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Research Paper

Impact of lunar periodicity on availability of fin and shell fish seed with special reference to *Penaeus monodon* in the estuarine systems of Sunderbans, West Bengal

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Abstract

The seed requirement for existing brackish water aquaculture practices in India is now being met from the seed produced at hatchery as well as from natural collections. The Sunderbans in West Bengal an intricate coastline with mangrove vegetation, cluster of deltas with interlinked channels, creeks and estuaries, are treasures of fin and shell fishes. The seeds enter into these waters from offshore spawning grounds along with tidal waters. Lunar phase control the tidal amplitude and thereby regulate the influx of the seeds. The investigation carried out in six estuarine systems of West Bengal namely Hooghly, Matla, Saptamukhi, Thakuran, Vidya and Jheela portrayed the impact of lunar periodicity on availability of fin and shell fishes from these estuaries. The study depicted maximum collection on 3rd day of lunar phase. Again collection was better during full moon phase compared to New moon phase. During seventh to eleventh day of the lunar phase negligible quantity of seeds were available. All the estuaries showed similar trend of rising graph of abundance both during Full moon and New moon periods. The fish seed availability during 1st to 7th days of the Full moon and also New moon phases was prominent in respect of the total numbers hauled and percentage of fin fish, shell fish and the *P. monodon*. The investigation has put through a guideline towards exploitation of seeds from these open water resources more pragmatically.

Keywords: Fin and shell fish, Sundarbans, Delta, Estuaries, Lunar periodicity

Introduction

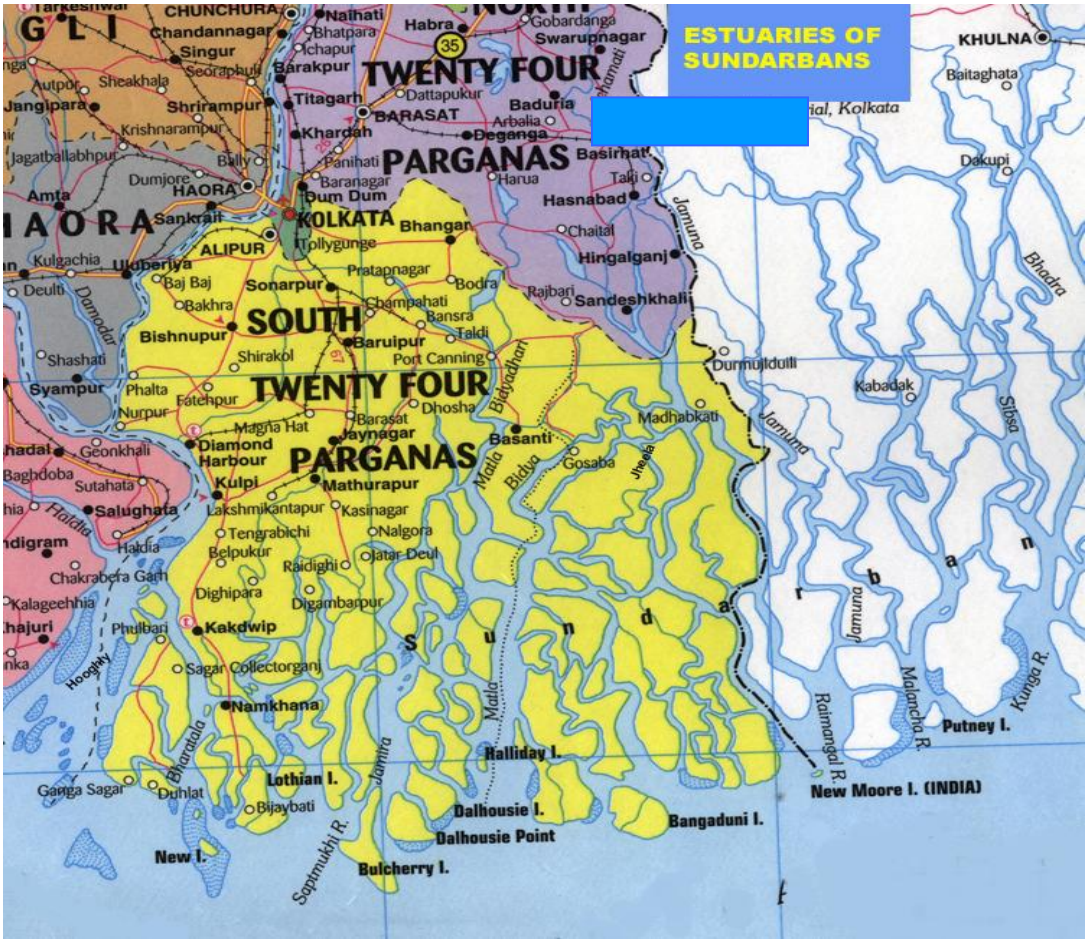
The demand for fin and shell fish seed have increased considerably with growing utilization of coastal areas for brackish water aquaculture. The seed requirement for existing brackish water aquaculture practices in India is now being met from the seed produced at hatchery as well as from natural collections. The Sunderbans in West Bengal possessing an intricate coastline blessed with mangrove vegetation, cluster of deltas, with interlinked channels, creeks and estuaries, are the treasure of fin and shell fish seeds. The seeds enter these waters from off-shore spawning grounds along with tidal currents. Tidal slopes in the estuaries, inter tidal pits and pools, creeks, estuarine canals etc. harbour sufficient brackish water fin and shell fish seeds [1]. Certain locations in such stretches are known to be as collection mine for desirable species. Usually hatchlings are more abundant in the marginal surface

currents of creeks, canals and estuaries. But tidal pools and inundated pits with some vegetation are ideal ground for fry and juveniles of fin fishes.

