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Water quality assessment of River Ganga for conservation of Gangetic dolphins (*Platanista gangetica*) at Garhmukteshwar

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Abstract

82 km stretch of River Ganga from Garhmukteshwar to Narora has been declared as Ramsar site because it inhabits rare and endangered Gangetic dolphins (*Platanista gangetica*). Dominance of Molluscs and Annelida communities of benthic macroinvertebrates provide proper feeding habitat for dolphins at more than 10-20 meter depth in River Ganga. Gangetic dolphin preferred a high level of flow velocity in River Ganga at Garhmukteshwar. Dolphins were commonly observed in biological water quality of moderate pollution (Class 'C'). Habitat degradation due to construction of dams/ barrages, extraction of water, siltation, pollution due to hazardous chemicals and other human activities are the main causes of its decline in the river.

Keywords:- *Habitat, Benthic macro-invertebrates, Endangered, Bio-monitoring*

Introduction

The Gangetic dolphin (*Platanista gangetica*) is one of the most rare and endangered species. The Ganga Action Plan had a mandate of conserving the rare and endangered species of River Ganga. The population of the animal distribution from tidal zone to foothill of the Himalayas, is declining very fast. Besides direct exploitation of the animal, the habitat degradation due to construction of dams/barrages, extraction of water, siltation, pollution due to hazardous chemicals (heavy metals, organochlorine pesticides) are the main causes of its decline in the river. A survey of dolphin population in River Ganga, has shown increase in number of Dolphins from 20 to 42 during Year 1993 to 2005 (Behera, 1995; WWF, 1999) in the stretch of River Ganga from Garhmukteshwar to Narora. Recently, 82 km river stretch from Garhmukteshwar to Narora has been declared as Ramsar site because of its bio-diversity and wise used concept. A 295 km stretch of River Ganga between Rishikesh and Narora where WWF-India has been co-ordinating the Dolphin conservation programme. This wetland area covered under the study is about 16,780 kms in U.P. and Uttarakhand states. 82 km river stretch from Garhmukteshwar to Narora inhabit not only rare and endangered Gangetic Dolphins but some of the migratory and resident birds have also been observed in the stretch of river Ganga at Garhmukteshwar. Rising from the icy caves of Gangotri glacier at the height of 4255 m above mean sea level, River Ganga starts its long journey to join River Alaknanda and becomes Ganga near Devprayag. Ganga is the longest river (2,525 km) and has largest river basin (861,404 km^2) in India. The main stretch of River Ganga runs from Haridwar to Allahabad through over Nagal, Bijnor, Garhmukteshwar, Hasanpur, Anupshahar, Narora, Sahaswan, Kasgang, Ptiali, Kampil, Kaimgang, Fatehgarh, Kannauj, Bihaur, Brahmavart, Kanpur and finally Allahabad. At Allahabad it joins with a major tributary River Yamuna and thereafter passing through Banaras, Patna. At Ganga sagar in West Bengal, it joins Bay of Bengal.

Garhmukteshwar is a holy place situated on the banks of holy river Ganga in Ghaziabad district in Uttar Pradesh, India. River Ganga is considered as holy and sacred and is subjected to flow of pilgrims

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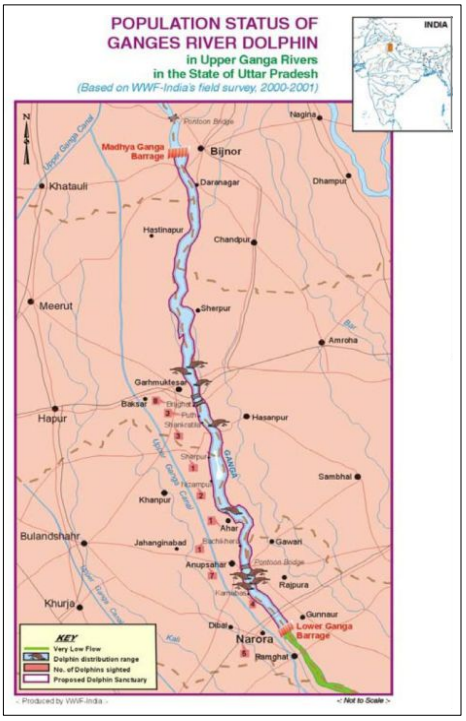
through out the year, who not only take bath but also dump the things like flowers, ash and bones of dead bodies *etc.* affecting the water quality.

