United States
Environmental Protection
Agency

Toxic Substances
Washington DC 20460

EPA-560/13-79-014
December, 1979

Toxic Substances

EPA

Analysis of EPA Pesticides Monitoring Networks

ANALYSIS OF EPA PESTICIDE MONITORING NETWORKS

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ABSTRACT

This report describes a brief investigation of six pesticide networks run by EPA. In this investigation, an attempt was made to answer several specific questions about each network including (i) the sampling procedures used, (ii) selected summary statistics and tests of significance appropriate for summarizing the data, and (iii) an examination of trends over time and differences in geographic areas for particular pesticides.

ACKNOWLEDGMENTS

The authors would like to thank Frederick Kutz, Sandy Strassman, Ann Carey, Thomas Dixon, and Henry Yank for their helpful comments in preparing this report. The authors also greatly appreciate the considerable effort by Ms. Carol Mitchell in typing this report under severe time constraints.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

In this report the Research Triangle Institute (RTI) will describe a brief investigation of six pesticide networks run by the Environmental Protection Agency. The investigation of each network is necessarily brief due to the fact that the time frame for this report was rather limited. The network data files used by RTI for analysis were prepared from tape files and documentation provided by EPA.

In particular, the data networks examined here are:

1. National Human Adipose Tissue Network,
2. National Soil Residue Network,
3. National Surface Water and Sediment Residue Network,
4. Air Network,
5. National Soil Application Network, and
6. National Urban Soil Network.

The data for these networks were in various stages of completeness when work on this task began. Several years of data were either still in hard copy form or were waiting to be edited. Accordingly, in order to meet its limited time schedule, RTI contracted Viar and Company to assist in data editing and converting hard copy data to computer readable form.

RTI personnel reviewed the existing software that comprise the HUMAN and SWEMS systems that are used to edit monitoring data. The decision was made for this task not to implement any of this software at the RTI computer facility (Triangle Universities Computation Center, TUCC). Instead, the Viar Company used the existing software and computing resources of EPA to complete the data editing that has been done to date.

In brief, the data finally available to RTI from each pesticide network were the following:

(1) National Human Adipose Tissue Network--Data on pesticide levels found in human adipose tissue from a national network of hospitals for the years FY 1970-FY 1977. The number of individuals and hospitals from which data were collected decreased over time (approximately 1400 persons in 1970 to 760

persons in 1977). Appendix Tables 1.1 and 1.2 present the data collection forms used for reporting the pesticide levels for this network.

(2) National Soil Residue Network--Data on pesticide levels found in a national network of agricultural soil sites (levels in soil and in crops) for the years FY 1969-FY 1974 excluding FY 1971 (note, data are no longer being collected for this network). In general, approximately 1,400 soil samples and 730 crop samples were collected once each year. The data collection form for this network is given in Appendix Table 1.3.

(3) National Surface Water and Sediment Residue Network--Data on pesticide levels found in a national network of water and sediment samples for the years 1976-1979. These data were collected quarterly for water and biannually for sediment. At the present time the first two quarters of 1976 and the last two quarters of 1979 are missing from RTI's analysis file. The sample sizes for water include approximately 130 sites and those for sediment approximately 100 sites. Appendix Table 1.4 presents the data collection form for recording pesticide levels for this network.

(4) Air Network--Data on pesticide levels in ambient air from three or four cities for the years 1975-1978. These data are quite limited and were collected for different cities in different years; thus, no trend analysis is possible. No data collection form was available to RTI for this network.

(5) National Soil Application Network--Data on compounds applied to a national sample of cropland sites for the years FY 1969-FY 1974 excluding FY 1971 (again, these data are no longer being collected). These data were collected once each year by personal interview with the landowner or operator of approximately 1,200 sampling sites. No data collection form was available to RTI.

(6) National Urban Soil Network--Data on pesticide levels found in urban and suburban soils from approximately 2100 sampling sites in 36 Standard Metropolitan Statistical Areas for the period FY 1971 - FY 1976. The sites employed in FY 1971 were resampled in FY 1977 enabling the effect of time to be examined.

In the original work plan for the pesticide network investigation described here, RTI was to receive a list of pertinent questions for each pesticide network from EPA. These questions were to form the basis for the investigation. Because only a few specific questions were supplied to RTI, RTI developed its own set of questions so that the investigation could be carried out in the required time frame. RTI's list of questions are the following:

(1) What statistics are appropriate to summarize the pesticide levels for the network (e.g., arith. means, geom. means, percent detected, mean of positive values, percent trace, percentiles....)?

(2) How should the various summary statistics be tested for differences over time (e.g., before and after an event such as DDT use stoppage, years, seasons,....) and for one time period (e.g., between Census Regions)?

(3) What trends, if any, exist over time in particular pesticide levels for the network, nationally and for geographic areas such as Census Regions (using the tests given in 2)?

(4) What geographical differences exist in particular pesticide levels for a given time period (using the tests given in 2)?

(5) For the Human Tissue network are there age, race, and sex differences in pesticide levels over time and for a given time period?

(6) In general, how can the various networks be used for pesticide monitoring (e.g., a surveillance network that flags unusual trends and increases in percent detected for particular pesticides)?

(7) What objectives can be met using the present sampling plan for the network?

(8) How might the present sampling plan be altered to meet additional network objectives?

(9) Is there potential for matching network data files (e.g., water and tissue data) for analysis purposes (e.g., how long does it take for increased water levels of a pesticide to be detected in human tissue)?

Within the available time frame RTI has attempted in this report to answer the above questions for each of the six pesticide networks investigated.

In particular, in this report, Section 2 addresses the questions listed above for which answers are pertinent to all of the six networks (e.g., summary statistics, tests of significance,...), Sections 3 through 8 describe each of the six networks in detail and the questions listed above that apply to each network (e.g., network trends over time for particular pesticides). Section 9 discusses in general terms the accuracy of pesticide chemical analyses, while Section 10 gives recommendations and a brief summary of the report. In each of Sections 3 through 8 a sampling procedure subsection is first presented, which gives the sampling procedure used for each network and addresses questions concerning generalizability of the data; then a data analyses subsection is given which discusses such questions as trends over time and geographic differences for particular pesticides.

Before proceeding with a description of the analysis of the data, it is worthwhile to mention that all of the data for the various pesticide networks with the exception of the Air Network, has been loaded on the TUCC computer system at RTI and is available for additional analysis.

In general, the original formats (see Appendix Tables 1.5 and 1.6) were retained for these files, except for a few modifications which were necessary before analysis could be undertaken. The original records for the HUMAN System were written as variable length but were in fact fixed length; hence, they were rewritten as fixed. In some cases data were repositioned in the file for a particular network to preserve consistency. For example, the Human Tissue files did not contain the pesticide levels in the same position on each record and it was therefore necessary to reconstruct some records. The size of the Soils Residue file was reduced by decreasing the number of pesticide residues from 39 to 13. This was done to create a smaller, more efficient file for analysis. The new record length is 316 bytes as opposed to the original 536 bytes. At the same time, a decimal point in the Soil residue measurement was explicitly entered. In order to accomplish this, the least significant digit was dropped in some cases. Similarly, the Water Residue file was reduced from a length of 536 bytes to a length of 390 bytes. The list of residues included in these analysis files is presented in Appendix Table 1.7.

2. DISCUSSION OF QUESTIONS PERTINENT TO ALL NETWORKS

Summary Statistics

The first question examined by RTI for the various pesticide networks was what summary statistics seemed appropriate to describe the levels of a particular pesticide at one point in time. After examining the data, it was found that in many cases the distribution of particular pesticide levels had a large number of zero values and a few positive values. For example, for the soil residue data the following distributions were found for aldrin (A), dieldrin (D), and heptachlor (H) in 1972 (fiscal year):

Value (ppb)	Frequency			Cumulative Frequency			Cumulative Percent		
	A	D	H	A	D	H	A	D	H
0 - 10	1239	983	1305	1239	983	1305	89.9	71.3	94.7
10 - 100	91	213	54	1330	1196	1359	96.5	86.8	98.6
100 - 200	17	83	10	1347	1279	1369	97.8	92.8	99.3
200 - 500	17	78	6	1364	1357	1375	99.0	98.5	99.8
> 500	14	21	3	1378	1378	1378	100.0	100.0	100.0

Similarly for the water data, the following frequencies describe atrazine levels over the four quarters of 1977.

Value (ppb)	Frequency	Cum. Freq.	Cum. Percent
0	455	455	92.9
0 - .400	8	463	94.5
.400 - .600	9	472	96.3
.600 - .800	6	478	97.5
.800 - 1.100	6	484	98.8
> 1.100	6	490	100.0

Accordingly, it is quite clear that the pesticide levels do not follow a normal distribution. In fact, in many cases the distributions appear to be a mixture of a discrete distribution (a large number of zero or less than detectable values) and a continuous distribution (the positive values). In addition, in many cases the positive values are skewed to the right indicating a lognormal or exponential distribution. Thus, it appears for this type of data that primarily three summary statistics should be computed; namely, (1) the proportion of positive values, (2) the geometric mean of the positive values (or if almost all values are positive, the geometric mean of all values), and (3) the proportion of values greater than some "meaningful" value. That is, since the distributions are a mixture of discrete and continuous, more than one summary statistic is needed to describe them. Of course, other summary statistics may also be used (e.g., medians and percentiles of the positive values), but in general, the proportion of positive values, the geometric mean, and the proportion greater than some "meaningful" value seem to be the most appropriate. It should be noted that if the proportion of positive values is large for a particular pesticide (this is true for some of the human tissue data) that the geometric mean of the positive values will be close to the geometric mean of all values (including zeros) which appears to be one of the primary statistics used currently in EPA reports to summarize the pesticide levels (e.g., see [2.1] and [2.2]). (Note, when computing geometric means of data with zero values, a constant must be added to each data point, see Appendix 2).

As an illustration of the proportion greater than a particular value, consider for the soil residues data aldrin and dieldrin proportions found to be greater than .05 and .10 ppm over time.

	Aldrin		Dieldrin	
Year (FY)	.05 ppm	.10 ppm	.05 ppm	.10 ppm
1969	.058	.042	.163	.099
1970	.070	.045	.200	.138
1972	.150	.035	.187	.132
1973	.040	.029	.184	.128
1974	.019	.014	.128	.078

The preceeding type of table is an extremely useful procedure for tracking pesticide levels over time for all of the monitoring networks. Of course, defining "meaningful" levels for each pesticide for the various networks is a complex problem. For the current report, meaningful levels were not available to RTI; and therefore, when the proportion greater than particular levels are given they simply were selected for convenience. However, it would appear to be worthwhile for EPA to consider defining "meaningful" levels whenever possible since a summary statistic such as the geometric mean over time may be of little value if the observed means are of little practical interest (e.g., relatively small).

Tests of Significance

Assuming that the proportion of positive values, geometric means, and the proportion of values greater than a particular level are used as summary statistics, then appropriate statistical tests to use to detect pesticide level differences; such as, differences over time or between geographic areas are:

(1) For the proportion positive or greater than some "meaningful" value a χ^2 test may be used to test if the proportions for several years or several geographic regions are equal - i.e., suppose the proportion of positive values for soil levels for a particular pesticide are P_1, P_2, ..., P_6 from 1969 through 1974 over the entire soil network. Then to test if these six proportions are equal, the following test statistics applies:

$$\chi^2_{(5)} = \frac{n_1(P_1 - \overline{P})^2}{\overline{P}\,\overline{Q}} + \frac{n_2(P_2 - \overline{P})^2}{\overline{P}\,\overline{Q}} + \ldots + \frac{n_6(P_6 - \overline{P})^2}{\overline{P}\,\overline{Q}}$$

$$\text{where } \overline{P} = \frac{\sum_{i=1}^{6} n_i P_i}{\sum_i n_i}$$

$\overline{Q} = 1 - \overline{P}$; n_i = the number of observations that each P_i is based upon and $\chi^2_{(5)}$ is the χ^2 statistic with 5 degrees of freedom.

A standard χ^2 table may be used to determine if the test is significant (e.g., at the .05 level of significance $\chi^2_{(5)} = 11.1$). If the test is significant then it may be of interest to determine which of the proportions are significantly different (see [2.5]).

(2) For the geometric means a one-way analysis of variance (ANOVA) may be used to test if a series of geometric means are equal. This test may be carried out by taking the natural logarithms of the pesticide levels and using an ANOVA on the transformed values (note, it may be advisable to add the minimum positive value to each number before taking logs or to transform the data by a simple scale factor (ppm to ppb) to avoid obtaining large negative numbers after taking logs [see Appendix 2]).

For example, suppose the mean positive DDT levels for several years are to be tested from the following data matrix:

	1970	1971	....	1974
	X_{11}	X_{12}	....	X_{15}
	⋮			⋮
	X_{a1}	X_{a2}		X_{a5}

where X_{ij} are the DDT levels in year j for sampling site i.

After taking the natural logarithms of the data, the following ANOVA table may be generated (e.g., see [2.3]):

ANOVA TABLE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Test
Between Years (T)	4	$SS(T) = \sum_j Y_{\cdot j}^2/a - \frac{Y_{\cdot\cdot}^2}{5a}$	$MS(T) = \frac{SS(T)}{4}$	MS(T)/MS(W)
Within Years	5 (a-1)	$SS(W) = \sum_{ij} Y_{ij}^2 - \sum_j Y_{\cdot j}^2/a$	$MS(W) = \frac{SS(W)}{5(a-1)}$	
Total	5a-1			

where $Y_{ij} = \log_e(X_{ij})$, $Y_{\cdot j} = \sum_i Y_{ij}$, $Y_{\cdot\cdot} = \sum_i \sum_j Y_{ij}$.

The test for equality of the geometric means is the F-test given in the last column of the ANOVA table. A standard F-table may be used to determine significance (e.g., at the .05 level of significance the F-test with 5 and 120 degrees of freedom is significant if the calculated F-value exceeds 2.29). If the F-test is significant, it implies that the geometric means for 1970 through 1974 are statistically significant. In this case, it may be of interest to examine which geometric means are significantly different by using a procedure such as the Duncan Multiple-Range Test (see [2.3]). In addition, if a trend over time is evident, one might fit a regression equation with pesticide levels as the dependent variable and time as the independent variable. This would then quantify the observed trend.

It should be noted here that the one-way ANOVA given above reduces to a simple two-tailed Student t-test if only two geometric means are being compared (e.g., only two time periods such as before and after DDT use was suspended). It is also important to note that the above statistical tests assume independent observations in determining the proportion of positive values, proportion greater than some level, or the geometric means. This assumption is probably not true for testing different time periods (e.g., the water samples from the water network are collected at the same locations from season to season). In general, ignoring this lack of independence may result in declaring too few significant differences over time. Unfortunately, the data available on the pesticide data files are for very limited time periods; and therefore, time series analysis which would take into account correlations between samples over time cannot be used effectively. Hopefully, in the future when several years of pesticide data are available on the data files, it will be possible using appropriate techniques, to take into account correlations over time in making statistical tests among time periods.

Finally, it is important to note that the above analyses have not considered more than one factor at a time in analyzing pesticide levels (i.e., only time or geographic region were considered).

However, when analyzing pesticide levels from a data base such as the human tissue network, it is necessary to consider several factors at a time (e.g., age, race, sex, ...) in the analysis. To handle this problem, models such as the following may be needed:

$$P_{ijk\ell mn} = \mu + A_i + S_j + R_k + T_\ell + L_m + \varepsilon_{ijk\ell mn}$$

where

$P_{ijk\ell m}$ = pesticide level in tissue for the n^{th} individual, in the m^{th} location, for the ℓ^{th} time period, in the (ijk) age-race-sex group;

μ = mean pesticide level;

A_i = age effect for the i^{th} age group;

S_j = sex effect for the j^{th} sex group;

R_k = race effect for the k^{th} race group;

T_ℓ = time effect for the ℓ^{th} year;

L_m = location effect of the m^{th} location;

$\varepsilon_{ijk\ell mn}$ = random error.

In the above model, testing for age, sex, race, time and location effects corresponds to testing the equality of the A_i, S_j, R_k, T_ℓ and L_m. Standard statistical computer software may be used to carry out these tests for unweighted data and specialized software is available at RTI for carrying out the analyses for weighted data (e.g., [2.4]). In Section 3 a model similar to the above is used for testing the proportion of positive values and the geometric means of the positive values for several pesticides found in human tissue.

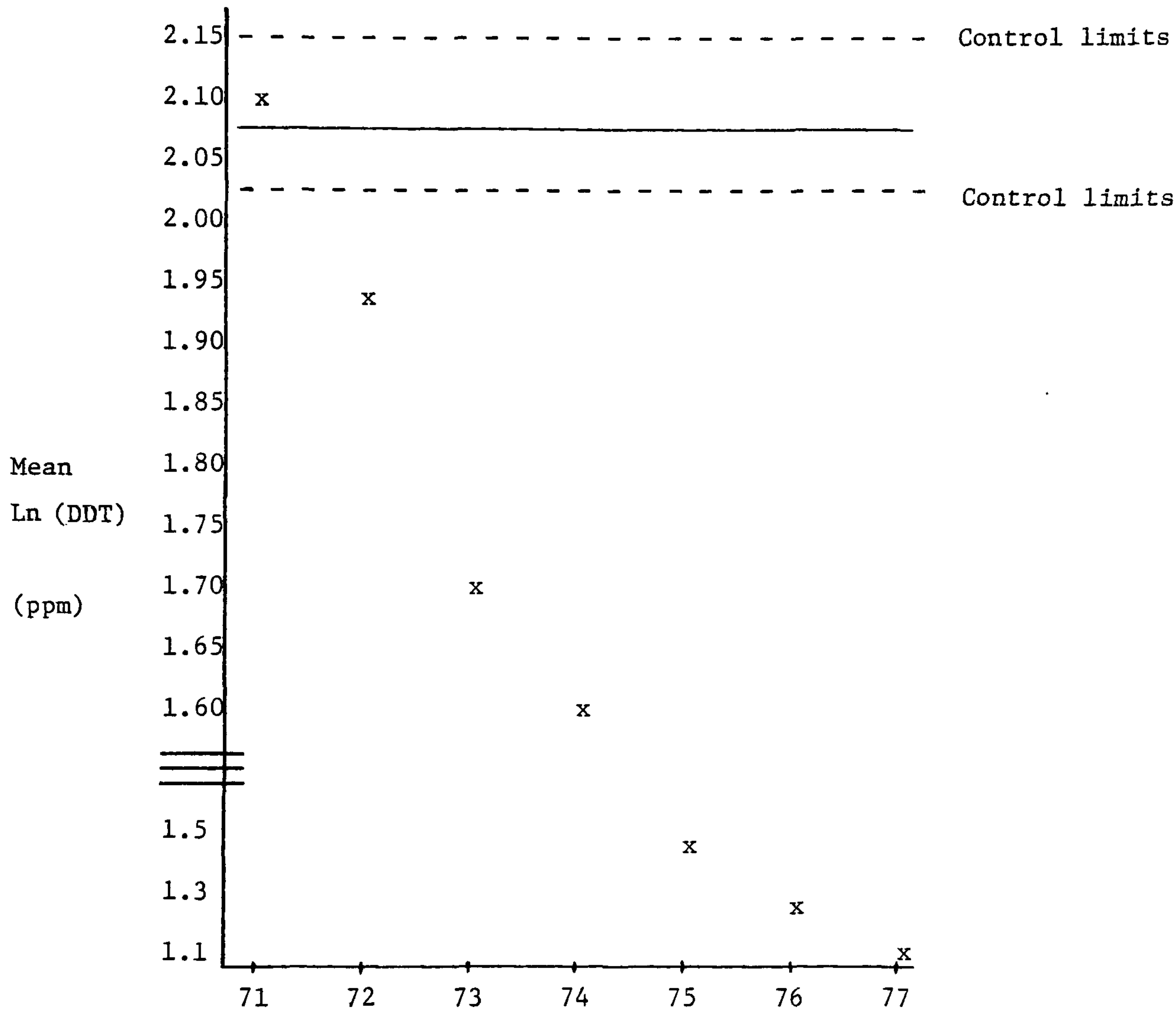
Monitoring Procedures

One of the primary purposes of the various pesticide networks should be to determine if unusual or unexpected trends are occurring in the various pesticide levels over time. This might be a national trend or a trend for a smaller geographic area such as a Census region or a State. In order to detect unusual or unexpected trends in the various networks, several approaches might be investigated including:

1. control charts on the geometric means of the positive values for each pesticide,
2. control charts on the percent positive or the percent greater than some level for each pesticide,
3. comparisons of trends for percent positive or percent greater than a particular level, or geometric means of positive values from past data and current data.

The control charts would simply involve computing the means and standard deviations of the statistic of interest (e.g., percent positive) for a particular pesticide in a geographic area from past data and then determining if current data were within $\pm$ 2 standard deviations (say) of the historical mean. Values outside the $\pm$ 2 standard deviation would be flagged. (Note, $\pm$ 2 standard deviation represents 95 percent confidence limits for the normal distribution). For example, for human tissue levels of DDT from 1971 through 1977 the following control chart could be used.

CONTROL CHART FOR MEAN LOG (DDT) LEVELS OVER HUMAN TISSUE NETWORK



In constructing the above control chart, the center line was the mean of the natural logs of DDT levels in 1970 and 1971, and the dashed control lines are $\pm$ 2 standard deviations from this mean (center line).

The comparisons of trends might involve computing regressions over time of a pesticide level from historical data and then predicting the current value of the pesticide level and its confidence limits from the regression equations. The current value of the pesticide levels could then be compared with the predicted value and its confidence limits. Of course, if the slope of the regression line is not significantly different from zero (i.e., no trend is evident) then control chart analysis is probably sufficient to monitor the data.

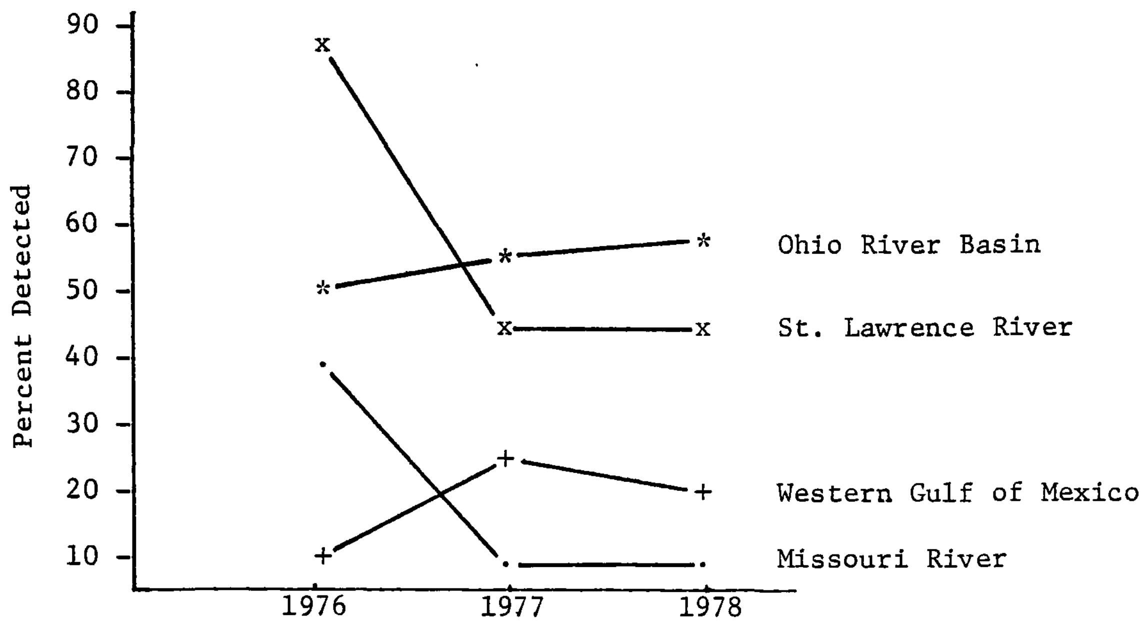
Furthermore for trends over time, it would also seem very important to be able to detect pesticides that had not been detected in the past at any sampling site but then are detected at a few sites. This phenomenon would not be detected by a control chart on percent positive since all historical data is zero. Therefore, it would seem appropriate when a few sites (e.g., 1 or 2%) begin to show positive values to flag these sites and to investigate in detail where the percent positive sites are located. For example, if the positive sites are all in one area, this might be cause for some specific action such as oversampling of this area (e.g., the special 1976 Mirex study in southern States) to determine the extent of the problem caused by the particular pesticide. As an example of this, consider PCB percent positive in the approximately 1400 agriculture soil sites in the Soil Network from 1972 to 1974.

Year	Sample Size*	No. Pos. Sites	% of Sites Positive
1972	1401	0	0
1973	1403	2	.14
1974	1388	24	1.73

* Number of sampling sites

The table indicates that in 1972 no sites had detectable PCB levels, but in 1973 and 1974, there is an indication that PCB levels are beginning to be detected at a few sites. RTI examined the location of the 24 positive PCB sites in 1974 and found four of them to be in New York, three of them in Michigan, and three in Nebraska. No other state had more than two positive sites.

In addition to trends over time for a particular geographic area, it may also be instructive to examine trends over time for several geographic areas simultaneously. This will indicate how different areas of the country compare over time with regard to percent positive, percent greater than a particular level, or geometric means for a particular pesticide. For example the following plot indicates for sediment samples the percent of sites from four water basins where PCB levels were detected in 1976, 1977 and 1978:



Of course, in addition to the above type of plot, statistical tests of significance should also be performed to determine if the various basin percentages are significantly different from one another. It is also important to note here that if geographic areas of the country are to be compared for human tissue pesticide levels that it will be necessary to adjust for such demographic factors as age, sex, and race.

The above are only examples of a few surveillance techniques; many more could be examined. For example, monitoring of the percent change from year to year in the geometric means, or tracking the deviation of current pesticide levels from the levels in some base period. In general, all of these techniques should be computerized so that plots or tables may be automatically generated and flagged values identified. This might even include computer-graphic techniques that automatically indicate on maps of the U.S. areas of the country which are increasing, remaining constant or decreasing with regard to levels of various pesticides.

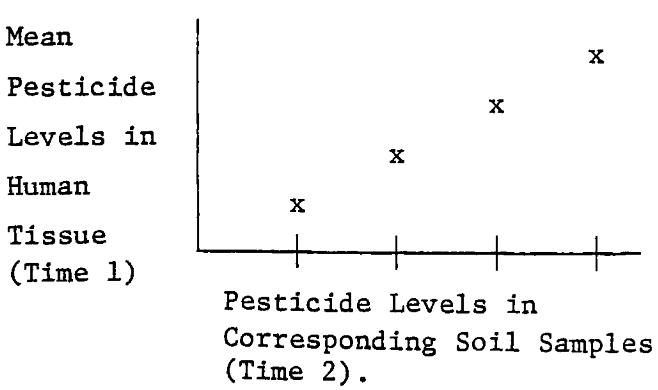
Matching of Pesticide Networks

Currently RTI has not examined, in detail, the possibility of matching the data files from the various pesticide networks so that joint analyses could be performed on these matched files. However, this does not seem feasible as the different networks are presently constructed. Few, if any, sampling sites among the networks are geographically close. Possible crude linkage by state or census region is possible, but the value of this level of matching is questionable (e.g., note, there are limited urban soil and human tissue data from the same cities).

The ability to relate observations of one network to another could have many advantages. For example, if the soil application, soil and crops residue, water residue, and human tissue networks were linked appropriately, increasing concentrations of specific pesticides might be traced from the application on crops to the water supply and into the human population. Questions about the rate at which pesticides move through the environment and sources of contamination could be investigated.

Linkage of the networks would require a special sampling plan that considered the various networks simultaneously. One feasible plan might be to randomly sample watersheds then sub-sample the city(ies) and water supply(ies), the soils (and crops) in the watershed, and the ambient air levels. Other factors that could effect the concentration of pesticide in adipose tissues might also be sampled such as pesticide levels in commonly consumed food (e.g., milk).

Of course, it should be emphasized, that even if the monitoring networks were matched in some manner, the prediction of tissue levels from soil, water, air, and food levels might be impractical due to the relatively large number of uncontrolled factors in the individuals sampled (e.g., smoking habits, weight, diet, occupation, where time is spent, general health history, ..., etc.). However, averages over geographic areas might prove to be extremely useful in examining the sources of pesticide residues in humans. For example, with properly designed pesticide networks, plots such as the following could be examined for a given geographic area.



Thus, it would seem worthwhile to at least investigate the possibility of matching data from the various networks. However, it is important to state that designing sampling procedures so that data from the various networks could be matched would probably sacrifice geographic coverage of a particular network for a fixed amount of funds. That is, if the soil network were tied to the human tissue network, then for a given amount of funds the soil network would not be able to cover as many geographic areas as it would if its sampling procedures were independent of the human tissue network.

Practical versus Statistical Significance

Before preceeding with the analyses of the various pesticide network data files it is important to discuss, briefly, practical versus statistical significance. To facilate the discussion, consider the following example from the Human Tissue Network that involves the geometric means of hexachlorobenzene levels by sex over years.

	Sample Size	Geometric Mean (ppm)
Male	1562	.044
Female	1564	.039

A test of significance of the two geometric means is statistically significant at the .01 level of significance because of the large sample sizes. However, from a practical standpoint, the two geometric means are probably not significantly different; particularly since the levels of hexachlorobenzene are only recorded to two significant digits. Thus, it is very important to keep in mind that an investigator should not indiscriminately run and report the results of statistical tests of significance without keeping in mind what differences in his data are different from a practical standpoint. This is analogous to the discussion given above on defining "meaningful" levels when summarizing the data for a particular pesticide. Simply performing statistical tests, particularly with large sample sizes, is not sufficient to determine what differences are important. The investigator should incorporate his knowledge and experience of his particular data in interpreting what differences are really meaningful.

Running several statistical test on a data base is fine, but it should not be done in a vacuum where intimate knowledge of the data by the investigator is ignored when results are reported.

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3. NATIONAL HUMAN ADIPOSE TISSUE NETWORK

3.1 Detailed Description of the Network

3.1.1 Sampling Procedures

a. Sample Design

The statistical design used to collect data for the Adipose Tissue Survey of the National Human Monitoring Program (NHMP) has several stages. The contiguous 48 states were stratified into several regions. Sampling sites were selected from a list of eligible places proportional to the population. Within the sampling sites, the subsampling was performed by cooperating pathologists and medical examiners.