Among the seed of most of the commercially important shrimps-*Penaeus monodon* are available extensively along with *Penaeus indicus, Metapenaeus brevicornis, M. monoceros* as well as fishes *Liza parsia,L. tade* and *Lates calcarifer* [2]. With a view to putting forward the impact of lunar periodicity on availability of seed of fin and shell fishes particularly *Penaeus monodon*, an investigation was carried out in the estuarine systems of Sunderbans of West Bengal.

Materials and Methods

Sunderbans the largest deltaic tropical plain of India is located in the Southern part of 24 Parganas and is situated in the coastal belt of West Bengal of which about 1750 sq. Km is under the tidal rivers, creeks and brackish water lagoons [3]. The study was carried out consequently for 4 years from 1994 to 1998 in 6 estuarine systems viz. Hooghly, Matla, Saptamukhi, Thakuran, Bidhya and Jheela (Figure1) following 2 stage random sampling technique. Initially 10 villages from each estuary were selected and then 30 seed collectors from each village were selected at random [4].Thus, 300 seed collectors from each estuary constituted the sample of the study. They were interviewed personally with a structured schedule developed for the purpose.



(Source-Atlas)

Figure 1: Estuarine systems of Sunderbans.

Meteorological status

Coastal West Bengal falls under moist sub-humid region with large winter water deficiency [5]. Coastal Sunderbans of West Bengal is affected by Southwest monsoon which lasts for four months (June-September) with the annual average of 1580 mm [6]. Variability of rainfall regulates the flow of freshwater into rivers which end up in the estuaries. The most important climatic factors are the high frequency of violent cyclonic depressions in the Bay of Bengal. Generally, on an average 4 -5 cyclonic storms are experienced by the West Bengal coast every year.

The head of the funnel shaped Bay of Bengal perhaps receive the most serious thrust from the surges driven by the storm waves reaching 5-8 m height. As many as six hails, ten thunders, two fogs, three squalls are experienced annually at the deltaic regions of the Hooghly estuarine system. Dust storms are practically unknown in these regions [7].

Results and Discussion

The *Penaeid* and *Palaemonid* shrimps possess characteristic of migratory behaviour. The post larvae invade the estuarine habitats and grow upon their to complete the initial phases of life cycle. The juveniles and mature adults return back the coastal offshore areas of the sea either to spawn or the hatch their eggs. The migratory behaviour of prawns is also considered to be dependent on tidal flow, salinity, diurnal activity, feeding and lunar periodicity. Lunar phase control the tidal amplititude and thereby regulate the influx of the seeds in case of euryhaline fishes whose early part of the development is mainly completed in marine zone and fishes migrate back into estuary for feeding and maturity [8].

Seed availability in the estuaries of Sunderbans

The fin and shell fish seed availability varied from estuary to estuary along with time frame (Figure 2-5)

