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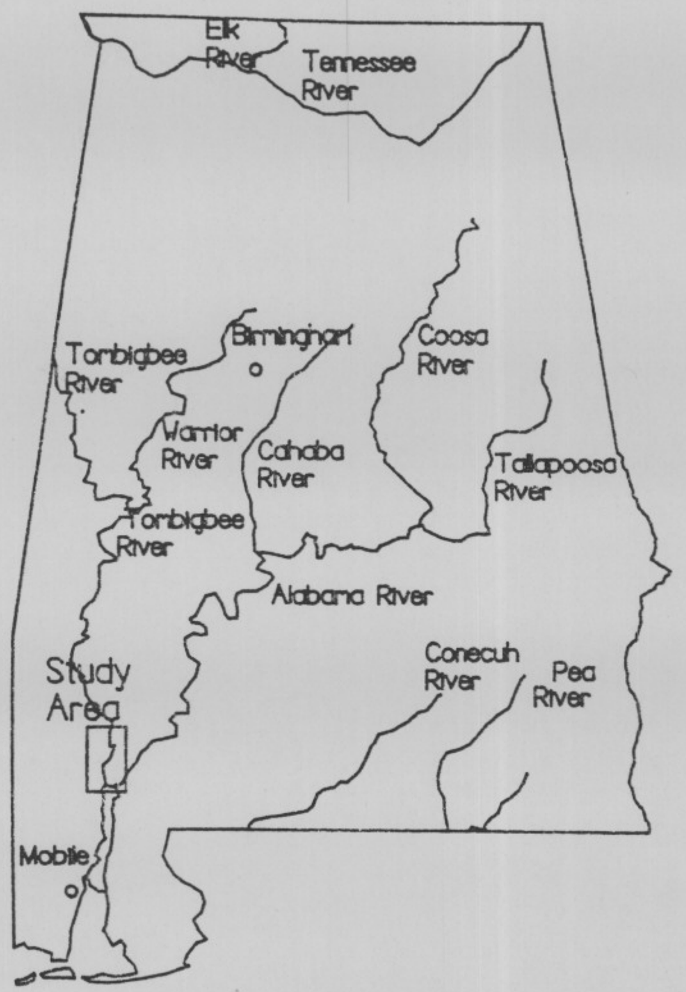
AN EVALUATION OF MERCURY AND DDT CONTAMINATION IN FISH AND SEDIMENTS COLLECTED FROM THE TOMBIGBEE RIVER NEAR MCINTOSH, ALABAMA



PREPARED BY

U.S. FISH AND WILDLIFE ENHANCEMENT

DAPHNE, ALABAMA

JULY 1992

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United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
P.O. Drawer 1190
Daphne, AL 36526

November 3, 1992

To: Addressee

Enclosed is a copy of a recent report by the Daphne Alabama Field office, U.S. Fish and Wildlife Service. The report concerns levels of DDT and mercury, two contaminants of major concern for many years in the Lower Tombigbee - Mobile River area. The report, which covers sampling of river fish from 1988 to 1990, indicates very high levels of these contaminants remain in the biota of this area. For additional information on this study, please contact Mr. Pete Douglas of the Daphne Field office at (205) 441-5181.

Sincerely,

Larry E. Goldman
Field Supervisor

EXECUTIVE SUMMARY

Between 1988 and 1990 the Daphne, Alabama Field Office, U.S. Fish and Wildlife Service (FWS) conducted a contaminant study on the Tombigbee River near McIntosh, Alabama. Fish and sediment samples were collected and analyzed for mercury and DDT, two contaminants determined from earlier investigations as occurring in the rivers biota at concentrations of concern. The results of our study are presented in the enclosed report entitled "An Evaluation of Mercury and DDT Contamination in Fish and Sediments Collected from the Tombigbee River Near McIntosh, Alabama".

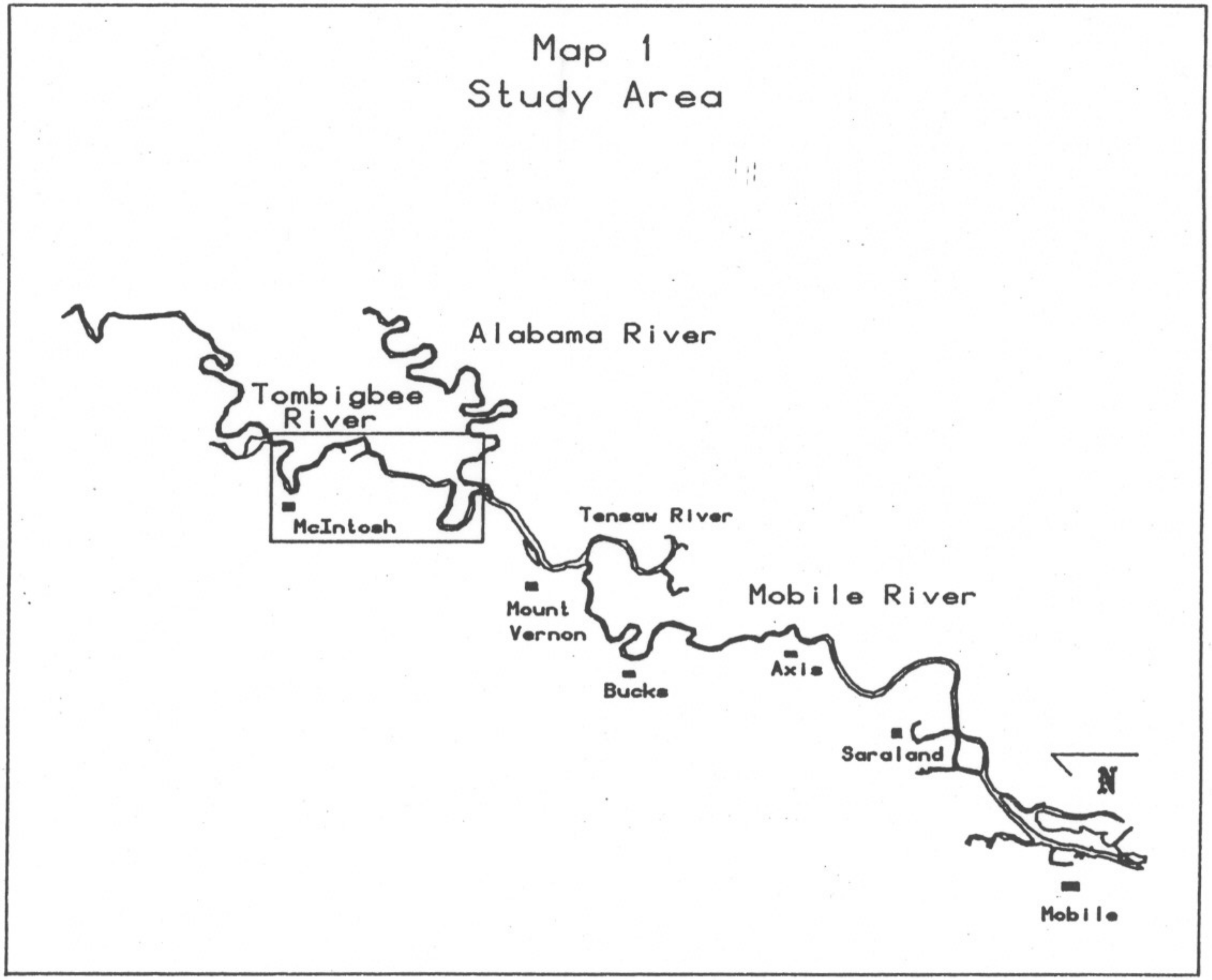
Total DDT concentrations in whole body samples of largemouth bass ranged from 0.36 ppm to 34.52 ppm.(parts per million). Levels in the edible portions, filets, were considerably less ranging from 0.08 ppm to 2.22 ppm. Approximately 50% of the fish collected during the 1990 survey were found with DDE residues exceeding 3.0 ppm, a concentration documented as causing egg shell thinning in consuming avian species. As a result, fish eating species, i.e., bald eagles, herons, egrets, etc., forging in this area of the river could be subject to a decrease in reproductive success.

Detectable levels of mercury were found in all fish samples analyzed. Contrary to the DDT findings, the higher mercury values occurred in the edible portions rather than the whole body. Concentrations in filet samples ranged from 0.08 ppm to 0.67 ppm with a mean of 0.37 ppm while whole body samples ranged from 0.07 ppm to 0.50 ppm with a mean of 0.23 ppm. In addition, whole body mercury concentrations of 1.89 ppm have been reported in fish collected from a lake within the study area that is flooded during annual high river stages.

FWS research investigations have documented that reproduction in waterfowl has been significantly impared when the birds were fed a diet containing 0.50 ppm mercury. The aforementioned lake provides an apparently attractive wintering habitat for a number of ducks and wading birds that eat fish and invertebrates. There is a concern that the mercury concentrations in the lake's biota could be adversely affecting the reproduction of these birds.

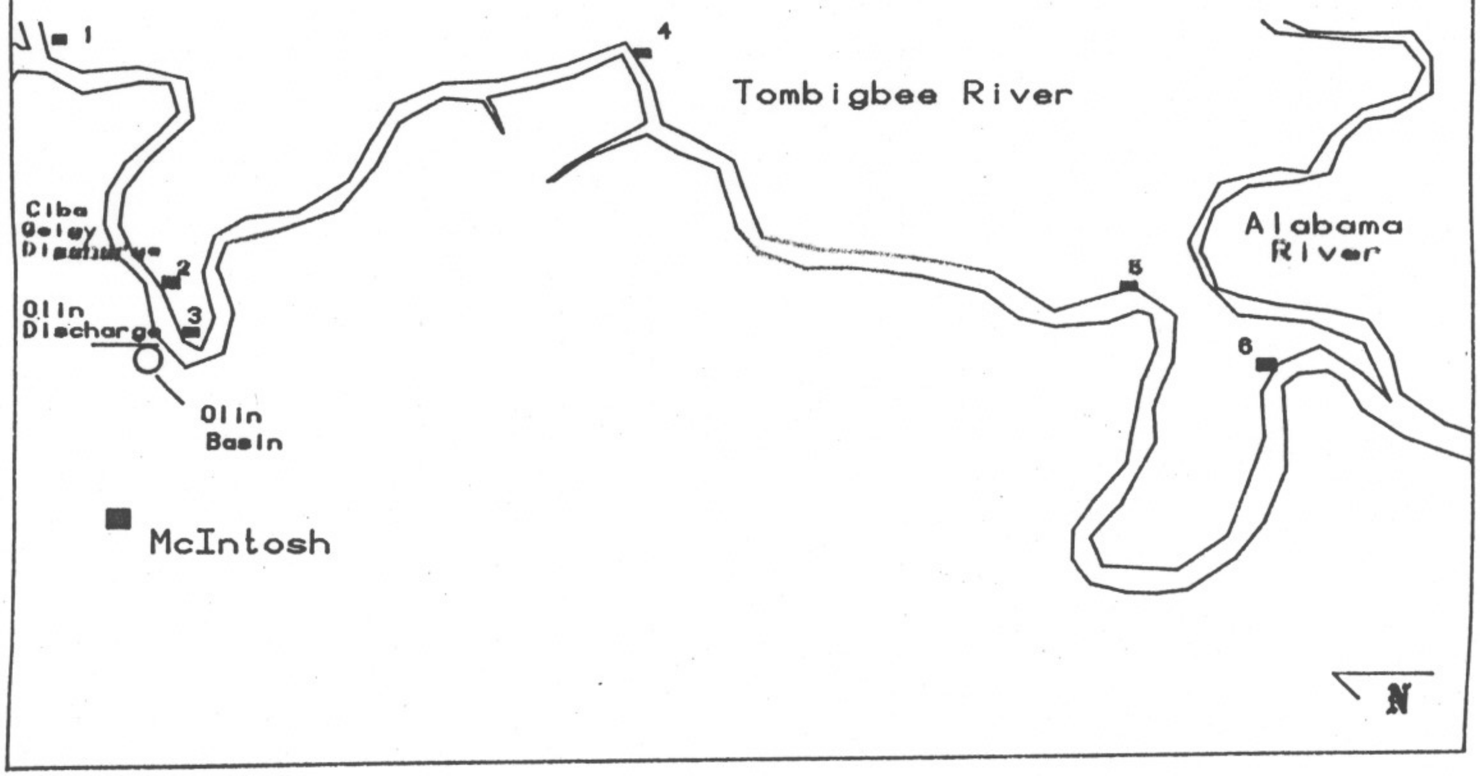
Since 1964 the Fish and Wildlife Service has maintained a national monitoring network collecting fish samples throughout the country. These samples are analyzed for a number of contaminants including DDT and mercury. One of the network stations is located on the Alabama River at Chrysler, Alabama, which is a drainage adjacent to the Tombigbee River. In contrast to the elevated levels of contaminants in the Tombigbee River, during the period of record for the network, DDT concentrations in fish taken at Chrysler have not exceeded 0.32 ppm and mercury has not been found above 0.22 ppm.

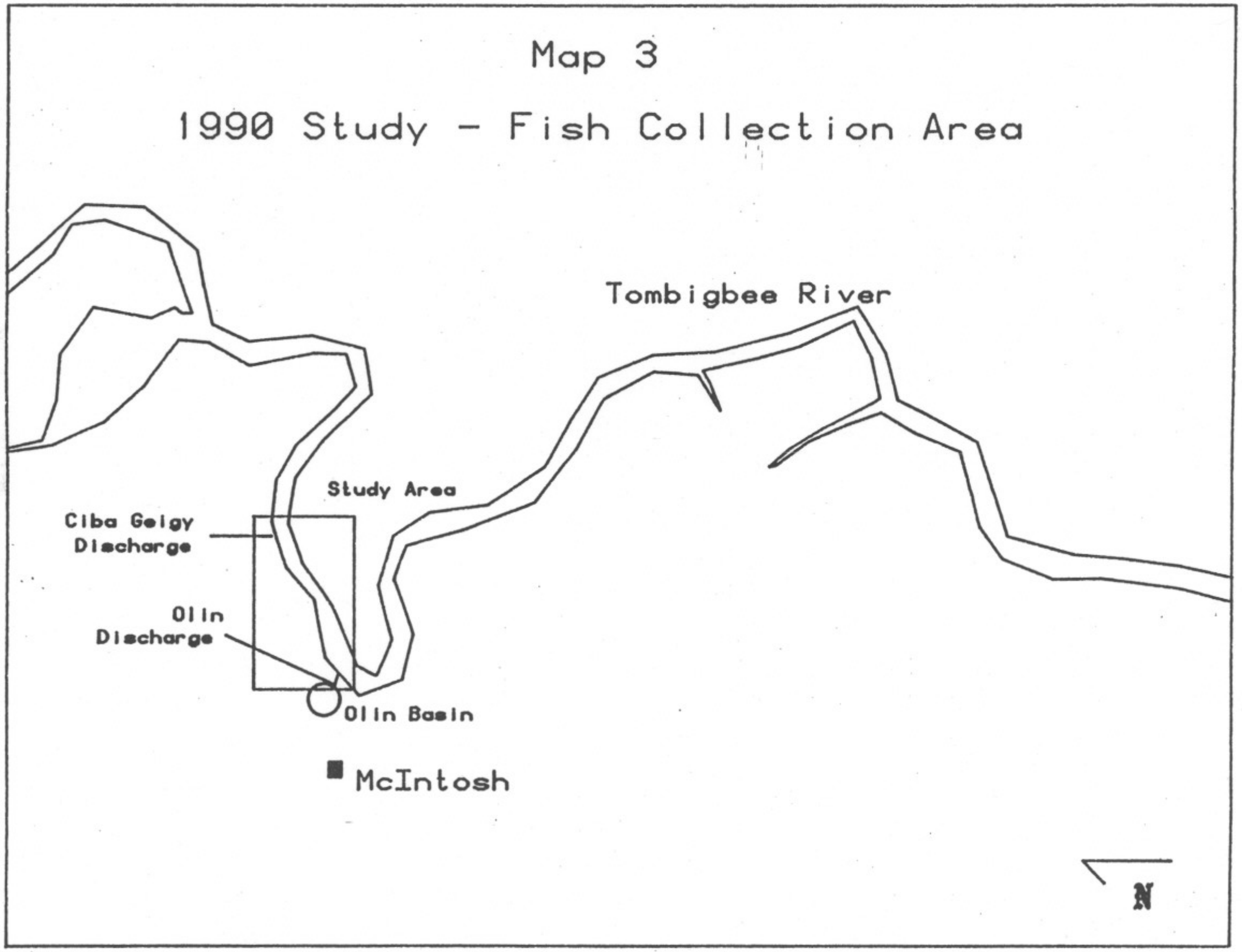
The FWS is anticipating conducting additional studies to track the migration of these contaminants through the higher trophic levels of the food web, principally avian species foraging along the river system.


Map 1
Study Area
Alabama River
Tombigbee River
McIntosh
Tensaw River
Mobile River
Mount Vernon
Bucks
Axis
Saraland
N
Mobile

Map 2

1988 Study - Sampling Stations

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BACKGROUND

The National Pesticide Monitoring Program (NPMP) was begun in 1964 with a charge to monitor levels of organochlorine pesticides in the Nation's water, soil, air, food, plants, animals, and people (Jacknow, et al. 1986). Twelve networks were divided among several Federal agencies, of which three were managed by the U.S. Fish and Wildlife Service (Service). In recent years, the entire program has been expanded to include industrial chemicals and metals, as well as pesticides. Because of these changes, the networks composing the Service programs were renamed the National Contaminant Biomonitoring Program (NCBP). The purpose of the monitoring programs is to answer two basic questions: How do levels of pollutants in fish and wildlife vary according to geographic region? And, what changes are occurring over time?

