Multidecadal Variability in Fishery Potential of Chilika Lagoon, East Coast of India: A Review

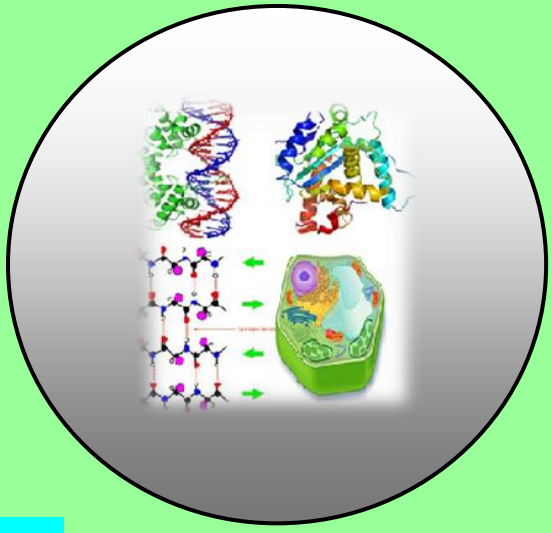
By

Mitali Priyadarsini Pati, Lakshman Nayak, Subhalata Samantaray and Satyabrata Das Sharma

ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

Journal Impact Factor: 4.275
Global Impact factor of Journal: 0.876
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 3.66
Index Copernicus International Value
IC Value of Journal 47.86 Poland, Europe

J. Biol. Chem. Research
Volume 33 (1) 2016 Pages No. 241-248



Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 33, No. 1: 241-248, 2016
(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)
Ms 33/1/87/2016

ISSN 0970-4973 (Print)
ISSN 2319-3077 (Online/Electronic)

Dr. S.D. Sharma
http:// www.sasjournals.com
http:// www.jbcr.in
jbiolchemres@gmail.com

REVIEW ARTICLE

Received: 17/02/2016 Revised: 01/3/2016 Accepted: 03/03/2016

Multidecadal Variability in Fishery Potential of Chilika Lagoon, East Coast of India: A Review

Mitali Priyadarsini Pati, Lakshman Nayak, Subhalata Samantaray and Satyabrata Das Sharma

P.G. Department of Marine Sciences, Berhampur University, Berahmpur-760007, Orissa, India

ABSTRACT

Chilika the largest brackish water lagoon of Asia, a designated Ramsar site, is a wetland of international repute. It is one of the hotspot of biodiversity in the country and some rare, vulnerable and endangered species which have been listed in the IUCN Red list of threatened animals, inhabit in the lagoon. A total of 259 species of fishes, 28 species of prawns/shrimps and 35 species of crabs are recorded from the lagoon. The fish production is fluctuating from year to year. The fish landing was highest during 2003-04 being 10286.34 MT and lowest was observed to be 1056 MT during 1995-96. The highest shrimp landing was observed to be 6413.91 MT during 2011-12 and the lowest was observed to be 136.93 MT during 1998-99. The highest crab landing was observed to be 358.26 MT during 2011-12 and lowest was observed to be 3 MT during 1994-95. The maximum growth rate of fish, shrimp and crab landing was observed to be 59.94, 83.16, and 90.35% during the year 2000 to 2002. Similarly, the minimum growth rate was observed in the year 1994-95.

Key Words: Fish, Shrimp and Crab Landing, Chilika Lagoon and East Coast of India.

INTRODUCTION

Orissa is a maritime state having 480 km of coastline and is naturally blessed with extensive system of creeks, estuaries, mangroves and brackish water lagoons. The estuaries and the brackish water including the Chilika lagoon are known for their rich sources of fish supply. Biodiversity in this ecosystem is very impressive. They are the best settling places for clams and oysters. They also act as nursery and breeding ground for a variety of Shrimp, Fin fishes and other marine organisms (Rajendra *et al*. 2004). Lagoons are shallow coastal bodies of

water separated from the ocean by a series of barrier islands which lie parallel to the shoreline. Inlets, either natural or man-made, cut through barrier islands and permit tidal currents to transport water into and out of the lagoons. The Chilika Development Authority (CDA) made an artificial mouth near the village of Sipakuda on 23 September, 2000 with an initial cut of 80m in length and around 200m in width (Roy 2001). In the month of August, 2008, a new mouth had formed naturally at Gabakunda which is located one kilometre distance from the present in let of Sipakuda (Gopikrishna *et al*. 2014). Lagoons are characteristically shallow, strongly influenced by precipitation and evaporation, which results in fluctuating water temperature and salinity. Lagoons can also be fragile ecosystems susceptible to pollution effects from municipal, industrial and agricultural runoff.