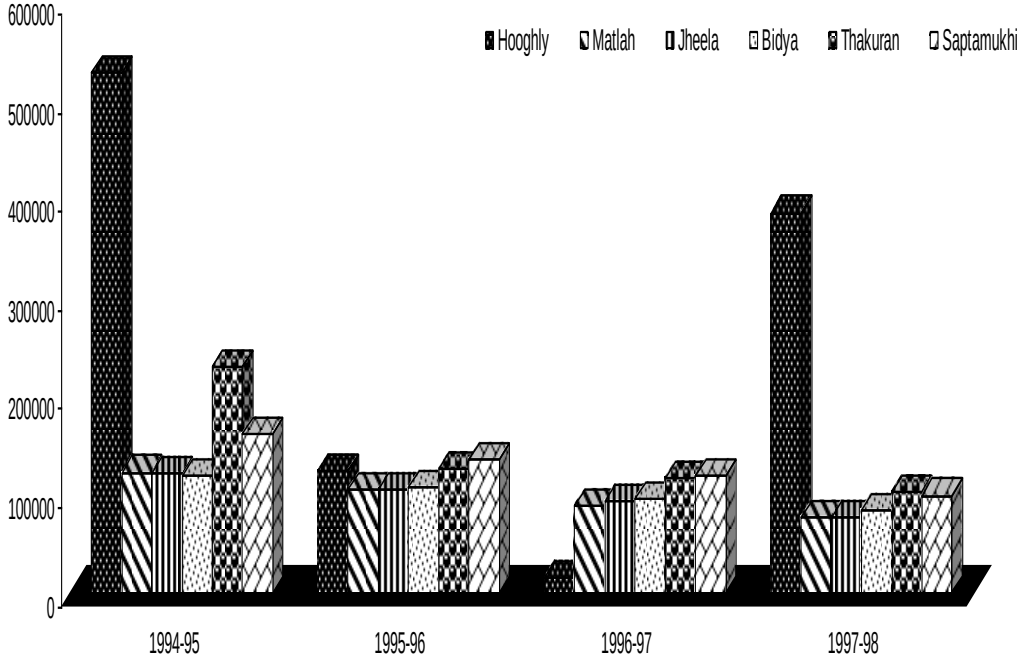


Figure 2: Average total seed availability in different estuaries

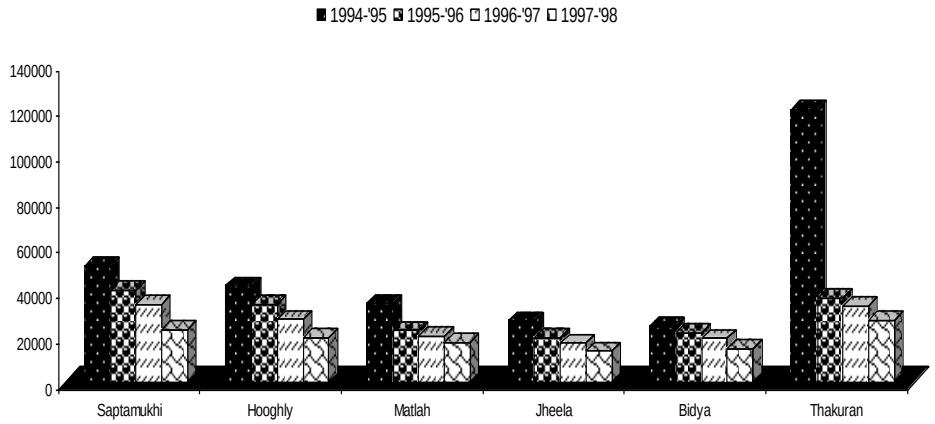


Figure 3: Average shellfish seed availability in different estuaries

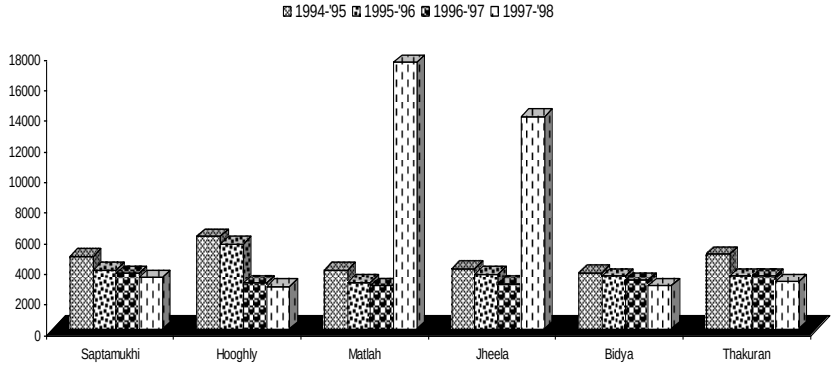


Figure 4: Average finfish seed availability in different estuaries

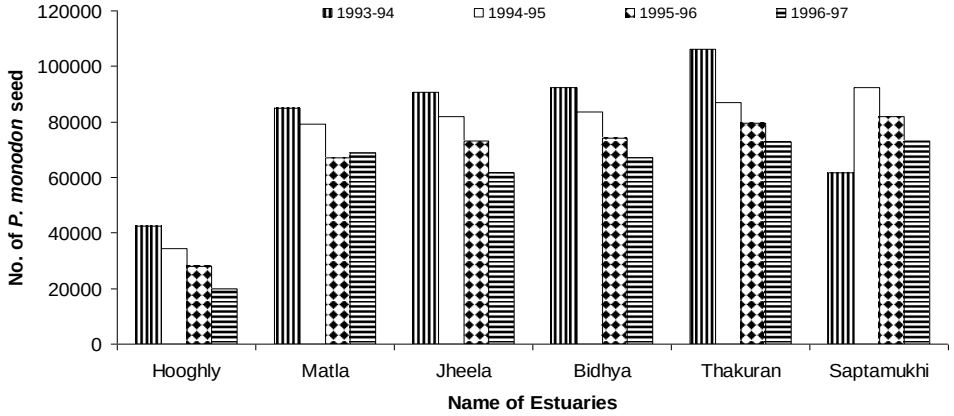


Figure 5: Average *Penaeus monodon* seed availability in different estuaries

Hooghly estuary

The annual average of fin and shell fish seed catch was observed to be 10,062 nos./net/day of which 66-77% comprised of shell fish, 2.9-4.0% *P. monodon* and 20 – 30% fin fishes. The peak period of seed availability was during June to September when average catch varied between 9,371 nos / net/day and 19,182 nos/net/day. Average catch of shrimp during the period was in the range of 6,935 nos/net/day and 12,153 nos/net/day and that of *P. monodon* between 379 nos./net/day and 988 nos./net/day. The seed availability in the rest period of the year was almost in the similar order and the composition did not show much variation.Out of all the estuaries including the main stream, the seed abundance was second in rank for the Hooghly estuary.

