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Trace Elements in Fish from the Arabian Gulf and the Shatt al-Arab River, Iraq

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The aquatic environment has been polluted by effluent wastes containing trace metals from human activities. These inputs arise from various treated or untreated municipal and industrial wastes, agricultural runoff as well as inputs from the atmosphere. Their components may alter quantitatively and qualitatively the natural biochemical cycle (Grimanis et al. 1978). Fish which live in polluted waters may accumulate toxic trace elements via their food chains thus possibly endangering human health. In the Arabian Gulf region, recently, vast industrial, agricultural, economic and social developments have taken place, in addition to an increase in population. This may enhance the magnitude of environmental pollution year by year.

No detailed study has been undertaken to assess the concentrations of trace elements in commercial species of fish from the Arabian Gulf and the Shatt al-Arab River, despite the fact that fish are considered an essential part of the diet in the region. Therefore, an investigation was carried out on the concentration of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn in the following fish species from the Arabian Gulf: *Tylosurus strongylurus*, *Eleutheoronema tetradactum*, *Pomadasys arel*, *Platycephalus indicus*, *Ilisha elongata*, *Thryssa hamiltonii*, *Arius thalassinus*, *Acanthophagrus luteus*, *Johnieops sina*, *Liza dussumeiri*, *Hilsa ilisha*, *Nematolosa nasus* and *Otoliths argenteus*, and on species from the Shatt al-Arab River: *Mesopotamichthys sharpeyi*, *Barbus xanthopterus*, *Barbus scheich*, *Aspius vorax*, *Cyprinus carpio*, and *Barbus grypus*. Trace element levels in sediment samples from the area (Figure 1) were also determined since sediments can accumulate different elements and may reflect the extent of pollution by these elements (Thomas 1972).

MATERIALS AND METHODS

Fish and sediments were collected from the Shatt al-Arab River and N.W. Arabian Gulf (Khawr al-Zubair area) during January 1986. The fleshy part of 5-10 fish specimens were sliced off and mixed together. These composite samples were stored in a deep freezer until reaching the laboratory, then freeze-dried and ground with agate mortar. Fish samples (1 g dry wt) were digested according to the procedure described by Goldberg et al.

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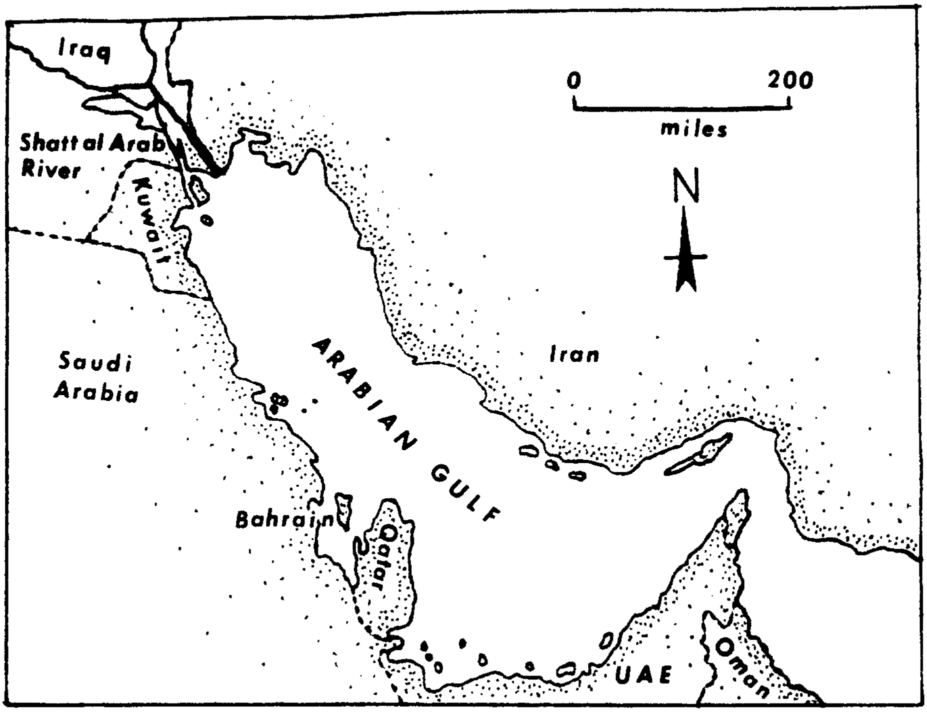

Figure 1. Map of the Arabian Gulf and the Shatt al-Arab River

(1983) in which concentrated HNO_3 and $HClO_4$ were used in Teflon beakers placed on a hot plate. After digestion, residue was redissolved with 2N HNO_3. Sediment samples were obtained by means of a Van Veen grab sampler from representative sites. Trace element analysis was performed on the <63 μm fraction of the sediment which had been separated by sieving after freeze-drying and grinding. Trace elements were digested with concentrated HNO_3, $HClO_4$ and HF in Teflon beakers placed on a hot plate. Only atomic absorption grade acids and double distilled deionized water were used throughout this work.

