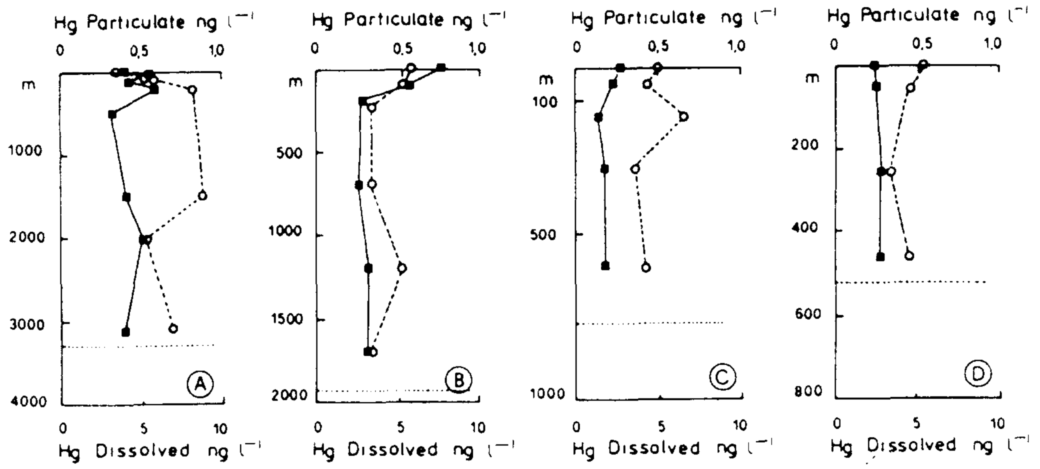

Fig. 2 Behaviour of dissolved (—) and particulate (---) fraction of total mercury as function of the depth measured in Ionian sampling station (A) and Aegean sampling stations (B, C, D) shown in Fig. 1. .....= depth of the sampling station.

Maserti, 1988), there are no significant variations of mercury concentration as a function of depth.

The range of the mercury concentration values observed by us in the eastern basin of the Mediterranean (3.8–10.5 ng l^{-1} for the dissolved fraction and 0.2–0.8 ng l^{-1} for the particulate fraction) is comparable to those we determined (2.0–15.1 ng l^{-1} and 0.2–1.3 ng l^{-1} respectively) in various areas of the western basin (Tyrrhenian Sea, Strait of Gibraltar, Alboran Sea) (Ferrara et al., 1986, 1988) and those reported by other authors (Breder *et al.,* 1981; May & Stoeppler, 1983; Copin-Montegut *et al.,* 1986).

We confirm, as we have already noted for the western basin, that the cinnabar ore deposits present in mineralized areas of the Mediterranean have little or no influence on mercury levels in the water column and in suspended particulate matter. Mercury concentrations are of the same order of magnitude of those measured in the oceans (Miyake & Suzuki, 1983; Gill & Fitzgerald, 1985).

*R. FERRARA**
*B. E. MASERTI**
M. MORELLI†
M. A. PANICHI†

**C.N.R. Istituto di Biofisica, via S. Lorenzo, 26, 56100 Pisa;*
†*Centro Interuniversitario di Biologia Marina, p. le Mascagni, 57100 Livorno, Italy*

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Distribution and Sources of Aliphatic Hydrocarbons in Fish from the Arabian Gulf

A major fraction of petroleum consists of aliphatic hydrocarbons which may be used to detect its presence in the environment. Despite its importance, only limited data concerning the fate of hydrocarbons in the Arabian Gulf are available. An important route is the uptake and assimilation of these components by marine organisms in general and fish in particular (Luquet *et al.,* 1983). Thirteen fish species were collected during 1985 from locations shown in Fig. 1. Each sample consisted of at least 25 individuals of uniform size of adult fish of the same species. The edible tissues were extracted following the procedure of Risebrough *et al.* (1983). N-alkanes were analysed by gas chromatography following the conditions outlined in Fig. 2. Procedural blanks consisting of all reagents and glassware used during the analysis were periodically determined.