Matla estuary

In Matla estuary the annual average of fin and shell fish seed abundance was 8883 nos./net/day. Shell fish contributed 71-77% *P. monodon* 2.9-3.0% and fin fish 20- 26% of the total catch. The peak period of seed availability was during June to September coincides with that of Hooghly estuary. During peak period total seed catch ranged between 8,838 nos/net/day and 18,400 nos/net/day with the support of 7,154 – 12,188 nos/net/day of shell fish, 362-892 nos/net/day of *P. monodon* and 1271-6491 nos/net/day of fin fish species. Seed availability in non-peak period did not show much fluctuation including the percentage composition of the shell fish, *P. monodon* and fin fish.

Saptamukhi estuary

Among all the estuaries, Saptamukhi was observed to be highly potential source of seeds and the average annual total catch during 1994-95 to 1999-98 was recorded to be10,786 catch/net/day. Percentage wise contribution depicted shell fish as 64.5-75.2% while *P. monodon* 2.5-3.4% and fin fish 23.4-32.0%. The peak period of seed availability was during June to September (15,569 – 22,952 nos/net/day). In peak period, shell fish seed abundance was between 8,031 nos/net/day and 13,165 nos/net/day, while *P. monodon* between 387 nos./net/day and 1,058 nos/net/day and fin fish 1,696 nos/net/day and 9,670 nos/net/day. Other than peak season, the total seed availability was almost in similar range with little changes in percentage contribution of the shell fish, *P. monodon* and fin fish seeds.

Thakuran estuary

In Thakuran estuary the annual average of fin and shell fish seed abundance was 8883 nos./net/day. The peak period of seed availability was during June to September which coincides with that of Hooghly estuary. During peak period total seed catch ranged between 15,0822 nos./net/day and 23,084 nos./net/day with the support of 9,713 – 13,230 nos./net/day of shell fish, 878 – 1,073 nos./net/day of *P. monodon* and 4,491 –8,781 nos./net/day of fin fish species. Seed availability in non-peak period did not show many fluctuations including the percentage composition of the shell fish, *P. monodon* and fin fish.

Bidya estuary

Average annual seed abundance in Bidya during 1994-95 and 1997-98 was 8,593 nos./ net/ day. Percentage contribution of shell fish seed was towards higher side between 76 and 79 for the estuary. The *P. monodon* contributed 3.0 - 3.4%, and fin fish species 17.6 – 20.8% of the total seeds. Tallying with the other estuaries, the peak period of seed abundance in the estuary was during June and September with average total catch of 9,306 – 14,504 nos./net/day. The contribution of *P. monodon* was close to 3.0% in the catch. Fin fish seed availability was comparatively lower in the estuary.

Jheela estuary

At the extreme east of the Sunderbans delta in West Bengal, the estuary yielded on an average 8174 nos./net/day of seeds during 1994-95 and 1997-98. *P. monodon* seed was available @ 3.3-3.6% of the total catch while the fin fish ranged between 15.3 and 19.5%. Like all other estuaries Bidya also yielded

maximum seeds during June to September of the years. Overall percentage of shell fish seed was comparatively higher in Bidya round the year.

Seed composition in the estuaries of Sunderbans

The composition of fin and shell fish seeds varied between the estuaries. In Hooghly estuary 71.75% of the seeds composed of shell fish species, 9.6% of mullets and 6.5% of thread fins. The other species contributing the total seeds collected from the system were *H.nehereus* (1.15%), *M.gulio* (1.1%), *T.jarbua* (0.53%), *L.calcarifer* (0.91%), *T.ilisha* (0.31%), and miscellaneous (7.5%). Matla, Saptamukhi, Thakuran, Bidya and Jheela yielded lower percentage (63.07-68.10%) of shell fish seeds (Bhaumik et.al.2004). Among the other groups mullets were in almost similar percentage (6.91-7.84%) while threadfins were caught in lower abundance (2.91-5.0%) compared to the Hooghly estuary. The contribution of miscellaneous species increased significantly (14.62-23.61%) in the estuaries other than the Hooghly (Table 1).