Blank values were negligible for all elements studied. Standard addition methods were employed whenever necessary to overcome matrix effects. To check the possible loss of trace elements during sample processing, quality control samples containing known amounts of trace elements in fish muscles and sediments, supplied by U.S. Environmental Protection Agency (U.S. EPA) were processed and analyzed. The results of triplicate analyses agreed with the literature values to within 5%.

RESULTS AND DISCUSSION

The mean concentrations, standard deviations of trace elements in fish species studied are presented in Table 1. The mean concentrations of trace elements in sediment samples are presented in Table 2.

Table 1. Trace element concentrations in fish muscles (μg g^{-1} dry wt.) from the Arabian Gulf and the Shatt al-Arab River.

	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
ARABIAN GULF SPECIES										
Tylosurus strongylurus (Forktail needle fish)	0.04±0.02	1.3±0.1	1.5±0.2	5.3±0.3	50.5±5	3.2±0.2		0.02±0.0	2.0±0.3	16.6±0.0
Eleutheronema tetradactum (Fourfingered threadfin)	N.D.	1.3±0.0	0.8±0.0	4.8±0.2	21.9±2	2.0±0.0	3.5±0.1	N.D.	1.4±0.0	8.8±0.1
Ilisha elongata (Elongate ilisha)	N.D.	1.3±0.1	0.5±0.1	5.3±0.1	34.3±2	2.1±0.0	6.8±0.4	N.D.	0.9±0.0	8.8±0.1
Thryssa hamiltonii (Hamilton's thryssa)	0.05±0.01	1.5±0.1	0.2±0.1	4.5±0.3	50.7±7	4.1±0.2	3.3±0.5	0.05±0.1	2.6±0.1	11.4±0.2
Arius thalassinus (Sea catfish)	0.13±0.05	1.0±0.1	0.3±0.1	16.4±0.2	58.5±2	4.8±0.4	0.3±0.1	0.12±0.01	1.9±0.3	22.5±0.3
Acanthopagrus luteus (Yellowfin seabream)	0.05±0.1	1.2±0.0	0.8±0.2	5.2±0.3	55.2±6	6.9±0.2	4.8±0.3	0.5±0.01	4.6±0.2	10.7±0.3
Johnieops sina (Croaker)	0.28±0.01	0.8±0.1	1.0±0.1	5.5±0.2	66.3±1	1.4±0.1	4.2±0.5	0.28±0.10	2.0±0.2	11.4±0.2
Nematalosa nasus (Threadfin shad)	0.09±0.01	1.2±0.1	1.0±0.1	10.5±0.3	83.5±1	3.7±0.2	4.0±0.1	0.09±0.0	1.6±0.1	10.7±0.5
Liza dussumeiri (Mullet)	0.04±0.01	1.2±0.0	1.5±0.0	11.4±0.4	77.5±2	1.0±0.0	1.9±0.2	0.04±0.0	4.5±0.5	9.9±0.1
Hilsa ilisha (Indian shad)	0.01±0.0	0.4±0.0	4.8±0.1	N.D.	51.5±3	1.0±0.1	1.6±0.1	0.39±0.02	5.3±0.1	6.3±0.1

