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Analysis of Diet composition, Feeding dynamics and Proximate composition of Bombayduck, *Harpodonnehereus* along Sunderban Area of West Bengal, India

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ABSTRACT

Food is an important factor in the biology of fishes, which governing their growth, feeding and migratory movements. The basic function of an organism is growth, development and reproduction andit takes place at the expense of energy which enters the organism in the form of its food. The present study aims on diet composition and feeding dynamics of Bombayduck, Harpodonnehereus along Sunderban area by employing 'points method' for an one year duration from August, 2008 to July, 2009. Non- penaeid prawns are the main food item, contributing maximum percentage were noticed during the November (54.80%) and lowest during the August (20.90%). Juveniles of Bombay duck formed the second important gut content of Harpodonnehereus, which indicates the cannibalistic feeding behavior. The percentage of Bombay duck juveniles ranged from 15.49% (November) to 41.63% (May). Small pelagic fishes recorded in gut contents ranged from 7.70% (October) to 24.29% (February) mainly Coiliadussumieri. Plant matter,zooplankton, sand and mud and miscellaneous items are also noticed in guts, but they are less quantities when compare to previous food items. Non penaeid prawns are the major diet for the Bombayduck fisheries. So, based on the shoalsofnon penaeidprawns, Bombay duck migrations can be traced out.
The proximate composition of fish varies with feeding conditions and levels of food supply, reported changes in proportion to muscle biochemical constituents viz., protein, lipid, ash, moisture and energy contents were examined group wise i.e.immature and mature group. Proximate composition values of Harpodonnehereus was found to bemoisture 86.72%, protein 7.10%, fat 1.73% and ash 1.48% for immature group & 88.64% of moisture, 7.43% of protein, 2.0% of fat and 1.52% of ash for mature group. In the present study, the mature fish group exhibited relatively more values in terms ofbiochemical constituents than immature group. It might be due to fundamental nitrogen required for maturation, high lipids and proteins are required for liver during pre-spawning stage.

Key words:*Diet composition,Feeding dynamics, Prawns, Cannibalism, Proximate composition, Harpodonnehereus, Sunderbans.*

INTRODUCTION

The study of the food and feeding behavior of marine fisheries is necessary for fish species interaction i.e. prey and predator, fish stock assessment and ecosystem modeling. Due to the variation in the seasonal and diurnal abundance of the favorite food organisms of different species of fish may leadstothe horizontal and vertical movements of the fish stocks in a particular region. Hence, the correct knowledge of the relationship between the fishes and food organism is essential for the production and exploitation of the fish stocks and also know the interactions between keystone species in an environment. The relationships should be properly integrated in the orientation of a commercially exploited fishery, taking into account, the diversity of the component species constituting the total fishery of the region. *Harpodonnehereus*(Bombayduck or*Loitta)*, is small to medium-sized (maximum 40 cm), a predator-cum-scavenger which ascends to the upper part of the estuarine zone[1]. It is one of the important fishery species of the upper Bay of Bengal. In India, it is produced in large quantities on the south and southeast coasts of Saurashtra, on the Gujarat coast and the Konkan coast of Maharashtra. It produced little quantities in estuaries of West Bengal and Orissa coasts[2]. The discontinuous distribution of Bombay duck along the coasts of India has been attributed to various factors, the principal ones being the distribution and movements of various food components, variation of salanity along the coast, the 70^0F isotherm barrier of July etc. Food and feeding habits of fishes were studied byanalyzing the gut content of fishes during different seasons. There were little earlier studies on food and feeding habits of Bombayduck was studied by Pillay, [3] along the hooghlymatlah estuarine coast of Sunderbans. The present study aims to give an overview and upgrade the Diet composition and Feeding dynamics of Bombayduck, *Harpodonnehereus* along Sunderban area.

