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START FEEDING OF SALMONIDS WITH LAKE ZOOPLANKTON

by

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ABSTRACT

Fry and small fingerlings of Atlantic salmon (Salmo salar) and rainbow trout (Salmo gairdneri) were fed with lake zooplankton in small fine-meshed cages. The zooplankton were pumped into the cages. Growth rates and food selection are discussed.

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INTRODUCTION

This paper is a preliminary report dealing with an alternative way to start-feed fry of Atlantic salmon (Salmo salar) and rainbow trout (Salmo gairdneri).

The method is based on the floating cage culture of Atlantic salmon in Lake Kvernavatnet south of Bergen, Norway. The fishfarm in the lake consists of a number of 40 m³ cage units, designed for a total production of ca 300 000 smolts per year.

Division of Aquaculture, Institute of Marine Research, started a pilot project in 1979 rearing salmonid fingerlings in floating net cages. The facilities were transferred to a local corporation, A/S Kvernsmolt, in 1980. In cooperation with the manager of the fishfarm, pilot projects concerning start feeding with zooplankton were carried out in 1981 and 1982.

First feeding with live zooplankton is a natural method applied on many species. Artificial food particles (dry feed pellets) are lacking an important quality due to immobility.

Zooplankton feeding of salmonid fry and fingerlings is well known. Paul, Hood and Nevě (1976) reared fry of chum salmon (Oncorhynchus keta) in an artificial upwelling pond. The fry fed on different diatoms and a copepod, Acartia clausi.

Urquhart and Barnard (1979) fed pink salmon fry (Oncorhynchus gorbuscha) mainly on calanoid copepodes transported into the pen by tidal currents.

Different coregonids (Coregonus lavaretus and C. albula) have been reported reared using live freshwater zooplankton trapped with light (Jäger and Nellen 1980).

Holm (1982) describes rearing of yearlings of Atlantic salmon (Salmo salar) in Lake Kvernavatnet. The lake zooplankton was delivered to the fish in an artificial current set up by a floating propeller.

MATERIAL AND METHODS

This paper deals with two experiments. In 1981 a pilot project using rainbow trout fry was carried out. In 1982 Atlantic salmon fry were used.

The 1981 rainbow trout experiment

In primo July, about 4000 rainbow trout fry were transported to Lake Kvernavatnet. The fry were hatched in artificial substrate, see Hansen and Møller (1982).

The fry were placed into a floating experimental cage unit, see fig.1. The net in the cage wall and bottom had a mesh size at 1 - 1.5 mm, and the volume was ca 0.5 m³. Water containing lake zooplankton was delivered by a low pressure pump with a 150 l/min capacity.

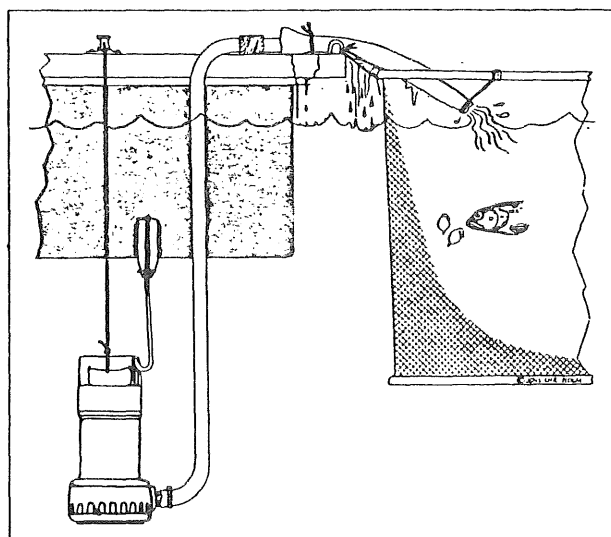


FIGURE 1: SKETCH OF EXPERIMENTAL DESIGN.

START FEEDING IN LAKE KVERNAVATNET 1981 AND 1982.
FROM HANSEN AND HOLM (1981).

Samples of 50 - 100 fry were anesthetized before fork length measuring. Stomach contents samples were taken and roughly examined. Parallell to this, general surveys on the zooplankton stock were done. This was also done in 1982.

The 1982 Atlantic salmon experiment

A more advanced experimental design were put through in 1982. Four cage units, each with a 1 m³ volume were used. The principal design as showed in fig.1.

Two groups (cage unit no 3 and 4) got a moderate to high input of unfiltered water containing lake zooplankton. The two others got a surplus of dry feed pellets and a minimum of water supply. Two pumps (same kind as in 1981) were used, the amount of water input is sketched in table 1.

