Water Quality Trends of Selected Ambient Monitoring Stations in Alabama Utilizing Aquatic Macroinvertebrate Assessments

1974 - 1992

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Field Operations Division
Special Studies Section

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EXECUTIVE SUMMARY

Since 1974, the ADEM (formerly the Alabama Water Improvement Commission (AWIC)) has monitored the ambient water quality of seven major drainage basins throughout the state utilizing both chemical data collected monthly and biological data generally collected on an annual basis. The location and number of stations within the drainage basins were chosen to assess the impacts of point source (industrial and municipal) discharges, non-point source discharges, as well as for use as background stations. Of the twenty-five stations monitored, nineteen are presently classified as "Fish and Wildlife" or better, five as "Agricultural and Industrial Water Supply" and one has a water use classification of "Industrial Operations". A detailed description of the Alabama water use classifications is located in Appendix B. The stations were divided between wadeable, non-wadeable, and tidally influenced stations, with most of the wadeable streams monitoring the effects of municipalities and industries, and the non-wadeable sites monitoring larger municipalities and industrial effluents, primarily paper mills. The tidally influenced stations were chosen to monitor the effects of industrial discharges or as background stations.

The main objective of this report is to determine trends in water quality throughout the state based on the biological information obtained since 1974. Several improvements in organism identification and sampling methodology over the past two decades make this task more difficult. From 1974 - 1982, organism identifications were made to the taxonomic level of order or family. Due to the existing water quality conditions of the monitored sites, this degree of resolution was sufficient to make an assessment of the benthic community health. As water quality began to improve in many streams and the measures of macroinvertebrate community health required more refinement, a more detailed level of identification was needed to more adequately assess water quality. From 1982 to the present, most organisms have been identified to the taxonomic level of genus. To make comparisons between years, however, it was necessary to "lump" taxonomic groups to match levels of identification made throughout the past twenty years. Since a change in the macroinvertebrate community below the family or ordinal level cannot be detected, it should be noted that this analysis is a conservative estimate of the trends in ambient water quality.

Another problem in analyzing long term trends in water quality arises from changes in sampling methodology. From 1974 - 1989, biological monitoring at all sites was conducted utilizing quantitative, artificial substrate samplers. This method allowed sample collection in locations that were difficult to sample with other available methodology (Plafkin et al. 1989), but was time consuming, requiring two trips to the site (one to deploy and one to retrieve the samplers) and approximately six weeks for colonization. Sample collection was uncertain due to the difficulty of retrieving plates after high flows. In 1990, a modified form of EPA's Rapid Bioassessment Protocol (Plafkin et al. 1989) and North Carolina Department of Environmental Regulation's Multihabitat Assessment (Lenat 1988) was adopted by the ADEM for use in wadeable streams (ADEM 1992). Because few states have attempted to analyze long term water quality data, there is scant information on the relationship between these two methodologies, further complicating comparisons. However, several recent studies indicate that, because macroinvertebrate community structure differs between habitats, methodology which samples all available habitat (RBP-Multihabitat) will have higher taxa diversity and richness than methods which sample only one habitat type (Artificial Substrate Samplers) (Grubaugh et al. unpubl. data). For this reason, direct comparisons between the two sampling methods utilizing taxa richness might overestimate improvements in water quality.

Therefore, a biotic index was utilized in order to compare water quality between years for 1982 to 1992. The index used in this report was adapted from Hilsenhoff (1987) and North Carolina (1992). In general, a biotic index is a relative measure of the tolerance of macroinvertebrates to environmental stresses. It is scaled from 0 to 10, with greater numbers signifying increasing tolerance. Although there is probably some natural variation in the tolerance values of macroinvertebrate communities of different habitats, these numbers are more comparable than measures of taxa richness and diversity between the two methodologies.

Forty percent of the twenty-five stations sampled showed a slight to substantial improvement in water quality since 1974. Of these stations, 50 percent monitored municipal discharges (C-4, Vi-1, CL-1, SO-1, SH-1a). These improvements may be due in part to changes in treatment of effluents or the removal of the discharges entirely. Since 1972, all untreated and primary-treated municipal discharges were eliminated, and 52 percent of the domestic discharges now provide advanced treatment levels (ADEM 1992a).

Twenty percent of the ambient monitoring stations deteriorated slightly during the sampling period. Among these is Bankhead Lake, one of the two stations (BL-1, LF-1) which monitors a municipality of Birmingham. The degradation at this site may be attributable to the high population growth of this area leading to increased point- and non-point source adverse impacts. The "Environmental Protection Plan for the State of Alabama" (1989) cited the urban population growth as approximately fifty percent higher than the overall population growth from 1970 to 1989. This can be translated to increased demands on existing wastewater treatment facilities and an increased number of industrial and municipal discharges to Alabama's streams. Three of the other stations (B-1, S-1, CO-2) which showed a slight degradation in water quality monitored industrial discharges (two textile plants and one paper mill). The last of these stations (T-4) monitors the water quality of the Tombigbee River as it enters the state from Mississippi.

The remaining ten stations (C-2, C-3, LC-1, LF-1, T-4, A-1, A-2, A-3, HB-1, CS-1), three of which are wadeable and seven non-wadeable have maintained their water quality since 1974. They monitor both industrial and municipal discharges and all have at least a water use classification of 'Fish and Wildlife' with the exception of Hog Bayou (HB-1) classified as 'Agricultural and Industrial water supply'.

Several states have begun monitoring entire basins extensively on a biennial or triennial rotation (South Carolina 1992, North Carolina 1992). In order to determine basin wide trends in ambient water quality from our existing data, the average annual biotic index score within a basin was plotted against the average biotic index score for the entire basin over the entire sampling period. The Upper and Lower Tombigbee River Drainage Basins were combined for this purpose. The Mobile River Basin was excluded from this analysis due to the limited applicability of the biotic index for estuarine conditions.

The strongest trends in water quality were obtained in the two basins containing the highest number of ambient monitoring stations, regardless of the number of years sampled consecutively. The Cahaba River Basin, which contains six sampling stations showed an overall improvement in water quality since 1982. The Black Warrior River Basin, which contains four sampling stations, also showed an improvement in water quality. These results suggest that monitoring more sampling stations within one river basin on a biennial or triennial rotation may more adequately assess trends in water quality than sampling fewer stations on an annual basis. The biotic integrity of three of the six drainage basins indicated moderate levels of pollution (Tallapoosa, Alabama and Tombigbee) with no change in water quality evident over time.

In general, the biotic index increased between water use classifications: "Swimming"<"Fish and Wildlife"<"Agriculture and Industry", although there was variability within the classifications and no significant differences (p=0.05). Water use classifications and the associated criteria have historically been based on water quality parameters. Because benthic (bottom dwelling) macroinvertebrates are relatively long-lived and immobile, the macroinvertebrate communities reflect overall ecological integrity (i.e., chemical, physical and biological integrity) and may provide a better assessment of water quality over time (Plafkin et al. 1989). The results of this analysis further suggest that biological assessments may more adequately measure water quality and permit differentiation in stream quality that are not apparent when water chemistry data alone is utilized.

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INTRODUCTION

Alabama is one of the leading states in stream resources, ranking 7th in the nation with 47,072 stream miles (ADEM 1992a). The 1990 census, of slightly over 4 million people, reflected a population growth of nearly 18 percent (18%) over the 1970 census. The "Environmental Protection Plan for the State of Alabama" (1989) cited the urban population growth as approximately fifty percent higher than the overall population growth from 1970 to 1989. This can be translated to increased demands on existing wastewater treatment facilities and an increased number of industrial and municipal discharges to Alabama's streams. However, since 1972, all untreated and primary-treated municipal discharges were eliminated, and 52 percent of the domestic dischargers now provide advanced treatment levels (ADEM 1992a).

The Alabama Environmental Planning Council (1989) stated that "Alabama has severe erosion problems throughout the state". The primary pollutant in state streams is sediment eroding from the land. As of 1989, the state's agricultural industry had the sixth highest cropland soil erosion in the nation. Timber harvesting increased from approximately 700 million cubic feet in 1970 to nearly one billion cubic feet in 1990. Reforestation efforts also increased from approximately 135,000 acres in 1970 to approximately 225,000 acres planted in 1990, a 70 percent increase (Alabama Forestry Commission 1993). Tons of soil are lost annually through transportation development, construction activities, improper forestry management practices and mining (Alabama Environmental Planning Council, 1989). Many of the State's waters are adversely impacted by nutrients and pesticides associated with soil erosion and stormwater runoff.

In keeping with the goals of the Clean Water Act, Section 106 (as amended), monitoring the status of Alabama's water quality is a priority task for the Alabama Department of Environmental Management (ADEM). To assist in accomplishing this task the Department operates a fixed station ambient stream monitoring network. As part of the monitoring program, the in-stream biological community is sampled at selected stations.

PROGRAM HISTORY

The ADEM, formerly the Alabama Water Improvement Commission (AWIC), has conducted biological monitoring of aquatic macroinvertebrate communities since 1974. Benthic (bottom dwelling) macroinvertebrate communities reflect overall ecological integrity (i.e., chemical, physical, and biological integrity). "Therefore, biosurvey results directly assess the status of a water body relative to the primary goal of the Clean Water Act. Macroinvertebrate communities integrate the effects of different pollutant stressors and thus provide a holistic measure of their aggregate impact. Communities also integrate the stresses over time and provide an ecological measure of fluctuating environmental conditions." (Plafkin et al. 1989) Assessing the integrated response of biological communities to highly variable pollutant inputs offers a particularly useful approach for monitoring point- and nonpoint-source impacts and the effectiveness of certain Best Management Practices. "Routine monitoring of biological communities can be relatively inexpensive, particularly when compared to the cost of assessing toxic pollutants, either chemically or with toxicity tests." (Plafkin et al. 1989) The status of biological communities is also of direct interest to the public as a measure of a clean environment, while reductions in chemical pollutant loadings are not as readily understood by the laymen as positive environmental results. "Where criteria for specific ambient impacts do not exist (e.g., nonpoint-source impacts that degrade habitat), biological communities may be the only practical means of evaluation." (Plafkin et al. 1989)

The aquatic macroinvertebrate biological monitoring program is conducted primarily by the Special Studies Section of the Field Operations Division of the ADEM. At the program's inception in 1974, biological monitoring was conducted at a limited number of sites using an artificial substrate sampler. These samplers were allowed to be colonized for a designated period of time by the macroinvertebrates inhabiting the stream. Two trips to the site were required for each sample (one to set and one to retrieve). Samplers were sometimes lost due to sedimentation, extremely high or low flows, or vandalism during the relatively long colonization period. However, this type of sampler allowed collection in locations that were difficult to sample with other available methodology. (Plafkin et al. 1989)

During the first 8 years, organism identifications were made to the taxonomic level of order or family. Due to the existing water quality conditions of the monitored sites, this degree of resolution was sufficient to make an assessment of the benthic community health. As water quality began to improve in many of the streams, a more detailed level of identification became necessary. From 1982 to the present, most organisms have been identified to the taxonomic level of genus.

As more emphasis is placed on an integrated assessment of water quality utilizing multiple indicators, such as toxicity testing, chemical and physical parameters, and in-stream biological monitoring, refined methods for sampling the aquatic macroinvertebrate community have been developed that allow greater resolution of impairments or improvements in water quality than were available utilizing the artificial substrate samplers. Beginning in 1990, a modified form of the Rapid Bioassessment Protocol developed by the Environmental Protection Agency (Plafkin et al. 1989), and North Carolina Department of Environmental Regulation's Multihabitat Assessment (Lenat 1988), was adopted by the ADEM for use in wadeable streams (ADEM 1992). Similar draft methodology has been proposed to assess the water quality of non-wadeable streams. This method was utilized during the 1993 sampling season. In order to better understand the differences in macroinvertebrate community structure due solely to the change in the methodology, both types of samples were collected at some of the non-wadeable stations during 1993.

DATA EVALUATION METHODOLOGY

Water quality may be indicated by the analysis of biological metrics or indices (biometrics). These biometrics consider the overall community composition (community structure), the presence or absence of pollution sensitive taxonomic groups (Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa richness), the number of different kinds of organisms (total taxa richness and Chironomidae taxa richness), and the overall pollution tolerance of the organisms collected (biotic index).

Several recent studies indicate that, because macroinvertebrate community structure differs between habitats, methodologies which sample all available habitats will have higher taxa richness than methods which sample only one habitat type (Grubaugh et al.). For this reason, measurements of taxa richness may over estimate improvements in water quality at stations historically monitored with the single habitat Hester-Dendy multiplate sampler, and later monitored with the multiple habitat assessment. A biotic index was therefore utilized in order to compare trends in water quality between years and methodologies. The biotic index was adapted from Hilsenhoff (1987), Bode (1988), and North Carolina (1992) to reflect genus and family level identifications. Although there is probably some natural variation in the tolerance values of macroinvertebrates of different habitats, these numbers are more comparable than measures of taxa richness between the two methodologies (Grubaugh et al.).

For those stations that have been monitored entirely utilizing the Hester-Dendy multiplate samplers, measures of taxa richness, such as EPT, Chironomidae, and total taxa richness, are appropriate for comparisons between years as long as the levels of identification are similar (1982-1992). Due to varied levels of identification (often order) in the early years of the monitoring program (1974-1981), a community composition metric was utilized that would allow comparison between years. The identifications for each year (1974-1992) were simplified to their major groups (usually orders) as percentages of the organisms collected. Changes in the structure of the community were utilized to determine a trend in water quality.

The following is a brief description of the biometrics presented in the report.

COMMUNITY STRUCTURE

Healthy aquatic macroinvertebrate communities are generally characterized by a diverse group of organisms. A macroinvertebrate community that is dominated by any one group tends not to be as stable as an evenly distributed community and may indicate a situation in which the community is stressed and one type of organism has become opportunistic. Therefore, in general, the more evenly the community is distributed between different taxonomic groups the healthier it is.

The taxonomic groups utilized in these illustrations include:

Ephemeroptera: mayflies. These organisms are one of the three groups generalized as "good water quality" indicators. They are considered generally intolerant of pollution.

Plecoptera: stoneflies. These organisms are one of the three groups generalized as "good water quality" indicators. They are considered generally intolerant of pollution.

Trichoptera: caddis flies. These organisms are one of the three groups generalized as "good water quality" indicators. They are considered generally intolerant of pollution.

Megaloptera: dobsonflies, alderflies. These organisms are generally pollution-intolerant.

Odonata: These include the dragonfly and the damselfly families. These organisms are considered facultative and can exist in a wide range of water quality conditions.

Coleoptera: true beetles. Both adult and/or larval forms of many true beetles are aquatic. These organisms are considered facultative and can exist in a wide range of water quality conditions.

Amphipoda: scuds or sideswimmers. These organisms are considered facultative and can exist in a wide range of water quality conditions. Certain genera of this group are often found in estuarine conditions.

Isopoda: aquatic sowbugs. These organisms are considered facultative and can exist in a wide range of water quality conditions. Certain genera of this group are often found in estuarine conditions.

Decapoda: crayfishes, shrimps, crabs. These organisms are considered facultative and can exist in a wide range of water quality conditions. Certain genera of this group are often found in estuarine conditions.

Mollusca: These include snails, clams, and limpets. These organisms are considered facultative and can exist in a wide range of water quality conditions. Dominance of this group may indicate a degraded aquatic community.

Diptera: true flies. These include many families with semi-aquatic or aquatic larvae such as: midge flies, black flies, and crane flies. These true flies are generally tolerant of pollution. Dominance of this group usually indicates a degraded aquatic community.

Annelida: segmented worms. These include the leeches and aquatic worms. These organisms are generally tolerant of pollution. Their dominance usually signifies poor water quality. Dominance of polychaete worms in tidally influenced streams does not necessarily signify poor water quality.

Hemiptera: true bugs. Adult forms of many true bugs are aquatic. These organisms are considered facultative and can exist in a wide range of water quality conditions.

Misc: miscellaneous. Those organisms that are not included in the above listed groups.

TOTAL TAXA RICHNESS

Total taxa richness is the number of different kinds of organisms collected during a particular sampling effort. In general, the taxa richness increases with increasing water quality. Only data collected utilizing similar sampling methodologies may be compared utilizing this metric. This metric was calculated on data collected from 1982 to 1992.

EPT TAXA RICHNESS

This is the portion of the taxa richness that includes three generally pollution-intolerant groups--Ephemeroptera (E), Plecoptera (P), Trichoptera (T). The EPT taxa richness generally increases with increasing water quality. Only data collected utilizing similar sampling methodologies may be compared utilizing this metric. This metric was calculated on data collected from 1982 to 1992.

CHIRONOMIDAE TAXA RICHNESS

The Chironomidae taxa are part of the larger, generally pollution-tolerant dipteran group. An increase in the Chironomidae taxa richness does not generally signify a decrease in water quality. Chironomidae taxa richness often follows the same pattern as the EPT taxa richness; increasing in value as water quality increases. However, this group should not dominate a sample in percentage of the total organisms as this may indicate environmental stress. This metric was calculated on data collected from 1982 to 1992.

BIOTIC INDEX

The biotic index ranges from 0 to 10. In general, the larger the number the poorer the water quality. The index was developed by Hilsenhoff (1987) to summarize the overall pollution tolerance of the benthic arthropod community with a single value. It has since been modified to include non-arthropod organisms (Plafkin et al. 1989). Most taxa collected during a bioassessment have been assigned a tolerance value which also ranges from 0 to 10. The higher the number, the generally more tolerant an organism is to pollution. The biotic index is calculated by multiplying the tolerance value for each taxon by the number of organisms in that taxon; then dividing this value by the total number of organisms with a tolerance value in the sample. This quotient is then summed for each taxon in the sample. Estuarine and marine organisms (tidally influenced streams) are not included in the calculation of the biotic index due to the lack of tolerance values available in the literature.

A linear regression line is plotted along with the actual biotic index data points to indicate the general trend in the biotic index values. A line that slopes markedly down indicates an improvement in the health of the biological community. This metric was calculated on data collected from 1982 to 1992.

The following table, published by Hilsenhoff (1987), was the guideline for evaluating the biotic index of riffle samples from Wisconsin in March to May, September and early October. Though it may not be directly applicable to Alabama's waters, it is a good indicator of approximate water quality. As more data is gathered from Alabama streams, the condition categories may be modified to more accurately reflect the ranges of water quality in Alabama. It should also be noted that the biotic index values as listed below should only be used with samples collected utilizing the RBP-multihabitat methodology. These ranges were not designed to be used with samples collected utilizing Hester-Dendy multiplate samplers.

BIOTIC INDEX	WATER QUALITY	DEGREE OF POLLUTION
0.00-3.50	EXCELLENT	NO APPARENT POLLUTION
3.51-4.50	VERY GOOD	POSSIBLE SLIGHT POLLUTION
4.51-5.50	GOOD	SOME POLLUTION
5.51-6.50	FAIR	FAIRLY SIGNIFICANT POLLUTION
6.51-7.50	FAIRLY POOR	SIGNIFICANT POLLUTION
7.51-8.50	POOR	VERY SIGNIFICANT POLLUTION
8.51-10.00	VERY POOR	SEVERE POLLUTION

Several states have begun monitoring entire basins on a biennial or triennial rotation (South Carolina 1992, North Carolina 1992). In addition to evaluation of Alabama's ambient monitoring sites on an individual basis, basin wide trends in ambient water quality, from 1982 to 1992, were determined from our existing data utilizing the biotic index. The average annual biotic index scores for each station within a given basin were added together, divided by the number of stations within the basin, and then plotted against the average biotic index score for the entire basin over the entire sampling period. (See table 1 for a listing of ambient monitoring stations by river basin.)

The following trend stations (Figure 26) were chosen from the ADEM's fixed station ambient stream monitoring network to determine trends in water quality throughout the state based on the biological data collected since 1974. This report illustrates a portion of the information available through aquatic macroinvertebrate analyses utilizing artificial substrate samplers. Stations were sampled primarily with modified Hester-Dendy multiplate artificial substrate samplers. Current in-stream bioassessment methodology for wadeable streams (RBP-Multihabitat) allows a much more comprehensive evaluation than is illustrated here. The proposed bioassessment methodology for non-wadeable streams will also provide a more detailed evaluation than has previously been available for non-wadeable streams. Although any type of assessment is most useful when used in conjunction with other types of information, in-stream biological assessments are often useful as a sole source of information and may characterize stream conditions that are not apparent using either chemical analyses or toxicity testing.

Comparison of macroinvertebrate assessments are most reliable when all variables, such as season of collection, stream flow, and sampling method, are similar. Due to resource constraints, especially in the early sampling years, the season of collection was not always comparable. Stream flow has not been addressed due to the limited scope of this discussion. However, the stream flow can usually be expected to be similar for sampling events during the same season of the year, unless rainfall for that year was abnormally high or low. The sampling methods used throughout this discussion are similar except where noted on the figures. It should also be noted that the following discussions are of long term trends in the quality of the biological community and not analyses of individual sampling events.

The final determination of the trend in water quality for each of the individual stations is based upon the "best professional judgement of biologists familiar with the methods and biometrics utilized in this report. The water quality trend descriptions utilized are as follows: 1. "maintained"--no notable trend in the metrics is exhibited. 2. "slight", "moderate" or "substantial improvement"--one to all of the metrics utilized indicate an improvement in the macroinvertebrate community. 3. "slight", "moderate" or "substantial deterioration"--one to all of the metrics utilized indicate a deterioration in the macroinvertebrate community.

RESULTS AND DISCUSSION

The discussion of the individual sampling stations was divided into three sections: I. Wadeable Streams, II. Non-Wadeable Streams, and III. Tidally Influenced Streams. Analysis of the trends in the biometrics calculated on the historical macroinvertebrate data indicated four of the nine wadeable streams showed some improvement in water quality, two showed a slight deterioration in water quality and three maintained their water quality over the 1974 to 1992 sampling period. In general, the ambient monitoring sites on the wadeable streams were located to monitor the influence of wastewater treatment facilities on water quality. The improvements noted may be due in part to elimination of all untreated and primary treated municipal discharges and the increased use of advanced treatment levels. Of the two sites that exhibited some level of degradation, Buck Creek (B-1) was associated with several wastewater treatment facilities and Sugar Creek (S-1) was associated with both a wastewater treatment facility and a discharge from a textile mill. The Sougahatchee Creek (SO-1) site, also associated with a wastewater treatment facility and a textile mill, showed a general improvement in water quality.

Non-wadeable streams are usually the larger flowing water bodies where water quality changes take place more slowly over time. Because the flow from any one tributary constitutes only a small portion of the total flow in major rivers, any improvements in the water quality of the tributaries are not necessarily reflected in those rivers. Two of the ten non-wadeable streams monitored showed slight improvement in water quality, three had slightly deteriorated water quality, and five maintained their water quality over the 1974 to 1992 sampling period. Of the five stations that maintained their water quality, four were located to monitor the effects of paper mills (A-1, A-2, A-3, T-2) and one monitored the effects of industrial and municipal discharges (LF-1a). The two sites that showed improvement in water quality (C-4, CL-1) were established to monitor the effects of smaller municipalities and industrial discharges. Improvements in NPDES (National Pollutant Discharge Elimination System) permitting procedures and enforcement of permit limits could have contributed to these improvements. Of those sites which exhibited a deterioration in water quality (BL-1, CO-2, T-4), the Tombigbee River at station T-4 was impounded during the sampling period creating a site more resembling that of a lentic (non-flowing) system. This resulted in a loss of riverine habitat and therefore taxa, which would result in the conclusion of degradation. The Coosa River station (CO-2) monitors the effects of a paper mill in Alabama and is also an interstate water that may be affected by adverse impacts from Georgia. Bankhead Lake (BL-1) is an impoundment just west of Birmingham that receives waters from several tributaries that flow through the metropolitan area. The degradation at this site may in part be attributable to the high population growth of this area leading to increased point- and non-point source adverse impacts. The "Environmental Protection Plan for the State of Alabama" (1989) cited the urban population growth as approximately fifty percent (50%)

higher than the overall population growth from 1970 to 1989. This can be translated to increased demands on existing wastewater treatment facilities and an increased number of industrial and municipal discharges to Alabama's streams.

The tidally influenced streams were the most difficult to evaluate. In addition to the normal annual variability in the aquatic communities due to weather conditions, such as temperature and rainfall, the aquatic community was subjected to variations in salinity. It was concluded that the salinity was often different from year to year even when sampling took place during the same time period. A sample collected one year may be dominated by freshwater organisms with numerous taxa, including EPT taxa. The next year it may be dominated by estuarine and marine taxa. This makes evaluation extremely difficult. However, when sampling of many of these sites was initiated, the presence of any type of organism, whether freshwater or estuarine, was a positive evaluation. The year 1985 was an exceptionally active year for tropical weather. Several tropical weather systems influenced the Mobile Bay watershed during the summer and fall. Most significantly, Hurricane Elena passed through the bay area on the first and second of September prior to the October 1985 sampling. Flow in the Mobile River system and local tributaries was abnormally high and salinity was low, especially for early fall which is normally a time of low flow and high salinity. This is apparently reflected in the large proportion of dipteran organisms in the 1985 collection. As a contrast the summer months of 1988 were exceptionally calm with drought conditions and only minor tropical activity. Consequently flow in area streams was lower than average and salinity was higher than average. This is somewhat evident in the greater numbers of amphipods, decapods, and annelids present in the collections. The following years 1989 and 1990 represent conditions between the extremes of 1985 and 1988. As a result the invertebrate communities from 1989 and 1990 showed an overall decrease of estuarine taxa and an increase of freshwater taxa from 1988. New methods of evaluating the tidally influenced streams will be required for more complete assessments in the future. Four of the six tidally influenced streams monitored had a slight improvement in water quality and the remaining two maintained their water quality. Of those sites that showed improvement (CS-2, MO-1a, TE-1, TE-2), the two sites on the Tensaw River (TE-1, TE-2) were located for use as background stations as they lack any major discharges. The sites on Chickasaw Creek (CS-2) and the Mobile River (MO-1a) were located to monitor industrial discharges. The water quality was maintained at Hog Bayou (HB-1) and Chickasaw Creek (CS-1) sites. The industrial discharge was removed from the Hog Bayou site prior to any assessment activities. However, an insufficient amount of data has been collected at this site to indicate any changes in water quality.

The strongest basin-wide trends in water quality were obtained in the basins containing the highest number of ambient monitoring stations (Cahaba and Mobile River basins), regardless of the number of years consecutively sampled. The Cahaba River Basin (Figure 28), which contained six sampling stations showed an overall improvement in water quality since 1982. These results suggested that monitoring more sampling stations within one river basin on a biennial or triennial rotation may more adequately assess trends in water quality than sampling fewer stations on an annual basis. The Black Warrior (Figure 28) and Coosa River (Figure 29) Basins have shown a degradation in water quality in recent years. The water quality of the Alabama (Figure 29) and Tombigbee (Figure 28) Rivers, the two largest watersheds monitored, appears to have been maintained. Changes in water quality in these larger water bodies are more difficult to assess, however.

In general the biotic index increased between water use classifications: "Swimming"<"Fish and Wildlife"<Agricultural and Industrial Water Supply"< Industrial Operations, although there was variability within classifications and no significant difference ($p=0.05$). Water use classifications and the associated criteria (ADEM 1993) have historically been based on water quality parameters (dissolved oxygen, pH, water temperature, bacteria, turbidity). Because benthic macroinvertebrates are relatively long-lived and immobile, the macroinvertebrate communities reflect overall ecological integrity (i.e. chemical, physical, and biological integrity) and may provide a better assessment of water quality over time (Plafkin et al. 1989). The results of this analysis further suggests that biological assessments may more adequately measure water quality impairments that are not apparent when water chemistry data alone is utilized.

TABLE 1

AMBIENT MONITORING STATIONS BY RIVER BASIN

ALABAMA RIVER BASIN

Alabama River A-1

Alabama River A-2

Alabama River A-3

CAHABA RIVER BASIN

Buck Creek B-1

Cahaba River C-2

Cahaba River C-3

Cahaba River C-4

Little Cahaba River LC-1

Shades Creek SH-1a

TALLAPOOSA RIVER BASIN

Sougahatchee Creek SO-1

Sugar Creek S-1

LOWER TOMBIGBEE RIVER BASIN

Tombigbee River T-2

BLACK WARRIOR RIVER BASIN

Village Creek VI-1

Valley Creek VA-1

Bankhead Lake BL-1

Locust Fork LF-1

MOBILE RIVER BASIN

Chickasaw Creek CS-1

Chickasaw Creek CS-2

Hog Bayou HB-1

Mobile River MO-1

Tensaw River TE-1

Tensaw River TE-2

COOSA RIVER BASIN

Choccolocco Creek CL-1

Coosa River CO-2

UPPER TOMBIGBEE RIVER BASIN

Tombigbee River T-4

FIGURE 26

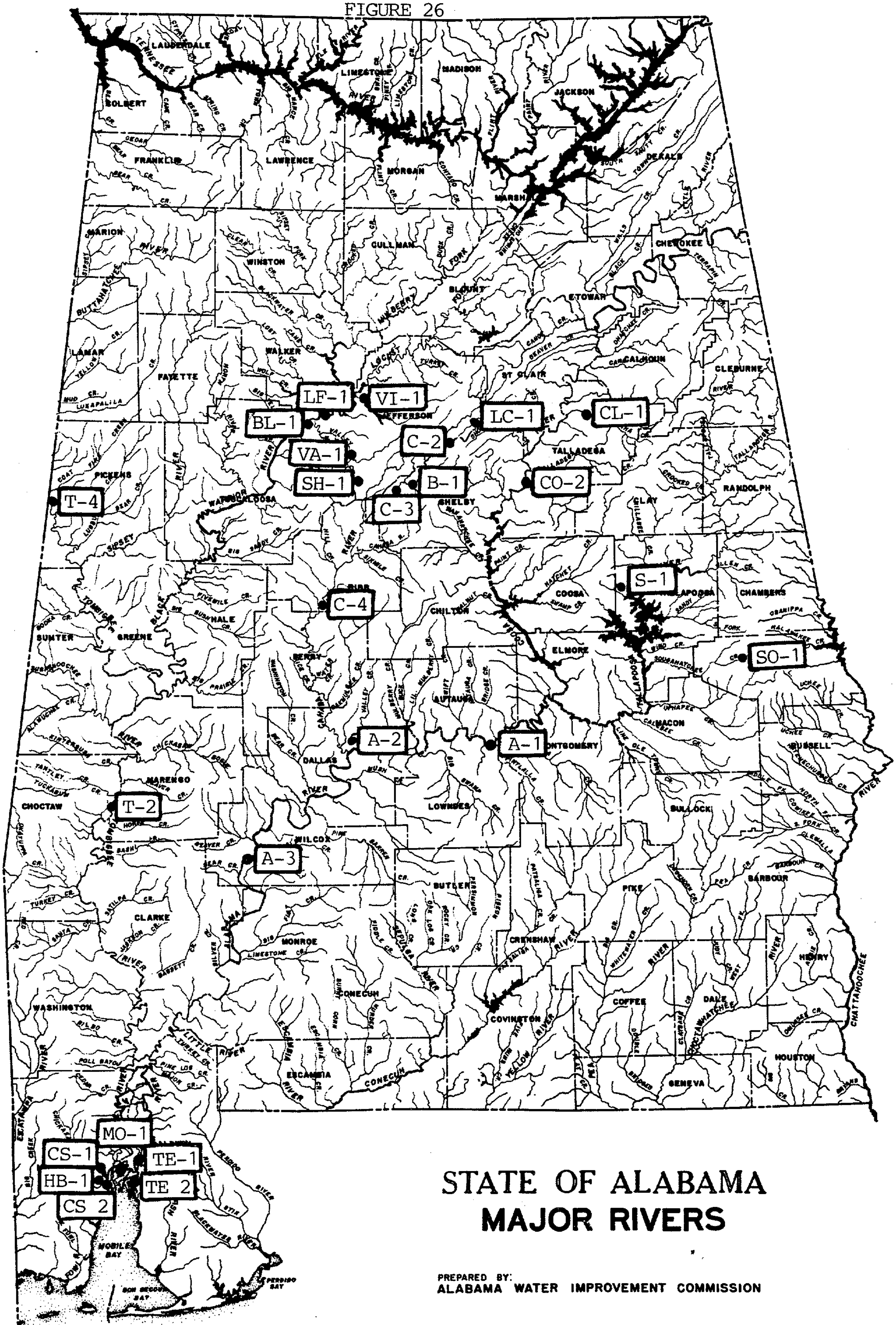
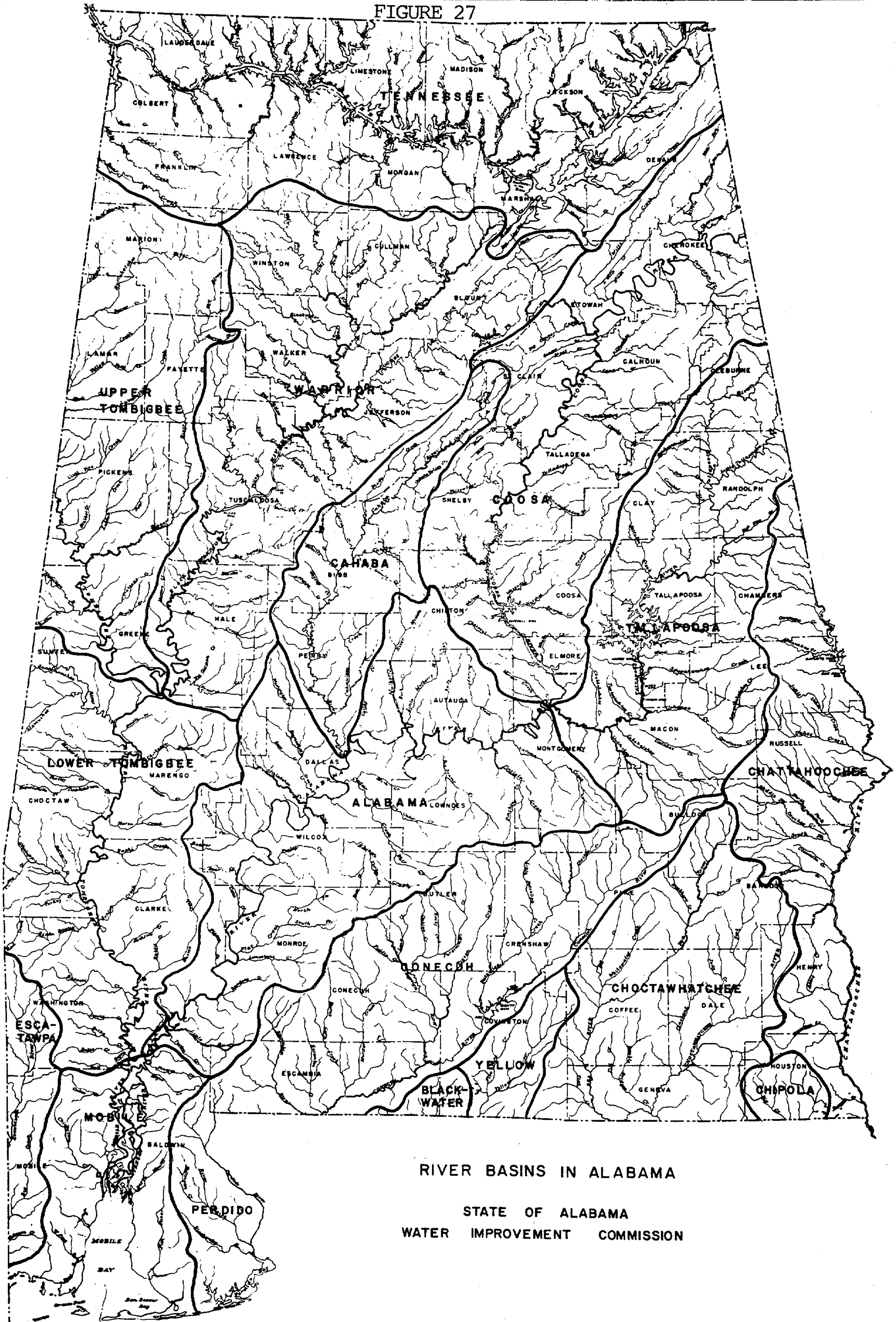

STATE OF ALABAMA
MAJOR RIVERS
PREPARED BY:
ALABAMA WATER IMPROVEMENT COMMISSION
LF-1
VI-1
BL-1
LC-1
CL-1
C-2
VA-1
SH-1
B-1
CO-2
T-4
C-3
S-1
C-4
SO-1
A-2
A-1
T-2
A-3
MO-1
CS-1
TE-1
HB-1
TE 2
CS 2

FIGURE 27



RIVER BASINS IN ALABAMA

STATE OF ALABAMA
WATER IMPROVEMENT COMMISSION

6-479

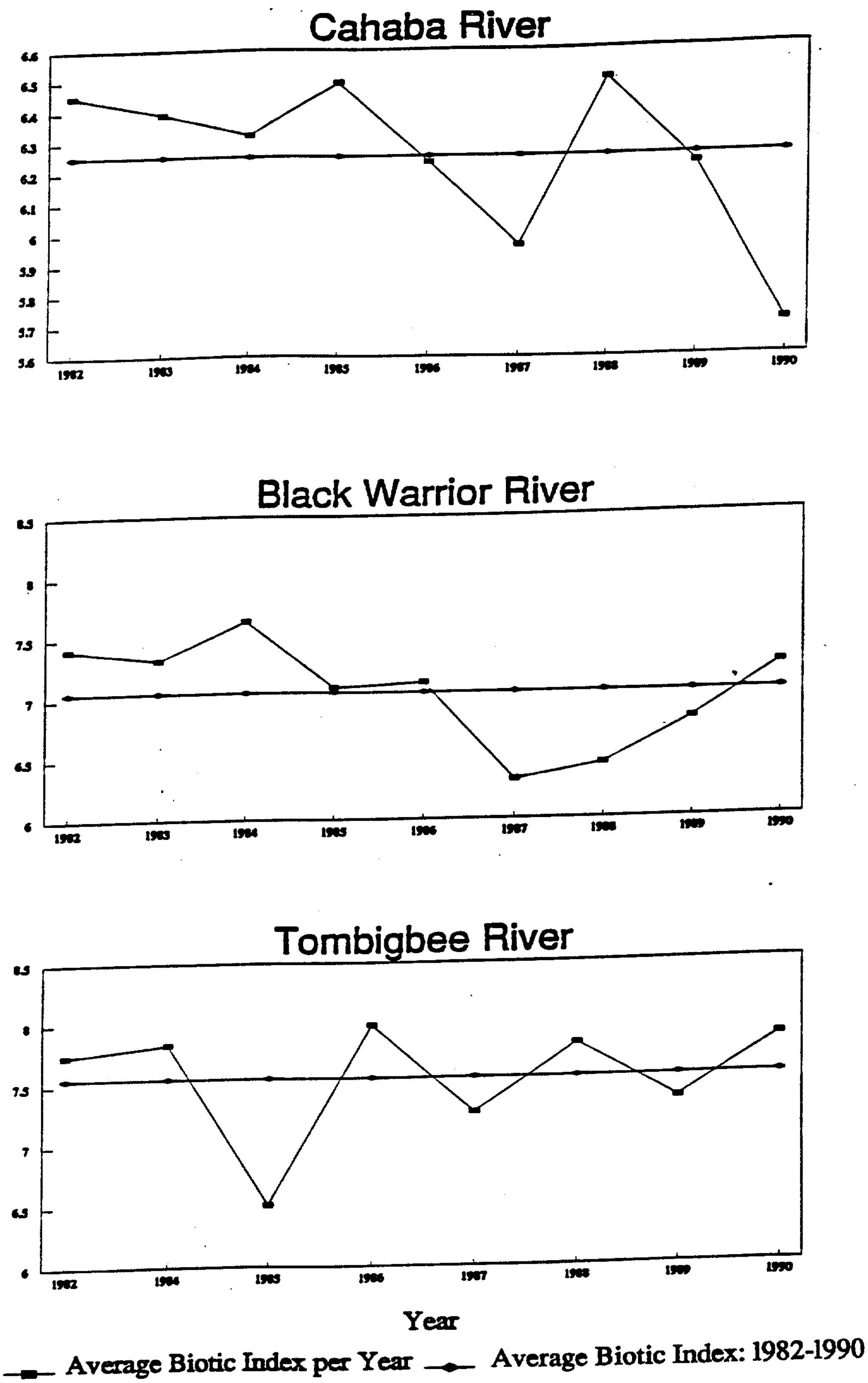


Fig. 28. **Basin wide trends in ambient water quality:** The average annual biotic index scores of the Cahaba, Black Warrior, and Tombigbee River basins plotted against the average biotic index score for each basin over the entire sampling period.

