

Abundance of Shrimp (*Penaeus Monodon*) Post Larvae (PL) and to Quantify the Damage of Different Aquatic Fauna during Shrimp PL Collection in Mongla Tidal River (Rampal), Bagerhat

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Abstract

The study was conducted in Mongla tidal river (Rampal) of Bagerhat district from November 2014 to October 2015 to assess the abundance of black tiger shrimp (*Penaeus monodon*) post larvae (PL) and to quantify the damage of different aquatic fauna during collection of *P. monodon* PL. Insignificant variation in water temperature, pH, salinity and hardness were found but salinity and hardness showed great fluctuation during the study period. On average 6.3 million of *P. monodon* PL were collected annually from the studied area and around 0.16 million man days/year were estimated to be involved in shrimp PL collection activities. It was found that about 412 other shrimp larvae, 391 fin fishes and 1696 other macrozooplankton were killed during the period of collection for only one PL of *P. monodon*. It was also calculated from the present study that about 29,874 million of other shrimp species, fin fishes and macrozooplankton were destroyed annually by the shrimp seed harvesting process in Mongla river. The study implies that present seed collection practice caused severe damage of other valuable aquatic fauna, which directly affect the biodiversity of tidal waters, natural productivity, improvement of mother stock and environment friendly of coastal and marine water.

Keywords: *P. monodon* post larvae; Quantify; Indiscriminate damage; Aquatic fauna; Tidal river Mongla.

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1. Introduction

Shrimp, the non-piscine fisheries organism is the most precious fishery commodity of the country. The culture of shrimp in the coastal zone is a major export earning activity for Bangladesh. This culture was started in the coastal belt during the early 1980s to supply shrimp in the international markets and earn foreign currencies [1]. The Government and private sector intensified efforts to increase export earnings from this sector. This industry was initially dependent on natural sources for seed supply [2]. Though a few shrimp post

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larvae (PL) hatcheries have been established in shrimp farming region to produce seed and meet the growing demand for PL, supply is still insufficient to meet industry requirements. As a result, people are collecting PL from natural stock, which causes destruction of huge number of fry of different fish species and other aquatic fauna. Due to this practice the wild fish and shrimp stock might be affected [3]. Farmers think that wild PL of shrimp to be of excellent quality than hatchery produced shrimp PL. Due to high demand, low investment and lucrative business of *P. monodon* PL, it is encouraged thousands of resource poor people of the coastal areas to be engaged in shrimp seed collection. Wild PL collection has given employment opportunity for thousands of coastal landless and unemployed people [4–6]. In Bangladesh more than 0.42 million people are involved in shrimp seed collection activities [7].

On the other hand, wild PL fishing has assumed a notorious impact on coastal biodiversity [8–11]. It has been reported that around 1650 larvae of other shrimp species, 1562 fin fishes and 6787 other macrozooplankton were cruelly damaged at the time of collection just for single PL of *P. monodon* in the Mongla river (Mongla), Bagerhat [12], which is a great threat to the biodiversity. Thousands of rural poor are involved in shrimp PL collection in the tidal rivers and along the coastal belt of Bangladesh as part of their livelihood.

Shrimp PL collection is a regular activity in the Mongla river throughout the year. Generally, drag net, push net and set bag nets are mostly used in shrimp fry collection activities. The collector or other member of the family/group generally sort out and collect only the targeted *P. monodon* PL and the rest of the haul composed of other shrimp, macrozooplankton and fin-fish larvae, which are valueless to them is carelessly discarded on the dry shore. This causes serious loss of biodiversity and creates pollution in the coastal areas. In this way a huge number of precious aquatic organisms are destroyed by the seed harvester, which is alarming and also a threat to natural food cycle as well. Keeping these views in mind, the present year-round study was undertaken to assess the abundance and catch composition of the drag/push net used for collecting PL of *P. monodon* and to quantify the damage caused to different shrimp species, fin fishes and zooplankton larvae while collecting PL of tiger shrimp in the Mongla tidal river (Rampal), Bagerhat.