One of the network stations was established on the lower Tombigbee River near McIntosh, Alabama, Map 1. It became readily apparent that fish collected from this station contained DDT and mercury (Table 1) in excess of the average values reported from the network. The results of the 1984 survey (Schmitt, et al. 1990), the most recent year of statistically scrutinized data, found the geometric mean of total DDT residue in fish collected at the McIntosh station to be 4.8 ug/g (Figure 1). This was the second highest value reported from the network, exceeded only by a station on the Yazoo River in the Mississippi Delta, an area known historically for some of the heaviest pesticide

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applications in the country. A trend analysis of the McIntosh station found that total DDT concentrations have not decreased appreciably since the 1976 collection period. In fact, during the 1986 survey a channel catfish composite reported a concentration of 5.5 ug/g.

Mercury was another contaminant the NBCP found to be elevated at McIntosh. The 1984 survey (Schmitt, et al. 1990) reported the station exceeding the 85th percentile, having the 9th highest concentration within the (NCBP) network, Figure 2. The Mann-Kendall test for trends concluded no significant increase or decrease from the 1976 data.

There are two industries on the river in the vicinity of the McIntosh station that are on the EPA Superfund National Priorities List: Olin Corporation and Ciba Geigy.

The Ciba Geigy facility, formerly owned by Geigy Chemical Corporation began operations in October 1952 with the manufacture of one product, DDT. Through 1970 the company expanded its operation by adding the production of fluorescent brighteners used in laundry products; herbicides; insecticides; agricultural cheating agents; and sequestering agents for industry. In 1972 DDT was banned for use in the United States and production ceased at the Ciba Geigy facility. However, by that time the ground water as well as the surrounding surface environment had become contaminated with DDT. In 1986 the U.S. Fish and Wildlife Service Daphne Field Office conducted a Preliminary Natural Resource Survey of the site and concluded that trust resources of the Department of the Interior (Interior) were in the vicinity of the industry and that a release from liability should not be granted until adequate data had been collected to assess impacts.

Olin also began operations at McIntosh in 1952 with the production of caustic soda and chlorine using the mercury cell process. In 1981 the organic plant was closed and Olin switched from the mercury cell process, which produces mercury as a waste product, to the diaphragm cell process. Subsequent investigations by the company found area ground water and the Olin Basin (a lake in the flood plain between the plant and the river) contaminated with mercury.

In 1986 the Daphne field office conducted a Preliminary National Resource Survey of the Olin site and concluded that Interior trust resources were present. However, because of the limited biological data base it was not possible to determine the impacts to these resources. The report provided a suggested study design to generate the necessary data.

In 1988, the Daphne Field Office carried out a study on the lower Tombigbee River near McIntosh to determine if contaminants were still present in the fish adjacent to the two industries and

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evaluate the extent of downstream contamination, Map 2. Mercury and DDT analyses were run on whole composite fish (channel catfish and largemouth bass) and sediment samples collected at six stations beginning 5 miles upstream from the Ciba Geigy outfall and extending for 15 miles downstream from the outfall.

The highest body burdens of mercury, 0.95 ug/g, were found in largemouth bass collected at the McIntosh station adjacent to the Ciba Geigy/Olin outfalls (Figure 3). At the station 5 miles below the outfalls fish tissue concentrations of mercury had decreased to 0.20 ug/g. This appeared to be a background concentration for this reach of the river since the mercury concentrations found in largemouth bass upstream of the outfalls as well as those at the remaining stations downstream were in the range from 0.20 ug/g to 0.26 ug/g.

Mercury concentrations in the sediments were slightly higher at the McIntosh station, 0.15 ug/g, than the remainder of the study area where levels ranged from 0.04 ug/g to 0.10 ug/g. Overall, concentrations in the sediment were considerably lower than those found in fish tissues.

As with mercury, the highest DDT concentration, 8.9 ug/g, was found in fish taken at the McIntosh station (Figure 4). Residue levels were found to be considerably less in fish from the downstream stations with the exception of the station 10 miles

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below McIntosh where a 4.44 ug/g concentration was detected. Also, a concentration of 1.18 ug/g occurred in fish collected at the site five miles above McIntosh. These values could have been indicative of additional DDT introduction into the river or possibly these stations are within the spacial range of fish in the McIntosh area. Without a more comprehensive data base it was not possible to provide a more detailed assessment.

Based on the available data it appeared that the McIntosh area was the principal source of both the mercury and DDT concentrated in the river biota. Although the maximum mercury was found in fish collected at the McIntosh station, elevated DDT levels were found throughout a broader reach of the river. Largemouth bass were found to be capable of concentrating the two contaminants to a much greater degree than channel catfish. It also appeared that DDT may have been more mobile in the river biota than mercury or that there may have been additional sources of DDT other than from the McIntosh area.

Sediments displayed very little ability to uptake mercury with values found near the level of detection at all stations. Similar results were found with DDT with the exception of the McIntosh station where a sediment concentration of 1.18 ug/g was reported.

All the fish data from the McIntosh area gathered prior to 1990 and presented above was generated from composite samples analyzing the whole body. Compositing samples has the advantage of allowing a number of samples to be analyzed at a reduced analytical cost. The disadvantage is that an average value is produced that mask the concentrations of the individual samples. For example, the composite largemouth bass sample that reported 8.9 ug/g DDT obviously contained fish with higher as well as lower concentrations. In the same sense analyzing whole fish tends to generate an average value obscuring sites within the body that may be more prone to sequestering the contaminant.

The most recent investigation presented below is an attempt to address these issues as well as to further assess the McIntosh area as a source of mercury and DDT contamination in the lower Tombigbee River.

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MATERIALS AND METHODS

On November 14, 1990 electrofishing gear was used to collect 15 largemouth bass from the Tombigbee River in the immediate vicinity of the Ciba Geigy and Olin Corporation facilities near McIntosh, Alabama, Map 3. Largemouth bass were selected because they have historically been one of the most successful endemic species in concentrating a variety of contaminants and are intensively pursued for human consumption. The plan was to began collecting fish adjacent to the industry outfalls and progress upstream and downstream from this area until the required sample had been secured. Samples would be taken on the same side of the river as the industries until the effort had progressed to a point that was a greater distance from the industries than the distance across the river. At that time collecting would began across the river adjacent to the industries. This collection pattern, alternating sides of the river, would continue until the required sample had been obtained. In this way fish would be collected in the closest proximity to the industries. In reality, largemouth bass were found to be relatively common and all fish were taken within one mile of the industries. In an attempt to standardize the data base fish of a relatively uniform size were collected, 150 grams - 504 grams. However, two larger individuals, 1280 grams and 1733 grams were also included in the analyses to evaluate if age and resident time in the river was a factor in residue levels.

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As the fish were collected they were immediately placed on wet ice. At the Daphne Field Office, a right side filet was removed from each fish. It was then skinned, weighed, and wrapped in solvent rinsed aluminum foil. The remainder of the carcass, along with the skin from the removed filet, was weighed and also wrapped in solvent rinsed aluminum foil. The filet knife was washed with soap and water, solvent rinsed, distilled water rinsed, and then air dried between processing each sample. Detailed records were maintained in order to associate a filet with the appropriate carcass. Within five hours of collection, the samples had been processed and were in the Daphne office freezer awaiting shipment for analysis.

On January 2, 1991 the samples were shipped to the U. S. Fish and Wildlife Service Patuxent Analytical Control Facility for analysis. Each sample was analyzed for total mercury and the various homologs of DDT. The data was reported as ug/g wet and dry weight. However, to make the values more comparable with the existing literature, only ug/g wet weight has been referenced in this report.

Samples are defined by a combination of alpha numeric characters. The first two characters <u>DA</u> define the sample as originating from the Daphne office. The next two characters <u>90</u> indicate that the sample was collected during 1990. The final characters after the dash line is the individual sample number. In this investigation the samples are numbered 1 thru 15. Each sample number is then followed by the letter A delineating the carcass sample (less the filet) or the letter B for the filet.

In addition to reporting the concentrations of mercury and DDT in carcass and filet samples a third value, total concentration, has been calculated using the following formula;

$$\frac{[\text{sample A (ug/g) x sample wt.}] + [\text{sample B (ug/g) x sample wt.}]}{\text{total wt.}}$$

sample A = right side filet

sample B = remaining carcass, including skin from the removed filet

RESULTS

MERCURY:

Analytically detectable levels of mercury (>0.001 ppm. wet wt.) were found in all samples. Of the 15 bass analyzed, 13 were found with higher concentrations in the filets (muscle tissue) than in the carcass (Figure 5). Mercury in the filets ranged from 0.08 ug/g to 0.67 ug/g with a mean of 0.37 ug/g (Table 2). The carcass samples ranged from 0.07 ug/g to 0.50 ug/g with a mean of 0.22 ug/g (Figure 6).

Total body mercury for each fish was determined by combining the filet and carcass concentrations, adjusted for the relative sample weight of each component. The concentrations ranged from 0.07 ug/g to 0.50 ug/g with a mean of 0.23 ug/. The relative percent concentration of mercury was compared between the filet and carcass samples for each of the 15 fish (Figure 7). Only two fish were found with a higher percent concentration in the carcass. Thirteen of the fish had over 50 percent located in the filet with one exceeding 75 percent.

A sample size to mercury concentration correlation was conducted to evaluate if weight (age) was a factor in residue uptake. The three largest fish (1733, 1284, and 504 grams) contained total body concentrations of 0.25 ug/g, 0.50 ug/g, and 0.47 ug/g respectively. The remaining samples which ranged from 180 to 388 grams contained concentrations from 0.07 ug/g to 0.28 ug/g.

DDT:

Detectable levels of DDT were found in each of the 15 fish analyzed with total body burdens ranging from 0.36 ug/g to 34.52 ug/g with a mean of 8.00 ug/g (Figure 8). Total DDT was considerably more evident in the carcass samples than the filet (Table 3). In only one sample, DA90-15, were concentrations found to be greater in the muscle tissue (Figure 9). Total DDT in the filets varied from 0.08 ug/g to 2.22 ug/g with a mean of 0.70 ug/g while carcass samples ranged from 0.06 ug/g to 0.49 ug/g with a mean of 0.22 ug/g.

The percent relative concentration was computed for carcass and filet samples of each fish (Figure 10). The carcass was found to contain from 82.2% to 96.6% of the total DDT with the muscle tissue making up only 3.1% to 17.8%. This divergence would probably have been even more significant had not the carcass sample also contained the left side filet which, in essence, provided some degree of dilution of DDT to the carcass samples.

All samples contained concentrations of DDT as well as the metabolites DDD, and DDE. DDE was found at higher levels than the other forms in all analyses, with the exception of one sample. DDE concentrations ranged from 0.03 ug/g in a filet sample to

18.9 ug/g in a carcass (Figures 11 and 12). The second highest metabolite was DDD which varied from 0.01 ug/g in a filet to 11.0 ug/g in a carcass sample. The parent compound DDT, with levels from 0.03 ug/g in a filet to 7.4 ug/g in a carcass, was occasionally found to be higher than DDD, usually in samples exhibiting low residue levels near detection limits.

DDT homologs were also reported from carcass and filet samples, table 4. In only three samples was o,p′ not found to equal or exceed p,p′ in analyses of the parent compound DDT. Although the highest actual concentrations were most frequently found in the p,p′ homolog associated with DDE analyses.

DDT levels were compared with fish size (weight) to assess if a correlation existed between age and residue levels. The highest concentration, 34.52 ug/g, occurred in a fish that weighted 504 grams with the lowest, 0.36 ug/g in a fish weighing 380 grams whereas the two largest fish, weighing 1280 grams and 1673 grams, reported 7.07 ug/g and 5.03 ug/g respectively.

DISCUSSION

The 1990 study was conducted to determine if elevated DDT and mercury levels were still present in largemouth bass in the Tombigbee River at McIntosh, Alabama. Individual fish were analyzed to ascertain the actual range of concentrations rather than average values produced previously from composite samples. Two separate analyses, the right side filet and the remaining carcass, were run on each of the 15 collected fish to assess avenues of contaminant uptake for food chain organisms as well as potential impacts to the human consumer. These values were then combined to compute total body residues.

The presence of a DDT source in the McIntosh study area impacting the Tombigbee River was documented by the elevated levels found in largemouth bass collected from the river at the site. Total DDT in whole body samples ranged from 0.34 ug/g to 34.52 ug/g with a mean of 8.0 ug/g. This graphically demonstrates the value of analyzing individual samples rather than composite averages in determining maximum residue levels in the environment. If these samples had been combined and analyzed as a composite sample, the data would have only reflected a mean value and not the higher residue concentrations.

A study of the breeding success of brown pelicans in relation to residues of DDT in their major food source, the northern anchovy, found a correlation between DDT in the anchovy and productivity of the pelicans (Anderson, et al. 1975). As the food source residues decreased from a mean of 3.4 mg/kg to 0.15 mg/kg there was a corresponding increase in fledged pelicans with a concurrent increase in eggshell thickness. However, even at these lower concentrations, eggshell thickness was below normal and productivity was too low to maintain population stability. It was concluded that to avoid adversely affecting reproduction, DDT levels in the food source should be below 0.15 mg/kg.

Blus, et al. (1974) reported that normal reproductive success in brown pelicans occurred when the total DDT concentration in the eggs was below 2.5 mg/kg and DDE less than 0.5 mg/kg. Much higher concentrations were found in the eggs than in pelican parent food sources. A study conducted by Longcore, et al. (1971) determined that DDT in the eggs of black ducks was 10 times greater than their food source. If this concentration factor is used with Blus' data, the threshold for DDT in the food source to maintain normal reproduction is 0.25 mg/kg which is similar to the value of 0.15 mg/g established by Anderson. Using this factor for the more toxic DDE, the threshold in the food source becomes 0.05 mg/kg.

A summary of the knowledge on the causes of bird eggshell thinning was compiled by the U.S. Fish and Wildlife Service Research Information Bulletin (November 1981). It was concluded that the DDT metabolite DDE was the principal culprit over all other chemicals tested. Thinning was repeatedly documented with dietary source levels lower than 3 ppm.

Using this rather conservative value of 3 ppm, approximately 50% of the largemouth bass collected at McIntosh during the 1990 survey contained DDE residues that have been documented to result in eggshell thinning when consumed by area avian populations. If the aforementioned computed value of 0.05 mg/kg is used, all the bass collected would pose a reproductive threat.

In reviewing the DDT data it was found that from 3.1% to 17% of the residues were contained in the filet samples with the remaining sequestered in the organs and related tissues of the carcass. Since only the right side filet was removed, the left filet remained with the carcass and was incorporated in that sample analyses. Including this lower residue level tissue with the sample probably reduced to some degree the DDT residues that otherwise would have been reported in the carcass. Therefore, if both filets had been removed and analyzed separately it is anticipated that the partitioning of DDT in the carcass would have been more dramatic.

The Food and Drug Administration (FDA) Action Level (Action Level For Poisonous or Deleterious Substances in Human Food and Animal Feed, 1987) for DDT in edible portions is 5.0 ug/g total DDT. The highest concentrations found in largemouth bass during this study, 34.52 ug/g total body residue, only resulted in a filet (edible portion) concentration of 2.22 ug/g. Studies conducted at the Wheeler National Wildlife Refuge, an area impacted by massive DDT contamination from the adjacent Redstone Arsenal, reported mallard duck carcass concentrations as high as 480 ug/g with a geometric mean of 4.0 ug/g (O'Shea and Flemming 1980). Although the muscle tissue for these birds had a maximum of 150 ug/g, the mean was only 0.67 ug/g. It would appear that extremely high DDT loading in both birds and fish would be required to produce residue levels in excess of the FDA Action Level.

The highest total DDT concentrations reported from the NCBP at the McIntosh station was 48.0 ug/g for a carp composite collected in 1973, followed by 21.8 ug/g in a largemouth bass composite collected in 1972. From 1973 through the last reporting date in 1986, the highest DDT concentration was 7.56 ug/g in a smallmouth buffalo composite collected in 1979. It is interesting to speculate what the individual fish concentrations must have been in 1972 in order to produce such a high average value.

The highest DDE concentration, 32.0 ug/g, was found in a carp composite sample collected in 1973 with the lowest, 0.19 ug/g, in a channel catfish sample taken in 1986. A second catfish composite taken in 1986 contained 2.64 ug/g DDE. Largemouth bass, which have consistently exhibited the much greater uptake ability, were not taken during that particular collection but were analyzed during the 1984 survey and were found to contain 4.71 ug/g. Even using these lower values produced by composite analyses DDE has continually been reported at avian dietary source levels sufficient to cause eggshell thinning.

In 1988 DDT analyses were run on composited largemouth bass, channel catfish, and sediment samples collected at stations on the Tombigbee River which were established at 5 river mile increments beginning 5 miles above McIntosh and extending for 20 miles downstream. The maximum concentration reported in the largemouth bass, 8.9 ug/g, occurred at the McIntosh station. DDT residues in composite bass samples collected at the remaining stations decreased considerably, ranging from 0.49 ug/g to 4.44 ug/g. Inexplicably, the lowest level reported was found at the station immediately downstream from McIntosh while the succeeding downstream station had the second highest value.

Catfish did not exhibit this same high level at McIntosh. Values only ranged from 0.28 ug/g to 0.73 ug/g with the greatest, 0.73 ug/g, found at the most downstream station. The second highest level, 0.50 ug/g did occur at the McIntosh site.

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One of the more interesting findings was the high percentage of the homolog o,p′ relative to p,p′ in analyses for the parent DDT compound in fish samples collected during the 1990 survey. Since o,p′ is basically an impurity in the DDT formulation, manufacturers allowed only a very small percentage of this homolog in the final product. The presence of higher than 20 percent o,p′ residues in fish tissue suggest a source other than insecticidally applied DDT, such as a site of manufacture, formulation, or chemical waste storage (Schmitt et al. 1985). It was not uncommon for manufacturers to discard a batch of pesticides that did not meet quality control requirements.

With the exception of McIntosh, all stations during the 1988 survey were found with DDT sediment values ranging between 0.17 and 0.21 ug/g. At McIntosh sediment values were reported at 1.18 ug/g. Although somewhat higher concentrations were found at McIntosh, low levels persisted at the more distant downstream stations.