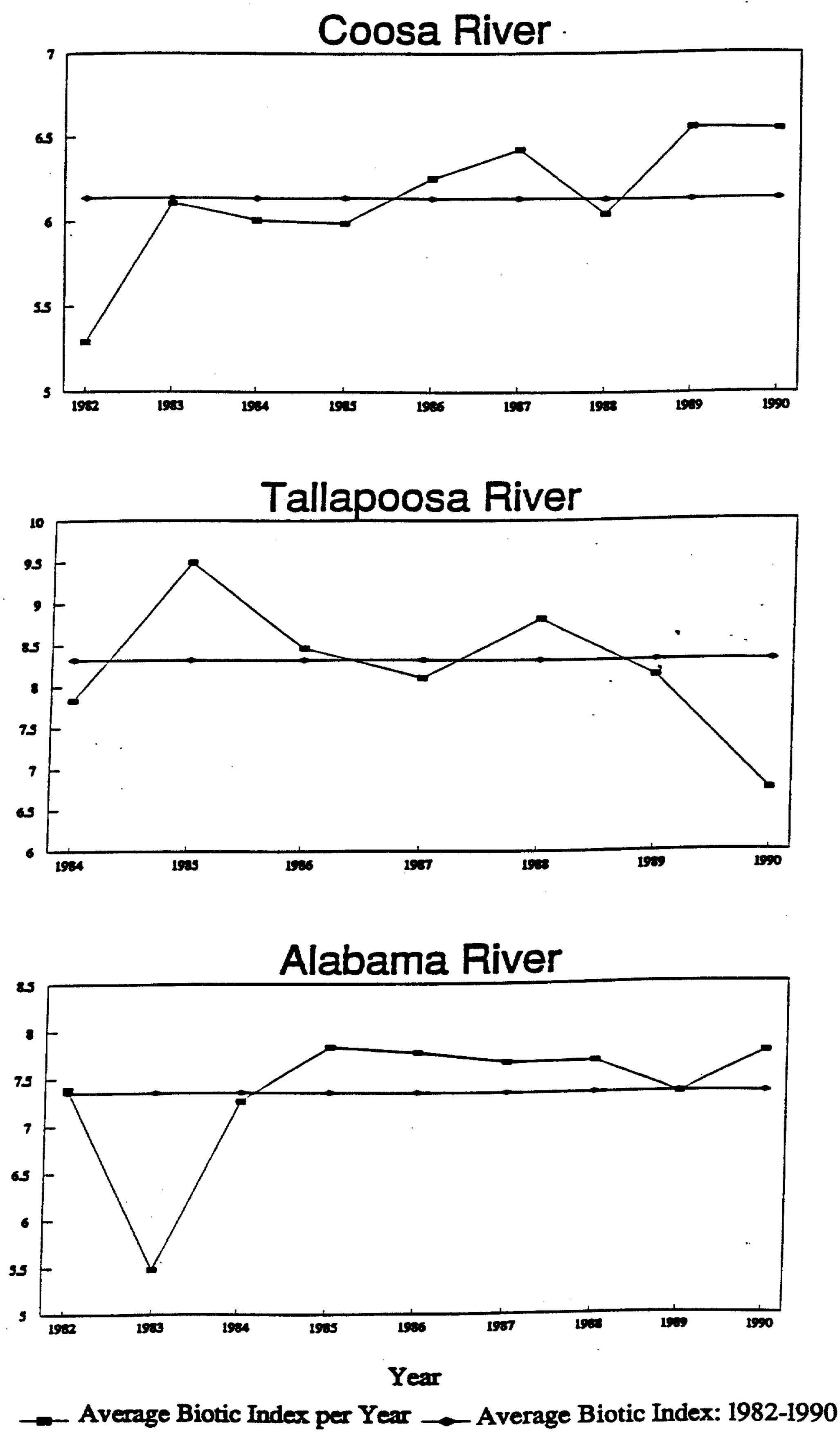


Fig. 29. **Basin wide trends in ambient water quality:** The average annual biotic index scores of the Coosa, Tallapoosa, and Alabama River basins plotted against the average biotic index score for each basin over the entire sampling period.

PART I
WADEABLE STREAMS

CAHABA RIVER DRAINAGE BASIN

BUCK CREEK B-1

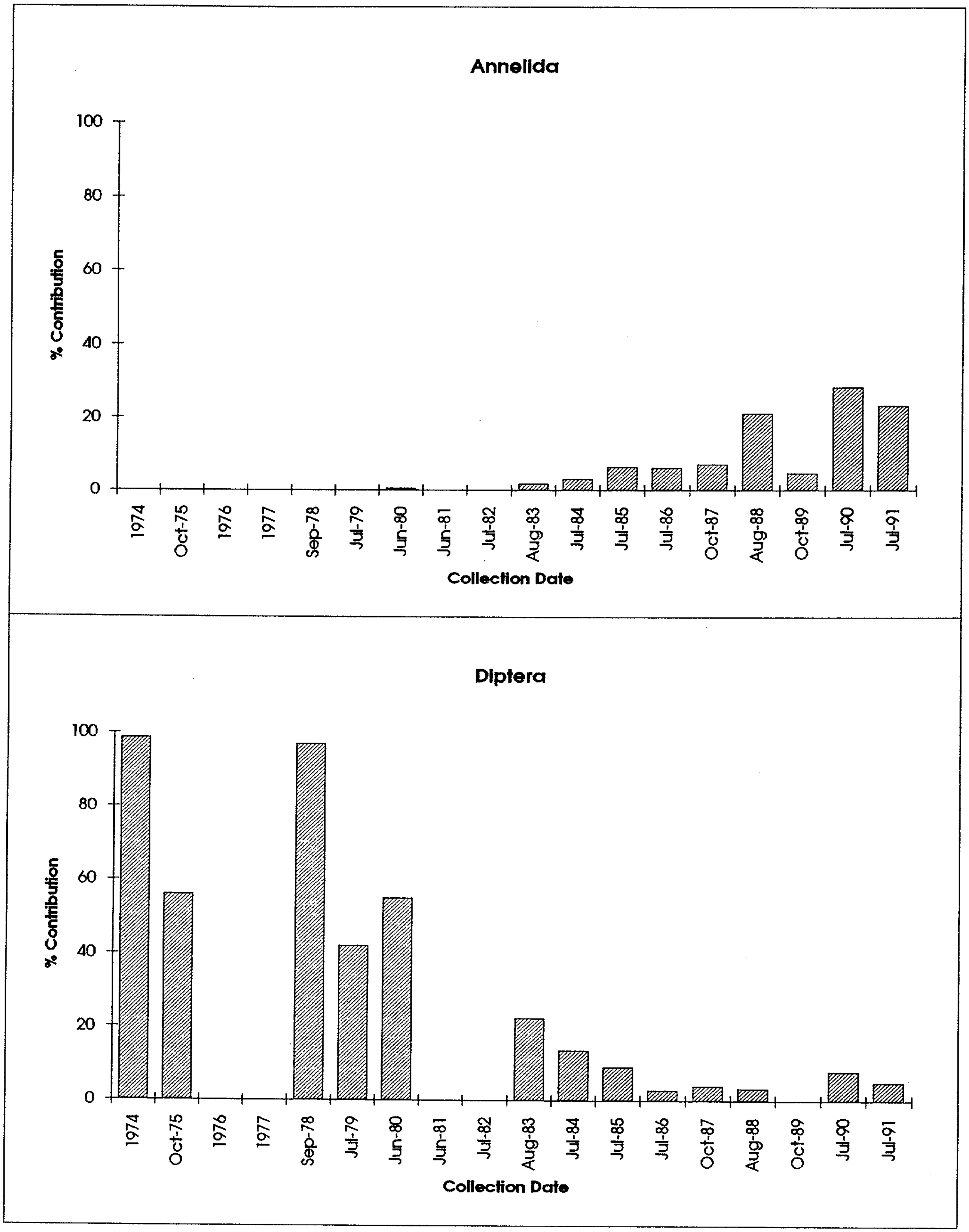
Station B-1 is located immediately below the dam in Helena off Hwy. 261 in Shelby County. The site was chosen to monitor the effects of a municipal wastewater treatment facility discharge and a textile plant. The water use classification for this section of Buck Creek is 'Fish and Wildlife'.

Analysis of early data collected at Buck Creek (1974 to 1980) indicated that the macroinvertebrate community (Figure 1A) was dominated by dipterans, a pollution-tolerant group. In the following years Ephemeroptera (1982-83) and, to a lesser extent, Trichoptera (1982) were dominant. In 1981, and then again from 1984 to 1991, the collected community was dominated by molluscs (gastropods). These organisms can exist in a wide range of water quality, but dominance of this group often indicates a degraded aquatic community. There was also a coinciding increase in the percent contribution of the Annelids, which are generally pollution tolerant.

During the years that Hester-Dendy multiplate samplers were utilized and the levels of taxonomic identifications allowed comparisons (1982 - 1989), a noticeable deterioration was observed in the EPT and total taxa richness. Data collected during 1990 and 1991 utilized the RBP-Multihabitat methodology which sampled a greater diversity of microhabitats than that provided by the Hester-Dendy multiplate samplers. Therefore, the higher taxa richness in 1990 did not necessarily indicate improved water quality (Figure 1 C). It is not clear whether the reduced taxa richness observed in 1991 resulted from natural variability or water quality impairment.

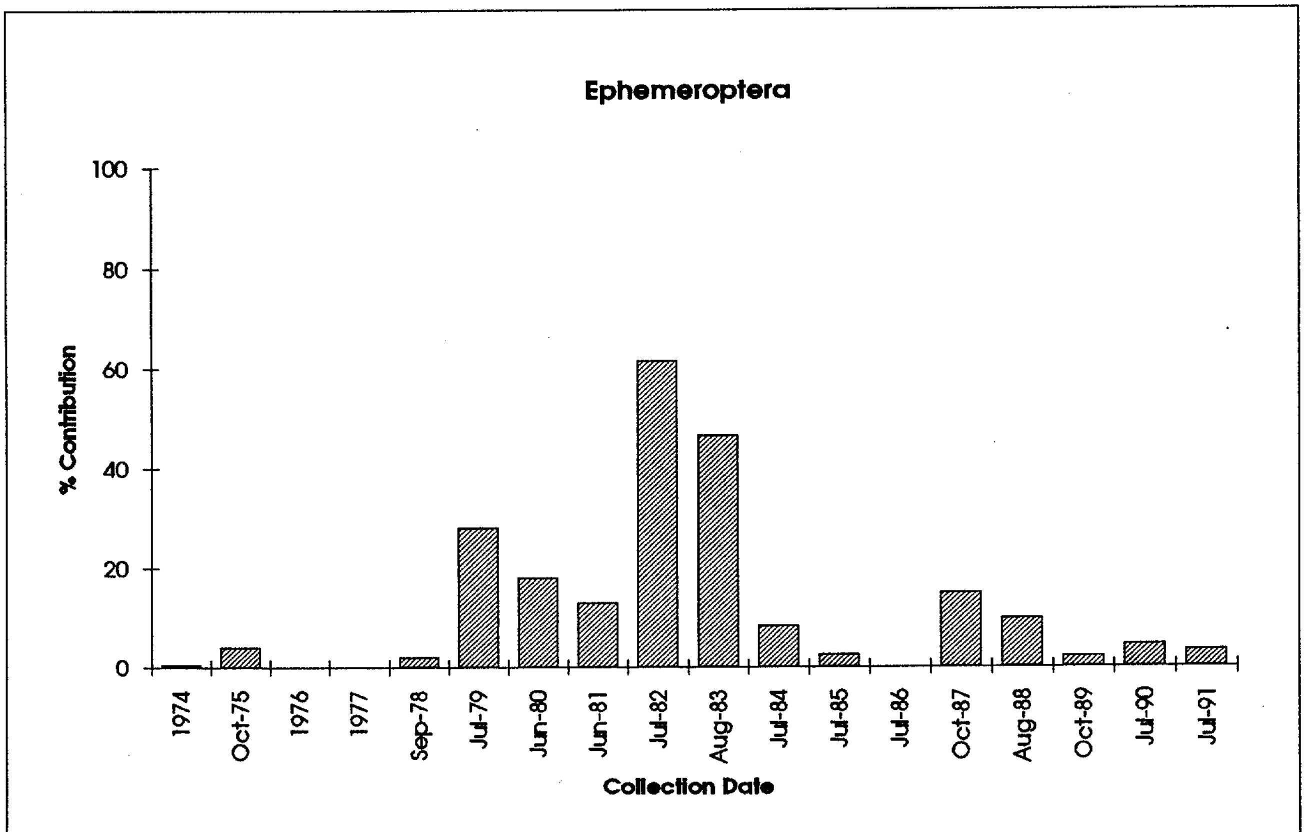
The biotic index indicated little change in the pollution tolerance of the macroinvertebrate community (Figure 1B). This was primarily due to the fact that the community has been dominated since 1984 by a single taxon (g. *Elimia*) with a tolerance value of six. Since the biotic index is weighted by the percent contribution of the organism, the index value will be skewed closer to six in this situation. Analysis of data collected indicated that there has been a slight deterioration in the water quality of Buck Creek at station B-1.

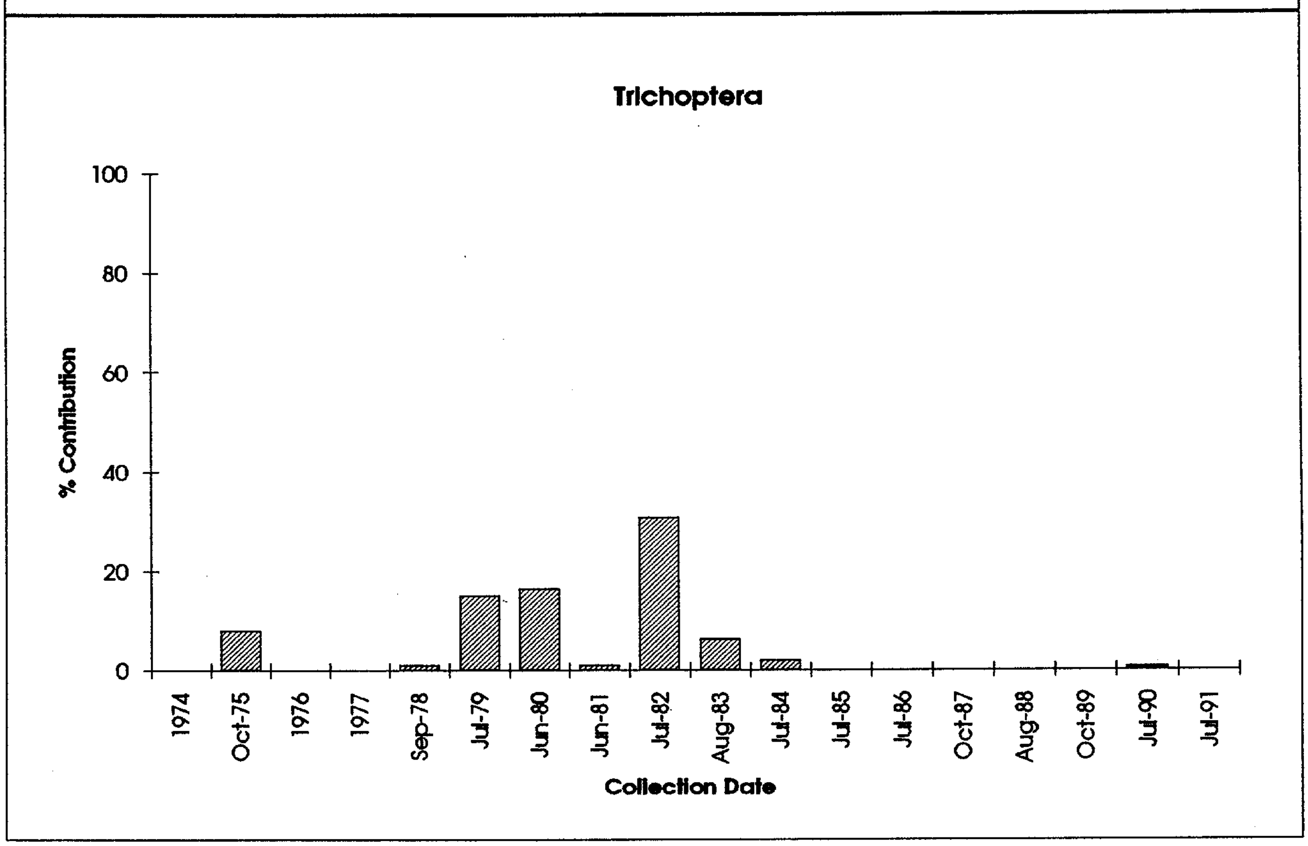
Figure 1A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: B-001 1974-1991



*-Data was not collected during 1976 and 1977.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

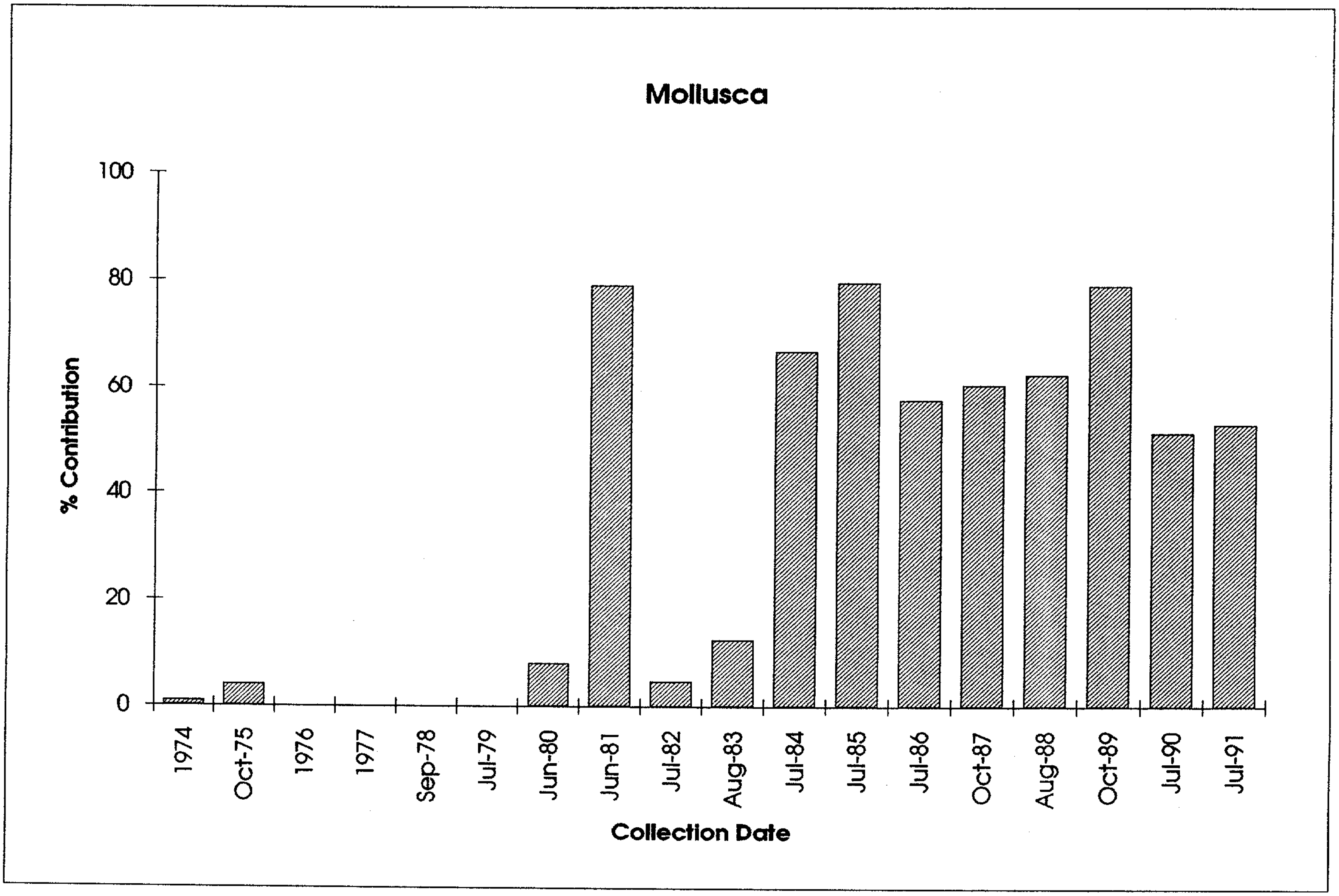
Figure 1A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: B-001 1974-1991





*-Data was not collected during 1976 and 1977.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

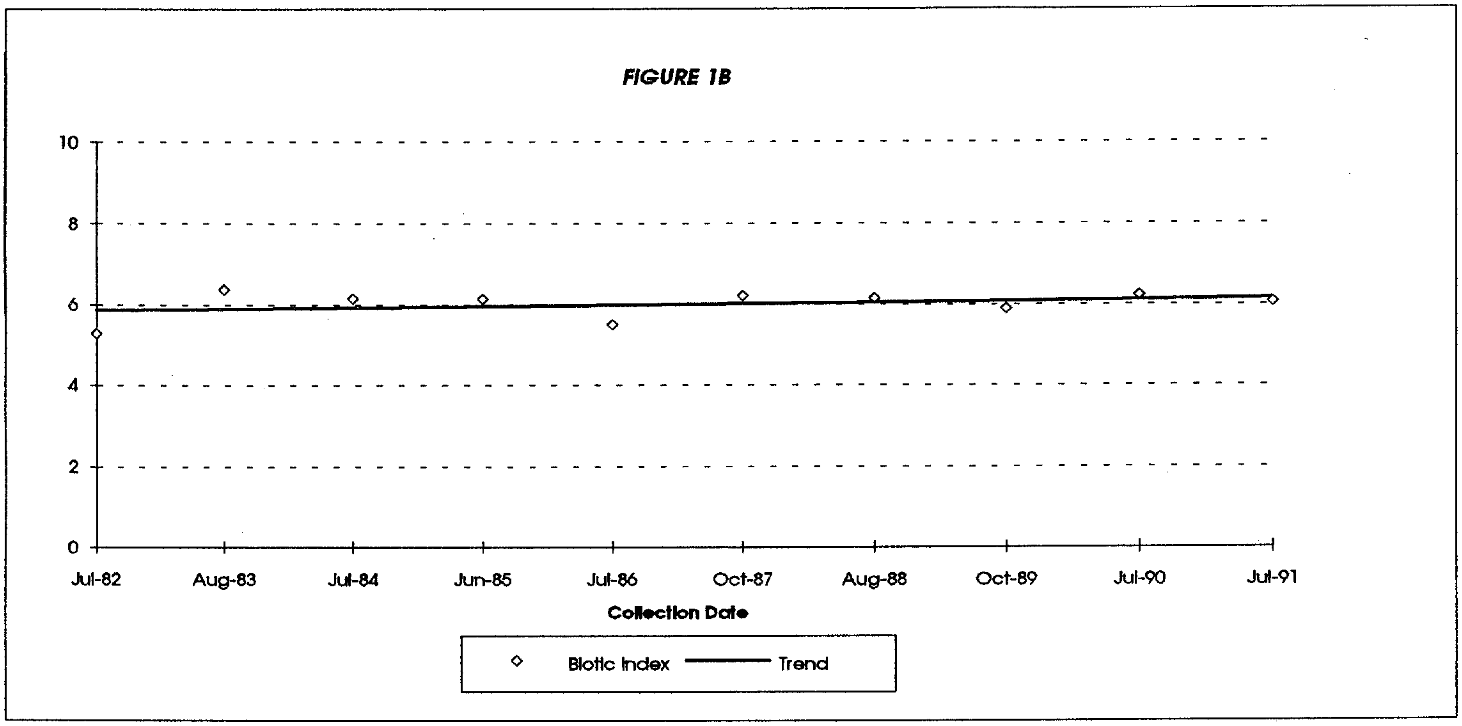
Figure 1A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: B-001 1974-1991



*-Data was not collected during 1976 and 1977.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

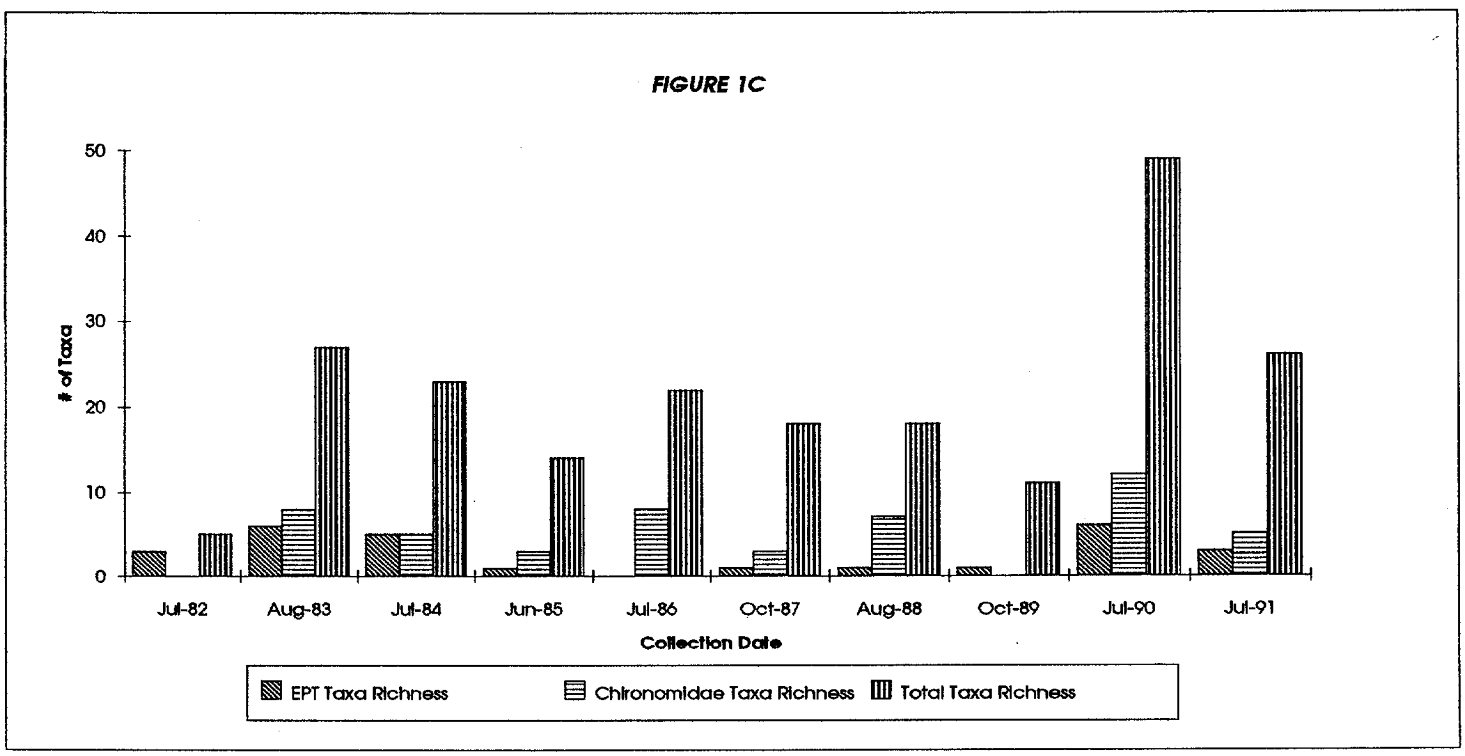
BIOTIC INDEX

AMBIENT MONITORING STATION: B-001 1982-1991



TAXA RICHNESS

AMBIENT MONITORING STATION: B-001 1982-1991



In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

CAHABA RIVER C-2

Station C-2 is located on the Cahaba River at Shelby County Road 29. The site was selected to monitor changes in water quality downstream from station C-1. The Cahaba River above station C-1 receives discharges from a municipality and a poultry plant. The water use classification for this section of the Cahaba River is 'Fish and Wildlife'.

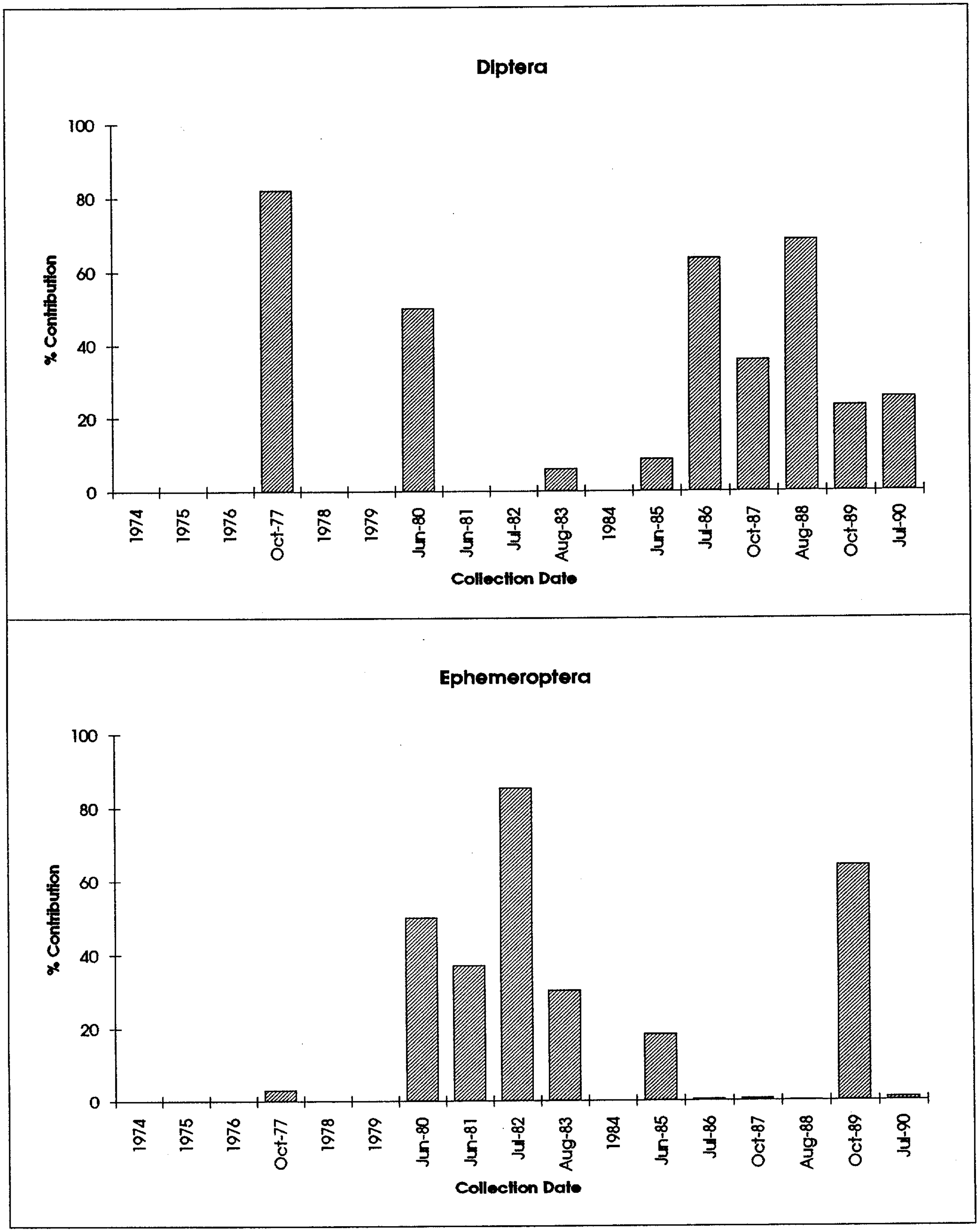
Aquatic macroinvertebrate samples were first collected from this location in 1977 and then again from 1980 to 1990. The community structure showed improvement over the 1980 to 1983 sampling period with the dominant group shifting from Diptera to Ephemeroptera (Figure 2A). Beginning in 1985 and continuing through 1988, the community structure appears to deteriorate as seen in the shift from a well balanced community (Appendix A-2) to one that is dominated by more pollution-tolerant groups (Diptera, Mollusca). Community structure in 1989 and 1990 was dominated by pollution-intolerant groups (Trichoptera, Ephemeroptera).

EPT, Chironomidae, and total taxa richness (Figure 2C) showed minimal changes between 1985 and 1988. The samples collected in 1982, 1983, and 1989 have lower EPT and total taxa richness. However, these years were characterized by higher than normal stream flows. This may have resulted in a reduced number of taxa due to scouring effects on the samplers. The biotic index indicated little change in the pollution tolerance of the macroinvertebrate community (Figure 2B).

Data collected during 1990 utilized the RBP-Multihabitat methodology instead of Hester-Dendy multiplate samplers. Therefore, the apparent improvement in the taxa richness categories did not necessarily indicate improvement in the water quality. However, a biotic index of 5.19 (Table 2B) indicates "Good" water quality with "some pollution" based on Hilsenhoff's (1987) guideline for interpreting the biotic index.

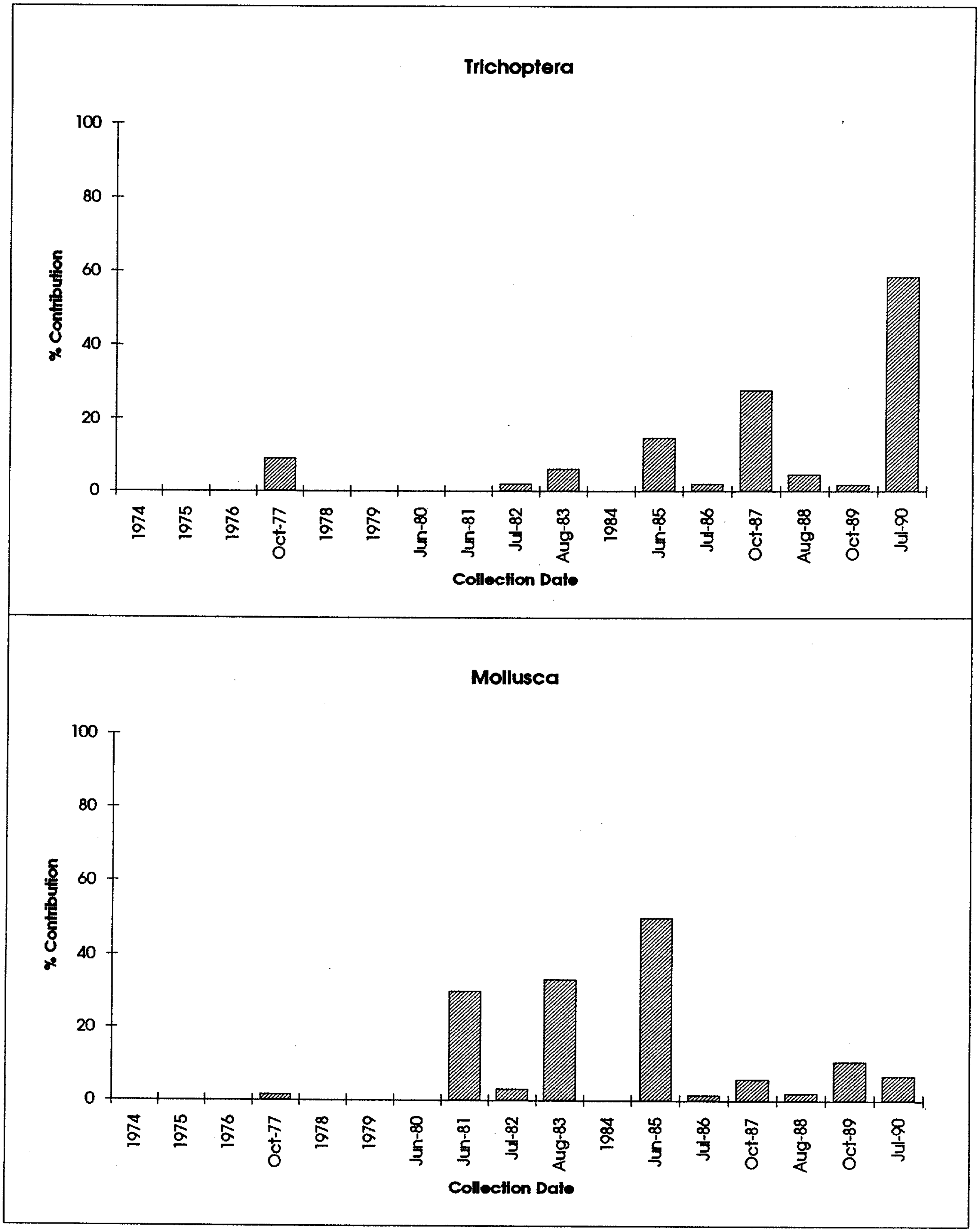
Analysis of data collected indicated that the water quality of the Cahaba River at station C-2 has been maintained during the monitoring period.

Figure 2A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: C-002 1974-1990



*-Data was not collected during 1974, 1975, 1976, 1978, 1979, and 1984.
In 1990, RBP-Multihabitat sampling protocol was used.

Figure 2A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: C-002 1974-1990

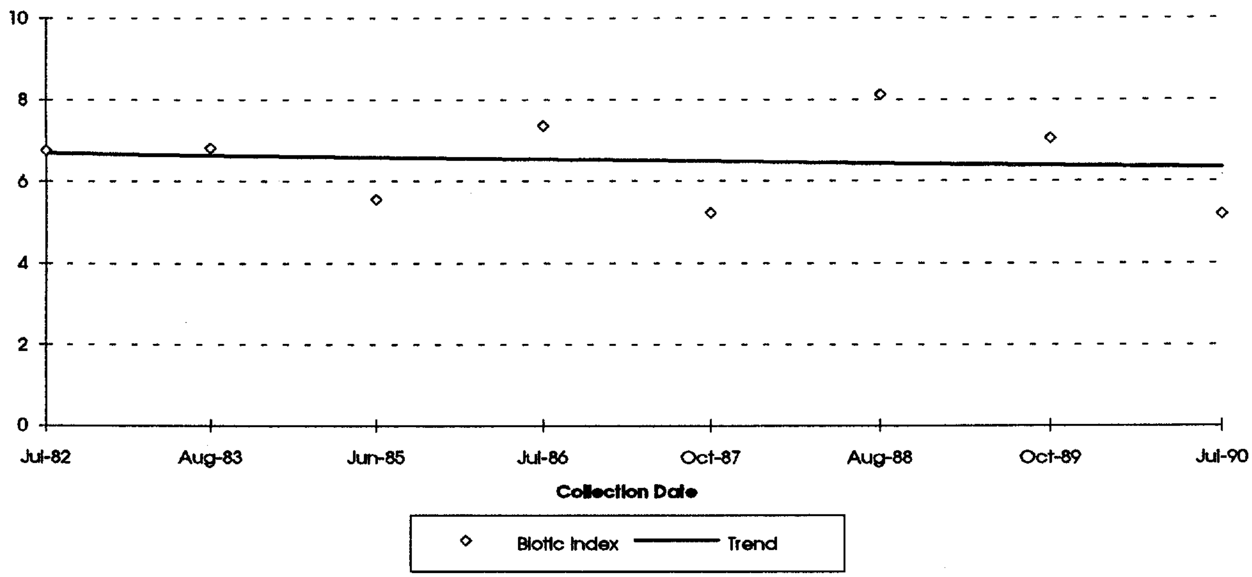


*-Data was not collected during 1974, 1975, 1976, 1978, 1979, and 1984.
In 1990, RBP-Multihabitat sampling protocol was used.

BIOTIC INDEX

AMBIENT MONITORING STATION: C-002 1982-1990

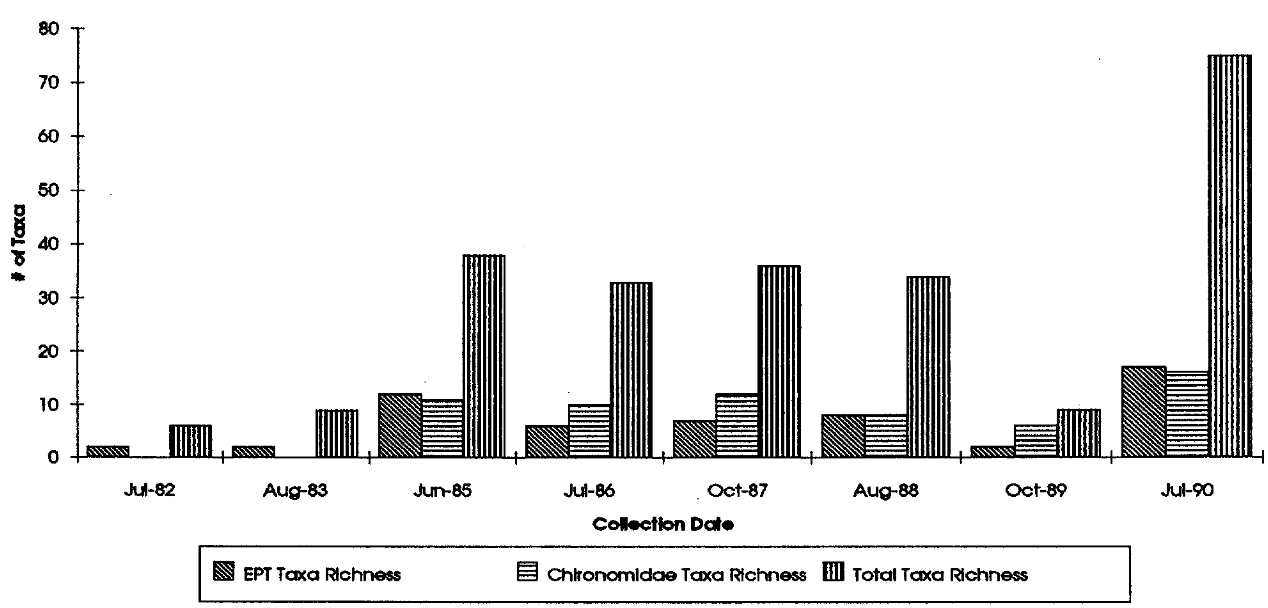
FIGURE 2B



TAXA RICHNESS

AMBIENT MONITORING STATION: C-002 1982-1990

FIGURE 2C



In 1990, RBP-Multihabitat sampling protocol was used.

CAHABA RIVER C-3

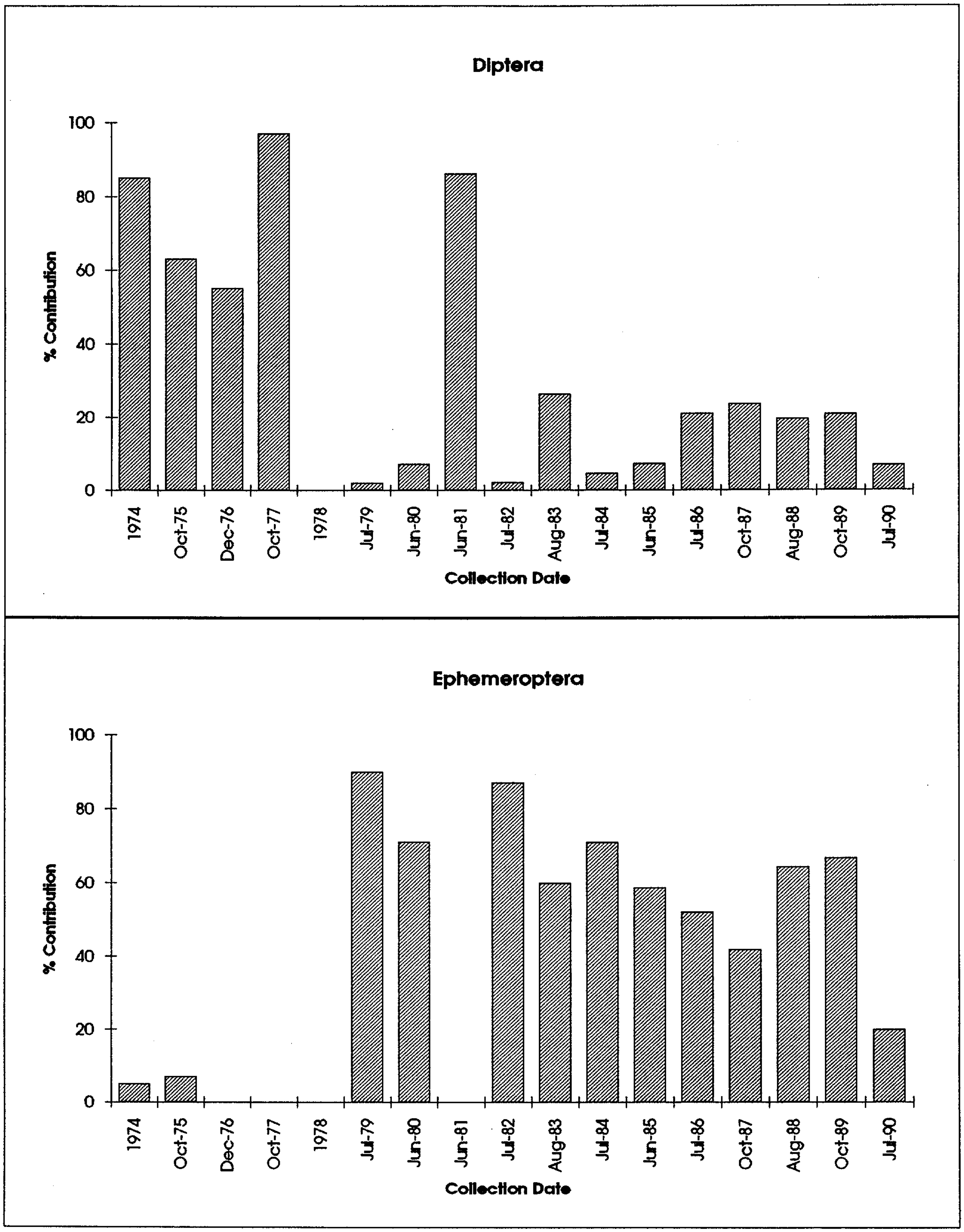
Station C-3 is located west of Helena, Alabama, above the Shelby County Road 52 bridge. The site was located just below the confluence of Buck Creek to monitor the effects of that stream on the Cahaba River. The stream reach of the Cahaba River containing this station has a water use classification of 'Fish and Wildlife'.