Table 1: Seed composition in the estuarine systems of Sunderbans (in percent)

S No	Species	Percentage composition					
		Hooghly	Matla	Saptamukhi	Thakuran	Bidya	Jheela
1	*P. monodon*	3.0	2.9	3.1	3.05	3.2	3.5
2	*P. indicus*	15.2	13.9	14.7	13.8	12.0	10.7
3	*M. monoceros*	16.7	15.03	15.06	15.02	17.2	16.5
4	*M. brevicornis*	23.7	22.03	21.74	21.0	22.9	23.1
5	*P. styliferus*	6.03	6.71	6.92	6.3	6.1	6.71
6	*P. sculptilis*	4.12	2.1	4.08	3.6	3.7	3.8
7	*M. rosenbergii*	3.0	3.1	2.5	-	-	-
8	*L. tade*	1.61	1.9	1.5	2.1	2.3	2.2
9	*L. parsia*	2.5	2.9	2.1	2.71	2.61	2.31
10	*M. cunnesius*	3.4	2.75	3.2	2.64	2.15	2.1
11	*R. corsula*	0.45	0.37	0.4	0.39	0.38	0.3
12	*S. argus*	0.50	0.29	0.3	0.31	0.33	0.32
13	*Sillaginopsis panijus*	0.25	0.13	0.2	0.21	0.22	0.21
14	*P. paradesius*	2.5	1.7	2.0	-	-	-
15	*Pama pama*	1.1	1.1	1.2	1.05	-	-
16	*Elutheronema tetradactylum*	2.9	2.02	5.3	1.93	2.81	2.91
17	*H. nehereus*	1.15	0.9	1.05	0.93	-	-
18	*M. cyprinoides*	0.04	0.05	1.0	0.70	-	-
19	*M. gulio*	1.1	0.93	0.8	0.83	0.73	0.21
20	*L. calcarifer*	0.41	0.23	0.3	0.23	0.23	0.28
21	*T. ilisha*	0.31	0.32	0.2	0.30	0.29	0.47
22	*T. jarbua*	0.53	0.49	0.5	0.47	0.48	0.21
23	Miscellaneous fish	7.50	18.15	14.62	22.43	22.37	23.61

Time schedule on availability of fin and shell fish seed in abundance from the estuarine systems

There is no standard measure coined as yet to define the stages as seed of brakish water fin and shell fish. In the present investigation, the young stages of fin and shell fishes were mostly in the size range of 15 to 30 mm in total length and have been referred to as seed (Table 2).

As brackish water aquaculture promises great prospects, standardization of seed based on size and gear for collection of the same from the natural resources warrant urgent attention from all the corners [9-10].Seasonal fluctuation of estuarine fin and shell fish seeds are subjected to changes in relation to ecosystem and spawning success of brood stocks in nature.

Table 2: Calander of availability fin and shell fish seed in the estuarine systems

Species	Hooghly	Matla	Saptamukhi	Thakuran	Bidya	Jheela
Shell fish						
Penaeus monodon	May -Sept	April –Sept	May-Sept	May-Aug	April-Sept	April-Sept
Penaeus indicus	Apr-Oct	Mar-Oct	Apr-Sept	May-Oct	June-Aug	Jun-Jul
Palaeomon styliferus	May-Sept	May-Oct	Feb-Apr	Apr-Nov	Jul-Nov	Jun-Oct
Metapenaeus brevicornis	Mar-May	Apr-Aug	May-July	Jul-Aug	Jun-Aug	Aug-Nov
Metapenaeus monoceros	Jul-Aug	Jul-Aug	Jul-Aug	Jul-Aug	Jul-Aug	July-Aug
Macrobrachium rosenbergii	Jun-Aug	-	-	-	-	-
Acetes sp.	Nov.-Mar	Nov.-Mar.	Nov.-Mar.	Nov.-Mar.	Dec.-Mar.	Dec.-Mar
Fin fish						
Liza parsia	Mar.-May	Feb-Apr	Feb-May	Feb-Mar	Jan-Feb	Jan-Feb
Liza tade	Apr.-Sep.	Apr.-Sep.	Jun-Sept.	Jun-July	May-Sept	May-Aug
Mugil cunnesius	Jun-Aug	Jun-Aug	Jun-Aug	Jul-Sept	Jun-Aug	Jun-Sept
Rhinomugil corsula	Jul-Aug	Jul-Aug	Jul-Aug	Jul-Sept	Jul-Oct	Jul-Oct
Lates calcarifer	Apr.-Jun	May-Aug	May-Jul	MayAug	May-Aug	Mayl-Aug
Tenualosa ilisha	Mar.-May	Oct-Dec	May-Jun.	-	-	-
Polynemus paradiseus	Apr-July	May-Jul	May-Aug	-	Jun-Sept	-
Elutheronema tetradactylum	Jul.-Sep.	Jul.-Aug.	Jul.-Aug.	Jul.-Aug	May-Jul	May-Jul
Megalops cyprinoides	May-Aug	Jun-Aug	Jun-Aug	Jun-Sept	Jun-Aug	Jun-Sept
Plotosus canius	-	Sept-Oct	Sept-Oct	Sept-Oct	-	-
Therapon jarbua	Apr.-Sept	May-Sept	Apr.-Sept	Apr.-Sep.	Sep.-Oct	Sep.-Oct
Scatophagus argus	Jun.-Sep.	Jun.-Sep	Jun.-Sep.	Jul.-Oct	Jul.-Oct	Jul.-Oct
Mystus gulio	Sep.-Oct	Sep.-Oct	Sep.-Oct	Oct	Oct	Oct
Sillaginopsis panijus	Apr-Jun	May-Jun	May-Jun	May-Jun	May-Jun	May-Jun
Pangasius pangasius	May-Jul	May-Jul	May	-	-	-
Setipinna phasa	Apr.-Aug.	Apr.-Aug.	Apr.-Aug.	Apr.-Aug.	-	-
Pama pama	Nov.-Jun.	Nov.-Jun.	Nov.-Jun.	Nov.-Jun.	-	-
Harpodon nehereus	Sep.-Dec.	Sep.-Dec.	Sep.-Dec.	Sep.-Dec.	-	-

