International Council for
the Exploration of the Sea.

C.M. 1985/F: 29
Mariculture Committee

THE INFLUENCE OF A SIMULATED TRANSPORTATION OF NEWLY FERTILIZED ATLANTIC SALMON EGGS ON MORTALITY TO THE EYED STAGE.

By

Yngve Ulgenes

Matre Aquaculture Station
Institute of Marine Research.
Directory of Fisheries,
N-5198 Matredal, Norway.

ABSTRACT.

Transport of newly fertilized eggs has often resulted in severe mortality of the eggs during incubation to the eyed stage. To investigate the effect of transport on mortality, pooled eggs from several females were handled through a simulated transportation experiment after fertilization and swelling. Egg groups handled in different ways and duration were incubated separately to the eyed stage and mortality was registered.

The results showed variable mortality figures but there was increased mortality for egg groups handled for a longer period after fertilization.
The mortality also seemed dependent upon how the eggs were handled.

The reasons to mortality as a result of handling is not known and more work is needed to investigate this.

INTRODUCTION.

The geographic placement of hatcheries relative to broodstock farms necessiates transportation of eggs from where they are stripped to where they are incubated and hatched. Transportation of newly fertilized and water hardened eggs is thus often necessary and following such transports it is too often experienced a high mortality of the eggs during incubation to the eyed stage. It is suspected that mechanical disturbance caused by transportation is an important reason for this.

Transportation of eyed eggs is prefered because at this stage the eggs tolerate mechanical handling. Transport of unfertilized salmon eggs has also been suggested because at this stage they can tolerate transportation and be of good quality after several days if stored cool (ca $4^{o}C$) and free of water and pollution (Senstad, 1982) To reduce mechanical disturbance increasing the viscocity of the water in which newly fertilized eggs are transported has also been suggested (Laird and Wilson, 1979).

It has been difficult to quantify the mortality of eggs up to the eyed stage as a result of transportation, partly because the transportation process is usually not standardized. The experiments described here were designed to investigate the effect of a standardized simulated transportation of newly fertilized eggs on the mortality during incubation to the eyed stage.

MATERIALS AND METHODS.

The transportation simulation apparatus.

50 ml vials containing eggs and water were secured into cavities drilled into a length of PVC tubing 5 cm in diameter, which was supprted at each end. The tube was rotated at a constant speed of approximately 2 rpm (Fig. 1).

Eggs.

Eggs stripped from 4 individual Atlantic salmon (Salmo salar) broodfish matured in 10 ppt salinity, average weight 6 kg, were used. The eggs were pooled before fertilization . Milt from 3 different males were used to fertilize the eggs. After fertilization the excess milt was removed and the eggs left for swelling for 2 1/2 hrs in fresh water, pH = 6.5, temperature = 6 ^{o}C. Three control groups which were not handled were put directly into incubators after swelling.

Experiment A.

Approximately 150 eggs (25 ml) were put into 50 ml vials in totally 32 vials and each vial filled with water. The vials were randomly divided into two series of egg groups. Each series of 16 vials were secured into the transportation simulation apparatus for handling the eggs (Fig 1). The two series of egg groups were treated at two different temperatures, 2 ^{o}C and 7.5 ^{o}C. Each egg group (one vial) were handled from time = 0 (at final swelling) until time = N. At each temperature one vial

was removed every 3rd hour and put into the incubator. The experiment lasted for 48 hours. Consequently the least handled egg group was handled from the start until the 3rd hour while the most handled egg group was handled from the start until the 48th hour.

Experiment B.

As in experiment A, 32 vials were filled with 150 eggs, making two series of egg groups, 16 vials in each. The two series of egg groups were from the start of the experiment left undisturbed at a surface in two temperatures 2 °C and 7.5 °C. Every third hour one vial was put into the apparatus for handling the eggs (Fig. 1) and the eggs handled continously from this point till the 48th hour after swelling. Consequently the most handled eggs were those put into the apparatus after standing 3 hours with no disturbance, while the least handled eggs were left undisturbed for 48 hours at the surface and poured directly into the incubator with a minimum of movement.

Treatment of eggs in the hatchery.

The eggs were incubated at 8 $\pm$ 1 °C pH 6.5 $\pm$ 0.5 and treated three days a week with malachite green to reduce fungal growth. At the eyed egg stage dead and living eggs in each individual group was registered.

RESULTS.

Control groups.

The average mortality of the three control groups was 16 % ranging from 12 to 19 %.

Experiment A.

The mortality of eggs handled from the start to time = N at the two temperatures 2 °C and 7.5 °C are presented in Fig 2. The data are presented on basis of degree hours (hours x °C) after swelling. At the lowest temperature (2 °C) the most handled eggs reached only 96 degree hours of development while at 7.5 °C the most handled eggs reached 360 degree hours of development before they were put in the incubators. The mortality data indicated a cyclic variation in sensitivity to handling. The highest mortality of the egg groups handled at 7.5 °C was 32 %, and 28 % for those handled at 2 °C.

