Availability of Crabs in Chilika Lagoon in Relation to some Hydrological Parameters

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ABSTRACT

Chilika Lagoon, a much focused designated Ramsar site of international importance and largest coastal wetland ecosystem in Indian subcontinent, is one of the finest repositories of aquatic biodiversity and steady sources of fishery. In the process of degradation of ecosystem, the Lagoon fishery became the major victim .Chilika is a hot spot of biodiversity with 277 species of fishes and 34 species of crabs. The different species of crabs found in Chilika are *Scylla* species, *Protunus* species, *Charybdis* species etc. The crab availability depends upon the hydrological parameters of the Lagoon. The major hydrological parameters affecting the crab availability are salinity, temperature and dissolved oxygen. Salinity plays the major role in the availability of crabs. The study was carried out in the four sectors of the Lagoon during June 2007 to May 2008. The highest salinity was found to be 27.3 ppt in the outer channel sector. The lowest was recorded in the northern sector which was found to be 7.1 ppt. The highest temperature was recorded to be 38.5°C and lowest was 25.2°C. Similarly the dissolved oxygen value ranged from 5.9 mg/l to 8.3 mg/l. Crabs are abundantly available in the outer channel sector as the salinity value in this sector is suitable for them. In the northern and central sector their availability of crab was low in comparison to the outer channel sector.

INTRODUCTION

Chilika Lagoon is the largest coastal wetland ecosystem in Indian subcontinent. It is a much focused designated Ramsar site of international importance. Hydrologically the Lagoon is influenced by three sub systems, the Mahanadi distributaries (Delta River), 52 rivulets and streams draining into the Lagoon from western catchment and the sea (Bay of Bengal). The lagoon is an assemblage of marine, fresh water and brackish water.

The Lagoon is broadly divided into four sectors basing on the ecological characters namely Northern, Central, Outer channel and Southern sector. The northern, southern and the outer channel sector are mostly influenced by fresh water inflows and the tidal ingress pushing the sea water into the lagoon during November- June. The four sectors characteristically differ from each other with different salinity pattern, bathymetry profile, biodiversity of the ecosystem, food niches, recruitment rates and productive level.

Salinity is the most dominating factor determining the Lagoon's ecology and it is controlled by the combination of factors like the nature of the connection to the sea and

the fresh water inflow to the lagoon from the Delta Rivers and western catchments. The fresh water inflow plays a vital role in the salinity variation and distribution of different flora and fauna of the lagoonal ecosystem. Chilika lagoon is the finest repositories of aquatic biodiversity, ecotourism and a steady source of fishery, sustaining the livelihood and nutritional need of about 0.20 million of local fisher folk. The lagoon was critically threatened during last few decades due to natural changes coupled with anthropogenic pressure. In September 2000 as a part of its management endeavor the Chilika Development Authority (CDA) had opened a new mouth at Sipakuda to facilitate efficient tidal mixing between the lagoon and the sea. The creation of a new mouth, considered historical and the most successful hydrological intervention, have brought changes such as reduction in weeded area, rise in salinity, flushing rate and sea grass cover. Sea water exchange takes place predominantly through outer channel. The total catchments area of Chilika lagoon is 4146 km^2 with an average rainfall of 1,238 mm. (Gupta *et al*, 2008). The lagoon has an average area of 868 km^2. (Khandelwal, *et al* 2008).

Chilika lagoon is a hot spot of bio-diversity inhabiting a number of endangered species listed in the IUCN Red list of threatened species (World Bank, 2005 & CIFRI 2005). It is the wintering refuse for more than one million migratory birds and has global importance as waterfowl habitat (Balachandran, et al, 2003). It is one of two lagoons in the world that support Irrawadi dolphin Population (World Bank, 2005).

The lagoon supports a diverse and dynamic assemblage of fish, invertebrates, and crustacean species belonging to marine, brackish and fresh water habitats. In total, 225 fish species, 24 prawns and 28 species of crab recorded from Chilika lagoon till 1999-2000 (Mohanty, 2002). After the hydrological intervention, particularly after opening of the new mouth of the lagoon, 56 numbers of new records of fish and shell-fish species were documented comprising of 43 fish species, 24 prawn species, 7 crab species and 2 Indian spiny lobsters. (Mohapatra et al 2007). So a total of 35 species of crabs are available in Chilika lagoon. All the crab species collected during pre and post intervention period belongs to marine- brackish water-marine habitat.

The different species of crabs available in Chilika lagoon are *Scylla* species, *Portunus* species, *Charybdis* species, *Varuna* species etc. The most commonly occurring species are *Scylla serrata* and *Scylla tranqubarica*. *Scylla tranqubarica* was not documented as separate mud crab species other then commonly occurring *Scylla serrata* due to controversy in the species identification problems in the genus Scylla.