With the exception of the McIntosh station, DDT loading in the river sediments was very low. Even at McIntosh, where sediment levels were somewhat elevated, residues in catfish were not significantly different from the other sites. It appears that sediments were not an effective concentrator of DDT, and even when higher levels occurred, it was not noticeably transferred to the bottom dwelling catfish.

The biomagnification of DDT throughout the food chain is well documented. Woodwell, et al.(1967) tracked DDT through the food web in a Long Island marsh and observed the following uptake, ppm wet wt.: plankton 0.04, water plants 0.08, snail 0.26, shrimp 0.16, minnow 0.94, bill fish 2.07, heron 3.5, cormorant 26.4, and gull 75.5. Johnson and Finley (1980) compiled the results of toxicity test on fish and aquatic invertebrates that had historically been conducted at the U.S. Fish and Wildlife Service Columbia National Fisheries Research Laboratory. They found that DDT was accumulated in invertebrates as much as several thousand times exposure levels. These exposure levels often ranged as low as 80 ng/l. In fish, the food was determined to be more important than water as a source of body residues. Since the largemouth bass, found with the greater residues, feeds at the top of the food chain, it would appear that the food source is the major avenue of transfer through the river environment.

Mercury in the 15 largemouth bass analyzed from the 1990 survey ranged from 0.07 ug/g to 0.50 ug/g, somewhat less than the concentration, 0.95 ug/g, recorded from the bass composite sample taken near McIntosh in 1988. Since composite data are averages, it was expected that the individual fish analyses would have produced a range of values bracketing the composite value, similar to that found with the DDT results. However, this could have resulted from several factors.

The sample size may have been inadequate to characterize the stratification of mercury in the river biota. One value with a high mercury level in a 5 fish composite could have produced the average value reported in the 1988 study. Because of the random sampling nature of the 1990 survey these higher residue level fish may have not been taken in that collection. An example of the effect of individual data points on an average can be demonstrated with the 1990 DDT data in which if the two highest concentrations, 34.52 and 18.8 ug/g, are deleted the average would decrease from 8.0 ug/g to 5.13 ug/g.

The principal suspected source of mercury into the Tombigbee River in the McIntosh area is the Olin Basin, a lake in direct contact with the river during higher river stages. Analyses of fish taken from the basin have reported mercury levels as high as 1.89 ug/g, (unpublished Olin data, 1989). This is considerably greater than values found in the adjacent river. It is, therefore, reasonable to assume that, in the McIntosh area, fish with access to the basin will have higher mercury levels than fish without access to the basin. Since fish can only move between the river and the basin during high river stages, the mercury body burdens in these species would, to a certain degree, be influenced by the river stage and resulting access to the basin. We also note that mercury impacts extend beyond the Olin Basin into the river proper.

River stages were plotted from data collected at the Berry Steam Plant gauging station, located 30 river miles downstream from McIntosh, during the period of the 1988 and 1990 surveys (Figure 14). The graph displays the river stage during the month of the two surveys as well as for the previous month. During the actual month of the surveys the river stages were almost identical. However, during the month prior to the collections the river was much higher in 1988, which coincides with the year of higher mercury levels found in fish taken from the river adjacent to the Olin Basin.

We have not yet determined the stage reading at the Berry Steam Plant which correlates with the river overtopping the bank and completely entering the Olin Basin. However, the 1988 survey period was during the highest river stages reported for that year, whereas the 1990 survey was conducted during a period of the lowest annual river stages.

There appeared to be a correlation in the 1990 survey between the size (age) of the fish and total mercury body burdens with the higher concentrations found in the larger species. Fimreite et al. (1971) collected a number of fish species near mercury sources in the Great Lakes and found a positive correlation between mercury levels and weight, indicating that larger fish contain relatively more mercury per unit weight than smaller fish. Striped dolphin, a mammal, exhibited a similar phenomenon with mercury increasing with age until reaching a plateau at age 20-25. It was also found that kidney tissue had the highest concentrations, although muscle tissue accounted for about 90 % of the body burden, Eisler (1987).

Wildlife species have also been reported with mercury related impacts. Three generations of mallards that were fed 0.5 ppm methyl mercury laid significantly more eggs outside their nest boxes, produced fewer sound eggs, and produced significantly fewer young to one week of age than did controls (Heinz 1979).

CONCLUSIONS

1. Extremely high levels of DDT were found in largemouth bass collected from the Tombigbee River near McIntosh, Alabama. This confirmed the historically elevated values reported by the U.S. Fish and Wildlife Services National Contaminant Biomonitoring Program station at this site.

2. The high percentage of the DDT homolog o,p′, a production impurity, in fish samples collected at McIntosh indicates this to have been an area of DDT manufacturer or formulation.

3. Total DDT residues in largemouth bass were consistently at or above values known to cause adverse effects on consuming biota.

4. DDT was concentrated predominately in the carcass. The edible portions (filets) contained levels well below FDA Action Levels.

5. There was no obvious correlation between age (size) and DDT residue levels.

6. Largemouth bass were found with much higher concentrations of DDT than channel catfish, with the lowest values reported in sediments.

7. Mercury in fish samples collected at the McIntosh station were below the values reported during the 1988 survey but well above background levels confirming this area as a suspected mercury source.

8. As with DDT, mercury had a much greater affinity for largemouth bass than channel catfish. The lowest levels consistently occurred in sediment samples.

9. Mercury was not as site specific in the organism as DDT with only slightly higher levels found in the muscle tissue as opposed to the carcass.

10. There appeared to be somewhat of a positive correlation between the size of the fish (age) and whole body mercury levels.

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RECOMMENDATIONS

Elevated levels of DDT and mercury are now well documented in fish collected from the river at McIntosh, Alabama. The Environmental Protection Agency Superfund program is presently investigating two industries in the McIntosh area to determine the sources of these contaminants. However, there are no plans to expand the investigation beyond the facilities.

Mercury and DDT are just two of the contaminants of concern in the lower Tombigbee River/Mobile River drainage. Over 15 major industries are located on the river between Jackson, Alabama and Mobile. Four of these facilities have been designated by EPA as Superfund sites with documented contaminant releases to the offsite environment. The impacts of many of these other industries have not yet been assessed. There has been little investigation into the effects of any of these industries on the offsite adjacent environment.

A comprehensive study should be conducted to assess the transport as well as effects of these contaminants throughout the river systems food chain, ie. fish, birds, mammals, etc. This investigation should characterize the total effluent loading into the system with particular emphasis on constituents with the ability to bioconcentrate.

It is suggested that a consortium of involved local, state and federal agencies be formed to develop the study plan. These agencies would then support the operation of the investigation and the preparation of reports. This would assure the necessary input for developing a comprehensive study plan and the allocation of the work load to minimize the impact on the contributing agencies.

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Schmitt, C.J., et al. 1990. National Contaminant Biomonitoring Program: Residues of Organochlorine Chemicals in U.S. Freshwater Fish, 1976-1984.

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TABLES

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TABLE 1. NATIONAL CONTAMINANT BIOMONITORING PROGRAM. MERCURY AND DDT IN COMPOSITE FISH SAMPLES COLLECTED IN THE TOMBIGBEE RIVER AT THE MCINTOSH STATION, 1969-1986. UG/G WET WT.

Year	SPECIES	DDE	DDD	DDT	TOTAL DDT	MERCURY
1969	Carp	2.95	0.74	0.14	3.83	
	LM Bass	5.85	2.73	1.57	10.15	
	Striped Bass	4.55	2.26	1.12	7.93	
1970	Carp	2.13	1.00	0.27	3.40	
	Largemouth Bass	3.26	1.12	0.77	5.15	
	Striped Mullet	2.34	0.97	0.73	4.04	
	Striped Mullet	1.00	0.59	0.57	2.16	
1971	Carp	0.43	0.26	0.04	0.73	
	Carp	2.92	1.30	0.09	4.31	
	Largemouth Bass	4.18	0.80	0.55	5.53	
	Largemouth Bass	1.21	0.68	0.43	2.33	
	Striped Mullet	0.94	0.46	0.21	1.61	
	Striped Mullet	3.26	0.82	0.32	4.40	
1972	Channel Catfish	2.20	0.70	0.24	3.14	
	Channel Catfish	0.90	0.41	0.17	1.48	
	Largemouth Bass	15.00	5.00	1.80	21.80	
	Striped Bass	0.26	0.15	0.10	0.51	
1973	Carp	32.00	5.00	11.00	48.00	
	Largemouth Bass	2.80	0.50	ND	3.30	
	Largemouth Bass	6.80	1.60	1.20	9.60	
	Striped Bass	1.30	0.40	0.30	2.00	
1974	Freshwater Drum	0.47	ND	ND	0.47	
	SM Buffalo	0.40	0.30	0.30	1.00	
1977	Freshwater Drum	1.06	0.20	0.20	1.46	0.50
	Mixed Species	0.80	0.18	0.38	1.36	0

TABLE 1. NATIONAL CONTAMINANT BIOMONITORING PROGRAM. MERCURY AND DDT IN COMPOSITE FISH SAMPLES COLLECTED IN THE TOMBIGBEE RIVER AT THE MCINTOSH STATION, 1969-1986. UG/G WET WT.

Year	SPECIES	DDE	DDD	DDT	TOTAL DDT	MERCURY
1979	SM Buffalo	4.43	1.18	1.95	7.56	0.18
	SM Buffalo	0.50	0.20	0.16	0.86	0.10
	White Crappie	0.21	0.04	0.02	0.27	
1981	Black Crappie	0.90	0.26	0.25	1.41	0.13
	Blue Catfish	0.61	0.24	0.25	1.10	0.01
	Blue Catfish	1.66	0.40	0.58	2.64	0.05
1984	Channel Catfish	2.05	0.67	0.52	3.24	0.13
	Channel Catfish	2.26	0.98	0.56	3.80	0.06
	Largemouth Bass	4.71	1.16	0.28	6.15	0.29
1986	Channel Catfish	2.64	2.75	0.11	5.50	0.12
	Channel Catfish	0.19	0.05	0.01	0.25	0.03
	White Crappie	0.37	0.07	0.02	0.46	0.08

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TABLE 2. MERCURY CONCENTRATIONS IN LARGEMOUTH BASS COLLECTED FROM THE TOMBIGBEE RIVER AT MCINTOSH, ALABAMA. NOVEMBER 11, 1990.

SAMPLE #	CARCASS		FILET		
	MERCURY (ug/g)	WEIGHT (grams)	MERCURY (ug/g)	WEIGHT (grams)	T.MERCURY (ug/g)
DA90-01	0.14	220	0.18	20	0.15
DA90-02	0.21	280	0.59	28	0.24
DA90-03	0.14	208	0.08	22	0.13
DA90-04	0.23	256	0.17	30	0.22
DA90-05	0.22	348	0.36	40	0.22
DA90-06	0.24	344	0.67	36	0.28
DA90-07	0.24	180	0.26	28	0.24
DA90-08	0.49	1180	0.63	100	0.50
DA90-09	0.24	1667	0.53	66	0.25
DA90-10	0.46	464	0.58	40	0.47
DA90-11	0.18	346	0.30	40	0.19
DA90-12	0.15	126	0.22	24	0.16
DA90-13	0.13	150	0.55	26	0.19
DA90-14	0.06	160	0.12	24	0.07
DA90-15	0.17	144	0.33	36	0.20

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Table 3. DDT And Metabolites In Largemouth Bass Collected From The Tombigbee R. at McIntosh, AL. November 11,1990

SAMPLE #	DDT (ug/g)	DDD (ug/g)	DDE (ug/g)	TOTAL DDT (ug/g)	WEIGHT (grams)
01-Carcass	1.95	2.60	10.00	14.50	220
01-Filet	0.17	0.12	0.58	0.87	20
01-Total	1.8	2.39	9.22	13.41	240
02-Carcass	0.45	0.62	2.60	3.67	280
02-Filet	0.04	0.03	0.05	0.12	28
02-Total	0.41	0.57	2.37	3.35	308
03-Carcass	1.59	2.05	6.20	9.84	209
03-Filet	0.23	0.20	1.32	1.75	22
03-Total	1.46	1.87	5.74	9.07	231
04-Carcass	0.76	1.26	3.70	5.72	256
04-Filet	0.08	0.08	0.11	0.27	30
04-Total	0.66	1.14	3.32	5.15	286
05-Carcass	0.73	2.00	3.20	5.93	348
05-Filet	0.05	0.08	0.08	0.21	40
05-Total	0.66	1.80	2.88	5.34	388
06-Carcass	0.06	0.04	0.27	0.37	344
06-Filet	0.03	0.01	0.03	0.08	36
06-Total	0.06	0.04	0.26	0.36	380
07-Carcass	0.76	0.91	3.20	4.87	180
07-Filet	0.05	0.03	0.22	0.30	28
07-Total	0.66	0.79	2.80	4.25	208
08-Carcass	1.52	3.50	2.57	7.59	1180
08-Filet	0.13	0.17	0.60	0.90	100
08-Total	1.41	3.24	2.42	7.07	1280

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TABLE 3. DDT METABOLITES IN LARGEMOUTH BASS COLLECTED FROM THE TOMBIGBEE RIVER AT MCINTOSH, ALABAMA, NOVEMBER 11, 1990.

SAMPLE #	DDT (ug/g)	DDD (ug/g)	DDE (ug/g)	TOTAL DDT (ug/g)	WEIGHT (grams)
09-Carcass	0.48	0.94	3.80	5.22	1667
09-Filet	0.06	0.06	0.56	0.23	66
09-Total	0.46	0.91	3.66	5.03	1733
10-Carcass	7.40	11.00	18.90	37.30	464
10-Filet	0.38	0.49	1.35	2.22	40
10-Total	6.84	10.17	17.51	34.52	504
11-Carcass	0.36	0.48	1.92	2.76	346
11-Filet	0.05	0.04	0.15	0.24	40
11-Total	0.33	0.44	1.74	2.51	386
12-Carcass	0.24	0.28	2.28	2.80	126
12-Filet	0.06	0.03	0.21	0.30	24
12-Total	0.21	0.24	1.95	2.40	150
13-Carcass	0.57	0.66	7.80	9.03	150
13-Filet	0.12	0.16	0.74	1.02	26
13-Total	0.50	0.59	6.76	7.85	176
14-Carcass	2.43	3.70	15.30	21.43	160
14-Filet	0.17	0.16	0.86	0.72	24
14-Total	2.14	3.24	13.42	18.80	184
15-Carcass	0.23	0.11	0.74	1.08	144
15-Filet	0.21	0.10	0.96	1.27	36
15-Total	0.23	0.12	0.78	1.13	180

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TABLE 4. DDT HOMOLOGS IN LARGEMOUTH BASS COLLECTED FROM THE TOMBIGBEE RIVER AT MCINTOSH, ALABAMA. NOVEMBER 11, 1990

SAMPLE #	DDT		DDD		DDE	
	o,p	p,p'	o,p'	p,p'	o,p'	p,p'
01-Carcass	1.20	0.75	0.90	1.70	5.10	4.90
01-Filet	0.08	0.09	0.02	0.10	0.23	0.35
02-Carcass	0.29	0.16	0.31	0.31	1.00	1.60
02-Filet	0.02	0.01	0.02	0.01	0.29	0.02
03-Carcass	1.0	0.59	0.75	1.30	2.50	3.70
03-Filet	0.15	0.08	0.08	0.12	0.53	0.79
04-Carcass	0.49	0.27	0.51	0.75	1.60	2.10
04-Filet	0.05	0.02	0.03	0.04	0.10	0.01
05-Carcass	0.54	0.19	1.00	1.00	1.90	1.30
05-Filet	0.03	0.01	0.04	0.04	0.06	0.02
06-Carcass	0.21	0.04	0.01	0.03	0.02	0.25
06-Filet	0.01	0.01	ND	ND	ND	0.02
07-Carcass	0.51	0.25	0.39	0.52	1.30	1.90
07-Filet	0.02	0.02	0.01	0.01	0.07	0.15
08-Carcass	0.79	0.73	1.40	2.10	2.30	0.27
08-Filet	0.08	0.05	0.07	0.10	0.25	0.35
09-Carcass	0.13	0.35	0.17	0.77	1.10	2.70
09-Filet	0.02	0.03	0.01	0.04	0.02	0.03
10-Carcass	4.3	3.1	3.30	7.70	6.90	12.00
10-Filet	0.21	0.17	0.16	0.33	0.47	0.88
11-Carcass	0.17	0.19	0.15	0.33	0.72	1.20
11-Filet	0.02	0.02	0.02	0.02	0.03	0.12

TABLE 4. DDT HOMOLOGS IN LARGEMOUTH BASS COLLECTED FROM THE TOMBIGBEE RIVER AT MCINTOSH, ALABAMA. NOVEMBER 11, 1990.

SAMPLE #	DDT		DDD		DDE	
	O.P′	P,P′	O,P′	P,P′	O,P′	P,P′
12-Carcass	0.12	0.12	0.17	0.11	0.58	1.70
12-Filet	0.03	0.02	0.01	0.01	0.05	0.16
13-Carcass	0.45	0.12	0.29	0.37	2.10	5.70
13-Filet	0.09	0.02	0.07	0.08	0.33	0.41
14-Carcass	1.80	0.63	1.30	2.40	8.40	6.90
14-Filet	0.13	0.04	0.07	0.09	0.39	0.47
15-Carcass	0.11	0.12	0.03	0.07	0.29	0.46
15-Filet	0.10	0.11	0.03	0.07	0.25	0.71

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FIGURES

Fig. 1 Geometric Mean Concentrations of DDT for National Contaminant Biomonitoring Stations Exceeding The 90TH Percentile Concentration, 1984.