Haridwar is a well known pilgrim-place and is situated in Uttarakhand, around 200 kms from Delhi. During mass bathing on religious occassions like Kumbh, Ardh Kumbh mela *etc.*, huge amount of bleaching powder is added for chlorination of river water for disinfection during bathing. The analysis report for various samples found residual chlorine in the range 35.30 to 35.88 mg/l (PCRI report, 1998). Chlorine input has a definite role in formation of Dioxine and Furan therefore, minimization of chlorine input is required. The levels of PCDD and PCDF in Indian fishes, meat and wildlife samples have been found in the order: Country chicken<Fat bodies of goat/lamb<Fishes<River Dolphins<Predatory birds. Due to hydrophobic properties and scarce water solubility, dioxin and furans remain adsorbed on the surface of suspended particles, which settle fast to bottom substrate (CPCB, 2004) and consumed by dolphins through feeding on benthic animals. The method of bio-monitoring is based upon proper establishment of biological communities of benthic macro-invertebrates on natural substratum of river (Hellawell, 1978). Unlike fish, benthos cannot move around much so they are less able to escape from the effects of sediment and other pollutants that diminish the water quality. Therefore, benthos can give us reliable information on river water quality at various habitats of Gangetic Dolphins in River Ganga.

Materials and Method

Five locations namely, Rishikesh, Hardwar, Bijnor, Garhmukteshwar and Narora, have been selected on a 295 km stretch of River Ganga for present study (Map 1). Based on substratum composition of river bed of River Ganga (Fig. 5), various sampling devices were used for collection of benthic macro-invertebrates.

Stony River bed: At Rishikesh and Hardwar, the river bed substratum composed of mainly, boulders, cobbles, pebbles and gravels. Benthic macro-invertebrates were collected by picking up large boulders and cobbles randomly from the fast flowing shallow



Map 1:- Different sampling site

stream and placing the sampling net firmly on the stream bed against the flow and kicking up the stream bed by foot for collection of animals in the net.

Sandy, mud and silty bed: At Bijnor, Garhmukteshwar and Narora, grab samples were picked up by shovel, from the river bed and the samples were washed in the sieve, by river water.

Water Plants: At Garhmukteshwar downstream and Narora barrage, the floating and submerged plants were uprooted and collected into sampling net and placed on sieve for collection of benthic invertebrates.

Benthic macro-invertebrates were identified up to family/genus level for Saprobic score and Diversity Score for water quality evaluation using Biological Water Quality Criteria (LATS/13/1998-99).

The MINARS data of physico-chemical parameters was collected for the study (MINARS/14/2001-2002, 1998), (MINARS/24/2006-07, 2004).

Results and Discussion

The Ganges river dolphin is a unique endangered freshwater cetacean, which is completely blind. The only designated protected area for these dolphins, the Vikramshila Gangetic Dolphin Sanctuary in Bhagalpur, Bihar. It is possibly one of the few places in the Ganges river system where an almost intact assemblage of Gangetic floodplain vertebrates is still seen. The Vikramshila Sanctuary is a 65 km river stretch lies in Bhagalpur and Khagaria districts in Bihar. The nearby towns of Sultangang and Kahalgaon are places of Pilgrimage for Hindus. Dolphins can be easily viewed from the Barari bridge or from the Sultanganj and Kahalgaon ghats (Kelkar, 2009). Habitat of Gangetic Dolphin, has been recently identified in River Ganga at Garhmukteshwar. Presence of benthic macro-invertebrates in the gut content of dolphin suggested its feeding habit dependence on benthic invertebrates. The seasonal variation in habitat of benthic invertebrates at river bed substratum of Ganga, varied with respect to sampling locations. Maximum number of benthic macro-invertebrates was collected during winter and summer at Patna and lowest at almost entire stretch during post-monsoon. Among all the taxa of benthic macro-invertebrates, Oligochaetes were found in highest abundancy in winter compared to summers. Among Arthropods, abundancy of insects increases during winter and Gastropods and Pelycypods and Polychaetes increased during summer Buxar, Patna and Rajmahal were most suitable locations on River Ganga, for habitat of crustaceans in winter and summer (Fig. 1). However, Fig. 2 indicated dominance of arthropods in the upper stretch of River Ganga from Rishikesh to Narora Barrage. In this stretch, dolphins were observed only at Garhmukteshwar having comparatively lower dominance of arthropods. The arthropod communities significantly lowered from Buxar to Farakka.

