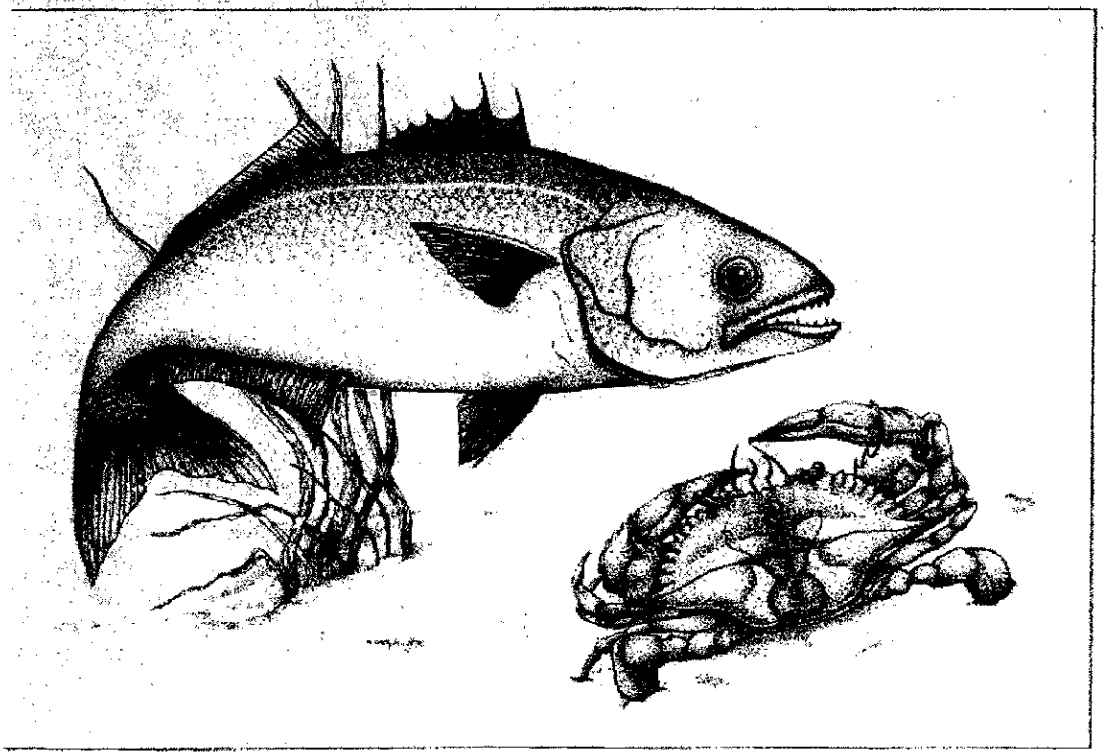
New Jersey
Department of Environmental Protection and Energy
Division of Science and Research

Polychlorinated Biphenyls (PCBs), Chlordane, and DDTs In Selected Fish and Shellfish from New Jersey Waters, 1988-1991: Results From New Jersey's Toxics in Biota Monitoring Program



Jim Florio, Governor

Scott Weiner, Commissioner

July, 1993

POLYCHLORINATED BIPHENYLS (PCBS), CHLORDANE, AND DDTs IN SELECTED FISH AND SHELLFISH FROM NEW JERSEY WATERS, 1988-1991: Results from New Jersey's Toxics in Biota Monitoring Program

by

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EXECUTIVE SUMMARY

This report presents the results of monitoring carried out between 1988 and 1991 under the direction of the New Jersey Department of Environmental Protection and Energy's (DEPE) Toxics in Biota Technical Committee. It presents data on the levels of polychlorinated biphenyls (PCBs), chlordane, and DDT and its metabolites DDD and DDE ("DDTs") in ten species (brown bullhead, carp, largemouth bass, channel catfish, white perch, American eel, striped bass, bluefish, weakfish, and blue crab) collected at forty-nine stations throughout the state. Results for a total of 217 single-fish samples and composite samples (generally consisting of edible tissue from five animals) are presented.

The results are generally consistent with previous findings that showed the Northeast region to be the most severely contaminated. Regional means for PCBs in three species from the region- -American eel, carp, and blue crab (hepatopancreas) --were elevated (i.e, exceeded the FDA action level) . Elevated PCB levels were also found in individual samples of bluefish, blue crab (hepatopancreas /muscle mixture), and striped bass from this region, and in some striped bass from the North Coast and South Coast regions; in bluefish from the North Coast, South Coast, and Atlantic regions; and in one brown bullhead sample from the Camden region (from Raccoon Creek at the Delaware River).

All exceedances of FDA action levels in individual samples are covered by a consumption advisory, ban, or other information already issued by the State, with the exception of: carp samples from Stations 7 and 7A on the Passaic River; a brown bullhead sample from Station 25 on Raccoon Creek; and two striped bass samples from Station 39 (Seaside Park to Brigantine).

There is some indication of decreasing contaminant levels, as reflected in the occurrence of fewer exceedances of FDA action levels. For example, in contrast with the 1986-1987 results, in the Camden region no regional means, and no results for specific composite samples, exceeded FDA action levels. However, small sample sizes for the 1988-1991 sampling efforts make detailed comparisons difficult. PCB levels in striped bass from the Northeast and North Coast regions appear to have decreased since surveys in the 1970s and early 1980s. This decrease is consistent with results for striped bass from New York waters.

Large bluefish (total length $\geq$60 cm) contained, on average, approximately two to three times the level of a given contaminant found in small bluefish. In blue crabs, levels in hepatopancreas samples were approximately six to eight times the levels in samples of muscle tissue.

This work was funded by appropriations from the New Jersey Legislature.

I. INDRODUCTION

This is the fifth technical report published by the New Jersey Department of Environmental Protection and Energy (DEPE) on the levels of organic contaminants in fish and shellfish, and the second report from DEPE' s Toxics in Biota Monitoring Program. It summarizes data collected between 1988 and 1991 under the direction of DEPE' s Toxics in Biota Technical Committee, which was formed in 1983.

A. Previous Reports

In 1982, the Office of Cancer and Toxic Substances Research (later the Office of Science and Research (OSR), and currently the Division of Science and Research), in conjunction with the Division of Fish, Game and Wildlife, released a report detailing five years (1975-1980) of fish bioaccumulation data for PCBs (1). The results of that effort showed that 75% of the finfish and 50% of the shellfish analyzed had detectable levels (ZO.1 parts per million (ppm)) of PCBs in their flesh. A total of 11.1% of the finf- ish and none of the shellfish had PCB levels greater than the current U.S. Food and Drug Administration (FDA) action level of 2.0 ppm. (The action level was lowered from 5.0 ppm to 2.0 ppm in 1984.) Freshwater species had lower levels than the estuarine and marine species tested. The heavily urbanized and industrialized northeastern portion of the state, within the Hudson River - Newark Bay - Raritan Bay complex, was the most severely contaminated.

The second OSR report (2), released in 1983, presented the results of sampling conducted during 1981 and 1982, which concentrated on the above-described drainage area as well as the adjacent ocean waters. In addition to PCB data, the 1983 report contained limited data on chlordane levels in bluefish.

The data published in the 1982 report and the then-unpublished results of the 1981-82 work led to the establishment of consumption advisories and fishing bans for certain species in a number of areas of the state in late 1982. (See Appendix A for a discussion of the advisories and fishing closures currently in place.) Based on these findings, it was clear that the existing data base had to be expanded and a routine monitoring program put into place in order to track the levels of organic contaminants in f ish and shellfish and to protect New Jersey's fish-consuming public from unnecessary and excessive exposure to these contaminants.

The discovery of extensive soil contamination with dioxin (specifically, 2,3,7,8tetrachlorodibenzo-p-dioxin, or 2,3,7,8,TCDD) at a site adjacent to the Passaic River in Newark prompted an intensive study of dioxin levels in sediments and biota in 1983 and 1984. This study focused on the waters of the Newark Bay complex, but also included sampling in other areas of the state. The results of this study, which were compiled in a 1985 OSR report

(3), led to the establishment of a number of consumption advisories and fishing closures in the Newark Bay complex. (See Appendix A.)

The results of the first two years (1986 and 1987) of the Toxics in Biota Monitoring Program, presented in a 1990 report (4), were consistent with previous findings that showed the Northeast region of the state to be the most severely contaminated. Elevated levels were also found in the Camden region, and in striped bass from the North Coast region. Analysis of the 19861987 results also showed that for all three contaminants, mean levels in large bluefish (≥60 cm) were approximately twice those in small bluefish (<60 cm), and mean levels in blue crab hepatopancreas tissue were approximately an order of magnitude higher than those in blue crab muscle tissue.

B. The Toxics in Biota Monitoring Program

In 1983 the Toxics in Biota Technical Committee, consisting of representatives of the Division of Science and Research, the Division of Fish, Game and Wildlife, and the Division of Water Resources (now represented by the Bureau of Water Monitoring) was formed. (The committee now includes representatives of the Division of Publicly Funded Site Mitigation and the Department of Health as well). The committee developed a program in 1985 to monitor the levels of PCBs and organochlorine pesticides in selected species collected from New Jersey waterways in which elevated levels of these toxic chemicals in fish and/or shellfish had been found or might be suspected.

The program originally called for the annual collection and analysis of 223 samples from a total of 42 sites. Over time, the Technical Committee has adjusted the sampling program, in light of past results and available funds. Changes and adjustments in the current sampling program include: collection of blue crabs at two new sites, the Navesink River (Station 44) and the Shrewsbury River (Station 45); collection of striped bass from a single station (station 43) covering Delaware Bay; and, as of 1989, a change from composite samples of striped bass and bluefish in the North Coast and South Coast regions to single-fish samples collected at several newly defined sites. These new sites were, for striped bass, Station 37A (Sandy Hook to Barnegat Light), replacing Stations 37 (Sandy Hook to Asbury Park) and 38 (Asbury Park to Seaside Park), and Station 38A (Barnegat Light to Cape May), replacing Station 39 (Seaside Park to Brigantine) and 40 (Brigantine to Cape May); and, for bluefish, Station 46 (Off Barnegat Inlet)-, representing the entire Atlantic coast from Sandy Hook southward.

Between 1988 and 1991, the New Jersey Marine Sciences Consortium, based at Sandy Hook, collected and processed a total of 267 samples for the general Toxics in Biota program, most of them

(181) in 1988.[1] The results of chemical analyses performed at the Department of Health's (DOH) laboratory facilities on 217 samples are presented in this report. Of the remaining 50 samples, 30 samples (12 single-fish striped bass samples (out of 24 collected) and 18 single-fish bluefish samples (out of 32 collected)) were collected in 1989 but not analyzed due to funding limitations, and 19 samples (Table 1) were collected at sites along the main stem of the Delaware River and analyzed, through a cooperative arrangement with the Delaware River Basin Commission's Toxics Management Program, at the U.S. Fish and Wildlife Service's (FWS) laboratory in State College, Pennsylvania. Because of differences between the analytical methods used by the DOH and FWS laboratories, and because the FWS results will be reported elsewhere, the FWS results are not presented here. Finally, the analytical results of one combined hepatopancreas /muscle sample of blue crab are not reported here because of quality assurance problems involving sample labelling.

The Technical Committee reviews the results as they become available, and on the basis of its own results and. other information makes recommendations concerning new or amended consumption advisories needed to protect the public.

Funds were last made available for the Technical Committee's program of sample collection and analysis in 1988. Those funds supported the 1988 program, and the remaining funds were used to support sample collection and analysis in subsequent years.

C. Species Collected

The 1988-1991 monitoring program considered ten aquatic species. They included three freshwater species (brown bullhead, Ictalurus nebulosus; carp, Cyprinus carpio; and largemouth bass, Micropterus salmoides), two species that are found in both fresh water and estuarine waters of moderate salinity (channel catfish, Ictalurus punctatus; and white perch, Morone americana), one catadromous species (American eel, Anguilla rostrata), one anadromous species (striped bass, Morone saxatilis), two marine species (bluefish, Pomatomus saltatrix; and weakfish, Cynoscion regalis) , and one estuarine species - (blue crab, Callinectes sapidus). Table 2 shows the species collected at each site.

D. Contaminants Considered

The fish and shellfish samples collected between 1988 and 1991

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[1] These totals do not include samples collected for a special study by the Division of Fish, Game and Wildlife on contaminant levels in different tissues (muscle, liver, and gonad) of several species, primarily weakfish but also including bluefish and white perch.

were analyzed for PCBs and two organochlorine pesticides, chlordane and DDT. All are persistent in the environment, and share the properties of low solubility in water and a lipophilic nature, i.e., they tend to become dissolved in lipid (fatty) material. These properties result in their tendency to accumulate in the tissue of f ish and other organisms, especially in those tissues and organisms with a high lipid content.

PCBs, first commercially produced in 1929, were commonly used in transformer oils and electrical products. In 1977 the U.S. Environmental Protection Agency (EPA) banned the production of PCBs, but many PCB-laden transformers, capacitors, and other electrical equipment remain in service. Spills, effluent discharges, incineration, and disposal in landfills have dispersed this persistent contaminant throughout the environment. PCBs are classified by EPA as a probable human carcinogen. many chronic and acute health effects, as well as birth defects, have been associated with PCBs.

Chlordane was widely used for the control of termites, as an insecticide in homes, gardens, and lawns, and for the control of soil insects in corn fields until 1976, when EPA restricted its use to underground application f or termite control. EPA completely banned the use of chlordane in 1988. Chlordane is a probable human carcinogen. Exposure to high levels of chlordane can also affect the central nervous system, lungs and skin.

DDT (dichlorodiphenyltrichloroethane) is an organochlorine pesticide used f or agricultural purposes and to control disease vectors. It was banned for most uses in the United States in 1972 because of its detrimental ecological impacts, particularly increases in the frequency of egg breakage and a decrease in the populations of certain birds, including the peregrine falcon, golden eagle, and osprey. DDT appears to affect estrogen levels in birds, altering egg calcification, egg laying, and nesting. Only at very high doses does DDT have acute toxic effects on humans; there is no evidence of mutagenicity or carcinogenicity based on laboratory experiments. Like many other chlorinated hydrocarbons, DDT is highly persistent. Dicofol, a pesticide ' still widely used on U. S. agricultural crops, contains DDT impurities, and DDT is still widely used in many developing countries for the control of insect-transmitted diseases. Alteration of DDT in the environment yields two main breakdown products, DDD and DDE.

II. METHODS

A. Sample Collection

Samples were collected by gill netting, otter trawls, electrof-ishing, hook and line, f ish traps, and crab pots. Some samples (i.e., weakfish, bluefish and striped bass) were obtained from commercial and recreational fishermen. Sampling locations are

shown in Figure 1 and listed in Table 1. After collection, samples were sealed in plastic bags and stored in ice chests that had been cleaned with a laboratory detergent, such as Liqui-Nox, flushed with pesticide grade hexanes, and finally rinsed with distilled water. "Cold packs" or ice sealed in plastic containers was used.

B. Sample Processing

Before actual processing, all samples were identified to species level, weighed, and measured. (Blue crabs were measured across the shell, point to point). Shell condition and physical abnormalities in blue crabs were also noted. Samples were stored frozen at approximately -210F until processing.

1. Finfish

All sample processing was done on a stainless steel surface with metal instruments. Homogenization took place in a blender with stainless steel blades. The work surface, instruments, and blender container, after being cleaned with a laboratory detergent such as Liqui-Nox, were flushed with pesticide grade hexanes between each fish lot. In any given set of samples, species were processed in ascending order of lipid content.

The samples excised from edible finfish consisted of a scaled fillet with skin intact for all species except American eels, catfish, and bullheads, for which samples consisted of a skinless fillet. The standard fillet was defined as the portion of the fish bounded anteriorly by the pectoral fin and posteriorly by the caudal fin, and from the mid-dorsal line to the mid-ventral line, including the rib cage and belly flap.

These standard fillets were either used as an individual sample from a single fish or combined with other individuals of the same species and size to form a composite sample usually consisting of five fish, although some composites consisted of f ewer f ish. (See Table 3 for a list of those samples consisting of fewer than five organisms.) Where possible, the portion taken from each fish consisted of 100 grams, yielding a five-f ish composite sample of 500 grams. For individual fillets that exceeded 100 grams in weight, the portion was taken by cutting from the anterior portion of the fillet and proceeding posteriorly until 100 grams were obtained. For extremely large fish, three cross-sections of the fillet--one from, behind the pectoral f ins, one from halfway between the first slice and the vent, and one from behind the vent--were taken and combined to yield the 100-gram portion. The five-fish composite sample was then thoroughly homogenized, packaged in PCB free aluminum foil, labeled, and stored frozen in polypropylene bags until requested for analysis.

2. Blue Crabs

All storage containers, packaging, work surf aces, and utensils were thoroughly scrubbed, rinsed with pesticide grade acetone or hexanes, and finally rinsed with distilled water. Immediate work surfaces and utensils were washed and rinsed with acetone or hexanes and distilled water after each sample was processed.

Samples designated for processing were removed from the freezer and thawed. After the sample was weighed, measured, and examined with respect to shell condition and abnormalities, the thoracic body cavity was opened and the hepatopancreas completely removed with a small laboratory spoon. All edible meat was then removed, and the rest of the animal discarded. The tissue was homogenized and stored in contaminant-free aluminum foil at approximately -21OF until analysis.

Blue crab samples were composite samples consisting of the edible meat portions (thoracic, claw, leg, and tail meat), the hepatopancreas, or a mixture of both tissues from five animals of approximately equal size. A given sample contained roughly equal portions from each of the animals in the composite. The separate hepatopancreas and muscle samples consisted of the two tissue types from the same set of five animals. Hepatopancreas/muscle mixtures f or blue crabs consisted of all of the available tissue of both types, not equal masses of each tissue type.

C. Analyses

The homogenized tissue samples were extracted and quantified by gas chromatography at the New Jersey Department of Health laboratory. A Tracor Model 222 gas chromatograph equipped with two dissimilar chromatographic columns and electron capture detectors was used f or the analyses. EPA methods (5, 6, 7, 8) f or PCB and pesticide analyses were used with slight modification in the initial tissue preparation and extraction sections. In the referenced methods, where PCBs are not specifically mentioned, they are co-eluted with the pesticides and are efficiently separated by specific column chromatography techniques (9).

Ten grams of tissue were soxhlet-extracted for six hours in a 3: 1 hexane-acetone mixture. The extract was then isolated and cleaned up using gel permeation chromatography. The final extract was then concentrated, characterized by gas chromatography and quantified by comparison with standards for PCB Aroclors 1248, 1254, or 1260, the alpha and gamma isomers of chlordane, and p,p^1-DDT, p,p^1-DDE and p,p^1-DDD. The results for PCB Aroclors 1254 and 1260 indicate approximately equal amounts of the two Aroclors present in the samples. Since the profiles for the two Aroclors differ only slightly, either one may be used satisfactorily to quantify that PCB Aroclor.

Quality control followed EPA-recommended guidelines (9, 10) and included spiking muscle tissue of one sample with appropriate standards, as well as analyzing replicates of one of the samples in a set. Recoveries for samples spiked with the analyses of interest ranged from 72 to 130 percent. These recoveries were calculated using the 95 percent confidence interval (± 2 standard deviations) for the mean of the spiked component in the control sample.

Detection limits were 0.1 ppm for PCB Aroclors 1248 and 1254/1260; 2.5 parts per billion (ppb) for alpha and gamma chlordane; 5 ppb for p,pl-DDE; and 10 ppb for p,pl-DDD and p,plDDT. These figures were calculated by using the 1/2 standard peak height concentration divided by the highest quantity of sample extract that could be injected into the chromatographic column without permanently damaging the system.

III. RESULTS AND DISCUSSION

A. General

Results for each site-species-year combination (e.g., bluefish at Site 10 in 1988) are presented in Appendix B. Analytical results are presented as reported (i.e., two decimal places). **For all parameters, results reported as "below detection limit" were assigned a value equal to the detection limit for the purpose of data analysis.** PCB Aroclors 1248 and 1254/1260, DDT/DDD/DDE, and alpha and gamma isomers of chlordane were summed to yield values for PCBs, DDTs, and chlordane, respectively.

For purposes of graphic presentation and discussion the results for 1988 through 1991 have been combined to form one data set and the sites have been grouped into the following six regions[2]:

Northeast:	Sites within the Hudson, Raritan, Hackensack and Passaic River drainages
North Coast:	All ocean sites and estuarine sites between Sandy Hook and Seaside Park
South Coast:	All ocean sites and estuarine sites between Seaside Park and Cape May, and sites in Delaware Bay
Camden:	Sites within Stewart Lake, Cooper River,

[2] Although, as discussed below, there are good arguments for *reassigning certain* stations to different regions, or dividing or redefining entire regions, the regions defined in the data report on the 1986-1987 data set (4) have been retained to allow comparison between the two data sets.

Pennsauken Creek and Newton Creek drainages

Delaware: Sites on the main stem of the Delaware River, tributaries to the river (except those in the Camden area), and tributaries to Delaware Bay

Atlantic: Sandy Hook to Cape May

The Atlantic region consists of just one site, Station 46 (Off Barnegat Inlet), which was selected to represent the entire Atlantic coastline from Sandy Hook southward for bluefish. Figure 1 and Table 4 indicate the region to which each site belongs. Because concentrations will vary among sites in a region, readers interested in values for a specific site, or in the reasons behind differences in regional means, should refer to Appendix B. (See also Section III.B below.)

Table 5 lists all samples in which the PCB concentration exceeded the FDA action level (2.0 ppm). (There were no exceedances [3] of the action levels for chlordane (300 ppb) and DDTs (5000 ppb.)3 Almost two-thirds (23 of 37) are-from the Northeast region, previously identified (1,2,4) as the most severely contaminated area of the state. These samples comprise 36% (23 of 64) of all samples taken from that region. Table 5 also shows thirteen PCB exceedances for striped bass and bluefish collected along the Atlantic coastline, most of them (9 of 13) from the area between Sandy Hook and Barnegat Inlet. A single sample from the Camden region contained PCBs at a concentration in excess of the action level.

In terms of regions and species represented, the exceedances shown in Table 5 are generally consistent with those for the 19861987 data, although there are slightly fewer exceedances in the current data set. The principal difference between the lists of exceedances for the two data sets is the absence of any exceedances for chlordane in 1988-1991; there were 10 such exceedances in 19861987, mainly for carp and American eel in the Camden region. However, because of the small number of samples collected in this

[3] While the following discussion focuses on comparing regional means with FDA action levels, it should be noted that even when the regional mean is below the action level, the level in a given composite sample from that region (see Appendix B), and especially levels in individual organisms within those composites, may exceed the action level. In addition, the action levels are based on both health and economic factors, and are designed to protect the average fish consumer. DEPE, along with agencies in many other states, considers all of these factors in determining what measures (e.g., consumption advisories) are needed to protect the public, especially those segments of the public that may be at greater risk, such as recreational anglers.

region in 1988-1991 (2 for American eel, 1 for carp), it is difficult to draw any definite conclusions from these differences.

