

Seasonal Variation of Food Composition and Feeding Activity of Small Adult Barramundi (*Lates calcarifer*, Bloch) in the South West Coastal Water near Khulna, Bangladesh

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Abstract: Only a few studies has been found on seasonal variation of food composition and feeding activity of small adult Barramundi (*Lates calcarifer*) from the South West coastal waters of Bangladesh. The food habits of small adult Barramundi in the Rupsha and Shibsha river were investigated by examining the gastro intestine contents of 720 specimens collected from June, 2010 to July, 2011. Food and feeding habits of small adult Barramundi were studied based on analysis of the gut contents. Gravimetric Method was adopted for determining the fullness of the stomach of the fish. The major components of the diet in the stomach of small adult Barramundi were teleosts (32.40%), macro-crustacean (22.65%), zooplankton (17.16%), algae (10.40%) and insects (9.89%). Monthly fluctuations were also witnessed in the percentage occurrence of stomachs with different degrees of fullness. It is evident that higher percentage of fullness of the stomach was recorded in pre-monsoon due to pre-spawning fattening process. Higher percentage of emptiness of the stomach was recorded in monsoon due to starvation during breeding seasons. It is also observed that the percentage of stomach fullness was higher in Summer than the percentage in Winter in small adult Barramundi.

Key words: *Lates calcarifer*, food and feeding habits, monsoon, Vetki, Bangladesh

INTRODUCTION

Barramundi (*Lates calcarifer*, Bloch) is a brackish water fish and commonly known as cock-up sea perch. It is locally called as Vetki in Bangladesh. *L. calcarifer* is a commercial important euryhaline fish of Indian sub-continent and it grows to comparatively large size with delicate, flavoured flesh and commands high price in the markets (Das, 2000). Barramundi are valuable both as recreational and commercial fish with a high, fairly stable price (Luna, 2008). It has become a vulnerable in marine species due to over exploitation (Cheung *et al.*, 2005). It is available in seas and estuaries of India, Ceylon and Bangladesh to throughout most of Northern part of Eastern Indian Ocean, Western Central pacific area and South ward to Northern coasts of Australia also Westward to Karachi (Fischer, 1974). Some other studies stated the evidence of *L. calcarifer* in Bangladesh (Rahman, 1989), India (Kapoor *et al.*, 2002), Pakistan (Bianchi, 1985), Myanmar (Hla Win, 1987), Sri-lanka (Pethiyagoda, 1991), Thailand (Yadav, 1999) and East Africa (Kungvankij *et al.*, 1986) have been found. *L. calcarifer* is a diadromous species (Kungvankij *et al.*, 1986) inhabiting rivers before returning to the estuaries to spawn. Small adult Barramundi inhabit the upper reaches of rivers (Allen *et al.*, 2002). Some common habitats of *L. calcarifer* are the Bay of Bengal commonly found in estuaries of Barishal, Patuakhali and Khulna of the South Western coastal region of Bangladesh (Rahman, 1989).

Few previous studies like Mookerjee *et al.* (1946), Menon (1948), Dunstan (1959), De (1971), Davis (1985), Tacon *et al.* (1991) and Kailasam *et al.* (2002) studied food and feeding habit of *Lates calcarifer* around the world. This is an important baseline study on the seasonal variation in food composition and feeding activity of this commercially important fish at small adult stage from the South West coastal waters of Bangladesh. The results of the study would be an effective tool for fishery biologists, managers and conservationists to initiate early management strategies and regulations for the sustainable conservation of the remaining stocks of these economically important species in the Shibsha and the Rupsha river ecosystem.

Moreover, information on the on the seasonal variation in food composition and feeding activity for small adult *L. calcarifer* from the South Western coastal region of Bangladesh are clearing lacking from literature and data bases. Therefore, the results of this study provide invaluable information for the online database as well as providing an important baseline for future studies within the Shibsha and the Rupsha river and surrounding ecosystems such as rivers from the Mangroove ecosystem of the Sunderbans of Bangladesh.