TABLE 1: INPUT OF UNFILTERED WATER INTO THE EXPERIMENTAL CAGES. LAKE KVERNAVATNET 1982.

PERIOD	GRADE OF INPUT IN CAGE NO			
	1 (DRY FEED)	2 (DRY FEED)	3 (ZOOPL.)	4 (ZOOPL.)
0706 - 2606	Low	Low	High	Moderate
2706 - 3006	Low	Pump stop	High	Pump stop
0107 - 1707	Low	Low	High	High

The pipelines, leading the water into the cages, were manipulated in such a way that the fish in all four cage units got the same current environment except for the period 2706 - 3006.

The fry were hatched in arti-ficial substrate in the outlet of Lake Kvernavatnet. The experimental period started 7th June. Stomach contents and size samples were preserved in 5 % formaldehyde solution. Mortality were estimated. PH was satisfactory, but water temperature was reaching a maximum over 21 °C at 1 m depth during the experimental period.

In 1982, fish samples were length measured one week after preserving and later dried at 105 °C for a minimum of 24 hours, before weighing.

RESULTS AND DISCUSSION

Rainbow trout

The fry fed on different species of Copepoda and Cladocera and seemed to be non-selective.

The growth rate in July was good, but reached a temporary peak in the end of the month (see figure 2). This was probably due to a breakdown in the zooplankton community in Lake Kvernavatnet. Later on (12th August), we started feeding with dry feed pellets, and in September the growth rate again was satisfactory.

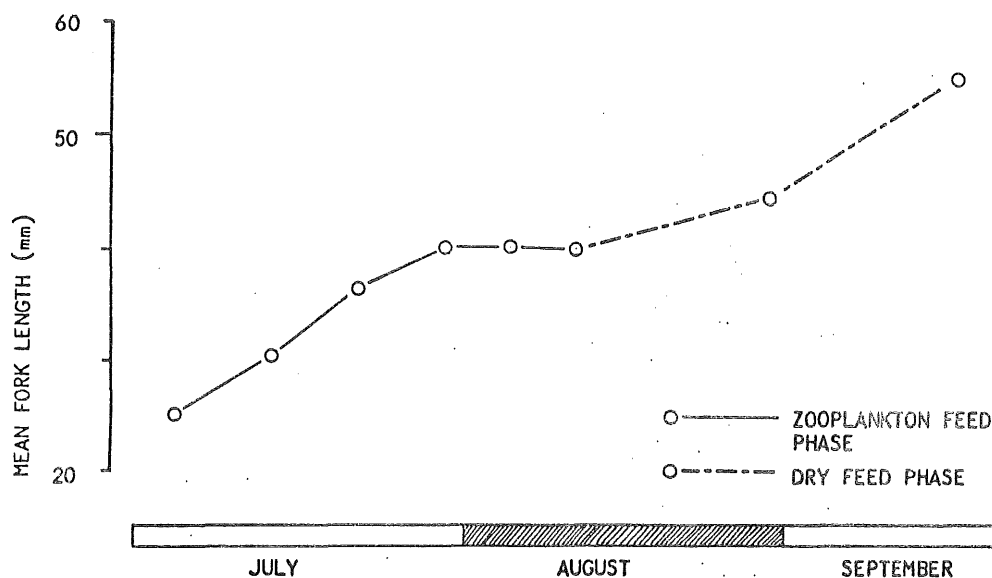


FIGURE 2: GROWTH RATE OF RAINBOW TROUT, FIRST FED WITH ZOOPLANKTON AN AFTERWARDS WITH DRY FEED PELLETS. LAKE KVERNAVATNET 1981. FROM HANSEN AND HOLM (1981).

Atlantic salmon

The survival for the groups varied between 64 (cage unit no 2) and 84 % (cage unit no 3). The mortality was probably caused by a combination of high temperature and an unknown epidemical disease.

The qualitative distribution of different prey items pumped into the cages are presented in table 2.

TABLE 2: THE COMPOSITION OF THE ZOOPLANKTON (MEAN PERCENT VALUES) PUMPED INTO THE EXPERIMENTAL CAGES. LAKE KVERNAVATNET 1982.

SPECIES/GROUP	D A T E				
	0706	1406	2206	0107	1307
<u>Bosmina longispina</u>	95	68	94	32	3
<u>Daphnia longispina</u>	5	23	2	55	56
<u>Diaphanosoma</u> sp.	0	3	0	0	0
<u>Copepoda</u> (mainly cal.)	0	4	4	23	41

The amount of zooplankton reached a maximum in the first week of July. The trend was the same as in 1981.