Impact of Lunar periodicity on availability of seeds

Lunar phase control the tidal amplitude and thereby regulate the influx of seed. In the present investigation maximum seed collection was recorded on 3rd day of lunar phase. Again collection was better during Full moon phase compared to New moon phase. Collections of seeds were made during first to sixth day and again during twelfth to fifteenth day of each lunar phase when good quantity and quality of seeds were obtained. During seventh to eleventh day of the lunar phase negligible quantity of seeds were available for which maximum seed collectors did not put their nets for collection.

The influence of the lunar periodicity on fin and shell fish seed abundance from all the estuarine systems was evident from the increasing number in seed haul per net per day. All the estuaries showed similar trend of rising graph of abundance both during full moon and New moon periods. The fish seed availability during 1st to 5th-7th days of the Full moon and also New moon phases was remarkable in respect of the total numbers hauled and percentage of fin fish, shell fish and the *P. monodon* in the nets.

Though increase in abundance was applicable for all the groups like shell fish, fin fish and *P. monodon*, difference in commencement and duration of maximum availability period varied between the Full moon and New moon phases.

The seed availability of *P. monodon* has been depicted in the (Figures 6-12). In Hooghly estuary, by and large, the Full moon catch of *P. monodon* seeds was higher compared to New moon phase. The duration of high abundance period was more in New moon phase during non monsoon season while it was less during monsoon spell of the year. Further, the total high abundance period during both Full & New moon phases was lesser in monsoon months though the overall catch of the nets at that time were much higher compared to the non monsoon seasons. The periods and trends of abundance of the species for the Saptamukhi estuary were similar to Hooghly. In Jheela Thakuran & Bidya estuaries the period of abundance and also the trends in percentage of individual group were different from those of the Hooghly and Saptamukhi estuarine systems. By and large, the period of higher abundance was slightly longer almost throughout the year in Jheela, Thakuran & Bidya.

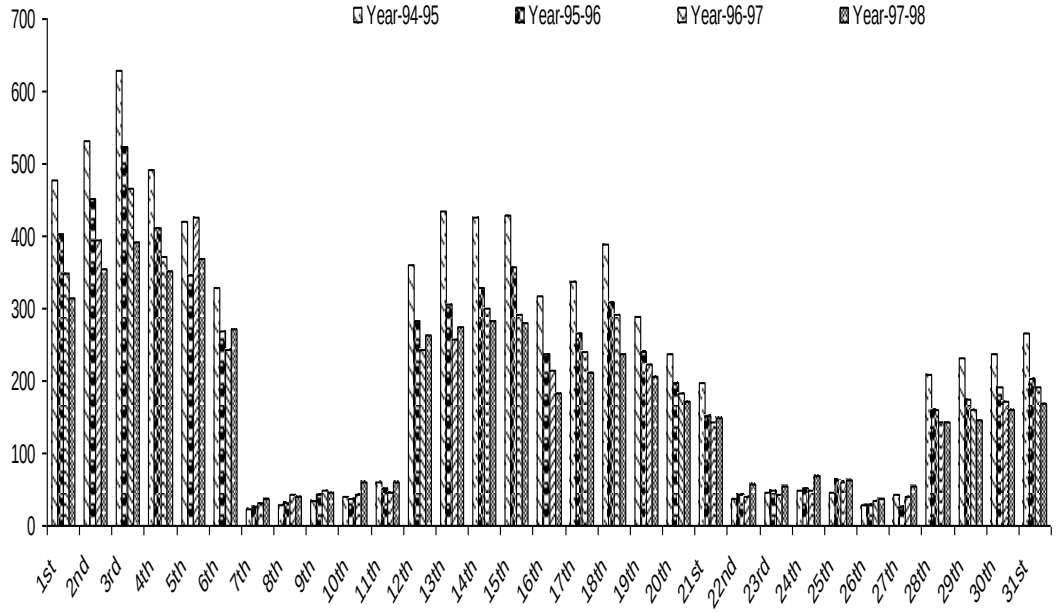


Figure 6: Average seed availability of P. monodon as per lunar periodicity in different estuaries

