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Full Length Research Paper

Human Impact on Olive Ridley Turtles at Rushikulya: An Assessment of Coastal Water Anthropological Factors

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The olive ridley turtle (*Lepidochelys olivacea*) is known for its spectacular mass nesting behavior. The Rushikulya river mouth has emerged as one of the major mass nesting site in the world. To study the status of hydrological characteristics viz. depth, air and water temperature, salinity, conductivity, pH, total suspended solid, turbidity, dissolve oxygen, biochemical oxygen demand, nutrients (NO_2-N, NO_3-N, (NH_3+NH_4)-N, SiO_3 and PO_4-P), petroleum hydrocarbon and dissolved trace metals such as Pb, Cd and Hg are evaluated in mass nesting period of olive ridley turtles at Rushikulya mass nesting site. In order to evaluate the status level of the pollutants and ultimately to protect the precious marine environment, an intensive monitoring has been carried out near Rushikulya, Gopalpur, Chatrapur and Haripur Creek of mass nesting site. The basic scientific objective of the present study is to determine the concentration, migration pattern and dynamics of the pollutants in the estuary and coastal environment.

Key words: Environmental pollution, water quality, trace metals, olive ridley (*Lepidochelys olivacea*), Rushikulya mass nesting site.

INTRODUCTION

Orissa is a maritime state of India having coastline length about 482 km. This coastal track is bestowed with many diversified and complex ecosystems such as estuaries, coastal lagoons, mangroves, creeks, sandy beaches and mud flats. The variety of habitats with their rich species and genetic biodiversity had attracted the attention of naturalists for conservation of different flora and fauna, particularly those that have socio–economic relevance and ecological significance. The olive ridley sea turtle (*Lepidochelys olivacea*), recognized as an endangered species by International Union for Conservation of Nature (IUCN) and constitutes an important species of wild fauna of this coast.

Olive ridley is widely distributed and more abundant species of sea turtles found in the world. A large proportion of its population breeds synchronously at only a few rookeries in Mexico, Costa Rica and on the east coast of India (Pritchard, 1997). Olive ridley turtles come to the coastal waters of Orissa during Nov-March every year and mass nesting takes place during January to March. The three mass nesting sites, also known as rookeries are Gahirmatha, Devi and Rushikulya (Mohanty et al., 2008). A number of studies on the biological aspects viz., size of nesting population, inter-beach nesting, hatching success, size-class characteristics of nesting populations, nearshore reproductive conger-gations, microsatellite conservation etc, have been well documented for these populace (Das and Kar, 1990; Pandav et al., 1994a; Pandav and Choudhury, 2000; Shanker et al., 2003). However, information on anthropo-genic influences in coastal water quality on their mating, nesting and hatchlings which is considered to be an important factor was not evaluated. This paper attempts

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to explain the anthropogenic influence in coastal water quality on the turtle population.

Study area

The extensive sandy beach near Rushikulya river mouth is known worldwide as the mass nesting site of the olive ridley sea turtles. The Rushikulya rookery claims as the third largest rookeries in the world. Thousands of turtles congregate in the nearshore waters of the study area during every winter for mass mating. The study area (long 84°91'- 85°13' N and lat 19°24' - 19°44'E) encompasses with the area sector Rushikulya estuary and at Gopalpur (Figure 1). The topography of the area has undergone many recognizable changes during the past one decade. The backwater of Rushikulya estuary runs parallel to the nesting beach of about a distance of 1 km Northward and forming a lagoon on its own. This lagoon is connected with the Chilika Lake through the Palur canal.

Sea turtle nesting and the availability of turtle eggs in this locality was first reported by Panigrahy et al. (1990). Later 2 km long the sandy beach to the North of Rushikulya River mouth has been identified as a major nesting ground of olive ridley(Pandav et al., 1994a, b).

The beach is relatively free from anthropogenic influences as the human settlements include. Those living in two fishing villages viz. Purunabandha and Paliabandha, the major fish landing centers close to the rookery are Gokharkuda, Kantigada and Nuagan. The other features of this area are the presence of abandoned prawn fields behind the nesting beach and presence of a Chloro-alkali plant, which discharges effluents directly to the estuary.