Geological Characteristics

Chilika is the largest brackish water lagoon of Asia with captivating beauty, abundant biological resources and rich economic attributes. Ecologically it is wetland of International importance under the Ramsar Convention since 1981. It is pear shaped lagoon located on the east coast of Peninsular India. It stretched over three districts namely Puri, Khurda and Ganjam. It is separated from the Bay of Bengal by a barrier spit attached at its Southern end (Venkataratnam 1970). The Chilika lagoon has originated since long due to the earth's crustal moment causing depression for holding water. Actually some of the most remarkable lakes in the world has been originated due to tectonic phenomenon and therefore rightly called tectonic lagoon based upon the observation of the Blanford (1872) and Venkataratnam (1970). It may be well regarded as tectonic in origin.

Biological Characteristics

Chilika lagoon is one of the hot spot of biodiversity in the country and some rare, vulnerable and endangered species have been listed in the IUCN (International Union for Conservation of Nature) Red List of threatened animals inhabits in the lagoon for at least part of their life cycle. The lagoon is also only one of two lagoons in the world that is home to the Irrawady Dolphin (The other being the Songkhal lagoon in Thailand). It is one of the "Mega diverse lagoons of the country as well as of Asia. Due to its rich biodiversity it attracts many bird watchers and ecotourists. Many organisms starting from microorganisms to the spectacular dolphins are found in the Chilika lagoon. Recently, Sharks have been observed in it during the visit to the new mouth at Sipakuda. There are 52 rivers and rivulets draining in to the lagoon. This treasured gift of nature has been the source of sustenance and survival for 0.2 million indigenous fisher folks, besides fulfilling the needs of the consumers by way of providing quality fish products since ancient times. The lagoon has witnessed much controversy and concern during the past two decades for the accelerated degradation of its environment by a wide array of human impacts and over exploitation of its fishery resources (Bhatta and Panda, 2008). The recent initiatives for mitigating the environmental problems and conserving the fishery resources of the lagoon have been taken up by the Chilika Development Authority (CDA). The openness of the lagoon to marine and freshwater subsystems resulted in two antagonistic hydrological processes (Freshwater and saline water) particularly in northern, central and outer channel sectors with penetration of fish and shellfish faunas respectively from marine and inland origin. The cyclic change of salinity gradient, provide diverse habitat condition in Chilika lagoon for both migratory and resident/endemic fish and shellfish faunas with greater diversity (Rajawat, et al. 2007).

Comparatively southern sector with more stable salinity profile having least seasonal variations exhibited less ichthyofaunal diversity (Mohapatro *et al*.2007).

Physico chemical Characteristics

The water depth varies from 0.38 to 4.9 m during different seasons of the year. The physical parameters like temperature varied from 17.5 to 32^{o}c (Banerjee & Roy Choudhury 1996). Now the temperature has increased up to 35.6^{o}c to its maximum (Nayak and Mohanty 2006). The salinity varied from trace to 36.0 ppt during 1966 and reduced to 0.50 ± 0.01 to 32.0 ±0.43 ppt during 2004 (Nayak and Behera 2004). Similarly the transparency has varied from 0.3 to 1.4 m during 1966 and reduced to 67.1 ± 30 cm to 86.5 ± 16 cm during 2007 (Mohapatro *et al.* 2007). Due to anthropogenic pollution, human activities, siltation, reduction in salinity and excessive growth of fresh water weeds, some important fish species and crustacean are disappearing from the lagoon.

