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PRELIMINARY RESULTS FROM STOCKING SALMONID FRESHWATER ENCLOSURES WITH FLOUNDER (*Platichthys flesus*)

by

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ABSTRACT

Stocking of flounder in salmonid freshwater culture are suggested as a possible way of reducing loadings of surplus food to surrounding environment. Flounder of different sizes were transferred from an estuary to Atlantic salmon trays and net pens in fresh water. The flounder fed on surplus salmon dry food. Transfer mortality, growth potential and feeding habits in duoculture with salmon are discussed.

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INTRODUCTION

This paper is a preliminary report dealing with an approach to reduce the problems with deposits of food and faeces in salmonid freshwater culture.

In Lake Kvernavatnet, a coastal lake in western Norway, net pen production of Atlantic salmon smolt have occured since 1979. In 1983 a total of about 13 tons dry food pellets were used in the production, and a total of 229.000 salmon parr were held in the pens at the end of the year. About 100.000 smolts were delivered this year.

Two groups of rainbow trout (Salmo gairdneri) have been used counting about 700 Floy tagged (2+) individuals. The aims for these stocking were several; relevant for this paper is the intention to use the rainbow trout as "garbage feeders", reducing the loadings of surplus food to lake bottom.

Another possible way of reducing the loadings is stocking with flounder, Platichthys flesus. Due to practical reasons, having the flounder in net pens or trays has been preferred.

Flounder is traditionally a non-edible fish for most Norwegians. Only in the Lågen delta, eastern Norway, the use of flounder has some tradition. The authors do not believe that flounder farming in Norway will be of any economic interest itself as more traditional flatfish farming.

There are several reasons for using flounder for stocking with salmon. Predation on the salmon is assumed to be negligible if flounder and salmon size is adjusted to each other. The growth potential of flounder in a saline or brackish environment must be recognised as remarkable.

Cieglewicz (1935) observed a monthly growth rate for 0+ flounders caught in the bay of Danzig and in the western Baltic between 1 cm (July, August) and 0.2 cm (December). Bregnballe (1961) observed daily length increments as high as 0.9 mm for 0+ flounder in the Kysing Fjord. He also assumed an efficiency of conversion better than 5, perhaps as good as 4.

The preliminary experiments in Lake Kvernavatnet aimed to minimalize transfer induced mortality, illustrate the flounder growth potential in a freshwater fishfarming situation and to give an impression of the feeding habits of flounder in salmonid culture.

MATERIALS AND METHODS

Flounders were collected with shore seine, gill or bag nets in the estuarine area outside the small river draining Lake Kvernavatnet. Flounders of different sizes up to 800 g were catched. Groups of different size (except the assumed 0+ flounder) were tagged with Floy Anchor Tags; tag position as shown in Fig. 1.

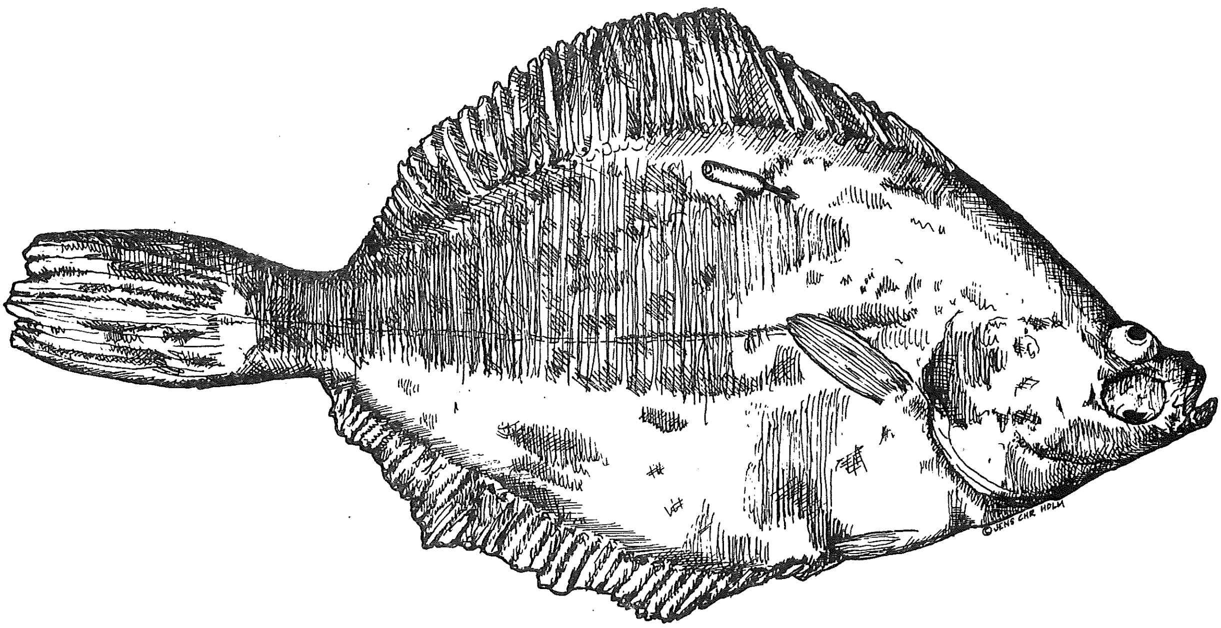

Fig.1: Tagging position Floy Anchor Tag. Tag was injected between neural spines. Drawn after a photography of a 59 g flounder (which increased weight to 103 g in 28 days).

