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STUDIES ON NURSING MUGIL CEPHALUS FRY

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ABSTRACT

The present investigation was conducted to test the effect of feeding **Mugil cephalus** fry with natural and artificial feeds, under two levels of water flow. The fry were nursed in twelve earthen ponds for 71 days.

Combined feeding on natural food and artificial feed achieved by far the best growth and survival rates and the differences were highly significant. Natural food gave a significantly better growth rate than that of artificial feed. Fish fed artificial feed only had the poorest growth and survival rates. Fish growth and survival percentage were higher in the ponds which had flowing water than those reared in ponds with still water. The difference in length was significant, while the difference in weight was insignificant. Water flow had a slight effect on water quality.

INTRODUCTION

The grey mullets (**Mugil cephalus** Risso, and **Mugil capito** Cuv.) are considered highly esteemed fish in Egypt. They are also the most important salt water fish used for culture either in brackish or fresh water (Eissawy, et al., 1974). Because of their great productivity for aquaculture, there is a worldwide interest in mullet culture (family Mugilidae). They are recognized as a highly wanted fish for pond culture in Italy, Japan, Philippines and other parts of the world (Yashouv, 1966; Lin, 1968; Bardach et al., 1972, and Oren, 1975).

In Egypt, although up to the present data the seeds (fry) used for culture have been collected from natural habitats in definite seasons, most of them die throughout the rearing processes. Generally, the surfvival rate ranged from 12-25% (El-Zarka et al., 1966 and Eissawy et al., 1974). Investigations on improving the culture of these species appear essential and would increase their production.

Previous studies revealed the importance of fry nursing. Feeding appears to play a decisive role in this concern (Salama et al., 1984 and Salama, 1989). The present study was conducted to clearify the effect of artificial and natural feed on mullet (**Mugil cephalus**) fry growth and survival raised under different water flow rates.

MATERIALS AND METHODS

The present experiment was conducted at the Alexandria Governorate Fish Farm near El-Nozha Airport in Alexandria, Egypt. **Mugil cephalus** fry of about 2.1 cm standard length (S.L.) and 0.1 g body weight stocked in September, 1988 into twelve earthen ponds, each with an area of 600 m^2 and a mean depth of about one meter, at a stocking rate of 250 000 fry/ha (Salama, 1989).

The first group of four ponds were initially fertilized with cow manure (714 kg/ha). A mixture of 23.8 kg of superphosphate and 35.7 kg of urea per hectare was used as a fertilizer and added for each pond twice a weak for maintenance of plankton. Plankton biomasses were estimated before stocking the fry, then were adjusted to about 3.5 ml biomass/100 liter water according to Tomas et al. (1979). The water flow of two of these four ponds was adjusted at a rate of three l/min, while the other two were left with still water.

In a second group of four ponds the fry were given artificial feed at a daily rate of 10-15% of their estimated body weight six days a week without pond fertilization. The feed had 39% crude protein and contained: 25.6% fish meal, 32.0% soyabean meal, 18.4% wheat bran, 8.0% blood meal and 16.0% powdered milk. Two of these four ponds had a water flow rate of 3 1/min while the other two had still water.

A third group of four ponds were initially fertilized as described in the first group (cow manure, superphosphate and urea). In addition, the fry were given artificial feeds as in the second pond group. Two ponds of this third group had the same water flow rate as above, while the other two ponds had still water.

Water quality criteria were assessed in terms of temperature, dissolved oxygen mg/l, pH and transparency according to the techniques of American Public Health Association Anon.,(1980) and Largler (1956).

From each pond, individual fish body weight, and standard length were recorded on a random sample of at least 50 fish. Growth rate was estimated according to Kilambi et al. (1982) as follows:

$$\text{Growth rate (\%/day)} = (\text{Lin } W_2 - \text{Lin } W_1)/t \times 100$$

where W_1= initial weights of fish; W_2= weights of fish at the end of rearing period; and t = 71 days.

At the end of nursing period (71) the ponds were completely drained and the fingerlings were collected, counted and weighed.

RESULTS AND DISCUSSION

Water Quality

In general, water quality for all the experimental ponds were suitable for **Mugil cephalus** fry rearing (Table 1). Water temperature varies between 15 and 19.5°C. Mullets could tolerate temperature from as low as 3°C to as high as 35°C (Pillai, 1975 and Nagel, 1979). A positive correlation was observed between dissolved oxygen, pH and water transparency with water flow. This indicates that the water quality of the ponds with water flow is slightly higher than those with still water with exception of water plankton population density. The increase of water flow caused a decrease in this population. The secchi-disc reading clearly indicates an intensive growth of phytoplankton in ponds with still water (Table 1).