Experiment B.

The mortality of eggs handled after standing at the desk until time = N and thereafter handled to the 48th hour at the two temperatures are presented in Fig. 3. An arbitrary point at the curve means that the eggs were put into the apparatus at this time of development (degree hours) and handled to the 48th hour.

This setup caused no severe mortality for the eggs handled at 2 °C, the highest mortality being 27.5 % for those eggs handled from the 6th to the 48th hour. The eggs handled at 7.5 °C showed an inreased mortality relative to the increased period of standing at the surface before handling. The three egg groups with least mechanical handling showed highest mortalities around 50 % (Fig 3). The mortality data showed a positive correlation between mortality and development (degree hours) from fertlization.

DISCUSSION.

The eggs in these experiments were investigated for the sensitivity to movement (disturbance/transportation) after fertilization. As stated in several handbooks (i.e. Leitritz 1960, Bardach et al. 1972) salmon eggs are supposed to tolerate gentle handling the first 48 hours after fertilization. The apparatus described for handling the eggs did not give any mechanical shocks as the eggs only rolled upon each other as the rotor turned. This was supposed to give a very gentle and standardized treatment of the newly fertlized salmon eggs. Still there were rather severe mortalities exceeding 50 % in some of the groups (Fig. 2 and 3).

Very little data semms to be available from the literature concerning the sensitivity of eggs to handling. Naevdal (1982) desciribed an experiment carried out in a practical way where the eggs were transported by car and boat for up to 460 degree hours before they were put into the hatchery. The data indicated that if the eggs were transported beyond approximately 100 degree hours after fertilization and swelling the mortality to the eyed stage was more than 25 % higher than the control groups.

It is difficult to compare Naevdal's experiment with the simulated transportation experiments described here because the two setups were different. In both experiments however the variation in mortality between nearly equally treated egg groups was large. Some variation is to be expected as shown from the data of the control groups in which the mortality ranged from 11 to 21 %.

In this simulated transportation a cyclic variation with time in the sensitivity to handling was indicated. This is shown by the mortality valus for the eggs handled from the start to time = N (Fig. 2).

It was surprising to registrate that the eggs that were least handled in experiment B at 7.5 °C were those showing the highest mortality (Fig. 3). In fact those eggs which were left undisturbed for 48 hours , and the only movement was while pouring them into the incubator were those showing among the highest mortality. The reason for the high mortality of the least handled eggs compared to those handled the whole experimental period is not known. It may be speculated that when the eggs were left standing for so long an anoxic area developed round the eggs and that the mortality may be a reult of lack of oxygen. Reinsnes (1984) investigated the effect of stopping waterflow on eyed eggs
from Arctic charr (Salvelinus alpinus). At this developmental stage of the eggs lack of waterflow for 48 hours at 1.8 °C did not severely influence the mortality of the eggs. Newly fertilized salmonid eggs have very low oxygen consumption and it is believed that development can continue under anoxic conditions (Blaxter, 1969). Lack of oxygen may therefore be of minor importance.

In summary the experiments indicated a cyclic variation in the sensitivity of newly fertilized salmon eggs to handling. The mortality also seemed to be influenced by the way the eggs are handled and whether they are left undisturbed for longer periods between swelling and mechanical handling. More work is needed to establish how sensitivity of newly fertilized salmonid eggs to handling varies with time.

REFERENCES.

Bardach, J.E., Ryther, J.H. and McLarney, W.O., 1972. Commercial culture of freshwater salmonids. In: Bardach, J.E., Ryther, J.H. and McLarney, W.O. (eds.): Aquaculture. The farming and husbandry of freshwater and marine organisms. Wiley-Interscience, N.Y., pp 396-449.

Blaxter, J.H.S., 1969. Development: Eggs and larvae. In: Hoar, W.S. and Randall, D.J. (eds) Reproduction and growth, bioluminescence, pigments, and poisons. Fish Physiology, Vol III. Academic Press, N.Y. and Lond., pp 177-252.

Laird, L. and Wilson, S., 1979. Viscous water safeguards eggs in transit. Fish Farmer, 2(3): 6.

Leitritz, E., 1960. Salmon and trout culture. Hatchery methods. Fish Bull. No 107., Dep. Fish and Game.

Naevdal, G., 1982. About quality of eggs. Norsk Fiskeoppdrett, 9: 30. (In Norwegian)

Reinsnes, T.G., 1984. How much can eggs tolerate if the waterflow is stopped? Norsk Fiskeoppdrett, 11:13. (In Norwegian)

Senstad, C., 1982. Storing and transportation of unfertilized salmon eggs. Norsk Fiskeoppdrett, 2: 15-16.

