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A Check List on Ichthyofaunal Diversity of Bahuda Estuary, Odisha, East Coast of India

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ABSTRACT

The ichthyofaunal diversity of Bahuda estuary was studied during January 2012 to December 2012 from five stations. Sufficient work has not been done on the ichthyofaunal diversity from this estuary. The ichthyofaunal diversity samples were collected using different types of nets with the help of the local fishermen at monthly interval of time. There were 25 fish species observed under 2 classes, 6 orders and 18 families. The order Clupiformes was dominated contributing 30.08% followed by Mugiliformes (21.79%), Tetradontiformes (18.54%), Perciformes (15.45%), Siluriformes (10.41%) and Cypridontiformes (3.74%). The fish species *Rastrelliger kanagurta* was dominating contributing 13.01% followed by *Mugil cephalus* (11.38%), *Thryssa kammlensis* (9.76%), *Mystus gulio* (9.27%), *Anchovilla indica* (9.11%), *Thryssa setirostris* (7.32%) and *Arius arius* (7.15%). The marine fish species were highest at station 1 of the estuary as compared to brackish and fresh water species. The marine species were lowest at station 5 which is away from the mouth. The Margalef and Menhinik richness index ranged from 2.408-4.737 and 1.543-2.225, respectively which indicated high richness of organism in station 1 and moderate richness in station 5. The Shannon diversity index of this estuary varied between 2.114-2.863 which indicative that the estuary is less polluted.

Key words: Check list, ichthyofauna, Bahuda estuary, Odisha, India

INTRODUCTION

Estuaries represent a special class of aquatic habitat in the marine biosphere, distinctly different from the open sea on one end and the freshwater bodies on the other. It is a state of influx and dynamic in nature providing home for many ecological niches of diverse biota. The estuaries act as dynamic source for feeding, spawning and nursery ground for most of the aquatic community. The variation of hydrographical character in the estuarine ecosystem having deep influence on seasonal occurrence of the juveniles and fish stocks. The changing environment of estuaries i.e., from fresh to marine and marine to fresh having effect on the survival, growth and breeding of fishes. The complete band of the distribution and species composition of juvenile fish in relation to the dynamic changes of hydrographical features of estuaries and fish juveniles are abundantly available in the shallow coastal, estuarine and brackish waters as they are safe from predators and their composition change with seasons (Brinda *et al.*, 2010). An estuary is a dynamic ecosystem facilitates mixing of marine and fresh water with high nutrients which provides conducive environment for distribution of many fish species (Oliva-Paterna *et al.*, 2006). Brackish water basin act as the

breeding, feeding and nursery ground for both fin fish and shell fishes which migrate from either fresh or marine waters (Paterson and Whitfield, 2000). The seasonal and temporal variation of fish species is influenced by hydrological changes, geomorphological process and interaction among the marine organism (Letourneur *et al.*, 2001). The brackish water basins act as excellent ground for development of fish larvae and juveniles so that numerous fishes are migrating to this area (Perez-Ruzafa *et al.*, 2004). Review of literature showed that a large bulk of published literature exists on the fisheries of the major estuaries (Jha *et al.*, 2008; Day, 1989; Kathiresan and Rajendran, 2005; Wafar *et al.*, 2011) covering many aspects, however, very little is known about the current functional aspects (Gopal and Chauhan, 2006). A number of study has been made on fish species richness in different rivers and estuaries of India. Some of the few notable ones are (David, 1963; Dutta *et al.*, 1973; Sinha *et al.*, 1998; Jhingran, 1991; Ramakrishniah and Selvaraj, 2000; Gupta and Gupta, 2006; Sarkar and Bain, 2007; Heda, 2009; Lakra *et al.*, 2010; Rankhamb, 2011). No wok has been carried out on fishery diversity of Odisha coast in general and Bahuda estuary in particular. So present work is an attempt to study on checklist of Ichthyofaunal diversity of Bahuda Estuary, Odisha, East coast of India.

