INITIAL FEEDING RATES OF ATLANTIC HALIBUT LARVAE
(Hippoglossus hippoglossus) AT DIFFERENT PREY DENSITIES

by

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ABSTRACT

At the end of yolksac stage (36 days after hatching) halibut larvae were offered the prey organism *Artemia salina* at different densities ranging from 1 to 100.000 litre^{-1}. The feeding experiment was carried out in 11 black plastic tanks (10 litre) each containing 20 larvae. The optimal prey concentration in the initial first feeding situation was found to be in the range of 700 - 7.000 *Artemia* litre^{-1}.

INTRODUCTION

Recent progress in larviculture of Atlantic halibut (*Hippoglossus hippoglossus* L.) using live prey organisms at first feeding has put forward the need of comprehensive knowledge of the bioenergetics of halibut larvae. Due to lack of larval material experimental studies are scarce, but recent development of incubators for yolk-sac larvae has made such studies possible.

Both methods for stripping, egg incubation and larvae incubation of Atlantic halibut have been developed (Rabben, 1987; Jelmert & Rabben, 1987; Rabben & al., 1987) and are at present being applied by several commercial production units. Although many problems, such as egg quality and larval deformities, still are frequent, the main scientific effort has been put on the first feeding (Næss & al., 1990; Harboe & al., 1990; Skjolddal & al., 1990). At the time of first feeding the halibut larva is relatively large (12 mm length) and requires large prey items from the onset of feeding. Both calanoid copepods and *Artemia salina* have been applied and have resulted in high feeding activity, growth and survival (Naas & al., 1987; Næss & al., 1990).

To offer the larvae correct feeding regimes requires reliable estimates of energetic demands and food consumption rates. However, in the development of an energetic model for halibut larvae, it is necessary to establish optimum conditions for several biotic and abiotic factors.

This paper presents the first attempts to find optimal prey densities in the first feeding situation of Atlantic halibut.

MATERIAL AND METHODS

Halibut eggs were stripped from one female and fertilized with sperm from one male. The eggs were incubated for 10 days at 7°C in 250 l incubators before they were transferred to a 5 m³ silo, with water temperature of 7.3 °C. Thirty six days after hatching (260 day-degrees) the yolk-sac was absorbed and the larvae were carefully sampled and transferred to the experimental facility.

The feeding experiment was conducted in 11 black 10 litre tanks and 20 larvae were administered to each tank. The water temperature was 12.3 °C and the water contained a concentrated suspension of natural phytoplankton. During the experiment the tanks were kept outdoor with a relatively diffuse illumination (cloudy), and the light intensity at the surface varied between 1500 and 2000 lux during the 4 hour experiment.

Newly hatched *Artemia salina* nauplii were administered to each tank at theoretical densities ranging from 1 to 100,000 *Artemia* litre^{-1}. From all tanks except the 5 lowest concentrations, 5 samples of 10 ml was taken to estimate the actual prey densities. The coefficient of variation (STD*100/mean) was less than 25 %.

RESULTS AND DISCUSSION

The larval batch used in the experiment had a rather high frequency of deformities (58 %), and the number of normal larvae able to ingest food particles was between eight and fourteen at each prey concentration.

Highest feeding incidence (fraction of normal larvae with food items in the gut) was found at the highest prey concentration (75 *Artemia* ml^{-1}, Fig. 1)). This finding may reflect an extreme situation with inactive feeding (drinking). The arguments for such a conclusion are 1) that at the same prey concentration the number of prey items per gut was relatively low, and 2) that the maximum number of prey items per gut co-occurred with the second maximum of feeding incidence. The prey concentration which seemed optimal was between 0.7 and 7 *Artemia* ml^{-1}.