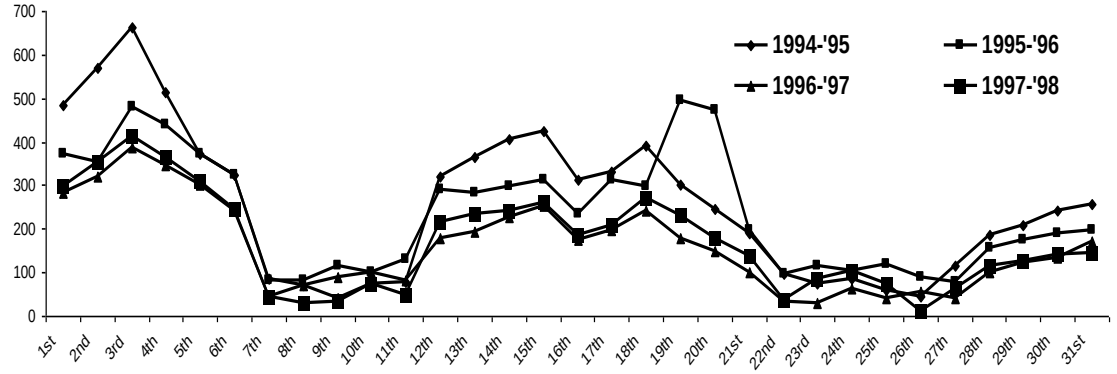


Figure 7: Average P.monodon seed availability as per lunar periodicity in the Hooghly estuary

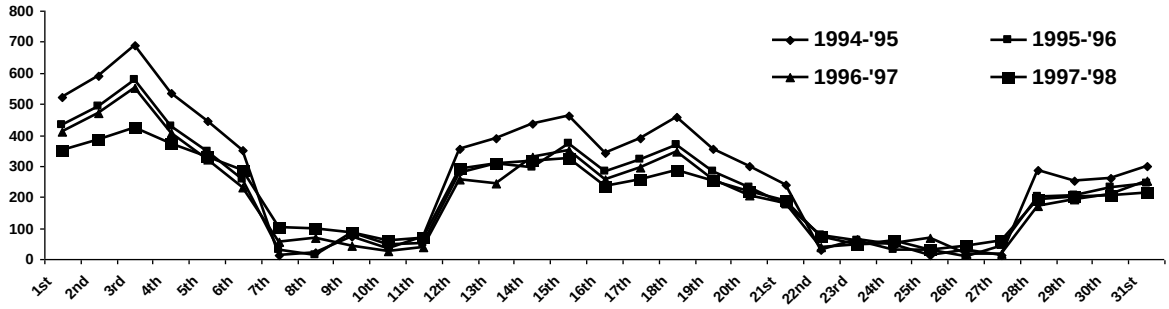


Figure 8: Average P.monodon seed availability as per lunar periodicity in the Saptamukhi estuary

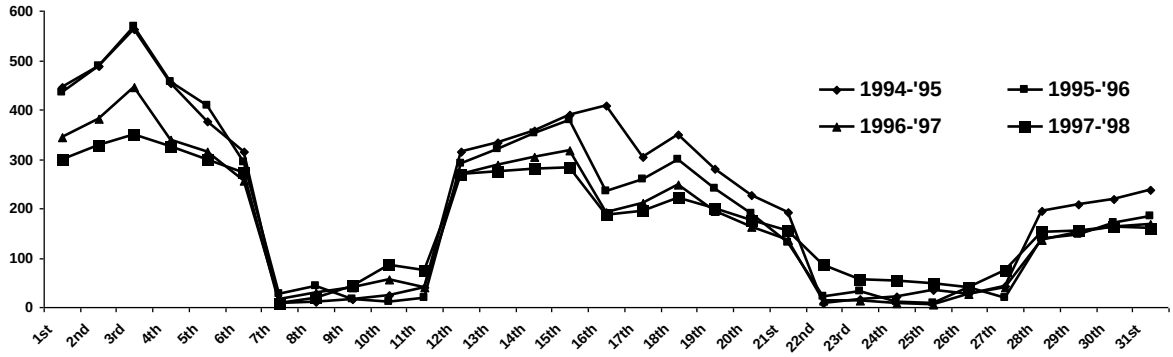


Figure 9: Average. P.monodon seed availability as per lunar periodicity in the Jheela estuary

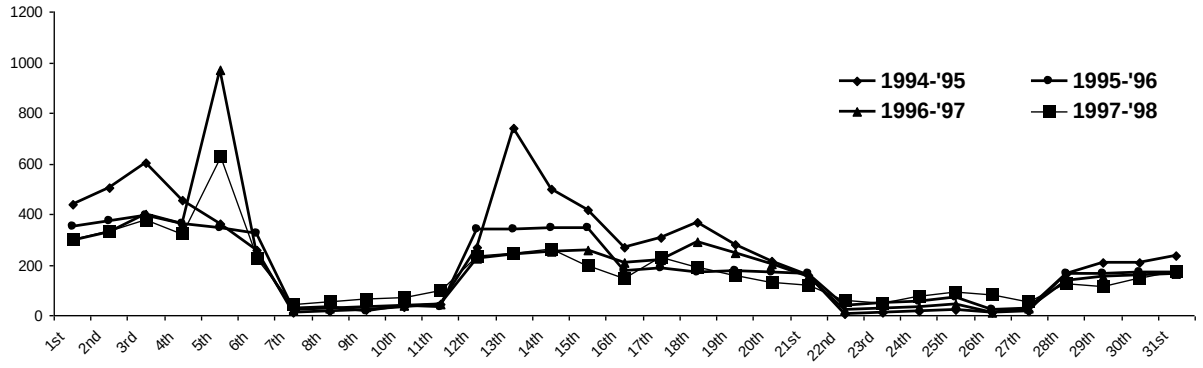


Figure 10: Average P.monodon seed availability as per lunar periodicity in the Matla estuary