MATERIALS AND METHOD

Study area: Bahuda estuary is situated between 19°3' and 19°10' N and 84°45' and 84°50' E on the Odisha coast (Fig. 1). It is one of the rivers of India which originates from Khondalit terrain of Eastern Ghats of Jarada Hills in Gajapathi district which enters Srikakulam district at

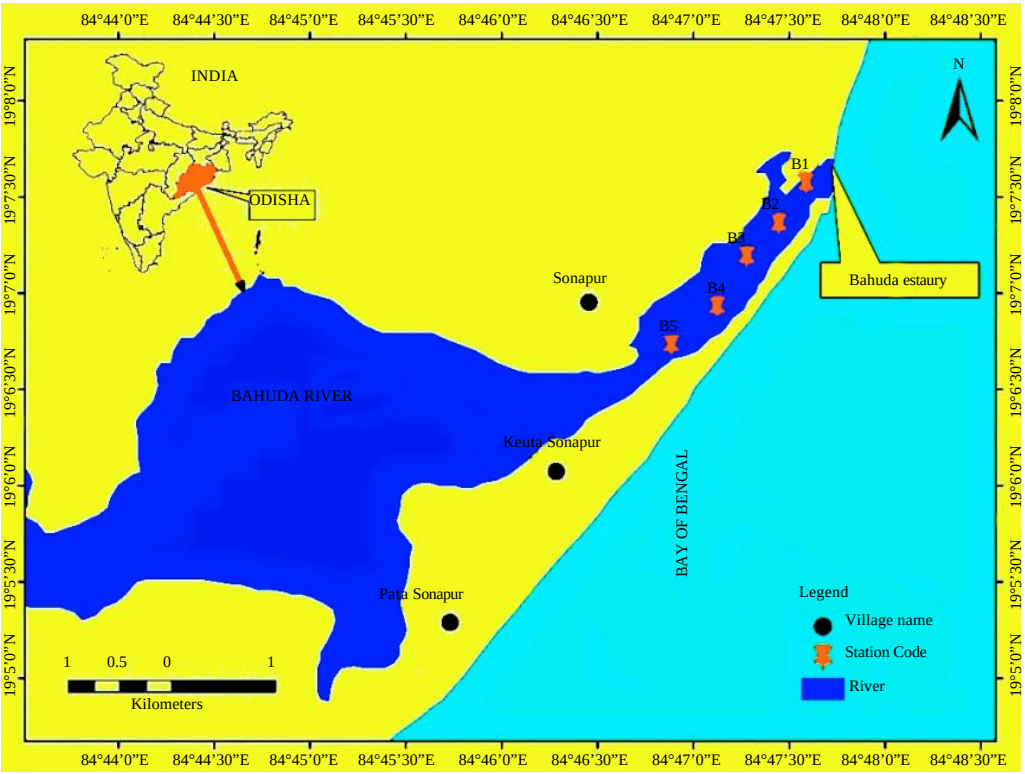

Fig. 1: Maps showing the study area of Bahuda estuary

Boddabada village of Ichapuram and finally opens in to the Bay of Bengal near Sonapur in Ganjam district of Odisha. The estuary covers an area of 15 km^2 with an average depth of 2.6 m and is connected to Bay of Bengal by a channel of about 3 km. The estuary shows shallowness except in the monsoon flux from land drainage system. The water way exhibit the feature of the typical tropical positive estuary a semi perennial river that drains into Bay of Bengal at Sonapur mouth. It is influenced by semi-diurnal tide and thus ingress and outgress of seawater occurs twice daily. The estuary's basin near the mouth and head region is sand dominated, while its mid reaches is characterized by silt and clay dominated sediment which harbor rich fish diversity.

Methodology: The present study was carried out during Jan. 2012 to Dec. 2012 from five stations which was designated as B1, B2, B3, B4 and B5 in estuarine region of the river. The fish survey has been conducted from five selected stations on river with the help of local fishermen using gill net, cast net, scoop net, drag net, hook and line. The fishes were collected and brought to the laboratory. The fish specimens were cleaned, photographed and finally preserved in 10% formalin. The standard literature used for the identification of fish species were (Day, 1878, 1994; Smith, 1950; Munro, 1955; Talwar and Kacker, 1984; Talwar and Jhingran, 1991; Jayaram, 1999). Fish base was followed to evaluate to fish and fix the name of the species and their International Union for Conservation of Nature status.