MATERIALS AND METHODS

Study site: Specimens of *L. calcarifer* were obtained from different sites (Fig. 1) from the Rupsha and the Shibsha

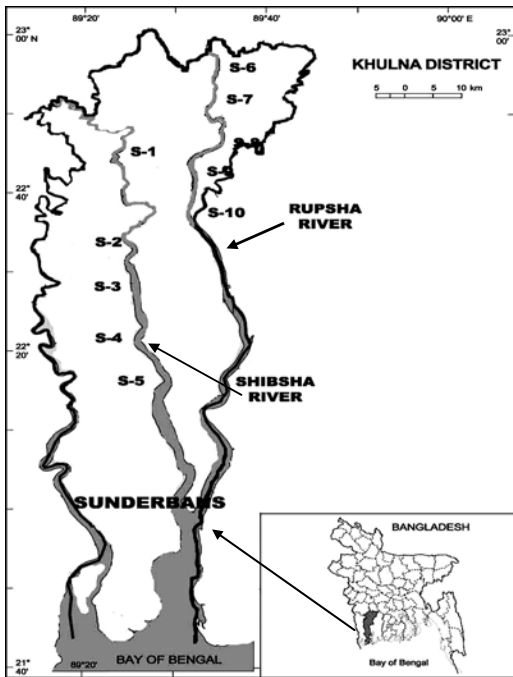


Fig. 1: Map of Khulna district including sampling station of the Shibsha river (Site 1-5) and the Rupsha river (Site 6-10), South West coastal of Bangladesh (Banglapedia, 2003)

river, near Khulna of the South Western coastal region by commercial gill net or triangular net or cast net. Both the rivers are believed to be an important spawning and feeding ground for marine fish species of South Western coastal region of Bangladesh. *L. calcarifer* specimens were collected monthly from the sampling sites during day time (11:00-17:00 h) from June, 2010 to July, 2011 by means of traditional gill nets. Specimens were preserved in 10% buffered formalin, packed in wooden boxes and transported to the laboratory.

Data analysis: A total of 720 fish measuring 25.4-40.1 cm Total Length (TL) were examined. Total Length (TL) and Alimentary Canal Length (ACL) was measured with a slide caliper to the nearest 0.01 cm and the standard length in cm were recorded. Fish were opened and the degree of stomach fullness was assessed according to the subjective scale described by Gravimetric Method (Hynes, 1990; Pillay, 1952). The data were then used to calculate the monthly Fullness Index (FI):

$$FI (\%) = \frac{\text{Number of stomachs with the same degree of fullness}}{\text{Total number of stomachs examined}} \times 100$$

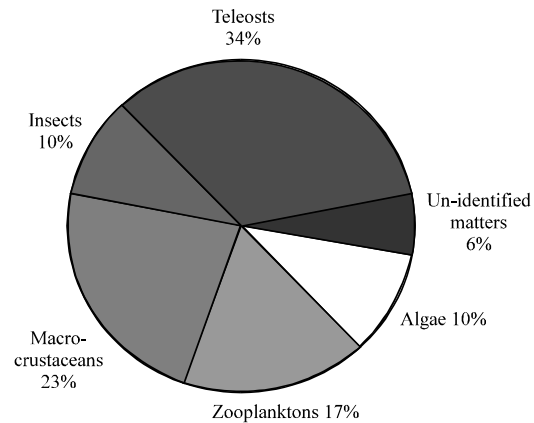


Fig. 2: Proportion of food items in the stomach of small adult *Lates calcarifer* (July, 2010 to June, 2011)

The gut was then excised, weighed (g) together with its contents and preserved in 70% alcohol. Subsequently, stomach contents were suspended in water in Petri dishes and undigested prey were identified to the possible taxon using the identification keys of Smith (1977), Todd and Levarak (1991) and Needham and Needham (1962).

The contribution of each food type to the diet and the frequency of occurrence were determined according to Hynes (1990). The proportion of total prey items contributed by each prey group for the entire year was determined according to the Numerical Method (Bowen, 1983).