Beginning in 1974, the sampled community was dominated by a pollution-tolerant group (Diptera) and was characterized by a low diversity of taxonomic groups (Appendix A-3). No data was collected in 1978. In 1979, data indicated a shift in the community structure toward a more pollution-intolerant population (Ephemeroptera). The shift may be partially due to a change in the time the samples were collected (fall to summer; no month was recorded for the 1974 sample), but later sampling efforts during the fall season (OCT 87) did not reflect a similar community structure as seen in collections from 1974 to 1977. From 1979 to 1990 more groups were represented in the community structure (Figure 3A).

The biotic index indicated only a slight shift toward a more pollution-intolerant population (Figure 3B). The EPT taxa richness, Chironomidae and total taxa richness (Figure 3C) also show minimal changes over the 1982 to 1990 sampling period.

Increased macroinvertebrate diversity in the early 1980's indicated an improvement in water quality at station C-3 as compared to the late 1970's. Recent collections (1983 - 1990) indicated that the water quality at Station C-3 has been maintained during the monitoring period.

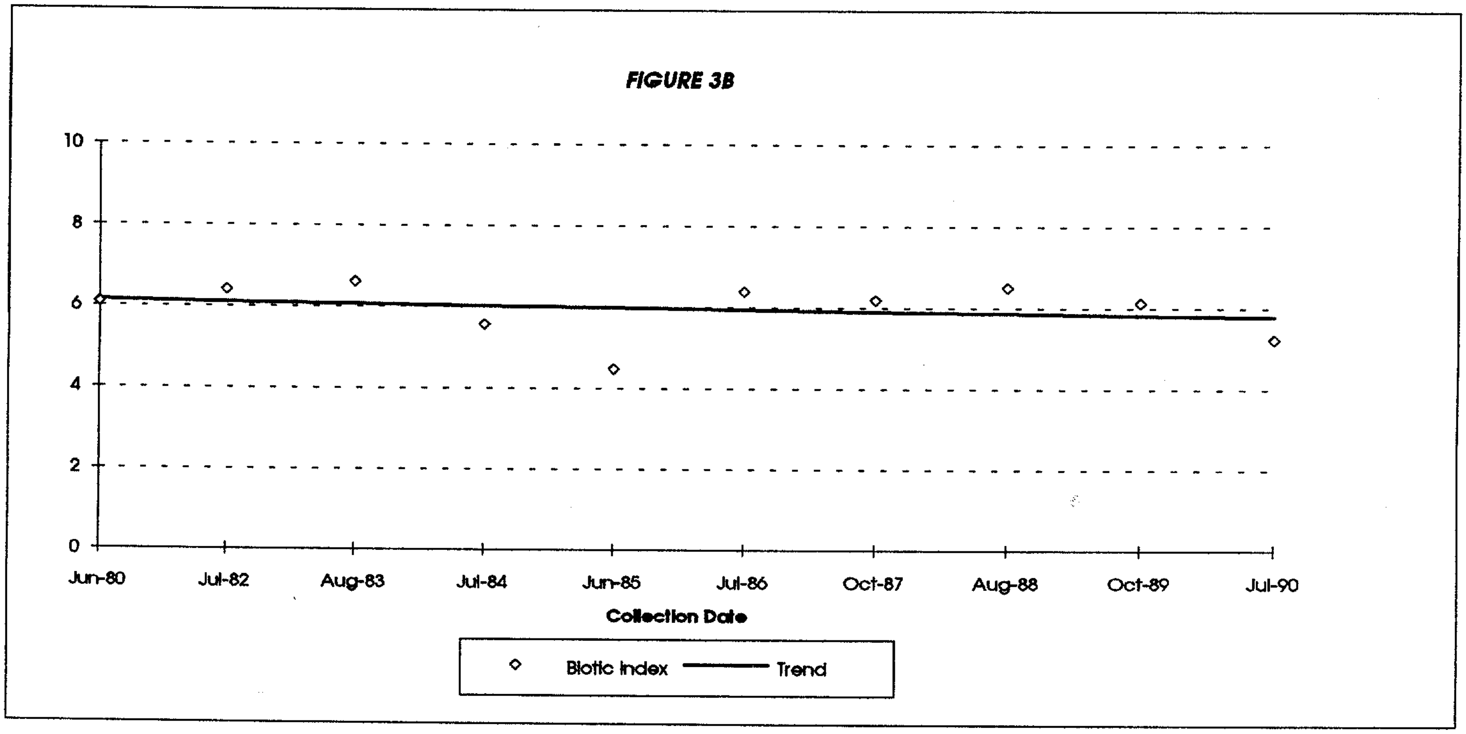
Figure 3A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: C-003 1974-1990



*-Data was not collected during 1978.
In 1990, RBP-Multihabitat sampling protocol was used.

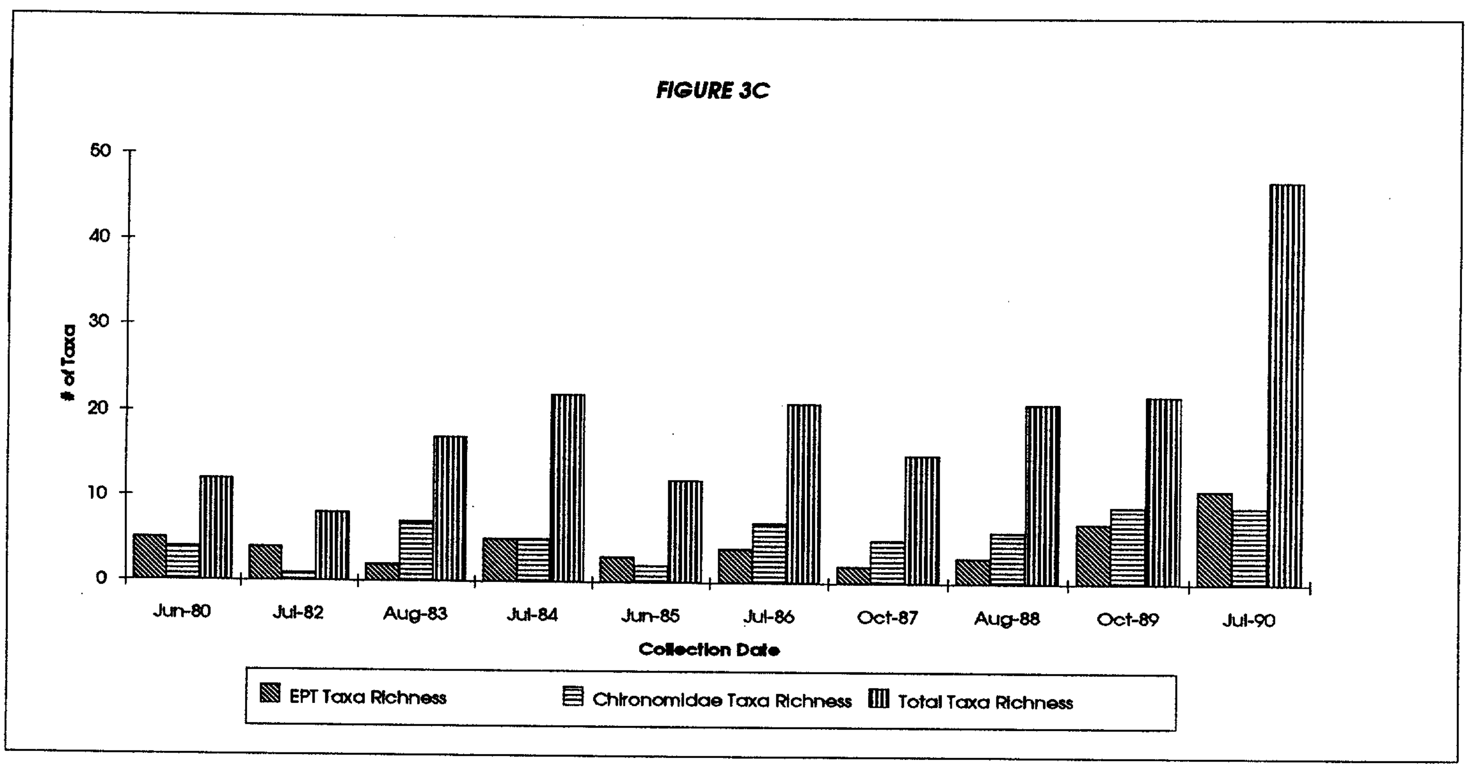
BIOTIC INDEX

AMBIENT MONITORING STATION: C-003 1980-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: C-003 1980-1990



In 1990, RBP-Multihabitat sampling protocol was used.

LITTLE CAHABA RIVER LC-1

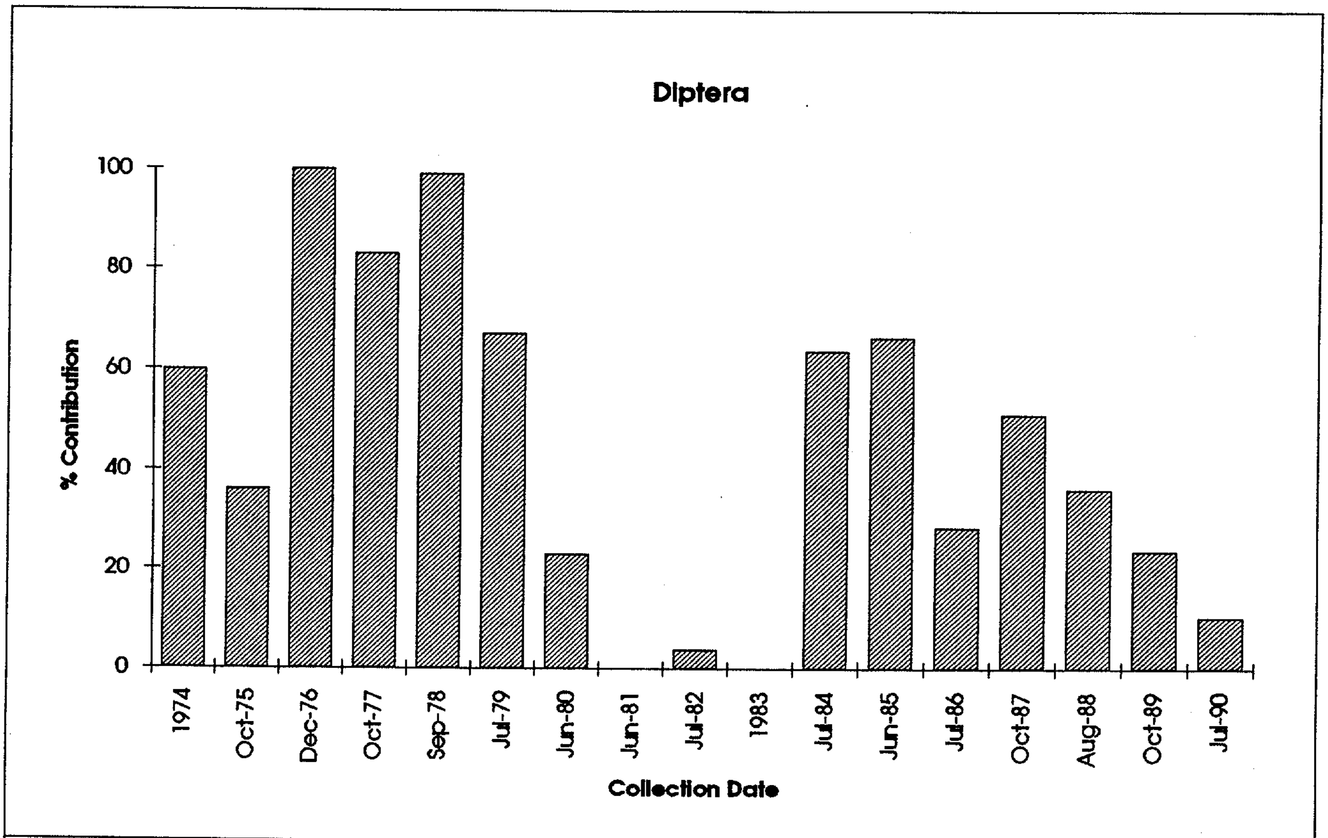
Station LC-1 is located on the Little Cahaba River in Jefferson County near the southern city limits of Leeds. The site was selected to monitor the effects of municipal discharges from Leeds and several industrial discharges. The water use classification for this section of the Little Cahaba River is 'Fish and Wildlife'.

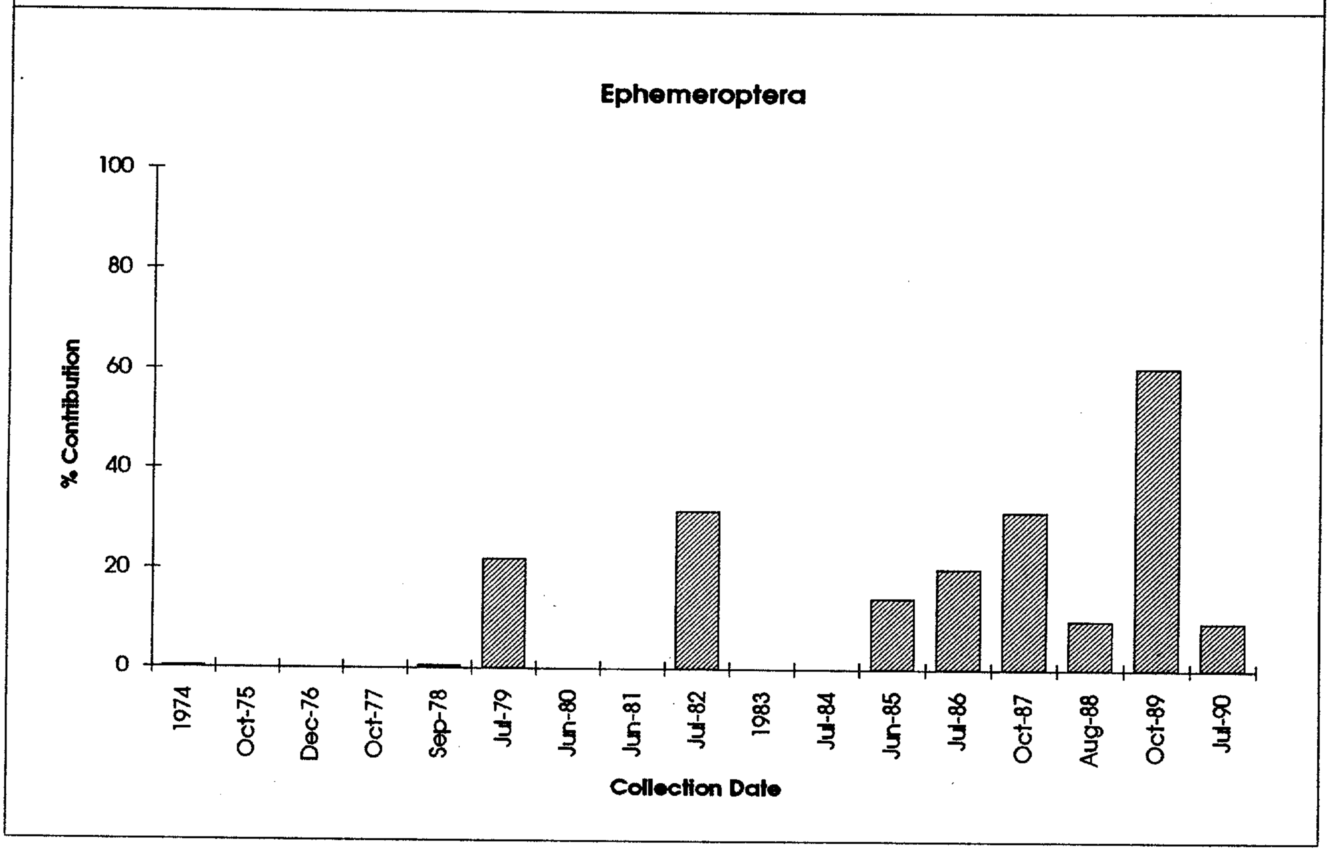
Aquatic macroinvertebrate samples were first collected from this location in 1974 (Figure 4A). Beginning in 1980, community structure appeared to shift from a community composed of one or two groups (Appendix A-4) and dominated by pollution-tolerant dipterans, toward a more evenly distributed and diverse community. However, the community structure remained dominated by one or two pollution-tolerant groups (Diptera, Mollusca) with the exception of 1989 when the dominant group was Ephemeroptera (Figure 4A). The trend in community structure is slight improvement.

The 1982 sampling year was characterized by higher than normal stream flows, therefore, lower taxa richness in all three categories would be expected due to scouring of the multiplate sampler (Figure 4C, Table 4C). EPT taxa richness and total taxa richness demonstrated minimal changes between 1985 and 1989.

Data collected during 1990 utilized the RBP-Multihabitat methodology rather than Hester-Dendy Multiplates. Therefore, the apparent improvement in the taxa richness categories did not necessarily indicate improvement in the water quality. However, a biotic index of 5.08 (Table 4B) indicates "Good" water quality with "some pollution" based on Hilsenhoff's (1987) guideline for interpreting the biotic index. The biotic index generally decreased between 1982 and 1990, indicating a slight improvement in the stream quality (Figure 4B). Analysis of data collected indicated that the water quality of the Little Cahaba River at station LC-1 has improved slightly during the monitoring period.

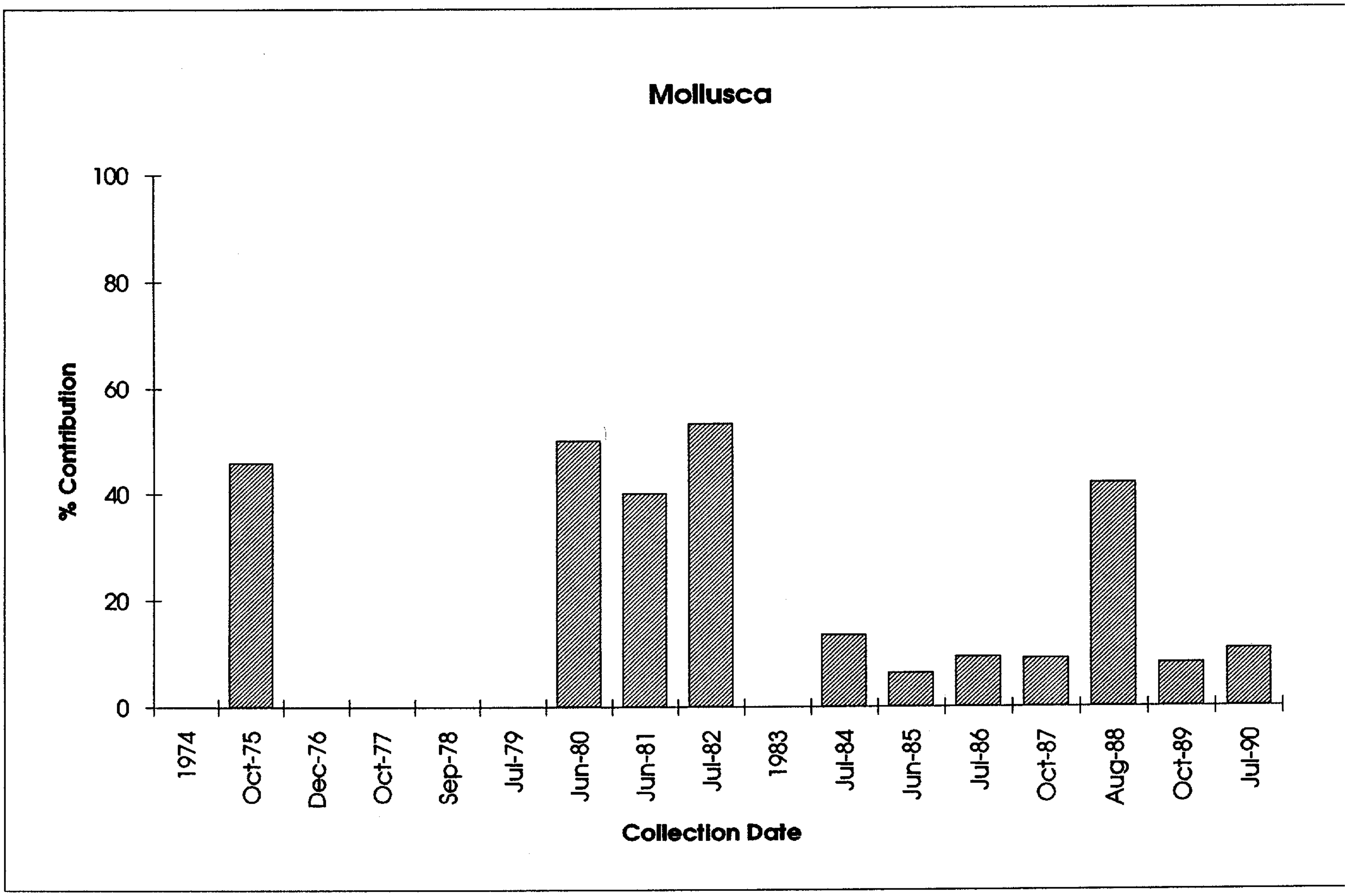
Figure 4A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: LC-001 1974-1990





*-Data was not collected during 1983.
In 1990, RBP-Multihabitat sampling protocol was used.

Figure 4A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: LC-001 1974-1990

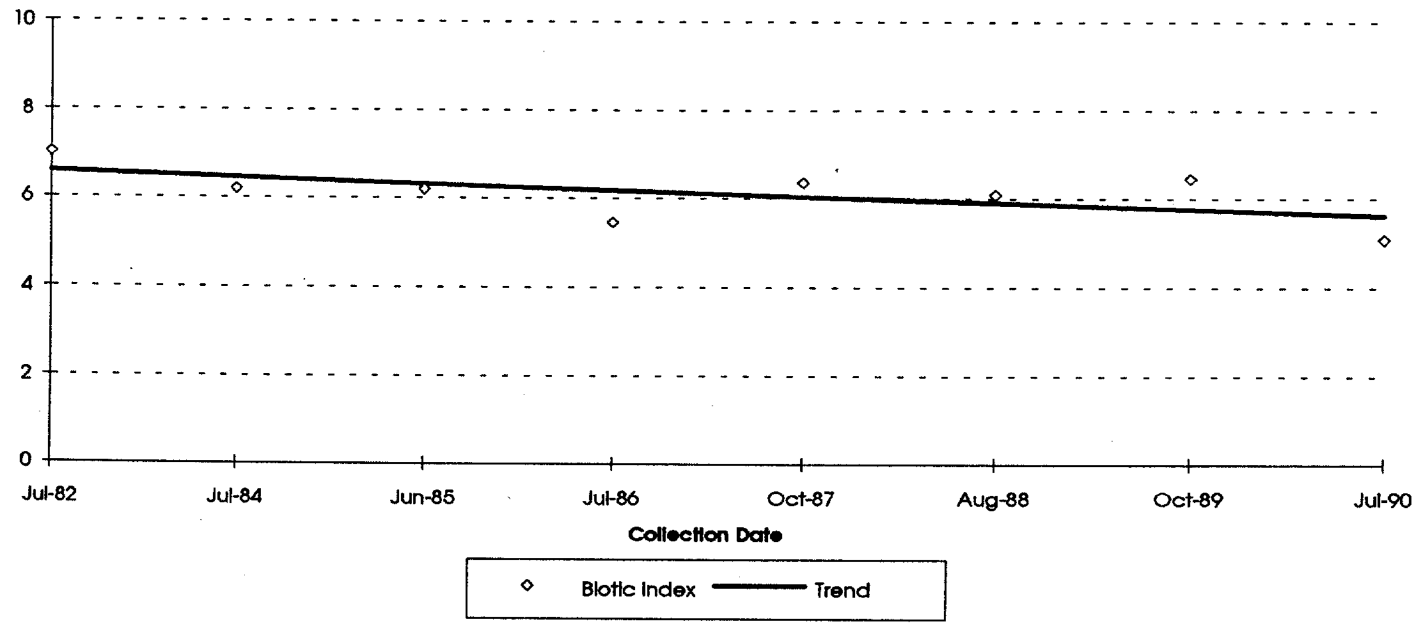


*-Data was not collected during 1983.
In 1990, RBP-Multihabitat sampling protocol was used.

BIOTIC INDEX

AMBIENT MONITORING STATION: LC-001 1982-1990

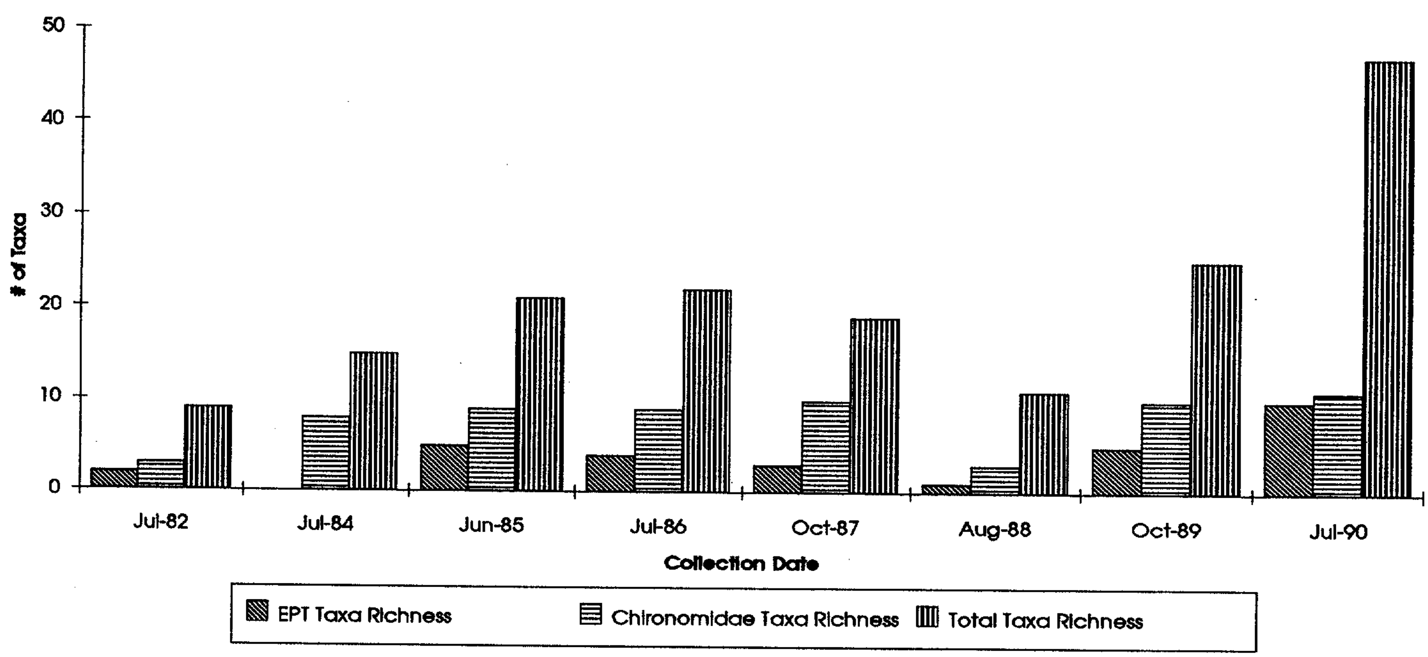
FIGURE 4B



TAXA RICHNESS

AMBIENT MONITORING STATION: LC-001 1982-1990

FIGURE 4C



In 1990, RBP-Multihabitat sampling protocol was used.

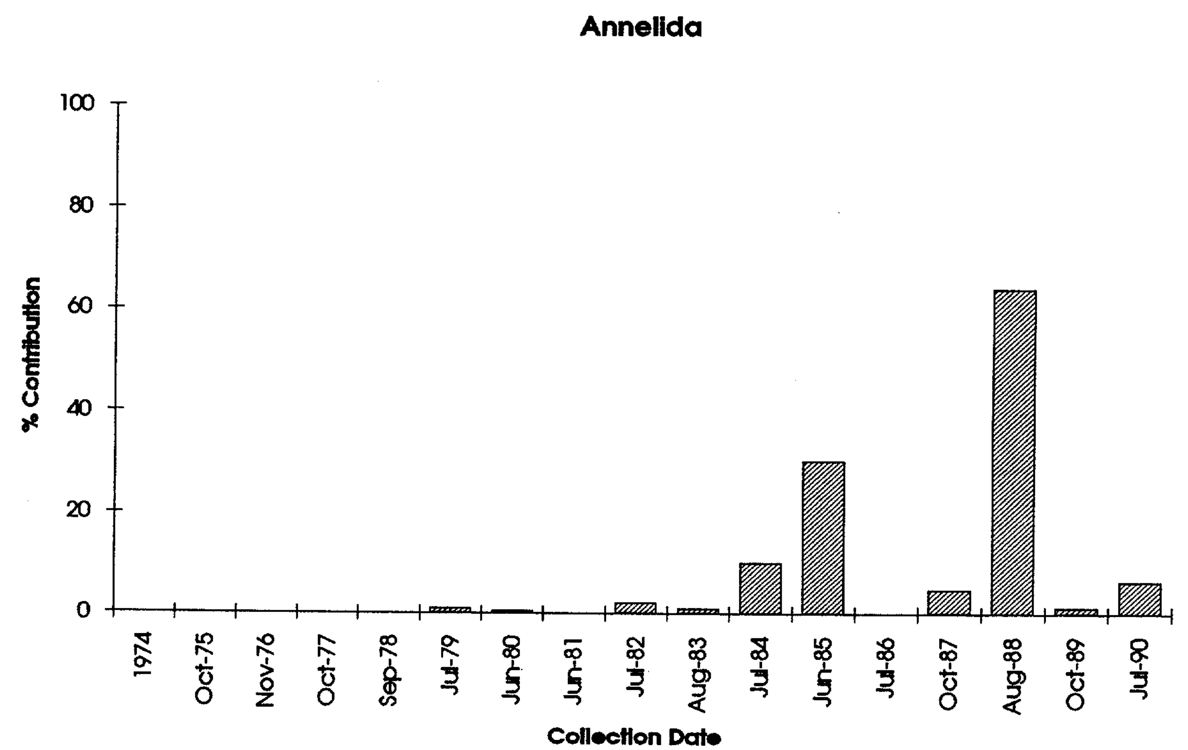
SHADES CREEK SH-1 & SH-1a

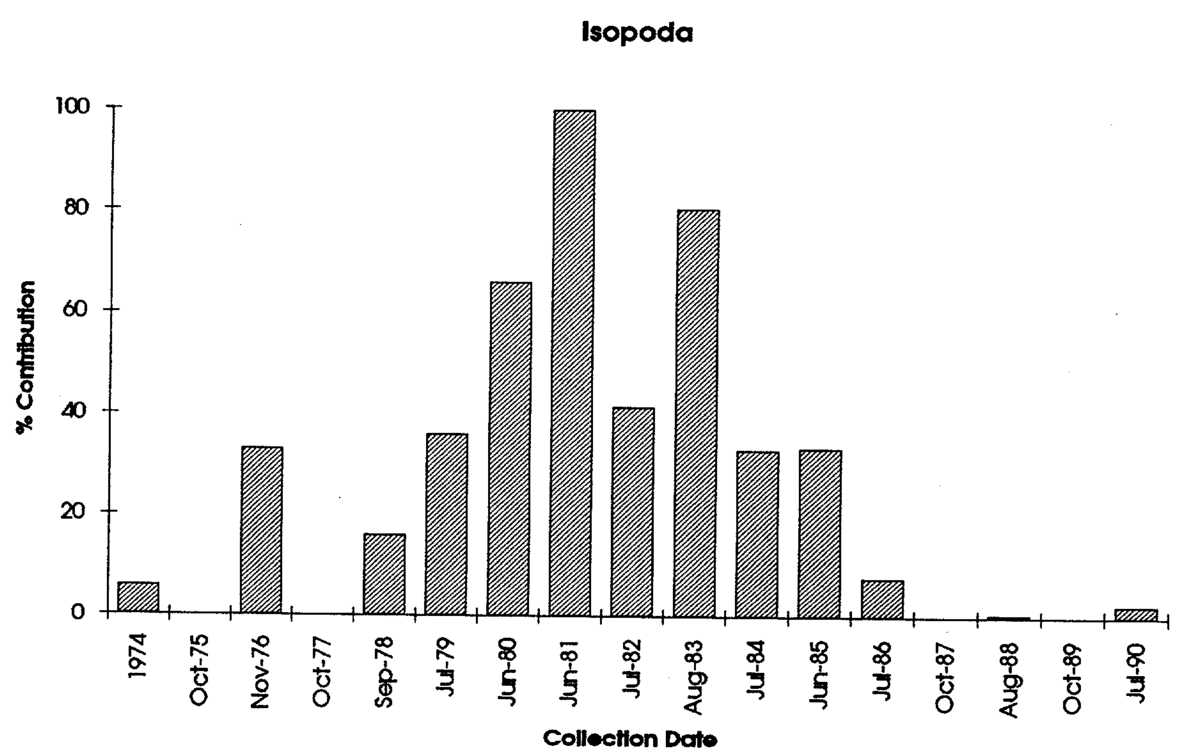
The Shades Creek station was originally located at the Alabama Highway 150 bridge (SH-1) in Jefferson County. In 1978, it was relocated (for safety reasons) to the Jefferson County Road 6 bridge (SH-1a), approximately one mile downstream of the original location. The stations were chosen to monitor the effects of municipal discharges. In 1974, this site had a water use classification of 'Agricultural and Industrial Water Supply'. The municipal discharges were removed from Shades Creek and, in March of 1986, this section was upgraded to a 'Fish and Wildlife' classification. There are currently no permitted discharges to this creek.

Analysis of early data collected at Shades Creek (1974 to 1984) indicated that the macroinvertebrate community was composed of one or two pollution-tolerant groups (Diptera, Isopoda) (Figure 5A). In 1986, Ephemeroptera were collected for the first time and continued to be present through the July 1990 collection. Collections after 1985 showed improvement in the balance and diversity of taxonomic groups.

The biotic index (Figure 5B) showed a substantial shift toward a more pollution-intolerant population. The EPT taxa richness, Chironomidae and total taxa richness (Figure 5C) also experienced an overall improvement. The community structure and metrics used to analyze the data all suggested that there has been a substantial improvement in the water quality of Shades Creek.

Figure 5A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: SH-001 & SH-001a 1974-1990



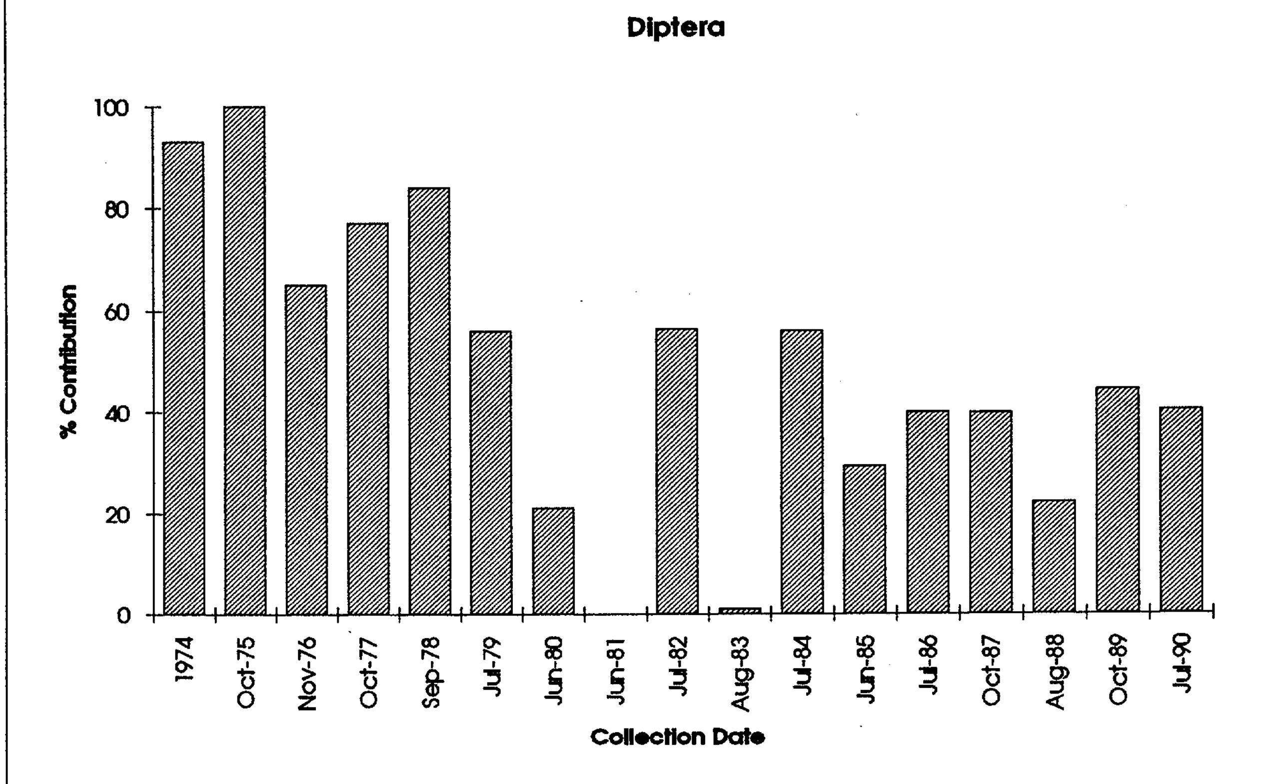


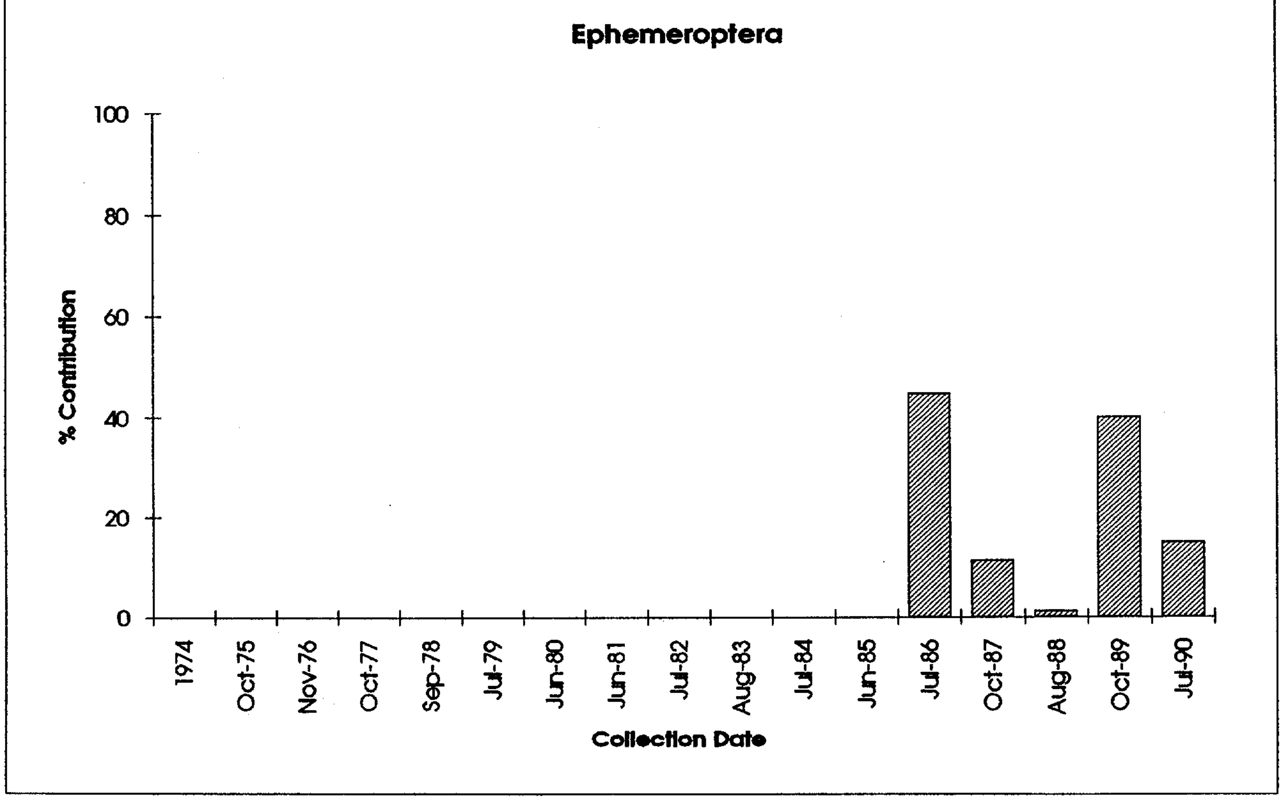
*- In 1990, RBP-Multihabitat sampling protocol was used.

