

BASELINE

Edited by E. I. Hamilton

Marine Pollution Bulletin, Volume 20, No. 12, pp. 629-630, 1989.
Printed in Great Britain.

0025-326X/89 \$3.00+0.00
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The objective of BASELINE is to publish short communications for the concentration and distribution of elements and compounds in the marine environment. Only those papers which clearly identify the quality of the data will be considered for publication. Contributors to Baseline should refer to 'Baseline—A Record of Contamination Levels' (*Mar. Pollut. Bull.* 13, 217-218).

DDT Residues in Fishes from the Eastern Arabian Sea

Samples of *Sardinella fimbriata* (sardine), *Sardinella longiceps* Valenciennes (Indian oil sardine), *Apolectus niger* (black pomfret), *Pampus argenteus* (silver pomfret) and *Penaeus* sp. (prawn) from the coastal Arabian Sea (location approx. 15°N 73°E; Fig. 1) were obtained from the commercial jetty within 2 h of landing while those from the open sea (16°30'N 69°E-19°30'N 67°E, Fig. 1) such as *Tylosurus* sp. (longtom), *Coryphaena hippurus* (dolphin fish), *Loligo* sp. (squid) and *Chiloscyllum indicus* (shark) were caught with a hook and line from ORV *Sagar Kanya*. The specimens were individually weighed and their length measured before being stored frozen, wrapped in hexane-cleaned aluminium foil until analysed.

Subsamples were obtained and processed essentially following the EPA Manual for the Analysis of Pesticides (1980). Two species of large fish were dissected for liver using a pre-cleaned stainless steel scalpel while only the muscle tissue was taken from the rest of the samples. The extractable organic matter (lipid) content was determined gravimetrically after which the residue was taken up in a known volume of petroleum ether (distilled at 60°C). Analytical runs were made on cleaned extracts using a Perkin-Elmer 3920 B gas chromatograph equipped with a glass column (3.65 m × 0.63 cm) packed with 25% OV-17 + 2.5% QF-1 on 80-100 Chromosorb W-AW (temp. 200°C) and a ⁶³Ni electron capture detector (240°C). A mixture of argon-methane (95:5) was used as the carrier gas at a flow rate of 65 ml min⁻¹. Aldrin was included in the samples as the internal standard to calibrate fluctuations in operational conditions. The recovery was 87 to 96% while the accuracy and precision of the analytical method was 10% and 3%, respectively. The organochlorine pesticide residues were quantified by comparison with EPA standards such as o,p'-DDT, p,p'-DDT, o,p'-DDE, p,p'-DDE,DDD (mixture), isomers of HCH, all of purity >99%. The concentrations of the standard compounds chosen were such that the height of sample

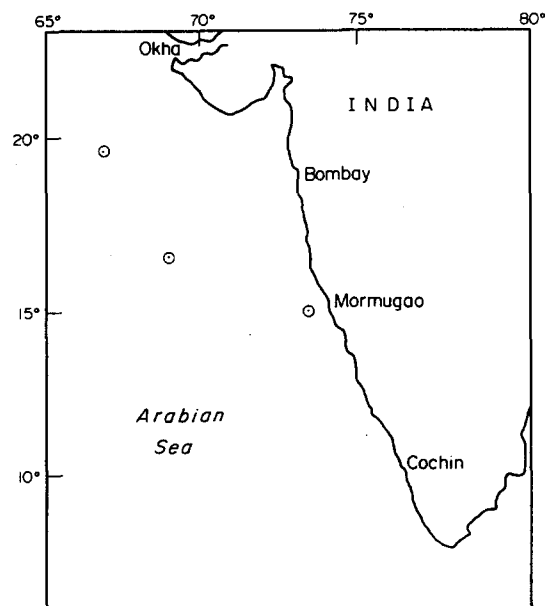


Fig. 1 Sample collection sites.

and standard peaks did not vary by more than 20%. The detection limit was 0.005 µg g⁻¹ (3σ, n=9) for p,p'-DDE as determined using tissue samples spiked with different concentrations of the standard pesticide.

Results indicate that the metabolites of DDT are ubiquitous in the samples analysed (Table 1); p,p'-DDE was the most frequently detected DDT metabolite, and was present in 60% of the coastal and 75% of the open ocean fish samples. Its concentration ranged 14.89-36.62 ng g⁻¹ wet wt in the coastal samples and from traces to 50.42 ng g⁻¹ in the open ocean samples. p,p'-DDD was found in three out of nine samples and was the only other metabolite of DDT detected. The few samples of liver analysed had higher concentrations of t-DDT residues as expected from the fat solubility of the chlorinated hydrocarbons. The presence of p,p'-DDD only in the liver of *Chiloscyllum indicus* and *Pampus argenteus* and not in the muscle indicates that the conversion of DDT to DDD is more extensive in the liver of certain species of fishes than in the muscle.