The concentration of n-alkanes in the Arabian Gulf fish varied from 6.4 $\mu g\ g^{-1}$ in *J. sina* to 32.6 $\mu g\ g^{-1}$ dry wt in *O. argenteus* (Table 1). Variations in hydrocarbon content of different fish species from the same location is and may be attributed to feeding patterns, type of habitat and fat content (Table 2).

The range of carbon chain length of n-alkanes for the Arabian Gulf fish are C_{10}–C_{32} (Table 1). The bimodel distribution with two maxima around C_{17} and C_{27} suggest two different sources of hydrocarbons both biogenic and anthropogenic (Fig. 2). Biogenic sources for hydrocarbons is indicated by the dominance of the odd carbon n-alkanes (C_{15}, C_{17}, C_{25}, and C_{29}), which are synthesized by marine algae (Blumer *et al.*, 1971), and higher plants wax (Matsumoto & Hanya, 1981). The presence of pristane in significant concentrations supports the biogenic origin of hydrocarbons in these fish; it has been reported to be synthesized by both zooplankton and fish (Blumer *et al.*, 1982). On the other hand, the anthropogenic contribution of hydrocarbons is evident from the presence of the unresolved complex mixture (UCM) in all of the samples analysed. The UCM represents components resistant to weathering and bacterial breakdown and its presence in chromatograms has frequently been taken as an evidence of petroleum contamination (Farrington *et al.*, 1977).

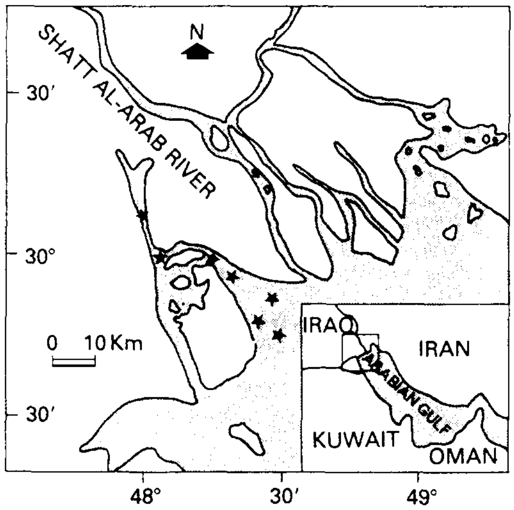

Fig. 1 Sampling locations.

This study also shows the presence of even-carbon numbered n-alkanes, which may be related to a contribution from artificial sources (Matsumoto & Hanya, 1981). The carbon preference index (CPI) which is an important parameter in relation to hydrocarbon sources (Mazurek & Simoneit, 1984) has a ratio close to unity and is assigned to a polluted environment. CPI for the Arabian Gulf fish ranged from 1.1 in *C. arel* to 2.1 in *I. elonagata* which may indicate both biogenic and anthropogenic sources of hydrocarbons in these fish.

The presence of squalane, a major organic constituent in polluted waters, was intimately correlated with anthropogenic sources of hydrocarbons (Matsumoto & Hanya, 1981). This compound was encountered in all fish sampled from the Arabian Gulf (Table 2) and may serve to indicate the polluted nature of the

TABLE 1

n-Alkane concentrations in fish muscles ($\mu g\ g^{-1}$ dry wt) from the Arabian Gulf.

