Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 1894-1898

Received: 24-07-2018
Accepted: 25-08-2018

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# Production of green back mullet, *C. subviridis* in monoculture management at different artificial feeds

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**Abstract**
A five month long (April-August/2017) comprehensive study with different feeds ($T_1$-commercial feed, $T_2$-natural feed and $T_3$-formulated feed) was conducted to evaluate the production potentials of green back mullet in monoculture management at Brackish water Station of Bangladesh Fisheries Research Institute (BFRI) Paikgacha, Khulna. Fingerlings of Green Back Mullet (*C. subviridis*) were stocked at the rate of 9000/0.1 ha in each treatment. The physico-chemical parameters of water *viz.* transparency, temperature, dissolved oxygen, pH, salinity and total alkalinity recorded during the study period were found within optimum range. Phytoplankton ($9.1*10^3$ No/L) and zooplankton ($3.5*10^3$ No/L) concentration were also highest in $T_2$ compared to other treatments. Average final weight was 15.88±0.89 g, 17.13±0.735 g and 14.93±0.135 g in $T_1$, $T_2$ and $T_3$ respectively. In case of final weight, $T_1$ and $T_3$ were significantly ($p$<0.05) different from $T_2$ and no significant difference ($p$>0.05) was found between $T_1$ and $T_3$. Significantly ($p$<0.05) highest production was found in $T_2$ (1331.4 kg/ha) followed by $T_1$ (1209.4 kg/1 ha) and $T_3$ (1115.4 kg/1 ha). Highest BCR (1.874) was found in $T_2$ compared to $T_1$ and $T_3$ which suggest the profitable culture practice of *C. subviridis* in Bangladesh coast.

**Keywords:** Feed, fertilizer, *C. subviridis*, brackishwater, monoculture and fish production

## 1. Introduction
Green back mullet, *Chelon subviridis* (Val. 1836) earlier known as *Liza subviridis* belongs to the Mugillidae family is a catadromous fish and widely distributed in the coastal waters of tropical and sub-tropical regions extending from 420N to 420S [27, 26]. It is a euryhaline and eurythermal fish. This fish is locally known as parse/bata and commonly available in shallow coastal waters, estuaries and mangrove swamps of Bangladesh [28]. The high quality of flesh, high economic value and wide temperature and salinity tolerance capacity make this species popular for aquaculture in the intertidal ponds [1].

There are about 1.5 million ha brackish water *ghers* (large hydrological units protected by embankment with provisions of controlled drainage and irrigation infrastructures connecting with coastal rivers) in the southwest region of Bangladesh [2]. Brackish water aquaculture in Bangladesh is mostly directed to traditional farming of brackish water shrimp, *Penaeus monodon* with or without fin fishes. The culture practice of this fish in the coastal impoundments (locally called *ghers*) of Bangladesh is getting much popularity [25, 26]. At present, the farmers depend upon wild seed for stocking to their *ghers*. Due to indiscriminate harvest from natural sources and some environmental reasons; the abundance of this fish is decreasing day by day. There is no alternate of supply of seed from artificial sources to conserve the natural biodiversity and increase production of this fish. *Chelon subviridis* has high demand in the national and international market. It is now imperative to develop a suitable culture technology of this species to increase productivity of the *ghers*. But no potential attempt has yet been taken in this regard. Long back, a few attempts were undertaken by Bangladesh Fisheries Research Institute and studies were conducted on the production performance of this fish with shrimp [3-5] using mullet seed from wild source. Recently Saha and Kabir [6] reported preliminary success of breeding of this fish in captivity. Efficacy of formulated feed for the culture of green back mullet, *Liza subviridis* studied [7]. The study indicated that protein level, source of protein in the diets and natural live food cumulatively played a significant role on the growth and survival of juveniles of this fish.

Later on, no further attempt was undertaken in this regard for the development of either nursery management or culture technology on this species. Realizing the importance of this fish, the present study was conducted to develop culture technology of green back mullet, *C. subviridis* with minimum feed cost.

## 2. Materials and Methods

### 2.1 Description of the study area and duration

The present study was conducted (April-August/2017) in the pond complex of Bangladesh Fisheries Research Institute, Brackish water Station, Paikgacha Upazilla (22º35.3'N 89º20.2'E), Khulna district, Bangladesh. The study on the efficacy of different artificial feeds on the growth and survival of green back mullet, *C. subviridis* was carried out in nine earthen ponds of 0.1ha under three treatments *viz.*$T_1$, $T_2$ and $T_3$ with three replications each.