The proximate composition of fish varies with feeding conditions, levels of food supply and also on growth. Previous works on proximate composition of Bombayduck, *Harpodonnehereus*wereby, Nair and Suseela[4], Azam*et al.*[5].However, there is a noearlier works on the changes of biochemical constituents in different groups of fishes i.e. immature and mature groups in case of Bombayduck, *Harpodonnehereus*. The current study reveals thecomparison of biochemical constituents from immature group to mature group in relation to the biological activities.

MATERIALS AND METHODS

Sampling Site

Fishes are procured for the present study, diet composition and feeding dynamics from the Diamond harbour locality of Sunderban area, which is situated at the apex of the Bay of Bengal (between 21^0, 13^1 to 22^0, 40^1 N latitude and 88^0, 03^1 to 89^0, 07^1 E longitude). It is located on the southern fringe of the state West Bengal, covering the major portions of the North and South 24 paraganas districts. The region is bordered by Bangladesh in the east, theHooghly River in the west.

Stomach Content analysis

The fishes were collected from the sampling site and dissect out full digestive tract. Then preserve the dissected gut in 6% formalin for further study of gut content analysis. Before preceding theanalysis the weight of gut was recorded by electronic balance as well condition of gut eye estimation respectively. Gut contents were analyzed by both quantitative and qualitative method. In the current study, Points method was employed for the estimation of food items in the gut of fish, was described by the Hynes[6]. The food items were identified byreferringthe standardliterature. The unidentified materials were grouped under the miscellaneous group.

For qualitative and quantitative analysis, gut contents were washed inpetridish and thefood items were identified bynaked eye (for macro organisms) and by microscope (for micro/small organisms). For quantitative analysis of different food itemswere done by usingSedgwick Rafter Counting Cell.

Proximate composition

Methods were used to assess theproximate composition of the muscle of Bombayduck, *Harpodonnehereus*are described below.

Determination of moisture content

The moisture content was determined by drying the sample in hot air oven was described in AOAC[7].About 5 g of finely chopped meat of samples was taken in moisture bottles and dried in a hot air oven, maintained at 105 ± 2^0C for

12 hours. Then the moisture bottle was allowed to cool in a desiccator before weighing. The weight loss was expressed in terms of percent moisture content of the sample.

$$\text{Percentage of solids} = \frac{\text{Weight of solids (after drying)}}{\text{Weight of sample (before drying)}} \text{ X } 100$$

Percentage of moisture = 100 –Percentage of solids

Protein estimation

The protein estimation was done based on the conversion of organic nitrogen to inorganic nitrogen were followed by Microkjeldahl's method AOAC[7]. About 2 g of moisture free sample was transferred into 250 ml of digestion tube, then add10 to 12 ml sulphuric acid with 0.2 g of digestion mixture (Potassium sulfate, anhydrous sodium sulfate and copper sulfate in the ratio of 9:1:1)and were digested in a digestion chamber till a clear digest or colorless or slight green color was obtained. After cooling the volume was made up to 100 ml with distilled water. Then, 5 ml of digested solution was taken for distillation along with 10 ml of 40 % sodium hydroxide solution. The liberated ammonia was absorbed in 2% boric acid solution containing mixed indicator (ethyl red and ethylene blue is dissolved in ethyl alcohol). Then, the boric acid solution was titrated against N/70 standard hydrochloric acid solution until the boric acid solution turned pink. Total nitrogen was calculated and expressed as g/100 g of sample. Protein content was obtained by multiplying nitrogen content with a factor 6.25.

Determination of fat content

Fat content of moisture free sample was determined by extracting the fat with a suitable solvent (petroleum ether) by using Soxhlet apparatus was described in AOAC[7]. Briefly, 10 g of moisture free sample was taken in an extraction thimble and it was placed in the extractor with an attached receiving flask. The solvent was poured into the thimble through a glass funnel. The receiver containing petroleum ether was heated (40 to 60°C) at such a rate the ether drops from the condenser to the thimble at the rate of 5 to 6 drops per second. When sufficient solvent was transferred to the extracting tubes to fill the siphon arm, it siphoned back into the receiver. This process was continued until the extraction was completed(around 16-18 hrs). After that, the flask was removed and the volatile solvent was evaporated at 60 to 80°C on a rotary flash evaporator. The residue was dried in an oven and cooled in a desiccator and weighed. The least weight of residue gives the weight of fat in the sample. The fat content of the sample was expressed on wet weight basis as percentage.