There are 17 crab landing stations in Chilika lagoon. But the crabs are available mostly in the outer channel sector because the higher salinity in comparison to other sectors due to inflow of sea water into the lagoon. Secondly crabs spawns in marine environment. The eggs hatch and zoea larva emerge. The larvae prefer marine condition for their development. After developing into juveniles they return to the lagoon. So they are mainly available in the higher saline water. The crabs can

survive under a wide range of temperature variation 15- 45°C, (Bhanu and Babu, 2000). Mud crabs are found to be oxynoformers with limited physiological capacity to survive hypoxic conditions. Total Organic Carbon (TOC) also played an important role in distributation of crabs. Crabs are not found in the northern and southern sectors. They are caught by the local fishermen from the outer channel area. They are brought and sold at different marketing places.The conservation and management of biodiversity in general and fish biodiversity in particular were almost impossible without restoration of the lagoon ecosystem. In the process of eco degradation, the lagoonal fisheries were major victim. Fish yield and biodiversity seemes to be very sensitive to salinity and hydrological dynamics of the lagoon.

Recently a new mouth has been opened at about 800 m towards north of the mouth of Sipakuda having 70 m width during 1st August, 2008. This natural mouth was widened and reached upto 450 m till 10th of August, 2008 (Samaj, 2008).

MATERIALS AND METHODS

Chilika is the largest brackish water lagoon of Asia with captivating beauty, abundant biological resources is located on the east coast of Orissa, between the latitude 19° 28′ to 19° 54′ N and longitude 85° 05′to 85° 38′E (Fig 1). It is an open lagoon situated on the south- west of Puri district. It fluctuates in area from maximum of 1,165 km^2 during monsoon to 906 km^2 during the summer season (Average is 923 km2). The lagoon is separated from Bay of Bengal by a sand bar between 100 m and 1.5 km wide. A 30 km outer channel connects the main lagoon with Bay of Bengal. The 14 km long Palur Canal connects southern end of the lagoon of the sea through Rushikulya river mouth.

Sampling was done every month from June 2007 to May 2008. Different stations were chosen for the study. Eight stations were chosen for sampling, where crabs are available through out the year. The stations are Arakhakuda, Alupatana, Gangadharpur, Satapada, Berhampura, Mainsha, Janhikuda and Khirisahi. Water samples were collected for analysis of Temperature, Salinity and Dissolved Oxygen. Sediment samples were collected for determination of Total Organic Carbon (TOC).Temperature was measured on the field by the thermometer and expressed in°C. Salinity was determined in the laboratory. After sampling, samples were brought to the laboratory for analysis. Salinity was determined by titrometric method using silver nitrate (Ag NO_3) as titrant. The result was expressed in ppt. For dissolved oxygen analysis, the sample was fixed in the field by adding Winkler's A and Winkler's B solution to the sample. Then it was brought to the laboratory, after removing the precipitation by sulphuric acid, it was titrated by sodium thiosulphate using starch solution as indicator. The result was expressed in ml/l. Total organic carbon of the sediment was calculated by Walky and Black method. The sediment was sun dried and grinded to powder. Then it was titrated against ferrous ammonium sulphate. It was expressed in percentage (%).