Species	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}
Tylosurus strongylurus	0.1	0.1	0.2	0.1	0.1	0.5	0.3	0.6	0.4	0.9	0.6	1.1	0.6	0.4	0.5	0.3	0.4	1.5	0.3	0.1	0.1	0.2	0.1
Eleutheronema tetradactum	0.2	0.3	0.3	0.2	0.5	0.9	0.7	1.4	1.2	1.8	0.7	0.9	0.5	0.6	0.8	0.9	0.6	1.9	0.6	1.8	0.6	0.4	0.3
Pomadasys argenteus	0.1	0.2	0.1	0.4	0.3	1.1	1.3	1.7	1.6	1.9	0.9	1.1	0.6	0.7	0.5	0.8	0.4	0.8	0.3	0.2	0.1	0.1	0.1
Cynoglosus arel	—	0.2	0.3	0.4	0.6	0.4	0.9	1.1	0.8	1.0	0.9	0.9	0.7	0.8	0.9	1.2	0.6	0.8	0.3	0.2	0.1	—	—
Platycephalus indicus	—	—	0.1	0.2	0.3	0.6	0.3	0.5	0.3	1.2	0.6	0.9	0.4	0.3	0.2	0.7	0.6	0.8	0.3	0.1	0.2	—	—
Ilisha elongata	—	—	0.1	0.2	0.3	0.9	0.3	0.8	0.7	1.8	0.6	1.5	0.3	0.4	0.3	0.9	0.6	1.0	0.4	0.7	0.2	0.1	—
Thryssa hamiltonii	0.1	0.3	0.2	0.1	0.5	0.9	0.6	0.7	0.6	1.2	0.8	1.4	0.7	0.8	0.6	0.9	0.7	1.8	0.9	0.5	0.3	0.1	0.2
Arius thalassinus	0.3	0.3	0.4	0.5	0.2	1.6	0.6	0.9	0.8	1.9	0.9	1.6	0.7	0.8	0.7	0.9	0.5	0.7	0.6	0.5	0.4	0.3	0.2
Acanthopagrus latus	0.2	0.3	0.4	0.8	0.7	1.6	0.8	2.9	1.9	1.6	0.8	1.9	0.9	0.6	0.7	0.8	0.8	2.3	0.8	1.3	0.3	0.2	0.2
Johnieops sina	—	0.1	0.2	0.3	0.2	0.7	0.3	0.6	0.2	0.4	0.3	0.6	0.3	0.2	0.3	0.6	0.3	0.4	0.2	0.1	0.1	—	—
Liza dussumeiri	0.1	0.2	0.2	0.4	0.4	1.6	0.7	0.8	0.4	2.7	2.1	0.6	0.8	0.9	0.6	0.7	0.8	1.2	0.7	0.3	0.2	0.1	0.3
Nematalosa nasus	0.2	0.3	0.4	0.4	0.5	1.2	0.9	1.6	1.2	2.1	0.6	1.5	1.2	0.7	0.8	0.5	0.6	1.3	0.7	0.9	0.5	0.3	0.1
Otoliths argenteus	0.1	0.2	0.4	0.6	0.9	1.9	0.9	2.5	1.8	2.6	0.9	2.9	0.9	0.8	0.8	0.9	1.2	0.6	0.9	0.8	0.6	0.3	0.1

TABLE 2

Pristane, phytane, squalane and total n-alkanes ($\mu g\ g^{-1}$ dry wt) in fish muscles and CPI, UCM values and fat.

Species	Pristane	Phytane	Squalane	Total n-alkanes	CPI	UCM	Fat %
Tylosurus strongylurus	0.3	0.4	0.1	9.5	1.5	3.2	2.6
Eleutheronema tetradactum	0.9	0.7	0.2	18.1	1.6	7.1	2.9
Pomadasys argenteus	0.9	0.7	0.5	15.3	1.4	6.3	2.5
Cynoglosus arel	0.6	0.4	0.1	13.1	1.1	4.2	2.6
Platycephalus indicus	0.2	0.3	0.2	8.6	1.6	2.1	2.3
Illisha elongata	0.6	0.3	0.1	12.1	2.1	5.6	4.1
Thryssa hamiltonii	0.5	0.4	0.1	14.9	1.4	7.8	5.7
Arius thalassinus	0.5	0.6	0.2	16.3	1.6	8.9	5.8
Acanthopagrus latus	1.2	1.3	0.8	22.8	1.7	12.1	5.9
Johnieops sina	0.2	0.3	0.1	6.4	1.6	2.1	2.1
Liza dussumeiri	0.2	0.3	0.1	16.8	1.3	4.6	5.9
Nematalosa nasus	0.7	0.8	0.2	18.5	1.4	8.2	6.0
Otoliths argenteus	1.2	0.9	0.2	23.6	1.5	10.5	6.1

