



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

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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

Memorandum

Subject: Evaluation of Fish Residue Data for Chlordane,
Mirex, DDT, Heptachlor and Aldrin/Dieldrin.
No MRID Number
No Accession Number
RCB Nos. 2430 - 2453, 2381 - 84, 2379, 2848

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Introduction

The Registration Division of the Office of Pesticide Programs (OPP) has asked EPA Regional Offices, state agencies and other federal agencies to provide OPP with fish residue monitoring data for the following pesticides:

Aldrin/Dieldrin
Chlordane
DDT
Heptachlor
Mirex

Many of these organizations responded by providing OPP with fish residue data in a variety of formats (e.g. summary tables, individual raw data sheets, etc.). RCB has been asked to review these data as part of the fish action levels reevaluation project for these pesticides.

These data come from a variety of sources which utilized different analytical methods, sampling schemes, sample preparation techniques, QA/QC procedures and data reporting

methods. Additionally, the particular analytical methods used in most of these studies were not identified. For these reasons, a sound statistical analysis of these data which would provide conclusive relationships among residue level and fish species, location, aquatic environment, time, etc., cannot be performed.

However, RCB has attempted to identify potential trends in these data which might give some indication of where greater fish residues might be expected to be found. Before proceeding, however, we will point out some of the sources of uncertainty which arise from the use of these incongruous data sets.

Residue Variation with Data Source

RCB previously recommended fish action levels for these chemicals based solely on FDA surveillance monitoring data for FY 1985 and FY 1986 (M. Metzger, 3/25/87). It was assumed that these data were collected utilizing a sampling scheme in which residue levels in fish tissue were representative of residues likely to be found in the entire national fish population (fish utilized for human consumption or as animal feed). Additionally, the sampling schemes, sample preparation techniques, analytical methods, QA/QC procedures and data reporting were assumed to be consistent from year to year.

The current data set utilized by RCB contains these FDA data as well as data from numerous other sources. Therefore, the data are not nationally randomized for residues likely to be found in fish tissues. Parameters such as analytical methodology, sampling schemes, use of composite vs. individual fish samples, etc., become variables which cannot be isolated; and therefore, the causes of residue level variations cannot easily be assigned to a particular variable. Rather, it must be stated that these variations in residue levels may be due to one or more factors which may be reflective of the sampling and analytical methodologies used as well as the actual variations in the residue levels.

We have compared the FDA data to all other data ("non-FDA data") to estimate the differences in averages between these data sets. These comparisons will not provide conclusive information regarding the causes of these differences, nor will they allow estimation of differences among FDA data and data from individual non-FDA studies.

Residue Variation with Species

The fish species analyzed in these studies were divided into 4 groups based on their feeding habits so that residue level variation with feeding habits could be identified. The four groups are "High(er) level predators", "low(er) level

predators/bottom-feeders", "neither or unknown" (e.g. "caviar") and "shellfish". High(er) and low(er) level predators refers to higher or lower level positions in the food chain. Both fresh water and salt water species are included in each group. Additionally, data analyses were performed utilizing or excluding individual fish species. Bluefish were isolated for statistical analysis because a large number of bluefish were analyzed relative to the total number of fish analyzed. Separate statistical analyses of bluefish and non-bluefish would allow determination of how the large number of bluefish samples biased the results. American eels were analyzed separately since this species of fish differs significantly from most other species sampled.

When examining the data subsets broken down in this manner, it must be remembered that other, non-isolable variables (other than feeding habits) may be causing the differences seen. The most likely reasons for the observed residue variations with species are the following: *

- (1) actual differences in residues in different kinds of fish due to different feeding habits;
- (2) differences in residues due to a greater number of fresh water species (containing higher residues than salt water species) in a particular data subset;
- (3) differences in residues due to a greater number of fish from a particular data subset being taken from a more highly contaminated (or less contaminated) location;
- (4) differences in analytical method (recoveries), sampling techniques, data reporting (were reported data corrected for recovery?);
- (5) differences in residues due to a greater number of high or low residue species in a specific data subset;
- (6) different studies monitoring for all or only part of the residue of concern for a particular chemical.

Reasons other than those listed are possible. In a well designed sampling scheme, these factors would be controlled so that only the single variable to be examined would be a factor contributing to observed residue variations. However, in this data set, any individual factor or combination of the factors above could cause the observed residue variations.

Residue Variation with Aquatic Environment (Fresh vs. Salt Water Fish)

Fish were also divided according to whether they lived in "Brackish or salt water", "fresh water", "either" or "unknown or not applicable" (e.g. "caviar"). Fish such as bass or trout could be of either fresh or salt water varieties and were classified as "either" since, in many cases, the aquatic environment or sampling location was not specified.

When examining the data broken down by aquatic environment, factors similar to those discussed for "residue variation with species" must be considered. In addition to (3), (4), (5) and (6) discussed there, the following factors could be responsible for apparent residue variations with aquatic environment:

- (7) actual differences in residues in fish from different aquatic environments due to the aquatic environment;
- (8) differences in residues due to a greater number of high level predators or low level predators/bottom-feeders in a particular data subset.

Residue Variation with Time

Data for all divisions by species, location, etc. were examined for samples collected in 1985, 1986 and for combined 1985 + 1986 data sets. This was done in order to estimate residue decline from 1985 to 1986. Changes in average residues seen from year to year could be due to actual residue variation due to time. Additionally, factors previously discussed in (2), (3), (4), (5), (6) and (8) could be entirely or partially responsible for the observed residue variation.

Residue Variation with Location

Data from the various locations from which samples were obtained were examined separately to determine if there are specific locations which have higher or lower residues of particular pesticides than other locations. Residue variations observed could be due to actual variations in residues due to location, or they could be due to (2), (3), (4), (5), (6) or (8) discussed earlier.

Statistical Analysis

The data set utilized for statistical analysis is composed of studies performed for a variety of purposes utilizing various analytical and sampling methods, sample preparation techniques,

QA/QC procedures and data reporting methods. For these reasons, the data are not random or representative of the total U.S. fish population, and results of the statistical analyses must be viewed keeping in mind all of the possible variables which could cause the residue variations observed. RCB cannot attribute observed residue variations to any single factor such as location or species; rather, the residue variation could be due to any of the numerous variables which are not held constant for a particular data subset.

In order to examine these data, residue values and other important parameters (e.g. location, year, species, etc.) were entered into a dBase III Plus data base file. Average residues as well as 95% confidence limits (assuming a normal distribution) were calculated using a dBase III Plus program. Each residue value and the number of times it appeared in a data subset were calculated and printed out for each data set.

Information for tolerance limit calculations for 95% confidence and 95% population coverage was provided by Richard A. Levy (Leader, Biostatistics Team, Toxicology Branch, HED). Mr. Levy provided a 70-page computer print-out which allowed RCB to calculate the appropriate tolerance limits for a data set containing a specific number of values. One-sided statistical tolerance limits calculated for the various data subsets furnish limits below which we confidently (i.e. 95% confidence) expect to find a prescribed proportion of individual items (i.e. 95% population coverage) of the population. These calculations assumed no distribution in determining the tolerance limits. The reader is referred to the following for more information regarding this statistical method:

Wilks, S.S., Statistical Prediction with Special Reference to the Problem of Tolerance Limits, Princeton University, Princeton, N.J.

Wilks, S.S., Determination of Sample Sizes for Setting Tolerance Limits, Princeton University, Princeton, N.J.

CHLORDANE

Chlordane Residue Variation with Data Source, FDA vs. Other Data

Chlordane residue variation with data source is shown in Figure 2. In all cases, the data from sources other than the FDA show average residue values greater than or equal to the average residue values for FDA data. This is primarily due to

the large number of non-FDA samples from Regions 5 and 7 which have greater average residues (particularly Region 7) than those of the entire data set.

Chlordane Residue Variation with Species

Chlordane residue variation with fish species is shown in Figure 3. No consistent year to year trend is seen showing higher residues in either high level predators or low level predators/bottom-feeding fish. However, low level predators/bottom feeders in Regions 5 and 7 tend to have significantly higher residues than the average national residues for all fish.

American eels, bluefish and non-shellfish have average residues very similar to the national average for all fish. Shellfish show significantly lower residues than other fish (residues in shellfish were non-detectable in most cases).

Chlordane Residue Variation with Aquatic Environment

Chlordane residue variation with aquatic environment (water type, fresh vs. salt water species) is shown in Figure 1. For the entire data set, fresh water fish have higher average residues than salt water fish. This trend is also seen for low level predators/bottom-feeding species but is reversed for high level predators in which the fresh water species have slightly lower residues.

Chlordane Residue Variation with Time

Chlordane residue variation with time is shown in Figure 5. No consistent residue decline is seen in the various data subsets analyzed. The FDA data shows a slight decline in residues from 1985 to 1986. All other data sets have increases in residues from 1985 to 1986, some significant. The reasons for these trends could be numerous, as described in the Introduction.

Chlordane Residue Variation with Location

Chlordane residue variation with location is shown in Figure 4. Region 7 has significantly higher residues than any other location (greater than 2X the average residue for all locations). Regions 2 and 5 show slightly higher residues than the average residues for all locations, whereas all other locations show significantly lower residues. This trend corresponds very well with the source of the data: Regions 2, 5 and 7 data are primarily non-FDA data, whereas the data from the other locations are almost exclusively FDA data. Additionally, the data from Regions 2, 5 and 7 are primarily for fresh water fish, whereas the data from the other locations are for both fresh and salt water fish.

Clordane: Other Considerations

Table 1 shows averages and tolerance limits (95% confidence, 95% population coverage, no distribution assumed) for selected data subsets. RCB's previous action level for chlordane was 0.3 ppm (M. Metzger, 3/25/87). This recommendation was based on FDA surveillance monitoring data only.

Utilizing 95% confidence and 95% coverage of the fish population, and utilizing the entire data set presently available to RCB, we estimate that residues of chlordane and its metabolites are not likely to exceed 0.4 ppm nationally with local areas of possibly higher concentration found in Region 5 (Great Lakes, maximum residue = 0.5 ppm) and Region 7 (Mississippi and Missouri Rivers and several fresh water lakes; maximum residue = 2.0 ppm).

Table 1: Chlordane Summary Statistics

<u>Year</u>	<u>Region</u>	<u>Water Type</u>	<u>Fish Type</u>	<u>FDA Data</u>	<u>Number of Samples</u>	<u>Average Residue (ppm)</u>	<u>Tolerance Limit (ppm)</u>
1985	All	All	All	FDA	936	0.088	0.240
	All	All	All	All	2156	0.121	0.335
1986	All	All	All	FDA	588	0.068	0.245
	All	All	All	All	863	0.134	0.539
85 +	Reg 5	All	All	All	480	0.145	0.450
	Reg 7	All	All	All	172	0.301	1.926
86	Reg 2	All	All	All	1758	0.133	0.368
	All	All	All	FDA	1525	0.080	0.235
	All	All	All	All	3020	0.125	0.372

MIREX

Mirex Residue Variation with Data Source, FDA vs. Other Data

Mirex residue variation with data source is shown in Figure 7. No mirex residues were found in fish by the FDA for 1985 or 1986. In non-FDA data, mirex residues were found exclusively in Lake Ontario and the Saint Lawrence River in NY (Region 2) in 1985 only (1 detectable residue found in 1986). The difference between the FDA data and the other data could be due to FDA's not obtaining samples from the contaminated NY water bodies.

Mirex Residue Variation with Species

Mirex residue variation with species is shown in Figure 8. Since detectable residues were found primarily only in 1985, species variation can be observed only for 1985 data. However,

Figure 1:
CHLORDANE: Residue Variation with Water Type (Salt vs. Fresh Water)

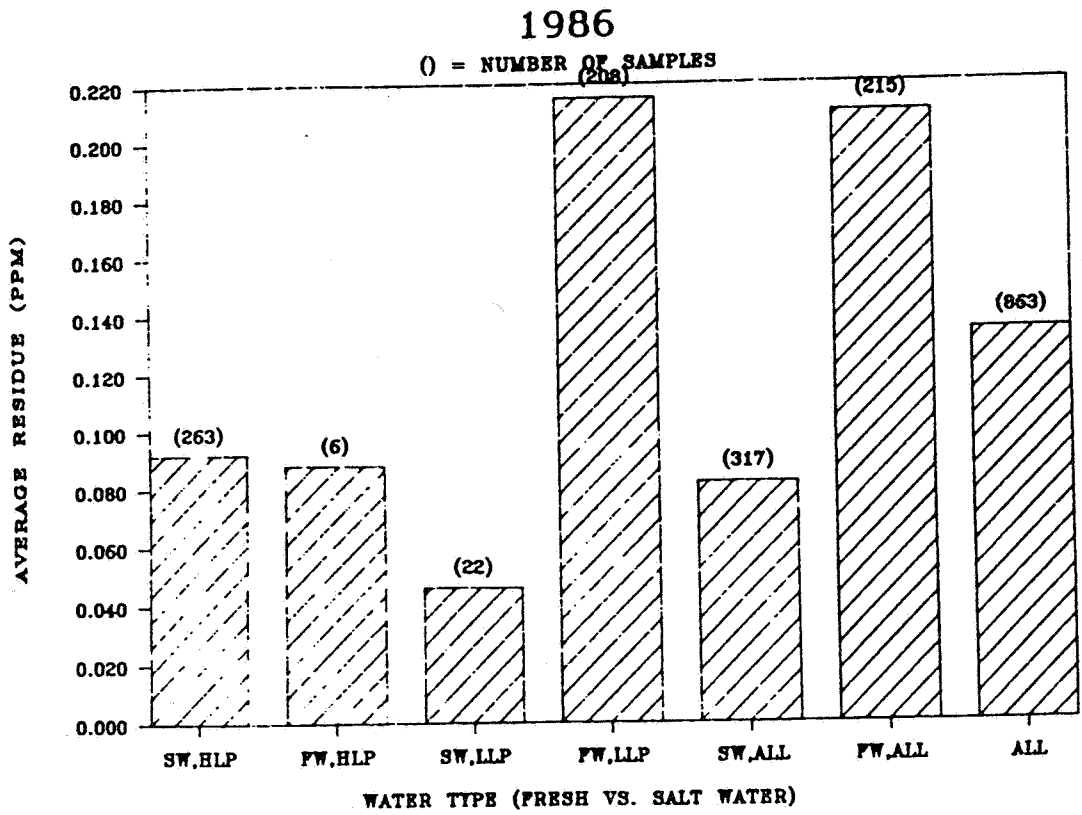
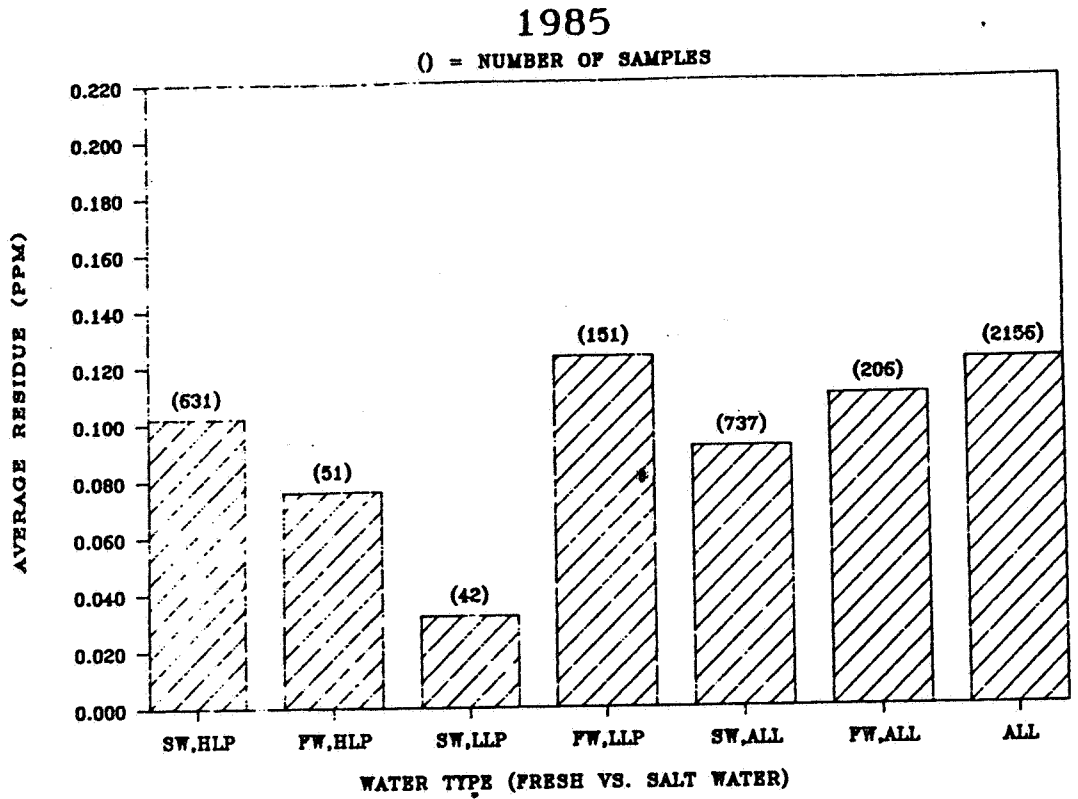
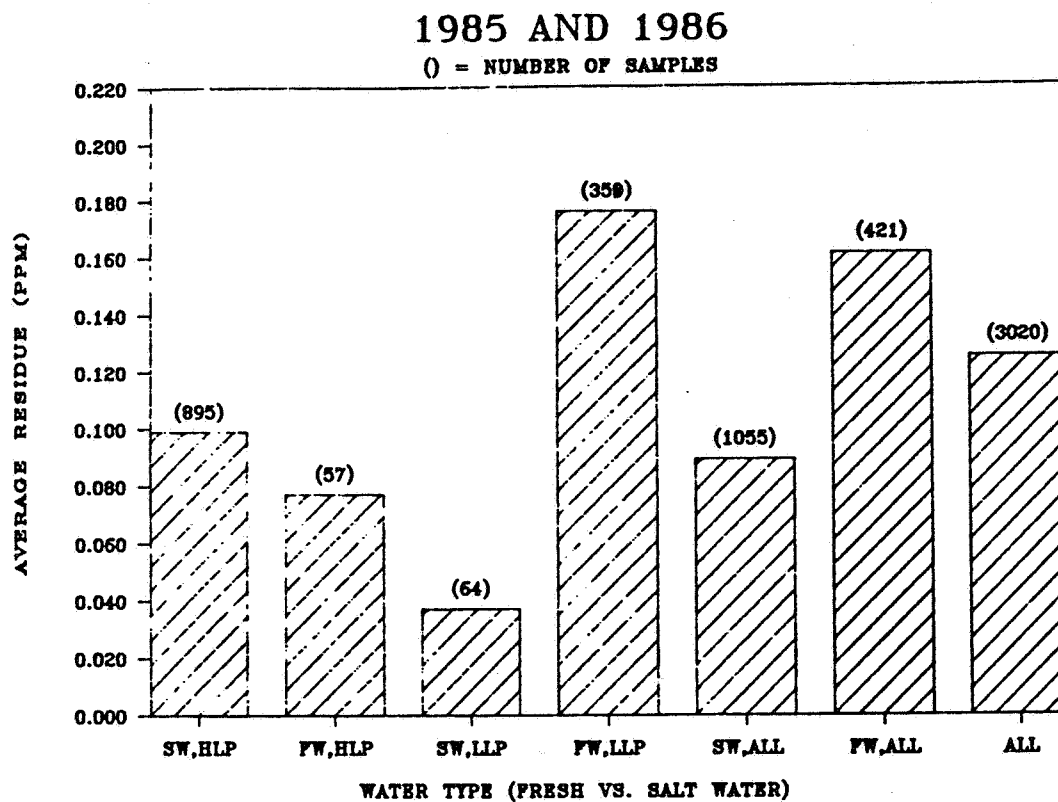


Figure 1 (cont.):
CHLORDANE: Residue Variation with Water Type (Salt vs. Fresh Water)



SW = Salt Water Fish
HLP = High level predatory fish
FW = Fresh water fish
LLP = Low level predatory / bottom-feeding fish
All = All high level predatory and low level predatory / bottom-feeding fish

Figure 2:
CHLORDANE: Residue Variation with Data Source (FDA vs. Non-FDA data)

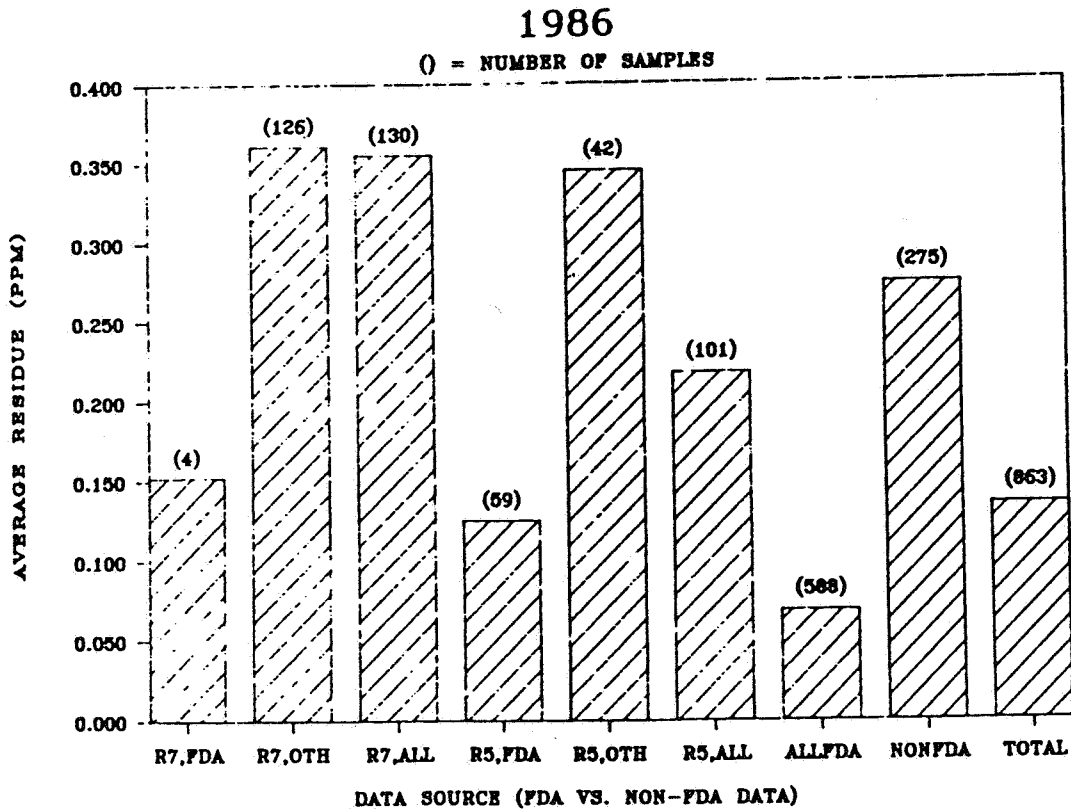
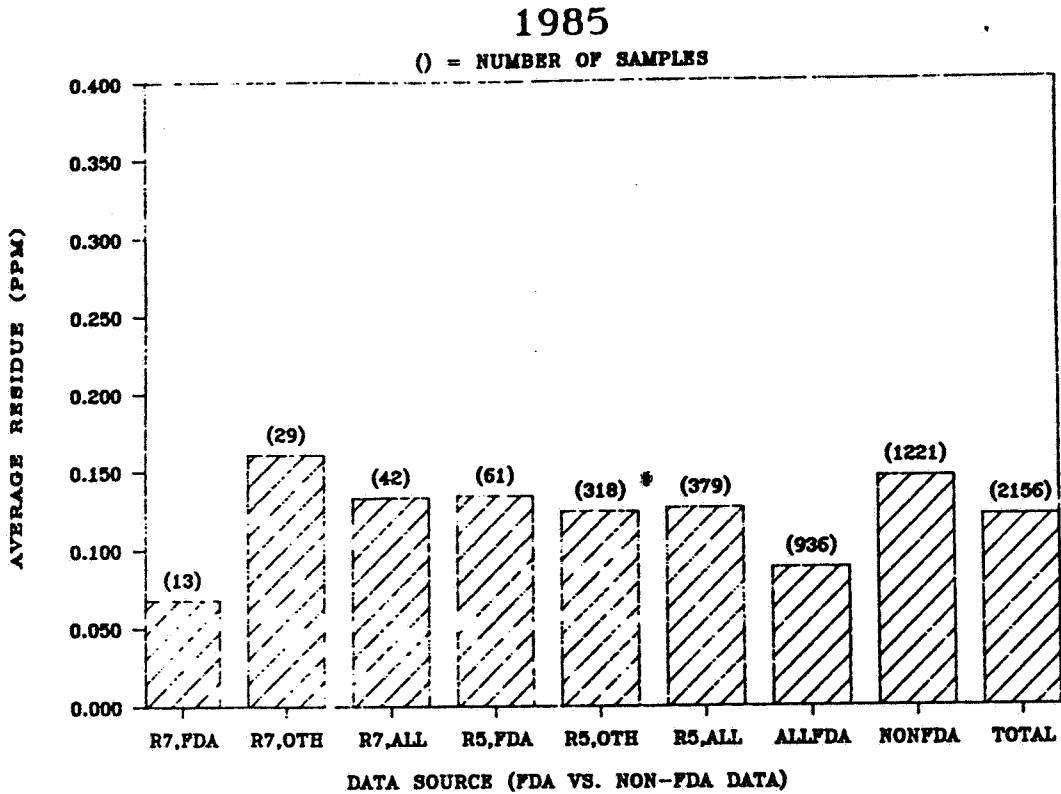
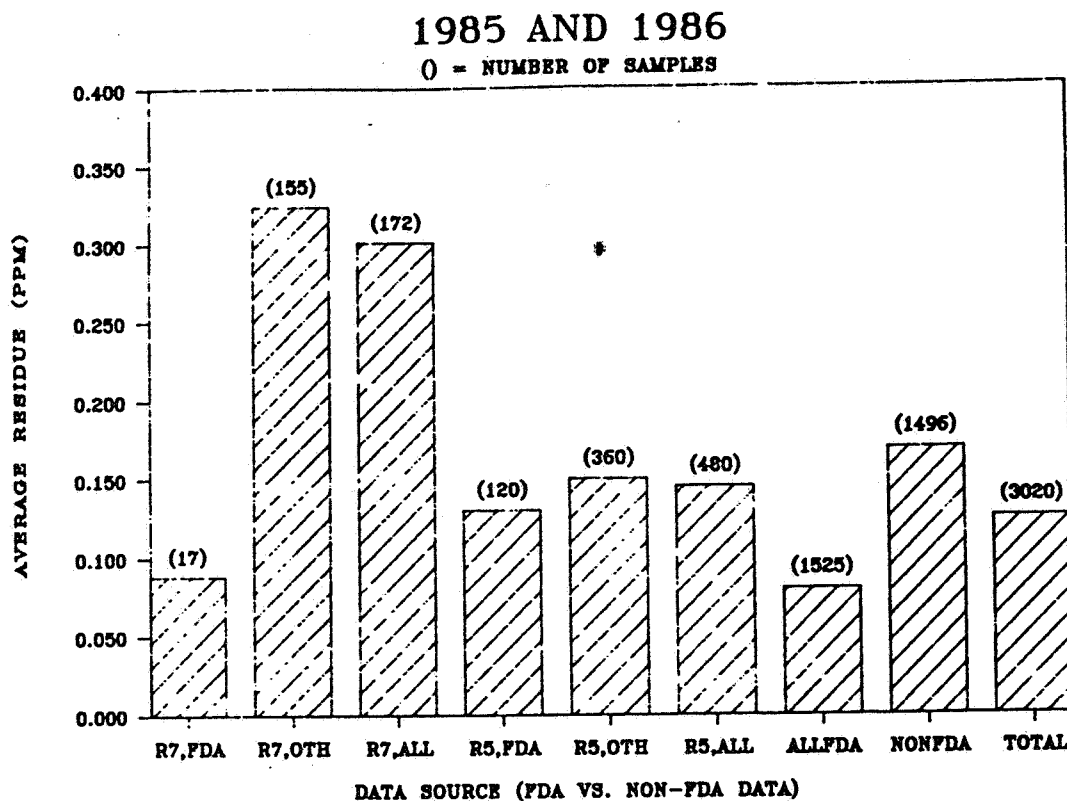


Figure 2 (Cont.):
CHLORDANE: Residue Variation with Data Source (FDA vs. Non-
FDA data)



R7 = EPA Region 7
R5 = EPA Region 5
FDA = FDA data only
OTH = All data other than FDA data
ALL = All FDA data and other (non-FDA) data
ALLFDA = FDA data from all locations
NONFDA = All data other than FDA data from all locations
TOTAL = All data

