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Residues of o,p'-DDT in Southern California Coastal Sediments in 1971

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Technical DDT is the commercial grade insecticide and is comprised of about 20 percent o,p'-DDT; yet this isomer has seldom been detected in samples from the natural environment and it is apparently degraded rapidly (LAMONT et al. 1970). o,p'-DDT (along with o,p'-DDD and o,p'-DDE) was detected in small amounts off southern California in the late 1960s and early 1970s (LAMONT et al. 1970, CASTLE and WOODS 1972, MACGREGOR 1974), apparently associated with a point source of environmental contamination (BURNETT 1971, GRESS et al. 1973, see also ANDERSON and RISEBROUGH 1976).

Other than from the pharmacological viewpoint regarding pesticide degradation in natural environments, the need to document the presence and amounts of the o,p'-isomer off Southern California has acquired increased importance since the results of FRY and TOONE (1981), who associated o,p'-DDT importantly with feminization of gull embryos. It is therefore our objective here to report the results of some previously unpublished data on the occurrence of o,p'-DDT in sediments near Los Angeles in 1971 and to compare such results to similar samples farther away from the suspected point source of DDT (see BURNETT 1971).

SAMPLING AREA AND METHODS

A small number of sediment samples was obtained during studies by D.W.A. in August of 1971 for the purpose of determining environmental levels of DDT-related residues and relating them to wildlife problems off Southern California in the 1960s and 1970s (see ANDERSON et al. 1975, 1977), but these data were never reported. Combined samples of five to ten, 6-cm diameter cores, two to four cm deep, were taken at various locations on the north and south outlets of several drainage systems along the California Coast (Fig. 1). All samples were taken within the intertidal zones on the ocean-facing shores of these river outlets. The sampling intent was to obtain cores that represented coastal sediments which, additionally, would also reflect any unique pollutant output from a particular river-mouth. Each aggregate sample from each side represented a single sample for analysis and most outlets were represented by two pools (one from the north and

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one from the south). Samples could have therefore represented oceanic, riverine, or combined sources of contamination.

These sediments were frozen until analysis in 1975 at the laboratory of the California Department of Fish and Game, Sacramento, by gas chromatography according to methods already described by CASTLE and WOODS (1972). Both the o,p'- and p,p'-isomers of DDE, DDD, and DDT would be detected. Polychlorinated biphenyls were also detected by the methods used. Sensitivity on a dry-weight basis of extracted sediments was 0.0005 ppm. All residues are expressed as ppm dry-weight basis (dw). Sample areas for subsequent discussion are defined in Fig. 1.

