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Study on Preferred Food Items of Hilsa (*Tenualosa Ilisha*)

Debasis De[1], P.S. Shyne Anand[1], Subhasmita Sinha[1]and V.R. Suresh[2]

[1]Kakdwip Research Centre of Central Institute of Brackishwater Aquaculture (I.C.A.R.)
[2]Central Inland Fishery Research Institute, Barrackpore, West Bengal.

Abstract

The Indian shad hilsa (Tenualosailisha) is one of the most important tropical fish of the Indo-Pacific region. There is a compelling need for domestication and culture of the species for conservation and rehabilitation of its declining fishery and information on the food and feeding habits of the species is essential for its domestication. For this purpose a study on gut content analysis of T. ilisha of different size groups were carried out to know the preferred food items of the species in Hooghly estuarine stretch in West Bengal. Fish specimens of different size groups were collected from different habitats viz., marine (Namkhana and Fresser Gunge), brackishwater (Kakdwip Lot.8 and Nischintapur) and freshwater (Godakhali, Sultanpur and Diamond Harbour) habitat in West Bengal. The specimens were dissected and gut contents were analyzed by frequency of occurrence of food items and volumetric analysis method. Fishes (n=90) were divided into 9 different size groups as per their body weight i.e. 1-5 g, 5-10 g, 10-30 g, 30-50 g, 50-100 g, 100-200 g, 200-400 g, 400-600 g and 600-800 g. Frequency of occurrence of gut contents (%) of fishes below 10 g size indicated that diatoms were the major items in the gut with Coscinodiscussp. andBiddulphiasp. asdominant among diatoms. In 10-30 g size group, copepods, diatoms and filamentous algae were the major items in the gut and Coscinodiscussp. was dominant among diatoms. In 30-50 and 50-100 g size group, diatoms followed by copepods formed the major food items. Coscinodiscussp. and Nitzschiasp. were dominant in 30-50 g group whereas Biddulphiasp. and Pleurosigmasp. were dominant in 50-100 g group. In fishes of above 100g diatoms formed the major food items followed by copepods. Among the diatoms, Coscinodiscussp. And Biddulphiasp.

were dominant in 100-200 g and 200-400 g group. Coscinodiscussp., Nitzschiasp. and Asterionellasp. were dominant in 400-600 g group whereas Coscinodiscussp. andThalassiothrixsp. were dominant in 600-800 g group. Majority of items in the gut were in digested state. Sand particles (4.17 to 37.50% of total gut volume) observed in the guts of majority of the specimens, may be attributed to turbid habitat from where animals were caught. Volumetric index analysis (%) of gut samples indicated that digested food occupied highest volume in 1-5 g size groups.Copepod occupied more volume than diatom in fishes of 5 to 50 g body weight range,whereasdiatoms occupied maximum volume in fishes weighing more than 50g. The study indicated that hilsa (Tenualosailisha) prefer copepod in their early stages and shift their preference towards diatom when they grew beyond 50 g size.

Keywords: Tenualosailisha, gut analysis, preferred food, diatom, copepod.

1. Introduction

Hilsa Shad (*Tenualosailisha*) inhabits coastal shelf, estuaries and freshwater rivers in Indonesia, Sumatra, Myanmar, Bangladesh, India, Pakistan, Kuwait, Iraq and Iran. Hilsa Shad is anadromous, reported to ascend rivers as far as 1,200 km inland for breeding (Pillay and Rosa 1963) and after spawning in freshwater returns to marine habitats. It is the most important fish species from the socioeconomic point of view in the northern part of the Bay of Bengal. A significant amount of researches have been conducted on the riverine and estuarine phase of life of Hilsa Shad in India (Pillay 1955, 1958; Pillay and Rosa 1963; Mathur 1964; Gopalakrishnan 1969, 1973; Bhanot 1973; Jones 1984; De and Dutta 1990).Few research on food and feeding habit of hilsa indicated hilsa shad is a filter feeder and feed on plankton (Hora, 1938; Jones and Sujansingani, 1951). Pillay and Rao (1962) observed that from January to March feeding was fairly intensive and from June to November feeding intensity was less as little amount of feed was available in the stomach of all collected sample and they found that the diatoms are the predominant food items in the river Godavari.