### 2.2 Pond preparation

The ponds were prepared by sun drying followed by liming the soil with CaO @ 250 kg/ha and then filled with tidal water up to 100 cm. Water of the ponds was treated with rotenone and dipterex, both @ 1.5 ppm to kill all unwanted animals. After removing all dead animals, ponds treated with dolomite @ 20 ppm. After five days of liming, water of the ponds fertilized with 25 ppm urea and 30 ppm TSP to enhance growth of plankton and waited for a week to allow the water becoming suitable for stocking.

### 2.3 Stocking of fish

After two days of fertilization, hatchery produced good quality fingerlings of green back mullet (*C. subviridis*) were stocked (April-August/2017) at the rate of 9000/0.1 ha under all treatments. Before stocking the initial mean weights of the fingerlings were measured using sensitive balance (OHAUS Model CS-2000).

### 2.4 Feeding experiment

From the second day of stocking, fries of treatment $T_1$ and $T_3$ were fed daily with commercial feeds and formulated feeds @15% of estimated biomass and gradually reduced with the growth of fish and terminated @ 3% of estimated body weight. The ingredients (Fish Meal-20%, Soyabean Meal-25%, Rice-bran-29%, Flouer-5%, MOC-20% and Vitamin Mix-1%) of formulated feed was proportionally weighted and mixed together except MOC. The mixture was added with soaked MOC and was made into dough balls to provide fishes three times daily. On the other hand, ponds of $T_2$ were fertilized weekly with mustard oil cake @ 187.5 kg/ha, urea @ 25 kg/ha and TSP @ 10 kg/ha to grow sufficient plankton. Growth of fishes was checked fortnightly and feed was adjusted accordingly. During the culture trial, in every month all the ponds were limed at the rate of 125 kg/ha to maintain pH and water qualities. Experimental design of three different feeds is given below.

**Table 1:** Experimental design of green back mullet, *C. subviridis* in monoculture management at different feeds.

| Treatments (T) | Name of feeds |
|---|---|
| $T_1$ | Commercial feed (30% protein) |
| $T_2$ | Natural feed (mustard oil cake @ 187.5 kg/ha, urea @ 25 kg/ha and TSP @ 10 kg/ha) |
| $T_3$ | Formulated feed (30% protein) (Fish Meal-20%, MOC-20%, Soyabean Meal-25%, Rice-bran-29%, Flouer-5% and Vitamin Mix-1%) |

Replications: three of each treatment

### 2.5 Growth measurement

The growths of fishes of all ponds were monitored fortnightly by using random sampling method. At least 50 fishes were sampled with the help of a cast net to measure the growth to assess the health status and for feed adjustment.

### 2.6 Water quality parameters

The pond environment parameters such as surface water temperature, water depth, transparency, dissolved oxygen and pH was measured weekly using a Celsius thermometer, a graduated pole, a secchi-disk a portable dissolved oxygen meter (HI 9142, Hanna Instruments, Portugal), Salinity by refractometer and a portable pH meter (HI 8424, Hanna Instruments, Portugal). Total alkalinity and ammonia-nitrogen was determined following the titrimetric method according to the standard procedure and methods [8].

### 2.7 Quantitative Study of plankton

The quantitative study of plankton was done by S-R cell under microscope. The cell was filled and covered with cover slip so as to eliminate air bubbles and left to stand for 15 minutes to allow the plankton to settle. The under microscope plankton were counted in 10 or more fields randomly using the following formula [9]:

$$N = \frac{A*1000*C}{V*F*L}$$

Where, N= No. of plankton cell
A= Total no. of plankton counted
C= Volume of final concentrated sample in ml
V= Volume of a field in cubic mm
F= Number of field counted
L= Volume of original water in liter

### 2.8 Harvesting of Fish:

Growth and well-being of fishes were checked fortnightly and feed was adjusted accordingly. After five months of rearing, all fishes were harvested by draining out the ponds and growth and production of fishes were estimated and compared**.**

### 2.9 Statistical analysis

Comparison of treatment mean was carried out using one-way analysis of variance (ANOVA), followed by testing of pair wise differences using Duncan's Multiple Range Test [10]. Significance was assigned at the 5% level ($P$>0.05). All statistical analysis was done by using the SPSS (Statistical Package for Social Science) version-16.5.

