and chlorophylls in the polluted lagoon. The benthic diatoms, very frequent in our lagoons, and the small phytoflagellates, the most abundant group in the polluted lagoon, are often associated with heterotrophic uptake (Lewin & Lewin, 1960; Hobbie & Wright, 1965; Ellis & Stanford, 1982). Nevertheless, such algal heterotrophs were probably not able to compete effectively for the substrates present with the bacteria, who developed tremendously: by a factor of 10 compared to the clean lagoon and by a factor of 100 compared to the adjacent coastal sea.

Also, it is likely that the domestic sewage contained some noxious substances that inhibited phytoplankton growth in the polluted lagoon.

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BASELINE

Distribution of Petroleum Residues in Surficial Sediments from Shatt al-Arab River and the North-west Region of the Arabian Gulf

About one-third of the world's oil is produced around the Arabian Gulf and it is one of the world's busiest oil transport arteries. It has 26 oil terminals served by between 20 and 100 tankers passing via the Strait of Hormuz every day (UNEP-UNDESA, 1976). The Gulf is a small water body, with rather shallow depth; in addition, the waters of the upper Gulf are characterized by having high temperature and salinity and limited circulation.

Samples of surface sediment were collected between November 1979 and April 1980 from 30 stations (Fig. 1) by Van Veen grab samplers. As soon as the samples have been acquired, they were placed in glass jars and kept frozen until the time of analysis. A reference station (RF) was chosen at the exit of the Euphrates River from Hor al-Hammar north-west of Basrah City, far from oil contamination. The procedure used for extraction and analyses of petroleum hydrocarbons in the sediment samples was based upon that of IOC (1976, 1982), using a Jobin Yvon JY3 spectrofluorometer. API Kuwait crude oil was chosen as an arbitrary standard for comparison. In order to characterize the extracted hydrocarbons (Berlman,

TABLE 1

Total hydrocarbon concentrations in samples of surface sediment from Shatt al-Arab River and the north-west region of the Arabian Gulf together with their sedimentological parameters. November 1979–April 1980

Site	Petroleum hydrocarbon $\mu g\ g^{-1}$ dry weight (API Kuwait crude oil equivalent)	Sedimentological parameters: Sediment type	% TOC
1	2.6	muddy sand	0.51
2	4.4	sandy mud	0.54
3	7.6	mud	0.72
4	20.5	sandy mud	1.00
5	9.2	sandy mud	0.79
6	32.0	sandy mud	0.98
7	21.6	sandy mud	0.88
8	24.0	sandy clay	0.20
9	44.0	sandy mud	0.68
10	30.0	sandy mud	0.54
11	30.0	sandy mud	0.85
12	26.0	mud	0.78
13	40.0	mud	0.82
14	28.0	mud	0.27
15	10.0	sandy mud	0.50
16	12.0	mud	0.65
17	24.0	sandy mud	0.96
18	1.0	sandy mud	0.38
19	20.0	mud	0.89
20	1.0	mud	0.77
21	3.6	sandy mud	0.44
22	0.4	sandy mud	0.89
23	16.0	muddy sand	0.51
24	22.0	sandy mud	0.89
25	3.6	mud	0.26
26	12.0	sandy mud	0.43
27	13.0	mud	0.32
28	5.3	muddy sand	0.30
29	3.5	muddy sand	0.29
30	3.5	muddy sand	0.41
RF	N.D.	sandy mud	1.40

N.D. = Not detected.
RF = Reference station.