In FY70-FY72 the contiguous 48 states were stratified by census region. Beginning in FY73 the strata were changed to census divisions. The details of the census regions and divisions by States is given in Appendix 3.1. In the earlier period, the number of sites selected within each stratum is determined by its population as given in the 1960 Census. The allocation was: Northeast 11, (28%); North Central 12 (30%); South 9 (24%) and West 7 (17%). In FY73, the allocations were revised based on 1970 Census data. The strata were also changed to coincide with the nine Census divisions. The allocations are summarized in Table 3-1a.

In FY77, the sample sites where changed from cities of greater **than** 25,000 persons to Standard Metropolitan Statistical Areas (SMSA). The allocation of the 40 sample sites is also summarized in Table 3-1a.

In FY70-72, the eligible places were cities with populations greater than 25,000 persons based on the 1960 Census. In FY73-76, the eligible places were cities greater than 25,000 based on the 1970 Census. In FY77, the sample sites were SMSA's with size also being based on the 1970 Census. For FY70, FY73, and FY77 the sample sites were independently selected for each stratum with probability proportional to size. This was done by listing the sites in random order along with their cumulative totals. An interval for each stratum was calculated by dividing the total population for all sites listed by the number to be selected in the stratum. (An example of this process is given in Appendix 3.2). A random number was obtained between 0 and the length of the

TABLE 3-1a

Number of Sample Sites for Each Stratum FY73 - FY77

Census Division	FY 73-76	FY 77	Percent of Allocation
New England	4	2	6
Middle Atlantic	14	7	18
East North Central	15	8	20
West North Central	6	3	8
South Atlantic	11	6	15
East South Central	5	3	6
West South Central	7	4	10
Mountain	3	2	4
Pacific	10	5	13
	75	40	100

TABLE 3-1b

Sample Size by Design and Surplus Records

Year	Total number of records	Number of design records	Number of surplus records	Number* used for weights
1970	2919	1436	1483	1456
1971	3379	1595	1784	1624
1972	4351	1922	2429	2034
1973	1276	1117	159	1213
1974	1050	924	126	1050
1975	910	793	117	910
1976	785	689	96	785
1977	907	773	134	907

* This number includes all "D" records and surplus "S" records from cities selected in sample design.

interval to give a starting point. The sites were selected by matching their cumulative totals with the starting point or integer multiples of the interval plus the starting point. A listing of the originally selected sites can be found in Appendix 3.3.

When no cooperative pathologist or medical examiner could be found, alternate sites were selected. These sites were chosen by position in the listing with respect to the nonrespondent site. The first alternate was the site immediately below the originally selected site, the second alternate the one immediately above, the third alternate was the second site following and so on. A listing for each year of the sites where samples were supposed to be taken is given in Appendix 3.3.

The subsampling within each site was done with the aid of cooperating pathologist and medical examiners. Each site was assigned a quota based on the demographic characteristic of age, sex and race. The ages were grouped into three ranges 0-14, 15-44, and greater than 44. The races were classified as white and nonwhite. The quotas for FY70-FY72 were based on the National demographic characteristics according to the 1960 Census [ref. 3.1]. The quotas for FY73-FY76 and FY77 + were determined by the appropriate demographic characteristics for each census division. Appendices 3.4 and 3.5 contain the quotas for each site and census division.

Below the sample city (or SMSA) level there was no probability structure for obtaining the participants in the survey. The hospitals, pathologist and medical examiners were selected subjectively. Also, the tissue samples from cadavers and surgical patients were selected subjectively by the cooperating pathologists, etc. Guidelines for selecting patients were distributed by EPA. Appendix 3.6 contains the letter sent to each cooperating professional containing these guidelines.

b. Computation of Sample Weights

Even if one assumes the selection process within sample sites is approximately random, the sample design of the NHMP adipose tissue network does not assign equal "probabilities" of selection to all elements in the sample. In this situation a sample weight for each observation should be calculated that reflects its approximate probability of selection. Including weights in the analysis should reduce bias in estimating means or proportions (for probability sampling this results in strictly unbiased estimations for such statistics). In the following paragraphs procedures are given for computing weights for the NHMP (true sampling weights cannot be calculated because some stages involve non-probability sampling).

With the information on hand, RTI was not able to calculate the probability of selecting individuals within each sampling site (city or SMSA). Hence, equal probability of selection was assumed for the within site stage of sampling. This assumption, within the given time, was required for RTI to calculate the probability of selecting an individual. This method involved dividing the number of individuals selected by the population of the city. The probability of a city being selected is calculated by dividing the population of the city by the length of the selection interval (see Section 3.1.1a, above). Hence the weight is given by

$$\text{weight} = \frac{\text{length of interval}}{\text{population of city}} \times \frac{\text{population of city}}{\text{number selected in city}}.$$

Note that the population of city terms cancel giving the simplier expression

$$\text{weight} = \frac{\text{length of interval}}{\text{number selected in city}} .$$

For several of the larger cities, the population was larger than the interval, hence these cities were selected with probability one.

Quotas were assigned for each site depending on the population characteristics of age, sex and race. The quotas were based on stratum or national characteristics which most likely did not reflect the demographic characteristics of the individual sites. The time limitations of this task and other design factors did not permit taking these factors into consideration in computing weights.

Only a subset of the data for each year is used in calculating the weights. The data for each year is classified into two groups. The data record is classified as a design "D" record or a surplus "S" record. "D" records are usually from cities selected in the sample design and included in the quota for the site. "S" records are all samples from cities not selected in the design and also surplus samples from design cities not included in the quota.

For purposes of weight calculation, there appears no reason to treat "D" and "S" data differently from the same sample site. Hence, in calculating the weights, RTI includes both "D" and "S" records into the number selected from each sample site. All data from cities not included in the sample are excluded in calculating the weights (see Table 3-1b). The weights are also adjusted for "nonresponse" depending on the confidence codes.

Analysis of the data files using the weights calculated above is continuing at RTI. The results will be reported at a future date. For this report, because of limitations; however, it was necessary to carry out some analysis with unweighted data.

c. Evaluation of NHMP Sampling Plan

The present sampling plan for the NHMP adipose tissue network can be used to answer various questions of concern. The basic sampling plan has many good features but could be improved. Some general comments and recommendations are given below. Since several stages of the sample plan are done judgmentally, estimates of the variance of means and proportions cannot be done using an exact sampling distribution. One must make assumptions on the unknown effects of certain stages of the sample design to make statistical inference.

Several important topics can be addressed with the NHMP data files. With the files the concentration of many pesticides for a relatively large subset of the U.S. population can be recorded. Changes over time (trends), differences between various subpopulations based on age, sex, and race can be investigated using these files. These topics can be investigated nationally or for various geographic regions.

If a true surveillance network is desired, then the capability is needed to subsample quickly suspected hot spots. The NHMP could arrange in advance to have additional pathologists and laboratories available to select and analyze samples. The additional information would be helpful in discovering any causes of the unusual readings detected by the overall program. To make this effective, the lagtime (presently more than a year) from obtaining samples to reporting results would have to be reduced.

Finally, the following are a few general comments and recommendations on the current sampling design:

The purposive exclusion of cities less than 25,000 persons or non-SMSA's in the sampling frame should be modified. This results in a significant fraction of the total population having no chance of being selected in the sample. Allowing the selection of sampling sites from places greater than 2,500 persons would essentially eliminate this difficulty. The techniques of selecting alternate sites need improvement. Repeating the process by which the original sites were selected would be satisfactory (3.1.1.a above).

The purposive method of selecting hospitals within sample sites is undesirable. The method of subsampling within cities needs to be modified so that the selection probabilities for individuals may be calculated. Sampling frames for hospitals or pathologist could be constructed for selected cities. The pathologist could then be randomly selected from these frames with a known probability. A simple protocol describing how surgical patients and cadavers are to be sampled would allow for calculations of the selection probability for this stage of sampling. Invoking the assumptions that patients live in the same geographic area as the hospital from which the sample was obtained could be improved on by recording the zip code of residence. The site from which the tissue sample is taken could be recorded. This would help in investigating and accounting for the difference in tissue concentrations of residues. These alterations are offered for consideration, recognizing that some, while theoretically desirable, may not be practical.

3.1.2 Data Available on Data File

Pesticide and chemical residue data collected through the National Human Monitoring Program were available in machine readable form for 15,577 individuals. For each individual, residue amounts in adipose tissue were determined for nineteen (19) different pesticides and polychlorinated biphenyls (PCB's) for fiscal years through 1977. In addition to the 20 different residue amounts, each individual's record contained information on the fiscal year the sample was taken, the census division in which the sample was taken, the individual's age, race and sex, and whether or not the sample was taken as part of the National Human Monitoring Program's designed sample discussed in Section 3.1.1. Although not complete for all samples, information was also obtained on diagnosis, height, weight, and occupation for each individual. Of the 15,577 samples collected, 9,249 (60%) were from the designed sample.

3.1.3 Assumptions Made in Analysis of the Network

It was decided to attempt analysis of all twenty residue amounts; however, six of the DDT derivatives were combined to form a total DDT equivalent by the formula:

Total DDT = pp'DDT+op'DDT+1.114(pp'DDE+op'DDE+pp'DDD+op'DDD).

Hence, analysis was confined to the following fifteen residues:

- Total DDT Equivalent
- α-BHC
- β-BHC
- Lindane
- δ-BHC
- Aldrin
- Dieldrin
- Endrin
- Heptachlor
- Heptachlor Epoxide
- Polychlorinated Biphenyls (PCB)
- Oxychlordane
- Mirex
- _Trans_ Nonachlor
- Hexachlorobenzene

Factors appearing on the individual records were categorized into the following levels:

Factor	Levels
Time	FY 1970 1971 1972 1973 1974 1975 1976 1977
Age	0 - 14 15 - 44 ≥ 45
Race	White Black Other
Sex	Male Female

Census Divisions	New England Middle Atlantic South Atlantic East South Central East North Central West South Central West North Central Mountain Pacific

For each record, a decision was made with respect to its inclusion in the analyses and for each residue on that record certain decisions and data transformations were made. On an individual record basis the following decisions were made:

- If the observation was not from the designed sample it was not considered for analysis (only "D" samples considered, recall that the analysis in this section is on unweighted data),
- If a residue amount had unsuccessful confirmation, then the residue amount was made equal to zero (confidence code I or J),
- If the record indicated that a technical error had been made for a particular residue amount, that residue amount was considered missing (confidence code K),
- If the confidence code for a particular residue amount was blank, that residue amount was considered missing,
- If the record indicated that there was less than 10% Lipid Extractable Material, all residue amounts were considered missing for that record,
- If a residue amount was a trace amount, then that residue amount was set equal to zero,
- All residue amounts except PCB's were divided by the proportion of Lipid Extractable Material and were the basis of analysis,
- For all positive, non-PCB residue amounts, the natural logarithm of the amount was calculated,
- For all residue amounts, an indicator variable was created which was one if the residue amount was positive and zero if the residue amount was zero. If the residue amount was missing, the indicator variable was considered missing,

- For PCB an additional indicator variable was created which was one if the PCB residue amount was greater than three parts per million (3ppm) and zero if less than 3ppm. The indicator variable was considered missing if the PCB residue amount was missing.

3.2 Data Analysis

3.2.1 Overview

With the data set created pursuant to the rules given in Section 3.1.3, two analyses were conducted for each of the fifteen residues.

For the non-PCB residues, an analysis of variance was conducted on the natural logarithms of the positive residue amounts to test for differences among the factor levels (also given in Section 3.1.3). In addition, for each residue (including PCB), a chi-squared analysis was performed to test for differences among the same factor levels in the percent of positive detections of the pesticide. For PCB's, the proportion of individuals with greater than 3ppm PCB was analyzed by chi-squared techniques to test for differences among the factor levels. In all the analyses conducted, the contribution of a specific factor to the variable (% positive or log [amount]) being analyzed was assessed after statistically adjusting all other factors. This method of analysis is equivalent to comparing the levels (e.g., fiscal years) of a factor (time) after adjusting for all other factors.

The use of the analysis of variance and chi-squared techniques given above presumes data present in sufficient quantity to allow statistically valid comparisons among the factor levels. Therefore, the following rules were made to allow the comparisons:

- If a residue had many fewer than 10% positive detections or many more than 90% positive detections only difference among the years were tested using the statistic percent positive detections; however, tests employing the geometric mean were performed where appropriate.
- If a residue had fewer than 1% positive detections, no tests were performed.
- If a residue had more than 99% positive detections, no tests were performed using the statistic percent positive detections;

however, other tests using the statistic geometric mean were performed where appropriate.

- If fewer than 10% of the amounts were positive for a particular residue, then no tests were performed using the statistic geometric mean.
- For Oxychlordane, Trans Nonachlor and Hexachlorobenzene, the percent positive detections could not be distinguished from blanks for all years. For these pesticides, tests employing the statistic percent positive detections are based only on the data from years where the percent positive detections could be unambiguously determined.

The above rules led to the following tests for the different residues:

Residue	% Positive Detections	Geometric Mean
Total DDT Equivalent	no test	all factors
α-BHC	years only	no test
β-BHC	years only	all factors
Lindane	years only	no test
δ-BHC	no test	no test
Aldrin	no test	no test
Dieldrin	years only	all factors
Endrin	no test	no test
Heptachlor	no test	no test
Heptachlor Epoxide	years only	all factors
PCB's	all factors (includes % >3ppm)	
Oxychlordane	years only	all factors
Mirex	no test	no test
Trans Nonachlor	years only	all factors
Hexachlorobenzene	years only	all factors

3.2.2 Tests

The statistical tests done assume simple random sampling from the U.S. population. Insofar as the actual sampling procedures are not simple, the indicated significance levels may be somewhat too high. However, while the statistical tests used do not precisely accomodate the sampling procedures, still some important patterns are recognizable.

In addition, because the sample sizes are so large virtually all differences are statistically significant. Perhaps what is more important than statistical significance is the actual magnitude of a statistically significant difference (i.e., practical significance).

3.2.3 Summary Statistics

Summary statistics for the residues appear both graphically and in tabular form for Total DDT Equivalent, Dieldrin, Hexachlorobenzene and PCB's (Figures 3.1 - 3.4).

For rarely observed positive residue amounts (<1%) only the percent positive detections (over all factors) are given. These pesticides are δ-BHC, Endrin, Heptachlor, and Mirex and are shown in Table 3.2.

For the uncommly observed (<10%) positive residue amounts, the percent positive detections are given by year, and differences among the years are tested for significance. These pesticides are α-BHC and Lindane, and are shown in Table 3.3. Also given in Table 3.3 is the percent positive detections for Aldrin which was not tested because in the years when it was apparently detected it could not be distinguished from PCB's.

For all other pesticides, summary statistics are given for each level of each factor given in Section 3.1.3, with statistical testing performed where the sample requirements of 3.2.1 are met.

For PCB's, the summary statistics are percent positive detections and percent >3ppm by factor level (Table 3.4).

Tables 3.5 - 3.11 give summary statistics in terms of percent positive detections, geometric means and the standard error of the geometric mean by factor level for the remaining pesticides.

3.2.4 Analysis Results

a. Time Trends

For each residue tested, time (in years) was an important source of variation. However, a particular pattern of trend was not discernible for all pesticides.

The following lists and denotes by X the residue and statistic with discernible time patterns:

Residue	Time Pattern Type	% Positive	Geometric Mean	Table
α-BHC	Decreasing	X		3.3
PCB's	Increasing	X (also % >3ppm)		3.4
Total DDT	Decreasing		X	3.5
β-BHC	Decreasing		X	3.6
Dieldrin	Decreasing		X	3.7
Oxychlordane	Decreasing	X	X	3.9

b. Age Differences

Age differences are present for all residue amounts, the oldest age group has the greatest amount of residue as measured by the geometric mean. The percent positive detections also vary by age but not as systematically as the geometric means.

c. Racial Differences

Except for Hexachlorobenzene, whenever there were sufficient data to allow testing, Blacks had greater amounts of pesticide residue then Whites. Again, the percent positive varied between Black and Whites but not in the systematic way as did the geometric means.

d. Sex Differences

With one exception, males showed greater amounts of pesticide residue for all pesticides for which there were sufficient data. The exception is β-BHC, where females showed slightly greater amounts of residue than males.

e. Census Divisions Differences

Again, for the pesticides for which there were sufficient data, census divisions were a significant source of variation. Attempting to summarize this variation for each pesticide for which a test was performed, the following gives, by pesticide, those census divisions with geometric mean amounts 25% greater than the national geometric mean:

Pesticide	Census Division With GM >1.25 GM National
PCB (>3ppm)	Mid Altantic, New England
Total DDT	South Atlantic
β-BHC	East South Central, South Atlantic, West South Central
Dieldrin	None
Heptachlor	None
Oxychlorodane	West South Central
Trans Nonachlor	East South Central, West South Central
Hexachlorobenzene	Pacific

3.2.5 Final Remarks

The analyses presented in this section represent a first step in the simultaneous assessment and testing of the importance of various factors on human adipose pesticide/chemical residues.

Future analyses of these data should examine more subtle hypotheses than have been examined in this report. For example, knowing that there is significant yearly variation in the data may not be sufficient information to make policy decisions. More subtle hypotheses would uncover, where they exist, orderly time trends and, perhaps, differential time trends for different population subgroups.

Also, future analyses of the data should be performed using techniques which accomodate the complex selection procedure of the individual samples. The complexity of selection derives from both the unequal selection probabilities of the individual samples and the clustering of sample elements that occurs due to the hospital based collection of tissue samples. While the hospital based collection procedure is, perhaps, the only reasonable way to obtain tissue samples, it does have an impact on the data variability and should be accounted for in subsequent analyses.

Finally, the pesticide/chemical residue data analyzed in this report represent all the residues for which information is routinely gathered by the National Human Monitoring Program's data collection instrument "Tissue Pesticide Residue Analysis Report" (Appendix 1). Unfortunately, this instrument does not contain information concerning pesticide substitutes. For instance, recommended substitutes for DDT (e.g., parathion, malathion, etc.) do not appear on this data file and questions concerning exposure to the substitutes cannot be answered.

Figure 3.1. Percent Positive Occurrences and Geometric Means by Year for Total DDT Equivalent

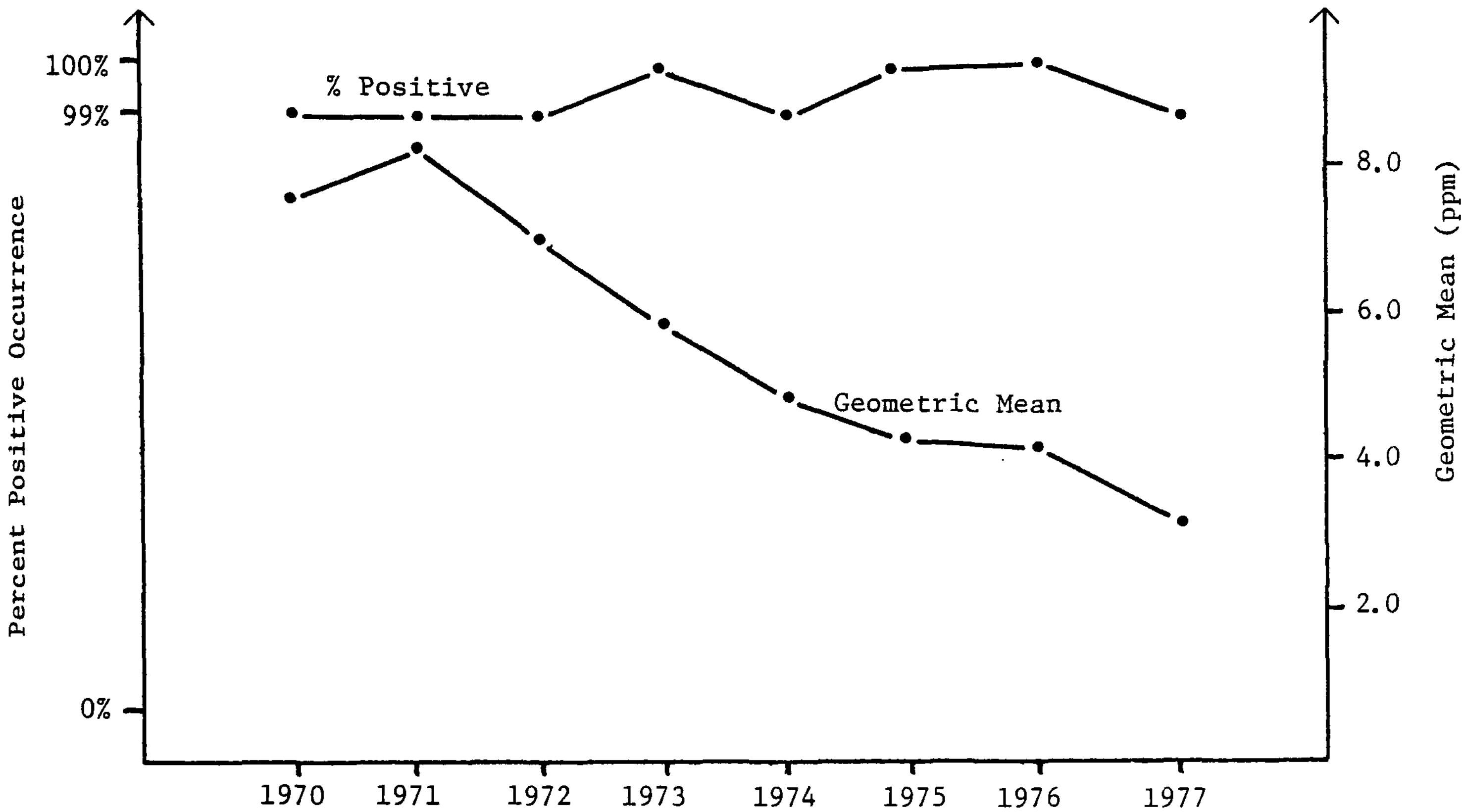

Figure 3.2. Percent Positive Occurrences and Geometric Means by Year for Dieldrin

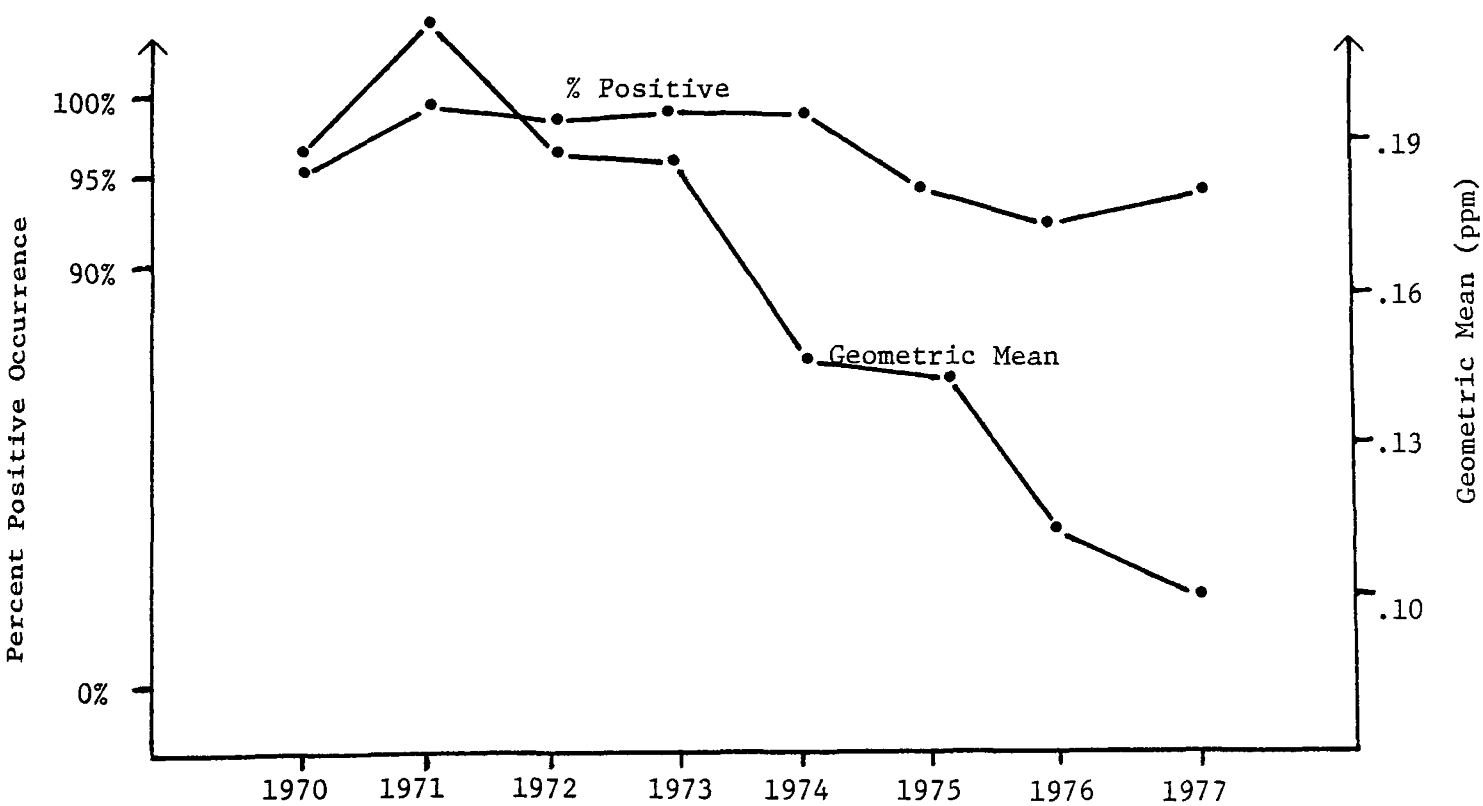

Figure 3.3. Percent Positive Occurrence and Geometric Mean by Year for Hexachlorobenzene

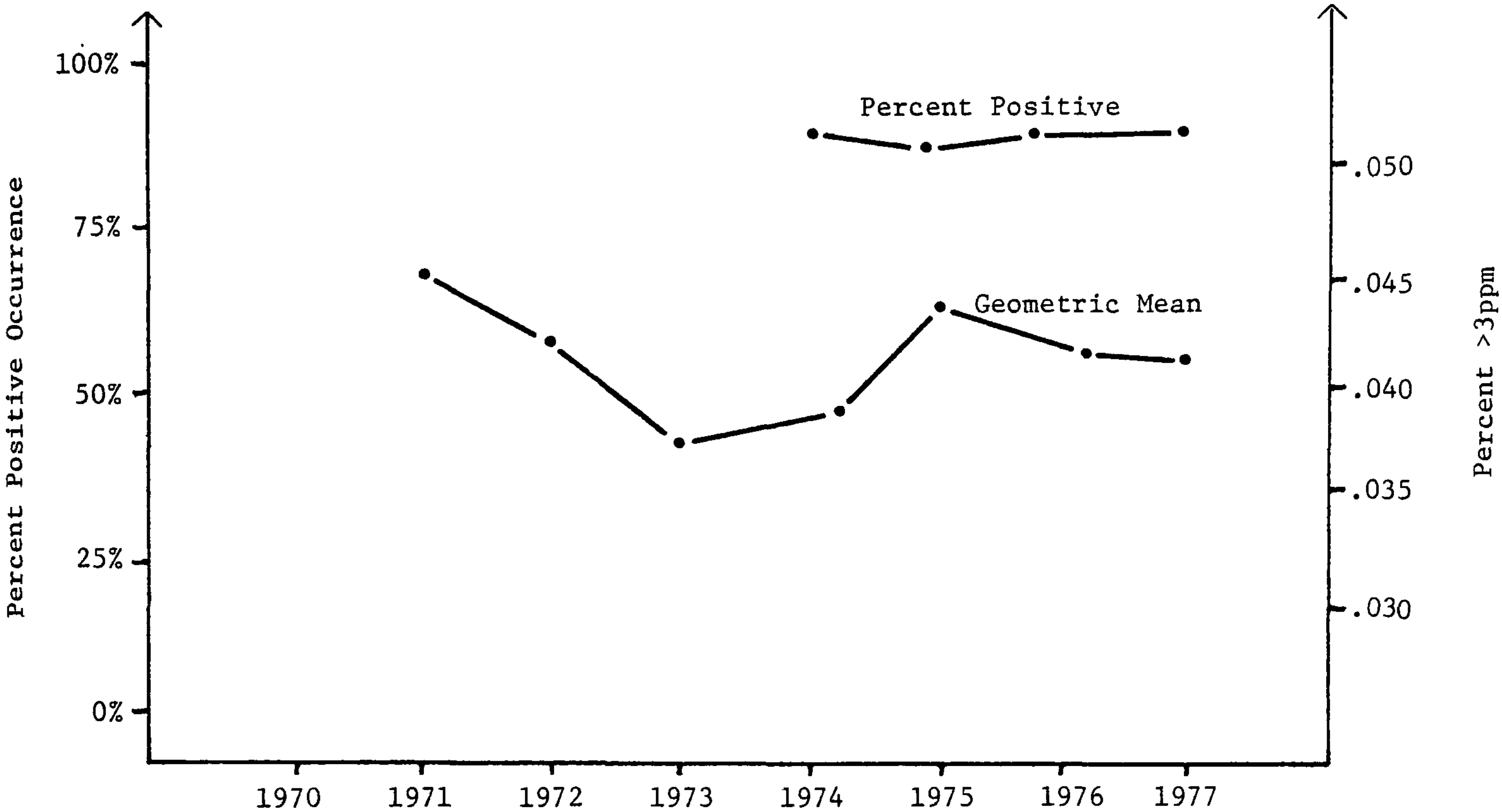

Figure 3.4. Percent Positive Occurrence and Percent >3ppm by Year for PCB

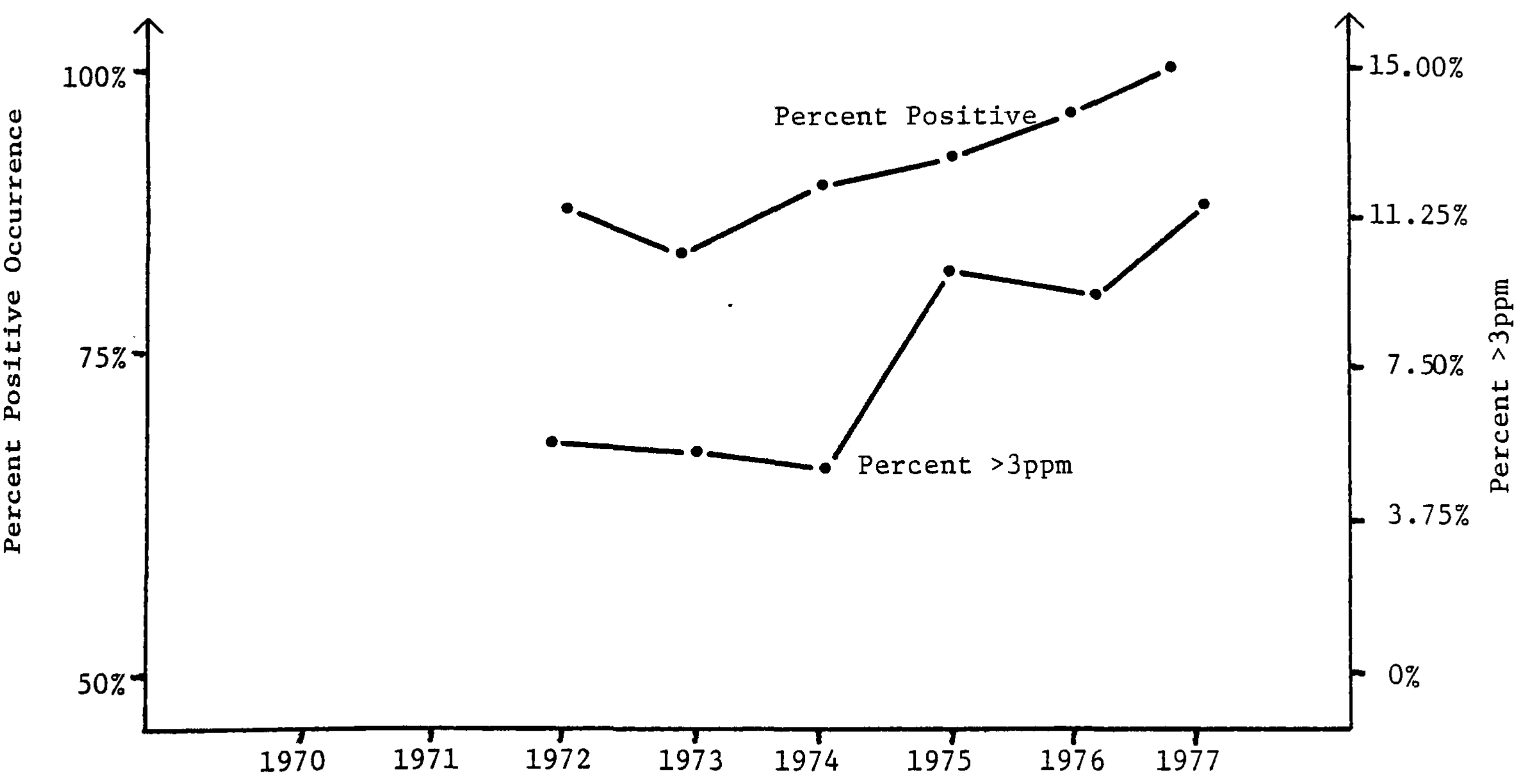

Table 3.2

Summary Statistics for Rarely Observed (< 1%) Residues

Residue	N	Percent Positive	
δ-BHC	9041	.02%	No tests performed
Mirex	9050	.09%	No tests performed
Endrin	9041	.01%	No test performed
Heptachlor	9051	.02%	No test performed

Table 3.3

Summary Statistics for Uncommonly Observed (< 10%) Residues

		Residue		
Years	N	α-BHC % Positive	Lindane % Positive	Aldrin % Positive
ALL YEARS	9042	1.10	1.12	2.11
1970	1380	2.10 **	1.81**	0.86 NT
1971	1559	0.12	1.47	11.48
1972	1885	2.01	0.26	0
1973	1092	1.64	1.55	0
1974	901	0.44	0.55	0
1975	779	0.12	0.51	0
1976	682	0.29	0.43	0
1977	764	0.78	2.62	0

** = Differences among the years significant at the 1% level (99% confidence).

NT = No tests performed because in 1970-71 Aldrin was not distinguishable from PCB's.