Otoliths argenteus (Silverbanded croaker)	0.01±0.0	0.4±0.1	2.7±0.2	3.1±0.1	38.5±2	5.1±0.3		0.15±0.05	2.5±0.3	10.5±0.0
Cynoglosus arel (Forgue sole)	0.01±0.0	0.5±0.1	2.8±0.1	7.1±0.2	29.4±1	3.1±0.0		0.08±0.0	1.0±0.2	9.0±0.5
Pomadasys argenteus (Silvery grunt)	0.01±0.0	0.6±0.1	2.3±0.0	4.7±0.0	30.5±1	2.1±0.0		N.D.	1.5±0.3	5.9±0.1
Platycephalus indicus (Indian flathead)	0.13±0.02	0.4±0.0	1.3±0.0	N.D.	37.3±2	5.1±0.4		0.21±0.02	2.3±0.4	8.6±0.3
THE SHATT AL-ARAB RIVER SPECIES										
Barbus grypus (Carp)	N.D.	0.8±0.0	5.5±0.1	8.0±0.2	56.0±1	3.4±0.1		0.82±0.01	1.7±0.2	9.5±0.4
Cyprinus carpio (Carp)	N.D.	0.5±0.1	6.7±0.2	6.9±0.3	58.2±3	4.4±0.5	1.5±0.3	0.57±.06	1.3±0.1	13.8±0.3
Barbus scheich (Minnow)	N.D.	0.7±0.0	7.4±0.2	10.3±0.4	46.7±1	5.6±0.3	4.3±0.1	0.5±0.01	1.3±0.2	10.2±0.5
Mesopotamichthys sharpeye (Minnow)	0.02±0.0	0.7±0.0	4.2±0.0	5.1±0.0	51.3±1	4.7±0.1		0.46±0.01	1.6±0.3	10.0±0.6
Aspius vorax (Minnow)	0.01±0.0	0.6±0.1	4.5±0.2	5.0±0.1	60.5±3	7.3±0.3		0.46±0.03	1.0±0.1	13.0±0.1
Barbus xanthopterus (Carp)	0.01±0.0	0.5±0.0	6.0±0.1	3.9±0.1	68.8±3	1.2±0.0	4.0±0.1	0.16±0.01	1.3±0.0	9.3±0.6
Average concentrations in fish muscles (Bryan 1976)	0.1	0.2	0.1	3	50	10	1	3	1	5
Concentrations from polluted site (Dallinger and Kautzky 1985)	0.92	—	8.9	36.9	—	3.9	7.8	20.1	—	517.8

N.D. = None detectable
Common name of fish in brackets.

Table 2. Trace metal concentrations in sediments ($\mu g\ g^{-1}$ dry wt) from the Arabian Gulf and the Shatt al-Arab River.

	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
Shatt al-Arab River (Present study)	0.03	17.4	48.1	39.6	6205	914	57.2	19.0	70.1	25.8
Arabian Gulf (Khawr al-Zubair) (Present study)	0.03	18.6	50.4	24.2	5869	751	39.8	6.6	67.8	25.2
Shatt al-Arab River (Abaychi and DouAbul 1985)	0.17-2.8	15.8-17.8	81.8-112.4	21.8-44.0	5452-7584	521-998	530-811	11.3-28.1	153-208	17.6-34.7
Arabian Gulf (Abaychi and DouAbul 1986)	0.14-0.23	—	70.9-114.2	17.3-37.1	4450-9371	915-1643	386-637	5.6-25.6	150-186	27-43

Unfortunately, there are no data available on the concentrations of trace elements in fishes from other areas of the Arabian Gulf for comparative purposes; however, Bryan (1976) has reported the geometric mean concentrations of trace elements in different groups of organisms, including fish (Table 1). It can be seen from this table that, in general, concentrations of Cd, Mn, Pb in species studied were lower than the baseline concentrations, while those for Co, Cr, Cu, N, V and Zn were relatively higher.

However, all the concentrations obtained are much lower than those reported at heavily polluted sites (Dallinger and Kautzky 1985). No significant correlation was observed between trace element concentrations in fish muscles and their feeding habits, i.e., pelagic, filter or bottom feeders or between the concentrations and fish positions in the food chain, i.e., herbivorous, omnivorous or carnivorous.

In the Shatt al-Arab River, the determined trace element concentrations in the sediment are in close agreement with those reported by Abaychi and DouAbul (1985) with the exception of Cd, Cr, Ni and V, which exhibit lower concentrations in the present work (Table 2). In the Arabian Gulf, the trace element data were compared with those reported by Abaychi and DouAbul (1986). Similarly, a general agreement between the two studies was observed, with the exception of Cd, Cr, Mn, Ni and Zn, which were lower. This may be attributed to the reduction in industrial and navigational activities during the past seven years in the Shatt al-Arab River and the sampled area of the Arabian Gulf.

No significant differences were observed between the concentrations of trace elements in sediments from the Shatt al-Arab River and those from N.W. Arabian Gulf. A comparison of the concentrations obtained with those reported as an average for continental crust (Bryan 1976) show that the concentrations obtained are, in general, lower indicating the absence of pollution by trace elements with the exception of Pb in the Shatt al-Arab River which shows rather high concentrations. This may be attributed to heavy automobile traffic at the city of Basrah.

Therefore, it can be concluded that the concentrations of trace elements studied are acceptable although there were slight increases in the concentrations of Cr, Cu, Ni, V and Zn relative to the expected average.

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