Only fish without skin damages were used for experiments, and were after tagging transferred to net pens or trays used for commercial Atlantic salmon smolt production. In most of the transfer experiments, fish were offered unfiltered lake water containing some zooplankton and other organisms. Despite this, dry food pellet or granulate (type EWOS) were the main food offer.

Total length and weight measurements from live fish were easily obtained without use of any anesthetic. Stomach contents were taken after the fish were killed with an overdose of anesthetic or a blow in the head.

RESULTS AND DISCUSSION

Several transfers of flounder were accomplished in the period July - December. A total of 210 flounders were followed through periods with different temperature and feeding conditions. The results from the transfer experiments are listed in table 1.

The table underline a relatively clear tendency of an obligate need for food in the transfer situation. Among tagged individuals, small flounders showed higher mortality or growth stagnation (See also Fig. 2). This can be due to osmoregulatory problems. If so, food represents the only chance for the flounder to compensate for losses of salts or dissolved organic compounds. Temperature seems to influate less on the transfer success than food availability do.

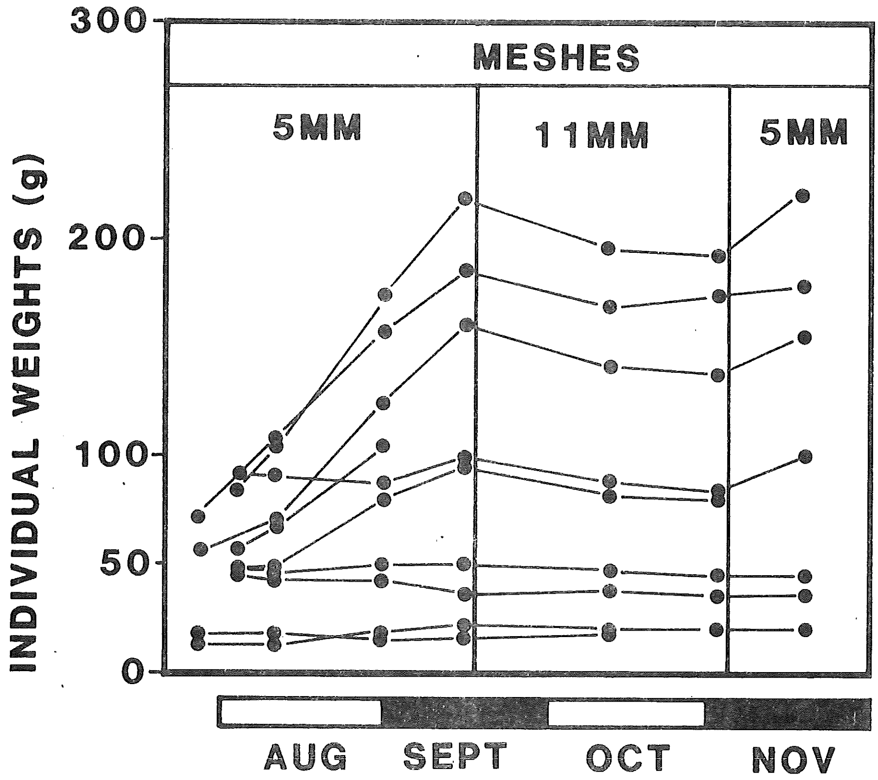

Fig. 2: Individual growth of a group of flounder in Lake Kvernavatnet, 1983. Two net pens with different mesh sizes (5 an 11 mm) were used.

The growth of the 30 - 60 mm flounder (assumed to be fish of the year) were not as good as daily length increments reported by Bregnballe (op. cit.). When cleaning the trays daily, many of the 0+ flounder died, probably due to unfavorable feeding conditions. This occured despite the fact that salmon food was available. The particles of this food may be too big for the flounder so that a physical breakdown have to occur to reduce the salmon food to a suitable size or consistence. Lebour (1918) found only diatoms when examinating 5.5 - 10 mm flounders. He attributed the absence of larger food organisms to the small mouth and long narrow oesophagus in the flounder.

The high growth rate of the older flounder (from 100 mm and above) leeds to speculations of the size of daily rations. Remarkable high growth rates for some individuals are shown in table 2 and Fig. 2. Some individuals doubled their weight in a months period.

