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Assessment of impact of ten days fishing ban in the major spawning grounds of hilsa (*Tenualosa ilisha*, Fisher and Bianchi, 1984)

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Abstract
A study was undertaken to find out the impact of ten days fishing ban in the major spawning grounds of hilsa during October to December. The study revealed a positive impact of fishing ban during spawning season on reproduction success of hilsa. Proportionate distribution of male and female hilsa also showed a significant level of distribution in and around the spawning grounds where the ratio was 35:65. Percent of oozing hilsa during fishing ban period in the spawning grounds was observed 1.61%. About 5% spent hilsa was observed in the fish landing centers and was compared with the data of Global Environment Facility (GEF) and Bangladesh Fisheries Research Institute (BFRI) studies and was found about 2.80 - 3.57 times higher than that of the findings of 2002 and 2003. Estimated egg production value showed about 46,800 Kg of eggs could have been produced that indicating a positive impact of 10 days fishing ban in spawning season. Abundance of higher percentages of gravid hilsa was found which were not available in the same quantity and condition in the non-fishing ban period. During the present investigation, fairly higher amount of spent hilsa and juveniles were also observed in the spawning grounds. Along with the jatka fry, spawn and fries of other fishes were also found in higher quantity than the previous years and thus it is assumed that fishing ban also might have positive impact on the successful breeding of other fishes. Overall, the fishing ban was found effective for successful breeding of hilsa.

Key words: Hilsa, Spawning, Fishing ban

Introduction

Hilsa (*Tenualosa ilisha*) (Hamilton) (Fisher & Bianchi 1984) is the most widespread tropical shads found from north Sumatra in the east to Kuwait in the west and is the basis of important fisheries in Bangladesh, India, Burma, Pakistan and Kuwait (Al-baz and Grove 1995, Whitehead 1985, Blaber 2000). It is the national fish of Bangladesh and the largest single species fishery that accounts nearly half of the total marine catch and about 12-13% of total fish production of the country (Haldar 2008). The hilsa fishery in Bangladesh has been suffered by a combination of factors *viz.* serious recruitment over-fishing (indiscriminate harvest of gravid fishes) and growth over-fishing (indiscriminate catching of *jatka*).

Hilsa is caught and landed throughout the year, the majority of landing (60-70%) is found during the peak breeding season (September-October). In this season, about 60-70% hilsa are found to be sexually mature and ripe. At least 30% of the population appears to be ripening at any time in most areas. The BFRI and GEF studies, explored four main spawning grounds of hilsa *viz*, (1) surrounding of Dhalchar, (Char fashion, Bhola, 125 square kilometer, N-21^{0}42'-21^{0}55' and E-90^{0}53'-91^{0}05'), (2) Monpura (near Monpura island, 80 square kilometer, N-22^{0}00'- 22^{0}15'and 91^{0}12'-91^{0}20'), (3) Moulavirchar (near Hatia, 120 square kilometer, N-21^{0}53'-22^{0}03' and E-91^{0}17'-91^{0}27') and (4) Kalirchar (near Sandwip, 194 square kilometer) in the Meghna estuary. It has been identified that the highest number of ripe and running hilsa are being caught indiscriminately during five days before and five days after the full moon of September-October every year during their peak spawning time and thus their recruitment was being hampered. Hence, fishing ban is required for certain time specification for their successful breeding. In the above context, Government has enacted a new rule under the Protection and Conservation of Fish Act, 1950 banning the hilsa catch during this period for successful spawning. The rule is being implemented by Department of Fisheries (DoF) from 2009 involving different stakeholders, and law enforcing agencies including Navy and Coast Guards.

The study of the impact of fishing ban on breeding performance has not yet been conducted in Bangladesh, so literature on this aspect is scanty. Some authors worked on this subject sporadically like Haldar (2004) conducted research on many aspects of hilsa including impact of jatka fishing ban and closed fishing season on abundance of jatka and hilsa production. Some other authors like Mazid and Islam (1991) Shafi and Quddus (1976), Quereshi, (1968) and Islam *et al.* (1987) worked on sex ratio of hilsa. Besides, many authors (Ahmed *et al* 2008, Miah *et al.* 1999, Rahman *et al.* 1998 and Rahman *et al.* 1995) worked on reproduction and spawning ground of hilsa in Bangladesh. But particularly impact of fishing ban on reproductive success of hilsa has not yet been attempted in Bangladesh. So, to study the impact of fishing ban implementation on reproduction and spawning success, Riverine Station of BFRI, Chandpur was assigned by DoF and in the above background the study was conducted with the following objectives:

- to estimate the size, sex and percent composition of gravid hilsa;
- to determine the percent composition of oozing hilsa;
- to determine the percent composition of spent hilsa and spawning success;
- to assess the degree of abundance and distribution of spawn and juvenile hilsa,
- to determine the extent of alteration of previously identified spawning grounds of hilsa.