Statistical analysis: The diversity indices i.e. (Shanon and Simphon diversity index, 1949; Menhinik and Margalef index, 1968; Richness index, 1959) were computed following basic programme PAST. The Paleontological Statistics (PAST) version 2.15 has grown in to a complete statistical package that is used not only by paleontologists but in many field of life sciences, earth science and other technological studies. Margalef's richness index:

$$R_1 = \frac{s-1}{\ln(n)}$$

where, S is the number of species and n is the total number of individuals observed in sample. Menhinik index:

$$R_2 = \frac{s}{\sqrt{n}}$$

where, s is the number of species and n is the total number of individuals observed in sample. Simpsons' diversity index:

$$\lambda = \sum_{i=1}^{s} \frac{n_i(n_i - 1)}{n(n-1)}$$

where, ni is the total number of individuals in the ith species and n is the total number of individuals in the sample. Shannon's diversity index:

$$H' = \sum_{i=1}^{s} (p_i \ln p_i)$$

where, S is the number of species in the sample and pi is the proportion of ith species total sample. Sheldon evenness index:

$$E_2 = \frac{e^H}{S}$$

where, H' is the diversity index and S is the total number of species in a sample. Dominance index:

$$D = 1\text{-}j$$

where, j is the evenness index.

RESULTS

Fish faunal composition: The ichthyofaunal composition of Bahuda estuary showed presence of 615 specimens of 25 fish species belonging to 6 order, 18 families of class Teleostomi and Actnopterigii. The complete checklist of fishes along IUCN status are given in Table 1. The fish faunal composition of different stations showed that the station 2 having highest number of fish species composition which are shown in Fig. 2. The different order of fish with their dominance and contribution are in the order, Clupiformes (30.08%) with species (185), Mugiliformes (21.79%) with species (134), Tetradontiformes (18.54%) with species (114), Perciformes (15.45%) with

Table 1: Checklist of Icthyofauna encounter in Bahuda estuary along with IUCN status

Fishes	Family	Order	Class	IUCN red list status
Anchoviella indica (van Hasselt, 1823)	Engraulidae	Clupeiformes	Teleostomi	NE
Thryssa kammlensis (Bleeker, 1849)	Engraulidae	Clupeiformes	Teleostomi	NE
Thryssa setirostris (Broussonet, 1782)	Engraulidae	Clupeiformes	Teleostomi	NE
Dussumieria acuta (Valenciennes, 1847)	Dussumieridae	Clupeiformes	Teleostomi	NE
Mugil cephalus (Linnaeus, 1758)	Mugilidae	Mugiliformes	Teleostomi	LC
Rhinomugil corsula (Hamilton Buchanan, 1882)	Mugilidae	Mugiliformes	Teleostomi	TS
Liza Parsia (Hamilton, 1822)	Mugilidae	Mugiliformes	Actnopterigii	NE
Johnius dussumieri (Cuvier, 1830)	Sciaenidae	Perciformes	Teleostomi	NE
Johnius (Kathala) axiliaris (Cuvier, 1830)	Sciaenidae	Perciformes	Teleostomi	NE
Lutjanus johni (Bloch, 1792)	Lutjanidae	Perciformes	Teleostomi	NE
Lutjanus russelli (Bleeker, 1849)	Lutjanidae	Perciformes	Teleostomi	NE
Leiognathus dussumieri (Valencieunes, 1835)	Leiognathidae	Perciformes	Teleostomi	NE
Secutor ruconius (Hamilton Buchanan, 1822)	Leiognathidae	Perciformes	Teleostomi	NE
Epineplelus merra (Bloch, 1793)	Serranidae	Perciformes	Teleostomi	LC
Kishinoella tonggol (Bleeker,1851)	Thumidae	Perciformes	Teleostomi	DD
Lates calcarifer (Bloch,1790)	Latidae	Peciformes	Actinopterygii	NE
Lagocephalus inermis (Temminck and Schlegel, 1850)	Lagocephalidae	Tetradontiformes	Teleostomi	NE
Therapon jarbua (Forsskal, 1755)	Theraponidae	Tetradontiformes	Teleostomi	LC
Rastrelliger kanagurta (Cuvier, 1816)	Scombridae	Tetradontiformes	Teleostomi	DD
Chelonodon patoca (Hamilton-Buchanan, 1822)	Tetraodontidae	Tetradontiformes	Teleostomi	NE
Mystus gulio (Hamilton-Buchanan, 1822)	Bagridae	Siluriformes	Teleostomi	LC
Mystus vittatus (Bloch, 1794)	Bagridae	Siluriformes	Teleostomi	LC
Arius arius (Hamilton-Buchanan, 1822)	Ariidae	Siluriformes	Teleostomi	LC
Tricanthus biaculeatus (Bloch, 1786)	Hemiramphidae	Cyprinodontiformes	Actinopterygii	NE
Nematolosus nasus (Bloch, 1795)	Clupeidae	Clupeiformes	Actinopterygii	LC

TS: Threatened species, NE: Not evaluated, LC: Least coucerned, DD: Data deficient, NA: Not available