Determination of ash content

The Ash content of samples was estimated as per AOAC [7]. Briefly, moisture free samples were taken in pre-weighed crucible and incinerated in a muffle furnace at a temperature of 600 ±50ºC for 4 to 5 hours. Then the crucible was removed from the muffle furnace, allowed to cool in a desiccator. The weight of the crucible was taken and the value was expressed on wet basis as percentage.

RESULTS AND DISCUSSION

Diet composition

Food and feeding habits of the fishes varies from habitat to habitat and food items are also different with respect to time and space in response to food requirement and different stages of life [8]. The variations in the composition of the diet with age and size are substantial adaptation towards increasing the range of food supply of population by enabling the species as a whole to assimilate a variety of food [9]. The food items observed in the gut content were prawns, small Bombay duck fish, small pelagic fishes, plant matter, zooplankton, crustacean larvae, sand and mud as well as miscellaneous items (Fig-1 & Table-1).

During the present study, prawns formed the main food item, occurred throughout the study period. Maximum percentage on non-penaeid prawns were noticed during the month of November (54.80%) and lowest during the month of August (20.90%). Juveniles of Bombay duck formed the important gut constituent of *Harpodonnehereus*, which indicates cannibalistic feeding. The percentage of Bombay duck juveniles ranged from 15.49% (November) to 41.63% (May). Crustacean larvae contributed maximum up to 11.94% during August month in gut contents. Small pelagic fishes recorded considerably in gut contents of Bombay duck, which ranged from 7.70% (October) to 24.29% (February). Plant matter, zooplankton, sand and mud and miscellaneous items are also noticed in guts of

Bombay duck, but they are less quantities when compare to previous food items. Month wise food items are represented inTable-2&Fig-2.

Table 1: Average annual diet composition of *Harpodonnehereus*

Food items	Plant matter	Zooplankton	Bombay duck	Other fishes	Prawns	Crustacean larvae	Sand & Mud	Miscellaneous
Percentage composition	3.41	2.50	30.27	16.47	38.26	2.74	2.09	4.21

Fig 1: Diet composition of *Harpodonnehereus*:

