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Rearing of halibut. I. Incubation and the early larval stages

by

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INTRODUCTION

ROLLEFSEN (1934) undertook artificial fertilization of Atlantic halibut (Hippoglossus hippoglossus) eggs and described the subsequent development of the eggs and the newly hatched larvae.

FORRESTER and ALDERDICE (1973) did the same with the Pacific halibut (Hippoglossus stenolepis) and their investigation included the influence of temperature and salinity on the developement and hatching of the eggs.

The larvae in both experiments died within two weeks, showing little developement and still having large york sacs. In February 1974 we artificially fertilized halibut eggs with sperm from halibut, plaice and flounder and hatched the eggs at the laboratory of the Institute of Marine Research, Bergen.

The aim of the investigation was to:

- find whether it was possible to fertilize halibut eggs at the fishing ground and then transport them to the laboratory;
- develope systems for incubation of halibut eggs giving high hatching percentages;
- follow the developement of the halibut larvae;
- develope a system for rearing halibut larvae;

- produce a hybrid from a halibut female with plaice and flounder males, respectively.

MATERIAL AND METHODS

We fished the parent stock of halibut with gill-nets at a depth of 650 m in Austfjorden north of Bergen. The fishes were stripped of eggs after coming on board and most of the eggs were then dry fertilized in separat portions with sperm from halibut, plaice and flounder. After fertilization, water of 36‰ salinity was added at a temperature of 4° C. A smaller fraction of the eggs were fertilized with sperm suspended in seawater. Some eggs were transported to the laboratory inside the gonads and were fertilized there 8 - 10 hours after the fish were caught.

The eggs were, usually fertilized on board and transported a few hours later to the laboratory in plastic bags. A few eggs were kept on board for 1 - 3 days in order to investigate the effects on them of long periods of transport. These eggs were stored in thermos flasks or plastic beakers in a refrigerated room where the temperature was 2 - 4 ° C. Incubation continued at the laboratory within the temperature range 4 - 7 ° C. A small fraction of eggs in thermos flasks were subjected to pronounced but slow temperature oscillations from 3.5 - 8.5° C.

The eggs were divided between three incubation systems.

1. Open circulation with the eggs floating (S = 36‰) or at the bottom (S = 34‰).
2. Recirulation of seawater (S = 36‰) through a charcoal filter with the eggs floating.
3. Stagnant seawater (S = 36‰) with antibiotics added at the concentrations used by SHELBOURNE (1963).

Most of the larvae were reared in three stagnant water systems, the temperatures of which were 5, 7 and 9° C respectively.

RESULTS AND DISCUSSION

Fertilization

Eggs stripped from halibut females immediately after boarding and quickly fertilized with halibut, plaice or flounder sperm, usually gave 90 - 100% fertilization results. Eggs fertilized with plaice and flounder sperm

8 - 10 hours after the female halibuts were caught, gave fertilization percentages of 10 to 50%.

We may therefore conclude that the fertilization ought to take place soon after landing the parent fish. Fertilization with both dry and suspendend sperm was successful.

Egg transport

ROLLEFSEN (1934) and FORRESTER and ALDERDICE (1973) found halibut eggs to be very sensitive to mechanical shock. According to FORRESTER and ALDERDICE (1973) the eggs were most sensitive one day after fertilization (very early blastodermal egg stage) and five days later (closure of blastopore stage). Handling of the halibut eggs during transport and when dividing them out at the laboratory did not cause any measurable mortalities.

Incubation

A mass mortality of eggs started after five days, continuing for three days. After that the death rate was moderate and at hatching insignificant. Very few newly hatched larvae died. The eggs subjected to total darkness and daily temperature oscillations from 3.5 - 8.5° C did not show an increased mortality rate compared to the other groups, and they hatched normally.

Hatching began 13 days after fertilization with the maximum occuring 2 - 5 days later. Just before hatching the neutral buoyancy of the eggs was 35.5 - 36.5‰.

The hybrid eggs had a longer incubation period (20 - 25 days) in water of 4 - 7° C. Many larvae died at the onset of, or just after, hatching and some of them could not come completely out of the eggcases.

The majority of larvae were obtained from eggs reared at the bottom of a large container.

Incubation of halibut eggs can just as easily be done pelagicaly in a recirculating system. This would, however, involve an artifical increase in the salinity.

The halibut larvae

We had a total of 5000 larvae. The halibut larvae are surprisingly undeveloped when hatched, compared with those of other flatfish. The york sacs were very

large and the resorbtion period was 1½ to 2 months long.

For two weeks after hatching the mouth was still rudimentary. After that it opened and stayed wide open. The larvae were unable to shut their mouths and accordingly unable to eat. At the end of the york sac stage the larvae developed funtional mouths and the underjaw gained its characteristic angle (about 45°) to the body axis (THOMPSON and VAN GREVE 1936). The larvae were offered nauplii of the brine shrimp (Artemia salina) after three weeks. Five weeks after hatching larvae were observed with brine shrimp nauplii in their guts. Of the few larvae forming a normal mouth only three started to eat.

The main problem was to keep the larvae floating, as those that sank to the bottom died after a few days. At hatching the larvae had a neutral buoyancy of 33 - 34‰. A group of larvae kept in seawater of this salinity became gradually heavier and after three weeks their neutral buoyancy was 45‰.

However, we kept most of the larvae floating at a salinity of 36 - 40‰ although every day many larvae sank to the bottom and died. After 5 weeks some larvae developed a reduced neutral buoyancy even as low as 27‰.

Some eggs that were ready to hatch were separated into beakers containing seawater of salinities from 25‰ with 5‰ steps up to 45‰. The larvae survived for 10 days at 45‰ and for three weeks at 25‰. The temperature range was from 6 - 11° C.

We obtained our best results with larvae at the york sac stage when using a recirculating system where we could control the salinity. The larvae were reared in the dark and any disturbance was kept to a minimum.

The hybrid larvae

On hatching, the hybrid larvae had pigmentation in their eyes and bodies and were therefore in this way different from the halibut larvae. Most of the hybrid larvae were very deformed. Only seven out of 100 larvae investigated had normal bodies and even these were different from the halibut larvae in that they behaved very sluggishly. None of the larvae survived for more than two weeks.

These results indicate that a hybrid from halibut eggs and plaice and flounder sperm is unlikely to be viable.

Summary

1. Eggs were stripped from halibut caught with gill-nets, fertilized, then transported to the laboratory and incubated there.
2. 5000 larvae were reared of which the longest living survived for 60 days. They retained their york sac for $1\frac{1}{2}$ - 2 months and only three larvae started to eat.
3. Hybrids were produced from halibut eggs with plaice and flounder respectivily. None of the larvae were viable.
4. Several egg incubation systems were tested and investigations were also made into different methods of rearing larvae after hatching.

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