MATERIALS AND METHODS

Water samples were collected from coastal area 0.5, 1 and 2 km from coastline along four transect namely off Haripur creak (H_0, H_1 and H_2), off Gopalpur port (G_0, G_1 and G_2), Off Chatrapur (C_0, C_1 and C_2) and off Rushikulya (R_0, R_1 and R_2). The station locations were identified field using Global Positioning System (GPS) and the sampling was carried out using mechanized boats. Collections were made during the turtle breeding season 2006.

Surface water samples were collected using a clean plastic bucket and stored in acid cleaned polythene bottles. The number of replicates for each sample was. The water quality parameter like Water Temperature (WT), pH, Salinity, Conductivity, Total suspended Solid (TSS), Turbidity, Dissolved Oxygen(DO), Biochemical Oxygen demand (BOD), Nutrients Such as NO_2-N,NO_3-N, (NH_3+NH_4)-N, SiO_3 and PO_4-P, Petroleum Hydrocarbon (PHC), and dissolved toxic metals like Pb, Cd and Hg were analyzed using standard methods of APHA, 1998. The water quality parameter like temperature, pH, Salinity, Conductivity, Turbidity, Dissolved Oxygen (DO) were measured immediately at onboard using battery operated water quality checker (Model No. WQC-22A). Depth and air temperature were measured by rope with heavy weight and thermometer respectively. Analysis of BOD and nutrients: NO_2-N, NO_3-N, (NH_3 + NH_4)-N, SiO_3 and PO_4-P were carried out using standard procedure (USEPA, 2000; Von den Berg, 1990). The dissolved metals were estimated using Perkins Elmer-3110 AAS. A separate digestion was carried out for Hg using aquarigia and analyzed in flame less mode of AAS. Filtration of water samples for suspended solids and extraction of petroleum hydrocarbon to an organic solvent were carried out on board.

RESULTS AND DISCUSSION

The water quality characteristics of an aquatic environment arise from a multitude of physical, chemical and biological interaction. The spatial variation of water quality parameter with their maximum, minimum, average and standard deviation at different station and along Rushikulya mass nesting site submerged in Table 1.

The depth (m) around the study area varied from 2.80 to 14.5 with an average of 8.88 and it shows increasing trend towards offshore stations. The air temperature (°C) varies from 29.1 to 33.3 with an average of 31.68 and the water temperature (°C) from 29.3 to 33.20 with an average of 31.31. No significant variation was found in air and water temperature. Salinity (PPT) values ranged from 20.2 to 35.4 with an average 31.58. Salinity showed a clear increasing trend towards the sea from the near shore stations. The low salinity value at stations R_0 and H_0 is due to fresh water run off by the Rushikulya River and Haripur Creek respectively. Conductivity (millimoh/ cm) ranged from 33.50 to 57.10 with an average value of 50.58 and the conductivity of the study area has increased towards offshore along with the increases of salinity. The pH value of the study area lied between 7.22 to 8.47 with an average value of 8.10. It is well within the permissible limits required for aquatic life. The pH value is low at station R_0 due to the influence of industrial discharge containing acidic substances. The low pH and high bacterial activities in the near shore water adjacent to the chloro-alkali plant may have deleterious effects to the turtle population and their forage and fauna. Total Suspended Solid (mg/l) ranged from 7.98 to 98.30 with an average value of 22.81. Higher values were found at station H_0 which could be due to high suspended load derived from Haripur creek. The turbidity (NTU) of the water column ranged from 0.40 to 12.00 with an average value of 2.58. Highest value was reported at station R_0, which was associated with the river water.