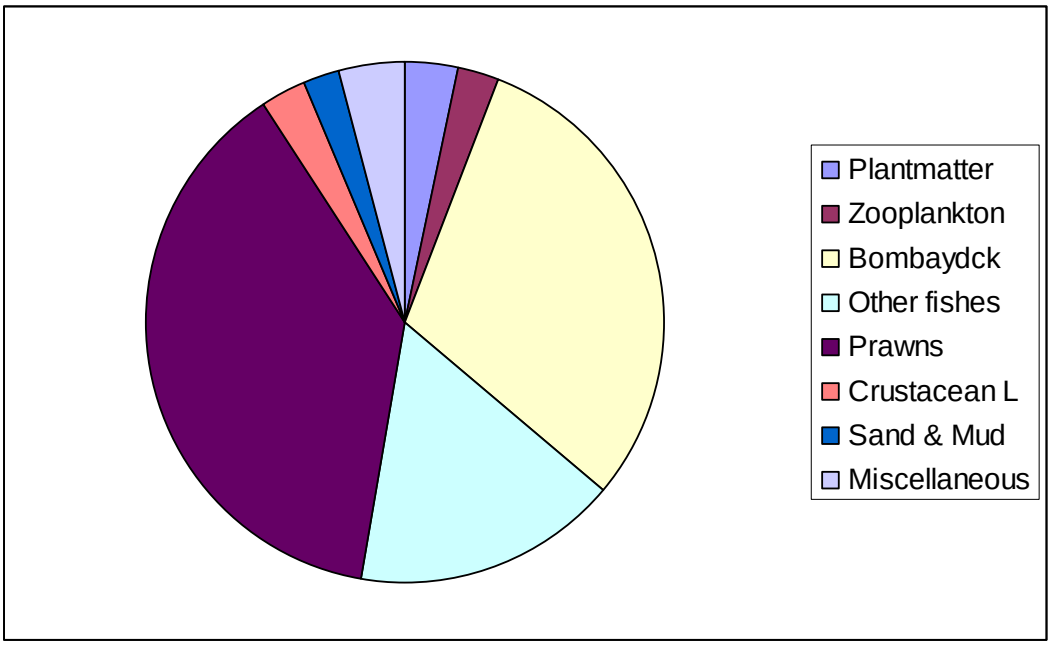


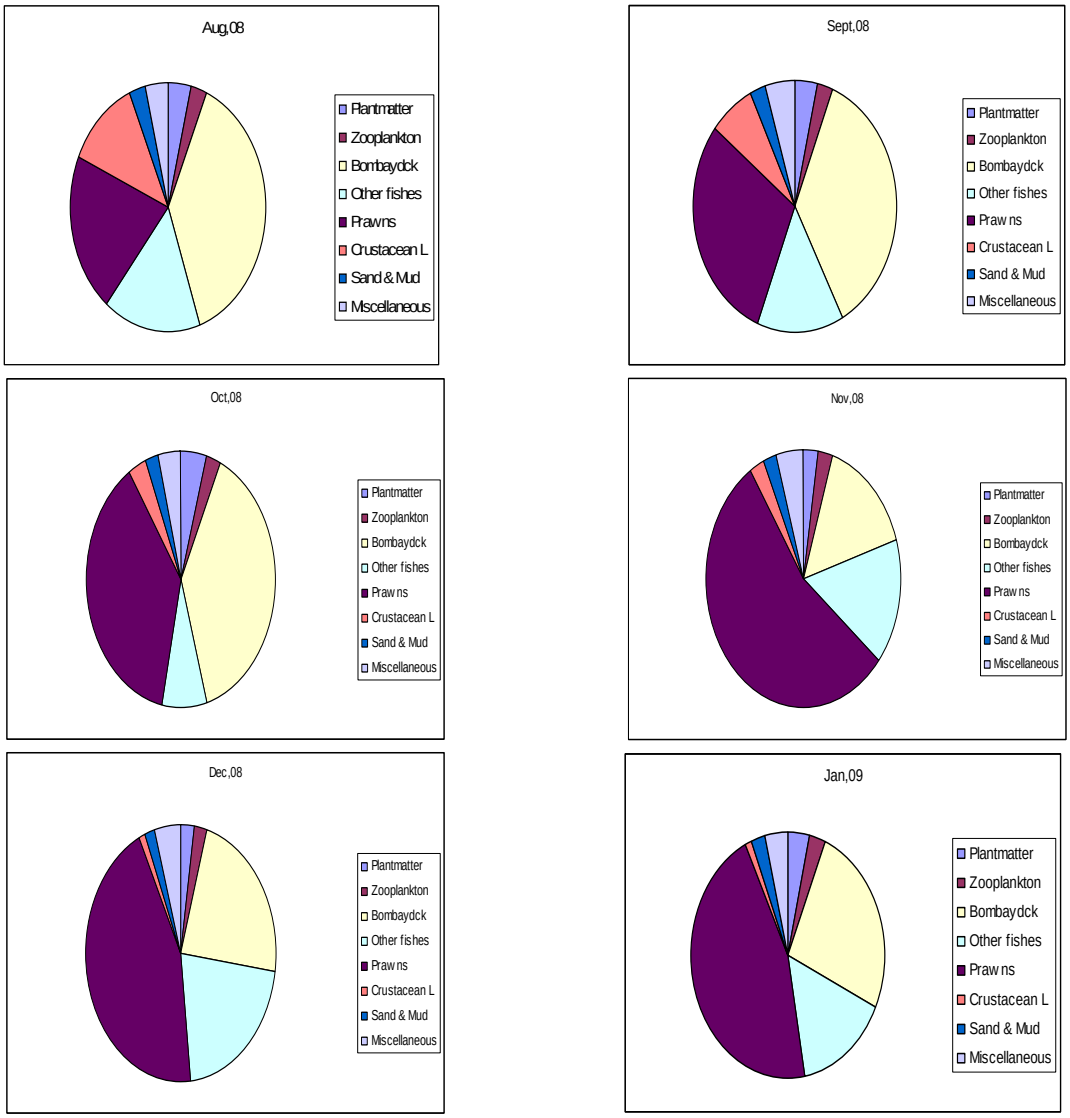
Table 2: Percentage diet composition in *Harpodonnehereus* during different months