Knowledge on the diet of fish is important from the perspective of studies concerning food webs, trophodynamics, resource partitioning and ecological energetic. Food is an important factor in the biology of fishes to the extent of governing their growth, fecundity and migratory movements (Rao 1964). Knowledge of food and feeding habits of various fish species is advantageous in their proper management and exploitation (Khan and Fatima 1994). An understanding of the relationship between fishes and their favorite food items, the seasonal distribution of the food items helps to locate the potential feeding grounds which may in turn be helpful for exploitation of these resources. Stomach content analysis and features of the alimentary system provide information on food, feeding habits and selective feeding if any (Kuruppasamy

and Menon 2004). The stomach content analysis also helps to understand the tropic dynamic and the prey predator interaction in the ecosystem, which facilitate the ecosystem based fisheries management.

The present study was undertaken with a view to provide information on preferred food items for hilsa keeping in view for culturing those food items in mass scale for providing to the fish during culture in captivity.

2. Materials and Methods

Fish specimens of different size groups were collected fromdifferent habitats *viz*., marine (Namkhana and Fresser Gunge), brackishwater (Kakdwip Lot.8 and Nischintapur) and freshwater(Godakhali, Sultanpur and Diamond Harbour) habitat in West Bengal.Fishes (n=90) were divided into 9 different size groups as per their body weight*i.e.* 1-5 g,5-10 g, 10-30g, 30-50 g, 50-100g, 100-200 g, 200-400g, 400-600 g and 600-800g.The total length (mm) of all fishes of different size groups were measured. After dissecting the fishes the total gut length (mm) were also measured and relative lengths of gut (RLG) were calculated. The RLG values of all size group fishes were depicted in Table 1.

2.1 Gut content analysis

Under each size group ten fishes were dissected and their gut was taken out and content was squeezed out to 5 ml cryo tube containing 4% neutralized buffer formalin (4 g potassium dihydrogen phosphate and 6 g dipotassium hydrogen phosphate is dissolved in 100 ml raw formaldehyde solution and is made the volume to 1 litre.) and wassubsequently analyzed both qualitatively and quantitatively. The qualitative analysis of food items was done by matching the planktons with the available photographs and food items were identified up to the generic level. The quantitative estimation of the gut contents were analyzed by frequency of occurrence of food items and volumetric analysis method (Hynes 1950).

2.1.1 Frequency of occurrence (%)

Itis the number of each food items present inside gut and it was calculated using the formula (Hynes, 1950; Hyslop, 1980; Bowen, 1983) :

$F_i = 100n_i / n$Where: F_i = frequency of occurrence (%) of the i food item in the sample.

n_i = number of stomachs in which the i item is found.

N = total number of stomachs with food in the sample.

Here for each size group frequency (%) of individual food items and groups of food items were calculated.

2.1.2 Volumetric analysis index (%)

Itindicates the relative abundance of a particular item found in the stomach samples. Its calculation was based on points ascribed to distinct food items after a simple visual

inspection of the stomach's food contents.The points ascribed to each food item found in a sample of stomachs were transformed into an arithmetical mean or rather the value that represents the mean abundance of a determined food item in the sample:

$M_i = \sum_i / n$
Where:
M_i = mean of the ascribed points for the i food item ;
$\sum_i$ = sum of the ascribed points for the i food item;
n= total number of stomachs with food in the sample.
The volumetric analysis index(%) is expressed as V_i
$V_i = 25\ M_i$
Where :
V_i = Volumetric analysis index of the i food item in the sample ;
25 : multiplication constant to obtain a percentage ;
M_i = mean of ascribed points for the i food item.

