

Petroleum hydrocarbon concentration in selected species of fish and prawn from northwest coast of India

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Concentration of petroleum hydrocarbons in 6 fish and prawn species sampled at 10 transects from Veraval to Ratnagiri were determined using alkali digestion and alumina column chromatography followed by fluorescence spectroscopy. Efficiency of the method was in the range of 36.9-78.5% for 1-10 $\mu\text{g.g}^{-1}$, wet wt chrysene concentrations. The levels observed were low ranging from 0.2 to 10.0 $\mu\text{g.g}^{-1}$ (wet wt, chrysene equivalent units). The most abundant species *Johnius glaucus* and *Coilia dussumieri* showed comparatively higher levels of petroleum hydrocarbons than others. Samples from Bassein and Thana creeks as well as from Bassein and Bombay coastal stations revealed relatively high accumulations. Comparison of values with concentrations in water and sediment from corresponding locations was discussed.

Northwest coast of India is vulnerable to oil pollution from the inputs of domestic and industrial wastewater discharges, port activities and marine operations including tanker traffic and oil production. Present study deals with distribution of petroleum hydrocarbons in six commercially important species of fish and prawn as a part of the marine pollution monitoring programme along northwest coast of India.

Trawling was done along seven transects off Veraval, Diu, Daman, Bassein, Bombay, Murud and Ratnagiri covering fourteen stations (Fig. 1). Stations 1-4, 9, 11 and 13 were considered as nearshore locations (2-5 km from shore) and sts 5, 10, 12 and 14 were treated as offshore locations (10-12 km from shore). Samples were also collected from Versova, Mahim and Thana Creeks situated around Bombay (sts 6-8). Above transects were selected on the basis of ecological sensitivity and possible land based inputs of industrial and domestic wastewaters. Trawling was carried out with the help of a mechanised trawler during February-April, 1989. A high opening bottom trawl net of 20.7 m length was used for trawling. Four species of fishes—croaker (*Johnius glaucus*), anchovy (*Coilia dussumieri*), bombil (*Harpodon nehereus*) and pomfret (*Pampus argenteus*) and two species of prawns *Metapenaeus brevicornis* and *Exhippolysmata ensirostris* were selected for petroleum hydrocarbon accumulation study.

Samples were frozen during transport and preserved in deep freeze until analysis. They were thawed, wiped, dried, subsampled and preserved according to FAO procedure¹. Tissue (~10 g) was saponified² with 5N KOH (50 ml) for 120 min. Sodium chloride (50 g) was added to the cooled reaction mixture which was then extracted with hexane (spectroscopic grade, 50 ml \times 3). The residue obtained after evaporating the organic layer was column chromatographed using alumina³. Solutions

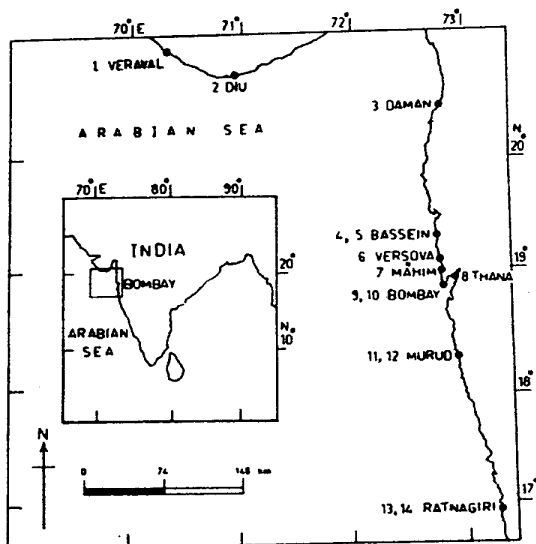


Fig. 1—Map showing sampling locations

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of eluates in hexane (10 ml) were analysed on Perkin Elmer LS 3b fluorescence spectrophotometer at 360 nm (excitation at 310 nm). Efficiency of the method was studied using chrysene solutions of 1-10 $\mu\text{g.g}^{-1}$ wet wt range. The recoveries were found in the range of 36.9-78.5%. The concentrations (PHC) were reported as chrysene equivalent units of which ratio to Saudi Arabian Crude equivalent units was 0.146.