While only metabolites of DDT were found in the open ocean fishes, in the coastal samples a variety of other chlorinated hydrocarbons were also recorded (Table 1). These included hexachlorobenzene, isomers of HCH and 1-hydroxychlorodene.

The fish analysed in this study have different feeding habits, but no remarkable food-chain magnification of accumulated pesticide residues was evident. The values of total DDT reported in zooplankton (Kureishy *et al.*, 1978; Kannan & Sen Gupta, 1987) and sediment (Sarkar & Sen Gupta, 1987) from the Arabian Sea are 0.3-3.2 µg g⁻¹ and 10.8-179.1 ng g⁻¹, respectively,

TABLE 1
Concentrations (ng g⁻¹ wet wt) of chlorinated hydrocarbon pesticide residue in coastal and open ocean fish.

Organism (tissue)	No. specimens	Date	Site of collection	p,p'-DDE	p,p'-DDD	t-DDT*	Extractable lipid (%) (Mean)	Concn. on lipid basis	Others (traces)
A: Coastal samples									
<i>Sardinella longiceps</i> Valenciennes (muscle)	12	16 Oct. 87	15°N 73°E	Range 14.9–28.8 Mean 19.7 S.D. ± 1.5	N.D.	19.7	5.0 ± 0.5	392.9	1-Hydroxy chlordene
<i>Apolectus niger</i> (muscle)	12	16 Oct. 87	15°N 73°E	N.D.	N.D.	–	0.5 ± 0.02	–	–
<i>Sardinella fimbriata</i> (muscle)	11	16 Oct. 87	15°N 73°E	26.7–36.6 30.5 ± 5.1	18.8–28.6 23.9 ± 4.9	54.3	2.9 ± 0.3	1876.9	α-HCH, γ-HCH
<i>Pampus argenteus</i> (muscle)	3	31 May 88	15°N 73°E	N.D.–24.2 8.1 ± 14.0	N.D.	8.1	0.9 ± 0.2	666.6	Hexachlorobenzene
(liver)				N.D.	N.D.–162.5 54.2 ± 93.8	54.2	6.1 ± 1.4	451.3	–
<i>Penaeus</i> sp. (whole)	6	31 May 88	15°N 73°E	N.D.	N.D.	–	0.7 ± 0.2	–	γ-HCH
B. Open ocean samples†									
<i>Tylosurus</i> sp. (muscle)	1	28 Jan. 88	16°30'N 69°E	41.4 ± 12.5	N.D.	41.4	0.7 ± 0.1	5377.7	–
<i>Coryphaena hippurus</i> Linnaeus (muscle)	1	28 Jan. 88	16°30'N 69°E	31.9 ± 5.8	N.D.	32.0	0.4 ± 0.1	9705.6	–
<i>Loligo</i> sp. (muscle)	1	16 Jan. 88	19°30'N 67°E	N.D.	N.D.	–	0.3 ± 0.05	–	–
<i>Chiloscyllium indicus</i> (muscle)	1	16 Jan. 88	19°30'N 67°E	traces	N.D.	traces	0.1 ± 0.03	–	–
(liver)				171.3 ± 20.2	33.2 ± 16.5	204.5	22.2 ± 2.1	924.1	–

N.D.—Not detected. *t-DDT: DDT and metabolites. †3 subsamples were taken from each sample for replicate analysis.

whereas among the fish samples analysed the herbivorous species such as *Sardinella longiceps* had a t-DDT value of 19.7 ng g⁻¹, carnivores like *Pampus argenteus* had a value of 62.2 ng g⁻¹ and omnivorous species such as *Sardinella fimbriata* had a mean value of 54.3 ng g⁻¹. The open ocean carnivorous species had values ranging from 31.9 to 41.4 ng g⁻¹. However, all the fishes analysed were migratory.

DDT metabolite residues, though widely prevalent in the Arabian Sea fish samples, are well below the 5000 ng g⁻¹ wet wt limit accepted as hazardous for human health (FDA, 1978). Also, the presence of a high proportion of DDE in relation to the total DDT burden in the tissue of the fish samples analysed, particularly in the coastal samples, indicates that 1. migratory species can, perhaps, convert DDT rapidly to its metabolites because of high metabolic rates or 2. this area in the Arabian Sea is not threatened by new inputs of DDT. It is generally assumed that an increasing proportion of DDE in relation to total DDT concentration reflects a decreasing exposure to new sources of DDT pollution and vice versa (Buhler *et al.*, 1975; Addison *et al.*, 1984).

We thank the Director, NIO, for his interest in this work.

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