3. Result

Diatoms, algaeand crustaceans formed the major constituents of food in gut sample of hilsa of all nine size groups. The sand grainswas also observed in gut of all size groups. Various genera of diatoms were found in the stomachof Hilsa Shad and those constituted the main identifiable fooditem. It was observed that *Coscinodiscus, Pleurosigma, Bacillaria, Nitzschia, Biddulphia, Diatoma*and *Asterionella*were the most common generaconsumed by hilsa. Besides that other genera *Chaetoceros, Diploneis, Pinnularia,Rhizosolenia, Thallassiothrix , Prorocentrum* were also found in gut of hilsa. The main genera of algae found in the gutwere Coccolithophores, Ulothrix, Chaetomorpha. Ceratiumwas only dinoflagellates found as food of hilsa samples. Crustaceans werefound to be most important constituent. Copepodsformed the bulk of the crustaceans. Calanoid copepodsformed the dominant genera throughout the study period.Occurrence ofNaupli of copepod has also been recorded throughout thestudy period. The frequency of occurrence of individual food items in gut contents (%) of different size groupsof fishes revealed that below 10 g size (1-5 g & 5-10 g) indicated that diatoms were the major items in the gut (Table 4) with *Coscinodiscussp.* and*Biddulphiasp.* asdominant among diatoms (Table 3). In 1-5 g size groups it was observed that*Coscinodiscussp*. and*Biddulphiasp*. covers 16.04% frequency of occurrence out of total 18.51% diatoms.In 5-10 g size groups it was also observed that *Coscinodiscussp.* and*Biddulphiasp.* covers 18.92% frequency of occurrence out of total 18.92% diatoms (Table 3). In 10-30 g size group, copepods(22.22 %), diatoms (18.89%) and filamentous algae (8.89%) were the major items in the gut(Table 2) and *Coscinodiscussp*. (11.11%)was dominant among diatoms (Table 3). In 30-50 and 50-100 g size group, it was found that diatoms (35.29% & 37.14% respectively) followed by copepods (25.49 % &17.14% respectively) formed the major food items (Table 2). *Coscinodiscussp*.(7.84%) and*Nitzschiasp*.(9.80 %) were dominant in 30-50 g group

whereas *Biddulphiasp.*(14.29%) and *Pleurosigmasp.*(8.57%)were dominant in 50-100 g group (Table 3). In fishes of above 100g it was found thatdiatoms formed the major food items followed by copepods (Table 4).Among the diatoms, *Coscinodiscussp.*(14.86% & 14.58%respectively)and*Biddulphiasp.*(9.46% &11.46% respectively)were dominant in 100-200 g and 200-400 g group. *Coscinodiscussp.*(21.74%), *Nitzschiasp.*(12.17%) *and Asterionellasp.*(9.57%) were dominant in 400-600 g group whereas *Coscinodiscussp.*(40.25%) and *Thalassiothrixsp.*(10.39%) were dominant in 600-800 g group (Table 3).The composition in terms of volumetric index (%) of different groups of food itemsof nine size groups i.e 1-5 g, 5-10 g, 10-30 g, 30-50 g, 50-100 g,100-200 g, 200-400 g, 400-600 g and 600-800 g was given in Fig. 2A & 2B.Volumetric index analysis (%) of gut samples (Table 4) indicated that digested food occupied highest volume (46.25%) in 1-5 g size groups.It was observed thatcopepod occupied more volume than diatom in fishes of 5 to 50 g body weight range (29.17%, 39.58% and 34.4% of 5-10g, 10-30g & 30-50g respectively) whereasdiatoms(37.5%, 37.51%, 31.26%, 40.7% &58.3% of 50-100g, 100-200g, 200-400g,400-600g & 600-800g respectively) occupied maximum volume in fishes weighing more than 50g.

Stomach content analysis of fry, juvenile and adult hilsa revealed that copepods were the most important food items consumed by the fish of all sizes as observed by De and Datta(1990). It was observed that fry and juveniles ofhilsa mainly feed on copepods and diatom. Hilsa prefers to reside in the brackish water region due to the presence of sub surface oxygen, relatively low salinity, strong tidal flow, high turbidity, heavy siltation, & rich growth of planktons (Pillay and Rosa 1958). During maturation, hilsa minimize their food intake and stop feeding during spawning migration. Majority of items in the gut were in digested state. Sand particles (4.17 to 37.50% of total gut volume) observed in the guts of majority of the specimens, may be attributed to turbid habitat from where animals were caught.But,Hora and Nair(1940) reported that presence of sand grains in stomachs of young hilsa might be due to bottom feeding habits of hilsa.Volumetric index analysis (%) of gut samples indicated that digested food occupied highest volume (46.25%) in 1-5 g size groups.Copepod occupied more volume than diatom in fishes of 5 to 50 g body weight range (29.17%, 39.58% and 34.4% of 5-10g, 10-30g & 30-50g respectively) whereasdiatoms(37.5%, 37.51%, 31.26%, 40.7%, 58.3% of 50-100g, 100-200g, 200-400g,400-600g & 600-800g respectively) occupied maximum volume in fishes weighing more than 50g.The study indicated that hilsa (*Tenualosailisha*) prefer copepod in their early stages and shift their preference towards diatom when they grew beyond 50 g size. The gradual increase of relative length of gut (RLG) from fry (32-47 mm) to adult fishes (371-405 mm) also indicated their change of feeding habit from zooplankton to phytoplankton as they grew.De andDatta(1990) also reported increase in relative length of gut (RLG) from fry to adult hilsaas an indicator of the changes of feeding habits in the same environment.