Table 3.4

Summary Statistics for PCB

Factor	Factor Levels	N	Percent Positive	Percent > 3 ppm
ALL		6058	90.6	7.5
YEARS	1970	0	----	----
	1971	0	----	----
	1972	1765	89.7**	5.8**
	1973	1114	78.5	5.6
	1974	924	90.9	5.0
	1975	793	94.2	10.4
	1976	689	97.9	9.3
	1977	773	99.7	12.3
AGE	0-14	1057	81.9**	1.6**
	15-44	2000	92.3	6.5
	≥ 45	3001	92.5	10.2
RACE	White	5147	91.3**	6.5**
	Black	851	86.9	13.0
	Other	60	85.0	10.0
SEX	Male	3101	90.6 NS	9.0**
	Female	2957	90.6	5.9
CENSUS DIVISIONS	E. No. Central	1332	88.8**	6.6**
	E. So. Central	396	82.8	9.3
	Mid-Atlantic	1384	88.4	10.4
	Mountain	204	97.6	3.4
	New England	228	99.1	16.6
	Pacific	656	91.9	4.7
	So. Altantic	688	94.7	8.3
	W. No. Central	434	92.8	5.2
	W. So. Central	736	91.4	3.9

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

TABLE 3.5

Summary Statistics for Total DDT Equivalent
Total DDT Equivalent = [pp'DDT+op'DDT+1.114(pp'DDE+op'DDE+pp'DDD)]

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) [1/]
ALL		9036	99.9	6.04	< .009 GM
YEARS	1970	1380	99.9[NT]	7.90**	< .025 GM
	1971	1557	99.7	8.14	< .025
	1972	1884	99.9	6.89	< .020
	1973	1092	100.0	5.87	< .025
	1974	901	99.8	5.06	< .030
	1975	779	100.0	4.63	< .030
	1976	682	100.0	4.34	< .035
	1977	761	99.8	3.25	< .030
AGE	0-14	1285	100.0[NT]	2.47**	< .025
	15-44	2737	99.8	5.89	< .020
	≥ 45	5014	99.9	7.69	< .015
RACE	White	7611	99.8[NT]	5.47**	< .010 GM
	Black	1335	100.0	10.39	< .025
	Other	90	100.0	7.18	
SEX	Male	4709	99.9[NT]	6.24**	< .015 GM
	Female	4327	99.8	5.50	< .015
CENSUS DIVISIONS	E. No. Central	1912	99.9[NT]	4.22**	< .020 GM
	E. So. Central	694	99.8	7.07	< .035
	Mid-Atlantic	2152	99.9	6.17	< .020
	Mountain	263	99.6	5.55	< .055
	New England	320	100.0	4.98	< .050
	Pacific	1025	100.0	7.19	< .030
	So. Atlantic	1055	100.0	7.82	< .030
	W. No. Central	676	99.4	5.59	< .035
	W. So. Central	939	100.0	7.52	< .030

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm s SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.6

Summary Statistics for β-BHC

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) 1/
ALL		9075	96.6	.272	< .001 GM
YEARS	1970	1387	98.6**	.381**	< .020
	1971	1570	98.7	.353	< .020
	1972	1889	91.9	.302	< .020
	1973	1094	98.9	.264	< .025
	1974	905	98.1	.221	< .025
	1975	784	97.1	.201	< .030
	1976	683	96.7	.197	< .030
	1977	763	94.3	.161	< .030
AGE	0-14	1306	89.3 NT	.116**	< .020 GM
	15-44	2745	97.7	.222	< .015
	≥ 45	5024	97.8	.372	< .010
RACE	White	7642	96.7 NT	.267**	< .010 GM
	Black	1343	96.2	.367	< .020
	Other	90	94.4	.242	< .075
SEX	Male	4735	96.0 NT	.268*	< .015 GM
	Female	4340	97.2	.276	< .015
CENSUS DIVISIONS	E. No. Central	1915	96.1 NT	.208**	< .020 GM
	E. So. Central	710	94.2	.382	< .030
	Mid-Atlantic	2156	97.2	.237	< .020
	Mountain	263	98.0	.258	< .050
	New England	321	99.0	.187	< .040
	Pacific	1029	94.6	.244	< .025
	So. Atlantic	1058	98.7	.383	< .025
	W. No. Central	682	95.8	.273	< .030
	W. So. Central	941	96.9	.441	< .025

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.7

Summary Statistics for Dieldrin

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) 1/
ALL		9100	96.8	.169	< .008 GM
YEARS	1970	1394	95.6**	.197**	< .020 GM
	1971	1575	98.2	.222	< .020
	1972	1899	97.5	.189	< .020
	1973	1097	98.5	.181	< .025
	1974	904	98.5	.150	< .025
	1975	783	95.0	.141	< .030
	1976	683	93.4	.116	< .030
	1977	765	95.1	.099	< .030
AGE	0-14	1315	91.5 NT	.106**	< .025 GM
	15-44	2753	97.3	.156	< .015
	≥ 45	5032	98.0	.199	< .015
RACE	White	7662	96.9 NT	.163**	< .009 GM
	Black	1347	96.5	.214	< .025
	Other	91	93.4	.158	< .080
SEX	Male	4751	96.7 NT	.184**	< .015 GM
	Female	4349	97.0	.155	< .015
CENSUS DIVISIONS	E. No. Central	1925	97.0 NT	.166**	< .020 GM
	E. So. Central	713	95.0	.201	< .030
	Mid-Atlantic	2156	97.6	.171	< .020
	Mountain	264	98.1	.130	< .050
	New England	331	97.8	.133	< .045
	Pacific	1033	96.4	.138	< .025
	So. Atlantic	1064	96.2	.199	< .025
	W. No. Central	679	96.3	.184	< .030
	W. So. Central	945	96.8	.178	< .025

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.8

Summary Statistics for Heptachlor Epoxide

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) [1/]
ALL		9118	93.8	.092	< .008 GM
YEARS	1970	1390	94.1**	.100**	< .020 GM
	1971	1584	94.6	.095	< .020
	1972	1897	89.6	.100	< .020
	1973	1102	96.8	.096	< .025
	1974	910	95.2	.081	< .022
	1975	785	93.6	.091	< .025
	1976	683	94.1	.085	< .030
	1977	767	95.6	.077	< .025
AGE	0-14	1320	82.5 NT	.061**	< .020 GM
	15-44	2754	95.4	.081	< .015
	≥ 45	5044	95.8	.109	< .010
RACE	White	7673	94.0 NT	.091 NS	< .008 GM
	Black	1354	92.8	.100	< .020
	Other	91	87.9	.078	< .080
SEX	Male	4764	93.5 NT	.099**	< .010 GM
	Female	4354	94.1	.085	< .015
CENSUS DIVISIONS	E. No. Central	1921	95.0 NT	.092**	< .020 GM
	E. So. Central	717	90.0	.105	< .030
	Mid-Atlantic	2162	94.9	.100	< .015
	Mountain	264	93.9	.076	< .050
	New England	322	96.8	.075	< .040
	Pacific	1032	89.3	.063	< .025
	So. Atlantic	1069	95.8	.112	< .025
	W. No. Central	684	94.2	.100	< .030
	W. So. Central	947	92.7	.090	< .025

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.9

Summary Statistics for Oxychlordane

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) 1/
ALL		4218	97.2	.123	< .008 GM
YEARS	1970	1380	< 1.0 NT	.134**	< .270 GM
	1971	1571	53.4	.125	< .025
	1972	1893	91.8	.130	< .015
	1973	1092	98.4 **	.126	< .020
	1974	901	98.4	.120	< .025
	1975	779	96.4	.120	< .025
	1976	683	96.9	.117	< .025
	1977	763	95.3	.113	< .025
AGE	0-14	806	88.5 NT	.072**	< .020 GM
	15-44	1554	99.3	.115	< .015
	≥ 45	1858	99.3	.148	< .015
RACE	White	3632	97.4 NT	.116**	< .008 GM
	Black	533	96.8	.166	< .020
	Other	64	73.4	.126	< .080
SEX	Male	2055	96.6 NT	.134**	< .015 GM
	Female	2184	97.8	.112	< .015 GM
CENSUS DIVISIONS	E. No. Central	1003	96.4 NT	.107**	< .020 GM
	E. So. Central	283	97.5	.130	< .030
	Mid-Atlantic	787	97.8	.137	< .020
	Mountain	181	88.3	.130	< .045
	New England	169	98.8	.101	< .040
	Pacific	380	96.5	.096	< .025
	So. Atlantic	563	97.8	.141	< .025
	W. No. Central	319	98.4	.104	< .030
	W. So. Central	533	95.8	.158	< .025

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.10

Summary Statistics for Trans Nonachlor

Factor	Factor Levels	N	Percent Positive	Geometric Mean (ppm)	Standard Error (ppm) [1/]
ALL		2225	97.2	.119	< .008 GM
YEARS	1970	1380	0 NT	----	----
	1971	1559	0	----	----
	1972	1885	0	----	----
	1973	1092	< 1	.106**	< .680 GM
	1974	902	5.2	.114	< .010
	1975	779	97.2 NS	.121	< .030
	1976	683	97.2	.135	< .030
	1977	763	97.2	.104	< .025
AGE	0-14	456	89.7 NT	.067**	< .035 GM
	15-44	813	99.1	.112	< .025
	≥ 45	956	99.2	.158	< .025
RACE	White	1896	97.6 NT	.113**	< .020 GM
	Black	292	96.2	.158	< .045
	Other	37	83.8	.146	< .125
SEX	Male	1118	96.9 NT	.129**	< .025 GM
	Female	1107	97.6	.109	< .025
CENSUS DIVISIONS	E. No. Central	572	92.1 NT	.095**	< .030 GM
	E. So. Central	152	96.2	.150	< .055
	Mid-Atlantic	435	92.9	.133	< .035
	Mountain	110	87.3	.097	< .070
	New England	117	91.6	.093	< .065
	Pacific	168	96.2	.088	< .055
	So. Atlantic	258	90.6	.135	< .045
	W. No. Central	153	91.9	.124	< .056
	W. So. Central	260	92.2	.172	< .045

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

TABLE 3.11

Summary Statistics for Hexachlorobenzene

Factor	Factor Levels	N	Percent Positive		Geometric Mean (ppm)	Standard Error (ppm) [1/]
ALL		3126	92.9		.041	< .009 GM
YEARS	1970	1380	0	NT	---	---
	1971	1563	7.0		.045**	< .060 GM
	1972	1894	42.7		.043	< .025
	1973	1095	70.6		.037	< .025
	1974	901	93.7	NS	.039	< .025
	1975	779	91.5		.044	< .025
	1976	683	93.4		.042	< .025
	1977	763	92.9		.042	< .025
AGE	0-14	650	80.5	NT	.040**	< .025 GM
	15-44	1148	96.9		.039	< .015
	≥ 45	1328	95.6		.043	< .015
RACE	White	2672	93.7	NT	.041*	< .010 GM
	Black	408	89.2		.041	< .030
	Other	46	78.3		.047	< .090
SEX	Male	1562	92.1	NT	.044**	< .015 GM
	Female	1564	93.7		.039	< .015
CENSUS DIVISIONS	E. No. Central	752	92.1	NT	.038**	< .020 GM
	E. So. Central	188	96.2		.036	< .035
	Mid-Atlantic	610	92.9		.045	< .020
	Mountain	150	87.3		.047	< .045
	New England	143	91.6		.036	< .045
	Pacific	242	96.2		.077	< .030
	So. Atlantic	408	90.6		.030	< .030
	W. No. Central	248	91.9		.034	< .035
	W. So. Central	385	92.2		.041	< .025

NT = Factor not tested because of sample size (percent positive) requirements given in section 3.2.

NS = Not significant at the 5% level (less than 95% confidence).

* = Factor significant at the 5% level (95% confidence level).

** = Factor significant at the 1% level (99% confidence level).

1/ Standard Error of the Geometric Mean given as its proportion of the mean. For example, if the geometric mean is .236 ppm then SE < .03 GM implies SE < (.03)(.236 ppm) = .00708 ppm.

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4. NATIONAL SOIL RESIDUE NETWORK

4.1 Detailed Description of Network

4.1.1 Sampling Procedures

The National Soil Residue Network is a subsample of the Conservation Needs Inventory (CNI) Survey [4.1] and [4.2]. The CNI is briefly described in the following paragraphs.

a. Target Population

The target population for the CNI study included all soils of the conterminous United States. The frame was constructed of every county of the conterminous United States except those strictly metropolitan in character. Metropolitan areas include: Cities, villages, and other built-up areas of more than ten acres; industrial sites, railroad yards, cemeteries, airports, golf courses, shooting ranges, institutional and public administrative sites; and similar types of areas. This separation did not necessarily include all land inside city and village limits, and did include some land outside of such limits. Where the acreage covered by roads and railroads is large enough to be significant, it will be included under this item.

b. Sampling Rate and Size of Sample Area

The basic sampling rate was two percent. As standard procedure, the statistical laboratories selected two sets of sample areas without replacement for each county. Each set represented approximately two percent of the county. The majority of the counties in the United States range from 250,000 to 500,000 acres. In these counties only one set of samples was mapped. To maintain the same degree of reliability in the data, the rate of sampling was reduced in larger counties and increased in smaller ones. The size of sample areas ranges from 40 to 640 acres; the sampling rate from less than one percent to eight percent.

c. Selecting Sample Areas

The laboratories used the following procedure in selecting sample areas. The county was divided into blocks called "strata". These were then subdivided into 48 (at Iowa State) or 49 (at Cornell) equal-sized sample areas. One sample area was selected at random from each stratum for the sample. One additional sample area was selected in each stratum to serve as a second 48-area sample. Farm boundaries were ignored, but in sectionized areas each stratus consisted of twelve sections (one-third of a township) and each sample area was a quarter-section (160 acres). Sample areas in states of the northeast were 100 acres in size. Nationwide, the sample area size ranged from 40 acres to 640 acres.

Sample areas were located on county base maps. In mapping soils on sample plots, sample areas in urban and built-up areas were classified as to land use only and were not soil surveyed. Federal land identified on the sample area map generally was not mapped. If a federal land included cropland farmed under lease or permit and if a total acreage of federal land could be obtained, that falling in sample areas was soils mapped. Land use was mapped on all sample areas.

In measuring acreages on sample area maps, each individual soil mapping unit was measured separately so that data could be combined by land capability units or other desired interpretive groupings. The soils data from the source areas were interpreted in terms of land capability according to standards in use locally by the SCS in the National Cooperative Soil Survey and in soil conservation district operations. Land use and other information was reported at 18 to 25 points within the 100 acre units with approximately 38 to a 160 acre unit. The points were randomly selected with a template prepared for this purpose.

d. <u>1967 Selection of Sample Sites to Determine Pesticide Residue Levels</u>

The land use and treatment needs part of the CNI data for each county was based on inventory collected by field inspection of stratified random sample areas. The 1958 samples developed at Iowa State University and Cornell University were used. For the 1967 inventory, sample area patterns in all counties were reexamined by the Iowa State University Statistical Laboratory to determine that coverage was adequate. The laboratory drew new or additional samples for areas not adequately covered, such as intensively developed irrigated areas, to get an acceptable degree of precision.

e. Selecting Soil Samples

To select a soil sampling site from the CNI sites, the sample points in a sample site were divided into two land-use categories: Cropland: includes land in corn, wheat, other grain, soybeans, hay, vegetables and potatoes, orchards, sugar beets, sugar cane, tobacco, cotton, and other crops. This area covers about 400 million acres. Noncropland: includes woodland, pastures, grazing land and all other lands not defined as cropland. This area covers about 1-1/2 billion acres.

For each CNI site in a State, a record was made of the total number of sample points and the number in each of the categories cropland and noncropland to make this total. These numbers were used to provide the ratios of cropland and noncropland to total in each sample site expressed as a 5 place decimal. In those cases when the sampling rate deviates from a 2 percent rate, a multiplier was applied to these ratios to make the total equivalent to a 2 percent rate. A listing was made in some preassigned order of the CNI sample location designations with the associated numbers and ratios described above. The ratios were accumulated in the order of the listing and added to the same listing. The final values in each of the cropland and noncropland accumulations should provide an estimate of the relative amounts of cropland and noncropland in the state.

Cropland was sampled at 0.025% or one 10-acre block for every 40,000 acres of cropland. This provides for 9,468 cropland sample sites. Noncropland was sampled at a rate of 0.0025% or one-tenth of that for cropland. This provided for 3,832 noncropland sample sites.

A random method of selecting sample segments from the CNI was devised. A method of selecting a 20-acre site within the CNI segment was applied with the aid of data available for points within the segment. Two points are selected about which a 10-acre sampling site was located for the soil monitoring program. The method of selecting the samples with the 10-acre sampling sites is outlined by Wieroma, Sand and Cox [4.3].

f. Generalization of the Results

Even though the above paragraphs describe the sampling plan in general terms and in some specific detail, there is no reference to the probability framework. The selection probabilities of all the elements in the population, along with the selection procedure, must be known before the results can be generalized to any population other than the specific sites.

Before the results can be generalized, additional information must be known. For example, as follows:

- the complete frame from which the sample was selected,
- the number of sample sites by State, by County, by Cropland and Noncropland, and by all other stratification variables, and
- the random method or methods of selecting the sample segments from the CNI.

RTI has asked the statistical Laboratory at Iowa State University, Ames, Iowa, for specific information about the sampling plan.

If detailed information is not available, it may be desirable to develop a new area probability sample design following specification of the population of interest; e.g., the entire U.S., certain urban and rural areas, cropland, noncropland, areas subjected to specific pesticide, etc.

4.1.2 Data Analysis

a. Introduction

The nationwide monitoring program, designed to determine pesticide residue levels in agricultural soil and crops, became fully operational in 1968. In accordance with the program sampling design, a total of 1533 sites were scheduled for both soil and crop (mature) sampling on an annual basis. Through this network of sampling sites, pesticide residues were monitored during the years FY 1969 through FY 1974 (excluding FY 1971) at which time the program was discontinued. Although every State was scheduled for sampling each year, some States were excluded because of budgetary constraints. These were the larger western States and some of the small grain producing mid-western States. Soil and crop samples were collected and analyzed, however, from 33 States in each year the monitoring program was operating -- these are shown in Figure 4.1. Pesticide residue levels and related information reported in this section apply only to the States shown in Figure 4.1. Restricting the analysis to data from those States sampled in every test year enables one to make comparisons by time periods (year) that are free of location effects, but the results of the comparisons are no longer suitable for national-level inference.

This report covers an analysis of residue levels of PCB and seven pesticides found in cropland soil during the period from 1968 (FY69) to 1973 (FY74) when the soil monitoring program was discontinued. These pesticides were selected by EPA as being the most important pesticides to examine and include: aldrin, dieldrin, heptachlor, heptachlor epoxide, $\sum$DDT, lindane, and parathion. A very large number of the soil sample analyses indicated these compounds to be below the minimum detectable level and the observations are shown as zeros in the data file. As a result, each compound is examined for the percentage of occurrence (i.e., number of positive detections expressed as a percentage) and how this percentage changes with time. In addition, the geometric mean of the positive values for each compound is examined to see if and how it changed over the years from 1968 to 1973.

b. Percentage of Occurrence

Table 4.1 gives, by year and by compound, the number of soil samples analyzed, the number of samples in which the residue level was positive, and the percentage of positive detections. A plot of the latter statistic is given in Figure 4.2. For three of the compounds -- lindane, parathion, and PCB -- the number of positive detections were so small that percentages were not calculated and plotted.

Aldrin, dieldrin, heptachlor and heptachlor epoxide show a similar pattern with respect to percentage of occurrence over time. In all cases, the estimated percentage of occurrence was slightly higher in FY70 than in FY69. This was followed by a steady decline (see Figure 4.2) in the percentage of occurrence over the next three test years -- FY72, FY73, and FY74. The null hypothesis of a common percentage over all years was tested using a chi-square (see Section 2 for a discussion of this technique) statistic. As evidenced by the chi-square values given in Table 4.1, this hypothesis was rejected for each compound. This is not surprising since small changes in sample percentages can be statistically significant with sample sizes of approximately 1400 as employed in the soil monitoring program.

In the case of $\sum$DDT the estimated percentage of occurrence decreased from 27.8 percent in FY69 to approximately 23.6 percent in FY70 and FY72. There followed another decline to 21.7 percent for the years FY73 and FY74. The later decline could be reflective of the restriction placed on DDT in December 1972. A chi-square test rejected the null hypothesis of a common percentage of occurrence over time. Apparently this was not due to the higher percentage observed during FY69, although this was not tested.

c. Geometric Means

The estimated geometric mean and associated standard error for aldrin, dieldrin, heptachlor, heptachlor epoxide and $\sum$DDT are shown in Table 4.1 for each test year. Plots of the geometric means are shown in Figure 4.2. An analysis of variance was used to test for significant differences among yearly means. This statistical procedure is discussed in Section 2. The resulting F-values were non-significant for aldrin and heptachlor while the other three pesticides showed significant differences over time (see F-values in Table 4.1). In soil samples where measurable amounts of dieldrin and $\sum$DDT were found, the levels of residue increased from FY69 to FY72 then showed a decline in the last two test years. This is in contrast to a general decline in the percentage of soil samples having a measurable amount of these pesticides. In the case of heptachlor epoxide, the estimated geometric mean appears to level off in FY74 after a steady increase from FY69.

Regulatory action by EPA on aldrin and dieldrin occurred after the soil monitoring program was discontinued; hence, its effect cannot be evaluated directly from data generated in this program. There is only one year of test data on DDT following the regulatory action taken in late 1972. A before/after comparison (FY 1973 vs. FY 1974) showed no change in the percentage of positive detection but a significant decrease (from .221 to .107 ppm) in the geometric mean of positive values. This is a continuation of a decline that apparently began two years earlier. There is no evidence of an increase in the levels of parathion (a recommended substitute for DDT) during this time period.

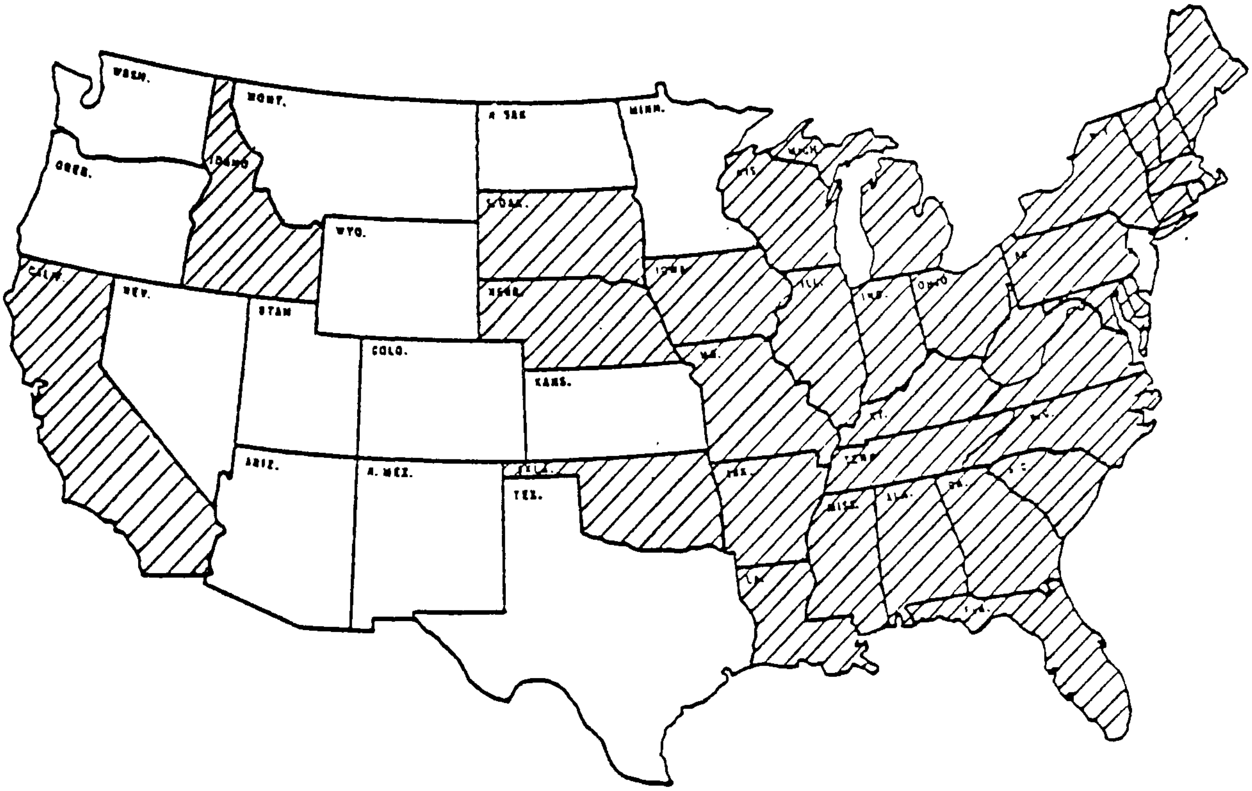


Figure 4.1. States where agricultural soil and crops were sampled for pesticides during 1968-73 -- National Soils Monitoring Program, U.S. Environmental Protection Agency.