MATERIAL AND METHODS

Chilika, the largest brackish water lagoon of Asia with captivating beauty, abundant biological resources, is located on the east coast of India between the latitude 19° 28´ to 19° 54´ N and longitude 85° 05´to 85° 38´E. It fluctuates in area from maximum of 1165 Km^2 during monsoon to 906 Km^2 during the summer season (Gupta, 2014). The lagoon can be divided in to four sectors depending on the survey and estimation of fish production and water characteristics: - Namely Southern, Central, Northern and Outer channel. Two tributaries such as Daya and Bhargabi drain in to the lagoon in the northern sector. The secondary data pertaining to the fishes were collected from Chilika Development Authority and the Fisheries Department, Government of Orissa, Cuttack. In the present paper, a comparative analysis of fisheries potential from 1985-86 to 2013-14 has been discussed. The periodic data were analyzed and calculated for percentage of growth over previous years represented in tabular forms.

RESULTS AND DISCUSSION

Fishes

Chilika lagoon acts as a repository of diverse varities of finfish and shellfish resources and a highly productive fishery ground. It has immensely contributed to the commercial capture fishery of Orissa. It accounted for 10.08% of the brackish water fish production of the state of Orissa during 1996-97 (GoO 1997).

Table 1. Common Important Group of Fishes Found in Chilika Lagoon.

Sl. No.	Name of the Group	Composition in %
1.	Mullets	12.25
2.	Prawn	17.19
3.	Hilsa	2.15
4.	Other clupeids	17.04
5.	Perches	8.28
6.	Etroplus	4.44
7.	Threadfins	4.99
8.	Catfish	9.49
9.	Beloniforms	2.73
10.	Sciaenids	3.72
11.	Misc.	17.72

Table 2. Fish, Shrimp and Crab Landings (in Metric Tons) From Chilika Lagoon During 1985-86 to 2013-14.

Year	Fish landing	Shrimp Landing	Crab Landing	Total
1985-86	7446.00	1144.00	79.00	8669.00
1986-87	7283.00	1587.00	54.00	8924.00
1987-88	6863.00	1241.00	39.00	8143.00
1988-89	5211.00	917.00	44.00	6172.00
1989-90	5493.00	1177.00	36.00	6706.00
1990-91	3792.00	481.00	24.00	4297.00
1991-92	3680.00	876.00	30.00	4586.00
1992-93	3207.00	951.00	15.00	4173.00
1993-94	2799.00	686.00	11.00	3496.00
1994-95	1239.00	176.00	3.00	1418.00
1995-96	1056.00	213.00	5.00	1274.00
1996-97	1352.00	281.00	12.00	1645.00
1997-98	1492.00	149.51	10.40	1651.90
1998-99	1565.00	136.93	9.68	1711.61
1999-00	1556.00	180.40	9.03	1745.43
2000-01	3817.81	1071.38	93.60	4982.79
2001-02	9530.03	2347.78	111.07	11988.88
2002-03	8265.16	2478.82	149.81	10893.79
2003-04	10286.34	3611.37	155.51	14053.22
2004-05	8097.77	5000.71	161.89	13260.37
2005-06	7774.81	4296.02	154.08	12224.91
2006-07	6463.92	3368.97	122.94	9955.83
2007-08	6610.23	3298.08	139.12	10047.43
2008-09	6534.85	3929.68	237.50	10702.03
2009-10	7892.98	3851.49	210.89	11955.36
2010-11	7736.54	5043.18	285.90	13065.62
2011-12	7456.03	6413.91	358.26	14228.20
2012-13	7114.30	5034.05	318.58	12466.93
2013-14(P)	7699.71	4927.66	308.97	12936.34
(P): Provisional				

Source: Handbook on Fisheries Statistics, Orissa, Cuttack

Though it is basically a traditional fishery with subsistence and artisanal sectors, the commercial sector has developed and expanded prominently during the second half of the past century in to which the modern advances of fishing industry have cropped up. The brackish water characteristics and the high primary productivity of the lagoon provide hospitable environments to the most economic species of finfish and shellfish such as Mullets, Perches, Prawns and Crabs which enhance its commercial significance. As it is a multi –species capture fishery, man has only to reap without having to sow, nature herself sowing the seed through self-propagation of the species (Jhingran 1991). Besides, it has the advantage over culture fishery for sheltering a wide variety of uncultivated finfish and shellfish. The most common important group of fishes found in Chilika lagoon is represented in (Table – 1).

Table 3. Annual Growth Rate of Fish, Shrimp and Crab Landing (in Metric Tons) From Chilika Lagoon during 1985-86 to 2013-14.