Table 1: The Relative length of Gut (RLG) values of all fishes in different size groups.

Size groups	Total Length(mm)	Total Gut length(mm)	RLG value
1-5 g	32-47mm	29.6	0.75
5-10 g	81-84 mm	73.85	0.9
10-30 g	110-132 mm	130.15	1.09
30-50 g	150-164 mm	180.13	1.15
50-100 g	190-204 mm	236.26	1.2
100-200 g	203-250 mm	286.32	1.25
200-400 g	250-312 mm	389.96	1.4
400-600 g	332-362 mm	528.66	1.51
600-800 g	371-405 mm	603.69	1.54

Table 2: The frequency of occurrence (%) of groups of food items in gut content of hilsa of nine size groups.

Size groups	Diatom	Dinoflagellate	Copepod	Filamentous algae	Algae	Digested food particle	Sand particle
1-5 g	18.51		40.74			40.74	
5-10 g	18.92		10.81			37.84	32.43
10-30 g	18.89		22.22	8.89		28.89	21.11
30-50 g	35.29		25.49			23.53	15.69
50-100 g	37.14		17.14			25.71	20.00
100-200 g	41.89	2.70	18.91		12.17	18.92	5.41
200-400 g	42.71		25.00		12.5	14.58	5.21
400-600 g	61.75		20.00		7.83	10.43	
600-800 g	66.23	3.90	29.87				

Table 3: The frequency of occurrence (%) of individual food itemsin gut content of hilsa of nine size groups.

Food items	**1-5 g**	**5-10 g**	**10-30 g**	**30-50 g**	**50-100 g**	**100-200g**	**200-400g**	**400 - 600 g**	**600-800g**
Coscinodiscussp	14.81	5.41	11.11	7.84	5.71	14.86	14.58	21.74	
Coscinodiscusradiatus	2.47			9.80					6.49
Coscinodiscuslineatus									9.09
Coscinodiscuseccentricus									6.49
Coscinodiscusgigas									10.39
Coscinodiscusjonesianus									7.79
Biddhuphia sp.	1.23	13.51	4.44			8.11	1.04		
Biddhuphia parts					14.29	1.35	10.42	5.22	
Nitzschia sp.			1.11	9.80	2.86	6.76	2.08	12.17	
Thallassiothrixnitzschioides			2.22	3.92			1.04		3.90
Pleurosigma sp.				3.92	8.57	6.76	4.17	5.22	
Diatoma sp.					5.71	4.05	4.17	7.83	
Asterionella sp.							5.21	9.57	
Pleurosigmanormanii									2.60
Chaetoceroscompressus									3.90
Diploneisrobustus									1.30
Pinnularia alpine									1.30
Rhizosoleniacrassipina									6.49
Thallassiothrix sp.									6.49
Ceratium sp.						2.70			
Prorocentrum sp.									3.90
Copepod			2.22	1.96		4.05	5.21	5.22	20.78
Parts of Copepod		10.81	17.78	23.53	8.57	13.51	12.50	12.17	9.09

Nauplii of copepod			2.22		8.57	1.35	7.29	2.61	
Ulothrix sp.						5.41	6.25	2.61	
Chaetomorpha sp.						6.76	5.21	0.87	
Coccolithophore sp.							1.84	4.35	
Filamentous algae			8.89						
Digested food particle	40.74	37.84	28.89	23.53	25.71	18.92	14.58	10.43	
Sand particle	40.74	32.43	21.11	15.69	20.00	5.41	5.21		

Table 4: The volumetric analysis index (%) of groups of food items in gut content of hilsa of different size groups.