All samples listed in Table 5 were covered by one of the consumption advisories, bans, or other information described in Appendix A, with the exception of carp samples from Stations 7 and 7A on the Passaic River; a brown bullhead sample from Station 25 on Raccoon Creek; and two striped bass samples from Station 39 (Seaside Park to Brigantine). All are discussed below in detailed sections on specific regions, stations, and species.

Table 6 and Figures 2 through 5 show the mean level of PCBs in each species by region. (Where both composite and single-f ish samples of the same species were collected from the same region (e.g., striped bass in the North Coast region), the means in Tables 6 through 8 are not weighted for sample size.) Only the Northeast region had any species with mean PCB levels greater than or equal to the FDA action level of 2.0 ppm. They were American eel (2.03 ppm, N=7), blue crab (hepatopancreas) (3.29 ppm, N=7), and carp (2.03 ppm, N=7). No regional means for chlordane (Table 7; Figures 6 through 9) or DDTs (Table 8; Figures 10 through 13) exceeded FDA action levels.

These results are again broadly consistent with earlier results (1,2,4) showing the Northeast region to be the most contaminated. In fact, the regional mean PCB level for American eel (2.03 ppm, N=7) is higher than the mean for 1986-1987 (1.71 ppm, N=10). However, there are fewer regional means above FDA action levels in the current data set than in the data for 19861987. Mean PCB levels in the Northeast region dropped from 2.06 ppm (N=6) to 1.28 ppm (N=3) in white perch, and from 2.14 ppm (N=16) to 1.80 ppm (N=14) in striped bass. A similar decrease in striped bass was seen in the North Coast region (2.33 ppm, N=10 to 1.64 ppm, N=18). (Temporal trends for PCBs in striped bass are discussed in Section III.C.5 below.) Exceedances by 1986-1987 regional means of FDA action levels for American eel in the Camden region (for PCBs and chlordane) and for carp in the Northeast region (for chlordane) did not recur in 1988-1991, although the small samples sizes in the Camden region again make comparisons difficult.

B. Variation Within Regions

As noted above, regional means may have substantial variation within regions in contaminant levels in a given species. The following sections discuss such variation for several regions and species.

1. Delaware Region

Because the Delaware region is so heterogeneous, stretching from the Delaware River at Easton through the industrialized and densely populated lower Delaware River to the much less heavily

developed areas of the Maurice and Cohansey Rivers along Delaware Bay, it is especially important to look beyond regional means in order to avoid overlooking important inter-station variation. One sample of brown bullhead, for example, was collected at each of four stations in this region: one at each of the two stations on Raccoon Creek, a tributary to the lower Delaware River (Station 24, Raccoon Creek at Swedesboro, and Station 25, Raccoon Creek at Delaware River), one in a tributary to Delaware Bay (Station 26, Maurice River at Mauricetown), and one on the Delaware River between Trenton and Camden (Station 26, Delaware River at Burlington Island). The regional means shown in Table 9 hide the considerable variation among the four stations. As noted above, the PCB level in the sample from Station 25 exceeds the FDA action level, and the mean PCB level for the two Raccoon Creek stations (1.95 ppm) is very close to the FDA action level. These results warrant further investigation.

The sharp distinction between the stations along Delaware Bay and the others in this region is also clear from the data on contaminant levels in American eel (Table 10) and white perch (Table 11). The PCB level in the white perch sample from Station 28 (Delaware River at Deepwater), 1.92 ppm, approached the FDA action level and, as with the results for brown bullhead from Raccoon Creek, warrants further investigation.

2. Northeast Region

As for the Delaware region, for several species in the Northeast region there is significant inter-station variability that deserves mention. PCB levels in white perch (Table 12) were much lower at the extreme upstream station along the tidal portion of the Hackensack River (Station 3, Hackensack River at Rivervale) that at stations in the tidal reaches of the Hudson and Raritan Rivers (Station 1, Hudson River at Alpine, and Station 11, Raritan River at Kin Buc landfill). Levels of all three contaminants in American eel were also much lower at upstream, non-tidal stations along the North and South Branches of the Raritan River (Stations 12 and 13) than at stations in the Hudson Raritan estuary (Table 13).

3. Carp from the Passaic River

PCB levels in exceedance of the FDA action level were found in carp from both Station 6 (Passaic River at Monroe Street bridge) and Station 7 (Passaic River at Elmwood Park) in the 1986-1987 sampling program (4). Although Station 6 is covered by a comprehensive ban on fish and shellfish consumption for the tidal Passaic River, Station 7 is above the Dundee Dam, the upstream limit of the area covered by the consumption ban, and the 1986-1987 results showing exceedances of the PCB action level led to repeated sampling at this station in 1988, 1989, and 1991. In addition, Station 7A (Passaic River at Pompton River confluence) was added to

the Sampling program, and carp were collected there in 1989 and 1991.

Table 14 presents the PCB results for carp from these stations for the entire 1986-1991 period. The level at Station 6 decreased, but remained well above the action level. At Stations 7 and 7A, levels dropped from over 3 ppm to less than 1 ppm in the spring of 1991. Levels at Stations 6 and 7A were lower in spring samples than in samples collected in November and December.

While these sharp decreases in a fairly small number of samples may reflect real changes in ambient conditions, it is important to consider whether seasonal or other differences between samples might explain the results.

Figures 14 and 15 are plots of PCB concentrations versus mean weight and lipid content, respectively. There is considerable scatter in the PCB/mean weight plot, although it might be concluded that for a given size, carp from the tidal Passaic River (Station 6) will have higher PCB levels than those from the farthest upstream station (Station 7A). However, a clearer relationship between PCB levels and lipid content appears to emerge from Figure 15. The contrast between Stations 6 and 7A is the same as in the preceding figure. In addition, except for the data point for one of the spring 1989 samples, the variation in PCB levels in carp from Station 7 appears to be explained by lipid content. The 1989 and 1991 samples from Stations 7 and 7A that had PCB levels below the 2 ppm action level (with the single above-mentioned exception) had the lowest lipid contents among all carp samples collected in the region between 1986 and 1991. This points to the need f or additional sampling at stations along the Passaic River upstream of the Dundee Dam.

4. North Coast Region

PCB levels were also higher in American eel at Station 32 (Shark River at Route 35 bridge) than at the next station to the south, Station 33 (Toms River at Ocean Gate) (Table 15). This might reflect a greater influence of the outflow from the Hudson Raritan system on the Shark River station. The Toms River station is both farther south and, due to its' location in Barnegat Bay, more sheltered from, the direct influence of the ocean. PCB levels in blue crab hepatopancreas were also slightly higher at the Shark River station (0. 38 ppm) than at the Tom's River station (0. 29 ppm) .

C. Selected Species

1. Blue Crabs

The 1986-1987 sampling effort for blue crabs focused almost exclusively on the Northeast region. The current program also collected numerous samples in that region, but expanded collection of blue crabs in other regions beyond the single sample collected

in the Delaware region in 1986. Samples were collected for the first time at Stations 32 (Shark River at Route 35 bridge), 33 (Toms River at Ocean Gate), 44 (Navesink River) , and 45 (Shrewsbury River) in the North Coast region; and at Stations 35 (Absecon Bay at Absecon) and 36 4 (Great Egg Harbor at Route 9 bridge) in the South Coast region.

Tables 6 through 8 show that crabs from the Northeast region had the highest levels of all contaminants considered, in all three sample types. For all other regions, mean contaminant levels in muscle and combined hepatopancreas /muscle samples were all at or near the detection limit, except for the DDT levels in the hepatopancreas /muscle samples from the Delaware region (two samples collected at Station 26, Maurice River at Mauricetown). These levels were still quite low and well below those found in the Northeast region.

2. Blue Crabs - Variation in Contaminant Levels by Tissue Type

The hepatopancreas (Figure 16) (11) is the main site of lipid storage, enzyme secretion and nutrient absorption. As a lipid-rich tissue, it is also a likely site of concentration of lipophilic contaminants such as those considered in the present study. Early DSR research on 2,3,7,8-TCDD in the Newark Bay complex (3) revealed preferential concentration in the hepatopancreas as opposed to muscle. The 19861987 results (4) showed that levels of all three contaminants considered were approximately, an order of magnitude higher in hepatopancreas samples than in muscle tissue.

Contaminant levels in hepatopancreas samples from the current program were approximately six to eight times greater than the levels found in muscle tissue (Table 16; Figure 17). The hepatopancreas-to-muscle contaminant ratios are smaller than those for the 1986-1987 samples (which ranged from 9 to 16), primarily because of the inclusion for the first time of samples from outside the Northeast region; in these samples levels in muscle tissue were often at the detection limit, although they are reported as equal to the detection limit. This tends to mask even lower levels in muscle tissue and thus artificially reduce the hepatopancreas-tomuscle ratio. The ratios for the Northeast region (approximately 9 to 10) are higher than those for all regions combined, and more closely match the ratios for the 1986-1987 samples, which were based entirely on samples from the Northeast region.

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[4] Average lengths for all composites in the 1988-1991 sampling program were over 4 inches, the minimum legal size for hard-shelled crabs. (Minimum legal sizes for peelers/shedders and soft-shelled crabs are 3 inches and 3.5 inches, respectively.)

3. Bluefish

Table 6 presents mean PCB levels in bluefish collected in various regions - A clearer inter-regional comparison emerges, however, if the known dependence of contaminant levels (especially for PCBs) on fish size (2,4,12,13) is considered, and attention is focused on large bluefish. i.e., those over 60 cm (approximately 24 inches) in length. (The current advisory for limited consumption of bluefish caught along the coast applies to such large bluefish.) Indeed, the single-fish samples from Station 46 (Off Barnegat Inlet) were selected for analysis precisely because they were the largest among those collected, ranging-from 68 to 81 cm in length and weighing between 8 and 11 pounds.

Table 17 presents the results for large bluefish (single fish at least 24 inches in length, and composites in which the average length was at least 24 inches).[5] Mean contaminant levels for the North Coast and South Coast regions were slightly lower than those for Barnegat Inlet, but there is considerable overlap between the ranges of values. The higher average length and (especially) weight of the large bluefish caught off Barnegat Inlet as compared with the North Coast and South Coast bluefish may explain the remaining differences, particularly in PCB levels. The high PCB levels in large bluefish for the Northeast region, despite their lower average length and weight, points to the Hudson-Raritan estuary as an area of PCB contamination, as have previous studies (1,2,4). Table 18 and Figure 18 compare contaminant levels in large and small bluefish; Figure 19 plots PCBs versus length for all bluefish from the current data set.

4. Striped Bass

Elevated levels of PCBs in striped bass have led to consumption advisories for striped bass in both New Jersey and New York. Levels in striped bass exceeded the FDA action level in a number of striped bass samples from the current program. Table 6 shows that the highest regional mean (1.80 ppm, N=14) was in the

[5] There was little overlap of small and large bluefish in the composites. Only two of the seventy f ish (3%) that made up the fourteen large composites were less than 24 inches in length; none of the thirty fish that made up the six small composites were over 24 inches in length. Overall mean lengths were 71.2 cm (28.0 inches) for the large composites, and 41.2 cm (16.2 inches) for the small composites. This is even less than the extent of overlap in the 1986-1987 data set, in which 14% (15 of 107) of the individual fish in the large composites were small fish, and 12% (24 of 207) of the individual fish in the small composites were large fish. Overall mean lengths in 1986-1987 were 51.5 cm (20.3 inches) for the small composites and 70.2 cm (27.6 inches) for the large composites.

Northeast region; levels in 5 of the 14 composite samples collected in that region (36%) exceeded the action level. Although the mean was lower than that for the 1986-1987 sampling program (2.14 ppm, N=16), the proportion of samples with PCB levels exceeding the action level was virtually the same as for the 1986-1987 program (6 of 16, or 38%).

In the North Coast region, the regional mean for all samples, both composite and single-fish (1.64 ppm, N=18, unweighted for sample size) is also less than the 1986-1987 mean (2.33 ppm, N=10), but a substantial proportion of the samples (6 of 18, or 33%) had PCB levels over the action level, although this proportion was also lower than that for 1986-1987 (7 of 10, or 70%).

5. Striped Bass -- Temporal Trends

PCB levels in striped bass from the Northeast, North Coast, and South Coast regions were all lower than those found in the 1986-1987 monitoring effort (4). When earlier results are also considered, the results as a whole suggest a decreasing trend in PCB concentrations since the late 1970s.

Table 19 presents the results of the current program and the 1986-1987 effort (4) for the Northeast and North Coast regions, along with selected results from previous DEPE surveys (1,2). These regions are highlighted here because the early surveys only sampled in these areas. As the table shows, levels appear to have fallen substantially since the time of the first two surveys. Because of changes in analytical methodologies over time (the first survey considered only PCB Aroclor 1254, the second survey at first considered only Aroclor 1254 and then added Aroclor 1248, and the two most recent surveys considered Aroclors 1248 and, together, 1254 and 1260), it is not possible to determine the magnitude of the change. However, because fewer Aroclors were considered in the early surveys, the results from those surveys almost certainly understate "total PCBs11 as defined in the more recent surveys by a significant amount. A comparison of the 1981 results from. the Hudson River with those for 1982, for example, shows that considering Aroclor 1254 alone instead of both Aroclor 1254 and Aroclor 1248 could have resulted in an underestimation of PCB content of over 50%. Thus, the levels in striped bass from the Hudson River and Newark Bay in the first survey 'may have been close to 7 ppm if both Aroclors had been considered.

This apparent pattern of falling PCB concentrations in striped bass is consistent with findings reported by the New York State Department of Environmental Conservation (14, 15) for striped bass taken in New York waters. Mean PCB levels in striped bass from the lower Hudson River (below river mile 80, near Poughkeepsie) have fallen, although not steadily from year to year, from around 5 ppm in the late 1970s to less than 3 ppm in 1990 (15). Levels in New York Harbor have fallen even more sharply, from around 3.5 to

almost 6 ppm in the mid-1980s to 1.74 ppm in 1990 (14). In striped bass caught in New York waters off the southern shore of western Long Island (somewhat analogous to New Jersey's North Coast region), mean PCB levels decreased from around 3 ppm in the mid1980s to 1.20 ppm in 1990; a similar, though less steep, trend was seen in striped bass caught off the northern shore of western Long Island.6

6. Striped Bass - Inter-regional Comparisons

Unlike the 1986-1987 sampling program, in which striped bass from the South Coast region were collected only at Stations 39 (Seaside Park to Brigantine) and 40 (Brigantine to Cape May), the current sampling program included striped bass from Delaware Bay (Station 43). This allows a three-way comparison among areas outside of the Hudson-Raritan estuary. In addition, this section considers individual stations within the South Coast region, since Station 39 straddles Barnegat Inlet, the southern boundary of the region covered by the current advisory for limited consumption of striped bass. 7 This is of particular interest with respect to New Jersey's coastal striped bass, which are thought to be comprised of two populations, one associated with and spawning in the Hudson

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[6] The decreases in PCB levels in striped bass led New York State to relax its consumption advisories in April 1992. Prior to that time, New York advised no consumption of striped bass from the entire Hudson River below the Federal Dam at Troy, New York Harbor, and the waters off western Long Island, and consumption of no more than one meal per month of striped bass from the waters of f eastern Long Island. New York's new advisories are: no consumption of striped bass from the Hudson River above the Tappan Zee Bridge; no more than one meal per month of striped bass from waters south of the Tappan Zee Bridge, including New York Harbor, and western Long Island Sound; and no more than one meal per week of striped bass from eastern Long Island Sound, Peconic and Gardiners Bays, and all waters off the south shore of Long Island. These new advisories are similar to New Jersey's existing advisories for striped bass: very limited consumption (no more than one meal per month) of striped bass from the Hudson River; and limited consumption (no more than one meal per week) of striped bass from the rest of the Northeast region and offshore waters south to Barnegat Inlet).

[7] The current advisory for limited consumption of striped bass applies to the Northeast and North Coast regions (down to Barnegat Inlet). (There is also an advisory for very limited consumption of striped bass from the Hudson River.) While information on the exact location(s) at which Station 39 samples were collected was not available, sampling personnel reported that it was likely that they were collected within a short distance to north or south of Barnegat Inlet. This would put Station 39 near to or within the area covered by the consumption advisory.

Raritan estuary, and the other associated with and spawning in the Delaware estuary. (This is in contrast with bluefish, which migrate up and down the entire Atlantic coast.)

Tables 20 through 22 present descriptive statistics for contaminant levels in striped bass from the Northeast, North Coast, and South Coast regions, as well as individual stations in the South Coast region. There is no marked difference in contaminant levels between striped bass from Delaware Bay (Station 43) and those clearly from the area between Barnegat Inlet and Cape May (Stations 38A and 40). Especially for PCBs, mean levels are higher for Northeast and North Coast striped bass than for those from the South Coast, particularly when Northeast and North Coast striped bass are compared with those collected well to the south of Barnegat Inlet (Stations 40 and 43). Mean contaminant levels in striped bass from Station 39 are much closer to those for the North Coast region than to those for the other stations in the South Coast region. Moving Station 39 from the South Coast region to the North Coast region would lower the mean PCB level for the South Coast region from 1.09 ppm to 0.92 ppm; it would also lower the mean level for the North Coast region, but only slightly, from 1.64 ppm to 1.63 ppm.

7. Striped Bass of Legal Size

To help conserve the resource by allowing the fish to spawn before being subject to harvest, New Jersey has established minimum legal sizes for striped bass caught in the state's waters: 36 inches (approximately 91 centimeters (cm)) for Delaware Bay, the Delaware River, and their tributaries; and 28 inches (approximately 71 cm) for all other waters. This section focuses on striped bass of legal size to determine whether contaminant levels in these fish differ from the overall levels in all striped bass collected.

Table 23 presents the results for all legal-size striped bass (single fish at least 28 inches in length, and composites in which the average length was at least 28 inches), and contrasts them with the results for all striped bass samples in each region, regardless of size. (No composites from Delaware Bay met even the 28-inch criterion.) The table reveals no marked differences between legal-size striped bass and the overall sample of striped bass collected during the current sampling effort. One reason may be the overlap between legal and sub-legal composites, which was much greater than the overlap between large and small bluefish composites. Eight of the forty fish in the eight legal-size composites (20%) were less

[8] Moving Station 39 to the North Coast region would have changed the 1986-1987 results for PCBs in striped bass as follows: the South Coast mean would have been 0.87 ppm (N=3) instead of 1.35 ppm (N=5), and the North Coast mean would have been 2.29 ppm (N=12) instead of 2.33 ppm (N=10).

than 28 inches in length, and 20 of the 174 fish in the sub-legal composites (11%) were over 28 inches in length. Another reason may be the relatively small difference in size between the two categories: average sizes of sub-legal striped bass and legal-size striped bass never differed by more than 30%: 58.3 cm versus 82.1 cm for the Northeast region, 64.7 cm versus 75.7 cm for the North Coast region, and 66.7 cm versus 75.9 cm for the South Coast region. (In contrast., small bluefish averaged 41.2 cm in length, versus 71.2 cm for large bluefish.) Thus, even if the overlap between legal and sub-legal composites is eliminated by restricting attention to single-fish samples (Table 24), there is still no marked difference between the two size classes, perhaps owing to the small difference in average size.

8. Weakfish

The results for weakfish in Tables 6 through 8 also serve to illustrate the importance of the Hudson-Raritan estuary as an area of contamination, especially for PCBs (means and standard deviations of 1.16±0.21 ppm for the Northeast region (N=2); 0.62±0.27 ppm for the North Coast region (N=6); and 0.28±0.16 ppm for the South Coast region (N=30)). Eliminating one outlier from each of the two Delaware Bay stations (Stations 41 and 42) reduces the mean for the South Coast region even further, to 0.24±0.08 ppm (N=28). Unlike the situation for striped bass, contaminant levels in weakfish from Station 39 do not differ from those for other stations in the region (0.23±0.03 ppm, N=3). Levels in weakfish from Delaware Bay (Stations 41 and 42) were slightly higher than levels in weakfish from the South Coast stations along the Atlantic coastline (Stations 34-36 and 39-40) (e.g., PCB levels of 0. 33±0.20 ppm for the Delaware stations (N=18) versus 0.21±0.02 ppm for the others (N=12). Even this small difference is diminished by eliminating the two Delaware Bay outliers, which reduces the level for those two stations to 0.27±0.10 ppm (N=16).[9]

[9] Only 1 of 38 weakfish composites had an average length below the legal minimum size for weakfish (13 inches); the average length of the fish in that composite was 12.6 inches. Among the other species considered in this report, channel catfish and largemouth bass are the only species (besides those already discussed) for which minimum legal sizes have been established. Two of the 3 channel catfish composites had average sizes above the minimum legal size of 12 inches; the average length of the f ish in the third composite was 10.6 inches. Similarly, 2 of the 3 largemouth bass composites had average sizes over the legal minimum size (also 12 inches); the average length for the third composite was 11.8 inches.

IV. CONCLUSIONS

- The results are generally consistent with previous findings that showed the Northeast region of the state to be the most severely contaminated. Regional means f or PCBs in three species from the region--American eel, carp, and blue crab (hepatopancreas) --were elevated (i. e, exceeded FDA action levels). Elevated PCB levels were also found in individual samples of bluefish, blue crab (hepatopancreas/muscle mixture), and striped bass from this region.

- In contrast with the 1986-1987 results (especially for chlordane), in the Camden region no regional means, and no results for specific composite samples, exceeded FDA action levels. However, small sample sizes for the 1988-1991 sampling efforts make detailed comparisons difficult.

- Levels of PCBs in some striped bass from the North Coast and South Coast regions; in bluefish from the North Coast, South Coast, and Atlantic regions; and in one brown bullhead sample from the Camden region (from Raccoon Creek at the Delaware River) also exceeded the FDA action level.

- All exceedances of FDA action levels in individual samples are covered by a consumption advisory, ban, or other information already issued by the State, with the exception of: carp samples from Stations 7 and 7A on the Passaic River; a brown bullhead sample from Station 25 on Raccoon Creek; and two striped bass samples from Station 39 (Seaside Park to Brigantine).

- Large bluefish (total length $\geq$60 cm) contained, on average, approximately two to three times the level of a given contaminant found in small bluefish.

- In blue crabs, the contaminants considered were found at much higher levels (approximately six to eight times higher on average) in hepatopancreas samples than in muscle samples.

