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STUDY OF SECTORAL VARIATION OF SOME COMMERCIALLY IMPORTANT FISH GROUPS IN RELATION TO ENVIRONMENTAL VARIABLES OF CHILIKA LAKE, EAST COAST OF INDIA

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Abstract: The present study was carried out for a period of one year from March 2008- February 2009 in order to understand the role of environmental parameters like salinity, pH and water temperature up on different fish groups. Chilika lake appeared as the major factor for distribution of fishes in the lake premises. Mullets did not show any kind of relation with salinity suggested their euryhalaine property. Clupeiods were appeared as the most dominant group of fishes. The salinity showed sharp seasonal variation whereas pH exhibited consistent values in four sectors of Chilika lake and remained slightly alkaline through the study period.

Keywords: Chilika Lake, Fish Landing, Hydrography, Distribution of Fish.

INTRODUCTION

Chilika lake is situated between 19^0 28' and 19^0 54' North latitude and 85^0 05' and 85^0 38' East longitudes. It is an important Ramsar site (No.229) of India and the possess the unique combination of fresh water, brackish and marine ecosystems that helps for greater biodiversity and enriched fishery resources. It provides livelihood for more than 0.2 million of fisher folks existing in and around the lake premises which are contributed more than 71% of the economic value from Chilika lake. The lagoon was under stress in the since past two decades due to (i) Shrinkage of area due to siltation, (ii) Decrease of salinity gradients, (iii) Shifting of lagoon inlet mouth in the north-east direction, (iv) Extensive growth of the invasive weed such as *Phragmites karka* and (v) Depletion of fishery resources (Bhatta and Panda 2008).

Due to the anthropogenic problems that leads the lake in to the drastic stage. Some of these problems are (i) Excessive fishing pressure/over fishing, (ii) Destructive fishing practices (killing of juveniles and brood stock), (iii) Charges in traditional capture fishery and introduction of modern fishing gears, (iv) Extensive prawn gherry in the shore lines of the lagoon, (v) Dependence of more stakeholders on lagoon resources, (vi) Operation of excess number of motorized boats and (vii) Obstruction of migratory routes of economic species in the creeks of the lagoon (Bhatta and Panda 2008) .

The fish landing data of Chilika lake over years have given ideal information to access the health of the lake and also the kind of stress is putting on it. It was evidenced that before opening the dredged mouth the fish landing was hardly 2000 tones but after opening of mouth it was increased about seven fold and appeared about 14, 000 tones. Hydrological intervention which was made during 23rd Sepetember 2000 supported the the Chilika lake fishery in a great manner. Thus fish landing data becomes very important to access the status of the aquatic ecosystem. There are many reports available regarding fish landing of Chilika lake starting from 1929-30 by the Fisheries Department Devasundarm (1954) reported fisheries of Chilika from 1948-52, Jones and Sujansinghni (1954) reported Chilika fish landing from 1948-50. A comprehensive description of fish landing was published by Jhingaran and Natarajan (1969), whereas Sengupta and Patro (1970) reported the fish landing of 1968-69. Chilika Development Authority (CDA) has also published the fish landing data from 2000 to 2004 in their bulletins (CDA, 2002 and 2005). A detailed account on the fish landing scenario of Chilika in the post-dredging period was reported by Mohanty *et al.* (2003), Bhatt *et al.* (2004), Mohanty *et al.* (2005) and Mohapatra *et al.* (2007). However studies pertaining to the distribution of fish groups in relation to environmental parameters for different sectors are found less. Thus the present investigation deals with the dominant and commercial important fish groups of Chilika lake and their sectoral distribution in relation to hydrographical parameters which was or given less importance in previous studies.

MATERIALS AND METHODS

The present study period stretched from March 2008 to February 2009 included the study of fish landing of six groups of fishes namely sciaenids, beloniformes, perches, clupeids, mullets, threadfins were studied in order to understand the influence of

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hydrographical relation over the distribution of these groups. The fish landing data were collected from 18 regular and established fish landing centers covering four ecological sectors such as Northern, Central, Southern and Outer channel of Chilika lagoon. The standardized sampling method was adopted as per the recommendation of Central Inland Fisheries Research Institute (CIFRI), Barrackpore (Gupta *et al.*1991). The frequency of sampling covered 6 days in a month in 3 equal intervenes of 10 days taking 2 consecutive days for each sampling. Landing data were collected for 6 major groups such as clupeids, perches, beloniformes, mullets, threadfins and sciaenids. The sampling map of fish landing centre was given in the figure no.1. In order to get the *in situ* data regarding the water temperature, salinity, and pH was also made for each sector by using water quality checker (WQC, TOA DKK, Made in Japan). The statistical analysis was made by using SPSS V.16 statistical software.