Figure 5A

% Contribution of Dominant Orders*

AMBIENT MONITORING STATION: SH-001 & SH-001a 1974-1990

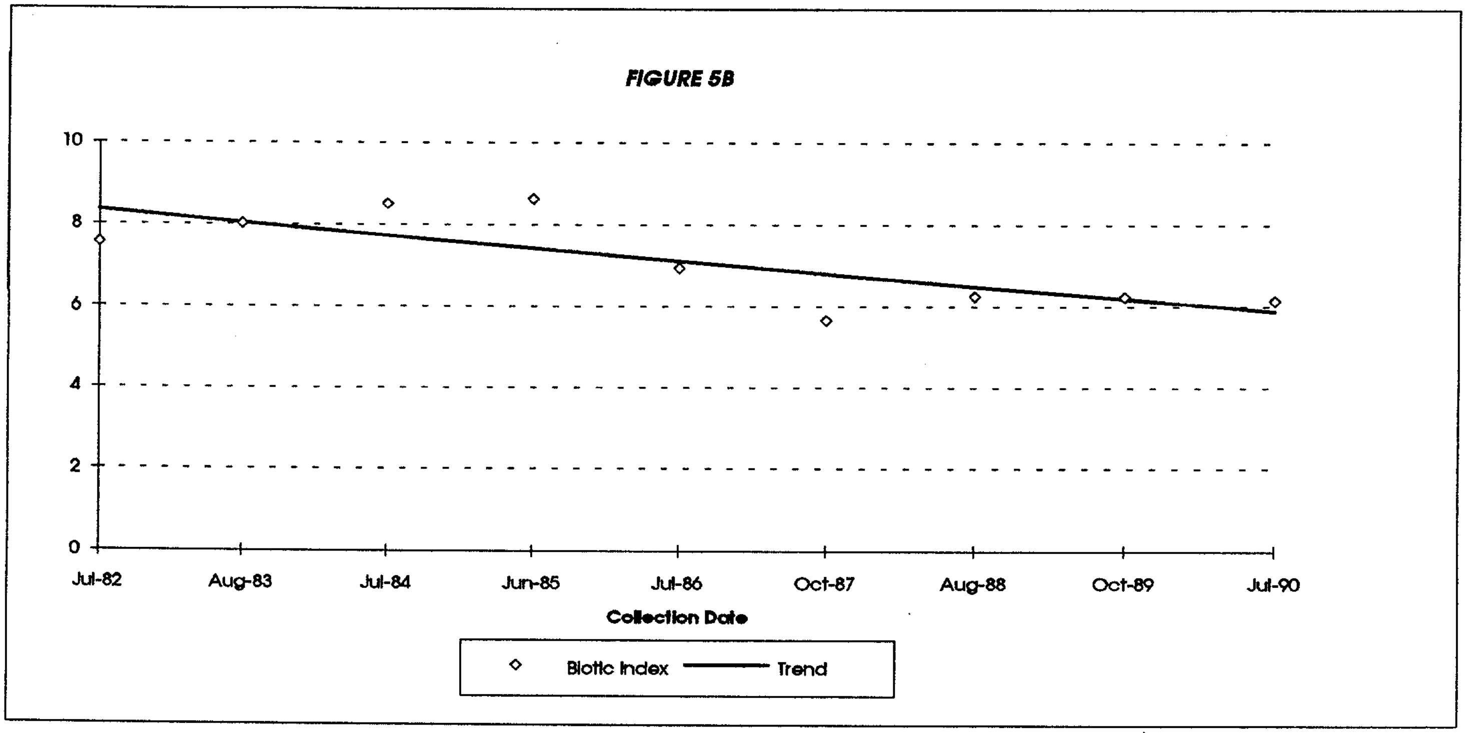




*- In 1990, RBP-Multihabitat sampling protocol was used.

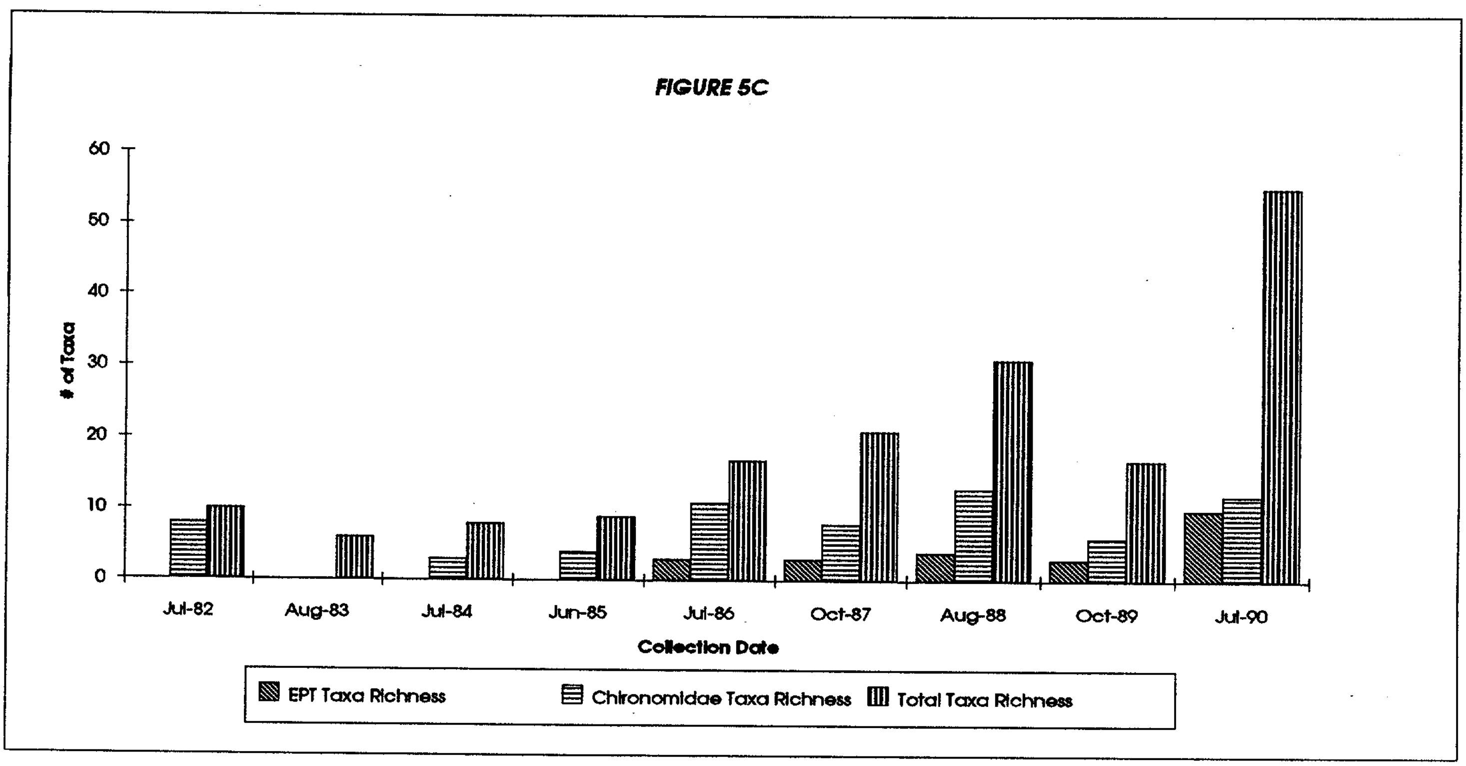
BIOTIC INDEX

AMBIENT MONITORING STATION: SH-001 & SH-001a 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: SH-001 & SH-001a 1982-1990



In 1990, RBP-Multihabitat sampling protocol was used.

TALLAPOOSA RIVER DRAINAGE BASIN

SUGAR CREEK S-1

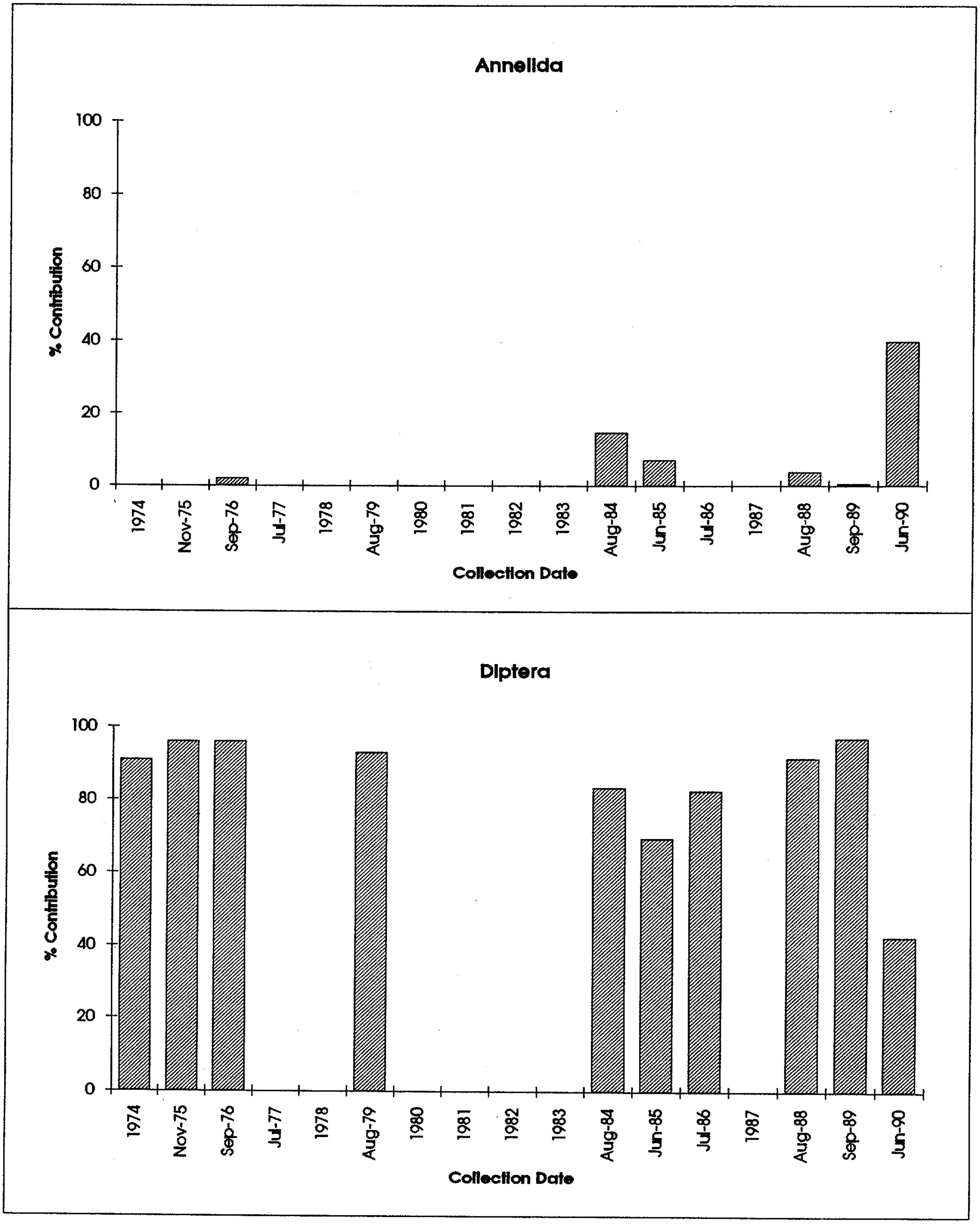
Station S-1 is located on Sugar Creek at the Alabama Highway 63 bridge south of Alexander City in Tallapoosa County. The site is located downstream from a municipal discharge and a textile plant. This section of Sugar Creek has a water use classification of 'Agricultural and Industrial Water Supply'.

Since 1974, community structure has been dominated by the pollution-tolerant dipteran group (Figure 6A) with the exception of 1977 when the dominant group was molluscs (Appendix A-6). When the molluscan group is dominant it may also indicate a degraded aquatic community. There were few taxonomic groups represented in the macroinvertebrate communities collected (Appendix A-6).

The EPT taxa richness, Chironomidae and total taxa richness demonstrated minimal changes over the 1982 to 1990 sampling period (Figure 5C). The trend in the biotic index from 1984 - 1989 indicated a general increase in the pollution tolerance of the macroinvertebrate community (Figure 5C).

Data collected during 1990 utilized the RBP-Multihabitat methodology rather than Hester-Dendy multiplate samplers; therefore, the apparent improvement in the taxa richness categories does not necessarily indicate improvement in the water quality. However, a biotic index of 8.22 (Table 5B) is considered to indicate "Poor" water quality with "very significant pollution" based on Hilsenhoff's (1987) guideline for interpreting the biotic index. The general increase in the biotic index as well as the overall low taxa richness, especially EPT taxa richness, and the general dominance of the Dipteran group indicate that there has been a slight deterioration in the water quality of the Sugar Creek S-1 ambient monitoring station.

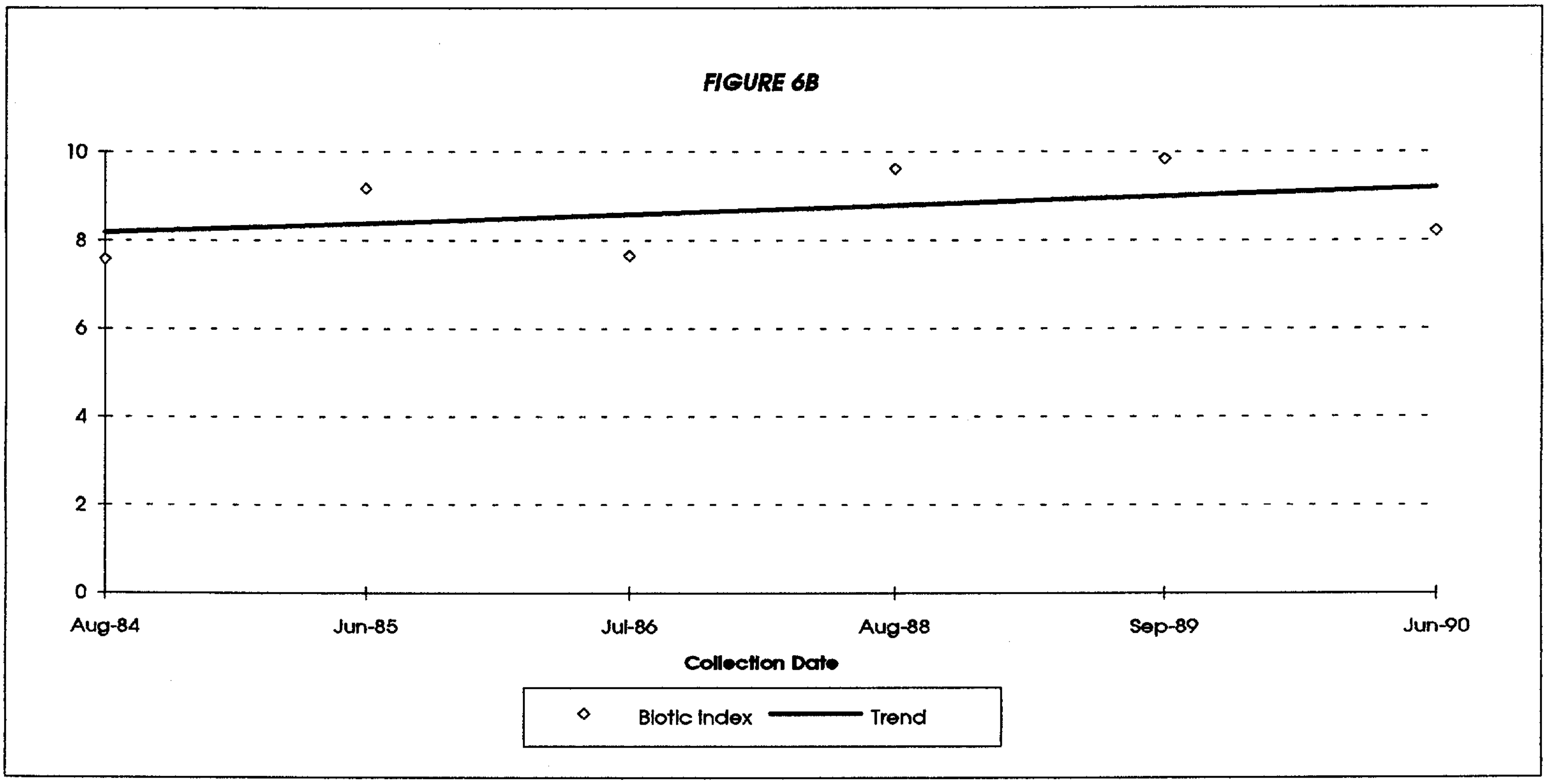
Figure 6A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: S-001 1974-1990



*-Data was not collected during 1978, 1980, 1981, 1982, 1983, and 1987.
In 1990, RBP-Multihabitat sampling protocol was used.

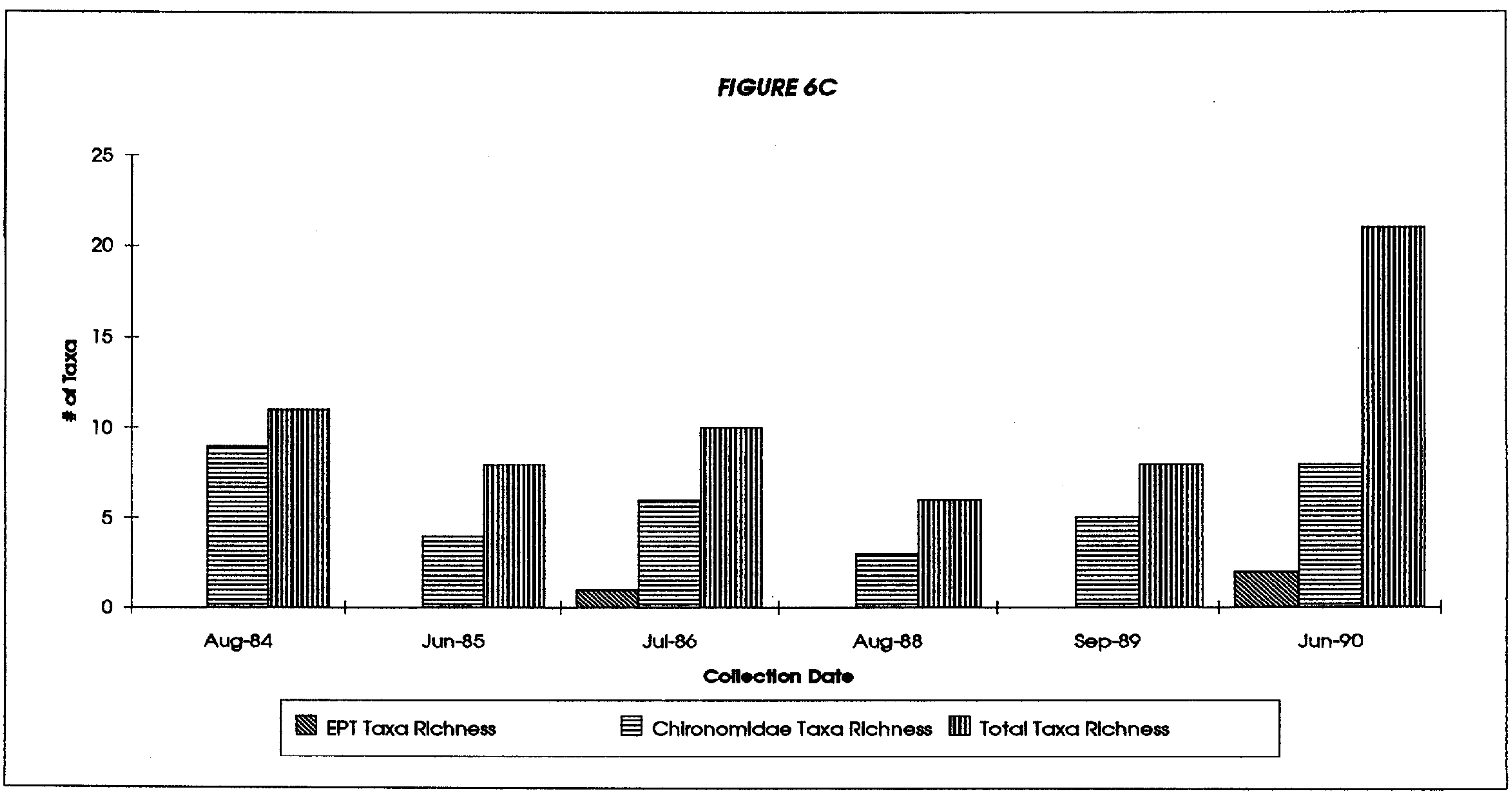
BIOTIC INDEX

AMBIENT MONITORING STATION: S-001 1984-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: S-001 1984-1990



In 1990, RBP-Multihabitat sampling protocol was used.

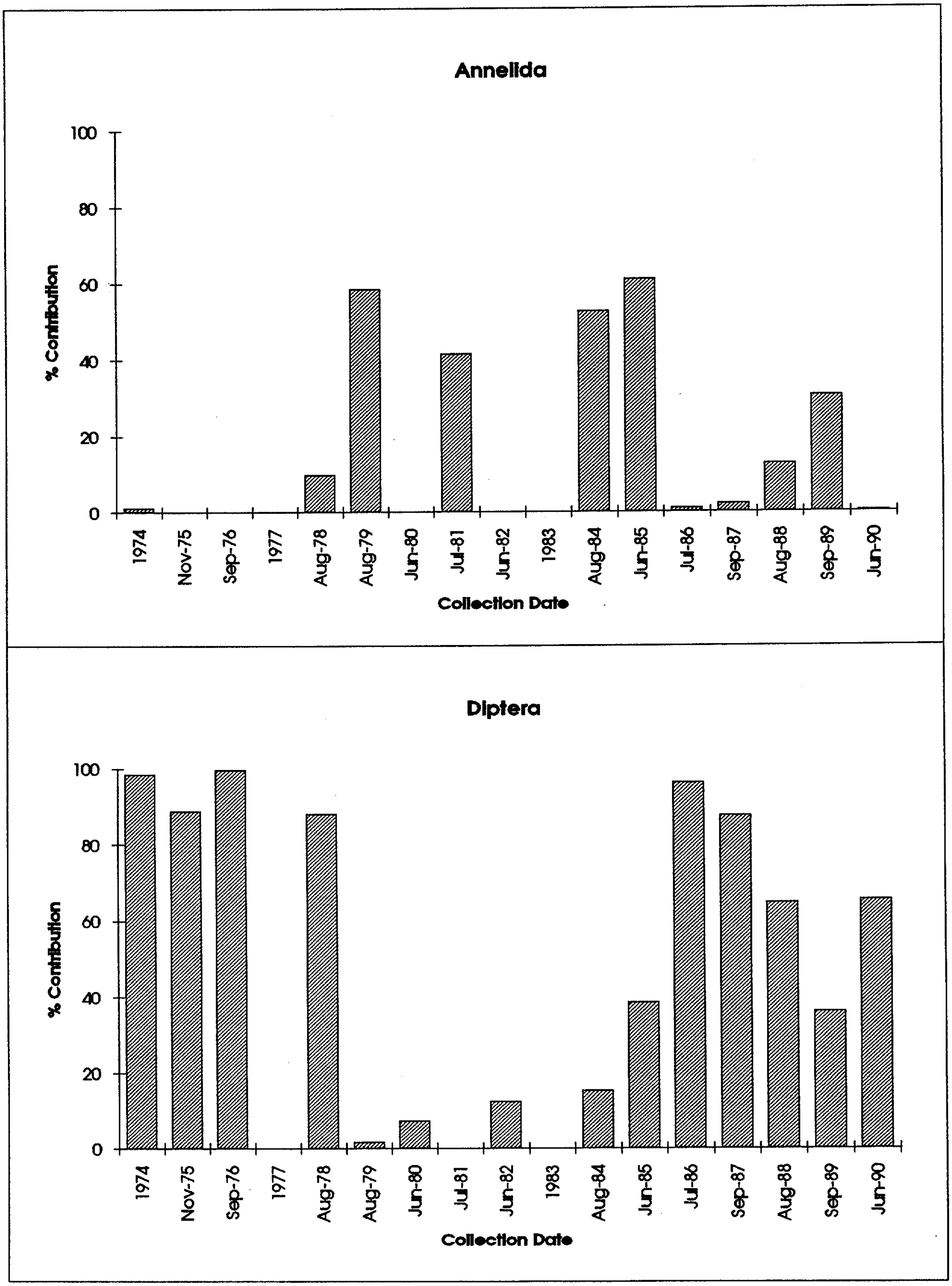
SOUGAHATCHEE CREEK SO-1

Station SO-1 is located at the Lee County 35 Road bridge, north of Auburn, Alabama. Its' purpose is to monitor the effects of a municipal discharge and a textile plant. In 1974, this location on Sougahatchee Creek had a water use classification of 'Navigation'. In December of 1977, the stream reach was upgraded to a water use classification of 'Agricultural and Industrial Water Supply'.

The structure of the aquatic macroinvertebrate community illustrated in Appendix A-7 showed minimal changes and appeared to be generally dominated by one or two pollution-tolerant groups (Figure 7A) (Annelida, Diptera). The balance of taxonomic groups collected after 1986 appeared to have improved slightly.

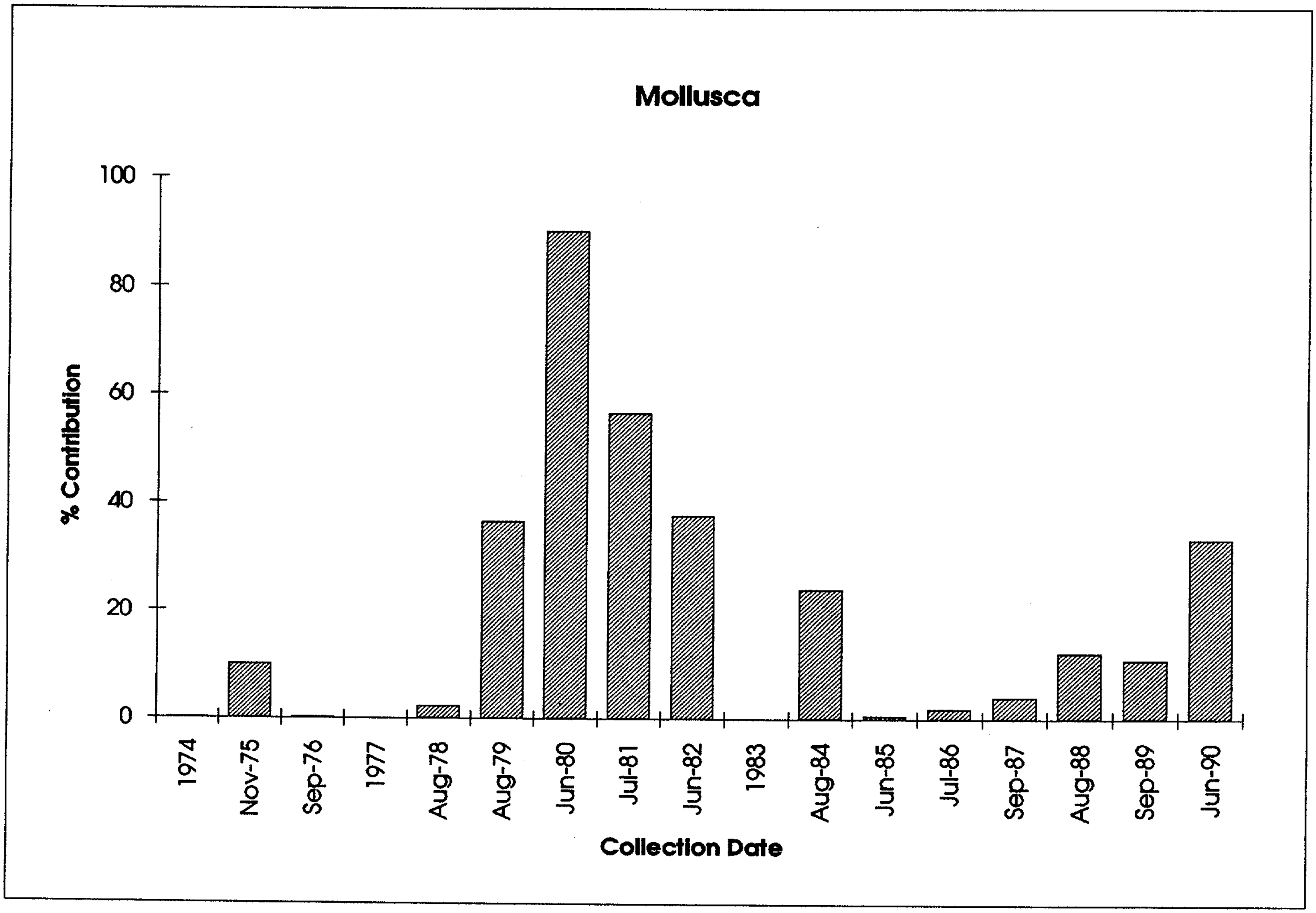
The biotic index, as illustrated in Figure 7B, showed a substantial shift toward a more pollution-intolerant macroinvertebrate community. The EPT taxa richness, Chironomidae and total taxa richness metrics (Figure 7C) also showed substantial increases. The community structure and metrics used to analyze the data all suggested that there has been a substantial improvement in the water quality of Sougahatchee Creek.

Figure 7A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: SO-001 1974-1990



*- Data was not collected during 1977 and 1983.
In 1990, RBP-Multihabitat sampling protocol was used.

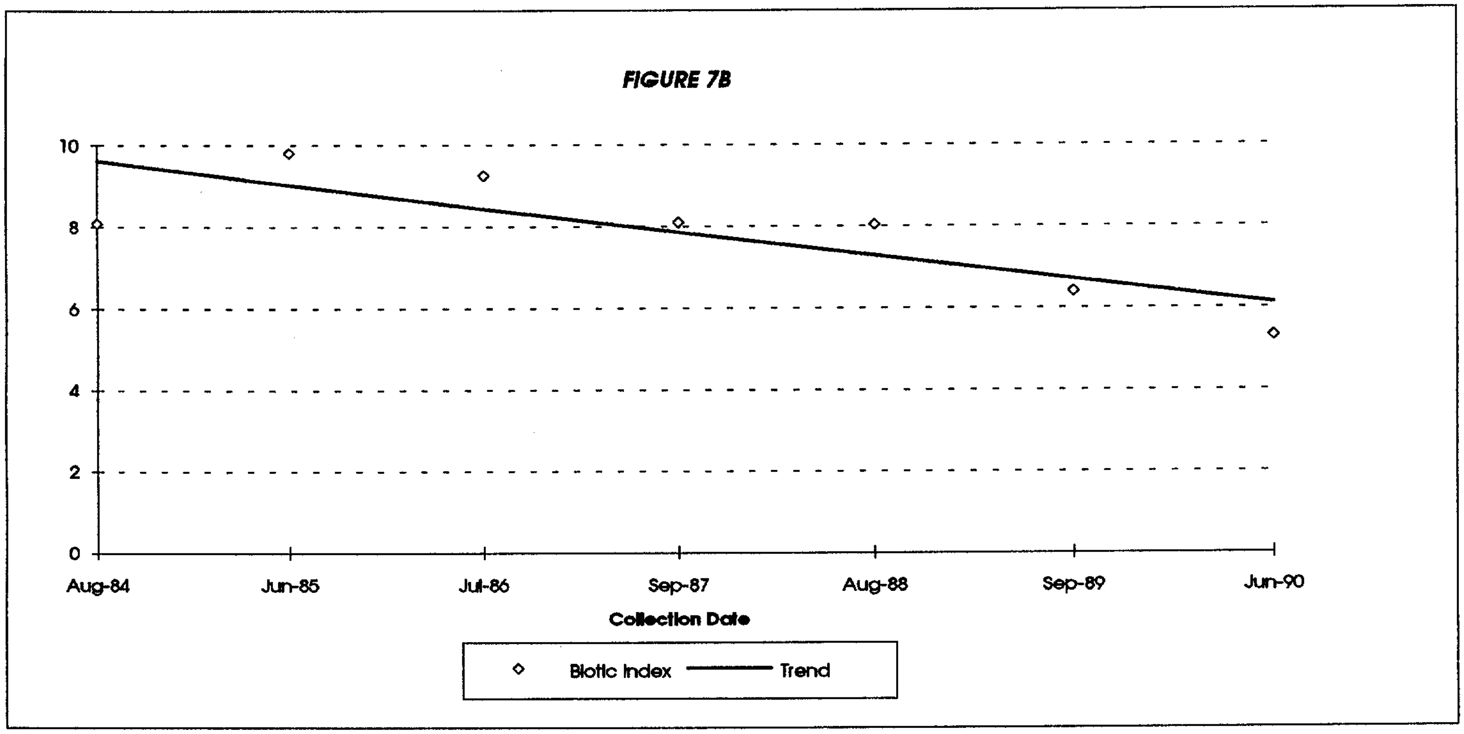
Figure 7A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: SO-001 1974-1990



*- Data was not collected during 1977 and 1983.
In 1990, RBP-Multihabitat sampling protocol was used.

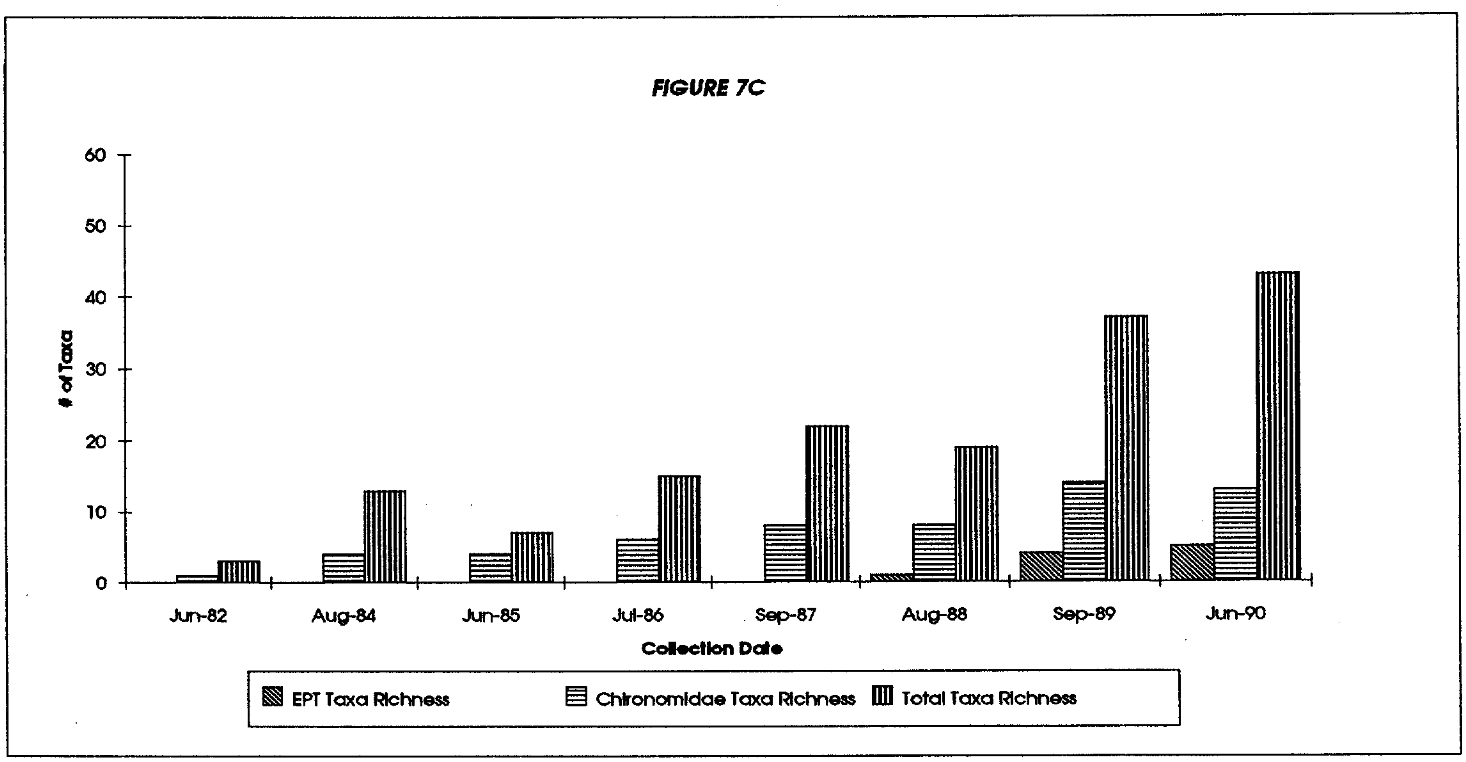
BIOTIC INDEX

AMBIENT MONITORING STATION: SO-001 1984-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: SO-001 1982-1990



In 1990, RBP-Multihabitat sampling protocol was used.

WARRIOR RIVER DRAINAGE BASIN

VALLEY CREEK VA-1

Station Va-1 is located at the Jefferson County Road 36 bridge. Sampling at this site monitors the effects of several industries discharging to Valley Creek. In 1974, the segment of Valley Creek extending upstream from this station to its confluence with Opossum Creek was classified for 'Treated Waste Transportation'. In 1977 this segment was upgraded to an 'Industrial Operations' water use classification.

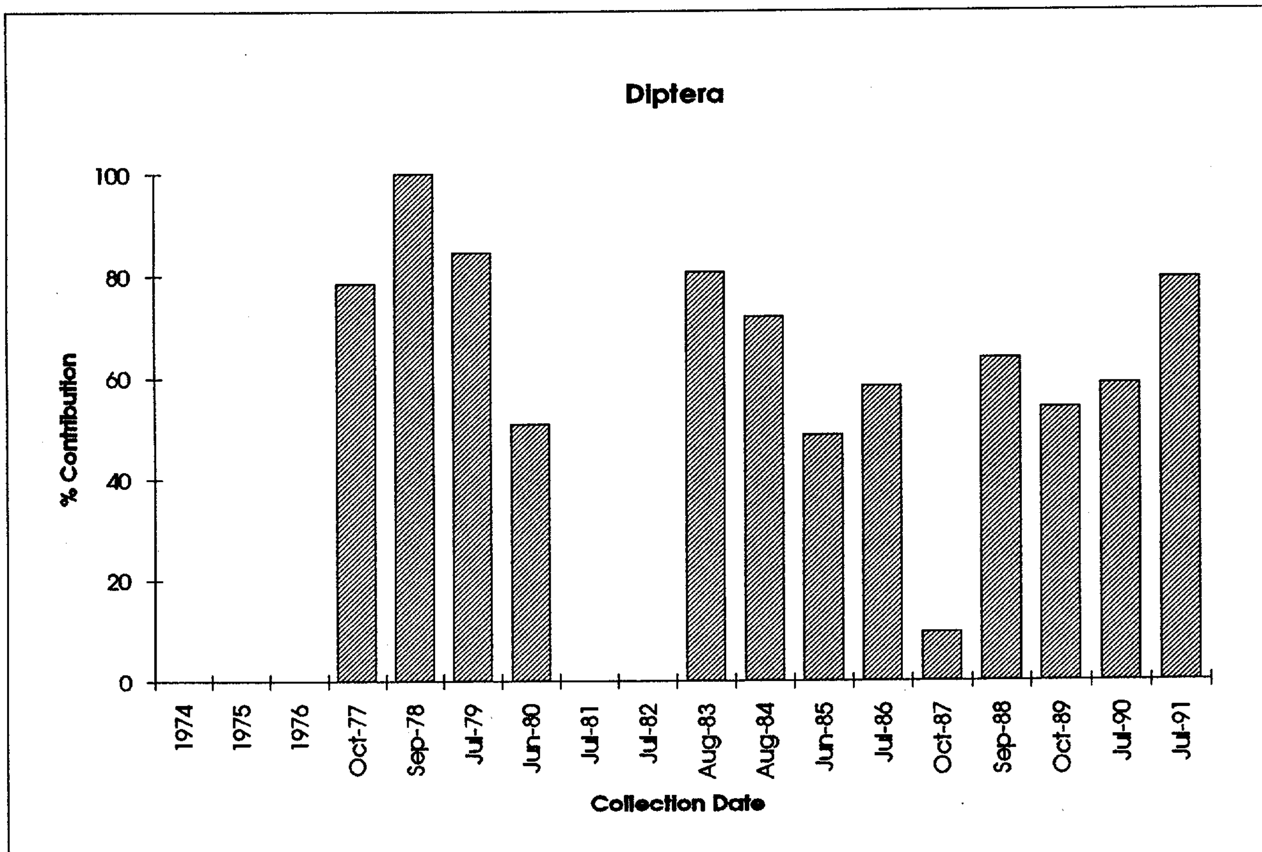
The structure of the aquatic macroinvertebrate communities collected since 1977 was generally dominated by a pollution-tolerant group (Diptera) (Figure 8A). Odonata and Mollusca comprised the entire 1981 sample. However, the number of groups collected after 1981 improved over previous samples (Appendix A-8). Ephemeroptera were collected from 1983 to 1988 and again in 1991.