Figure 3:
CHLORDANE: Residue Variation with Species of Fish

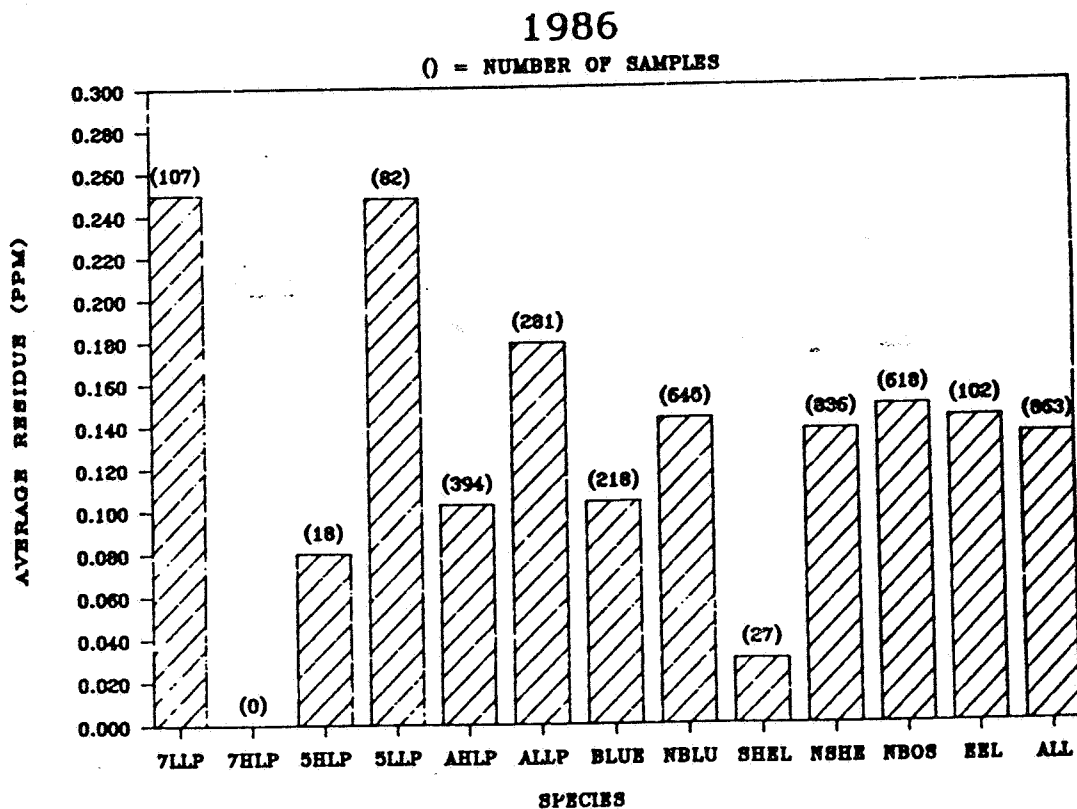
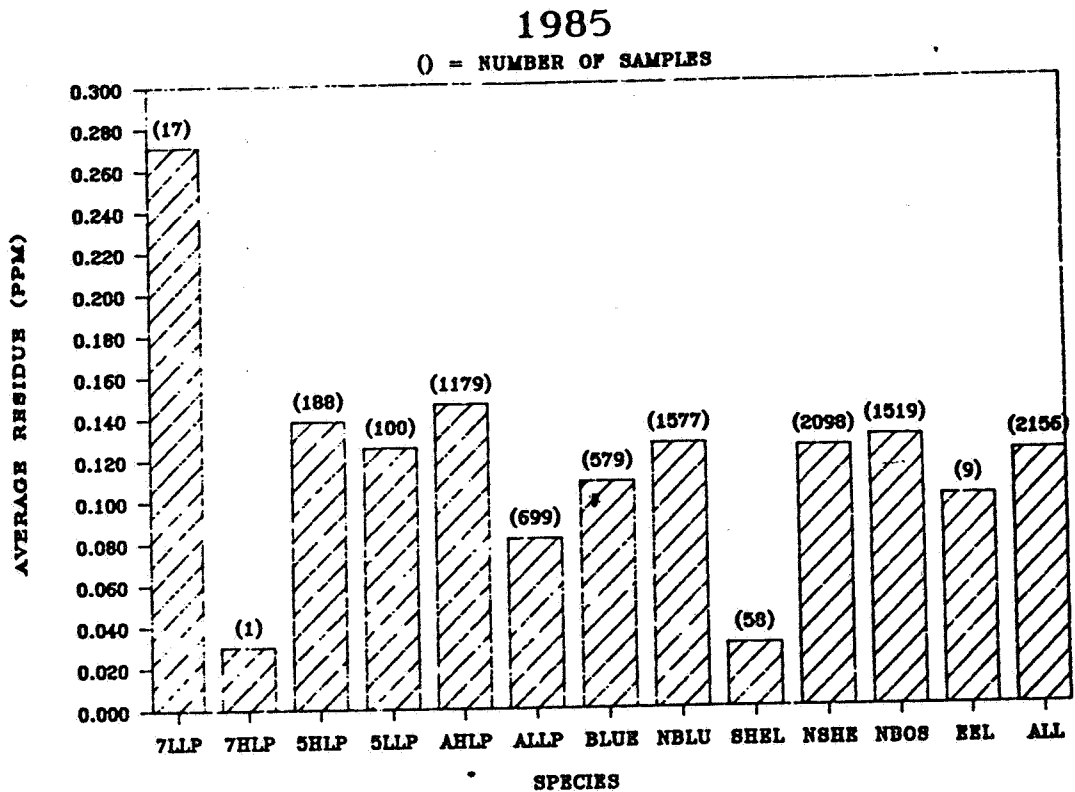
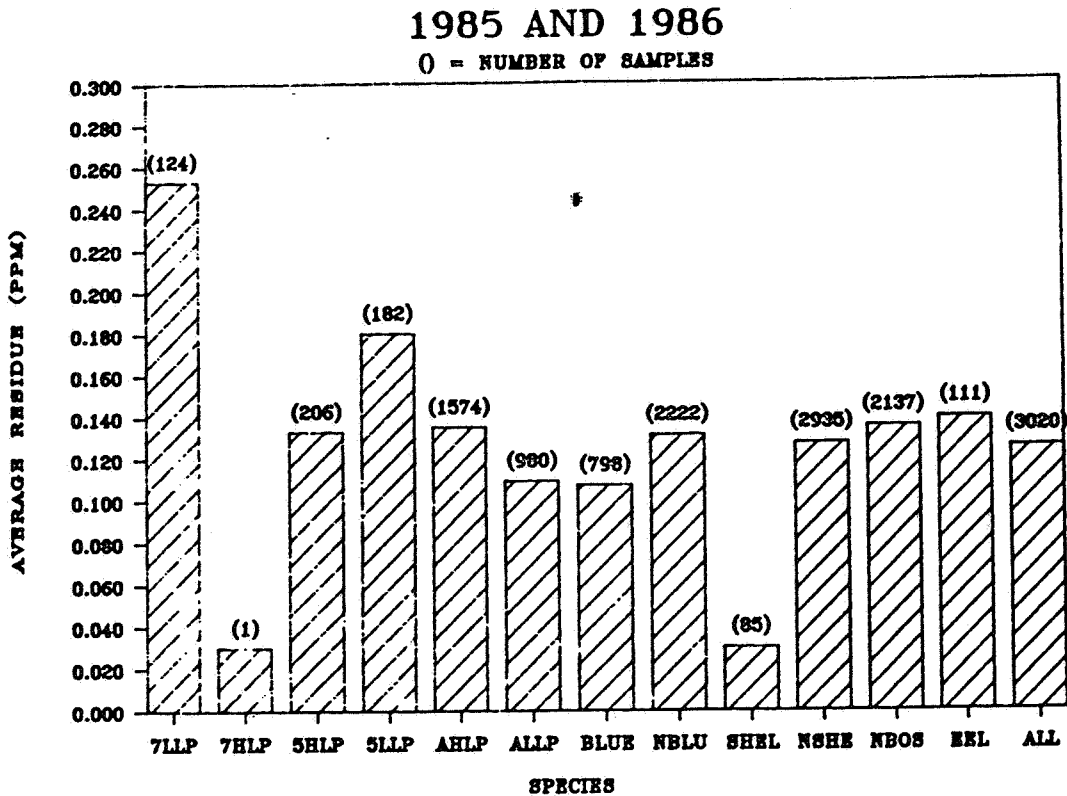


Figure 3 (Cont.):
CHLORDANE: Residue Variation with Species of Fish



7LLP = EPA Region 7, low level predatory and bottom-feeding fish
7HLP = EPA Region 7, high level predatory fish
5HLP = EPA Region 5, high level predatory fish
5LLP = EPA Region 5, low level predatory and bottom-feeding fish
AHLP = High level predators, all locations
ALLP = Low level predators, all locations
BLUE = Bluefish
NBLU = All fish except Bluefish
SHEL = Shellfish
NSHE = All fish except shellfish
NBOS = All fish except Bluefish and shellfish
EEL = American Eels
ALL = All fish

Figure 4:
CHLORDANE: Residue Variation with Location / Region

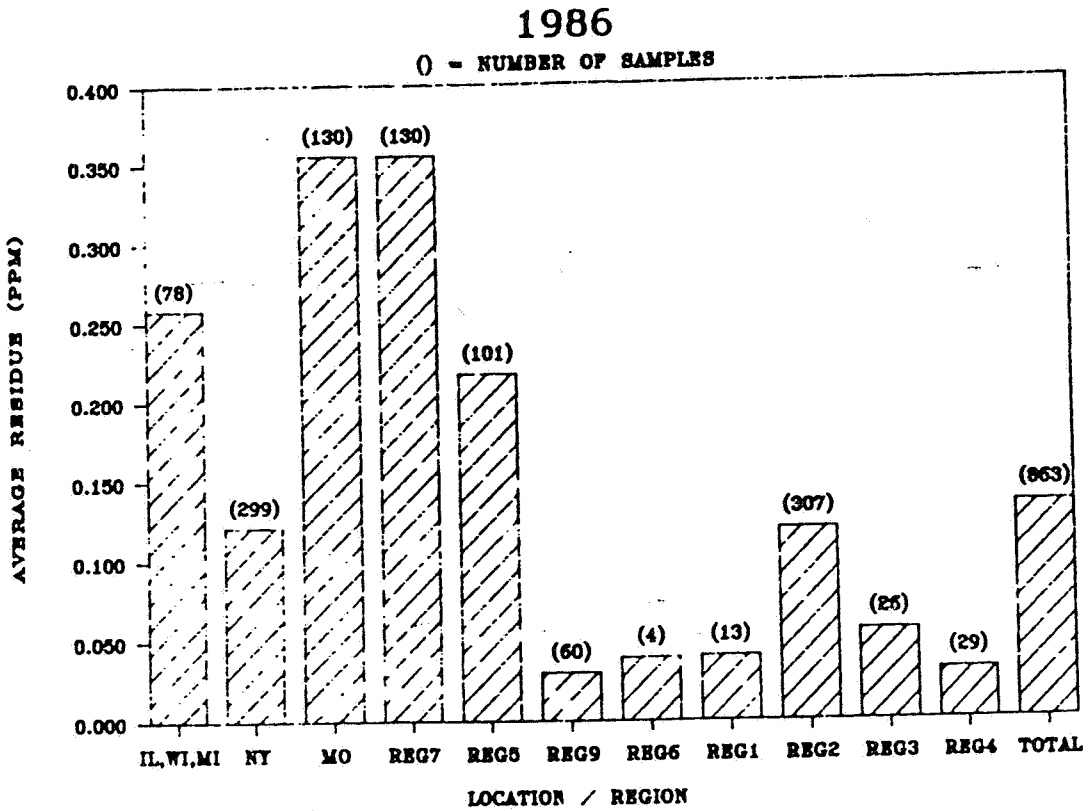
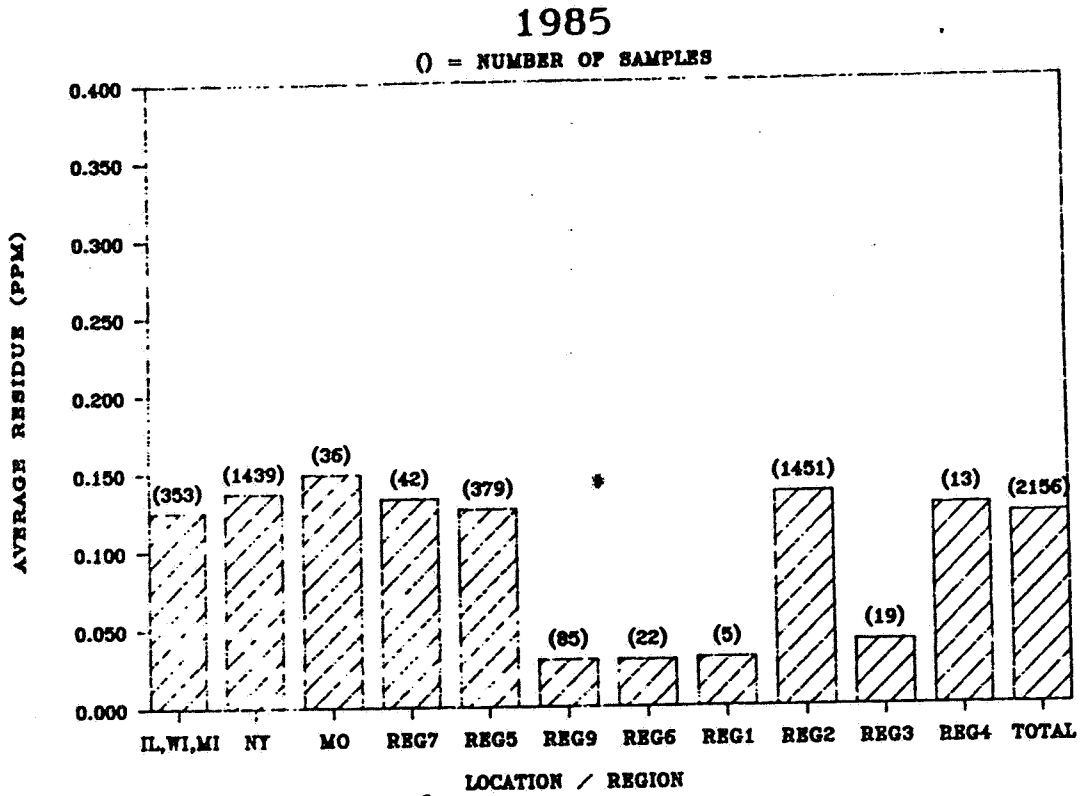
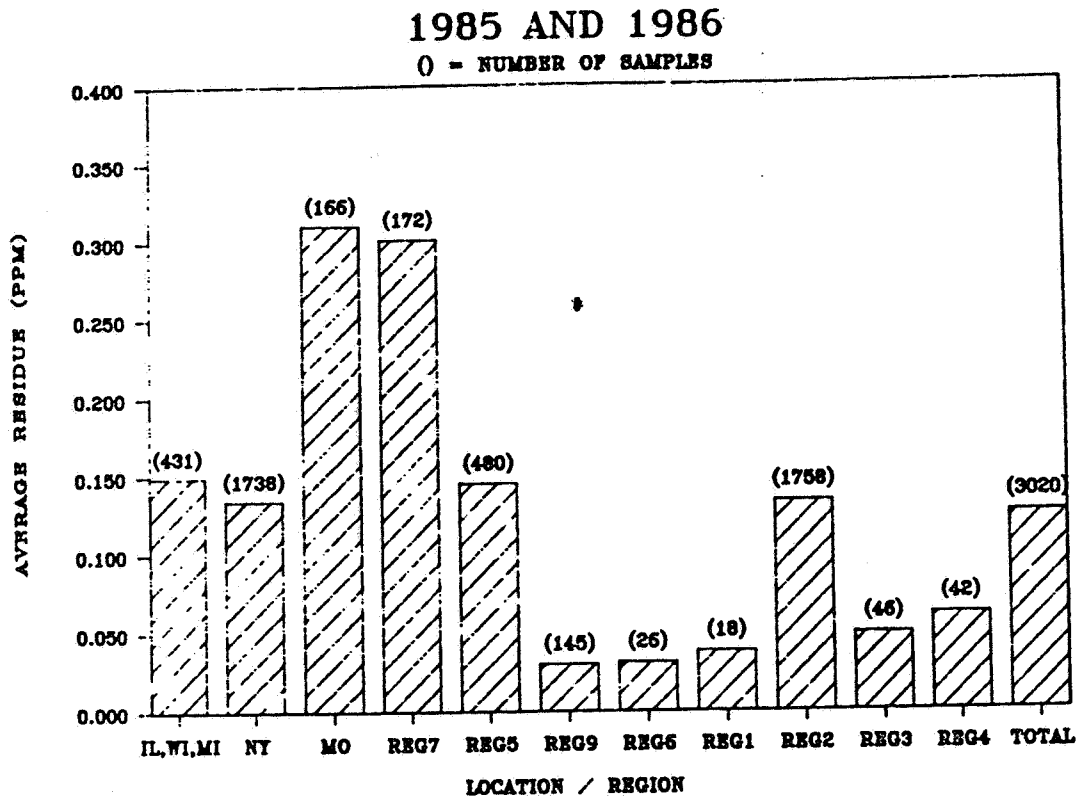
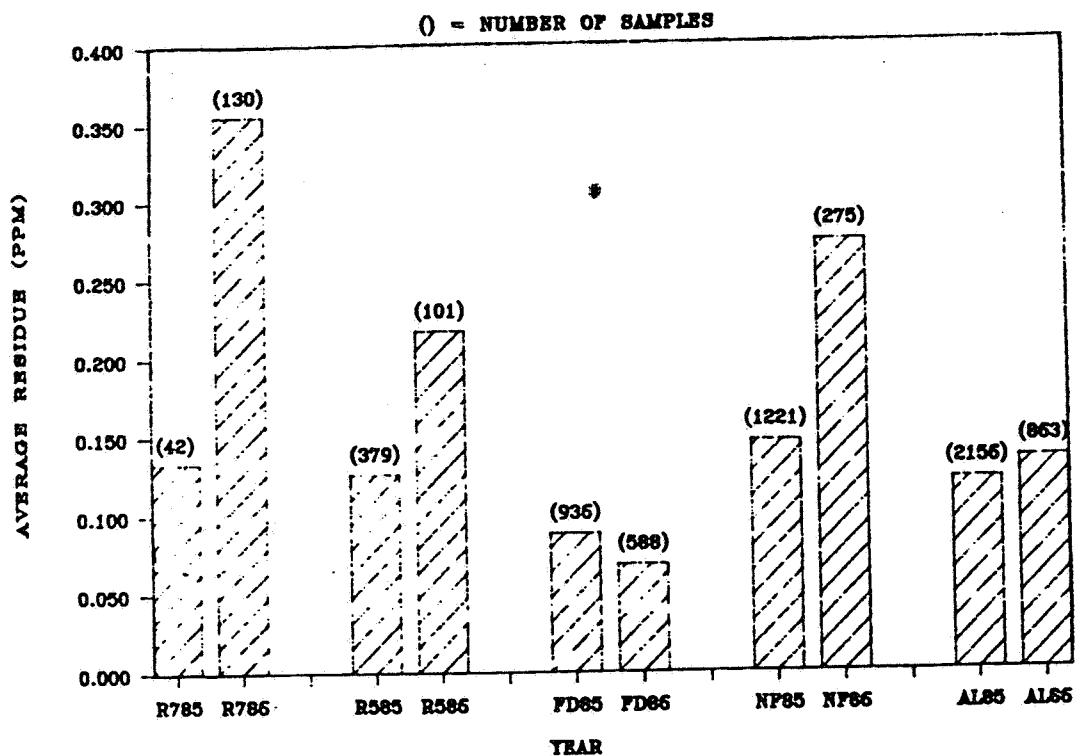


Figure 4 (Cont.):
CHLORDANE: Residue Variation with Location / Region



IL,WI,MI = Illinois, Wisconsin and Michigan
NY = New York
MO = Missouri
REGX = EPA Region X
TOTAL = Combined data from all locations

Figure 5:
CHLORDANE: Residue Variation with Time



R785 = EPA Region 7 data, 1985
R786 = EPA Region 7 data, 1986
R585 = EPA Region 5 data, 1985
R586 = EPA Region 5 data, 1986
FD85 = FDA data, 1985
FD86 = FDA data, 1986
NF85 = All data except FDA data, 1985
NF86 = All data except FDA data, 1986
AL85 = All data, 1985
AL86 = All data, 1986

since most of the samples were obtained from NY and were primarily high level predators (trout), comparison of mirex residues based on fish species is impossible.

Mirex Residue Variation with Aquatic Environment

Mirex residue variation with aquatic environment (water type, fresh vs. salt water) is shown in Figure 6. All of the NY data were for bass and trout. These were not included under either the fresh water or salt water categories since different species of these fish could be either fresh or salt water fish, and since in many cases, whether the fish were fresh or salt water was not specified. Therefore, we are unable to identify trends in mirex residue concentration for fresh vs. salt water fish.

The 1985 and combined 1985 + 1986 data sets show higher average residue values for all fish than for individual subsets. This is due to detectable mirex residues only being found in species not fitting into any of the fish type categories shown in the graph.

Residue Variation with Time

Mirex residue variation with time is shown in Figure 10. Most of the samples from NY were obtained in 1985 except for American eels in which mirex residues were not found. Therefore, mirex residue variation with time cannot be estimated using these data.

Mirex Residue Variation with Location

Mirex residue variation with location is shown in Figure 9. Detectable residues of mirex were found only in 1985 in NY (Region 2) in Lake Ontario and in the Saint Lawrence River, and only in samples analyzed in programs monitored by the state of NY. All other laboratories and locations monitoring for residues of mirex showed no detectable residues.

Mirex: Other Considerations

Table 2 shows averages and tolerance limits (95% confidence, 95% coverage of the population, no distribution assumed) for selected data subsets. RCB previously recommended that no replacement action level be set for residues of mirex in fish since no mirex residues were found in fish by the FDA (M. Metzger, 3/25/87).

Utilizing 95% confidence with 95% coverage of the population and utilizing the data set currently available to RCB, we estimate that mirex residues are not likely to exceed 0.3 ppm nationally and 0.4 ppm in Region 2 (NY). Residues found in fish from most locations would be considerably less than these values.

Figure 6:
MIREX: Residue Variation with Water Type (Salt vs. Fresh Water)

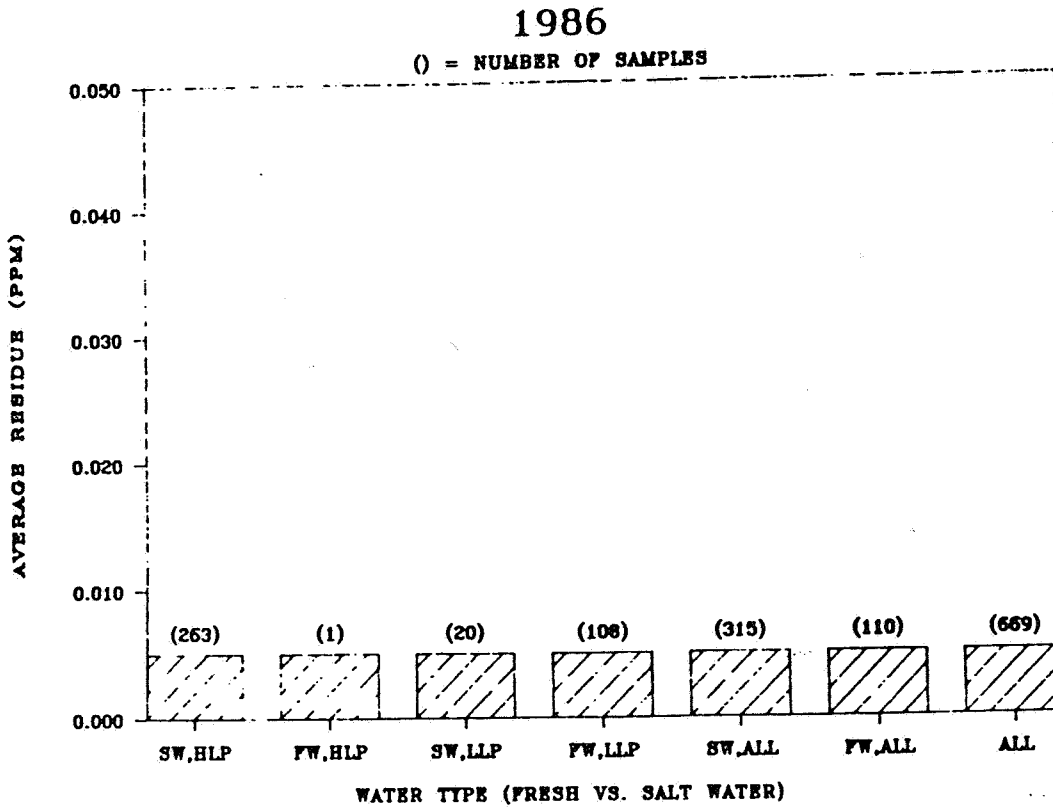
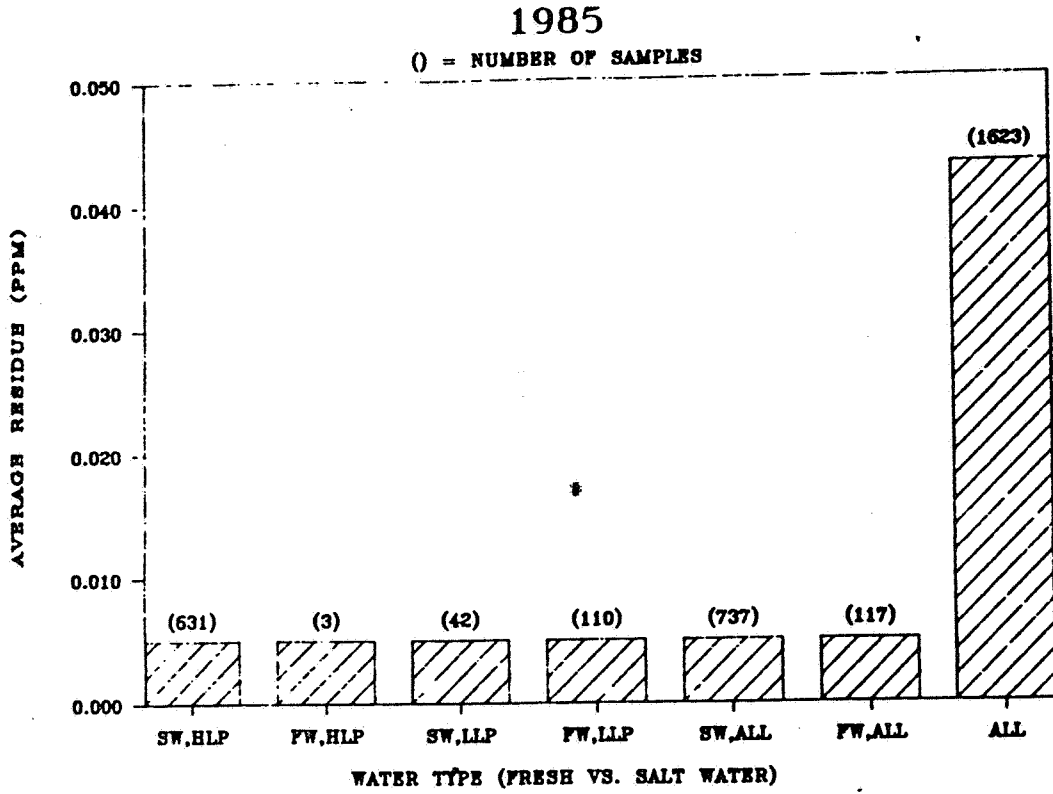
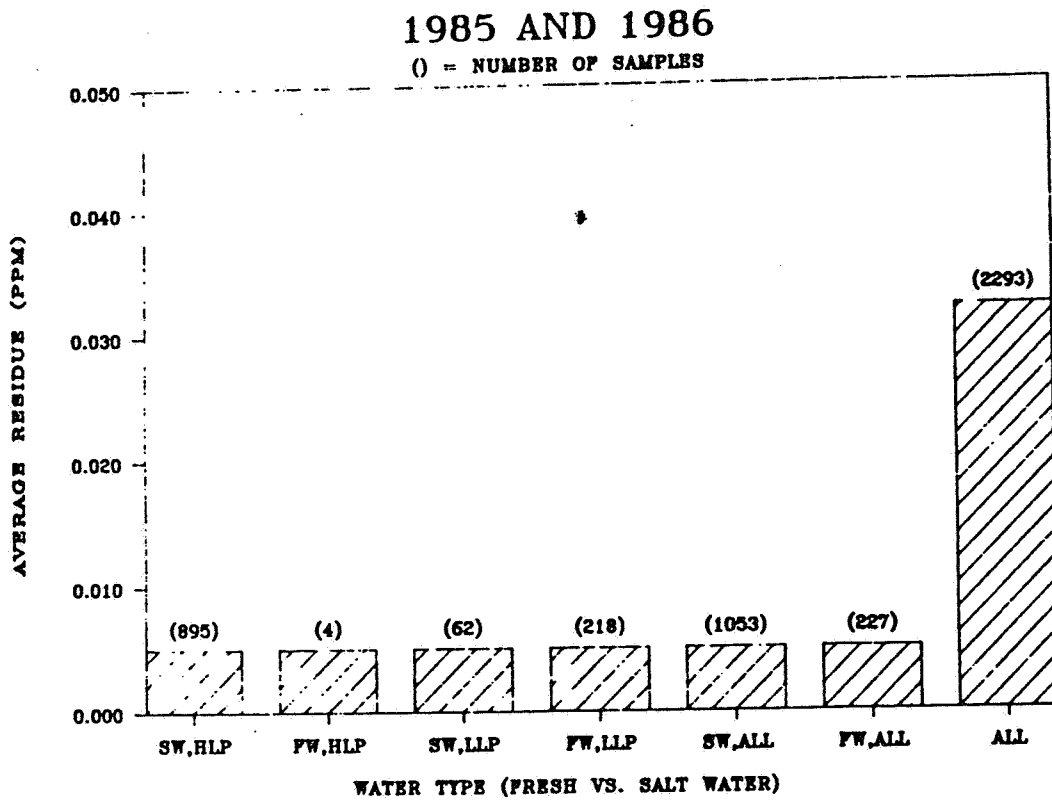


Figure 6 (Cont.):
MIREX: Residue Variation with Water Type (Salt vs. Fresh Water)



SW = Salt Water Fish
HLP = High level predatory fish
FW = Fresh water fish
LLP = Low level predatory / bottom-feeding fish
All = All high level predatory and low level predatory /
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Figure 7:
MIREX: Residue Variation with Data Source (FDA vs. Non-FDA data)

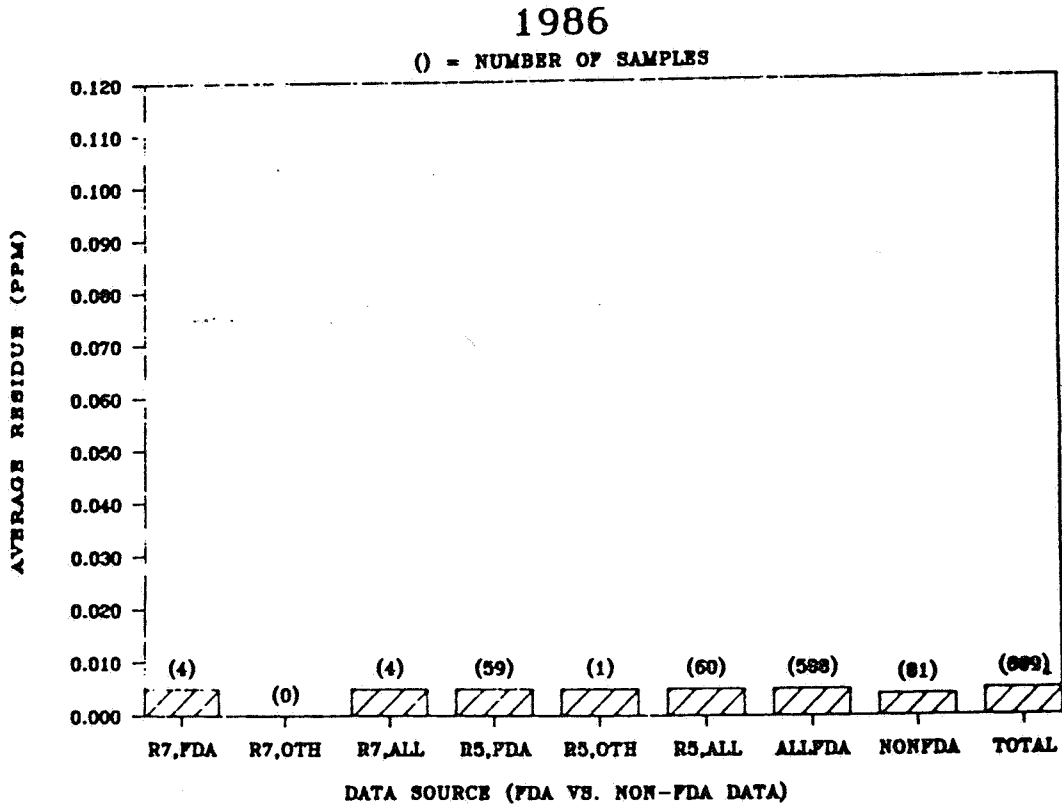
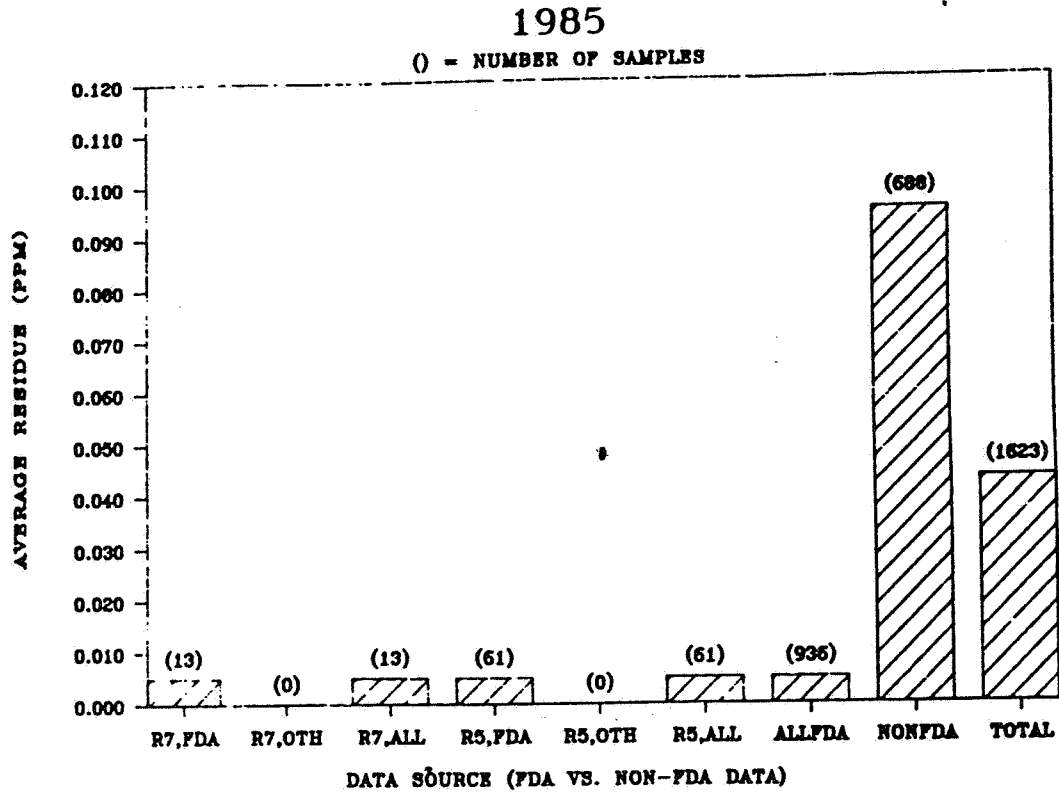
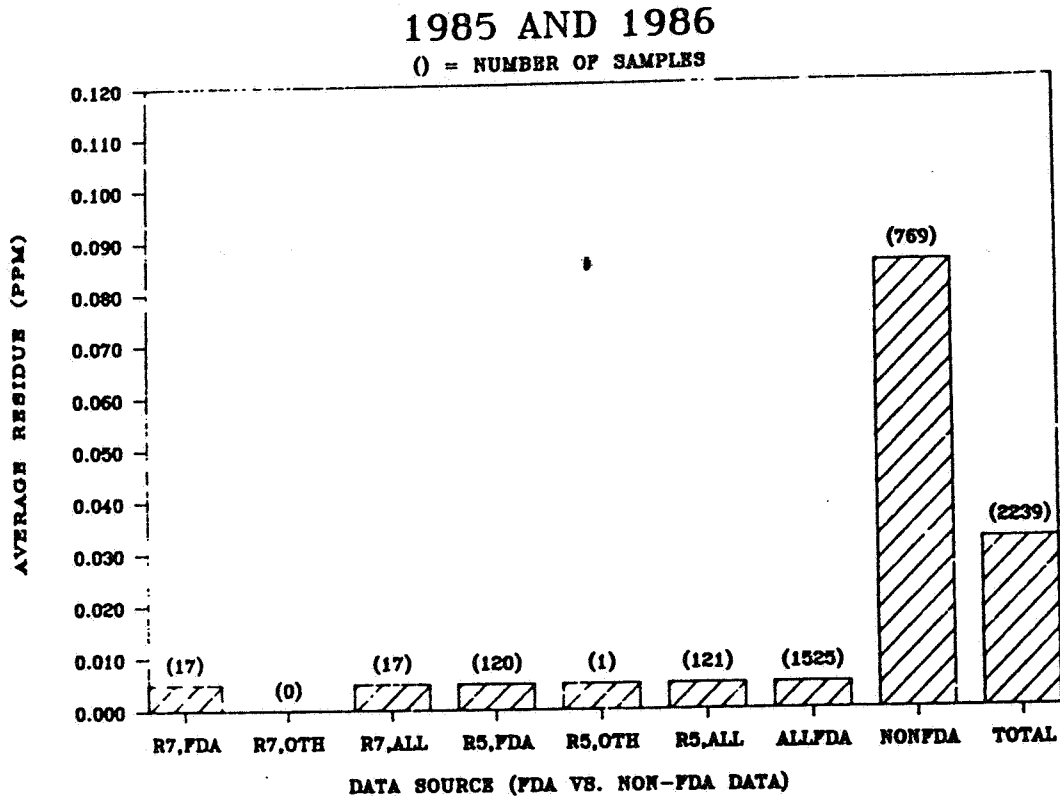