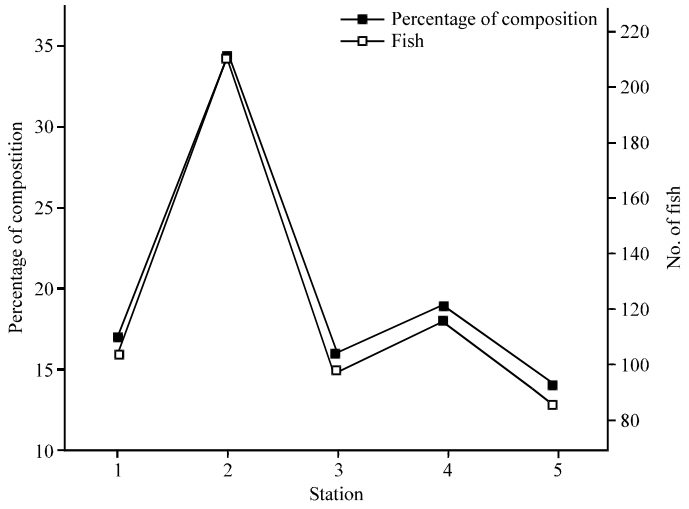

Fig. 2: Percentage composition and number of fish encountered in different study station of Bahuda estuary

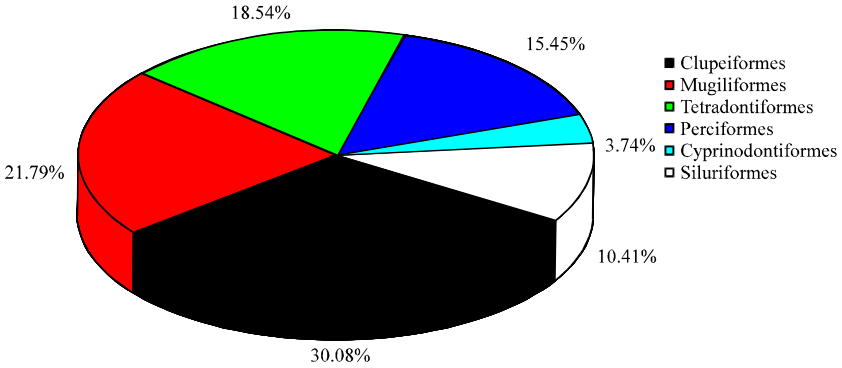

Fig. 3: Major dominating fish order in Bahuda estuary

species (95), Siluriformes (10.41%) with species (64), Cypridontiformes (3.74%) with species (23) in number. The fish species *Rastrelliger kanagurta* (80 individuals) contributing highest dominance of 13.01% followed by *Mugili cephalus* (70 individuals) (11.38%), *Thryssa kammlensis* (60 individuals) (9.76%), *Mystus gulio* (57 individuals) (9.27%), *Anchoviella indica* (65 individuals) (9.11%), *Thryssa setirostris* (45 individuals) (7.32%), *Arius arius* (2 individuals) (7.15%) of total contributing 67% of 7 fish species and rest 18 species of fish contributing 33% of dominance in study area which are shown in Fig. 3, 4.

Diversity status: The value of Shannon Wiener index (H') and Margalef richness (M) were calculated for different stations of the Bahuda estuary and shown in Fig. 5a-f. After pooling whole sample (25), total H value was found 2.819. Highest Shanon diversity index was (2.863) found at station 2 and lowest was (2.114) found at station 3 (Fig. 5e). The Margaleaf richness value for pooled 25 samples was 3.737 (Fig. 5c). The maximum Margalef richness value was observed to be 4.737 at station 1 where minimum value was observed 3.847 at station 4. Similar to Shannon

