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Polychlorinated biphenyls in the Elizabeth River : final report

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POLYCHLORINATED BIPHENYLS IN THE ELIZABETH RIVER

Final Report

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Introduction:

For the past eight years, the Virginia Institute of Marine Science has been a participant of the National Pesticide Monitoring Program. Within the framework of this program, oyster samples have been collected from areas throughout the Chesapeake Bay and analyzed for chlorinated hydrocarbon pesticides. The data from the last three years show that polychlorinated biphenyls (PCB's) are being concentrated by the eastern oyster, Crassostrea virginica. The highest concentrations found were always from one station, Hospital Point, in the Elizabeth River. Samples from this station, collected during the spring of 1971, contained residues of the PCB, Aroclor 1254®, of 2.8 ppm. For this reason, a special study was undertaken to pinpoint the source of this pollution.

Methods and Procedures:

Field: Oysters were collected from a location in the Rappahannock River which closely corresponded to the salinity regime in the Elizabeth River. These animals were placed in trays constructed of galvanized wire and suspended at thirteen locations in the Elizabeth River as indicated in Figure I. A subsample was saved as a control.

The trays were initially put out in May of 1972. Less than one month later the Chesapeake Bay drainage basin was flooded by Tropical Storm Agnes. The resultant deluge of fresh water into the normally saline environment caused a 90% mortality of the test animals by the first week in July. The experiment was repeated after the normal salinity regime was established in late July, 1972.

Samples of oysters (12 animals) were collected from each existing tray in September and October. These samples had been exposed to the pollution potential of the estuary for one and two months respectively.

The Station 2 tray was missing by the September sampling and Stations 3 and 7 were absent by the October sampling. The animals at Station 11 were found dead by the October sampling.

Laboratory: The animals were extracted for PCB's utilizing the techniques established for the Pesticide Monitoring Program (1). Aroclors 1242® and 1254® were identified by comparing retention times between standards and samples on two chromatographic columns, 3% DC 200 and 5% QFI. The PCB's were calculated using the method of Risebrough (2). Only the first two major peaks were used in the calculation to avoid interferences by DDT and its metabolites.

Results and Discussion:

The analytical results of the control, September and October samplings are given in Table 1.

The Aroclor 1242® levels indicated by the September sampling are generally lower than the controls which suggest an intermittant imput of the pollutant into the system or possibly that the animals were not fully acclimated to the new environment. The Araclor 1254® data however, do not support the acclimation theory.

The data indicate that the upper Elizabeth River is source for Aroclor 1242®. The area most highly suspected is in the region of the junction of the Southern Branch and the Eastern Branch of the river. The Stations 10, 11 and 12 show a marked increase over the controls, with concentrations at Station 12 as high as 1.13 ppm (Aroclor 1242®) after two months exposure. The animals from Station 11 were all dead by the October sampling indicating a possible relationship between mortality and this PCB.

The Aroclor 1254® data indicate that this pollutant is being introduced at relatively constant rates and at low levels. The concentrations are generally higher than the controls with the possible source in the Western Branch. This assumed source is not nearly as well supported as that for Aroclor 1242®.

Conclusions:

These data indicate that the source for Aroclor 1242® in the Elizabeth River is at or near the junction of the Southern and Eastern Branches while the source for Aroclor 1254® appears to be in the Western Branch.

Previous bottom sediment and oyster analyses for the trace metals, cadmium, copper, mercury, lead and zinc show the source area for Aroclor 1242® to also have a source for these metals. It is believed that the Navy shipyard located in this segment of the river is the metals source and possibly that of the PCB's.

The various State agencies with interest or pollution regulatory powers have been notified of these findings.

