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A NEW TECHNOLOGY FOR REARING ELVERS [1)]

by

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Of all candidates known up to now to be suitable for intensive warm water aquaculture the eel (Anguilla anguilla) obviously is one of the most interesting fishes regarding economics. The results obtained after several years investigation in an experimental eel-farming - station in the brackish thermal effluent of a conventional power station operated by the Institute for Coastal and Inland Fisheries with financial support of the Federal Ministry of Research and Technology were encouraging enough to see an economical feasibility of this kind of eel-culture.

On the other hand in the case of a growing eel-culture soon we will run short of eel-fingerlings,which up to now are a very important stocking-material for natural waters as well as for eel farming.

In view of this problem, and hoping, that the results even can be improved when using selected fast growing elvers for stocking material, we intensified our investigations on rearing elvers.

Preliminary investigations in the years before had shown, that conventional rearing methods for example in rectangular basins with sieves at the outlet gave results which were very unsatisfactory.

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1) A part of these results has been presented by a paper, which has been submitted also to the EIFAC-Symposium on new developments in the utilization of heated effluents and of recirculation systems for intensive aquaculture held from 28 May to 30 May 1980 in Stavanger.

The elvers are bottom-living-fishes, which under these rearing conditions are forced to live in close contact with faeces, food residuals and mud. Mainly gill-diseases, which are highly promoted under these conditions result in heavy mortalities.

Cleaning procedures and separation of dead elvers are rather complicated and give severe stress to the animals. Using boxes with perforated bottoms gave slightly better results, but losses were still rather high.

To improve the rearing method we made effort to attract the elvers to the surface in order to separate them from mud and dead eels. Especially equipped silos proved to be very suitable.

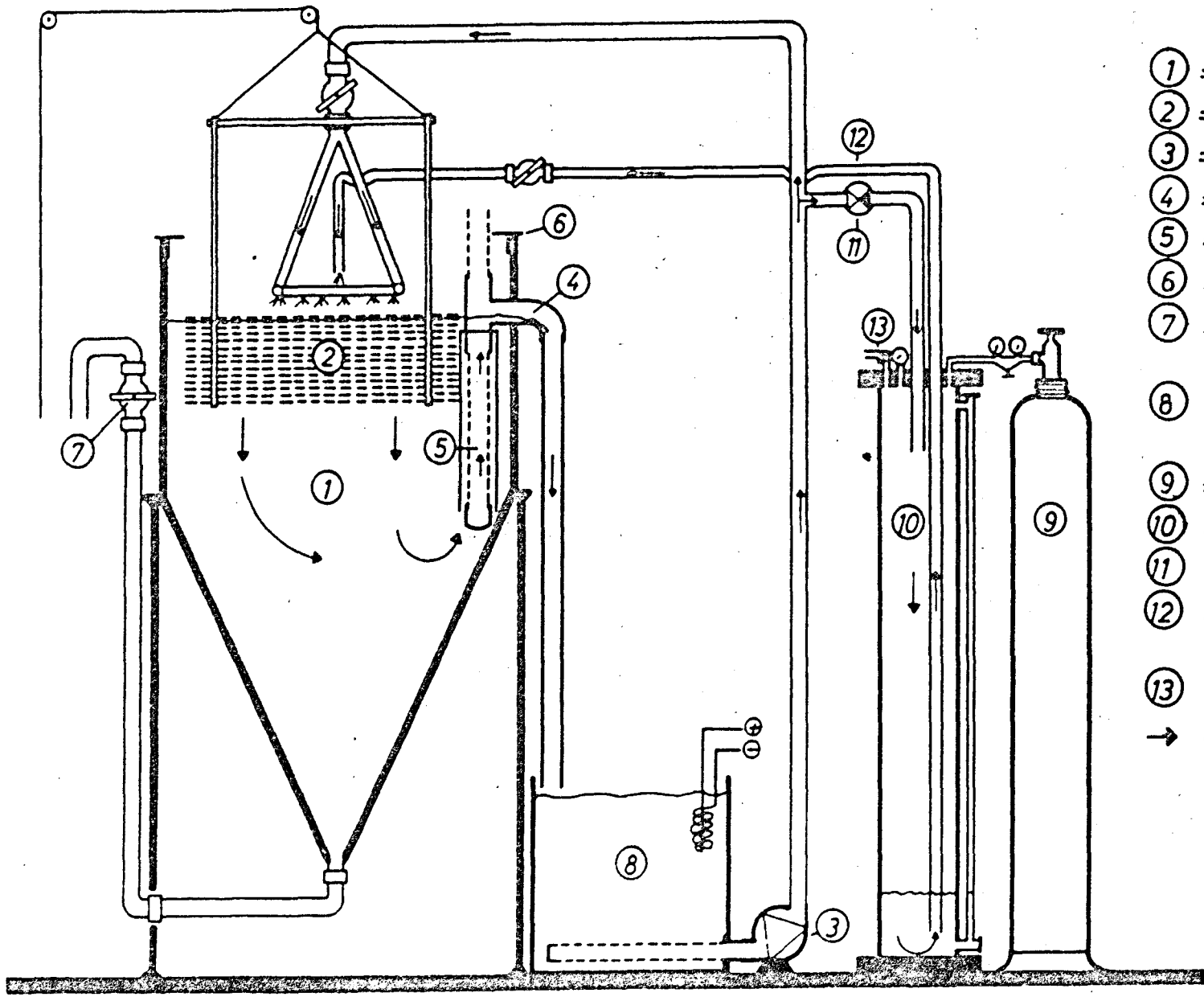
The technique was developed with small scale silos made from demand-feeders, which are relatively cheap and still in use for special comparative experiments.