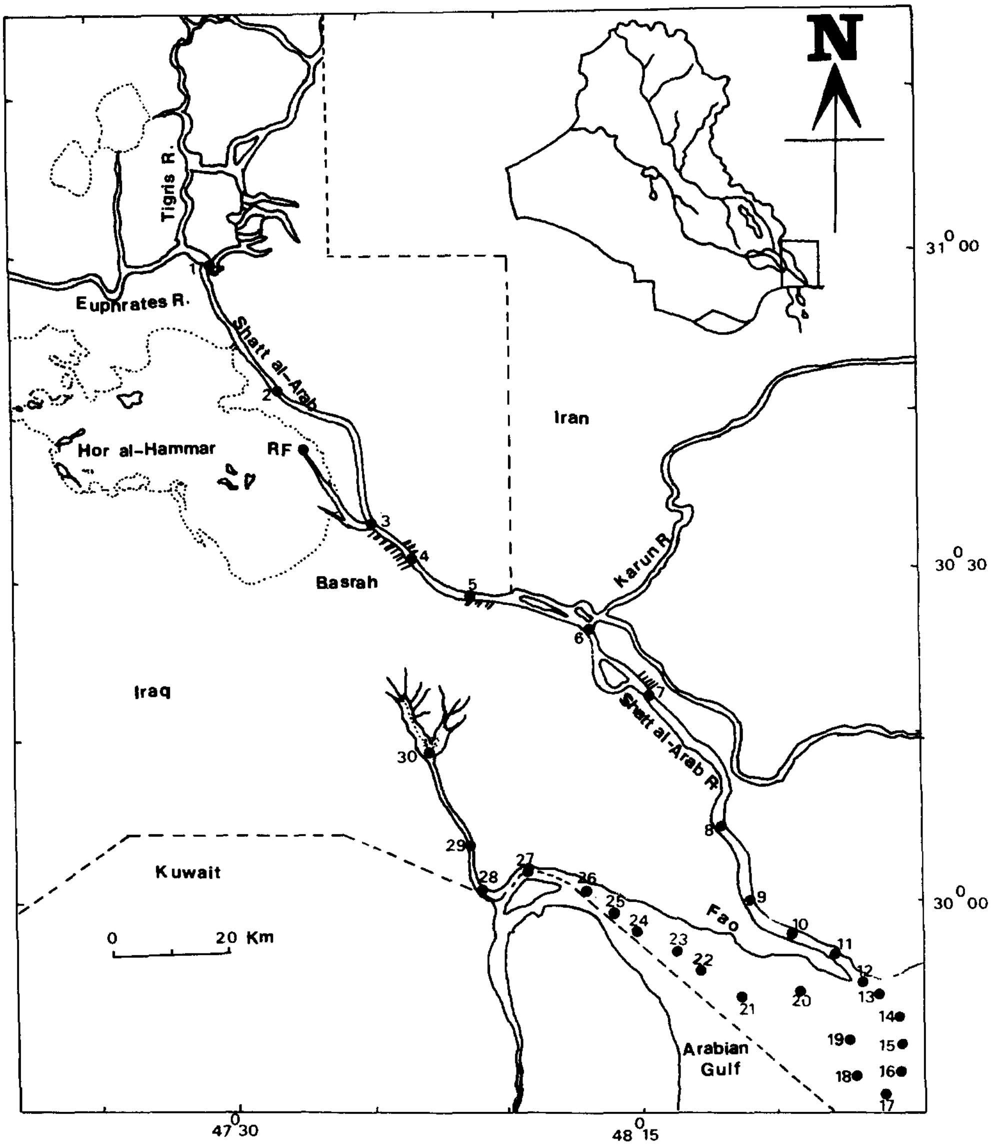

Fig. 1 The survey area showing the locations of sampling sites.

1971; McKay & Latham, 1972) some of the samples were analysed by Hewlett-Packard model 5710A gas chromatograph with dual flame ionization detector and 1.5 m × 4 mm i.d. glass column packed with 3% methyl silicon (OV-101) on chromosorb W. Granulometry of representative slips of the bulk samples were conducted by the combined dry sieve and pipette method (Folk, 1974). Percentage organic carbon (% TOC) was by the procedure of El-Wakeel & Riley (1957).

The results of the analyses (Table 1) represents the average concentrations from at least six determinations. The concentration of petroleum hydrocarbons in the sediment samples ranged from 0.4 $\mu g\ g^{-1}$ at station 22 to 44.0 $\mu g\ g^{-1}$ at station 9 dry weight, expressed as Kuwait crude oil equivalents. From the results presented here it is evident that, excluding the reference station (RF), all the sites are contaminated to some extent with petroleum hydrocarbons. The highest concentrations (>20 $\mu g\ g^{-1}$) were found in two areas: (1) in Shatt al-Arab River near port areas (Basrah, Abadan and Fao) and (2) the offshore area adjacent the Iraqi oil terminal in Khawr al-Amaya. Oil pollution has possibly originated from at least two different sources; the first coming from refineries and port areas and the second source is probably due to tank-shipping operations. Sediment samples from three stations (17, 19 and 24) showed elevated levels of hydrocarbons (24, 20 and 22 $\mu g\ g^{-1}$ Kuwait crude oil equivalents respectively) which may be due to the maintenance dredging of Khawr Abdulla navigational channel. The concentrations of