Table (1)

Water quality criteria of the experimental nursing ponds.

Treatments	Artificial food		Pond fertilization		Pond fer. & Artif. feeding	
	Artificial food, and warer flow	Artificial food, without flow	Fertilization and water flow	Fertilization without water flow	Fertilization feeding and water	Fertilization feeding without water
Water temperatu °C	15.0-19.2	15.0-19.0	15.3-19.5	15.2-19.5	15.0-19.5	15.3-19.5
Dissolved oxygen mg/l	6.0	5.8	6.2	5.8	6.1	5.5
pH	7.3	7.1	7.8	7.4	7.3	7.1
Water transperancy cm	38	31	22	20	20	18

Survival and Growth

Tables 2, 3 & 4 and Fig. 1 clearly demonstrated that **Mugil cephalus** fry could be nursed with artificial feed alone. The relative growth (Table 2) achieved 400% and survival ranged from 52.1 to 55.9% (Table 4). It is preferable to change the pond water in case of using artificial feed alone (Fig. 1 and Table 2). Hepher et al.(1981) reported that mullet feed readily on proteinrich pellets or meals. Pillai (1975) and Sivalingam (1975) observed that mullet feed on artificial food.

Table (2)

Relative growth of **Mugil cephalus** reared in water with or without flow and fed natural and artificial feed.

Treatment	Relative growth*		Treatment	Relative growth*	
	length	Weight		Length	Weight
Artificial food and water flow	71	400	Artificial food without water flow	55	400
Pond fertilization and water flow	124	1100	Pond fertilization without water flow	118	900
Pond fertilization art. feeding and water flow	186	2600	Pond Fertilization art. feeding without water flow	181	2170

* Relative growth $= \frac{M_2 - M_1}{M_1} \times 100$

where M_1 is initial weight or length, and M_2 is final weight or length

Table 3
Analyses of variance of final body weight and standard length of **Mugil cephalus** at the end of the nursing period.

S.O.V.	d.f.	Mean squares	
		Body weight	Standard length
Ration	2	38.16**	58.54**
Water flow	1	2.12	4.93*
Error	104	1.84	0.94

* $P \leq 0.05$
** $P \leq 0.01$

TABLE (4)

Survival and growth of **Mugil cephalus** fry nursed under different treatments for 71 days.

Treatments	Stocking data			Haresting data			Growth data	
	Stocking density thousand fry/ha.	Av. initial weight g	Mean biomass at stocking kg/ha.	Average final weight g	Mean biomass at harvest kg/ha.	Survival %	Daily weight gain mg/day	Specific growth rate % / day
Artific. feeding:								
Artificial food and water flow	250	0.13	25.00	0.50 [b]	68.85	55.10	5.63	1.88
Artificial food	250	0.10	25.00	0.50 [b]	66.09	52.90	5.63	1.88
Pond fertilization :								
Fertilization and water flow	250	0.10	25.00	1.20 [b]	174.78	58.29	15.49	2.38
Fertilization without water flow	250	0.10	25.00	1.02 [b]	147.85	58.00	12.96	2.31
Pond fer., & Ar. feeding :								
Fertilization, feeding and water flow	250	0.10	25.00	2.70 [a]	425.35	63.04	36.62	2.62
Fertilization, & feeding without water flow	250	0.10	25.00	2.27	345.36	60.88	30.56	2.58

* In the same column insignificant differences between means with same letter ($P \leq 0.01$).

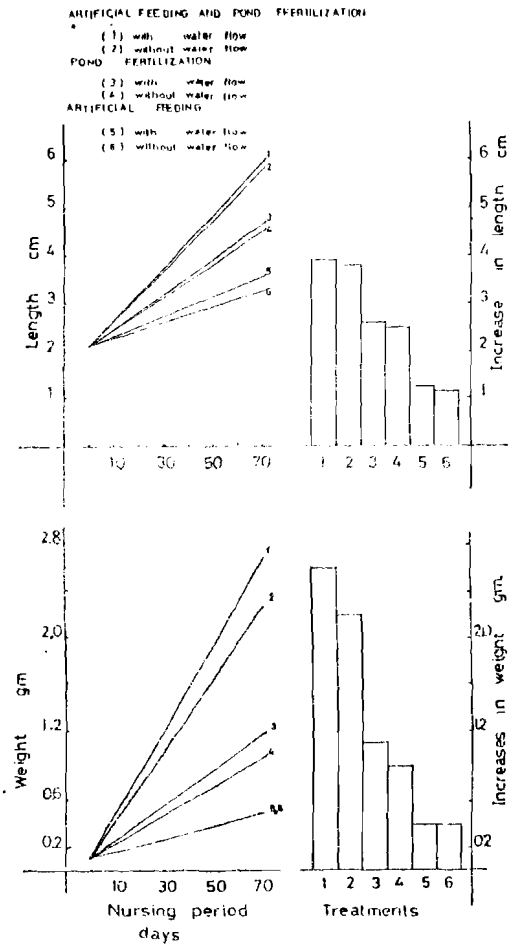

Fig. (1)
Growth of **Mugil Cephalus** Fry
During the Nursing Period.

