Assessment of Mud Crab (*Scylla* spp.) Resources in the Coastal Area of Bangladesh

Researchers: Dr. Md. Latiful Islam, Senior Scientific Officer
Mollah N.S. Mamun Siddiky, Scientific Officer
Md. Mizanur Rahman Washim, Scientific Officer
Shazad Kuli Khan, Scientific Officer
Ahmad Fazley Rabby, Scientific Officer
Md. Matiur Rahman, Scientific Officer

Objectives

- To assess the qualitative and quantitative production of mud carb in major harvest areas
- To assess the stock status of mud crab through estimating the catch per unit efforts (CPUE)
- To identify the breeding biology and spawning seasons of the mud crab in Bangladesh environment
- To estimate the genetic diversity (composition) of mud crab species in Bangladesh coastal areas.

Achievements

Genetic diversity of mud crab (*Scylla* spp.): According to the morphological characteristics, 98.25% of the stock was *Scylla olivacea*, whereas only 1.75% of the sampled crab was *S. serrata* (Fig 1). The rest two species (*S. paramamosain* and *S. tranquebarica*) were not found in the samples yet. Though, some of the samples seemed confused to identify from the keys available on morphological features.

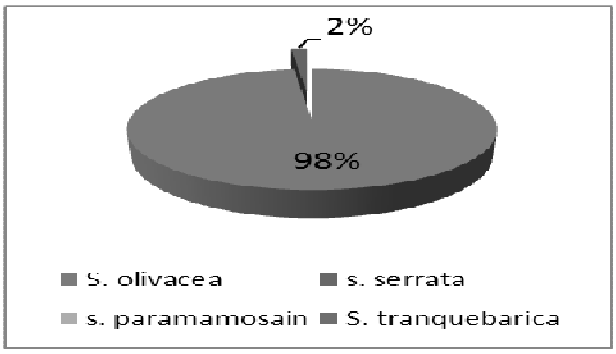

Fig. 1. Genetic composition of sampled crabs.

Landing status and production: As stipulated in Fig. 2, the average monthly production or landing of mud crab was the highest in Satkhira (12,621 kg) followed by Khulna (12,213 kg) and Bagerhat (11,147 kg) region and the lowest for Patuakhali (3,228 kg) and Barguna (5,340 kg) region. Average monthly production (6,110 kg) of Coxs Bazar was found moderate.

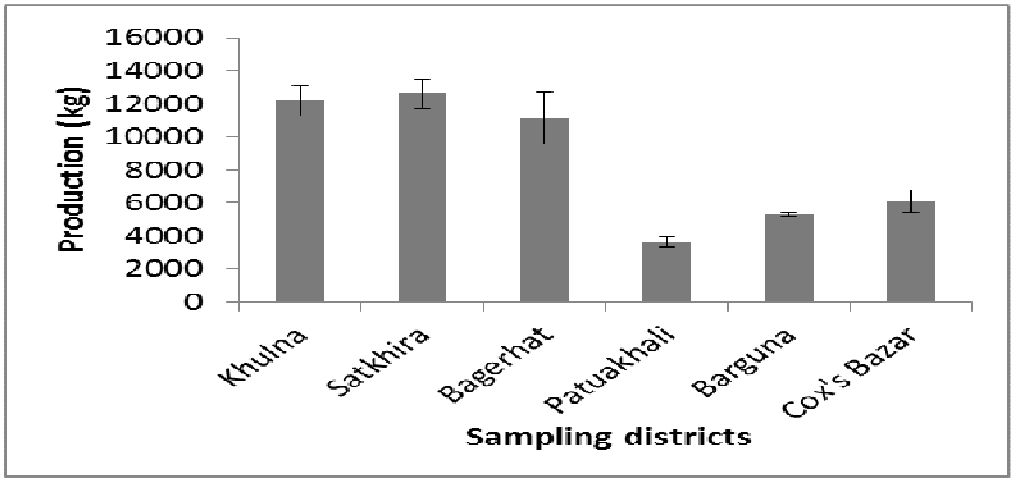

Fig. 2. Monthly average landing of mud crab in different sampling districts.

In all the districts except Khulna (May), higher production was noticed in April. Meanwhile, the lowest production was recorded in March for all the sampling places (Table 1).