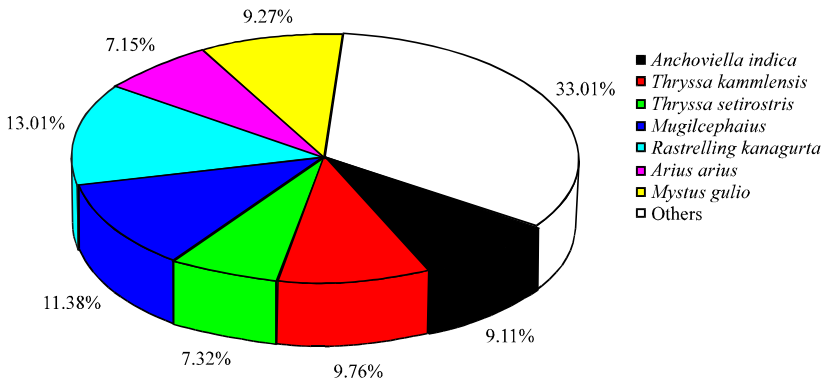

Fig. 4: Major fish species dominance in Bahuda estuary

diversity index no significant difference was observed in mean Margalef richness value among the stations. The Simpson index value pooled for 25 samples was 0.9251 (Fig. 5f). The maximum Simpson index value was 0.9282 observed at station 2 but the minimum value was 0.8617, which was observed in station 5. The Menhinick index value pooled for 25 samples was 1.008 (Fig. 5d) where the maximum value was observed at station 1 was 2.225 and minimum value was observed to be 1.458 at station 2. The evenness index value for pooled 25 samples was 0.674 (Fig. 5b) where the highest (0.8279) and the lowest (0.6509) poled evenness recorded in station 5 and station 1, respectively. Similarly the dominance index pooled for same sample was 0.07485 (Fig. 5a) where the highest (0.1383) and lowest (0.07182) recorded dominance in station 5 and 2.

DISCUSSION

Apart from the economic value, the fish showed highest species diversity among all the vertebrate taxa from the biodiversity point of view. It is believed that out of 61,259 species of vertebrates recognized world over, 32,300 are fish species of which 15,170 are fresh water while 16,764 are marine (Eschmeyear *et al.*, 2010). Bahuda is a positive estuary which showed high dominance of marine species in head region and middle stretch of the estuary as compared to brackish and fresh water species. The Biodiversity index in Fig. 5 a-f seek to characterized the diversity of sample or community by a single number (Magurran, 1988). The species diversity involves mainly two components having number of species or richness and distribution of individuals among species where the measurement of species richness is complex (Williamson, 1973). In a Shannon wiener legislation the aquatic environment of soil and water is divided as good when H>4, good quahty is 4-3, moderate quality 3-2, poor quality 2-1 and very poor quality <1. The Shannon index in present observation is within the range of (2.114-2.863) which indicated that this estuary is less polluted. A community becomes more dissimilar as the stress increases and accordingly species diversity decrease with poor water quality. A community dominated by relatively few species indicates that the environment is under stress (Plafkin *et al.*, 1989). The high Shannon diversity index involved with low individuals and low diversity involved with high number of individuals. These main causes of difference occurring in biodiversity index are due to seasonal variation of nutrients affecting the coexistence of many fish species (Huh and Kitting, 1985), atmospheric air currents and environmental conditions (Keskin and Nsal, 1998) and seasonal fish migration (Ryer and Orth, 1987). The Simpsons index of low value (0.8417) in