Figure 7 (Cont.):
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Figure 8:
MIREX: Residue Variation with Species of Fish

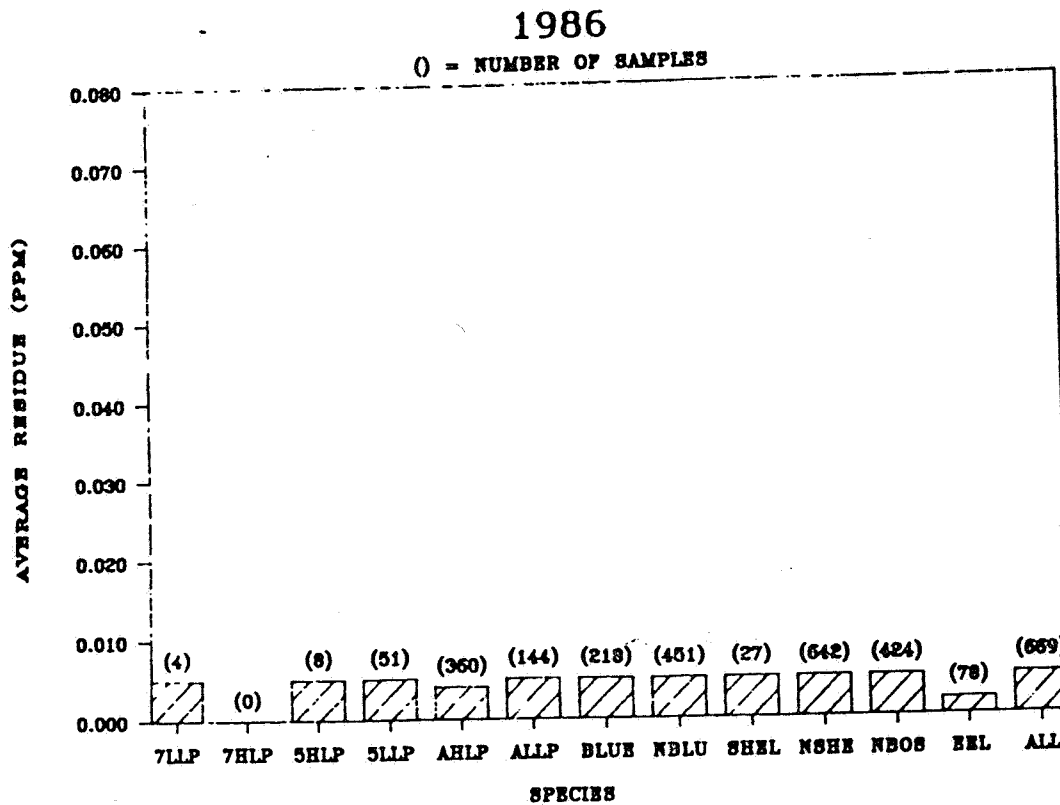
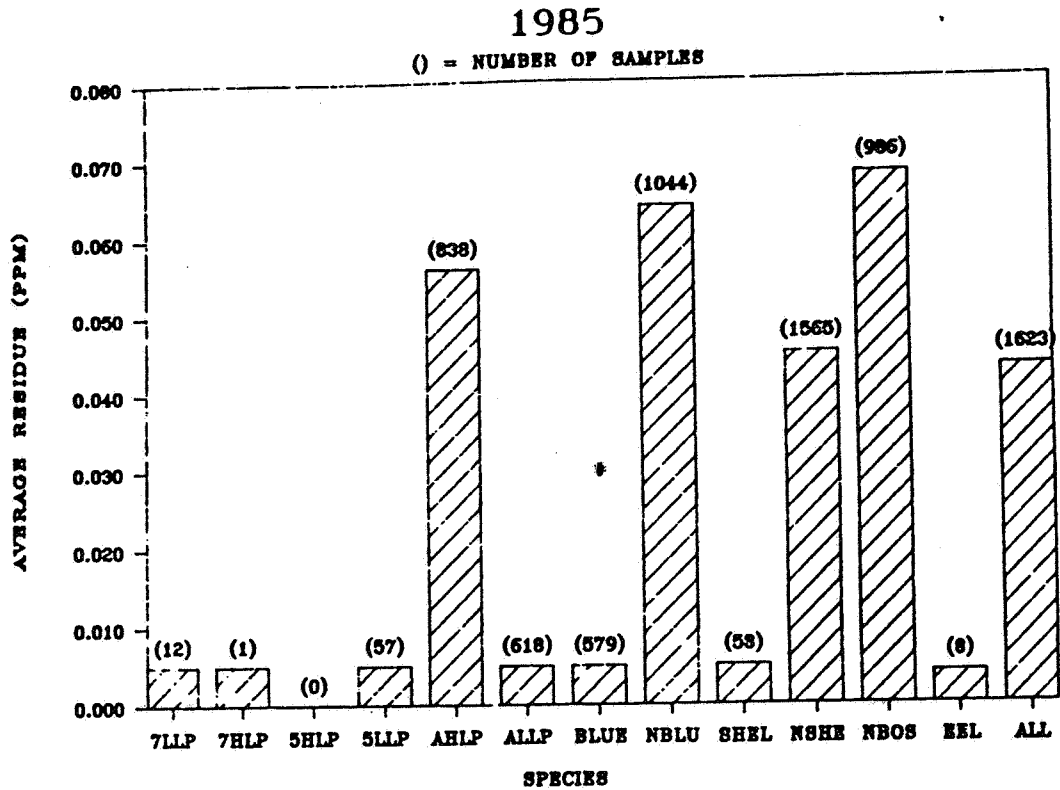
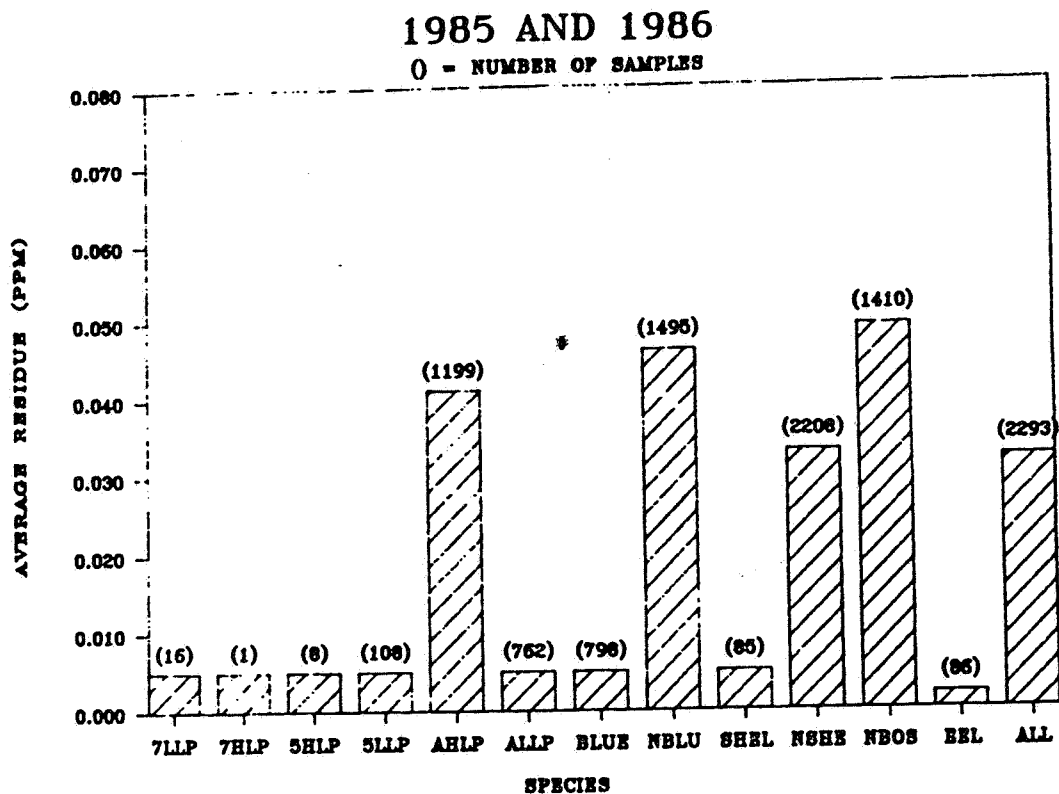


Figure 8 (Cont.):
MIREX: Residue Variation with Species of Fish



7LLP = EPA Region 7, low level predatory and bottom-feeding fish
 7HLP = EPA Region 7, high level predatory fish
 5HLP = EPA Region 5, high level predatory fish
 5LLP = EPA Region 5, low level predatory and bottom-feeding fish
 AHLP = High level predators, all locations
 ALLP = Low level predators, all locations
 BLUE = Bluefish
 NBLU = All fish except Bluefish
 SHEL = Shellfish
 NSHE = All fish except shellfish
 NBOS = All fish except Bluefish and shellfish
 EEL = American Eels
 ALL = All fish

Figure 9:
MIREX: Residue Variation with Location / Region

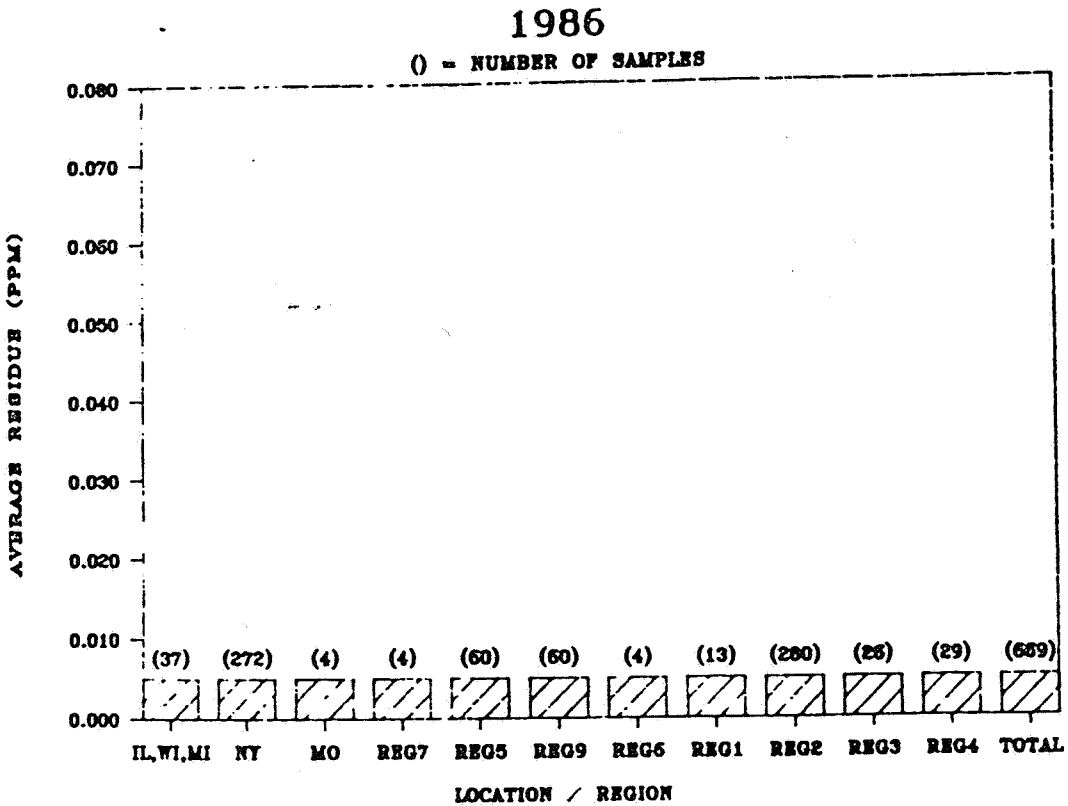
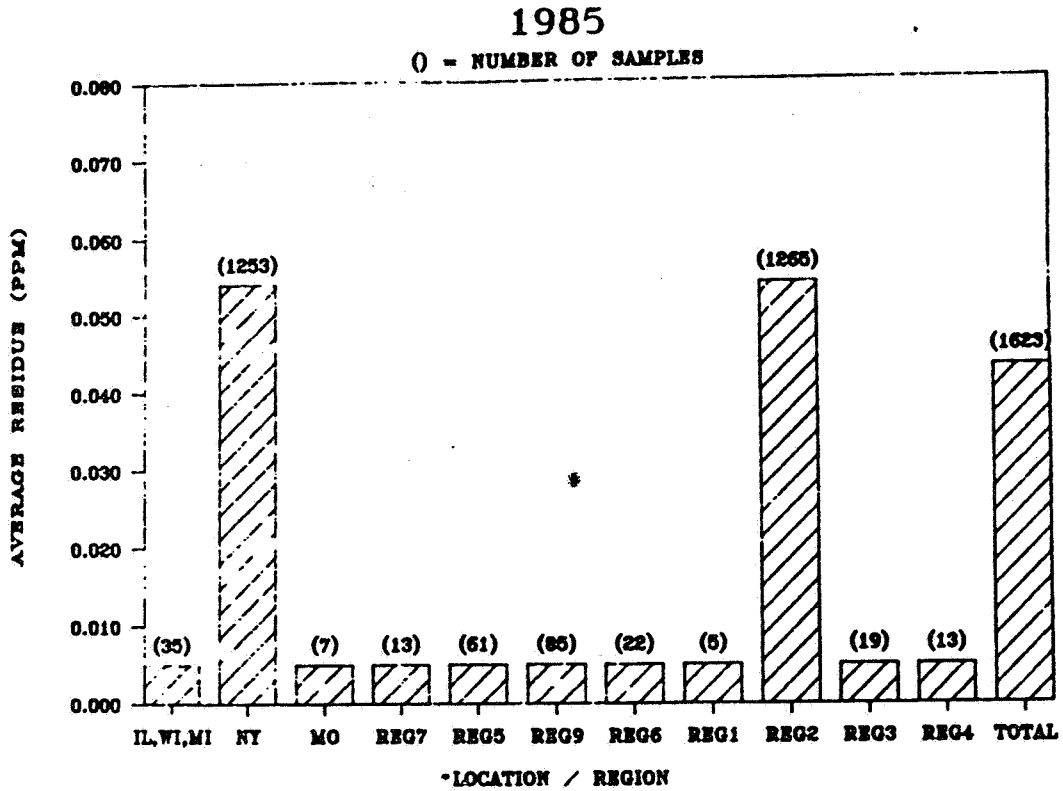
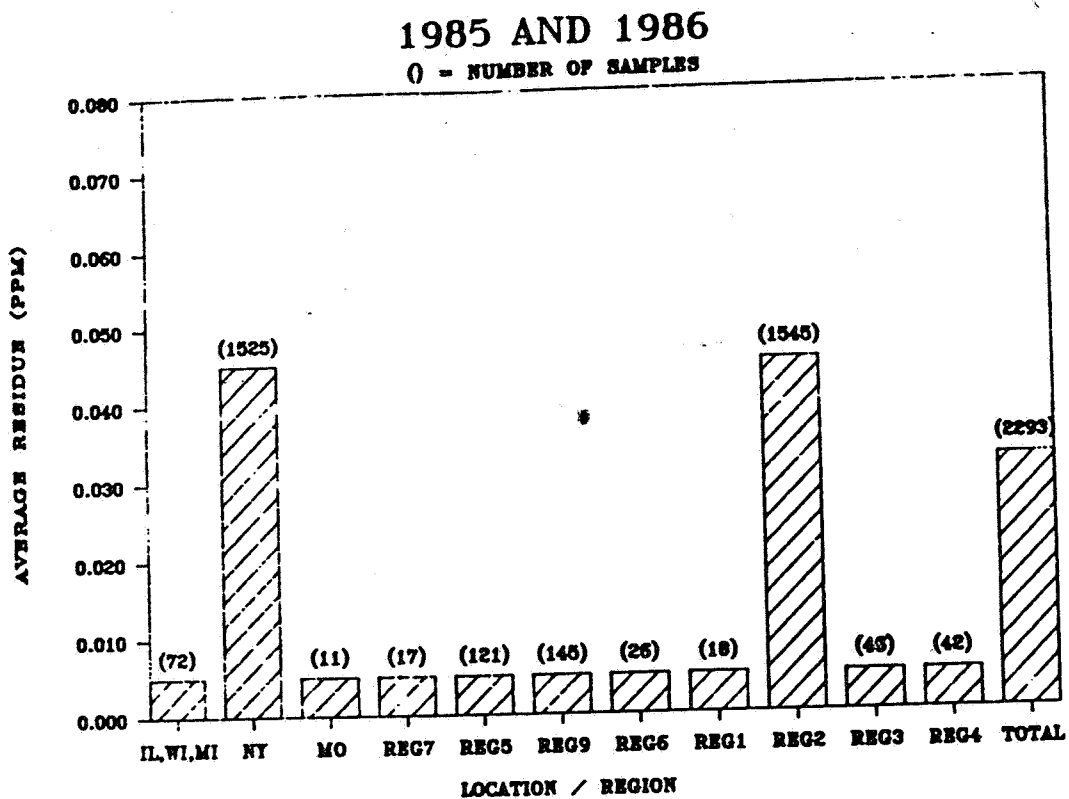
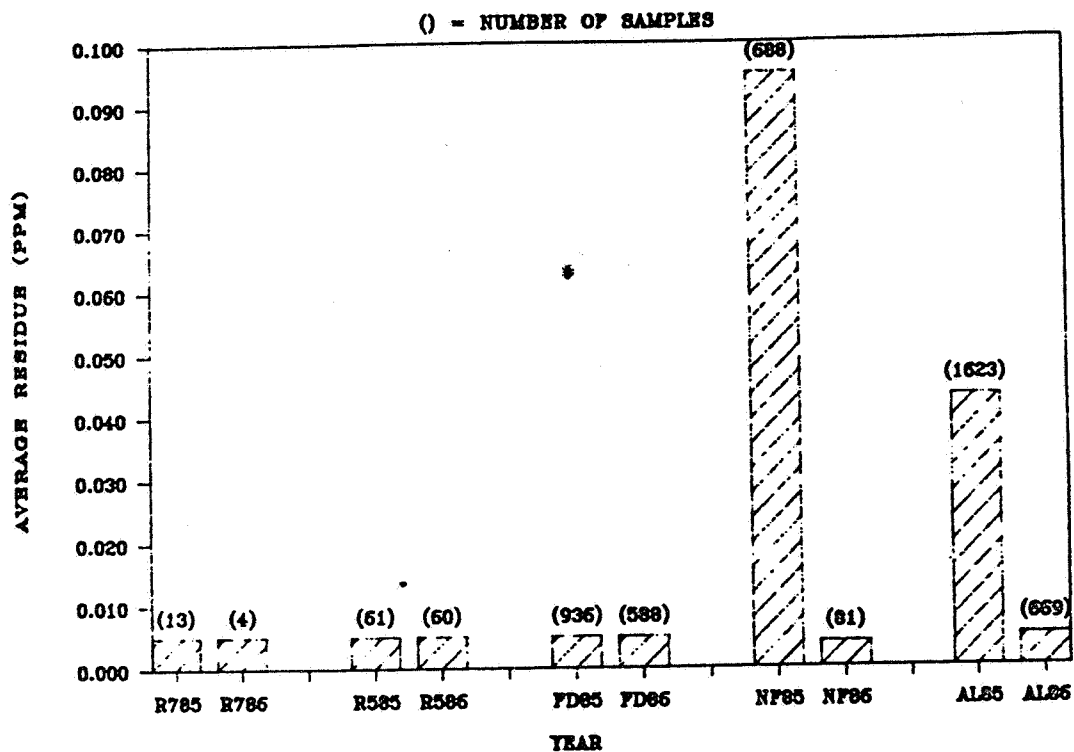


Figure 9 (Cont.):
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NF85 = All data except FDA data, 1985
NF86 = All data except FDA data, 1986
AL85 = All data, 1985
AL86 = All data, 1986

Table 2: Mirex Summary Statistics

<u>Year</u>	<u>Region</u>	<u>Water Type</u>	<u>Fish Type</u>	<u>FDA</u>	<u>Number of Samples</u>	<u>Average (ppm)</u>	<u>Tolerance Limit (ppm)</u>
1985	All	All	All	FDA	936	0.005	0.005
	All	All	All	All	1623	0.043	0.351
1986	All	All	All	FDA	588	0.005	0.005
	All	All	All	All	81	0.004	0.108
85 + 86	Reg 5	All	All	All	121	0.005	0.005
	Reg 7	All	All	All	17	0.005	0.005
	Reg 2	All	All	All	1545	0.045	0.355
	All	All	All	FDA	1525	0.005	0.005
	All	All	All	All	2293	0.032	0.252

HEPTACHLOR

Heptachlor Residue Variation with Data Source, FDA vs. Other Data

Heptachlor residue variation with data source is shown in Figure 12. For combined 1985 + 1986 data, the average for the FDA data is greater than that for the non-FDA data (difference = 0.007 ppm). This trend is consistent for both years, and is also seen in the Region 5 data subset (difference = 0.021 ppm for combined 1985 + 1986 data). The opposite trend, but of smaller magnitude (i.e. averages for non-FDA data greater than those for FDA data), is seen for the Region 7 data.

Heptachlor Residue Variation with Species

Heptachlor residue variation with species is shown in Figure 13. Since most of the samples analyzed for heptachlor from all locations and species showed no detectable residues, trends in residue variation cannot be seen for most species. It can be seen, however, that low level predators/bottom-feeding species from Region 5 had higher average residues than those for the entire data set. The apparent lower average residues for American eels is due to a lower limit of detection for the analytical method used to determine residues in this species.

Heptachlor Residue Variation with Aquatic Environment

Heptachlor residue variation with aquatic environment (water type, fresh vs. salt water) is shown in Figure 11. Low level predators/bottom-feeding species and the entire data set show higher average residues for fresh water species than for salt water fish. High level predators show the opposite trend with salt water species having higher residues than fresh water fish. These trends are consistent over both years.

Heptachlor Residue Variation with Time

Heptachlor residue variation with time is shown in Figure 15. In all cases shown, an apparent increase in the average residues is seen going from 1985 to 1986. The possible reasons for this trend are numerous and cannot be determined from the available data.

Heptachlor Residue Variation with Location

Heptachlor residue variation with location is shown in Figure 14. For all locations analyzed other than Region 5, the average residues found are approximately equal to the national average.

Heptachlor residues from Region 5, particularly in samples from the Great Lakes, are significantly higher than the national average (difference = 0.008 ppm for combined 1985 + 1986 data; difference = 0.019 ppm for IL,MI,WI, 1986).

Heptachlor: Other Considerations

Table 3 shows the average residues and the tolerance limits (utilizing 95% confidence, 95% coverage of the fish population, no distribution assumed) for select data subsets. RCB previously recommended an action level for combined residues of heptachlor and heptachlor epoxide of 0.02 ppm based on FDA surveillance monitoring data for FY 1985 and FY 1986 (M. Metzger, 3/25/87).

Utilizing 95% confidence and 95% population coverage and using the entire data set currently available to RCB, we estimate that heptachlor residues are not likely to exceed 0.02 ppm nationally, and 0.1 ppm in Regions 5 and 7. Residues would likely be less than these values in most locations.

Table 3: Heptachlor Summary Statistics

<u>Year</u>	<u>Region</u>	<u>Water Type</u>	<u>Fish Type</u>	<u>FDA</u>	<u>Number of Samples</u>	<u>Average (ppm)</u>	<u>Tolerance Limit (ppm)</u>
1985	All	All	All	FDA	936	0.011	0.015
	All	All	All	All	1503	0.010	0.013
1986	All	All	All	FDA	588	0.012	0.025
	All	All	All	All	801	0.011	0.035
85 +	Reg 5	All	All	All	210	0.019	0.085
	Reg 7	All	All	All	147	0.010	0.086
86	Reg 2	All	All	All	1338	0.008	0.010
	All	All	All	FDA	1525	0.012	0.015
	All	All	All	All	2305	0.010	0.015

Figure 11:
HEPTACHLOR: Residue Variation with Water Type (Salt vs. Fresh Water)

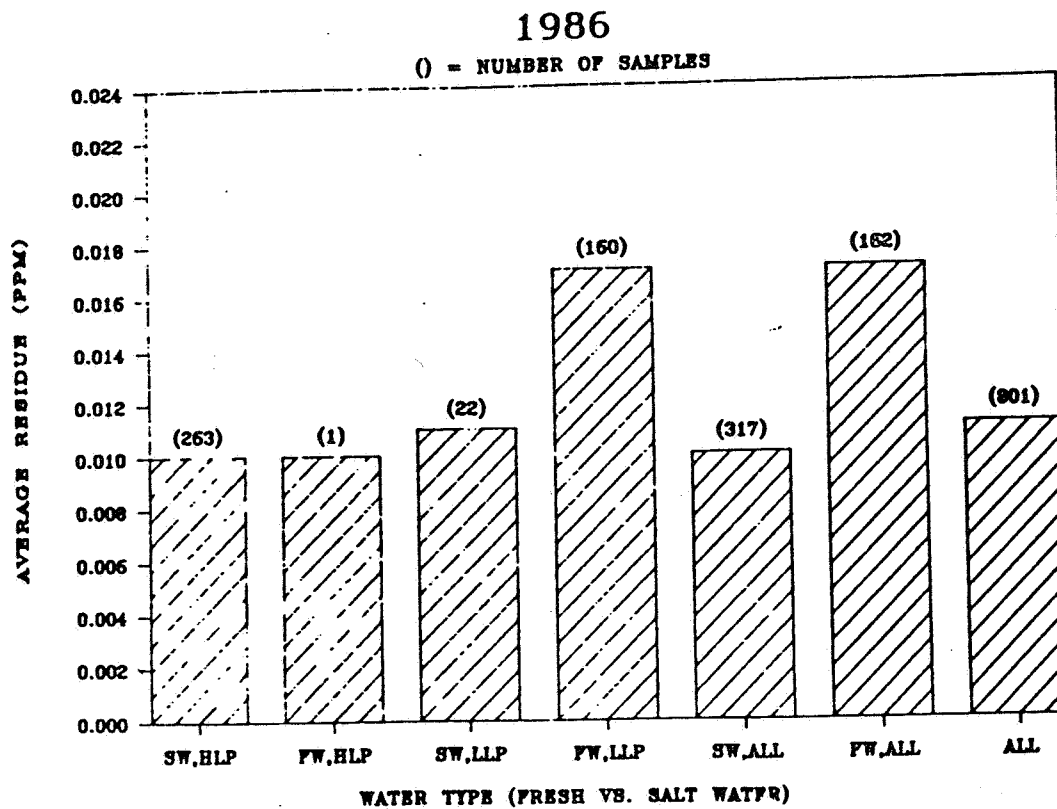
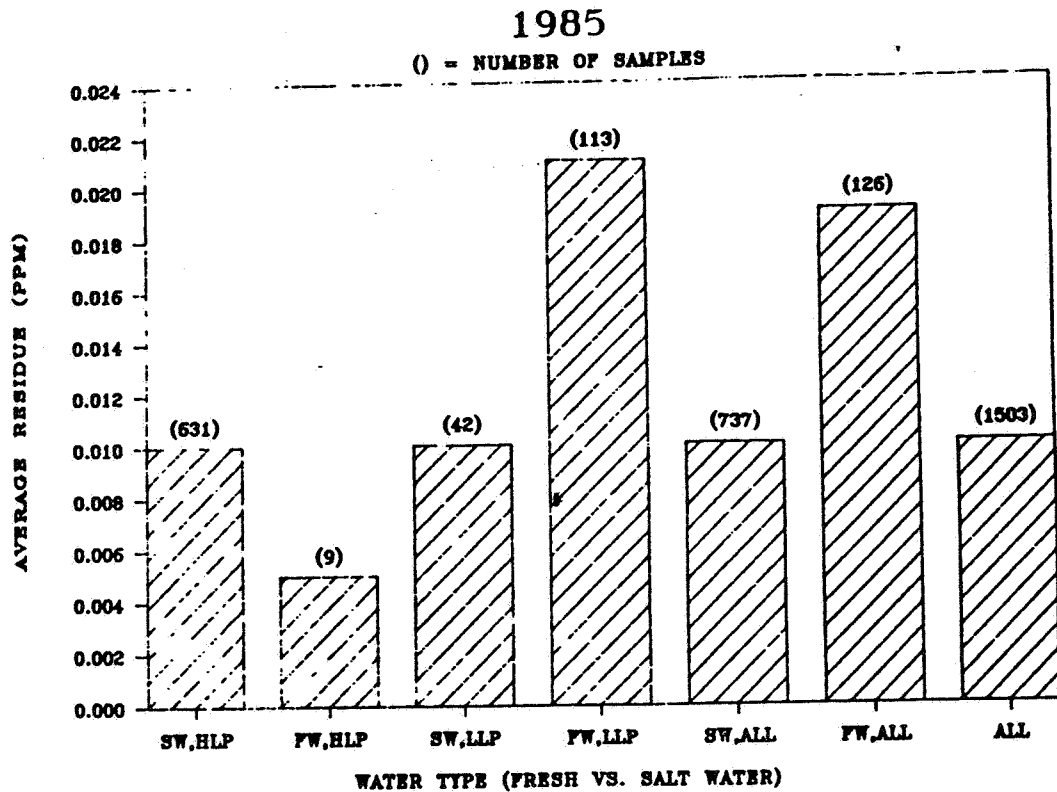
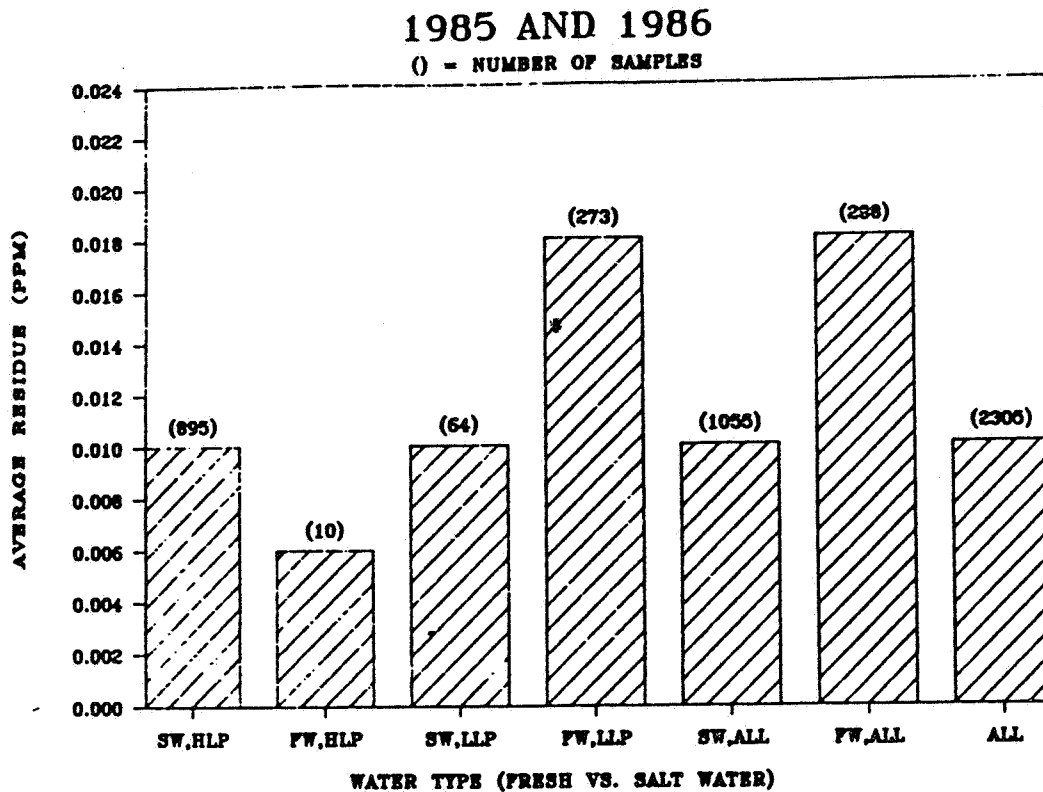