Table 1. Range of monthly production of mud crab in different districts

District	Lowest Production		Highest Production	
	(kg)	Month	(kg)	Month
Khulna	10,984	March	13,000	May
Satkhira	11,385	March	13,387	April
Bagerhat	8,813	March	12,113	April
Patuakhali	3,200	March	3,780	April
Barguna	5,110	March	5,430	April
Cox's Bazar	5,200	March	6,700	April

As shown in Fig. 3, the male-female ratio in the sample seemed similar and ranged between 0.93 and 1.27 for all the sampling sites except in Barguna district, where male crabs were prominent over female (M:F = 1:1.56).

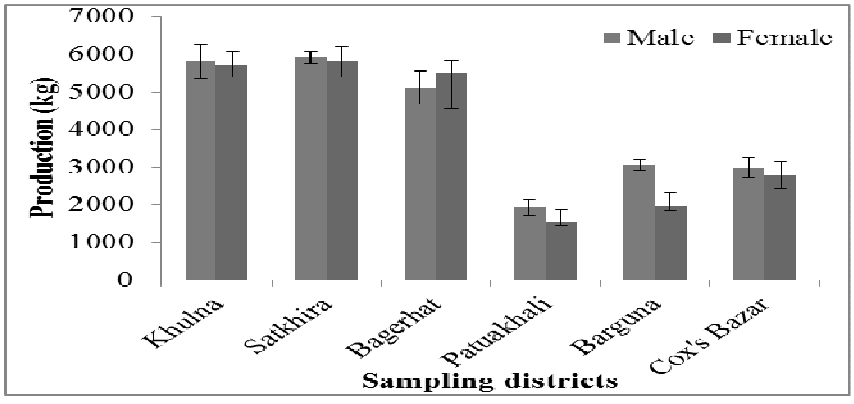

Fig. 3. Male-female ratios of landed crabs in different districts.

During harvesting of crabs from the natural sources, a considerable amount of juvenile and sub-adult crabs were being caught (Fig. 4) from all sites. The proportion (by weight) of the juvenile crabs to the adult ranged from 10.18% in Bagerhat to 14.97% in Satkhira (Table. 3).

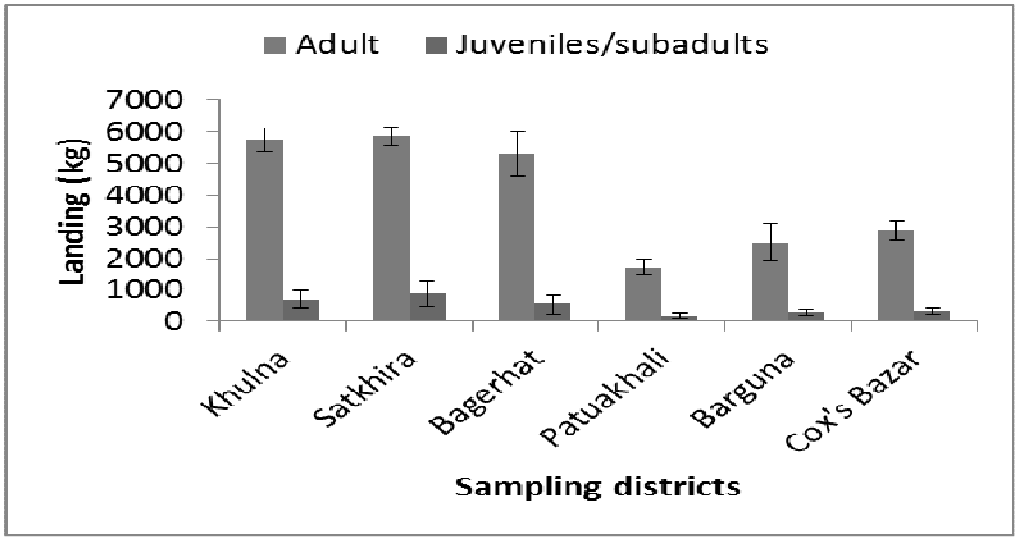

Fig. 4. Status of juvenile and sub-adult crab harvesting in relation to adults.

Stock status by (CPUE): Likelihood the production, CPUE (Fig. 5) was also the highest in Satkhira (0.078 crabs/bait/hour) followed by Khulna (0.075 crabs/bait/hour) and Bagerhat (0.072 crabs/bait/hour). The lowest was recorded for Patuakhali (0.025 crabs/bait/hour) and Barguna (0.027 crabs/bait/hour). CPUE in Cox's Bazar region was (0.042 crabs/bait/hour). The results on CPUE indicated that the sampling points closer to the main mangrove forest provided higher availability of crabs.