The stomach contents are shown in table 3 and 4.

TABLE 3: THE COMPOSITION OF DIFFERENT PREY ITEMS (MEAN PERCENT VALUES) IN THE STOMACH CONTENTS. ZOOPLANKTON FED GROUPS. ATLANTIC SALMON, LAKE KVERNAVATNET 1982.

SPECIES/GROUP	D A T E					
	0706 ¹	1406	2206	0107	1307	1707
<u>Bosmina longispina</u>	99	53	50	38	8	83
<u>Daphnia longispina</u>	0	43	32	15	51	14
<u>Diaphanosoma</u> sp.	1	0	0	0	0	0
<u>Polyphemus pediculus</u>	0	0	0	0	0	2
<u>Copepoda</u> (mainly cal.)	0	4	18	41	41	1
No of stomachs examined	5	5	10	5	10	5

¹ Samples for stomach content analysis were taken 2 hours after transferring the fry to the experimental cages.

TABLE 4: THE COMPOSITION OF DIFFERENT PREY ITEMS
(MEAN PERCENT VALUES) IN THE STOMACH CONTENTS.
DRY FED GROUPS.
ATLANTIC SALMON, LAKE KVERNAVATNET 1982.

SPECIES/GROUP	D A T E				
	1406	2206	0107	1307	1707
<u>Bosmina longispina</u>	17	85	62	19	57
<u>Daphnia longispina</u>	80	9	25	31	6
<u>Copepoda</u> (mainly cal.)	3	6	8	12	0
<u>Chironomidae</u>	0	0	0	0	15
Dry feed particles	0	0	5	38	22
No of stomachs examined	5	10	10	10	5

Ivlev's electivity indices (Ivlev 1961) were not calculated since the values in table 2 do not represent the correct offer of potential prey organisms. Some trends can still be pointed out.

The zooplankton fed groups were much more capable at taking Copepoda than the dry feed groups. Copepodes evade capture at higher speeds than cladocerans (Drenner, Strickler and O'Brien 1978). Fish that are used to taking dry feed pellets are not, to the same extent as the zooplankton fed ones, used to a living prey, and may prefer cladocerans due to their low evading speed. Sosiak, Randall and McKenzie (1979) showed that dry pellet fed Atlantic salmon parr used more than 2 months to get enough training to take the same number of taxas and eat the same amount as the native fish when transplanted into a stream.

In 1981, Atlantic salmon yearlings took mainly Daphnia when these were present in adequate amounts (Holm 1982). This did not happen in the 1982 experiment. In 1982, the fish of both categories fed well on Bosmina and for some groups, Copepoda.

In the 1981 yearling experiments, a much slower, not so well defined current was used to carry the zooplankton into the fish cages. This could permit the fastswimming species in the zooplankton community to obtain a more successful escape. In 1982 (the experiment described in this paper), the fish snapped the prey items at the same moment they arrived in the jet of water.

The mean fork lengths and dry weights are shown in figure 3 and 4, respectively.