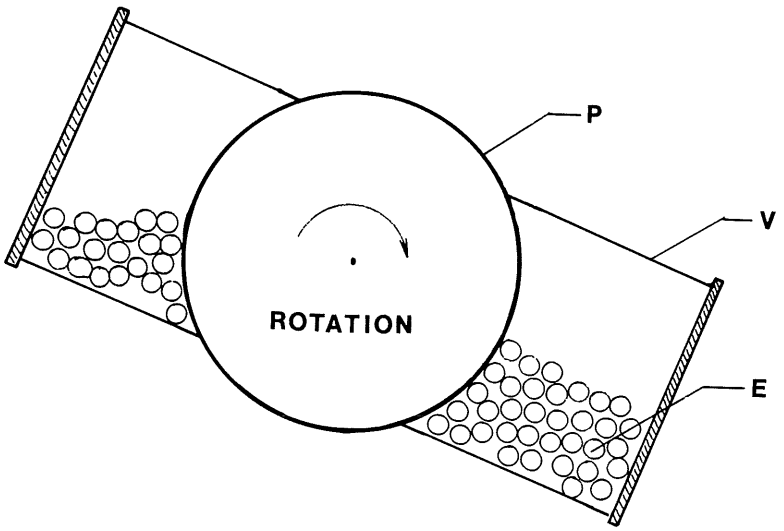

Fig. 1. The apparatus for simulating transportation of newly fertilized eggs.
P = Rotatring PVC-pipe
V = 50 ml vial
E = eggs