Year	Fish landing	Variation over previous Year	Growth rate in % age	Shrimp Landing	Variation over previous Year	Growth rate in % age	Crab Landing	Variation over previous Year	Growth rate in % age
1985-86	7446			1144			79		
1986-87	7283	-163	-2.24	1587	443	27.91	54	-25	-46.30
1987-88	6863	-420	-6.12	1241	-346	-27.88	39	-15	-38.46
1988-89	5211	-1652	-31.70	917	-324	-35.33	44	5	11.36
1989-90	5493	282	5.13	1177	260	22.09	36	-8	-22.22
1990-91	3792	-1701	-44.86	481	-696	-144.70	24	-12	-50.00
1991-92	3680	-112	-3.04	876	395	45.09	30	6	20.00
1992-93	3207	-473	-14.75	951	75	7.89	15	-15	-100.00
1993-94	2799	-408	-14.58	686	-265	-38.63	11	-4	-36.36
1994-95	1239	-1560	-125.91	176	-510	-289.77	3	-8	-266.67
1995-96	1056	-183	-17.33	213	37	17.37	5	2	40.00
1996-97	1352	296	21.89	281	68	24.20	12	7	58.33
1997-98	1492	140	9.38	149.51	-131.49	-87.95	10.4	-1.6	-15.38
1998-99	1565	73	4.66	136.93	-12.58	-9.19	9.68	-0.72	-7.44
1999-00	1556	-9	-0.58	180.4	43.47	24.10	9.03	-0.65	-7.20
2000-01	3817.81	2261.81	59.24	1071.38	890.98	83.16	93.6	84.57	90.35
2001-02	9530.03	5712.22	59.94	2347.78	1276.4	54.37	111.07	17.47	15.73
2002-03	8265.16	-1264.87	-15.30	2478.82	131.04	5.29	149.81	38.74	25.86
2003-04	10286.34	2021.18	19.65	3611.37	1132.55	31.36	155.51	5.7	3.67
2004-05	8097.77	-2188.57	-27.03	5000.71	1389.34	27.78	161.89	6.38	3.94
2005-06	7774.81	-322.96	-4.15	4296.02	-704.69	-16.40	154.08	-7.81	-5.07
2006-07	6463.92	-1310.89	-20.28	3368.97	-927.05	-27.52	122.94	-31.14	-25.33
2007-08	6610.23	146.31	2.21	3298.08	-70.89	-2.15	139.12	16.18	11.63
2008-09	6534.85	-75.38	-1.15	3929.68	631.6	16.07	237.5	98.38	41.42
2009-10	7892.98	1358.13	17.21	3851.49	-78.19	-2.03	210.89	-26.61	-12.62
2010-11	7736.54	-156.44	-2.02	5043.18	1191.69	23.63	285.9	75.01	26.24
2011-12	7456.03	-280.51	-3.76	6413.91	1370.73	21.37	358.26	72.36	20.20
2012-13	7114.3	-341.73	-4.80	5034.05	-1379.86	-27.41	318.58	-39.68	-12.46
2013-14	7699.71	585.41	7.60	4927.66	-106.39	-2.16	308.97	-9.61	-3.11

***Source*:** Handbook on Fisheries Statistics, Orissa, Cuttack

The various species of fish inhabitating the lagoon have marine, brackish and fresh water origins and the 3 categories are represented by 47.25%, 31.87% and 20.88% of the total fish landing from the lagoon respectively (Panigrahi 2003). Higher diversity and abundance of fish fauna supported by the lagoon is evidence by a total of 225 species of fish recorded from it, besides 25 species of prawns and 28 species of crabs (Dean and Saaltink 1991). The recent addition to the list by the CDA(2007) have made the total number of reported fish species 259 prawn/shrimp species 28 and crab species 35. However, some species traced in the lagoon are the occasional visitors and the dominant and commercially significant species belong only to a small number of taxonomic groups. The fish production was fluctuating from year to year, in Chilika lagoon due to several factors like salinity, siltation, eutrophication, pollution, overexploitation etc.

Table. 4 Fish Production in Orissa (Quantity in Metric Tons) during 1985-86 to 2013-14.