In march 1980 a first 500 l-silo was stocked with 5 kg of glass-eels (fig. 1). The silo (1) is built of transparent PVC. At the lowest point there is an outlet (7). The water is given into the silo on the surface with a pump (3), fed from a pump-basin (8). Freshwater is added into the pump-basin and heated there. A certain amount of recirculated water, corresponding to the amount of freshwater-influx is drained by an outlet.

The silo-outlet is protected against elver-escape by a slitted tube (5). Slit-size is 1.5 x 15 mm. The tube is wrapped with a second tube, which is 3 cm larger in diameter. By this it is prevented that sinking particles immediately attracted by the sieve. On the other hand the water is drained not directly from the surface, but at the lower end of the cylindrical part of the silo. Thus the water body of the silo is divided into a flow-through area (cylindrical part) and a rather stagnant area (conical part), where sinking particles and dead animals are sedimentating and easily can be drained twice a day by simply opening the valve (7).

The outflow of the silo is given back to the pumping-basin. The construction is operated as a semi-closed system without biological purification.

Fig.1: SILO FOR REARING ELVERS



(1) = Silo
(2) = Meshwire-plates
(3) = Pump
(4) = Silo-overflow
(5) = perforated tube
(6) = Collar to prevent elver-escape
(7) = Valve for draining mud, dead elvers and to take out the fishes
(8) = Pump-basin with heating, freshwater supply and overflow
(9) = O_2-supply
(10) = O_2-reactor
(11) = Ball check valve
(12) = Pipe for O_2-oversaturated water
(13) = Safety valve
→ = Flow direction

During the first one or two weeks the elvers try to escape over the uppar-edge of the silo. This is prevented by a collar (6).

Immediately after stocking all elvers are sinking down to the tip of the silo. When oxygen-content is sinking in this region, more and more eels start swimming up to the well oxygenated surface. After about two days the large majority of elvers have accepted the meshwire plates (2) for housing and enjoy the clean, well oxygenated surface-water.

Food is offered on the upper meshwire-plate a few millimeters outside the water-surface twice a day. Feeding outside the water reduces food-losses considerably. The amount of food is adjusted to a feeding-time of 15-20 minutes.

Fishing-out of the silo is done by opening the valve (7) and turning down the pipe. The elvers are lead directly into meshwire-boxes to be graded.