## 3. Results and Discussion

### 3.1 Fish Production

At the end of five months rearing period, growth performance observed on the basis of three different feeding strategy *viz.*,Commercial feed (30% protein) in $T_1$, Natural feed

(mustard oil cake @ 187.5 kg/ha, urea @ 25 kg/ha and TSP @ 10 kg/ha in $T_2$ and formulated feeds with 30% protein (Fish Meal-20%, MOC-20%, Soyabean Meal-25%, Rice bran-29%, Flour-5% and Vitamin premix-1%) in $T_3$. Growth parameters of *C. subviridis* in different treatments are given in Table2.

**Table 2:** Growth parameters of green back mullet, *C. subviridis* in monoculture management at different feeds in different treatments

| Treatment | Initial wt. (g) | Final wt. (g) | Survival (%) | Culture period (month) | SGR (%) | Production (kg/ha) |
|---|---|---|---|---|---|---|
| **$T_1$** | 0.25 | 15.88±0.89[a] | 84.66±2.5 | 5 | 2.76[a] | 1209.4[b] |
| **$T_2$** | 0.25 | 17.13±0.73 [b] | 86.33±2.08 | 5 | 2.81[a] | 1331.4[a] |
| **$T_3$** | 0.25 | 14.93±0.135[a] | 83±2.65 | 5 | 2.725 [a] | 1115.4[c] |

Values in the same row having the same superscripts are not significantly different ($P$>0.05).

Average final weight was 15.88±0.89 g, 17.13±0.735 g and 14.93±0.135 g in $T_1$, $T_2$ and $T_3$ respectively. In case of final weight, $T_1$ and $T_3$ were significantly ($p$<0.05) different from $T_2$ and no significant difference ($p$>0.05) was found between $T_1$ and $T_3$. During the period of study, higher survival rate (86.33±2.08) was found in $T_2$. Survival rates were found 84.66±2.51 and 83±2.65 in $T_1$ and $T_3$ respectively. Similar survival rate was found by Islam *et al.* [11] where they found 90% survival in *C. subviridis* culture ponds. Significantly ($p$<0.05) highest production was found in $T_2$ (1331.4 kg/ha) followed by $T_1$ (1209.4 kg/1 ha) and $T_3$ (1115.4 kg/1 ha) (Table-2). Yasmin *et al.* [12] found net fish production 23.22 Kg/dec in nursery pond of *C. subviridis.* Das *et al.* [32] have studied efficacy of formulated feed for the culture of green back mullet, *Liza subviridis*. The study indicated that protein level, source of protein in the diets and natural live food cumulatively played a significant role on the growth and survival of juveniles of this fish. Mou *et al.* [31] have evaluated the efficacy of different fertilizers on the growth and survival of brackish water catfish, *Mystus gulio* (Hamilton) fry in nursery ponds and reported that organic fertilizer (cattle dung) was significantly more effective for nursery rearing of this fish than that inorganic (urea & TSP) and mixture of organic and inorganic fertilizer.

Commercial feed cost is usually higher than formulated feed cost and fertilizer cost which impact the net benefit. Highest production and selling price found in $T_2$ than other treatments. Highest BCR (Benefit–cost ratio) found in $T_2$ (1.874) followed by $T_3$ (1.447) and $T_1$ (1.363) respectively. Comparatively highest benefit found in $T_2$ than other treatments (Table-3).

**Table 3:** Details of economic return from mono-culture management of green back mullet, *C subviridis* with different feeds under different treatments after 150 days of culture.

| Items | Treatment ( Types of feed) | | |
|---|---|---|---|
| | Cost | | |
| | T1 (Commercial feed) | T2 (Natural feed) | T3 (Formulated feed) |
| Pond preparation | 5000 | 5000 | 5000 |
| Fingerling price | 67500 | 67500 | 67500 |
| Commercial feed (56 Tk./kg) | 1,25,272 | ------- | ------- |
| Urea, TSP and MOC | ------- | 81.080 | ------- |
| Formulated Feed( 49 Tk./Kg) | ------- | ------- | 95,550 |
| Harvesting cost | 4000 | 4000 | 4000 |
| Labor cost | 20,000 | 20,000 | 20,000 |
| Total costs | 2,21,772 | 1,77,580 | 1,92,050 |
| | Gross benefit | | |
| Sell price of *C. subviridis* | 3,02,350 | 3,32,850 | 2,78,050 |
| Net benefits (B-A) | 80,578 | 1,55,270 | 86,000 |
| BCR | 1.363 | 1.874 | 1.447 |