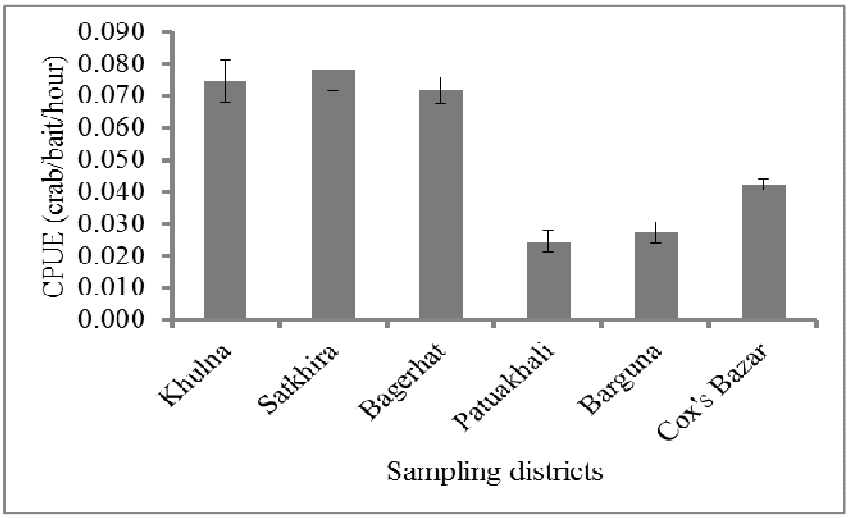

Fig. 5. Catch per unit effort of mud crab in different districts.

Development of Technique for Breeding and Larval Rearing of Mud Crab, *Scylla olivacea*

Researchers: Dr. Md. Latiful Islam, Senior Scientific Officer
Subrina Khatun, Scientific Officer
Mollah N.S. Mamun Siddiky, Scientific Officer

Objectives

- To develop brood of mud crab, *Scylla olivacea* in captivity
- To develop larval rearing techniques of mud crab, *S. olivacea*.

Achievements

Expt. 1. Standardize the effect of different salinity levels on gonadal maturation and spawning success of female of mud crab, Scylla olivacea

From the Table 1, it could be seen that spawning success was similar (11%) for both 25 and 30 ppt salinity levels. Likelihood the incubation period was also similar in both the salinity levels and took 12 days. Fertilization rate was 91% for 25 ppt salinity level and 93% for 30 ppt salinity level. Hatching rate was 95% and 98% for 25 ppt and 30 ppt salinity level respectively. No remarkable difference was observed for the reproductive performances for both the salinities. Protozoan infestation was found on egg mass of the berried broods which developed in salinity level of 25 ppt.

Table 1. Performance of berried female production under different salinity levels

Particulars	Treatments	
	25 ppt	30 ppt
Ave. body weight (g)	225± 4.30	237±5.89
Carapace width (cm)	10.6.0±0.35	10.8±0.49
Total number of brood	18	18
No. spawned	2	2
Spawning success (%)	11	11
Spawning to hatching (%)	100	100
Incubation (days)	12	12
Fertilization rate (%)	91	93
Hatching rate (%)	95	98

Expt. 2. Impact of green water and different feeding regimes on the development of larvae of mud crab, S. olivacea

Larvae stage index (LSI) under different treatments has been presented in Fig. 1. Larvae stage index (LSI) was similar up to day 3 of rearing, but started to differ from day 4. LSI seemed higher for green water culture than clear water culture system, indicated that green water media had stimulated the growth of larvae.

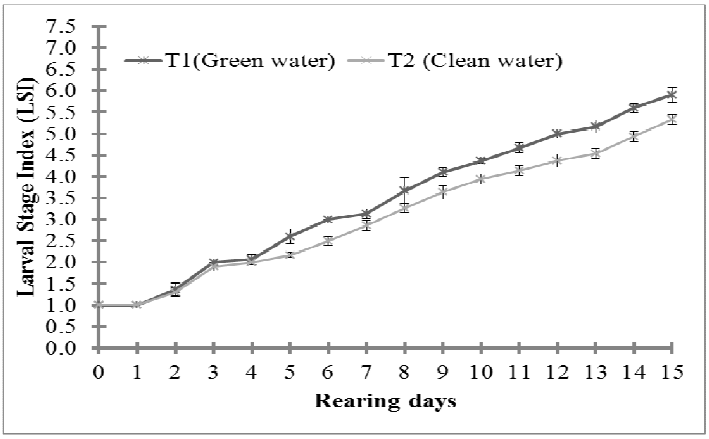

Fig. 1. Larval stage index of larvae under green and clean water culture system.