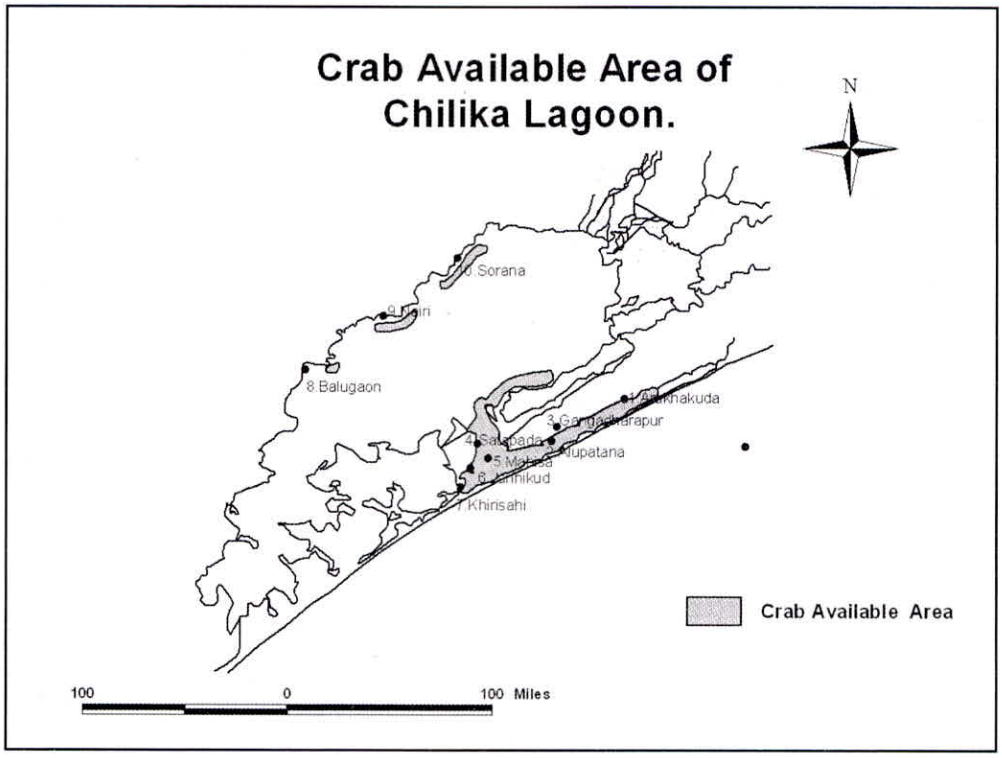

Fig 1 : Map of Chilika Lagoon showing different sampling stations

RESULTS

Chilika lagoon is the assemblage of marine, brackish and fresh water. Salinity is the main parameter in the Chilika lagoon. It plays a vital role in distributation of plants and animals in the Chilika lagoon. Temperature and dissolved oxygen also play some role in distribution of flora and fauna. The temperature, pH, salinity, dissolved oxygen and total organic carbon of the sediment was noted and tabulated for different season of the year. The year is divided into 3 seasons i.e. pre-monsoon, monsoon and post-monsoon. The observation was taken for the three different seasons from different stations.

From table-1 the highest temperature was observed to be 38.5°C from Arakhakuda and the lowest was 35.8°C from Berhampura. The highest pH was observed to be 8.5 from Satapada and lowest was 7.3 from Arakhakuda. Highest salinity was observed from Alupatana which was 27.3 ppt and lowest was 21.9 ppt from Satapada. Highest dissolved oxygen was observed to be 8.1 ml/l from Khirisahi and lowest was 5.9 ml/l from Gangadharpur. The highest Organic Carbon was observed to be 2.36% from Satapada and lowest was 1.08 % from Arakhakuda.

Table 1: Average environmental parameters for the pre- monsoon season from Chilika lagoon.

Stations	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen(ml/l)	Total Organic Carbon(%)
1.Arakhakuda	38.5	7.3	23.1	6.7	1.08
2.Alupatana	37.5	7.5	27.3	7.3	1.14
3.Gangadharpur	36.1	8.1	22.5	5.9	2.12
4.Satapda	36.3	8.5	21.9	6.5	2.36
5.Berhampura	35.8	8.3	22.2	7.1	1.98
6.Mainsha	36.8	7.6	21.8	6.9	1.57
7.Janhikuda	37.2	7.8	22.8	7.8	2.09
8.Khirisahi	35.9	8.2	23.4	8.1	1.68

From table- 2, the highest temperature was observed to be 34.2°C at Arakahakuda and lowest was 30.6oC at Satapada. The highest pH value was observed to be 8.5 from Satapada and lowest was 7.0 from Khirisahi. Salinity was highest from Alupatana which was 12.3 ppt and lowest was 7.9 ppt from Gangadharpur. The highest dissolved oxygen was observed to be 7.8 ml/l from Arakhakuda and 5.9 ml/l from Berhmapura. The highest organic carbon was observed from Gangadharpur which was 2.93 % and lowest was 1.69 % from Berhampaura.

Table 2: Average environmental parameters for the monsoon season from Chilika lagoon.

Stations	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen(ml/l)	Total Organic Carbon(%)
1.Arakhakuda	34.2	8.3	11.9	7.8	2.01
2.Alupatana	32.3	8.1	12.3	6.1	1.90
3.Gangadharpur	31.8	7.8	7.9	7.5	2.93
4.Satapda	30.6	8.5	10.9	6.9	2.28
5. Berhampura	32.8	7.5	9.3	5.9	1.69
6.Mainsha	31.9	7.6	12.1	6.3	2.19
7.Janhikuda	33.1	7.9	10.3	7.7	2.05
8.Khirisahi	32.5	7.0	8.5	7.3	1.97

From table-3, the highest temperature during post- monsoon season was observed to be 32.5°C from Khirisahi and lowest was 30.6°C from Arakhakuda. The highest pH value was observed to be 8.3 from Mainsha and the lowest pH value was 7.1 from Janhikuda. The highest salinity was observed from Gangadharpur which was 14.4 ppt and lowest was 11.6 ppt from Berhampura. The highest dissolved oxygen was observed to be 8.3 ml/l from Janhikuda and lowest was 5.9 ml/l from Arakhakuda. Total organic carbon was highest from Arakhakuda which was 2.94 % and lowest was 1.78 % from Berhampura.