Siddik and Khan [13] analyzed the cost and benefit of Monosex Tilapia (*Oreochromis niloticus*) monoculture system and got the net benefit of BDT 69,277.32/ha/6 months where fish were fed formulated feed which is lower than the present findings may be due to the price of the fish. Kohinoor *et al.* [14] got the net benefit BDT 32,919 to 42,291/ha/6 months in monoculture of *Mystus cavasius*. In the present study, the net benefit was higher than the above findings. In another study, Kohinoor *et al*. [20] have found that monoculture of Rajpunti (*Puntius gonionutus*) gave a net benefit BDT 68,135 to 75,028/ha/6 months. In the present study, the net benefit was higher than the above findings.

### 3.2 Water quality parameters

The physico-chemical parameters of the rearing water during the experimental period are given in Table 4.

**Table 4:** Mean physico-chemical parameters of water during the rearing period.

| Treatments | Water temp ($^0$C) | Salinity | DO | Transparency | pH | Total Alkalinity |
|---|---|---|---|---|---|---|
| T1 | 31.5(±5.12) | 11.4(±3.25) | 5.2(±1.23) | 41(±9.12) | 8.2(±0.45) | 138(±52.79) |
| T2 | 31.8(±4.69) | 11.6(±2.75) | 4.9(±2.07) | 45(±8.77) | 8.5(±0.54) | 140(±64.45) |
| T3 | 31.9(±2.35) | 11.6(±2.76) | 3.5(±1.65) | 32(±12.94) | 8.7(±0.52) | 125(±52.76) |

Temperature of water during study period varied from 25-32 $^o$C which were within the suitable range for growth of fish in tropical ponds [15, 16]. Salinity varied from 3-12 ppt. Morning-DO ranged from 3.5 to 6.8 mg/L in all treatments. Dissolved oxygen content of a productive pond should be 5.00 mg/l or more reported [15]. Transparency ranged from 13 to 45 cm in all the three treatments. According to Boyd [17] transparency values of about 15-40 cm are appropriate for fish culture,

which are strongly supported in this result. pH of water of all treatments was found congenial for rearing and varied from 6.1 to 8.5. According to Swingle [18] pH 6.5 to 9.0 is suitable for pond culture which agreed to the present study. Total alkalinity varied from 125 to 279 mg/L in all treatments. The variations in total alkalinity in all the treatments were within the productive range for aquaculture ponds [19, 20].

Plankton is the basic food of all the organisms living in the water. The concentration of Phytoplankton and Zooplankton in the present study has illustrated in Table 5.

**Table 5:** Concentration of phyto- and zooplankton of the rearing ponds during the study period.

| Treatment | Phytoplankton (nos/L) | Zooplankton (nos/L) |
|---|---|---|
| T1 | $8.7*10^3$ No/L | $3.2*10^3$ No/L |
| T2 | $9.1*10^3$ No/L | $3.5*10^3$ No/L |
| T3 | $6.2*10^3$ No/L | $2.8*10^3$ No/L |

The physicochemical properties play an important role in governing the production of phytoplankton i.e. primary production in fishponds [29, 30]. For successful aquaculture, knowledge on several factors is very important among which fertilization is one of them [21, 22]. Fertilizer is helpful for the increase of natural food of fish i.e. plankton, benthos and periphyton [23, 24]. In the present study concentration of phyto- and zooplankton of the ponds used for rearing of fingerlings at different fed treatments were 6.2-9.1*$10^3$ No/L and 3.2-3.5*$10^3$ No/L respectively. Lowest phytoplankton counts were found in $T_3$ (6.2*$10^3$ No/L) and highest in $T_2$ (9.1*$10^3$ No/L). Zooplankton counts were found lowest in $T_1$ (3.2*$10^3$ No/L) and highest in $T_2$ (3.5*$10^3$ No/L) respectively, which was similar to Yasmin *et al.* [12].

## 4. Conclusion

From the present study, it can be concluded that the production and economic return was highest where green back mullets were reared with natural food compared to commercial feed and formulated feed which will lead the further research areas; in particular, the plankton composition and nutritive value in culture with natural food as well as the comparative efficacy of different fertilizers on the production of this species in monoculture and polyculture system. Therefore, these will pave the way for expanding cost effective culture of this species in the coastal area of Bangladesh.

## 5. Acknowledgement

The authors thank to Bangladesh Fisheries Research Institute for providing research fund and instrumental facilities.

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