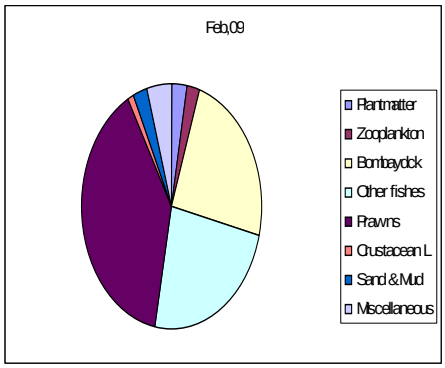
Months	Plant matter	Zoo-plankton	Bombay duck	Other fishes	Prawns	Crustacean larvae	Sand & Mud	Miscellaneous
August'08	3.94	2.44	38.27	16.19	20.90	11.94	2.40	3.90
September	3.71	2.52	36.03	13.73	29.69	7.22	2.35	4.77
October	4.45	2.50	38.51	7.70	37.74	3.021	2.17	3.89
November	2.44	2.48	15.49	15.49	54.80	2.75	2.03	4.51
December	2.35	2.10	22.81	21.17	44.35	0.98	1.89	4.36
January'09	3.59	2.73	25.49	15.50	45.4 9	1.10	2.12	3.96
February	2.90	2.16	23.73	24.29	38.72	1.36	2.48	4.33
March	4.83	2.82	20.58	18.34	43.85	2.62	2.17	4.79
April	1.53	2.36	39.08	22.44	28.05	0.78	1.66	4.09
May	2.70	2.52	41.63	16.97	30.98	-	1.87	3.31
June	2.35	2.69	40.92	15.02	32.03	1.76	1.66	3.56
July	5.97	2.68	20.71	10.82	52.47	-	2.26	5.08

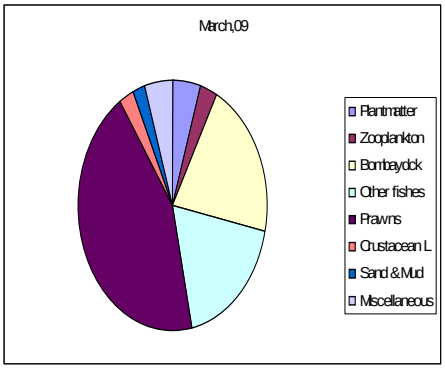
The major food items encounter in the guts of Bombayduck, *Harpodonnehereus*are non penaeid shrimps, Bombay duck and small pelagic fishes. During the period of investigation, shrimps formed the prime gut components and contribute up to 54% of total gut contents during the month of November. Based on the occurrence of non penaeid shrimp shoals the migration patterns of Bombay duck can be traced. The second highest food item in gut contents are juveniles of Bombay duck. The maximum percentage was found during the month of May (41.63%). The peak spawning season of Bombay duck is usually during February, so the maximum juveniles were available during May and June which might have caused substantial Bombay duck juveniles being found in the gut contents. Due to the observation of juveniles of the same species Bombayduck is a cannibalistic feeder. The small pelagic fishes also formed the important constituents of gut contents of *Harpodonnehereus*, which ranged from 7.70 to 24.29