Table 4.1

Summary Statistics and Tests of Significance

Year (FY)	Sample Size	ALDRIN Positive Detections No.	%	GM 2/	Standard Error 1/	DIELDRIN Positive Detections No.	%	GM	Standard Error	HEPTACHLOR Positive Detections No.	%	GM	Standard Error
1969	1440	184	12.8	0.057	0.006	436	30.3	0.055	0.003	66	4.6	0.039	0.006
1970	1388	196	14.1	0.059	0.006	441	31.8	0.074	0.004	95	6.8	0.041	0.005
1972	1401	139	9.9	0.062	0.008	395	28.2	0.086	0.005	73	5.2	0.046	0.007
1973	1403	129	9.2	0.059	0.008	397	28.3	0.078	0.005	57	4.1	0.031	0.005
1974	1388	51	3.7	0.067	0.014	354	25.5	0.055	0.004	25	1.8	0.030	0.008
Test of Significance Among:													
Percentages (χ^2) =			101.6**				15.3**				43.5**		
GM (F values) =				0.18				12.04**				1.11	

Year (FY)	Sample Size	HEPTACHLOR EPOXIDE Positive Detections No.	%	GM	Standard Error	$\sum$DDT Positive Detections No.	%	GM	Standard Error	No. Positive Detections: Lindane	Parathion 3/	PCB
1969	1440	128	8.9	0.027	0.002	400	27.8	0.189	0.017	14	6	0
1970	1388	141	10.2	0.031	0.002	327	23.6	0.267	0.026	6	0	0
1972	1401	102	7.3	0.038	0.003	332	23.7	0.305	0.030	0	3	0
1973	1403	95	6.8	0.041	0.004	305	21.7	0.221	0.022	0	7	2
1974	1388	82	5.9	0.038	0.004	302	21.8	0.107	0.011	0	0	24
Test of Significance Among:												
Percentages (χ^2) =			22.6**				19.1**					
GM (F values) =				3.55**				16.38**				

** = Significant at .01 level of significance

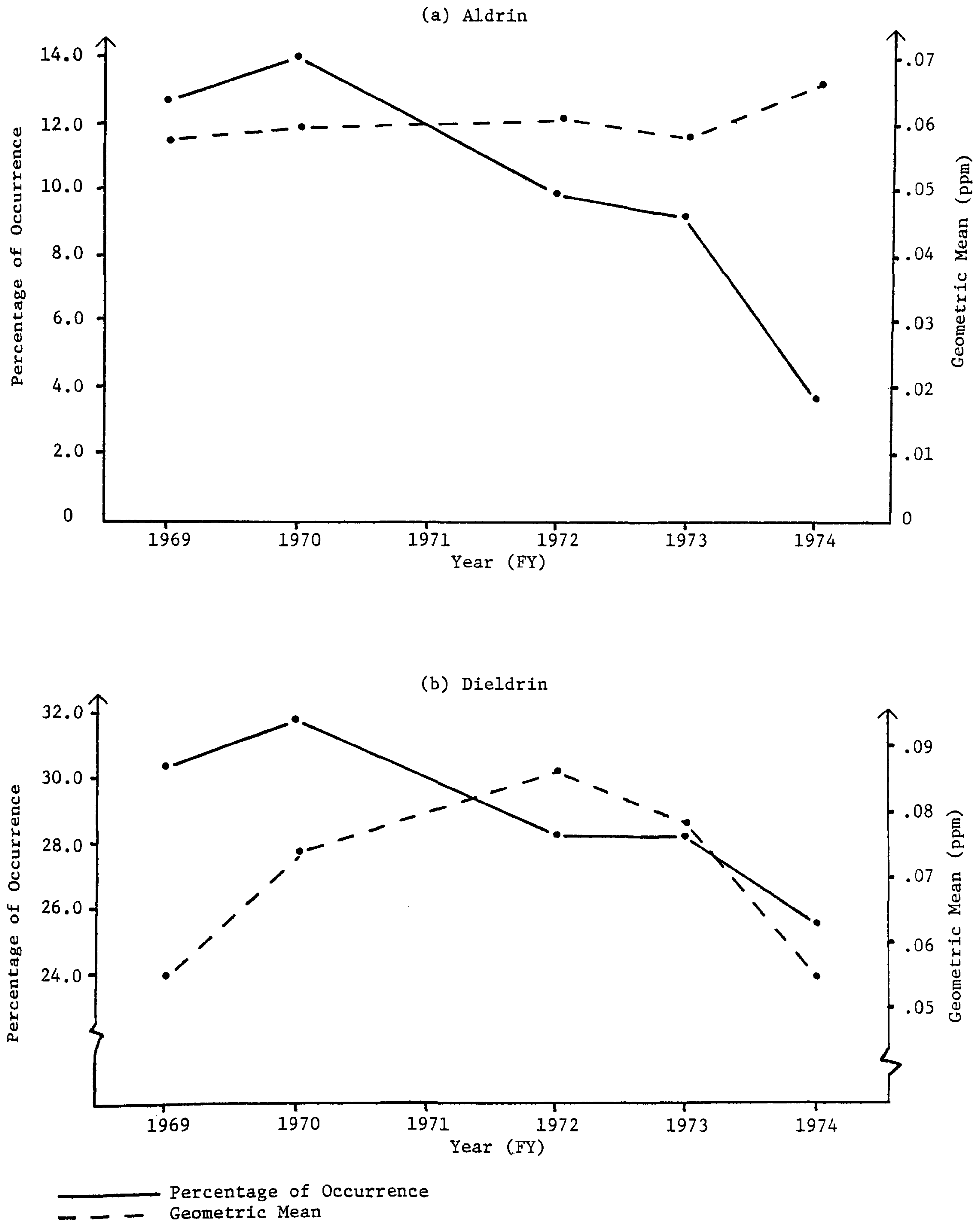
1/ = Based on pooled within year variance

2/ = GM = Geometric Mean (ppm) of dry weight.

3/ Sample sizes for years 1969-1974 are respectively 59, 4, 1069, 1152 and 939. Analyses for organophosphorous compounds were not made on all soil samples.

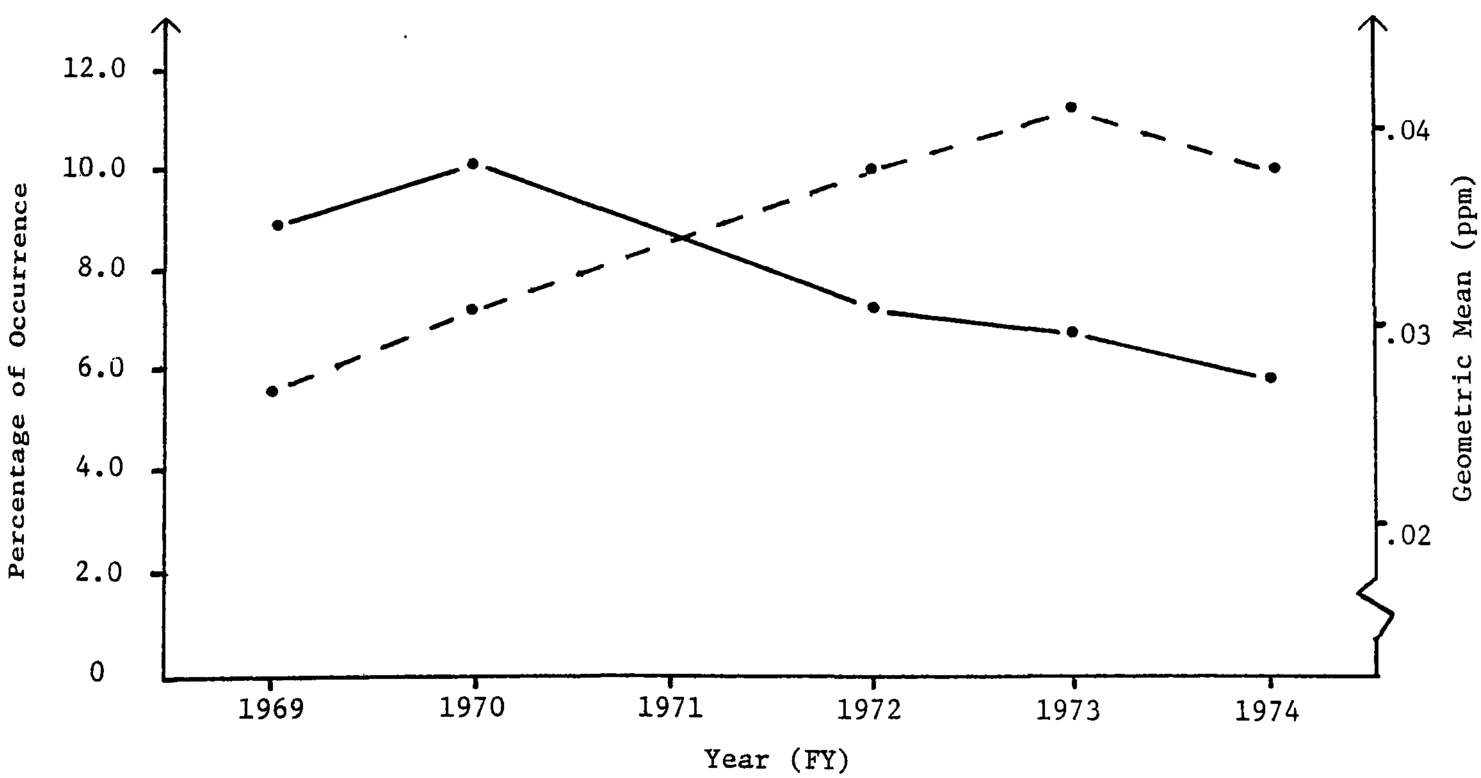
Figure 4.2

Percentage of Occurrence and Geometric Mean by Years



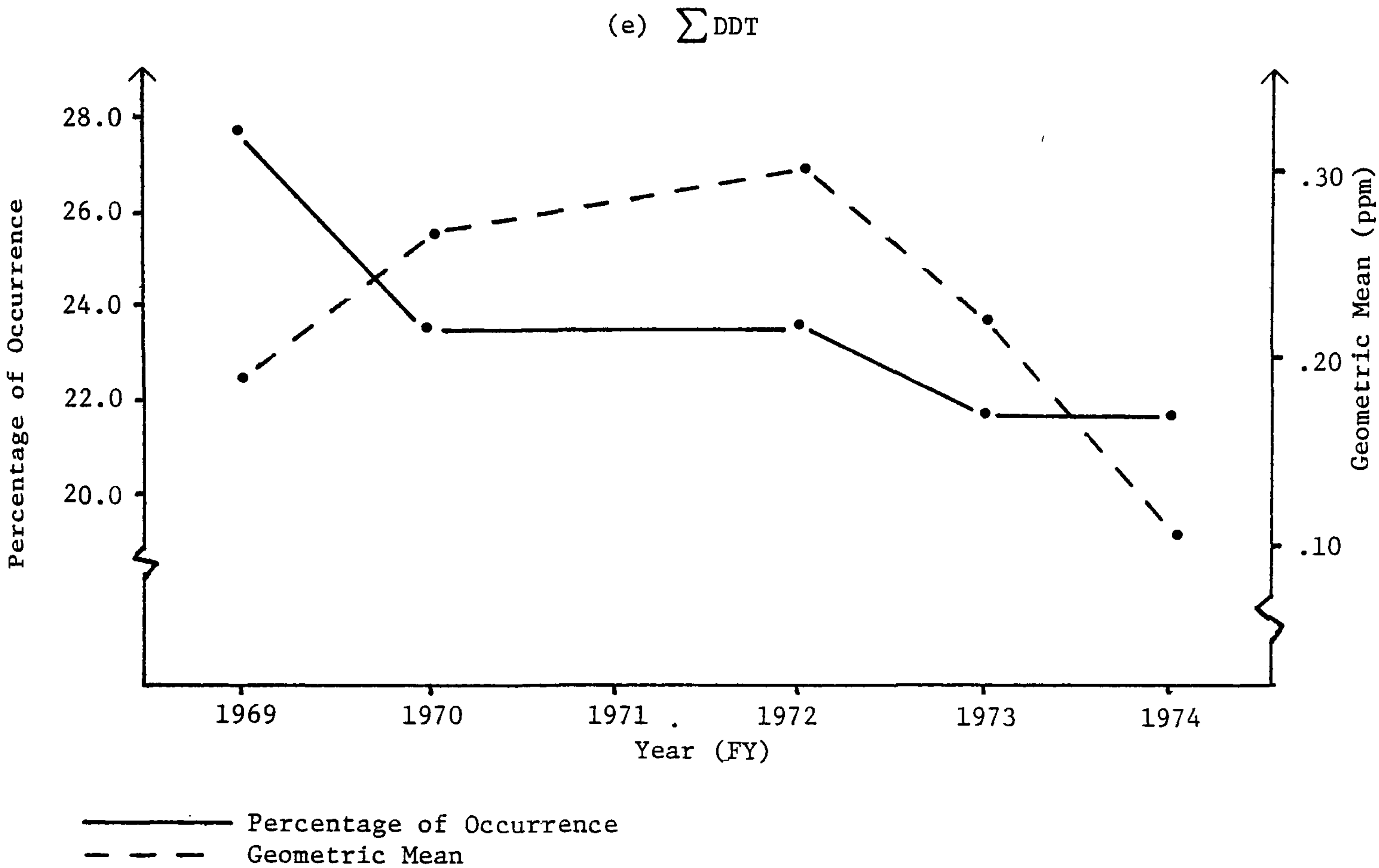
(c) Heptachlor

(d) Heptachlor Epoxide



——— Percentage of Occurrence
– – – Geometric Mean

Figure 4.2 (cont'd)



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[4.2] National Handbook for Updating the Conservation Needs Inventory, August 1966. United States Department of Agriculture.

[4.3] Wiersma, G.B., P.F. Sand and E.L. Cox, 1971. A sampling design to determine pesticide residue levels in soils of the conterminous United States. Pesticides Monitoring Journal. Vol 5:1, pp. 63-66.

5. NATIONAL SURFACE WATER AND SEDIMENT RESIDUE NETWORK

5.1 Description of the Network

5.1.1 Sampling Procedures

Sampling points for the National Surface Water and Sediment Residue Network were selected from the National Stream Quality Accounting Network (NASQAN). NASQAN is a series of stations at which systematic and continuing water quality measurements are obtained. The United States was subdivided into 27 major basins by the Water Resources Council; these, in turn, were subdivided into 324 accounting units. Stations were selected within each unit to provide a measure of discharge and water quality for approximately 90 percent of the water leaving the unit. For units along the periphery of the country where it is impractical to meet the 90 percent outflow goal with measurements at a reasonable number of stations (coastal regions, Great Lakes, international boundaries), a "representative" station or array of stations was selected that could serve as an index for estimating the outflow from the unit. The 324 hydrologic units are based on watershed configurations and convenience of unit size. Stream-flow and water-quality stations were selected to provide flow and quality information for each unit independent of actual or suspected water-quality conditions.

In order to accomplish the objectives of the water and sediment residue monitoring program, sampling of approximately one-half of the stations of the National Network (NASQAN) was planned. Accordingly, one station was selected from each of the odd-numbered accounting units within each of the 27 major drainage basins. Exceptions to this selection process were made where there were no surface waters in a given odd-numbered unit. In those instances, a station was selected from an adjacent even-numbered unit. To complete the network, two to three stations each in Alaska, Hawaii, and Puerto Rico were selected at random from stations listed in the water quality section of the Office of Water Data Coordination Catalog of Information on Water Data. There may be additional restrictions and/or rules on the selection of stations for the Water and Sediment Monitoring Network; background information is still being sought by RTI.

Given what is now known, the network can best be described as a purposively selected sample of stations. There is no known probability structure for the sample selection; therefore, even though there is a broad geographical coverage of the United States, the only totally defensible inferences that can be made are restricted to the stations in the network, although selecting odd numbers may be reasonably random, depending on the purpose and system of numbering.

For future water and sediment monitoring, a probability sample of sites could be selected following specification of the population of interest.

5.1.2 Data Available On Data File

The water and sediment residue file, after modification to allow analysis, contained site and date information, and data on twenty-four compounds thought to be of most interest. PCB's were originally classified as 1242, 1248, 1254, or 1260, with the overwhelming majority being 1254. For purposes of analysis, an occurrence of any of these types was treated as simply "PCB". The six DDT residues on the file were combined using the rough formula

$$\sum DDT = DDT\ (o,p^1) + DDT\ (p,p^1) + 1.11\ [DDE\ (o,p^1) + DDE\ (p,p^1) + DDD\ (o,p^1) + DDD\ (p,p^1)].$$

After these conversions, the data were reduced to sixteen pesticides.

Sites from all water basins in the nation are on the file, although some basins are represented sparsely, particularly those on the west coast.

File entries were assigned by month code to season 1 or 2 for sediment, and season 1, 2, 3, or 4 for water, corresponding to the supposed sampling intervals. For water, approximately 144 sites appear in each season's data, from the last quarter of 1976 through the second quarter of 1979; a small sample of 39 sites is present for the third quarter of 1976. Sediment data, varying from 39 to 112 entries, is present for 1976 through the first half of 1979.

Many sites contain "missing values" for all or some of the compounds. It is understood that most of these represent data for which tests are incomplete. Table 5.1 shows the location of these gaps.

Table 5.1

Periods for Which Data is Missing

Compounds	Water Dates	Sediment
Aldrin, Chlordane, Dieldrin, Heptachlor, Heptachlor Epoxide, Lindane, Parathion, PCB, DDT, Toxaphene	No large gaps	Before July, 1976
2,4-D, Silvex, 2,4,5,-T	Oct, 1978 - present	early 1976 and July, 1978-present
Atrazine	April, 1978 - present	July, 1978-present

For the previous draft of this report, much of the 1978 data was missing. It now has been keypunched and added to the file. However, reanalysis is still in progress, and most of the new results will be found in the addenda.

5.1.3 Assumptions Made in Analysis of the Network

The assumptions made in combining PCB's and DDT residues are discussed above. Reported levels were assumed to be in parts per billion, with a zero entry indicating tested for but below the detectable level.

In the initial analysis, PCB levels in water were left as they were on the original file, although over 90 percent of the detections were reported with values less than 15 parts per billion. Because of the questionable validity of observations below .15 ppb, tests and statistics for PCB's have been redone, changing these low numbers to half the minimum detectable level (.075).

5.2 Data Analysis

5.2.1 Summary Statistics

For a given year or season, the typical distribution of a compound's concentrations in water or sediment is a large majority of zero values and a few, if any, positive detections. As discussed in the section dealing with all the networks (Section 2), the proportion of positive values in the sample and the geometric mean of those values were considered to be the best descriptive statistics for the file.

With some of the compounds, the number of observations above a certain level may be a useful statistic. These results appear in the addenda.

The nature of the distribution of the positive values was investigated using normal probability paper. Atrazine in water for 1977 (the frequencies are given in Section 2 of this report) and $\sum$DDT in sediment for 1976 were chosen because they had a reasonable number of positive detections. In both cases, a plot of the original values yielded a poor fit to the normal distribution; a plot of the logarithms of those values produced a very good fit. This supports the assumption that the positive values are distributed approximately lognormally, and therefore that the geometric mean is an appropriate statistic.

In the original analysis, because the data for one year represented different seasons than did the data for any other (due to the large gaps in the file), it was thought best to report the summary statistics by seasons within the years, rather than over entire years. These statistics are found in Tables 5.2 and 5.3, but now include 1978 data. Summary statistics by year may be found in the addenda.

Only atrazine and PCB in water, and chlordane, dieldrin, PCB and $\sum$DDT in sediment had enough positive detections to justify giving the full set of statistics. For the remaining compounds, if there were more than two detections in the entire file, the percent positive detections is listed. Included in these compounds are toxaphene and parathion, with only a handful of positive detections. Other DDT substitutes were undetected or not on the file. Percent detected and geometric means are presented for each water basin in Tables 5.5 and 5.6. Because some basins had very few observations, the data for the entire period of monitoring were grouped together.

5.2.2 <u>Tests for Trends Over Time</u>

To prevent bias caused by possible seasonal variation, tests for trends over time were done using only the seasons for which data were present in each year being compared. For sediment, before we had data from the first half of 1978, this meant that the only possible tests would compare the second halves of years 1976, 1977, and 1978.

For atrazine in water, both the third and fourth quarters could be used in comparing 1976 and 1977 levels; PCB levels were compared two different ways, as shown in Table 5.4.

For each compound, a χ^2 test was performed on the proportions of samples with positive detections, and a one-way analysis of variance was used to test for differences in the geometric means over time. No tests for trends were conducted for individual water basins because of the sparseness of the data. Additional tests utilizing the 1978 data now available are presented in the addenda.

5.2.3 Observed Trends

The results of the χ^2 and ANOVA tests are shown in Table 5.4. The only significant difference from year to year in the geometric mean of detected values was that of PCB in sediment, from 1976 to 1978. In general, it can be seen in the plot of geometric means over time (Figures 5.1 and 5.2) that the differences are not in the nature of a trend, but rather show an erratic, up and down behavior with the exception of PCB in water (the geometric mean of which varies little over time).

The χ^2 test of percent of occurrence tells a different story. With the exceptions of atrazine in water and PCB in sediment, the proportions of detected values were significantly different from one year to the next in the compounds showing up with any substantial frequency. From graphs, it appears that in all these cases -- PCB in water; chlordane, dieldrin, and $\sum$DDT in sediment -- the trend was down.

5.2.4 Geographic Differences

Because of the methodology used to select sites, any formal statistical test comparing means or percent detected between water basins would be of dubious validity. Nevertheless, a breakdown of the data by basin may be of considerable interest, as can be seen from the summary statistics (Tables 5.5 and 5.6). More extensive tables, incorporating 1978 data and modified PCB values, may be found in the addenda. For the water file, the presence of PCB residues is almost constant across the nation. However, atrazine appears only in the Mississippi, Missouri, Ohio, and Great Lakes basins. In the sediment file, the statistics are less dramatic, but may suggest to the informed eye problems with certain compounds in some regions.

TABLE 5.2. Summary Statistics by Compound by Year and Season - Water - Over All Sampling Sites

ATRAZINE

Year	Season	Sample Size	Positive Detections %	Geometric Mean (ppb)	Standard Error
1976	3	35	23	.82	.15
	4	130	2	.89	.60
1977	1	126	3	.30	.08
	2	117	9	1.28	.42
	3	122	15	.63	.09
	4	125	2	.48	.07
1978	1	77	0	---	---
	2	32	19	1.01	.37

PCB 1/

Year	Season	Sample Size	Positive Detections %	Geometric Mean (ppb)	Standard Error
1976	3	23	43	.120	.038
	4	128	58	.083	.006
1977	1	133	23	.089	.014
	2	130	78	.086	.003
	3	132	5	.092	.018
	4	135	9	.090	.090
1978	1	98	7	.078	.015
	2	102	1	.086	----
	3	115	1	.006	----
	4	131	2	.081	.039
1979	1	144	2	.070	.006
	2	134	4	.069	.009

OTHER COMPOUNDS - Percent Positive Detections 2/3/

Year	Season	Chlordane	2,4-D	Dieldrin	Heptachlor Epoxide	2,4,5-T	Toxaphene	Diazinon	Parathion
1976	3	0	3	0	0	3	0	0	0
	4	0	2	2	1	0	0	0	0
1977	1	1	1	3	3	0	0	3	0
	2	2	2	3	4	0	2	3	0
	3	0	0	1	0	0	2	0	3
	4	1	1	1	0	0	0	3	0
1978	1	0	0	0	0	0	0	1	0
	2	0	3	0	0	0	4	0	0
	3	0	1	0	0	4	1	0	1
	4	0		0	0		0	0	0
1979	1	0		0	0		0	0	0
	2	1		0	0		0	0	1

1/ Values below .15 ppb left as originally reported. Reanalysis in addenda.

2/ A blank indicates data missing or not yet analyzed.

3/ Based on sample sizes approximately the same as for Atrazine and PCB.

TABLE 5.3. Summary Statistics by Compound by Year and Season - Sediment - Over All Sampling Sites

		CHLORDANE				DIELDRIN			
			Positive Detections				Positive Detections		
Year	Season	Sample Size	%	Geometric Mean (ppb)	Standard Error	Sample Size	%	Geometric Mean (ppb)	Standard Error
1976	2	87	22	4.18	1.92	87	33	.43	.14
1977	1	105	20	6.95	3.29	105	15	1.62	.30
	2	70	3	3.11	1.42	70	6	1.99	1.29
	1	81	11	4.30	1.84	81	12	.43	.69
1978	2	81	5	8.91	4.04	81	4	.66	.06
1979	1	39	8	21.7	26.6	39	3	.96	---

		PCB				$\sum$ DDT 2/			
			Positive Detections				Positive Detections		
Year	Season	Sample Size	%	Geometric Mean (ppb)	Standard Error	Sample Size	%	Geometric Mean (ppb)	Standard Error
1976	2	84	26	18.0	6.5	87	32	2.48	.98
1977	1	104	19	38.3	10.3	105	21	5.77	2.58
	2	69	30	2.2	.47	69	13	1.71	.43
	1	81	23	9.8	5.7	80	11	2.05	.70
1978	2	81	26	22.9	6.9	80	8	5.41	1.87
1979	1	38	8	48.2	35.7	39	8	4.98	5.29

OTHER COMPOUNDS - Percent Positive Detections 3/

Year	Season	Heptachlor Epoxide	Toxaphene	Lindane
1976	2	6	2	0
1977	1	1	2	1
	2	1	0	1
	1	1	1	0
1978	2	1	0	0
1979	1	0	0	0

2/ DDT + 1.11 (DDF + DDD)

3/ Based on sample sizes approximately the same as for PCB.

Table 5.4

Tests for Trends Over Time - Water and Sediment

Compound	Seasons Compared	Test Using Proportion Detected=χ^2	Significance	Test Using Geometric Mean = F	Significance
Water:					
Atrazine	Seasons 3 and 4 1976 vs. 1977	.608	N.S.[1/]	1.8	N.S.
PCB	Seasons 1 and 4 1977 vs. 1978	18.2	< .01[2/]	.19	N.S.
3/	Season 1 1977 vs. 1978 vs. 1979	31.9	< .01	.18	N.S.
Sediment:					
Chlordane	Season 2 1976 vs. 1977 vs. 1978	32.6	< .01	.47	N.S.
Dieldrin	"	35.5	< .01	1.98	N.S.
PCB	"	1.29	N.S.	18.30	.01
$\sum$DDT	"	18.2	< .01	.80	N.S.

1/ N.S. = not significant at the .10 level

2/ .01 = significant at the .01 level.

3/ Values below .15 ppb left as originally reported. Reanalysis in addenda.

Table 5.5

Summary Statistics by Compound by Water Basin - Water (1976 - 1979 Combined)[1/]

Basin	Atrazine Sample Size	Atrazine Percent Detected	Atrazine GM*(ppb) of Detected	PCB [2/] Sample Size	PCB Percent Detected	PCB GM (ppb) of Detected
North Atlantic Slope (1)	39	0	---	67	27	.09
South Atlantic Slope & (2) Eastern Gulf of Mexico	87	0	---	144	19	.08
Ohio River (3)	77	12	.44	120	20	.10
St. Lawrence River (4)	51	2	.97	82	23	.08
Hudson Bay & Upper Mississippi River (5)	62	19	.84	93	18	.09
Missouri River (6)	94	13	1.25	158	23	.09
Lower Mississippi River (7)	93	17	.85	125	24	.08
Western Gulf of Mexico (8)	81	0	---	127	19	.09
Colorado River (9)	41	0	---	67	18	.07
The Great Basin (10)	33	6	.49	52	21	.06
Pacific Slope - California (11)	15	0	---	30	17	.25
Pacific Slope - Washington (12)	22	0	---	37	22	.11
Snake River (13)	10	0	---	17	18	.11
Pacific Slope - Oregon & Lower Columbia River (14)	23	0	---	35	20	.06
Alaska (15)	4	0	---	11	36	.09
Hawaii (16)	11	0	---	16	25	.09

GM = Geometric Mean

1/ Not including recently added 1978 data. Reanalysis in addenda.

2/ Values below .15 ppb left as originally reported. Reanalysis in addenda.

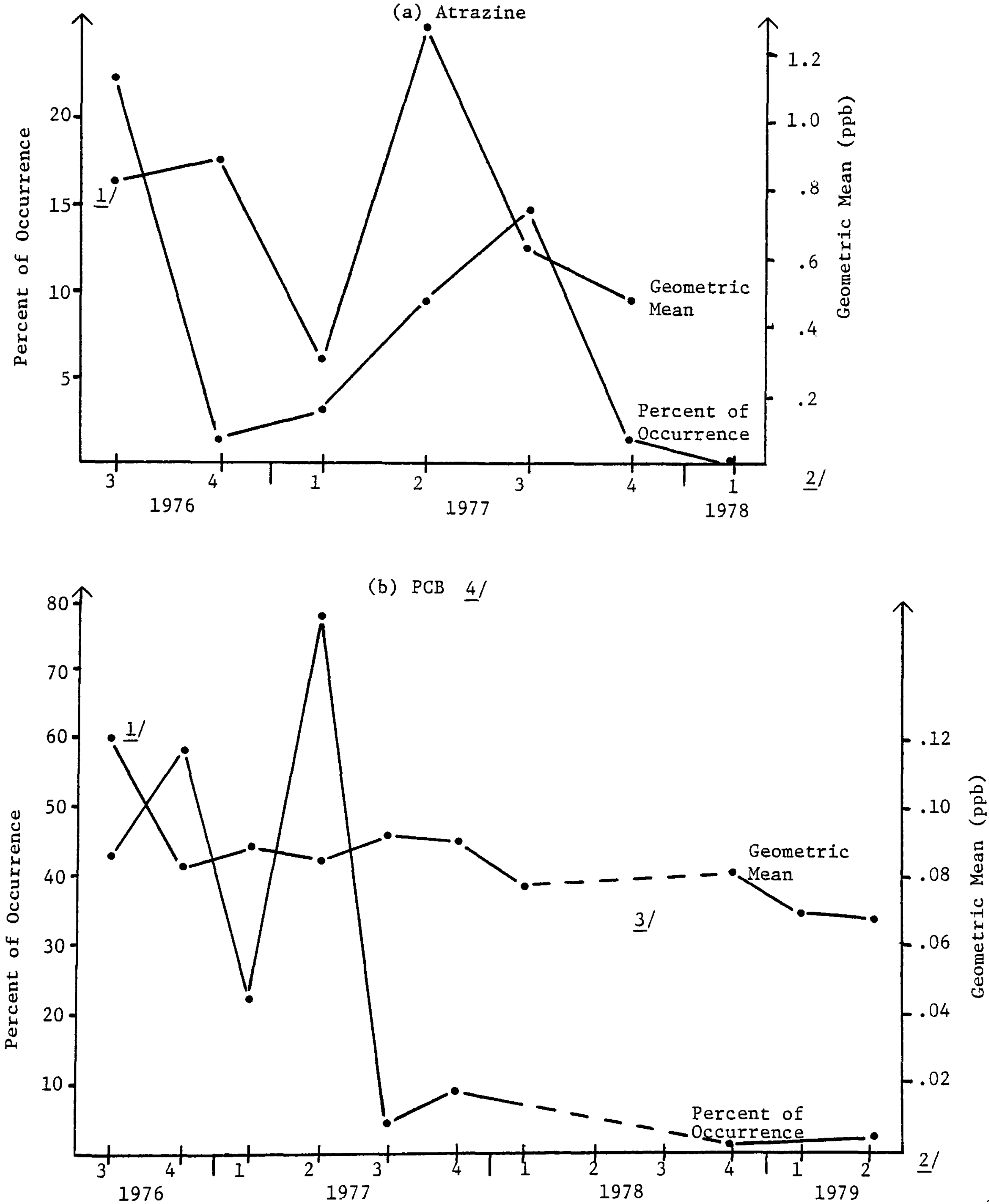
Table 5.6

Summary Statistics by Compound by Water Basin - Sediment (1976 - 1979 combined)[1/]

Basin		CHLORDANE			DIELDRIN			PCB			ΣDDT		
			Positive Detections			Positive Detections			Positive Detections			Positive Detections	
		Sample Size	%	Geometric Mean (ppb)	Sample Size	%	Geometric Mean (ppb)	Sample Size	%	Geometric Mean (ppb)	Sample Size	%	Geometric Mean (ppb)
N. Atlantic	(1)	23	35	4.1	23	26	1.17	23	26	17.2	23	35	4.1
S. Atlantic & E Gulf of Mexico	(2)	53	15	3.4	53	13	.84	53	17	6.9	53	21	3.7
Ohio River	(3)	37	27	9.8	37	35	.87	38	53	61.7	37	16	3.8
St. Lawrence River	(4)	27	7	1.2	27	7	.32	27	63	22.8	27	19	4.1
Hudson Bay & Upper Miss.	(5)	33	18	8.7	33	12	2.08	30	17	13.0	33	9	1.2
Missouri River	(6)	65	0	---	65	5	.28	65	11	2.5	65	2	2.8
Lower Mississippi	(7)	41	5	2.5	41	7	.19	41	15	3.1	40	15	10.0
Western Gulf of Mexico	(8)	37	11	4.6	37	14	.67	37	19	7.3	37	35	1.2
Colorado River	(9)	23	4	2.4	23	4	.65	22	5	3.2	23	22	2.7
Great Basin	(10)	18	11	4.0	18	6	.12	18	33	11.4	18	6	13.3
Pacific Slope California	(11)	6	50	2.3	6	33	.27	5	20	7.3	5	60	.9
Snake River	(13)	6	0	---	6	33	.74	6	17	174.	6	33	15.3
Pacific Slope Oregon	(14)	8	25	4.0	8	38	.54	8	25	20.8	8	25	5.9
Alaska	(15)	2	0	---	2	0	---	2	0	---	2	0	---
Hawaii	(16)	3	100	48.1	3	67	41.8	2	0	---	3	67	95.1

1/ Not including recently added 1978 data. Reanalysis in addenda.