2. Materials and Methods

The samples were collected from three different sites/spots of Mongla river (Rampal) under Bagerhat district from November 2014 to October 2015 (Fig. 1). Sampling was done at monthly intervals using fine meshed (1.0 mm) nylon net with bamboo split frames (1.6 x 0.6 m). Sample was taken in the course of full-moon and new-moon. The net was operated in the shallow water of the river against the current. Each hauling time was about 10 min. Two samples were collected at the time during low and high tides. Samples were immediately stored in plastic pot and preserved in 5% neutralized formalin after collection for sorting shrimp PL, larvae of fin fishes and other organisms. Samples were brought into

the laboratory for analysis and it was performed within two weeks from the date of collection. Penaeid shrimp larvae were identified up to species level following Muthu [13], and Motoh and Buri [14]. Macrozooplankters, other shrimp species and fin fishes were identified as major taxonomic groups following Fischer and Withead [15], George [16], and Shafi and Quddush [17].



Fig. 1. Map of Rampal upazilla showing the location of sampling stations.

Salinity of water of each spot/area was recorded by a hand refractometer (ATAGO, Hand-Held Refractometer). Water temperature and pH were measured by alcohol thermometer and pH meter, respectively. Total hardness of water was determined titrimetrically using a standard solution of EDTA-0.800 M and Manver 2.

3. Results and Discussion

Monthly mean values of water temperature, salinity, pH and total hardness are presented in Fig. 2. There was no significant variation in water temperature but a wide fluctuation in

salinity was found in all the sites. The highest temperature (33.1°C) was recorded in September and the lowest (22.0°C) in February. This observation is almost similar with the observation made by Islam *et al.* [9,12] who recorded temperature ranging from 19.4 to 32.7°C and 21.5 to 31.7°C in Mongla river, Bagerhat and in Andermanik river as well as Kuakata coast in Patuakhali, respectively.

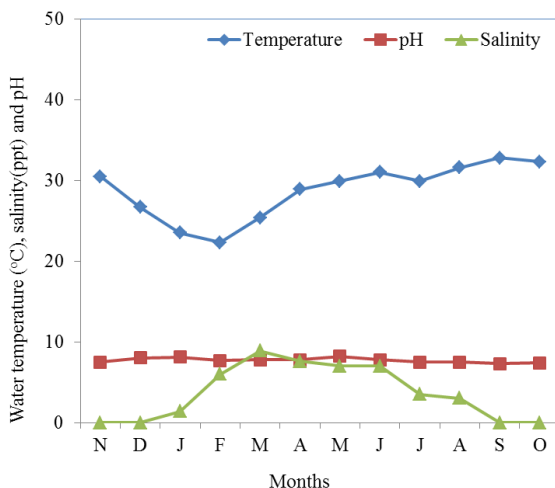


Fig. 2. Monthly fluctuation of water temperature (°C), salinity (ppt) and pH in the river of Mongla.

Water salinity ranged from 0.0 to 13.5, which is related to the findings of Islam *et al.* [12] who recorded salinity of 0.0 to 12.5 ppt from the tidal water in Mongla river (Mongla). The highest salinity (13.5 ppt) was recorded in March at all the sites. Salinity was gradually decreased after the month of June and it declined to zero ppt from September to December, which might be due to monsoon effect, run-off, land drainage and heavy shower, which was found to increase during post-monsoon with the onset of dry season.

The range of pH value in the present study was 6.9–8.4. The highest value (8.4) of pH was recorded in May and the lowest (6.9) was recorded in August. This observation is agreed with the observation made by Islam *et al.* [12] who recorded pH ranging from 6.8 to 8.2 in Mongla river, Bagerhat. The values of total hardness ranged from 166.2-1252.0 mg/L was found to coincide with the findings of Islam *et al.* [1] who reported hardness values ranging from 162-1350 mg/L Mongla river (Rampal), Bagerhat.

