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SELECTIVE BREEDING OF MARINE FISH. I. AUTOMATIZED FEEDING OF PELAGIC FISH LARVAE UNDER CONTROLLED ENVIRONMENTAL CONDITIONS

by

Per Bratland and Per Solemdal [x)]

INTRODUCTION

Pelagic flatfish larvae are tender and difficult to handle in experimental work. For this reason it is of importance to reduce the duration of the pelagic stage by giving the larvae optimal environmental and feeding conditions.

The present paper describes an apparatus for rearing pelagic fish larvae with automatized feeding of *Artemia* naplii to the larvae. Some preliminary results on the duration of the pelagic stage and growth of metamorphosed plaice larvae are also given.

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x) Institute of Marine Research,
Directorate of Fisheries,
Bergen, Norway.

DESCRIPTION OF THE APPARATUS

Fig. 1 gives a schematic drawing of the apparatus in vertical section. The rearing system consists of 2 identical polyester waterbaths, independently supplied by seawater, (D). Each waterbath contains 9 rearing cylinders. The rearing cylinders (A), are made of Perspex, and the water passes from the cylinder through a nylon mesh to the waterbath. For pelagic larvae no bottom substance is used in the cylinders. After metamorphosis sand and gravel covers the bottom of the cylinders.

The Artemia-hatchery, (B), is placed above the rearing cylinders and consists of a Perspex-cylinder of about 20 litres surrounded by a waterbath. The Artemia-eggs hatch at the surface and the nauplii is concentrated at the outlet by a lamp, (C), No air is bubbled through the water in the Artemia-hatchery.

3 fluorescent tubes of 40 Watts, each, (E), mounted above each waterbath illuminates the rearing cylinders.

The system is operated by 3 timed switches and the programme is repeated 12 times a day.

The first switch, (F), controls electromagnetic valves, (G), between Artemia-hatchery and rearing cylinders. When the valve opens water (containing Artemia nauplii) flows through the 3 mm pipes to the rearing cylinders. The Artemia-hatchery water is sterilized by a UV-unit (not shown on the fig.). The UV-radiation is synchronized with the Artemia flow. 4-5 litres of Artemia-suspension flows out of the hatchery before the valve is closed. The hatchery refills through small holes in the cylinder wall, (H).

The second timer, (J), switches on the fluorescent tubes, illuminating the rearing cylinders. The tubes are started independently, (K).

Now the larvae are allowed to feed for $1\frac{1}{2}$-2 hours without any disturbing water currents in the rearing cylinders.

The third switch, (L), operates the electromagnetic valves, (M), controlling the circulation of seawater in the rearing cylinders. Seawater of the same temperature as the waterbath is circulated through the rearing cylinders for about $\frac{1}{2}$ hour.

A complete cycle takes about 2 hours, but it is possible to regulate the timed switches in the range of 0-5 hours.

The electromechanical equipment has been working since the middle of March this year without any trouble, and seems to be very reliable.

The Artemia-hatchery could be improved by supplying eggs to the hatchery continuously. At present eggs are manually filled into the hatchery during day-time, resulting in "dead" periods when no nauplii hatch.

The UV-unit has not sufficient capacity to sterilize the Artemia suspension. Because of high temperature in the hatchery the content of bacteria is rather high.

The problems of contamitation and cleaning of the rearing cylinders are considerable and time-consuming, and no effort has so far been done to automatize this procedure.

RESULTS AND DISCUSSION

Table 1 gives some preliminary results of the plaice rearing in 1971. The eggs were stripped from plaice females, which had been in captivity for some months. The eggs were artificially fertilized. Larvae from more than 20 plaice females were tested in the rearing apparatus. The viability of the larvae varied to a great extent. Egg batches from some plaice females produced very viable larvae, others very poor larvae. This probably reflects the difficulty of stripping the eggs on the right day combined with the general tendency for low-quality eggs from plaice not adapted to captivity (Bowers 1966).

The eggs developed in temperatures between 7 and 8°C. After hatching the larvae were kept for one week in this temperature before being transferred to the rearing cylinders. According to Ryland and Nichols (1967) this is the optimal temperature for yolk-sac larvae. The pelagic plaice larvae were fed exclusively on Atermia nauplii of the Californian stock. Part of the Artemia were produced in the automatic hatchery, and another part of the Artemia given to the larvae were pre-fed on Isochrysis galbana, as recommended by Wickins (1970). After metamorphosis the diet was gradually changed from Artemia to finely ground Calanus and Euphausiids. Later, live enchytraeids were also given.

From table 1 it can be calculated that the period from 50 % hatching to 50 % metamorphosis is about 7 weeks in 10.2°C and 6 weeks in 14.4°C. In another type of apparatus (see Shelbourne 1964) it took 10-12 weeks before the plaice larvae metamorphosed, (Ryland 1966). The temperature during the experiment increased from 7 to 11°C.

Measurements of the larvae were not carried out systematically, but a number of larvae were measured about 80 days after hatching. Table 1 shows that larvae reared in warm water had a mean length of 16.2 mm, larvae from coolder water only 10.9 mm. It should be noticed that the larvae reared in warm and cold water have the same parents and the eggs are fertilized the same day. - Compared to size-distributions of plaice 84 days after hatching (Riley 1966, fig. 8) the mean length of the warm water reared plaice are larger than any of the groups shown in Riley's figure. The size range is also larger, 10-32 mm, compared to 9-27 mm in Riley's paper. The temperature was rising from 8 to 15°C furing Riley's experiment.