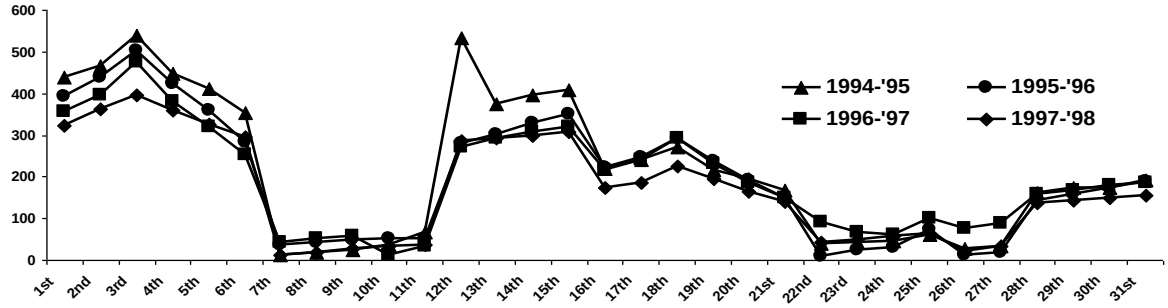


Figure 11: Average. P.monodon seed availability as per lunar periodicity in the Bidya estuary

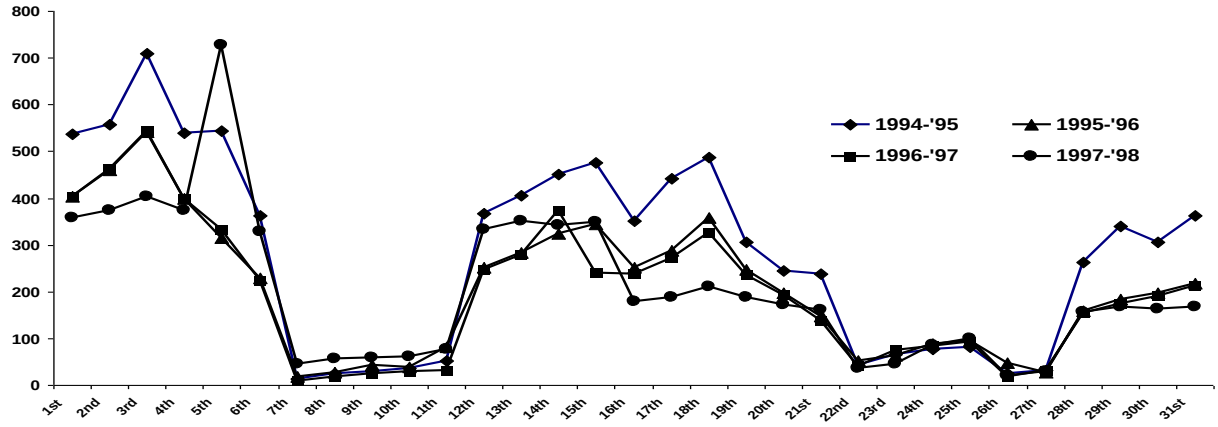


Figure 12: Average. P.monodon seed availability as per lunar periodicity in the Thakuran estuary

Tidal amplitude and its nature were observed to have much influence over the seed abundance. During Full moon and New moon period increased tidal amplitude accompanied by higher flow rate facilitate more entry of seed during 1st to 6th day whereas during 7th to 11th day tidal amplitude and flow of water were minimize during neap tide which indulged negligible availability of seed. Again during spring tide from 12th to 15th day seed availability increased. Indicated [11] greater tidal force with maximum abundance of seed.

Further, average day collection in New moon period and night collection in Full moon period during November months were recorded rich in Hooghly and Saptamukhi. The observation is in conformity with the study [12].

Conclusion

Fin and shell fish seeds are one of the major inputs in culture system. The results of the investigation carried out in the estuaries of Sunderbans have portrayed the scenario on brackish water seed potentiality of the systems. The treatise on fin and shell fish seed particularly *Penaeus monodon* of the studied estuaries depicted availability and period of abundance as per lunar periodicity. This has put through a guideline towards exploitation of estuarine resources more judiciously. Thus, the achievements made in the investigation may facilitate the fishers of Sunderbans to exploit seeds more pragmatically.

Acknowledgement

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