RESULTS

The proportion of total food items contributed to each items for the entire year (Fig. 2) shows that the major component of the diet was teleosts were dominant (32.40%). Among the teleosts, *Apocryptes lanceolatus*, *Jonieops*, *Otolithoides*, *Harpodon*, *Coilia dussumieri*, *Polynemus paradiseus*, *Pama pama*, *Therapon jarbua*, *Chanda nama*, *Lactarius lacterius*, *Setipinna taty*, *Gobioides* and *Mugiloides* were some identified fish groups found in the stomach of *Lates calcarifer*. The next major food group were macro-crustacean (22.65%), followed by zooplankton (17.16%), algae (10.40%) and insects (9.89%). The major zooplanktons items were Euglena, cladocerans (*Daphnia* and some others), copepodes (Calanoides), shrimp larvae, megalopa larvae of crabs. Among the identified algae in the stomach of *L. calcarifer*, *Coscinodiscus* and *Bacillariophyceae* are the most expected groups. The common macro crustacean food items of *L. calcarifer* are decapodes (*Macrobrachium rosenbergii*, *Penaeus monodon*, *Metapenaeus monoceros*, *Caphyra* and *Grapsus*), stomatopodes and branchiuras.

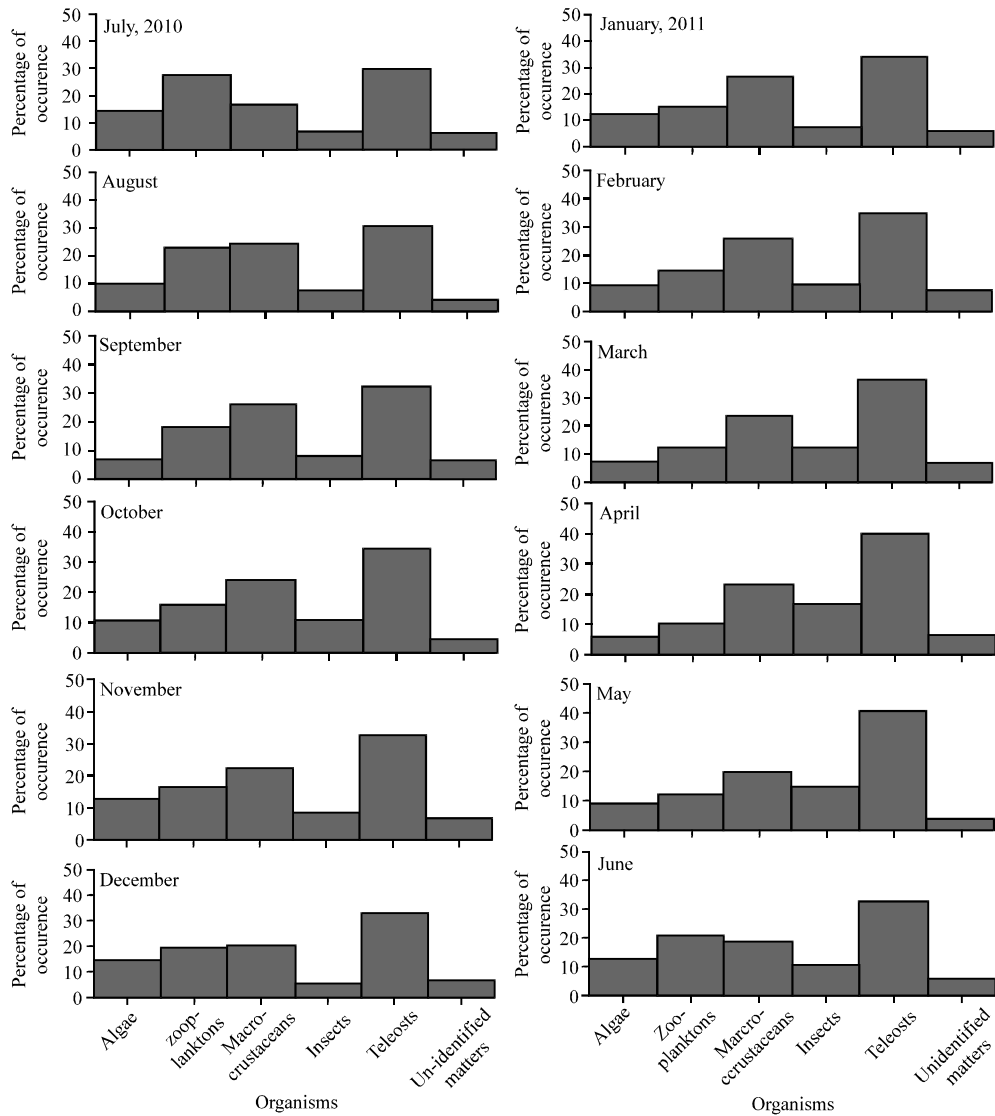


Fig. 3: Mean percentage frequency of occurrence of different food groups in the stomach of small adult *L. calcarifer* during the study periods

The highest percentage (14.5%) of algae was detected in the month of December and the lowest percentage (5.9%) was found in April (Table 1 and Fig. 3). The highest percentage (26.9%) of zooplankton was detected in the month of July and the lowest percentage (10.5%) was found in April. The highest percentage (26.5%) of macro crustacean was detected in the month of September and the lowest percentage (16.5%) was found in July. The highest percentage (16.5%) of insect was detected in the month of April and the lowest percentage (6.25%) was found in December. The highest percentage (40.5%) of teleosts was detected in the month of May and the lowest percentage (29.5%) was found in July.