- PCB levels in striped bass from the Northeast and North Coast regions appear to have decreased since surveys in the 1970s and early 1980s. This decrease is consistent with results for striped bass from New York waters.

- Despite decreases in contaminant levels in some species and regions, the results still point to widespread occurrence of contaminants above background levels in the edible portions of many species from many areas of the - state. The existing framework of consumption advisories and bans, fishing prohibitions, and sales bans continues to serve as an important way of protecting the public from excessive exposure to contaminants found in fish and shellfish.

V. RECOMMENDATIONS

- It has been four years since substantial numbers of samples were collected from the network of stations established in 1986. Regular monitoring at these stations should resume as soon as practicable. Detection of changes in contaminant levels requires regular sampling. Sound decisions concerning this issue depend on adequate and reliable data.

- Special efforts should be made to collect data on contaminant levels in: bullhead, white perch and other benthic species along the lower Delaware River and its tributaries (the Delaware River Basin Commission is acquiring such data, which should be reviewed before any decisions on new sampling are made); a variety of species, including carp, from the Passaic River above the Dundee Dam; and striped bass from the North Coast and South Coast regions (to detect changes in levels).

- Future sampling of bluefish should further explore the relationship between contaminant levels and fish size.

- There is a need for better data on contaminant levels in fresh water species. Such data could be collected as part of the Basinwide Ambient Systematic Sampling (BASS) Program recently proposed by DEPE's Water Monitoring Management office.

- Besides following the consumption advisories that apply to particular species from specific areas, consumers can reduce their potential intake of contaminants by taking other simple steps:

  • Since contaminants accumulate in fish over a long period of time, **smaller** fish often contain lower levels of contaminants than larger fish of the same kind. This has been found, in this study and elsewhere, to be the case for bluefish. **Selecting smaller fish** can thus reduce exposure.

  • For finfish, especially fatty species such as bluefish, **removing the fatty tissues before cooking** can also reduce exposure. These include the **belly flaps, dark meat along the lateral line,** and the **skin.**

  • Using cooking techniques that allow fats to drip away from the fish (such as **grilling, broiling, or baking on a rack)** and avoiding coatings that hold in fats and oils is another way to reduce exposure.

  • Intake of contaminants that may be found in crabs and lobsters can be minimized by **discarding the internal organs ("tomalley," "green gland," or "mustard") before cooking** or, if the animals are cooked whole, by **not using these organs in any sauces or juices.**

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TABLE 1

Delaware River Samples Analyzed by U.S. Fish and Wildlife Service

Site Number	Location	Species	N
25	Raccoon Creek	Channel catfish	1
		White perch	1
25A	Petty Island	Channel catfish	1
		White perch	1
28	Deepwater	Channel catfish	1
		White perch	1
		Blue crab (H/M)	2
		Blue crab (H)	1
		Blue crab (M)	1
29	Burlington Island	Channel catfish	1
		White perch	1
30	Trenton (above tidal influence)	Channel catfish	1
		White perch	1
31	Easton	Channel catfish	1
31A	Lambertville	Channel catfish	1
		Striped bass	2
		Walleye	1

TABLE 2
Sampling Sites and Species Collected
1988-1991

Site Number	Location	Species Collected[1]
1	Hudson River at Alpine	10,11
2	Upper New York Bay at Robbins Reef	2,7
3	Hackensack River at Rivervale	10
4	Hackensack River at Laurel Hill	1,2
5	Passaic River at confluence with Newark Bay	2,7
6	Passaic River at Monroe Street Bridge	1,5
7	Passaic River at Elmwood Park	1,5
7A	Passaic River at Pompton River	5
8	Newark Bay at Central Railroad of New Jersey bridge	1,2,7
9	Arthur Kill at Rahway River	1
10	Raritan River at Route 35 bridge	2,3,7
11	Raritan River at Kin Buc landfill	2,3,7,10
12	North Branch Raritan River at North Branch	1
13	South Branch Raritan River at Neshanic	1
14	South River at Old Bridge	4
15	Raritan Bay at Union Beach	3,7,8
16	Raritan Bay at Earle Ammunition Pier	3,7,8
17	Upper Strawbridge Lake at Moorestown	1,4
18	Lower Strawbridge Lake at Moorestown	4
19	Pennsauken Creek at Forked Landing Road	4
20	Cooper River at Evans Pond	4
21	Cooper River at Cooper River Lake	4,5,10
22	Newton Lake at Newton Creek	4,6
23	Stewart Lake at Woodbury Creek	1,4f6
24	Raccoon Creek at Swedesboro	4
25	Raccoon Creek at Delaware River	4
26	Maurice River at Mauricetown	1,2,4
27	Cohansey River at Greenwich	10
28	Delaware River at Deepwater	10,11
29	Delaware River at Burlington Island	1,4
30	Delaware River at Trenton (above tidal influence)	1,11
31	Delaware River at Easton	1,6
32	Shark River at Route 35 bridge	1,2
33	Toms River at Ocean Gate	1,2
34	Barnegat Bay at Little Egg Harbor	8
35	Absecon Bay at Absecon	2,8
36	Great Egg Harbor at Route 9 bridge	1,2,8
37	Sandy Hook - Asbury Park	3,7,8
37A	Sandy Hook to Barnegat Light	7
38	Asbury Park - Seaside Park	3,7,8
38A	Barnegat Light to Cape May	7

TABLE 2
(Continued)

39	Seaside Park - Brigantine	3,7,8
40	Brigantine - Cape May	3,7,8
41	Cape May - Fortescue	8
42	Fortescue - Salem	8
43	Delaware Bay	7
44	Navesink River	2
45	Shrewsbury River	2
46	off Barnegat Inlet	3

[1] Numbers correspond to species as follows:

1 = American eel

2 = Blue crab

3 = Bluefish

4 = Brown bullhead

5 = Carp

6 = Largemouth bass

7 = Striped bass

8 = Weakfish

9 = White catfish (not collected in this survey)

10 = White perch

11 = Channel catfish

TABLE 3

Samples Consisting of Fewer Than Five Fish

Site	Region	Species	Year	# in Sample
1	Northeast	Channel catfish	1988	1
8	Northeast	American eel	1988	1
9	Northeast	American eel	1988	1
10	Northeast	Striped bass	1988	4
17	Camden	American eel	1988	3
22	Camden	Brown bullhead	1988	1
23	Camden	Brown bullhead	1988	1
26	Delaware	American eel	1988	2
31	Delaware	Largemouth bass	1988	2
37A	North Coast (6 samples)	Striped bass	1989	1
38A	South Coast (6 samples)	Striped bass	1989	1
46	Atlantic (14 samples)	Bluefish	1989	1

TABLE 4

Regions and Corresponding Sampling Sites

Region	Sites[1]
Northeast	1-16
North Coast	32, 33, 37, 37A, 38, 44, 45
Camden	17-23
Delaware	24-31
South Coast	34-36, 38A, 39-43
Atlantic	46

[1] See Table 1 for list of site numbers and locations.

TABLE 5

Results at or in Excess of FDA Action Level for PCBs[1]

Species	Site	Region	Year	PCBs (ppm, wet wt.)
Striped bass	2	Northeast	1988	2.68
Blue crab (H)	2	Northeast	1988	3.90
Blue crab (H)	2	Northeast	1989	2.95
American eel	4	Northeast	1988	3.74
Blue crab (H)	4	Northeast	1988	2.47
Striped bass	5	Northeast	1988	2.48
Blue crab (H/M)	5	Northeast	1988	2.05
Blue crab (H)	5	Northeast	1988	3.69
American eel	6	Northeast	1988	2.46
Carp	6	Northeast	1988	2.99
Carp	7	Northeast	1988	3.30
Carp	7A	Northeast	1989	3.64
Striped bass	8	Northeast	1988	2.00
American eel	8	Northeast	1988	2.53
Blue crab (H)	8	Northeast	1988	3.51
American eel	9	Northeast	1988	3.05
Bluefish	10	Northeast	1988	2.81
Striped bass	10	Northeast	1988	2.73
Blue crab (H)	10	Northeast	1988	2.99
Blue crab (H/M)	11	Northeast	1988	2.07
Blue crab (H)	11	Northeast	1988	3.52
Bluefish	15	Northeast	1988	2.02
Striped bass	16	Northeast	1988	2.49
Brown bullhead	25	Camden	1988	2.60
Bluefish	37	North Coast	1988	2.77
Striped bass	37	North Coast	1988	2.35
Striped bass	37	North Coast	1988	2.27
Striped bass	37A	North Coast	1989	2.67
Striped bass	37A	North Coast	1989	2.08
Striped bass	37A	North Coast	1989	2.59
Striped bass	38	North Coast	1988	3.33
Striped bass	38A	South Coast	1989	2.52
Bluefish	39	South Coast	1988	2.17
Striped bass	39	South Coast	1988	2.43
Striped bass	39	South Coast	1988	2.05
Bluefish	46	Atlantic	1989	2.25
Bluefish	46	Atlantic	1989	2.15

[1] Results for discrete samples, not station means. Other samples may have been analyzed for the same species/site/year combination. See Appendix B. Action level is 2.0 ppm for PCBs.

TABLE 6
PCBs by Region
(ppm, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
American eel	1.11 (2)	0.60 (4)	0.89 (2)	2.03 (7)	0.56 (1)	--
Blue crab						
Hepatopancreas	--	0.43 (1)	0.44 (4)	3.29 (7)	--	--
Muscle	--	0.20 (1)	0.20 (40)	0.35 (7)	--	--
HepatopancreasMuscle Mixture	--	0.25 (1)	0.20 (4)	1.45 (9)	0.20 (2)	--
Blue fish	--	--	0.95 (6)	1.48 (6)	0.91 (8)	1.39 (14)
Brown bullhead	0.62 (8)	1.07 (4)	--	1.03 (1)	--	--
Carp	1.73 (1)	--	--	2.02 (7)	--	--
Largemouth Bass	0.36 (2)	0.20 (1)	--	--	--	--
Striped bass	--	--	1.64 (18)	1.80 (14)	1.13 (17)	--

TABLE 6
(Continued)

PCBs by Region
(ppm, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
Weakfish	--	--	0.62 (6)	1.16 (2)	0.28 (30)	--
White perch	0.85 (1)	1.09 (2)	--	1.28 (3)	--	--
Channel Catfish	--	0.95 (2)	--	1.81 (1)	--	--

[1] Mean values; number in parentheses = number of data points
FDA Action Level = 2.0 ppm

TABLE 7
Chlordane by Region
(ppb, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
American eel	163.96 (1)	38.20 (4)	43.94 (2)	129.37 (7)	17.89 (1)	--
Blue crab						
Hepatopancreas	--	13.41 (1)	15.00 (4)	66.57 (7)	--	--
Muscle	--	5.00 (1)	5.00 (4)	6.48 (7)	--	--
Hepatopancreas Muscle Mixture	--	6.12 (1)	5.97 (4)	33.30 (9)	5.30 (2)	--
Blue fish	--	--	30.97 (6)	63.78 (6)	35.30 (8)	50.66 (14)
Brown bullhead	101.87 (8)	64.77 (4)	--	52.73 (1)	--	--
Carp	275.38 (1)	--	--	149.14 (7)	--	--
Largemouth Bass	47.62 (2)	5.00 (1)	--	--	--	--
Striped bass	--	--	59.15 (18)	51.93 (14)	40.56 (17)	--

TABLE 7
(Continued)
Chlordane by Region
(ppb, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
Weakfish	--	--	22.36 (6)	9.08 (2)	9.77 (30)	--
White perch	146.15 (1)	59.23 (2)	--	55.60 (3)	--	--
Channel Catfish	--	41.57 (2)	--	30.08 (1)	--	--

TABLE 8
DDTs by Region
(ppb, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
American eel	258.33 (1)	215.66 (4)	111.82 (2)	393.52 (7)	87.60 (1)	--
Blue crab						
Hepatopancreas	--	64.84 (1)	36.57 (4)	338.30 (7)	--	--
Muscle	--	25.19 (1)	25.14 (4)	38.83 (7)	--	--
Hepatopancreas	--	39.65 (1)	28.38 (4)	143.30 (9)	25.19 (2)	--
Muscle Mixture						
Bluefish	--	--	93.18 (6)	168.32 (6)	100.73 (8)	145.38 (14)
Brown bullhead	141.55 (8)	295.07 (4)	--	169.80 (1)	--	--
Carp	371.83 (1)	--	--	176.36 (7)	--	--
Largemouth Bass	60.74 (2)	26.47 (1)	--	--	--	--
Striped bass	--	--	151.40 (18)	146.90 (14)	110.46 (17)	--

TABLE 8
(Continued)

DDTs by Region
(ppb, wet weight)[1]

Species	Camden	Delaware	North Coast	Northeast	South Coast	Atlantic
Weakfish	--	--	84.08 (6)	37.80 (2)	60.74 (30)	--
White perch	221.17 (1)	358.33 (2)	--	137.31 (3)	--	--
Channel Catfish	--	297.59 (2)	--	112.46 (1)	--	--

[1] Mean values; number in parentheses = number of data points
FDA Action Level = 5000 ppb

TABLE 9
Contaminant Levels in Brown Bullhead Samples from the Delaware Region
(N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
24	Raccoon Creek At Swedesboro	1.29	85.37	419.92
25	Raccoon Creek At Delaware River	2.60	160.94	699.30
26	Maurice River At Mauricetown	0.20	5.94	29.21
29	Delaware River At Burlington Island	0.20	6.81	31.84

TABLE 10
Contaminant Levels in American Eel Samples from the Delaware Region
(N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
26	Maurice River At Mauricetown	0.20	7.86	35.77
29	Delaware River At Burlington Island	0.76	53.92	348.54
30	Delaware River At Trenton	0.63	46.53	209.56
31	Delaware River At Easton	0.82	44.47	268.75

TABLE 11

Contaminant Levels in White Perch Samples from the Delaware Region (N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
26	Cohansey At Greenwich	0.26	13.91	71.68
29	Delaware River At Deepwater	1.92	104.55	644.97

TABLE 12

Contaminant Levels in White Perch Samples from the Northeast Region (N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
1	Hudson River At Alpine	1.92	38.82	78.78
3	Hackensack River at Riverdale	0.32	51.29	78.37
11	Raritan River at Kin Buc landfill	1.61	76.69	255.98

TABLE 13
Contaminant Levels in American Eel Samples from the Northeast Region
(N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
4	Hackensack River At Laurel Hill	3.74	250.35	512.01
6	Passaic River at Monroe Street Bridge	2.46	194.70	254.24
7	Passaic River at Elmwood Park	1.43	130.24	169.05
8	Newark Bay at Central RR of N.J. bridge	2.53	95.54	325.98
9	Arthur Kill at Rahway River	3.05	152.50	1238.01
12	North Branch Raritan River at North Branch	0.54	27.68	52.00
13	South Branch Raritan River at Neshanic	0.49	54.60	203.36

TABLE 14
PCB Levels in Carp Samples from the Passaic River -- 1986-1991
(ppm, wet weight)

Site Number	Location	PCB Level (Year) May-June	PCB Level (Year) November-December
6	Passaic River At Monroe Street bridge	2.99 (1988)	5.83 (1986)
7	Passaic River Elmwood Park	3.11 (1987) 3.30 (1988) 1.12 (1989) 0.49 (1991)	2.66 (1986) 1.63 (1989)
7A	Passaic River at Pompton River confluence	0.96 (1991)	3.64 (1989)

TABLE 15
Contaminant Levels in American Eel Samples from the North Coast Region
(N = 1 in all cases)

Site Number	Location	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
32	Shark River At Route 35 bridge	1.50	59.34	148.54
33	Toms River At Ocean Gate	0.27	28.53	75.10

TABLE 16

Contaminant Levels by Tissue Type -- Blue Crabs

All Sites -- 1988-1991

	Muscle	Hepatopancreas	Hepatopancreas Muscle Mixture
PCBs (ppm, wet weight)	0.29 ± 0.12	2.10 ± 1.52	0.87 ± 0.70
Chlordane (ppb, wet weight)	5.86 ± 1.03	44.95 ± 31.78	20.38 ± 22.00
DDTs (ppb, wet weight)	33.13 ± 9.85	214.94 ± 185.80	90.17 ± 68.49
N	12	12	17

TABLE 17
Contaminant Levels in Large Bluefish

Region	N[1]	Average Length (cm)	Average Weight (lbs.)	PCBs[2] (ppm)	Chlordane (ppb)	DDTs (ppb)
Northeast	4	66.0	5.6	1.92 ± 0.66	80.69 ± 35.61	218.41 ± 90.61
North Coast	4	71.4	7.0	1.14 ± 1.19	40.84 ± 37.16	120.44 ± 101.59
Atlantic	14	76.7	9.6	1.39 ± 0.51	50.66 ± 16.50	145.38 ± 57.02
South Coast	6	74.6	8.2	1.15 ± 0.53	45.14 ± 12.91	123.66 ± 29.39

[1] Number of samples; single-fish samples in Atlantic region, composite samples in other regions

[2] All concentrations are wet weight.

TABLE 18

Contaminant Levels by Size -- Bluefish

All Sites -- 1988-1991

	Small (<60 cm)	Large (≥60)
Mean Length [1]	41.2	72.1
PCBs (ppm, wet weight)	0.46 ± 0.29	1.38 ± 0.67
Chlordane (ppb, wet weight)	15.66 ± 11.54	52.36 ± 24.66
DDTs (ppb, wet weight)	46.26 ± 17.68	147.59 ± 69.04
Number of composites	6	14
Number of single-fish samples	0	14
Total number of fish	30	84

[1] Lengths were weighted by sample size to calculate average lengths; analytical results were not weighted.

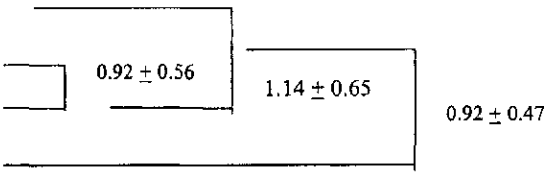
TABLE 19
PCB Levels in Striped Bass from the Northeast and North Coast Regions -- 1975-1991
(ppm, wet weight)

		NORHTEAST REGION					NORTH COAST REGION
Year(s)/ Aroclors Measured	Ref.	Hudson River/ Upper NY Bay	Newark Bay	Passaic River	Raritan River	Raritan/ Sandy Hook Bays	
1975-80 (1254)	1	3.49	3.65		1.56	0.83	2.21
1981 (1254)	2	1.56		6.04		3.93	
1982 (1248+ 1254)	2	3.18					
1986-87 (1248+ 1254/60)	4	1.42	3.61	2.61	1.55	2.09	2.33
1988-91 (1248+ 1254/60)	this report	1.89	1.81	1.94	1.59	1.90	1.64

TABLE 20

PCB Levels in Striped Bass

Region	N[1]	PCBs (ppm)
Northeast	14	1.80 ± 0.63
North Coast	18	1.64 ± 0.75
South Coast	23	1.09 ± 0.58
Station 39	6	1.58 ± 0.61
Station 38A	6	0.97 ± 0.78
Station 40	6	0.87 ± 0.29
Station 43	5	0.90 ± 0.15



Brackets indicate combinations of two or three stations in the South Coast region to which particular statistics apply, i.e., the level for Stations 38A and 40 combined is 0.92 ± 0.56 ppm, the level for Stations 39, 38A, and 40 combined is 1.14 ± 0.65 ppm, and the level for Stations 38A, 40, and 43 combined is 0.92 ± 0.47 ppm.

[1] Number of samples; single-fish samples at Station 38A and for 6 of 18 samples in North Coast region; composite samples elsewhere.

TABLE 21

Chlordane Levels in Striped Bass

Region	N	Chlordane (ppb)
Northeast	14	51.93 ± 25.61
North Coast	18	59.15 ± 27.06
South Coast	23	40.16 ± 17.64
Station 39	6	54.77 ± 20.65
Station 38A	6	39.02 ± 18.43
Station 40	6	36.11 ± 13.78
Station 43	5	28.87 ± 3.12

37.56 ± 15.59

43.30 ± 18.77

35.01 ± 13.65

Brackets indicate combinations of two or three stations in the South Coast region to which particular statistics apply, i.e., the level for Stations 38A and 40 combined is 37.56 ± 15.59 ppb, the level for Stations 39, 38A, and 40 combined is 43.30 ± 18.77 ppb, and the level for Stations 38A, 40, and 43 combined is 35.01 ± 13.65 ppb.

[1] Number of samples; single-fish samples at Station 38A and for 6 of 18 samples in North Coast region; composite samples elsewhere.

TABLE 22

DDT Levels in Striped Bass

Region	N	DDTs (ppb)
Northeast	14	146.90 ± 36.61
North Coast	18	151.40 ± 67.21
South Coast	23	106.10 ± 35.31
Station 39	6	138.88 ± 30.80
Station 38A	6	93.82 ± 42.52
Station 40	6	97.53 ± 30.66
Station 43	5	91.79 ± 5.77

95.68 ± 35.39

110.08 ± 39.10

94.23 ± 29.55

Brackets indicate combinations of two or three stations in the South Coast region to which particular statistics apply, i.e., the level for Stations 38A and 40 combined is 95.68 ± 35.39 ppb, the level for Stations 39, 38A, and 40 combined is 110.08 ± 39.10 ppb, and the level for Stations 38A, 40, and 43 combined is 94.23 ± 29.55 ppb.

[1] Number of samples; single-fish samples at Station 38A and for 6 of 18 samples in North Coast region; composite samples elsewhere.

TABLE 23

Contaminant Levels in Striped Bass -- Legal-Size Versus All Samples

Region	Average Length (cm)[1]	PCBs (ppm)	Chlordane (ppb)	DDTs (ppb)
Northeast				
Legal Size:				
Composites (N = 1)	82.1	1.40 --	57.64 --	154.08 --
All Samples:				
Composites (N = 14)	60.0	1.80 ±0.63	51.93 ±25.61	146.90 ±36.61
North Coast				
Legal Size:				
Composites (N = 3)	75.5	1.27 +0.06	54.10 +25.04	135.22 +32.45
Single Fish (N = 3)	76.6	1.82 +0.82	58.83 +38.85	170.31 +81.62
All Legal Size (N = 6)	75.7	1.54 +0.60	56.47 +29.35	152.77 +58.78
All Samples: (N = 18)	67.7	1.64 +0.75	59.15 +27.06	151.40 +67.21
South Coast				
Legal Size:				
Composites (N = 4)	75.9	1.41 ±0.71	54.53 +16.85	126.14 +31.85
All Samples: (N = 23)	68.7	1.09 +0.58	40.16 +17.64	106.10 +35.31

[1] Lengths were weighted by sample size to calculate average lengths; analytical results were not weighted.

