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Ecological Effect to the Status of the Indus Dolphin

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Abstract: River dolphins are reported as endangered around the world due to the vulnerability of the riverain habitat to increasing pollution and environmental deterioration. Indus dolphin predominantly inhabits the turbid water of the Indus river. The degree of contamination, proximity to pollution source and the metabolic ability of river dolphin suggest that the species are at greater risk from the environmental contamination by the study of heavy metal. Ecological interest in the species developed in the 1970's but approaches reducing the pollution load of the river water particularly in low flow are advocated.

Key words: River dolphin, Indus, status, pollution, heavy metal

INTRODUCTION

The Indus River represents one of the major water distribution systems of south East Asia and is the most important river of Pakistan (Ittekkot and Arain 1986). In Pakistan, like other countries of the world, the level of pollution of fresh water bodies, the especially the rivers, is often no longer within safe limits for human consumption. Earlier base line studies have identified elevated levels of certain trace metals in local fresh water systems, especially rivers and lakes (Jaleel *et al*., 1991; Jaffar *et al*., 2000) arising mainly from agricultural and industrial processes. Water is said to be universal solvent because most of the biochemical reactions take place in it, thus making it essential for all forms of life (Ahmed *et al*., 1989). Surface water is a visible natural resource and is intensively used for various purposes in all countries of the world (Gachal *et al*., 2006). The major sources of surface water contamination are municipal and industrial discharges and agricultural run off. Many tropical countries still use DDT to control malaria mosquitoes and some of this DDT is illegally diverted into agriculture (Gachal and Slater, 2002). Every species saved and many more become threatened and endangered from human activities around the globe. Although the US and other developed countries are now main sources of many global contaminants. Thus surface water pollution is one of the major problems particularly in developing countries. However, the use of potentially environmentally harmful pesticides and artificial fertilizers has increased from 1981 to 1987 (WWF, 1992) because of high yielding varieties were protected chemically and led to the increased use of such pesticides in commercial agriculture sector. In many countries, the treated water from lakes and other sources is being used for drinking and various other purposes. A number of lakes, ponds, marshes, canals and rivers make the ideal wetlands for biodiversity (Gachal and Slater, 2004). If polluted water is not properly treated, it gives rise to serious health problems for human beings, animals and aquatic life (Khan and Khan, 1980). The Indus River is an important source of livelihood of millions of people. It mainly supplies water for drinking purposes to towns and agriculture side along its entire route (Tahir *et al*., 1990). The Indus River system naturally supports a great variety of flora and fauna. Pilleri (1970) described the water quality of the river as good for human consumption as well as the animal life in the Indus River. Dudgeon (1992) showed concern for the water quality of Asian Rivers. Else where Rozengurt (1993) quoted the decline of the Sardine catch due to the ecological degradation of the Nile River in Egypt. Kannan *et al*. (1993) showed the accumulation of heavy metals, organ chlorine pesticides and polychlorinated biphenyls (PCBs) in river dolphins in India. The polychlorinated biphenols, or PCBs, are just such a present day menace. They are chemically related to the organochlorine pesticides and are extremely persistent in Indus dolphin (Gachal and Slater, 2001). Not all of the pollutants that threaten our wildlife and wilderness ecosystems are complex synthetic compounds like the PCBs, Dioxins and organochlorine pesticides. Radioactive elements and heavy metals like lead, mercury, cadmium and arsenic also contaminate waterways and soils. However the some metals toxic in their elemental forms, others are toxic when they are chemically reduced in nature. It was observed that streams of raw sewage entering the river and floating on river surface (Gachal and Slater, 2004). Pilleri (1970) described the river water quality as good aquatic habitat. It was also reported that streams of raw sewage entering the river and floating on river surface (Gachal and Slater, 2004).

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Tariq *et al*. (1996) described the Indus River as a dump house for all types of waste products streaming into river via its tributaries.

The World Conservation Union regards this species as vulnerable (Klinowska, 1991). Smith *et al*. (1994) said the species is threatened by rapid deterioration of the habitat due to pollution, construction of dams and mining and directed and incidentals catch.

The present study is aimed at evaluating the pollution status of the Indus river water samples sediments, fish muscles for heavy metal analysis. Further, Indus river water, sewage and industrial effluents were collected for analysis from Rohri, Sukkur, Guddu locations in the Sindh provinces of Pakistan. It is also a part of this project to explore the ecology of Indus dolphin, which is endemic to the Indus river system to determine the bio magnification effect of the species and the river ecosystem.

MATERIALS AND METHODS

Water samples, fish muscle, sediments were collected from midstream between Sukkur, Rohri and Guddu. The samples for sediments collected from sites using a dredge, each sample was oven dried at 100°C and ground in an agate motar. Fish (prey of dolphine) were captured from sites by using hand nets and oven dried at 105°C. Dead dolphin tissues were temporarily preserved in 5% formalineand then transferred to ethanol before analyses. Heavy metals analysis of water, fish muscle and sediments were done by Gas chromatography, Mass spectrometry program using Rhodium as an internal standard. Dolphin tissues were analysised using Gas chromatography Electron capture detection (GC-ECD). All the analysis of samples were carried by standard method (APHA, 1980).