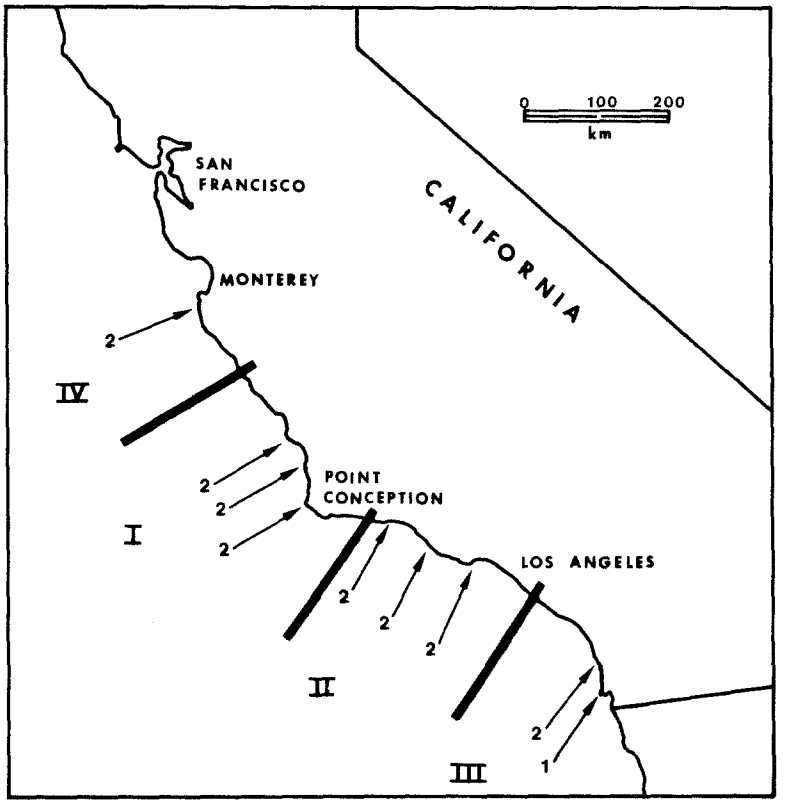

Figure 1. Location map: Southern California sediment samples, 1971, analyzed for organochlorine pollutants, especially DDT-related compounds. The "Los Angeles area" represents areas I and II combined, and "Outliers" areas III and IV. Arrows point to sample locations and corresponding numbers represent aggregate samples from that area. If there is only one aggregate sample, we could not obtain access to part of the area.

RESULTS AND DISCUSSION

There were no detectable differences in residues found to be associated with any particular river mouth. DDT-related compounds dominated the measured residues from core samples and PCBs were present, but below the level of quantitation used. Residues of p,p'-DDT, p,p'-DDE, p,p'-DDD, and o,p'-DDT (= t DDT) dominated all samples (Table 1). Thus, our discussion will be confined to those residues. Studies of other pollutants would have required further separations and identifications at greater levels of sensitivity. Similar patterns of DDT-related residues have been confirmed in Southern California biological samples by GCMS techniques (LAMONT et al. 1970).

Table 1. Total residues of DDT and metabolites detected in sediment samples from coastal California in 1971.[1]

Residue	Sample Area:[2] Los Angeles area ppm	Outliers ppm	Probability Level of Differences
Sample-size	12	5	
p,p'-DDE	0.032 ± 0.012 (24)	0.015 ± 0.009 (26)	< 0.15
p,p'-DDD	0.062 ± 0.036 (48)	0.040 ± 0.024 (70)	NS
p,p'-DDT	0.032 ± 0.017 (24)	0.002 ± 0.001 (4)	< 0.15
o,p'-DDT	0.005 ± 0.003 (4)	<0.0005 (Trace)	< 0.01
t DDT	0.131 ± 0.050	0.057 ± 0.034	< 0.15

[1]Only DDT and metabolites are examined here and therefore other compounds could also have been present (see text). Values given are means ± 1 standard error (in ppm dry-weight) followed by percentages of totals in parentheses.

[2]See Fig. 1 for definitions. Differences in means between these two sample areas were tested-for by the nonparametric Wilcoxon two-sample test (SOKAL and ROHLF 1969:391 and VERDOOREN 1963).

The major finding of interest here is the presence of o,p'-DDT (Table 1), at a time when biological problems were evident (see ANDERSON et al. 1975, and review by ANDERSON and RISEBROUGH 1976). Since then, there have been some newly-discovered effects possibly associated with this isomer (FRY and TOONE 1981).

Due to small sample sizes, it is difficult to test for differences between local areas in residue levels, except to compare those samples obtained near the Los Angeles point-sources of DDT (see references cited above and especially SCHMIDT et al. 1971) with outlying areas where degradation of o,p'-DDT might be expected to have occurred. In outlying areas o,p'-DDT was found in only one sample and in amounts <0.0005 ppm (dw) (Table 1). Most other residue levels, comparing the two general sample areas tended to be significant at low levels of probability (Table 1). Residues of t DDT were not significantly different between areas I and II (Fig. 1). Residues of t DDT in the "Outliers" declined by a factor of about 1/2.

Our results support one important aspect of the hypothesis of FRY and TOONE (1981) in that some of the biological problems of wildlife off Southern California in the 1970s might have been associated with o,p'-DDT, because it has been detected in so many types of samples (previous discussion). Our results also support the notion that the major source(s) of t DDT was primarily technical-grade DDT close to a point-source or sources. Yet, o,p'-DDT must also disappear rapidly compared to other forms of DDT, as suggested by its virtual disappearance at any distance from such a point-source (see also SCHMIDT et al. 1971).

One never knows what the values of a series of samples might be, often until after-the-fact. We therefore urge that field investigators continue to sample routinely and systematically in various environmental substrates.

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