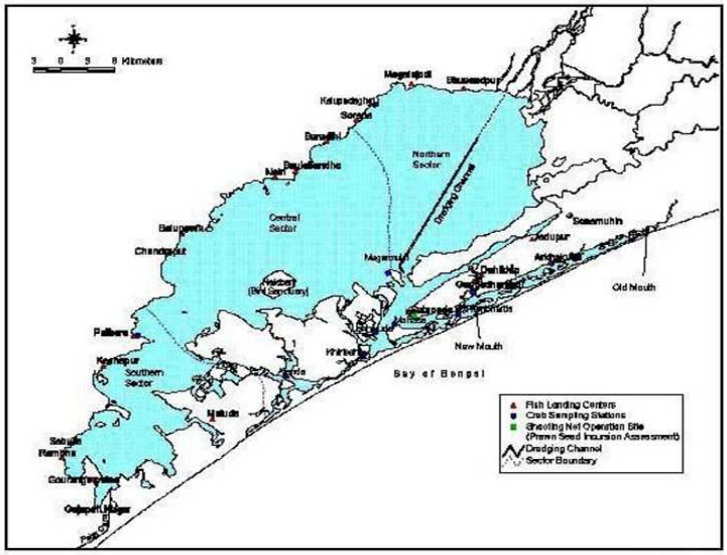

Figure.1: Map of Chilika lake showing fish landing stations.

RESULT AND DISCUSSION

Water quality parameters:

The Salinity is regarded as the most important environmental parameter that has tremendous effect on the density, diversity and distribution of fishes in the coastal ecosystems like estuaries and coastal lagoons. In the present study the salinity values was ranged from 0 to 36.9 psu (mean 11 ± 8) for whole lake (Table no.1). The sectoral values showed that higher values of salinity were observed in the outer channel area (19.5 psu) whereas lower values were observed in the northern sector (3.6 psu). The central and southern sector showed 8.3 and 11 psu respectively (Figure 2). There was sharp spatial heterogeneity was observed of salinity from northern sector to outer channel area. The same finding was in agreement with the work made earlier (Mohapatra et al., 2007; Bhatta & Panda 2008; Mohanty et al., 2009).

The pH of the aquatic ecosystem is indispensable parameters as it denotes the buffering capacity of the aquatic medium whether it is alkaline or acidic for the organisms living in coastal aquatic ecosystem. It also plays very critical role in the chemical reactions of aquatic medium and physiological behavior of the organisms which determining their density, biomass, diversity and distribution. It is reported that low pH (acidic condition) is detrimental to the aquatic life particularly fishes and very high pH also put negative impacts to the biota. The pH below 5 is detrimental to fish life and extreme pH also (highly alkaline) can kill the adult fish, other invertebrates and also make the damage to the juvenile of fishes. Again the values of pH are regarded as an indicator that shows the toxicity of ammonia. Ammonia become more toxic at higher values of pH than the normal range. Thus pH is very important for fish distribution and abundance. Many fishes breed at a specific range of pH. The preferable range of pH for better fishery resource is 6 – 9 (Source: www.llenntech.com/aquatic/acid-alkalis.htm).

The pH of the study area was ranged from 7.23 to 9.17 (Mean 8.24±1) and appeared as slightly alkaline in nature (Figure.2 & Table no.1). Higher values of pH was seen in central and northern sector whereas lowest was recorded in outer channel area. Over all the Chilika Lake was appeared as the alkaline in nature which is in agreement with earlier studies earlier (Mohapatra et al., 2007; Mohanty et al., 2009; Panigrahi et al., 2007 &2009).

The water temperature plays a covariant for other chemical parameters of the aquatic ecosystem. The impact of water temperature over aquatic organisms is prominent as their larval stage and development is guided by surrounding temperature of aquatic medium. During the present study the water temperature was varied from 22.1 to 33.2°C. Less spatial variation among different sectors signifies a moreover homogenous environment. Southern sector which was less influenced by fresh water have shown higher values of water temperature as compared to the other sectors.