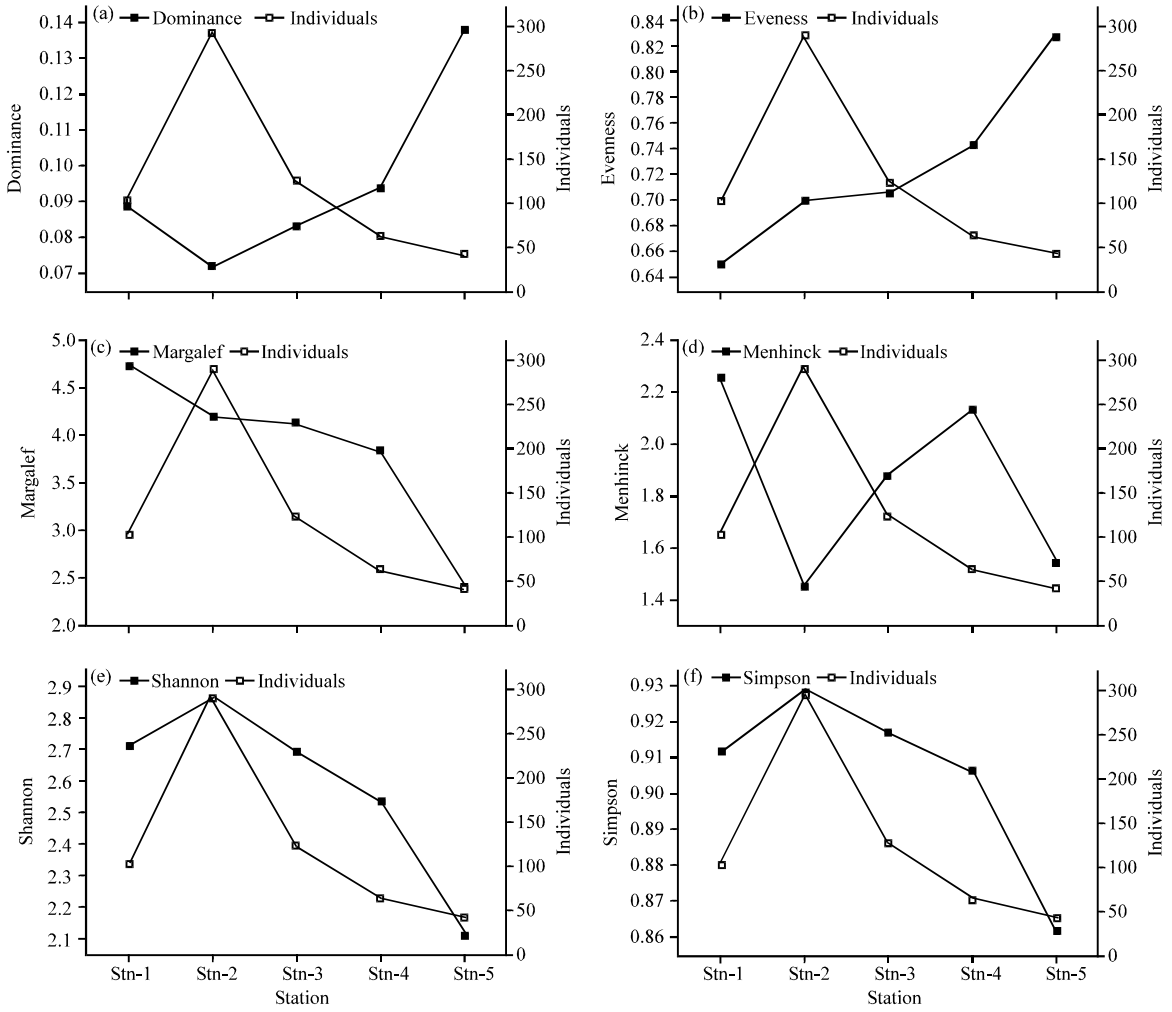

Fig. 5(a-f): Different diversity indices of ichthyofauna from Bahuda estuary, (a) Dominance index, (b) Evenness index, (c) Margalef index, (d) Menhinck index, (e) Shannon index and (f) Simpson index

station 5 indicated that the increase in dominance of few species and maximum (0.9282) in station 2 showed favorable conditions for fish abundance. A scale of pollution in terms of species diversity (3.0-4.5 slight, 2.0-3.0 light, 1.0-2.0 moderate and 0.0-1.0 heavy pollution) has been described by Staub *et al.* (1970). According to this range, the estuary is quite below the pollution level (the value ranged 2.114-2.863). Dominance diversity index value was highest in station 5 and lowest value was in station 2. If we compare the temporal variation of dominance of fish species status among all the station did not fluctuate for a greater magnitude, so main reason why the number of individuals increased towards the station 5 in our study is that new fresh water species joined the estuarine fish stock during monsoon season however the more number of individuals at station 5 may be due to influx of fresh water during the monsoon season. In addition to this, ecological conditions also have an effect on the distribution of the fish species. The evenness index rise at station 5 which is almost similar to Shannon diversity index. The Margalef and Menhinik richness index ranged from 2.408-4.737 and 1.543-2.225, respectively which indicated

high richness of organism in station 1 and moderate richness in station 5. Mishra *et al.* (1999) have studied a checklist of the Marine and estuarine fishes of south Orissa, East coast of India. They have observed 118 species of fishes, out of which 7 belong to class Chondrichthyes and 111 to class Osteichthyes. The former class comprised 1 order, 2 families and 3 genera. Osteichtyes class was represented by 13 orders, 53 families and 78 genera. Ninty three species have been identified as marine forms, while 25 species were estuarine in their occurrence. In the present study, 25 species of fishes are estuarine. They are coming under 6 order, 18 families. In the present study, 25 species of fishes are observed which are coming under 6 order, 18 families. The present result is partially in agreement with the work of Mishra *et al.* (1999) this may be due to the differences in wider range of study area of Mishra and coworker as compared to narrower range of study area of Bahuda estuary.

CONCLUSION

The present study is preliminary survey of one year for fish diversity from five selected stations. Very few species of fish were observed during the short study period so long term monitoring is required more than 2-3 years stretching over 15-20 study station to know the occurrence and distribution of fish diversity of this fertile, dynamic estuarine ecosystem.

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