Monthly distribution (individuals/unit effort) data of *P. monodon* PL, larvae of other shrimps, fin-fishes and other macrozooplankton of the surveyed waterbodies during the study period has been depicted in Table 1. Data in Table 1 clearly showed that during the period of August to October, *P. monodon* PL was entirely absent in all the sites while salinity was moderately lower or zero ppt. The larvae of *P. monodon* were very rarely available during February to June though salinity gradually increased. On the other hand,

abundance of other shrimp species was found to increase during the month of August to February and maximum was recorded in September through January and February in all the sites. There was no uniform pattern in distribution of both fin fishes and zooplankton. Their abundance also fluctuated from one month to another month. During post monsoon period, comparatively higher amount of fin fishes and macrozooplankton were observed than the other part of the year. This result is in agreement with the results of Islam *et al.* [9,12] and Rahman *et al.* [17] where the authors implied that lower salinity and temperature are probably the key factors influencing greatly the larval distribution of aquatic fauna.

Table 1. Monthly distribution (individual/unit effort)* of *Penaeus monodon* PL, other shrimps, fin fishes and other macrozooplankton of the Mongla river, (Rampal).

Major Groups	Months												Yearly Total	%
	N	D	J	F	M	A	M	J	J	A	S	O		
Mongla river (Spot 1)														
<i>P. monodon</i> PL	1	0	0	1	1	0	0	1	1	0	0	0	5	0.06
Other shrimps	137	88	195	192	80	100	155	79	64	163	285	95	1633	18.27
Fin fishes	149	160	187	163	88	65	18	28	35	55	250	295	1493	16.71
Other	155	517	497	598	160	237	390	478	854	1005	299	615	5805	64.96
macrozooplankton														
Total	442	765	879	954	329	402	563	586	954	1223	834	1005	8936	100.00
Mongla river (Spot 2)														
<i>P. monodon</i> PL	1	0	0	1	0	0	0	1	0	0	0	0	3	0.03
Other shrimps	140	103	89	215	80	88	167	66	75	160	299	87	1558	15.42
Fin fishes	169	145	209	165	71	85	15	47	25	71	257	267	1526	15.10
Other	217	548	518	585	233	211	425	507	790	1399	948	637	7018	69.45
macrozooplankton														
Total	527	796	816	966	384	373	607	621	890	1630	1504	991	10105	100.00
Mongla river (Spot 3)														
<i>P. monodon</i> PL	0	1	0	0	1	1	0	0	1	0	0	0	4	0.04
Other shrimps	140	89	238	217	130	102	140	75	80	175	265	100	1751	16.02
Fin fishes	179	185	225	202	93	89	25	37	35	64	248	288	1670	15.27
Other	237	509	590	630	245	283	435	539	898	1519	968	655	7508	68.67
macrozooplankton														
Total	556	784	1053	1049	469	475	600	651	1014	1758	1481	1043	10933	100.00

* Operating a push net (1.6 × 0.6 m) for about 10 minutes taken as a unit effort.

Post larvae of *P. monodon* were found to occupy very small portion in the total annual catch composition such as 0.06, 0.03 and 0.04% at three sites in Mongla river (Rampal), respectively. Islam *et al.* [12] reported that the annual catch composition of *P. monodon* was 0.02, 0.01 and 0.01%, respectively at three sites in Mongla river (Mongla) which is slightly lower than the present findings. Juveniles of other shrimp species (*P. indicus*, *Metapenaeus monoceros*, *M. brevicornis*, *Palaemon styliferus*, *Macrobrachium rosenbergii*, *M. villosimanus*, *M. dyanus*, *M. dolichodactylus* and *M. rude*, etc.) exerted 18.27% in spot 1, 15.42% in spot 2 and 16.02% in spot 3 of Mongla river which is almost similar with the findings of Islam *et al.* [12] who reported the annual catch composition of other shrimp species of 18.34%, 15.39% and 16.01%, respectively in three spots in