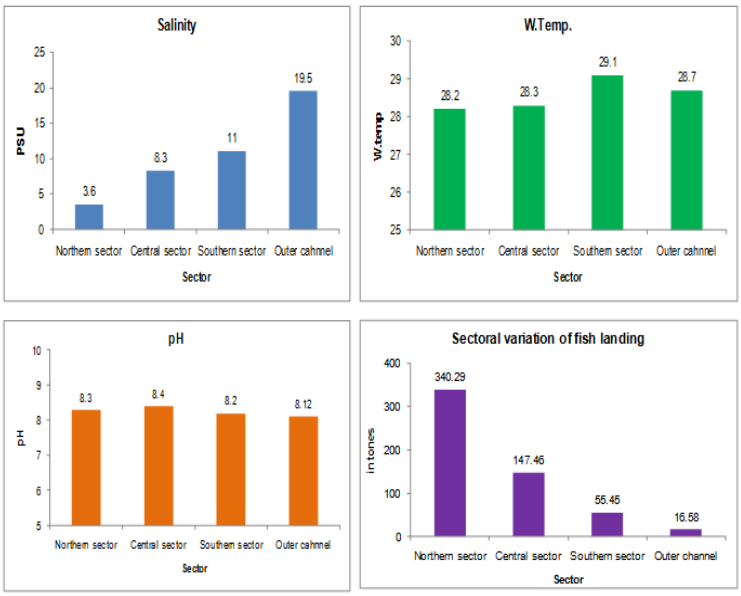

Figure.2: Sectoral variation of water quality parameters and fish landing during 2008-09

Table.1: showing the mean values of water quality parameter per sector and for the whole lake for 2008-09

Parameter	NS	CS	SS	OC	Whole lake
Salinity	3.6	8.3	11	19.5	9.3
pH	8.3	8.4	8.2	8.12	8.24
Water Temp.	28.2	28.3	29.1	28.7	28.5

Table no. 2: showing the mean values of fish landing (in tons) of different fish groups per sector and for the whole lake of Chilika for 2008-09.

Fish groups	Northern Sector	Central Sector	Southern Sector	Outer channel	Whole lake
Mullets	16.44	15.59	11.68	7.96	51.67
Threadfins	19.97	5.72	1.24	0.27	27.2
Clupeids	79.85	42.31	18.62	2.17	142.94
Pearches	22.07	18.86	6.34	2.02	49.28
Sciaenids	33.16	4.38	0.37	0.43	38.34
Beloniformes	27.13	16.3	1.93	0.04	45.4
Total landing	340.29	147.46	55.45	16.58	559.78

Major Group habitat and distribution:

During the present study 6 commercially fish groups were studied such as mullets, sciaenids, perches, beloniformes, threadfins and clupeids (Figure.3). Mullets are commercially important fish group caught from Chilika lake. Some the conspicuous representatives belonging to mullets were those of *Mugil cephalus*, *Liza macrolepis*, *Liza parsia*, *Liza subviridis*, *Liza tade*. Mullets, mostly marine or estuarine in nature, are observed in all the sectors of Chilika lake also found in temperate and in tropical waters. Among Threadfins *Eleutheronema tetradactylum*, *Polydactylus sextarius* were the important representatives of this group. These are mostly found in the all sectors of Chilika lake also seen in Persian gulf and all south Asian countries. Among clupeids *Nematalosa nasus*, *Tenualosa ilisha*, *Hilsa kelee* predominantly found in the southern sector, outer channel and central sector of Chilika lake. This is also observed in the Indo-west pacific region. However *Tenulosa hilsa* was seen in northern, central and outer channel of Chilika lake and northern part of Indian ocean and various estuaries of India. Among engruilidae family *Stolephorus indicus*, *Stolephorus commersonnii*, *Thryssa hamiltonii*, *Thryssa mystax* were predominanat. These are mostly found in outer channel, central and southern region and also found in Southeast Asia. Among perches *Lates calcarifer*, *Rhabdosargus sarba*, *Terapon jarbua*,*Sillago sihama* , *Datnioides polota*. These are found in all sectors of Chilika lake also seen in indo-pacific region, Persian gulf etc. Among sciaenids, *Daysciaena albida*, *Dendrophysa russelii* commonly in all the sectors of chilika lake and also reported from coastal waters creeks, estuaries and in back water of Indian sub-continent. Among beloniformes *Strongylura strongylura* were predominant in the lake system (Satapathy, and Panda 2009). This group is very common in all sectors and seen in the estuarine and back water system of Indian sub-continent (Figure-3). The relative abundance of different fish groups can be revealed from figure 4. From this it was known that the mullets were dominant in the outer channel area represents 62 % followed by southern sector 29 and in central sector 15 % least values in northern sector having 8 % only. Clupeids, these were more in the southern sector having 46 % followed by central sector 41 % and northern sector 40 % only least value was observed in the outer channel area having 17 % only. Perches have shown consistent values in all the four sectors i.e. 11%. Sciaenids were mostly observed in northern sector having 17% followed by central sector 4% and outer channel area 2.5 % and southern sector 1% only. Beloniformes were more in central sector 16%, northern sector 14% southern sector

5 % and outer channel having 0.5 % only. Threadfins were more in northern sector 10 % followed by central sector 6%, southern sector 3 % and outer channel 2% only.