Figure 11 (Cont.):
HEPTACHLOR: Residue Variation with Water Type (Salt vs. Fresh Water)



SW = Salt Water Fish
HLP = High level predatory fish
FW = Fresh water fish
LLP = Low level predatory / bottom-feeding fish
All = All high level predatory and low level predatory / bottom-feeding fish

Figure 12:
HEPTACHLOR:

Residue Variation with Data Source (FDA vs. Non-FDA data)

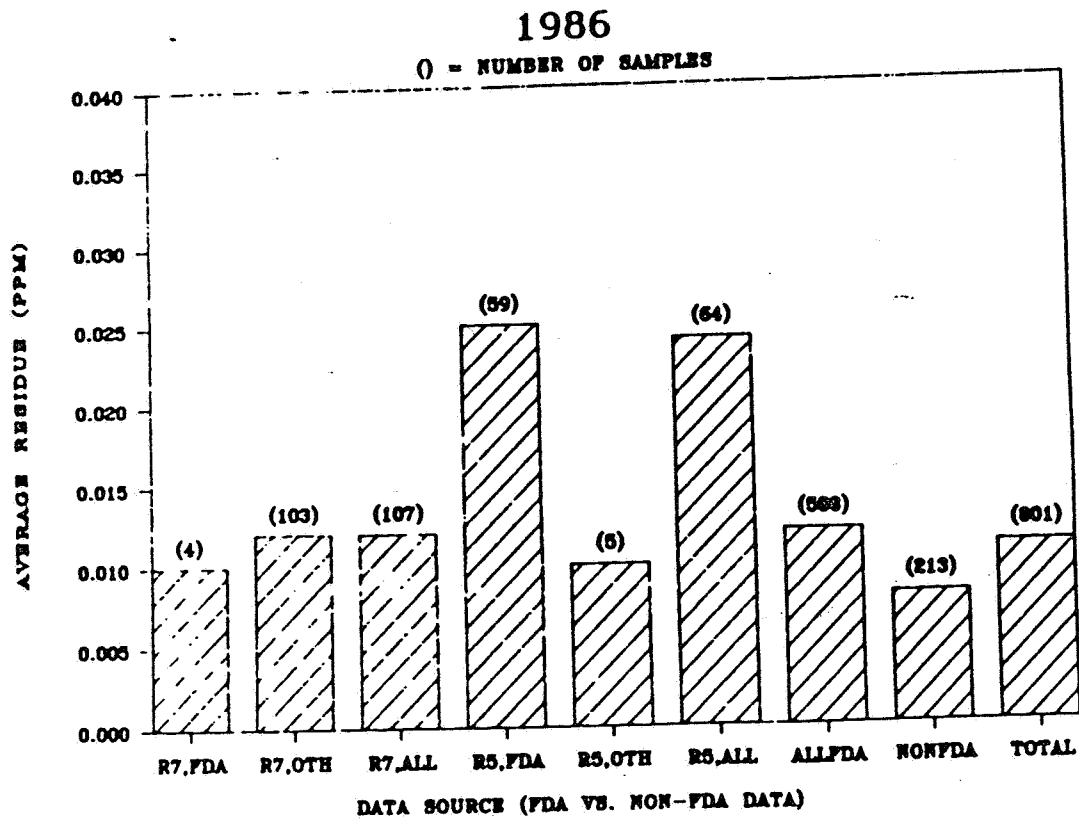
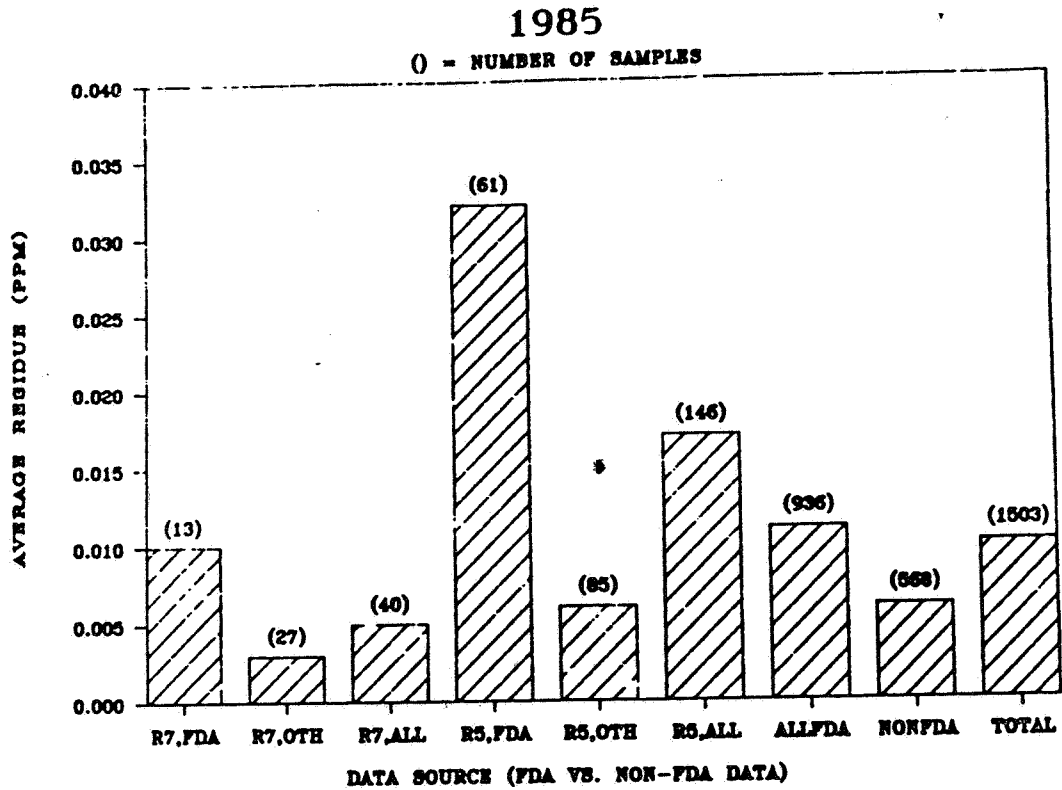
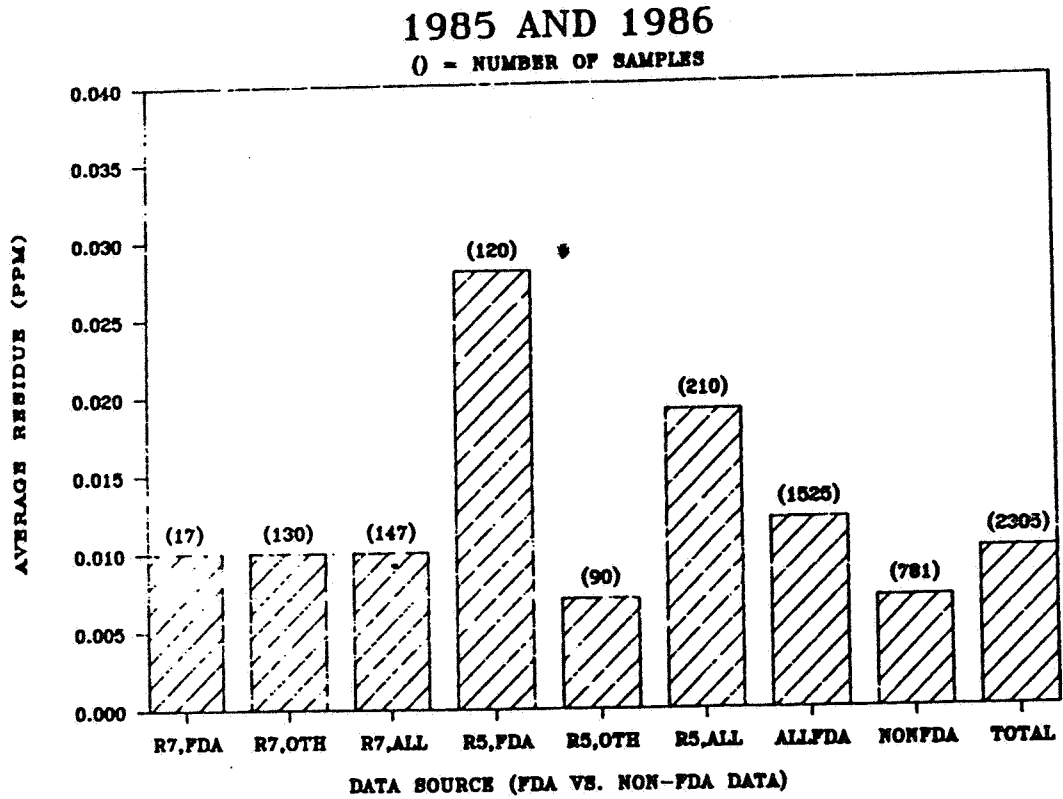


Figure 12 (Cont.):
HEPTACHLOR: Residue Variation with Data Source (FDA vs. Non-
FDA data)



R7 = EPA Region 7
R5 = EPA Region 5
FDA = FDA data only
OTH = All data other than FDA data
ALL = All FDA data and other (non-FDA) data
ALLFDA = FDA data from all locations
NONFDA = All data other than FDA data from all locations
TOTAL = All data

Figure 13:
HEPTACHLOR: Residue Variation with Species of Fish

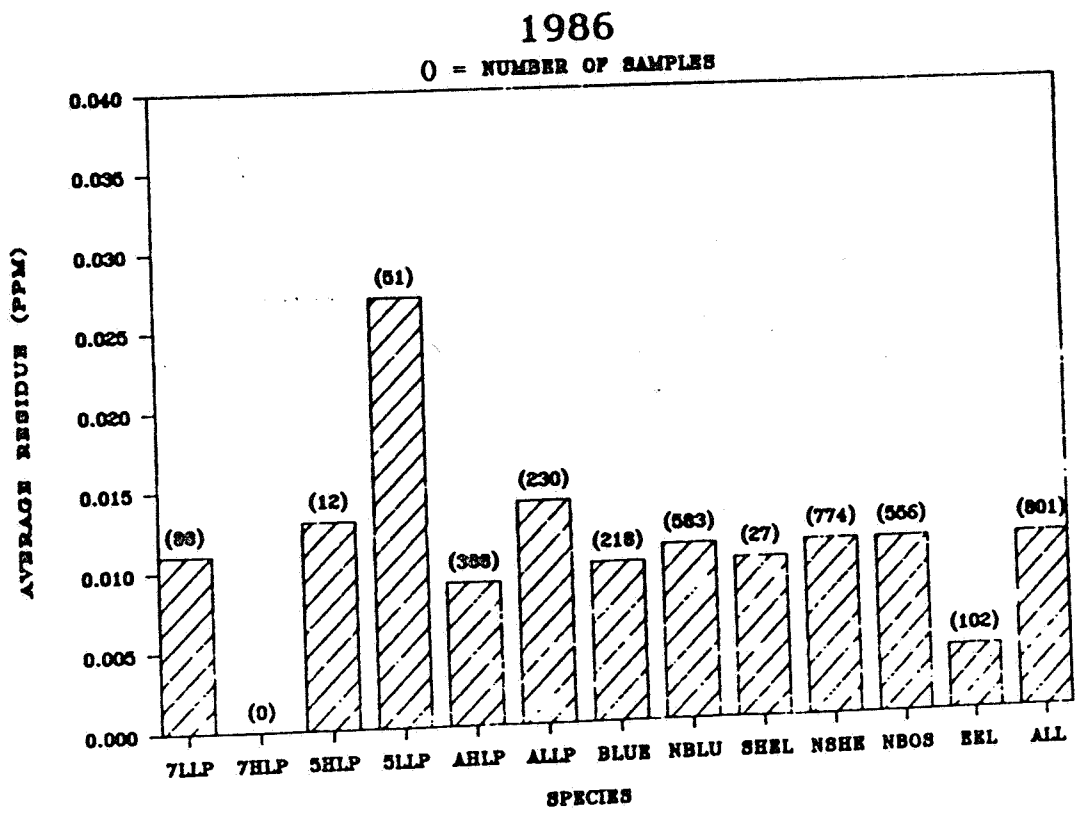
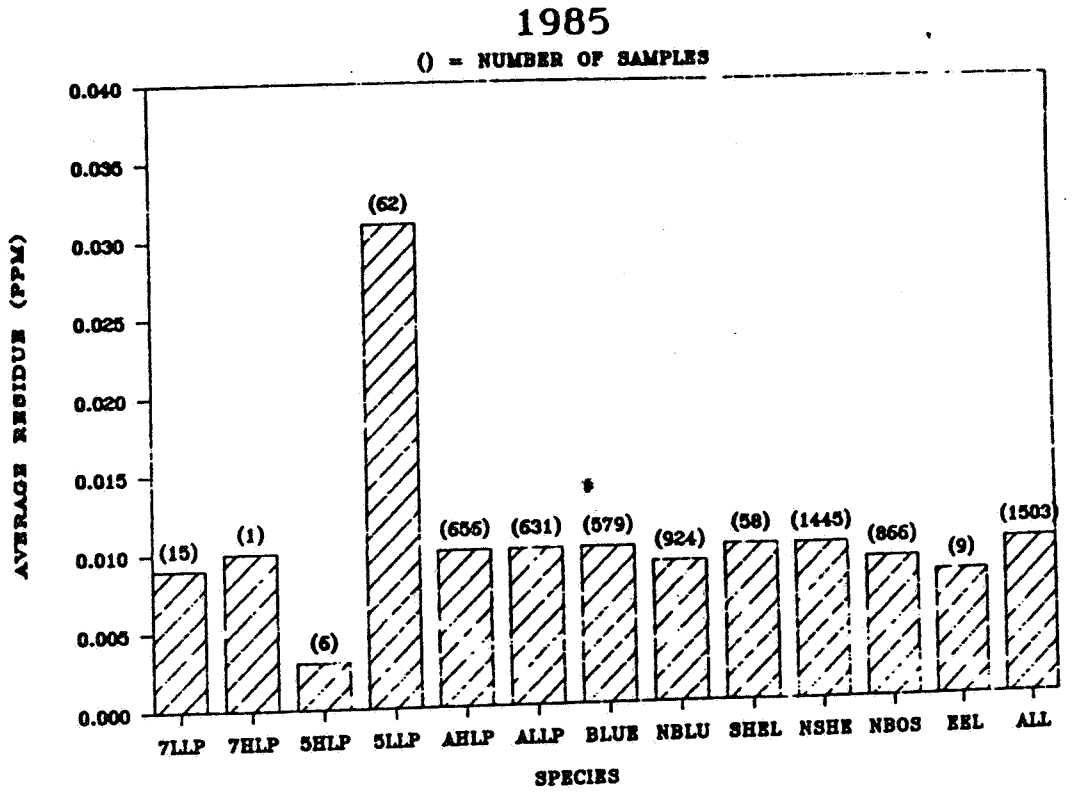
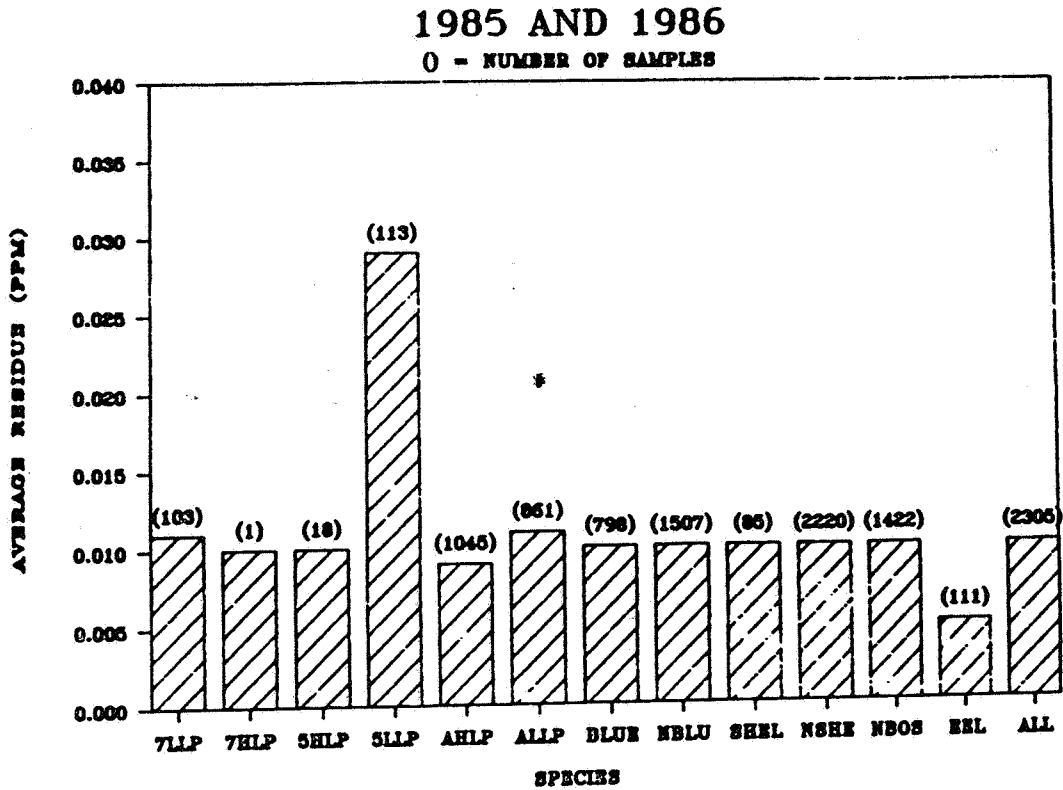


Figure 13 (Cont.):
HEPTACHLOR: Residue Variation with Species of Fish



7LLP = EPA Region 7, low level predatory and bottom-feeding fish
7HLP = EPA Region 7, high level predatory fish
5HLP = EPA Region 5, high level predatory fish
5LLP = EPA Region 5, low level predatory and bottom-feeding fish
AHL P = High level predators, all locations
ALLP = Low level predators, all locations
BLUE = Bluefish
NBLU = All fish except Bluefish
SHEL = Shellfish
NSHE = All fish except shellfish
NBOS = All fish except Bluefish and shellfish
EEL = American Eels
ALL = All fish

Figure 14:
HEPTACHLOR: Residue Variation with Location / Region

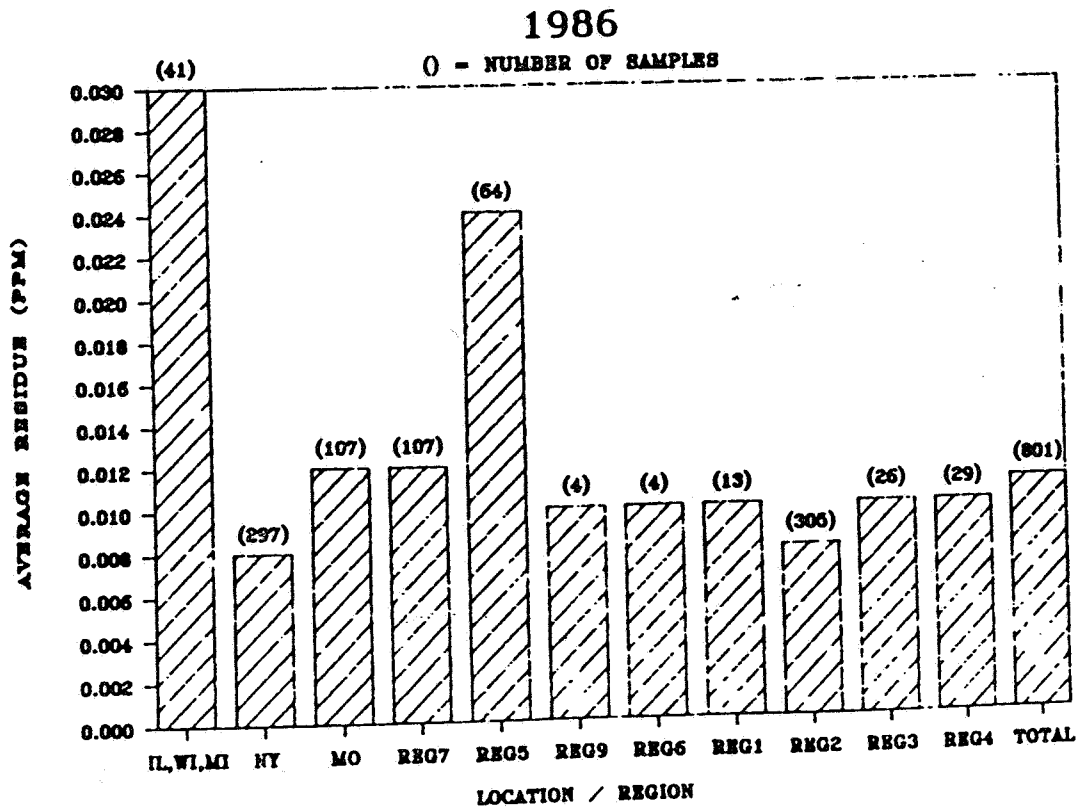
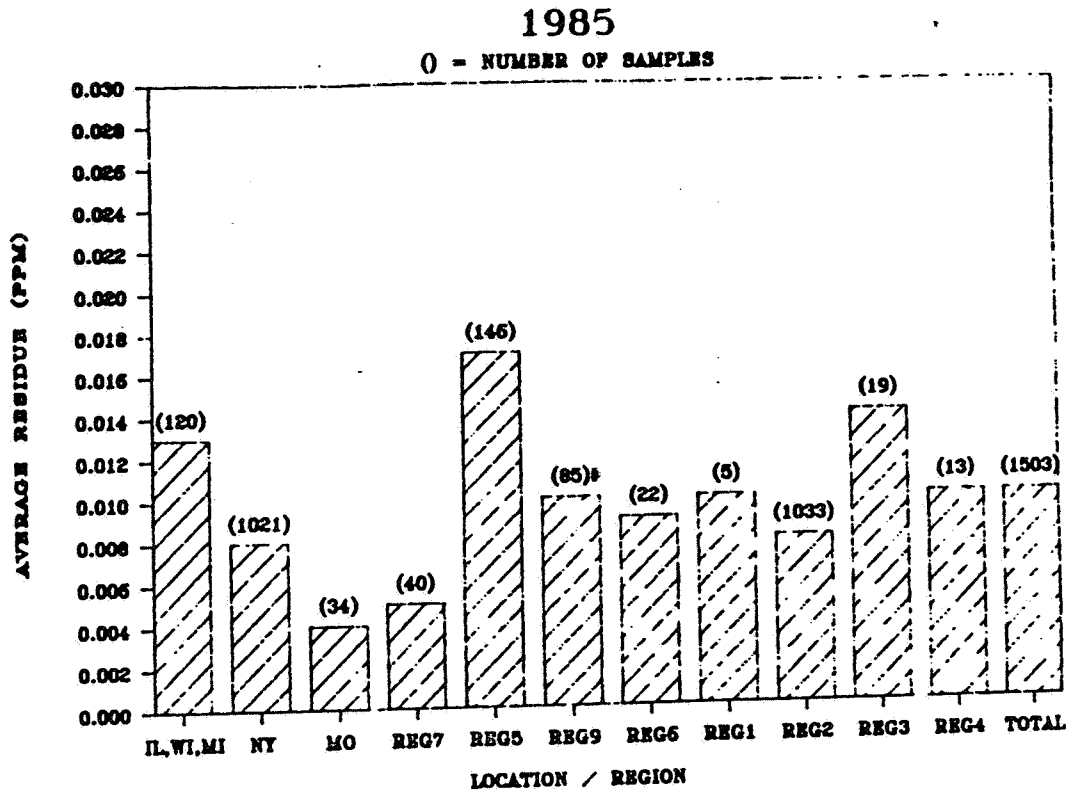
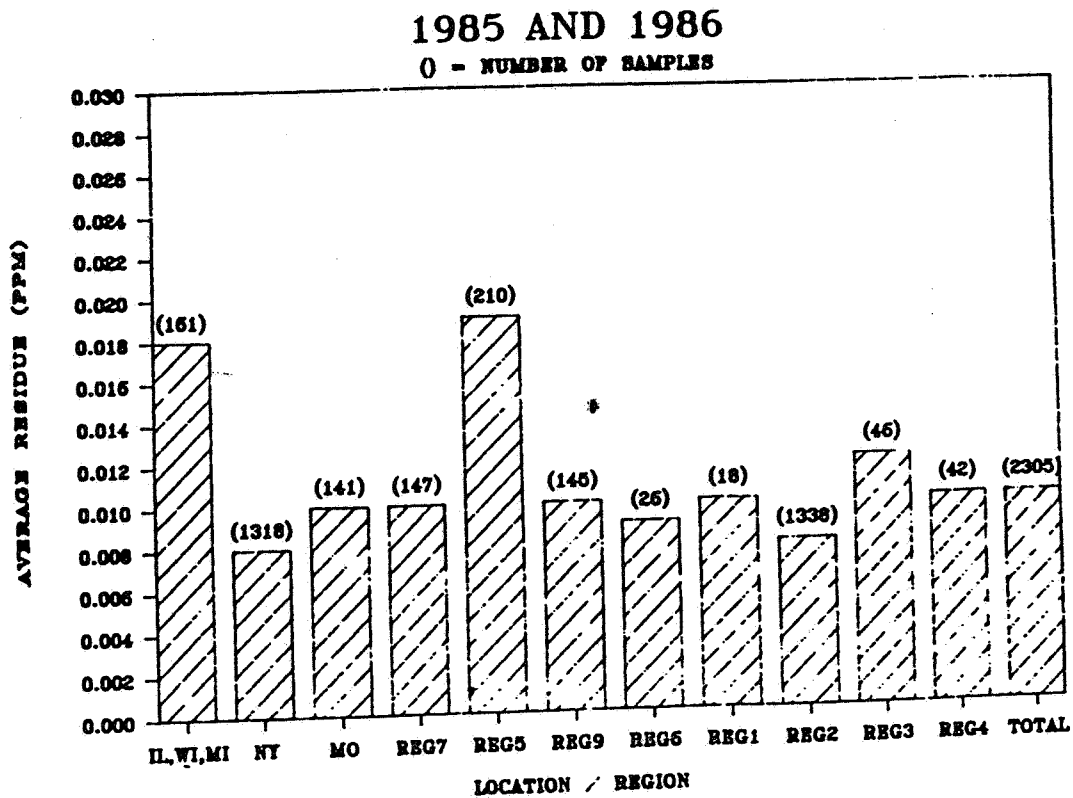
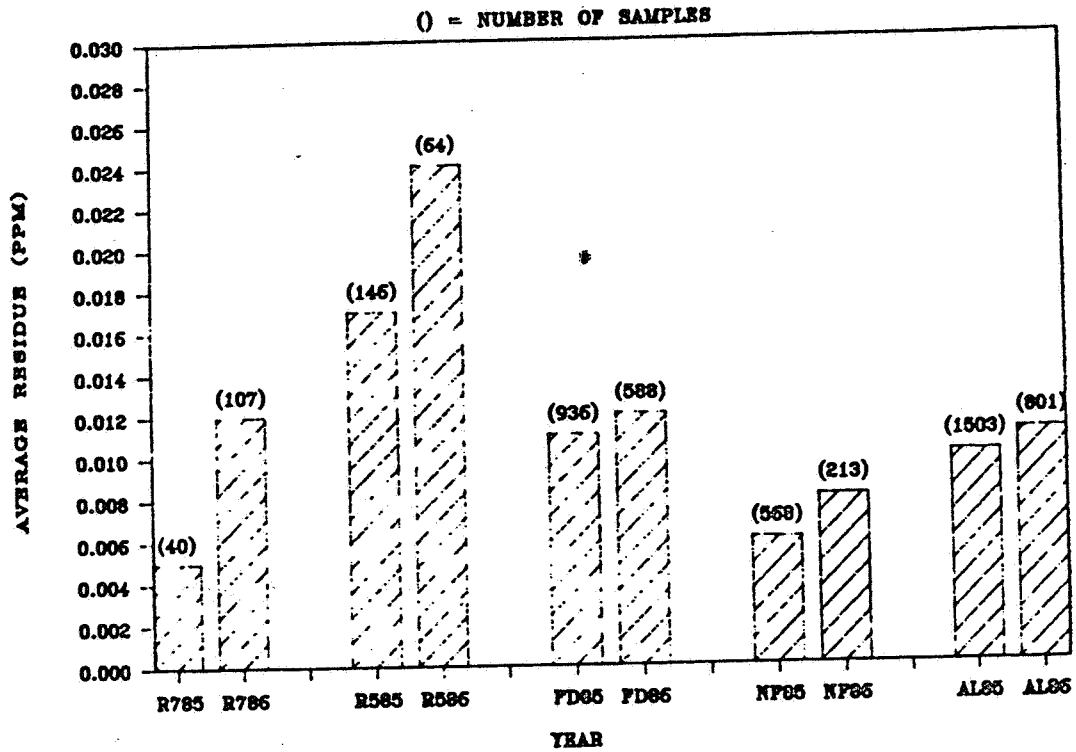


Figure 14 (Cont.):
HEPTACHLOR: Residue Variation with Location / Region



IL,WI,MI = Illinois, Wisconsin and Michigan
NY = New York
MO = Missouri
REGX = EPA Region X
TOTAL = Combined data from all locations

Figure 15:
HEPTACHLOR: Residue Variation with Time



R785 = EPA Region 7 data, 1985
R786 = EPA Region 7 data, 1986
R585 = EPA Region 5 data, 1985
R586 = EPA Region 5 data, 1986
FD85 = FDA data, 1985
FD86 = FDA data, 1986
NF85 = All data except FDA data, 1985
NF86 = All data except FDA data, 1986
AL85 = All data, 1985
AL86 = All data, 1986

DDT

DDT Residue Variation with Data Source, FDA vs. Other Data

DDT residue variation with data source is shown in Figure 17. For the entire data set, the average for the FDA data is lower than that for the other data by 0.2 ppm. For the two Regional subsets analyzed, the average of the FDA data from Region 7 is larger than that for other data by approximately 0.2 ppm, and the average of the FDA data from Region 5 is smaller than that for the other data by 0.91 ppm (combined 1985 + 1986 data). These trends are also reflected in the data sets for individual years. These trends could be due, in part, to the greater percentage of fresh water fish (which have higher average residues than salt water fish) in the non-FDA data.

DDT Residue Variation with Species

DDT residue variation with species is shown in Figure 18. Virtually no difference is seen between average residues found in high level predators and low level predators/bottom-feeders. Bluefish and American eels have average residues less than the average residues for all species, while shellfish show practically no DDT residue accumulation at all. Fish species other than bluefish, shellfish and American eels have average residues greater than average residues for all species. Major trends seen in the combined 1985 + 1986 data set are also seen in data sets for individual years.

DDT Residue Variation with Aquatic Environment

DDT residue variation with aquatic environment (water type, fresh vs. salt water) is shown in Figure 16. For low level predators/bottom-feeders and for the entire data set, fresh water fish have significantly higher residues than salt water fish. This trend is seen in both 1985 and 1986. For high level predators, a consistent year to year trend is seen in which salt water fish have slightly higher residues than fresh water fish.

DDT Residue Variation with Time

DDT residue variation with time is shown in Figure 20. Most data sets analyzed show a significant decrease in residues going from 1985 to 1986.