The Dissolve oxygen is critically important for aquatic life. The DO (mg/l) value showed a wide range of variation and ranged from 5.92 to 8.12 with an average of 7.26. The DO concentration in all the stations except G_0 is within the permissible limit. The low DO at G_0 station indicates a possible high organic load from Gopalpur port. The BOD (mg/l) also exhibited wide range of variation with value ranging from 0.83 to 3.80, an average of 1.79. The high BOD value at stations G_0, R_0 and R_1 could be due to the influx of organic sewage from the respective town ships. The BOD concentration of the mentioned stations exceeds the permissible limit and as

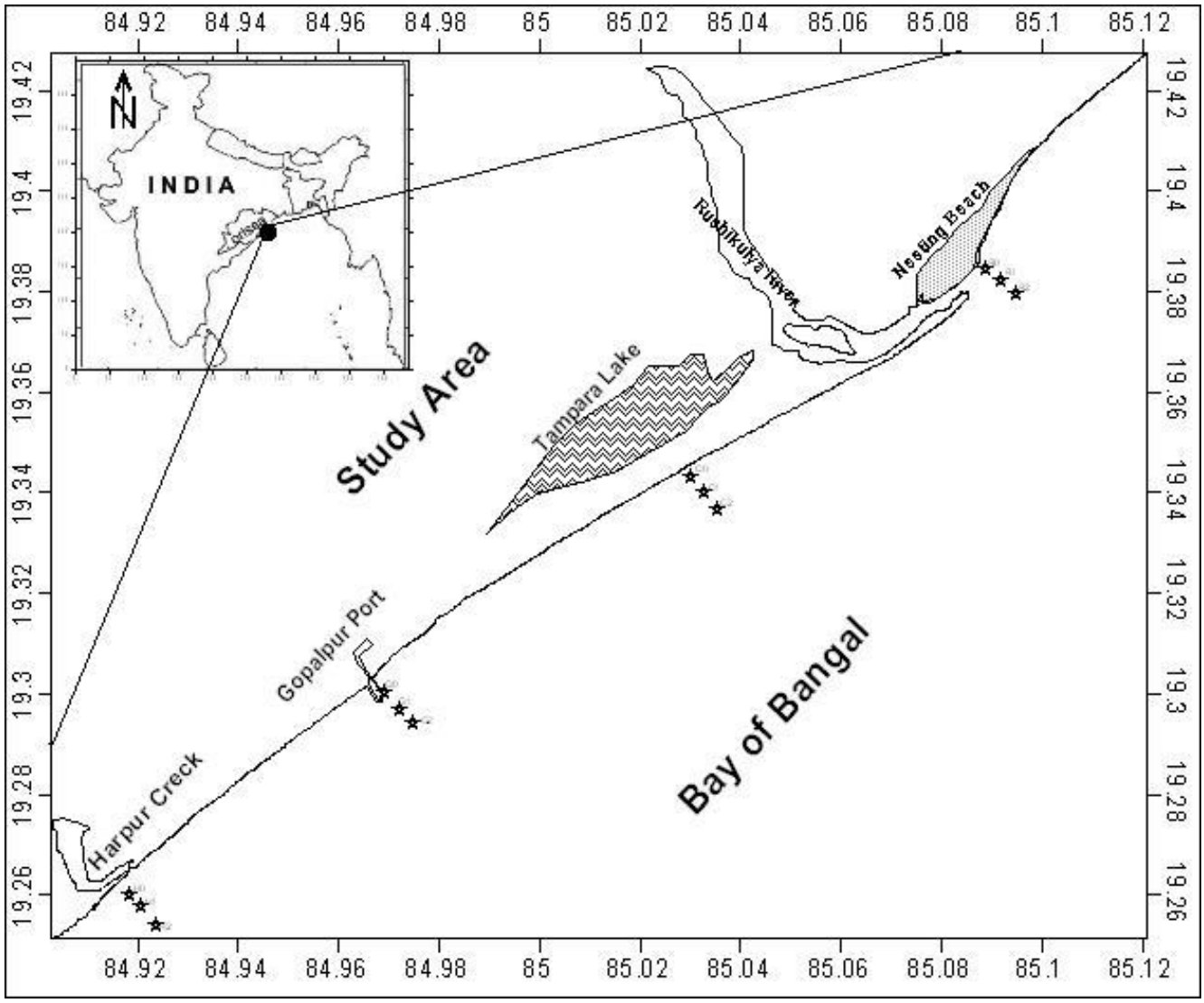

Figure 1. Station location map.

such can be considered harmful to the turtles. The anthropogenic influx of organic pollutants into Gopalpur port area are confirmed by high BOD and low DO earlier (Das et al 1997; Nayak et al., 2001; Pradhan et al., 1998).