TABLE 24

Contaminant Levels in single striped Bass:
Legal Size Versus Sub-Legal Size Samples

(All from Station 37A - Sandy Hook to Barnegat Inlet)

	Legal Size	Sub-Legal Size
N	3	3
Average Length (cm)	76.6 ± 4.9	65.5 + 1.7
PCBs (ppm)	1.82 ± 0.82	1.92 + 0.84
Chlordane (ppb)	58.83 ± 38.85	72.80 + 23.84
DDTs (ppb)	170.31 ± 81.62	194.26 + 72.15

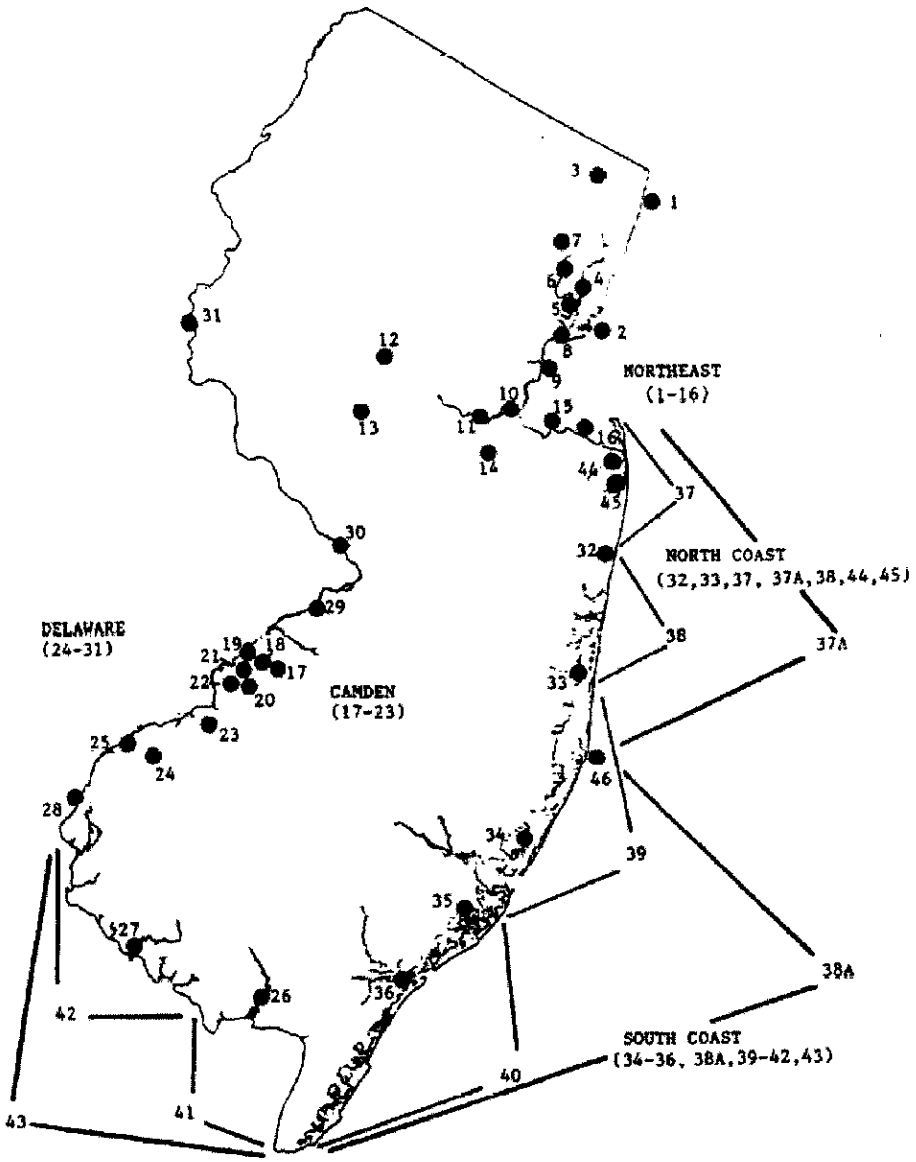
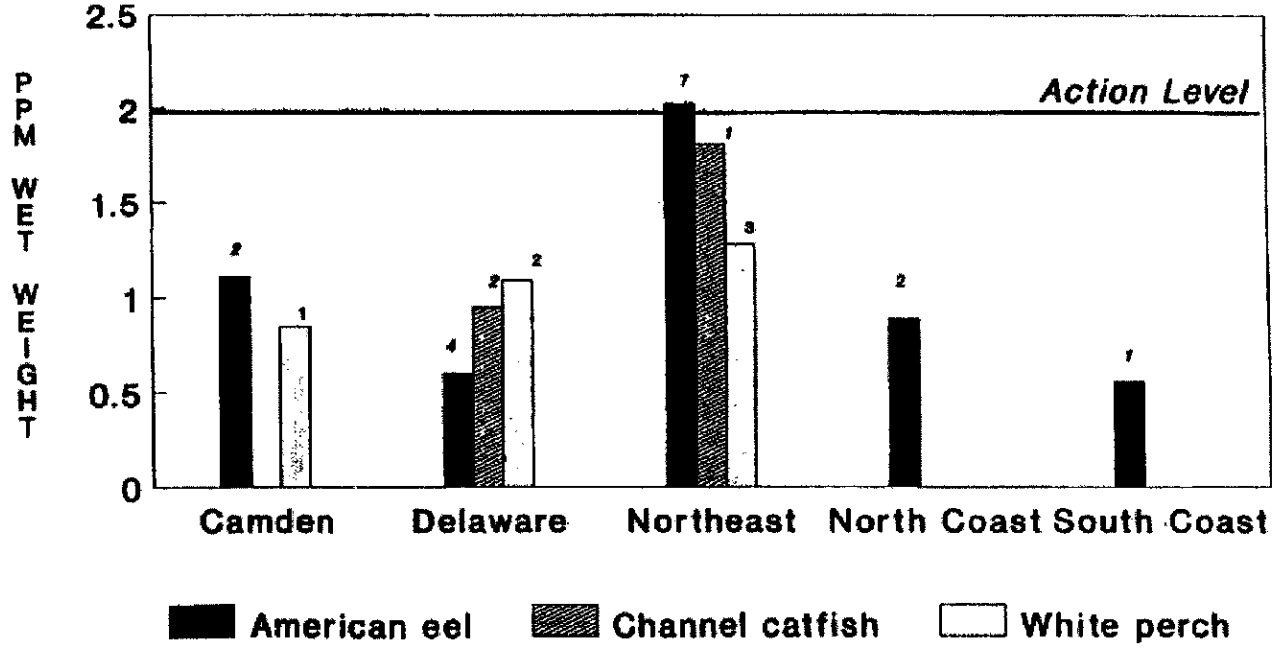


Figure 1
Sites and Regions

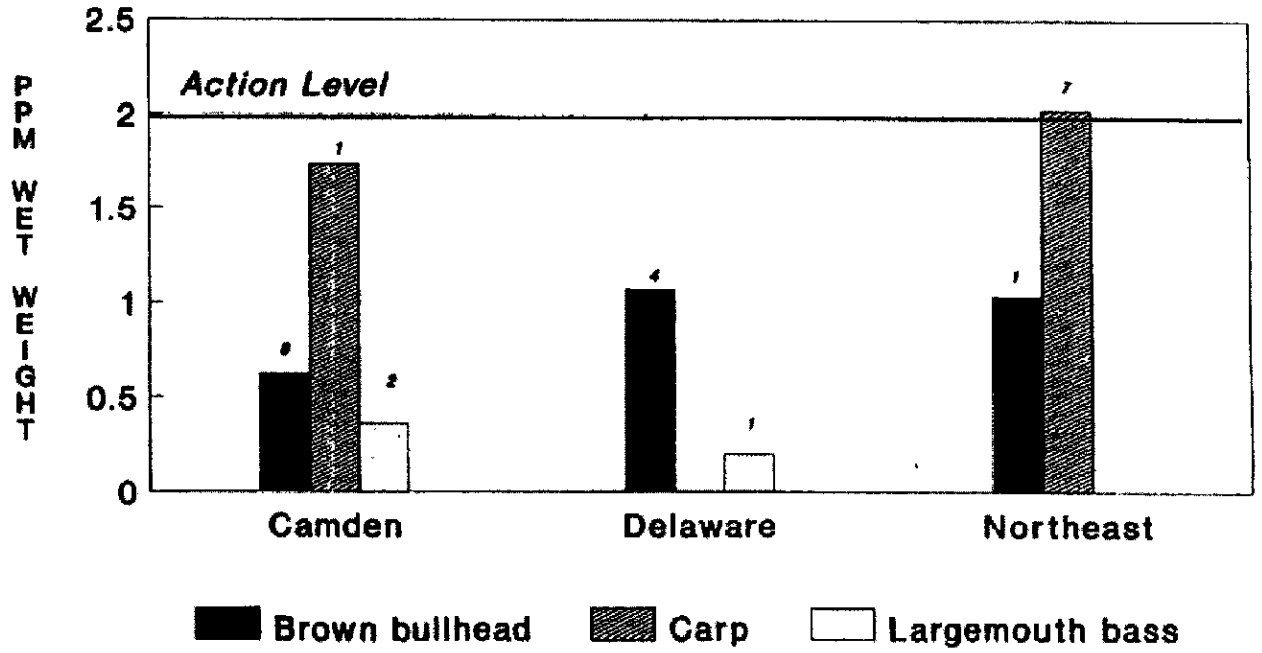
PCBs BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 2

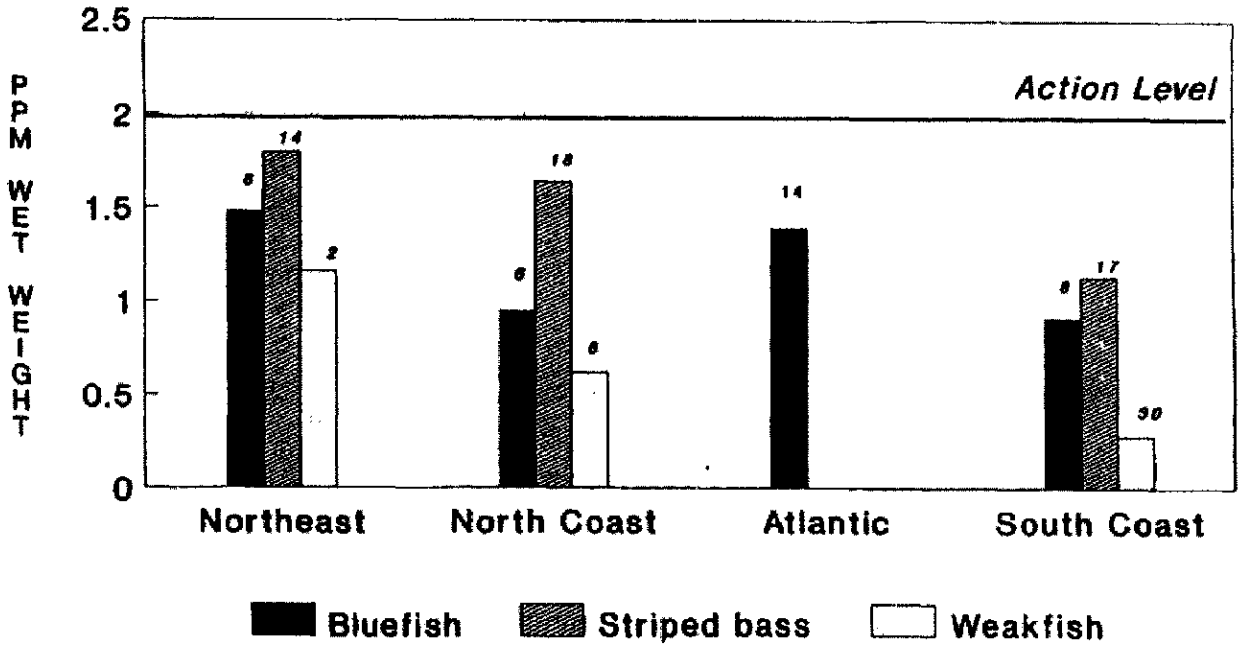
PCBs BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 3

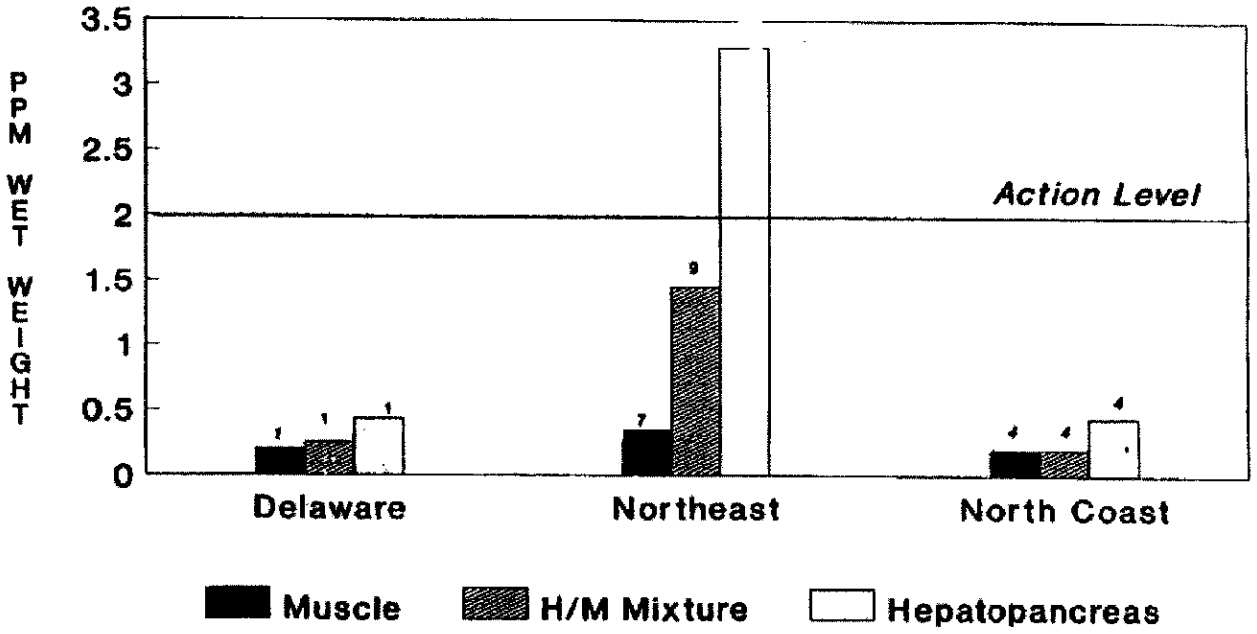
PCBs BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 4

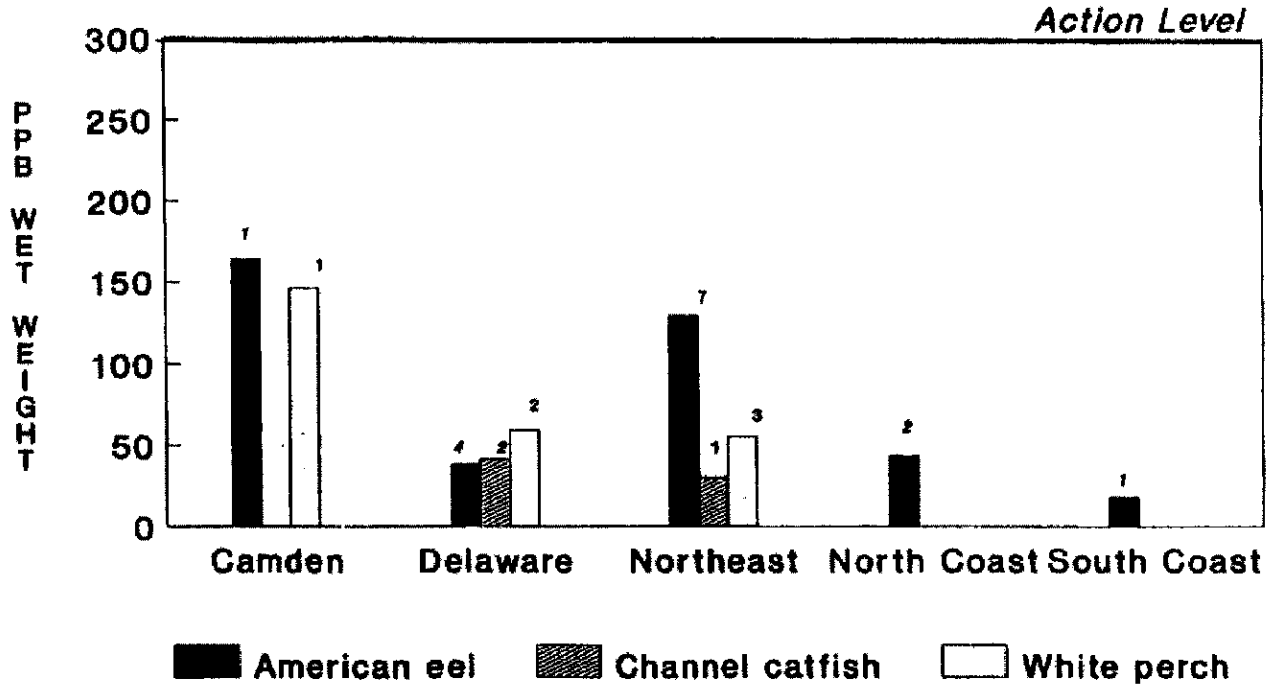
PCBs BY REGION
Blue Crabs -- 1988-1991



Mean Values; # on Bar = # of Data Points

Figure 5

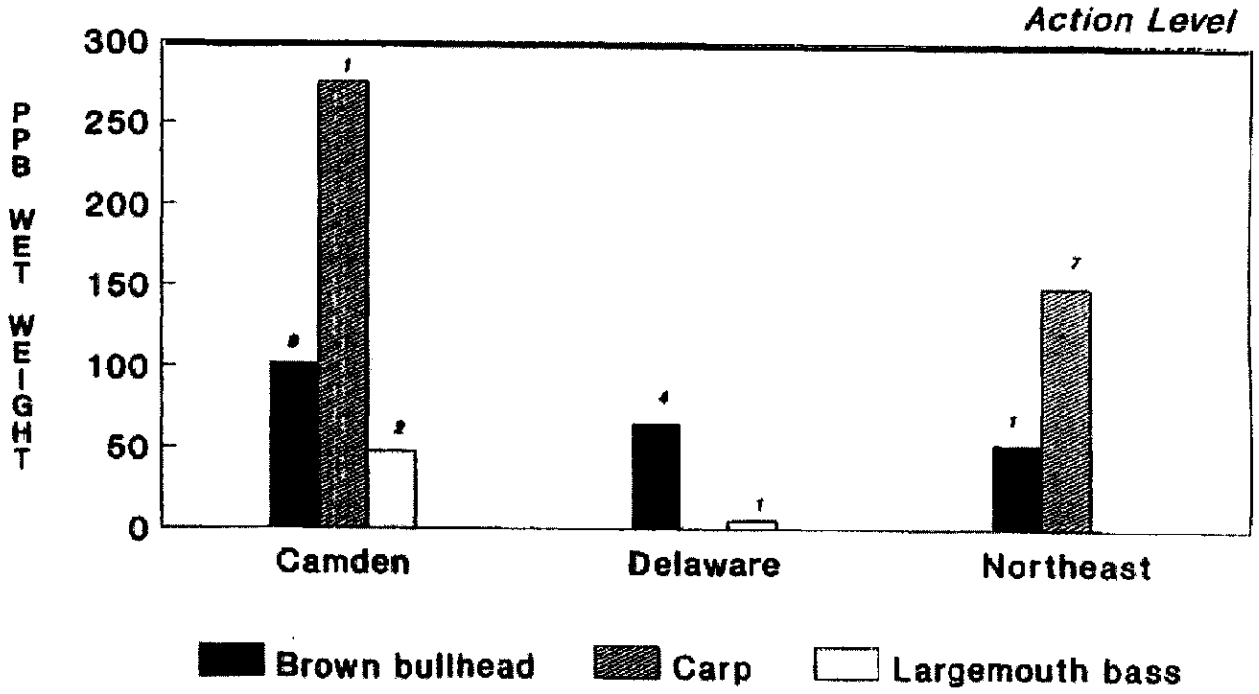
CHLORDANE BY REGION
1988-1991



Mean Values; # on Bar • # of Data Points

Figure 6

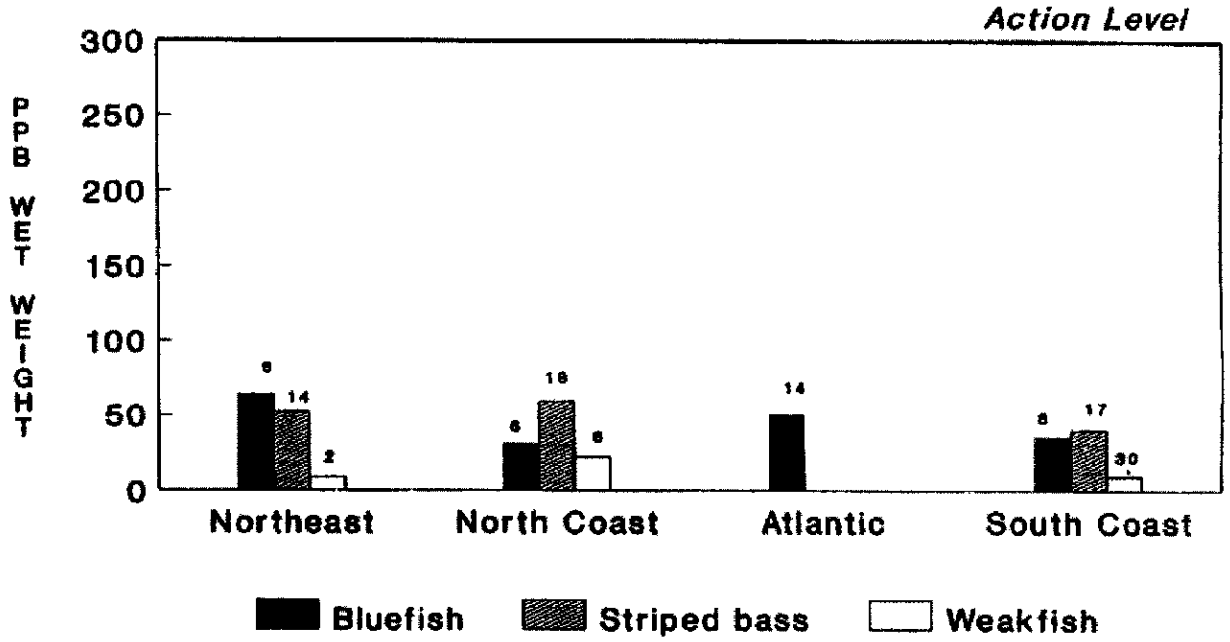
CHLORDANE BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 7