Comparing the size range fro warm and cold water reard plaice, table 1, the range is always larger for the warm water groups.

The plaice/flounder hybrid has the same duration of the pelagic stage as the plaice larvae, but the growth is somewhat slower, as shown in table 1.

SUMMARY

1) A rearing apparatus for pelagic fish larvae, with automatic *Artemia* feeding, is described.

2) The metamorphosis of the plaice larvae occurs in a shorter time than in other described equipment. The growth of the larvae is satisfactory during the first 80 days.

3) Plaice larvae reared in high temperatures metamorphose in a shorter time than larvae reared at lower temperatures.

The growth of the larvae reared at high temperatures is significantly better compared to larvae reared at lower temperatures.

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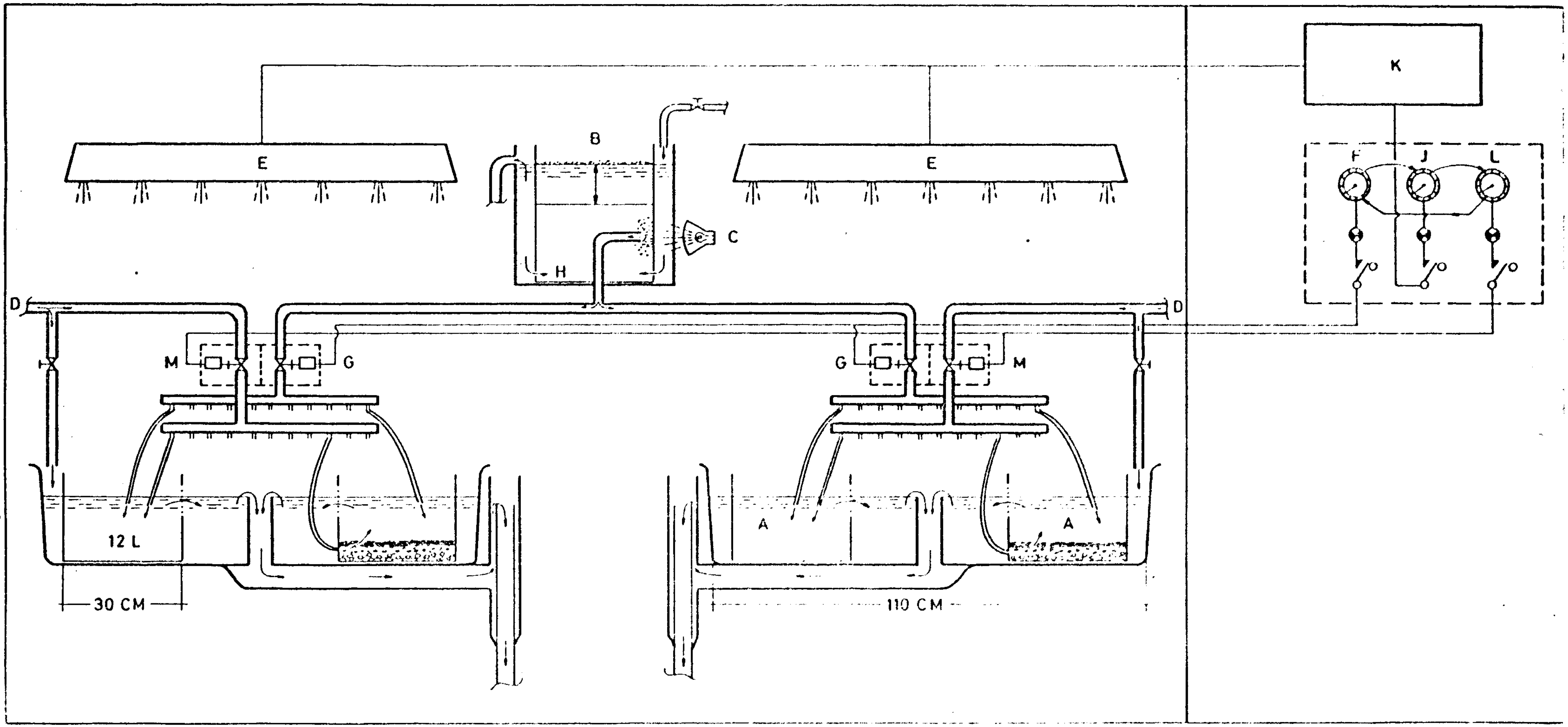

Fig. 1. Rearing apparatus with automatic Artemia feeding.

Parents	Rearing temp. to metamorph., °C	Days from 50% hatch to 50% meta-morph.	Temp after meta-morph., °C	Larvae 80 days after hatch	
				Mean length mm. (no)	Range, mm
Plaice, ♀ 3335 x ♂ 260	14.4	38	18.4	16.5 (6)	11-26
	10.2	56	14.8	10.5 (17)	8-14
Plaice, ♀ 3335 x ♂ 220	14.4	45	18.4	16.9 (8)	11-32
	10.2	51	14.8	11.3 (9)	8-15
Plaice, ♀ 3341 x ♂ 3414	10.2	41	-	-	-
Plaice, ♀ 3411 x ♂ 3414	10.2	45	-	-	-
Plaice, ♀ 3349 x ♂ 3338	14.4	-	18.4	15.1 (7)	10-27
Hybrid, ♀ plaice 3335 x ♂ flounder 222	14.4	41	18.4	14.0 (12)	10-18

Table 1. Duration of pelagic stage and length 80 days after hatching of plaice larvae.