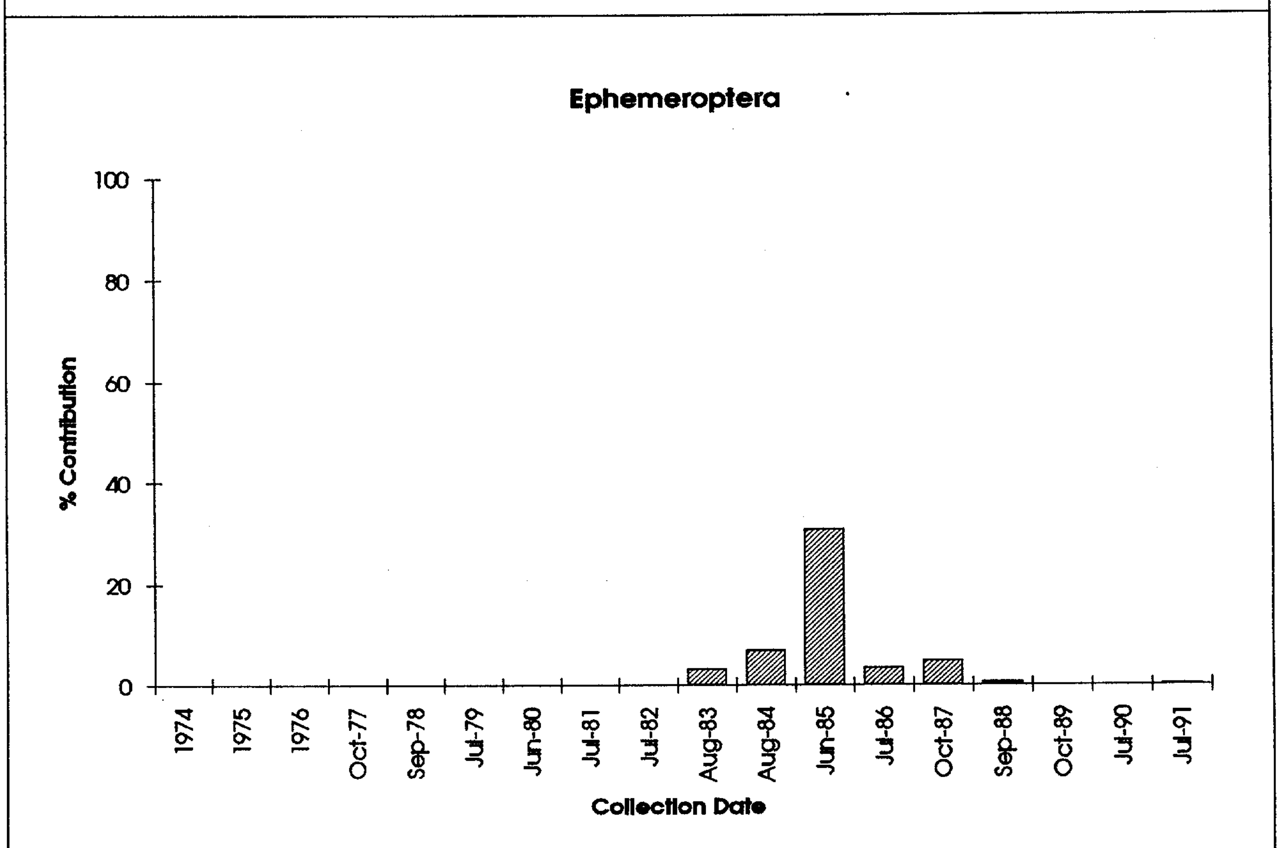
The biotic index for the 1982 to 1991 sampling period, as illustrated by the trend line in Figure 8B, showed a improvement. However, little change is noted in data taken from 1985 to 1991. Total taxa richness has shown a small improvement, while the EPT taxa richness exhibited no change (Figure 8C). The community structure and metrics used to analyze the data suggest that there has been a slight improvement in the water quality of Valley Creek.

Figure 8A

% Contribution of Dominant Orders*

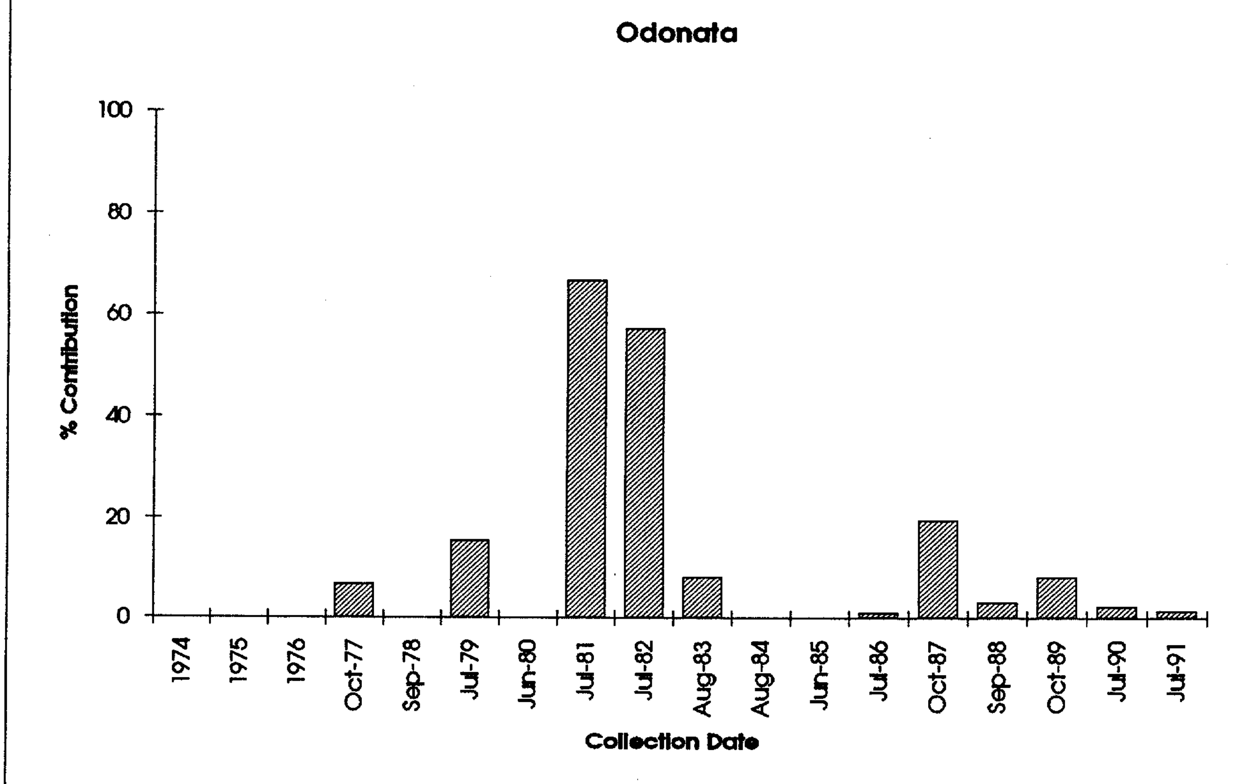
AMBIENT MONITORING STATION: VA-001 1974-1991

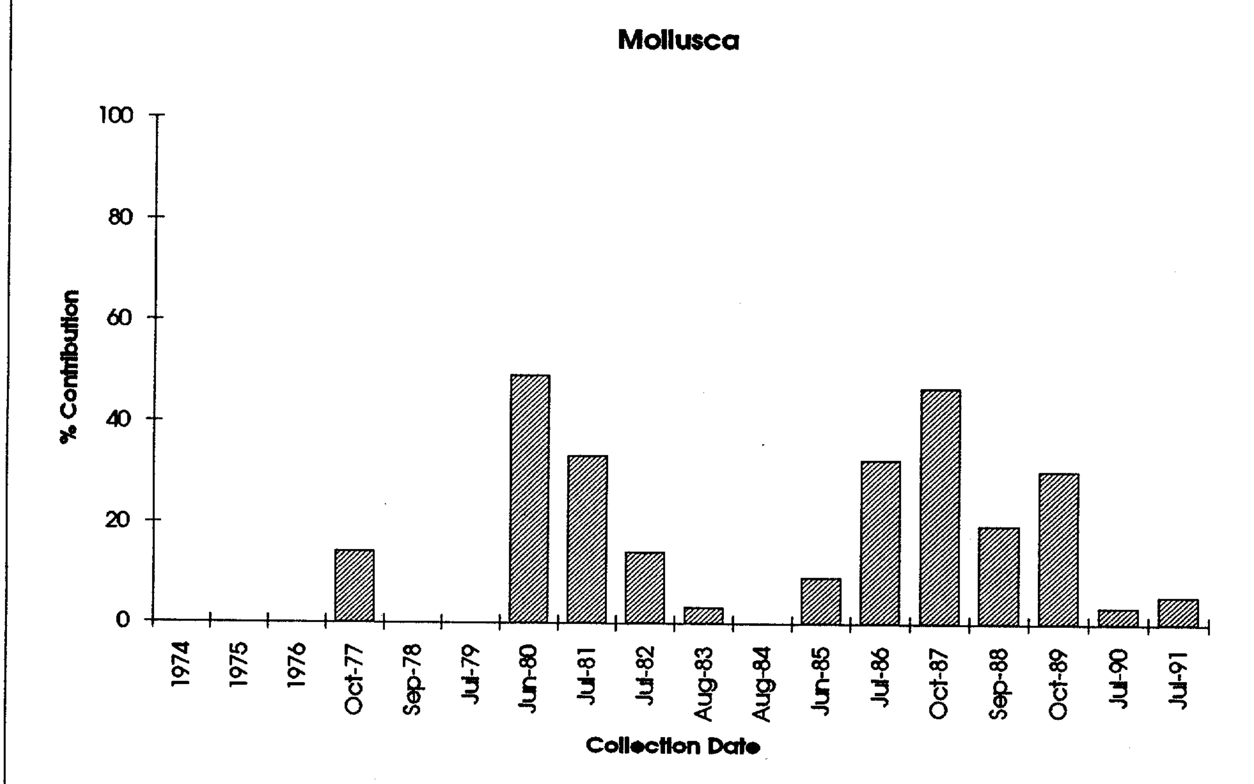




*-Data was not collected during 1974, 1975, and 1976.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

Figure 8A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: VA-001 1974-1991

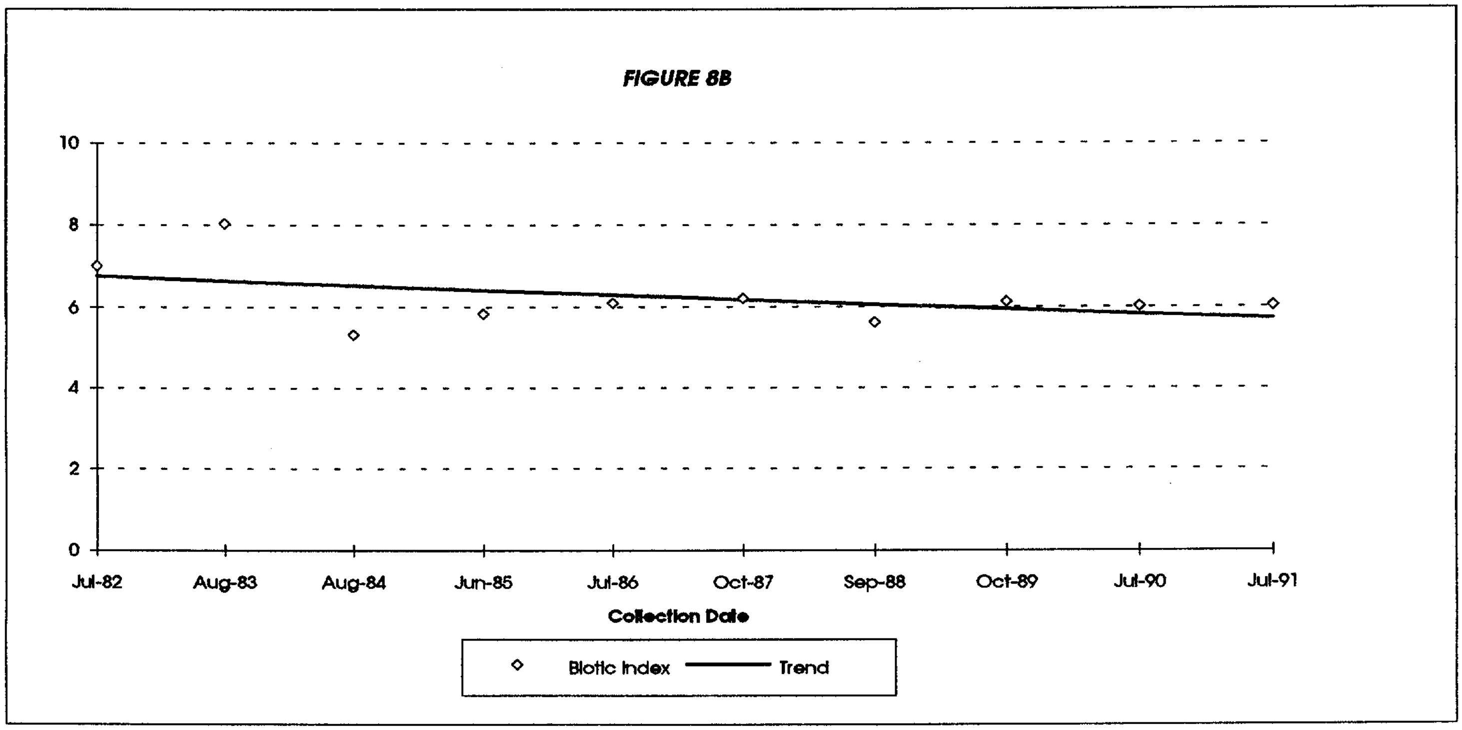




*-Data was not collected during 1974, 1975, and 1976.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

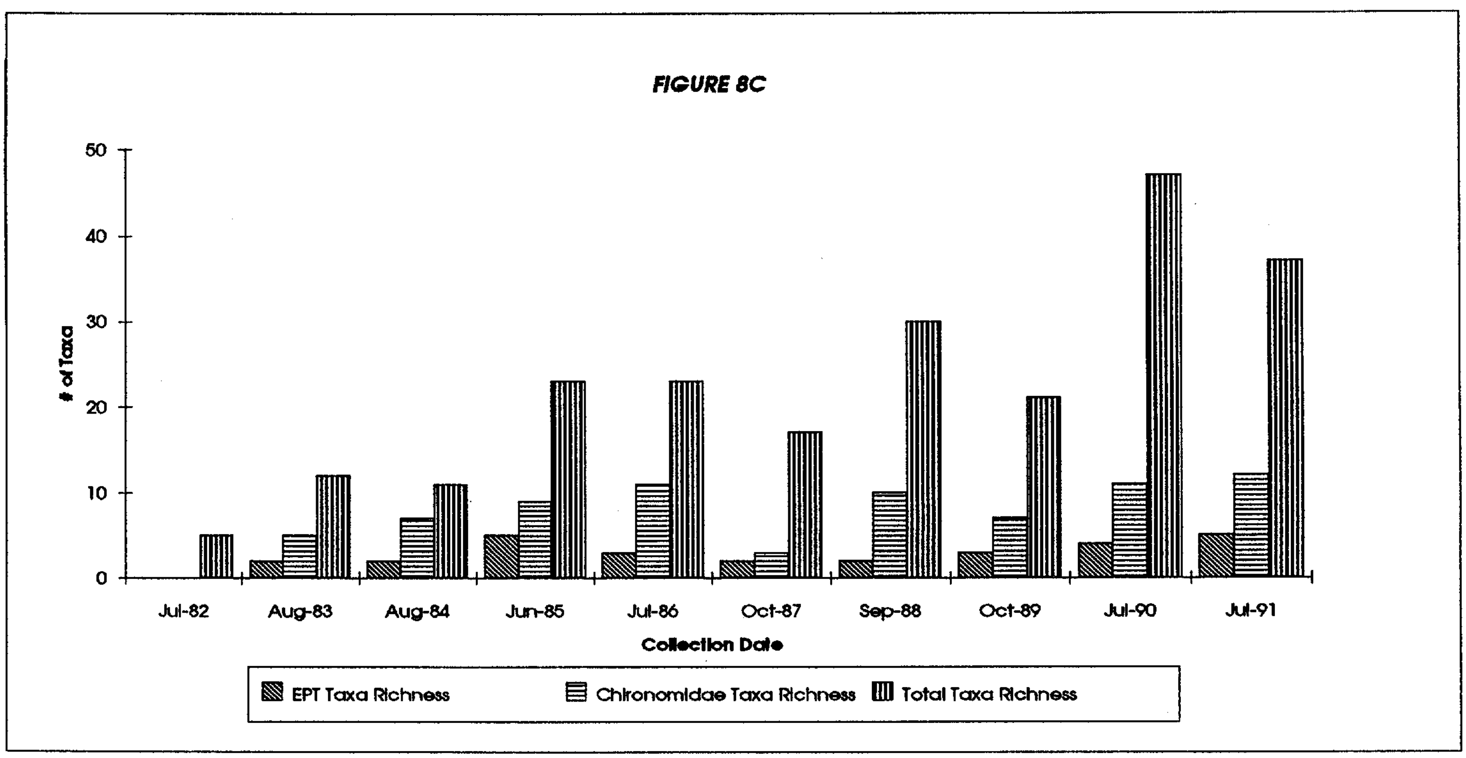
BIOTIC INDEX

AMBIENT MONITORING STATION: VA-001 1982-1991



TAXA RICHNESS

AMBIENT MONITORING STATION: VA-001 1982-1991



In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

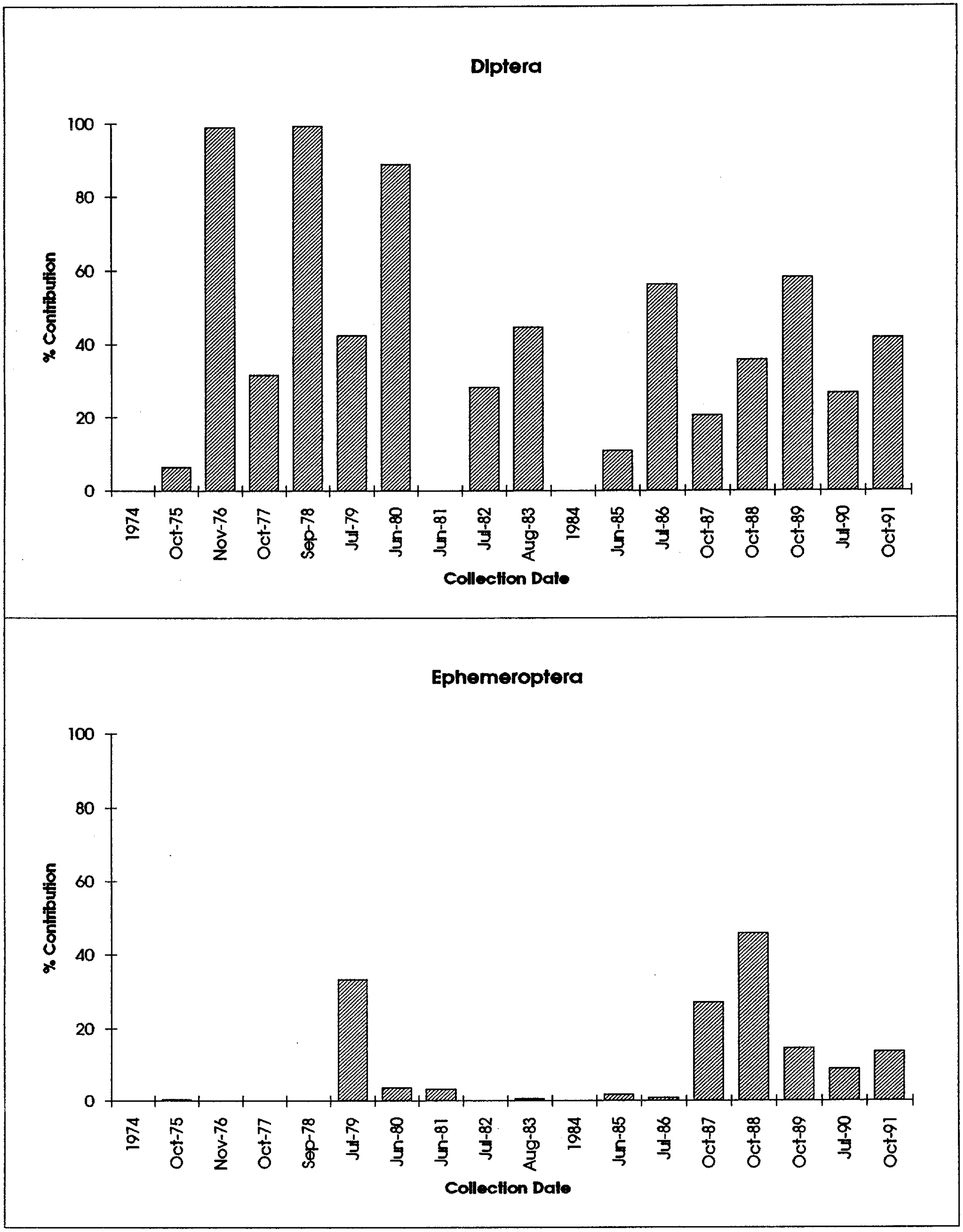
VILLAGE CREEK VI-1

Station Vi-1 is located in Jefferson County at the FAS-12 Road west of Mulga. Numerous industrial and municipal point sources as well as non-point sources are in the watershed. The station is downstream of Bayview Lake and serves to monitor the water quality of Village Creek below the dam. This stream segment has a water use classification of 'Agricultural and Industrial Water Supply' (A&I).

Analysis of early data collected at Village Creek (1975 to 1981) indicated that the macroinvertebrate community was composed of one or two pollution-tolerant or facultative groups (Diptera, Mollusca) (Figure 9A). Later collections showed an improvement in number and the balance of the taxonomic groups (Figure 9A, Appendix A-9).

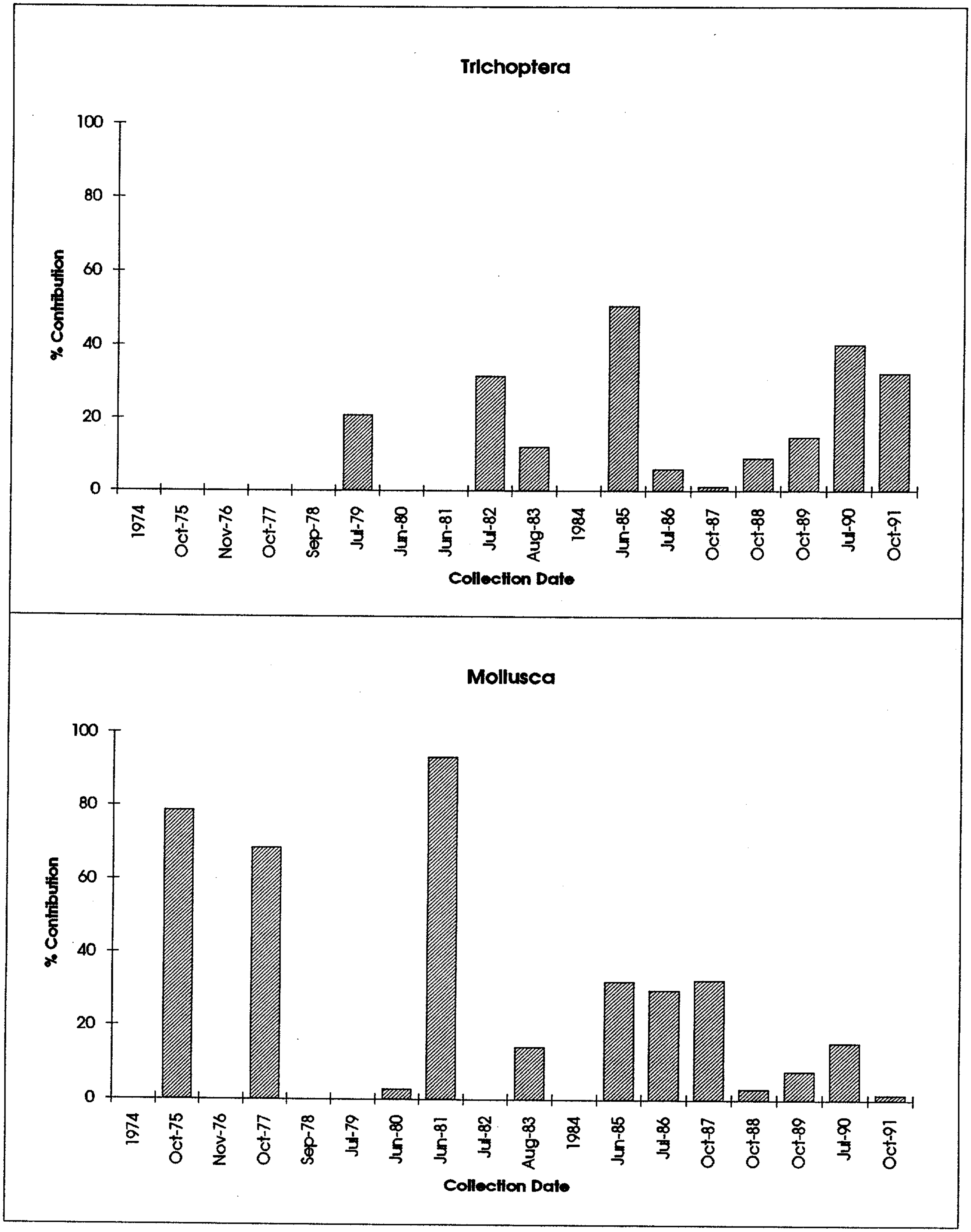
The biotic index (Figure 9B) showed a substantial shift toward a more pollution-intolerant population. The EPT taxa richness, Chironomidae and total taxa richness metrics (Figure 9C) also experienced an overall increase. The community structure and metrics used to analyze the data suggest that there has been a substantial improvement in the water quality of Village Creek.

Figure 9A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: VI-001 1974-1991



*-Data was not collected during 1974, and 1984.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

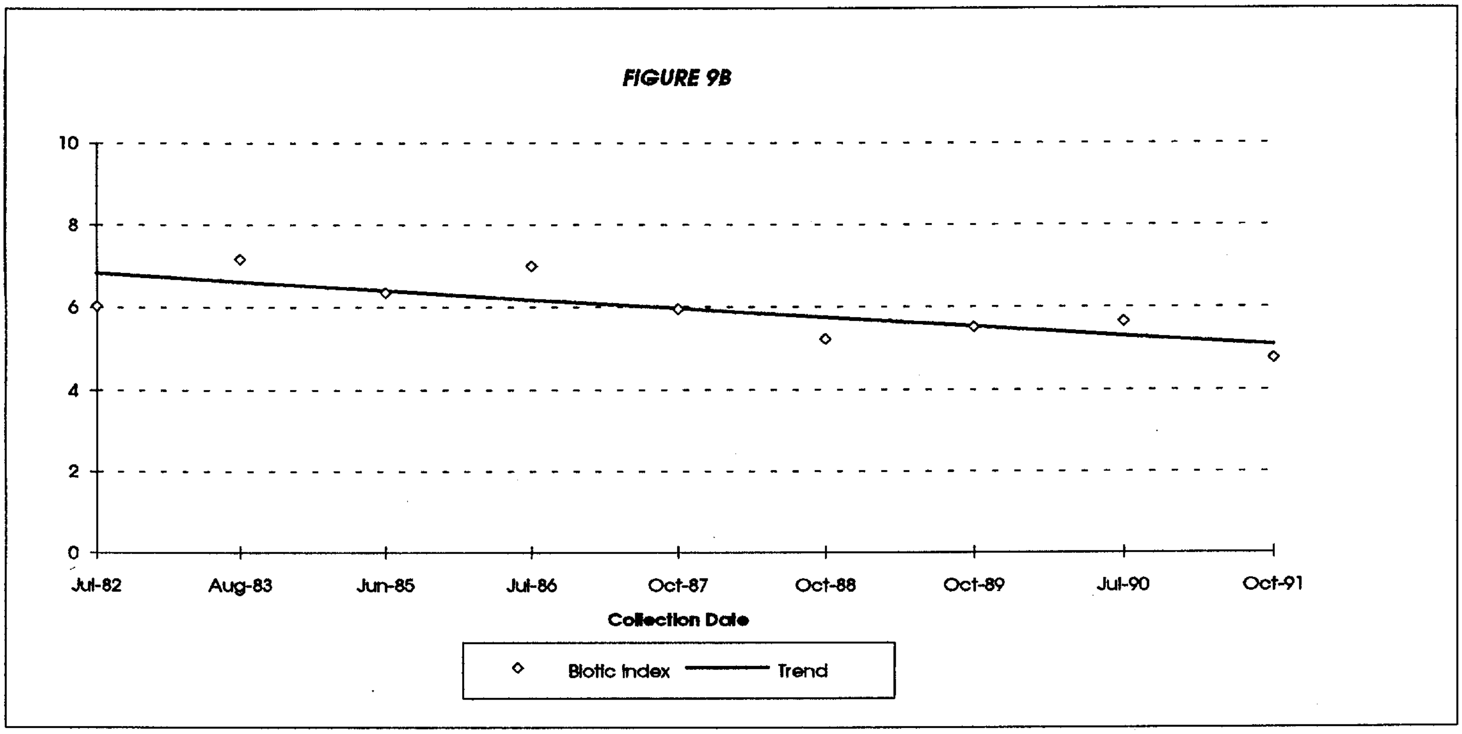
Figure 9A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: VI-001 1974-1991



*-Data was not collected during 1974, and 1984.
In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

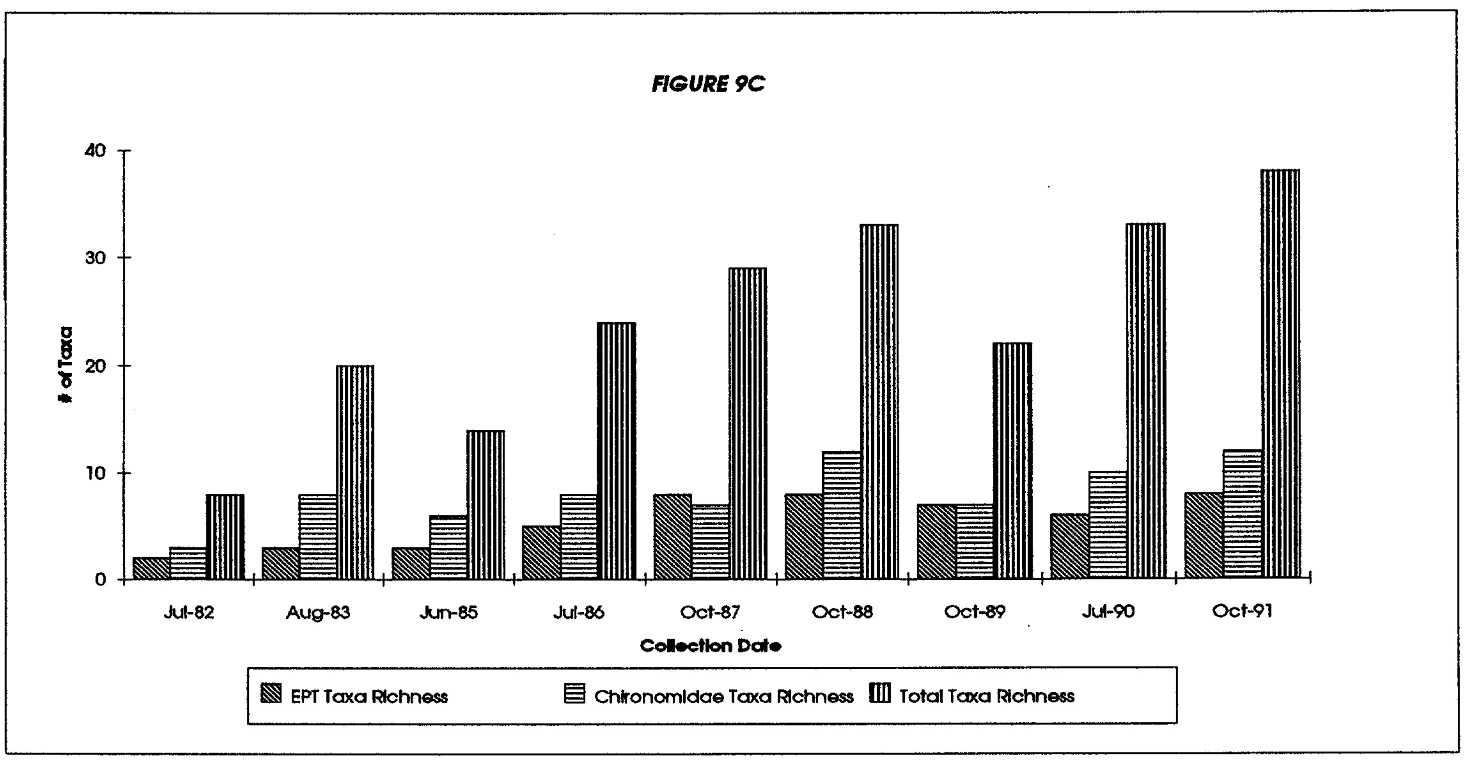
BIOTIC INDEX

AMBIENT MONITORING STATION: VI-001 1982-1991



TAXA RICHNESS

AMBIENT MONITORING STATION: VI-001 1982-1991



In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

PART II

NON-WADEABLE STREAMS

ALABAMA RIVER DRAINAGE BASIN

ALABAMA RIVER A-1 & A-1a

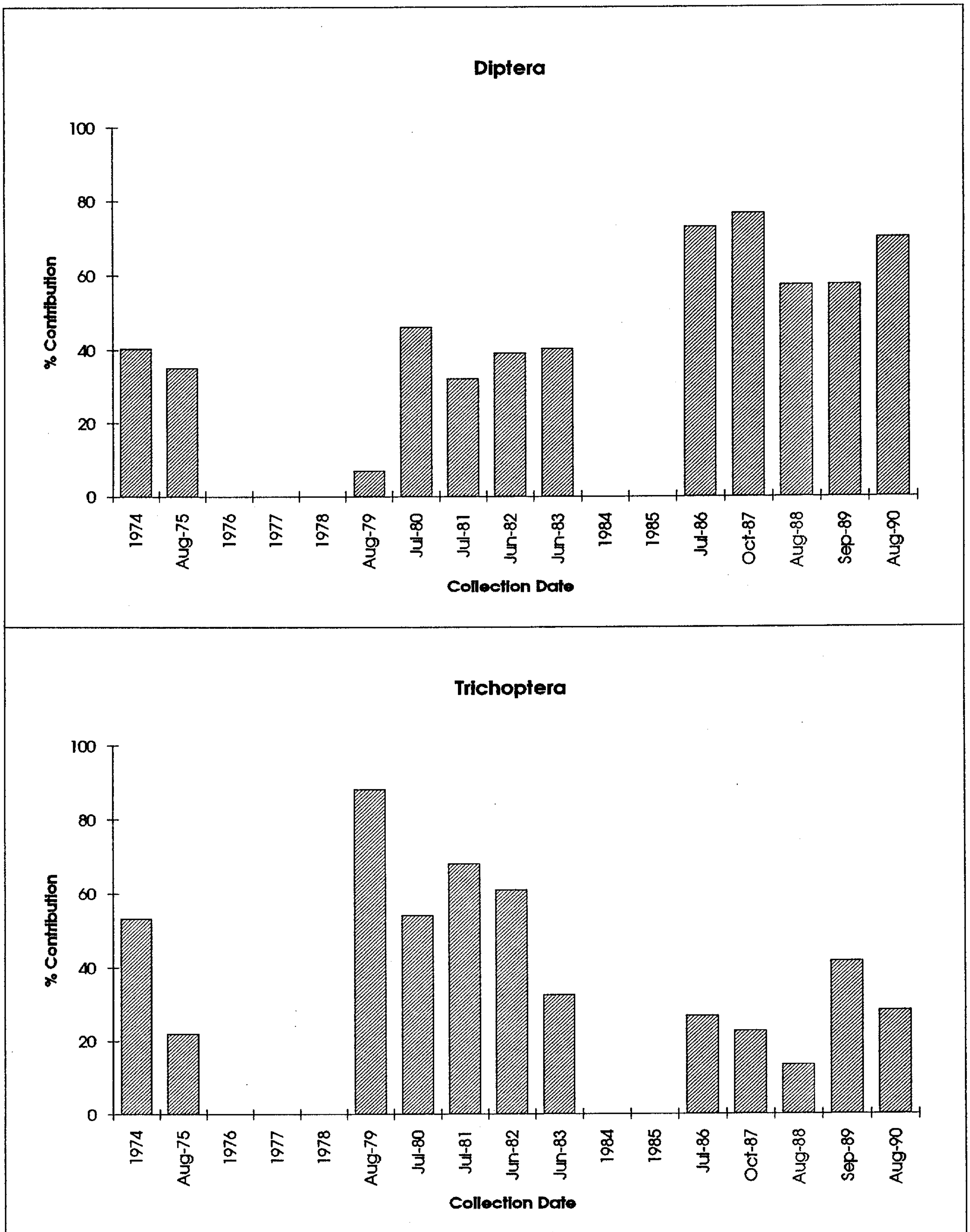
Station A-1 is located on the Alabama River in Lowndes County, ¼ mile below the mouth of Pintlala Creek. The site was located to monitor the effects of the city of Montgomery, and the discharge from a paper mill on the Alabama River. This station was relocated further downstream in August 1990 to site A-1a, ¼ mile above the mouth of Tallawassee Creek, to monitor the effects of a plastic plant in addition to the original sources for station A-1. This section of the Alabama River has water use classifications of 'Swimming and Other Whole Body Water-Contact Sports' and 'Fish & Wildlife'.

This station was first assessed in 1974 (no month designation was available) and 1975. At that time the collected community was fairly evenly distributed between the generally pollution-intolerant Ephemeroptera and Trichoptera, and the pollution-tolerant Diptera (Figure 10A, Appendix A-10). Station A-1 was not assessed again until 1979. From 1979 to 1983, the generally pollution-intolerant Trichoptera, or Trichoptera and Ephemeroptera, dominated the community collected. From 1986 to 1990 the structure shifted to a community dominated by the more pollution-tolerant dipteran group.

The biotic index indicated minimal changes in the pollution tolerance of the samples collected (Figure 10B). EPT taxa richness showed no distinguishable trend, while the total taxa richness and Chironomidae taxa richness showed slight improvement in the diversity of the collected macroinvertebrate community (Figure 10C). Analysis of data collected indicated that the water quality of the Alabama River at station A-1/A-1a has been maintained during the monitoring period.

Figure 10A
% Contribution of Dominant Orders*

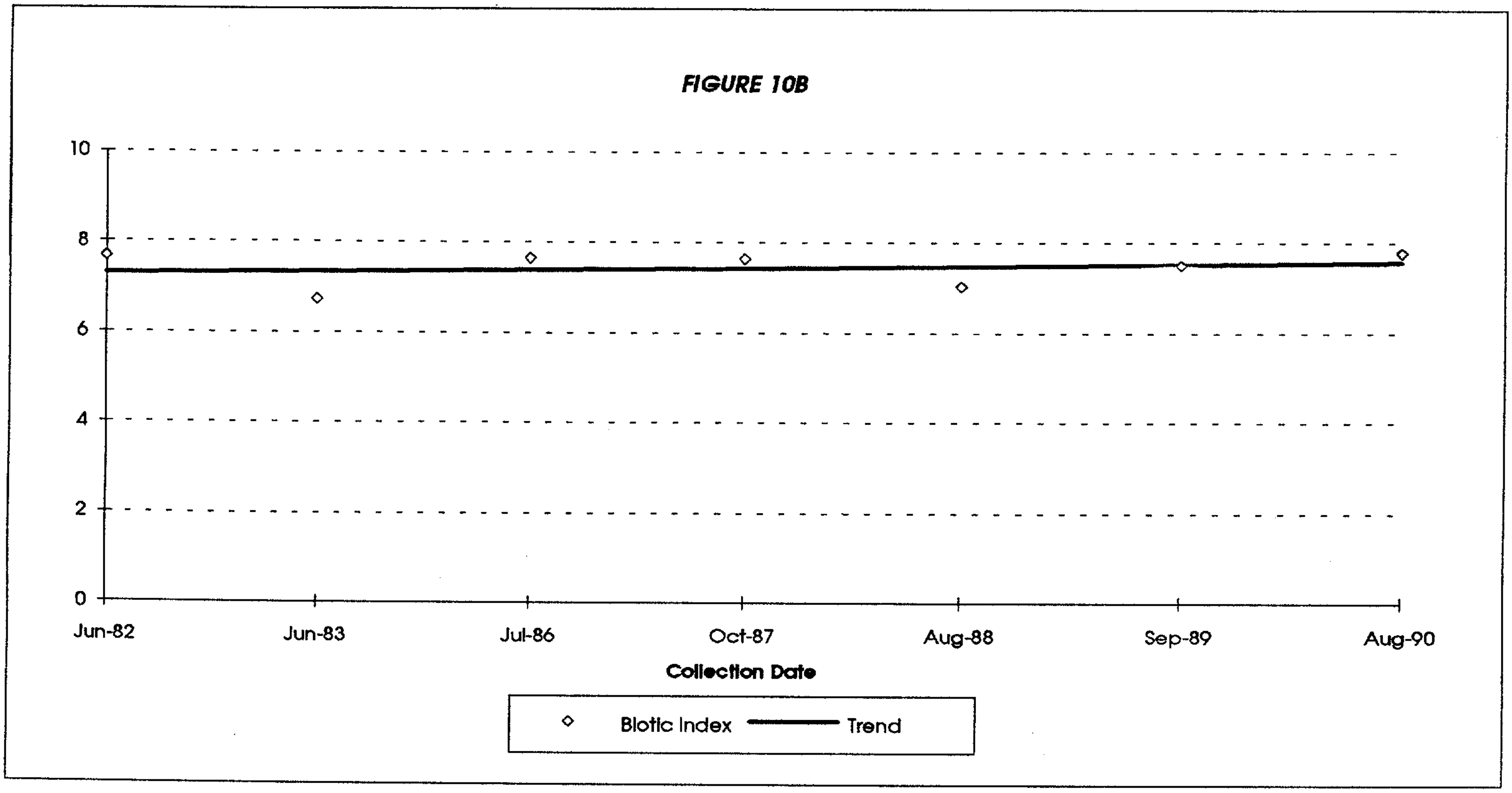
Ambient Monitoring Station: A-001 & A-001a 1974-1990



*-Data was not collected during 1976, 1977, 1978, 1984, and 1985.
In Aug 1990, A-001 was moved to A-001a.