DDT Residue Variation with Location

DDT residue variation with location is shown in Figure 19. The average residues for Region 4 for 1985 and for combined 1985 + 1986 are 15.334 ppm and 5.522 ppm respectively. These residues are much higher than average residues for other

locations due to some unusually large values in the data subsets for Region 4 including one of 122.2 ppm, and because of the small size of the data subsets. Because of this small size, we cannot conclude that these large average residues are the average residues likely to be found in fish from Region 4. However, since the trend is seen for both 1985 and 1986 data, we can conclude that Region 4 appears to have significantly higher DDT residues than other locations.

Average residues from Region 5 (particularly in samples from the Great Lakes) have significantly higher values than the average from all locations (difference = 0.47 ppm for IL,MI,WI, combined 1985 + 1986 data). Average residues in NY are approximately equal to the average residues for all locations. Average residues from Regions 1, 3, 6, 9 and 7 (MO) are lower than the national average. These trends are consistent from year to year although the magnitude of the average residues vary.

DDT: Other Considerations

Table 4 shows the average residues and the tolerance limits (utilizing 95% confidence, 95% population coverage, no distribution assumed) for select data subsets for DDT. RCB's previous action level recommendation for residues of DDT and its metabolites in fish was 1 ppm based only on FDA surveillance monitoring data from FY 1985 and FY 1986.

Utilizing 95% confidence with 95% coverage of the fish population, and utilizing the entire data set currently available to RCB, we estimate that it is unlikely that combined residues of DDT and its metabolites would exceed 10 ppm in Region 5, and 2 ppm nationally. Residues found in most locations would likely be lower than these values.

Table 4: DDT Summary Statistics

<u>Year</u>	<u>Region</u>	<u>Water Type</u>	<u>Fish Type</u>	<u>FDA</u>	<u>Number of Samples</u>	<u>Average Residue (ppm)</u>	<u>Tolerance Limit (ppm)</u>
1985	All	All	All	FDA	936	0.379	0.615
	All	All	All	All	2239	0.482	1.525
1986	All	All	All	FDA	588	0.181	0.650
	All	All	All	All	803	0.178	0.650
85 +	Reg 5	All	All	All	245	0.730	8.794
	86	Reg 7	All	All	147	0.053	0.415
	Reg 2	All	All	All	2041	0.366	1.413
	All	All	All	FDA	1525	0.302	0.575
	All	All	All	All	3043	0.402	1.326

Figure 16:
DDT: Residue Variation with Water Type (Salt vs. Fresh Water)

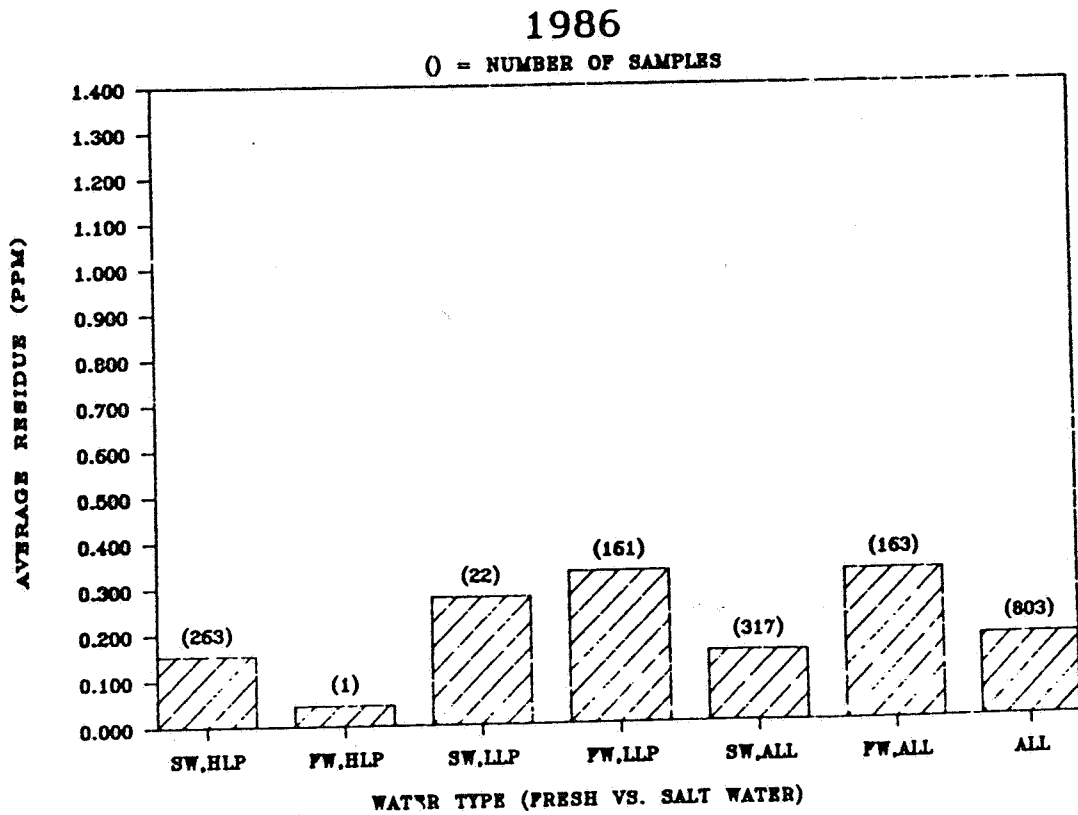
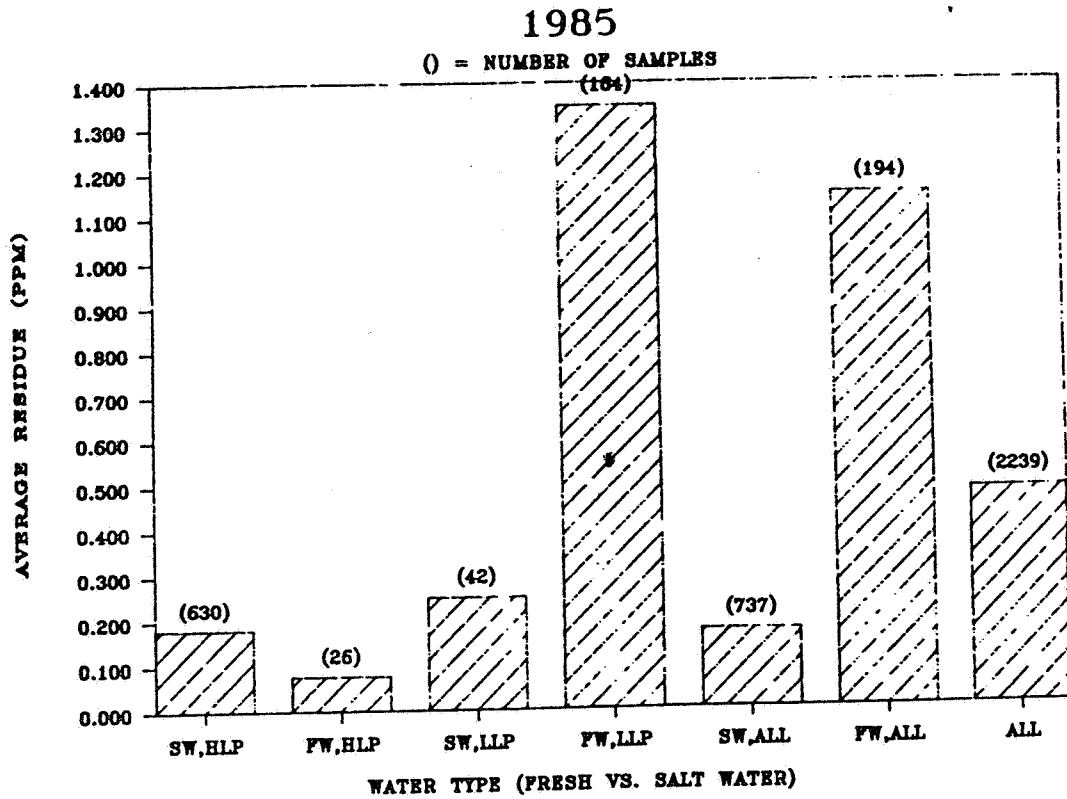
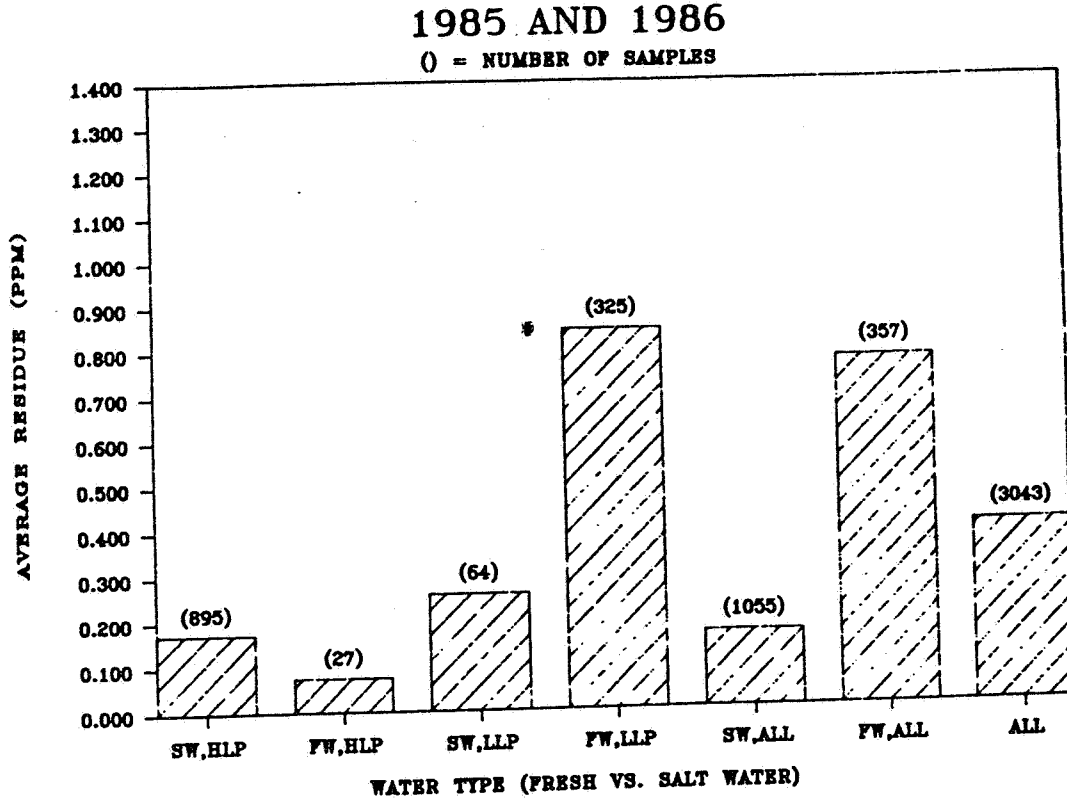


Figure 16 (Cont.):

DDT: Residue Variation with Water Type (Salt vs. Fresh Water)



SW = Salt Water Fish
HLP = High level predatory fish
FW = Fresh water fish
LLP = Low level predatory / bottom-feeding fish
All = All high level predatory and low level predatory / bottom-feeding fish

Figure 17:
DDT: Residue Variation with Data Source (FDA vs. Non-FDA data)

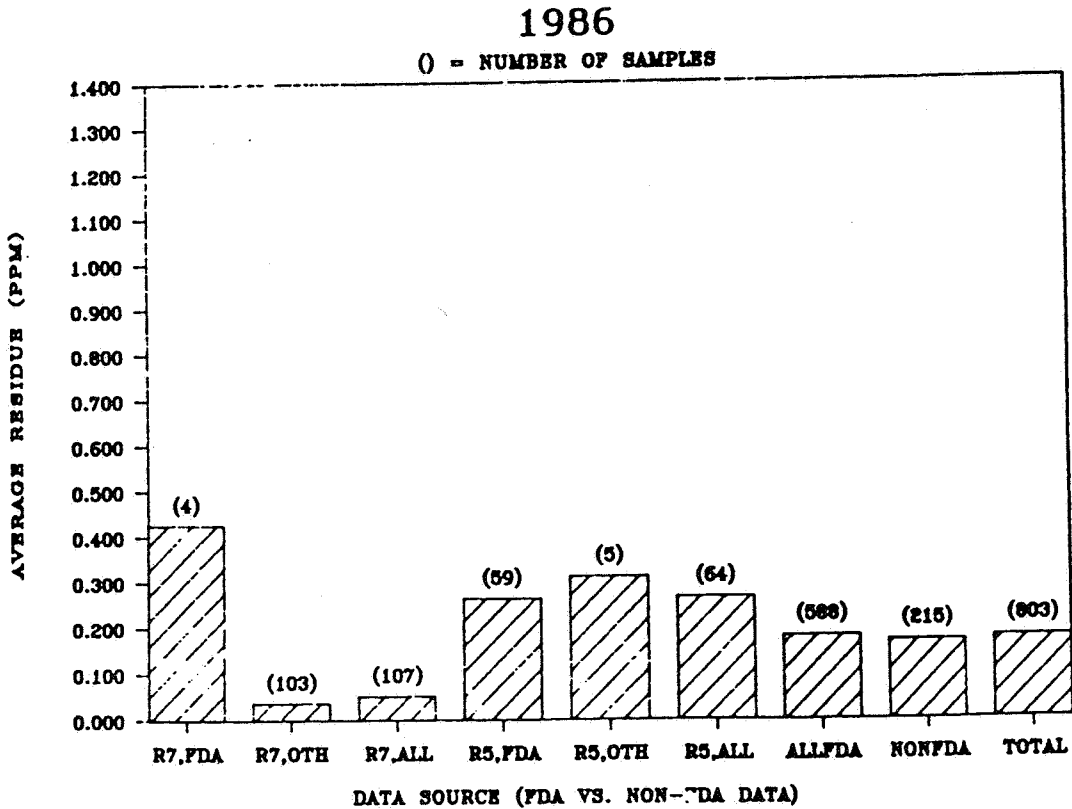
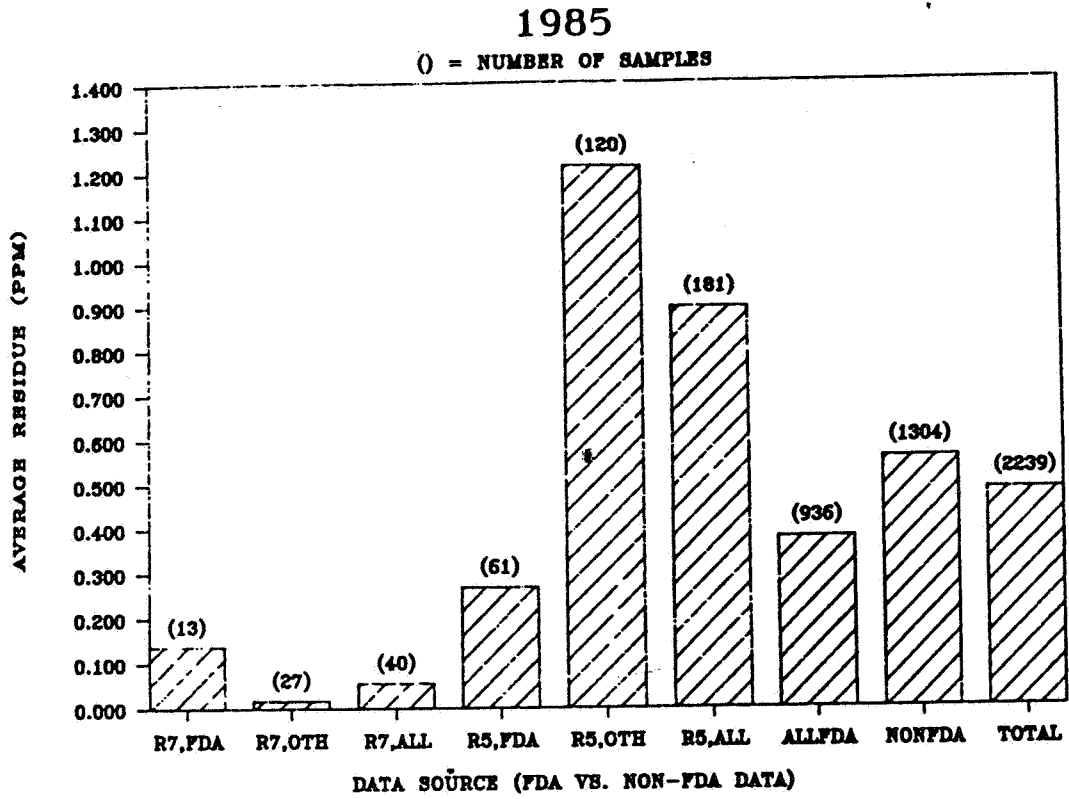


Figure 24:
ALDRIN/DIELDRIN: Residue Variation with Location / Region

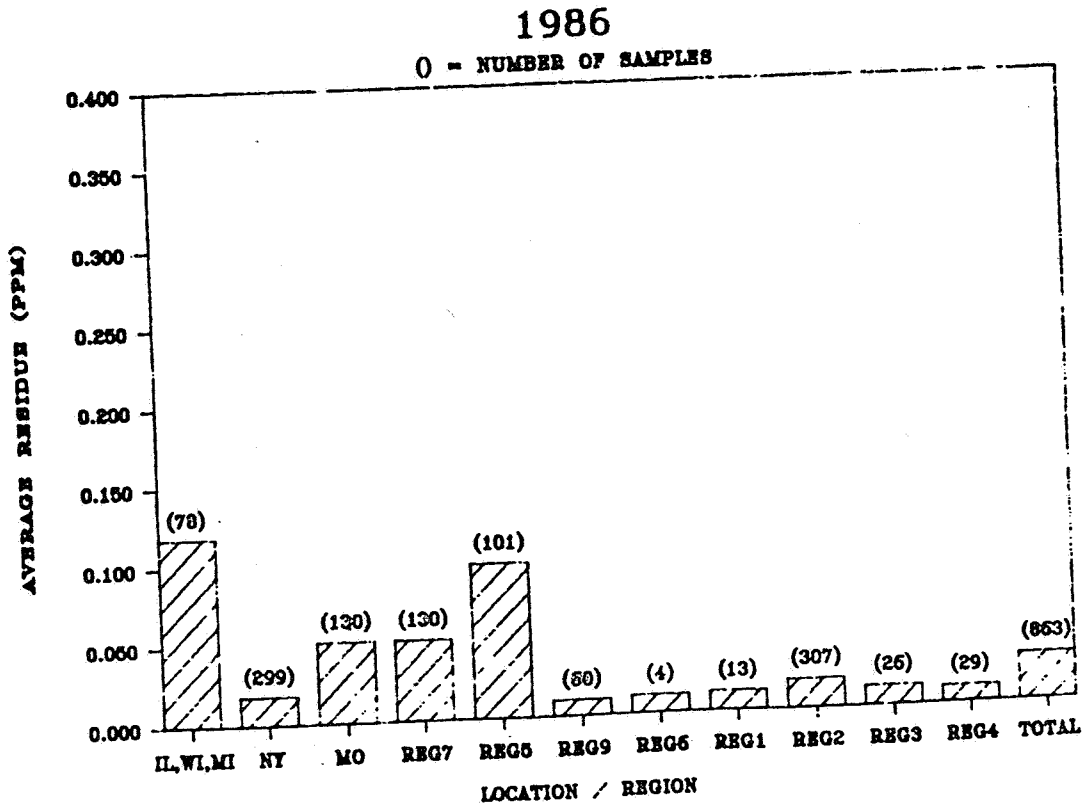
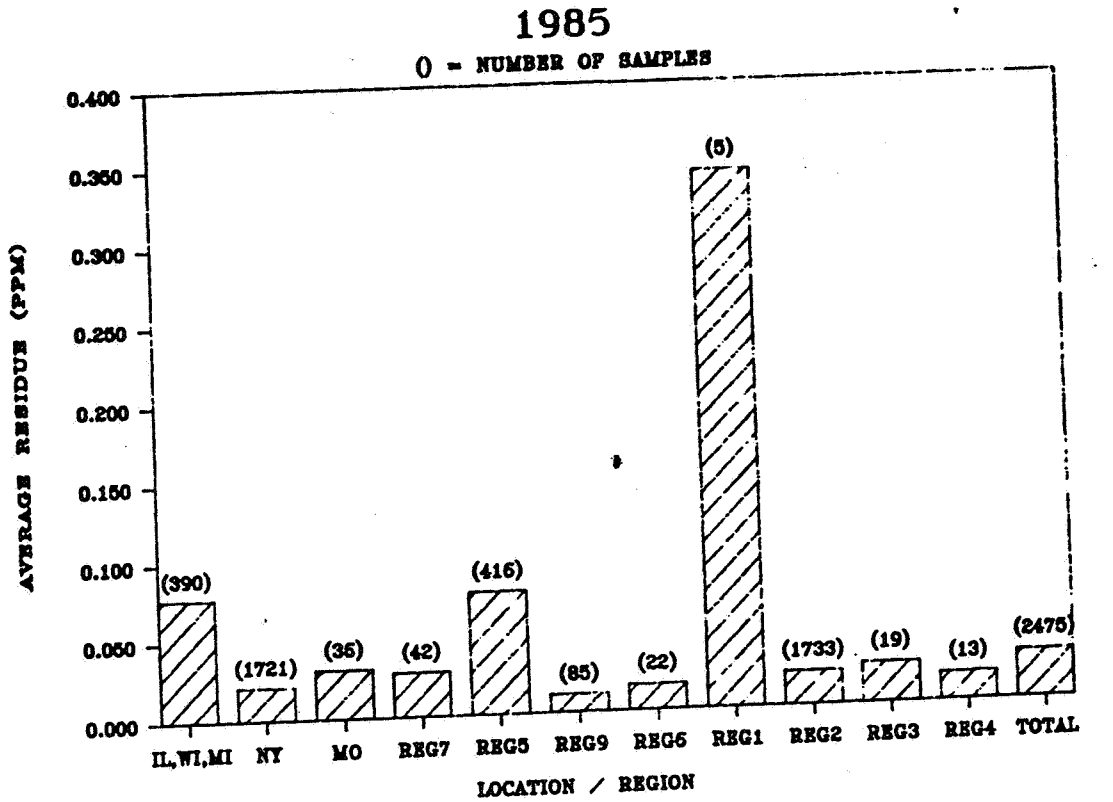
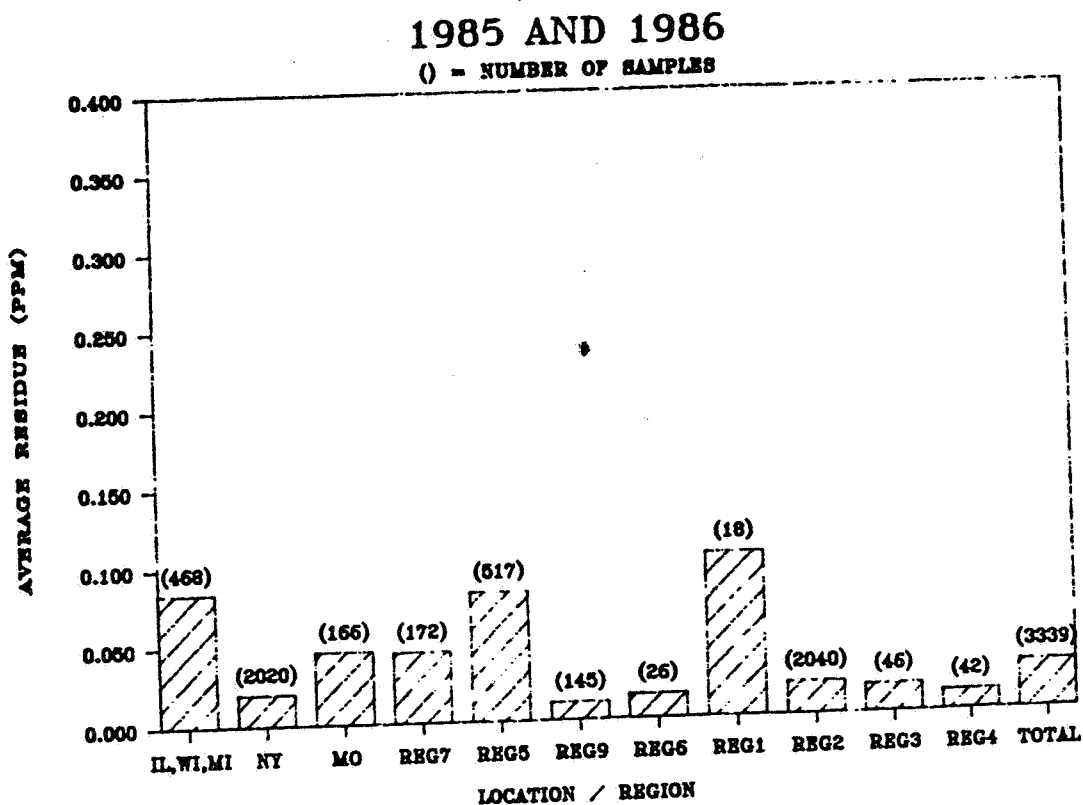
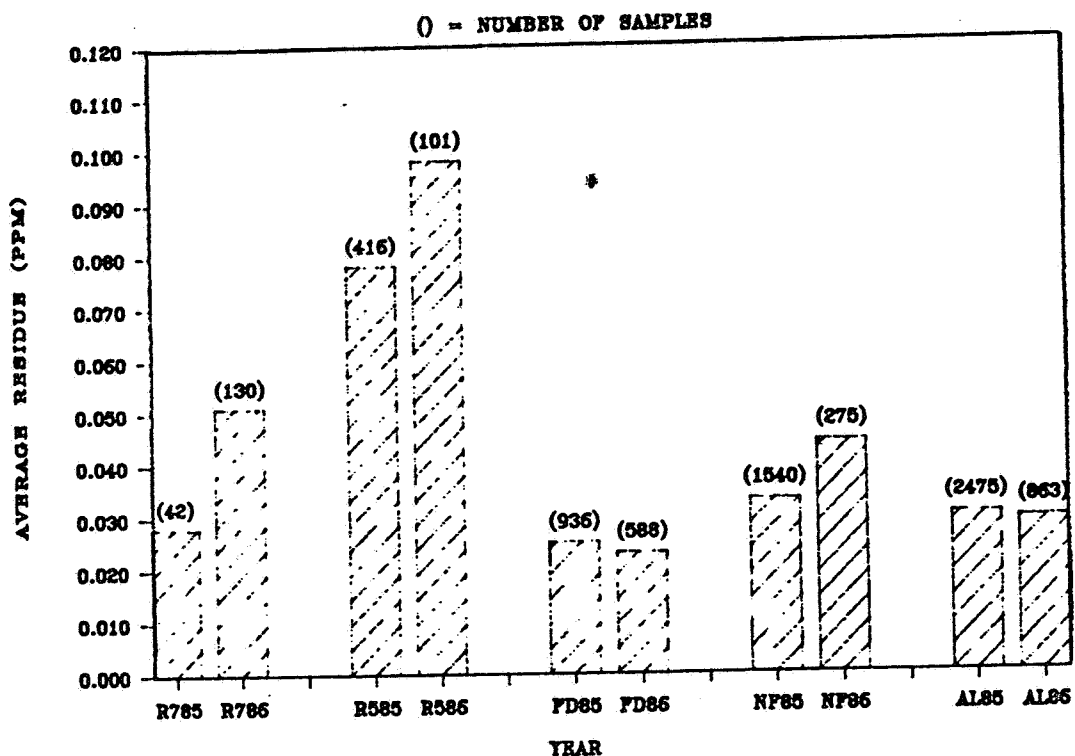


Figure 24 (Cont.):
ALDRIN/DIELDRIN: Residue Variation with Location / Region



IL,WI,MI = Illinois, Wisconsin and Michigan
NY = New York
MO = Missouri
REGX = EPA Region X
TOTAL = Combined data from all locations

Figure 25:
ALDRIN/DIELDRIN: Residue Variation with Time



- R785 = EPA Region 7 data, 1985
- R786 = EPA Region 7 data, 1986
- R585 = EPA Region 5 data, 1985
- R586 = EPA Region 5 data, 1986
- FD85 = FDA data, 1985
- FD86 = FDA data, 1986
- NF85 = All data except FDA data, 1985
- NF86 = All data except FDA data, 1986
- AL85 = All data, 1985
- AL86 = All data, 1986

Conclusions

- (1) The data set examined in this review includes numerous studies from various sources. The studies were performed for many purposes and utilized different analytical methods, sampling schemes, sample preparation techniques, QA/QC procedures and data reporting methods. Therefore, it is difficult to isolate single variables as causes for fish residue variations. Examination of these data and the conclusions below must be made keeping these factors in mind.
- (2) Neither the FDA data nor the non-FDA data have consistently greater average residues for all 5 of the subject chemicals. For chlordane and mirex, the FDA data have smaller average residues than non-FDA data. For aldrin/dieldrin, DDT and heptachlor, either the FDA data or the non-FDA data may show higher average residues depending on which data subset is being examined.
- (3) Several trends are seen in residue variation with species for the 5 chemicals.
 - (3a) For all 5 pesticides, shellfish have much smaller average residues than non-shellfish. Very few detectable residues of any of these pesticides were found in the 85 shellfish samples analyzed.
 - (3b) American eels have consistently lower average residues of all pesticides except chlordane than the average residues for all fish for each pesticide. This is most likely due to the reported lower limit of detection for the analytical method used to measure residues in American eels than analytical methods used to measure residues in other fish.
 - (3c) Average residues in Bluefish are less than or equal to the average residues for all fish for all pesticides.
 - (3d) For all chemicals except chlordane and mirex, low level predators/bottom feeders have slightly lower average residues than high level predators. This trend is reversed for chlordane. Mirex was found in only 1 Region (NY). Since primarily only samples of high level predators were obtained from this location, residue variation cannot be determined for mirex.
- (4) For all chemicals in which detectable residues were found in both salt and fresh water fish (i.e. all except mirex for which only fresh water fish samples showed detectable

residues), the entire data set and low level predators/bottom feeding species showed higher average residues in fresh water fish than in salt water fish, and for high level predators, salt water fish showed higher average residues.

(5) Of the 5 pesticides examined, only DDT showed a decrease in average residues from 1985 to 1986 for most data subsets examined. For the other chemicals, there is an apparent increase in residues in going from 1985 to 1986. A number of possible reasons are described in this review for this unexpected apparent increase in residues.

(6) The following Table shows locations in which particular residues were found in fish at significantly higher values than the average residue values for all locations.

<u>Pesticide</u>	<u>Location</u>	<u>Average Residue of Subset (ppm)</u>	<u>Average Residues in all Samples (ppm)</u>	<u>Residue Difference</u>
Chlordane	Region 7	0.301	0.125	0.176
Mirex	Region 2	0.045	0.032	0.013
Heptachlor	Region 5	0.019	0.010	0.009
DDT	Region 5	0.730	0.402	0.328
	Region 4*	5.522	0.402	5.120
Aldrin/	Region 5	0.082	0.030	0.052
dieldrin	Region 1*	0.104	0.030	0.074

*These average residue values do not likely represent average residues likely to be found due to the small number of samples involved and some inordinately high residue values found in the data subsets.

(7) The following Table lists current action levels, previously recommended action levels and maximum residues likely to be found in various locations assuming 95% confidence and 95% coverage of the fish population. It should be kept in mind that these values are calculated using data subsets in which location is not the only possible variable causing the observed residue level variation. Most locations would have considerably lower fish residues than those shown below (Table on next page).

<u>Chemical</u>	<u>Location</u>	<u>Maximum Likely Residue (ppm)</u>	<u>Current Action Level (ppm)</u>	<u>Previously Recommended Action Level (ppm)</u>
Chlordane	All	0.4	0.3	0.3
	Reg 5	0.5		
	Reg 7	2.0		
Mirex	All	0.3	0.1	None
	Reg 2	0.4		
Heptachlor	All	0.02	0.3	0.02
	Reg 5	0.1		
	Reg 7	0.1		
DDT	All	2.0	5	1
	Reg 5	10.0		
Aldrin/ Dieldrin	All	0.2	0.3	0.1
	Reg 5	0.4		
	Reg 7	0.4		

Recommendations

The data examined by RCB in this review are incongruous data sets due to the numerous purposes for which the data were monitored, the various sampling schemes and analytical methods used, the various data reporting formats, etc. Additionally, the information RCB has about these studies, other than the actual residue values, is minimal. Although each individual study may be adequate for the purposes for which it was performed, utilization of the results of these studies as a whole to determine maximum likely residues to be found in the edible portion of fish on a national basis is tenuous at best. Therefore, we recommend that only the FDA surveillance monitoring data be used for this purpose since these data are the most representative, randomized, appropriately weighted and consistent data set currently available.

Alternatively, we would recommend that a fish residue monitoring program be designed and implemented for the specific purpose of dietary exposure assessment.