Mongla river (Mongla). Larvae of fin fishes (*Liza parsia*, *L. tade*, *Rhinomugil corsula*, *Lates calcarifer*, *Setipina phasa*, *Tenuulosa ilisha*, *Pangasius pangasius*, *Glossogobius* spp., *Puntius* spp., and *Mystus* spp.) formed 16.71, 15.10 and 15.27% of the total catch in spot 1, spot 2 and spot 3, respectively. Islam *et al.* [12] stated that the larvae of fin fishes at three spots of Mongla river (Mongla) were 16.70, 15.09 and 15.23%, respectively. Islam *et al.* [1] also reported that the yearly catch composition of fin fish larvae in Mongla river at Mongla and Rampal part was 15.40 and 18.40%, respectively. These findings are coincided with the findings of present study. Macrozooplankton (*Acetes* sp., Mysids, Isopods, Copepod, Alima, Crab larvae, etc.) showed higher density of 64.96, 69.45 and 68.67% in three sites of Mongla river, respectively. Islam *et al.* [1, 12] reported that the total annual catch composition of macrozooplankton was recorded to be 64.94, 69.51 and 68.75% at three sites of Mongla river (Mongla), respectively and 58.80% in Mongla river (Rampal). Mahmood [18] stated that higher density of zooplankton (98.30%) was found in Chakaria Sundarbans followed by Satkhira (97.72%) and Khepupara (97.53%). Moreover, other shrimps and fin fishes occupied only about 2% of the zooplankton community and shrimp (*P. monodon*) PL alone contributed a very small quantity to the total annual catch (0.7% in Chakaria and Khepupara, and 1.2% in Satkhira). Islam *et al.* [9] reported that zooplankton recorded in Andermanik river of Patuakhali (53.51%) and Ichamati river (93.19%) as well as Kholpatua river (96.56%) of Satkhira district was also higher than fin fishes and other shrimps. Other shrimps and fin fishes secured 40.60 and 5.28%, respectively in Patuakhali Andermanik river. But these were 5.18 and 1.57% in Ichamati river, and 9.84 and 0.92% in Kholpatua river, Satkhira, respectively. PL of shrimp (*P. monodon*) alone scored the minimal number in both Patuakhali (0.61%) and Satkhira (0.06 and 0.05%) region, which are more or less similar with the present findings.

The catch composition and extent of damage caused to macrozooplankton and other aquatic organisms as a result of heartlessly harvesting of *P. monodon* PL are presented in Tables 2 and 3. It was found that on average in the total relative abundance, *P. monodon* PL contributed only 0.04%, other shrimp species 16.49%, fin fishes 15.64% and other macrozooplankton 67.69%. There are no remarkable differences in yearly catch composition in three spots of Mongla river (Rampal) (Table 1). But in the monthly distribution, higher amount of macrozooplankton was obtained in August in spot 3 (1519) followed by spot 2 (1399) and spot 1 (1005). The results of the study indicated that shrimp seed harvesters killed around 412 other shrimp species, 391 fin fishes and 1696 other macrozooplankton for catching a single PL of *P. monodon*. This finding is more or less coincided with the findings of Islam *et al.* [1] who obtained 569 other shrimp spp., 460 fin fishes and 1470 macrozooplankton were destroyed for catching only one PL of *P. monodon* in the Mongla river (Rampal). According to Mahmood [18] for catching only one PL of *P. monodon*, 14 other shrimp spp., 21 fin fishes and 1631 zooplanktons were killed in the Chakaria Sundarbans, Satkhira and Khepupara estuaries. The variations in the zooplankton population with the present findings might be due to difference in mesh size of the collection net. Mahmood [18] used a rectangular nylon net with smaller mesh size (0.5 mm). The mesh size of the net used in the present study was 1.0 mm, which is not

similar to that used by seed collectors. For this reason, smaller zooplankton and other species could escape through large mesh (1.0 mm) of net used in the present study. BFRI [19] reported that one PL of *P. monodon* was collected at the cost of 356 larvae of other shrimp species, fin fishes and macrozooplankton in the Bagerhat region in 1996. Islam *et al.* [1,20] stated that for catching a single PL of *P. monodon*, the fry collectors destroyed 587 and 2499 larvae of other shrimps, fin fishes and macrozooplankton in Satkhira region and Monglariver (Rampal), respectively. The great loss of valuable different aquatic organisms was also reported by BOBP [21] and Khan *et al.* [22]. In addition to this, practice also causes death of huge number of *P. monodon* PL due to there is every possibility of destructive different appendages of PL and also become stress during collection and transportation, which eventually causes dead.