Survival of larvae at different larval stages under green and clear water culture system has been presented in Fig. 2. Survival of larvae at different larval stages showed difference between green and clear water culture system. Larvae reared under clear water system hardly reached to the megalopa stage but not to the crablet stage. Larvae for the green water system metamorphosed to crablet with a survival of 0.54%, indicated its suitability over clear water system.

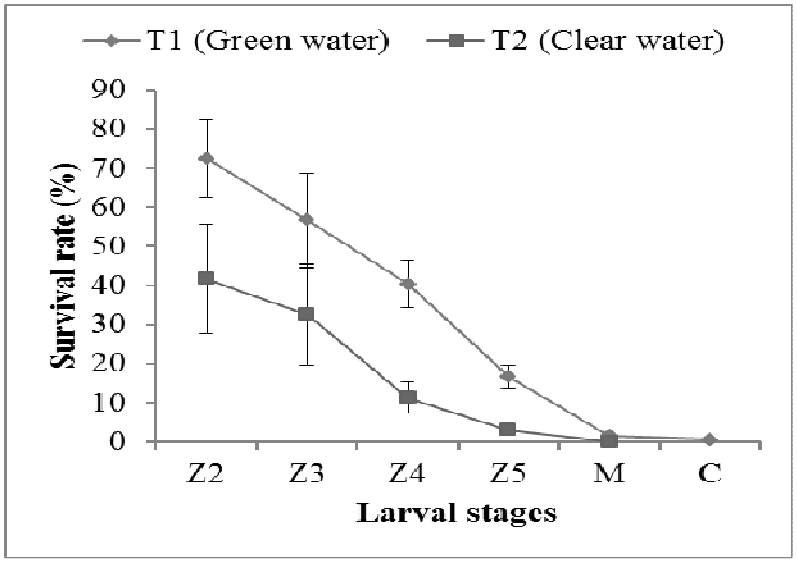

Fig. 2. Survival of larvae at different stages under green and clean water system.

Survival of larvae has been presented in Fig. 3. Mortality of larvae was higher in the early larval stages (Z2-Z4) and sharply dropped to 5% at Z4 (zoea-4) stages. Larvae took longer time to change the stages due to low temperature (26°C) during rearing time and infestation of protozoa. Only 0.01% larvae metamorphoses to megalopa stage but did not reach to crablet stage (Fig. 3). The trial was repeated for the second time.

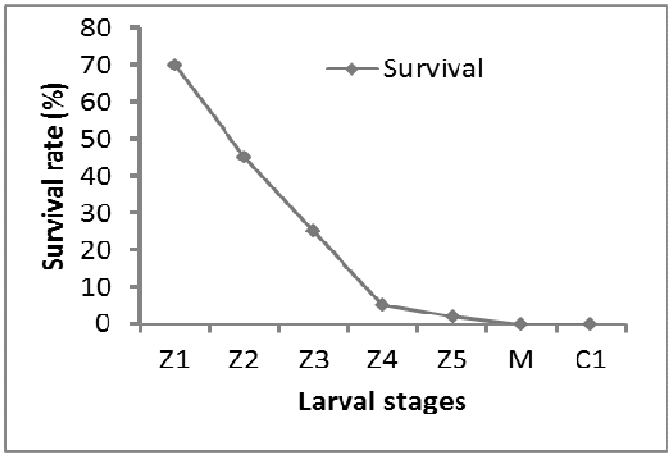

Fig. 3. Survival of larvae at different stages in green water system under different feeding schemes.

During repetition, a survival rate of 8% was found at Z5 stage but it dropped to 2% at megalopa stage and 0.01% at crablet stage (Fig. 4).

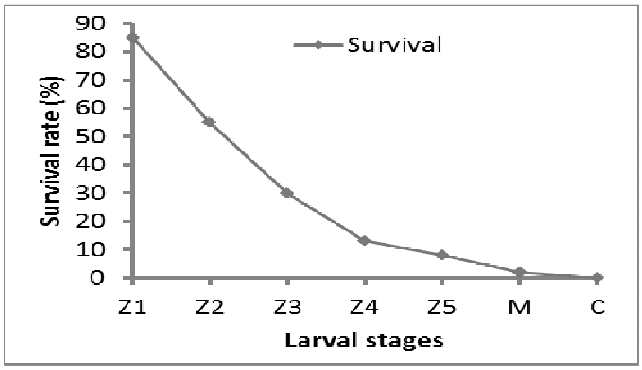

Fig. 4. Survival of larvae at different stages in green water system under different feeding schemes.