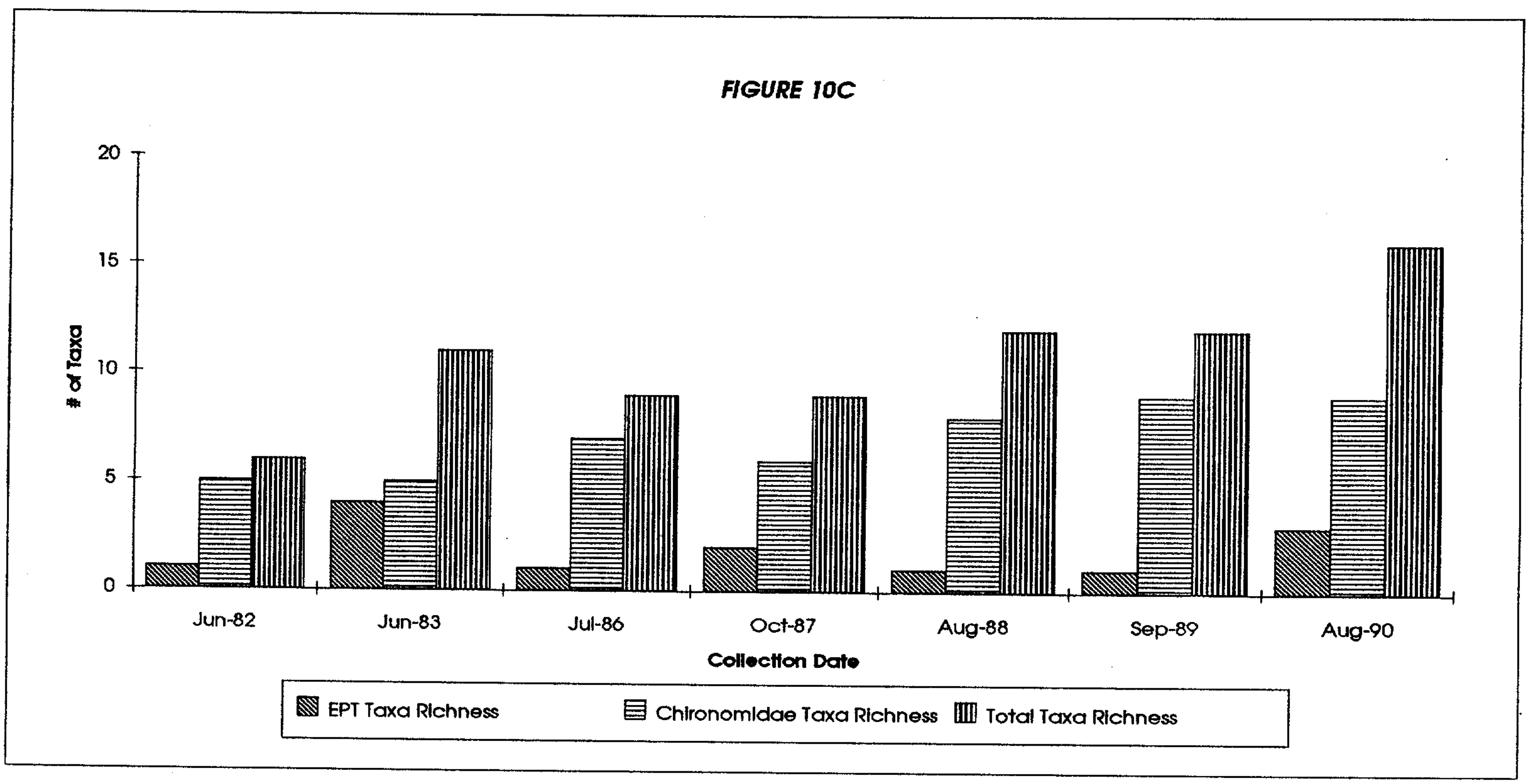
BIOTIC INDEX

AMBIENT MONITORING STATION: A-001 & A-001a 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: A-001 & A-001a 1982-1990



In Aug 1990, A-001 was moved to A-001A.

ALABAMA RIVER A-2

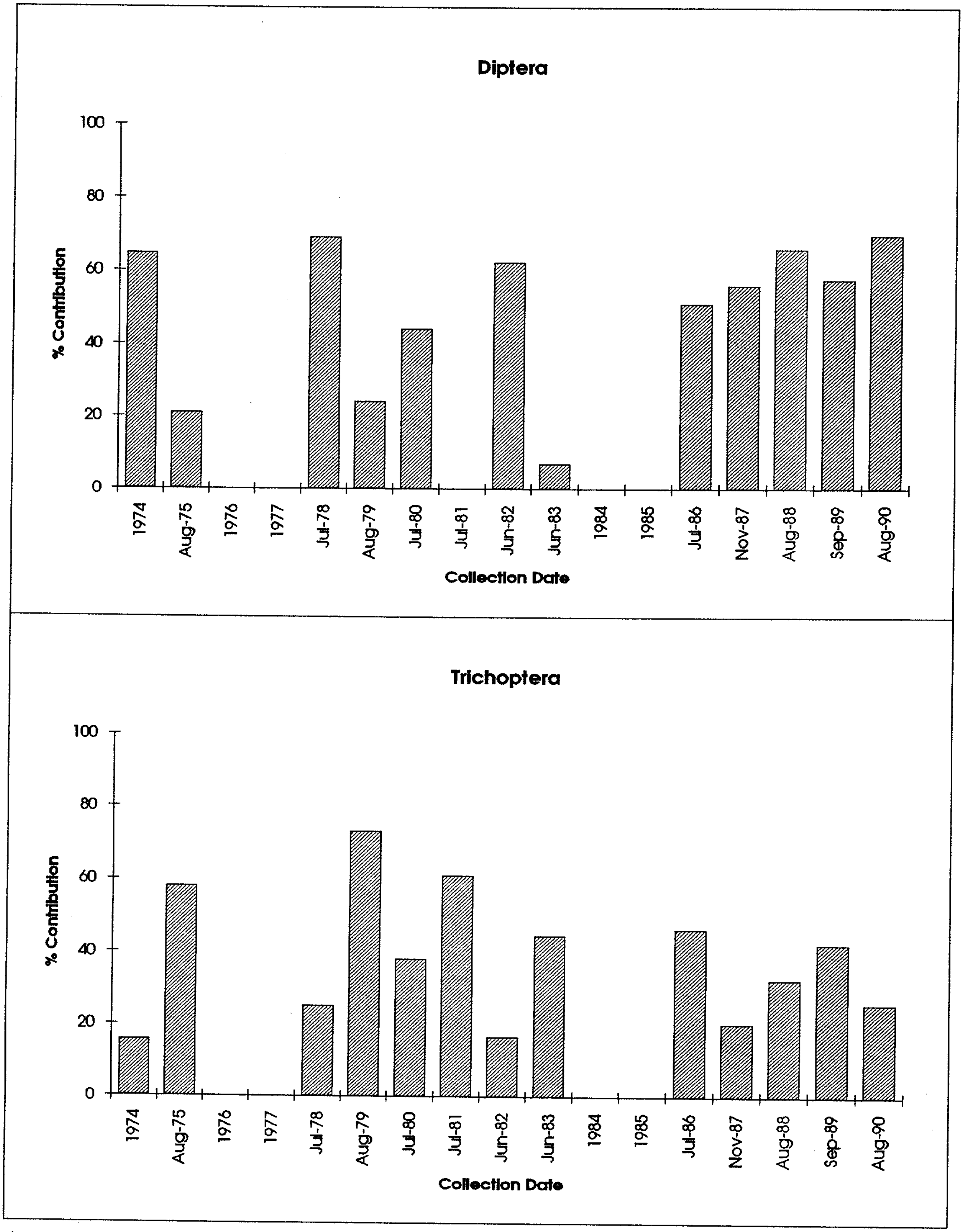
Station A-2 is located on the Alabama River approximately 10 miles upstream of the confluence with the Cahaba River. The Dallas County site was located to monitor the effects of the city of Selma and the discharge from a paper mill. The water use classifications for this section of the Alabama River are 'Swimming and Other Whole Body Water-Contact Sports' and 'Fish & Wildlife'.

Samples collected at station A-2 in 1975 and then again from 1978 to 1983 were generally dominated by the pollution-intolerant Trichoptera and Ephemeroptera (with the exception of the collections in 1978 and 1982) (Table 11A, Appendix A-11). Beginning in 1986, data indicated a shift in the sampled community structure to one consistently dominated by the generally pollution-tolerant dipteran group (Figure 11A).

The trend in the biotic index, as indicated in Figure 11B, indicated a slight shift toward a more pollution-tolerant population. However, this has been skewed by a very low biotic index value for the sample collected in June of 1983. By excluding this value, there is only a slight shift noted in the biotic index. The EPT taxa richness as well as total taxa richness showed minimal changes over the 1982 to 1990 sampling period (Figure 11C). Analysis of data collected indicated that the water quality of the Alabama River at station A-2 has been maintained during the monitoring period.

Figure 11A
% Contribution of Dominant Orders*

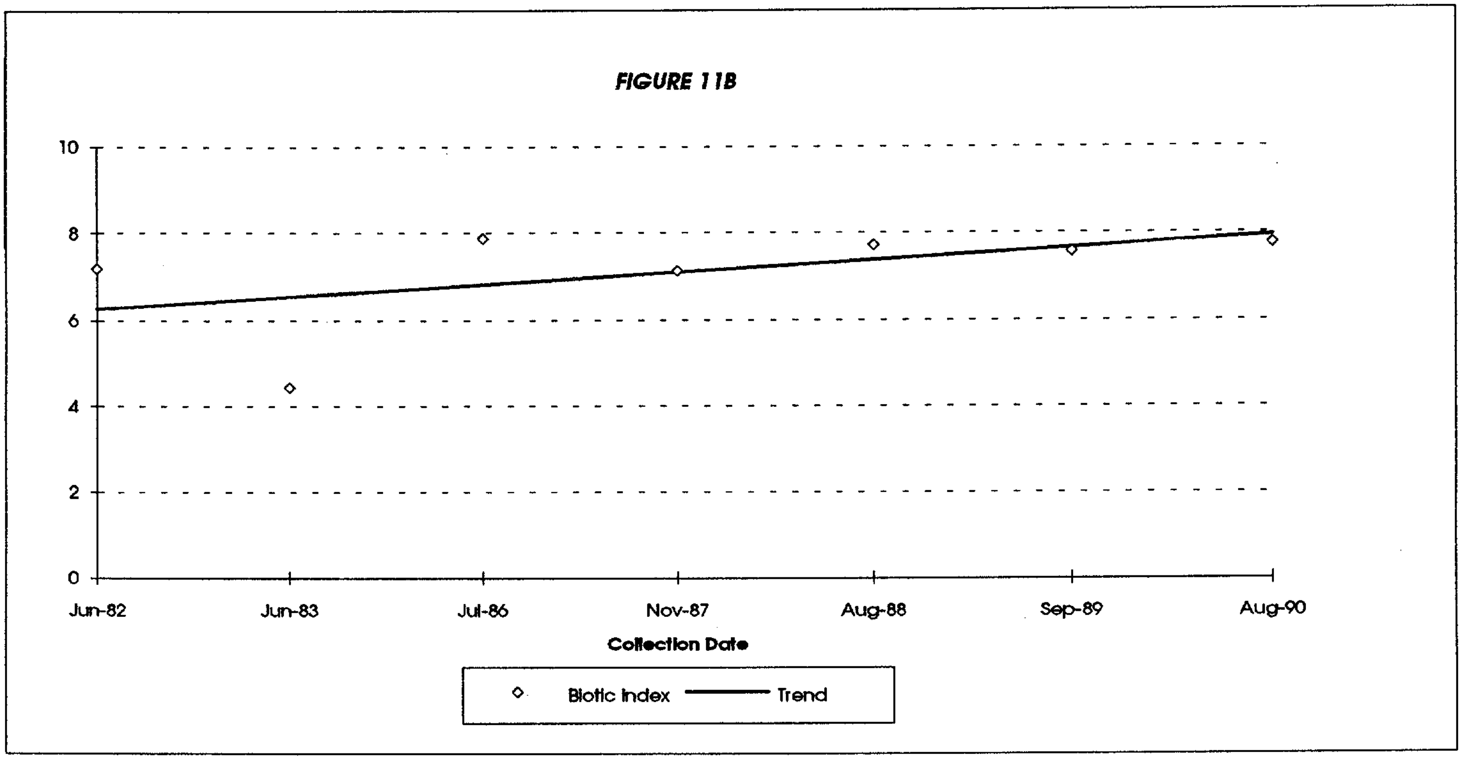
AMBIENT MONITORING STATION: A-002 1974-1990



*-Data was not collected during 1976, 1977, 1984, and 1985.

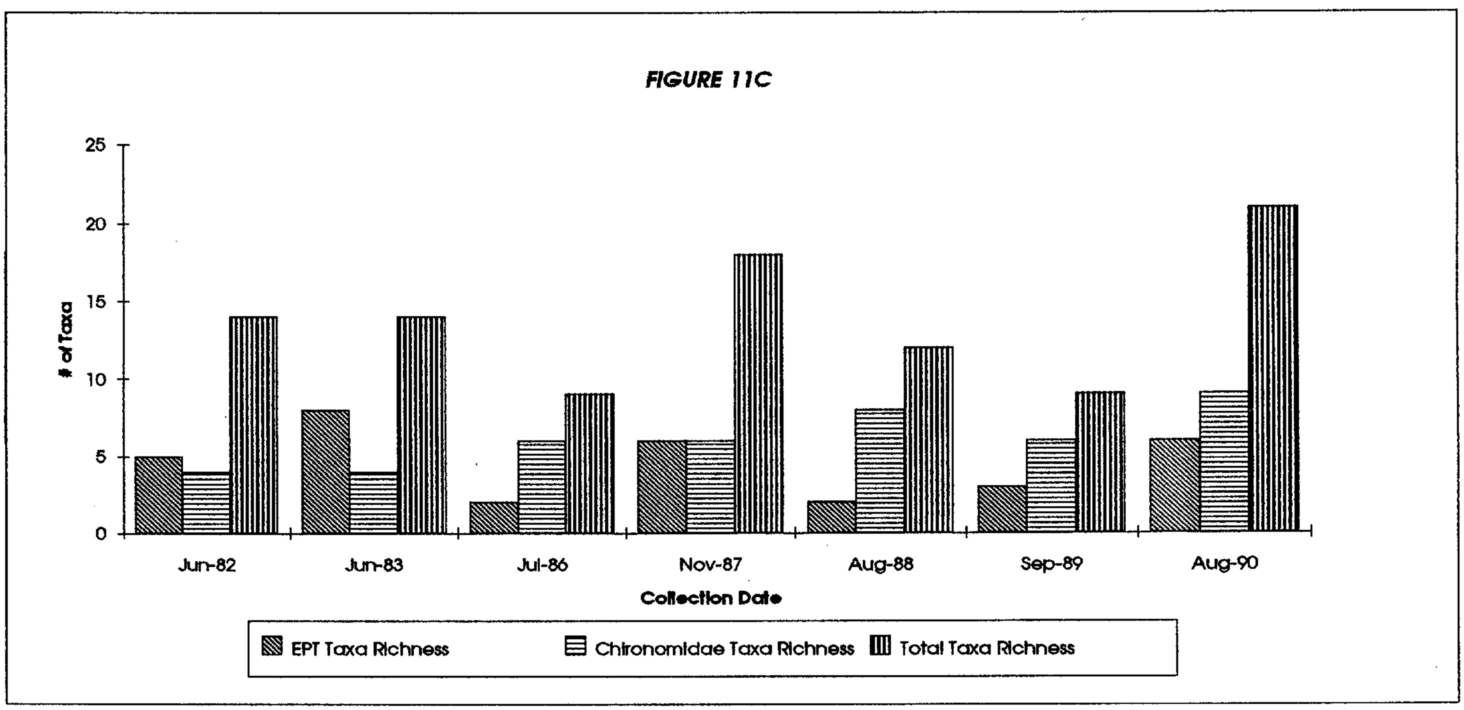
BIOTIC INDEX

AMBIENT MONITORING STATION: A-002 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: A-002 1982-1990



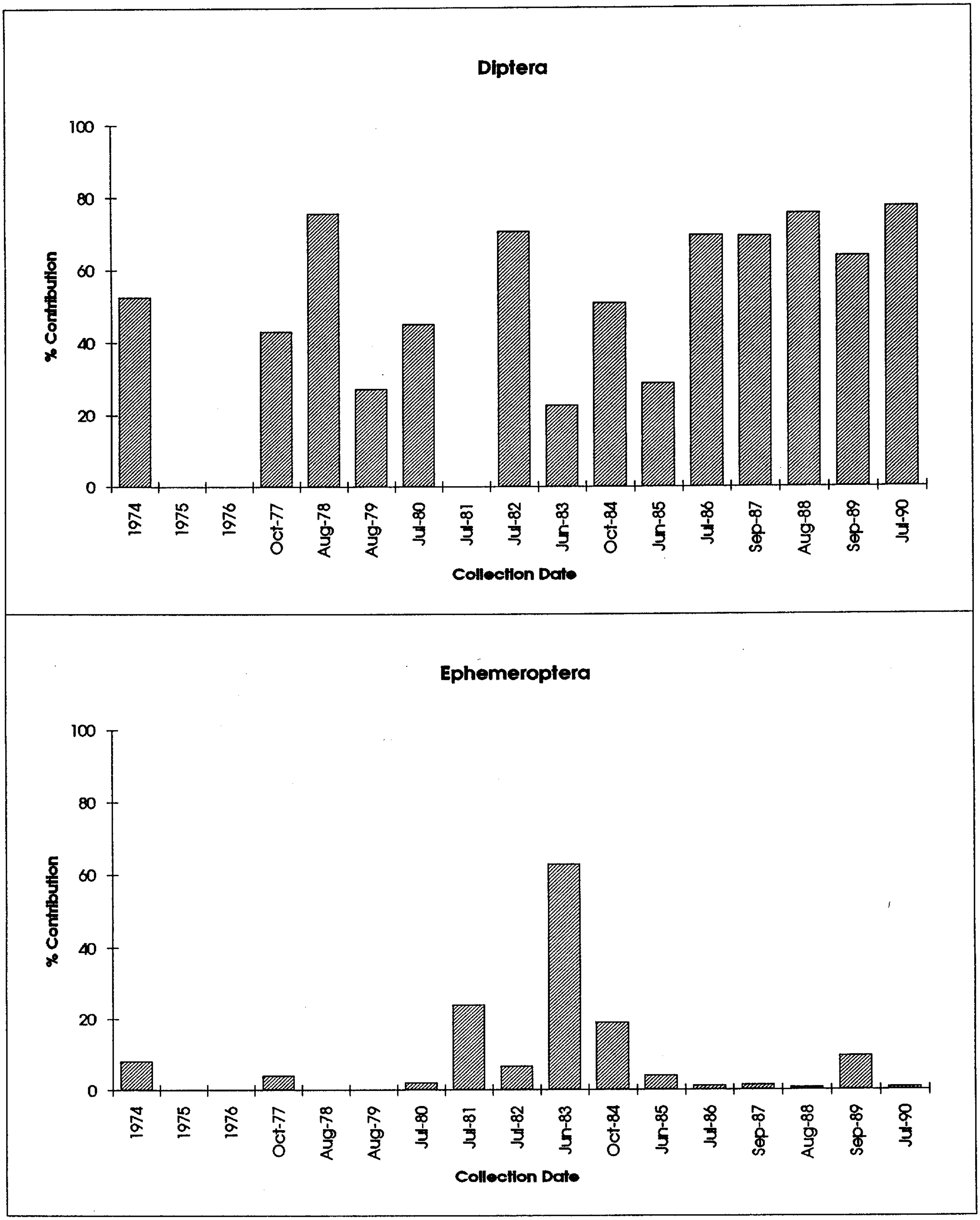
ALABAMA RIVER A-3

Station A-3 is located on the Alabama River at the Burlington Northern Railroad bridge near Pine Hill in Wilcox County. The site was located to monitor the effects of the discharge from a paper mill. This section of the Alabama River has a water use classification of 'Fish and Wildlife'.

Analysis of data collected over the nine year period from 1977 to 1985 showed that a majority of the samples (6) were dominated by the generally pollution-intolerant Trichoptera and/or Ephemeroptera groups (Figure 12A). The three remaining sampling events from the same time period were dominated by the pollution-tolerant dipteran group. The samples collected from 1986 to 1990 have been exclusively dominated by the dipteran group; a negative shift from the trend in the earlier sampling period.

The general trend in the biotic index from 1982 to 1990, as indicated in Figure 12B, indicated a slight degradation in the quality of the collected community. However, this trend line is skewed by a very low biotic index value for the sample collected in June of 1983. Without this value there is very little change noted in the biotic index. The EPT taxa richness, Chironomidae and total taxa richness have shown minimal changes over the 1982 to 1990 sampling period (Figure 12C). Analysis of data collected indicates that the water quality of the Alabama River at station A-3 has been maintained during the monitoring period.

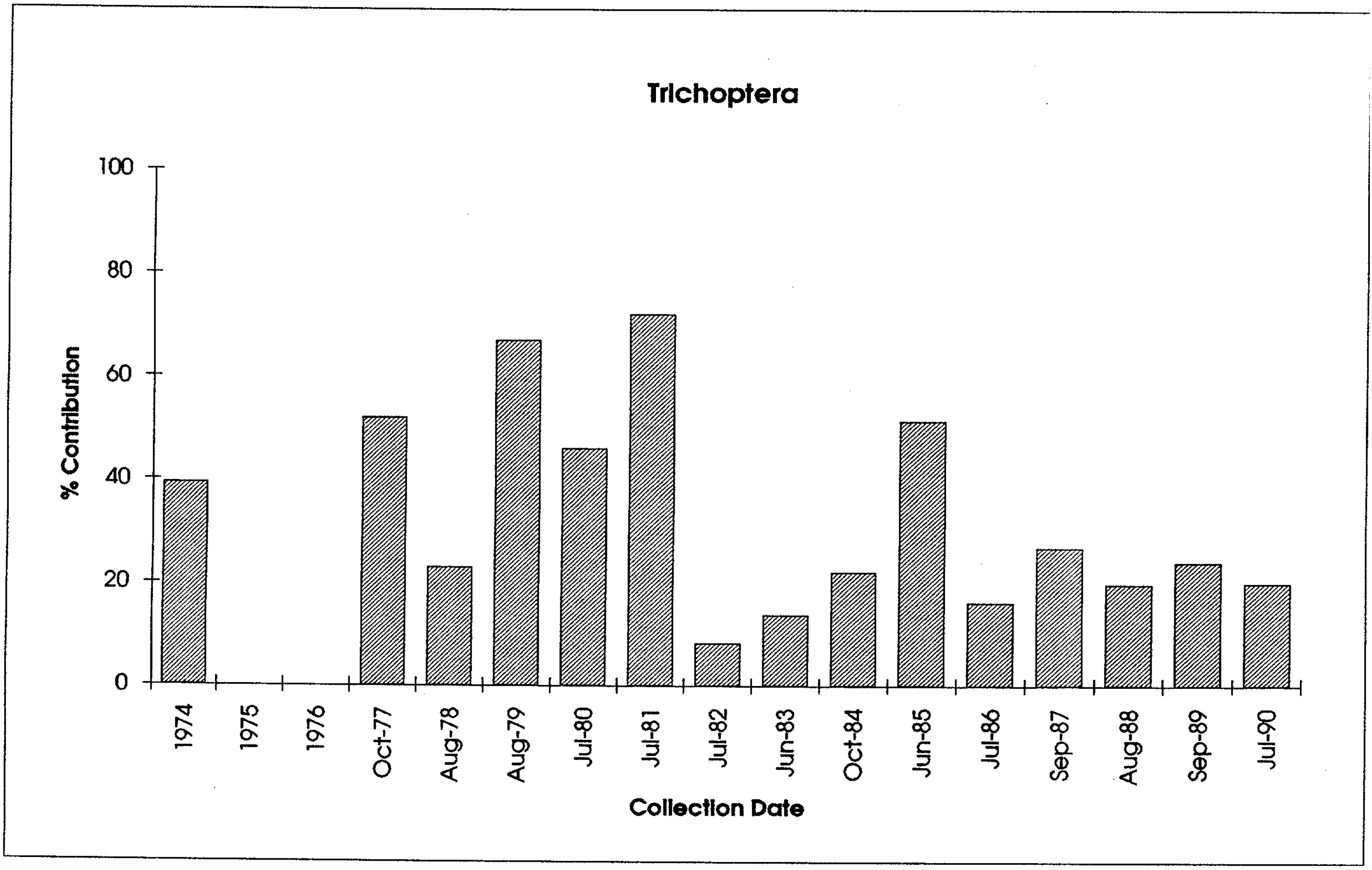
Figure 12A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: A-003 1974-1990



*-Data was not collected during 1975 and 1976.

Figure 12A
% Contribution of Dominant Orders*

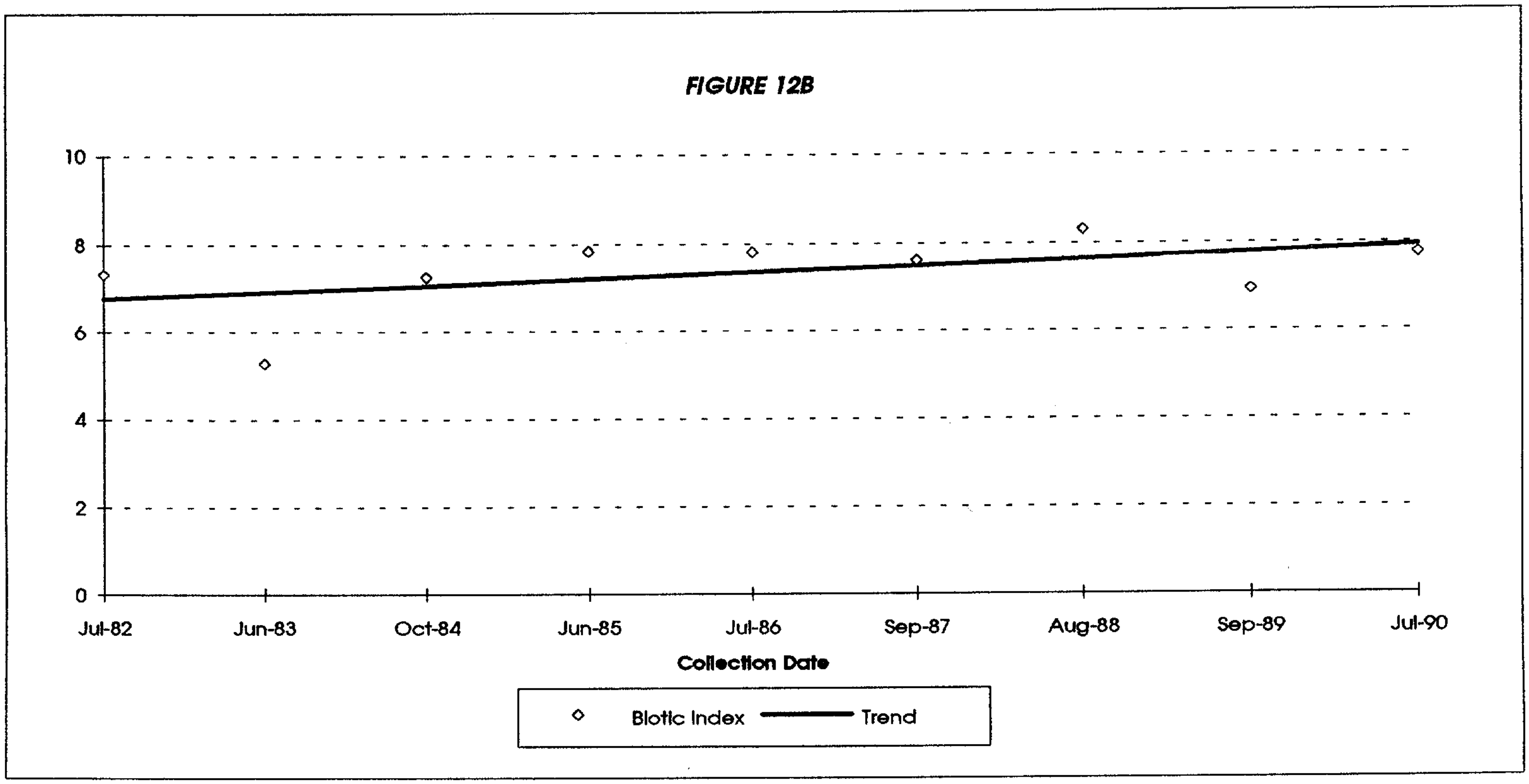
AMBIENT MONITORING STATION: A-003 1974-1990



*-Data was not collected during 1975 and 1976.

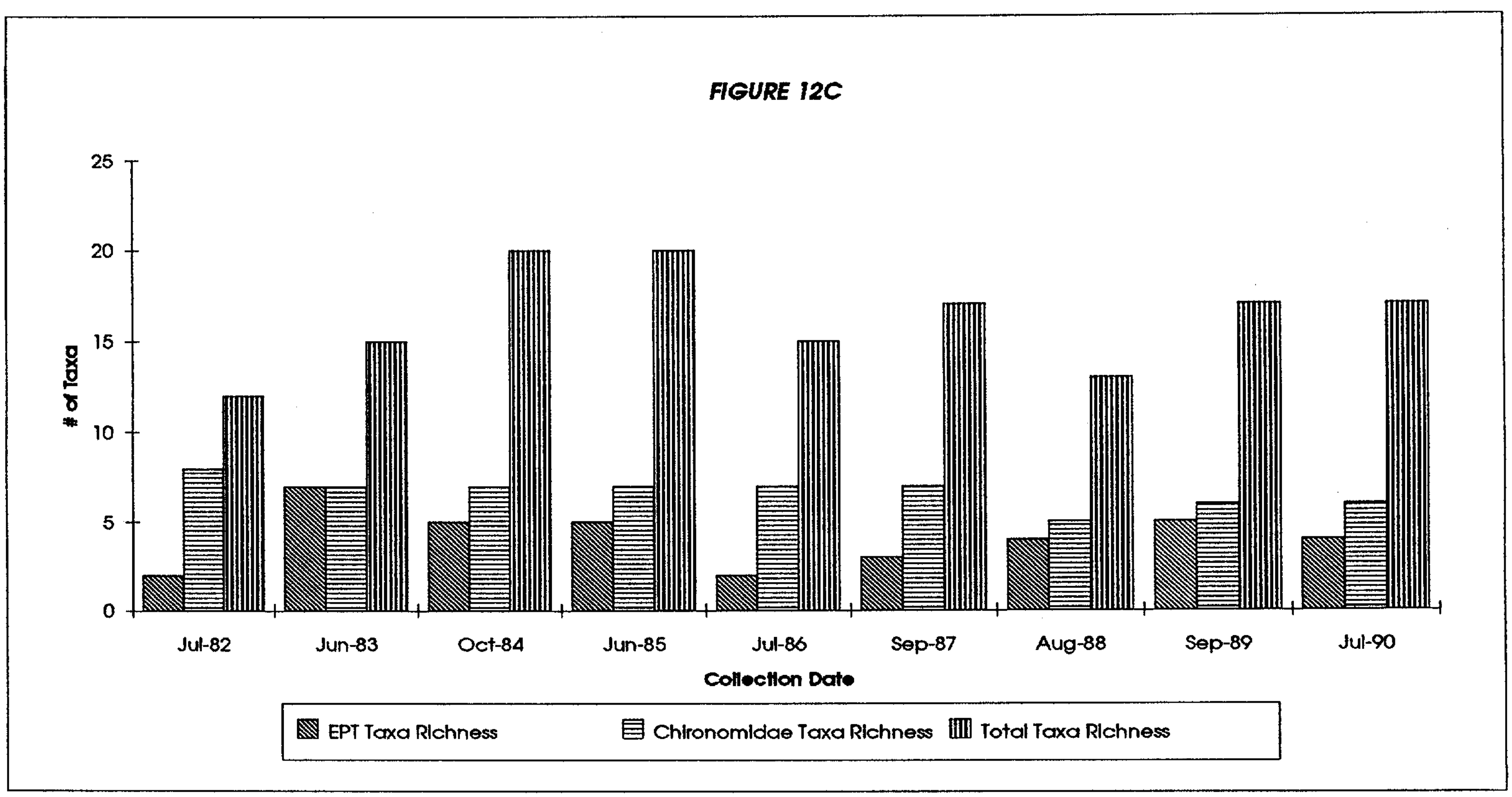
BIOTIC INDEX

AMBIENT MONITORING STATION: A-003 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: A-003 1982-1990



CAHABA RIVER DRAINAGE BASIN

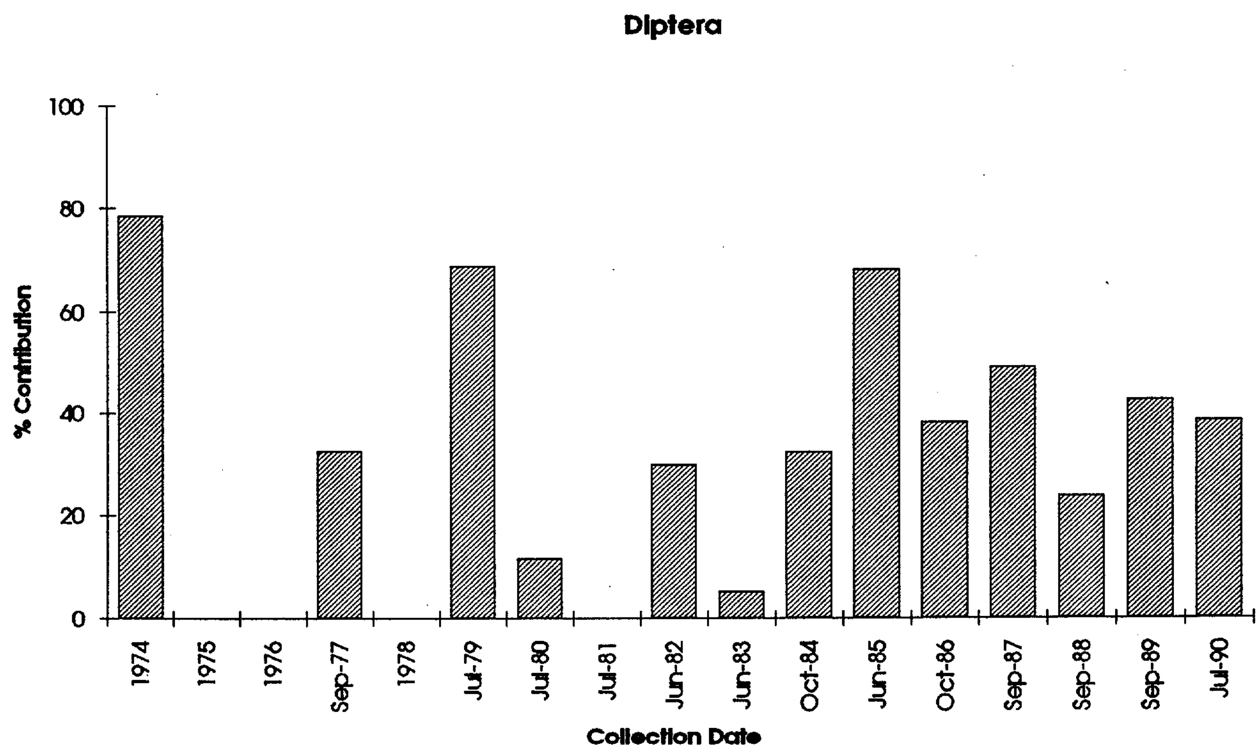
CAHABA RIVER C-4

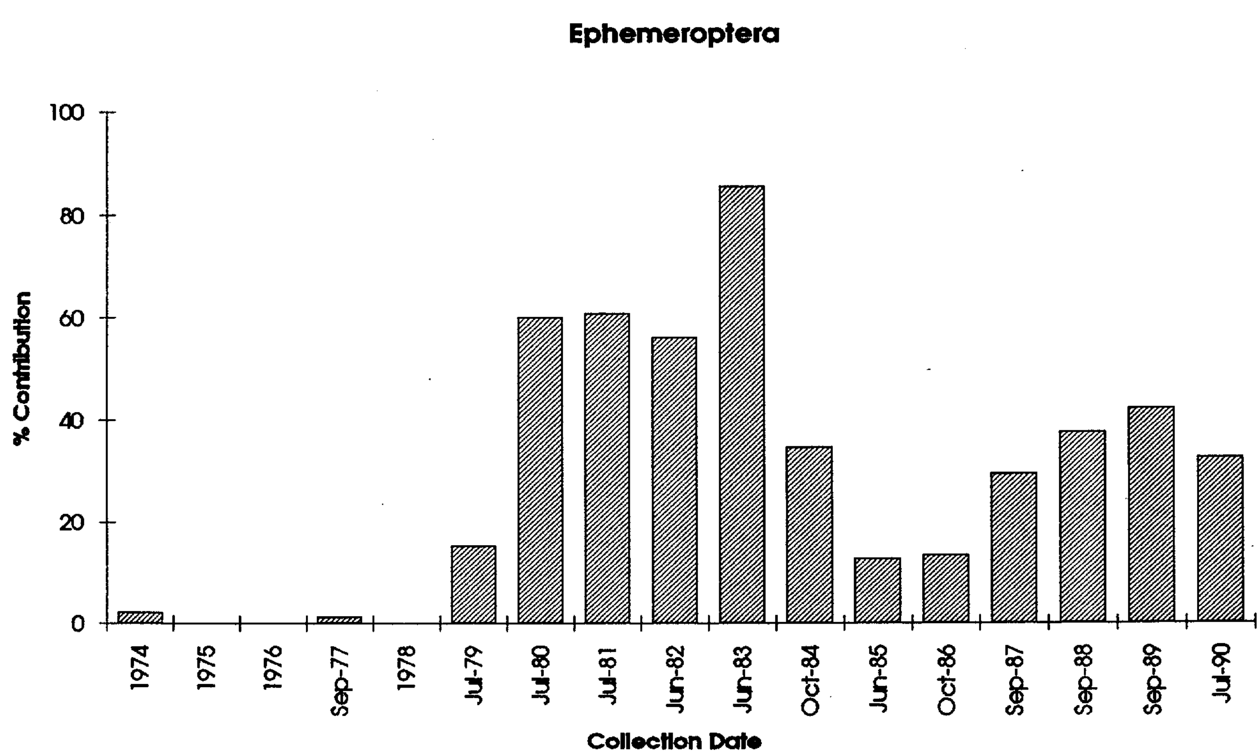
Station C-4 is on the Cahaba River southeast of Harrisburg. It is sampled to monitor the effects of discharges from a wood preserving plant and the municipalities of Brent and Centreville, Alabama. This section of the Cahaba River has a water use classification of 'Swimming and Other Whole Body Water-Contact Sports'.

Samples were first collected from this site in 1974 (no month available) and then again in 1977 and 1979. The majority of samples collected from 1974 to 1983 were dominated by the generally pollution intolerant Ephemeroptera or Trichoptera groups (5 of 7) (Figure 13A). The remaining two years were dominated by the Diptera group. Samples collected from 1984 to 1990 showed a slight improvement in the diversity of the groups represented. No single taxonomic group maintained dominance of the community structure over this time period.

The biotic index (Figure 13B) indicates a shift toward a more pollution-tolerant aquatic macroinvertebrate community, however the EPT taxa richness and total taxa richness (Figure 13C) both show slight improvement. Analysis of the data suggests there has been a slight improvement of the water quality of the Cahaba River at C-4.

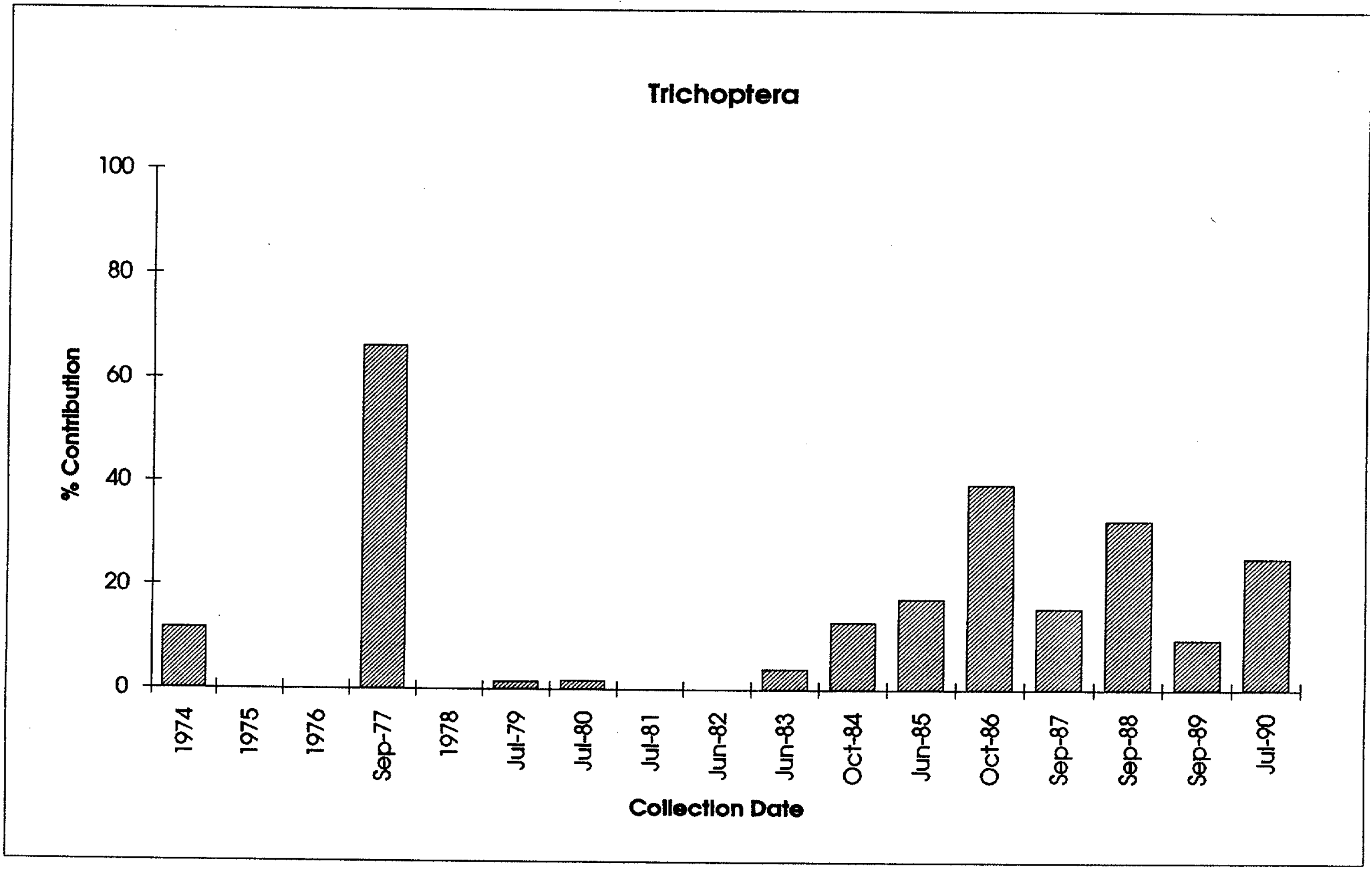
Figure 13A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: C-004 1974-1990





*-Data was not collected during 1975, 1976, and 1978.