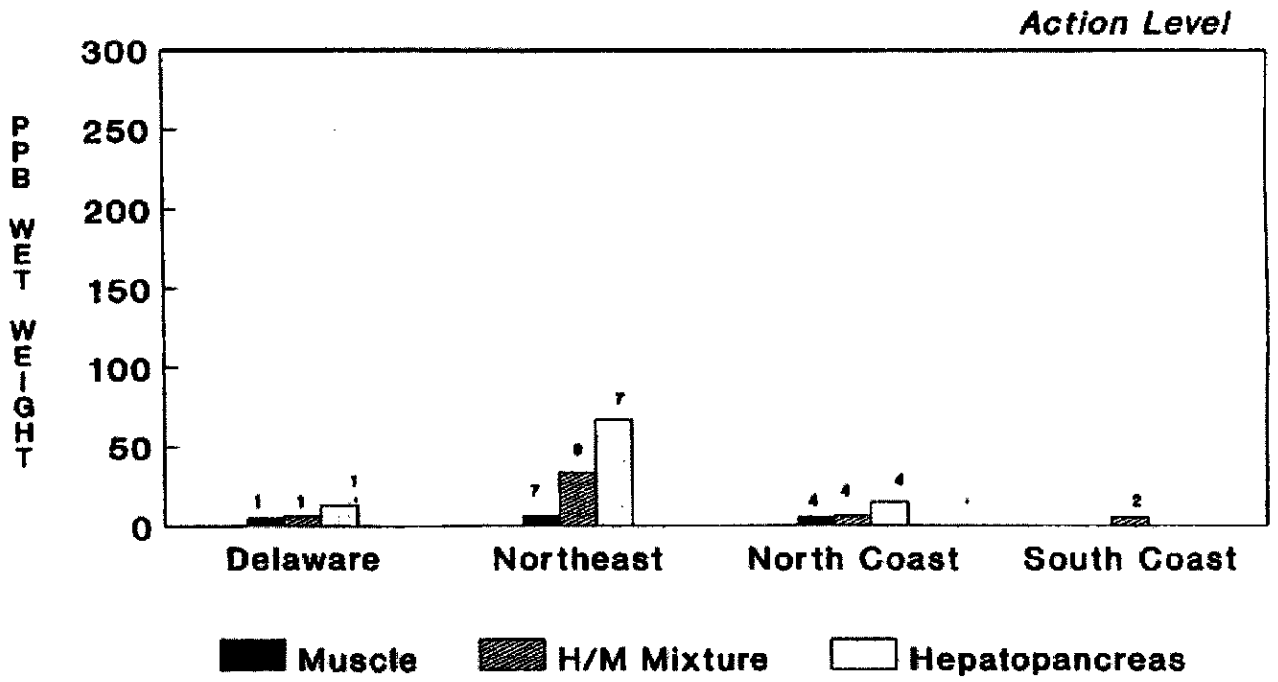
CHLORDANE BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 8

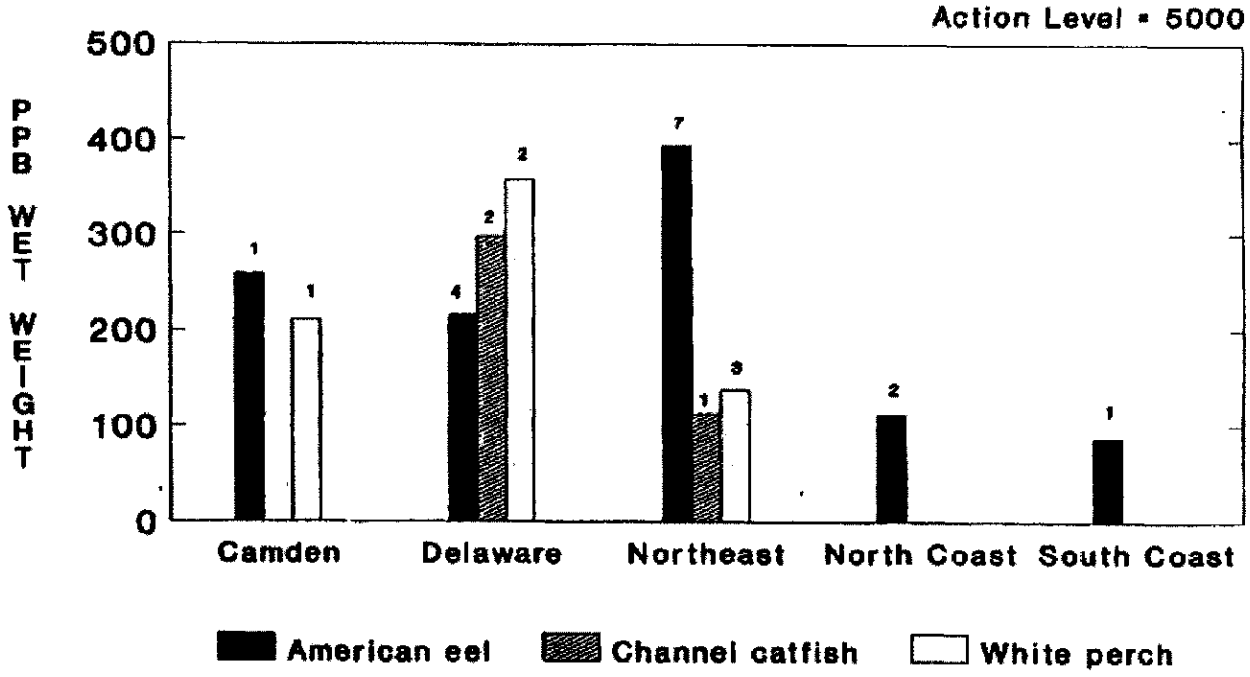
CHLORDANE BY REGION
Blue Crabs -- 1988-1991



Mean Values; # on Bar = # of Data Points

Figure 9

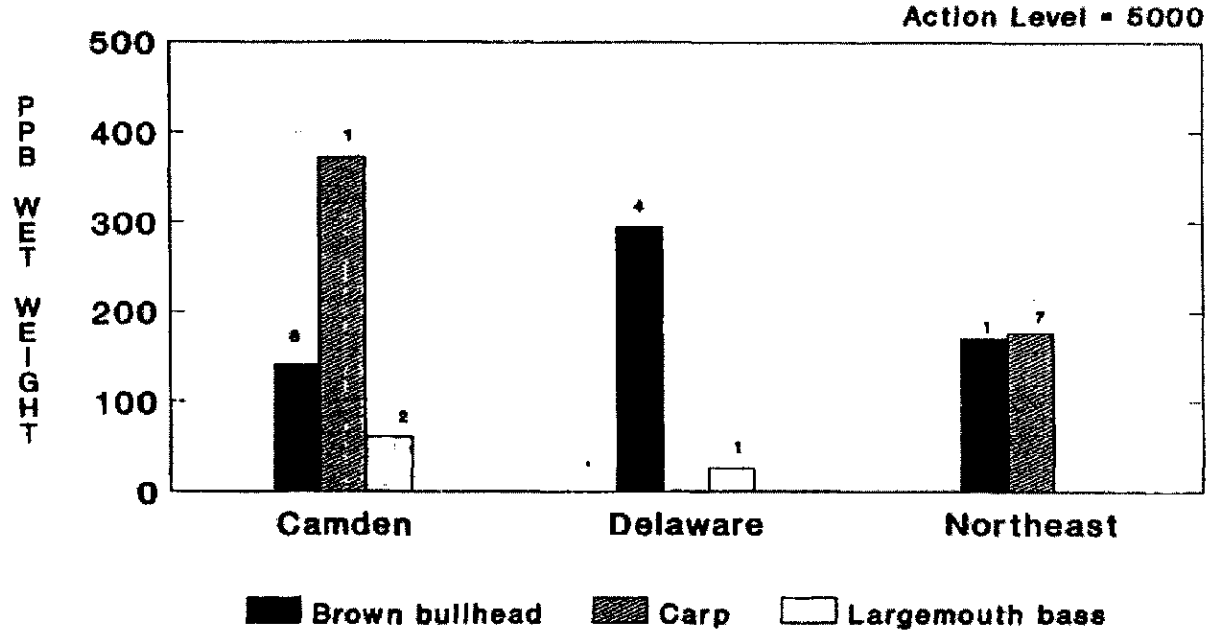
DDTs BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 10

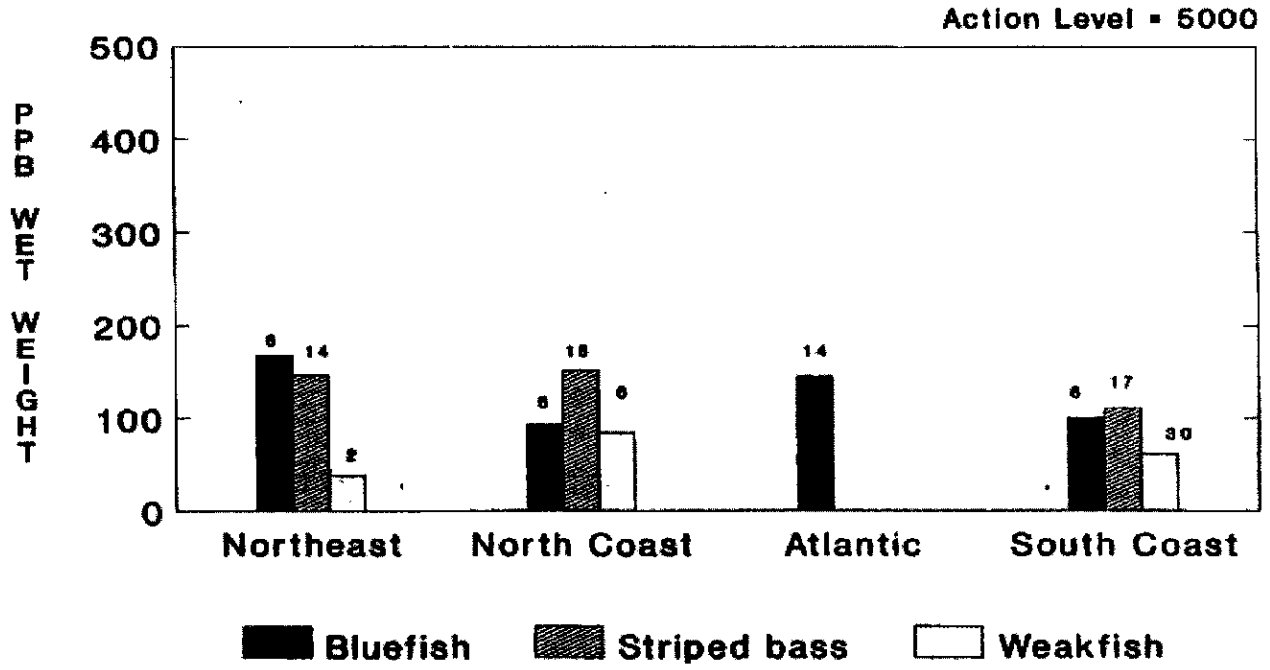
DDTs BY REGION
1988-1991



Mean Values; # on Bar = # of Data Points

Figure 11

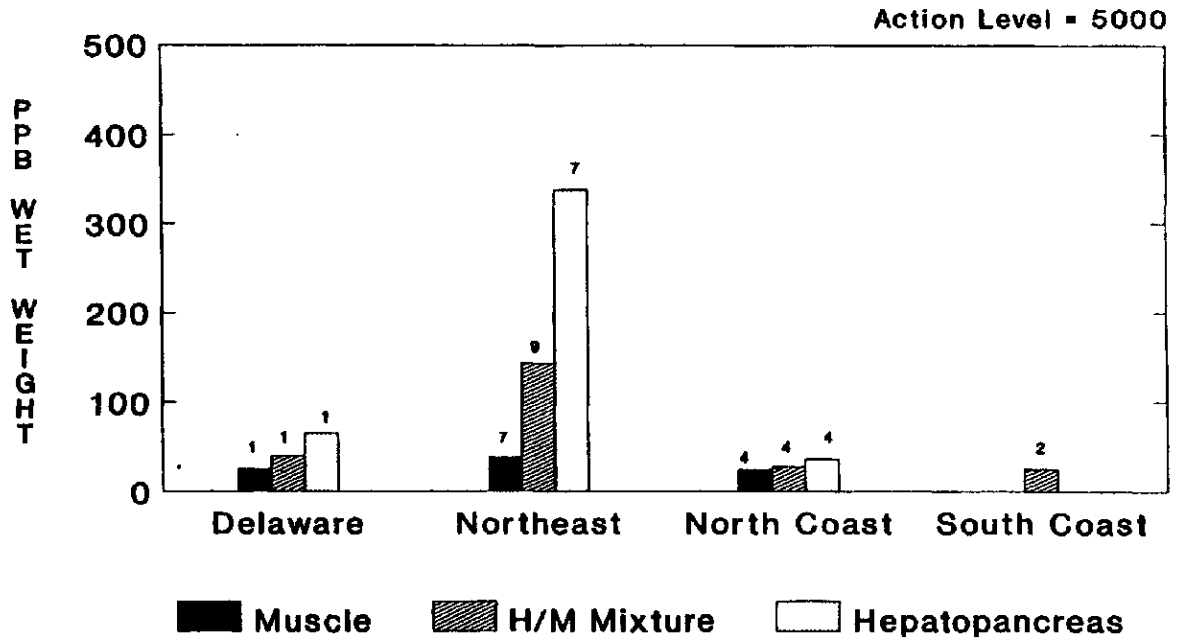
DDTs BY REGION
1988-91



Mean Values; # on Bar = # of Data Points

Figure 12

DDTs BY REGION
Blue Crabs -- 1988-1991



Mean Values; # on Bar = # of Data Point

Figure 13

PCBs vs. Weight

Passaic River Carp -- 1986-1991

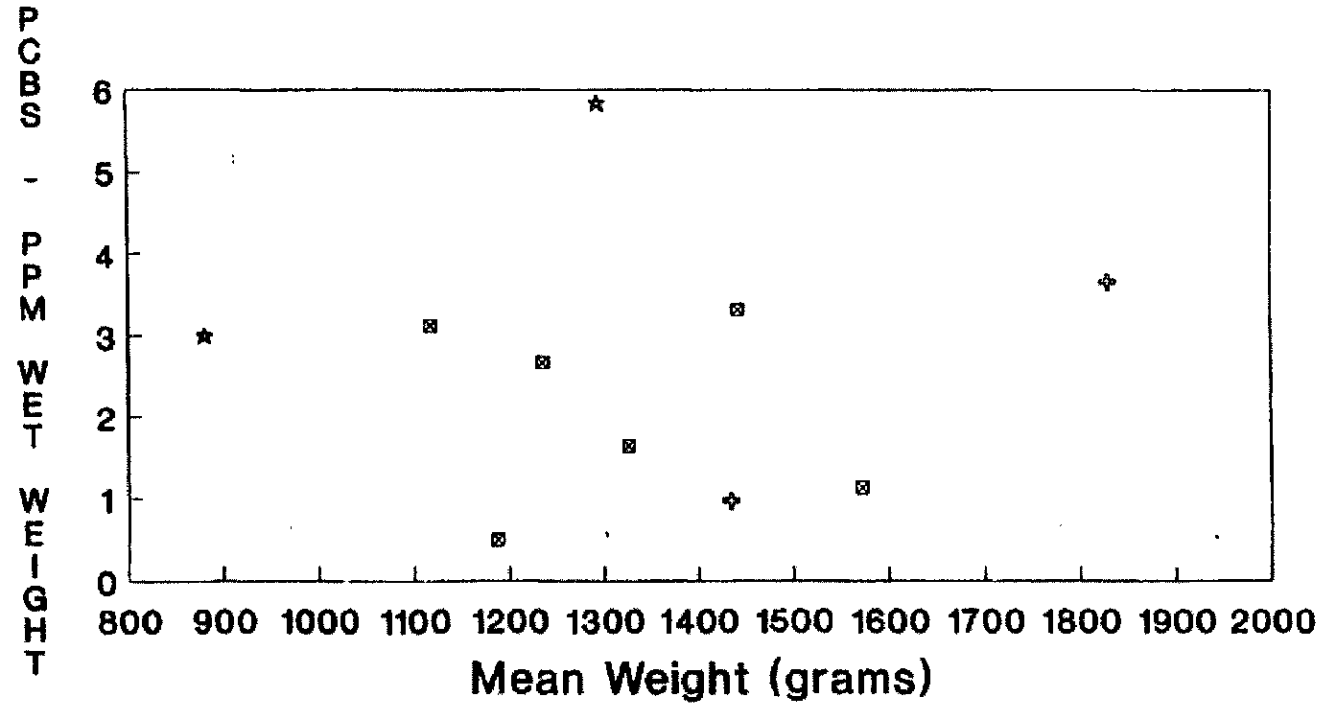


Figure 14

PCBs vs. Lipid Content
Passaic River Carp -- 1986-1991

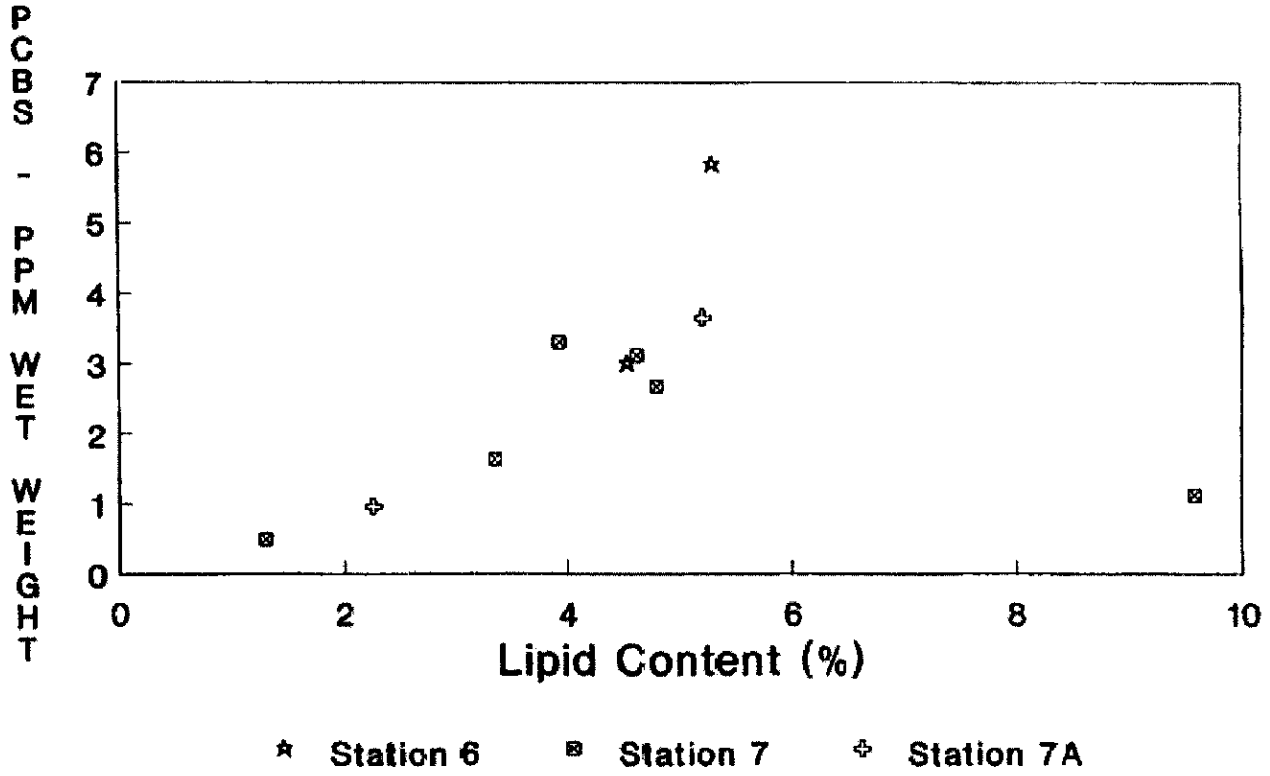
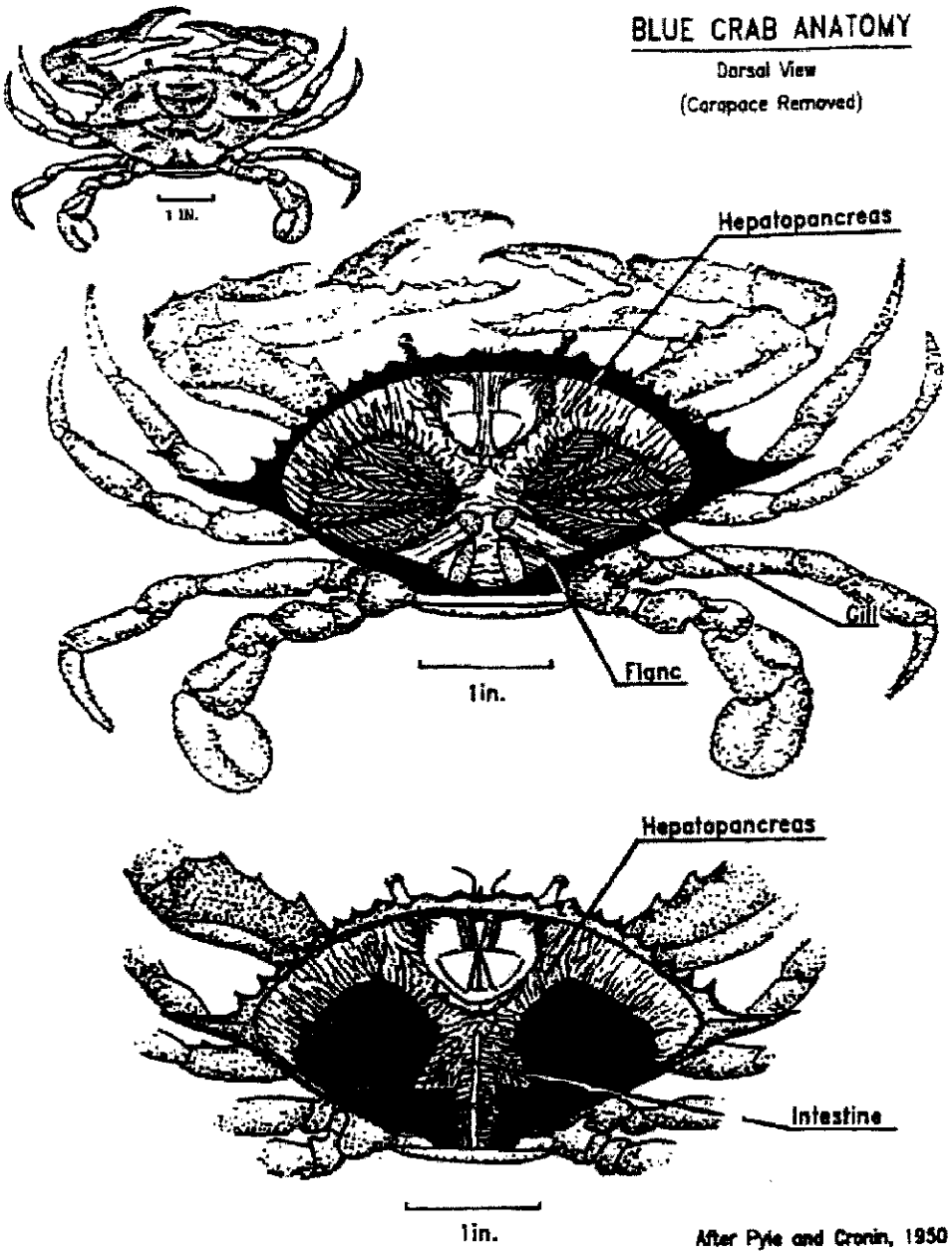
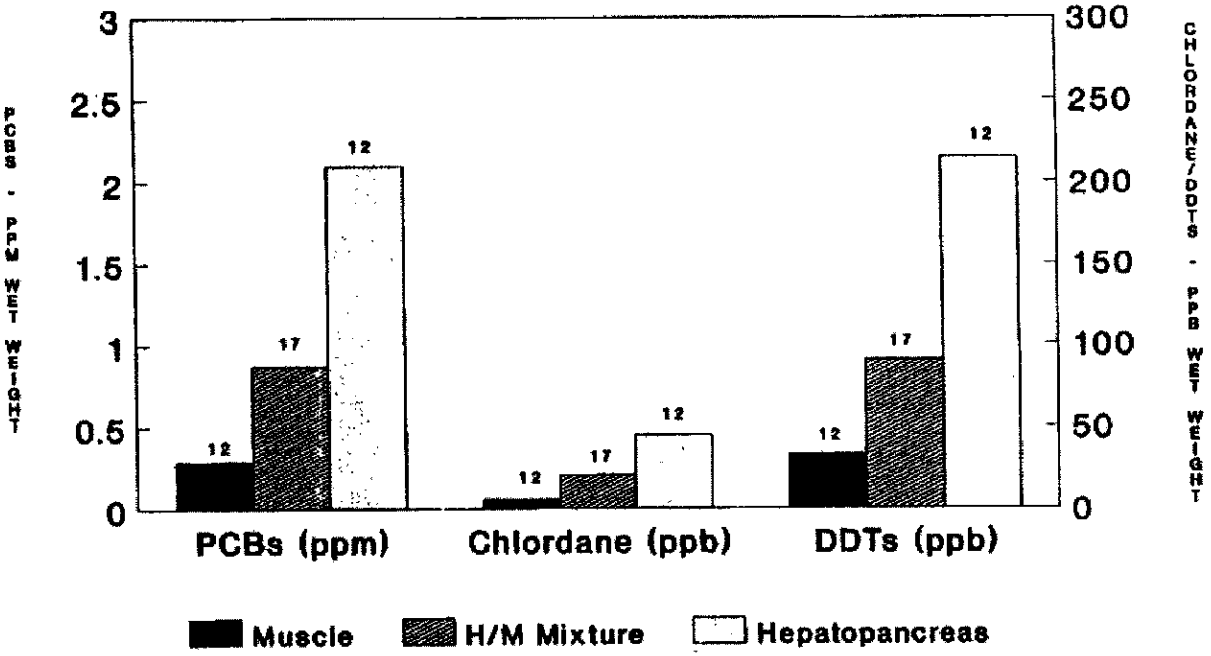