Monthly fluctuations were also witnessed in the percentage occurrence of stomachs with different degrees of fullness. It is evident that higher percentage of fullness of the stomach was recorded in pre-monsoon due to pre-spawning fattening process. Higher percentage of emptiness of the stomach was recorded in monsoon, due to starvation during breeding seasons. The highest number of full stomachs (richly fed and moderately fed) were found in the pre-monsoon period (February to May) where the lowest number of full stomachs (richly fed and moderately fed) were found in monsoon period (July and August, Fig. 4). The highest number of empty stomachs (empty and poorly fed) were found in the monsoon period

Table 1: Monthly variation in the percentage occurrence of various groups of food items in the stomachs of small adult *L. calcarifer* during the study period (n = 60 in each month, total of 720 specimens)

Time	Algae	Zoo-plankton	Macro-crustacean	Insect	Teleosts	Un-identified
2010						
July	14.50	26.9	16.5	6.50	29.5	6.10
August	9.90	23.4	24.5	7.50	30.7	4.00
September	7.25	18.5	26.5	8.50	32.5	6.75
October	10.50	15.8	24.2	10.40	34.2	4.90
November	12.90	16.5	22.5	8.50	32.8	6.80
December	14.50	19.3	20.5	6.25	32.9	6.50
2011						
January	11.60	15.3	26.2	7.50	33.5	5.90
February	9.20	14.1	25.8	9.50	34.5	6.90
March	7.50	12.5	23.6	12.50	36.5	7.40
April	5.90	10.5	22.5	16.50	38.2	6.40
May	8.50	12.5	20.5	14.50	40.5	3.50
June	12.50	20.7	18.5	10.50	32.4	5.40

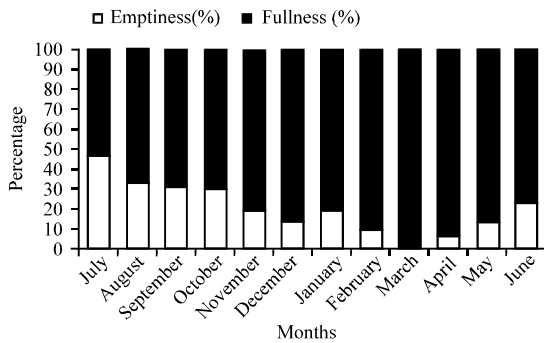


Fig. 4: Monthly variation of stomach fullness and emptiness of small adult *L. calcarifer* from July, 2010 to June, 2011