Distribution of major taxa of benthic macro-invertebrates from entire stretch of River Ganga from Rishikesh to Farakka indicated dominance of Arthropods gradually reduced from upstream to downstream. On the contrary, percentage of molluscs and annelids increased from upstream to downstream reaches of River Ganga (Fig. 2).

A comparison in physico-chemical water quality of River Ganga at Garhmukteshwar indicated lowering in BOD and increase in COD values whereas pH and DO values remained unchanged from year 1998 to 2008 (Fig. 3). DO values of 5.60-8.40 mg/l and BOD values of 1.70-15.50 mg/l in 1986 has been compared with DO values of 4.70-8.60 mg/l and BOD of 1.00-5.50 mg/l in 2005, for water quality on main stream of River Ganga under Ganga Action Plan (Annual report, 2005-06).

Heavy metals only contributed traces of Iron and Zinc to water quality and sediments of River Ganga at Garhmukteshwar. Studies have indicated that there was significant reduction in Coliform count in River Ganga at Garhmukteshwar during 2004 to 2006. Reduction in saprobic score and increase in diversity score from 2004 to 2009 indicated increased abundancy of tolerant benthic macro-invertebrate at Garhmukteshwar (Table-1). Present studies have indicated that Dolphins were commonly observed in biologicalwater quality of Moderate pollution (Class 'C').

Gangetic Dolphin preferred a high level of flow velocity in River Ganga at Garhmukteshwar. The flow in river was lowest at upstream Narora due to barrage (Fig. 4).

From Haridwar downstream the river bed substratum was mostly sandy and macrophytic vegetation dominated near the barrage area at Narora (Fig. 5).

The taxonomic composition of River Ganga at Garhmukteshwar indicated dominance of Arthropod communities compared to molluscs and annelids (Table-2).

Depth of water body at Garhmukteshwar was more than 20 meter only at a small stretch where the dolphin has been observed compared to other habitats of dolphins in River Ganga such as Patna. At Patna where the maximum dolphins have been counted, the composition of benthic macro invertebrates indicated dominance of Molluscs and Annelids compared to rest of the locations. Highest number of Oligochaetes at Patna during winter and

Table-1: Bio-monitoring of River Ganga for water quality status of Gangetic Dolphins at wetland of Garhmukteshwar (January-February, 2009)

Location of River Stretch/ Date of Sampling	Temperature (^{0}C)		pH	Saprobic Score	Diversity Score	BWQC	Biological Water Quality
	Air	Water					
Muni ki reti near water intake point, Rishikesh	-	12.50	7.00	7.10	0.66	A	Clean
Saptrishi ghat, near Jaiguru shri Ramanandacharya ghat, Hardwar	-	15.50	8.00	6.50	0.43	B-C	Slight to Moderate pollution
Downstream of bridge, Bijnore	-	14.00	7.00	5.77	0.42	C	Moderate pollution
Upstream of Brijghat,Garhmukteshwar	17.00	18.00	7.00	4.40	0.85	C	Moderate pollution
Downstream Brijghat,Garhmukteshwar	18.00	18.00	7.00	5.34	0.629	C	Moderate pollution
Upstream of Ch. Charan Singh Barrage, Narora	20.00	19.00	7.50	5.29	0.81	C	Moderate pollution
Ramghat, downstream barrage, Narora	24.00	19.00	6.00-7.00	5.46	0.61	C	Moderate pollution

Table-2: Taxonomic composition of River Ganga at wetland of Garhmukteshwar

% Taxa	Rishikesh	Hardwar	Bijnore	U/s Garhmukteshwar	D/s Garhmukteshwar	U/s Narora	D/s Narora
Arthropoda (81.25%)	100.00	94.11	88.88	66.66	80.00	70.58	66.66
Annelida (2.08%)	0.00	0.00	11.11	0.00	0.00	5.88	0.00
Mollusca (16.66%)	0.00	55.88	0.00	33.33	20.00	23.52	33.33
Platyhelminthes (0%)	0.00	0.00	0.00	0.00	20.00	0.00	0.00