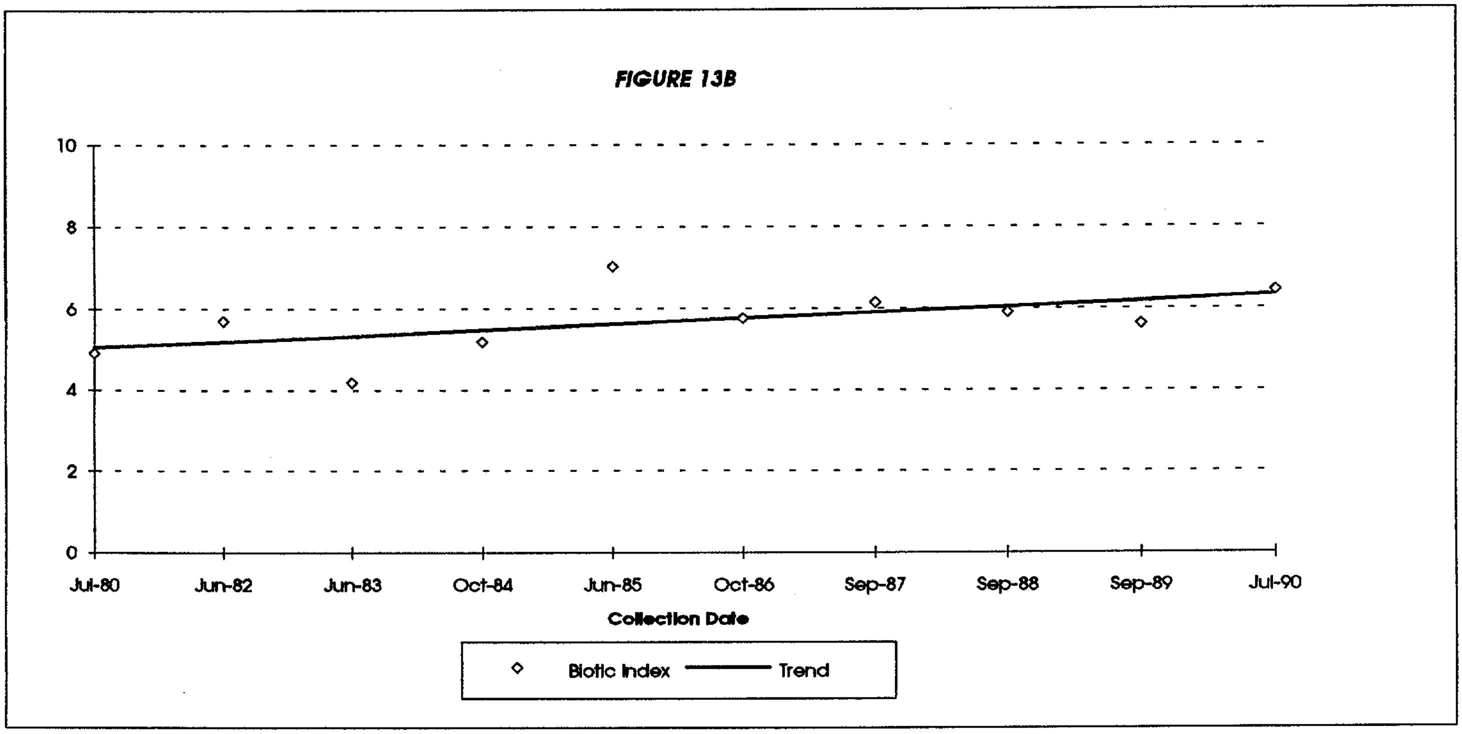
Figure 13A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: C-004 1974-1990



*-Data was not collected during 1975, 1976, and 1978.

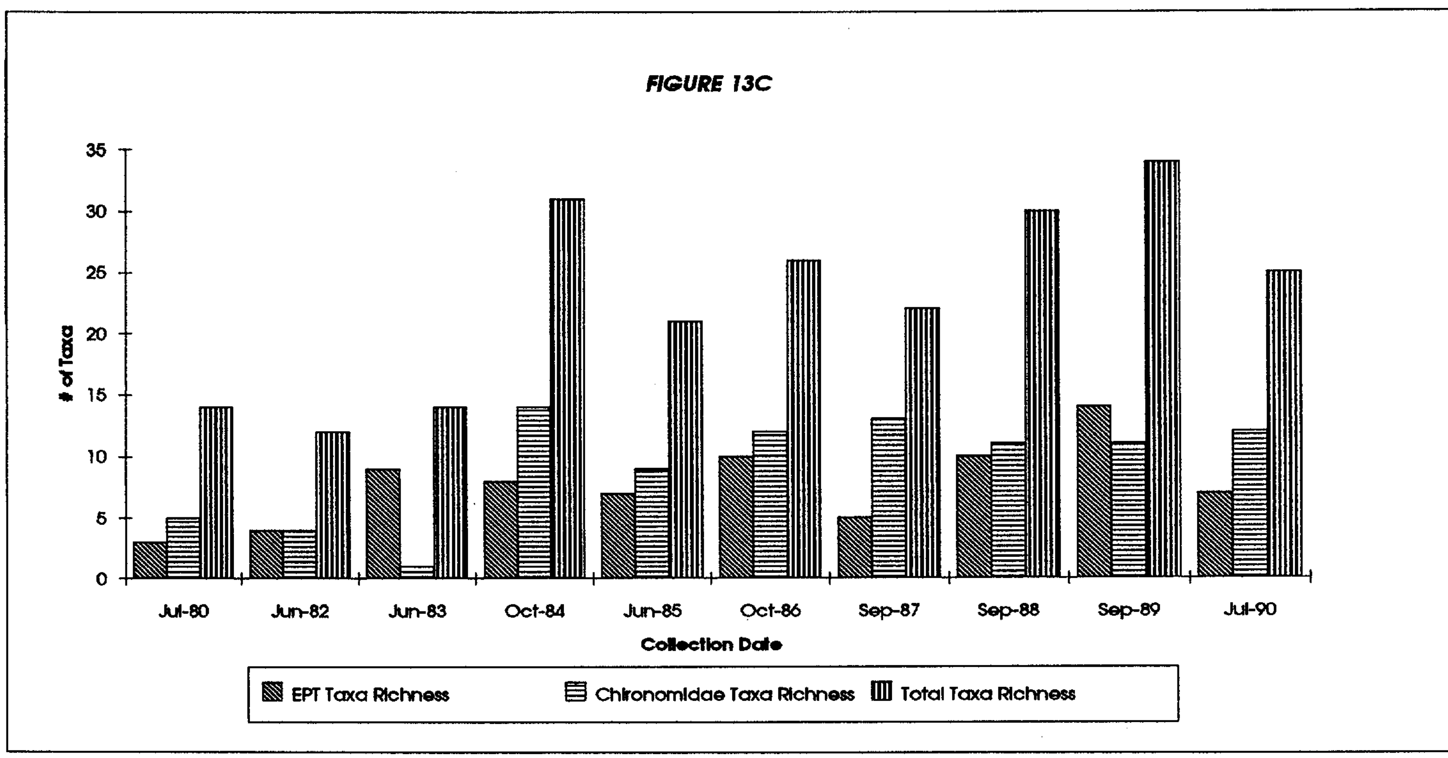
BIOTIC INDEX

AMBIENT MONITORING STATION: C-004 1980-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: C-004 1980-1990



COOSA RIVER DRAINAGE BASIN

CHOCCOLOCCO CREEK CL-1

Station CL-1 is located in Talladega County at the Alabama Highway 79 bridge north of Talladega. It was sampled to monitor the effects of municipal and industrial discharges from Anniston. This section of Choccolocco Creek has a water use classification of 'Fish and Wildlife'.

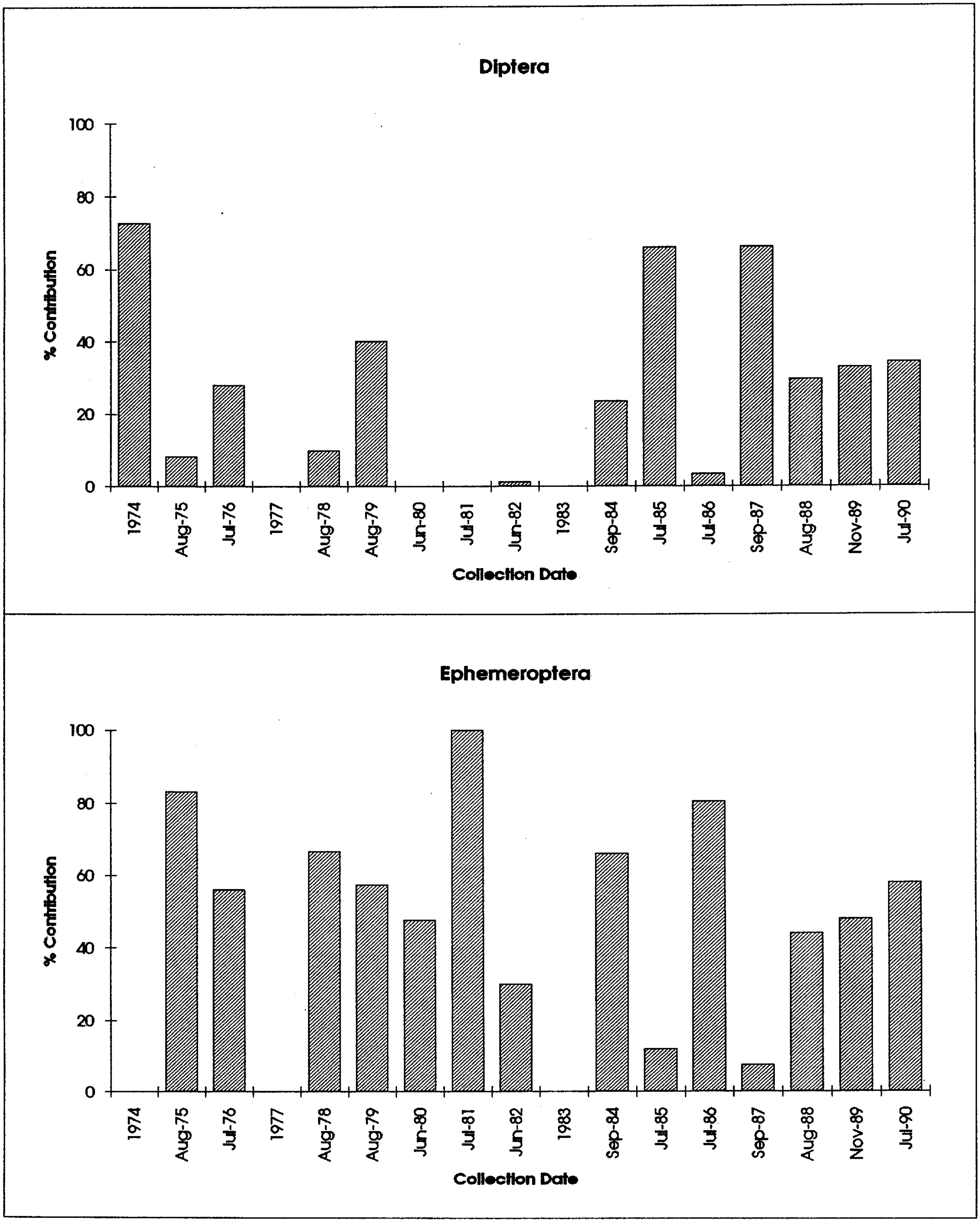
The structure of the aquatic macroinvertebrate community illustrated in Figure 14A shows minimal changes and appears to be generally dominated by one pollution-intolerant group (Ephemeroptera). However, beginning in 1982, the number of the taxonomic groups represented each year has increased.

The biotic index as illustrated in Figures 14B and 14C, shows minimal change over the 1980 to 1990 sampling period. The total and EPT taxa richness exhibits a slight increase over this same period. The community structure and metrics used to analyze the data suggested that there has been a slight improvement in the water quality of Choccolocco Creek.

Figure 14A

% Contribution of Dominant Orders*

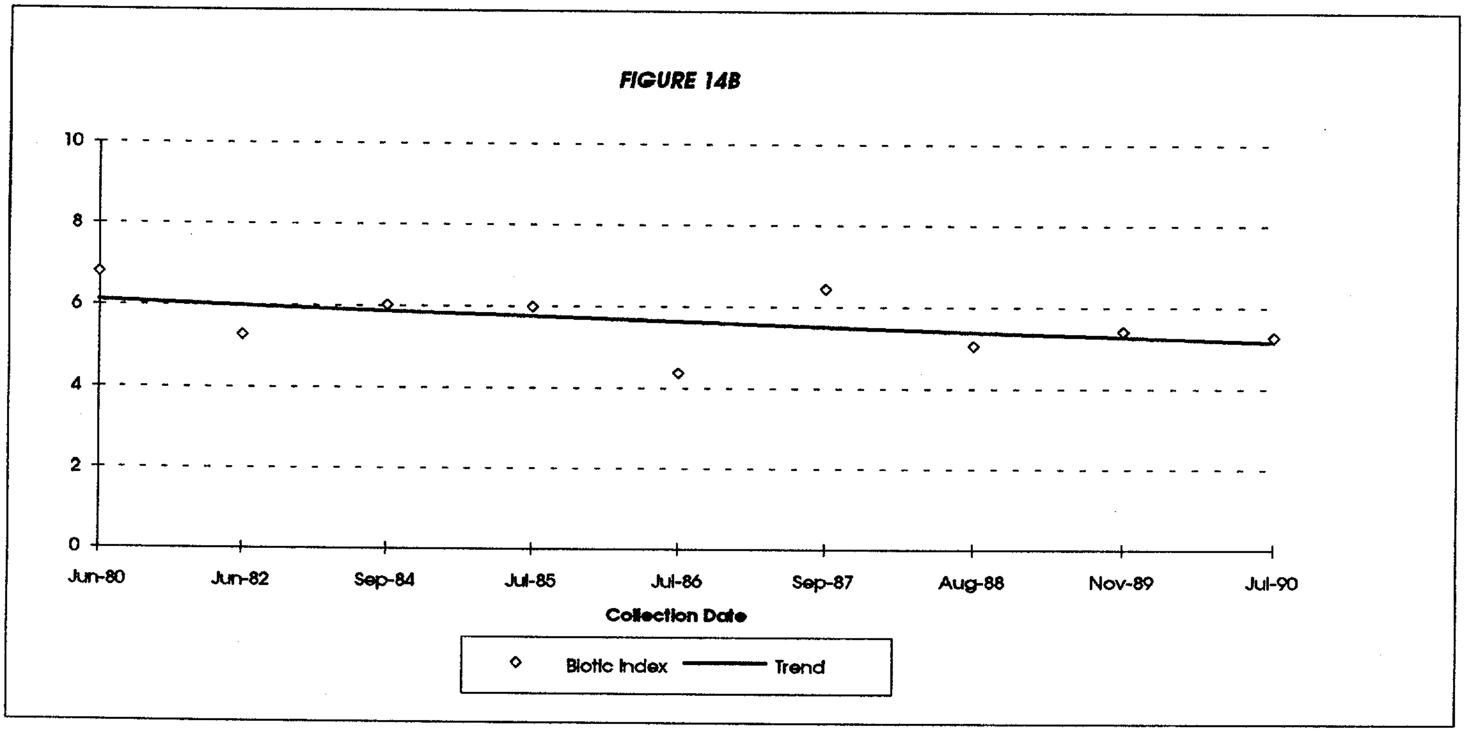
AMBIENT MONITORING STATION: CL-001 1974-1990



*-Data was not collected during 1977 and 1983.

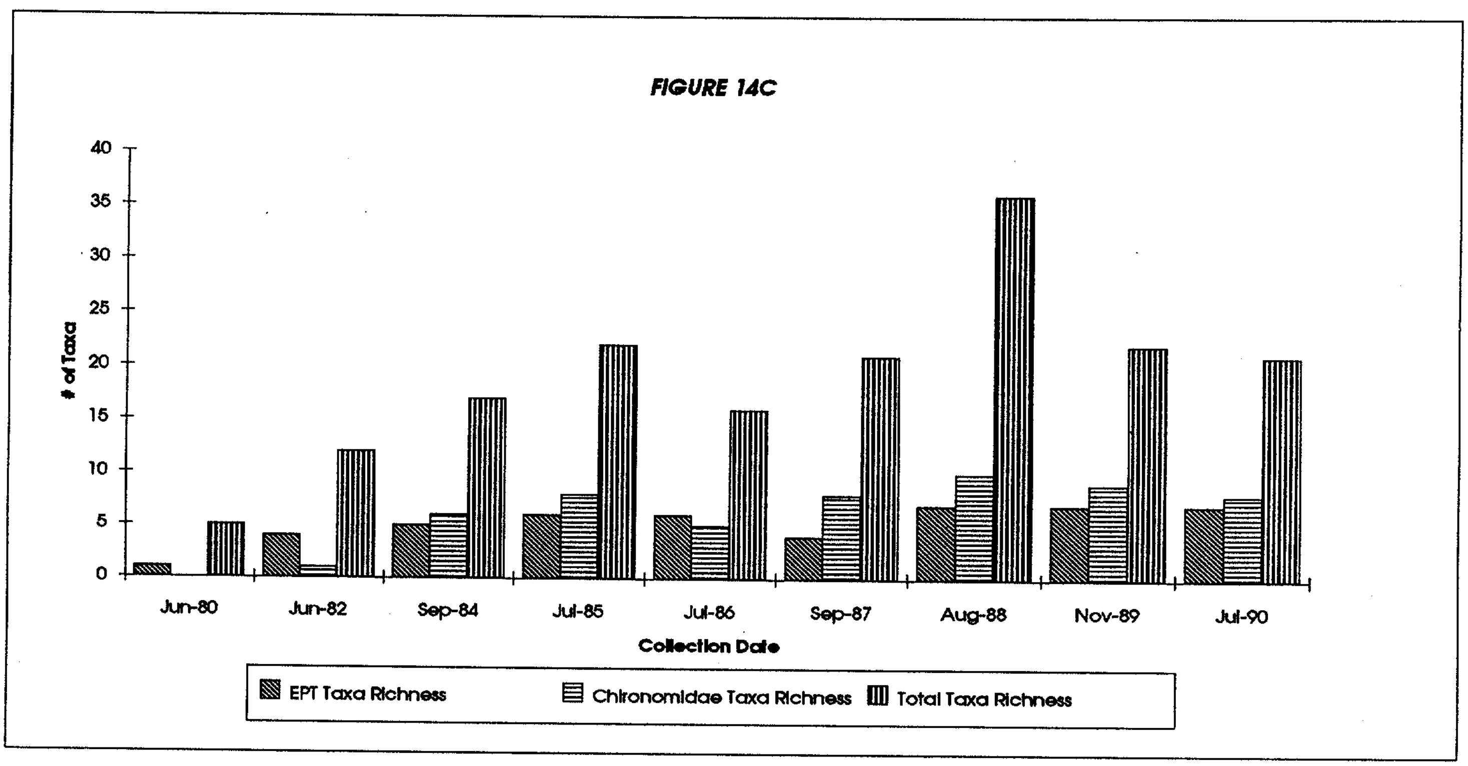
BIOTIC INDEX

AMBIENT MONITORING STATION: CL-001 1980-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: CL-001 1980-1990



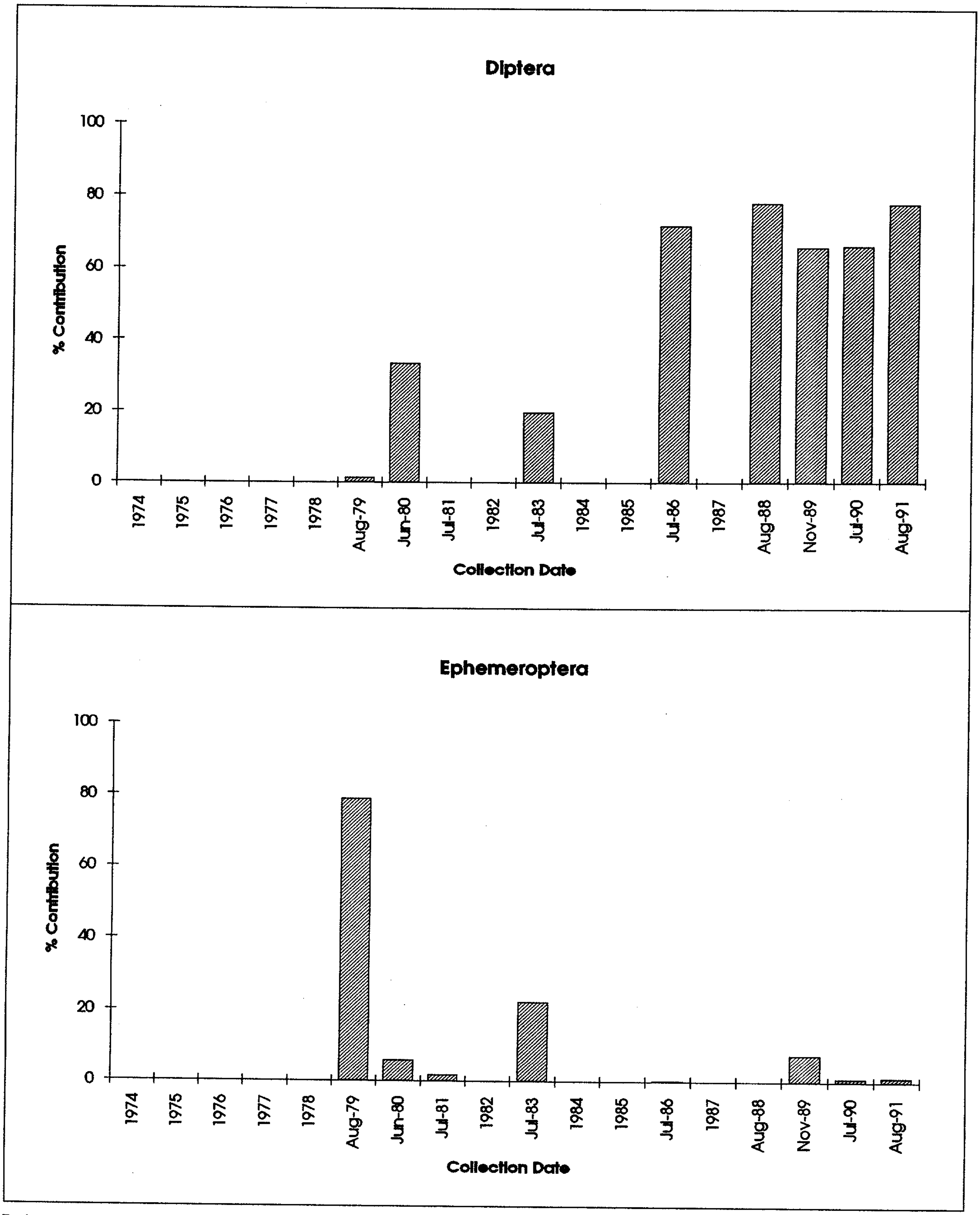
COOSA RIVER CO-2

Station CO-2 is located at the Highway 231 bridge at Childersburg. Its' primary purpose is to monitor the effects of a bleach kraft paper mill on the Coosa River. It is also located 13.5 miles downstream of the Logan Martin Dam tailrace. This section of the Coosa River has a water use classification of 'Fish and Wildlife'.

In Figure 15A, the community structure of the samples collected from 1979 to 1981 were dominated by generally pollution-intolerant taxonomic groups (Ephemeroptera, Trichoptera). Analysis of samples collected from 1986 to 1991 indicated that there had been a shift in the community structure toward domination by a more pollution-tolerant group (Diptera).

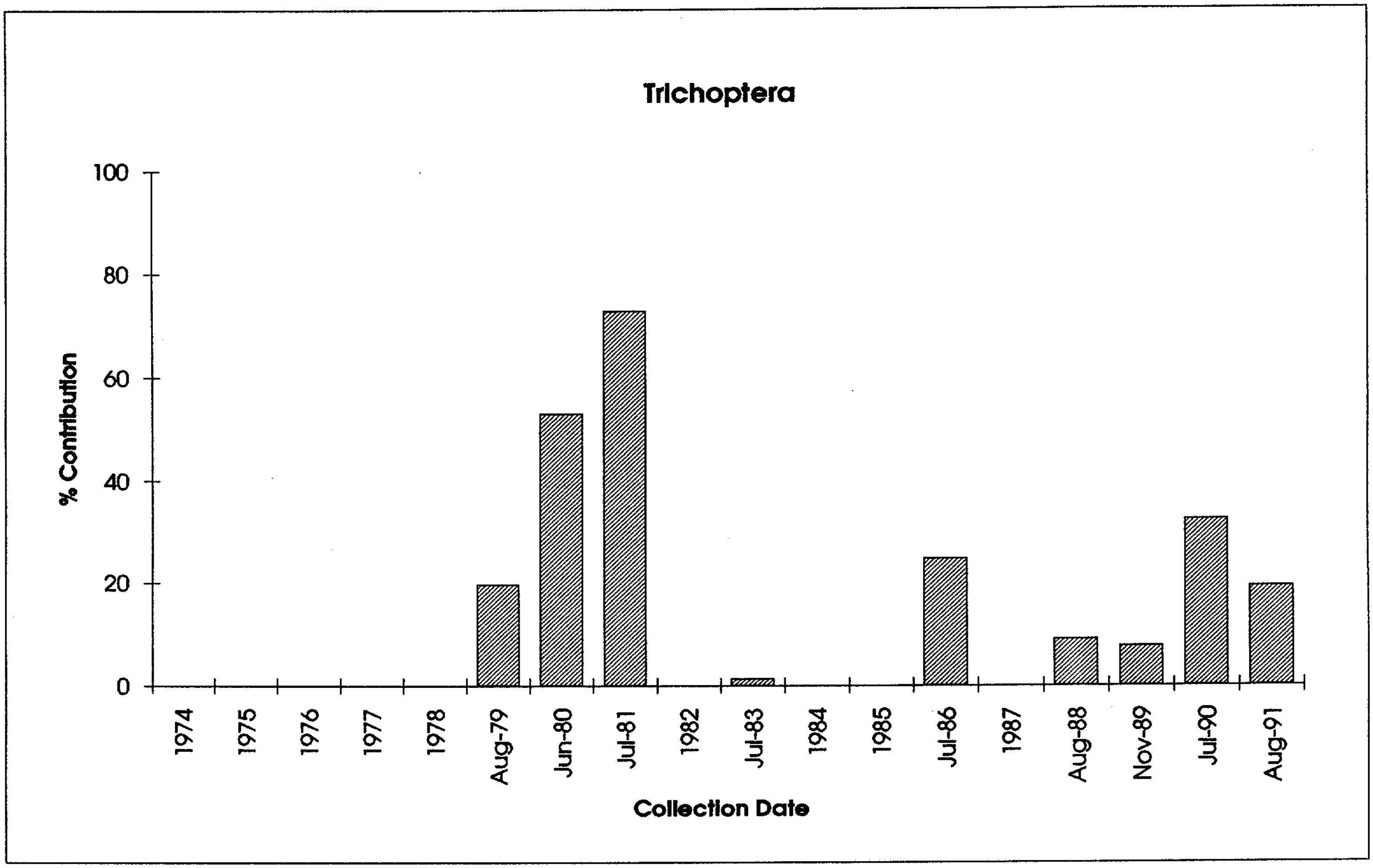
The biotic index (Figure 15B) indicates a slight shift toward a more pollution-tolerant aquatic macroinvertebrate community. The EPT taxa richness and total taxa richness (Figure 15C) showed only slight changes with no trend. Analysis of the data suggests there has been a slight deterioration of the water quality of the Coosa River at CO-2.

Figure 15A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: CO-002 1974-1991



*-Data was not collected during 1974, 1975, 1976, 1977, 1978, 1982, 1984, 1985, and 1987.

Figure 15A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: CO-002 1974-1991

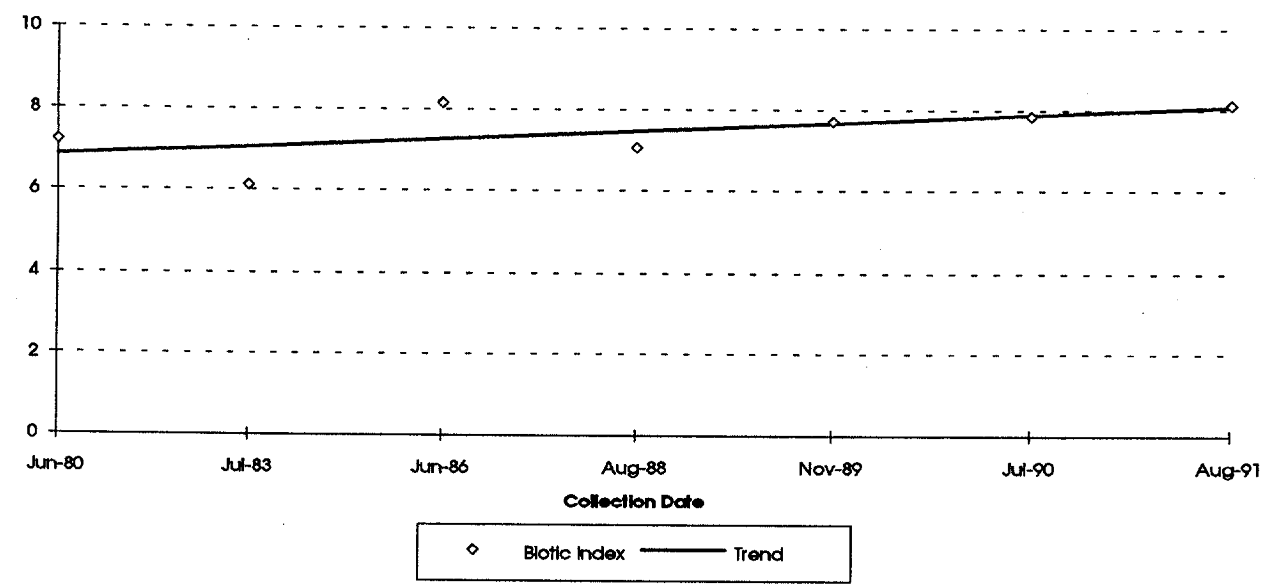


*-Data was not collected during 1974, 1975, 1976, 1977, 1978, 1982, 1984, 1985, and 1987.

BIOTIC INDEX

AMBIENT MONITORING STATION: CO-002 1980-1991

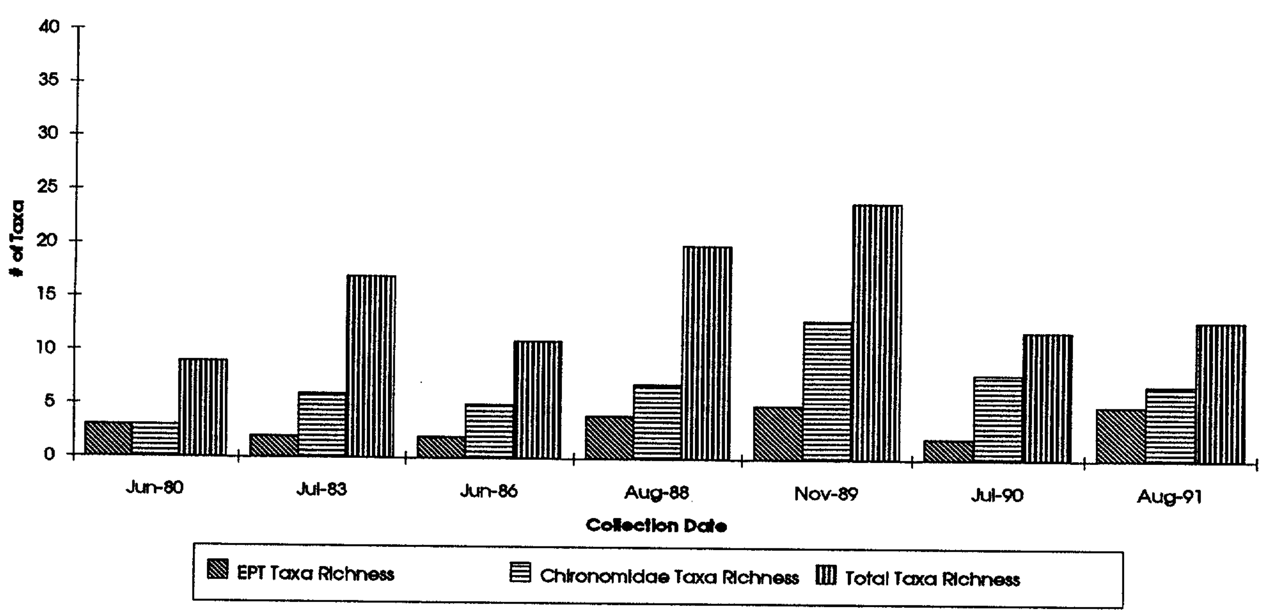
FIGURE 15B



TAXA RICHNESS

AMBIENT MONITORING STATION: CO-002 1980-1991

FIGURE 15C



UPPER / LOWER TOMBIGBEE RIVER DRAINAGE BASIN

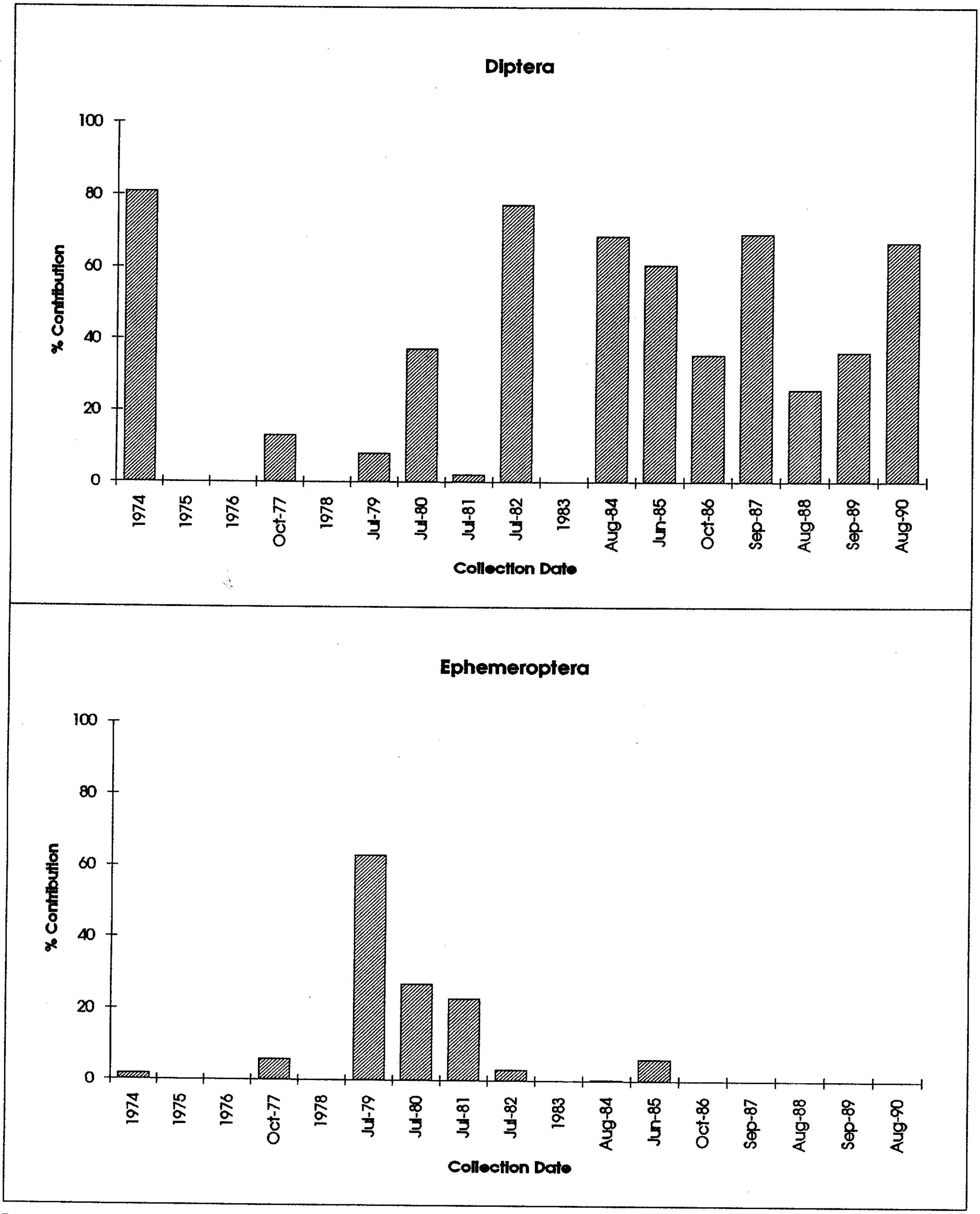
TOMBIGBEE RIVER T-2

Station T-2 is located on the Tombigbee River at the Alabama Highway 10 bridge west of Nanafalia in Marengo County. The site is located downstream from a paper mill discharge. The water use classification for this section of the Tombigbee River is 'Fish and Wildlife'.

Aquatic macroinvertebrate samples were first collected from this location in 1974 (Figure 16A). The community structure prior to 1982 was generally dominated by pollution-intolerant groups (Ephemeroptera, Trichoptera). Since 1982, the structure of the collected macroinvertebrate community has been generally dominated by the pollution-tolerant Diptera group. This shift generally indicates a decrease in the quality of the macroinvertebrate community. However, dominance by any one group whether pollution-tolerant or intolerant, is less desirable than a evenly distributed community structure.

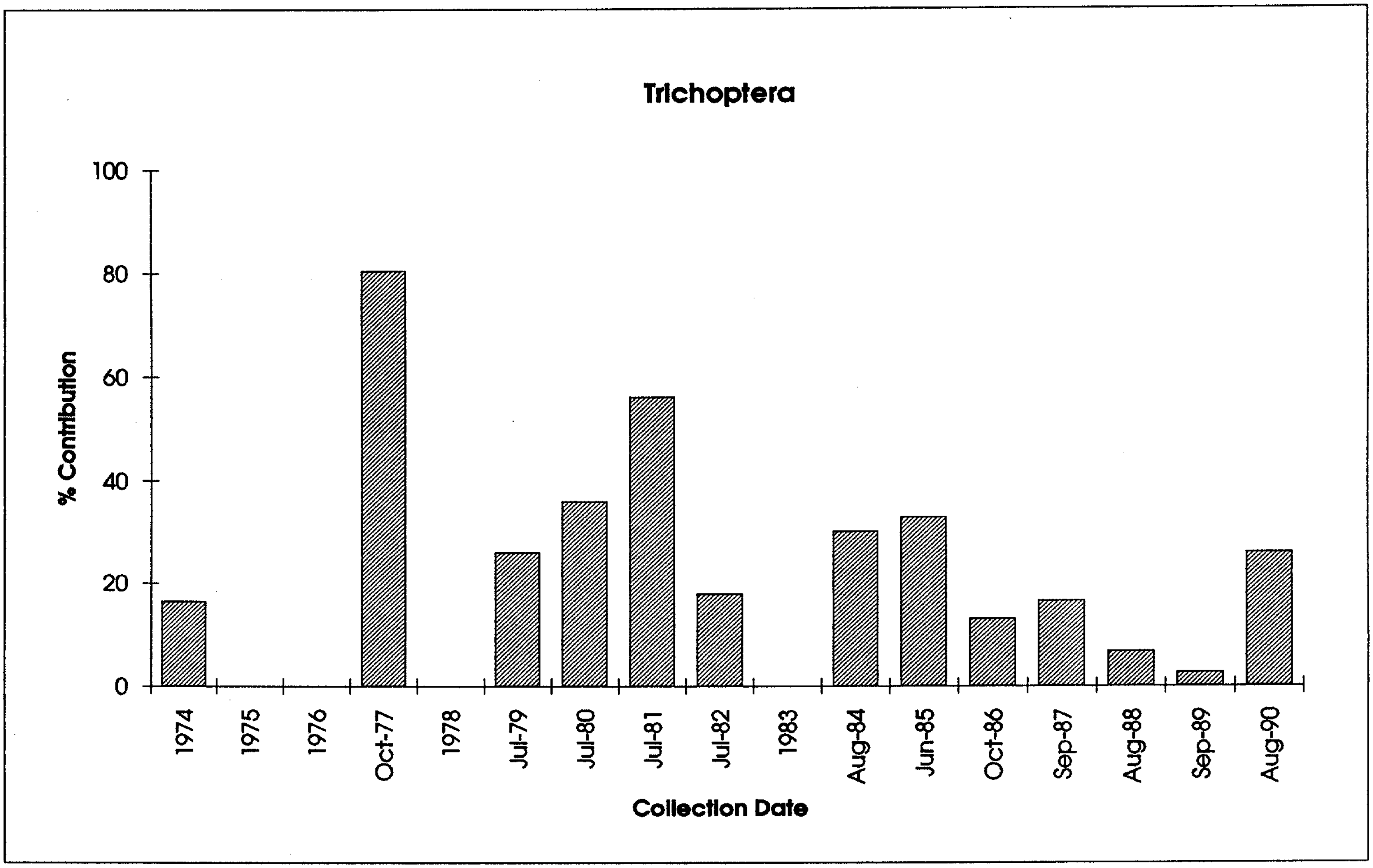
The EPT, Chironomidae and total taxa richness demonstrated minimal changes over the 1982 to 1990 sampling period (Figure 16C). The biotic index indicates little noticeable trend of the macroinvertebrate community's pollution tolerance (Figure 16B). Analysis of data collected indicated that the water quality of the Tombigbee River at the T-2 ambient monitoring station has been maintained during the monitoring period.

Figure 16A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: T-002 1974-1990



*-Data was not collected during 1975, 1976, 1978, and 1983.