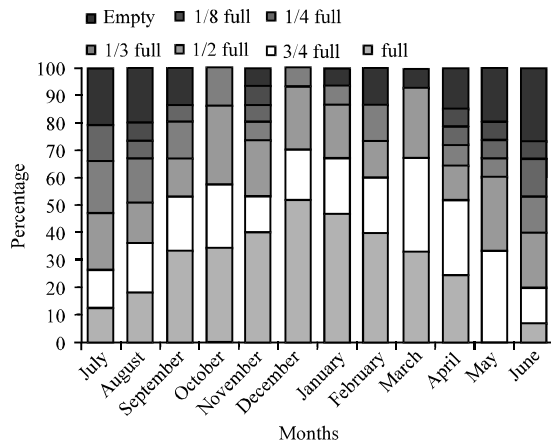


Fig. 5: Monthly variation of stomach fullness of small adult *Lates calcarifer* during the study periods

(July and August) where the lowest number of empty stomachs (empty and poorly fed) were found in pre-monsoon period (February to April, Fig. 4). From the study, it is also observed that the percentage of stomach fullness was higher in Summer than the percentage in

Winter in juvenile *L. calcarifer* because both the growth and metabolism rate are positively related to the increasing temperature (Fig. 4). Full stomachs were commonly occurred from November-February. Here, 3/4 full stomachs were mostly observed in March to May. And 1/2 full stomachs were found in most sampled *Lates calcarifer* in May and July where 1/3 and 1/4 full stomachs were found in June and July, the 1/4 full stomachs were available in *L. calcarifer* averagely almost in April to July where empty stomachs were observed averagely throughout the year except October and December in *L. calcarifer* (Fig. 5).

DISCUSSION

In present study, the food composition of juvenile *L. calcarifer*, breeding season (Monsoon season) and seasonal fluctuation (Summer and Winter) has an effect on stomach contents such as variation of food items. For this reason, the stomach consists of significant percentage teleosts, macro crustacean, zooplanktons, insects and algae. Analysis of monthly variations in stomach fullness indicated that feeding intensity fluctuated throughout the year. This maximum number of empty stomachs was observed during Winter and a minimum number observed during Summer. On the other hand, most of the richly and moderately fed stomach is observed in *Lates calcarifer* during pre-monsoon periods and most of the poorly fed stomach is observed in *Lates calcarifer* during monsoon periods. These finding can be compared to several previous studies on the food and feeding habits of bass groups.

Ferry *et al.* (1997) listed fishes, crustaceans, echinoderms and mollusks as the main food items for spotted sand bass from Los Angeles Bay in the Gulf of California. Mendoza-Carranaza and Rosales-Casian (2000) studied food and feeding habit of Spotted sand bass (*Paralabrax maculatofsciatur*) for the Punta Banda Estuary, Baja California and found that this fish takes prominently crustacean and teleostei and elagrass, mollusks and zooplankton as their food. In the stomach of *P. maculatofsciatur*, decapods represented the highest percentage of weight (64.0%) and frequency of occurrence (84.2%). Gammarids constituted the highest numeric percentage (70.7%). The feeding habits of barred sand bass (*Purulubrax nebulifer*) are described by Roberts *et al.* (1984) where the study showed that bass of intermediate size (240-320 mm SL) contained the species found in both large and small fish. Seasonal changes in feeding have been observed in the kelp bass (*Purulubrax cluthrutus*; Quast, 1968) and barred sand bass (*P. nebulifir*; Love and Ebeling 1978). Fujita *et al.*

(1988) studied the food and feeding habit of juvenile (12.3-20.0 cm total length) temperate bass *Lateolabrax latus* and *Lateolabrax japonicus* in Shimanto Estuary in Japan. He showed that copepoda (65.0%) and cladocera (33.4%) are the dominant groups of food in *Lateolabrax japonicus*. On the other side, copepoda (70.3%) and fish larvae (20.0%) are the dominant groups of foods in *Lateolabrax latus*. Katunzi *et al.* (2006) observed spatial and seasonal patterns in the feeding habits of juvenile *Lates niloticus* in the Mwanza gulf of lake Victoria. In this study, it is observed that at a size of 3-4 cm Nile perch shifted from cyclopoids to calanoids. Kische-Machumu *et al.* (2012) showed that shrimp (*Caridina nilotica*) and haplochromine cichlids were the most common prey types in *Lates niloticus*. Other studies on largemouth bass fry (*Micropterus salmoides*) proved that feed mainly on micro crustaceans and small insects, juveniles consume mostly insects and small fish and adults feed primarily on fish and crayfish (Carlander, 1977; Stuber *et al.*, 1982).