Figure 5.1. Percentage of Samples with Positive Detections and Geometric Means Over Time - Water - All Sampling Sites



1/ Very small sample size (< 40 sites)

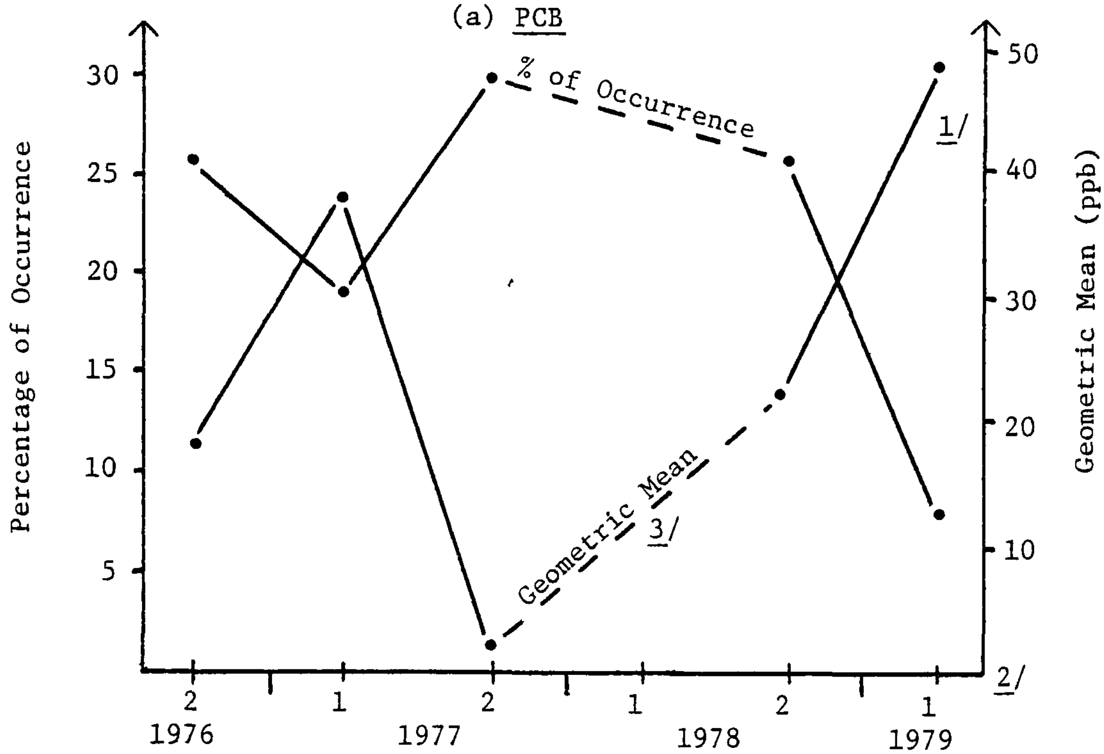
2/ 1, 2, 3, 4 within years refer to quarters

3/ Dashed line = data missing.

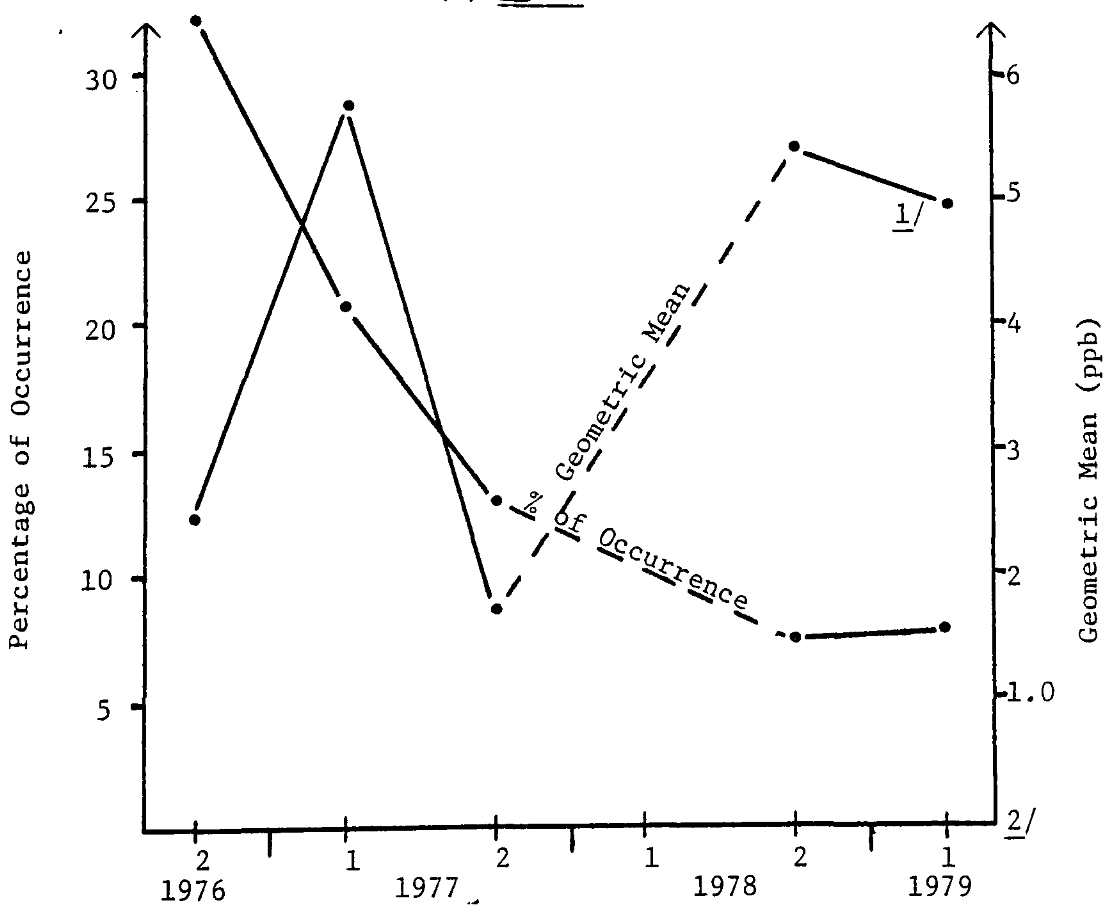
4/ originally reported. Reanalysis in addenda.

Figure 5.2. Percentage of Samples with Positive Detections and Geometric Means Over Time - Sediment - All Sampling Sites

(a) PCB



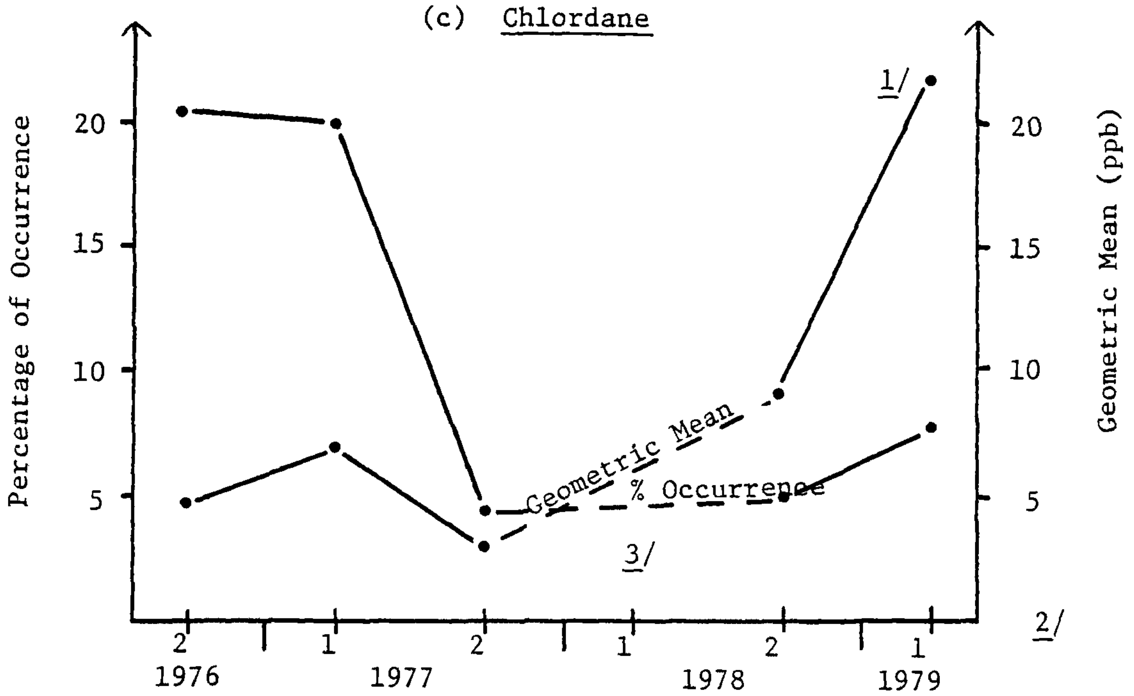
(b) ΣDDT

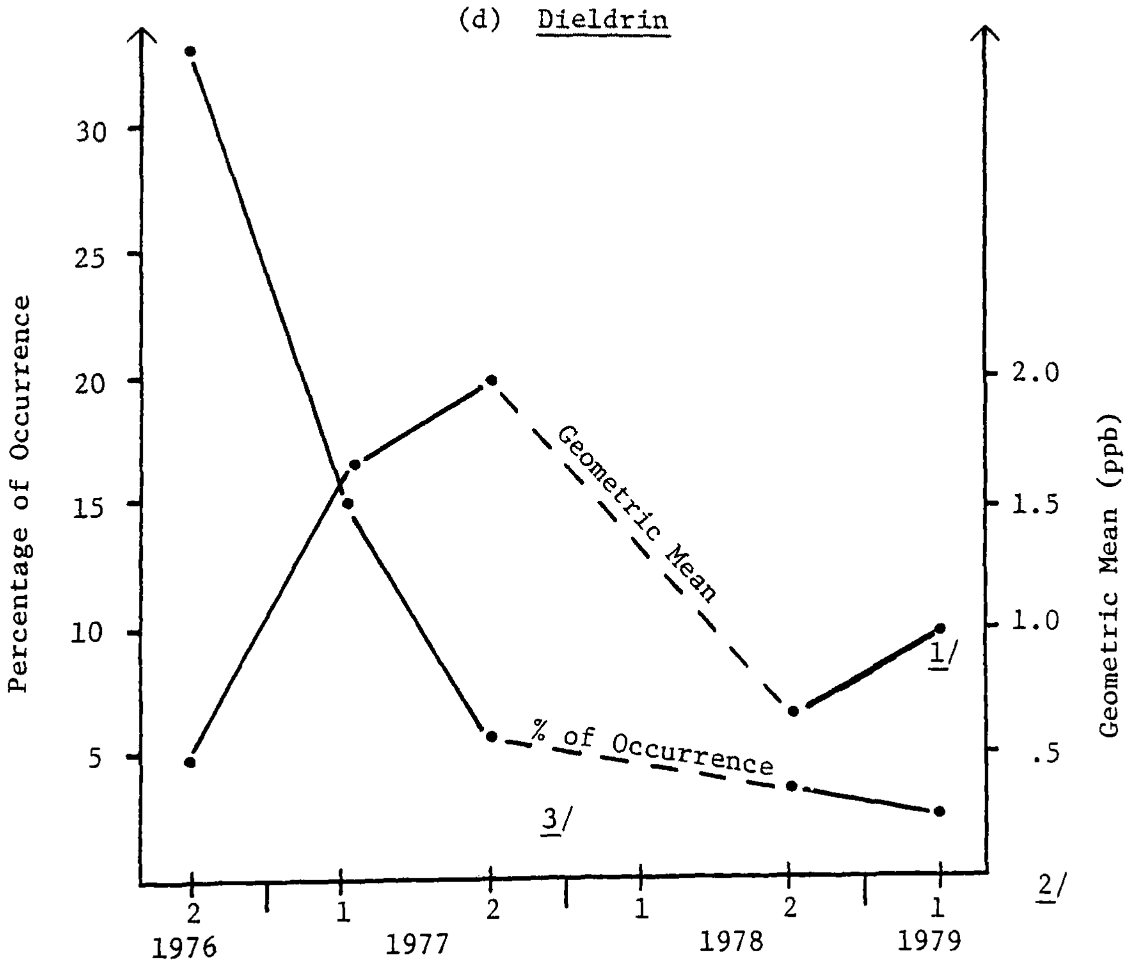


1/ Very small sample size (< 40 sites)

2/ 1 and 2 refer to the first and second half of the year.

Figure 5.2. (cont'd) Percentage of Samples with Positive Detections and Geometric Means Over Time - Sediment - All Sampling Sites





1/ Very small sample size

2/ 1 and 2 refer to the first and second half of the year.

3/

REFERENCES

[5.1] Ficke, J.F. and R.D. Hawkinson. The National Stream Quality Accounting Network (NASQUAN) - Some Questions and Answers. Geological Survey Circular 719.

[5.2] Pelty, H.R., W.T. Sayers and H.P. Nickolson, 1971. National monitoring program for assessment of pesticide residues in water. Pesticides Monitoring Journal, Vol. 5, pp. 54-62.

6. AIR NETWORK

6.1 Detailed Description of Network

6.1.1 Sampling Procedures

Many investigators have studied the role of air as a vehicle of pesticide exposure for the general population. Selected work in this area is reviewed by Kutz, Yobs, and Yang [6.2]. A pilot study was conducted in 1967 and 1968 by Midwest Research Institute for the Division of Pesticide Community Studies of the Environmental Protection Agency. The purpose of this study was to determine levels of 19 pesticides and metabolites in ambient air at 9 locations in the U.S. The sampling procedures at these 9 locations and the analytical methods used are discussed by Stanley, Barney, Helton, and Yobs [6.4].

During calendar years 1970, 1971, and 1972, an air monitoring program was initiated by the federal government. Samples of ambient air were collected at selected locations in the U.S. and analyzed for pesticide residues. In 1970, ambient air was collected at selected locations in 14 states with an ethylene glycol impinger sampler. In 1971 and 1972, samples were collected at selected locations in 16 states. The locations for this study, including both rural and urban areas, were selected primarily for their potentially high concentrations of pesticides in ambient air. Additionally, factors such as electrical power source needed for operating the sampler and accessibility of sampler for servicing and ethylene glycol collection were considered in location choice, according to Kutz, Yobs, and Yang [6.2]. At each sample location, two samplers were operated simultaneously for 24 hours, at a height representing the human breathing zone. A composite of the 4 12-hour samples was formed for chemical analysis. Accompanying each sample were certain climatological data collected from the nearest station of the U.S. Weather Bureau. Sampling sites during the course of this study were not always constant. Relocations prohibited yearly comparisons for those sites involved. A summary of the data collected through this program is given by Kutz, Yobs, and Yang [6.2].

During 1975 an air monitoring program was established to determine pesticide residues in ambient air in three suburban locations Miami, Florida; Jackson, Missippi; and Ft. Collins, Colorado. At each location, duplicate samples were collected by two ethylene glycol impinger samplers operating simultaneously side by side under identical conditions, twice at each location in May and June and once in April, 1975. Weather information obtained from the nearest National Weather Service Station was recorded at the beginning and ending of sampling. In the event of inclement weather, the sample was taken on the next day that weather permitted. The analytical procedures used for these samples is described by Kutz, Yobs, and Yang [6.2] and [6.3]. Selection of these three suburban locations was based on the particular interest in the detection of chlordane, heptachlor, and associated chemicals. Suburban locales appropriate for measuring major chlordane uses include turf, ornamental, and residential insect management areas. Results of this 1975 study are summarized by Kutz, Yobs, and Yang [6.2] and [6.3]. Kutz and Yang [6.1] examine the data with respect to evidence of polychlorinated biphenyls.

The number of sampling sites included in the air monitoring program was subsequently expanded. Throughout the remainder of the monitoring period, from 3 to 10 sites were included, and from 50 to 100 samples per year were analyzed. These sites, primarily suburban areas, were purposively selected. Considering this selection process, it is not possible to generalize the results to any population other than the particular sites.

For future air monitoring, a probability sample of sites could be selected following specification of the population of interest (e.g. the entire U.S., certain suburban areas, agricultural areas subject to use of specified pesticides, areas subject to mosquito control activity, etc.). The times and within-site locations for sampling could be randomly selected while considering such factors as seasonality concerns, pesticide spraying in the area, weather conditions, and other factors suspected of influencing the presence of pesticides in ambient air. Additionally, consistently monitoring the same sites throughout the time of the study, as opposed to observing different sites during each time period, would allow comparisons over time on a site-by-site basis.

6.1.2 Data Available on Data File

For this report, data from the network monitoring pesticide residues in ambient air were obtained from four reports (6.3, 6.5, 6.6, 6.7) using data from the periods 4/75 - 6/75, 8/75 - 3/76, 11/76 - 11/77, and 1/78 - 10/78, respectively.

All four documents provide, for several sites, the levels of various compounds detected for each date on which sampling took place, as well as meteorological observations for that date. Twenty-four compounds appear somewhere in the data, but different reports -- and even different sites within reports -- tabulate different subsets of these residues. Compounds tested appear in Tables 6.2 - 6.5.

The test sites also vary from one report to another. The time period for which RTI has data from a given site is listed in Table 6.1. Observations were made once or twice a month at each site, sometimes at erratic intervals.

Table 6.1

Periods of Air Sampling by Site

Fort Collins, Colo.	4/75-3/76	Wheaton, Ill.	12/76-9/77
Miami, Florida	4/75-3/76	Springfield, Ill.	1/78-9/78
Jackson, Miss.	4/75-3/76	Midvale, Utah	11/76-9/77
Greenville, Miss.	11/76-9/78	Florida 1/	2/78-10/78
Harrisburg, Penn.	9/75-3/76	South Carolina 1/	2/78-9/78
Lafayette, Ind.	8/75-3/76	Montana 1/	4/78-9/78
Pasadena, Calif.	11/76-9/78		

1/ Specific location unknown.

6.1.3 Assumptions Made in Analysis of the Network

Analysis of this file, for reasons discussed below, was limited, and few assumptions were required for what was done. Values listed as "Trace" were set to .02 or .1 ng/m^3 when computing geometric means, the specific value depending on the apparent scale of the positive observations. Where this arbitrary procedure had any substantial effect on the result, the mean was listed as "?". In the first two reports, two values were reported for each test site and date. It was assumed that the average of the two numbers could be used without serious consequences.

6.2 Data Analysis

6.2.1 Summary Statistics

Tables 6.2 - 6.5 give summary statistics for each of the four reports. The number of positive values detected and the geometric mean of those values were computed for each site, grouping together all the test dates. The percentage detected was not presented because of an ambiguity in the reports: it is unclear whether a blank entry means the compound was tested for but not detected, or that it was never tested for in that sample. The reasons for using geometric means given in the general discussion (Section 2) apply here. Because of the small sample sizes, standard errors were not computed.

6.2.2 Tests

The fragmentary nature of these data makes it unsuitable for formal testing. No two geometric means here are truly comparable. In one of the few situations where detected occurrences of a compound are present at one site during two time periods, namely malathion at Greenville in 1977 and 1978, it can be seen (Figure 6.1(c)) that the variance of the data is so large that any formal tests would be nonsignificant.

6.2.3 Trends

Although formal tests were not justified, it may be of interest to examine the levels of a compound plotted over time, when that compound is detected at a particular site. Examples of this are given in Figure 6.1 for chlordane, dieldrin, malathion, and DDT. Chlordane concentrations in Miami and Jackson appeared to decrease over FY 1976, as did dieldrin in Jackson. Data needed to assess long-term trends were unavailable.

6.2.4 Geographic Differences

Figures 6.1(a) and (d) compare concentrations of chlordane and DDT/DDD, respectively, for two sites. It is difficult to conclude from these which site has an overall higher level of these residues. As with testing for trends, there is too little data and too much variability.

Table 6.2

Summary Statistics - Pesticides in Air - April-June, 1975

(ng/m^3)

Pesticide	Fort Collins, Colorado		Miami, Florida		Jackson, Mississippi	
	Number of Pos. Detections	Geom. Mean of Pos. Det.	Number of Pos. Detections	Geom. Mean of Pos. Det.	Number of Pos. Detections	Geom. Mean of Pos. Det.
Alpha-BHC	5	2.2	5	.9	5	1.9
Lindane	4	.7	5	1.3	5	2.2
Heptachlor			5	1.9	5	9.0
Heptachlor Epoxide			0	---	1	.8
Oxychlordane			3	.8	1	.8
Chlordane			4	18.2	5	30.8
Dieldrin			4	.9	5	9.7
Beta-BHC					1	1.0
Diazinon	2	.6	4	1.0	4	.9
Parathion			3	1.8		
Malathion	1	3.8	4	2.0	2	.25
Endrin					1	.5
Disyston	1	.2	1	1.0	1	.9
PCB	5	67.9	5	31.5	4	10.8
	5 sampling dates		5 sampling dates		5 sampling dates	

NOTE: Most of the sample points were doubled - i.e., there were two detectors at each site. The average value was used here.

Table 6.3

Summary Statistics - Pesticides in Air - August 1975 - March 1976

(ng/m^3)

Pesticide	Fort Collins, Colorado		Miami, Florida		Jackson, Mississippi		Lafayette, Indiana		Harrisburg, Pennsylvania	
	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.
Alpha-BHC	8	1.3	10	1.0	9	1.1	9	1.1	9	1.1
Lindane	5	.2	10	1.0	9	.9	8	.2	5	.3
Heptachlor	7	.1	10	1.1	9	3.0	9	.9	8	.3
Heptachlor Epoxide			0	---	4	.7	4	.8		
Oxychlordane	2	<.1	8	.6	8	.4			3	.3
Chlordane	5	.8	10	9.2	9	4.2	8	5.4	6	3.5
Dieldrin	2	.2	10	.4	9	2.4	9	.7	6	.2
Beta-BHC					1	.9	2	.5	2	.8
p_1p^1-DDE	3	.1	5	.2	6	.1			6	.1
Diazinon	5	.5	10	.9	5	.9	4	.1	8	.5
Parathion, Methyl			5	2.6	3	2.8			5	.3
Malathion	0	---	8	1.9	1	9.0			1	1.0
Endrin					1	2.5				
HCB	7	.1	5	TR	7	<.1	6	<.1	9	.1
Thimet					1	7.4				
PCB	8	3.8	10	4.9	9	3.4	9	4.1	9	3.3
	8 sampling dates		10 sampling dates		9 sampling dates		9 sampling dates		9 sampling dates	

NOTE: Most of the sample points were double - i.e., there were two detectors at each site. The average value was used here.

Table 6.4

Summary Statistics - Pesticides in Air - November 1976 - September 1977[1/]

(ng/m^3)

Pesticide	Wheaton, Illinois		Pasadena, California		Greenville, Miss.		Midvale, Utah	
	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.	No. of Pos. Detections	Geom. Mean of Pos. Det.
Alpha-BHC	8	.7	3	.6	5	.8	8	1.0
Lindane	8	1.0	10	2.5	2	17.5	5	.4
Heptachlor	0	---	6	1.3	4	1.4	1	4.9
Heptachlor Epoxide	1	.3	0	---				
Cis-Chlordane	2	2.0	3	1.8	1	.7	0	---
Trans-Chordane	1	.8	11	3.3	6	1.3	0	---
Dieldrin	1	1.9	0	---				
Aldrin	2	2.2	0	---	1	.3	2	.4
DDT/DDD	7	5.2	10	6.0	3	6.1	6	2.5
DDE					1	3.4	0	---
Diazinon	0	---	3	1.9	7	4.8	1	1.9
Parathion, Methyl	0	---	0	---	4	9.8	0	---
Malathion	5	13.2	0	---	6	20.5	0	---
HCB	1	.6	1	.7	2	17.5	1	.7
Dursban					1	.5	0	---
Toxaphene	0	---	0	---	4	15.4	0	---
	10 sampling dates		12 sampling dates		12 sampling dates		11 sampling dates	

1/ The Pasadena data also has an observation for 11/23/77.

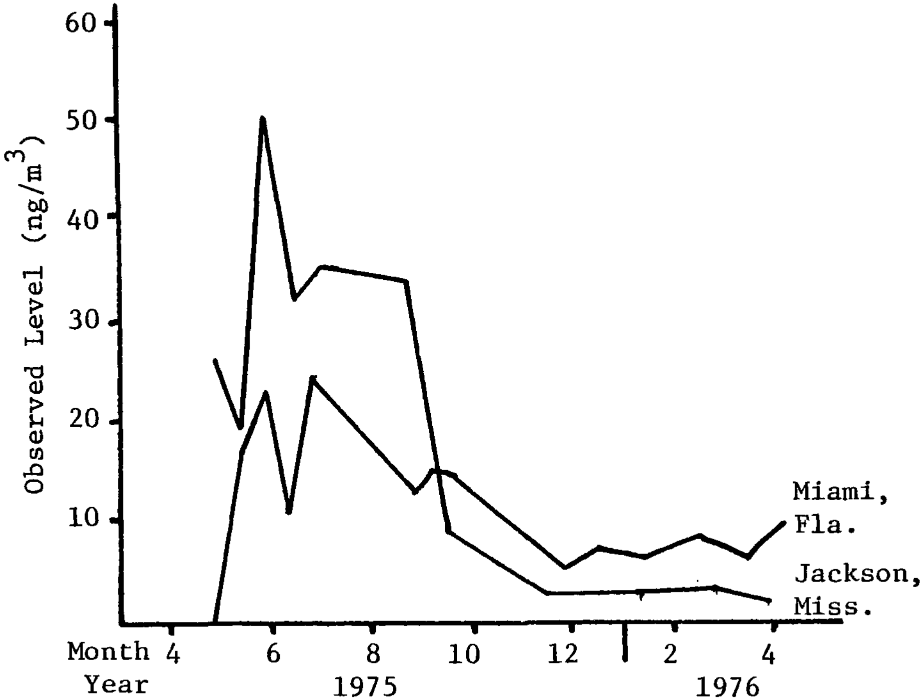
Table 6.5

Summary Statistics - Pesticides in Air - 1978

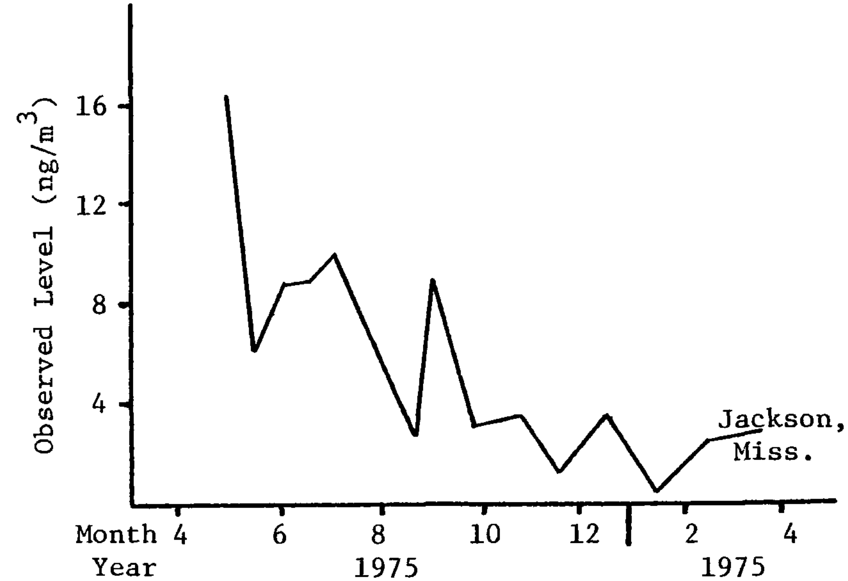
(ng/m^3)

Pesticide	Montana		So. Carolina		Greenville, Mississippi		Florida		Pasadena, California		Springfield, Illinois	
	No. of Pos. Det.	Geom. Mean of Pos. Det.	No. of Pos. Det.	Geom. Mean of Pos. Det.	No. of Pos. Det.	Geom. Mean of Pos. Det.	No. of Pos. Det.	Geom. Mean of Pos. Det.	No. of Pos. Det.	Geom. Mean of Pos. Det.	No. of Pos. Det.	Geom. Mean of Pos. Det.
Alpha-BHC	7	1.6	7	1.0	7	1.2	9	TR	7	1.3	7	1.1
Lindane	0	---	0	---	2	7.2	1	5.7	0	---	0	---
Heptachlor	5	3.9	10	3.1	7	11.3	1	.3	8	11.1	4	1.3
Cis-Chlordane	0	---	0	---	1	1.6	0	---	0	---	0	---
Trans-Chlordane	0	---	1	.4	4	.4	0	---	5	.9	1	2.6
Dieldrin	0	---	0	---	0	---	0	---	0	---	0	---
Aldrin	0	---	0	---	0	---	0	---	0	---	0	---
DDT/DDD/DDE	3	?	11	1.2	2	?	0	---	1	53.8	1	TR
Diazinon	2	1.4	7	1.0	5	1.3	7	1.0	5	1.4	6	4.0
Parathion							4	.5				
Parathion, Methyl	0	---	0	---	7	7.1	0	---	0	---	0	---
Malathion	2	.7	7	8.2	7	25.3	3	5.8	0	---	0	---
HCB	0	---	0	---	0	---	0	---	0	---	0	---
MOC	1	143.	0	---	1	72.7	4	300.	6	270.	1	64.8
Dursban							5	.7			1	17.8
Toxaphene	0	---	0	---	0	---	0	---	0	---	0	---
	8 sampling dates		12 sampling dates		11 sampling dates		13 sampling dates		11 sampling dates		11 sampling dates	

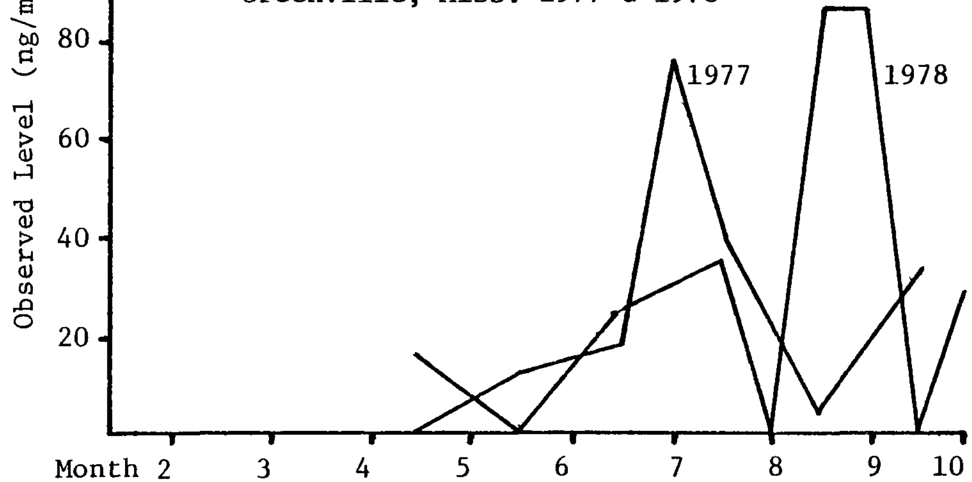
(a) Concentration of Chlordane in Air 4/75-4/76



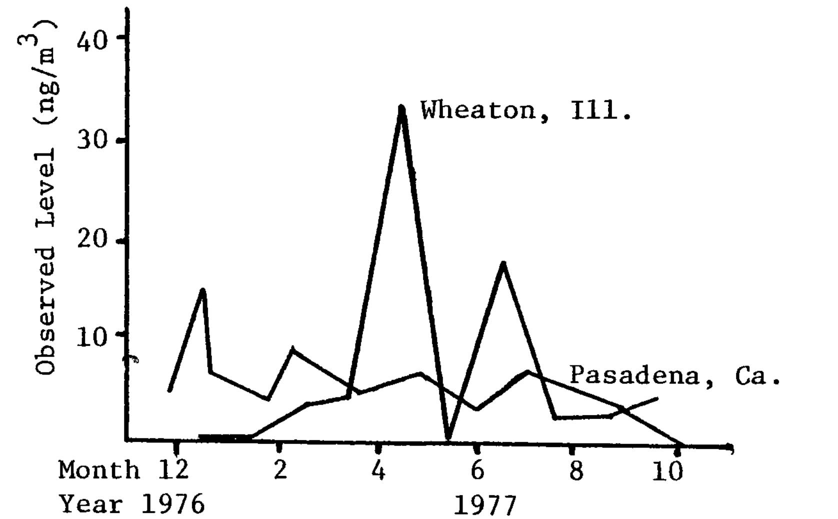
(b) Concentration of Dieldrin in Air 4/75-4/76



(c) Concentration of Malathion in Air Greenville, Miss.-1977 & 1978



(d) Concentration of DDT/DDD in Air - 1977



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[6.5] Report of Monitoring and Analyzing the Ambient Air for Pesticide Residues in Five Locations: Fort Collins, Colorado; Miami, Florida; Lafayette, Indiana; Jackson, Mississippi; and Harrisburg, Pennsylvania. August 1975 to March 1976.