Year	Inland Fish			Marine	Total Fish Production
	Freshwater	Brackish water	Total Inland fish		
1985-86	31221	23906	55127	53581	108708
1986-87	32791	24209	57000	55324	112324
1987-88	41000	23500	64500	59960	124460
1988-89	45365	24500	69865	61020	129985
1989-90	50500	25370	75870	77895	153765
1990-91	58720	22038	80758	78192	158950
1991-92	65118	22765	87883	95026	182909
1992-93	70829	22933	93762	119276	213138
1993-94	116371	11985	128356	103925	232281
1994-95	123958	10812	134770	122892	257662
1995-96	121941	12903	134844	123199	258043
1996-97	127293	16203	143496	133462	276958
1997-98	135636	16782	152418	156081	308499
1998-99	145006	14898	159904	124329	284233
1999-00	124861	10442	135303	125935	261238
2000-01	125114	13442	138556	121086	259642
2001-02	147400	20660	168060	113893	281953
2002-03	154237	19964	174201	115009	289210
2003-04	165060	24423	189483	116880	306363
2004-05	169881	23776	193657	121928	315585
2005-06	179740	23495	203235	122214	325449
2006-07	191632	22951	214583	128141	342724
2007-08	195747	22969	218716	130767	349483
2008-09	213003	26332	239335	135487	374822
2009-10	215803	25508	241311	129332	370643
2010-11	224956	27750	252706	133479	386185
2011-12	237470	30062	267532	114296	381828
2012-13	261919	29914	291833	118311	410144
2013-14 (P)	263862	30007	293869	120020	413889
(P): Provisional					

Source: Handbook on Fisheries Statistics, Orissa, Cuttack.

The highest fish landing was 10286.34 tons during 2003 - 04 and the lowest was 1056.00 tons during 1995- 96. The highest shrimp landing was 6413.91 tons during 2011-12 and the lowest was 136.93 tons during 1998 – 99. The highest crab landing was 358.26 tons during 2011 – 12 and the lowest was 3.00 tons during 1994–95 (Table 2)**.** Similarly the total fish, shrimp and crab landing was highest being 14053.22 tons during 2003-04 and the lowest being 1274 ton in the 1995-96.

The annual growth rate of fish, shrimp and crab landing from Chilika lagoon is represented in Table – 3. From the table it is observed that the percentage of growth rate of fish was highest being 59.94 during 2001-2002 and the lowest was being -125.91% during 1994 – 1995 (Nayak & Padhi 2006). The percentage of growth rate of shrimp was highest being 83.16% during 2000-01 and the lowest was being – 289.77% during 1994– 95. Similarly, the percentage of growth rate of crab was highest being 90.35% during 2000 – 2001 and the lowest was being -266.67% during 1994– 95. A sharp decline has been observed in the quantity of fish, shrimp, and crab landing due to the fall in salinity (Rajawat *et al.* 2007). High fish, shrimp and crab production have occurred in the Chilika lagoon due to increased in salinity after opening of new mouth during 2000-01and subsequent years.

There is also increase and decrease of fish production in Orissa is represented in Table-4. The brackish water fish production was highest being 30062 tons during 2011 – 2012 and the lowest being 10442 tons during 1999 – 2000, in marine fish production it was highest being 156081 tons during 1997 – 1998 and the lowest fish production was 53581 tons during 1985 – 1986. Similarly the total fish production including both brackish and marine was highest being 410144 tons during 2012 – 2013 and lowest being 108708 tons during 1985 – 1986 (Nayak & Padhi 2006).

CONCLUSION

This paper describes a comparative review on fishery production in Chilika as well as in Odisha by taking 30 years of survey data from 1985-86 to 2013-14. The High fish, shrimp and crab production had observed in the Chilika lagoon after 2000-01. The highest fish, shrimp and crab production had recorded in the year 2003 – 04 and 2011 – 12 respectively. This may due increased in salinity after opening of new mouth called Sipakuda during 2000 and Gabakunda in the year 2008. The brackish water fish production in Orissa showed highest in the year of 2011-12 but the marine fish production marked highest in the year 1997 – 1998. To improve the present status of fishery resources of Chilika lagoon some conservation measures should be taken. The measures such as collection of fish and shrimp seeds from the lagoon should be stopped. Dredging operation should be done continuously in the lagoon to avoid the siltation and decrease in the depth of the lagoon. To avoid soil erosion plantation of mangroves and casuarinas should be taken up by the Government on long term basis. Limited number of motorized boats should be allowed to operate in the lagoon. Processing plants and ice plants set up along the shore of the lagoon release waste water into the lagoon causing pollution in the water. So the release of untreated sewage water in to the lagoon should be avoided to stop pollution of the lagoon.