Figure 15

FIGURE 16

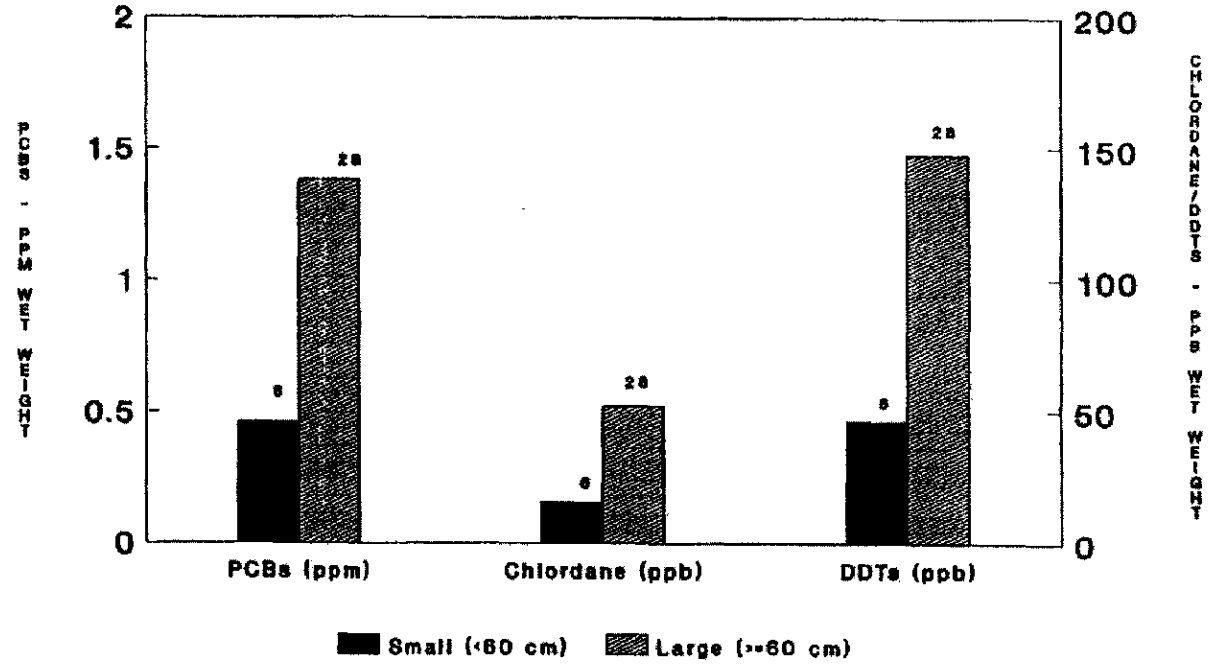


Contaminants in Blue Crab Tissues
All Stations -- 1988-1991



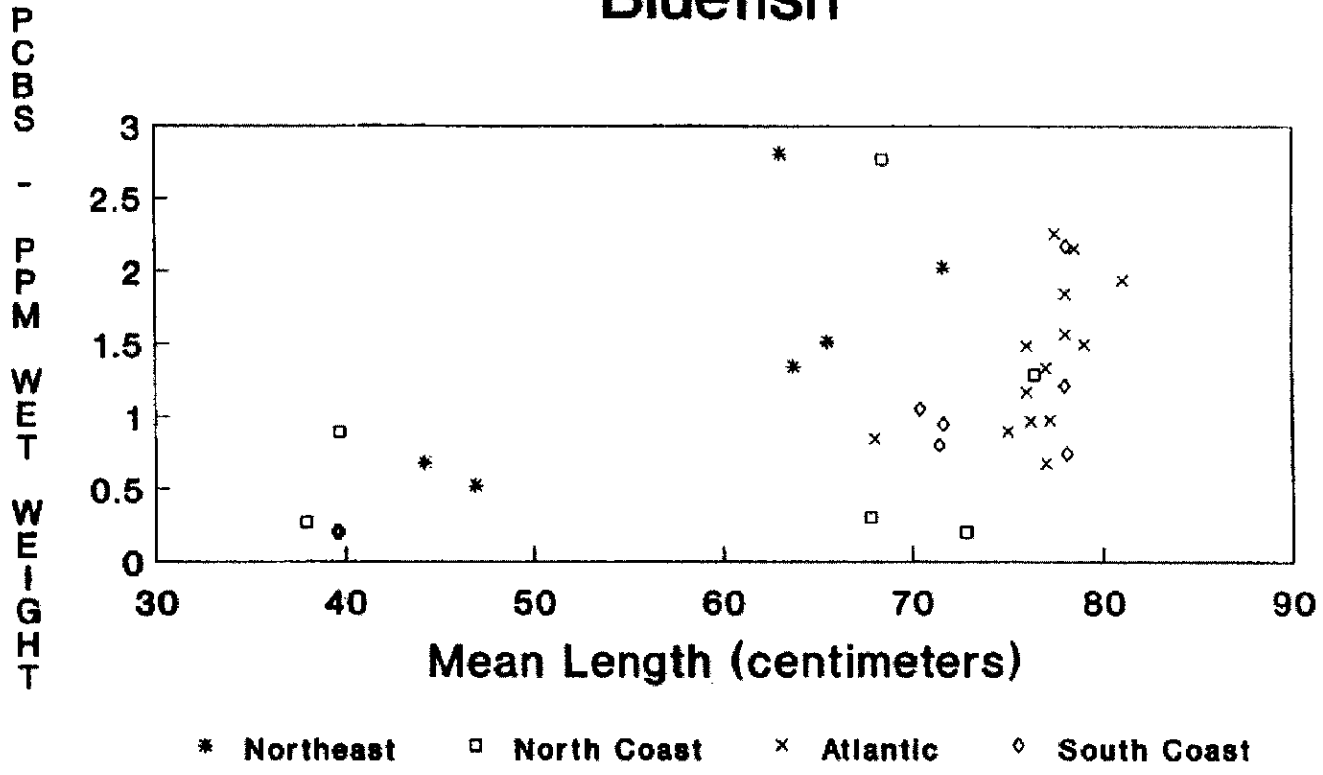
Mean Values; # on Bar = # of Data Points
Note Different Scales on Y-Axis
Figure 17

Contaminants in Bluefish by Size
All Stations -- 1988-1991



Mean Values; # on Bar = # of Data Points
Note Different Scales on Y-Axis
Figure 18

PCBs vs. Length
Bluefish



Single Fish in Atlantic Region;
Composite Samples in Other Regions
Figure 19

APPENDIX A

New Jersey Fisheries Prohibitions and Consumption Advisories

A. Summary

Based on the results of monitoring and research undertaken since the mid-1970s, the State of New Jersey has taken a number of steps, in the form of consumption advisories, closures, and sales bans, to limit the exposure of the fish-eating public to toxic contaminants. The advisories, closures, and prohibitions currently in place are summarized below.

1. Statewide Prohibitions

All sales of striped bass.

2. Statewide Advisories

Limited consumption of American eels.

Limited consumption of large bluefish.

3. Regional Prohibitions

a. Tidal Passaic River

Sale or consumption- of all fish, shellfish, and crustaceans.

b. Newark Bay Complex

Sale or consumption of striped bass and blue crabs.

Sale of American eels.

c. Hudson River

Sale of American eels.

d. Camden Area

Sale or consumption of all fish, shellfish, and crustaceans.

e. Delaware River (1-276 Bridge to Birch Creek)

Sale of channel catfish.

4. Regional Advisories

a. Hudson River

Very limited consumption of striped bass.

b. Northeast Region

Limited consumption of white perch and white catfish.

c. Northeast Region and Offshore Waters in Northern Coastal Area

Limited consumption of striped bass.

d. Delaware River (I-276 Bridge to Birch Creek)

No consumption of channel catfish.

B. Definitions

The following definitions apply to both the summary above and the background information that follows.

1. Regions

a. Tidal Passaic River means the Passaic River upstream to the Dundee Dam.

b. Newark Bay Complex means Newark Bay, the Passaic River upstream to the Dundee Dam, the Hackensack River upstream to the Oradell Dam, Arthur Kill, Kill Van Kull, and all tributaries.

c. Hudson River means the New Jersey portion of the river up to the New York-New Jersey border (approximately four miles above Alpine, N.J.), and Upper New York Bay.

d. Camden Area means Strawbridge Lake, Pennsauken Creek (North and South Branches), Cooper River and its' drainage, Cooper River lake, Stewart Lake, and Newton Lake.

e. Northeast Region means the region encompassing the New Jersey portion of Sandy Hook and Raritan Bays; the tidal portion of the Raritan River upstream to the Route 1 Bridge in New Brunswick; Arthur Kill and Kill Van Kull; Newark Bay; the Passaic River upstream to the Dundee Dam; the Hackensack River upstream to the Oradell Dam; the New Jersey portion of the Hudson River upstream to the New York-New Jersey border; and Upper New York Bay.

2. Advisories

a. Limited Consumption means that any person should not consume more than one meal per week of such fish, and that persons of high risk such as pregnant women, nursing mothers, women of child-bearing age, and young children should not eat any of such fish from the designated waters.

b. Very Limited Consumption means the same as limited consumption, except that any person should not eat more than one meal per month of such fish.

C. Background and References for Prohibitions and Advisories

1. N.J.A.C. 7:25-18A

These measures were based on findings of PCB contamination in several species. They were adopted as an emergency rule in late 1982, and readopted as a permanent rule with minor changes to 7:2518a.6 on early 1983.

a. Definitions (7:25-18A.3)

The regulations defines, among other terms, "limited consumption" and "Northeast Region".

b. Closures (7:25-18A.4)

i. Prohibition on sale of striped bass and of American eels from Hudson River, Upper New York Bay, Newark Bay, Lower Passaic River, Lower Hackensack River, Arthur Kill, and Kill Van Kull.

ii. No person may expose for sale, offer for sale, or sell striped bass anywhere in the state.

c. Advisories (7:25-18A.5)

Limited consumption of:

i. Striped bass from Northeast Region, including offshore waters in northern coastal area

ii. American eels from entire state, especially Northeast Region

iii. Bluefish from Northeast Region, including offshore waters in northern coastal area

iv. White perch from Northeast Region

v. White catfish from Northeast Region

This subsection also describes suggested preparation and cooking methods.

The bluefish advisory was amended by public notice on April 13, 1989 to (1) cover the entire coast, and (2) apply only to large bluefish (over 24 inches or 6 pounds).

2. Administrative Orders EO-40-1, EO-40-17, and EO-40-19

The discovery of widespread dioxin contamination in the Newark Bay Complex led to the issuance of three separate administrative orders by DEP Commissioner Robert E. Hughey in 1983 and 1984.

a. Administrative Order EO-40-1 (June 2, 1983) established a presumptive advisory against any consumption of any fish or shellfish taken from Newark Bay, the Passaic River upstream to the Dundee Dam, the Hackensack River upstream to the Oradell Dam, the Arthur Kill, and the Kill Van Kull. This order was superseded by Administrative Order EO-4017.

b. Administrative Order EO-40-17 (October 19, 1983) continued the presumptive advisory against any consumption of any fish and shellfish from Newark Bay, the Hackensack River upstream to the Oradell Dam, the Arthur Kill, and Kill Van Kull, and prohibited the sale or consumption of any fish and shellfish taken from the Passaic River from its mouth upstream to the Dundee Dam.

c. Administrative Order EO-40-19 (August 6, 1984) continued the prohibition against sale or consumption of any fish and shellfish taken from the Passaic River from its mouth upstream to the Oradell Dam, and additionally prohibited the sale or consumption of striped bass and blue crabs taken from Newark Bay, the tidal Hackensack River, the Arthur Kill, and Kill Van Kull.

3. Channel Catfish

An advisory against any consumption of channel catfish from the Delaware River between the Interstate 276-Highway Bridge and Birch Creek (opposite the Pennsylvania-Delaware border) was signed on March 20, 1989. It is based on findings of elevated levels of PCBs and/or chlordane. On November 19, 1990, the Department of Health promulgated regulations that ban the sale of channel catfish taken from the same stretch of the river (N.J.A.C. 8:21-2.42).

4. Other Advisories

a. By means of a f act sheet on "Dioxin in Fish - Health Advisories" dated October 20, 1983 and issued in conjunction with Administrative Order EO-40-17, DEP issued an advisory to limit consumption of striped bass from the New Jersey portion of the Hudson River to no more than one meal per month. This is described

in public information as an advisory for "very limited consumption." (See Section B.2 above.) As for "limit consumption advisories, pregnant women, nursing mothers, women of child-bearing age, and young children) are advised not to eat any striped bass from this area.

b. The discovery of widespread chlordane contamination in 1978 (16) led to a ban on the sale or consumption of all f ish, shellfish, and crustaceans from the Camden area (now including Strawbridge Lake, Pennsauken Creek (North and South Branches), Cooper River and its drainage, Cooper River Lake, Stewart Lake, and Newton Lake. The fishing ban was initially announced via a news release and has been continued and expanded several times. The contamination was initially discovered in the wake of a fire at a garden supply center in Mt. Laurel Township (Burlington County) , in which a pesticide warehouse was destroyed and it was suspected that pesticides had washed into the adjacent North Branch of Pennsauken Creek and downstream into Strawbridge Lake in Moorestown. Fish kills were observed in both areas, and several investigators at the fire scene experienced transient adverse health effects. Although the fire spurred the initial investigation into the contamination problem, there are also other likely sources of the chlordane in these water bodies (e.g., runoff) (17).

c. In addition to instructions on how to prepare and cook finfish (e.g., bluefish) so as to minimize potential ingestion of PCBs and other organic contaminants (as spelled out in N.J.A.C. 7:25-18A.5), the notice on consumption advisories, fishing prohibitions, etc. provided to anglers in the Division of Fish, Game and Wildlife's New Jersey Fish and Wildlife Digest states that consumers of blue crabs should not eat the hepatopancreas and should instead remove it before cooking so as not to contaminate the meat during cooking. It further notes that if the crab is cooked whole, the cooking water should be discarded and neither the cooking water nor the hepatopancreas (commonly called the tomalley or mustard) should be used in any juices or sauces.

APPENDIX B

MONITORING RESULTS BY SITE/SPECIES/YEAR

Notes: 1. Abbreviations appearing in the "species" column with blue crab results indicate the type of tissue analyzed, as follows:

H = hepatopancreas

M = muscle

H/M = hepatopancreas/muscle mixture

See Section II.B.2 for details.

2. Analytical results are presented as reported (i.e., two decimal places).

3. As indicated in Section III.A of the text, results reported as "below detection limit" were assigned a value equal to the detection limit ' f or the purpose of data analysis. Detection limits were as follows: 0.1 ppm for PCB Aroclors 1248 and 1254/1260; 2.5 ppb for the alpha and gamma isomers of chlordane; 5 ppb for p,p^1-DDE; and 10 ppb for p,p^1-DDD and p,p^1-DDT.

4. Samples marked with an asterisk (*) consisted of fewer than five individuals. See Table 3.

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

Site	Species	Mean Length	Mean Weight	% Lipids	Aroclors 1248	Aroclors 1254/60	Sum PCBs
1	channel catfish*	27	350	5.57	0.78	1.03	1.81
	white perch	20	105	0.97	1.06	0.86	1.92
2	(1998)						
	blue crab (H/M)	15	206	3.61	0.49	0.78	1.27
	blue crab (H/M)	16	250	1.66	0.42	0.72	1.14
	blue crab (H)	15	174	10.09	1.60	2.30	3.90
	blue crab (M)	15	174	0.79	0.12	0.17	0.29
	striped bass	43	843	1.39	0.71	0.38	1.09
	striped bass	39	691	2.41	1.24	1.44	2.68
2	(1989)						
	blue crab (H)	15	206	5.56	1.34	1.61	2.95
	blue crab (M)	15	206	0.65	0.15	0.10	0.25
3	white perch	19	104	1.47	0.21	0.11	0.32
4	American eel	52	304	12.88	1.41	2.33	3.74
	blue crab (H/M)	17	212	2.72	1.04	0.67	1.71
	blue crab (H)	15	188	7.28	1.24	1.23	2.47
	blue crab (M)	15	188	0.84	0.13	0.11	0.24
5	blue crab (H/M)	17	239	2.74	0.98	1.07	2.05
	blue crab (H/M)	16	205	1.04	0.76	0.61	1.37
	blue crab (H)	15	193	7.54	1.79	1.90	3.69
	blue crab (M)	15	193	0.76	0.19	0.25	0.44
	striped bass	41	715	1.03	0.78	0.61	1.39
	striped bass	45	1145	3.00	1.47	1.01	2.48
6	American eel	27	35	7.50	1.25	1.21	2.46
	carp	39	880	4.53	1.40	1.59	2.99
7	(1988)						
	American eel	25	29	3.93	0.71	0.72	1.43
	carp	47	1442	3.93	1.77	1.53	3.30
7	(1989)						
	carp	48	1571	9.57	0.77	0.35	1.12
	carp	45	1326	3.35	0.91	0.72	1.63
7	(1991)						
	carp	43	1187	1.30	0.23	0.26	0.49

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBs
7A	(1989)						
	carp	51	1829	5.21	1.99	1.65	3.64
7A	(1991)						
	carp	46	1434	2.26	0.51	0.45	0.96
8	American eel*	49	295	9.05	1.00	1.53	2.53
	blue crab (H/M)	16	205	0.68	0.50	0.40	0.90
	blue crab (H/M)	16	215	1.80	0.79	0.71	1.50
	blue crab (H)	18	325	5.94	0.94	2.57	3.51
	blue crab (M)	18	325	0.53	0.18	0.20	0.38
	striped bass	46	1028	0.73	0.90	0.71	1.61
	striped bass	39	627	1.09	1.18	0.82	2.00
9	American eel*	59	440	13.01	1.25	1.80	3.05
10	blue crab (H/M)	17	290	15.10	0.60	0.46	1.06
	blue crab (H)	19	179	8.45	1.23	1.76	2.99
	blue crab (M)	19	179	0.61	0.50	<0.10	<0.60
	bluefish	63	2364	13.80	1.21	1.60	2.81
	striped bass	40	739	2.43	0.63	0.50	1.13
	striped bass*	58	2276	2.12	1.47	1.26	2.73
11	blue crab (H/M)	16	189	2.17	0.78	1.29	2.07
	blue crab (H)	17	238	15.36	1.66	1.86	3.52
	blue crab (M)	17	238	0.77	0.13	0.14	0.27
	bluefish	64	2633	7.70	0.70	0.64	1.34
	striped bass	43	1055	1.20	0.78	1.00	1.78
	striped bass	41	689	1.16	0.36	0.37	0.73
	white perch	26	262	2.26	0.74	0.87	1.61
12	American eel	36	115	8.12	0.28	0.26	0.54
13	American eel	36	95	7.06	0.26	0.23	0.49
14	brown bullhead	21	178	1.86	0.56	0.47	1.03
15	bluefish	72	2814	6.52	0.84	1.18	2.02
	bluefish	44	916	4.79	0.27	0.41	0.68
	striped bass	82	6640	9.32	0.30	1.10	1.40
	striped bass	68	3363	2.17	0.71	1.24	1.95
	weakfish	40	633	10.71	0.64	0.66	1.30