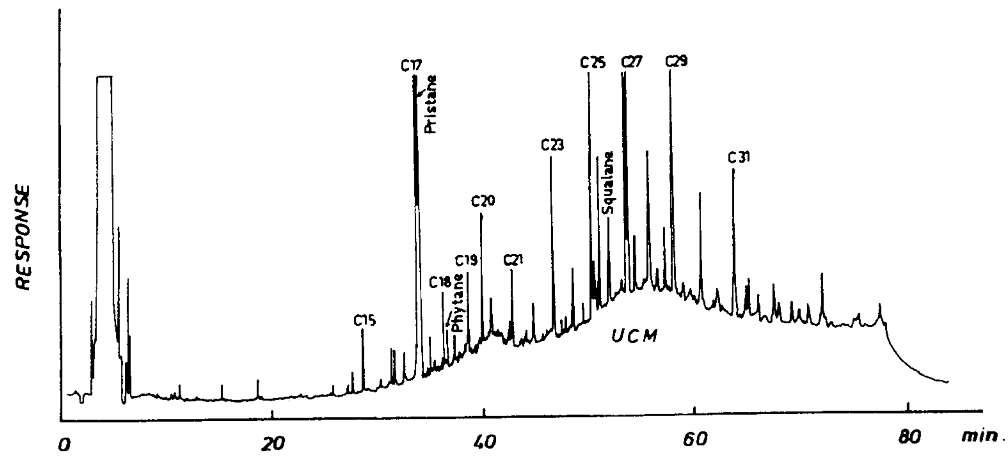

Fig. 2 Chromatograms of n-alkanes in the extracts of the Arabian Gulf fish. GC conditions were as follows: Perkin-Elmer Sigma 300 capillary GC equipped with an FID and a split/splitless injection port, a SE30 WCOT column (25 m long) with He as a carrier gas (1.5 ml min^{-1}) and a splitless injection. Temperature programmed from 50°C for 2 min to 300°C for 30 min at a rate of 4°C min^{-1}. The detector and injector temperatures were 310 and 300°C, respectively.

region. Burns *et al.* (1982) reported elevated values of squalane in fish caught from the Omani coastal waters, an area of the Arabian Gulf which is constantly subjected to oil pollution.

In conclusion, fish from the Arabian Gulf were found to contain measurable amounts of hydrocarbons. The components seem to be derived from both biogenic as well as anthropogenic sources. Monitoring of hydrocarbons in commercial fish from the Arabian Gulf is recommended.

HAMID T. AL-SAAD

Marine Science Centre,
University of Basrah,
Basrah, Iraq

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LETTERS

Options for Waste Disposal

A reply to Alasdair D. McIntyre

Sir,

The problems of waste disposal are often complex and involve difficult decisions, so it seems reasonable to expect that they would be looked at with both eyes fully open and both ears attuned to all the relevant issues. Unfortunately this is very seldom so and it seems necessary to reply on a recent case. In the Editorial of *Marine Pollution Bulletin*'s October edition, Dr. A. D. McIntyre gave several statements concerning oceanic disposal of waste and complained about missing arguments on the environmentalists' side. We will repeat some of the arguments used by the latter as far as it is possible in a rather short reply.

Unfortunately an intense use of the oceans as a waste repository by indirect intake via atmosphere and river inflow is not a mere option, but a fact. Taking this into account, the debate has to deal with the question of an additional use by direct deposition or incineration at sea. The urgent question we are faced with today, is, what to do considering the vast amount of hazardous waste in a responsible way. Leaving aside the ethic components of the subject, we will provide some scientific and some waste management implications, which in our opinion speak against a treatment of waste at sea and support a precautionary approach instead.

As one example Dr. McIntyre referred to marine based incineration as preferable compared to a land based incineration. Physical, chemical, and biological