Further, sediments samples were digested in nitric acid for the analysis of trace metals. The fish muscle samples were digested in nitric acid. Three replicates of all samples were made to allow the calculation of analytical and sample variability. Samples for trace metals were analyzed with internal standard (Rhodium) solution by ICP-MS (Inductively coupled plasma-Mass spectrometry or Perkin Elmer Elan 5000). Water samples were analyzed with same internal standard (Rhodium) solution for trace metals.

RESULTS

Zn concentration varied between 10.70 - 2.50 ppm in the months of May and August from the Guddu thermal site and Sukkur thermal water samples ranged 14.30 ppm in May and Rohri 28.60 ppm.

Zinc concentration in fish muscles was analyzed from Rohri, Guddu and Sukkur locations and found to be 80, 50 and 49 ppm in the month of December 99. Moreover, zinc concentration in sediments of Indus River are analyzed from Sukkur and Guddu locations were 110.3 and 51.65 ppm, respectively.

Copper concentration in water, sediments and fish muscles were evaluated and compared with WHO standard and ranged to be 3.76-0.53 ppm from Sukkur regent and Begari in the month of August and May 99. Sediment copper concentration varied between 9.20, 46.98 ppm from Guddu and mid River in the month of December 99 and fish muscle copper concentration varied between 4 - 8.8 ppm from Guddu and Sukkur in the month of December 99. Chromium in water samples from Guddu and Sukkur in May and August 99 and ranged between 4.13 and 1.35 ppm.

Fish muscle chromium concentration varied between 9.6 and 23 ppm from Sukkur and mid River in the month of December 99. Sediment chromium concentration was determined to be 107 and 64.9 ppm from mid River and Guddu in the month of December 99.

Iron values of fish muscles were determined and varied between 114 and 774 ppm in the month of December 99 from Sukkur and mid river locations. Sediments iron values were found to be 4.52 and 2.89 in the month of December 99 from mid river and Sukkur.

Lead values of water were analyzed and varied between 2.16 and 0.35 ppm in the month of May and August 99 from Guddu and mid river.

Lead concentration in fish muscles varied between 0.6 and 50.6 ppm in December 99 from Rohri and Guddu locations. Sediments lead values were estimated to be 17.72 and 36.3 ppm in the same month from Guddu and Sukkur.

Cadmium values of water were analyzed and were not detected in the Indus water. Only the Sukkur station in the month of August 99 indicated the cadmium 0.053 ppm. Cadmium concentration was also determined in fish muscles and varied between 191 and 96.2 ppm in the month of December 99 from Begari and Sukkur. Cadmium concentration was analyzed in sediments and ranged between 0.08 and 0.18 ppm in the month of December 99 from Guddu and mid river, cadmium was not detectable in Rohri sediments. Arsenic values of Indus water were analyzed and ranged to be 6.37 and 0.16 ppm in the month of May and August 99 from Guddu and Sukkur locations.

Sediment arsenic values were determined and varied between 4.06-10.53 ppm in the month of December 99 from Guddu and mid river.

Cobalt values of Indus water samples were evaluated and variation noted between 0.038-0.64 ppm in the month

Table 1: Comparison of element concentration (ppm) in river, fish and sediments of Indus River from May 1999 to December 1999

	Element	Guddu	Sukkur	Rohri	Begari	M.River	Mean and STD
River	Zn	10.70	14.30	28.26	1.78	2.50	11.54±10.91
	Cu	6.26	0.560	1.920	0.536	0.639	0.85-0.59
	Cr	1.35	1.51	3.60	1.66	1.88	2.00±0.91
	Cd	ND	ND	ND	ND	ND	ND
	As	0.611	ND	5.880	ND	ND	3.24±3.76
	P	6.6	16.6	4402	6.6	ND	1108±2196
	Pb	2.16	0.35	4.51	0.17	0.35	1.508±1.865
	Mg	6.26	6.94	11.66	14.07	5.51	8.88±3.763
	Ca	27.01	37.94	61.19	26.11	29.78	36.4±14.62
	Co	0.626	0.560	1.920	0.536	0.639	0.86±0.60
Fish weight 30 g	Zn	50	49	80	46	66	58.2±14.46
Length 10 cm`	Cu	4	18.8	4.8	8.0	5.4	8.20±6.11
	Cr	14.6	14.4	20.8	16.0	23.0	17.76±3.91
	Cd	125.4	191	140	96.2	122.0	134.92±35.1
	As	1.4	2.2	3.4	4.0	6.0	3.40±1.77
	P	ND	ND	ND	ND	ND	ND
	Pb	50.6	1.2	0.6	0.8	1.2	10.9±22.2
	Mg	821	933.2	1189.5	1036	1250	1045.9±177.2
	Ca	806	2052	3542	13150	6318	5174±4910
	Co	162.6	0.4	0.4	4.0	0.6	32±72
Sediment	Zn	51.65	110.3	100.95	72.50	111.15	89.38±26.30
	Cu	9.20	31.46	40.75	26.45	46.45	30.80±14.40
	Cr	65.42	65.85	86.43	70.62	107.01	79.07±17.80
	Cd	0.08	0.14	ND	0.08	0.18	0.12±0.05
	As	4.06	5.70	9.78	8.19	10.0	7.5±2.6
	P	964.6	1017	885.9	647.8	772	857.5±149.2
	Pb	17.7	36.30	33.74	21.15	24.93	26.76±8.01
	Mg	1.394	1.347	1.593	1.45	1.90	1.537±0.223
	Ca	5.37	5.416	4.623	4.84	5.37	5.126±0.369
	Co	9.69	12	14.71	12.6	18.37	13.47±3.269