TABLE 2

Petroleum hydrocarbons in sediments from polluted and non-polluted aquatic environments

Location	Concentration ($\mu g\ g^{-1}$)	Source
Narragansett Bay (USA)	50.0–120.0	Farrington & Quinn (1973)
Eastern passage, Nova Scotia (Canada)	5.0–37.0	Hargrave & Phillips (1975)
Scotian shelf (Canada)	1.0–94.0	Keizer *et al.* (1978)
Ghadira Bay (Malta)	22.0	Sammut & Nickless (1978)
St Paul's Bay (Malta)	37.8	
Baffin Bay (Canada)	1.25–33.75	Levy (1979)
Falmouth Bay (UK)	48.0	Law (1981)
Carmarthen Bay (UK)	34.0	Law (1981)
Liverpool Bay (UK)	29.0	
Coast of Oman	0.8–19.0	Burns *et al.* (1982)
Shatt al-Arab and the north-west region of the Arabian Gulf (Iraq)	0.4–44.0	Present study

petroleum hydrocarbons observed in the surficial sediments of Shatt al-Arab River and the north-west region of the Arabian Gulf do not relate to the grain size or %TOC, but appear to be governed mainly by their proximity to potential oil pollution source. Petroleum hydrocarbon concentrations found in sediments by other workers are compared to our data in Table 2. However, Goldberg (1975) has reported that the unpolluted open ocean sediments contain 1–4 $\mu g\ g^{-1}$ dry weight hydrocarbons, less than 100 $\mu g\ g^{-1}$ in coastal sediments and up to 12 000 $\mu g\ g^{-1}$ in highly polluted areas. The only previous data of petroleum hydrocarbons in Iraqi waters are by Al-Saad (1983).

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BOOKS

Analysing Natural Systems

Analysis For Regional Residuals-Environmental Quality Management. D. J. Basta and B. T. Bower (eds.). Resources for the Future, Washington, D.C., 1982. 546 pp. Price £25.00. ISBN 0-8018-2820-1.

First the bad news: this book is not about analysing natural systems. It is supposed to be a core text for the community of planners and consultants who use NSMs to assess AEQ for the purposes of REQM – to give you some of the flavour of the text: NSMs are Natural System Models, AEQ is Ambient Environmental Quality and REQM is Residuals-Environmental Quality Management. To go a little deeper, Chapter 4 (on analysing surface receiving water bodies) begins "Surface receiving water systems are defined as surface water bodies into which residuals are directly or indirectly discharged . . . include: . . . streams, rivers, lakes, ponds, reservoirs, estuaries, and offshore marine systems". Residuals are "those materials and energy flows which have no value in existing markets . . .", and so on.

Written for staffs of government agencies and consultant firms who "actually make the analyses to develop strategies for achieving and maintaining ambient environmental quality", the chapters tend to begin at the beginning of their topics and define the most elementary concepts – I almost wrote carefully, but that won't do because on page 117 secondary production is defined by Basta and Moreau in the following words: "Secondary production is the sum total of all animal consumer biomass within a given terrestrial ecosystem including all herbivores, carnivores and omnivores". Given such a depth of misunderstanding of ecology on the part of these authors, and their ability to commit such a schoolboy error, it is very hard for me to take the rest of the book seriously.

The text actually comprises multi-authored chapters describing various aspects of the work of planners in environmental quality control, with much emphasis on water and air quality simulation models having minimal content or sophistication concerning the natural living system in which the residuals occur. The chapter coverage includes the generation and discharge of residuals from urban land surfaces, within atmospheric systems (such as the notorious LAPCD or Los Angeles Air Pollution Control District), and within – you guessed it – surface receiving water bodies.

Now for the good news: you probably don't need to read this book.

ALAN LONGHURST

The Shatt al-Arab (Arabic: Ø´Ø· Ø§Ù„Ø¹Ø±Ø¨â€Ž, Shore of the Arabs), also known known as Arvand Rud (Persian: Ø§Ø±ÙˆÙ†Ø¯Ø±ÙˆØ¯â€Ž, Swift River), is a river of some 200 km (120 mi) in length formed by the confluence of the Euphrates and the Tigris in the town of al-Qurnah in the Basra Governorate of southern Iraq. The southern end of the river constitutes the border between Iraq and Iran down to the mouth of the river as it discharges into the Persian Gulf. It varies in width from about 232 metres (761 ft) at Basra to 800