ACKNOWLEDGEMENTS

The Authors are thankful to Chilika Development Authority and the Fisheries Department, Government of Orissa, Cuttack for pertaining the secondary data on fisheries.

REFERENCES

Banerjee, A. C. and Roy Choudhury, N. C. (1996). Observation of some physicochemical features of Chilika Lake. *Indian Journal of Fisheries* 13: 395 – 429.

Bhatta, K.S. and Panda, S. (2008). Post Hydrological Changes in Landing of Fishery Resources in Chilika Lagoon. *Proceeding of Taal: 2007: The 12th World Lake conference:* 1894-1902

Blanford, W. T. (1872). Sketch of the Geology of Orissa. *Rec .Geol. Surv*. *India*. 5:56.

Dean Saaltink (1991). Chilika Lake Conservation and development project, Orissa, India, Project Identification Mission, India program, Asia Branch, Canadian International Development Agency: 1 – 13.

GoO. (1997). *Handbook on Fisheries Statistics, Orissa*, 1996 – 1997, Directorate of Fisheries, Government of Orissa, Cuttack: 2 – 11.

Gopikrishna, B., Sinha, J. and Kudale, M.D., (2014). Impact on salinity of Chilika Lake due to changes in the inlet system. *Indian Journal of Marine Science,* 2014, Vol. 43 (7).

Gupta, M. (2014). Tide-induced geometrical changes in Chilika lagoon using remote sensing. *Current Science*, 107(1), 63.

Jhingran, V. G. (1991). *Fish and Fisheries of India*, 3rd Edn, Hindustan Publishing Corporation, Delhi: xxiii + 327.

Mohapatro, A., Mohanty, R. K., Mohanty, S. K., Bhatta, K. S. and Das, N. R. (2007). Fisheries enhancement and biodiversity assessment of fish, prawn and mud crab in Chilika lagoon through hydrological intervention. *Wetlands Ecological Management, Springer Publication.*15:229-251.

Nayak, L. and Behera, D. P. (2004). Seasonal variation of some physicochemical parameters of the Chilika lagoon (east coast of India) after opening the new mouth, near Sipakuda. *Indian Journal of Marine Sciences*, .33(2):206-208.

Nayak, L. and Mohanty, A. (2006). Impact of new mouth on the physicochemical parameters of Chilika lagoon. *Seminar proceeding and papers on Environmental Management of Chilika lake and its importance on tourism*: 34 – 41.

Nayak, L. and Padhi, P. (2006). Present status of Fishery resources of Chilika lagoon and its Conservation. *Seminar proceeding and papers on Environmental Management of Chilika lake and its importance on tourism*: 21 – 29.

Panigrahy, J. K. (2003). Environmental Impact Assessment on the Fishery Resources of Chilika Lake, Ph.D. thesis submitted to the Utkal University, Bhubaneswar, India: 346.

Rajawat, A. S., Gupta, M., Acharya, B. C. and Nayak, S. (2007). Impact of new mouth opening on morphology and water quality of the Chilika Lagoon – a study based on Resourcesat-1 LISS-III and AWiFS and IRS-1D LISS-III data. *Int. J. Remote Sensing*, 2007, 28, 905–923.

Rajendar, N., Sanjeevi, S. B., Khan, S. A., Balasubramanian, T. et al. (2004). Ecology and Biodiversity of Eastern Ghats – Estuaries of India. *EPTRI – ENVIS Newsletter.*10 (3): 2-8.

Roy, A., (2001). Ecological investigations on the plant resources of Lake Chilika, Orissa, India. PhD thesis, University of Calcutta.

Venkataratanam, K. (1970). Formation of the barrier spot and the other sand ridges near Chilika Lake on East Coast of India. *Marine Geol*. 9: 101 – 116.

Corresponding author: Dr. Satyabrata Das Sharma' P.G. Department of Marine Sciences, Berhampur University, Berahmpur-760007, Orissa, India.
Email: sbdsharma1984@gmail.com
Mobile no. 9861229849