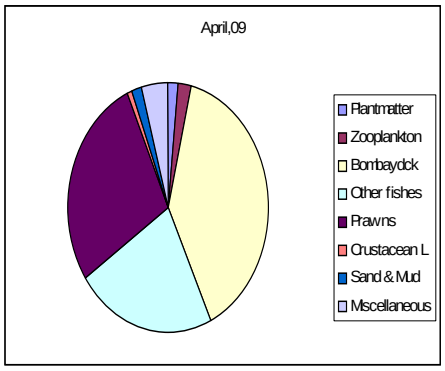
percentages. The other items like plant grasses, zooplankton, crustacean larvae, sand and mud and miscellaneous groups were also noticed, in lower quantities. The present findings regarding the food and feeding resembled with earlier works, as the non penaeid prawns are major food components [3, 10] fallowed by the juveniles of Bombay duck [11, 12].

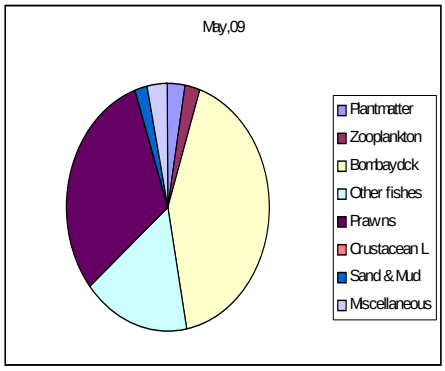
Fig 2:Percentage diet composition in *Harpodonnehereus* during different months

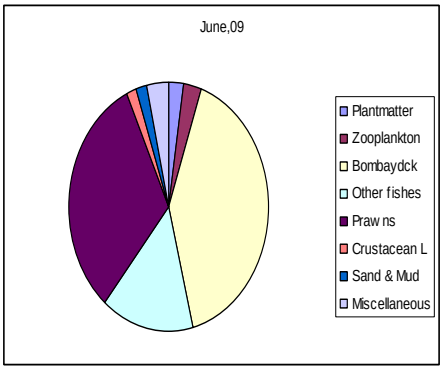


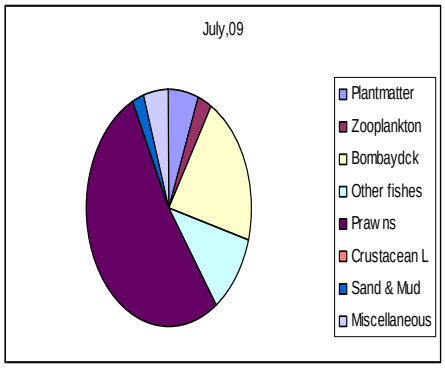












Proximate composition

Fish growth is defined as an accretion of body constituents' viz., protein, lipid, water, carbohydrate and inorganic substances by the process known collectively as 'anabolism'. In marine planktonic larval crustaceans protein and lipids are the primary energy sources during the larval development. Ramseyer[13] found a strong linear relationship between nitrogen content and body weight. The proximate composition of fish varies with feeding conditions and levels of food supply [14]. Muscle and especially the liver are usually proposed as energy storage organs for reproduction and over wintering [15].