ND = Not Detectable

Table 2: Pesticide analysis of Dolphin tissues 1999 (ppm in dry weight)

Metals	ppm
Copper	1.00
Zinc	2.00
Cadmium	0.100
Lead	1.00
Arsenic	2.00
Chromium	1.00
Manganese	2.00

of May and August 99 from mid river and Rohri locations. Fish muscle and sediment cobalt concentration lies between 162.6-0.4 ppm in the month of December 99 from Guddu and Rohri and 18.37-9.69 ppm from mid river and Guddu, respectively (Table 1).

Dolphin tissues biopsy revealed the dry weight concentration of copper as 1.00 mg kg^{-1}, zinc 2.00 mg kg^{-1}, cadmium 0.100 mg kg^{-1}, lead 1.00 mg kg^{-1}, arsenic 2.00 mg kg^{-1}, chromium 1.00 mg kg^{-1} (Table 2). The data have also provided the baseline but more work is needed to provide more replicates in time and space and specific species of fish. However means and standard deviations were calculated for each parameter at each sampling time and provide a measure of the variability of the results between samples.

DISCUSSION

The Indus River represents one of the major water distribution systems of south East Asia and most important river of Pakistan (Ittekkot and Arain, 1986). The Indus River, in Pakistan is one of the world's largest rivers in terms of drainage basin area (970,000 km), discharge and sediment load. The loss of fresh water inputs and release of industrial and domestic waste are probably the most serious ecological threats. Jaleel *et al.* (1991) voiced concern about the deteriorating state of fresh water with respect to metal pollution. Martin *et al.* (1976) recognized that the high trace metal pollution levels in fresh water that could be measured through the use of fish (James, 1985; Norris and Lake, 1984). Chaudhry *et al.* (1999) showed that pollution on River Ravi a tributary of the Indus has caused a drop in fish production of 5,000 tones per year, a consequence of pollution, which will be reflected throughout the food chain.

Trace metal pollution in Indus River water, fish and sediment was evaluated (Table 1 and 2) and indicated high values out side the WHO allowed level. In addition, the trace metals in such waters may undergo rapid changes affecting the rate of uptake or release by sediments (Boudou, 1981) thus influencing living organisms via the water sediment chain. Cu, Fe, Cr, Zn and Cd have been described most dangerous metals in environment are introduced to the food chain by industrial activities, waste and as a by product of fertilizers (Jaffar *et al.*, 2000). The heavy metals and persistent organic pollutants are capable of accumulating in plants and animals. AS they move up the food chain, these contaminants often increase in concentration and become more harmful to wildlife.

Metal concentration in Dolphin prey may be useful to understand trace metal bio-accumulation (Table 2). In general, the concentration levels of various trace metals in fish muscle are comparable with several common fish muscles from various areas of the world (Jaleel *et al.*, 1991). Zhou *et al.* (1994) reported high levels of heavy metal in tissues of finless porpoises from China and indicated the species susceptibility to contaminants.

However, unregulated sewage, industrial effluent and agricultural run off find their way into the Indus River at various places. Consequently, the Indus River acts as a dump house for all types of waste products streaming into it (Tariq *et al.*, 1996). This all leads to high oxygen demand and depletion of oxygen levels in the water body with harmful effects on aquatic life.

The River Indus and its tributaries suffers considerable pollution, some continuous as in the case of sewage and other sources are pulsed, e.g. pesticides and are evident in the bioaccumulation of such substance in the dolphin at the top of the food chain. The increasing need for freshwater for industrial and domestic use is the main reason for the dolphins endangered status (Gachal *et al.*, 2002). It is probable that a more wideranging approach to dolphin conservation might be of more value. If the pollution load of the river can be reduced then it would benefit both human and wildlife dependent upon river. A solution to the pollution problem needs to be relatively low cost. Wherever there is human habitation and/or industry along the river there is a generally untreated foul water discharge into the waterway. In many parts of the world, particularly in Europe and North America polluted waters are treated by passing them through natural or constructed wetlands (Perttu, 1993).

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