At higher stocking-densities an artificial oxygenation must be applied. In our experimental unit a part of the circulated water is given into a PVC-tube (reactor 10) at a pressure of 0.5 to 0.8 bar. This tube is filled with pure oxygen-gas. When pumped through the gas-volume, the water will be oversaturated to 13-35 mg O_2/l. depending on the quantity of water pumped through the tube and the size of the gas-volume. The supersaturated water is given into the silo at doses, that prevent oxygen content to undergo 5 mg O_2/l in the outlet-water. Corresponding to the amount of oxygen dissolved in the water, the gas-volume in the reactor decreases and the niveau of the water in the reactor raises. The gas volume can be refilled automatically by means of a solenoid-valve and a niveau-regulation-device. At a 100% utilisation-rate of the oxygen-gas the capacity of the reactor can be regulated within a very wide range.

Table 1 shows the results of comparative feeding-experiments on elvers, using boxes with perforated bottoms and small scale silos respectively. During all control-periods of the experiments the specific growth-rate proved to be about 50% better in the case of the silo-reared elvers in comparison to those, reared in boxes. In two control-periods growth-rates over 2% were obtained. Considering, that elvers are not domesticated fish-populations, these figures can be regarded as quite satisfying.

Tab. 1.: Comparison of growth rates of eels rared in a silo and in plastic boxes respectively

	Plastic box		Silo
6.9.-8.10.1979 (21°C)			13.9.-8.10.1979
24 feeding days			18 feeding days
initial and final average body weights	0.55-0.77	0.56-0.69	0.74-1.04
daily growth rate in % of body weight	1.47	0.87	1.92
8.10.-5.11.1979 (21°C)			
23 feeding days			
initial and final average body weights	0.77-1.14	0.69-1.02	1.04-1.69
daily growth rate in % of body weight	1.70	1.74	2.13
5.11.-26.11.1979(21°C)			
17 feeding days			
initial and final average body weights	1.14-1.35	1.02-1.13	1.69-2.18
daily growth rate in % of body weight	0.99	0.63	1.51
26.11.-17.12.1979 (20°C)			
17 feeding days			
initial and final average body weights	1.35-1.55	1.13-1.35	2.18-3.35
daily growth rate in % of body weight	0.84	1.07	2.55

In Table 2 the main data of the first experiment carried out in a 500 l-silo are given.The elvers were fed for about 1 week with minced spleen, which after that stepwise was replaced by dry-food and water. The dry-food was the same diet, which is used for bigger eels in our experimental-station at Emden.

Table 2: Feeding of elvers in a silo, 25.3.-5.5.1980

Exp.- days	41
Feeding-days	30
n_o	15 103
n_1	14 493
g_o	5 310 g
g_1	6 479 g
d_g	1 169 g
Losses	223 g
Gain	1 392 g

Food

wet	9 955 g
dry	4 169 g

Feed efficiency

wet	7.15
dry	2.99

Feeding rate

in % of body weight

per exp.-day	4.4 %
per feeding-day	6.0 %

Specific growth rate

per exp.-day	0.59%
per feeding-day	0.80%

Losses:	n		%
1. week	431	=	2.85
2. week	132	=	0.87
3. week	29	=	0.19
4. week	8	=	0.05
5. week	5	=	0.03
6. week	5	=	0.03
Total	610	=	4.04

Grading 5.5.1980 :

Total: 6 479 g = 14 493 spec.

$\bar{x}$ g = 0.45 g

Graded into 2 lots:

Lot 1: < 2 mm mesh -size

1 261 g = 4 732 spec.

$\bar{x}$ g = 0.27 g

lot 2: > 2 mm mesh -size

5 218 g = 9 761 spec.

$\bar{x}$ g = 0.53 g

Total system	1 380 l
Silo	500 l
Tapewater supply	2.4 - 4.2 l/min
Theoretical water exchange	9.5 - 5.4 hours
Flowrate into silo	24 l/min

wt °C

$\bar{x}$	=	24.5
s	=	1.37
min	=	23.0
max	=	27.4

In this experiment the specific growth-rate was less, than in the experiment of Table 1. This might be due to the fact, that the second experiment contrary to the first was started with newly caught elvers, a part of which normally will never feed and in consequence grow lean and dies.

With 4% in 41 days the losses were very low. 3.7% of the losses occurred during the first two weeks obviously due to handling- and transportation-stress. Later on there will be a second peak caused by a certain amount of non-feeding animals, which however are distinctly less in number in comparison to the experiments using the basin-or box-rearing method.