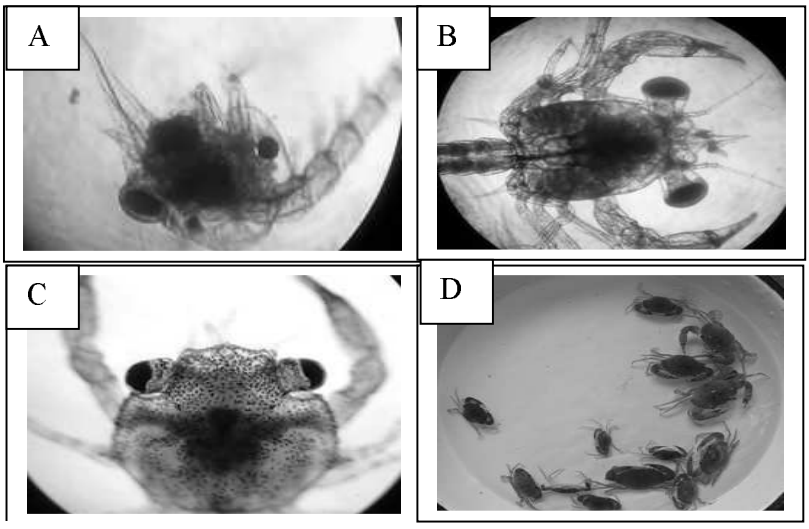

Plate 1. Stages of larvae, (A) Zoea-5 (Z5) stage, (B) Megalopa stage, (C) First crab stage (crab instars) (D) Crablet stage (C3)

However, larvae reared in clear water system might had lack of nutrient due to gradual decreasing of nutrients in live feed, especially in rotifer and in *Artemia*. Meanwhile, inadequate shell shedding in larvae (Plate 2) was noticed at later stages is associated with inadequate nutrients like essential fatty acids.

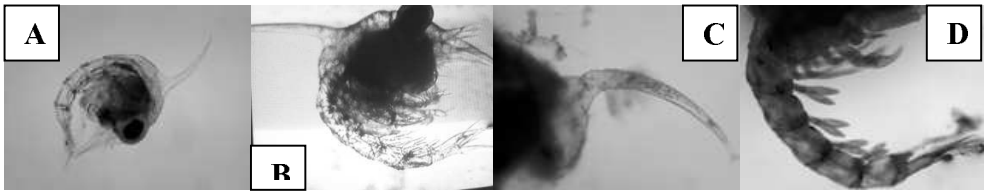

Plate 2. Features of some larval stage; A. normal Z1, B. normal Z5, C. infected back spine at Z5 stage, and D. Fungal infection at Z5 stage

Diversification of Culture Practice for Optimizing Production of the shrimp (*Penaeus monodon*) Culture System in the Coastal *Ghers*

Researchers: Syed Lutfor Rahman, Chief Scientific Officer
Md. Shafiqul Alam Rubel, Senior Scientific Officer
Md. Mizanur Rahman Washim, Scientific Officer

Objectives

- To study the ecology and production feasibility of different cropping patterns in *Penaeus monodon* culture system in the coastal *ghers*
- To maximize production capacity and profitability from the coastal *ghers*
- On station and on farm demonstration of crop diversification technology.

Achievements

Feasibility of double cropping with short culture period for increasing production of shrimp (Penaeus monodon) at different stocking densities

The experiment was conducted in twelve on-station ponds of 0.1 ha each following the design as given in Table 1.

Table 1. Design of the experiment

Treatments	Stocking densities (No/m^2)	Culture period	Crop(s)	Replication (No/m^2)
T_1	3	Short cycle (60 days)	Double	2
T_2		Long cycle (120 days)	Single	2
T_3	5	Short cycle (60 days)	Double	2
T_4		Long cycle (120 days)	Single	2
T_5	7	Short cycle (60 days)	Double	2
T_6		Long cycle (120 days)	Single	2

The specific growth rate (SGR) of weekly sampling has been depicted in Figs. 1, 2 and 3 below. The production performance of shrimp in both short and long culture ponds are summarized in Table 2. In the

1st crop of short cycle (60 days) culture, average growth of shrimp was 19.06g, 17.02g and 16.51g and production of shrimp was 506.55 kg/ha, 782.92 kg/ha and 1049.37 kg/ha at 3, 5 and 7 nos./ha density respectively. In the 2nd crop of short cycle (60 days) culture, average growth of shrimp was 17.95g, 16.11g and 15.69g at 3, 5 and 7 nos/m^2 density, respectively. In the long cycle (120 days) culture, average growth of shrimp was 38.45g, 33.57g and 32.33g and average production of shrimp was 1012.31 kg/ha, 1526.76 kg/ha and 2032.26 kg/ha at 3, 5 and 7 nos/ha density, respectively. Total production of both 1st and 2nd crop of short cycle culture was lower than that of long cycle culture at 3, 5 and 7 nos/m^2 densities and there were inferior differences in production between short cycle (two cycles) and long cycle culture at all three densities.