In the experiment no account was taken for the possible patching of the *Atremia*. Gulbransen (1990) found a high patch index by *Artemia* in his experimental units and concluded not to use *Artemia* in order to find functional response of halibut larvae. The fact is, however, that *Artemia*, along with natural zooplankton, is the main prey item for cultured halibut larvae, and both the size, appearance and behaviour of the two prey organisms probably make them incomparable. However, Gulbransen (1990) concluded that the optimal prey concentration was around 12 rotifers ml^{-1}, which is quite consistent with our findings. During the experiment patching of *Artemia* was not observed, and it is possible that the conditions in the black tanks and with a diffuse high light intensity favored a random distribution of *Artemia*.

The lower levels of prey concentration resulting in feed uptake were also consistent with reported values for other fish larvae (Laurence, 1974; Houde, 1977; Werner & Blaxter, 1980; Houde & Schekter, 1981; Quantz, 1985).

Further investigations are necessary to verify these results and to find optimal prey concentrations at different stages and different temperatures.

CONCLUSIONS

The study indicates that optimal prey concentration for initial feeding of halibut larvae is between 700 and 7,000 *Artemia* litre^{-1}. However, the material is so sparse that no attempt has been made to fit the data to any formula for functional response.

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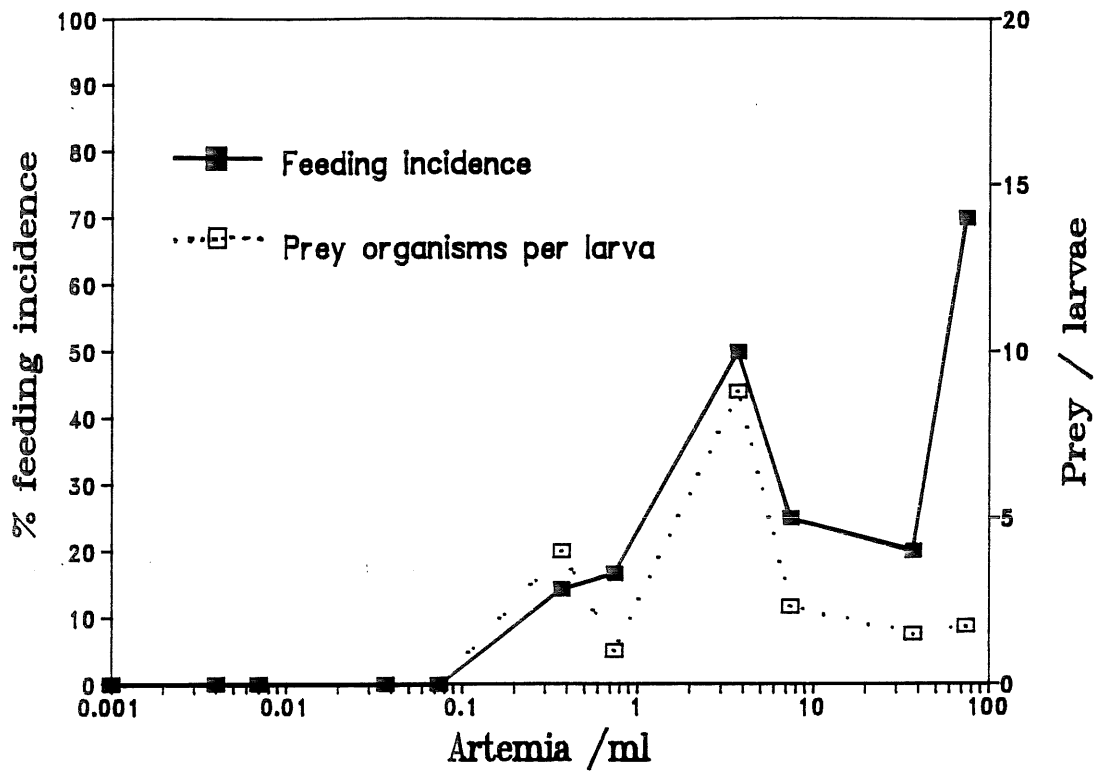
Figure 1. Feeding incidence (percent of normal larvae with gut content) and
number of prey organisms per larvae, at different prey densities.