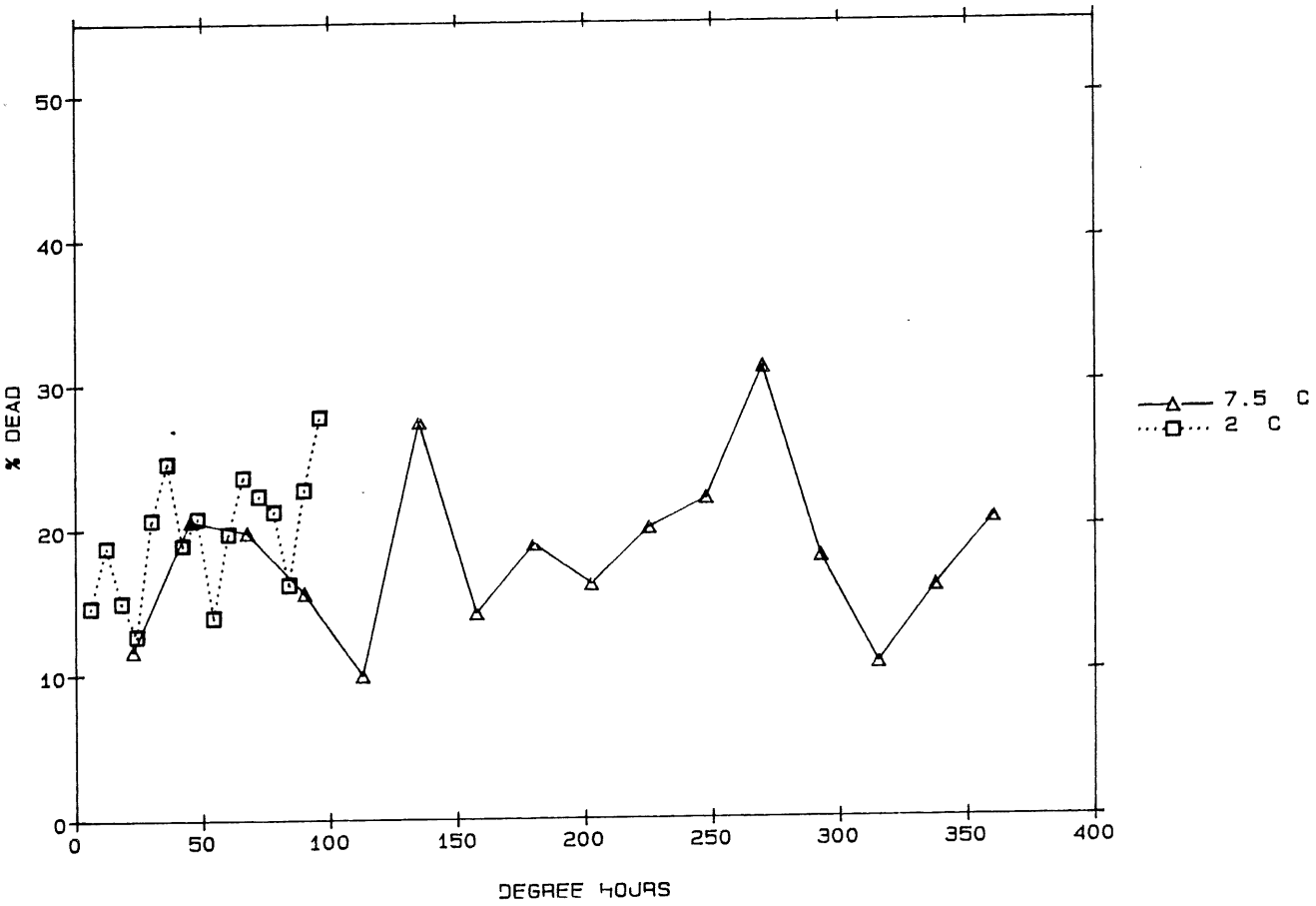

Fig. 2. Mortality of eggs handled from = O to time = N at two temperatures, 2°C (squares) and 7,5°C (triangles).

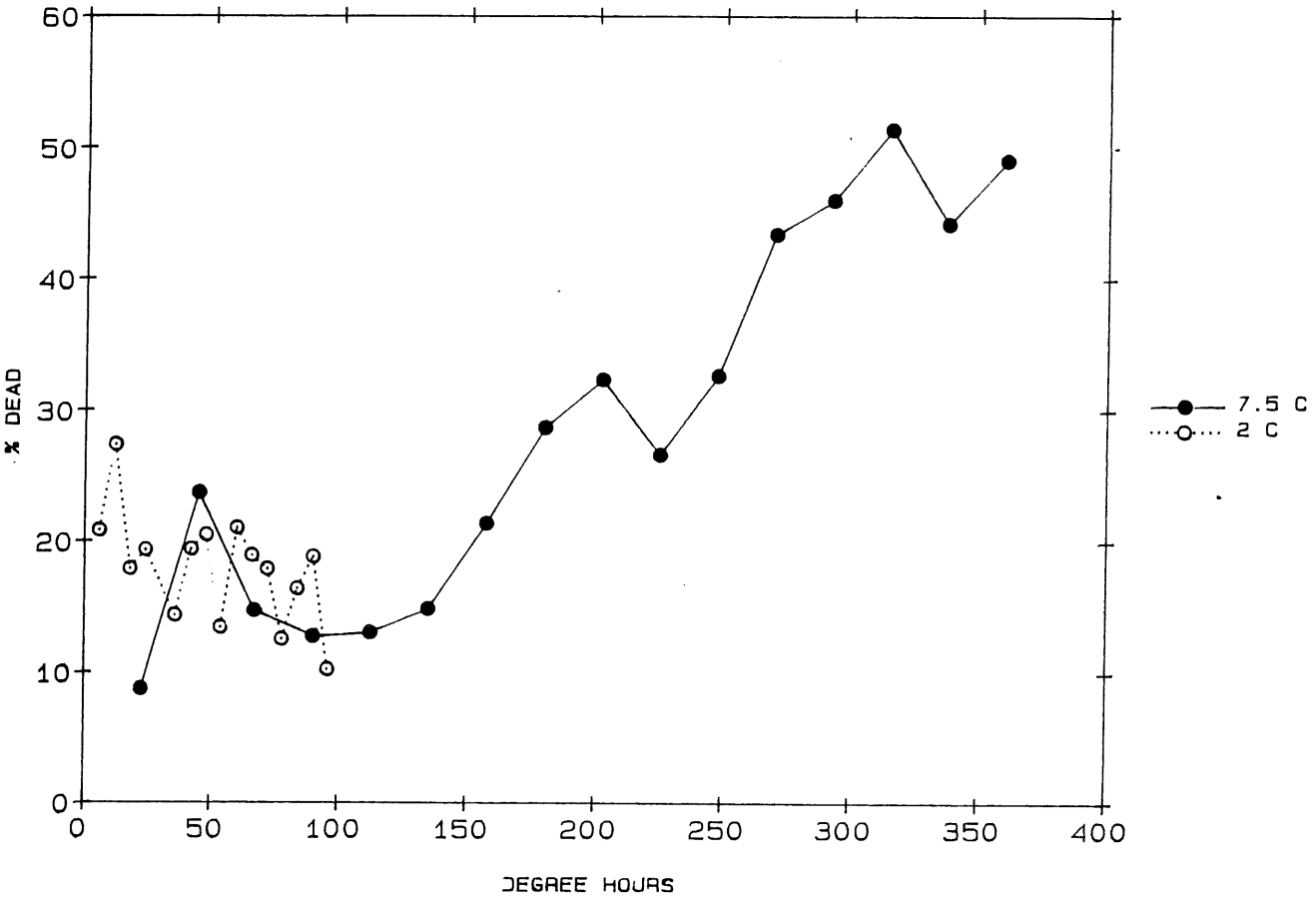

Fig. 3. Mortality of eggs handled from time = N to the 48. hour at two temperatures $2^{o}C$ and $7,5^{o}C$.