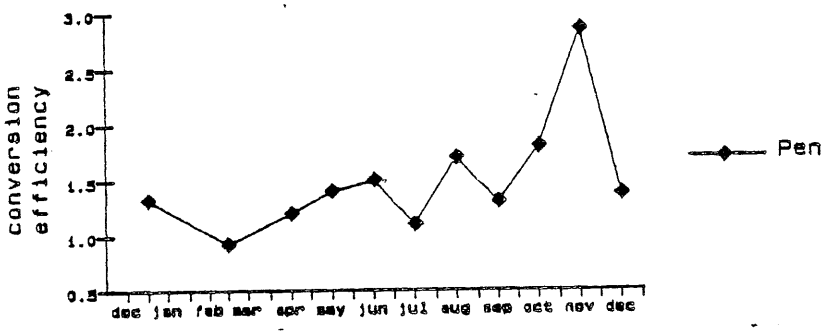

Fig. 4b Growth conversion effiency on a wet basis, calculated for each month during the experimental period.

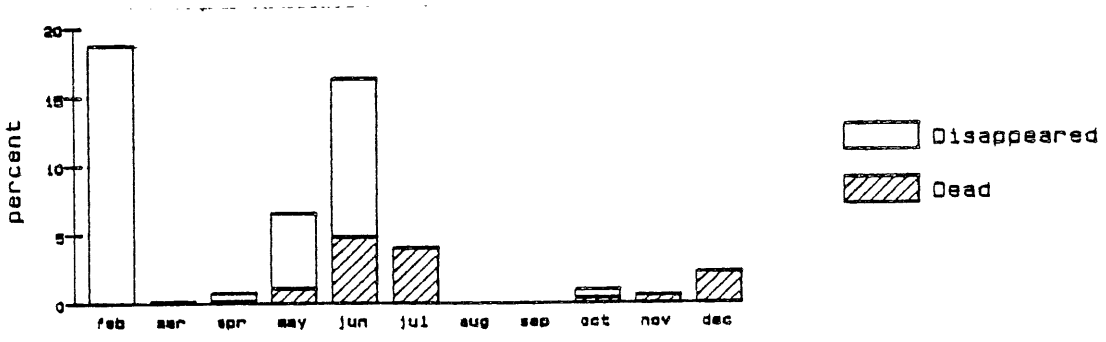

Fig. 4c Dead and disappeared fish on a monthly basis, given as percentage of the number alive previous month.