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBs
16	bluefish	66	2324	12.52	0.50	1.01	1.51
	bluefish	47	1066	5.38	0.21	0.31	0.52
	striped bass	71	3986	4.97	0.33	1.41	1.74
	striped bass	68	3314	4.37	0.89	1.60	2.49
	weakfish	54	1841	4.24	0.45	0.56	1.01
17	American eel*	36	107	8.33	0.84	0.21	1.05
	brown bullhead	32	498	0.84	0.39	<0.10	<0.49
18	brown bullhead	31	458	0.37	0.16	<0.10	<0.26
19	brown bullhead	31	374	2.08	0.26	0.47	0.73
20	brown bullhead	30	360	2.66	0.72	0.21	0.93
21	brown bullhead	28	316	1.66	0.53	0.16	0.69
	carp	53	1921	3.91	0.76	0.97	1.73
	white perch	18	69	2.44	0.57	0.28	0.85
22	brown bullhead	32	339	1.12	0.25	0.27	0.52
	brown bullhead*	24	170	3.01	0.62	0.29	0.91
	largemouth bass	34	703	0.91	0.28	0.23	0.51
23	American eel	36	160	10.03	0.63	0.54	1.17
	brown bullhead*	33	460	0.46	0.34	<0.10	<0.44
	largemouth bass	31	501	0.48	<0.10	<0.10	<0.20
24	brown bullhead	29	291	3.42	0.46	0.83	1.29
25	brown bullhead	32	475	2.95	0.68	1.92	2.60
26	American eel*	48	248	1.40	0.10	<0.10	<0.20
	blue crab (H/M)	13	130	1.41	<0.10	0.20	<0.30
	blue crab (H/M)	13	106	1.47	<0.10	<0.10	<0.20
	blue crab (H/M)	13	116	5.76	0.14	0.29	0.43
	blue crab (H/M)	13	116	2.53	<0.10	<0.10	<0.20
	brown bullhead	24	128	5.06	<0.10	<0.10	<0.20
27	white perch	24	204	1.04	<0.10	0.16	<0.26
28	channel catfish	33	300	4.54	0.42	0.86	1.28
	white perch	16	53	1.99	0.95	0.97	1.92

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBs
29	American eel	28	40	3.28	0.19	0.57	0.76
	brown bullhead	24	134	0.99	<0.10	<0.10	<0.20
30	American eel	32	68	9.89	0.19	0.44	0.63
	channel catfish	38	468	9.85	0.19	0.43	0.62
31	American eel	43	220	8.42	0.17	0.65	0.82
	largemouth bass*	30	300	0.28	<0.10	<0.10	<0.20
32	American eel	58	357	8.16	0.40	1.10	1.50
	blue crab (H/M)	15	170	1.20	<0.10	<0.10	<0.20
	blue crab (H/M)	15	161	1.85	<0.10	<0.10	<0.20
	blue crab (H)	16	223	7.88	0.18	0.20	0.38
	blue crab (M)	16	223	1.44	<0.10	<0.10	<0.20
33	American eel	51	235	8.11	0.10	0.17	0.27
	blue crab (H/M)	16	276	0.31	<0.10	<0.10	<0.20
	blue crab (H/M)	15	155	2.80	<0.10	0.10	<0.20
	blue crab (H)	16	233	6.92	0.19	0.10	0.29
	blue crab (M)	16	233	0.21	<0.10	<0.10	<0.20
34	weakfish	48	943	1.32	<0.10	0.12	<0.22
	weakfish	34	360	3.98	<0.10	<0.10	<0.20
35	blue crab (H/M)	14	134	0.62	<0.10	<0.10	<0.20
	weakfish	43	692	2.31	<0.10	<0.10	<0.20
	weakfish	39	494	2.05	<0.10	0.11	<0.21
36	American eel	55	338	10.53	0.10	0.46	0.56
	blue crab (H/M)	14	141	1.01	<0.10	<0.10	<0.20
	weakfish	38	495	1.19	<0.10	<0.10	<0.20
	weakfish	44	700	2.99	<0.10	0.13	<0.23

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBS
37	bluefish	69	2500	19.04	0.99	1.78	2.77
	bluefish	68	2277	0.93	<0.10	0.20	<0.30
	bluefish	73	2803	2.75	<0.10	<0.10	<0.20
	striped bass	79	6054	9.24	0.39	0.83	1.22
	striped bass	62	2315	2.30	0.57	0.63	1.20
	striped bass	70	3757	3.19	0.78	1.57	2.35
	striped bass	53	1665	0.63	0.76	1.51	2.27
	striped bass	62	2218	3.03	0.62	0.76	1.38
	striped bass	75	4885	4.41	0.46	0.78	1.24
	weakfish	50	1504	2.73	0.28	0.41	0.69
	weakfish	56	1836	3.38	0.31	0.37	0.68
	weakfish	70	3858	3.72	0.48	0.57	1.05
37A (1989)							
	striped bass*	67	3275	2.68	1.17	1.50	2.67
	striped bass*	76	5267	6.11	0.33	0.63	0.96
	striped bass*	66	3450	9.09	0.95	1.13	2.08
	striped bass*	64	3223	5.24	0.36	0.66	1.02
	striped bass*	72	2886	0.83	0.96	0.95	1.91
	striped bass*	82	6674	6.09	0.41	2.18	2.59
38	bluefish	38	513	0.89	<0.10	0.17	<0.27
	bluefish	76	5099	7.94	0.75	0.54	1.29
	bluefish	40	615	1.12	0.69	0.20	0.89
	striped bass	61	2096	5.87	1.24	2.09	3.33
	striped bass	64	2769	0.26	0.42	0.40	0.82
	striped bass	72	3941	5.17	0.60	0.74	1.34
	striped bass	71	3952	5.72	0.30	0.43	0.73
	striped bass	70	4069	0.94	0.56	0.72	1.28
	striped bass	70	3986	4.42	0.43	0.66	1.09
	weakfish	41	734	6.17	0.23	0.36	0.59
	weakfish	44	864	6.18	0.16	0.30	0.46
	weakfish	40	554	2.14	<0.10	0.14	<0.24
38A (1989)							
	striped bass*	50	1520	1.15	0.18	0.55	0.73
	striped bass*	55	1940	4.00	0.99	1.53	2.52
	striped bass*	52	1560	3.12	0.40	0.57	0.97
	striped bass*	60	2435	3.79	0.13	0.36	0.49
	striped bass*	61	2025	3.69	0.14	0.46	0.60
	striped bass*	57	1905	2.60	0.18	0.33	0.51

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBs
39	bluefish	78	3877	2.07	0.15	0.59	0.74
	bluefish	78	4131	2.29	0.67	1.50	2.17
	bluefish	78	4514	2.82	0.28	0.93	1.21
	striped bass	64	2479	2.62	0.65	0.52	1.17
	striped bass	64	2617	2.66	0.53	0.72	1.25
	striped bass	70	3868	4.41	0.66	1.12	1.78
	striped bass	73	4523	2.53	1.15	1.28	2.43
	striped bass	70	4413	9.91	0.93	1.12	2.05
	striped bass	71	4840	6.25	0.26	0.55	0.81
	weakfish	35	364	2.08	<0.10	<0.10	<0.20
	weakfish	37	461	2.65	<0.10	0.15	<0.25
	weakfish	42	622	1.55	<0.10	0.13	<0.23
40	bluefish	70	3142	4.64	0.29	0.76	1.05
	bluefish	71	3187	4.33	0.19	0.61	0.80
	bluefish	72	3360	4.36	0.30	0.64	0.94
	bluefish	40	581	1.18	<0.10	<0.10	<0.20
	bluefish	40	555	0.56	<0.10	<0.10	<0.20
	striped bass	69	4050	9.44	0.22	0.49	0.71
	striped bass	68	3889	4.13	0.17	0.31	0.48
	striped bass	67	3551	6.31	0.28	0.54	0.82
	striped bass	85	7182	4.38	0.31	0.59	0.90
	striped bass	72	4867	5.67	0.27	0.70	0.97
	striped bass	74	4950	7.71	0.49	0.85	1.34
	weakfish	32	302	3.50	<0.10	<0.10	<0.20
	weakfish	39	515	2.68	<0.10	0.10	<0.20
	weakfish	39	506	2.28	<0.10	<0.10	<0.20
41	weakfish	39	553	11.74	<0.10	0.10	<0.20
	weakfish	37	486	4.39	<0.10	0.16	<0.26
	weakfish	36	401	1.43	<0.10	<0.10	<0.20
	weakfish	36	424	1.98	<0.10	<0.10	<0.20
	weakfish	35	413	3.68	<0.10	0.16	<0.26
	weakfish	42	699	3.44	<0.10	0.10	<0.20
	weakfish	51	1300	2.60	0.13	0.30	0.43
	weakfish	52	1426	4.58	0.24	0.63	0.87
	weakfish	51	1222	4.86	0.10	0.40	0.50

PCBs
(PPM, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	AROCLORS 1248	AROCLORS 1254/60	(SUM) PCBS
42	weakfish	44	675	1.74	<0.10	0.11	<0.21
	weakfish	43	720	0.16	<0.10	<0.10	<0.20
	weakfish	34	403	1.85	<0.10	<0.10	<0.20
	weakfish	35	403	2.40	<0.10	0.11	<0.21
	weakfish	35	352	3.21	<0.10	0.11	<0.21
	weakfish	35	397	2.39	<0.10	<0.10	<0.20
	weakfish	50	1370	4.84	0.12	0.26	0.38
	weakfish	53	1445	4.11	0.13	0.28	0.41
	weakfish	51	1368	11.82	0.21	0.53	0.74
43	striped bass	67	3460	4.73	0.43	0.65	1.08
	striped bass	68	3530	4.38	0.23	0.48	0.71
	striped bass	69	3590	4.10	0.23	0.56	0.79
	striped bass	70	3420	5.02	0.31	0.69	1.00
	striped bass	64	2910	6.52	0.33	0.61	0.94
44	(1989)						
	blue crab (H)	14	156	3.63	0.27	0.24	0.51
	blue crab (M)	14	156	0.52	<0.10	<0.10	<0.20
45	(1989)						
	blue crab (H)	14	162	3.57	0.30	0.29	0.59
	blue crab (M)	14	162	0.56	<0.10	<0.10	<0.20
46	(1989)						
	bluefish*	75	3632	4.83	0.25	0.64	0.89
	bluefish*	78	4767	12.36	0.86	1.39	2.25
	bluefish*	76	4268	10.99	0.30	1.18	1.48
	bluefish*	77	3814	2.13	0.17	0.50	0.67
	bluefish*	78	4768	10.60	0.40	1.16	1.56
	bluefish*	76	4086	12.31	0.27	0.69	0.96
	bluefish*	78	4722	8.22	0.39	1.45	1.84
	bluefish*	77	4222	7.26	0.30	1.03	1.33
	bluefish*	79	4495	8.34	0.38	1.11	1.49
	bluefish*	76	3723	7.22	0.40	0.76	1.16
	bluefish*	81	4949	10.94	0.38	1.55	1.93
	bluefish*	77	4404	10.00	0.25	0.72	0.97
	bluefish*	79	4994	17.99	0.61	1.54	2.15
	bluefish*	68	3904	10.08	0.29	0.55	0.84

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
1	channel catfish*	27	350	5.57	9.49	20.59	30.08
	white perch	20	105	0.97	17.56	15.26	32.82
2	(1988)						
	blue crab (H/M)	15	206	3.61	15.79	5.77	21.56
	blue crab (H/M)	16	250	1.66	7.03	12.65	19.68
	blue crab (H)	15	174	10.09	49.34	11.68	61.02
	blue crab (M)	15	174	0.79	2.59	3.28	5.87
	striped bass	43	843	1.39	15.32	11.30	26.62
	striped bass	39	691	2.41	11.55	25.84	37.39
2	(1989)						
	blue crab (H)	15	206	5.56	30.83	6.67	37.50
	blue crab (M)	15	206	0.65	<2.50	<2.50	<5.00
3	white perch	19	104	1.47	37.99	13.30	51.29
4	American eel	52	304	12.88	174.20	76.15	250.35
	blue crab (H/M)	17	212	2.72	64.98	25.25	90.23
	blue crab (H)	15	188	7.28	37.36	13.82	51.18
	blue crab (M)	15	188	0.84	<2.50	4.09	<6.59
5	blue crab (H/M)	17	239	2.74	37.09	8.43	45.52
	blue crab (H/M)	16	205	1.04	15.03	8.82	23.85
	blue crab (H)	15	193	7.54	20.38	27.64	48.02
	blue crab (M)	15	193	0.76	4.76	2.52	7.28
	striped bass	41	715	1.03	28.09	15.98	44.07
	striped bass	45	1145	3.00	31.69	25.24	56.93
6	American eel	27	35	7.50	165.44	29.26	194.70
	carp	39	880	4.53	117.65	83.78	201.43
7	(1988)						
	American eel	25	29	3.93	110.29	19.95	130.24
	carp	47	1442	3.93	133.58	83.78	217.36
7	(1989)						
	carp	48	1571	9.57	120.00	68.33	188.33
	carp	45	1326	3.35	56.54	34.09	90.63
7	(1991)						
	carp	43	1187	1.30	22.11	15.26	37.37

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
7A	(1989)						
	carp	51	1829	5.21	158.33	76.67	235.40
7A	(1991)						
	carp	46	1434	2.26	46.15	27.29	73.44
8	American eel*	49	295	9.05	63.13	32.41	95.54
	blue crab (H/M)	16	205	0.68	15.80	3.51	19.31
	blue crab (H/M)	16	215	1.80	18.20	8.82	27.02
	blue crab (H)	18	325	5.94	76.92	23.88	100.80
	blue crab (M)	18	325	0.53	5.22	2.67	7.89
	striped bass	46	1028	0.73	33.01	13.08	46.09
	striped bass	39	627	1.09	15.41	12.86	28.27
9	American eel*	59	440	13.01	90.00	62.50	152.50
10	blue crab (H/M)	17	290	15.10	6.25	5.79	12.04
	blue crab (H)	19	179	8.45	66.49	18.90	85.39
	blue crab (M)	19	179	0.61	3.99	<2.50	<6.49
	bluefish	63	2364	13.80	85.10	37.79	122.89
	striped bass	40	739	2.43	35.16	7.63	42.79
	striped bass*	58	2276	2.12	30.06	26.47	56.53
11	blue crab (H/M)	16	189	2.17	33.24	7.26	40.50
	blue crab (H)	17	238	15.36	60.64	21.41	82.05
	blue crab (M)	17	238	0.77	3.71	<2.50	<6.21
	bluefish	64	2633	7.70	32.67	16.16	48.83
	striped bass	43	1055	1.20	36.93	10.29	47.22
	striped bass	41	689	1.16	10.42	19.81	30.23
	white perch	26	262	2 26	56.11	20.58	76.69
12	American eel	36	115	8.12	21.57	6.11	27.68
13	American eel	36	95	7.06	45.96	8.64	54.60
14	brown bullhead	21	178	1.86	32.61	20.12	52.73
15	bluefish	72	2814	6.52	74.75	22.61	97.36
	bluefish	44	916	4.79	17.06	9.75	26.81
	striped bass	82	6640	9.32	42.55	15.09	57.64
	striped bass	68	3363	2.17	69.01	50.00	119.01
	weakfish	40	633	10.71	6.82	3.68	10.50

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
16	bluefish	66	2324	12.52	41.05	12.63	53.68
	bluefish	47	1066	5.38	21.26	11.86	33.12
	striped bass	71	3986	4.97	31.25	9.44	40.69
	striped bass	68	3314	4.37	75.52	18.06	93.58
	weakfish	54	1841	4.24	5.16	<2.50	<7.66
17	American eel*	36	107	8.33	123.42	48.53	171.95
	brown bullhead	32	498	0.84	67.99	49.85	117.84
18	brown bullhead	31	458	0.37	48.08	33.48	81.56
19	brown bullhead	31	374	2.08	52.73	34.81	87.54
20	brown bullhead	30	360	2.66	102.94	58.51	161.45
21	brown bullhead	28	316	1.66	90.69	19.95	110.64
	carp	53	1921	3.91	175.87	99.51	275.38
	white perch	18	69	2.44	102.47	43.68	146.15
22	brown bullhead	32	339	1.12	43.60	24.27	67.87
	brown bullhead*	24	170	3.01	106.01	58.09	164.10
	largemouth bass	34	703	0.91	61.14	20.11	81.25
23	American eel	36	160	10.03	114.09	41.87	155.96
	brown bullhead*	33	460	0.46	16.46	7.50	23.96
	largemouth bass	31	501	0.48	9.74	4.24	13.98
24	brown bullhead	29	291	3.42	51.72	33.65	85.37
25	brown bullhead	32	475	2.95	89.29	71.65	160.94
26	American eel*	48	248	1.40	3.00	4.86	7.86
	blue crab (H/M)	13	130	1.41	3.44	3.80	7.24
	blue crab (H/M)	13	106	1.47	<2.50	<2.50	<5.00
	blue crab (H)	13	116	5.76	9.25	4.16	13.41
	blue crab (M)	13	116	2.53	<2.50	<2.50	<5.00
	brown bullhead	24	128	5.06	3.44	<2.50	<5.94
27	white perch	24	204	1.04	10.03	3.88	13.91
28	channel catfish	33	300	4.54	18.12	25.31	43.43
	white perch	16	53	1.99	63.41	41.14	104.55

CHLORDANE
(PPB, WET WEIGHT)

(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
29	American eel	28	40	3.28	43.60	10.32	53.92
	brown bullhead	24	134	0.99	4.31	<2.50	<6.81
30	American eel	32	68	9.89	35.61	10.92	46.53
	channel catfish	38	468	9.85	19.92	19.78	39.70
31	American eel	43	220	8.42	34.16	10.31	44.47
	largemouth bass*	30	300	0.28	<2.50	<2.50	<5.00
32	American eel	58	357	8.16	46.70	12.64	59.34
	blue crab (H/M)	15	170	1.20	<2.50	4.27	<6.77
	blue crab (H/M)	15	161	1.85	2.65	3.63	6.28
	blue crab (H)	16	223	7.88	11.07	3.13	14.20
	blue crab (M)	16	223	1.44	<2.50	<2.50	<5.00
33	American eel	51	235	8.11	21.88	6.65	28.53
	blue crab (H/M)	16	276	0.31	2.50	<2.50	<5.00
	blue crab (H/M)	15	155	2.80	2.81	3.01	5.82
	blue crab (H)	16	233	6.92	7.17	8.21	15.38
	blue crab (M)	16	233	0.21	<2.50	<2.50	<5.00
34	weakfish	48	943	1.32	4.95	<2.50	<7.45
	weakfish	34	360	3.98	6.90	<2.50	<9.40
35	blue crab (H/M)	14	134	0.62	<2.50	3.09	<5.59
	weakfish	43	692	2.31	<2.50	<2.50	<5.00
	weakfish	39	494	2.05	3.16	3.04	6.20
36	American eel	55	338	10.53	12.19	5.70	17.89
	blue crab (H/M)	14	141	1.01	<2.50	<2.50	<5.00
	weakfish	38	495	1.19	3.65	<2.50	<6.15
	weakfish	44	700	2.99	4.22	<2.50	<6.72

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
37	bluefish	69	2500	19.04	56.37	21.27	77.64
	bluefish	68	2277	0.93	7.72	3.19	10.91
	bluefish	73	2803	2.75	4.04	2.79	6.83
	striped bass	79	6054	9.24	41.22	10.78	52.00
	striped bass	62	2315	2.30	54.69	15.27	69.96
	striped bass	70	3757	3.19	78.13	22.22	100.35
	striped bass	53	1665	0.63	12.50	15.78	28.28
	striped bass	62	2218	3.03	19.38	11.71	31.09
	striped bass	75	4885	4.41	16.88	13.29	30.17
	weakfish	50	1504	2.73	14.67	6.03	20.70
	weakfish	56	1836	3.38	13.58	5.17	18.75
	weakfish	70	3858	3.72	26.99	11.88	38.87
37A (1989)							
	striped bass*	67	3275	2.68	54.69	21.08	75.77
	striped bass*	76	5267	6.11	24.68	12.95	37.63
	striped bass*	66	3450	9.09	45.31	49.70	95.01
	striped bass*	64	3223	5.24	33.75	13.86	47.61
	striped bass*	72	2886	0.83	24.17	11.03	35.20
	striped bass*	82	6674	6.09	62.50	41.17	103.67
38	bluefish	38	513	0.89	7.20	3.74	10.94
	bluefish	76	5099	7.94	54.69	13.28	67.97
	bluefish	40	615	1.12	7.18	4.36	11.54
	striped bass	61	2096	5.87	74.47	26.16	100.63
	striped bass	64	2769	0.26	39.06	15.28	54.34
	striped bass	72	3941	5.17	58.59	21.53	80.12
	striped bass	71	3952	5.72	19.33	15.94	35.27
	striped bass	70	4069	0.94	27.50	21.88	49.38
	striped bass	70	3986	4.42	22.00	15.63	38.13
	weakfish	41	734	6.17	15.00	13.28	28.28
	weakfish	44	864	6.18	12.67	9.38	22.05
	weakfish	40	554	2.14	3.00	<2.50	<5.50
38A (1989)							
	striped bass*	50	1520	1.15	16.67	13.23	29.90
	striped bass*	55	1940	4.00	46.73	22.12	68.85
	striped bass*	52	1560	3.12	33.72	17.32	51.04
	striped bass*	60	2435	3.79	13.82	6.63	20.45
	striped bass*	61	2025	3.69	14.47	8.43	22.90
	striped bass*	57	1905	2.60	13.16	28.31	41.47