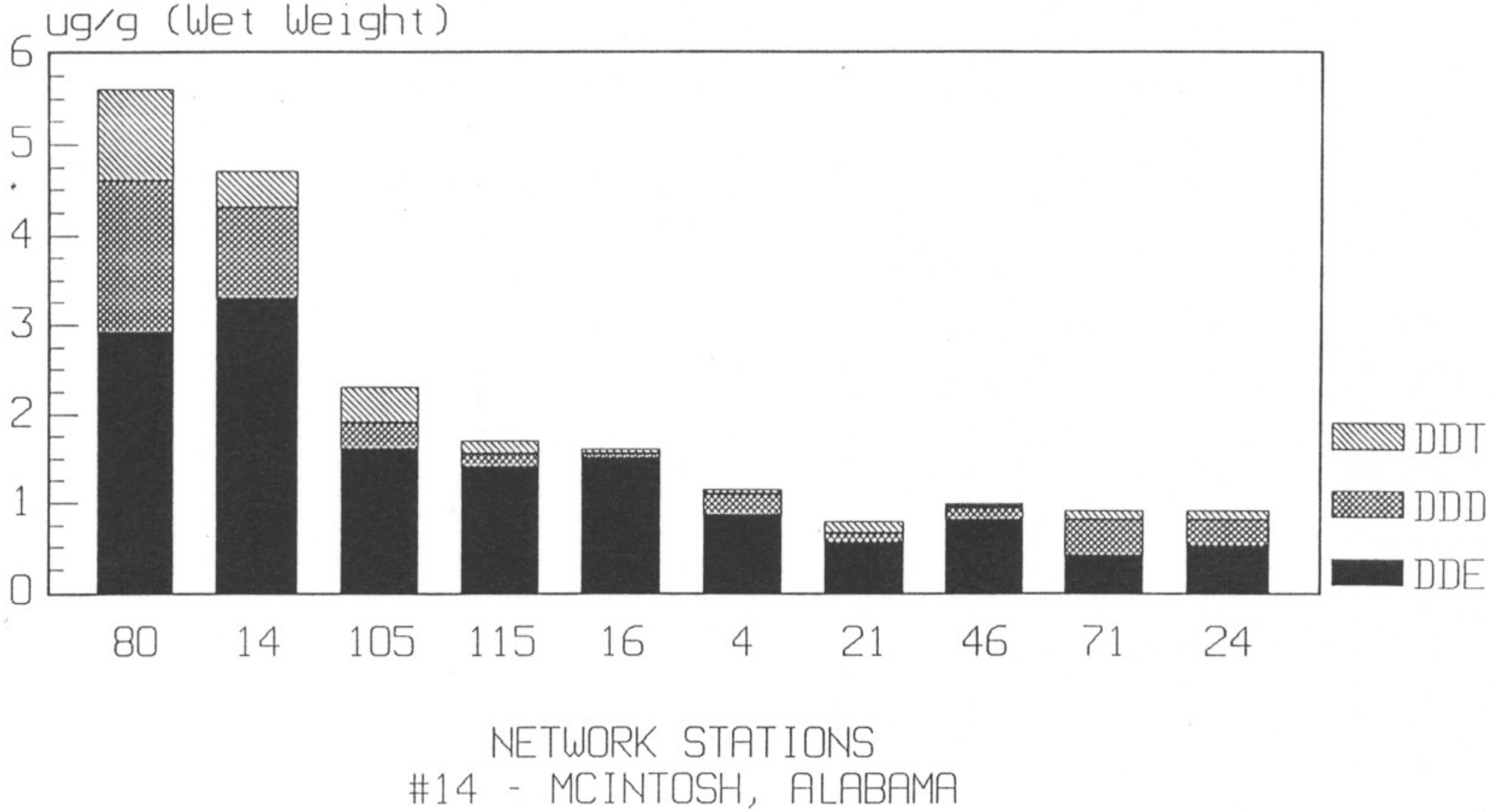


FIG. 2 GEOMETRIC MEAN CONCENTRATIONS OF TOTAL MERCURY FOR NATIONAL CONTAMINANT BIOMONITORING STATIONS EXCEEDING THE 90TH PERCENTILE CONCENTRATION, 1984.

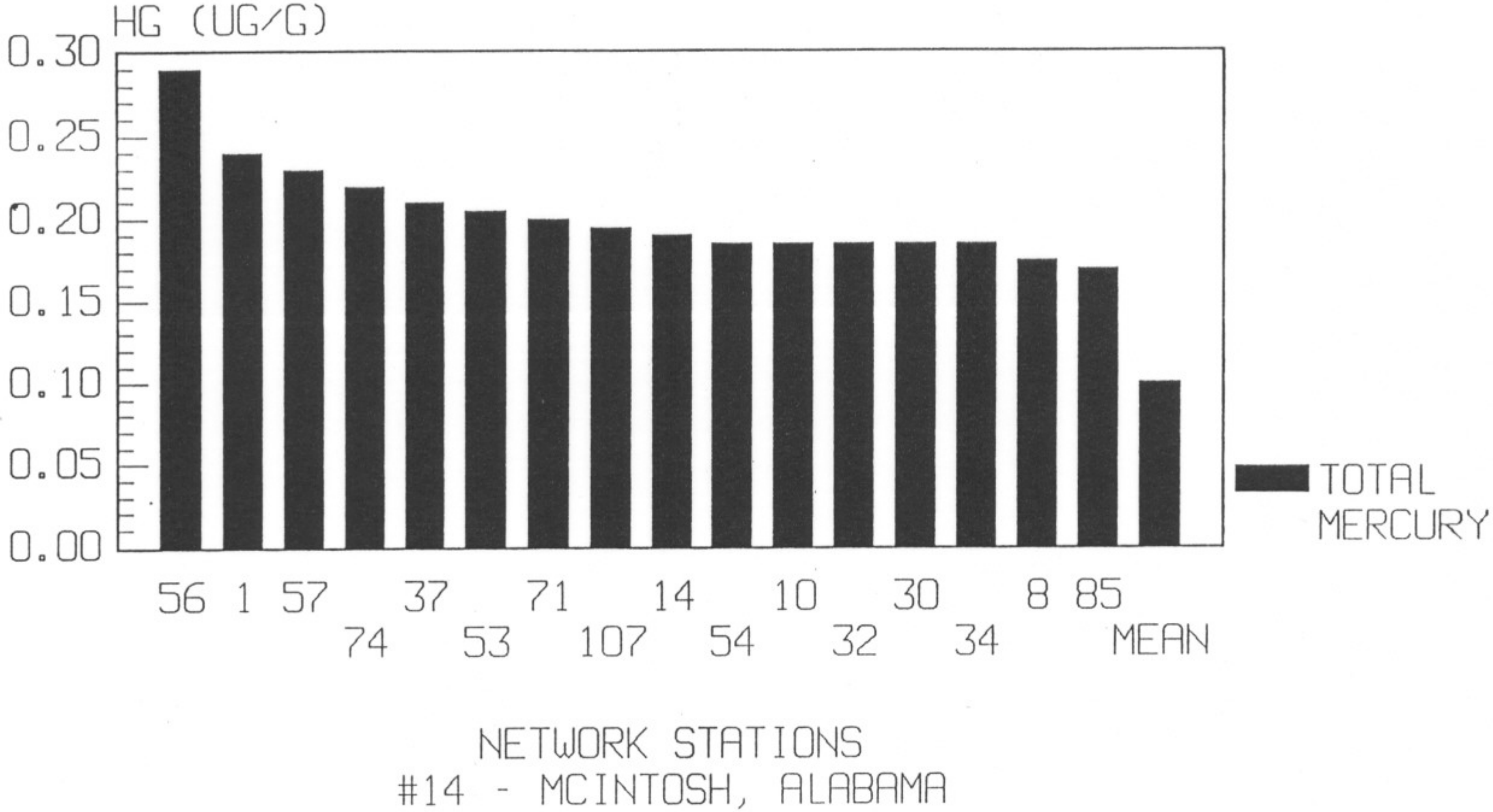


Fig.3 Total Mercury in Composite Fish And Sediment Samples From The Tombigbee River. August 1989

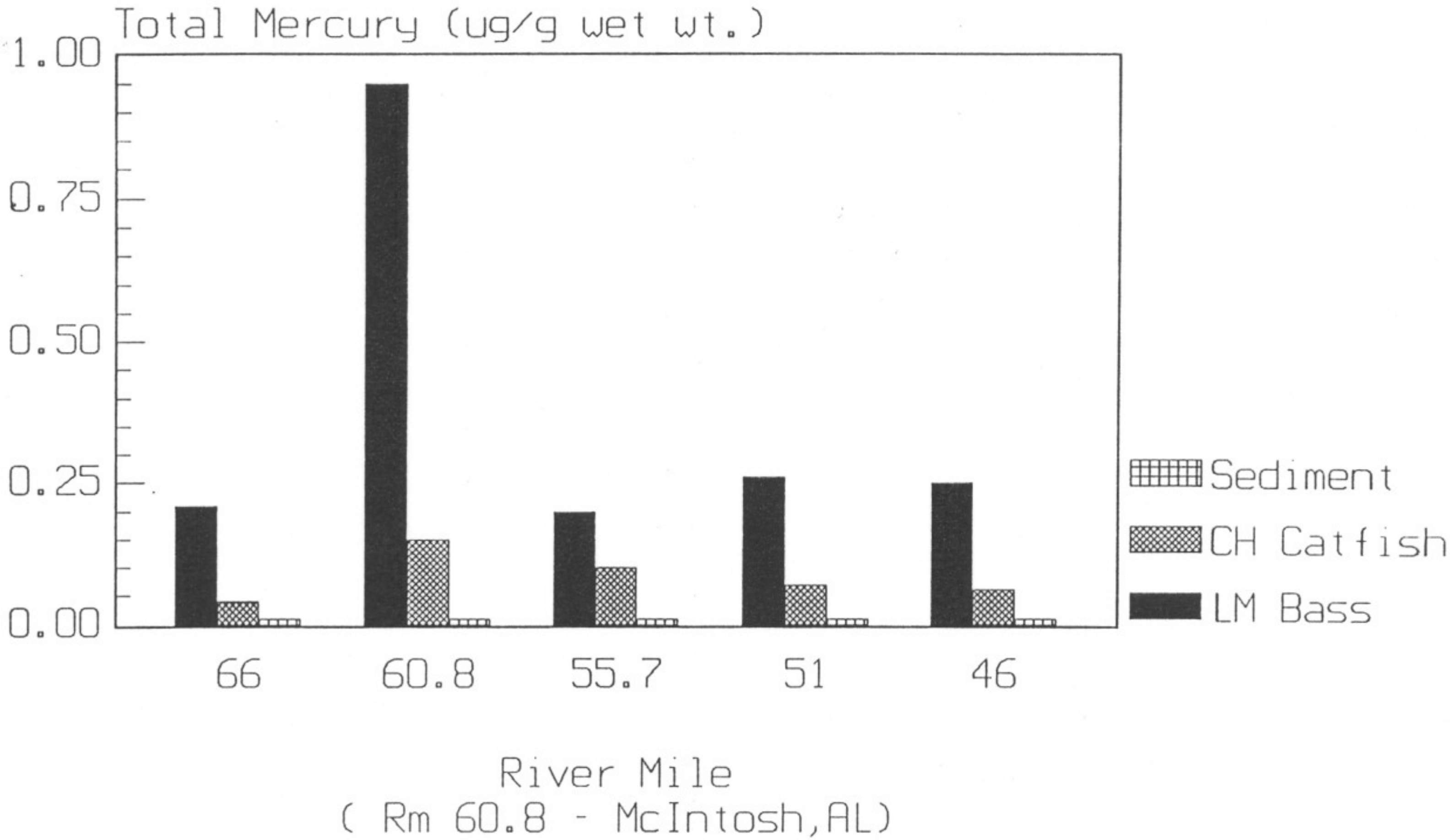
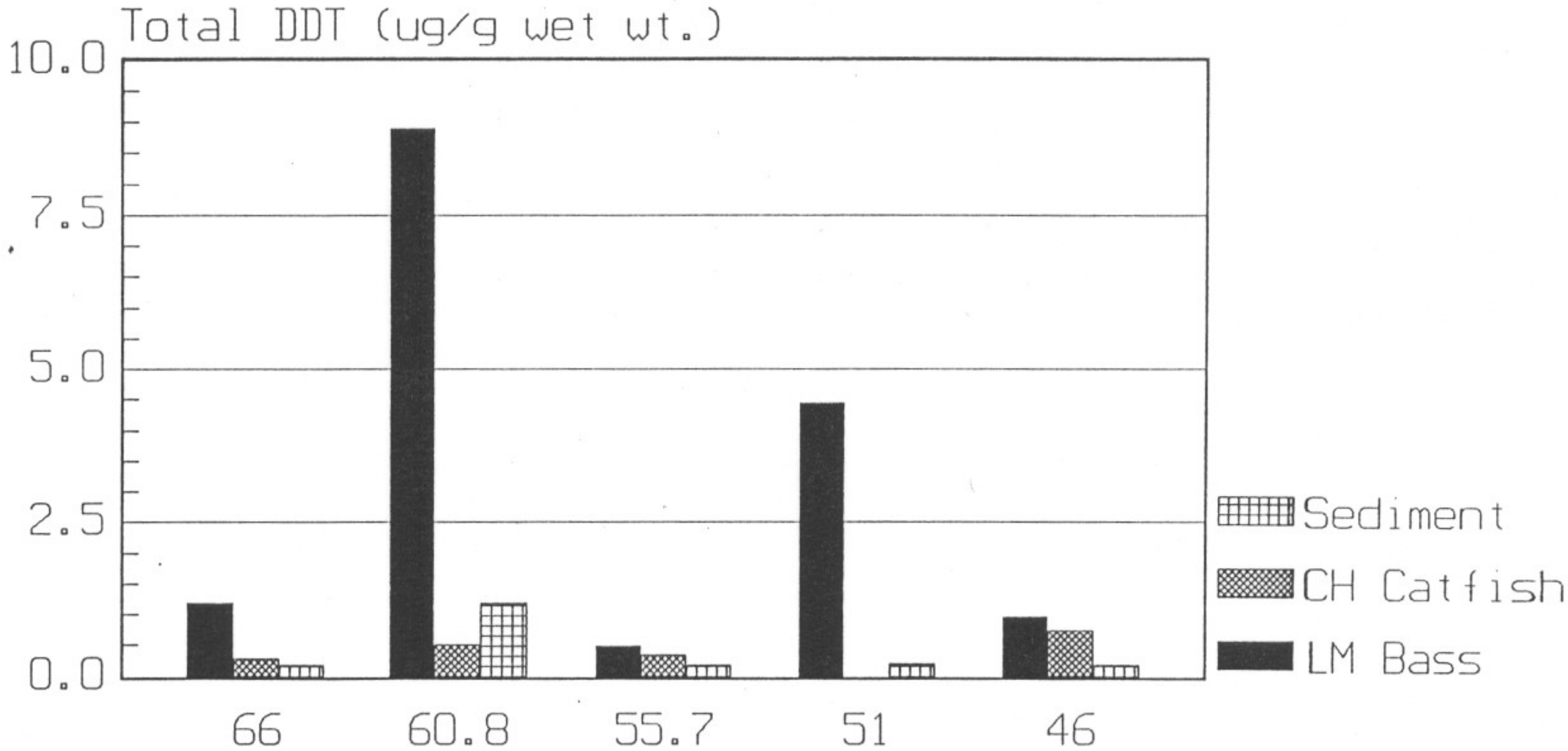


Fig. 4 Total DDT in Composite Fish And Sediment Samples From The Tombigbee River. August 1989



River Miles
(Rm 60.8 - McIntosh, Alabama)

Fig.5 Total Mercury in 15 Largemouth Bass Collected In The Tombigbee River At McIntosh, AL. November 1990. Filet and Whole Body less Filet

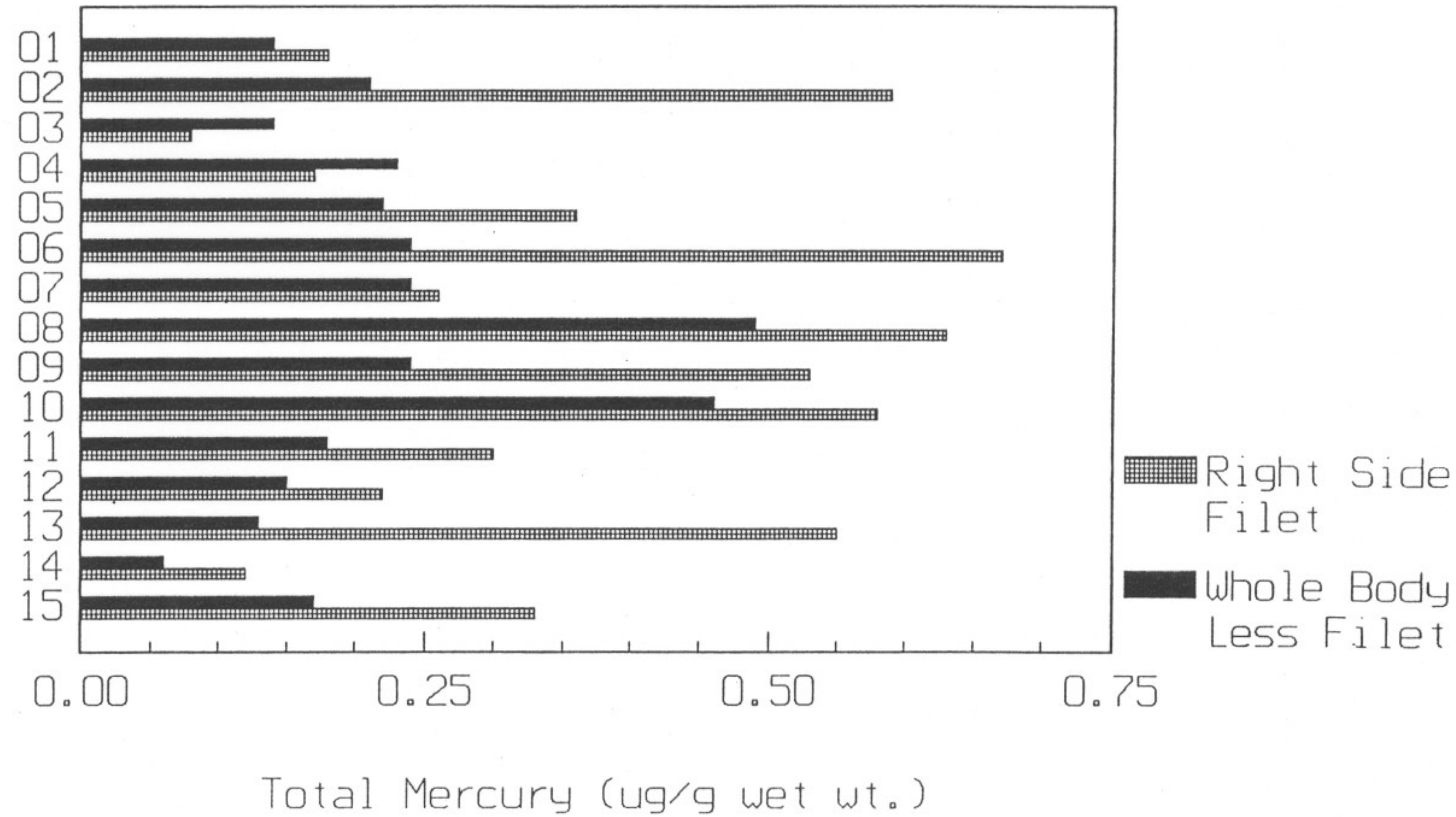


Fig. 6 Total Hg in 15 Largemouth Bass
Collected in the Tombigbee River at
McIntosh,AL. November 1990.