The concentration of nutrients (Nitrite, Nitrate, Ammonia, Silicate and Phosphate) showed significant variation. Nitrite (µmol/l) ranged between 0.27 to 1.94 with an average value of 0.66, Nitrite is most unstable and it always indicates the fresh input of organic load into water system. High value at G_0 could be attributed to the addition of municipal sewage loads, the main source of organic matter by the river to the sea.

Nitrate (µmol/l) ranged between 1.22 to 25.27 with an average value of 4.53. High Nitrate value was found at station G_0 is due to anthropogenic activity. Ammonia (µmol/l) ranged from 1.08 to 14.7 with an average 3.28. Ammonia value was high at station H_0 which could be due to addition of agriculture run off via the Haripur creek.

Silicate (µmol/l) varied between 1.85 to 6.87 with an average value of 3.52. The high silicate value was found at stations G_0, H_0 and R_0 justifying its input from more slicious mattrials gathered from its catchments area as were reported earlier (Bhattachary et al., 2002; Bramha et al., 2008; Goud and Panigrahy, 1992; Pai and Reddy, 1981; Sharma and Ghose, 1987). The phosphate (µmol/l) ranged between 0.34 to 7.39 with an average value of 1.99. High value of phosphate at station H_0 could be due to municipal sewage and industrial effluents entering in the coastal belt.

The PHC revealed wide variation. The PHC (mg/l) ranged from 0.28 to 2.56 with an average 0.89. The petroleum hydrocarbon concentration at Gopalpur port was much higher in comparison to the other stations. It is

Table 1. Maximum, minimum, average and standard deviation of water quality parameter of the study area.

Parameter	Unit	Gopalpur port				Haripur creek				Chatrapur				Rushikulya river			
		Max	Min	Ave	Std	Max	Min	Ave	Std	Max	Min	Ave	Std	Max	Min	Ave	Std
Depth	mt	12.50	4.00	8.67	4.31	10.50	2.80	7.03	3.91	14.50	9.00	11.63	2.76	12.50	3.50	8.20	4.51
Air temp	°C	30.80	29.10	30.13	0.91	32.80	31.20	32.20	0.87	33.30	30.20	32.00	1.61	33.30	0.87	27.72	10.34
Wat. temp	°C	30.90	30.50	30.67	0.21	32.60	31.00	31.63	0.85	33.20	31.20	31.97	1.08	33.20	0.21	27.57	10.41
Salinity	ppt	35.20	25.30	31.73	5.58	35.00	22.90	30.17	6.41	35.40	34.90	35.13	0.25	35.40	0.25	28.21	10.48
Cond.	millimoh/cm	57.10	41.30	50.83	8.39	56.90	37.70	47.13	9.60	57.10	55.10	56.10	1.00	57.10	1.00	45.22	16.77
pH	--	8.47	8.02	8.20	0.24	8.23	8.15	8.19	0.04	8.16	8.15	8.15	0.01	8.47	0.01	7.14	2.73
TSS	mg/l	22.40	14.80	18.66	3.80	98.30	7.98	41.58	49.40	15.31	8.63	11.65	3.39	98.30	3.39	23.74	25.60
Turbidity	NTU	1.10	0.40	0.67	0.38	3.40	2.20	2.80	0.60	3.90	1.20	2.30	1.42	12.00	0.38	2.14	2.39
DO	mg/l	8.12	5.92	7.30	1.20	7.34	6.75	7.13	0.33	7.29	7.06	7.19	0.12	8.12	0.12	6.37	2.31
BOD	mg/l	3.80	1.35	2.27	1.34	3.35	1.16	1.90	1.25	1.38	0.83	1.02	0.31	3.80	0.31	1.73	0.98
Nitrite	∝mol/l	1.94	0.83	1.23	0.62	0.83	0.32	0.51	0.28	0.57	0.39	0.49	0.09	1.94	0.09	0.67	0.47
Nitrate	∝mol/l	25.27	3.06	10.55	12.75	5.08	1.55	2.77	2.00	2.81	2.21	2.44	0.32	25.27	0.32	5.22	6.77
Ammonia	∝mol/l	7.95	1.95	4.85	3.00	14.70	1.31	5.79	7.72	1.28	1.09	1.17	0.10	14.70	0.10	3.76	4.13
Silicate	∝mol/l	4.08	3.26	3.62	0.42	4.75	1.85	2.85	1.65	3.78	3.25	3.58	0.29	6.87	0.29	3.15	1.41
Phosphate	∝mol/l	3.48	1.88	2.46	0.88	7.39	0.48	2.85	3.94	1.84	1.34	1.56	0.26	7.39	0.26	2.18	1.89
PHC	∝g/l	2.56	0.42	1.22	1.17	1.22	0.96	1.07	0.14	0.53	0.28	0.42	0.13	2.56	0.13	0.87	0.65
Pb	∝g/l	0.11	0.05	0.09	0.03	1.44	0.27	0.94	0.60	0.20	0.07	0.14	0.07	2.47	0.03	0.48	0.61
Cd	∝g/l	1.17	0.08	0.61	0.55	0.37	0.07	0.24	0.15	1.16	0.52	0.78	0.34	1.17	0.07	0.50	0.36
Hg	∝g/l	0.83	0.22	0.48	0.32	0.11	0.08	0.09	0.02	0.65	0.46	0.58	0.10	1.04	0.02	0.39	0.29