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
39	bluefish	78	3877	2.07	23.94	7.27	31.21
	bluefish	78	4131	2.29	40.99	24.43	65.42
	bluefish	78	4514	2.82	42.61	13.08	55.69
	striped bass	64	2479	2.62	55.99	13.89	69.88
	striped bass	64	2617	2.66	25.00	12.78	37.78
	striped bass	70	3868	4.41	27.38	12.78	40.16
	striped bass	73	4523	2.53	32.50	45.31	77.81
	striped bass	70	4413	9.91	40.83	31.25	72.08
	striped bass	71	4840	6.25	19.17	11.72	30.89
	weakfish	35	364	2.08	2.87	2.89	5.76
	weakfish	37	461	2.65	4.60	<2.50	<7.10
	weakfish	42	622	1.55	3.74	<2.50	<6.24
40	bluefish	70	3142	4.64.	33.38	9.44	42.82
	bluefish	71	3187	4.33	25.57	10.76	36.33
	bluefish	72	3360	4.36	29.92	9.45	39.37
	bluefish	40	581	1.18	4.02	<2.50	<6.52
	bluefish	40	555	0.56	<2.50	<2.50	<5.00
	striped bass	69	4050	9.44	18.38	2.79	21.17
	striped bass	68	3889	4.13	13.48	6.65	20.13
	striped bass	67	3551	6.31	25.73	9.31	35.04
	striped bass	85	7182	4.38	25.00	14.84	39.84
	striped bass	72	4867	5.67	30.83	14.06	44.89
	striped bass	74	4950	7.71	39.17	16.41	55.58
	weakfish	32	302	3.50	<2.50	<2.50	<5.00
	weakfish	39	515	2.68	<2.50	<2.50	<5.00
	weakfish	39	506	2.28	<2.50	<2.50	<5.00
41	weakfish	39	553	11.74	<2.50	<2.50	<5.00
	weakfish	37	486	4.39	4.86	<2.50	<7.36
	weakfish	36	401	1.43	<2.50	<2.50	<5.00
	weakfish	36	424	1.98	2.50	3.20	5.70
	weakfish	35	413	3.68	3.61	<2.50	<6.11
	weakfish	42	699	3.44	2.63	<2.50	<5.13
	weakfish	51	1300	2.60	11.76	7.89	19.65
	weakfish	52	1426	4.58	27.06	21.88	48.94
	weakfish	51	1222	4.86	2.65	5.00	7.65

CHLORDANE
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	ISOMERS ALPHA	ISOMERS GAMMA	(SUM) CHLORDANE
42	weakfish	44	675	1.74	<2.50	<2.50	<5.00
	weakfish	43	720	0.16	<2.50	<2.50	<5.00
	weakfish	34	403	1.85	<2.50	<2.50	<5.00
	weakfish	35	403	2.40	<2.50	<2.50	<5.00
	weakfish	35	352	3.21	2.56	<2.50	<5.06
	weakfish	35	397	2.39	<2.50	<2.50	<5.00
	weakfish	50	1370	4.84	8.82	7.50	16.32
	weakfish	53	1445	4.11	12.94	11.25	24.19
	weakfish	51	1368	11.82	20.59	16.25	36.84
43	striped bass	67	3460	4.73	23.94	5.75	29.69
	striped bass	68	3530	4.38	19.10	4.57	23.67
	striped bass	69	3590	4.10	24.60	5.02	29.62
	striped bass	70	3420	5.02	25.28	6.85	32.13
	striped bass	64	2910	6.52	23.88	5.34	29.22
44	(1989)						
	blue crab (H)	14	156	3.63	8.70	<2.50	<11.20
	blue crab (M)	14	156	0.52	<2.50	<2.50	<5.00
45	(1989)						
	blue crab (H)	14	162	3.57	14A7	4.36	19.23
	blue crab (M)	14	162	0.56	<2.50	<2.50	<5.00
46	(1989)						
	bluefish*	75	3632	4.83	22.78	11.78	34.56
	bluefish*	78	4767	12.36	55.38	22.99	78.37
	bluefish*	76	4268	10.99	54.59	15.80	70.39
	bluefish*	77	3814	2.13	16.46	5.75	22.21
	bluefish*	78	4768	10.60	41.93	14.36	56.29
	bluefish*	76	4086	12.31	32.44	11.49	43.93
	bluefish*	78	4722	8.22	41.13	14.36	55.49
	bluefish*	77	4222	7.26	38.76	7.18	45.94
	bluefish*	79	4495	8.34	35.60	10.78	46.38
	bluefish*	76	3723	7.22	27.69	17.96	45.65
	bluefish*	81	4949	10.94	55.38	17.24	72.62
	bluefish*	77	4404	10.00	27.69	8.62	36.31
	bluefish*	79	4994	17.99	42.72	23.00	65.72
	bluefish*	68	3904	10.08	17.41	17.95	35.36

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
1	channel catfish*	27	350	5.57	26.04	25.00	61.42	112.46
	white perch	20	105	0.97	12.21	24.21	42.36	78.78
2	(1988)							
	blue crab (H/M)	15	206	3.61	<10.00	26.64	45.75	<82.39
	blue crab (H/M)	16	250	1.66	<10.00	51.31	61.40	<122.71
	blue crab (H)	15	174	10.09	21.31	128.07	160.38	309.76
	blue crab (M)	15	174	0.79	<10.00	<10.00	16.20	<36.20
	striped bass	43	843	1.39	<10.00	24.04	46.59	<80.63
	striped bass	39	691	2.41	18.50	52.08	95.77	166.35
2	(1989)							
	blue crab (H)	15	206	5.56	<10.00	92.15	63.58	<165.73
	blue crab (M)	15	206	0.65	<10.00	<10.00	<5.00	<25.00
3	white perch	19	104	1.47	<10.00	29.44	38.93	<78.37
4	American eel	52	304	12.88	38.00	228.04	245.97	512.01
	blue crab (H/M)	17	212	2.72	<10.00	34.18	62.50	<106.68
	blue crab (H)	15	188	7.28	12.33	77.08	107.86	197.27
	blue crab (M)	15	188	0.84	<10.00	<10.00	14.52	<34.52
5	blue crab (H/M)	17	239	2.74	10.70	76.99	129.31	217.00
	blue crab (H/M)	16	205	1.04	<10.00	43.75	61.42	<105.17
	blue crab (H)	15	193	7.54	30.84	154.07	184.48	369.39
	blue crab (M)	15	193	0.76	<10.00	16.25	22.58	<48.83
	striped bass	41	715	1.03	<10.00	55.02	62.50	<127.52
	striped bass	45	1145	3.06	26.12	54.10	78.13	158.35
6	American eel	27	35	7.50	29.17	104.17	120.90	254.24
	carp	39	880	4.53	<10.00	153.98	125.00	<288.98
7	(1988)							
	American eel	25	29	3.93	16.67	72.46	79.92	169.05
	carp	47	1442	3.93	12.50	163.15	135.24	310.89
7	(1989)							
	carp	48	1571	9.57	<10.00	92.15	15.09	<117.24
	carp	45	1326	3.35	<10.00	56.99	53.57	<120.56
7	(1991)							
	carp	43	1187	1.30	<10.00	22.52	18.41	<50.93

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
7A (1989)								
	carp	51	1829	5.21	<10.00	172.28	25.86	<208.14
7A (1991)								
	carp	46	1434	2.26	<10.00	45.96	81.82	<137.78
8	American eel*	49	295	9.05	20.29	142.23	163.46	325.98
	blue crab (H/M)	16	205	0.68	14.98	88.32	114.22	217.52
	blue crab (H/M)	16	215	1.80	17.36	60.42	85.13	162.91
	blue crab (H)	18	325	5.94	17.12	221.92	353.45	592.49
	blue crab (M)	18	325	0.53	<10.00	15.40	26.72	<52.12
	striped bass	46	1028	0.73	<10.00	85.83	90.04	<185.87
	striped bass	39	627	1.09	16.79'	2§.85	49.11	95.75
9	American eel*	59	440	13.01	89.29	737.18	411.54	1238.01
10	blue crab (H/M)	17	290	15.10	<10.00	40.06	52.88	<102.94
	blue crab (H)	19	179	8.45	<10.00	125.87	177.97	<313.84
	blue crab (M)	19	179	0.61	<10.00	11.29	12.71	<34.00
	bluefish	63	2364	13.80	29.56	147.57	167.37	344.50
	striped bass	40	739	2.43	<10.00	46.88	48.35	<105.23
	striped bass*	58	2276	2.12	34.72	60.42	104.53	199.67
11	blue crab (H/M)	16	189	2.17	<10.00	58.59	103.81	<172.40
	blue crab (H)	17	238	15.36	15.85	197.75	206.02	419.62
	blue crab (M)	17	238	0.77	<10.00	15.14	15.97	<41.11
	bluefish	64	2633	7.70	10.86	73.24	73.15	157.25
	striped bass	43	1055	1.20	13.02	75.76	85.65	174.43
	striped bass	41	689	1.16	<10.00	58.30	58.11	<126.41
	white perch	26	262	2.26	32.55	127.84	95.59	255.98
12	American eel	36	115	8.12	11.67	<10.00	30.33	<52.00
13	American eel	36	95	7.06	36.76	33.65	132.95	203.36
14	brown bullhead	21	178	1.86	<10.00	113.39	46.41	<169.80
15	bluefish	72	2814	6.52	27.57	57.68	138.64	223.89
	bluefish	44	916	4.79	<10.00	21.70	32.76	<64.46
	striped bass	82	6640	9.32	10.56	52.79	90.73	154.08
	striped bass	68	3363	2.17	14.20	62.50	85.14	161.84
	weakfish	40	633	10.71	<10.00	15.15	18.05	<43.20

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
16	bluefish	66	2324	12.52	16.08	43.27	88.64	147.99
	bluefish	47	1066	5.38	<10.00	25.00	36.84	<71.84
	striped bass	71	3986	4.97	10.55	39.06	81.57	131.18
	striped bass	68	3314	4.37	14.20	73.66	101.40	189.26
	weakfish	54	1841	4.24	<10.00	<10.00	12.29	<32.29
17	American eel*	36	107	8.33	21.70	95.83	100.22	217.75
	brown bullhead	32	498	0.84	<10.00	62.50	66.67	<139.17
18	brown bullhead	31	458	0.37	<10.00	42.41	46.88	<99.29
19	brown bullhead	31	374	2.08	<10.00	117.75	135.78	<263.53
20	brown bullhead	30	360	2.66	12.50	72.46	55.33	140.29
21	brown bullhead	28	316	1.66	12.50	63.41	47.13	123.04
	carp	53	1921	3.91	13.99	172.57	185.27	371.83
	white perch	18	69	2.44	13.99	95.62	101.56	211.17
22	brown bullhead	32	339	1.12	<10.00	65.30	130.58	<205.88
	brown bullhead*	24	170	3.01	<10.00	29.17	80.82	<119.99
	largemouth bass	34	703	0.91	<10.00	29.02	46.01	<85.03
23	American eel	36	160	10.03	16.32	158.58	125.00	299.90
	brown bullhead*	33	460	0.46	<10.00	14.58	16.59	<41.17
	largemouth bass	31	501	0.48	<10.00	17.30	9.15	<36.45
24	brown bullhead	29	291	3.42	13.99	138.39	267.54	419.92
25	brown bullhead	32	475	2.95	35.71	242.54	421.05	699.30
26	American eel*	48	248	1.40	<10.00	<10.00	15.77	<35.77
	blue crab (H/M)	13	130	1.41	<10.00	17.72	18.42	<46.14
	blue crab (H/M)	13	106	1.47	<10.00	<10.00	13.16	<33.16
	blue crab (H)	13	116	5.76	<10.00	15.22	39.62	<64.84
	blue crab (M)	13	116	2.53	<10.00	<10.00	5.19	<25.19
	brown bullhead	24	128	5.06	<10.00	<10.00	9.21	<29.21
27	white perch	24	204	1.04	<10.00	22.39	39.29	<71.68
28	channel catfish	33	300	4.54	27.99	158.51	213.36	399.86
	white perch	16	53	1.99	27.99	235.51	381.47	644.97

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

	SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
	29	American eel	28	40	3.28	27.98	107.28	213.28	348.54
		brown bullhead	24	134	0.99	<10.00	<10.00	11.84	<31.84
	30	American eel	32	68	9.89	46.64	51.31	111.61	209.56
		channel catfish	38	468	9.85	44.31	47.55	103.45	195.31
	31	American eel	43	220	8.42	44.31	132.93	91.51	268.75
		largemouth bass*	30	300	0.28	<10.00	<10.00	6.47	<26.47
	32	American eel	58	357	8.16	11.49	55.80	81.25	148.54
		blue crab (H/M)	15	170	1.20	<10.00	<10.00	7.02	<27.02
		blue crab (H/M)	15	161	1.85	<10.00	<10.00	11.40	<31.40
		blue crab (H)	16	223	7.88	<10.00	13.10	5.56	<28.66
		blue crab (M)	16	223	1.44	<10.00	<10.00	5.56	<25.56
	33	American eel	51	235	8.11	<10.00	30.78	34.32	<75.10
		blue crab (H/M)	16	276	0.31	<10.00	<10.00	6.99	<26.99
		blue crab (H/M)	15	155	2.80	<10.00	<10.00	8.11	<28.11
		blue crab (H)	16	233	6.92	<10.00	<10.00	12.26	<32.26
+++		blue crab (M)	16	233	0.21	<10.00	<10.00	<5.00	<25.00
	34	weakfish	48	943	1.32	<10.00	<10.00	19.81	<39.81
		weakfish	34	360	3.98	<10.00	<10.00	19.74	<39.74
	35	blue crab (H/M)	14	134	0.62	<10.00	<10.00	<5.00	<25.00
		weakfish	43	692	2.31	<10.00	<10.00	12.50	<32.50
		weakfish	39	494	2.05	<10.00	<10.00	19.08	<39.08
	36	American eel	55	338	10.53	<10.00	28.92	48.68	<87.60
		blue crab (H/M)	14	141	1.01	<10.00	<10.00	5.38	<25.38
		weakfish	38	495	1.19	<10.00	<10.00	14.15	<34.15
		weakfish	44	700	2.99	<10.00	11.19	28.35	<49.54

+++ Note: Levels for blue crab (M) sample at Station 33 were reported as follows: DDT - <5.00 ppb; DDD - <10.00 ppb; DDE - <10.00 ppb. This was corrected to reflect reported detection limits of 10 ppb for DDT and DDD, and 5 ppb for DDE.

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
37	bluefish	69	2500	19.04	32.17	57.69	134.09	223.95
	bluefish	68	2277	0.93	<10.00	<10.00	18.18	<38.18
	bluefish	73	2803	2.75	<10.00	<10.00	8.41	<28.41
	striped bass	79	6054	9.24	12.67	57.01	88.71	158.39
	striped bass	62	2315	2.30	14.20	40.18	73.11	127.49
	striped bass	70	3757	3.19	23.67	60.26	106.13	190.06
	striped bass	53	1665	0.63	14.20	55.97	74.56	144.73
	striped bass	62	2218	3.03	<10.00	50.37	53.95	<114.32
	striped bass	75	4885	4.41	<10.00	36.38	51.75	<98.13
	weakfish	50	1504	2.73	<10.00	22.32	47.03	<79.35
	weakfish	56	1836	3.38	<10.00	21.43	34.32	<65.75
	weakfish	70	3858	3.72	11.03	36.09	57.50	104.62
37A	(1989)							
	striped bass*	67	3275	2.68	17.86	90.98	162.50	271.34
	striped bass*	76	5267	6.11	<10.00	31.65	53.75	<95.40
	striped bass*	66	3450	9.09	15.63	63.29	104.17	183.09
	striped bass*	64	3223	5.24	10.71	44.30	73.33	128.34
	striped bass*	72	2886	0.83	14.53	70.31	73.40	158.24
	striped bass*	82	6674	6.09	40.70	76.17	140.43	257.30
38	bluefish	38	513	0.89	<10.00	10.27	15.25	<35.52
	bluefish	76	5099	7.94	20.68	72.62	97.92	191.22
	bluefish	40	615	1.12	<10.00	13.18	18.64	<41.82
	striped bass	61	2096	5.87	33.78	95.49	173.73	303.00
	striped bass	64	2769	0.26	<10.00	26.79	49.53	<86.32
	striped bass	72	3941	5.17	14.20	53.57	81.37	149.14
	striped bass	71	3952	5.72	11.54	26.37	34.72	72.63
	striped bass	70	4069	0.94	12.01	31.74	52.08	95.83
	striped bass	70	3986	4.42	<10.00	31.74	49.77	<91.51
	weakfish	41	734	6.17	<10.00	34.18	77.55	<121.73
	weakfish	44	864	6.18	<10.00	27.34	54.63	<91.97
	weakfish	40	554	2.14	<10.00	<10.00	21.06	<41.06
38A	(1989)							
	striped bass*	50	1520	1.15	10.61	23.44	52.13	86.18
	striped bass*	55	1940	4.00	19.29	50.87	82.19	152.35
	striped bass*	52	1560	3.12	11.32	58.59	70.97	140.88
	striped bass*	60	2435	3.79	<10.00	15.63	29.66	<55.29
	striped bass*	61	2025	3.69	<10.00	17.19	43.65	<70.84
	striped bass*	57	1905	2.60	10.87	10.94	35.59	57.40

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	% LIPIDS	DDT	DDD	DDE	(SUM) DDTs
39	bluefish	78	3877	2.07	15.63	20.51	53.64	89.78
	bluefish	78	4131	2.29	24.55	33.14	98.86	156.55
	bluefish	78	4514	2.82	25.28	34.18	99.33	158.79
	striped bass	64	2479	2.62	14.20	53.57	80.19	147.96
	striped bass	64	2617	2.66	13.99	43.40	63.60	120.99
	striped bass	70	3868	4.41	20.99	58.59	85.53	165.11
	striped bass	73	4523	2.53	21.63	48.83	90.28	160.74
	striped bass	70	4413	9.91	11.83	61.04	81.02	153.89
	striped bass	71	4840	6.25	<10.00	31.74	42.82	<84.56
	weakfish	35	364	2.08	<10.00	<10.00	19.08	<39.08
	weakfish	37	461	2.65	<10.00	<10.00	27.41	<47.41
	weakfish	42	622	1.55	<10.00	<10.00	21.71	<41.71
40	bluefish	70	3142	4.64	16.08	31.74	81.47	129.29
	bluefish	71	3187	4.33	16.54	27.34	55.80	99.68
	bluefish	72	3360	4.36	16.08	29.30	62.50	107.88
	bluefish	40	581	1.18	<10.00	<10.00	16.00	<36.00
	bluefish	40	555	0.56	<10.00	<10.00	7.89	<27.89
	striped bass	69	4050	9.44	<10.00	24.03	38.18	<72.21
	striped bass	68	3889	4.13	<10.00	15.38	32.73	<58.11
	striped bass	67	3551	6.31	11.49	33.65	65.91	111.05
	striped bass	85	7182	4.38	12.01	24.41	47.45	83.87
	striped bass	72	4867	5.67	<10.00	51.26	64.81	126.07
	striped bass	74	4950	7.71	12.02	51.27	70.60	133.89
	weakfish	32	302	3.50	<10.00	<10.00	13.42	<33.42
	weakfish	39	515	2.68	<10.00	<10.00	18.63	<38.63
	weakfish	39	506	2.28	<10.00	<10.00	15.00	<35.00
41	weakfish	39	553	11.74	<10.00	<10.00	20.68	<40.68
	weakfish	37	486	4.39	<10.00	10.25	29.09	<49.34
	weakfish	36	401	1.43	<10.00	<10.00	9.09	<29.09
	weakfish	36	424	1.98	<10.00	<10.00	16.37	<36.37
	weakfish	35	413	3.68	<10.00	10.74	30.42	<51.16
	weakfish	42	699	3.44	<10.00	<10.00	21.19	<41.19
	weakfish	51	1300	2.60	<10.00	36.38	47.32	<93.70
	weakfish	52	1426	4.58	12.50	92.86	143.10	248.46
	weakfish	51	1222	4.86	<10.00	<10.00	64.22	<84.22

DDT AND METABOLITES
(PPB, WET WEIGHT)
(SAMPLES COLLECTED IN 1988, UNLESS OTHERWISE NOTED)

SITE	SPECIES	MEAN LENGTH (cm)	MEAN WEIGHT (g)	LIPIDS	DDT	DDD	DDE	(SUM) DDTs
42	weakfish	44	675	1.74	<10.00	<10.00	17.05	<37.05
	weakfish	43	720	0.16	<10.00	<10.00	18.86	<38.86
	weakfish	34	403	1.85	<10.00	<10.00	12.50	<32.50
	weakfish	35	403	2.40	<10.00	<10.00	19.92	<39.92
	weakfish	35	352	3.21	<10.00	<10.00	21.46	<41.46
	weakfish	35	397	2.39	<10.00	<10.00	19.81	<39.81
	weakfish	50	1370	4.84	<10.00	22.32	50.43	<82.75
	weakfish	53	1445	4.11	<10.00	44.64	84.48	<139.12
	weakfish	51	1368	11.82	10.71	83.93	131.89	226.53
43	striped bass	67	3460	4.73	<10.00	33.78	54.44	<98.22
	striped bass	68	3530	4.38	<10.00	29.96	44.49	<84.45
	striped bass	69	3590	4.10	10.55	27.45	49.39	87.39
	striped bass	70	3420	5.02	10.85	32.11	52.97	95.93
	striped bass	64	2910	6.52	<10.00	29.97	52.97	<92.94
44	(1989)							
	blue crab (H)	14	156	3.63	<10.00	<10.00	20.10	<40.10
	blue crab (M)	14	156	0.52	<10.00	<10.00	<5.00	<25.00
45	(1989)							
	blue crab (H)	14	162	3.57	<10.00	13.39	21.88	<45.27
	blue crab (M)	14	162	0.56	<10.00	<10.00	<5.00	<25.00
46	(1989)							
	bluefish*	75	3632	4.83	12.15	14.13	53.18	79.46
	bluefish*	78	4767	12.36	30.38	42.81	131.82	205.01
	bluefish*	76	4268	10.99	28.21	47.09	150.00	225.30
	bluefish*	77	3814	2.13	<10.00	15.41	37.73	<63.14
	bluefish*	78	4768	10.60	23.87	36.39	115.91	176.17
	bluefish*	76	4086	12.31	17.36	29.97	68.18	115.51
	bluefish*	78	4722	8.22	21.70	34.25	119.32	175.27
	bluefish*	77	4222	7.26	23.88	28.54	88.64	141.06
	bluefish*	79	4495	8.34	17.36	23.54	96.59	137.49
	bluefish*	76	3723	7.22	10.42	19.26	70.45	100.13
	bluefish*	81	4949	10.94	34.72	42.81	163.64	241.17
	bluefish*	77	4404	10.00	21.61	21.40	71.59	114.60
	bluefish*	79	4994	17.99	26.04	51.38	106.82	184.24
	bluefish*	68	3904	10.08	10.85	19.26	46.59	76.70