Attachments to S.F., Reviewer, Theodore M. Farber (TOX, TS-769C), Amy Rispin (SIS, TS-769C)
 cc: DDT, Chlordane, Mirex, Heptachlor, Aldrin/dieldrin, Fish, S.F., R.F., Circu, M. Metzger, PMSD/ISB, Theodore M. Farber (TOX, TS-769C), Amy Rispin (SIS, TS-769C)
 RDI:E.Zager:EZ:10/13/87
 TS-769C:RCB:M.Metzger:MM:Rm803a:CM#2:10/13/87

Appendix I

Sources of Data Used in Statistical Calculations

Data Sources

- (1) Missouri Department of Health, Health Advisory Issued for Missouri and Mississippi Rivers, News Release, 2/11/87, plus related attachments.
- (2) Missouri Department of Health, Health Advisory Issued for Wilson Creek and James River, News Release, 9/18/86, plus related attachments.
- (3) Missouri Department of Health, Health Advisory continued for Meramec River, News Release, 6/9/86, plus related attachments.
- (4) Ronald Crunkilton, Missouri Department of Conservation, Fish and Wildlife Research Center, Chlorinated Hydrocarbon Pesticides and PCBs in Lake of the Ozarks Fish, June, 1985.
- (5) Fish Contamination Monitoring Program, 1986 Annual Report, Michigan Department of Natural Resources, Nov., 1986.
- (6) Microcontaminants in Lake Michigan, Lake Superior, Green Bay and Their Tributaries Since 1983, computer printout, Wisconsin Department of Natural Resources, March 2, 1987.
- (7) Microcontaminants in Inland Waters of Wisconsin Since 1983, Wisconsin Department of Natural Resources, computer printout, March 2, 1987.
- (8) Microcontaminants in Whole Fish Samples from Wisconsin Waters Since 1978, computer printout, Wisconsin Department of Natural Resources, March 4, 1987.
- (9) EPA/FDA Great Lakes Fish Monitoring Survey for FY 1986, raw data sheets and summary tables.
- (10) FDA Surveillance Monitoring Data, Domestic Samples for FY 1985 and FY 1986, provided to OPP by Mr. Ellis L. Gunderson, Division of Contaminants Chemistry, Center for Food Safety and Applied Nutrition, FDA.
- (11) Max A. Anderson, Region 5 Fish Tissue Report, U.S. Environmental Protection Agency, Sept., 1986.
- (12) Bioaccumulation Monitoring Guidance: Selection of Target Species and Review of Available Bioaccumulation Data, Office of Marine and Estuarine Protection, U.S. Environmental Protection Agency, Prepared by Tetra Tech, Inc., Sept., 1985.

- (13) Report of the Analysis of Fishes Collected During 1985 from the Ambient Fish Tissue Monitoring Program Sites in Iowa, U.S. Environmental Protection Agency, Region VII, not dated.
- (14) Final report of an Intensive Water Quality Survey of the Lake of the Woods and the Lagoon in Swope Park, Kansas City, Missouri, U.S. Environmental Protection Agency, Region 7, July 1985, plus related attachments.
- (15) Computer printout, 1985 data from NY, Lake Ontario, trout.
- (16) Computer printout, 1985 data from NY, Long Island Ponds.
- (17) Computer printout, 1985 data from NY, Lake Ontario, Lake trout.
- (18) Computed printout, 1985 data from NY, Keuka Lake, Lake trout.
- (19) Computer printout, 1985 data from NY, Cayuga Lake, Lake trout.
- (20) Computed printout, data from NY, Saint Lawrence River.
- (21) Computer printout, data from NY, Fulton Chain Lakes.
- (22) Computer printout, 1985 data from NY, Onondaga lake.
- (23) Computer printout, data from NY, Lake Ontario.
- (24) Computer printout, Statewide toxic substances monitoring program.
- (25) Computer printout, data from NY, Organochlorines and Hg in Striped Bass from the Marine district, 1985.

Appendix II

Tabular Summary of Statistical Calculations

CHLORDANE, 1985

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	353	0.125	0.99	0.310	0.383
NY	All	All	All	1439	0.137	25.14	1.312	0.357
MO	All	All	All	36	0.149	2.96	1.023	0.788
Reg 7	All	All	All	42	0.133	2.96	0.945	0.788
Reg 7	All	LLP	All	17	0.271	2.96	1.506	0.788
Reg 7	All	All	FDA	13	0.068	0.041	0.296	0.041
Reg 7	All	All	NoFDA	29	0.161	2.96	1.123	0.788
Reg 7	All	HLP	All	1	0.030	0.030	-	-
Reg 5	All	HLP	All	188	0.138	0.99	0.343	0.470
Reg 5	All	LLP	All	100	0.125	0.47	0.302	0.415
Reg 5	All	All	FDA	61	0.134	0.415	0.330	0.415
Reg 5	All	All	NoFDA	318	0.124	0.99	0.304	0.380
Reg 5	All	All	All	379	0.126	0.99	0.308	0.380
Reg 9	All	All	All	85	0.030	0.030	0.030	0.030
Reg 6	All	All	All	22	0.030	0.050	0.039	0.050
Reg 1	All	All	All	5	0.031	0.035	0.035	0.035
Reg 2	All	All	All	1451	0.136	25.14	1.306	0.369
Reg 3	All	All	All	19	0.041	0.115	0.085	0.115
Reg 4	All	All	All	13	0.127	0.96	0.561	0.960
All	Salt	HLP	All	631	0.102	1.005	0.234	0.220
All	Salt	LLP	All	42	0.032	0.110	0.053	0.110
All	Salt	All	All	737	0.091	1.005	0.222	0.210
All	Fresh	HLP	All	51	0.076	0.386	0.188	0.386
All	Fresh	LLP	All	151	0.123	2.960	0.593	0.788
All	Fresh	All	All	206	0.109	2.960	0.518	0.470
All	All	HLP	All	1179	0.146	25.14	1.439	0.369
All	All	LLP	All	699	0.081	2.960	0.327	0.261
All	All	Bluefi	All	579	0.108	1.005	0.241	0.240
All	All	No Blfi	All	1577	0.126	25.14	1.259	0.385
All	All	Shellfi	All	58	0.030	0.035	0.031	0.035
All	All	No shel	All	2098	0.124	25.14	1.109	0.340
All	All	No Bf, S	All	1519	0.129	25.14	1.284	0.390
All	All	Eel	All	9	0.100	0.205	0.238	0.205
All	All	All	FDA	936	0.088	1.005	0.233	0.240
All	All	All	NoFDA	1221	0.146	25.14	1.43	0.415
All	All	All	All	2156	0.121	25.14	1.093	0.335

CHLORDANE, 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit. (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	78	0.258	2.69	1.011	2.690
NY	All	All	All	299	0.121	0.995	0.310	0.370
MO	All	All	All	130	0.355	6.735	1.586	1.926
Reg 7	All	All	All	130	0.355	6.735	1.586	1.926
Reg 7	All	LLP	All	107	0.250	2.045	0.829	1.389
Reg 7	All	All	FDA	4	0.152	0.520	0.525	0.520
Reg 7	All	All	NoFDA	126	0.361	6.735	1.609	1.926
Reg 7	All	HLP	All	0				
Reg 5	All	HLP	All	18	0.080	0.100	0.108	0.100
Reg 5	All	LLP	All	82	0.248	2.69	0.986	2.690
Reg 5	All	All	FDA	59	0.125	0.450	0.286	0.450
Reg 5	All	All	NoFDA	42	0.345	2.69	1.333	2.690
Reg 5	All	All	All	101	0.217	2.69	0.893	1.871
Reg 9	All	All	All	60	0.030	0.030	0.030	0.030
Reg 6	All	All	All	4	0.039	0.055	0.056	0.050
Reg 1	All	All	All	13	0.040	0.070	0.064	0.070
Reg 2	All	All	All	307	0.119	0.995	0.307	0.370
Reg 3	All	All	All	26	0.056	0.185	0.126	0.185
Reg 4	All	All	All	29	0.031	0.045	0.036	0.045
All	Salt	HLP	All	263	0.092	0.995	0.264	0.300
All	Salt	LLP	All	22	0.046	0.264	0.138	0.264
All	Salt	All	All	317	0.082	0.995	0.245	0.280
All	Fresh	HLP	All	6	0.088	0.100	0.134	0.100
All	Fresh	LLP	All	208	0.215	2.690	0.837	1.330
All	Fresh	All	All	215	0.210	2.690	0.824	1.330
All	All	HLP	All	394	0.103	0.995	0.278	0.343
All	All	LLP	All	281	0.179	2.690	0.743	0.961
All	All	Bluefi	All	218	0.104	0.995	0.285	0.340
All	All	No Blfi	All	645	0.143	6.735	0.800	0.745
All	All	Shellfi	All	27	0.030	0.030	0.030	0.030
All	All	No shel	All	836	0.137	6.735	0.721	0.548
All	All	No Bf, S	All	618	0.148	6.735	0.818	0.777
All	All	Eel	All	102	0.142	0.514	0.329	0.513
All	All	All	FDA	588	0.068	0.995	0.212	0.245
All	All	All	NoFDA	275	0.273	6.735	1.227	1.609
All	All	All	All	863	0.134	6.735	0.710	0.539

CHLORDANE, 1985 + 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	431	0.149	2.690	0.521	0.470
NY	All	All	All	1738	0.134	25.14	1.206	0.368
MO	All	All	All	166	0.310	6.735	1.483	1.926
Reg 7	All	All	All	172	0.301	6.735	1.456	1.926
Reg 7	All	LLP	All	124	0.253	2.96	0.959	1.389
Reg 7	All	All	FDA	17	0.088	0.52	0.364	0.520
Reg 7	All	All	NoFDA	155	0.324	6.735	1.531	1.926
Reg 7	All	HLP	All	1	0.030	0.030		
Reg 5	All	HLP	All	206	0.133	0.990	0.331	0.470
Reg 5	All	LLP	All	182	0.180	2.690	0.704	0.882
Reg 5	All	All	FDA	120	0.130	0.450	0.309	0.415
Reg 5	All	All	NoFDA	360	0.150	2.690	0.547	0.538
Reg 5	All	All	All	480	0.145	2.690	0.501	0.450
Reg 9	All	All	All	145	0.030	0.030	0.030	0.030
Reg 6	All	All	All	26	0.031	0.055	0.043	0.055
Reg 1	All	All	All	18	0.038	0.070	0.059	0.070
Reg 2	All	All	All	1758	0.133	25.14	1.199	0.368
Reg 3	All	All	All	46	0.049	0.185	0.111	0.185
Reg 4	All	All	All	42	0.161	0.960	0.314	0.960
All	Salt	HLP	All	895	0.099	1.005	0.244	0.250
All	Salt	LLP	All	64	0.037	0.264	0.095	0.264
All	Salt	All	All	1055	0.089	1.005	0.230	0.230
All	Fresh	HLP	All	57	0.077	0.386	0.185	0.386
All	Fresh	LLP	All	359	0.176	2.96	0.745	0.882
All	Fresh	All	All	421	0.161	2.96	0.692	0.777
All	All	HLP	All	1574	0.135	25.14	1.258	0.343
All	All	LLP	All	980	0.109	2.96	0.484	0.455
All	All	Bluefi	All	798	0.107	1.005	0.255	0.250
All	All	No Blfi	All	2222	0.131	25.14	1.150	0.423
All	All	Shellfi	All	85	0.030	0.035	0.031	0.030
All	All	No shel	All	2935	0.127	25.14	1.017	0.376
All	All	No Bf, S	All	2137	0.135	25.14	1.173	0.435
All	All	Eel	All	111	0.139	0.514	0.323	0.513
All	All	All	FDA	1525	0.080	1.005	0.226	0.235
All	All	All	NoFDA	1496	0.169	25.14	1.402	0.539
All	All	All	All	3020	0.125	25.14	1.002	0.372

MIREX, 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	37	0.005	0.005	0.005	0.005
NY	All	All	All	272	0.005	0.108	0.016	0.005
MO	All	All	All	4	0.005	0.005	0.005	0.005
Reg 7	All	All	All	4	0.005	0.005	0.005	0.005
Reg 7	All	LLP	All	4	0.005	0.005	0.005	0.005
Reg 7	All	All	FDA	4	0.005	0.005	0.005	0.005
Reg 7	All	All	NoFDA	0	0.005	0.005	0.005	0.005
Reg 7	All	HLP	All	0	0.005	0.005	0.005	0.005
Reg 5	All	HLP	All	8	0.005	0.005	0.005	0.005
Reg 5	All	LLP	All	51	0.005	0.005	0.005	0.005
Reg 5	All	All	FDA	59	0.005	0.005	0.005	0.005
Reg 5	All	All	NoFDA	1	0.005	0.005	0.005	0.005
Reg 5	All	All	All	60	0.005	0.005	0.005	0.005
Reg 9	All	All	All	60	0.005	0.005	0.005	0.005
Reg 6	All	All	All	4	0.005	0.005	0.005	0.005
Reg 1	All	All	All	13	0.005	0.005	0.005	0.005
Reg 2	All	All	All	280	0.005	0.108	0.016	0.005
Reg 3	All	All	All	26	0.005	0.005	0.005	0.005
Reg 4	All	All	All	29	0.005	0.005	0.005	0.005
All	Salt	HLP	All	263	0.005	0.005	0.005	0.005
All	Salt	LLP	All	20	0.005	0.005	0.005	0.005
All	Salt	All	All	315	0.005	0.005	0.005	0.005
All	Fresh	HLP	All	1	0.005	0.005	0.005	0.005
All	Fresh	LLP	All	108	0.005	0.008	0.006	0.006
All	Fresh	All	All	110	0.005	0.008	0.006	0.006
All	All	HLP	All	360	0.004	0.005	0.007	0.005
All	All	LLP	All	144	0.005	0.008	0.006	0.005
All	All	Bluefi	All	218	0.005	0.005	0.005	0.005
All	All	No Blfi	All	451	0.005	0.108	0.014	0.005
All	All	Shellfi	All	27	0.005	0.005	0.005	0.005
All	All	No shel	All	642	0.005	0.108	0.012	0.005
All	All	No Bf, S	All	424	0.005	0.108	0.014	0.005
All	All	Eel	All	78	0.002	0.005	0.005	0.005
All	All	All	FDA	588	0.005	0.005	0.005	0.005
All	All	All	NoFDA	81	0.004	0.108	0.024	0.108
All	All	All	All	669	0.005	0.108	0.012	0.005

MIREX, 1985

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	35	0.005	0.005	0.005	0.005
NY	All	All	All	1253	0.054	0.902	0.299	0.411
MO	All	All	All	7	0.005	0.005	0.005	0.005
Reg 7	All	All	All	13	0.005	0.005	0.005	0.005
Reg 7	All	LLP	All	12	0.005	0.005	0.005	0.005
Reg 7	All	All	FDA	13	0.005	0.005	0.005	0.005
Reg 7	All	All	NoFDA	0				
Reg 7	All	HLP	All	1	0.005	0.005		
Reg 5	All	HLP	All	0				
Reg 5	All	LLP	All	57	0.005	0.005	0.005	0.005
Reg 5	All	All	FDA	61	0.005	0.005	0.005	0.005
Reg 5	All	All	NoFDA	0				
Reg 5	All	All	All	61	0.005	0.005	0.005	0.005
Reg 9	All	All	All	85	0.005	0.005	0.005	0.005
Reg 6	All	All	All	22	0.005	0.005	0.005	0.005
Reg 1	All	All	All	5	0.005	0.005	0.005	0.005
Reg 2	All	All	All	1265	0.054	0.902	0.297	0.409
Reg 3	All	All	All	19	0.005	0.005	0.005	0.005
Reg 4	All	All	All	13	0.005	0.005	0.005	0.005
All	Salt	HLP	All	631	0.005	0.005	0.005	0.005
All	Salt	LLP	All	42	0.005	0.005	0.005	0.005
All	Salt	All	All	737	0.005	0.005	0.005	0.005
All	Fresh	HLP	All	3	0.005	0.005	0.005	0.005
All	Fresh	LLP	All	110	0.005	0.005	0.005	0.005
All	Fresh	All	All	117	0.005	0.005	0.005	0.005
All	All	HLP	All	838	0.056	0.902	0.290	0.409
All	All	LLP	All	618	0.005	0.005	0.005	0.005
All	All	Bluefi	All	579	0.005	0.005	0.005	0.005
All	All	No Blfi	All	1044	0.064	0.902	0.329	0.454
All	All	Shellfi	All	58	0.005	0.005	0.005	0.005
All	All	No shel	All	1565	0.045	0.902	0.266	0.355
All	All	No Bf, S	All	986	0.068	0.902	0.339	0.483
All	All	Eel	All	8	0.004	0.005	0.007	0.005
All	All	All	FDA	936	0.005	0.005	0.005	0.005
All	All	All	NoFDA	688	0.095	0.902	0.407	0.586
All	All	All	All	1625	0.043	0.902	0.261	0.351

MIREX, 1985 + 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	72	0.005	0.005	0.005	0.005
NY	All	All	All	1525	0.045	0.902	0.270	0.355
MO	All	All	All	11	0.005	0.005	0.005	0.005
Reg 7	All	All	All	17	0.005	0.005	0.005	0.005
Reg 7	All	LLP	All	16	0.005	0.005	0.005	0.005
Reg 7	All	All	FDA	17	0.005	0.005	0.005	0.005
Reg 7	All	All	NoFDA	0	0.005	0.005	0.005	0.005
Reg 7	All	HLP	All	1	0.005	0.005	0.005	0.005
Reg 5	All	HLP	All	8	0.005	0.005	0.005	0.005
Reg 5	All	LLP	All	105	0.005	0.005	0.005	0.005
Reg 5	All	All	FDA	120	0.005	0.005	0.005	0.005
Reg 5	All	All	NoFDA	1	0.005	0.005	0.005	0.005
Reg 5	All	All	All	121	0.005	0.005	0.005	0.005
Reg 9	All	All	All	145	0.005	0.005	0.005	0.005
Reg 6	All	All	All	26	0.005	0.005	0.005	0.005
Reg 1	All	All	All	18	0.005	0.005	0.005	0.005
Reg 2	All	All	All	1545	0.045	0.902	0.268	0.355
Reg 3	All	All	All	46	0.005	0.005	0.005	0.005
Reg 4	All	All	All	42	0.005	0.005	0.005	0.005
All	Salt	HLP	All	895	0.005	0.005	0.005	0.005
All	Salt	LLP	AFI	62	0.005	0.005	0.005	0.005
All	Salt	All	All	1053	0.005	0.005	0.005	0.005
All	Fresh	HLP	All	4	0.005	0.005	0.005	0.005
All	Fresh	LLP	All	218	0.005	0.008	0.006	0.005
All	Fresh	All	All	227	0.005	0.008	0.006	0.005
All	All	HLP	All	1199	0.041	0.902	0.241	0.323
All	All	LLP	All	762	0.005	0.008	0.005	0.005
All	All	Bluefi	All	798	0.005	0.005	0.005	0.005
All	All	No Blfi	All	1495	0.046	0.902	0.272	0.364
All	All	Shellfi	All	85	0.005	0.005	0.005	0.005
All	All	No shel	All	2208	0.033	0.902	0.222	0.269
All	All	No Bf, S	All	1410	0.049	0.902	0.281	0.404
All	All	Eel	All	86	0.002	0.005	0.005	0.005
All	All	All	FDA	1525	0.005	0.005	0.005	0.005
All	All	All	NoFDA	769	0.085	0.902	0.385	0.541
All	All	All	All	2293	0.032	0.902	0.218	0.252

DDT, 1985

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	155	1.004	18.65	5.560	10.367
NY	All	All	All	1722	0.395	12.96	1.901	1.594
MO	All	All	All	34	0.049	0.625	0.263	0.625
Reg 7	All	All	All	40	0.056	0.625	0.276	0.625
Reg 7	All	LLP	All	15	0.119	0.625	0.446	0.625
Reg 7	All	All	FDA	13	0.138	0.625	0.478	0.625
Reg 7	All	All	NoFDA	27	0.017	0.108	0.053	0.108
Reg 7	All	HLP	All	1	0.005	0.005		
Reg 5	All	HLP	All	26	0.283	0.757	0.642	0.757
Reg 5	All	LLP	All	67	0.261	0.740	0.660	0.740
Reg 5	All	All	FDA	61	0.262	0.740	0.674	0.740
Reg 5	All	All	NoFDA	120	1.212	18.65	6.326	14.024
Reg 5	All	All	All	181	0.894	18.65	5.138	9.397
Reg 9	All	All	All	85	0.309	8.700	2.007	8.700
Reg 6	All	All	All	22	0.138	0.735	0.444	0.735
Reg 1	All	All	All	5	0.062	0.075	0.093	0.735
Reg 2	All	All	All	1734	0.393	12.96	1.895	1.525
Reg 3	All	All	All	19	0.058	0.205	0.138	0.205
Reg 4	All	All	All	13	15.33	122.2	70.84	122.2
All	Salt	HLP	All	631	0.181	8.700	0.818	0.465
All	Salt	LLP	All	42	0.250	1.460	0.922	1.460
All	Salt	All	All	737	0.173	8.700	0.789	0.485
All	Fresh	HLP	All	26	0.076	0.757	0.334	0.757
All	Fresh	LLP	All	164	1.348	122.2	18.56	12.929
All	Fresh	All	All	194	1.150	122.2	16.99	7.550
All	All	HLP	All	1133	0.461	12.96	2.295	1.917
All	All	LLP	All	800	0.440	122.2	8.282	0.752
All	All	Bluefi	All	579	0.173	0.755	0.389	0.455
All	All	No Blfi	All	1660	0.590	122.2	6.415	2.017
All	All	Shellfi	All	58	0.040	0.465	0.141	0.465
All	All	No shel	All	2181	0.494	122.2	5.586	1.594
All	All	No Bf, S	All	1602	0.610	122.2	6.536	2.153
All	All	Eel	All	9	0.228	0.453	0.444	0.453
All	All	All	FDA	936	0.379	122.2	7.646	0.615
All	All	All	NoFDA	1304	0.556	18.65	2.889	2.238
All	All	All	All	2239	0.482	122.2	5.509	1.525

DDT, 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit' (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL,WI,MI	All	All	All	41	0.324	0.805	0.702	0.805
NY	All	All	All	299	0.215	4.035	0.709	0.697
MO	All	All	All	107	0.052	1.150	0.269	0.335
Reg 7	All	All	All	107	0.052	1.150	0.269	0.335
Reg 7	All	LLP	All	88	0.044	1.150	0.266	1.150
Reg 7	All	All	FDA	4	0.425	1.150	1.183	1.150
Reg 7	All	All	NoFDA	103	0.037	0.319	0.134	0.301
Reg 7	All	HLP	All	0				
Reg 5	All	HLP	All	12	0.279	0.390	0.426	0.390
Reg 5	All	LLP	All	51	0.269	0.805	0.668	0.805
Reg 5	All	All	FDA	59	0.264	0.805	0.643	0.805
Reg 5	All	All	NoFDA	5	0.312	0.390	0.391	0.390
Reg 5	All	All	All	64	0.267	0.805	0.633	0.805
Reg 9	All	All	All	60	0.199	2.795	0.890	2.795
Reg 6	All	All	All	4	0.050	0.085	0.086	0.085
Reg 1	All	All	All	13	0.095	0.240	0.193	0.240
Reg 2	All	All	All	307	0.213	4.035	0.702	0.697
Reg 3	All	All	All	26	0.123	0.430	0.296	0.430
Reg 4	All	All	All	29	1.123	9.230	4.351	9.230
All	Salt	HLP	All	263	0.154	4.035	0.623	0.425
All	Salt	LLP	All	22	0.278	2.795	1.358	2.795
All	Salt	All	All	317	0.152	4.035	0.672	0.430
All	Fresh	HLP	All	1	0.045	0.045		
All	Fresh	LLP	All	161	0.330	9.230	1.884	2.700
All	Fresh	All	All	163	0.326	9.230	1.873	2.700
All	All	HLP	All	388	0.189	4.035	0.631	0.628
All	All	LLP	All	231	0.266	9.230	1.626	2.030
All	All	Bluefi	All	218	0.164	4.035	0.660	0.415
All	All	No Blfi	All	585	0.183	9.230	1.076	0.760
All	All	Shellfi	All	27	0.041	0.095	0.076	0.095
All	All	No shel	All	776	0.183	9.230	1.000	0.655
All	All	No Bf,S	All	558	0.190	9.230	1.103	0.776
All	All	Eel	All	102	0.283	0.889	0.642	0.855
All	All	All	FDA	588	0.181	9.230	1.094	0.650
All	All	All	NoFDA	215	0.170	1.413	0.540	0.713
All	All	All	All	803	0.178	9.230	0.983	0.650

DDT, 1985 + 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smples	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	196	0.862	18.65	4.946	9.397
NY	All	All	All	2021	0.368	12.96	1.776	1.425
MO	All	All	All	141	0.051	1.15	0.267	0.415
Reg 7	All	All	All	147	0.053	1.15	0.271	0.415
Reg 7	All	LLP	All	103	0.055	1.15	0.299	0.625
Reg 7	All	All	FDA	17	0.206	1.15	0.724	1.150
Reg 7	All	All	NoFDA	130	0.033	0.319	0.122	0.267
Reg 7	All	HLP	All	1	0.005	0.005		
Reg 5	All	HLP	All	38	0.282	0.757	0.590	0.757
Reg 5	All	LLP	All	118	0.265	0.805	0.663	0.740
Reg 5	All	All	FDA	120	0.266	0.805	0.659	0.740
Reg 5	All	All	NoFDA	125	1.176	18.65	6.196	12.26
Reg 5	All	All	All	245	0.730	18.65	4.414	8.794
Reg 9	All	All	All	145	0.264	8.700	1.641	1.460
Reg 6	All	All	All	26	0.125	0.735	0.412	0.735
Reg 1	All	All	All	18	0.086	0.240	0.174	0.240
Reg 2	All	All	All	2041	0.366	12.96	1.768	1.413
Reg 3	All	All	All	46	0.096	0.430	0.246	0.430
Reg 4	All	All	All	42	5.522	122.2	38.59	122.2
All	Salt	HLP	All	895	0.173	8.700	0.765	0.445
All	Salt	LLP	All	64	0.259	2.795	1.095	2.795
All	Salt	All	All	1055	0.167	8.700	0.755	0.445
All	Fresh	HLP	All	27	0.075	0.757	0.328	0.757
All	Fresh	LLP	All	325	0.843	122.2	13.15	3.700
All	Fresh	All	All	357	0.774	122.2	12.52	3.030
All	All	HLP	All	1522	0.391	12.96	2.003	1.611
All	All	LLP	All	1031	0.401	122.2	7.340	0.826
All	All	Bluefi	All	798	0.171	4.035	0.489	0.425
All	All	No Blfi	All	2245	0.484	122.2	5.523	1.658
All	All	Shellfi	All	85	0.041	0.465	0.126	0.465
All	All	No shel	All	2958	0.412	122.2	4.811	1.353
All	All	No Bf,S	All	2160	0.502	122.2	5.636	1.676
All	All	Eel	All	111	0.278	0.889	0.629	0.855
All	All	All	FDA	1525	0.302	122.2	6.026	0.575
All	All	All	NoFDA	1519	0.502	18.65	2.680	1.917
All	All	All	All	3043	0.402	122.2	4.740	1.326

HEPTACHLOR, 1985

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL,WI,MI	All	All	All	120	0.013	0.095	0.049	0.095
NY	All	All	All	1021	0.008	0.048	0.014	0.010
MO	All	All	All	34	0.004	0.041	0.018	0.041
Reg 7	All	All	All	40	0.005	0.041	0.018	0.041
Reg 7	All	LLP	All	15	0.009	0.015	0.014	0.015
Reg 7	All	All	FDA	13	0.010	0.015	0.013	0.015
Reg 7	All	All	NoFDA	27	0.003	0.041	0.016	0.041
Reg 7	All	HLP	All	1	0.010	0.010		
Reg 5	All	HLP	All	6	0.003	0.009	0.008	0.008
Reg 5	All	LLP	All	62	0.031	0.095	0.081	0.095
Reg 5	All	All	FDA	61	0.032	0.095	0.081	0.095
Reg 5	All	All	NoFDA	85	0.006	0.026	0.017	0.026
Reg 5	All	All	All	146	0.017	0.095	0.057	0.095
Reg 5	All	All	All	85	0.010	0.010	0.010	0.010
Reg 9	All	All	All	22	0.009	0.010	0.012	0.010
Reg 6	All	All	All	5	0.010	0.010	0.010	0.010
Reg 1	All	All	All	1033	0.008	0.048	0.014	0.010
Reg 2	All	All	All	19	0.014	0.045	0.033	0.045
Reg 3	All	All	All	13	0.010	0.010	0.010	0.010
Reg 4	All	All	All	631	0.010	0.010	0.010	0.010
All	Salt	HLP	All	42	0.010	0.010	0.010	0.010
All	Salt	LLP	All	737	0.010	0.010	0.010	0.010
All	Salt	All	All	9	0.005	0.010	0.012	0.010
All	Fresh	HLP	All	113	0.021	0.095	0.060	0.085
All	Fresh	LLP	All	126	0.019	0.095	0.058	0.085
All	Fresh	All	All	656	0.010	0.010	0.012	0.010
All	All	HLP	All	631	0.010	0.095	0.031	0.045
All	All	LLP	All	579	0.010	0.010	0.010	0.010
All	All	Bluefi	All	924	0.009	0.095	0.027	0.041
All	All	No Blfi	All	58	0.010	0.010	0.010	0.010
All	All	Shellfi	All	1445	0.010	0.095	0.024	0.015
All	All	No shel	All	866	0.009	0.095	0.028	0.025
All	All	No Bf,S	All	9	0.008	0.010	0.014	0.010
All	All	Eel	All	936	0.011	0.095	0.027	0.015
All	All	All	FDA	568	0.006	0.048	0.014	0.015
All	All	All	NoFDA	1503	0.010	0.095	0.024	0.013
All	All	All	All					

HEPTACHLOR, 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL,WI,MI	All	All	All	41	0.030	0.075	0.068	0.075
NY	All	All	All	297	0.008	0.045	0.015	0.010
MO	All	All	All	107	0.012	0.097	0.047	0.091
Reg 7	All	All	All	107	0.012	0.097	0.047	0.091
Reg 7	All	LLP	All	88	0.011	0.097	0.041	0.097
Reg 7	All	All	FDA	4	0.010	0.010	0.010	0.010
Reg 7	All	All	NoFDA	103	0.012	0.097	0.048	0.091
Reg 7	All	HLP	All	0				
Reg 5	All	HLP	All	12	0.013	0.015	0.017	0.015
Reg 5	All	LLP	All	51	0.027	0.075	0.062	0.075
Reg 5	All	All	FDA	59	0.025	0.075	0.059	0.075
Reg 5	All	All	NoFDA	5	0.010	0.010	0.010	0.010
Reg 5	All	All	All	64	0.024	0.075	0.057	0.075
Reg 9	All	All	All	4	0.010	0.010	0.010	0.010
Reg 6	All	All	All	4	0.010	0.010	0.010	0.010
Reg 1	All	All	All	13	0.010	0.010	0.010	0.010
Reg 2	All	All	All	305	0.008	0.045	0.015	0.010
Reg 3	All	All	All	26	0.010	0.015	0.013	0.015
Reg 4	All	All	All	29	0.010	0.010	0.010	0.010
All	Salt	HLP	All	263	0.010	0.011	0.011	0.010
All	Salt	LLP	All	22	0.011	0.028	0.017	0.028
All	Salt	All	All	317	0.010	0.028	0.012	0.010
All	Fresh	HLP	All	1	0.010	0.010		
All	Fresh	LLP	All	160	0.017	0.097	0.049	0.075
All	Fresh	All	All	162	0.017	0.097	0.049	0.075
All	All	HLP	All	388	0.009	0.015	0.014	0.011
All	All	LLP	All	230	0.014	0.097	0.042	0.065
All	All	Bluefi	All	218	0.010	0.015	0.011	0.010
All	All	No Blfi	All	583	0.011	0.097	0.032	0.045
All	All	Shellfi	All	27	0.010	0.010	0.010	0.010
All	All	No shel	All	774	0.011	0.097	0.029	0.035
All	All	No Bf,S	All	556	0.011	0.097	0.033	0.045
All	All	Eel	All	102	0.004	0.015	0.010	0.013
All	All	All	FDA	588	0.012	0.075	0.025	0.025
All	All	All	NoFDA	213	0.008	0.097	0.034	0.059
All	All	All	All	801	0.011	0.097	0.029	0.035