[6.6] Draft Report - Monitoring and Analyzing the Ambient Air for Pesticide Residues in Four locations (Pasadena, California; Wheaton, Illinois; Midvale, Utah; and Greenville, Mississippi) - FY 1977.

[6.7] Untitled data provided by EPA: Analysis of pesticide residues in six locations (Montana; South Carolina; Florida; Greenville, Mississippi; Pasadena, California; and Springfield, Illinois) - January-October, 1978.

7. NATIONAL SOIL APPLICATION NETWORK

7.1 Detailed Description of Network

7.1.1 Sampling Procedures

Cropping and pesticide use information was collected for agricultural sampling sites as part of the National Soils Monitoring Program (NSMP). This information was obtained through personal interviews with the landowners or operators during collection of composite soil and crop samples. A summary of cropping and pesticide use data for the year 1973 and references to reports of such data for the years 1968, 1969, 1971, and 1972 are given by Gowen and Carey [7.2]. The agricultural sampling sites for the NSMP were selected from the sample segments of the Conservation Needs Inventory (CNI) of the Soil Conservation Service. The method of sampling within the CNI segments is outlined by Wiersma, Sand, and Cox [7.3] and [7.1]. Reference is made to Section 4.1.1 of this report for a discussion of information currently available to RTI concerning the sampling procedures of the NSMP and the inferences that may be drawn using data collected through this sampling plan.

7.1.2 Data Analysis

The set of 33 states that were sampled in each test year and used in the soil residue analysis of Section 4. was also used to obtain information on crops being raised and pesticides used.

Over the five year period for which data were available, the six most frequently occurring crop-code categories included five major crops -- wheat, soybeans, field corn, alfalfa/burr clover, and mixed hay -- and idle cropland (fallow). The number of sites by crop-code and year is shown below:

Crop-Code	FY 69	FY 70	FY 72	FY 73	FY 74
Wheat	216	90	109	111	78
Soybean	234	248	248	252	222
Corn	372	343	423	346	333
Alf./Burr Clover	105	105	112	96	77
Mixed Hay	49	110	112	102	82
Fallow	164	91	85	126	100

For each of the six crop-code categories shown above, an examination was made of the pesticides used each year. As one would expect, the total number of pesticides used on a given crop in a single year is quite large. For example, some 20 or more pesticides were used on wheat and soybeans in a given year and about twice that number used on field corn. Because many pesticides were used on a small number of sample sites (in many instances only on a single site), the analysis was restricted to those pesticides used on ten or more sites in the case of field corn and soybeans and five or more sites for the remaining crop-codes.

Under the above restrictions, only one pesticide was used on five or more sites in a given year for the last three crop-codes -- alfalfa/burr clover, mixed hay, and fallow. This was 2,4-D used on seven idle cropland sites in FY69. No further analyses of pesticide usage for these crop-codes were made.

Cotton was the seventh most frequently occurring crop. However, the number of sites reporting cotton was small relative to the six crop-codes shown above and for this reason was excluded.

In the case of wheat, soybeans and field corn, the pesticides of interest used each year are shown, respectively, in Tables 7.1, 7.2, and 7.3. The cell entries are the number of sites for which the pesticide was used. In Table 7.1 the frequency of use for all compounds is less during the latter years of the test program. The one exception is hexachlorobenzene, which shows a slightly higher frequency during FY72-FY74; however, the frequency is less than 10 percent. With regard to soybeans, the frequency of use of alachlor, linuron and trifluralin appear to be increasing with time (Table 7.2). From Table 7.3, alachlor, butylate, carbofuran and cyanazine appear to be increasing over time with regard to their frequency of use. The remaining pesticides of Table 7.3 show either a stable or decreasing use pattern over time. It should be noted that all comments relative to usage patterns over time are based only on a visual examination of Tables 7.1 - 7.3. Statistical tests were not conducted because of time constraints.

Table 7.1

List of Pesticides Applied to at Least
Five Sites in One or More Years - Wheat

	FY 69	FY 70	FY 72	FY 73	FY 74
No. of Sites	216	90	109	111	78
Pesticide					
Captan	1	0	0	5	1
EMTS	16	5	4	5	2
Ethylmercury Chlor.	14	3	3	4	0
Hexachlorobenzene	1	0	7	10	7
Methylmercury Acet.	11	1	0	0	0
Methylmercury Dicyandiamide	56	4	9	1	2
Parathian, Methyl	9	1	4	7	0
2, 4-D	70	9	28	27	27

Table 7.2

List of Pesticides Applied to at Least
Ten Sites in One or More Years - Soybeans

	FY 69	FY 70	FY 72	FY 73	FY 74
No. of Sites	234	248	248	252	222
Pesticide					
Alachlor	0	9	25	41	38
Captan	10	3	4	4	5
Chloramben	32	45	39	46	45
Linuron	7	8	16	31	24
Parathion, Methyl	2	10	3	5	3
Trifluralin	31	21	37	58	48

Table 7.3

List of Pesticides Applied to at Least
Ten Sites in One or More Years - Field Corn

	FY 69	FY 70	FY 72	FY 73	FY 74
No. of Sites	372	343	423	346	333
Pesticide					
Alachlor	0	2	38	36	40
Aldrin	59	51	39	29	30
Atrazine	109	137	186	178	152
Butylate	0	5	17	17	29
Bux-Ten	0	16	16	23	13
Captan	137	84	114	76	64
Carbofuran	0	1	17	14	15
Cyanazine	0	0	0	1	10
Diazinon	23	9	11	4	4
Dicamba	2	1	8	10	7
Heptachlor	29	19	6	4	5
Malathion	102	70	95	69	44
Methoxychlor	35	19	20	9	5
Porate	4	16	20	19	16
Propachlor	20	40	37	34	43
2, 4-D	120	71	72	70	66

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[7.3] Wiersma, G.B., P.F. Sand, and E.L. Cox (1971). A sampling design to determine pesticide residue levels in soils of the conterminous United States. Pestic. Monit. J. 5(1), 63-66.

8. NATIONAL URBAN SOIL NETWORK

8.1 Detailed Description of Network

a. General

The National Soil Residue Network for Urban Soils for the years 1972 to 1979 is a two-stage, stratified sample design. The first stage sampling units were Standard Metropolitan Statistical Areas (SMSAs) and the second stage sampling units were 231 square meter sites (usually 15.2-by-15.2 meter plots of ground). One dimension of stratification, the size of the SMSAs, was used at the first stage. Also, one dimension of stratification, urbanity, was used at the second stage. A sample of five first stage units was selected. A sample of second stage units was selected at the following rates:

- Urban stratum--one site per square mile.
- Suburban stratum--one site per twenty square miles.

b. Definition of the Target Population

The target population includes all soil in the Standard Metropolitan Statistical Areas (SMSAs) in the continental United States.

c. Stratification of the First Stage Frame

The first stage frame is the list of all SMSAs in the continental United States stratified as follows:

Stratum	Description (Based on 1970 Census)
1	All SMSAs with population greater than 1,000,000.
2	All SMSAs with population greater than 100,000 but less than or equal to 1,000,000.
3	All SMSAs with population less than or equal to 100,000.

d. Sample Selection of the First Stage Units (SMSAs)

The sample of five SMSAs was selected from the three strata as follows: one from stratum 1, three from stratum 2, and one from stratum 3. These SMSAs were selected with equal probability and without replacement with the proviso that an SMSA would be rejected if its land area was too large; i.e., if the sampling rate of one site per square mile in the urban stratum and/or one site per twenty miles in the suburban stratum would yield more samples than the laboratory could analyze in one year.

e. Stratification of the Second Stage Frame

The selected first stage units were stratified by urbanity into two strata an urban stratum and a suburban stratum. The urban stratum was the city(s) of the SMSA and the suburban stratum was surrounding counties (usually contiguous).

f. Sample Selection of the Second Stage Units (Sites)

Urban--A map was obtained of the city(s) part of the SMSA. On this map was drawn a one square mile grid. Each block in the grid was subdivided into an 8x8 grid. A two digit random number from 00 to 88 was selected. Starting with the lower right corner, the first digit was the number of spaces to the left and the second digit was the number of space up. This was the selected point on the map. If the point fell in an inaccessible spot, the random digits were reversed.

Suburban--A map was obtained of the suburban part of the SMSA. On this map was drawn a one square mile grid. The blocks in this grid were numbered. An equal probability sample without replacement was selected from these one square mile blocks at a rate of 1 in 20; i.e., if there were 400 square miles in the suburban area 20 one square mile blocks were chosen. The location of a point in each of the chosen square miles was the same as for the urban stratum.

Each selected point on the map represented a 15.2-by-15.2 meter square (50-by-50 foot); i.e., the sampler was permitted to select his sample anywhere in this 15.2-by-15.2 plot.

g. Generalization of the Results

The target population includes all soil in the Standard Metropolitan Statistical Areas (SMSAs) in the continental United States; however, the way the sample was selected the sampled population is a subset of the target population.

Excluded from the targeted population are all SMSAs whose land area is too large; i.e., if the sampling rate of one site per square mile in the urban stratum and/or one site per twenty square miles in the suburban stratum would yield more samples than the laboratory could analyze in one year. Also, because of the size of the second stage sampling unit the 15.2-by-15.2 meter plot relative to the sampling grid, the area frame is incomplete. As a result, conclusions drawn from the sample apply to the sampled population not the targeted population. If the conclusions are extended to the targeted population, serious nonmeasurable bias may be introduced.

8.2 Data Analysis

The Urban Soil Data File provided to RTI by Viar & Company gives pesticide residue concentration for the following:

Year (FY)	Number of Cities Sampled	Total No. Samples
1971	10	252
1972	4	223
1973	4	381
1974	5	441
1975	5	443
1976	8	377
1977	10	240

Different cities were sampled during the period 1971-1976. However, the cities and sampling sites used in 1977 were the same as those used in 1971. This is consistent with the sample design which calls for resampling cities every six years to determine changes in residue levels. It should be noted that fourteen cities were actually sampled in 1971 and again in 1977. Also, five cities were sampled in 1972 and 1973. Reasons why the present data file does not contain complete test data will be examined by RTI under another task assignment.

The frequencies of pesticides found annually in urban and suburban soil samples are shown in Table 8.1. Over the seven year test period, fifteen pesticides were detected in at least two soil samples in one or more years. Those pesticides which were detected only once in one or more years are not listed. In terms of the number of detections the major pesticides found in the soil include: $\sum$DDT, chlordane, dieldrin and heptachlor epoxide. Because of their relatively high frequency of occurrence, additional information is provided on these four pesticides. Specifically, Table 8.2 gives, by year, city and pesticide, the number of sampling sites and the number and percentage of sites with detectable levels of the various compounds. It is apparent from these results that within a given year the frequency of occurrence of a particular pesticide varies widely by city.

TABLE 8.1. NUMBER OF POSITIVE DETECTIONS FOUND IN URBAN SOIL BY YEAR BY PESTICIDE

	Year (FY)						
	1971	1972	1973	1974	1975	1976	1977
No. Cities Sampled	10	4	4	5	5	8	10
No. Samples Analyzed	252	223	381	441	443	377	240
Pesticide							
$\sum$DDT	120	168	95	202	187	277	149
Chlordane	47	47	36	84	80	155	62
Dieldrin	7	32	37	53	115	109	55
Heptachlor Epoxide	16	20	2	13	54	90	29
Toxaphene	4	11	0	1	21	7	9
PCB	0	2	4	11	13	13	17
Heptachlor	2	5	0	2	6	5	1
Gamma Chlordane	0	0	0	4	0	28	4
Endrin	0	1	0	0	11	1	3
Aldrin	0	4	0	1	7	5	0
Trifluralin	0	0	0	0	4	0	0
Hexachlorobenzene	0	0	0	0	2	5	1
Diazinon	0	0	0	0	0	0	2
Mecoprop	0	0	0	2	0	0	0
Methoxychlor	0	0	0	2	0	0	1

TABLE 8.2. NUMBER AND PERCENT OF POSITIVE DETECTIONS OF MAJOR PESTICIDES FOUND IN URBAN SOIL DURING 1971-1977, BY CITY BY YEAR

Year (FY)	City	State	Number Sampling Sites	Chlordane Positive Detections No.	Chlordane Positive Detections %	Dieldrin Positive Detections No.	Dieldrin Positive Detections %	Heptachlor Epoxide Positive Detections No.	Heptachlor Epoxide Positive Detections %	∑DDT Positive Detections No.	∑DDT Positive Detections %
1971	Mobile	Ala.	29	7	24.1	3	10.3	6	20.7	11	37.9
	Wilmington	Del.	27	2	7.4	0	0.0	1	3.7	11	40.7
	Honolulu	Hawaii	21	6	28.6	0	0.0	1	4.8	4	19.0
	Charleston	S.C.	27	3	11.1	0	0.0	0	0.0	2	7.4
	Grand Rapids	Mich.	23	10	43.5	0	0.0	5	21.7	20	87.0
	Greenville	Miss.	28	2	7.1	1	3.6	0	0.0	25	89.3
	Sikeston	Mo.	27	2	7.4	1	3.7	0	0.0	7	25.9
	Portland	Ore.	25	3	12.0	2	8.0	0	0.0	17	68.0
	Philadelphia	Pa.	26	11	42.3	0	0.0	2	7.7	20	76.9
	Cheyenne	Wyo.	19	1	5.3	0	0.0	1	5.3	3	15.8
1972	Gadsden	Ala.	55	4	7.3	7	12.7	1	1.8	39	70.9
	Hartford	Conn.	47	22	46.8	5	10.6	7	14.9	40	85.1
	Macon	Ga.	43	11	25.6	13	30.2	9	20.9	42	97.7
	Newport News	Va.	78	10	12.8	7	9.0	3	3.8	47	60.3
1973	Des Moines	Iowa	88	17	19.3	14	15.9	2	2.3	44	50.0
	Lake Charles	La.	69	3	4.3	15	21.7	0	0.0	1	1.4
	Fitchburg	Mass.	36	2	5.6	3	8.3	0	0.0	25	69.4
	Pittsburg	Pa.	188	14	7.4	5	2.7	0	0.0	25	13.3
1974	Washington	D.C.	132	40	30.3	19	14.4	9	6.8	78	59.0
	Evansville	Ind.	84	17	20.2	10	11.9	0	0.0	13	15.5
	Pittsfield	Mass.	45	5	11.1	0	0.0	0	0.0	25	55.6
	Greenville	S.C.	85	8	9.4	8	9.4	2	2.4	53	62.4
	Tacoma	Wash.	95	14	14.7	16	16.8	2	2.1	33	34.7
1975	Pine Bluff	Ark.	59	8	13.6	14	23.7	3	5.1	49	83.0
	San Francisco	Calif.	162	31	19.1	23	14.2	8	4.9	79	48.8
	Springfield	Ill.	71	26	36.6	48	67.6	30	42.3	17	23.9
	Gary	Ind.	85	15	17.6	25	29.4	13	15.3	35	41.2
	Durham	N.C.	66	0	0.0	5	7.6	0	0.0	7	10.6

Year (FY)	City	State	Number Sampling Sites	Chlordane Positive Detections		Dieldrin Positive Detections		Heptachlor Epoxide Positive Detections		$\sum$DDT Positive Detections	
				No.	%	No.	%	No.	%	No.	%
1976	Bakersfield	Calif.	42	2	4.8	10	23.8	4	9.5	35	83.3
	Waterbury	Conn.	44	32	72.7	18	40.9	15	34.1	37	84.1
	Miami	Fla.	50	24	48.0	27	54.0	6	12.0	49	98.0
	Manhatten	Kan.	50	21	42.0	14	28.0	14	28.0	22	44.0
	Camden	N.J.	50	15	30.0	11	22.0	5	10.0	50	100.0
	Houston	Tex.	47	28	59.6	12	25.5	17	36.2	18	38.3
	Salt Lake City	Utah	47	20	42.6	13	27.7	12	25.5	26	55.3
	Milwaukee	Wisc.	47	13	27.7	4	8.5	17	36.2	40	85.1
1977	Mobile	Ala.	24	8	33.3	6	25.0	5	20.8	8	33.3
	Wilmington	Del.	25	6	24.0	3	12.0	1	4.0	21	84.0
	Honolulu	Hawaii	21	14	66.7	14	66.7	8	38.1	7	33.3
	Charleston	S.C.	25	0	0.0	0	0.0	0	0.0	11	44.0
	Grand Rapids	Mich.	22	6	27.3	1	4.5	4	18.2	14	63.6
	Greenville	Miss.	28	0	0.0	8	28.6	1	3.6	26	92.9
	Sikeston	Mo.	27	7	25.9	2	7.4	1	3.7	12	44.4
	Portland	Ore.	25	8	32.0	7	28.0	3	12.0	22	88.0
	Philadelphia	Pa.	24	9	37.5	11	45.8	6	25.0	21	87.5
	Cheyenne	Wyo.	19	4	21.1	3	15.8	0	0.0	7	36.8

Time Trends

The ten cities sampled in FY1971 (see Table 8.2) were resampled six years later for the purpose of determining changes in residue levels over time.

Table 8.3 gives the number and percentage of positive detections in 1971 and 1977 for the five most frequently occurring pesticides. The difference in the two percentages for a given pesticide is an estimate of the effect of time. The results given in Table 8.3 clearly show that the percentage of soil samples with a detectable level of a given pesticide was higher in 1977 than in 1971. For four of the five pesticides, the increase was significant at the .10 (or lower) level of significance. The remaining pesticide - toxaphene - showed an increase in the percentage of positive detections in 1977 over 1971; however, this increase is not considered statistically significant at the .10 level.

In addition to examining how the percentage of occurrence changes with time, data for 1971 and 1977 were also analyzed to determine the impact of time on pesticide residue levels actually found in urban soil. This analysis was restricted to those pesticides exhibiting a substantial number of non-zero values of residue -- i.e., $\sum$DDT, chlordane, dieldrin and heptachlor epoxide. For each pesticide an analysis of variance was used to test for differences between yearly means (time effect) and for differences among the means for the ten cities sampled in 1971 and 1977. A general discussion of this statistical technique is given in Section 2. The analyses were actually conducted on $\log_e (X + .01)$, where X is the residue level observed in a particular soil sample. It was necessary to add a constant to each observation in order to make the transformation since many of the X values were zero. The results of these analyses are shown in Table 8.4. The mean (geometric) level of dieldrin increased from .001 (ppm) in 1971 to .004 in 1977. Statistically, this increase was significant; however, from a practical standpoint, this increase may not be very important. In interpreting this result one should keep in mind that dieldrin was detected in seven soil samples in 1971 and fifty-five samples in 1977 (see Table 8.3). The other three pesticides -- $\sum$DDT, chlordane and heptachlor epoxide -- did not show a significant change in the residue level from 1971 to 1977. Although each of these pesticides showed a significant increase

TABLE 8.3. NUMBER AND PERCENTAGE OF POSITIVE DETECTIONS FOUND IN URBAN SOIL SAMPLES FROM TEN CITIES SAMPLED IN 1971 AND AGAIN IN 1977

		Year (FY)		Test of
		1971	1977	Significance
No. Samples Analyzed		252	240	
Pesticide				
$\sum$DDT	No.	120	149	
	%	47.6	62.1	sign. @ .01 level
Chlordane	No.	47	62	
	%	18.7	25.8	sign. @ .1 level
Dieldrin	No.	7	55	
	%	2.8	22.9	sign. @ .01 level
Heptachlor	No.	16	29	
Epoxide	%	6.3	12.1	sign. @ .05 level
Toxaphene	No.	4	9	not
	%	1.6	3.8	sign. @ .1 level
PCB	No.	0	17	
	%	0.0	7.1	sign. @ .01 level

TABLE 8.4. GEOMETRIC MEANS BASED ON SAMPLES SELECTED FROM SAME LOCATIONS IN 1971 AND 1977

Year (FY)			Pesticide: $\sum$DDT	Chlordane	Dieldrin	Heptachlor Epoxide
1971			.046	.013	.001	.001
1977			.036	.012	.004	.002
		Test of Sig. Between Yearly Means	Not Sig. @ .1	Not Sig. @ .1	Sig. @ .01	Not Sig. @ .1
City	**State**					
Mobile	Ala.		.022	.012	.005	.003
Wilmington	Del.		.060	.003	.001	< .001
Honolulu	Hawaii		.017	.117	.008	.006
Charleston	S.C.		.007	.002	0.0	0.0
Grand Rapids	Mich.		.079	.028	< .001	.005
Greenville	Miss.		.143	.002	.003	< .001
Sikeston	Mo.		.012	.006	.001	< .001
Portland	Ore.		.095	.008	.004	.001
Philadelphia	Pa.		.175	.045	.003	.003
Cheyenne	Wyo.		.005	.005	.001	.001
		Test of Sig. Among City Means	Sig. @ .01	Sig. @ .01	Sig. @ .01	Sig. @ .01

in the percentage of positive detections from 1971 to 1977 (see Table 8.3), the observed levels were apparently too small to have an effect on a measure of central tendency such as the geometric mean.

With regard to cities sampled in 1971 and again in 1977, Table 8.4 shows that the residue level of every pesticide examined differs significantly from city-to-city.

Effects of Land Use and Location of Sites

Sampling sites within a given city are categorized according to two factors each with two levels. These are:

Factor	Level
Location (L)	Urban - located within the political boundaries of the city.
	Suburban - located in the adjacent counties within the Standard Metropolitan Statistical Area.
Land Use (U)	Lawn 1/
	Waste

This section discusses analyses conducted for the purpose of determining: (1) if, and to what extent, these factors affect the residue level of a given pesticide, (2) if there is an interaction effect of these two factors, and (3) if effects of these factors are the same from one city to another (i.e., city by factor (L or U) interaction). The analyses are restricted to $\sum$DDT and chlordane as these are the only pesticides with a sufficient number of positive values in cities tested in a given year to warrant an evaluation.

In the case of $\sum$DDT, an analysis of variance model involving the factors L, U, and C (city) and all possible interactions of these factors was fitted separately to three data sets:

1. Year: 1972. Cities: Gadsden, Ala.; Hartford, Conn.; and Macon, Georgia.
2. Year: 1974. Cities: Evansville, Ind.; Greenville, S.C.; and Washington, D.C.
3. Year: 1975. Cities: Gary, Ind.; Pine Bluff, Ark.; and San Francisco, Calif.

1/ Wiersma, G.B., H. Tai, and P.F. Sand, 1972. Pesticide residues in soil from eight cities -- 1969. Pestic. Monit. J. 6(2):126-129.

In each analysis the independent variable was $\log_e(\sum DDT + .01)$. The analysis of variance results (shown in Table 8.5) indicate highly significant main effects in two of the three years examined. This means that with respect to the mean level of $\sum$DDT cities differ, urban areas differ from suburban areas and sites classified as lawn differ from those classified as waste. Geometric means for the various levels of the three factors are given in Table 8.6. In 1972 for example, the geometric mean of $\sum$DDT in Macon, Georgia, was more than six times the level observed in Gadsden, Alabama. Urban areas show a higher level of $\sum$DDT than suburban areas and lawn sites exhibit a higher level than sites classified as waste. Even in the years where differences were not statistically significant, the estimates showed these patterns.

Table 8.5

Tests of Significance - $\sum$DDT

Effect	1972	1974	1975
C (city)	**	**	NS
L (location)	NS	**	**
U (land use)	**	NS	**
C x L	NS	**	**
C x U	NS	NS	NS
L x U	**	NS	NS
C x L x U	NS	NS	**

** = Effect significant at the 1% level
NS = Effect not significant at the 5% level

The analysis of interaction effects involving C, L, and U showed mixed results (see Table 8.5). In all three years the C x U interaction was not significant indicating that the effect of U (land use) was independent of city. The C x L interaction effect was highly significant in two of the three years thus providing strong evidence that the effect of location (L) changes from one city to another. This interaction is brought about by the fact that the mean (geometric) level of $\sum$DDT in urban sites is much higher than in suburban sites in some cities and is about the same in other cities. There was no case where the mean

TABLE 8.6. SUMMARY STATISTICS FOR $\sum$DDT

		1972		1974		1975	
Factor	Factor Level	N	G.M. (ppm)	N	G.M. (ppm)	N	G.M. (ppm)
City	1 (See	54	.032**	78	.005**	85	.035^{NS}
	2 list	47	.128	85	.025	59	.089
	3 below)	43	.190	130	.082	160	.021
Location	Urban	58	.093^{NS}	114	.085**	101	.069**
	Suburban	86	.086	179	.016	203	.022
Land Use	Lawn	59	.138**	144	.053^{NS}	118	.095**
	Waste	85	.065	149	.020	186	.014

NS = Not significant at the 5% level.

** = Factor significant at the 1% level.

1972: 1 = Gadsden, Ala.
2 = Hartford, Conn.
3 = Macon, Ga.

1974: 1 = Evansville, Ind.
2 = Greenville, S.C.
3 = Washington, D.C.

1975: 1 = Gary, Ind.
2 = Pine Bluff, Ark.
3 = San Francisco, Calif.

level was significantly lower in urban sites. The L x U and C x L x U interaction effects were not significant in two of the three years.

In the case of chlordane, an analysis of variance model involving the factors U and C (city) and their interaction was fitted to two data sets:

1. Year: 1973. Cities: Des Moines, Iowa and Pittsburg, Pa.
2. Year: 1976. Cities: Camden, N.J.; Houston, Texas; Salt Lake City, Utah; and Waterbury, Conn.

The independent variable was $\log_e$ (chlordane + .01). The factor L was not examined because of the small number of positive values. The analysis of variance results (shown in Table 8.7) indicated land use (U) to be a very significant factor and the effect of this factor did not change from one city to another (i.e., no C x U interaction effect). Sites classified as lawn exhibited much higher levels of chlordane than waste sites. Geometric means are shown in table 8.8.

Table 8.7

Tests of Significance - 'Chlordane

Effect	1973	1976
C (city)	NS	*
U (land use)	**	**
C x U	NS	NS

NS = effect not significant at the 5% level.
* = Effect significant at the 5% level.
** = Effect significant at the 1% level.