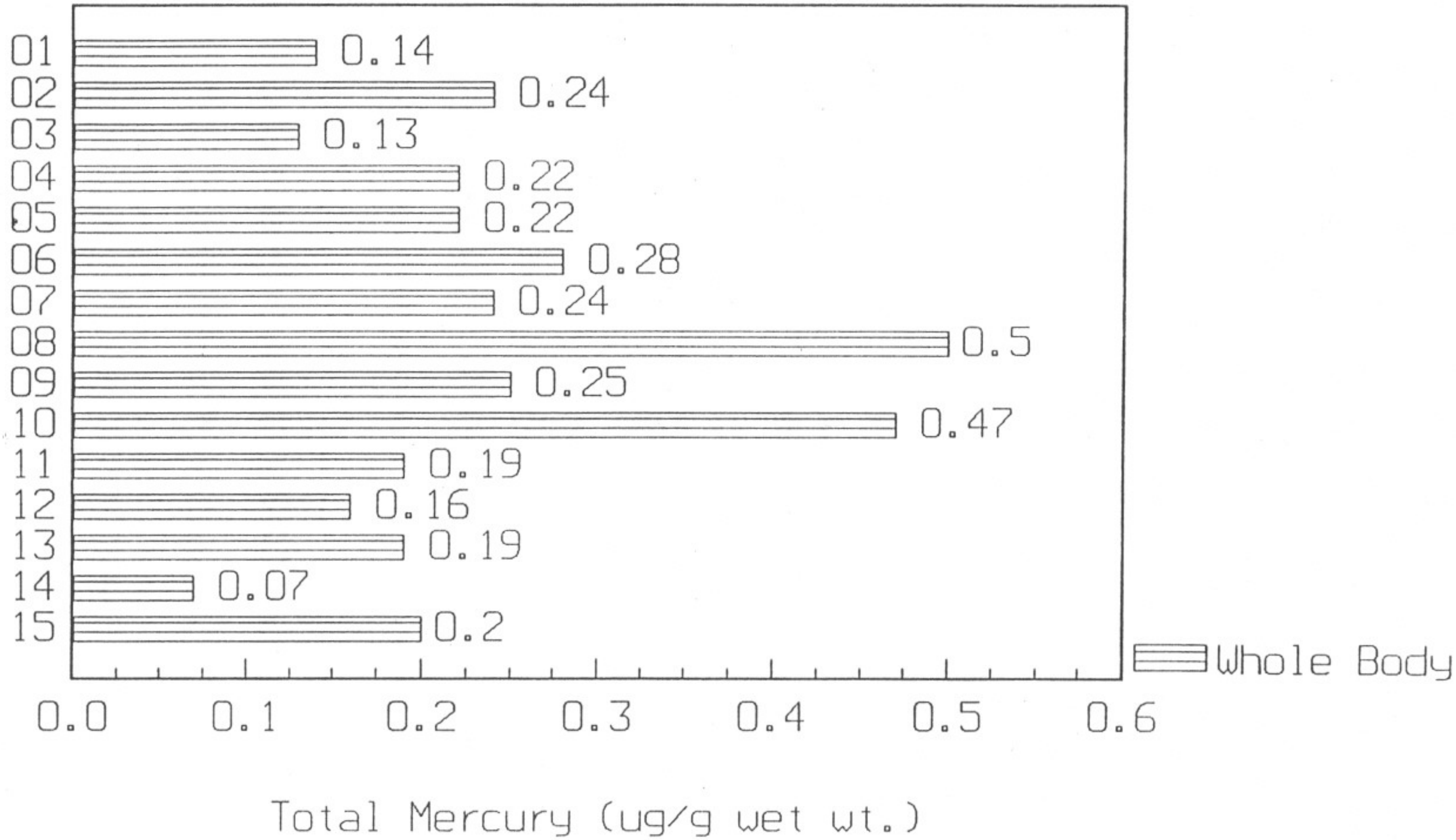


Fig. 7 Relative Concentration of Total Mercury in Filet and Carcass For Largemouth Bass. Tombigbee River at McIntosh, AL Nov. 1990

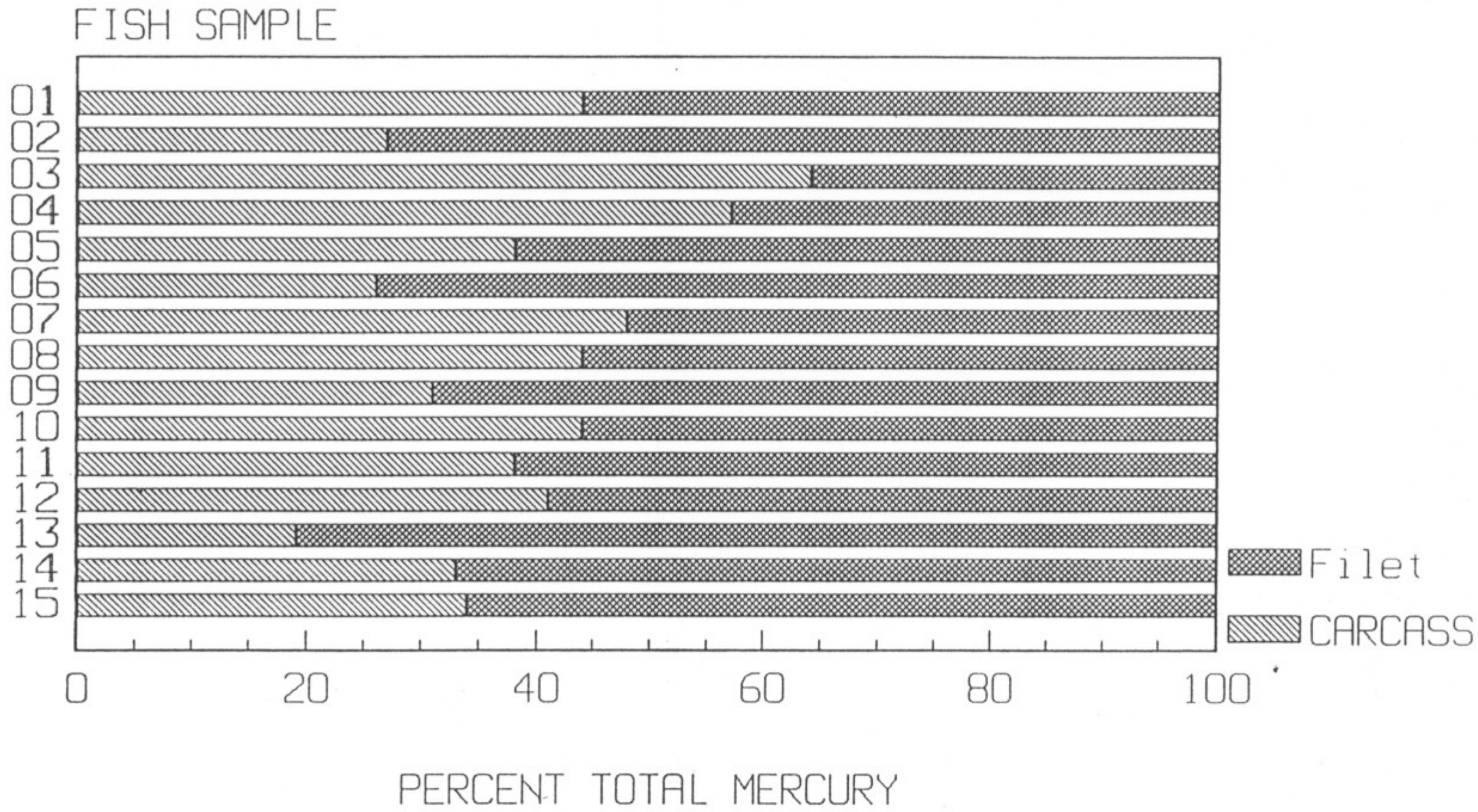


Fig. 8 Total DDT In 15 Largemouth Bass Collected in the Tombigbee River at McIntosh, AL. Total Body Burden. Nov. 11, 1990.

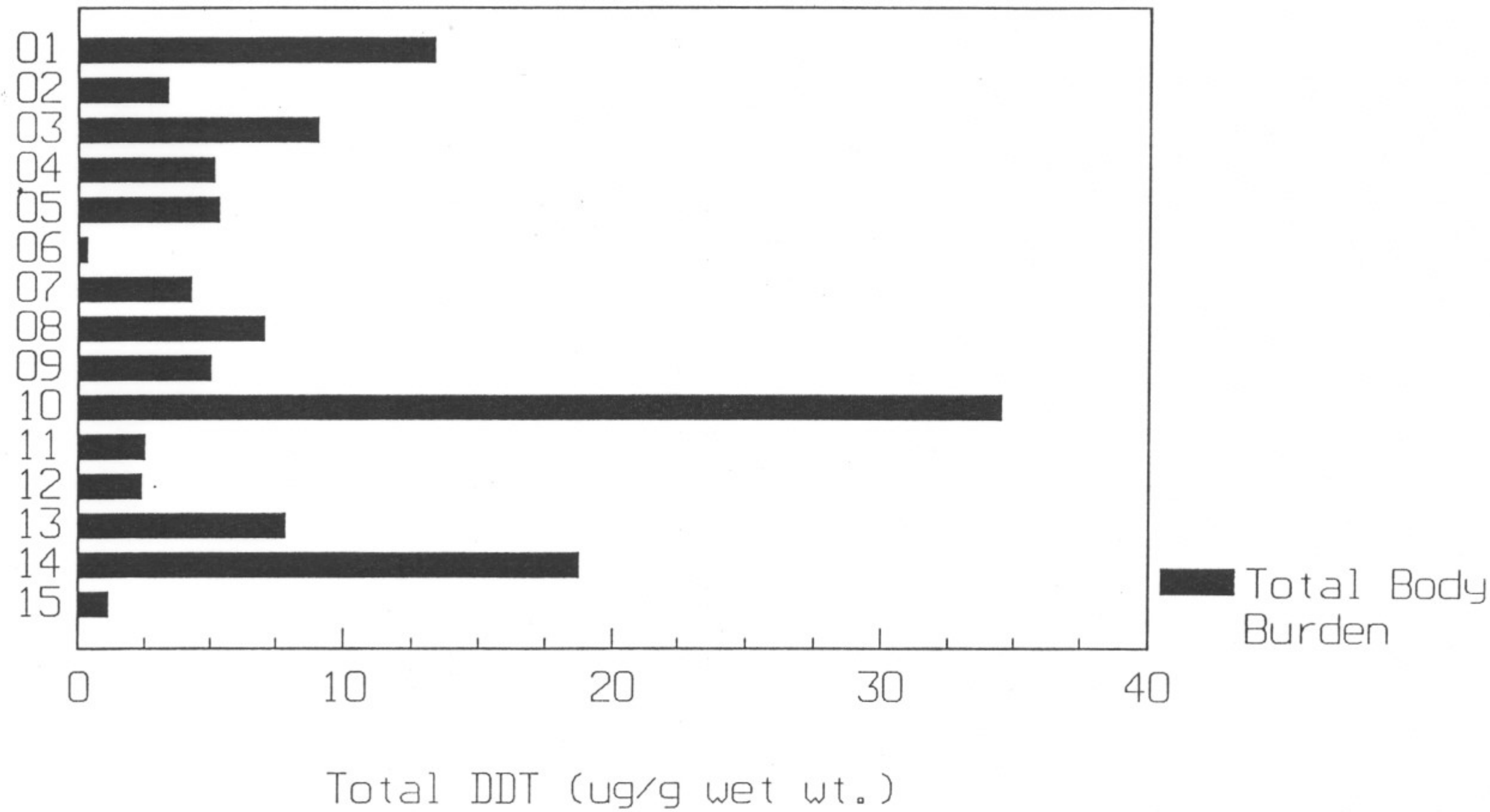


Fig. 9 Total DDT In 15 Largemouth Bass Collected In The Tombigbee River At McIntosh, AL on November 11, 1990

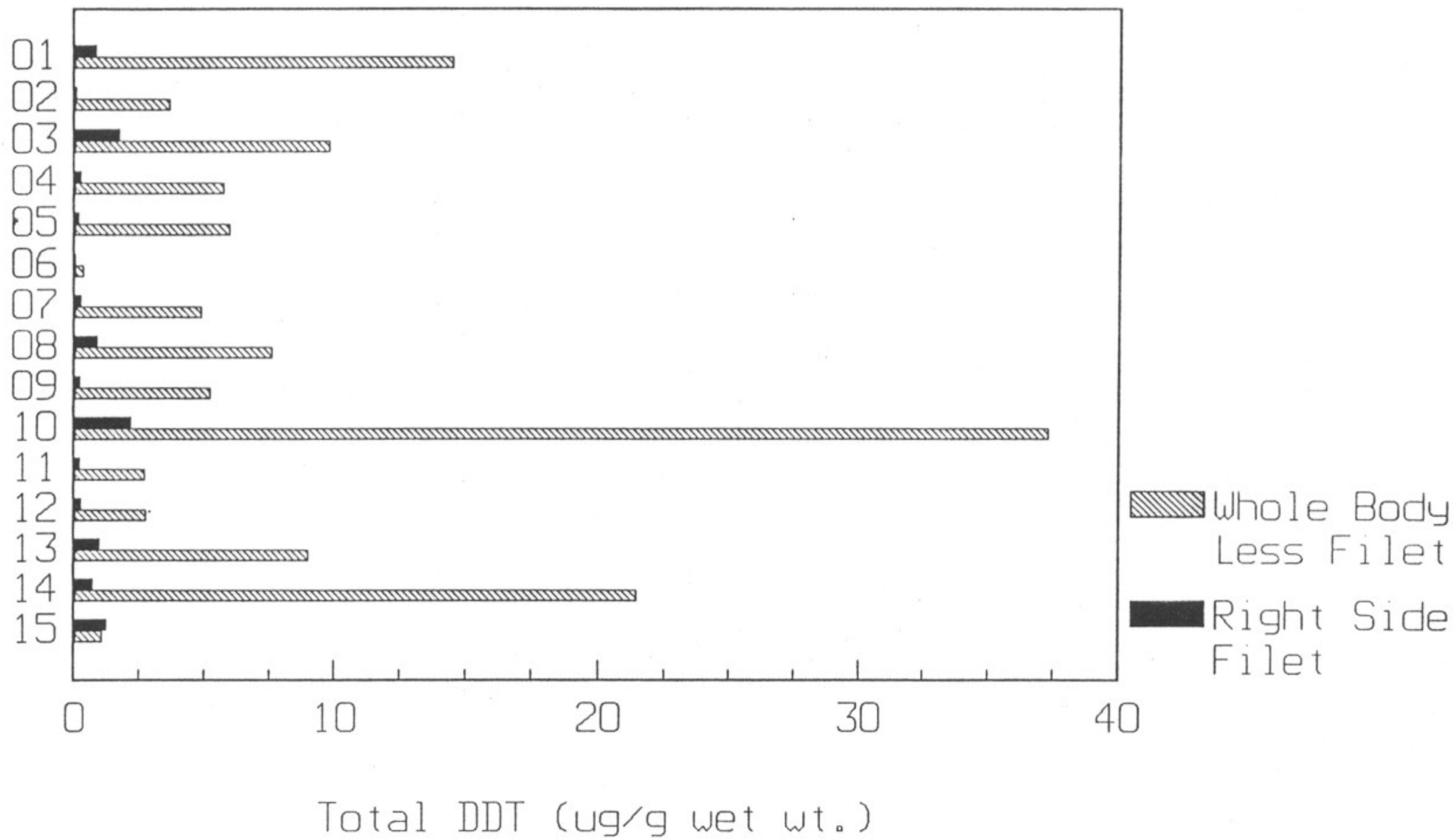


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Fig. 10. Relative Concentrations of Total DDT In Largemouth Bass. Tombigbee River, McIntosh, AL November 1990