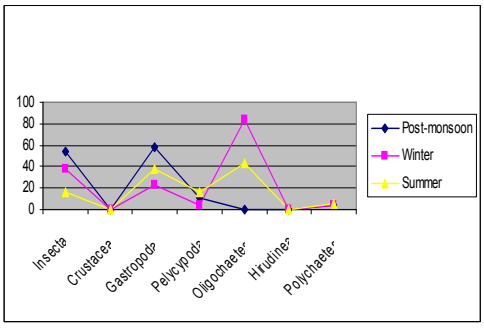


Fig. 1: Seasonal variation in % distribution of benthic macro-invertebrates of River Ganga

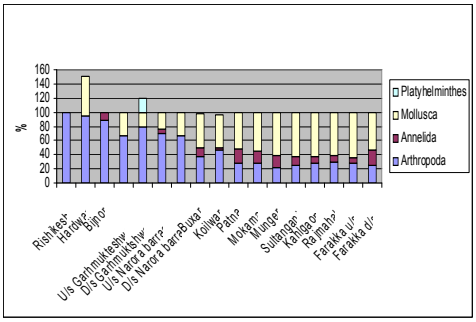


Fig. 2: Distribution of benthic macro-invertebrate texa in River Ganga

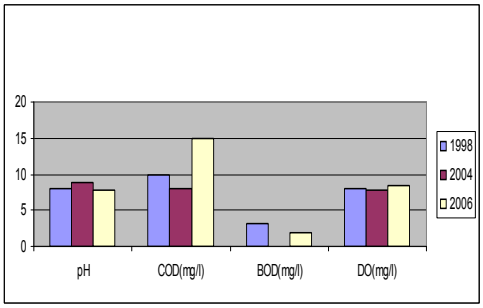


Fig. 3: Average physico-chemical characteristics of River Ganga at Wetland of Garhmukteshwar

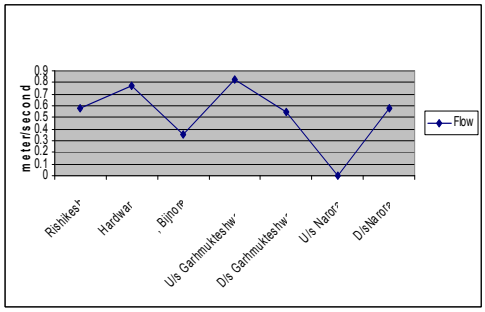


Fig. 4: Flow variation in River Ganga at wetland of Garhmukteshwar

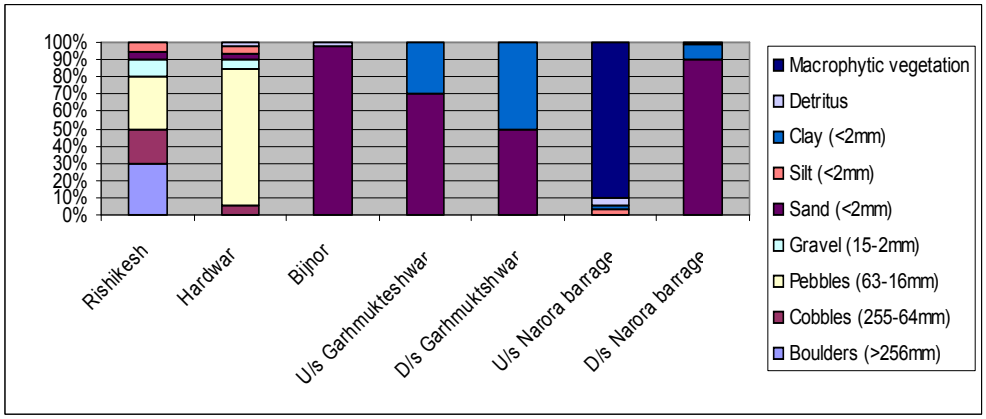


Fig. 5: Substratum composition of River Ganga for Gangetic Dolphins at Wetland of Garhmukteshwar

summers. Normally, Gastropods appeared during summer and postmonson specially in downstream reaches from Munger to Farakka but Koilwar was the most preferred habitat for gastropods during winter season. Palycypods are distributed throughout the stretch but maximum abundance has been observed at Sultangang and Rajmahal during summer season.

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