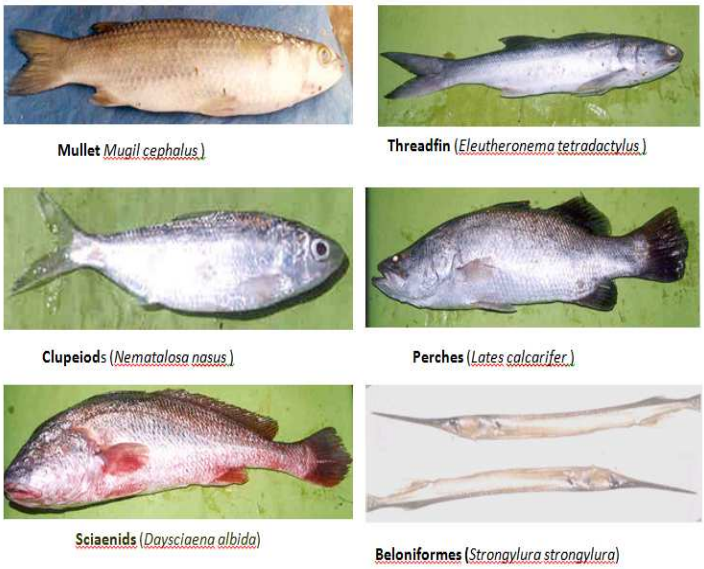

Figure.3: Dominant fish groups and their representative of Chilika lake collected during the study period

Overall group composition of Chilika lake fishes can be revealed from the figure 3. And it provides the information that clupeids are the most dominant group in Chilika lake followed by perches and mullets each having the sharing of 14 % , beloniformis contribution was 13 % were sciaenids and threadfins contributed 11% and 8% respectively during the study period(2008-2009) (Figure-4). From this it was apprehended that the representatives of clupeids group was dominant in the lake. The same observation was also made by earlier workers (Mohapatra et al., 2007; Bhatta & Panda 2008, Mohanty et al., 2009).

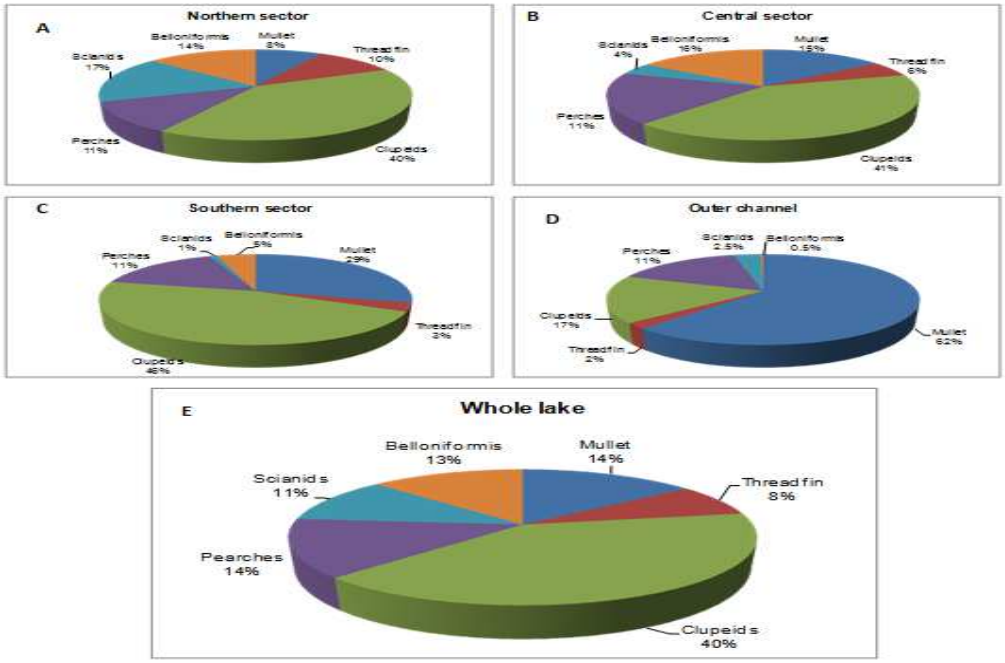

Figure.4: Sectoral variation of different groups of fishes of Chilika lake

Correlation matrix:

In order to understand the relationship between the fish groups with various environmental parameters such as salinity, pH and Water temperature, Pearson's correlation matrix it was carried outer which can derived from table no. 3

Table.3: Pearson's correlation matrix showing relation between water quality parameters and fish groups

	Salinity	pH	W.Temp.	Mullets	Threadfins	Clupeids	Perches	Sciaenids	Beloniformes	Total landing
Salinity	1									
pH	-0.77	1								
W.Temp.	0.56	-0.68	1							
Mullets	-0.97	**0.90****	-0.69	1						
Threadfins	-0.82	0.49	-0.75	**0.78***	1					
Clupeids	-0.93	0.68	-0.76	**0.91****	**0.97**	1				
Perches	-0.92	**0.88***	-0.83	**0.98****	**0.84***	**0.94****	1			
Sciaenids	-0.75	0.36	-0.69	0.68	**0.99****	**0.92****	0.75	1		
Beloniformes	-0.88	**0.75***	-0.86	**0.91****	**0.94****	**0.98****	**0.97****	**0.88***	1	
Total landing	-0.88	0.60	-0.77	0.85	0.99**	**0.99****	0.90**	**0.96****	**0.97****	1

Values in * are different from zero significant at 95 % confidence limit (p<0.05).
Values in ** are different from zero significant at 99% confidence limit (p<0.01).

From this table it was evidenced that there was strong relationship occurred between water pH and mullets group (p<0.01) and moderate relationship with perches and beloniformes (p<0.05) whereas salinity and water temperature exhibited moderate relation with other fish groups which was insignificant. It is obvious that the organisms inhabiting in the brackish water ecosystem have a wide range of salinity tolerance thus salinity was not limiting factor for their distribution. Again availability of food at different locations reduces the spatial specificity of the availability of a particular fish group. Mullets in general are euryhalaine in nature i.e. it can able to tolerate a wide fluctuation of salinity as reported by Thomsnon, 1966. However reports are available in support of influence of salinity and the distribution of young juveniles of mullets (Brusle, 1981; Cardona, 2000, 2006). They also reported that mullets like *M. cephalus* prefers oligohalaine or fresh water regions in their juvenile condition and the habitat preference shifted to the marine condition while adult stage is arrived. But in the present study only adult mullets and other fish groups were considered. The pH which determines the acidity or alkalinity of the water appeared as a major parameter for the distribution of the fish groups in the lake area. The distribution and occurrence of fish species in the wild is ruled by a combination of environmental biotic and abiotic factors (Cardona, 2006). According to Mohanty et al., 2007 abundance and movement of fishes are observed to be influence by water depth, shoreline activity, and sediment type, availability of oxygen, illumination, turbidity, pH, conductivity, salinity, spawning activities, food availability, predation and seasonal influence. Similarly Pombo et al., 2005 describe fish abundance and distribution as the products of interaction among fishes and other causes such as chemical, physical and industrial factors. Assessing the relative importance of environmental factors on the distribution of these mullet species showed that their occurrence and distribution was strongly affected by seasonality and salinity.

Most of the fish groups including mullets have strong preferences towards saline domain rather than the fresh water regions but adaptation to the brackish water medium enable them to thrive in the oligohalaine regions (Cardona 2000). Pombo et al., 2005 suggested that turbidity and temperature were the parameters that ruled the distribution of fishes with the lake system without any relevant role for salinity. However these conclusions may be premature as described by Pombo et al., 2005 because one time sampling survey per month is found insufficient. So it needs to increase the sampling site and sampling frequency to get more valuable information. More study is required in this aspect.

CONCLUSION

For Chilika lake it was found very difficult to deduct any specific trend for fish distribution as multiple parameters are affecting on Chilika lake due to which sharp seasonal variation was marked. Hence the role of any particular parameter upon fish distribution isn't established. During the present study clupeids were observed as the most significant group in the lake system where as other groups also made more or less contribution to the total fish catch. In the present study among environmental parameters the pH was found significant affecting the distribution of fish in the lake area. All these groups of fishes were found in all the four sectors more or less which confirm the healthiness of water quality to support enriched fishery resource of Chilika lake. More study is required further to establish this fact.

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