Materials and methods

The Hilsa Investigation Team of the Riverine Station, Chandpur carried out the investigations. Mechanized boat and speed boat were utilized for sampling and data collection. Major spawning grounds of hilsa and related areas *viz*, Ramgoti, Hatia, Dhalchar, Moulibirchar, Monpura, Kalirchar, Daulatkhan, Bhola, Dhulia, Patharghata,

Kuakata, Mohipur, Moudubi, Galachipa, Kalapara were visited for comprehensive study. To determine the size of group, captured hilsa from the above mentioned area were measured by measuring scale. Sex was determined by external observation, gentle stripping at their belly along the ventral scute line from anterior to anal direction with the fore and first finger together was applied. While at stripping along the belly, white milky or creamy liquid for the male and eggs with blood strain or food particle for the female usually came out through the anus. Seeing the milky/creamy liquid (the milt) and the eggs, hilsa was identified as male or female. When such milky liquid or eggs do not comes out, and then the fish is either of immature or premature stage. The potbellied, reddish and bigger anus also identified the fishes as female. As such, the percent composition of gravid and oozing hilsa was determined.

The spent fishes were identified by observing their very lean and thin and elongated body and health condition and shrunken belly. While stripping at their belly, isolated and distorted eggs came out with watery liquid or with or without blood strain. The hilsa are the gonochoristic (Blaber *et al.* 2001) and single shedding fishes (Haldar 2004). After shedding usually they do not die, locally called *Pite* (spent) fishes and are caught with other hilsa. The number and % of spent fishes was determined by observing the catches of the commercial fishermen in and around the spawning grounds immediately at the opening of fishing after the ban period.

The amount of fertilized egg production in the spawning grounds due to fishing ban as an indicator of spawning success was estimated using the following formula.

Total No. of Hilsa excluded due to fishing ban (TN) = No. of fishing boat × Haul/day × Fish caught/Haul × No. of days---------- (1)

Where, Total No. of fishing boat around the spawning areas: 12000 approximately

No. of haul per day	: 2
Fish caught per haul	: 60
No. of days	: 10

$$\text{Total fertilized eggs (Kg)} = \frac{TN \times FF \times SF \times EF}{1000} \quad \text{---------- (2)}$$

where, TN = Total No. of Hilsa excluded due to fishing ban;
FF = % of female fishes in the study area (65%);
SF = % of spent Fish (5%), and
EF = Average egg (g) per fish (100g).

Experimental egg/fry collection was done by a savar net (shrimp PL collecting net) prepared by fine meshed glass nylon in the spawning grounds and adjacent areas to see abundance and distribution of *jatka*. Finally, by the availability of immature and oozing hilsa statement about the previously identified spawning grounds were made.

Results and discussion

Estimation of the size, sex and percent composition of berried hilsa

During the river cruise gradually larger sized hilsa were found from Chandpur to the downstream (Table 1). In the upper region, most of the hilsa found were below 30 cm, whereas, more than 90% hilsa were above 30 cm in the downstream areas. In and around the spawning grounds among all the captured hilsa, male: female ratio was 35% and 65% respectively. Haldar (2004) also found male-female ratio almost 1:2 during 2002 and 2003. Although, there are conflicting views about the sex ratio of hilsa in earlier studies, Islam *et al.* (1987) found no significant difference of male-female ratio at four important landing centers *viz* Chittagong (1:1.04); Chandpur (1:1.08); Khepupara (1:0.8) and except Cox's Bazar (1:1.8). Similar observations also were made by Shafi and Quddus (1976) in respect of Padma and Meghna hilsa. Quereshi (1968) observed that although the sex ratio was 1:1 during the monsoon, the female dominated in October. Again Blaber *et al.* (2001) indicated that there is a bias in sex ratio and the male are more abundant among the smaller fishes. The majority of fishes over 30 cm are females and almost all over 40 cm are females and males are predominant between 10 and 25 cm length group, the present findings support these views.

Table 1. Region wise abundance (%) of different length group hilsa

Region	Length group (in cm)						
	Below 32 cm		Total	Above 32 cm			Total
	18-24	25-31	(%)	32-38	39-45	46-52	(%)
Char Bhairobi (%)	6.9	70.8	77.70	20.0	2.3	0.0	22.3
Kaliganj (%)	16.3	72.1	88.40	10.4	1.2	0.0	11.6
Char ludhua (%)	0.0	4.6	4.6	40.8	50.0	4.6	95.4
Ramgoti (%)	0.9	8.4	9.3	24.8	65.0	0.9	90.7
Hatia (%)	0.0	0.9	0.9	60.7	37.5	0.9	99.1
Monpura (%)	0.0	0.0	0.0	32.5	65.0	2.5	100

From the Table 1 it could be seen that, in the spawning ground areas (Monpura and Hatia) about 100% fishes are 32.0 cm and above sizes, which are breeder group of hilsa. These findings also reconfirm these areas as spawning grounds of hilsa.

