

Concentration of petroleum hydrocarbons in bivalve *Mytilopsis sallei* and in the harbour waters of Visakhapatnam, east coast of India

P Chandra Mohan

Marine Biology Laboratory, Department of Zoology, Andhra University, Visakhapatnam 530 003, India

and

R Raghu Prakash

Central Institute of Fisheries Technology, Veraval 362 269, Gujrat, India

Environmental pollution due to oil and consequent petroleum hydrocarbon contamination (PHC) needs greater attention in view of its complicated interaction with biological communities. Visakhapatnam harbour is subjected to such oil contamination and has led to the survival of a climax species. The bivalve *Mytilopsis sallei* has successfully colonized in spite of the PHC occurring in considerable proportion. With regard to hydrographical conditions, harbour waters reflect the conditions of the inshore waters depending on the extent of tidal action. In the entrance channel the crude oil content is $108\mu\text{g l}^{-1}$. While analyzing the tissue for uptake of PHC, $186\mu\text{g g}^{-1}$ was found which is far higher than that in the medium.

In recent years due to increasing activity of bulk carriers including oil tankers which are touching the Visakhapatnam port more frequently, considerable quantities of oil (petroleum hydrocarbons) are finding their way into the seawater in and around the harbor. On account of this and physiographical changes that have taken place, profound effect on water quality and the fauna inhabiting the coast are witnessed. Considerable damage has been done to the biota on account of pollution and the water quality has deteriorated.

The bivalve *Mytilopsis sallei* (Recluz) (Bivalve/Dresseinidae) an immigrant from North American waters has established itself well and has reached the proportion of a climax species. *Mytilopsis sallei* has been known to survive in highly polluted waters¹. In order to gain an insight into the bioavailability and how does it interfere with the biological processes, investigations were carried out on the concentration of petroleum hydrocarbons in the harbor as well as in the soft tissues of *M. sallei*.

To analyze the PHC concentration in water, samples were collected fortnightly, from two stations in the harbor area (Fig. 1) for a period of 12 months as per UNESCO² guide lines. Station 1 is situated in the entrance channel and station 2 in

the inner harbor (Coal jetty). PHC concentrations were measured by UV absorption^{3,4} using a Beckmans ACTA II beam spectrophotometer in the region of 210-350nm. As a blank n-hexane was used and South Arabian crude was used as a standard. Both these were treated in the same way as the samples.

To analyze the PHC accumulated in the tissue of *M. sallei*, specimens (2 cm) were collected from the sampling sites (Fig. 1) and brought to the

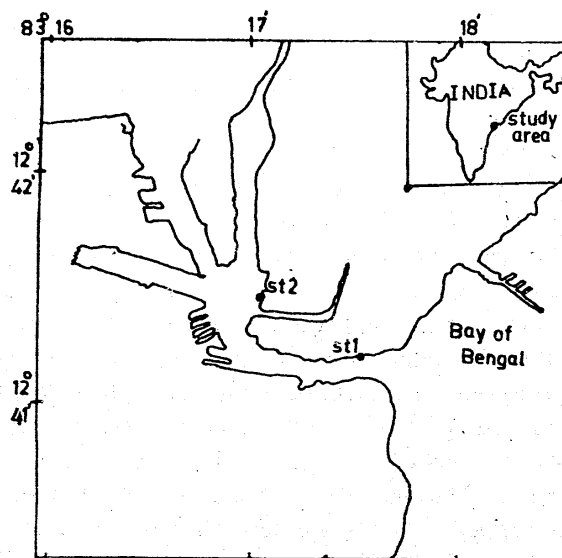


Fig 1—Map showing study area

laboratory. The shells were removed and the soft tissues were taken. Care was taken to avoid contamination. The tissues were homogenized and chilled in acetone and then extracted with methylene chloride. The extracted oil and fats were then transformed to *n*-hexane phase and hydrolyzed with potassium hydroxide dissolved in ethanol. The *n*-hexane phase was separated, later concentrated and chromatographed on a short column filled with activated silica gel and aluminum oxide (+5% H₂O with *n*-hexane⁵). The extract was analyzed by ultra violet fluorescence spectrometry using Perkin-Elmer 8.5 spectrometer. The quantitative measurements⁴ were made at fixed wave length (excitation 310 nm, emission 360nm). Kuwait crude oil was used as a standard. The values were expressed as Kuwait crude equivalents.