Table 2. Average catch composition (%) of *Penaeus monodon* PL, other shrimp species, fin fishes and macrozooplankton in the Mongla river (Rampal).

Major taxa	Catch/unit effort (No.)	Relative abundance (%)	No. of other species damaged for each <i>P.monodon</i> PL collection
<i>Penaeus monodon</i> PL	4	0.04	-
Other shrimp species	1647	16.49	412
Fin fishes	1563	15.64	391
Macrozooplankton	6777	67.83	1696
Total	9991	100.00	2499

Table 3. Comparative scenario of *Penaeus monodon* PL abundance and diversity of other organisms during the period of present study (November 2014-October 2015) and the previous study (May 2012-April 2013).

Name of the species	No. of the other species destroyed for catching single <i>Penaeus monodon</i> PL	
	Present study (November 2014-October 2015)	Previous study (May 2012-April 2013)
<i>Penaeus monodon</i> PL	-	-
Other shrimp species	412	1650
Fin fishes	391	1562
Macrozooplankton	1696	6787
Total	2499	9999*

* The mesh size of the collecting net used in the present study and the previous study was 1.0 mm and 0.3 mm, respectively. Comparatively higher number of other aquatic organisms is destroyed owing to small mesh size of the net.

Observation on the number of seed collectors/km, length of the river, number of boat and hour of appointment reveals that 0.16 million man days/year were involved in shrimp seed collection activities in Bagerhat district. This finding is closely associated to Islam *et al.* [12], who revealed that 0.18 million man days/year were engaged in shrimp seed collection activities in Mongla river (Mongla), Bagerhat. Funegaard [23] reported that about 20,000-25,000 people were engaged in shrimp fry collection in Satkhira district while according to Chowdhury [24] about 75,000 fry collectors were found only in Satkhira district. It was observed that about 6.3 million of *P. monodon* PL were collected in Mongla river (Rampal) in 2014-2015. Islam *et al.* [20] reported that about 11.60 million

P. monodon PL were collected in Satkhira in 1996 and it was 18.0 million in 1992 [19], which are higher than the present findings. From the present study, it was also ascertained that 29874 million of other shrimp species, fin fishes and macrozooplankton were destroyed annually by the shrimp seed collectors in Bagerhat Mongla river (Rampal) is closely related to the findings of Islam *et al.* [12] who estimated 29988 million of other aquatic organisms destroyed annually by the shrimp seed collection activities in Mongla river (Mongla), Bagerhat but it is much higher than the findings of Islam *et al.* [20] who estimated 6809 million of other aquatic organisms in Satkhira. This is very much alarming for the biodiversity of coastal waters. The severe impact of shrimp seed collection activities drastically reduced the availability of *P. monodon* from 2,000 shrimp fry/net/day [23] to only 200 fry/net/day [25] in Satkhira district. So the findings of the above mentioned studies and also the present study reveal that there has been a trend of gradual decreasing in the abundance of other shrimps, fin fishes and other zooplankton larvae in neritic and offshore waters. This might be connected with over fishing with smaller mesh sized nylon nets and indiscriminate killing of zooplankton and other shrimps that hinder the normal recruitment pattern to the original mother stock. Therefore, appropriate steps should immediately be taken to stop such indiscriminate killing of juvenile fish and shell fishes during collection of shrimp PL and to grow awareness among the seed collectors to release back the unwanted organisms into the waterbodies without any damage. These initiatives would help to preserve the biodiversity of aquatic fauna and to save environment friendly of tidal waterbodies.

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