The crab fisheries of Chilika lagoon have high demand in both national and international market. In domestic market it fetches good price giving a good income to the fishermen of Chilika lagoon. The crab landing from 17 stations of Chilika lagoon is represented for 5 years (Table-4).The highest mud crab landing was observed at Balugaon market during 2004-05 being 111.7 tones. The lowest mud crab landing was observed at Balugaon market during 2004-05 being 0.03 tones.

Table 3: Average environmental parameters for the post-monsoon season from Chilika Lagoon

Stations	Temperature (^{0}C)	pH	Salinity (pH)	Dissolved Oxygen(ml/l)	Total Organic Carbon(%)
1.Arakhakuda	30.6	7.8	13.2	5.9	2.94
2.Alupatana	32.3	7.5	12.1	6.9	2.06
3.Gangadharpur	32.1	7.6	14.4	6.1	1.93
4.Satapda	31.8	8.1	12.9	7.3	2.12
5. Berhampura	31.1	7.7	11.6	7.8	1.78
6.Mainsha	31.9	8.3	12.5	8.1	2.34
7.Janhikuda	32.3	7.1	13.6	8.3	2.21
8.Khirisahi	32.5	8.2	11.7	7.5	1.88

DISCUSSION

Bhanu and Babu (2000) have studied on the oxygen requirements in edible crab culture. They have concluded that the mud crabs can grow in a salinity range of 5-40 ppt. But the oxygen requirement depends on the variation of salinity. When the salinity varies from 20-30 ppt ,the oxygen consumption was observed to be 9.26- 8.69 ml/l. Therefore, when the salinity increases the oxygen consumption rate of the crabs generally decreases. When the salinity was 5 ppt the consumption of oxygen was 10.07 ml/l. but when the salinity was 30 ppt the consumption rate of oxygen was 8.69 ml/l. when the carapace width is 70 mm the oxygen consumption was 6.32 ml/l at 25 ppt salinity. As the crab grows to 90 mm carapace width the oxygen consumption was 8.77 ml/l at 25 ppt. So as the crab grows the oxygen consumption increases. The density of crab availability is quite suitable when the dissolved oxygen varies from 5-9.5 ml/l. Similarly crab can survive under 5-40 ppt salinity range. Temperature 15°C to 40oC is suitable for survival of crabs. The result of Bhanu and Babu (2000) coincides with the present result. The salinity of Chilika lagoon varies from 7.1-27.3 ppt observed in present study is suitable for crab availability in Chilika lagoon. The calculated value of organic carbon of mangrove sediment varied from 1.1-2.8 % as observed by Shriadah (2000) from Abu Dhabi, Arabian Gulf. The organic carbon of Chilika lagoon varied from 1.08-2.94 %.This organic carbon value is suitable for the availability of crabs. A single parameter is not responsible for the

Table 4: Mud crab landings in Tones from Chilika lagoon during 2001-2006

Landing stations	2001-02	2002-03	2003-04	2004-05	2005-06
Balugaon	77.94	101.87	110.41	111.70	104.40
Nairi	1.11	0.06	1.06	3.28	0.42
Baulabandha	1.66	0.17	1.82	2.12	11.09
Sorana	2.22	1.12	1.07	2.13	9.99
Gangadharpur	12.518	27.26	21.8	25.97	16.14
Kalupadaghat	1.01	0.67	3.12	2.12	6.04
Pathara	0.22	0.18	1.23	2.08	0.19
Chandraput	4.04	0.03	1.08	3.32	0.03
Gajapatinagar	2.012	0.15	2.91	00	0.39
Arakhakuda	0.05	2.18	1.05	1.33	0.90
Maludamarket	1.26	3.05	3.16	2.00	4.49
Boradi	0.04	2.15	0.51	00	00
Rambha	0.18	1.12	0.11	00	00
Sabulia	0.55	0.15	0.52	0.80	00
Bhusandapur	2.072	3.16	1.82	1.23	00
Alupatna	0.51	1.71	1.12	3.01	00
Gaurangapatna	3.88	4.18	2.12	0.80	00
Total	111.068	149.819	155.51	161.89	154.08

availability of crab. However, salinity plays a major role for the availability of crab in an area.

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