The percent composition of oozing/berried hilsa

The hilsa fishes of the spawning grounds were found with higher maturity stages/berried (maturity stages V and VI) than the other adjacent areas and % of the mature hilsa were found higher with the higher length group of fishes due to fishing ban in the spawning grounds (Table 2).

Table 2. Maturity stages of hilsa of different length group

Length group	% of fishes at Maturity stages (Ms)					
	Ms I	Ms II	Ms III	Ms IV	Ms V	Ms VI
18-24	0.00	0.00	60.00	20.00	20.00	0.00
25-31	0.00	5.89	17.65	41.18	27.45	7.83
32-38	0.00	0.00	8.33	29.17	33.33	29.17
39-45	3.45	3.45	0.00	17.24	68.96	6.90
46-52	0.00	0.00	0.00	14.29	85.71	0.00

Percent composition of oozing hilsa during fishing ban period in the spawning grounds was observed 1.61% which was relatively higher. In the year 2002 and 2003 only few oozing hilsa were observed in Kaligonj, Sandwip spawning ground area (Haldar 2004).

Determination of the percent composition of spent hilsa and spawning success

Analysis of the fishers' catch composition obtained from the major spawning grounds revealed that more than 95% captured hilsa weighing around 1.0 kg were gravid. About 5% spent hilsa was observed in the fish landing centers and this data was compared with the data of GEF-BFRI studies (Haldar 2004) and was found about 2.80 - 3.57 times higher than that of 2002 and 2003 (Table 3). The increased quantity of spent hilsa might be due to fishing ban in the peak spawning time. To determine the breeding success, percentage of spent hilsa could be an indicator among other factors, Haldar (2004) investigated the spent hilsa in Ilishaghat, Bhola, where he found the highest 3.66% spent hilsa in October followed by November (1.93%) and February (2.86%).

Table 3. Comparative % of spent hilsa observed in the landing centre

Year	% of spent hilsa	% increase (time)	Remarks
2002	0.50	-	Without management
2003	1.40	2.80	Improved management
2007	5.00	3.57	Fishing ban period

Estimation of egg/fry production during fishing ban

About 46,800 Kg eggs were produced due to imposing of 10 days fishing ban in spawning season in 2007. During experimental spawn and juveniles' collection, approximately 5-25 days old fries were found in all the surveyed areas in and around the spawning grounds (Table 4).

Table 4. Size, weight and age of captured fries and jatka from the major spawning grounds

Location	Lowest size (cm)	Highest size (cm)	Av. size	Minimum weight (g)	Maximum weight (g)	Average weight (g)	No. of jatka/haul	Approx. age (day)
Hatia	1.6	2.6	1.99	0.01	0.15	0.07	20	10-15
Char jonaki	1.9	3.7	2.54	0.04	0.48	0.17	20	15-20

Sakuchia	0.9	3.8	2.05	0.04	0.45	0.17	30	5-10
Janata (ht*)	2.1	4.0	2.75	0.08	0.54	0.23	45	15-25
Janata (lt**)	1.9	4.2	2.70	0.05	0.52	0.19	30	15-20
Monpura	1.8	3.7	2.60	0.04	0.45	0.15	54	15-20
Dhalchar	2.4	2.8	2.57	0.11	0.22	0.15	45	20-25

ht* – high tide, lt** – low tide

Due to impose of 10 days fishing ban in the spawning grounds, comparatively higher percentage of gravid hilsa were found which were not available in the same quantity and condition in the previous years *i.e.* during non-fishing ban period (Table 2). The average increase in jatka abundance was 570%, with increases at Mohanpur and Ishanbala, Chandpur when comparing 2003 and 2004 data indicating the complete fishing ban has a strong positive impact on jatka abundance (Haldar 2004). Similarly, complete fishing ban for 10 days in the spawning grounds showed that availability of plenty of spent fish (5%) and huge number of fries and juveniles of hilsa in and around spawning grounds indicating a positive impact on successful reproduction of hilsa.

Determination of the extent of alteration of previously identified spawning grounds of hilsa

Previously BFRI and GEF studies identified four spawning grounds of hilsa by the occurrence of fully ripe/oozing, spent hilsa and also on the availability of fry. During the present investigation, fairly higher amount of spent hilsa and fries were observed in the spawning grounds and adjacent areas. Moreover, larger sizes and higher percentage of mature fishes (maturity stage V to VI) were also found in the identified spawning grounds which indicate little or no changes of the spawning grounds that were reported in the previous studies.

Conclusion and recommendations

From the present study the following conclusion and recommendations could be made:

- The fishing ban was found effective for successful breeding of hilsa;
- The impact of 10 days fishing ban on breeding success of other fishes needs to be assessed;
- The fishing ban should be continued for sustainable reproduction of hilsa, and jatka as well as hilsa production; and
- The impact of fishing ban on breeding success need to be studied in depth in the forthcoming years.

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