HEPTACHLOR, 1985 + 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	161	0.018	0.095	0.056	0.085
NY	All	All	All	1318	0.008	0.048	0.014	0.010
MO	All	All	All	141	0.010	0.097	0.042	0.086
Reg 7	All	All	All	147	0.010	0.097	0.041	0.086
Reg 7	All	LLP	All	103	0.011	0.097	0.039	0.086
Reg 7	All	All	FDA	17	0.010	0.015	0.012	0.015
Reg 7	All	All	NoFDA	130	0.010	0.097	0.043	0.086
Reg 7	All	HLP	All	1	0.010	0.010		
Reg 5	All	HLP	All	18	0.010	0.015	0.019	0.015
Reg 5	All	LLP	All	113	0.029	0.095	0.073	0.095
Reg 5	All	All	FDA	120	0.028	0.095	0.071	0.095
Reg 5	All	All	NoFDA	90	0.007	0.026	0.017	0.026
Reg 5	All	All	All	210	0.019	0.095	0.057	0.085
Reg 9	All	All	All	145	0.010	0.010	0.010	0.010
Reg 6	All	All	All	26	0.009	0.010	0.012	0.010
Reg 1	All	All	All	18	0.010	0.010	0.010	0.010
Reg 2	All	All	All	1338	0.008	0.048	0.014	0.010
Reg 3	All	All	All	46	0.012	0.045	0.024	0.045
Reg 4	All	All	All	42	0.010	0.010	0.010	0.010
All	Salt	HLP	All	895	0.010	0.015	0.010	0.010
All	Salt	LLP	All	64	0.010	0.028	0.014	0.028
All	Salt	All	All	1055	0.010	0.028	0.011	0.010
All	Fresh	HLP	All	10	0.006	0.010	0.013	0.010
All	Fresh	LLP	All	273	0.018	0.097	0.054	0.075
All	Fresh	All	All	288	0.018	0.097	0.053	0.075
All	All	HLP	All	1045	0.009	0.015	0.013	0.010
All	All	LLP	All	861	0.011	0.097	0.034	0.048
All	All	Bluefi	All	798	0.010	0.015	0.010	0.010
All	All	No Blfi	All	1507	0.010	0.097	0.029	0.029
All	All	Shellfi	All	85	0.010	0.010	0.010	0.010
All	All	No shel	All	2220	0.010	0.097	0.026	0.015
All	All	No Bf, S	All	1422	0.010	0.097	0.030	0.035
All	All	Eel	All	111	0.005	0.015	0.010	0.013
All	All	All	FDA	1525	0.012	0.095	0.027	0.015
All	All	All	NoFDA	781	0.007	0.097	0.022	0.020
All	All	All	All	2305	0.010	0.097	0.026	0.015

ALDRIN/DIELDRIN, 1985

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smples	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	390	0.077	1.165	0.275	0.325
NY	All	All	All	1721	0.021	0.343	0.076	0.098
MO	All	All	All	36	0.031	0.503	0.184	0.503
Reg 7	All	All	All	42	0.028	0.503	0.170	0.503
Reg 7	All	LLP	All	17	0.060	0.503	0.271	0.503
Reg 7	All	All	FDA	13	0.027	0.145	0.090	0.145
Reg 7	All	All	NoFDA	29	0.029	0.503	0.194	0.503
Reg 7	All	HLP	All	1	0.010	0.010		
Reg 5	All	HLP	All	190	0.067	0.550	0.197	0.200
Reg 5	All	LLP	All	125	0.141	1.165	0.421	0.515
Reg 5	All	All	FDA	61	0.159	1.165	0.477	1.165
Reg 5	All	All	NoFDA	355	0.064	0.700	0.217	0.260
Reg 5	All	All	All	416	0.078	1.165	0.273	0.325
Reg 9	All	All	All	85	0.011	0.075	0.024	0.085
Reg 6	All	All	All	22	0.016	0.055	0.036	0.055
Reg 1	All	All	All	5	0.343	1.664	1.502	1.664
Reg 2	All	All	All	1733	0.021	0.343	0.076	0.098
Reg 3	All	All	All	19	0.025	0.125	0.086	0.125
Reg 4	All	All	All	13	0.017	0.025	0.027	0.025
All	Salt	HLP	All	631	0.014	0.045	0.019	0.015
All	Salt	LLP	All	42	0.013	0.075	0.032	0.075
All	Salt	All	All	737	0.016	1.664	0.123	0.015
All	Fresh	HLP	All	50	0.014	0.150	0.061	0.150
All	Fresh	LLP	All	214	0.085	1.165	0.320	0.355
All	Fresh	All	All	268	0.070	1.165	0.288	0.335
All	All	HLP	All	1296	0.030	0.550	0.105	0.130
All	All	LLP	All	860	0.031	1.165	0.172	0.225
All	All	Bluefi	All	579	0.015	0.045	0.018	0.015
All	All	No Blfi	All	1896	0.035	1.664	0.168	0.170
All	All	Shellfi	All	58	0.039	1.664	0.417	1.664
All	All	No shel	All	2417	0.030	1.165	0.133	0.150
All	All	No Bf,S	All	1838	0.035	1.165	0.152	0.170
All	All	Eel	All	9	0.015	0.025	0.030	0.025
All	All	All	FDA	936	0.025	1.664	0.165	0.115
All	All	All	NoFDA	1540	0.033	0.700	0.134	0.160
All	All	All	All	2475	0.030	1.664	0.147	0.150

ALDRIN/DIELDRIN, 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smples	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	78	0.118	0.480	0.324	0.480
NY	All	All	All	299	0.018	0.205	0.047	0.055
MO	All	All	All	130	0.051	0.578	0.221	0.367
Reg 7	All	All	All	130	0.051	0.578	0.221	0.367
Reg 7	All	LLP	All	107	0.037	0.578	0.164	0.293
Reg 7	All	All	FDA	4	0.050	0.065	0.086	0.065
Reg 7	All	All	NoFDA	126	0.051	0.578	0.224	0.367
Reg 7	All	HLP	All	0				
Reg 5	All	HLP	All	18	0.026	0.050	0.048	0.050
Reg 5	All	LLP	All	82	0.115	0.480	0.318	0.480
Reg 5	All	All	FDA	59	0.107	0.335	0.281	0.281
Reg 5	All	All	NoFDA	42	0.086	0.480	0.302	0.480
Reg 5	All	All	All	101	0.098	0.480	0.291	0.470
Reg 9	All	All	All	60	0.010	0.010	0.010	0.010
Reg 6	All	All	All	4	0.011	0.015	0.015	0.015
Reg 1	All	All	All	13	0.012	0.015	0.016	0.015
Reg 2	All	All	All	307	0.018	0.205	0.046	0.055
Reg 3	All	All	All	26	0.012	0.015	0.016	0.015
Reg 4	All	All	All	29	0.010	0.010	0.010	0.010
All	Salt	HLP	All	263	0.015	0.205	0.039	0.035
All	Salt	LLP	All	22	0.015	0.098	0.048	0.098
All	Salt	All	All	317	0.015	0.205	0.038	0.035
All	Fresh	HLP	All	6	0.010	0.010	0.010	0.010
All	Fresh	LLP	All	208	0.065	0.578	0.237	0.320
All	Fresh	All	All	215	0.063	0.578	0.233	0.320
All	All	HLP	All	394	0.017	0.205	0.042	0.043
All	All	LLP	All	281	0.051	0.578	0.206	0.295
All	All	Bluefi	All	218	0.016	0.205	0.042	0.035
All	All	No Blfi	All	645	0.034	0.578	0.156	0.235
All	All	Shellfi	All	27	0.010	0.015	0.012	0.015
All	All	No shel	All	836	0.030	0.578	0.139	0.195
All	All	No Bf, S	All	618	0.035	0.578	0.159	0.235
All	All	Eel	All	102	0.020	0.070	0.047	0.061
All	All	All	FDA	588	0.023	0.335	0.099	0.165
All	All	All	NoFDA	275	0.044	0.578	0.195	0.340
All	All	All	All	863	0.029	0.578	0.137	0.194

ALDRIN/DIELDRIN, 1985 + 1986

*See notes at end of Appendix II for guide to abbreviations.

Region	Water Type	Fish Type	FDA	# of Smpls	Avg. (ppm)	Max. Res. (ppm)	95% Conf. Limit' (Normal Dist.)	95% Conf. 95% Cov. (ppm)
IL, WI, MI	All	All	All	468	0.084	1.165	0.285	0.335
NY	All	All	All	2020	0.020	0.343	0.073	0.092
MO	All	All	All	166	0.046	0.578	0.214	0.367
Reg 7	All	All	All	172	0.045	0.578	0.210	0.367
Reg 7	All	LLP	All	124	0.040	0.578	0.183	0.201
Reg 7	All	All	FDA	17	0.033	0.145	0.093	0.145
Reg 7	All	All	NoFDA	155	0.047	0.578	0.219	0.367
Reg 7	All	HLP	All	1	0.010	0.010		
Reg 5	All	HLP	All	208	0.064	0.550	0.189	0.190
Reg 5	All	LLP	All	207	0.131	1.165	0.384	0.480
Reg 5	All	All	FDA	120	0.133	1.165	0.395	0.515
Reg 5	All	All	NoFDA	397	0.067	0.700	0.227	0.280
Reg 5	All	All	All	517	0.082	1.165	0.277	0.325
Reg 9	All	All	All	145	0.011	0.075	0.021	0.015
Reg 6	All	All	All	26	0.015	0.055	0.034	0.055
Reg 1	All	All	All	18	0.104	1.664	0.768	1.664
Reg 2	All	All	All	2040	0.020	0.343	0.072	0.092
Reg 3	All	All	All	46	0.017	0.125	0.058	0.125
Reg 4	All	All	All	42	0.012	0.025	0.020	0.025
All	Salt	HLP	All	895	0.015	0.205	0.028	0.015
All	Salt	LLP	All	64	0.014	0.098	0.038	0.098
All	Salt	All	All	1055	0.016	1.664	0.106	0.015
All	Fresh	HLP	All	56	0.014	0.150	0.058	0.150
All	Fresh	LLP	All	422	0.075	1.165	0.282	0.325
All	Fresh	All	All	483	0.067	1.165	0.265	0.320
All	All	HLP	All	1691	0.027	0.550	0.094	0.112
All	All	LLP	All	1141	0.036	1.165	0.181	0.235
All	All	Bluefi	All	798	0.015	0.205	0.029	0.015
All	All	No Blfi	All	2541	0.035	1.664	0.165	0.175
All	All	Shellfi	All	85	0.030	1.664	0.343	1.664
All	All	No shel	All	3254	0.030	1.165	0.135	0.153
All	All	No. Bf, S	All	2456	0.035	1.165	0.154	0.177
All	All	Eel	All	111	0.020	0.070	0.046	0.061
All	All	All	FDA	1525	0.024	1.664	0.144	0.105
All	All	All	NoFDA	1815	0.035	0.700	0.145	0.166
All	All	All	All	3339	0.030	1.664	0.145	0.150

List of Abbreviations

Abbreviations within Tables

All = All locations, both fresh and salt water, all fish species or both FDA and non-FDA data
IL,WI,MI = Illinois, Wisconsin and Michigan data
NY = New York
MO = Missouri
Reg X = EPA Region X
Salt = Salt water fish
Fresh = Fresh water fish
HLP = High level predatory species
LLP = Low level predatory species / bottom feeding species
Bluefi = Bluefish *
No Blfi = All fish except Bluefish
Shellfi = Shellfish
No Shel = All fish except shellfish
No Bf,S = All fish except Bluefish and shellfish
Eel = American Eel
FDA = FDA data only
NoFDA = All data except FDA data

Column Headings

Water type = Either fresh or salt water fish
Fish type = Species and/or category of fish by feeding habits
FDA = Data source (FDA or other data)
of Smpls = Number of samples
Avg. = Average residue (ppm)
Max. Res. = Maximum residue (ppm)

95% Conf. Limit

(Normal Distribution)

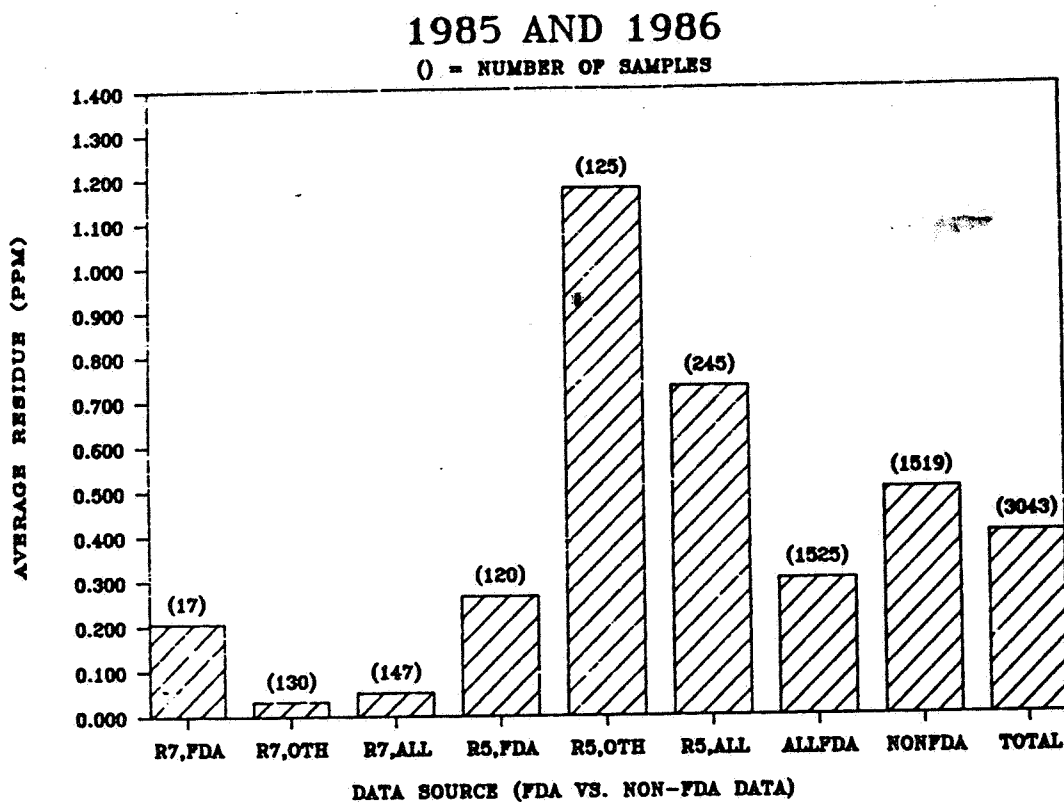
= 95% upper confidence limit assuming the data are normally distributed

95% Conf.

95% Cov.

= Tolerance limit utilizing 95% confidence, 95% population coverage (no distribution assumed)

Figure 17 (Cont.):
DDT: Residue Variation with Data Source (FDA vs. Non-FDA data)



R7 = EPA Region 7
R5 = EPA Region 5
FDA = FDA data only
OTH = All data other than FDA data
ALL = All FDA data and other (non-FDA) data
ALLFDA = FDA data from all locations
NONFDA = All data other than FDA data from all locations
TOTAL = All data

Figure 18:
DDT: Residue Variation with Species of Fish

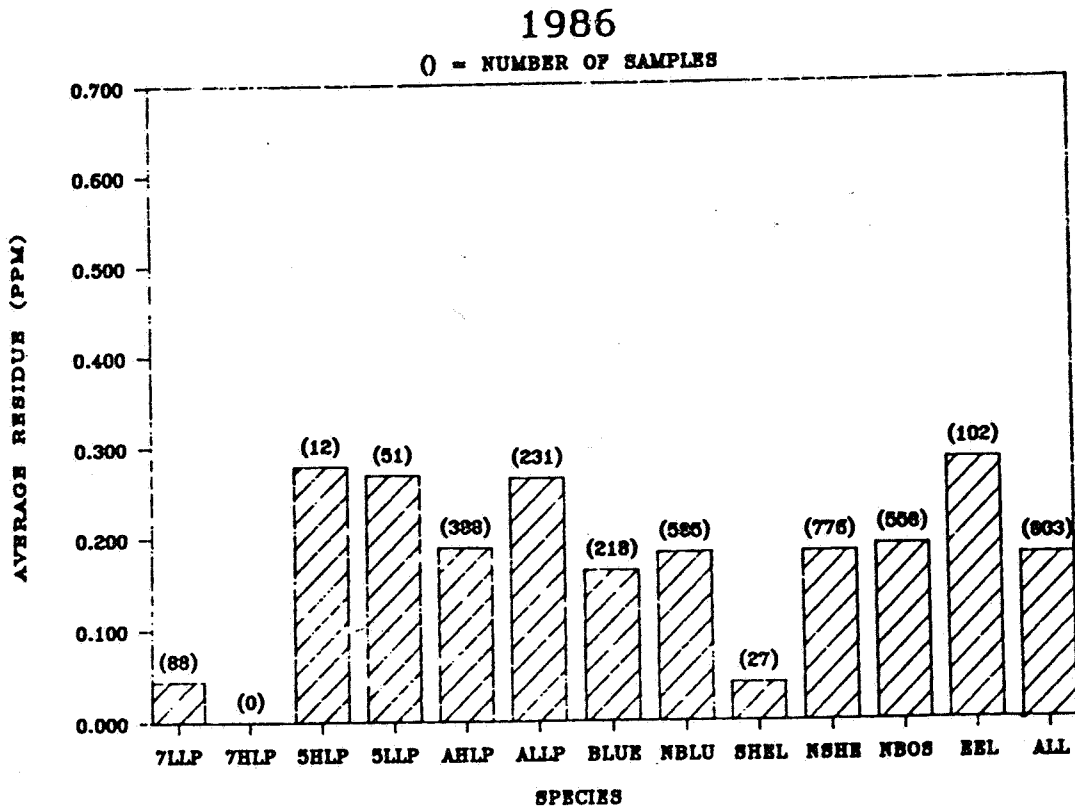
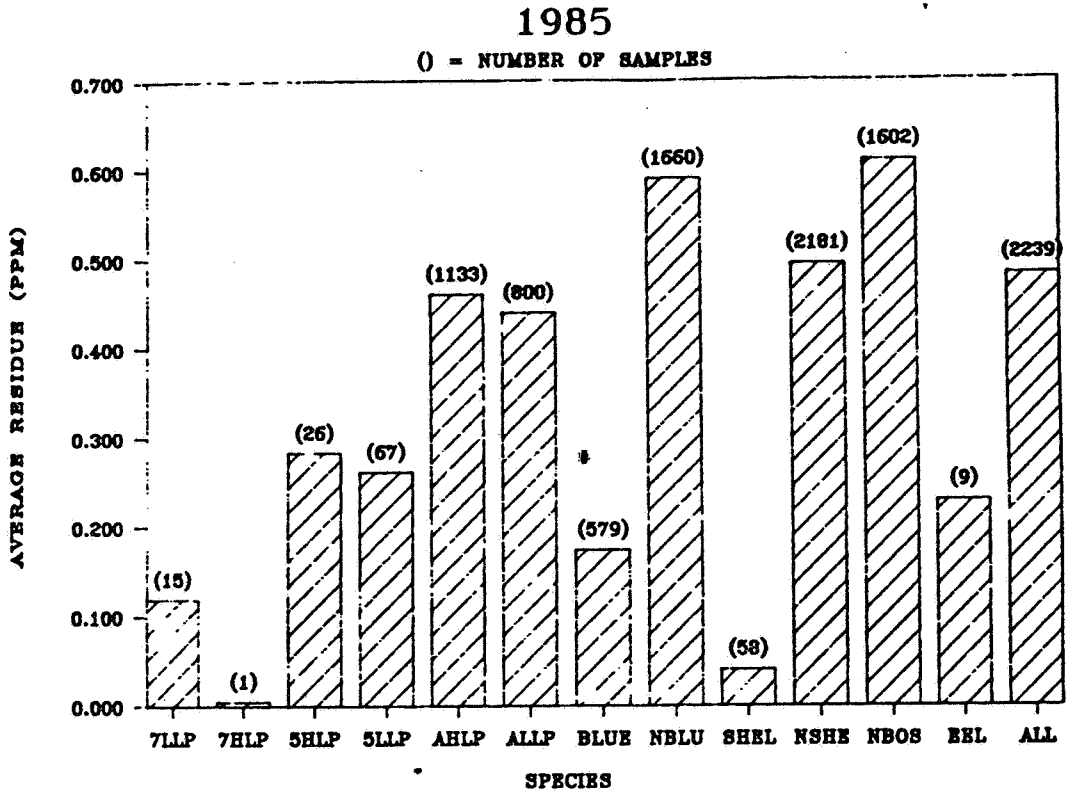
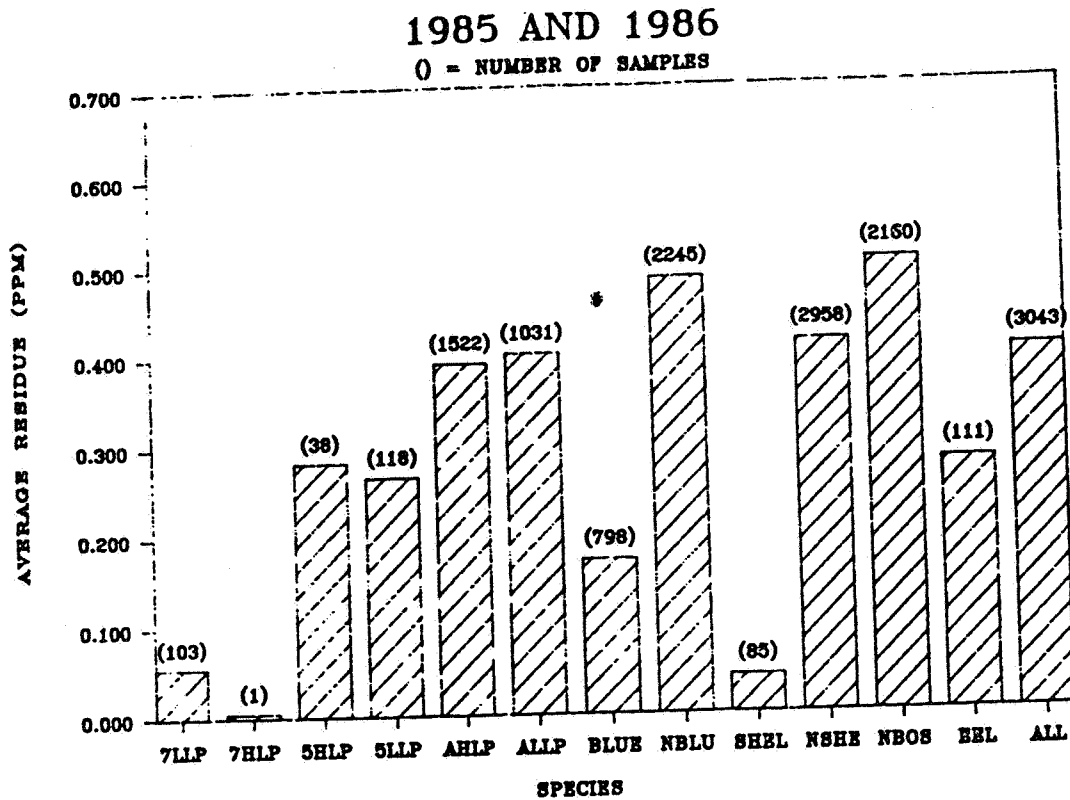


Figure 18 (Cont.):
DDT: Residue Variation with Species of Fish



- 7LLP = EPA Region 7, low level predatory and bottom-feeding fish
- 7HLP = EPA Region 7, high level predatory fish
- 5HLP = EPA Region 5, high level predatory fish
- 5LLP = EPA Region 5, low level predatory and bottom-feeding fish
- AHLP = High level predators, all locations
- ALLP = Low level predators, all locations
- BLUE = Bluefish
- NBLU = All fish except Bluefish
- SHEL = Shellfish
- NSHE = All fish except shellfish
- NBOS = All fish except Bluefish and shellfish
- EEL = American Eels
- ALL = All fish

Figure 19:
DDT: Residue Variation with Location / Region

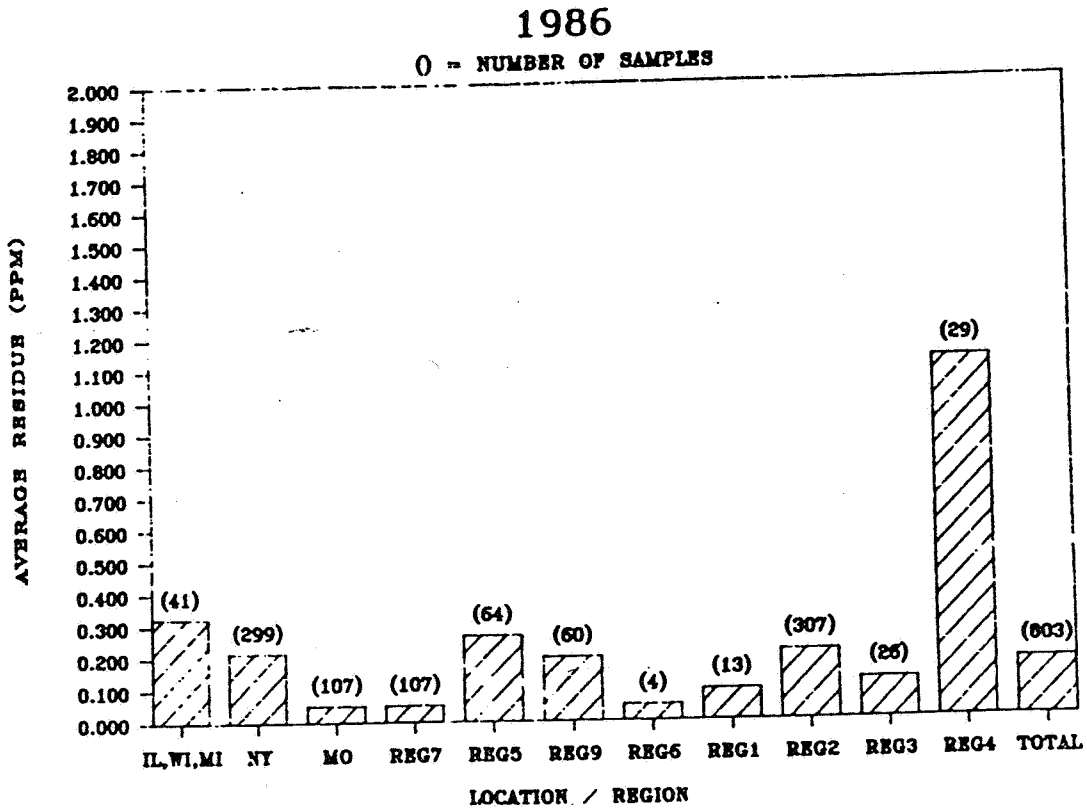
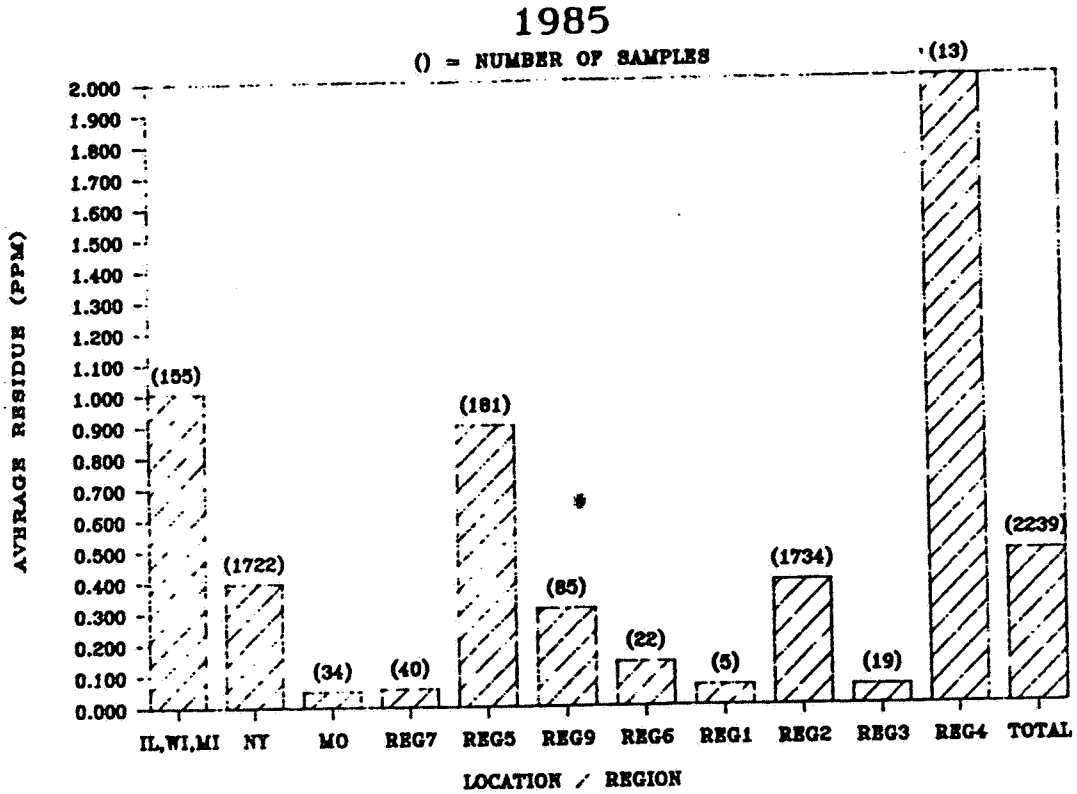
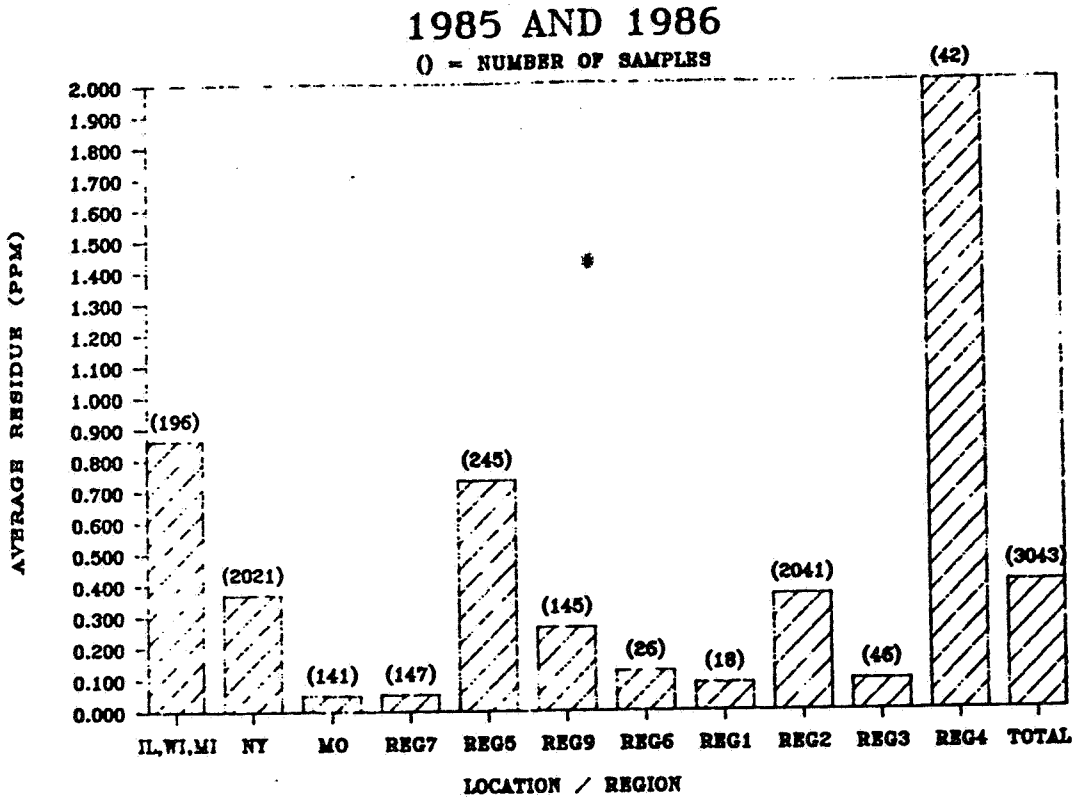
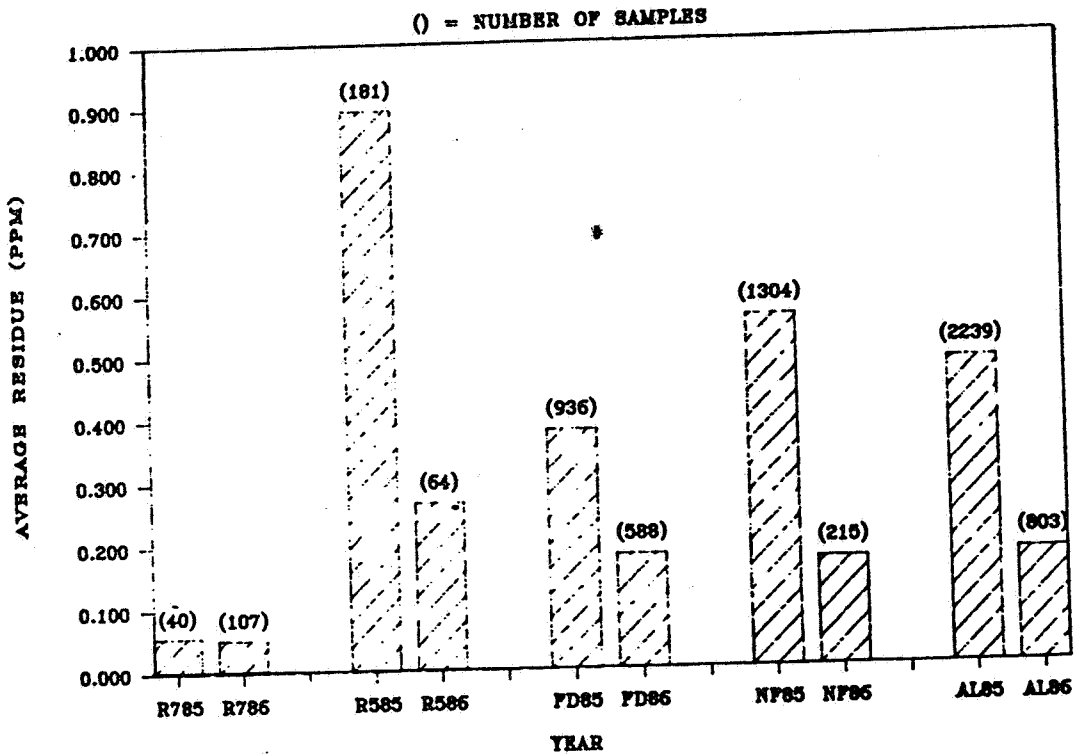


Figure 19 (Cont.):
DDT: Residue Variation with Location / Region



IL,WI,MI = Illinois, Wisconsin and Michigan
NY = New York
MO = Missouri
REGX = EPA Region X
TOTAL = Combined data from all locations

Figure 20:
DDT: Residue Variation with Time



R785 = EPA Region 7 data, 1985
R786 = EPA Region 7 data, 1986
R585 = EPA Region 5 data, 1985
R586 = EPA Region 5 data, 1986
FD85 = FDA data, 1985
FD86 = FDA data, 1986
NF85 = All data except FDA data, 1985
NF86 = All data except FDA data, 1986
AL85 = All data, 1985
AL86 = All data, 1986

ALDRIN/DIELDRIN

Aldrin/Dieldrin Residue Variation with Data Source

Aldrin/Dieldrin residue variation with data source is shown in Figure 22. The variation in residues found for the entire data set and both years is minimal (0.010 ppm). The variation is greater in 1986 (0.021 ppm) than in 1985 (0.008 ppm). For the entire data set, the average of the FDA data is lower than that of other data for both years.