Levels of petroleum hydrocarbons (PHC) in tissues varied from 0.2 to 10 $\mu\text{g.g}^{-1}$ wet wt chrysene equivalent units (Table 1) range. In fishes it varied from 0.2 to 10 $\mu\text{g.g}^{-1}$ and in prawns it varied from 0.2 to 8.1 $\mu\text{g.g}^{-1}$. Among them *Coilia dussumieri* collected from Thana creek (st. 8) and *Exhippolysmata ensirostris* collected from Murud (st. 12) showed highest concentration while *Pampus argenteus* and *Metapenaeus brevicornis* obtained from Murud (st. 11) and Ratnagiri (st. 13) respectively showed the lowest concentration. Overall low values were observed in present study. *J. glaucus* and *C. dussumieri* appeared to have accumulated comparatively high petroleum residue (0.8 to 10 $\mu\text{g.g}^{-1}$). Similarly *M. brevicornis* and *E. ensirostris* showed wide variations in petroleum hydrocarbon accumulation from 0.2 to 5.8 $\mu\text{g.g}^{-1}$ and 0.8 to 8.1 $\mu\text{g.g}^{-1}$ respectively. Comparison of concentrations in fishes and prawns from corresponding locations did not indicate any correlation. Veraval, Versova and Mahim (sts 1, 6, 7), which are polluted mainly by

domestic wastewater discharges, showed low residual values (0.8 to 3.0 $\mu\text{g.g}^{-1}$). However, samples collected off Bassein, in Thana creek and off Bombay (sts 4, 5, 8 and 9) receiving large quantities of domestic and industrial wastewaters showed comparatively high levels (2.1 to 10 $\mu\text{g.g}^{-1}$). Incidentally the area is also vulnerable to oil pollution from marine operations, tanker traffic, fishing activities, oil loading-unloading and bunkering operations⁴. Concentration values in the samples collected in the creeks situated around Bombay were 1.1-10 $\mu\text{g.g}^{-1}$, wet wt range while the concentrations in the ranges of 0.2-9.6 and 0.8-8.1 $\mu\text{g.g}^{-1}$, wet wt were observed for the samples corresponding to nearshore and offshore stations respectively. Though high contamination in the species sampled in the creeks and at nearshore stations may be anticipated, it was not observed in present study⁵. Identical trends were noticed for the concentrations in two species of fish namely *Johnius glaucus* and *Coilia dussumieri*.

Clark and Macleod⁶ reviewed several reports on distribution of petroleum hydrocarbons in tissues of marine organisms and suggested the levels in the range of 0.1-10 $\mu\text{g.g}^{-1}$ for unexposed areas, with concentrations up to 10 to 100 times more for exposed zones⁶. Comparison of these levels with the values in present investigation indicated that the animals were lowly contaminated at a safe limit corresponding to unexposed zone.

Table 1—Petroleum hydrocarbon concentrations (PHC, chrysene equivalent units) in tissue, water and sediment at different transects

Transect	St. no.	Tissue PHC ($\mu\text{g.g}^{-1}$, wet wt)						Water ($\mu\text{g.l}^{-1}$)	Sediment ($\mu\text{g.g}^{-1}$, wet wt)
		A	B	C	D	E	F		
<u>Creek</u>									
Versova	6	3.0	NS	NS	NS	NS	NS	2.4	NS
Mahim	7	1.1	1.8	NS	NS	2.7	NS	1.1	NS
Thana	8	3.0	10.0	NS	NS	NS	NS	1.6	NS
<u>Nearshore</u>									
Veraval	1	0.8	NS	NS	NS	NS	NS	0.9	0.1
Diu	2	NS	3.4*	4.4	NS	NS	NS	0.5	0.1
Daman	3	6.1	7.6	NS	NS	NS	NS	0.7	0.1
Bassein	4	2.9	9.6	NS	NS*	5.8	NS	0.8	1.1
Bombay	9	3.0	5.4	3.6	NS	NS	NS	0.7	0.2
Murud	11	3.3	1.0	NS	0.2	3.4	0.8	0.6	1.6
Ratnagiri	13	3.1	1.8	NS	NS	0.2	NS	0.6	0.8
<u>Offshore</u>									
Bassein	5	6.3	6.4	NS	NS	NS	NS	0.5	0.8
Bombay	10	2.1	2.1	NS	NS	NS	NS	1.2	0.1
Murud	12	2.4	1.9	NS	NS	0.8	8.1	0.5	1.8
Ratnagiri	14	1.8	NS	NS	NS	NS	NS	0.9	0.6

A = *J. glaucus*, B = *C. dussumieri*, C = *H. nehereus*, D = *P. argenteus*, E = *M. brevicornis*, F = *E. ensirostris*.
NS = Not Sampled

The average concentrations in water samples (0.5 to $2.4 \mu\text{g.l}^{-1}$, chrysene equivalent units, Table 1) collected simultaneously and the average values in surface sediments ($0.1-1.8 \mu\text{g.g}^{-1}$ wet wt chrysene equivalent units, Table 1) collected during 1988 at these locations were compared^{4,7} with the levels observed in present study. No specific correlation of the accumulation in the organisms with the levels in water and sediment was observed. This may be possibly due to fate and transport of heterogeneous petroleum residue in the ecosystem; food habits of migratory type of organisms and metabolism and depuration of petroleum hydrocarbons by the animals. Petroleum residue in fishes collected along northwest coast of India has been estimated for the first time and may serve as baseline data for future investigations.

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