TABLE 8.8. SUMMARY STATISTICS FOR CHLORDANE

		1973		1976	
Factor	Factor Level	N	G.M. (ppm)	N	G.M. (ppm)
City	1 (see	57	.024[NS]	50	.014*
	2 list	56	.015	47	.092
	3 below)	--	--	47	.022
	4	--	--	44	.117
Land Use	Lawn	59	.049**	109	.092**
	Waste	54	.003	79	.013

NS = not significat at the 5% level.

* = factor significant at the 5% level.

** = factor significant at the 1% level.

1973: 1 = Des Moines, Iowa
2 = Pittsburg, Pa.

1976: 1 = Camden, N.J.
2 = Houston, Tex.
3 = Salt Lake City, Utah
4 = Waterbury, Conn.

9. GENERAL ACCURACY OF PESTICIDE CHEMICAL ANALYSIS

To measure valid analytical results, the laboratories participating in the pesticide analysis program instituted a variety of quality control measures. One of the most reliable techniques for assessing overall analytical proficiency involved repeated analysis of a quality control (QC) sample containing known pesticide levels. Including QC sample(s) in daily analytical runs provided a means for monitoring analyst and instrumental performance.

The degree to which an analytical determination can be reproduced is termed precision and is conveniently expressed as standard deviation units (SDU) from a mean or true value. The expected fluctuation in a calculated concentration value is also expressed as relative standard deviation, (SDU/mean or true value) x 100. It has become customary to allow a variation corresponding to 2 SDU in the calculated concentration value for a single sample on repeated analysis. Analysis performed during a period when the concentration values for a QC sample differ by more than 2 SDU, are termed unacceptable and are repeated under proper analytical conditions. Thus, variations covering the range ± 2 SDU are permitted for QC samples and are likely to occur in the sample results.

The uncertainty in analytical accuracy corresponding to this "acceptable range" in sample results depends on the percent relative standard deviation (%RSD) appropriate for the particular measurement. The main factors in estimating %RSD are observed concentration level and pesticide type. A %RSD range of 7.5 - 10.0 % is reasonable for single component organochlorine and organophosphorous pesticides found at the ppm level. Thus, accuracy uncertainty is ± 15 - 20% of the reported concentration value. At the detection limit (10-30 ppb) for this group of pesticides, the %RSD equals 50% (by definition). This situation results in a ± 100% uncertainty in the accuracy of the reported data. Intermediate concentration values yield accuracy confidence limits between these extremes.

Reported Concentration Levels	Accuracy	%RSD
High: ppm	± 15-20%	7.5-10%
Interm: 100-500ppb	± 20-30%	10-15%
Low: 10-30 ppb	± 100%	50%

PCB concentration values are realistically qualified by a general ± 50% uncertainty in accuracy. The PCB analysis is an extremely complex case since this material is a mixture of isomers present in varying proportions. Toxaphene and Chlordane are also multi-component preparations and consequently are associated with greater uncertainty in analytical accuracy. At best, the three formulations mentioned above posses a detection limit of 100 ppb.

10. RECOMMENDATIONS AND SUMMARY

In this report, RTI has described the preliminary results of (i) taking EPA computer data files, unprocessed data, and hard copy documentation from six pesticide networks and then preparing from these materials machine readable analysis files at RTI and (ii) subsequently analyzing these data files. In the analyses, RTI has attempted to answer several specific questions about each data network including (i) the exact sampling procedures used and the population it represents, (ii) selected summary statistics and tests of significance which seem appropriate for summarizing the data, and (iii) an examination of trends over time and differences in geographic areas for particular pesticides. The six pesticide networks examined were (i) the Human Adipose Tissue Network (1970-1977), (ii) the Soil Residue Network (1969-1974), (iii) the Surface Water and Sediment Residue Network (1976-1979), (iv) the Air Network (1975-1978), (v) the Soil Application Network (1969-1974), and (vi) the Urban Soil Network (1971-1977).

In its analyses, RTI has found that (i) with the available documentation only the Human Adipose Tissue Network may be used to make inference about the entire U.S. (i.e., it is the only network where information presently at hand will allow the computation of sampling weights for observed pesticide levels); (ii) the Human Tissue, Soil Application Urban Soil, Soil Residue, and Water and Sediment Residue Networks do allow trends in various pesticide levels to be examined over time and by geographic area; therefore, these networks certainly have the potential to monitor trends in pesticide levels in the various media; (iii) a vast majority of the data for the various pesticides examined have distributions which have a relatively large number (quite often more than 50%) of zero or non-detected values; (iv) the data from the various pesticide networks cannot be easily matched for simultaneous analysis (except in some ad hoc manner); and (v) unweighted analysis of the Human Tissue Network indicates several statistically significant differences by race, age, sex, census division and year for several of the pesticides examined. (It is important to state as discussed in Section 2 that statistical significance is not the same as practical significance; therefore, statistically significant results given in this report should be examined with this in mind. Also, as stated in Section 3, RTI is presently examining weighted analysis of the Human Tissue Network since unweighted analysis may overstate significance levels).

The results of the preliminary analyses provide a basis for several recommendations regarding the existing data networks. These include:

(1) An investigation should certainly be undertaken to determine the feasibility of designing sampling plans so that the data from the various pesticide networks can be simultaneously analyzed. This might involve changing the sampling plans for some of the networks. If it could be accomplished in a reasonable manner, issues such as the source of pesticides in human tissue and the lag time from pesticide application to elevated levels in humans could be addressed. The trade-off is that the overall coverage of particular networks would be reduced to accommodate the simultaneous coverage.

(2) All of the pesticide networks should employ computer generated monitoring techniques (e.g., control charts, trend analyses, plots, etc.) which automatically flag unusual or unexpected trends in the various pesticide levels. When such events are identified, particularly pesticides which have been non-detected in the past, then each network should examine where these flagged values are occurring and determine if the levels are sufficiently high to warrant concern. If, for example, one geographic area has a majority of the flagged values (and these values are sufficiently high), then sampling procedures could be implemented to oversample the suspected area to better determine the extent of the apparent problem. This oversampling might be similar to the 1976 special Mirex study in southern states for the Human Tissue Network.

(3) Periodic EPA Reports (e.g., yearly) should be generated for all of the networks which not only indicate current pesticide levels but also time trends, geographic differences, etc. This has the advantage of combining all of the pertinent information from the network in <u>one</u> report. In fact, if

simultaneous analysis of the various networks becomes possible, it might be reasonable to publish a single report containing pertinent results from all of the networks, such as comparisons of Human Tissue levels in 1978 versus corresponding Soil levels in 1975. The periodic network report is not meant to discourage publishing interesting results from the analysis of network data in several journals but only to have in one document all the analysis results for the network(s). An example of a portion of this type of document is the "Pesticide Residue Levels in Soils and Crops" published annually by EPA through 1974 for the Soil Residue Network. This document contained results only for one year but could be expanded to indicate trends, geographic differences, etc. for several years.

(4) A document should be prepared for each network which provides detailed documentation of the network's data files over time. This would provide in one document all the information necessary to analyze the data from the network. For example, site, State and census division codes; pesticide codes; how minimum detectables are to be handled; the exact definition of 0's on the data file, sampling design; etc. This document should be updated periodically.

(5) The following recommendations apply to the data file systems for each pesticide network:

A. Have a single residue format for all surveys:

a. use the format that is now part of the Human Tissue System with some modification. Combine the units used into one byte similar to what can exist under SWEMS.

b. use a consistent set of codes for identifying residue. Note the differences that now exist between SWEMS and the Human Tissue System.

B. All survey data should be handled by a single software system, including the Air Monitoring System should it ever be automated. This system would have three basic subsystems.

a. data entry - reduction of hard copy data to machine readable form.

b. editing - develop a table driven edit system that will handle future modifications of the data.

c. data management system with analysis capability such as the Statistical Analysis System [2.4].

C. Specific codes should be introduced into the existing files and future files that indicate whether a specific residue was not looked for as opposed to not having been found under analysis.

D. Include Age on the Human Tissue System (at the present time it was necessary to compute it as the difference between birth date and date of collection).

E. Sampling weights and sampling design modifiers should be given for each data record.

(6) The available documentation for the Soil Application, Soil Residue, and Water and Sediment Networks was inadequate for determining how to generalize the results to any population other than the specific sampling sites. Thus, either (i) the precise sampling procedures for these networks should be documented so that it may be determined if generalizations to larger populations may be made or (ii) a newly designed area probability sample should be developed for each network, perhaps in conjunction with the Human Tissue Network and the Urban Soils Network, so that inferences to the entire U.S. (or specific subsets of the U.S., e.g., states where particular pesticides are being applied) may be made for each network.

(7) Consideration should be given to the reinstatement of the National Soil and Crop Pesticide Monitoring Program, perhaps on a scaled-down level. The basis for this recommendation is exactly the same objective for which the program was founded more than a decade ago--that is, to monitor changes in pesticide levels through time. Whilte the program may have provided

reliable information on pesticide levels during 1968-1973, its value is very limited in assessing current levels. Certainly, extrapolating to 1979 and 1980 from data generated in 1968-1973 should not be attempted. A monitoring system can be useful without analyzing a large number of samples each year. Gross changes from baseline levels can be detected with relatively small sample sizes tested at intervals exceeding one year. When baseline levels are low, which appears to be the case for agricultural soil residues, then large changes are of primary concern. A national estimate may not be the most appropriate or meaningful statistic to monitor. An alternative approach could include monitoring purposively selected areas representing worst case conditions if these potential hot-spots are known. As mentioned above, in considering a sample design for the Soil and Crop Residue Network, the Urban Soil and Human Tissue Network sample designs should be taken into consideration.

(8) Summary statistics for each network should include (i) percent of positive values detected, (ii) percent of values greater than some "meaningful" level, and (iii) the geometric mean of the positive values (or the geometric mean of all value if almost all values are positive). Of course, other summary statistics may also be used in characterizing pesticide levels (e.g., medians, percentiles, ...) but these three statistics seem to be reasonable in view of the distributions of the various pesticide levels. In addition, these summary statistics may easily be tested by a χ^2 and F-test (see Section 2). The above implies that, if possible, EPA personnel should define "meaningful" levels for each pesticide that is being monitored.

(9) All laboratories performing pesticide analysis for the various monitoring networks should follow the quality control procedures discussed in the EPA Manual for Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples, January, 1979, (EPA-600/1-70-008). Every effort should be made to establish inter-laboratory analytical con-

sistency, particularly with respect to gas chromatographic (GC) operating conditions and interpretation of the raw GC data. All the monitoring networks deserve and demand the same quality control effort. The need for establishing data validity exists whether a particular program involves the analysis of 10 samples or 1,000 samples. An explicit statement (qualification) should accompany submitted analysis results to indicate the degree of control under which the raw data were generated.

(10) An effort should be directed at reducing lag-time between pesticide network data collection and the results of statistical analysis of this data.

APPENDIX 1

Data Collection Forms

Table 1.1

FORM APPROV[illegible]
OMB NO. 158-R[illegible]

ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF PESTICIDE COMMUNITY STUDIES
Chamblee, Georgia 30341
HUMAN MONITORING SURVEY

TISSUE PESTICIDE RESIDUE ANALYSIS REPORT

DO NOT WRITE IN SHADED AREAS

1 2 | B | 1 |

PATIENT'S HOSPITAL I.D.# — 3 4 5 6 7 8 9 10

HOSPITAL

SPECIMEN: ADIPOSE ☐ BLOOD SERUM ☐ — 12-21 BLANK 22 23 24 25 26

OPERATING PARAMETERS: G.C. MAKE MODEL; DETECTOR — 27 28 29

COLUMN 1; COLUMN 2 — 30 31 32 33

WET WEIGHT MILLILITERS OR MILLIGRAMS; % LIPID EXTRACTABLE MATERIAL (XXX.X) — 34 35 36 37 38 39 40 41

METHOD OF ANALYSIS; DATE OF ANALYSIS (MONTH, DAY, YEAR) — 43 44 45 46 47 48

LABORATORY; CHEMIST — 51 52

Circle code and record results of Pesticide Residue Analysis in appropriate boxes. Place "X" in proper units column. Place alphabetic confidence level in column CL. Place "<" in column so marked if detectable but unmeasurable amount of residue is present and enter smallest measurable amount in AMOUNT colu[illegible]

53 PREF[illegible] ANAL[illegible]

1 2 | B | 2 | COLS. 3-26, 46-62 SAME AS B1

Code 27	Pesticide Residue	< 29	Amount 30	ppm 36	ppb 37	CL 38	Code 27	Pesticide Residue	< 29	Amount 30	ppm 36
37	pp' DDT		.				86	Oxychlordane		.	
38	op DDT		.				87	Mirex		.	
39	pp' DDE		.							.	
40	op DDE		.							.	
41	pp' DDD		.							.	
44	α -BHC		.							.	
45	β -BHC		.							.	
46	γ -BHC		.							.	
47	δ -BHC		.							.	
49	Dieldrin		.							.	
52	Hept. Epoxide		.							.	
85	PCB's		.							.	

Remarks: 1/ Used for FY 71-FY 76.

Table 1.2

MEDICAL RECORD: This form contains medical information the disclosure or release of which is restricted by U.S.C. 552, (b) (6); 45 CFR Part 5.

Form Approved
OMB No. 158-R0140

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDES PROGRAMS
TECHNICAL SERVICES DIVISION *(WH-569)*
ECOLOGICAL MONITORING BRANCH
WASHINGTON, D.C. 20460

NATIONAL HUMAN MONITORING PROGRAM FOR PESTICIDES

TISSUE PESTICIDE RESIDUE ANALYSIS REPORT

Record results of pesticide residue analysis in appropriate boxes. Place "X" in proper units column. Place alphabetic confidence level in column CL. Place "<" in column so marked if detectable but unmeasurable amount of residue is present and enter smallest measurable amount in AMOUNT column. ENTER ZERO IF NOT DETECTABLE.

DO NOT WRITE IN SHADED AREAS

SUMMARY 1 ☐ ACTION 2 ☐

HOSPITAL OR LOCATION *(Name, City and State)* — 3 4 5

PATIENT'S IDENTIFICATION NO. — PATIENT'S INITIALS — 6 7 8 9 10 11 12 13 14 — 15

DATE COLLECTED *(Month, Day, Year)* — 16 17 – 18 19 – 20 21 — 22 23

TISSUE TYPE
- [ ] ADIPOSE
- [ ] BLOOD SERUM
- [ ] OTHER *(Specify)* ____________

24 25: B 1

OPERATING PARAMETERS
- G.C. MAKE — MODEL — DETECTOR — 26 27 — 28
- COLUMN 1 — COLUMN 2 — 29 30 — 31 32

WET WEIGHT — % LIPID EXTRACTABLE MATERIAL *(XXX.X)* — 33 34 35 36 37 — 38 39 40 . 41

METHOD OF ANALYSIS — DATE OF ANALYSIS *(Month, Day, Year)* — 42 43 — 44 45 – 46 47 – 48 49

LABORATORY — CHEMIST — 50 51

CODE 52	PESTICIDE RESIDUE	< 54	AMOUNT 55	ppm 61	ppb 62	CL 63	CODE 52	PESTICIDE RESIDUE	< 54	AMOUNT 55	ppm 61	ppb 62	CL 63
37	pp'-DDT		•				50	ENDRIN		•			
38	op'-DDT		•				51	HEPTACHLOR		•			
39	pp'-DDE		•				52	HEPT. EPOXIDE		•			
40	op'-DDE		•				85	PCB's		•			
41	pp'-DDD		•				86	OXYCHLORDANE		•			
42	op' DDD		•				87	MIREX		•			
44	α-BHC		•				AP	TRANS-NONACHLOR		•			
45	β-BHC		•				AE	HEXACHLORO-BENZENE		•			
46	γ-BHC		•							•			
47	δ-BHC		•							•			
48	ALDRIN		•							•			
49	DIELDRIN		•							•			

REMARKS

1/ Used for FY 77.

SEX 71 ☐

AGE 72 73 ☐☐

ORIGIN 80 ☐

EPA Hq Form 8510-9 (Rev. 4-76) REPLACES EPA FORM 8510-9 (REV. 11-73) WHICH IS OBSOLETE.

Table 1.3

PESTICIDE ANALYSIS WORKSHEET

SECTION 1. SAMPLE IDENTIFICATION DATA

LAB NO.		SAMPLE ACCESSION NO.						CD NO.		DATE RECEIVED AT LAB
1	2	3	4	5	6	7	8	9	10	
								Ø	7	

SECTION 2. SAMPLING DATA *(To be completed at sampling time)*

SAMPLED BY *(Agency and last name)*:

DATE SAMPLED	SITE	STATION/SITE NUMBER
11 12 13 14 15 16	STATE 17 18 COUNTY OR REGION 19 20	21 22 23 24 25 26 27 28 29 30 31

SYSTEM	MATERIAL	CROP NUMBER *(If applicable)*
32 33 NS = NATIONAL SOILS MONITORING NE = NATIONAL ESTUARINE MONITORING NW = NATIONAL WATER MONITORING	34 35 36	37

PESTICIDES USED *(Check or specify)*

	2, 4–D		CHLORDANE		DIELDRIN		MALATHION		TRIFLURALIN						
	ALDRIN		DDT		ENDRIN		PARATHION								
	ATRAZINE		DIAZINON		HEPTACHLOR		TOXAPHENE								

SAMPLING REMARKS

SECTION 3. SPECIFIC SAMPLE CHARACTERISTICS

ESTUARINE	SPECIES *(Code)* 38 39 40 41 42 43				
SOIL	pH 38 39 40	% SAND 41 42 43	% SILT 44 45 46	% CLAY 47 48 49	% ORGANIC MATTER 50 51 52
DATE ANALYSIS COMPLETED:	53 54 55 56 57 58				

SECTION 4. RESIDUES DETECTED

9 10 Ø 8	PESTICIDE	CODE	AMOUNT	VAL*	9 10 Ø 9	PESTICIDE	CODE	AMOUNT	VAL*
		11 12 13	14 15 16 17 18 19	20			11 12 13	14 15 16 17 18 19	20
		21 22 23	24 25 26 27 28 29	30			21 22 23	24 25 26 27 28 29	30
		31 32 33	34 35 36 37 38 39	40			31 32 33	34 35 36 37 38 39	40
		41 42 43	44 45 46 47 48 49	50			41 42 43	44 45 46 47 48 49	50
		51 52 53	54 55 56 57 58 59	60			51 52 53	54 55 56 57 58 59	60
		61 62 63	64 65 66 67 68 69	70			61 62 63	64 65 66 67 68 69	70
		71 72 73	74 75 76 77 78 79	80			71 72 73	74 75 76 77 78 79	80

* M = P.P.M. *(default)*; B = P.P.B. *ug/kg whole body, wet weight;* T = P.P.T.

REMARKS

DATE							
ANALYST'S INITIALS							

EPA Form 8550–2 (Rev. 2–75)

PREVIOUS EDITION IS OBSOLETE

1	2-8 Blank	9–16	17 - 80 Blank	Table 1.4
		07197950		

Lab No. 9-64-872

Date Received at Lab 3/30/79

Remarks OK

D	Y M D	8 - 13 Blank	Time	List Sequence ID		No
1	2–7		14–17	18	19	20
D	790320		0900	2		

Sample Type	List ID	Aldrin	Chlor-dane	DDD*	DDE*	DDT*	Dieldrin	Endrin	Hepta-chlor	Heptachlor epoxide	Lin-dane	Methoxy-chlor	Toxaphen
Whole Water	A	U	U	U	U	U	U	U	U	U	U	U	U
Bottom Material	B												

Sample Type	List ID	2,4-D	2,4,5-T	Silvex	Atrazine	Simazine
Whole Water	C					
Bottom Material	D					

Polychlorinated biphenyl's (PCB)

Sample Type	List ID	PCB
Whole Water	G	U
Bottom Material	H	

Sample Type	List ID	Diazinon	Ethion	Malathion	Methyl Parathion	Methyl Trithion	Parathion	Trithion
Whole Water	E	U	U	U	U	U	U	U
Bottom Material	F							

Sample Type	List ID	1242	1248	1254	1260
Whole Water	G				
Bottom Material	H				

Other

Sample Type	List ID			
Whole Water				
Bottom Material				

Sample Type	List ID	P,P'DDD (TDE)	O,P'DDE	P,P'DDE	O,P'DDT	P,P'DDT
Whole Water	K					

Bottom Mat'l

Other

Sample Type	List ID		
Whole Water			

Bottom Mat'l

Table 1.5

SWEMS Format for Soil and Water Data

Positions Start	End	Field Name	Comment
1	1	Reserved	Usually zero
2	2	Sample Category	1 = Estuarine 2 = Water 3 = Soil
3	4	Lab Number	
5	10	Accession Number	
11	12	State Code	ZIPS
13	15	County Code	
16	25	Site Code	
26	31	Date Sampled	(month, day, year)
32	34	Sample Material Code	
35	38	Rain Fall	
39	42	Temperature	
43	60	Category Data	Soil Data
43	43	Crop Number	
44	46	Ph	
47	49	% sand	
50	52	% silt	
53	55	% clay	
56	58	% organic	
59	60	region code	
43	48	species code	Estuarine data
49	60	blank	filler
			Water Data
43	48	Flow rate	
49	54	suspended sediment	
55	60	blank	filler
61	66	Analysis date	(month, day, year)
67	67	Cropping Year	
68	68	Land Use Indicator	
69	70	Fiscal Year	
71	96	blank	filler
97	97	Residues	Repeat for each residue up to 40 sets
98	99	Group	
98	100	Code	
101	106	Amount	
107	107	Units*	

* Units: M - PPM
B - PPB
T - PPT

Table 1.6

Human Tissue Format

Positions Start	Positions End	Field Name	Comments
1	3	Hospital	
4	12	Patient	
13	13	ID - suffix	
14	19	Date Collected	year, month, day
20	22	County	
23	24	Tissue Code	
25	25	Design	
26	27	Region	
28	29	EPA State Code	
30	31	EPA Census Code	
32	33	FIPS State Abbrev.	
34	35	FIPS State Code	
36	44	Patient - Access No.	
45	50	Patient Date of Birth	month, day, year
51	52	Initials	
53	53	Sex	
54	54	Race	
55	57	Occupation Code	
58	60	Height	
61	63	Weight	
64	93	Diagnosis	6 - 5 byte fields
94	97	Indicators	P-S, HOSP, EMBLM, OUTSIDE
98	102	Wet Weight	
103	106	% LIPID	
107	108	Lab Code	
109	110	Mtnd. Code	
111	112	Inst. Code	
113	113	Detet. Code	
114	115	Col 1 Code	
116	117	Col 2 Code	
118	123	Analysis Date	month, day, year
124	124	Pref - Analysis	
		Residue	Repeats for 20 residues
125	126	Code	
127	127	Suffix	
128	128	Trace	
129	134	Amount	
135	136	Units	PPM, PPB
137	137	Confidence	
138	138	Override	

Table 1.7

Pesticides Included in Analysis Files

Soil File

Aldrin
DDTOP
DDTPP
DDEOP
DDEPP
TDEOP
TDEPP
Dieldrin
Heptachlor
Heptachlor Epoxide
Lindane
PCB
Parathion

Human Tissue

Total DDT Equivalent
α-BHC
β-BHC
Lindane
δ-BHC
Aldrin
Dieldrin
Endrin
Heptachlor
Heptachlor Epoxide
Polychlorinated Biphenyls (PCB)
Oxychlordane
Mirex
Trans Nonachlor
Hexachlorobenzene

Water File

Aldrin
Atrazine
Chlordane
2, 4-D
DDEOP
DDEPP
DDTOP
DDTPP
Dieldrin
Heptachlor
Heptachlor Epoxide
Lindane
Parathion, Methyl
Parathion
PCP
PCB's (4)
Silvex
2, 4, 5-T
TDEPP
TDEOP
Toxaphene

APPENDIX 2

(See Addendum)

APPENDIX 3.1

CENSUS BREAKDOWN OF THE UNITED STATES

CENSUS BREAKDOWNS OF THE UNITED STATES

Region	Division	States
North East	New England	Connecticut Maine Massachusetts New Hampshire Rhode Island Vermont
	Middle Atlantic	New Jersey New York Pennsylvania
North Central	East North Central	Illinois Indiana Michigan Ohio Wisconsin
	West North Central	Iowa Kansas Minnesota Missouri Nebraska North Dakota South Dakota
South	South Atlantic	Delaware District of Columbia Florida Georgia Maryland North Carolina South Carolina Virginia West Virginia
	East South Central	Alabama Kentucky Mississippi Tennessee
	West South Central	Arkansas Louisiana Oklahoma Texas

CENSUS BREAKDOWNS OF THE UNITED STATES (continued)

Region	Division	States
West	Mountain	Arizona Colorado Idaho Montana Nevada New Mexico Utah Wyoming
	Pacific	Alaska California Hawaii Oregon Washington

APPENDIX 3.2

MATERIALS FOR SELECTING SAMPLE SITES FOR
MIDDLE ATLANTIC CENSUS DIVISION FOR FY 1973

(2a).

Middle Atlantic

NEW JERSEY		
Atlantic City city	1	45,386
Bayonne city	2	69,398
Belleville town	3	39,226
Bergenfield borough	4	28,330
Bloomfield town	5	52,154
Camden city	6	100,966
Clifton city	7	81,465
East Orange city	8	74,946
Elizabeth city	9	111,414
Fair Lawn borough	10	47,090
Fort Lee borough	11	30,394
Garfield city	12	33,334
Hackensack city	13	43,521
Hoboken city	14	45,339
Irvington town	77	59,938
Jersey City city	15	253,467
Kearny town	16	37,262
Linden city	17	41,059
Lodi borough	18	25,513
Long Branch city	20	31,108
Montclair town	21	43,856
Newark city	22	374,976
New Brunswick city	24	41,909
Nutley town	24	32,122
Orange city	25	32,339
Paramus borough	26	38,105
Passaic city	27	53,731
Paterson city	28	142,319
Perth Amboy city	29	38,564
Plainfield city	30	46,344
Rahway city	31	29,034
Ridgewood village	32	27,357
Sayreville borough	33	32,370
Trenton city	34	102,211
Union City city	35	56,682
Vineland city	36	46,781
Westfield town	37	33,606
West New York town	38	40,061
West Orange town	39	43,222

NEW YORK		
Albany city	40	113,857
Amsterdam city	41	25,222
Auburn city	42	34,319
Binghamton city	43	63,229
Buffalo city	44	457,808
Elmira city	45	39,573
Freeport village	46	40,438
Garden City village	47	25,750
Glen Cove city	48	23,448
Hempstead village	49	41,562
Ithaca city	50	25,145
Jamestown city	51	39,222
Kingston city	52	25,198
Lackawanna city	53	23,393
Lindenhurst village	54	28,252
Lockport city	55	25,220
Long Beach city	56	32,507
Mount Vernon city	57	72,302
Newburgh city	58	25,319
New Rochelle city	59	74,697
New York City city	60	7,798,757
Niagara Falls city	61	84,732
North Tonawanda city	62	35,413
Port Chester village	63	25,526
Poughkeepsie city	64	31,496
Rochester city	65	293,695
Rockville Centre village	66	27,274
Rome city	67	47,926
Schenectady city	68	77,134
Syracuse city	69	192,529
Troy city	70	62,007
Utica city	71	90,802
Valley Stream village	72	40,332
Watertown city	73	30,523
White Plains city	74	49,573
Yonkers city	75	204,789

PENNSYLVANIA		
Allentown city	76	108,926
Altoona city	77	62,385
Baldwin borough	78	37,135
Bethlehem city	79	72,320
Chester city	80	56,197
Easton city	81	29,055
Erie city	82	125,941
Harrisburg city	83	63,828
Hazleton city	84	30,246
Johnstown city	85	42,065
Lancaster city	86	57,693
Lebanon city	87	28,141
McKeesport city	88	37,655
Monroeville borough	89	28,961
New Castle city	90	38,457
Norristown borough	91	38,310
Philadelphia city	92	1,927,863
Pittsburgh city	93	512,789
Pottstown borough	94	25,179
Reading city	95	86,470
Scranton city	96	102,294
State College borough	97	33,167
West Mifflin borough	98	27,576
Wilkes-Barre city	99	57,946
Wilkinsburg borough	100	26,364
Williamsport city	101	37,694
York city	102	50,008

14 pathologists
int — 1,186,231
starting pt — 271,028

Middle Atlantic

46	Freeport, N.Y.	40,438	40,438
12	Garfield, N.J.	33,534	73,972
23	New Brunswick, N.J.	41,909	115,881
21	Montclair, N.J.	43,856	159,737
82	Erie, Pa.	125,941	285,678
16	Jersey City	253,467	539,145
40	Albany, N.Y.	113,857	653,002
83	Harrisburg, Pa.	65,828	718,830
65	Rochester, N.Y.	293,695	1,012,525
49	Hempstead, N.Y.	41,562	1,054,087
36	Vineland, N.J.	46,781	1,100,868
09	Elizabeth, N.J.	111,414	1,212,282
17	Kearny, N.J.	37,262	1,249,544
30	Plainfield, N.J.	46,344	1,295,888
56	Long Beach, N.Y.	32,507	1,328,395
99	Wilkes-Barre, Pa.	57,946	1,386,341
78	Baldwin, Pa	27,135	1,413,476
14	Hoboken, N.J.	45,559	1,459,035
04	Bergenfield, N.J.	28,350	1,487,385
10	Fair Lawn, N.J.	47,089	1,534,474
91	Norristown, Pa.	38,310	1,572,784
53	Lackawanna, N.Y.	28,393	1,601,177
45	Elmira, N.Y.	39,873	1,641,050
11	Fort Lee, N.J.	30,394	1,671,444
75	Yonkers, N.Y.	204,789	1,876,233
92	Philadelphia, Pa.	1,927,863	3,804,096
19	Lodi, N.J.	25,518	3,829,614
84	Hazleton, Pa.	30,246	3,859,860

MA

22	Newark, N.J.	374,976	4,234,836
90	New Castle, Pa.	38,457	4,273,293
20	Long Branch, N.J.	31,108	4,304,401
86	Lancaster, Pa.	57,693	4,362,094
50	Ithaca, N.Y.	25,148	4,387,242
93	Pittsburgh, Pa.	512,789	4,900,031
102	York, Pa.	50,008	4,950,039
51	Jamestown, N.Y.	39,222	4,989,261
32	Ridgewood, N.J.	27,357	5,016,618
96	Scranton, Pa	102,294	5,118,912
43	Binghamton, N.Y.	63,229	5,182,141
98	West Mifflin, Pa.	27,576	5,209,717
38	West New York, N.J.	40,061	5,249,778
73	Watertown, N.Y.	30,525	5,280,303
59	New Rochelle, N.Y.	74,697	5,355,000
18	Linden, N.J.	41,059	5,396,059
48	Glen Cove, N.Y.	25,448	5,421,507
33	Sayreville, N.J.	32,370	5,453,877
05	Bloomfield, N.J.	52,154	5,506,031
47	Garden City, N.Y.	25,750	5,531,781
76	Allentown, Pa.	108,926	5,640,707
94	Pottstown, Pa.	25,179	5,665,886
89	Monroeville, Pa.	28,861	5,694,747
85	Johnstown, Pa.	42,065	5,736,812
101	Williamsport, Pa.	37,694	5,774,506
63	Port Chester, N.Y.	25,526	5,800,032
07	Clifton, N.J.	81,865	5,881,897
25	Orange, N.J.	32,339	5,914,236

67	Rome, N.Y.	47,926	5,962,162
68	Schenectady, N.Y.	77,134	6,039,296
97	State College, Pa.	33,167	6,072,463
62	North Tonawanda, N.Y.	35,813	6,108,276
87	Lebanon, Pa.	28,141	6,136,417
31	Rahway, N.J.	29,034	6,165,451
70	Troy, N.Y.	62,007	6,227,458
77	Altoona, Pa.	62,385	6,289,843
54	Lindenhurst, N.Y.	28,262	6,318,105
57	Mount Vernon, N.Y.	72,302	6,390,407
24	Nutley, N.J.	32,123	6,422,530
39	West Orange, N.J.	43,222	6,465,752
41	Amsterdam, N.Y.	25,222	6,490,974
29	Perth Amboy, N.J.	38,564	6,529,538
61	Niagara Falls, N.Y.	84,752	6,614,290
26	Paramus, N.J.	38,105	6,652,395
88	McKeesport, Pa.	37,655	6,690,050
42	Auburn, N.Y.	34,319	6,724,369
28	Paterson, N.J.	142,819	6,867,188
35	Union City, N.J.	56,662	6,923,850
34	Trenton, N.J.	102,211	7,026,061
58	Newburgh, N.Y.	25,919	7,051,980
13	Hackensack, N.J.	43,521	7,095,501
79	Bethlehem, Pa.	72,320	7,167,821
64	Poughkeepsie, N.Y.	31,496	7,199,317
60	New York City	7,798,757	14,998,074
15	Irvington, N.J.	59,958	15,058,032
81	Easton, Pa.	29,055	15,087,087

27	Passaic, N. J.	53,751	15,140,838
01	Atlantic City, N.J.	69,898	15,210,736
44	Buffalo, N.Y.	457,808	15,668,544
02	Bayonne, N.J.	69,898	15,738,442
72	Valley Stream, N.Y.	40,332	15,778,774
52	Kingston, N.Y.	25,198	15,803,972
95	Reading, Pa.	86,470	15,890,442
03	Belleville, N. J.	39,226	15,929,668
80	Chester, Pa.	56,197	15,985,865
71	Utica, N.Y.	90,802	16,076,667
100	Wilkinsburg, Pa.	26,564	16,103,231
06	Camden, N.J.	100,966	16,204,197
37	Westfield, N.J.	33,606	16,237,803
66	Rockville Centre, N.Y.	27,274	16,265,077
74	White Plains, N.Y.	49,573	16,314,650
69	Syracuse, N.Y.	192,529	16,507,179
55	Lockport, N.Y.	25,220	16,532,399
08	East Orange, N.J.	74,846	16,607,245

APPENDIX 3.3

ORIGINALLY SELECTED CITIES FY70, FY73, FY77
AND SELECTED CITIES INCLUDING ALTERNATES FY73-FY78

ORIGINALLY SELECTED CITIES

FY70

NORTHEAST

Bridgeport, Conn.
Fitchburg, Mass.
Newburg, N.Y.[1]
New York City, N.Y.(3)[2]
Ridgewood, N.J.
Philadelphia, Pa.
Bangor, Maine[1]
Pittsburgh, Pa.
New Rochelle, N.Y.