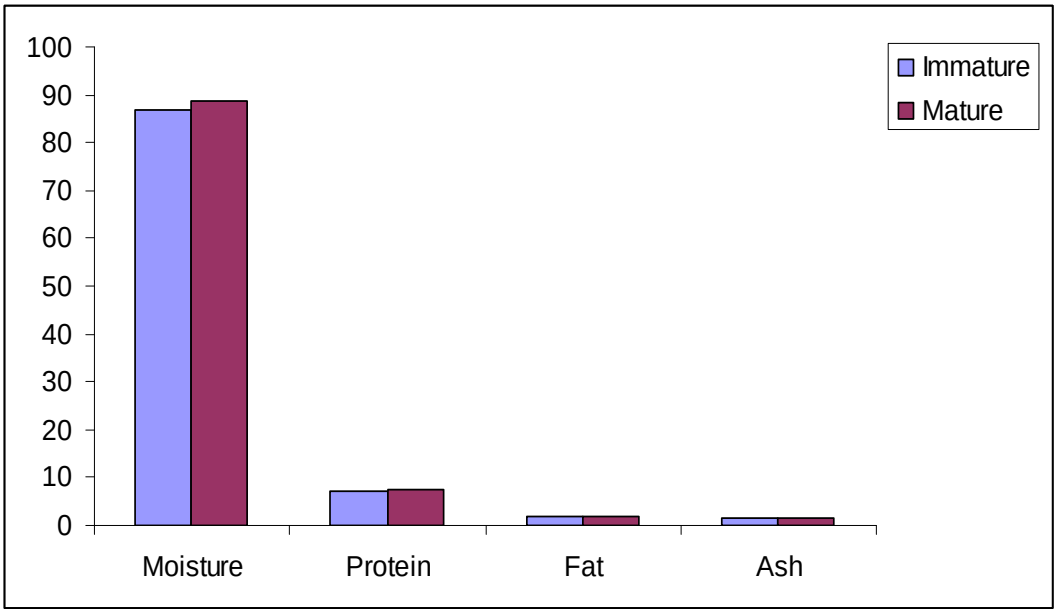
During the present study, the proximate composition values of immature and mature *Harpodonnehereus* were studied. In case of immature group, the fish contained moisture 86.72%, protein 7.10%, fat 1.73% and ash 1.48%. In case of mature group, the fish muscle had 88.64% of moisture, 7.43% of protein, 2.0% of fat and 1.52% of ash. Details of proximate composition of flesh in immature and mature groups of fish are represented in Table-3 and Fig-3. In the present study mature group fish exhibited relatively more values of different biochemical constituents than immature group. It might be due to fundamental nitrogen required for maturation and high lipids and proteins are required for liver during pre-spawning stage[16]. Higher values of nutrients in matured fish can be explained by the fact that energy requirements for gonads maturation and spawning activity as fishes show starvation condition during spawning period.

Protein was highest in the pre-spawning season during the monsoon period which may be due to its ready supply by the liver. The high content of protein values in the gonads may be due to the fundamental nitrogen demands required for maturation.

Table 3: Proximate composition (%) of muscle of *Harpodonnehereus* in mature and immature stages

Sl. No.	Group	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
1	Immature group	86.72 ± 0.58	7.10 ± 0.19	1.73 ± 0.55	1.48 ± 0.52
2	Mature group	88.64 ± 0.15	7.43 ± 0.23	2.0 ± 0.16	1.52 ±0.10

Fig 3: Proximate composition of muscle of *Harpodonnehereus* during mature and immature stages



CONCLUSION

The knowledge on the food and feeding habits of fishes helps in finding out the distribution of fish populations. Various physico-chemical factors together with seasonal and diurnal abundance of different food organisms influence the movement and migration of fishes. During the present study, prawns formed the main food item, occurred throughout the study period. Maximum percentage on non-penaeid prawns were noticed during the month of November (54.80%) and lowest during the month of August (20.90%). Based on the shrimp shoals the migration patterns of Bombay duck can be traced. Juveniles of Bombay duck formed the important gut constituent of *Harpodonnehereus*, which indicates cannibalistic feeding. The percentage of Bombay duck juveniles ranged from 15.49% (November) to 41.63% (May). The peak spawning season of Bombay duck is usually during February, so the maximum juveniles were available during May and June which might have caused substantial Bombay duck juveniles being found in the gut contents. Small pelagic fishes recorded considerably in gut contents of Bombay duck, which ranged from 7.70% (October) to 24.29% (February). Plant matter, zooplankton, sand and mud and miscellaneous items were also noticed in guts of Bombay duck, but they are fewer quantities when compared to previous food items. Theanalysis of biochemical constituents, percentage composition of flesh in immature group contained about 86.72% moisture, 7.10% protein, 1.73% fat and 1.48% ash. However the fish of mature group contained about 88.64% moisture, 7.43% protein, 2.0% fat and 1.52% ash. It might be due to fundamental nitrogen required for maturation and high lipids and proteins are required for liver during pre-spawning stage.

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