CONCLUSION

From the present study, it is determined that Barramundi is a mostly carnivorous fish at adult stage, the diet of which in the South Western coastal waters of Bangladesh comprises teleosts and macro crustaceans mainly. Feeding activity of Barramundi throughout the year probably depended on breeding season and water temperature.

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REFERENCES

- Allen, G.R., S.H. Midgley and M. Allen, 2002. Field Guide to the Freshwater Fishes of Australia. Western Australian Museum, Perth, Australia, ISBN-13: 9780730754862, Pages: 394.
- Bianchi, G., 1985. FAO species identification sheets for fishery purposes. Field guide to the commercial marine and brackish water species of Pakistan, 1-200. FAO. Rome.
- Bowen, S.H., 1983. Quantitative Description of the Diet. In: Fisheries Techniques, Nielsen, L.A. and D.L. Johnson (Eds.). American Fisheries Society, Bethesda, Maryland, pp: 325-336.
- Carlander, K.D., 1977. Handbook of Freshwater Fishery Biology. Vol. 2, Iowa State University Press, Ames, IA., USA.
- Cheung, W.W.L., T.J. Pitcher and D. Pauly, 2005. A fuzzy logic expert system to estimate intrinsic extinction vulnerabilities of marine fishes to fishing. Biol. Conserv., 124: 97-111.
- Das, N.G., 2000. Development of breeding technology of Development of breeding technology of Bhetki *Lates calcarifer*. Bangladesh Agricultural Research Council.
- Davis, T.L.O., 1985. The food of barramundi, *Lates calcarifer* (Bloch), in coastal and inland waters of Van Diemen Gulf and the Gulf of Carpentaria, Australia. J. Fish Biol., 26: 669-682.
- De, G.K., 1971. On the biology of postlarvae and juvenile stages of *Lates calcarifer* (Bloch). J. Indian Fish. Ass., 1: 51-64.
- Dunstan, D.J., 1959. The barramundi *Lates calcarifer* (Bloch) in Queensland waters. CSIRO Division of Fisheries and Oceanography, Technical Paper No. 5, pp: 22.
- Ferry, L.A., S.L. Clark and G.M. Calliet, 1997. Food habits of spotted sand bass (*Purulabrax niurulut-fascintttSs,e rranidae*) from Bahia de 10s Angeles, Baja California. South. Calif. Acad. Sci., 96: 1-17.
- Fischer, W., 1974. FAO Species Identification Sheets for Fishery Purposes: Eastern Indian Ocean (Fishing Area 57) and Western Central Pacific (Fishing Area 71). FAO/UN, Rome, Italy.
- Fujita, S., I. Kinoshita, I. Takahashi and K. Azuma, 1988. Seasonal cuurance and food habits of larvae and juveniles of two temperate basses in the shimanto estuary, Japan. Jpn. J. Ichthyol., 35: 365-370.
- Hla Win, U., 1987. Checklist of Fishes of Burma. Ministry of Livestock Breeding and Fisheries, Department of Fisheries, Burma.
- Hynes, H.B.N., 1990. The food of freshwater stickleback with a review of the methods used in studies of fishes. J. Anim. Ecol., 19: 41-57.
- Kailasam, M., A.R. Thirunavukkarasu, M. Abraham, P.K. Chandra and R. Subburaj, 2002. Influence of size variation and feeding on cannibalism of Asian sea bass *Lates calcarifer* (Bloch) during hatchery rearing. Indian J. Fish., 49: 107-113.
- Kapoor, D., R. Dayal and A.G. Ponniah, 2002. Fish Biodiversity of India. National Bureau of Fish Genetic Resources, Lucknow, India pp: 775.
- Katunzi, E.F.B., W.L.T. van Densen, J.H. Wanink and F. Witte, 2006. Spatial and seasonal patterns in the feeding habits of juvenile *Lates niloticus* (L.), in the Mwanza Gulf of Lake Victoria. Hydrobiologia, 568: 121-133.