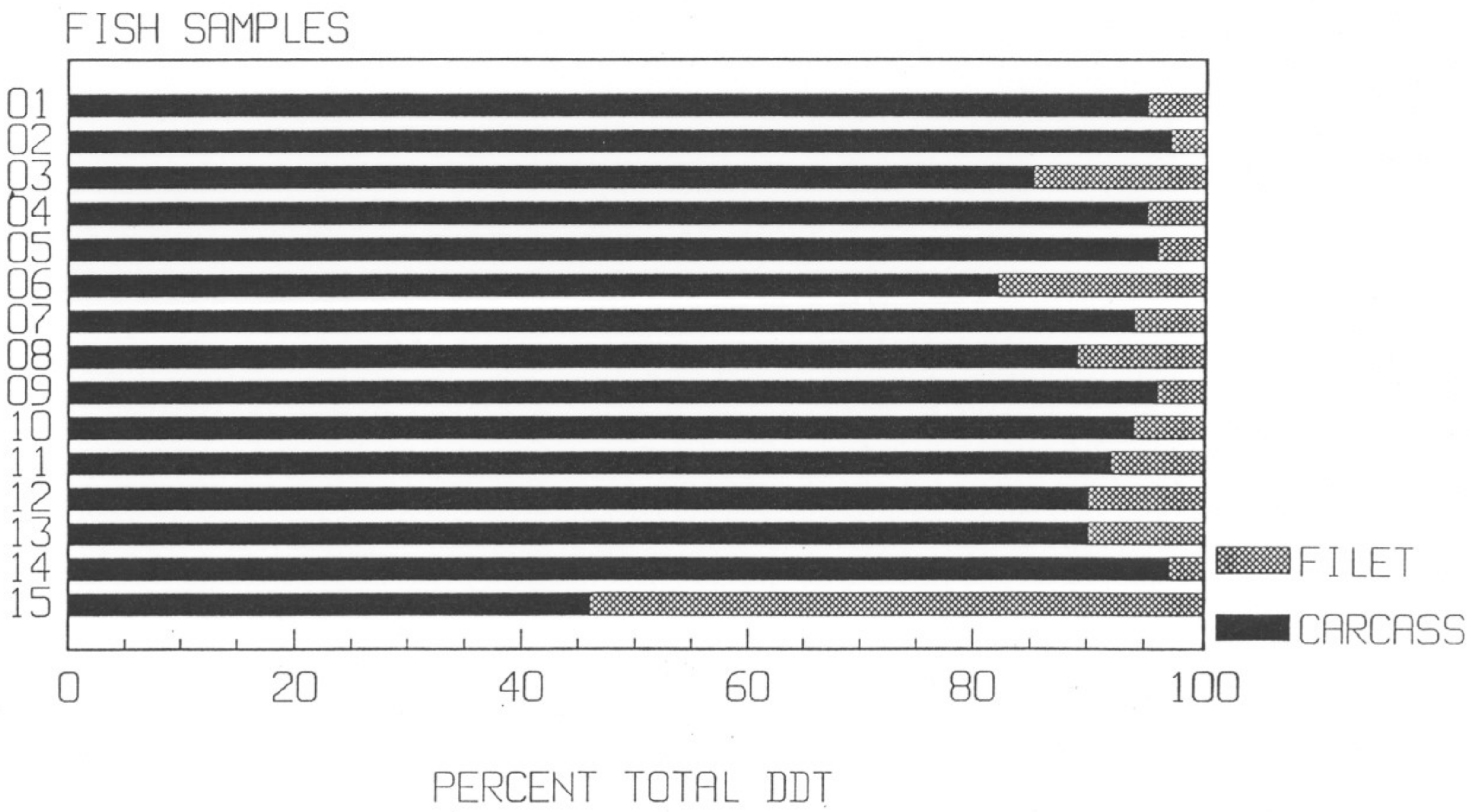

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Fig. 11 DDT Metabolites in Largemouth Bass, Whole Body (Less Right Side Filet), Tombigbee River Near McIntosh, AL.
November 11, 1990

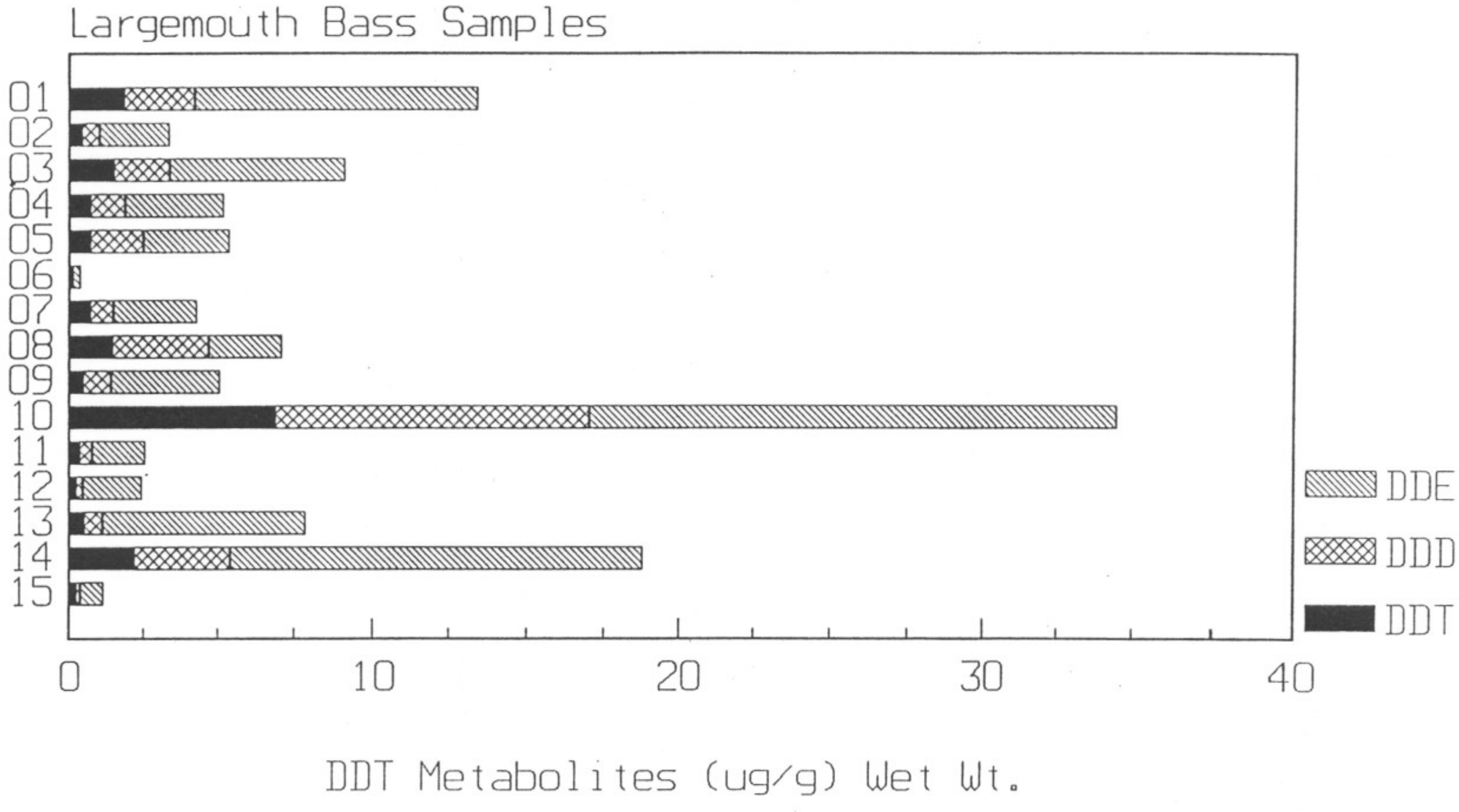


Fig. 12 DDT Metabolites In Largemouth Bass, Filet Samples, Collected In The Tombigbee River Near McIntosh, AL. November 11, 1990

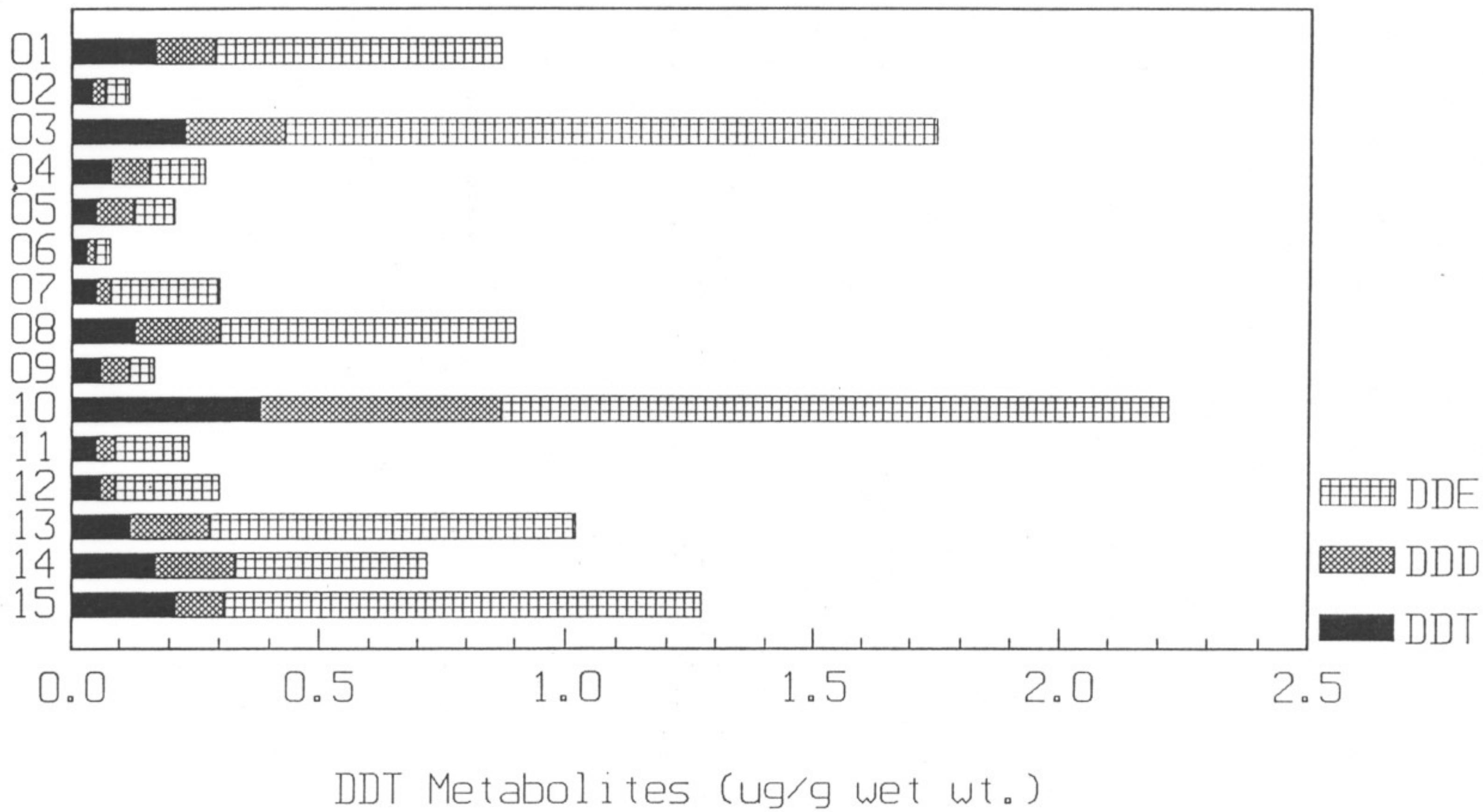


Fig. 13 DDT Metabolites In Largemouth Bass Whole Body (Less Right Side Filet) Samples Collected In The Tombigbee River Near McIntosh, AL. November 11, 1990

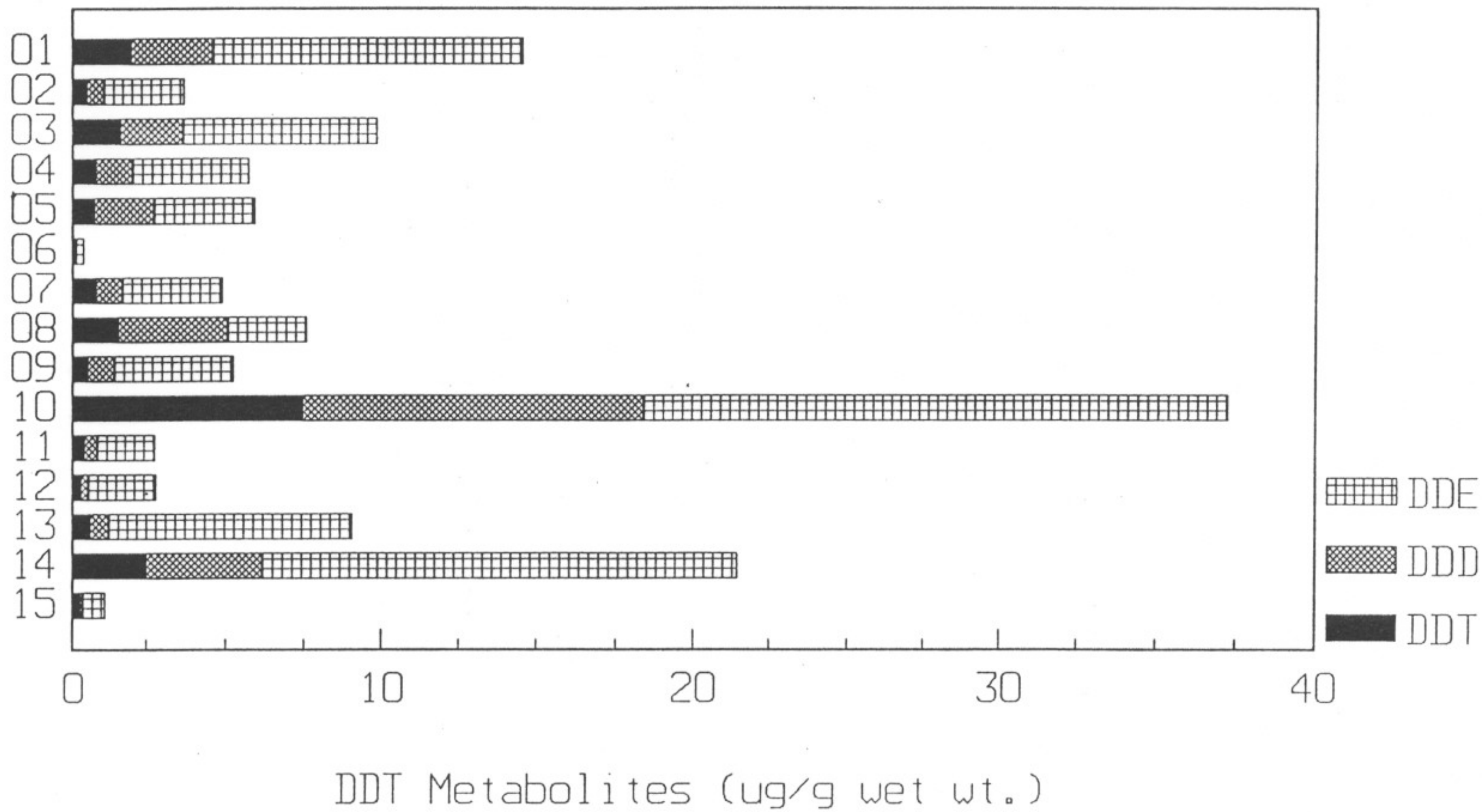
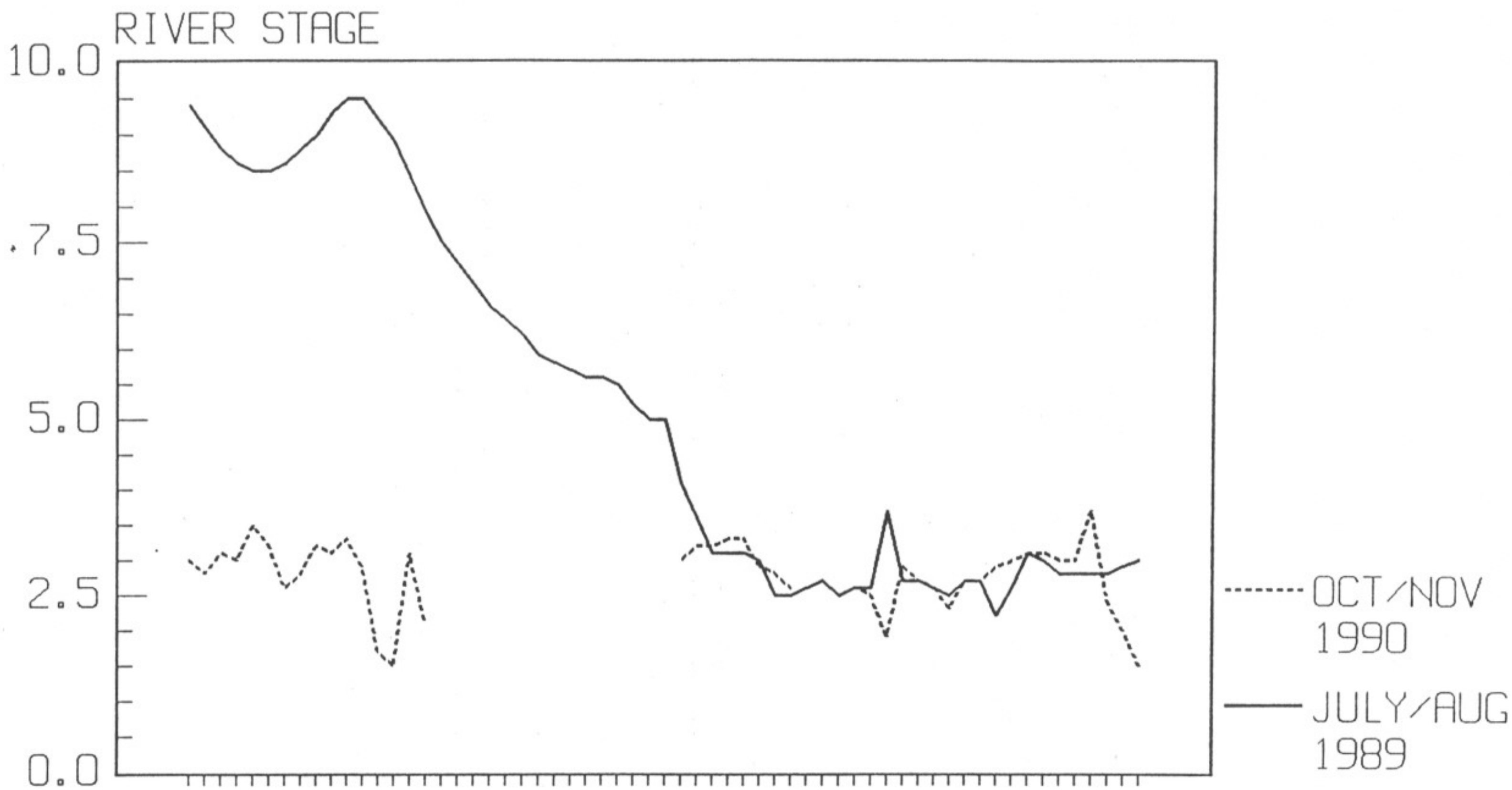