The nutritional value of foods depends on both the abundance and the ability of fish to consume them. Comparing the feeding regimes tested in the present study, the results clearly showed that poor growth was obtained with artificial feed alone. Similar results were reported by other investigators. In an experiment conducted to test the effect of carp feeding on unicellular algae alone and in combination with trout diet, Meske (1985) found that the poorest growth rate was obtained with the artificial diet alone. Liao et al: (1970) reported that experience so far gathered did not indicate that artificial feeding for mullet larvae could be used alone.

Natural feed appeared more suitable for **Mugil cephalus** fry (Fig. 1 and Tables 2 & 4). The growth and survival rates for the fish received live food instead of artificial diet were higher than thos of fish fed on artificial diet only (Table 4). Yashouv et al. (1968) studied the nutrition of **Mugil cephalus** and **M. capito** in laboratory conditions. They found that mullet fingerlings became active immediately upon introduction of the live food (cladocerans, copepode and chironomid larvae) into the aquaria, and moved in zigzag fashion with abrupt up and down turns corresponding to the movement of the prey animals. The same authors conducted an experiment with **M. cephalus** fry weighing 0.16-3.50 gm in laboratory aquaria. The fish were given pellets having 21 % protein (composed of wheat, fish meal, and soya flour) and plankton strained from fish ponds. They found that the growth rate of fish fed on plankton alone was superior to that of those fed on artificial feed alone. Also, it was found that the use of pure unicellular algae resulted in a significantly better growth rate than that of the trout diet alone (Meske, 1985). This effect was attributed to high vitamin content in this unicellular algae. Also, the growth and survival of other fish larvae was found higher with natural than with artificial feed (Beck and Bengston, 1978, and Dabrowski et al., 1979).

The natural feed of **M. cephalus** fry was found to be a mixture of microscopic forms of plants and animals, i.e., diatoms, blue green algae, and small crustacea, contained a very high protein content, about 60 % (Bishara, 1967, and Schaperclaus, 1961). Liao et al. (1970) found that the growth of mullet fry was superior in the water with large amounts of blue-green algae diatoms over that without the algae. Yashouv et al. (1968) came to the conclusion that plankton and other natural food might possibly stimulate better growth in **M. cephalus** than artificial feed alone.

The combination of both natural and artificial feed achieved by far the best growth and survival. Compared to the other two feeding methods, its superiority proved to be statistically highly significant (Table 4). Relative growth rate (% gain), daily gain and specific growth rate were all significantly greater (Tables 2, 3 and 4), and so were survival percentage and mean biomass (Table 4). Similar results were found by others for carp (Beck et al., 1978 and Horvath, 1978). Beck et al. (1978) reported that the artificial diet is contributing to growth, but the live food is necesary to ensure both continued survival and growth. Horvath (1978) reported that feeds containing natural live food organisms are of high nutritive value and have vitamins and amino acids essential for fish growth, and feeds with low nutritive value slowed the development of the fry and impeded its metabolism too.

The Influence Of Water Flow :

Fish growth, total gain and survival (Tables 2 & 4 and Fig. 1) were higher in the ponds which had flowing water than those reared in ponds with still water. The difference in length was significant, while the difference

in weight was insignificant (Table 3). Meske (1985) reported that the growth rate was positively correlated with water flow rate. He found that the weight increased at a flow rate of 3 l/min. to be 268 % and at 1 l/min. was only 152.2 %. In the present study the weight increased in ponds with the flow rate of 3 l/min. to be 400-2600% , while in the ponds with still water was 400-2170% (Table 2). The influence of water flow was more pronounced in the ponds in which the artificial feed was used (Fig. 1 and Tables 2 & 4). Graves (1973) found that the renewal of water reduced mortality and improved growth rate of yellow perch fingerlings.

The influence of water could be also observed on the water quality (Table 1). Dissolved oxygen and pH showed slight decrease in still water when compared with the flowing water ponds (Table 1). The exchange of water can help eliminating excretory products, which in turn improves the survival rate. It was observed that mullet fry were very sensitive to excretory products, such as ammonia (Salama et al., 1984).

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