At st 1 the PHC concentration ranged from 15.9 $\mu\text{g.l}^{-1}$ (August) to 85.9 $\mu\text{g.l}^{-1}$ (September) with an average of 44.5 and at st 2 it ranged from 25.6 $\mu\text{g.l}^{-1}$ (May) to 99.4 $\mu\text{g.l}^{-1}$ (July) with an average value of 44.4 $\mu\text{g.l}^{-1}$ (Table 1). At station I the PHC concentration in the tissue ranged from 21.8 $\mu\text{g.g}^{-1}$ (April) to 186 $\mu\text{g.g}^{-1}$ (May) with an average of 71.4 $\mu\text{g.g}^{-1}$ and at station 2 it ranged from 13.1 $\mu\text{g.g}^{-1}$ (June) to 122.9 $\mu\text{g.g}^{-1}$ (July) with an average value of 56.8 $\mu\text{g.g}^{-1}$.

The PHC concentration recorded in both the stations can be attributed to the movement of cargo vessels, oil tankers and fishing boats in these waters. The runoff from the river Mehadragedda originating from the eastern ghats run along the vicinity of major industries including the oil refinery (Hindustan Petroleum Corporation Limited), bring in wastes which include oil.

Much information has been gathered with regard to the PHC concentration along the Indian coast only during the last one decade or more (Table 2). On comparison it is evident that the PHC concentration in Visakhapatnam appears to be higher than Bay of Bengal⁶, Northern Arabian Sea⁷, Okha-Ratnagiri coastal waters⁸ and Madh (Bombay)⁹, and coastal waters of Goa¹⁰.

The present study revealed that *M. sallei* accumulated PHC into their tissues. Bivalves are known to accumulate pollutants into their body from the surrounding medium either passively or by active absorption⁵. The average PHC

Table 1—Petroleum hydrocarbon concentration in tissue of *Mytilopsis sallei* and the medium

Month	Station 1		Station 2	
	Tissue $\mu\text{g.g}^{-1}$	Water $\mu\text{g.l}^{-1}$	Tissue $\mu\text{g.g}^{-1}$	Water $\mu\text{g.l}^{-1}$
Jan	49.3	55.7	56.0	69.0
Feb	75.7	38.3	36.3	53.6
March	66.5	28.5	70.5	30.2
April	21.8	28.0	115.8	29.9
May	186.0	29.6	32.6	25.6
June	73.6	58.1	13.1	57.5
July	144.6	58.4	122.9	99.4
Aug	38.1	15.9	53.3	29.9
Sept	60.1	85.9	15.5	66.4
Oct	53.8	31.7	88.6	37.9
Nov	46.5	43.0	29.2	61.3
Dec	41.6	61.3	50.6	34.5
Mean	71.4	44.5	56.8	44.4

Table 2—PHC concentrations along the Indian coasts

Region	PHC concentration
North Arabian Sea ⁷	1.6-11.1 $\mu\text{g.l}^{-1}$
Okha-Ratnagiri ⁸	3.9-18.1 $\mu\text{g.l}^{-1}$
Madh (Bombay) ⁹	11.5-29.5 $\mu\text{g.l}^{-1}$
Goan coastal waters ¹⁰	22.8-42.8 $\mu\text{g.l}^{-1}$
Visakhapatnam (present study)	15.9-89.5 $\mu\text{g.l}^{-1}$

accumulated by *M. sallei* at the two stations were 71.4 $\mu\text{g.g}^{-1}$ and 44.45 $\mu\text{g.g}^{-1}$. Similar accumulation patterns were reported in *Mytilus edulis* (54 $\mu\text{g.g}^{-1}$) in the Northern Archipelago⁵. Investigations on *Macoma balthica* at intertidal sites in port Valdis revealed that accumulation 2-10 fold less was found at a distance 3 km away from the boat harbor terminal⁵. The temporal trends in PHC in *M. edulis* and *M. balthica* reflects selective retention and depuration of different hydrocarbons as well as hydrocarbon source. The same may be applicable to the difference in accumulation pattern of *M. sallei* in the present study. It is well known that bivalve molluscs are not passive accumulators of petroleum but can actively depurate this compound. Of the factors influencing the depuration rate the first factor is that of lower molecular weight and more water soluble compounds are discharged more rapidly. Second, animals briefly exposed to petroleum depurate rapidly at low residual concentrations while chronically exposed animals depurate slowly and

have higher residual concentrations ¹¹. The interplay of these factors which leads to temporal trends in accumulation is not yet understood properly.

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