FIG. 14 TOMBIGBEE RIVER STAGES
BERRY STEAM PLANT. JULY/AUG 1989 AND
OCT./NOV. 1990



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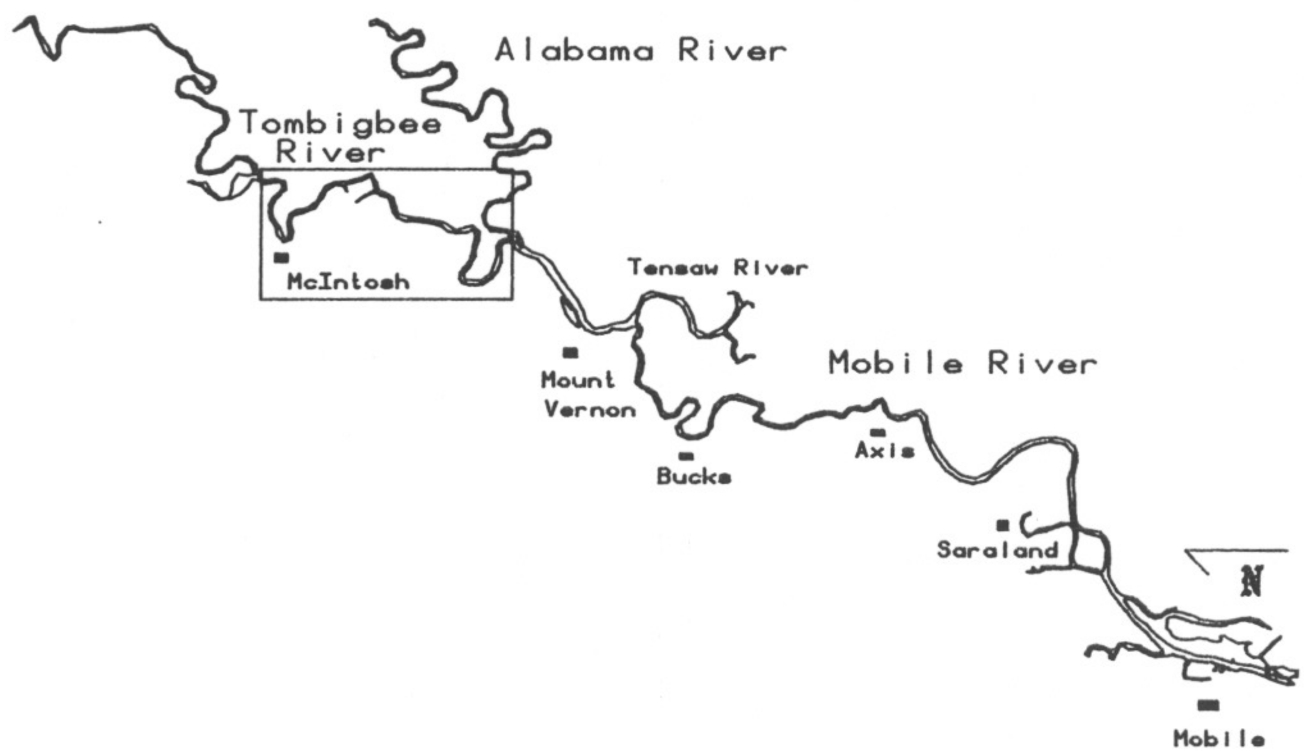
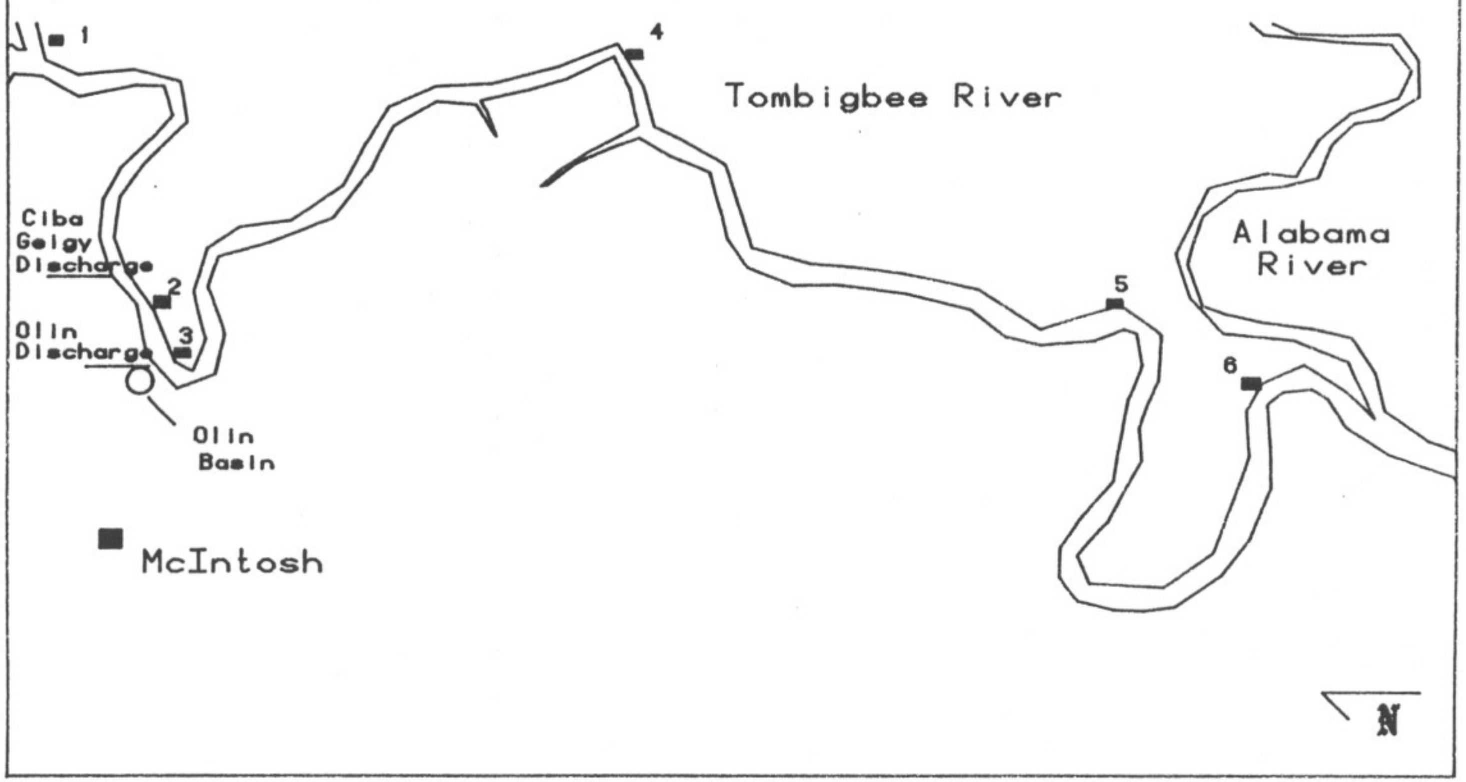
MAPS

Map 1
Study Area



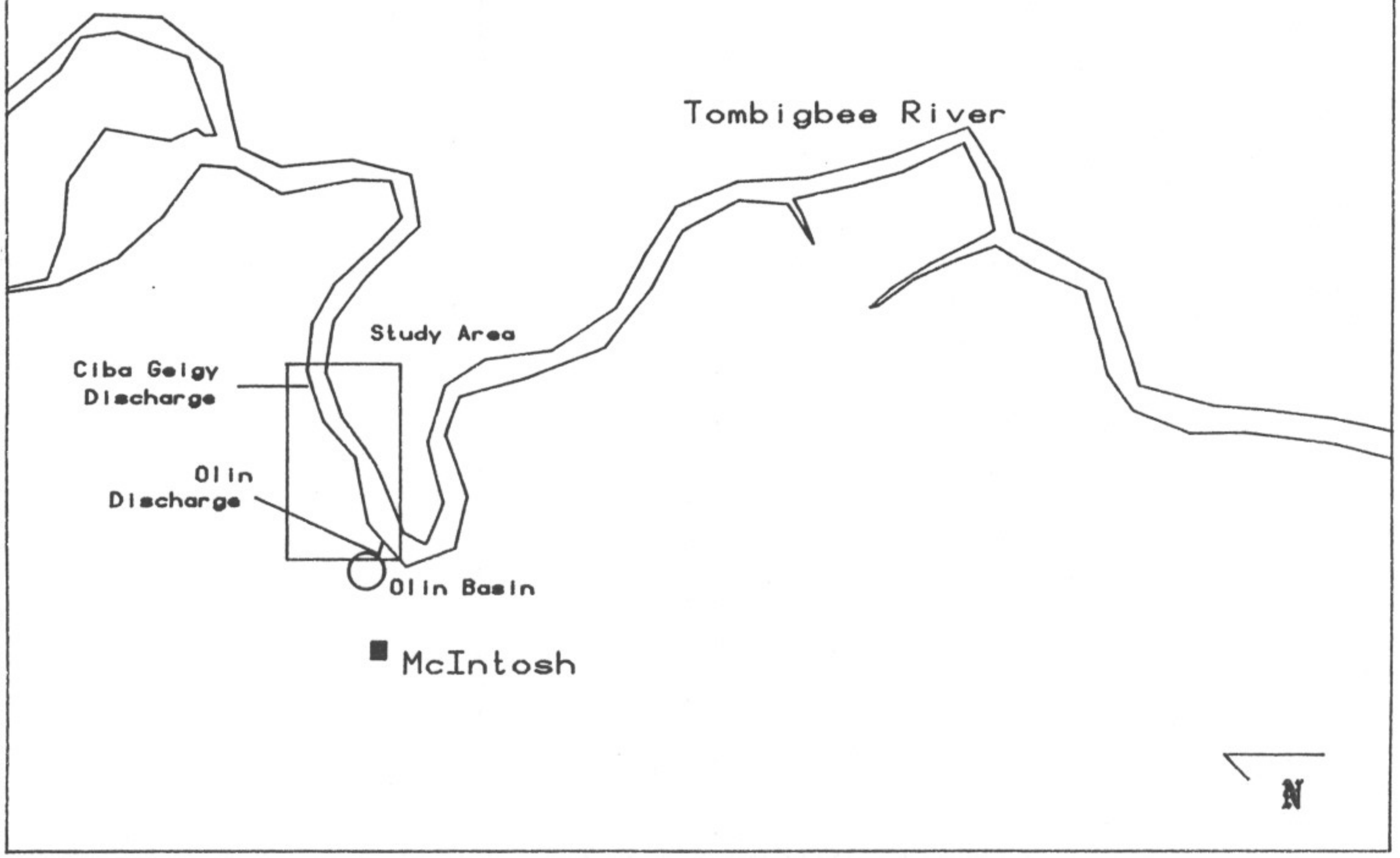
Map 2

1988 Study - Sampling Stations



Map 3

1990 Study - Fish Collection Area



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R4 Daphne

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entered OLDFWS ProCite

Date: May 22, 1990

To: Larry E. Goldman, Field Supervisor, FWE, Daphne, AL

From: Ernest H. Douglas, Fish and Wildlife Biologist

Subj: Survey of Mercury Levels in Fish and Sediments collected From the Lower Tombigbee River during the Summer of 1989

Prop. title

Attached are the results of mercury analyses of fish and sediment samples collected from the Tombigbee River near the Olin facility discharge at McIntosh, Alabama

The highest concentrations found, 0.95 ug/g wet weight, were in a composite sample of largemouth bass collected near the Olin/Ciba Geigy outfalls at McIntosh. This is significantly greater than any mercury value reported from the National Contaminant Biomonitoring Program (NCBP) for the last year of complied data, 1984. I should point out that this value was from a five fish composite. Composite samples are blended together and a subsample taken for the analysis. As a result the value is an average of the individual fish samples, which means that some of these fish would be expected to have mercury residues higher and some lower than the composite value.

In order to determine specific fish residues and confirm the high mercury concentration found during this investigation, I propose that we conduct a followup study to collect a number of bass samples for individual analyses from the area of the Olin/Ciba Geigy outfalls. In order to assess the potential threat to human consumers I propose that in addition to whole body analyses we also analyze the filets.

If elevated mercury levels are confirmed we should get involved in a more indepth investigation to determine the source of the mercury, pathway through the foodchain, effects on the river biota, and the ability clean up or control the access of mercury to the area environment. If filet residues are found to approach the FDA action level, 1.0 ppm, we should support State and Federal public health agencies in assessing threats to the local population.

Catfish were found with considerably lower mercury levels than bass. Concentrations were frequently below the mean of the NCBP data and were never outside the range reported from the network. Sediment concentrations were even lower, never being found much above the level of analytical detection at any of the stations.

Based on this data it would appear that there is a biologically available source of mercury in the Tombigbee River in the vicinity of McIntosh, Alabama. The low residue levels in river sediments do not indicate this medium as being the principal source to the aquatic biota. With the highest concentrations found in largemouth bass, it would appear that mercury is being biomagnified through the food chain. The question is the source of initial availability to the primary consumers.

An area that was not sampled during this investigation was the Olin Basin. The fact that this lake once received the direct discharge from Olin and is in contact with local groundwater makes it suspect to mercury contamination. Combine this with the fact that the lake is in contact with the river and one can immediately appreciate the importance of investigating the Olin Basin. Such an assessment of mercury uptake within the various mediums in the basin has been recommended by the Service to the EPA for incorporation into the Remedial Investigation to be carried out by Olin Corporation.

Don Schultz has been contacted and has approved field station spending for the additional analysis of largemouth bass samples. We will be returning to the river this summer to collect the needed samples.

Attachment

MAY 22 1990

AN EVALUATION OF MERCURY CONTAMINATION IN THE TOMBIGBEE RIVER NEAR AN INDUSTRY WITH A HISTORY OF MERCURY DISCHARGES

Prepared by; Fish and Wildlife Enhancement Office
U.S. Fish and Wildlife Service
Daphne, Alabama

BACKGROUND

In 1952 Olin Corporation began operation on the Tombigbee River at McIntosh, Washington County, Alabama, with the manufacturer of chlorine and caustic soda using the mercury cell process.

A principal disadvantage to the mercury cell process is the discharge of mercury with the brine water as a waste product. Prior to 1981 brine sludge containing mercury was discharged to containment ponds where the solids were allowed to settle out. Analyses of these sludge samples were found to contain mercury at levels ranging from 111-498 ppm. As a result of leachate from these ponds, mercury as well as a number of other materials entered and contaminated the area groundwater. It is also probable that mercury was a component of the company's wastewater discharge and contaminated area surface waters.

Groundwater in this area generally flows southward from the north property boundary. It then splits into two components, eastward and westward. The eastward component discharges to the Tombigbee River, which is approximately 1 mile east of the plant. The westward component discharges into the Bilbo Creek drainage approximately 3 miles southwest of the Olin facility.

Until the mid 1970's Olin discharged their effluent directly into a 100 acre lake, known as the Olin Basin, located between the plant and the river. It was later redirected into a canal that connects the basin with the river. During low river stages this canal is the only link with the river. However, during high water the river and the basin interact at a number of points.

The Tombigbee River receives area groundwater as well as effluent, via the Olin Basin, from the Olin facility. Since these waters are known to be contaminated with mercury, concern has risen as to the status of the river. In order to address these concerns the U.S. Fish and Wildlife Service's Daphne Field Office surveyed the lower Tombigbee River during the summer of 1989 to determine mercury uptake levels in sediments and fish.

STUDY OBJECTIVES

The study was designed to determine if mercury contaminated ground and surface waters associated with past activities at the Olin facility have impacted the Tombigbee River. Sediment samples were collected from the river above and below the plants discharge to determine areas of impact and the extent of downstream contamination. It was anticipated that sediments would provide a good historical record of mercury discharges into the river. Two species of fish, largemouth bass and channel catfish, were collected to determine if mercury found in the river sediments was bioavailable to endemic river biota and which of these species has the greatest affinity to concentrate mercury.

STUDY DESIGN

Six stations were established in the Tombigbee River above and below the Olin outfall, Fig.1. The first station was located 5 miles upstream of the Olin discharge point as a baseline station to establish area background levels. Station locations proceeded downstream at an approximate 5 river mile separation with the last station 1.0 miles upstream from the mouth of the Alabama River.

Composite sediment samples were taken from the right and left banks at each station with the exception of stations two and three where only right bank samples were collected. Particular emphasis was placed on collecting only sediments with high organic content. Sand or gravel bottom material was avoided to the point that if that was the only substrate available the sample was not taken.

A five fish composite of largemouth bass and channel catfish was to be collected at each station. Priority was given to the more mature adult individuals with a longer resident time in the river. Analyses were run on whole fish samples to provide a better assessment of uptake and availability through the foodchain.