It can surmise that in the first 3-4 week of grow-out period the SGR was found higher in both short and long culture pattern and then reduce successively and evenly as long as the culture period end. The initial SGR was found very higher in 2nd short culture than those of 1st short and long cycle culture. However, the highest deviation in SGR was observed in different treatments of 1st short cycle culture system. This variation is due to over fluctuation in moulting of shrimp in different treatment that may be the result of variation in water quality parameters and other ecological conditions of ponds.

Table 2. Production performance of shrimp in different treatments

Treatments	Stocking densities (No/m^2)	Culture period	Crop(s)	ABW (g)	Survival (%)	Production (kg/ha)	FCR
T_1	3	Short cycle (60 days each) culture	1st crop	19.06	88.59	506.55	1.15
			2nd crop	17.95	89.81	483.62	1.17
			Total			990.17	
T_2		Long cycle (120 days) culture	Single crop	38.45	87.76	1012.31	1.51
T_3	5	Short cycle (60 days each) culture	1st crop	17.02	92.00	782.92	1.16
			2nd crop	16.11	87.19	702.31	1.18
			Total			1485.23	
T_4		Long cycle (120 days) culture	Single crop	33.57	90.96	1526.76	1.52
T_5	7	Short cycle (60 days each) culture	1st crop	16.51	90.80	1049.37	1.14
			2nd crop	15.69	86.39	948.82	1.13
			Total			1998.19	
T_6		Long cycle (120 days) culture	Single crop	32.33	89.80	2032.26	1.57

The overall production and growth performance in both short and long culture cycle of crop diversification technology was satisfactory. These production scenario implies that, production rate (Kg/ha) has been increased manifolds than the traditional culture practice. In the long cycle culture pattern it is obvious to supply additional oxygen for successful completion of grow-out period that is impossible to maintain by marginal and medium farmer. However, considering infrastructure facilities in farm level and, in crop diversification technology it can be suggested that stocking density of 5/m^2 either short or long cycled culture would be suitable for increasing production and profitability of farmer as well. Similarly, for marginal farmer short culture (double crop) pattern will be more feasible because they could utilize their 1st crop return in their second short cycle crop as their investment capacity is limited.

Polyculture of Shrimp (*Penaeus monodon*) with Prawn (*Macrobrachium rosenbergii*) and Brackishwater catfish (*Mystus gulio*)

Researchers: Nilufa Begum, Senior Scientific Officer
Subrina Khatun, Scientific Officer
Md. Shariful Islam, Scientific Officer

Objectives

- To diversify the cropping pattern of coastal Shrimp ghers through introduction of polyculture system.
- To increase productivity of Shrimp ghers in the coastal area of Bangladesh.

Achievements

Impact of stocking density of brackish water catfish on growth and production of tiger shrimp and freshwater giant prawn in polyculture

The study was conducted in the pond complex of Brackishwater Station, Paikgacha with the following experimental design:

Table 1. Experimental design

Treatments	Replications	Species	Stocking density (Nos/ha)
T_1	3	*P. monodon*	20,000
		M. rosenbergii	10,000
		M. gulio	10,000
T_2	3	*P. monodon*	20,000
		M. rosenbergii	10,000
		M. gulio	20,000
T_3	3	*P. monodon*	20,000
		M. rosenbergii	10,000
		M. gulio	30,000

There are three different stocking density shows final weight of shrimp T_1 and prawn T_2 was higher than the other treatments (Table 2). SGR shows same sequence. Survival of shrimp 82.67% and prawn 73% in T_1 was found higher than other treatments. Final weight of catfish 18.44g in T_2 was found significantly ($p<0.05$) higher than T_3 but no significant difference ($p>0.05$) between T_1 and T_2 and between T_2 and T_3. In case of survival for catfish no significant difference ($p>0.05$) was found between T_1, T_2 and T_3 respectively. Total production was 750.6, 895.8 and 754.58 kg/ha at T_1, T_2 and T_3 respectively. Production of catfish was no significant difference between T_1 and T_3 and between T_2 and T_3. But it was significant difference ($p<0.05$) between T_1 and T_2. Ratio of male and female of prawn was male 18.42%, female 81.58% in T_1, male 25.42%, female 74.85% in T_2 and male 17.21%, female 82.79% in T_3. So it is understood that polyculture of shrimp, prawn and catfish with a stocking density of 50,000/ha would be environment friendly and economically viable for coastal areas of Bangladesh.