- Kishe-Machumu, M.A., F. Witte, J.H. Wanink and E.F.B. Katunzi, 2012. The diet of Nile perch, *Lates niloticus* (L.) after resurgence of haplochromine cichlids in the Mwanza Gulf of Lake Victoria. *Hydrobiologia*, 682: 111-119.
- Kungvankij, P., B.J. Pudadera, J.R.L.B. Tiro and I.O. Potestas, 1986. Biology and Culture of Sea Bass (*Lates calcarifer*). Aquaculture Department, Southeast Asian Fisheries Development Center, Bangkok, Thailand, Pages: 70.
- Love, M.S. and A.W. Ebeling, 1978. Food and habitat of three switch feeding fishes in the kelp forest off Santa Barbara, California. *Fish. Bull.*, 76: 257-271.
- Luna, S., 2008. *Lates calcarifer* (Bloch, 1790) Barramundi. Fisheries, Aquaculture, Gamefish, Aquarium. On-line FishBase. <http://fishbase.sinica.edu.tw/summary/speciessummary.php?genusname=Lates&speciesname=calcarifer>.
- Mendoza-Carranza, M. and J.A. Rosales-Casian, 2000. The feeding habits of Spotted sand bass (*Paralabrax maculatofaciatus*) in Punta banda estuary, Ensenada, Baja California, Mexico. *CalCOFI Rep.*, 41: 194-199.
- Mennon, P.M.G., 1948. On the food of the Bekti *Lates calcarifer* (Bloch) in the cold season. *Curr. Sci.*, 17: 156-157.
- Mookerjee, H.K., D.N. Ganguli and T.C. Majumder, 1946. On the food of estuarine fishes of Bengal. *Sci. Cult.*, 11: 564-565.
- Needham, J.G. and P.R. Needham, 1962. A Guide to the Study of Freshwater Biology. 5th Edn., Holden Inc., San Francisco, USA., pp: 108.
- Pethiyagoda, R., 1991. Freshwater Fishes of Sri Lanka. The Wildlife Heritage Trust of Sri Lanka, Colombo, ISBN: 9789559114000, Pages: 362.
- Pillay, T.V.R., 1952. A critique of the methods of study of food of fishes. *J. Zool. Soc. India*, 1: 185-200.
- Quast, J.C., 1968. Observations on the food and biology of the kelp-bass (*Purulubrix cluthrutus*). *Calif. Dep. Fish Game Fish. Bull.*, 139: 81-108.
- Rahman, A.K.A., 1989. Freshwater Fishes of Bangladesh. 1st Edn., Zoological Society of Bangladesh, Dhaka, Bangladesh, pp: 337-338.
- Roberts, D.A., E.E. DeMartini and K.M. Plummer, 1984. The feeding habits of Juvenile-Small adult Barred sand bass (*Paralabrax nebulifer*) in nearshore waters of Northern San Diego county. *CalCOFI Rep.*, 25: 105-111.
- Smith, D.L., 1977. A Guide to Marine Coastal Plankton and Marine Invertebrate Larvae. Kendal/Hunt Publishing Company, USA., Pages: 161.
- Stuber, R.J., G. Gebhart and O.E. Maughan, 1982. Habitat Suitability Index Models: Largemouth Bass. U.S. Department of Interior, Washington, DC., USA.
- Tacon, A.G.J., N. Rausin, M. Kadari and P. Cornelis, 1991. The food and feeding of tropical marine fishes in floating net cages: Asian seabass, *Lates calcarifer* (Bloch) and brown-spotted grouper, *Epinephelus tauvina* (Forsk.). *Aquacult. Fish. Manage.*, 22: 165-182.
- Todd, C.D. and M.S. Levarak, 1991. Coastal Marine Zooplankton: A Practical Manual for Students. Cambridge University Press, Cambridge, UK., Pages: 106.
- Yadav, B.N., 1999. Fish and Fisheries. Daya Publishing House, New Delhi, India, Pages: 366.