RESULTS

Mercury results from fish and sediment samples were reported as ug/g dry weight. In order to compare these values with the historical data base, the results have been converted to wet weight values. Therefore, all mercury levels in fish discussed in this report are wet weight values. Because of the low concentrations of mercury found in the sediment samples, usually near detection limits, the values were not converted and remain as ug/g dry weight.

A electrofishing unit was used to collect the fish samples which is quite effective in the upper water column but less so on the bottom in deeper waters. As a result, the largemouth bass samples were easily collected at all stations whereas channel catfish were more difficult.

The highest mercury residue levels reported, 0.95 ug/g, were found in largemouth bass at station #2 located immediately upstream of the Olin discharge. Channel catfish collected from this same site had much lower levels, 0.15 ug/g, than the bass but were highest reported for catfish during the study. This correlation in relative concentrations remained throughout the study with largemouth bass exhibiting considerably higher mercury levels than channel catfish.

Mercury levels in bass collected at the remaining stations were relatively consistent ranging from 0.20 ug/g at station #4 to 0.26 ug/g at station #5. The site upstream of the Olin discharge, station #1, reported a value in bass samples of 0.21 ug/g, near the low end of the range. Although catfish were found with lower values they did occur throughout a somewhat wider range, from 0.04 ug/g at station #1 to 0.15 ug/g at statio #2.

The U.S. Fish and Wildlife Service operates the National Contaminant Biomonitoring Program (NCBP)with over 120 stations nationwide. For the most recent year of compiled data, 1984, 29 stations collected largemouth bass for mercury analyses. The values ranged from 0.02 to 0.37 ug/g with a mean of 0.14 ug/g. All of the lower Tombigbee River bass samples exceeded the national network mean with values occurring in the upper half of the range. The concentration found at station #2 greatly surpassed any value for all species analyzed from the network during 1984.

Channel catfish collected for the NCBP during 1984 ranged in mercury levels from 0.02 to 0.21 ug/g with a mean of 0.07 ug/g. Three of the lower Tombigbee River stations were found with mercury levels in catfish equal to or greater than the national network mean. The highest value, 0.15 ug/g, at station #2 falls near the mid point of the range.

Mercury loading in the river sediments was found to be surprising low relative to the elevated levels found in fish. Values ranged from below the detection limit (0.02 ug/g) at the upstream stations #1 and #2 to 0.07 ug/g at the downstream stations #5 and #6. The variation between the right and left bank at station #6, 0.02 ug/g - 0.07 ug/g, was equal to that found between all the stations in the study area. There appeared to be no significant difference between sediment mercury levels at any of the sampled stations. Although an attempt was made to collect sediments of similar composition, the variation in mercury levels noted between collection sites could well have been due to differences in organic content and the resultant ability to attract contaminants rather than effects from mercury loading.

CONCLUSIONS

1. There was a considerable difference in the ability of largemouth bass and channel catfish to concentrate mercury, with largemouth bass being by far the more efficient. Based on the excellent ability of mercury to biomagnify through the foodchain these higher levels in bass could be the result of their being a top predator and feeding on a higher trophic level food source.

2. Mercury concentrations in largemouth bass were found to be consistently above the mean reported in the 1984 NCBP survey. The level in bass at the Olin/Ciba Geigy outfalls

was almost threefold greater than the overall highest value found during the survey.

3. Mercury levels in channel catfish were near the mean values reported from the 1984 NCBP. Only the station near the Olin/Ciba-Geigy outfall was somewhat higher than the mean. There were no stations with mercury levels in catfish that exceeded the range of values for that species collected during the 1984 NCBP.

4. There is no indication that lower Tombigbee River sediments collected within this study area function as a significant sink for mercury. Concentrations were seldom much above analytical detection limits.

RECOMMENDATIONS

The data collected during this study indicate that top predator species, i.e., largemouth bass, are effectively concentrating mercury in the lower Tombigbee River from a yet to be determined source. A site of concern appears to be in the area of the Olin/Ciba-Geigy outfalls. As a minimum, additional bass samples should be collected near these outfalls and analyzed separately for mercury. If this high value can be duplicated a comprehensive investigation should be carried out to determine the source, quantitate the amount, and, if possible, control the access of mercury to the river.

TABLE 1.
MERCURY LEVELS IN COMPOSITE FISH AND SEDIMENT SAMPLES COLLECTED FROM THE LOWER TOMBIGBEE RIVER DURING AUGUST AND SEPTEMBER, 1989

SAMPLE NO.	MEDIUM	MERCURY (ug/g) DRY WT	WET WT
STATION NO 1 - RIVER MILE 66			
DA89-5-1	Largemouth bass, composite (5)	.864	.21
DA89-5-2	Channel catfish. composite (2)	.14	.04
DA89-5-3	Sediment, composite - Rt bank	.03	
DA89-5-4	Sediment, composite - Lt bank	.02	
STATION NO 2 - RIVER MILE 60.8			
DA89-5-5	Largemouth bass, composite (5)	3.8	.95
DA89-5-6	Channel catfish, composite (2)	.737	.15
DA89-5-7	Sediment, composite - Rt bank	.01	
STATION NO 3 - RIVER MILE 60.5			
DA89-5-9	Sediment, composite - RT bank	.03	
STATION NO 4 - RIVER MILE 55.7			
DA89-5-11	Largemouth bass, composite (5)	.744	.20
DA89-5-12	Channel catfish, composite (5)	.38	.10
DA89-5-13	Sediment, composite - Lt bank	.051	
DA89-5-14	Sediment, composite - Rt bank	.050	
STATION NO 5 - RIVER MILE 51			
DA89-5-15	Largemouth bass, composite (5)	.961	.26
DA89-5-16	Channel catfish, (1)	.28	.07
DA89-5-17	Sediment, composite - Rt bank	.04	
DA89-5-18	Sediment, composite - Lt bank	.078	
STATION NO 6 - RIVER MILE 46			
DA89-5-19	Largemouth bass, composite (5)	.985	.25
DA89-5-20	Channel catfish, composite (2)	.23	.06
DA89-5-21	Sediment, composite - Rt bank	.02	
DA89-5-22	Sediment, composite - Lt bank	.071	

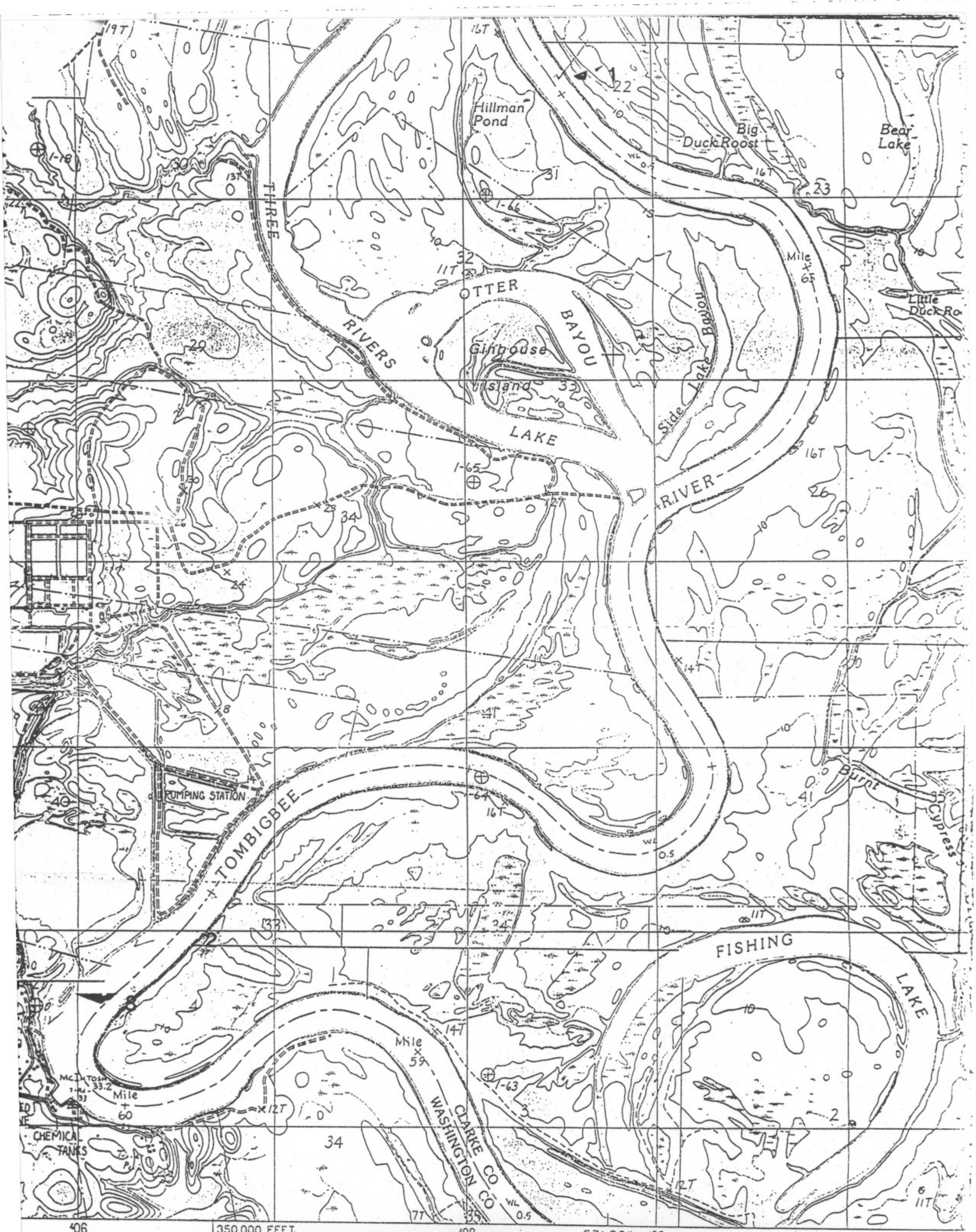
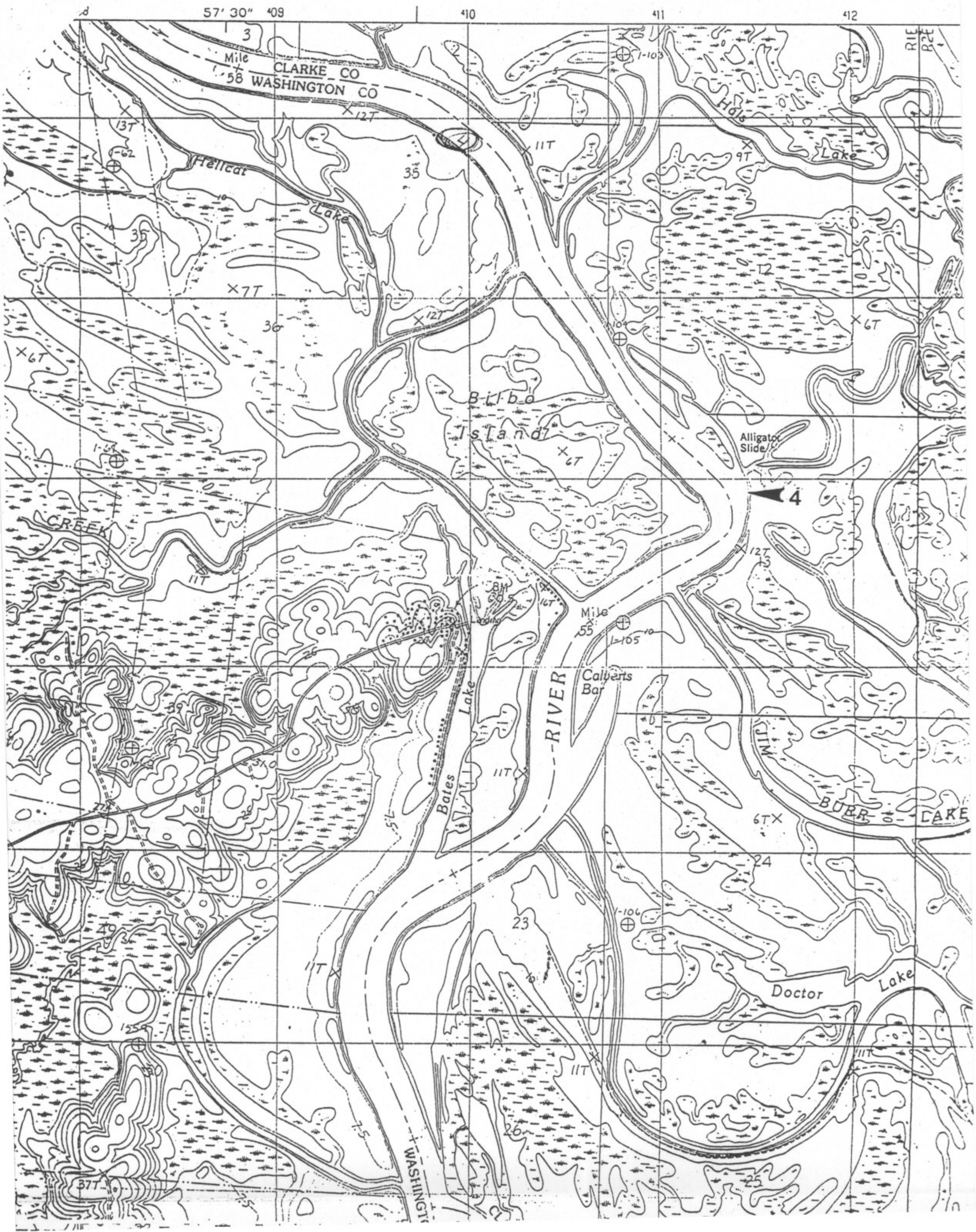


Figure 1. Study Area and Station Locations

ED STATES GEOLOGICAL SURVEY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409
410
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58
CLARKE CO
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Hellcat
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Alligator
Slide
4
CREEK
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Landing
Mile
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Calberts
Bar
RIVER
Bates
Lake
JIM
BURR
LAKE
Doctor
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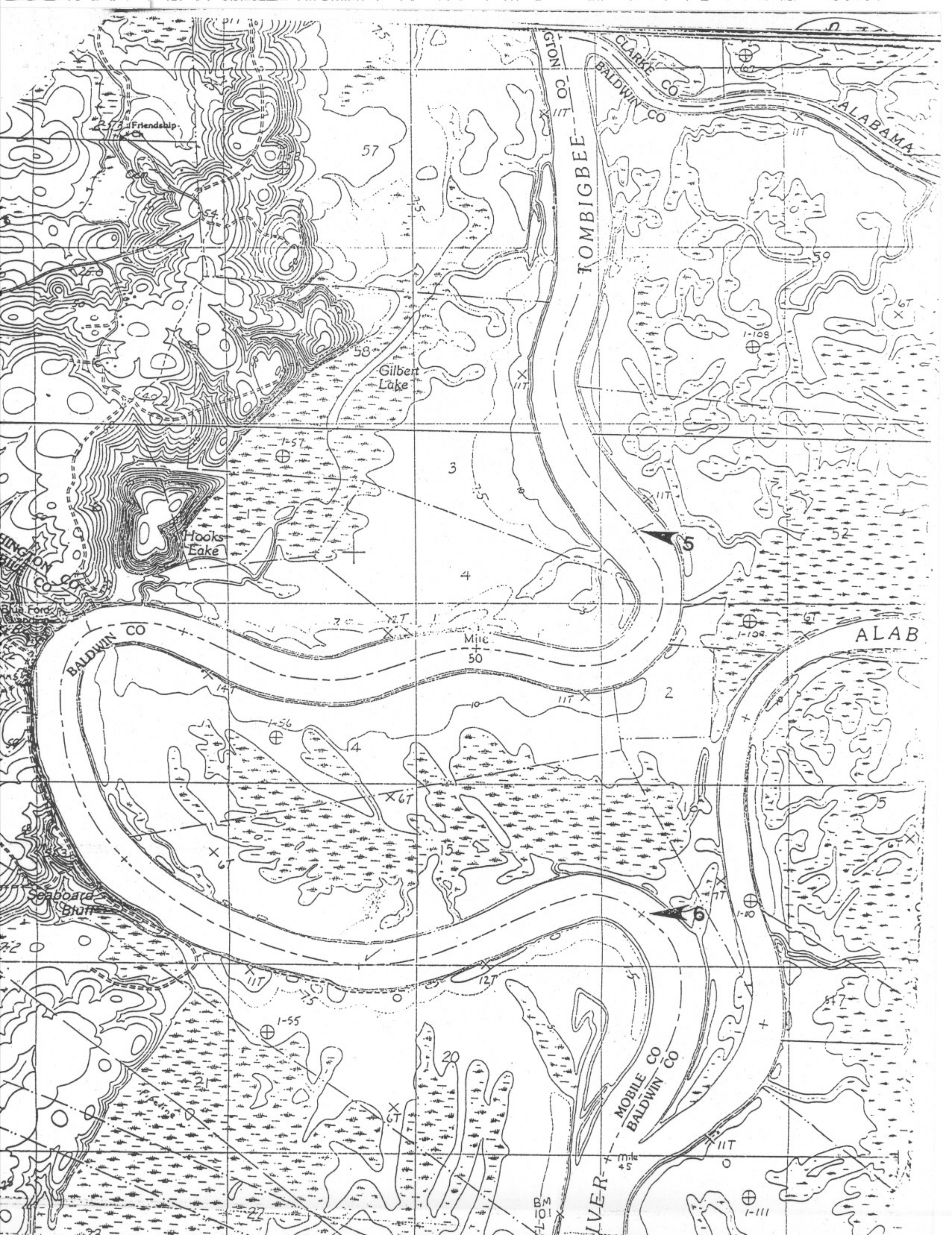
Friendship Ch
57
TOMBIGBEE
CLARKE CO
BALDWIN CO
ALABAMA
59
58
Gilbert Lake
1-108
1-57
3
Hooks Lake
4
5
52
ALAB
1-109
Mile 50
BALDWIN CO
2
1-56
14
15
Seaboard Bluff
6
1-110
1-55
20
21
MOBILE CO
BALDWIN CO
Mile 45
BM 101
1-111