Table 2. Stocking density, growth, survival, production and culture period of shrimp, prawn and catfish under different treatments

Treatment	Species	Stocking density/ha	Initial weight (g)	Final weight (g)	SGR %	Production (kg/ha)	Total prod. (kg/ha)	Survival (%)
T_1	Shrimp	20,000	0.006	23.3	8.83	387.9		82.67
	Prawn	10,000	0.05	35.33	5.38	258.4	750.6	73.00
	Catfish	10,000	1.1	18.44^{a}	2.85	104.3^{b}		57.30^{a}
T_2	Shrimp	20,000	0.006	22.3	8.78	357.9		80.30
	Prawn	10,000	0.05	49.78	5.72	352.7	895.8	70.83
	Catfish	20,000	1.1	16.62^{ab}	2.75	184.8^{a}		59.00^{a}
T_3	Shrimp	20,000	0.006	21.3	8.74	334.8		78.66
	Prawn	10,000	0.05	42.85	5.57	251.3	754.58	56.00
	Catfish	30,000	1.1	15.13^{b}	2.65	168.8^{ab}		37.00^{a}

Different superscript differ significantly ($P<0.05$).

Development of Breeding, Seed Production and Culture Technology of Green Back Mullet, *Chelon subviridis*

Researchers: Syed Lutfor Rahman, Chief Scientific Officer
Nilufa Begum, Senior Scientific Officer
Md. Shariful Islam, Scientific Officer

Objectives

- To evaluate the efficacy of different hormones for the breeding of *C. subviridis*
- To develop sustainable nursery management and culture technology of *C. subviridis*
- To evaluate the economic feasibility of production of *C. subviridis*

Achievements

Determination of quality and doses of different hormones for breeding of C. subviridis

Breeding performance, rate of spawning and fertilization of *C. subviridis* was studied and compared. The salinity and temperature level of 30 ppt and 26^{0}C were maintained for breeding. The larvae was reared using different live food like Rotifer, *Artemia* and shrimp larvae feed.

Table 1. Determination of hormones for breeding of *Chelon subviridis*

Types of hormones	Doses			Response
Carp pituitary extract (mg/Kg)	3	4	5	No
HCG (IU)	2500	3000	3500	No
GnRHa (Ovupin) (mg/Kg)	25	30	35	Yes

*Each treatment with three replications

Three types of hormones at different doses were tried for the experiment. Only ovupin showed positive results. PG and HCG showed no positive effect (Table 2). The range of spawning period varied from 30-33 hrs in each breeding trial and fertility rate ranged from 72 to 83 %. Hatching rate varied from 70 to 81 % (Table 2).

Table 2. Effect of different hormones doses for breeding of *C. subviridis*

Ovupin (mg/kg)	Spawning period (hrs)	Fertility rate (%)	Hatching period (hrs)	Hatching rate (%)
25	30-33	72	20-24	70
30	30-32	83	20-22	81
35	30-32	80	20-23	76

Expt. 2. Evaluation of efficacy of different fertilizers on the production of fry of green back mullet, Chelon subviridis in hapa nursery

To evaluate the efficacy of different fertilizers on the growth and survival of green back mullet, *C. subviridis* in nursery phase was carried out in hapa nursery which was set in 9 nursery ponds of 60 m^2 each. There were three treatments T_1 only organic fertilizers, T_2 only inorganic fertilizers and T_3 mixture of organic and inorganic fertilizers. The ponds prepared by sun drying followed by liming soil with CaO @ 250 kg/ha and then filling with tidal brackish water up to 100 cm. Water of the ponds treated with rotenone @ 3 ppm to kill unwanted fishes and then with dolomite @ 20 ppm to increase the buffer capacity of the ponds. After 5 days, particular pond fertilized with respective fertilizer and dose as given in the experimental design. Five days after fertilization, dipterex @ 1 ppm spread all over the water surface followed by netting for mixing uniformly to kill aquatic crustaceans and insects. Twenty four hours after spreading of dipterex, fry of *C. subviridis* stocked uniformly @ 200 nos/m^2 in all hapas. From the second day of stocking, fries were fed twice daily with a mixture of finely powdered commercial CP shrimp nursery feed (35% protein). Feed supplied @ 6 kg/million of fry and then raised to 10 kg from the 6^{th} day of stocking. Subsequently, feed increased @ 5 kg/million hatchlings every five days. Subsequent to stocking of fry, the ponds fertilized regularly at weekly interval with one fourth of the initial dose of fertilizer.