NORTH CENTRAL

Witchita, Kansas
Detroit, Mich.
St. Joseph, Mo.
Des Moines, Iowa
Oak Lawn, Ill.
Chicago, Ill. (2)[2]
Salina, Kans.
St. Louis, Mo.
Belleville, Ill.
Minneapolis, Minn.
Lorain, Ohio

South

Houston, Texas[1]
New Orleans, La.
Miami Beach, Fla.
Atlanta, Ga.
Oklahoma City, Okla.
Rock Hill, S. C.
Owensboro, Ky.
Macon, Ga.
Washington, D.C.

West

San Francisco, Calif.
Tucson, Ariz.
Portland, Oreg.
Gardena, Calif.[1]
San Bernardino, Calif.[1]
Los Angeles, Calif.
San Diego, Calif.

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1 Cities replaced by alternates during the first year of operation of the statistical design.

2 Number of pathologists selected in city; where no number is given assume number to be one.

NEW ENGLAND (4)

* Boston, Mass.
Worcester, Mass.
Pittsfield, Mass.
Westfield, Mass.

MIDDLE ATLANTIC (14)

* Erie, Pa.
Hoboken, N. J.
* Philadelphia, Pa.
Hazleton, Pa.
* Ridgewood, N. J.
Troy, N. Y.
* New York City - 7
Bayonne, N. J.

NC

EAST NORTH CENTRAL (15)

Allen Park, Mich.
* Toledo, Ohio
Wyandotte, Mich.
* Indianapolis, Ind.
* Columbus, Ohio
Mansfield, Ohio
* Evansville, Ind.
* Detroit, Mich.
Parma, Ohio
* Cleveland, Ohio
Inkster, Mich.
* Chicago, Ill. - 2
Beloit, Wisc.
Bay City, Mich.

WEST NORTH CENTRAL (6)

Iowa City
* St. Louis, Mo.
St. Louis Park, Minn
Raytown, Mo.
* Wichita, Kansas
Omaha, Nebr.

SOUTH ATLANTIC (11)

Norfolk, Va.
Greenville, S. C.
Panama City, Fla.
Baltimore, Md.
College Park, Md.
Hagerstown, Md.
Winston-Salem, N. C.
Huntington, W. Va.
* Washington, D. C.
Wilson, N. C.
Charlotte, N. C.

EAST SOUTH CENTRAL (5)

* Louisville, Ky.
* Tuscaloosa, Ala.
Mobile, Ala.
* Memphis, Tenn.
Kingsport, Tenn.

WEST SOUTH CENTRAL (7)

San Antonio, Tex.
* Dallas, Tex.
* Enid, Okla.
El Paso, Tex.
* Houston, Tex.
* Oklahoma City
* New Orleans, La.

W

MOUNTAIN (3)

* Salt Lake City, Utah
Denver, Colo.
Phoenix, Ariz.

PACIFIC (10)

San Bruno, Calif.
* Los Angeles City, Calif. - 2
Long Beach, Calif.
Bakersfield, Calif.
Lynwood, Calif.
Chula Vista, Calif.
Tacoma, Wash.
* San Francisco, Calif.
Glendale, Calif.

NATIONAL HUMAN MONITORING PROGRAM

COLLECTION SITES BY STATE

FY 1974

Alabama (6)

Mobile
Tuscaloosa

Arizona (8)

Phoenix

California (9)

Bakersfield
Glendale
Lakewood
Long Beach
Los Angeles - 2
National City
San Francisco

Colorado (8)

Denver

District of Columbia (5)

Florida (5)

Hialeah
Panama City

Illinois (3)

Chicago - 3
Oak Park

Indiana (3)

Evansville
Indianapolis
Mishawaka

Iowa (4)

Iowa City

Kansas (4)

Salina
Wichita

Kentucky (6)

Louisville

Louisiana (7)

New Orleans

Maryland (5)

Baltimore

Massachusetts (1)

Boston
Pittsfield
Westfield
Worcester

Michigan (3)

Detroit
Wyandotte

Minnesota (4)

St. Louis Park

Missouri (4)

St. Louis

Nebraska (4)

Omaha

New Jersey (2)

Hoboken

New York (2)

Buffalo
Jamestown
New York City - 7
Troy

North Carolina (5)

Charlotte
Winston-Salem

Ohio (3)

Cleveland
Columbus
Mansfield
Parma
Toledo

Oklahoma (7)

Enid
Oklahoma City

Oregon (9)

Eugene

Pennsylvania (2)

Erie
Hazelton
Philadelphia

South Carolina (5)

Anderson
Greenville

Tennessee (6)

Kingsport
Memphis

NATIONAL HUMAN MONITORING PROGRAM
COLLECTION SITES BY STATE
BY 1974 (continued)

Texas (7)

- Dallas
- El Paso
- Houston
- San Antonio

Utah (8)

- Salt Lake City

Virginia (5)

- Norfolk
- Petersburg

Washington (9)

- Tacoma

West Virginia

- Huntington

Wisconsin (3)

- Beloit

NATIONAL HUMAN MONITORING PROGRAM
COLLECTION SITES BY STATE
BY 1975 (continued)

Texas (7)

Dallas
El Paso
Houston
San Antonio

Utah (8)

Salt Lake City

Virginia (5)

Norfolk
Petersburg

Washington (9)

Tacoma

Wisconsin (3)

Beloit

NATIONAL HUMAN MONITORING PROGRAM

COLLECTION SITES BY STATE

FY 1975

Alabama (6)

Mobile
Tuscaloosa

Arizona (8)

Phoenix

California (9)

Bakersfield
Glendale
Lakewood
Long Beach
Los Angeles - 2
National City
San Francisco

Colorado (8)

Denver

District of Columbis (5)

Florida (5)

Hialeah
Panama City
Tampa

Illinois (3)

Chicago - 3
Oak Park

Indiana (3)

Evansville
Indianapolis

Iowa (4)

Iowa City

Kansas (4)

Salina
Wichita

Kentucky (6)

Louisville

Louisiana (7)

New Orleans

Maryland (5)

Baltimore

Massachusetts (1)

Boston
Pittsfield
Westfield
Worcester

Michigan (3)

Bay City
Detroit
Wyandotte

Minnesota (4)

St. Louis Park

Missouri (4)

St. Louis

Nebraska (4)

Omaha

New Jersey (2)

Hoboken

New York (2)

Buffalo
Jamestown
New York City - 7
Troy

North Carolina (5)

Charlotte
Winston-Salem

Ohio (3)

Cleveland
Columbus
Mansfield
Parma
Toledo

Oklahoma (7)

Enid
Oklahoma City

Oregon (9)

Eugene

Pennsylvania (2)

Erie
Hazelton
Philadelphia

South Carolina (5)

Anderson
Greenville

Tennessee (6)

Kingsport
Memphis

NATIONAL HUMAN MONITORING PROGRAM FOR PESTICIDES

Sampling Sites FY'76

Census Division	No. Sites	Sites
New England	4	Boston, MA Pittsfield, MA Westfield, MA Worcester, MA
Middle Atlantic	18	Buffalo, NY Jamestown, NY New York, NY (11) Troy, NY Erie, PA (2) Hazelton, PA Philadelphia, PA
East North Central	17	Chicago, IL (4) Oak Park, IL (2) Evansville, IN Indianapolis, IN Bay City, MI Detroit, MI Wyandotte, MI Cleveland, OH Columbus, OH Mansfield, OH Parma, OH Toledo, OH Beloit, WS
West North Central	6	Iowa City, IA Salina, KS Witchita, KS Omaha, NB St. Louis Park, MN St. Louis, MO
South Atlantic	13	Washington, D.C. Hialeah, FL Panama City, FL Tampa, FL Baltimore, MD (2) Charlotte, N.C. Winston-Salem, N.C. Anderson, S.C. Greenville, S.C. Norfolk, VA (2) Petersburg, VA

Census Division	No. Sites	Sites
East South Atlantic	5	Mobile, AL Tuscaloosa, AL Louisville, KY Kingsport, TN Memphis, TN
West South Central	8	New Orleans, LA (2) Enid, OK Oklahoma City, OK Dallas, TX El Paso, TX Houston, TX San Antonio, TX
Mountain	3	Phoenix, AZ Denver, CO Salt Lake City, UT
Pacific	9	Bakersfiled, CA Glendale, CA Lakewood, CA Long Beach, CA Los Angeles, CA National City, CA San Francisco, CA Eugene, OR Tacoma, WA

NATIONAL HUMAN MONITORING PROGRAM FOR PESTICIDES

SAMPLING SITES FY77

Census Division	No. Sites	Sites
New England	2	Hartford, CT Springfield-Chicopee-Holyoke, MA-CT
Middle Atlantic	7	Lancaster, PA New York, N.Y. (2) Northeast, PA (Wilkes-Barre-Scranton) Philadelphia, PA-NJ Pittsburgh, PA Reading, PA
East North Central	8	Chicago, IL Cleveland, OH (2) Detroit, MI (2) Madison, WI Dayton, OH Akron, OH
West North Central	3	Minneapolis-St. Paul, MN-WI Omaha, NE-IA St. Louis, MO-IL
South Atlantic	6	Charlotte-Gastonia, NC District of Columbia, DC-MD-VA Fort Lauderdale-Hollywood, FL Greenville-Spartanburg, SC Macon, GA Tampa-St. Petersburg, FL (No Collection)
East South Central	3	Birmingham, AL Nashville-Davidson, TN Lexington, KY Tuscaloosa,AL (Extra Collection Point)
West South Central	4	Dallas-Fort Worth, TX El Paso, TX Lubbock, TX Shreveport, LA
Mountain	2	Denver-Boulder, CO Salt Lake City-Ogden, UT
Pacific	5	Los Angeles-Long Beach, CA (2) Portland, OR-WA San Diego, CA Seattle-Everett, WA

(10) copy 2

missing 70, 71, 74
missing of alt. sample site, 73

NATIONAL HUMAN MONITORING PROGRAM FOR PESTICIDES

SAMPLING SITES FY1978

Census Division	No. Sites	Sites
New England	2	Hartford, CT Springfield-Chicopee-Holyoke, MA-CT
Middle Atlantic	7	Lancaster, PA New York, NY (2) Northeast, PA (Wilkes-Barre-Scranton) Philadelphia, PA-NJ Pittsburgh, PA Reading, PA
East North Central	8	Chicago, IL (2) Cleveland, OH Detroit, MI (2) Madison, WI Dayton, OH Akron, OH
West North Central	3	Minneapolis-St. Paul, MN-WI Omaha, NE-IA St. Louis, MO-IL
South Atlantic	6	Charlotte-Gastonia, NC District of Columbia, DC-MD-VA Fort Lauderdale-Hollywood, FL Greenville-Spartanburg, SC Charleston, W.VA Orlando, FL
East South Central	3	Birmingham, AL Nashville-Davidson, TN Lexington, KY
West South Central	4	Dallas-Fort Worth, TX El Paso, TX Lubbock, TX San Antonio, TX
Mountain	2	Denver-Boulder, CO Salt Lake City, UT
Pacific	5	Los Angeles-Long Beach, CA (2) Portland, OR-WA Sacremento, CA Seattle-Everett, WA

10/31/77

APPENDIX 3.4

SURVEY AND SITE QUOTAS FOR FY73-FY76

National Human Monitoring Program
Collected by Census Division

	Age Groups	Sex M	Sex F	Total
New England (1) - 4 Collection Sites - 1%				
	0-14	16	16	32
	15-44	20	20	40
	45+	16	20	36
	Total:	52	56	108
		# Negroes = 4		
Middle Atlantic (2) - 14 Collection Sites - 19%				
	0-14	56	42	98
	15-44	70	84	154
	45+	56	70	126
	Total:	182	196	378
		# Negroes = 42		
East North Central (3) - 14 Collection Sites - 19%				
	0-14	56	56	112
	15-44	70	84	154
	45+	56	56	112
	Total:	182	196	378
		# Negroes = 42		
West North Central (4) - 5 Collection Sites - 7%				
	0-14	20	20	40
	15-44	25	25	50
	45+	20	25	45
	Total:	65	70	135
		# Negroes = 5		

National Human Monitoring Program
Collected by Census Division

	Age Groups	Sex M	Sex F	Total
South Atlantic (5) - 11 Collection Sites - 15%				
	0-14	44	44	88
	15-44	55	66	121
	45+	44	44	88
	Total:	143	154	297
		# Negroes = 66		
East South Central (6) - 7 Collection Sites - 9%				
	0-14	28	28	56
	15-44	35	42	77
	45+	28	28	56
	Total:	91	98	189
		# Negroes = 35		
West South Central (7) - 7 Collection Sites - 9%				
	0-14	28	28	56
	15-44	42	42	84
	45+	21	28	49
	Total:	91	98	189
		# Negroes = 28		
Mountain (8) - 3 Collection Sites - 4%				
	0-14	12	12	24
	15-44	18	15	33
	45+	12	12	24
	Total:	42	39	81
		# Negroes = 3		
Pacific (9) - 10 Collection Sites - 13%				
	0-14	40	30	70
	15-44	60	60	120
	45+	40	40	80
	Total:	140	130	270
		# Negroes = 20		

National Human Monitoring Program
Collected by Census Division

	Age Groups	Sex M	Sex F	Total	Percent
Summary:					
	0-14	300	276	576	28.4
	15-44	395	438	833	41.1
	45+	293	323	616	30.4
	Total:	988	1037	2025	99.9

Negroes = 245

Percent = 12%

Total Males = 49%
Total Females = 51%
Total Negroes = 12%

Census Divisions

National Human Monitoring Program
Age, Race, Sex Distributions

	Age Groups	Sex M	Sex F	Total
New England (1)	0-14	4	4	8
	15-44	5	5	10
	45+	4	5	9
	Total:	13	14	27
	# Negroes = 1			
Middle Atlantic (2)	0-14	4	3	7
	15-44	5	6	11
	45+	4	5	9
	Total:	13	14	27
	# Negroes = 3			
East North Central (3)	0-14	4	4	8
	15-44	5	6	11
	45+	4	4	8
	Total:	13	14	27
	# Negroes = 3			
West North Central (4)	0-14	4	4	8
	15-44	5	5	10
	45+	4	5	9
	Total:	13	14	27
	# Negroes = 1			
South Atlantic (5)	0-14	4	4	8
	15-44	5	6	11
	45+	4	4	8
	Total:	13	14	27
	# Negroes = 6			

Census Divisions

National Human Monitoring Program
Age, Race, Sex Distributions

	Age Groups	Sex: M	Sex: F	Total
East South Central (6)				
	0-14	4	4	8
	15-44	5	6	11
	45+	4	4	8
	Total:	13	14	27
	# Negroes = 5			
West South Central (7)				
	0-14	4	4	8
	15-44	6	6	12
	45+	3	4	8
	Total:	13	14	27
	# Negroes = 4			
Mountain (8)				
	0-14	4	4	8
	15-44	6	5	11
	45+	4	4	8
	Total:	14	13	27
	# Negroes = 1			
Pacific (9)				
	0-14	4	3	7
	15-44	6	6	12
	45+	4	4	8
	Total:	14	13	27
	# Negroes = 2			

APPENDIX 3.5

Survey and Site Quotas for FY77 +

NATIONAL HUMAN MONITORING PROGRAM FOR PESTICIDES

SAMPLING DESIGN

CENSUS DIVISION DEMOGRAPHIC QUOTA

New England - 2 Collection Sites - 5.83%

Age Groups	Sex M	F	Total
0-14	12	10	22
15-44	16	16	32
45+	12	14	26
TOTAL	40	40	80

#Non-Caucasians = 2

Middle Atlantic - 7 Collection Sites - 18.28%

Age Groups	Sex M	F	Total
0-14	42	35	77
15-44	56	56	112
45+	42	49	91
TOTAL	140	140	280

#Non-Caucasians = 28

East North Central - 8 Collection Sites - 19.81%

Age Groups	Sex M	F	Total
0-14	48	48	96
15-44	64	64	128
45+	48	48	96
TOTAL	160	160	320

#Non-Caucasians = 32

West North Central - 3 Collection Sites - 8.03%

Age Groups	Sex M	F	Total
0-14	18	15	33
15-44	24	24	48
45+	18	21	39
TOTAL	60	60	120

#Non-Caucasians = 6

South Atlantic - 6 Collection Sites - 15.10%

Age Groups	Sex M	F	Total
0-14	36	36	72
15-44	48	54	102
45+	30	36	66
TOTAL	114	126	240

#Non-Caucasians = 48

East South Central - 3 Collection Sites - 6.30%

Age Groups	Sex M	F	Total
0-14	18	18	36
15-44	24	24	48
45+	18	18	36
TOTAL	60	60	120

#Non-Caucasians = 24

West South Central - 4 Collection Sites -.9.50%

Age Groups	M	F	Total
0-14	24	24	48
15-44	32	36	68
45+	20	24	44
TOTAL	76	84	160

(M and F printed under the heading "Sex")

#Non-Caucasians = 24

Mountain - 2 Collection Sites - 4.08%

Age Groups	M	F	Total
0-14	12	12	24
15-44	16	18	34
45+	10	12	22
TOTAL	38	42	80

#Non-Caucasians = 2

Pacific - 5 Collection Sites - 12.53%

Age Groups	M	F	Total
0-14	30	25	55
15-44	45	45	90
45+	25	30	55
TOTAL	100	100	200

#Non-Caucasians = 10

CENSUS DIVISIONS

NATIONAL HUMAN MONITORING PROGRAM

AGE, RACE, SEX QUOTAS

NEW ENGLAND (1)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	5	11
15-44	8	8	16
45+	6	7	13
TOTAL	20	20	40

NEGROES = 1 (Non-Caucasians)

MIDDLE ATLANTIC (2)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	5	11
15-44	8	8	16
45+	6	7	13
TOTAL	20	20	40

NEGROES = 4 (Non Caucasians)

EAST NORTH CENTRAL (3)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	6	12
15-44	8	8	16
45+	6	6	12
TOTAL	20	20	40

NEGROES = 4 (Non - Caucasians)

WEST NORTH CENTRAL (4)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	5	11
15-44	8	8	16
45+	6	7	13
TOTAL	20	20	40

NEGROES = 2

SOUTH ATLANTIC (5)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	6	12
15-44	8	9	17
45+	5	6	11
TOTAL	19	21	40

NEGROES = 8

EAST SOUTH CENTRAL (6)

0-14	6	6	12
15-44	8	8	16
45+	6	6	12
TOTAL	20	20	40

NEGROES = 8

WEST SOUTH CENTRAL (7)

0-14	6	6	12
15-44	8	9	17
45+	5	6	11
TOTAL	19	21	40

NEGROES = 6

MOUNTAIN (8)

0-14	6	6	12
15-44	8	9	17
45+	5	6	11
TOTAL	19	21	40

NEGROES = 1

PACIFIC (9)

AGE GROUPS	SEX M	SEX F	TOTAL
0-14	6	5	11
15-44	9	9	18
45+	5	6	11
TOTAL	20	20	40

NEGROES = 2

Total Males = 788 (49.25%)
Total Females = 812 (50.75%)
Non - Caucasians = 176 (11.00%)

APPENDIX 3.6

Copy of "Guidelines and General Information
About collecting Adipose Tissue for the
National Human Monitoring Program for Pesticides"

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Guidelines and General Information About Collecting Adipose Tissue For the National Human Monitoring Program for Pesticides

The National Human Monitoring Program for Pesticides is responsible for determining, on a national basis, the incidences, levels and other evidences of exposure to pesticides in the general population of the United States. At present, the program collects and analyzes adipose tissues for selected pesticides and their metabolites known to be stored in the lipid portion of these tissues. The results from the program are used in evaluating various factors and conditions pertaining to human health and effective pesticide regulation.

The adipose tissue for this program is secured through the cooperation of participating pathologists and medical examiners located throughout the continental United States. The tissue is obtained from surgical specimens previously excised for pathological examination and from postmortem examinations. The specimens are sent to the program office in Washington, D. C., from which they are subsequently forwarded to contract laboratories for chemical analysis. Periodic reports of the laboratory results are sent to each participating pathologist for the tissues which were submitted under his auspices. Summaries comparing results with other regions of the country are also provided as they become available.

In order to develop valid information on a national basis, collections must be made according to an experimental design which dictates the number of samples required according to the demographic distribution of the population in the appropriate census division. You should have a copy of the annual quota of samples expected to be collected from your location on a fiscal year basis. All collections should be made according to this age/sex/race distribution. You should be able to collect the number of samples required in each category. Since our total sample is relatively small and the validity of the results depends on a high response rate, your participation is particularly important. If you feel that you will be unable to collect the number of samples required, please let us know.

Criteria for Selection of Patients to be Sampled

Since the program objective is to reflect pesticide incidences and levels in the general (man-on-the-street) population, a few suggestions are listed here for your guidance:

- The highest priority should be given to satisfying the number and demographic distribution of your annual quota. This quota should be completed as soon after the start of the fiscal year as possible.
- Patients having known or suspected pesticide poisoning should not be sampled. If you are involved with a potential pesticide poisoning, we would like to know about it. However, samples should not be taken for the National Human Monitoring Program for Pesticides.

- Patients exhibiting cachexia or who have been institutionalized for long periods should not be sampled for the national program.

Legal Considerations

The National Human Monitoring Program for Pesticides is both interested and deeply concerned about the legal ramification of this human research project. Since the program operates in about 40 states, it is not feasible for us to handle the variety of local or state interpretations from our location in Washington. Therefore, as a matter of policy, the legal requirements, i.e., informed consent, confidentiality, are matters for your consideration and resolution. Collections for this program must be made in conformance with the applicable HEW guidelines on the protection of human subjects of biomedical and behavioral research. We will, however, be pleased to assist you in any way possible.

We have completed several studies on these matters and do not believe that they present major obstacles to your participation. In most documents authorizing postmortem examinations, there is a clause granting the examining physician permission to remove tissues for research purposes. We consider this project to be included in that category. In the case of specimens recovered from your surgical practice, the use of a small amount of tissue from a previously excised specimen certainly does not place the patient at risk in any way whatsoever.

As you will notice in our discussion of data needed for each patient sampled, we do have several mechanisms to assure confidentiality. In fact, the disclosure or release of certain data is protected by federal statute. The fees paid to you by our program are solely intended to remunerate you or your designee for professional services rendered.

Collection of Surgical Adipose Tissue

Collect samples of adipose tissue from unfixed specimens which have been surgically excised for therapeutic reasons. Take special care to keep samples from different patients separate, correctly and securely labeled, and avoid their contact with other chemicals, such as paraffin, disinfectants, preservatives, or plastics.

At least five grams of good quality (subcutaneous, perirenal, or mesenteric) adipose tissue should be collected; avoid fibrous or connective tissue, i.e., omentum. Place the fat, without any fixatives or preservatives into the provided chemically-cleaned container; legibly complete and attach the self-adhesive label in ball-point pen or pencil. The bottle labels should be affixed before freezing. Store the specimens up-right in a freezer at -4°F (-20°C) until shipment.

Collection of Postmortem Adipose Tissue

Adipose tissue samples must be obtained only from unembalmed cadavers. The interval between death and the collection of tissue should be as short as possible and must not exceed 24 hours, assuming refrigeration during the interval. Samples of adipose tissue must weigh at least five grams and should be placed in the supplied, chemically-clean container with a completed label affixed. Specimens should be stored at -4°F (-20°C) without any fixative or preservative until shipment. Submit only good quality fat; do not submit omentum as it contains too much connective tissue for satisfactory analysis.

Adipose should be taken dry, and should not be rinsed before placing in the provided containers. Many water supplies contain materials which would interfere with chemical analysis.

Instruments should be well-rinsed with distilled water and dried before taking the adipose sample.

Completion of the Patient Summary Report

A Patient Summary Report should be completed for each patient from whom a sample was taken. Special attention should be given to the completeness of the data. All medical information submitted is protected from disclosure or release by U.S.C. 552, (b) (6); 45 CFR Part 5. First and last initials, in that order, should be used instead of the complete name to insure that confidentiality is maintained. The initials, along with the data of birth, sex, and race, are used in this office to compose the AMA identification number. The patient's identification number and/or the pathology department's accession number are for your information in referring back to the individual patient when you receive the results of the pesticide analysis.

Confirmed diagnosis should be detailed in the spaces provided. Only the major ones should be supplied.

Other information required should be completed as accurately as possible. The complete forms should be held and sent under the lid of the insulated container when shipment is made.

Packing and Shipping

Tighten all lids on the specimen bottles carefully. This is important since we are required to use special aluminum foil cap liners which make tightening a little difficult. Be certain that a completed bottle label is firmly attached to each specimen bottle. Wrap each bottle in gauze or paper to prevent breakage during shipment and to keep the label on the container. Place the specimen bottles in the insulated mailer and fill it with dry ice. If you have difficulty obtaining dry ice, please call us and we can arrange alternative methods of refrigeration for you.

A franked addressed label is on the reverse side of the address card. This card is marked AIR MAIL - SPECIAL DELIVERY. (Do not send Air Express, please). There is no cost to the sender because of the franked label. All insulated mailers should have a PERISHABLE-PACKED IN DRY ICE label visible from all sides on the outside.

Specimens should be mailed on a Monday or Tuesday of a week with no federal holidays. This assures that they will arrive before the end of the work week on Friday.

Patient Summary Reports should be sent in the carton with the specimens when possible. They can be folded and placed on the top of the polyfoam lids.

Only samples which meet our criteria and are handled according to the guidelines can be accepted. No substitute containers will be accepted.

For Further Information

If you have any questions or comments, please contact us. Telephone (collect): 202/755-8060.

Sandra C. Strassman
Frederick W. Kutz, Ph.D.
National Human Monitoring Program
for Pesticides (WH-569)

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-560/13-79-014	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Analysis of EPA Pesticide Monitoring Networks		5. REPORT DATE December, 1979
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) T. Hartwell, P. Piserchia, S. White, R. Lucas N. Gustafson, A. Sherdon, D. Lucas, D. Myers, J. Batts, R. Handy, S. Williams		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Research Triangle Institute P. O. Box 12194 Research Triangle Park, North Carolina 27709		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-01-5848
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Protection Agency Office of Toxic Substances Washington, D. C. 20460		13. TYPE OF REPORT AND PERIOD COVERED October, 1979-December, 1979
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report describes a brief investigation of six pesticide networks run by EPA. In this investigation an attempt was made to answer several specific questions about each network including (i) the sampling procedures used, (ii) selected summary statistics and tests of significance appropriate for summarizing the data, and (iii) an examination of trends over time and differences in geographic areas for particular pesticides.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pesticide Networks: Human Adipose Tissue, Soil Residue, Surface Water and Sediment Residue, Air, Soil Application, Urban Soil, Statistical Analysis		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 165
	20. SECURITY CLASS (This page) Unclassified	22. PRICE