A flounder which increases it's weight with 1 g/day, having a conversion efficiency of dry food of about 2, will have a possible consume of 2 g dry pellet food/day. If 10 000 salmon parr with a mean weight of 10 g are held in a pen and offered 2 kg dry food pellet/ day, 20 % of the food ration is supposed to sink to bottom without being eaten by the salmon, a theoretical amount of 200 flounders should be sufficient to clean up the bottom deposits caused by the food itself. These values must only be considered as a rough indication. In addition, much of the food will sink through the bottom net, and other fishes (as rainbow trout) can take care of the surplus.

The stomach contents from three samples, totally 65 specimens, are given in table 3. Both 0+ and older fish consumed dry food pellets in addition to some organisms available in the enclosures. No remnants of salmon were observed, but further work will evaluate if the bigger flounder will predate on the smallest salmon.

According to Fig. 2 a small mesh size is important to achieve suitable feeding conditions. Using net pens with 5 mm meshes, positive growth rates were obtained, both in the August-September period (mean temperature of 16 C) and in the November period (mean temperature of 4 C). In a period between, 11 mm meshes were used, and the result was a decreasing weight. When inspected the 11 mm bottom net did not show the same ability to collect the surplus food as the 5 mm net. Cages with a floor of glass fiber with a mesh panel set in the centre are found suitable for flatfish culture (Anon 1979). When constructing net pens for Atlantic salmon/flounder duoculture purposes, fine meshed pen floor should be preferred.

SUMMARY

Flounder of different sizes (0.5 - 800 g) were catched in an estuary area and transferred to Atlantic salmon culture units in Lake Kvernavatnet, western Norway.

Cumulative mortality in a 14 days period after transfer is probably dependent of food availability.

The growth of small flounders (30 - 60 mm) were rather low, possibly due to morphological restrictions (small mouth and long, narrow oesophagus) when offered dry food particles.

Older flounder (from 100 mm and above) showed a promising high growth rate, maximum 2.5 g/day. Negative growth rate (weight) was observed after increasing the bottom net mesh size from 5 to 11 mm. This decrease was probably due to lack of food.

No predation on the salmon were observed.

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TABLE 1: **OUTLINES OF FLOUNDER TRANSFERS LAKE KVERNAVATNET 1983**

TIME OF CATCH	TIME OF TAGGING/ TRANSFER	TYPE OF UNIT	TEMPERATURE IN FRESH-WATER (C)	FISH SIZE RANGE (g)	SURVIVAL AFTER TWO WEEKS (%)	REMARKS
Primo July	19.07 (Not tagged)	Start feeding trays	18 - 20	0.5 - 5.0	81 (n=121)	Mortality increases when bottom deposits are removed
20.07 - 24.07	26.07	Net pen 5 mm meshes	18 - 20	10 - 75	100 (n=8)	The smallest flounders died after weight loss a month later. Filled stomachs observed.
25.07 - 02.08	03.08	Net pen 5 mm meshes	17 - 19	11 - 90	77 (n=13)	Same as above.
14.09 - 15.09	16.09	Net pen 11 mm meshes	10 - 14	100 - 800	7 (n=28)	Only empty stomachs observed.
Primo December	06.12	Tanks	2 - 0.5	50 - 400	50 (n=40)	Food available only in short periods.

TABLE 2: **GROWTH RATE OF FLOUNDER IN CULTURE TOGETHER WITH ATLANTIC SALMON.**

INITIAL SIZE (MONTH)	CULTURE TYPE	GROWTH RATES LENGTH (MM/DAY)	WEIGHT (G/DAY)
30 - 60 mm (July-August)	Together with 0+ salmon in small trays	0.39 (mean)	0.05 (mean)
100 - 170 mm (August)	Together with 1+ salmon in net pens	0.00 - 0.94	-0.05 - +1.96
100 - 200 mm (Aug.-Sept.)	Same as above	0.00 - 0.92	-0.08 - +2.45

TABLE 3: **STOMACH CONTENTS OF FLOUNDER**
Percentage values based on weights.
Sample "brackish water (0+)" from the estuary outside the small river draining Lake Kvernavatnet.
Sample "trays (0+)" taken from duoculture with 0+ salmon. Sample "Net pens (1+ and older)" taken from duoculture with 1+ salmon.

	T Y P E O F S A M P L E		
PREY TYPE	BRACKISH WATER (0+) (July 1983)	TRAYS (0+) (August 1983)	NET PENS (1+ AND OLDER) (August 1983)
Copepoda	21	3	0
Amphipoda	5	0	0
Vermes	39	0	0
Chironomidae	0	0	5
Dry food pellets	0	97	95
Unidentified	35	0	0
NUMBER OF STOMACHS	23	30	12