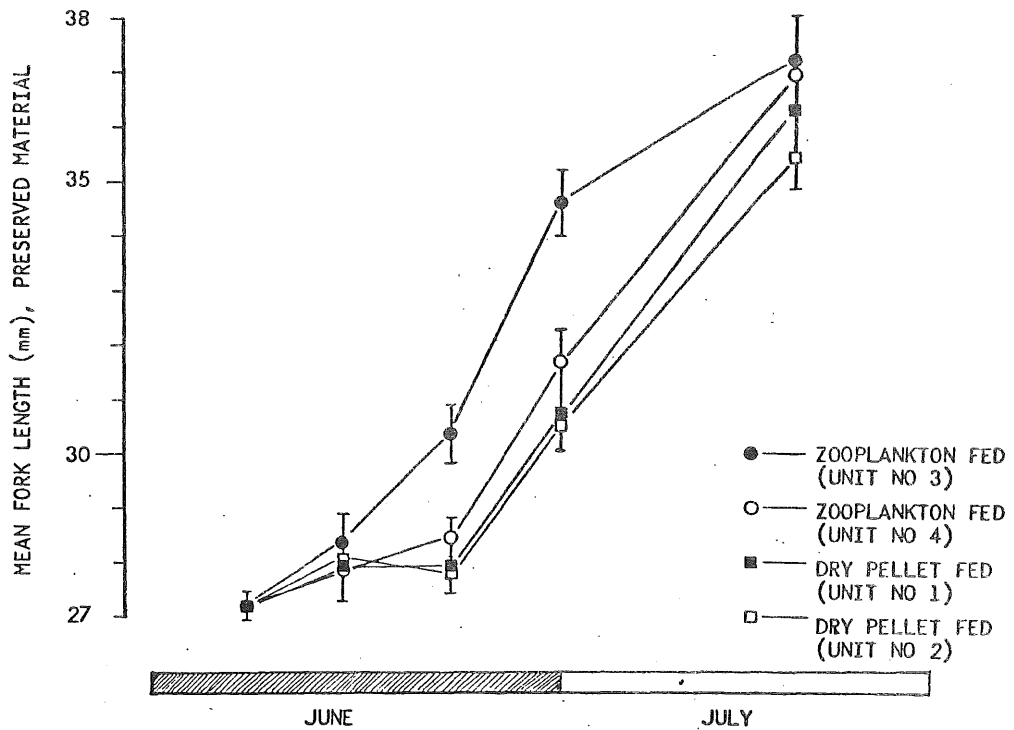


FIGURE 3: MEAN FORK LENGTHS OF ATLANTIC SALMON, PRESERVED MATERIAL. VERTICAL LINES INDICATE 95 % CONFIDENCE LIMITS. LAKE KVERNAVATNET 1982.

The dry feed groups had the traditional stagnation period in the beginning. The zooplankton fed groups did not have this stagnation, this is especially true for the group getting a high amount of of water containing zooplankton. The moderate water input and accidental pump stop may be recognized in the growth rates of group no 4.

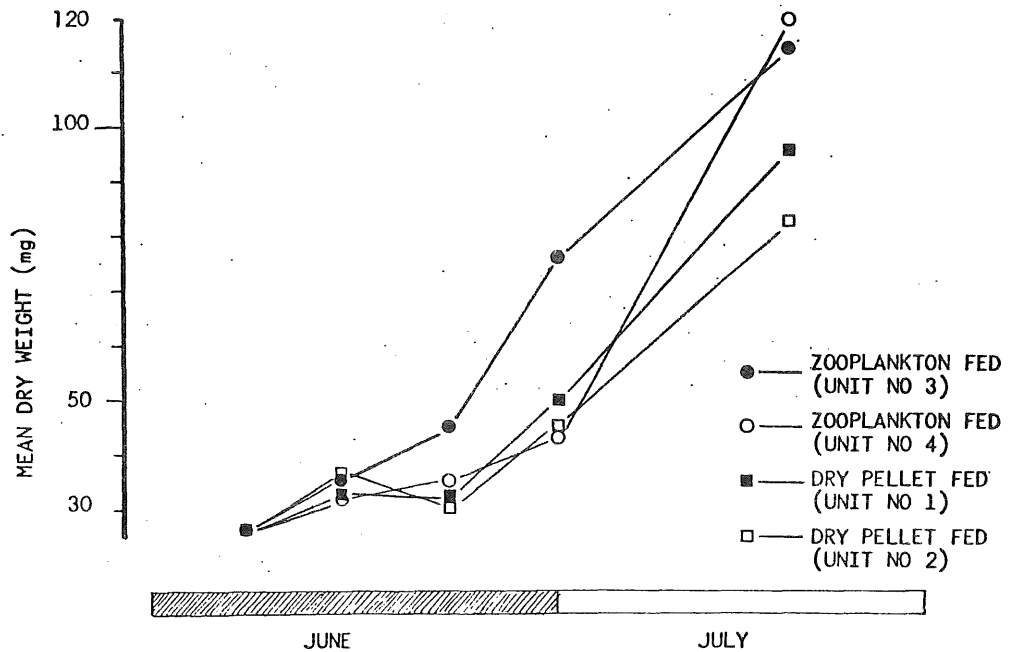


FIGURE 4: MEAN DRY WEIGHTS OF ATLANTIC SALMON.
LAKE KVERNAVATNET 1982.

SUMMARY

1. Rainbow trout and Atlantic salmon were fed with live zooplankton arriving the cage units in jets of water.
2. The zooplankton gave a satisfactory growth for both salmonid species.
3. For one of the zooplankton fed groups in the Atlantic salmon experiment, the growth rate was significantly better than for two groups given surplus of dry feed pellets.
4. Zooplankton fed groups of Atlantic salmon took a greater amount of copepodes than dry fed groups did.

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