Fry rearing period was 21 days. Average final length (cm) was recorded 3.48±0.12, 2.95±0.15 and 3.96±0.02 and final weight (g) was 0.90±0.01, 0.64±0.03 and 0.97±0.01 for T_1, T_2 and T_3 respectively. High survival (63.5%) was found in T_3 where mixture of organic and inorganic fertilizers was used followed by T_1 where organic fertilizer (62%) was used and T_2 (51.7%) where inorganic fertilizer was used. At the end of 21 days fry rearing period the production was recorded 111.24, 66.75 and 123.19 g/m^2 in T_1, T_2 and T_3 respectively.

Table 3. Result of efficacy of different fertilizers on the production of fry of green back mullet, *Chelon subviridis* in hapa nursery

Treatments (T)	Fertilizers and doses	Harvesting (nos/hapa)	Weight (g)	Length (cm)	Culture period (days)	Survival (%)	SGR (%)	Production (g/m^2)
T_1	Only organic (mustard oil cake @375 kg/ha)	2472	0.90±0.01	3.48±0.12	21	62	14.16	111.24
T_2	Only inorganic (Urea@ 50 kg/ha and TSP @ 21kg/ha)	2086	0.64±0.03	2.95±0.15	21	51.7	13.81	66.75
T_3	Mixture of organic + inorganic (mustard oil cake @187.5 kg/ha, urea@ 25 kg/ha and TSP @10 kg/ha	2540	0.97±0.01	3.96±0.02	21	63.5	14.23	123.19

- Only organic = mustard oil cake @ 375 kg/ha, Only inorganic = urea @ 50 kg/ha and TSP @ 21 kg/ha
- Mixture of organic + inorganic = mustard oil cake @ 187.5 kg/ha, urea @ 25 kg/ha and TSP @ 10 kg/ha)

Expt. 3. Production of green back mullet, C. subviridis in monoculture practice at different stocking densities

In this study, three stocking densities *viz.* 6, 9 and 12 nos/m^2 each with three replications were tried. Nine earthen ponds having an area of 1000 m^2 each were prepared by drying, liming (CaO @ 250 kg/ha) and then filling 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 were treated with dolomite @ 20 ppm. After five days of liming, water of the ponds was fertilized with 25 ppm urea and 30 ppm TSP to enhance growth of plankton. Fry of mullet were fed with commercial CP shrimp starter and grower feed (35% protein) @ 15% of estimated fish biomass for the 1st 15 days. The rate of feeding was gradually reduced with the progress of growth of fish and feed was supplied @ 3% of fish biomass in the last month of culture. Growth of fishes was checked fortnightly and feed was adjusted. Physico-chemical parameters of water *viz*., transparency, temperature, salinity, pH, dissolved oxygen and alkalinity were determined at seven days interval and plankton samples were analyzed at fifteen days interval. After five months of rearing, all fishes were harvested by draining out the ponds and growth and production of fishes were estimated and compared.

Table 3. Production of *C. subviridis* in monoculture management at different stocking densities (after 150 days of stocking)

Treat ments	Density (m^2)	Initial wt.(g)	Final weight (g)	Survival (%)	FCR	Culture period (months)	SGR (%)	Production (kg/ha)
T_1	(6/m^2)	1.5	21.24±2.35^a	80±0.12	1.86^a	5	2.78^a	1019.52^b
T_2	(9/m^2)	1.5	19.69±2.80^a	78±0.15	1.78^a	5	2.72^a	1382.24^a
T_3	(12/m^2	1.5	11.05±4.26^b	73±0.32	2.25^b	5	2.13^b	967.98^c

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

At the end of five months rearing period, growth performance observed on the basis of three different stocking densities of 6/m^2, 9/m^2 and 12/m^2. Average final weight (g) was 21.24±0.01, 19.69±0.03 and11.05±0.01 in T_1, T_2 and T_3 respectively. In case of final weight (g), T_1 and T_2 were significantly ($p<0.05$) higher than T_3. No significant difference ($p>0.05$) was found between T_1 and T_2. During the period of study, survival rate of 80±0.12 was found in T_1 where the stocking density was 6/m^2. Survival rates were found 78±0.15 and 73±0.02 in T_2 and T_3 respectively. Significantly ($p<0.05$) highest production was found in T_2 (1382.24 kg/ha) followed by T_2 (1019.52 kg/ha) and T_3 (967.98kg/ha).