due to fishing activities by the mechanized boats and trawlers. After the port is converted to an all weather port, PHC concentration would increase further which will be harmful to turtles.

The quantification of metal concentration in the coastal water was attempted through the calculation of enrichment ratio (Frostner and Wiltmann, 1979). The trace metal concentrations among the stations are Pb (mg/l) 0.05 to 2.47 with an average 0.67; Cd (mg/l) 0.07 to 1.17 with an average 0.49 and Hg (mg/l) 0.07 to 1.04 with an average 0.44. The Hg level at station R_0 was higher and beyond the permissible limit. The high Hg content is likely to affect the soft tissues of the newly born baby turtles. The high concentration of Hg in exchangeable fraction was usually posses high environmental risk to the aquatic biota. The high Hg could be ascribed to the release of Hg rich effluents into the sea from the estuary. Relatively high values of Pb, and Cd were also found at station R_0, which could be assigned to their addition from weathering action of catchments basin upstream region of the Rushikulya River. However, they are well with in the permissible limits.

Conclusion

Rushikulya rookery is one of the most intensive in the world and needs to protect from the anthropogenic influences. Measures should be taken up urgently to conserve the turtle population which is facing serious threats to its survival due to toxic pollutions and rich Nutrients draining from industries viz: chloro alkali plant, Indian Rare

Earth Ltd: massive coastal aquaculture, salt industries domestic sewage and small scale industries along the coastal area. This greatly enhances the conservation value of this population. It is clearly of all most importance that the present study needs immediate attention and priority measures. The Government of Orissa has taken initiative to activate the Gopalpur port fair weather port to all weather port. This is because of exploiter drilling activity by oil industries like ONGC, RIL and GAZRROM. In addition the Government of Orissa has singed MOU with Russian company to make collaboration or a Titanium Dioxide plant near to the coast. Such the rapid industrial growth may lead to alter the environmental set up of the study region. Moreover, the environmental adverse impact on turtles and their habitat may not be ruled out. It is therefore urged upon for immediate attention to evaluate the environmental status of the present study area. Intensive environment awareness involving the environmentalist, NGOs, people participation and policy maker is the need of the hour for the effective implementation of the conservation as well as protection measures.

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