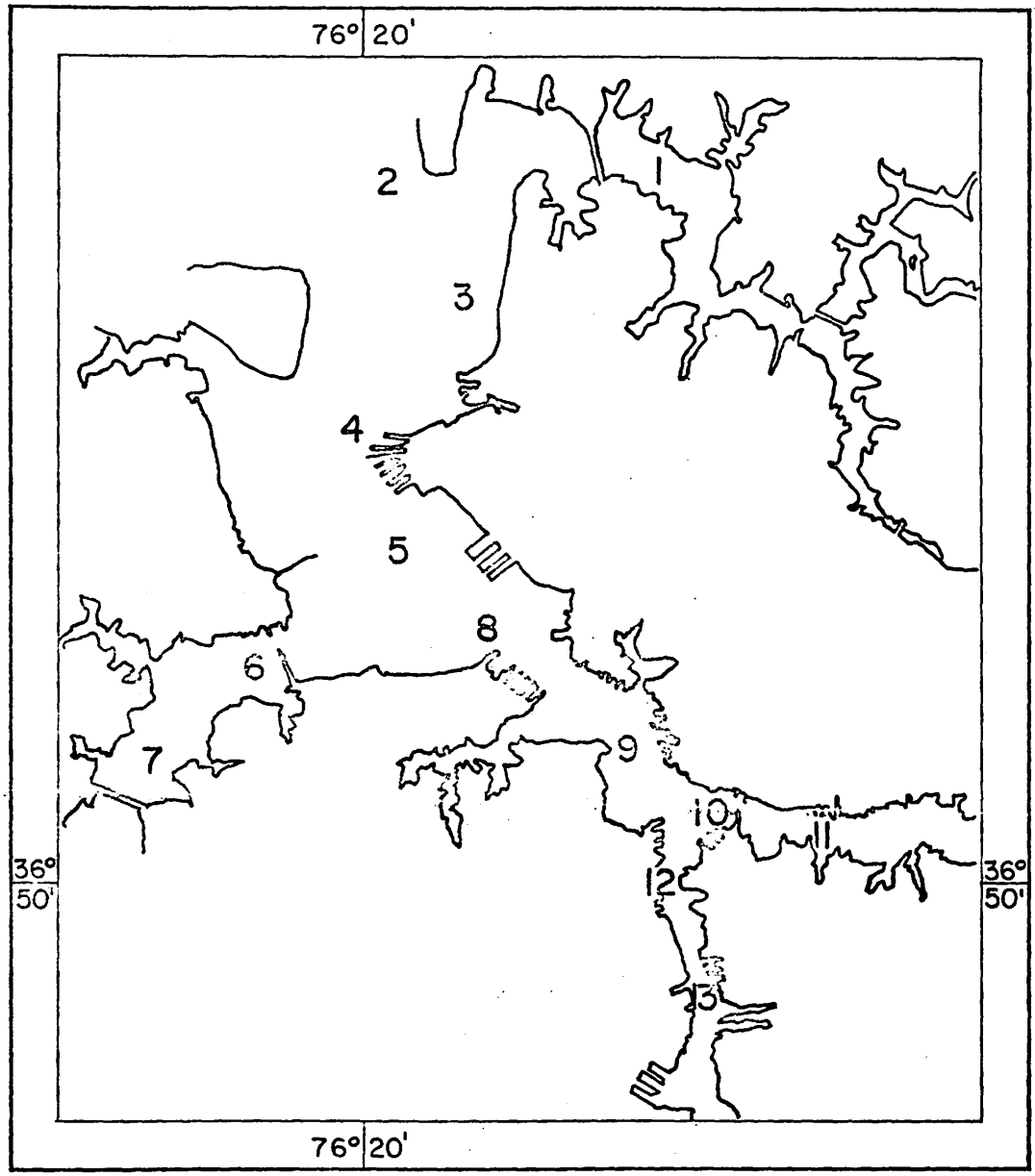

Figure 1. Oyster tray locations.

Table 1

Concentration of PCB's in Oysters Placed in the Elizabeth River

Station	ppm (whole body, wet wt.) Aroclor 1242®		ppm (whole body, wet wt.) Aroclor 1254®	
	September	October	September	October
Control	0.40[1]	0.40[1]	0.17[1]	0.17[1]
1	0.32	missing[2]	0.212	missing[2]
2	missing	missing	missing	missing
3	0.37	0.61	0.39	0.20
4	trace[3]	0.55	0.30	0.34
5	trace	0.72	0.26	0.29
6	0.36	0.68	0.31	0.30
7	trace	missing	0.25	missing
8	0.40	0.57	0.20	0.28
9	trace	0.83	0.23	0.35
10	0.52	0.78	0.18	0.23
11	0.86	100% mortality	0.23	100% mortality
12	trace	1.13	0.16	0.23
13	trace	0.38	0.20	0.23

[1] = Average of two analyses

[2] = Sample tray missing

[3] = Trace = <0.10 ppm

References

1. Wilson, A. J. 1965. Pesticide Analytical Manual for BCF Contracting Agencies. U. S. Bureau of Commercial Fisheries, Biological Laboratory, Gulf Breeze, Florida.

2. Risebrough, R. W. 1969. In Chemical Fallout M. W. Miller and G. G. Berg, Eds. (Thomas, Springfield, Ill.) pp. 5-23.