Size groups	**Diatom**	**Dinoflagellate**	**Copepod**	**Filamentous algae**	**Algae**	**Digested food particle**	**Sand particle**
1-5 g	18.75					46.25	37.5
5-10 g	20.83		29.17			37.5	12.5
10-30 g	29.16		39.58	10.42		20.83	4.17
30-50 g	25.00		34.4			28.1	6.3
50-100 g	37.5		31.25			18.75	12.5
100-200 g	37.51	4.17	29.17		12.5	12.50	4.17
200-400 g	31.26		37.51		9.39	12.50	9.38
400-600 g	40.7		28.2		9.3	15.6	
600-800 g	58.3		41.7				

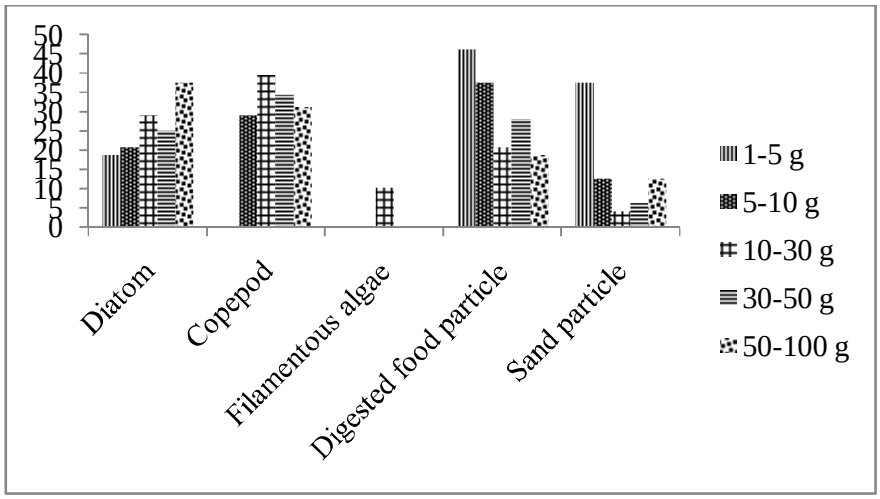

Fig. 2A: The composition of food items in terms of volumetric analysis index (%) of five size groups i.e 1-5 g, 5-10 g, 10-30 g, 30-50 g and 50-100 g.

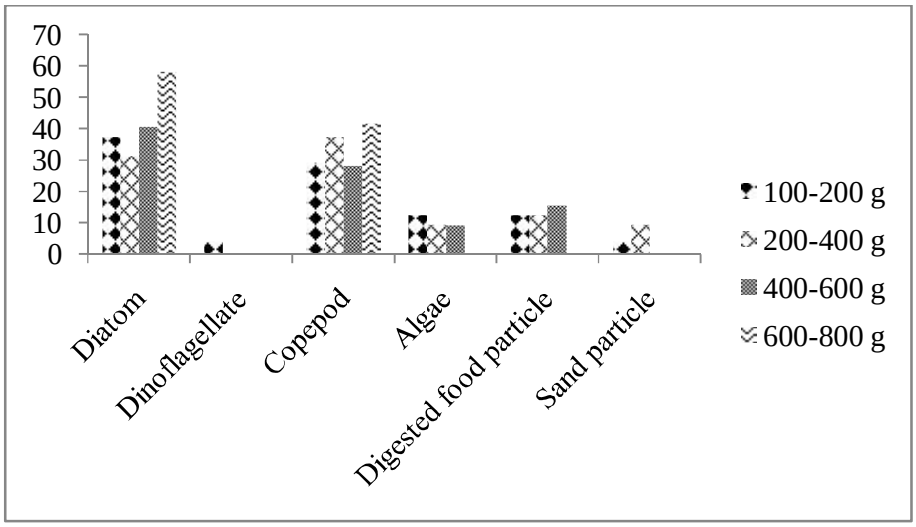

Fig. 2B: The composition of food items in terms of volumetric analysis index (%) of four size groups.i.e 100-200 g, 200-400 g, 400-600 g and 600-800 g.

4. Conclusion

The study indicated that hilsa (*Tenualosailisha*) prefer copepod in their early stages and shift their preference towards diatom when they grew beyond 50 g size.

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