This is in contrast to Region 5 data in which the average for the FDA data is higher than that of the other data by a significant amount (difference = 0.020-0.094 ppm for different years). Region 7 data shows a maximum difference in average residues of 0.014 ppm for the combined 1985 + 1986 data with the FDA data lower.

Aldrin/Dieldrin Residue Variation with Species

Aldrin/dieldrin residue variation with fish species is shown in Figure 23. Bluefish, shellfish and American eels have average residues less than or equal to the mean for all species. Low level predators/bottom-feeding species have higher average residues than high level predators, a trend which is particularly evident in data from Region 5. These trends are found in both 1985 and 1986 data.

Aldrin/Dieldrin Residue Variation with Aquatic Environment

Aldrin/dieldrin residue variation with aquatic environment (water type, fresh vs. salt water) is shown in Figure 21. Fresh water species are seen to have significantly higher residues than salt water species in most instances. The exception is high level predators which have approximately equal average residues for salt water and fresh water fish. These trends are consistent from year to year.

Aldrin/Dieldrin Residue Variation with Time

Aldrin/dieldrin residue variation with time is shown in Figure 25. The average residue level in fish for 1986 was greater than for 1985 for Region 5, Region 7 and non-FDA data. Average residues for the entire data set and for FDA data showed slight decreases from 1985 to 1986.

Aldrin/Dieldrin Residue Variation with Location

Aldrin/dieldrin residue variation with location is shown in Figure 24. Initial inspection of this graph suggests that Region 1 has much higher average residues than other locations. However, only a minimal number of samples were obtained from Region 1 (18), and 1 sample with an unusually high residue value accounted for this high average residue.

Regions 7 and 5, particularly Region 5, show higher average residues than other locations. Most of the samples taken from these two Regions were fresh water fish which generally have higher residues than the salt water fish taken from many of the other locations. However, samples taken from Region 2 (primarily NY) were also mostly fresh water fish but showed lower average residues than most other locations.

Aldrin/Dieldrin: Other Considerations

Table 5 shows the average values and tolerance limits (95% confidence, 95% coverage, no distribution assumed) for select data subsets. Our previous action level recommendation for aldrin/dieldrin of 0.1 ppm (M. Metzger, 3/25/87) was based on FDA surveillance monitoring data only.

Utilizing 95% confidence with 95% coverage of the fish population, and utilizing the entire data set currently available to RCB, we estimate that aldrin/dieldrin residues would not exceed 0.2 ppm on a national basis and 0.4 ppm in Regions 5 and 7 assuming 95% confidence and 95% coverage of the fish population.

Table 5: Aldrin/Dieldrin Summary Statistics

<u>Year</u>	<u>Region</u>	<u>Water Type</u>	<u>Fish Type</u>	<u>FDA?</u>	<u>Number of Samples</u>	<u>Average Residue (ppm)</u>	<u>Tolerance Limit (ppm)</u>
1985	All	All	All	FDA	936	0.025	0.115
	All	All	All	All	2475	0.030	0.150
1986	All	All	All	FDA	588	0.023	0.165
	All	All	All	All	863	0.029	0.194
85 +	Reg 5	All	All	All	517	0.082	0.325
	Reg 7	All	All	All	172	0.045	0.367
86	Reg 2	All	All	All	2040	0.020	0.092
	All	All	All	FDA	1525	0.024	0.105
	All	All	All	All	3339	0.030	0.150

Figure 21: ALDRIN/DIELDRIN: Residue Variation with Water Type (Salt vs. Fresh Water)

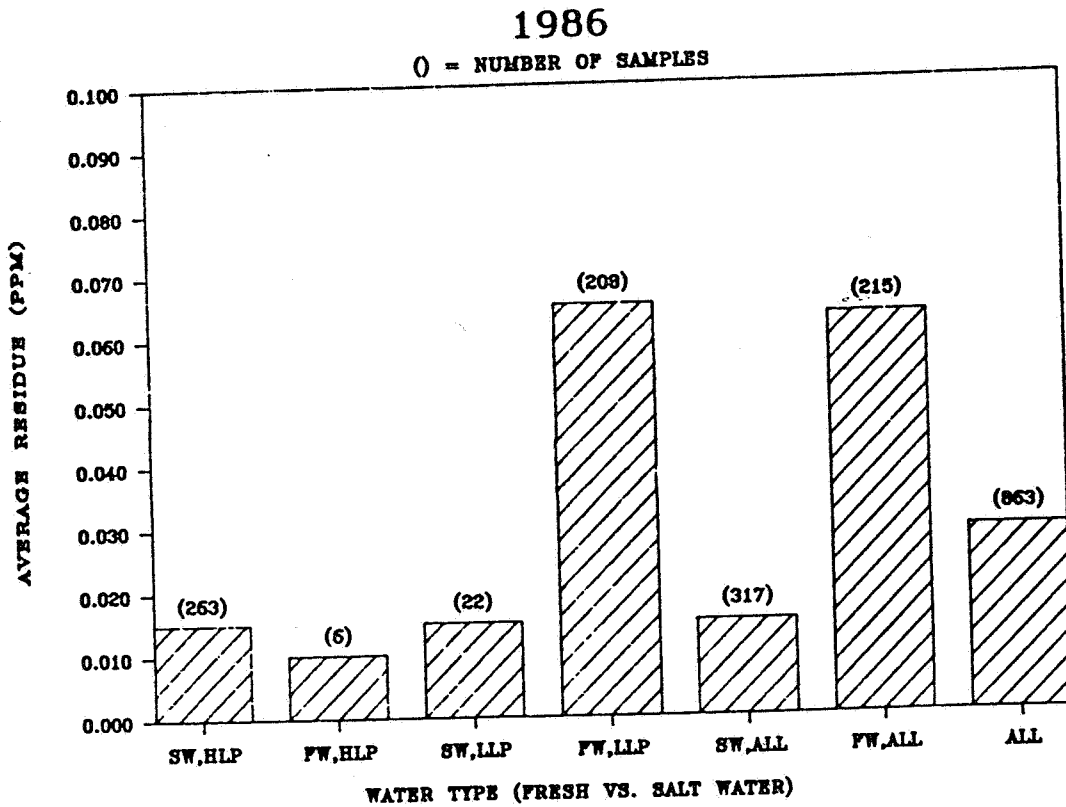
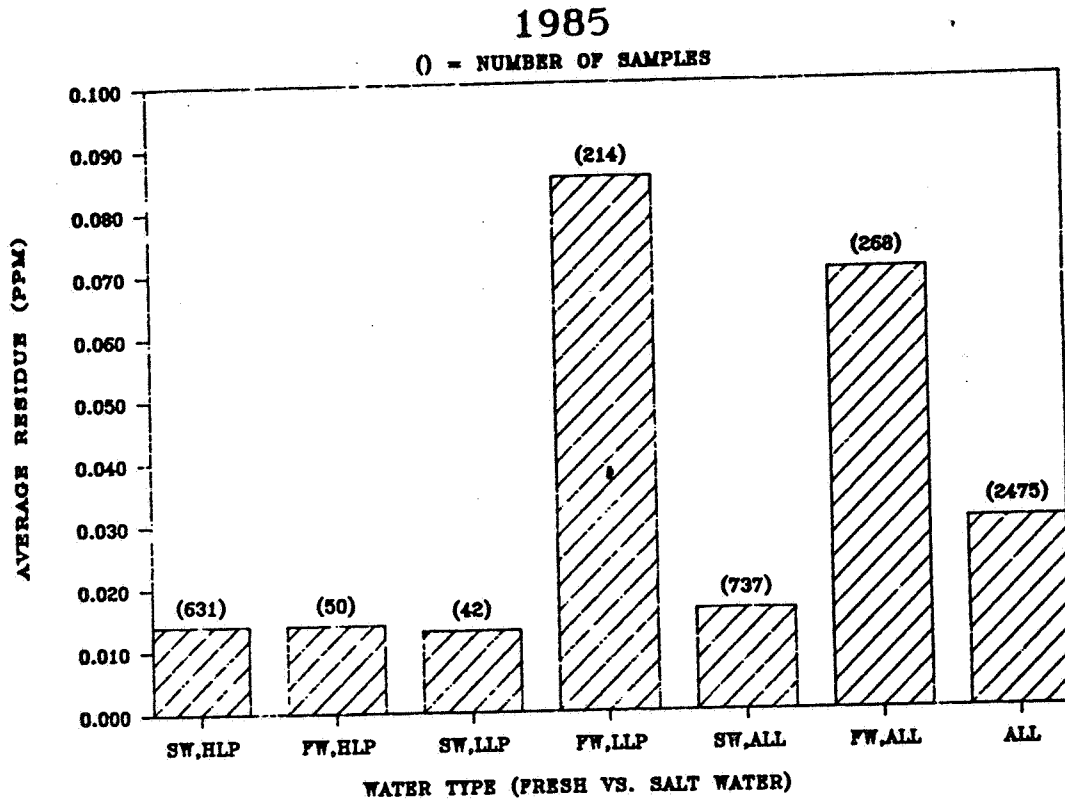
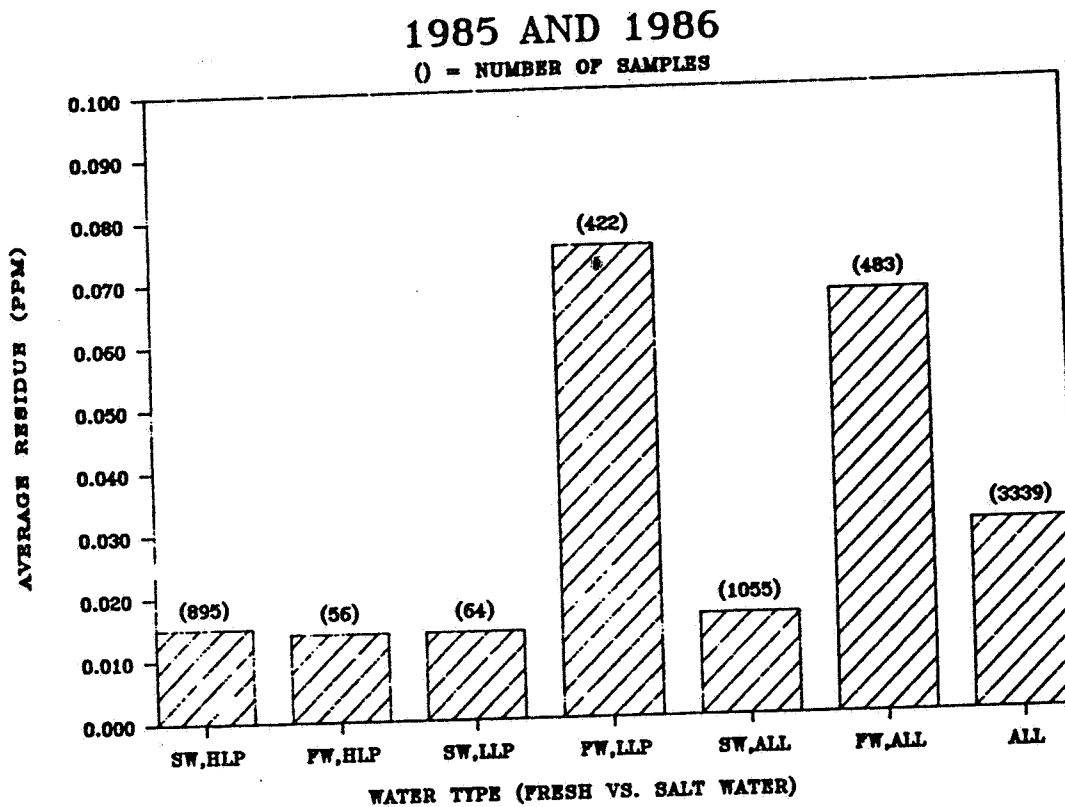


Figure 21 (Cont.):
ALDRIN/DIELDRIN: Residue Variation with Water Type (Salt vs. Fresh Water)



SW = Salt Water Fish
HLP = High level predatory fish
FW = Fresh water fish
LLP = Low level predatory / bottom-feeding fish
All = All high level predatory and low level predatory / bottom-feeding fish

Figure 22:
ALDRIN/DIELDRIN:

Residue Variation with Data Source (FDA vs. Non-FDA data)

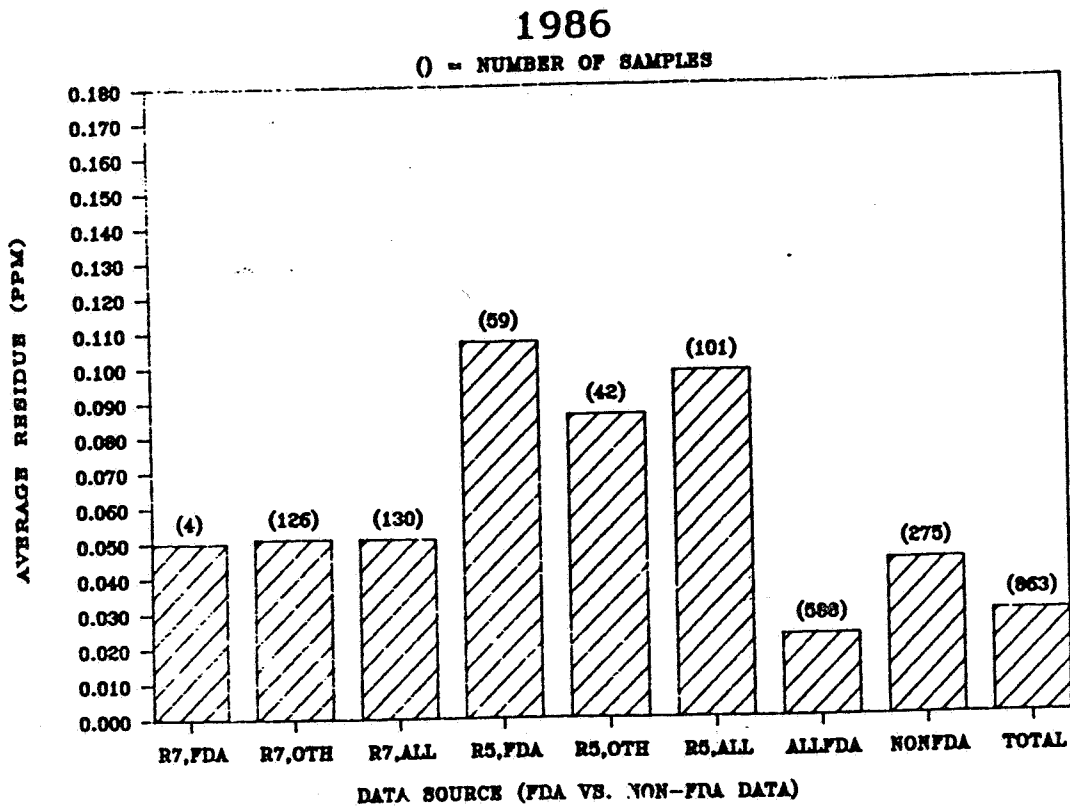
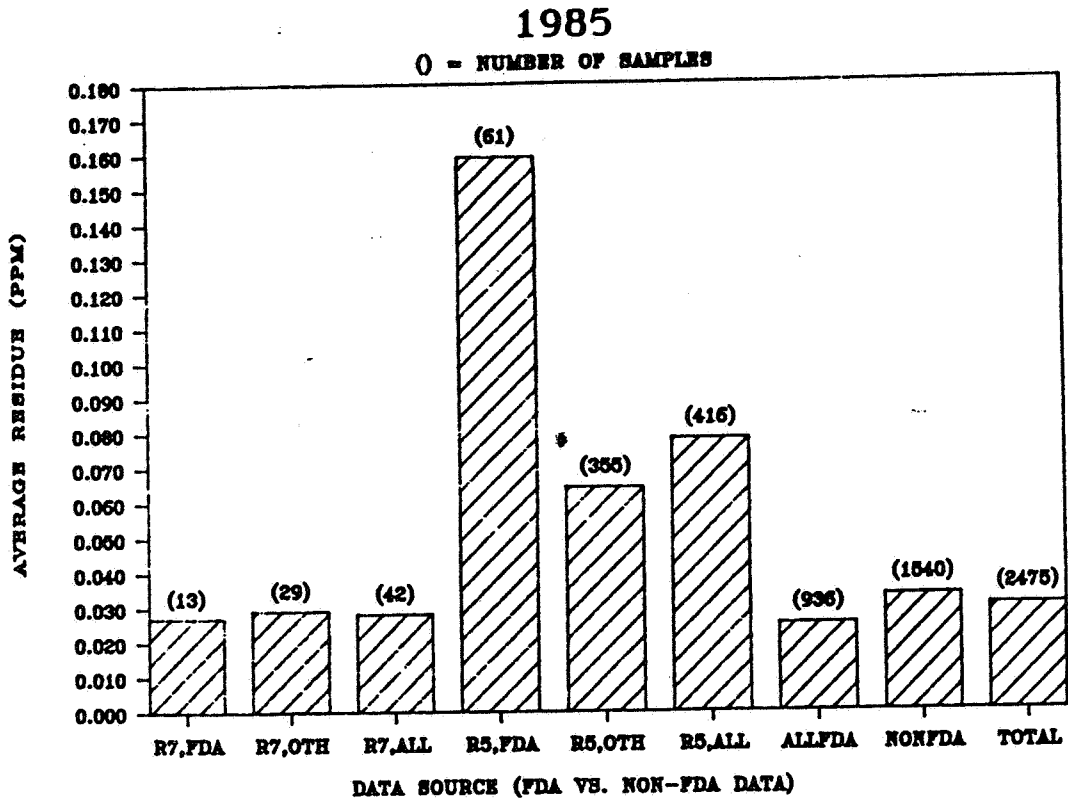
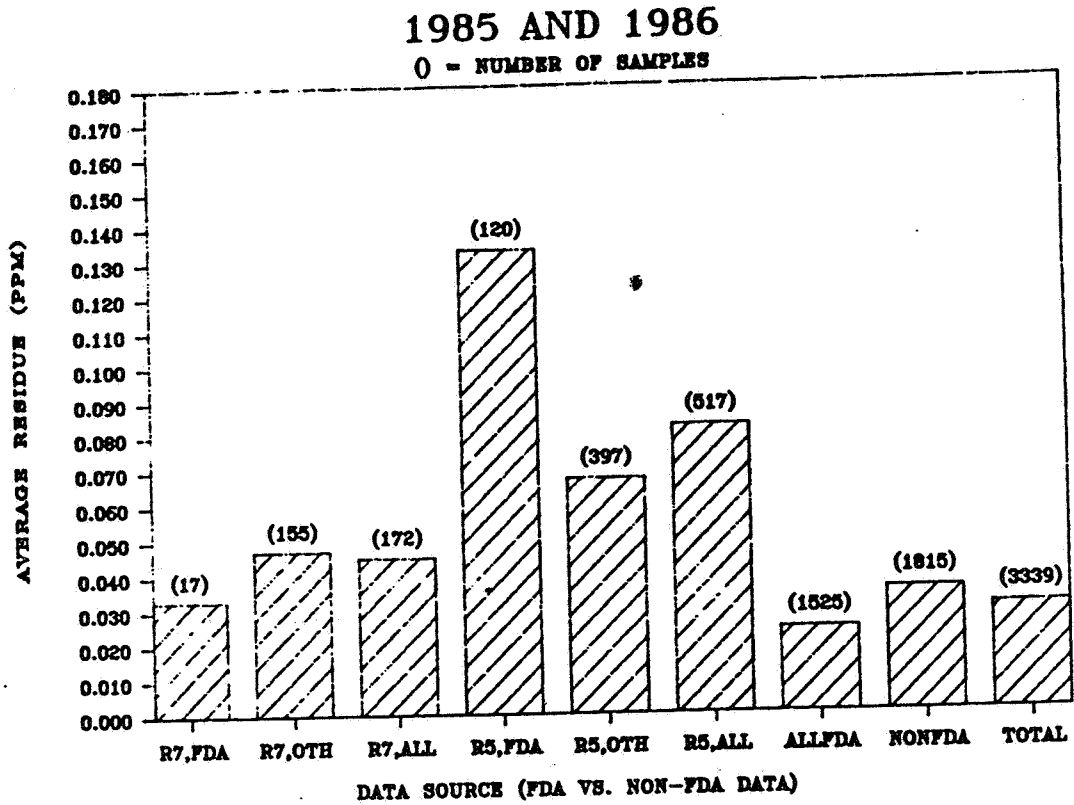


Figure 22 (Cont.):
ALDRIN/DIELDRIN:

Residue Variation with Data Source (FDA vs. Non-FDA data)



R7 = EPA Region 7
R5 = EPA Region 5
FDA = FDA data only
OTH = All data other than FDA data
ALL = All FDA data and other (non-FDA) data
ALLFDA = FDA data from all locations
NONFDA = All data other than FDA data from all locations
TOTAL = All data

Figure 23:
ALDRIN/DIELDRIN: Residue Variation with Species of Fish

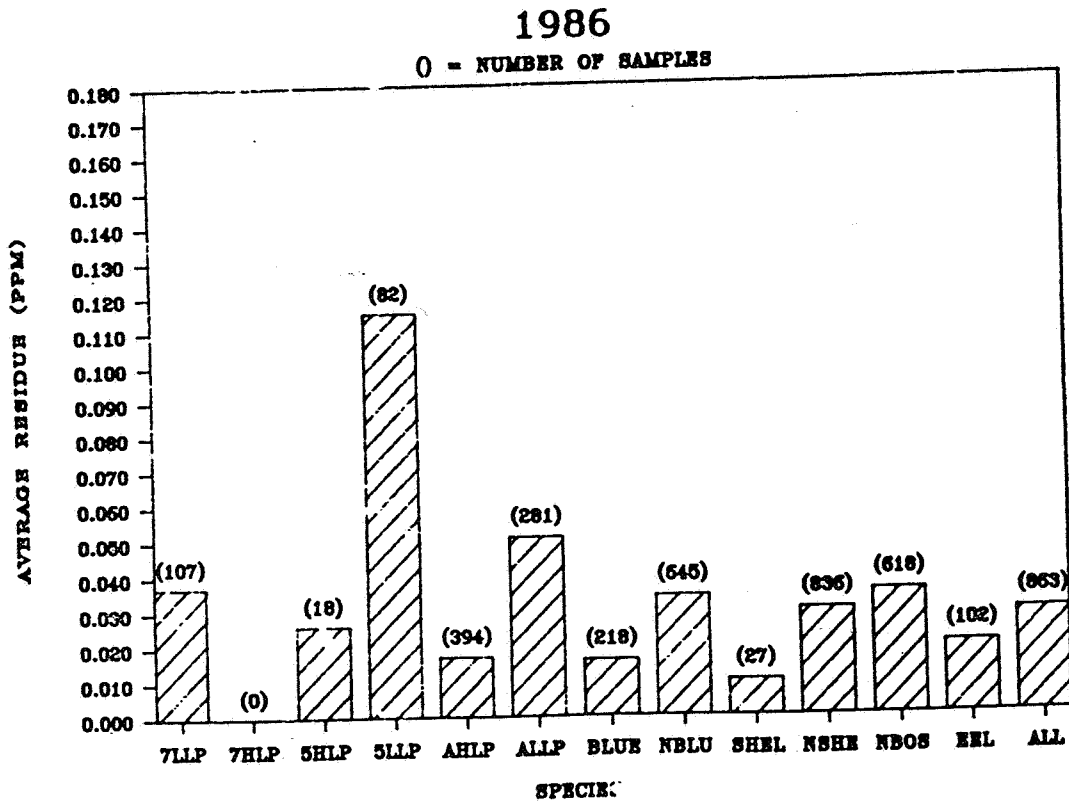
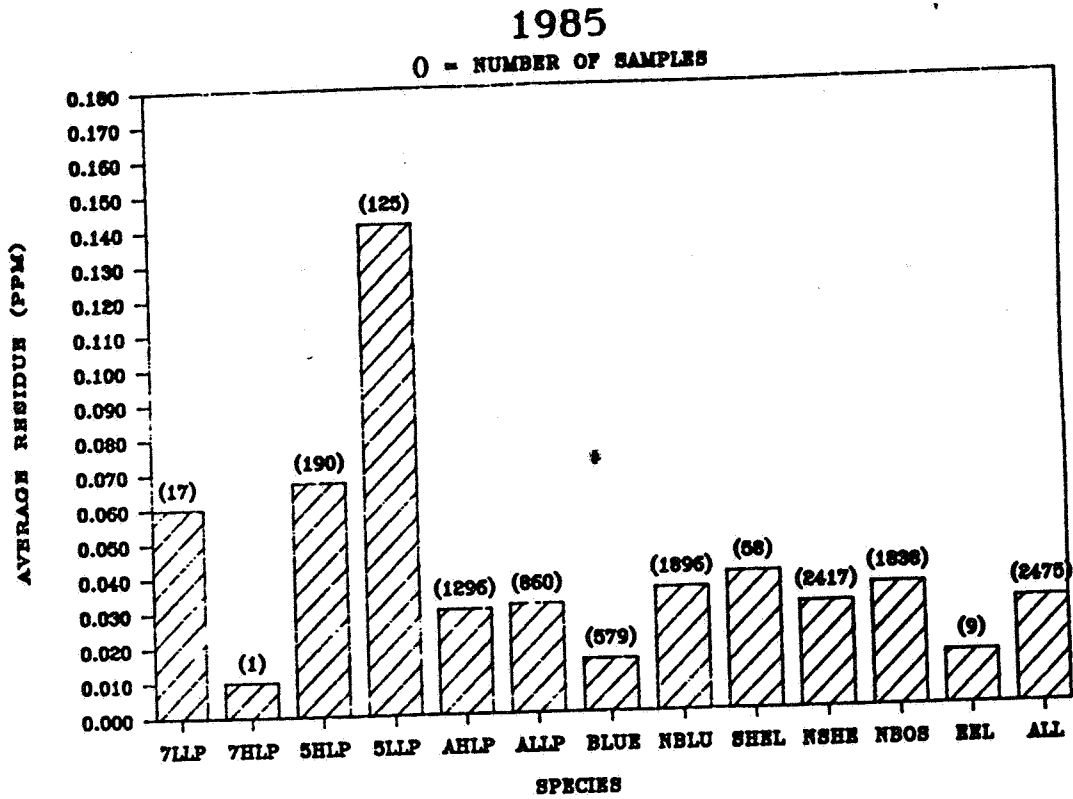
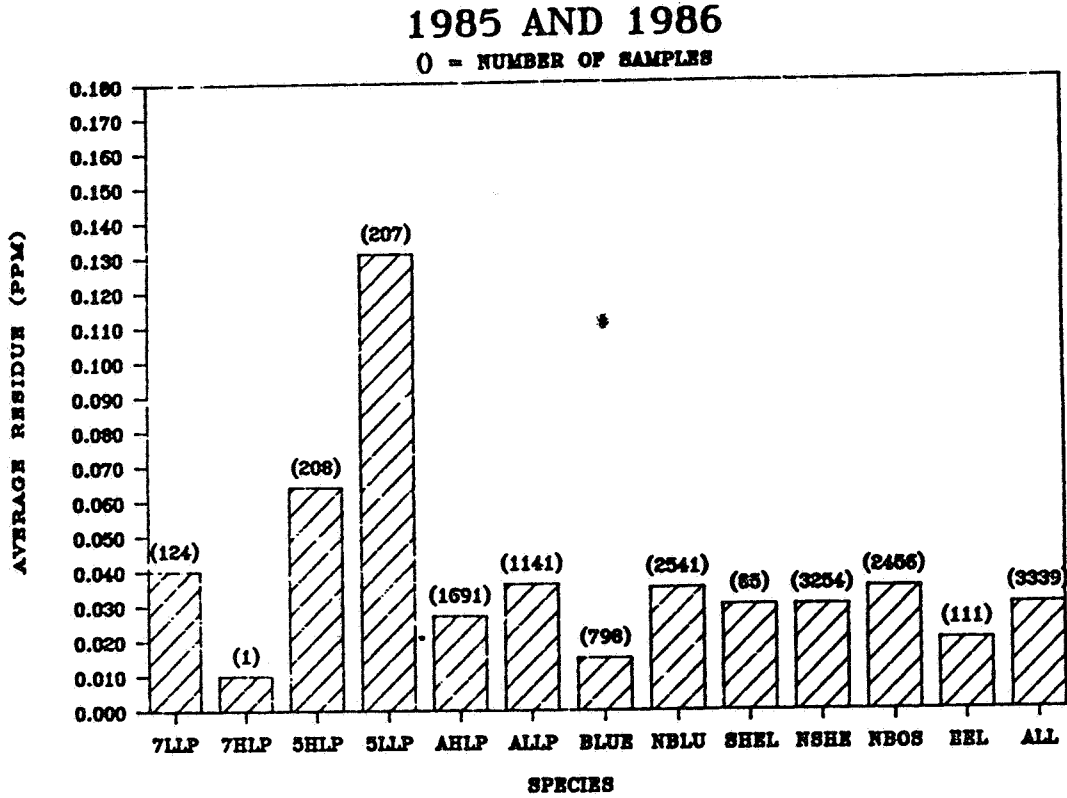


Figure 23 (Cont.):
ALDRIN/DIELDRIN: Residue Variation with Species of Fish



7LLP = EPA Region 7, low level predatory and bottom-feeding fish
7HLP = EPA Region 7, high level predatory fish
5HLP = EPA Region 5, high level predatory fish
5LLP = EPA Region 5, low level predatory and bottom-feeding fish
AHL P = High level predators, all locations
ALL P = Low level predators, all locations
BLUE = Bluefish
NBLU = All fish except Bluefish
SHEL = Shellfish
NSHE = All fish except shellfish
NBOS = All fish except Bluefish and shellfish
EEL = American Eels
ALL = All fish