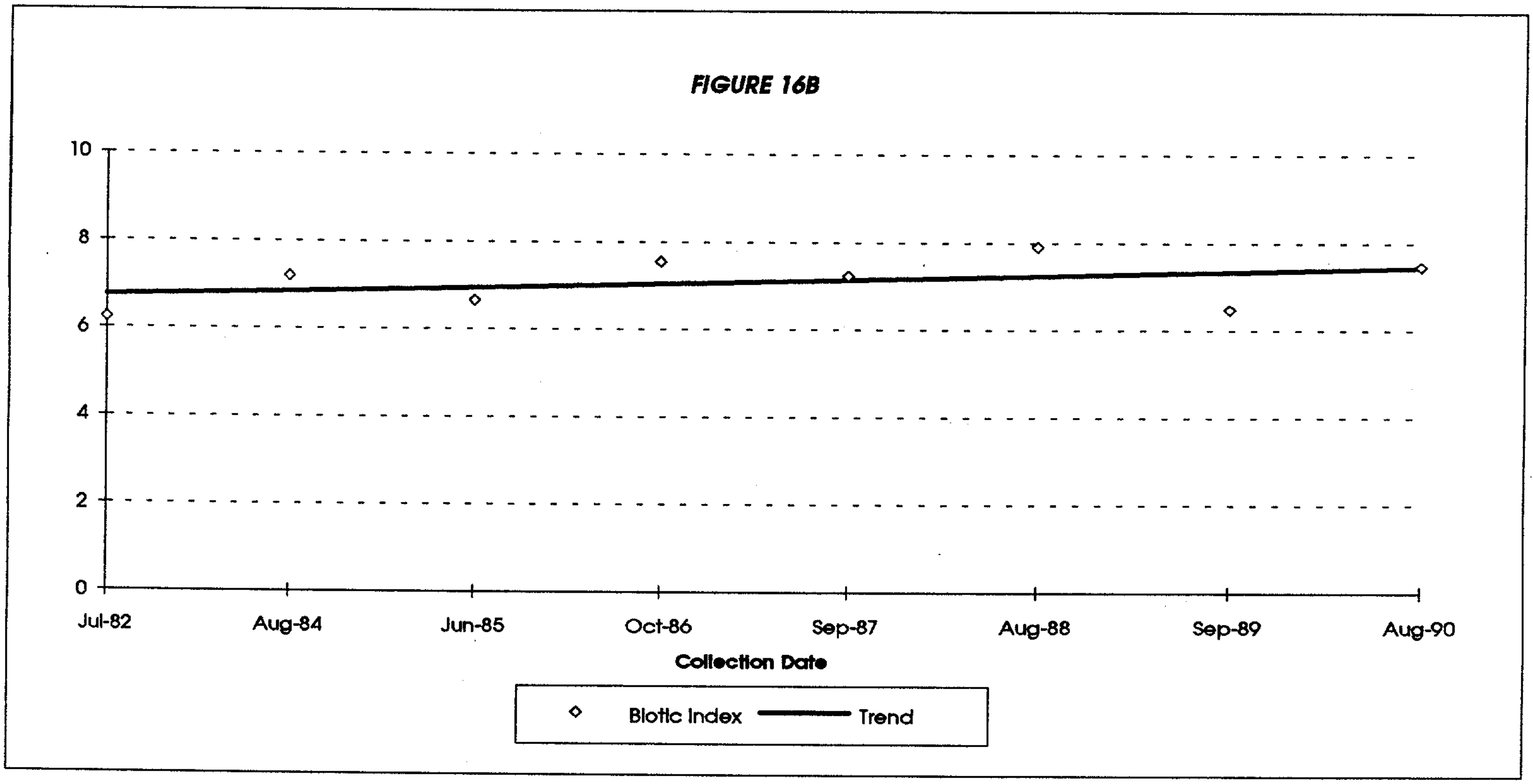
Figure 16A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: T-002 1974-1990



*-Data was not collected during 1975, 1976, 1978, and 1983.

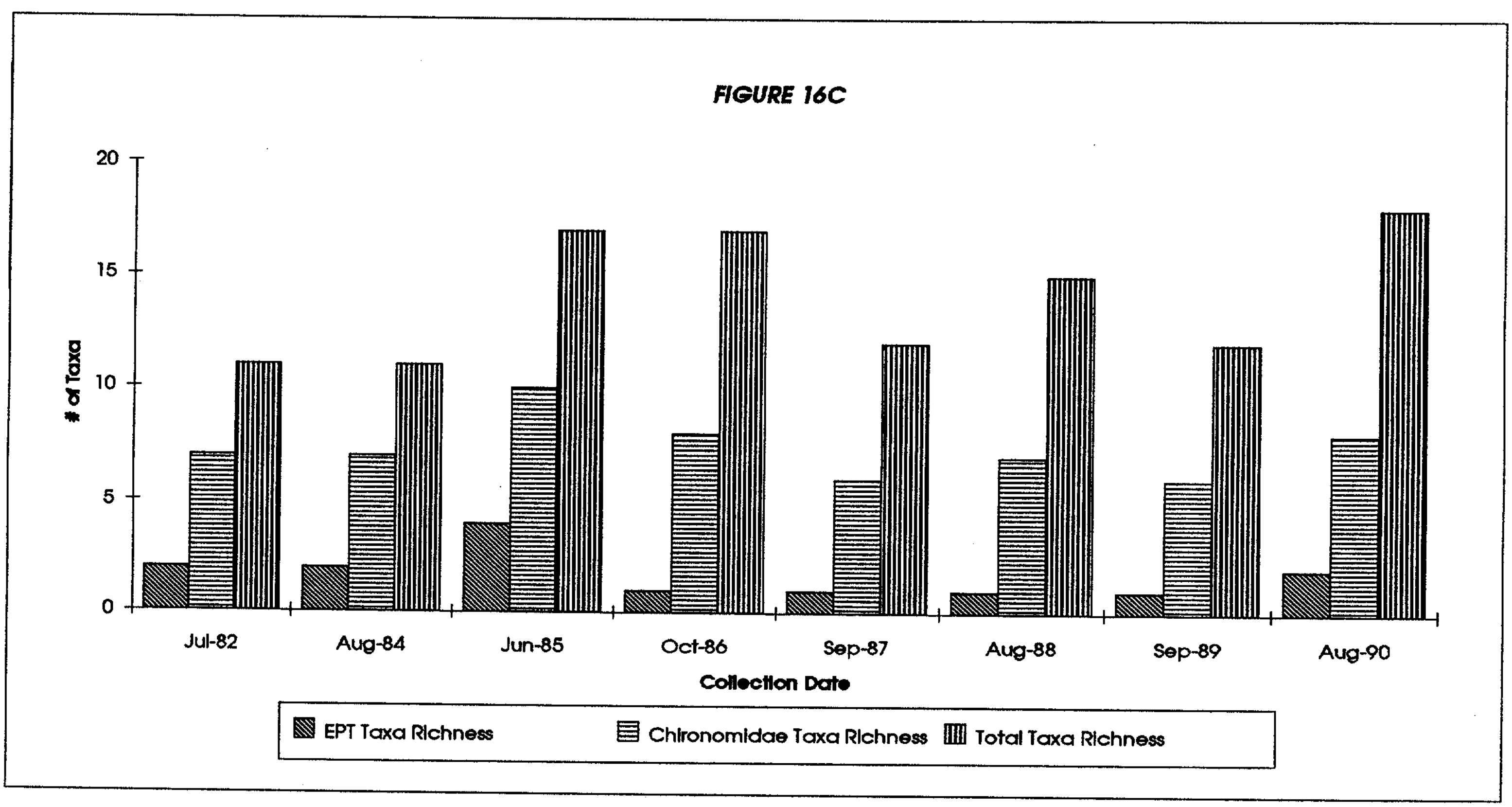
BIOTIC INDEX

AMBIENT MONITORING STATION: T-002 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: T-002 1982-1990



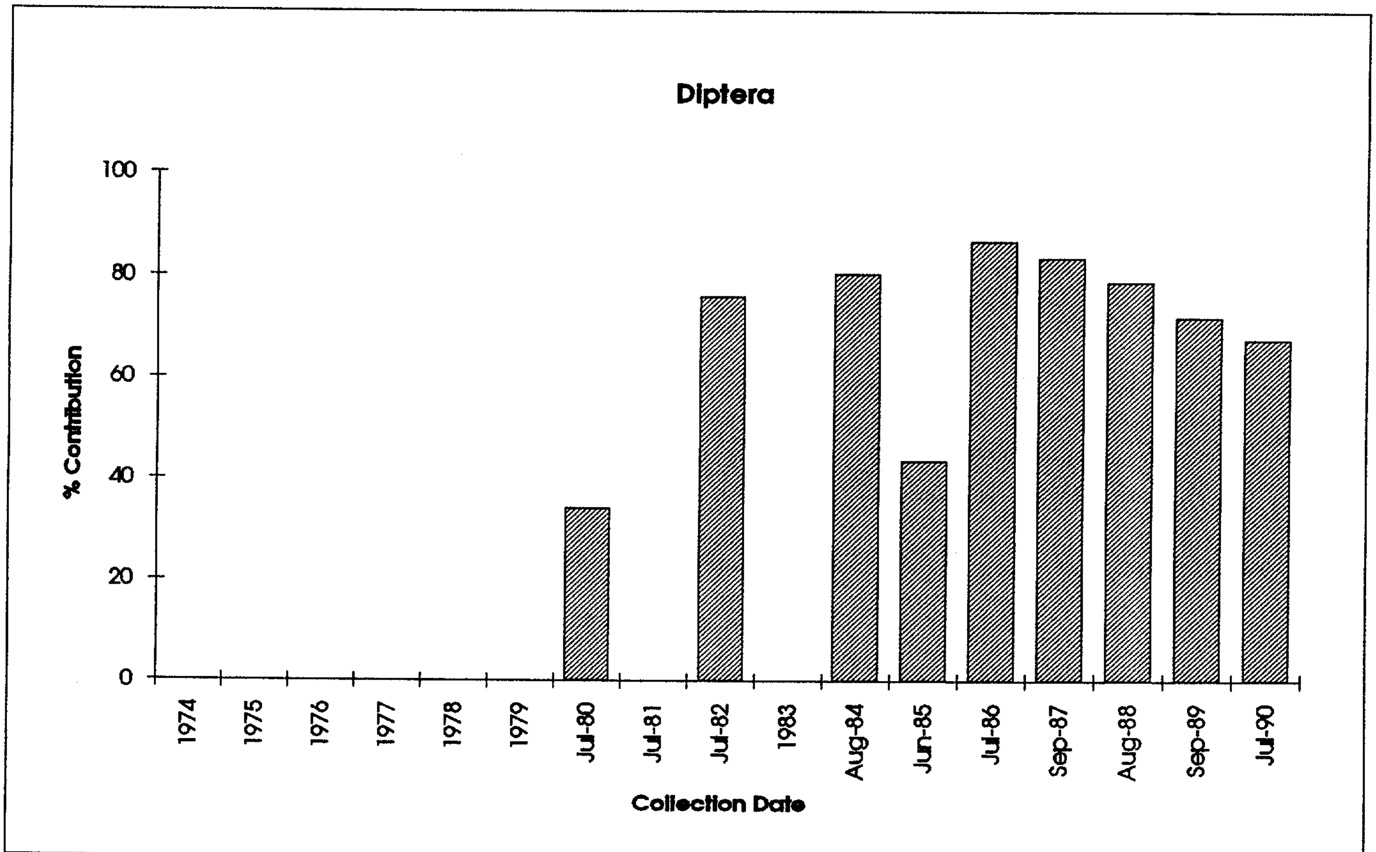
TOMBIGBEE RIVER T-4

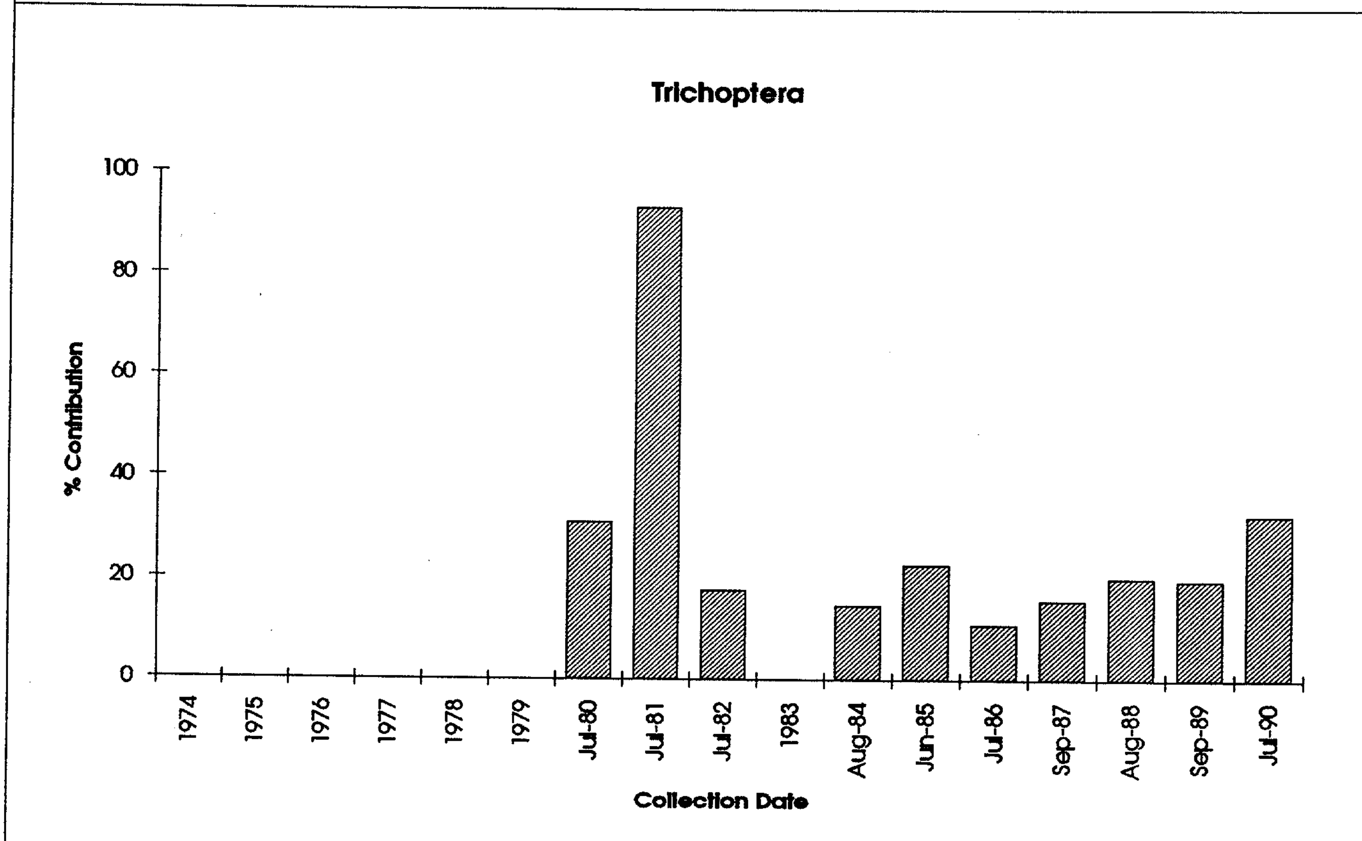
Station T-4 is located on the Tombigbee River upstream of the Aliceville Lock and Dam in Pickens County. The Tombigbee River was impounded in 1979 to create Aliceville Reservoir. The site is located to monitor the water quality of the Tombigbee River as it enters the State. This section of the Tombigbee River has water use classifications of 'Swimming and Other Whole Body Water-Contact Sports' and 'Fish and Wildlife'.

Aquatic macroinvertebrate samples were first collected from this location in 1980, one year after impoundment (Figure 17A). Since this time, community structure has been generally dominated by the pollution-tolerant Diptera group (with the exception of 1981 dominated by Trichoptera). The post-impoundment domination of the Diptera group is not unexpected due to the lentic (still water)characteristics exhibited by reservoirs.

Beginning in 1986, EPT taxa richness and total taxa richness appear to have declined, indicating a degradation of water quality (Figure 17C). The biotic index indicates little noticeable trend in the macroinvertebrate community's pollution tolerance (Figure 17B). Analysis of data collected indicated that there has been a slight deterioration of the water quality of the Tombigbee River at the T-4 ambient monitoring station.

Figure 17A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: T-004 1974-1990

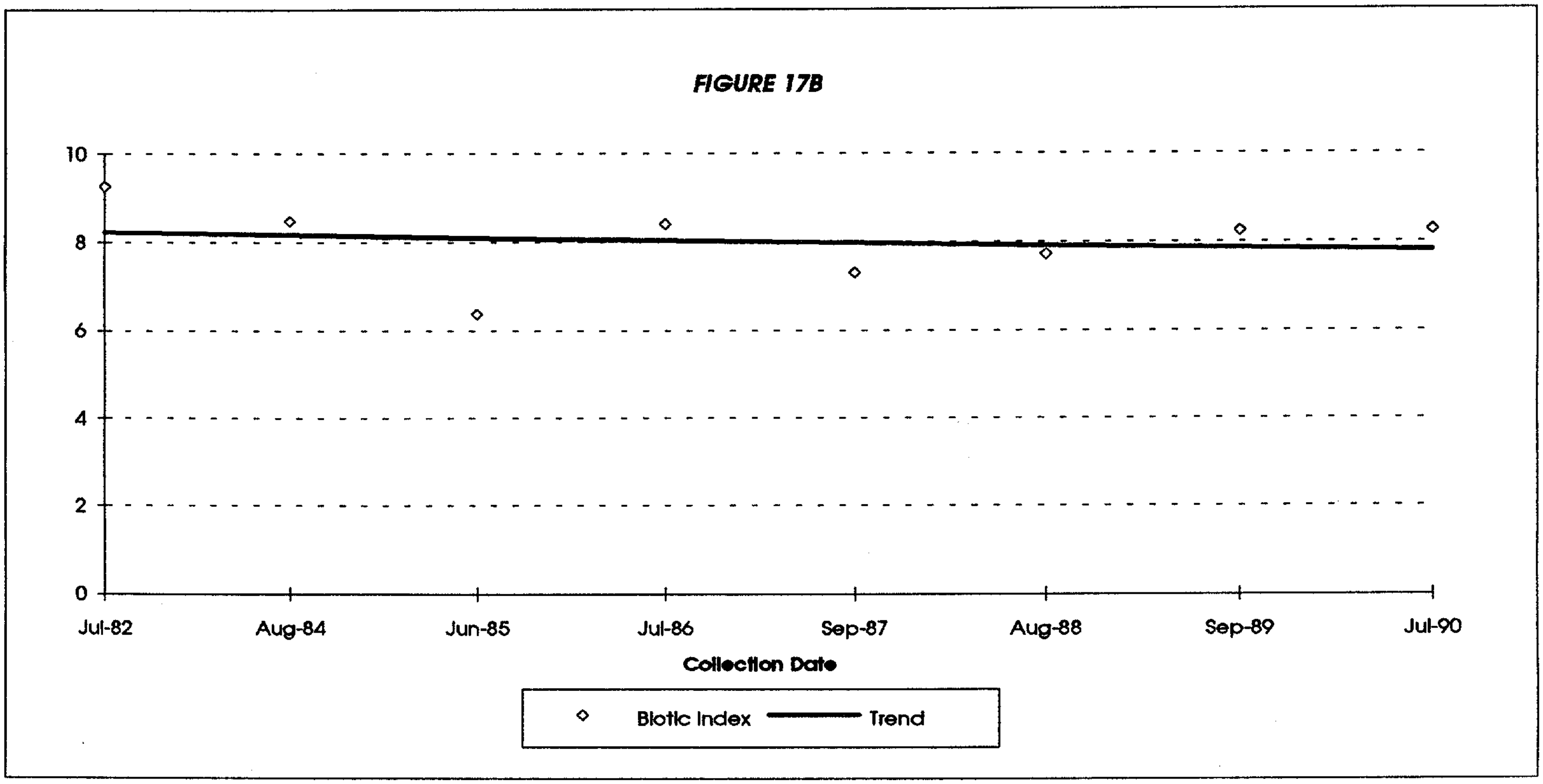




*-Data was not collected during 1974, 1975, 1976, 1977, 1978, 1979, and 1983.

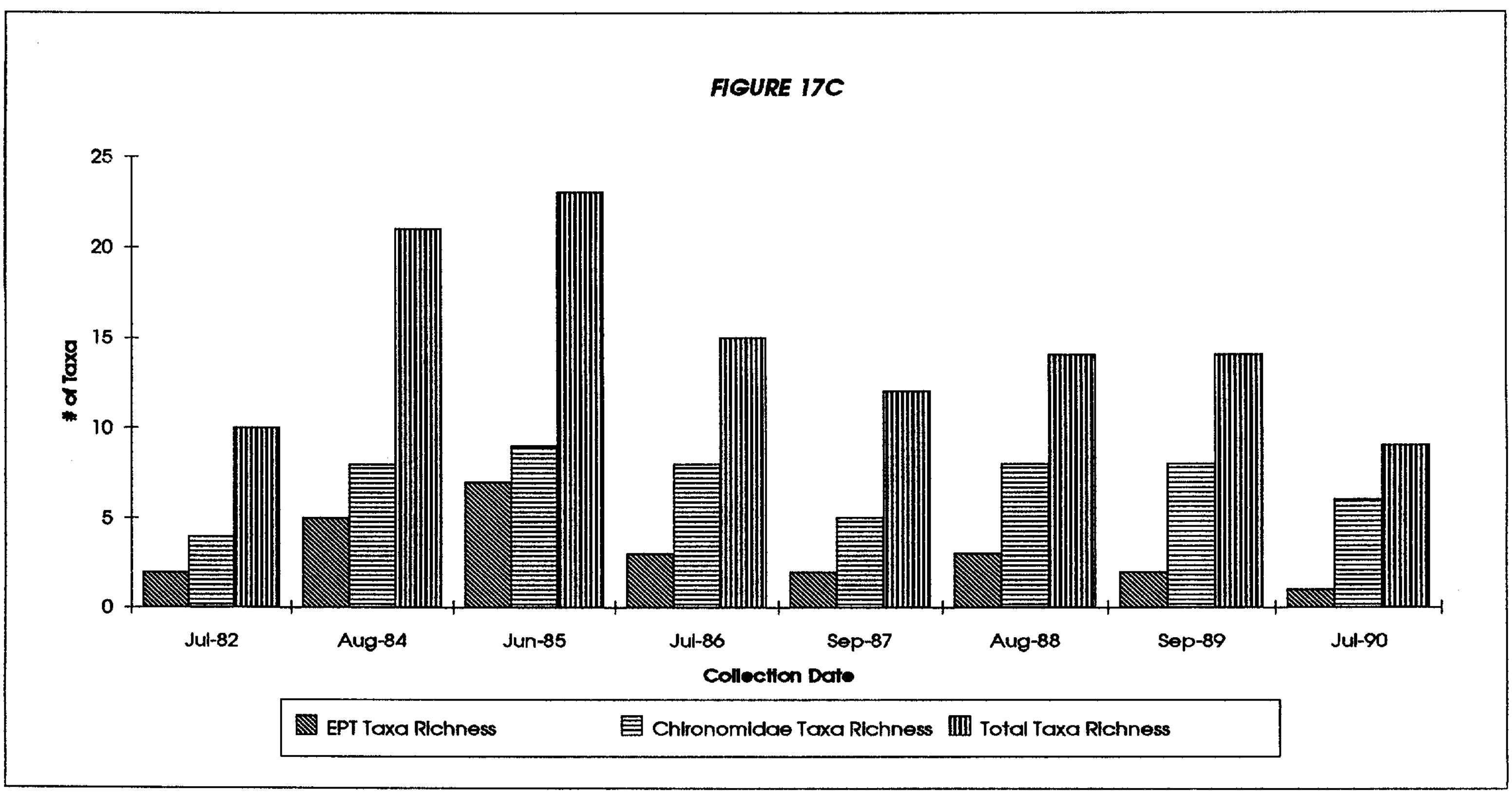
BIOTIC INDEX

AMBIENT MONITORING STATION: T-004 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: T-004 1982-1990



WARRIOR RIVER DRAINAGE BASIN

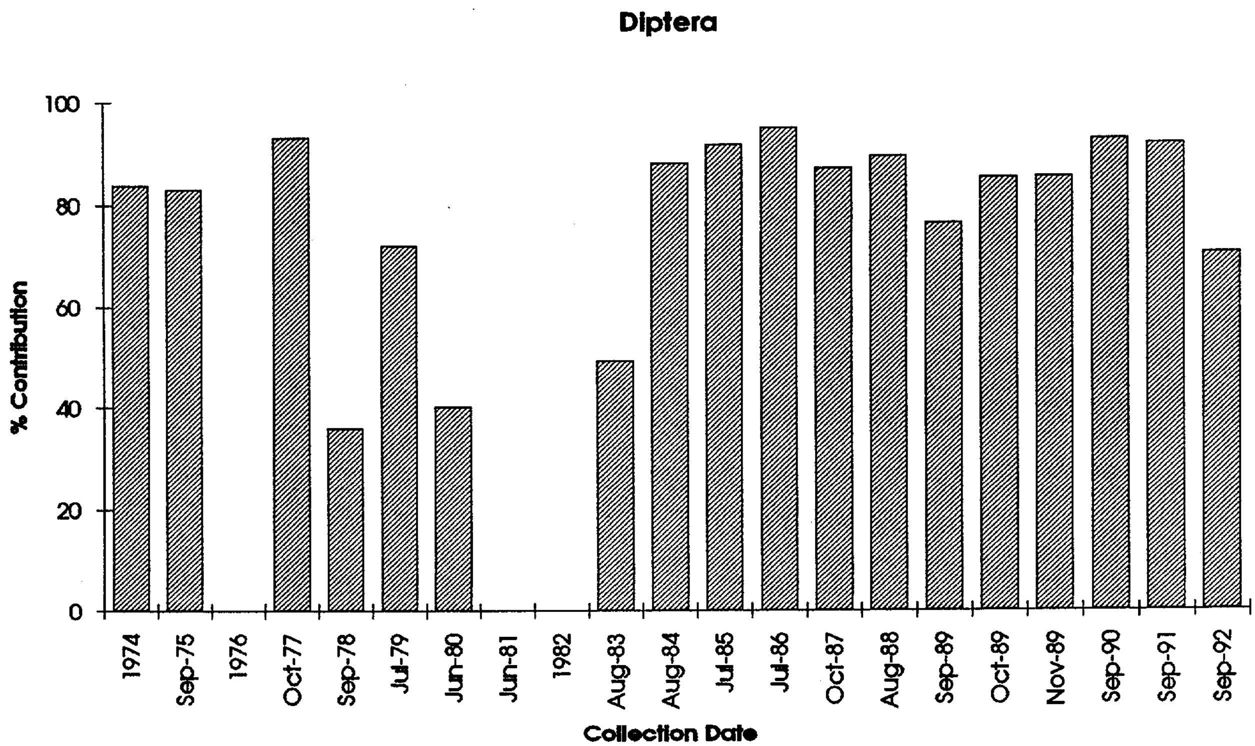
BANKHEAD LAKE BL-1

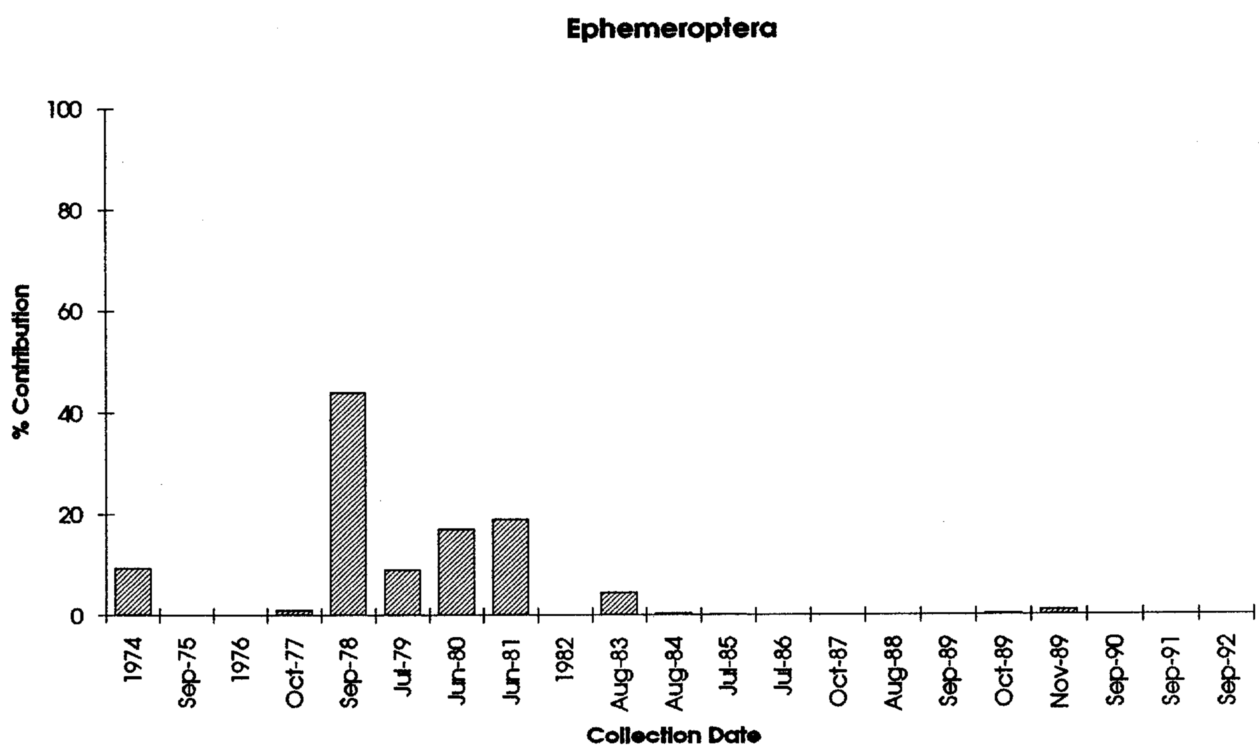
Station BL-1 is located on Bankhead Lake (Reservoir) at the bridge near Oliver Camp in Jefferson County. This reservoir station is located below two major tributaries which form the Black Warrior River; the Locust Fork and the Mulberry Fork and is sampled to monitor the effects of the city of Birmingham. Bankhead Lake was impounded in 1916. This section of Bankhead Lake has water use classifications of 'Public Water Supply', 'Swimming and Other Whole Body Water-Contact Sports', and 'Fish and Wildlife'.

Aquatic macroinvertebrate samples were first collected from this location in 1975. Since this time, the generally pollution-tolerant dipteran group has dominated the samples collected 16 of the 18 years (Table 18A). This was not unexpected, however, due to the generally lentic characteristics exhibited by reservoirs.

EPT taxa richness and total taxa richness (Figure 18C) have shown slight decreases over the 1983 to 1992 sampling period while Chironomidae taxa richness has increased slightly. The biotic index indicated little noticeable change in the pollution tolerance of the macroinvertebrate community (Figure 1B). Analysis of data collected indicate that there has been slight deterioration in the water quality of the Bankhead Lake at station BL-1.

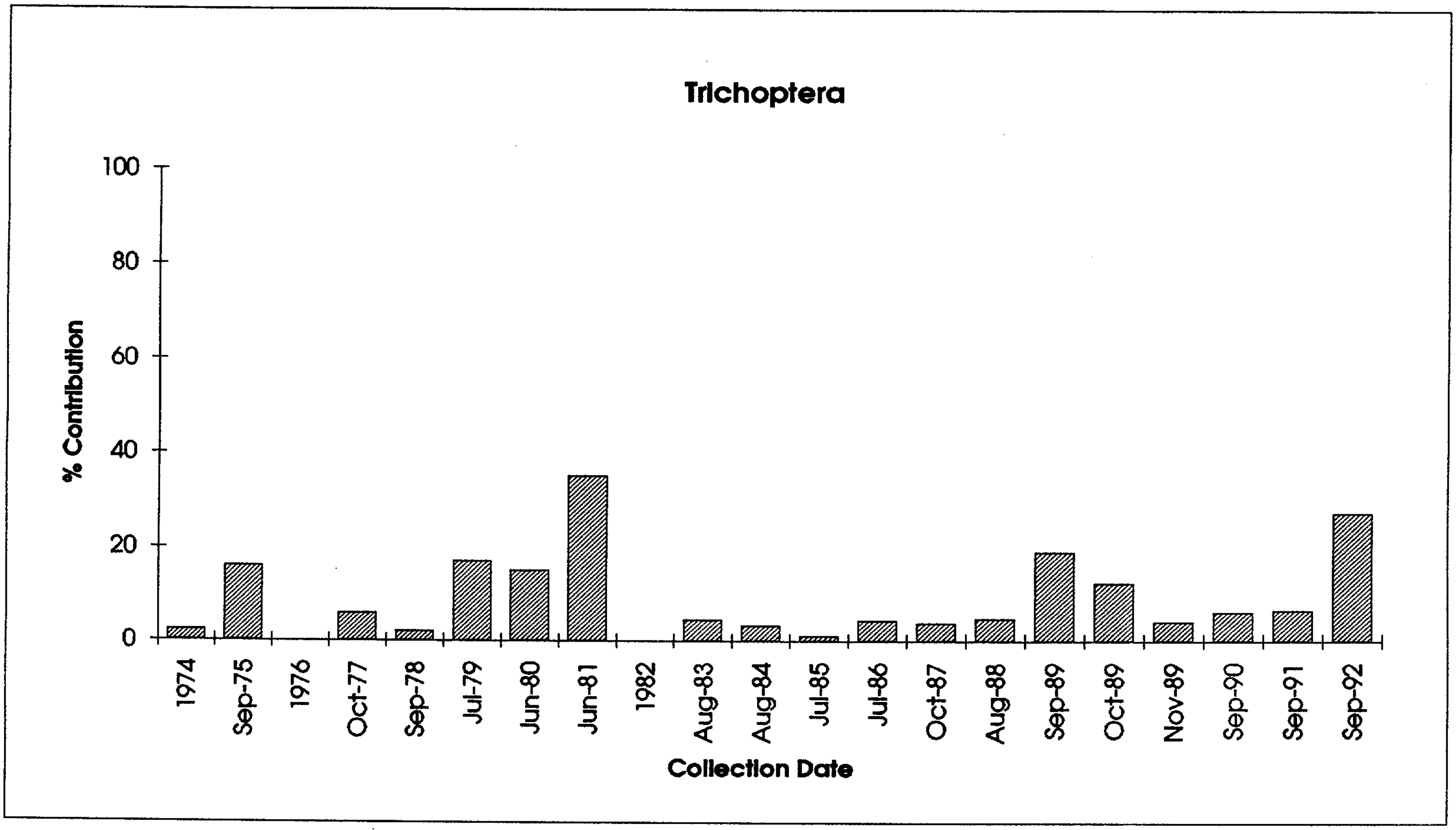
Figure 18A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: BL-001 1974-1992





*-Data was not collected during 1976 and 1982.

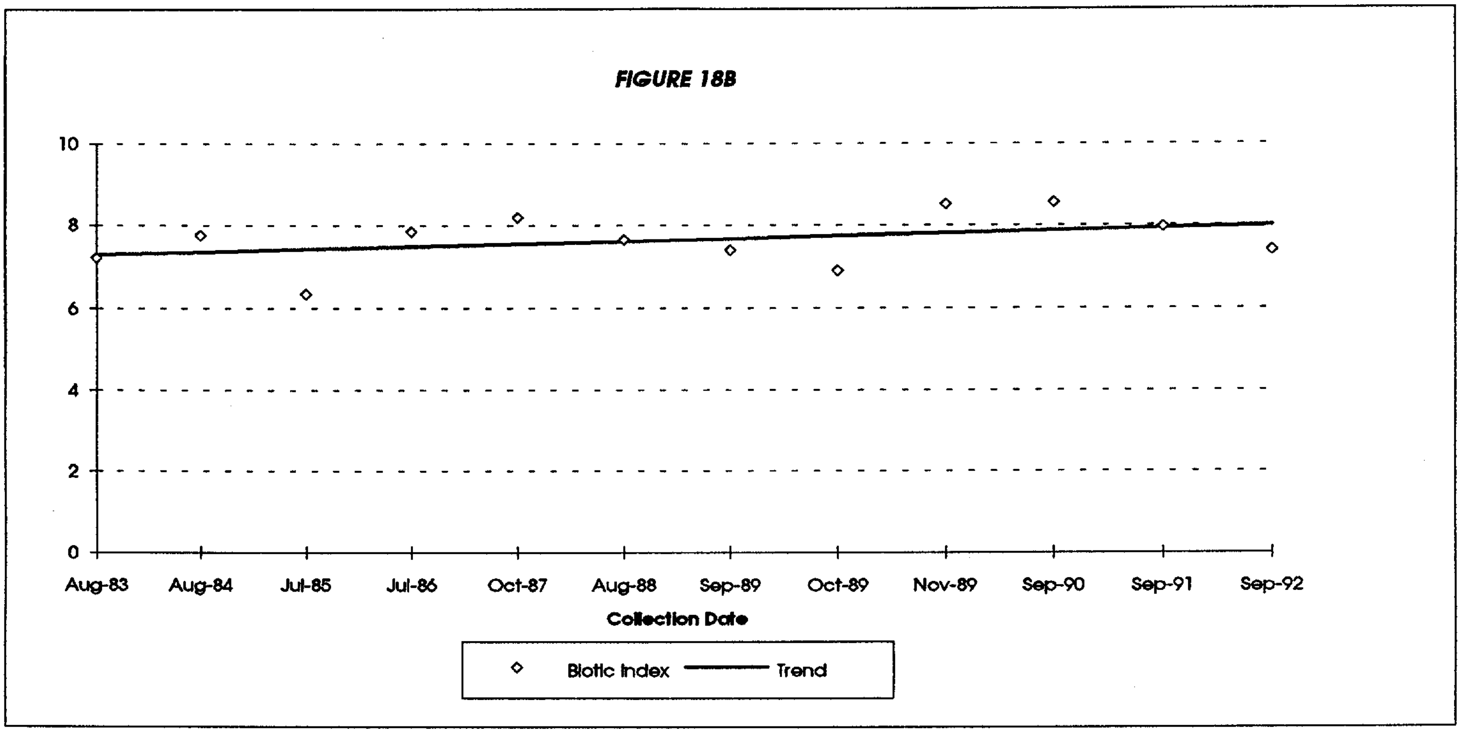
Figure 18A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: BL-001 1974-1992



*-Data was not collected during 1976 and 1982.

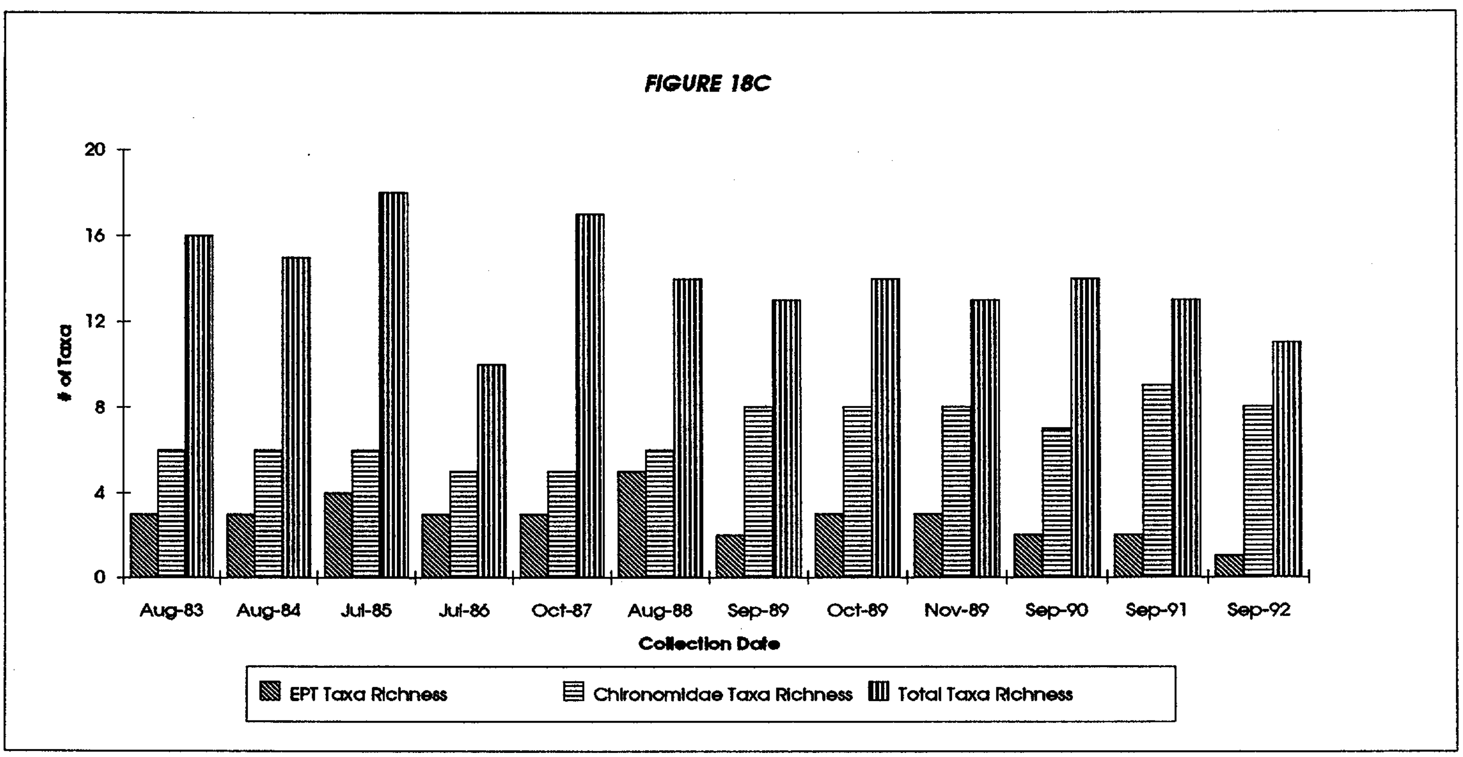
BIOTIC INDEX

AMBIENT MONITORING STATION: BL-001 1983-1992



TAXA RICHNESS

AMBIENT MONITORING STATION: BL-001 1983-1992



In 1990 and 1991, RBP-Multihabitat sampling protocol was used.

LOCUST FORK OF BLACK WARRIOR RIVER LF-1 & LF-1a

Station LF-1a is located on the Locust Fork of the Black Warrior River in Jefferson County near Powhatan. The site is downstream of Village and Five Mile Creeks which receive industrial and municipal discharges and urban runoff from the Birmingham area. This section of the Locust Fork has a water use classification of 'Fish and Wildlife'.

Aquatic macroinvertebrate samples were first collected from this location in 1974 (Figure 19A). Community structure has been generally dominated by the pollution-tolerant Diptera group. The community structure in 1980 was dominated by a more pollution-intolerant group (Ephemeroptera). However, dominance by any one group is less desirable than an evenly distributed community structure.

EPT taxa richness and total taxa richness appeared to peak in 1986 and then decrease to levels similar to 1982. (Figure 19C). The trend line for the biotic index, as shown in Figure 19B, indicates a slight shift toward a more pollution-intolerant macroinvertebrate community, however the individual values for each year range widely. Analysis of data collected indicated that the water quality of the Locust Fork of the Black Warrior River at the LF-1A ambient monitoring station has been maintained during the monitoring period.

Figure 19A
% Contribution of Dominant Orders
AMBIENT MONITORING STATION: LF-001 & LF-001a 1974-1990

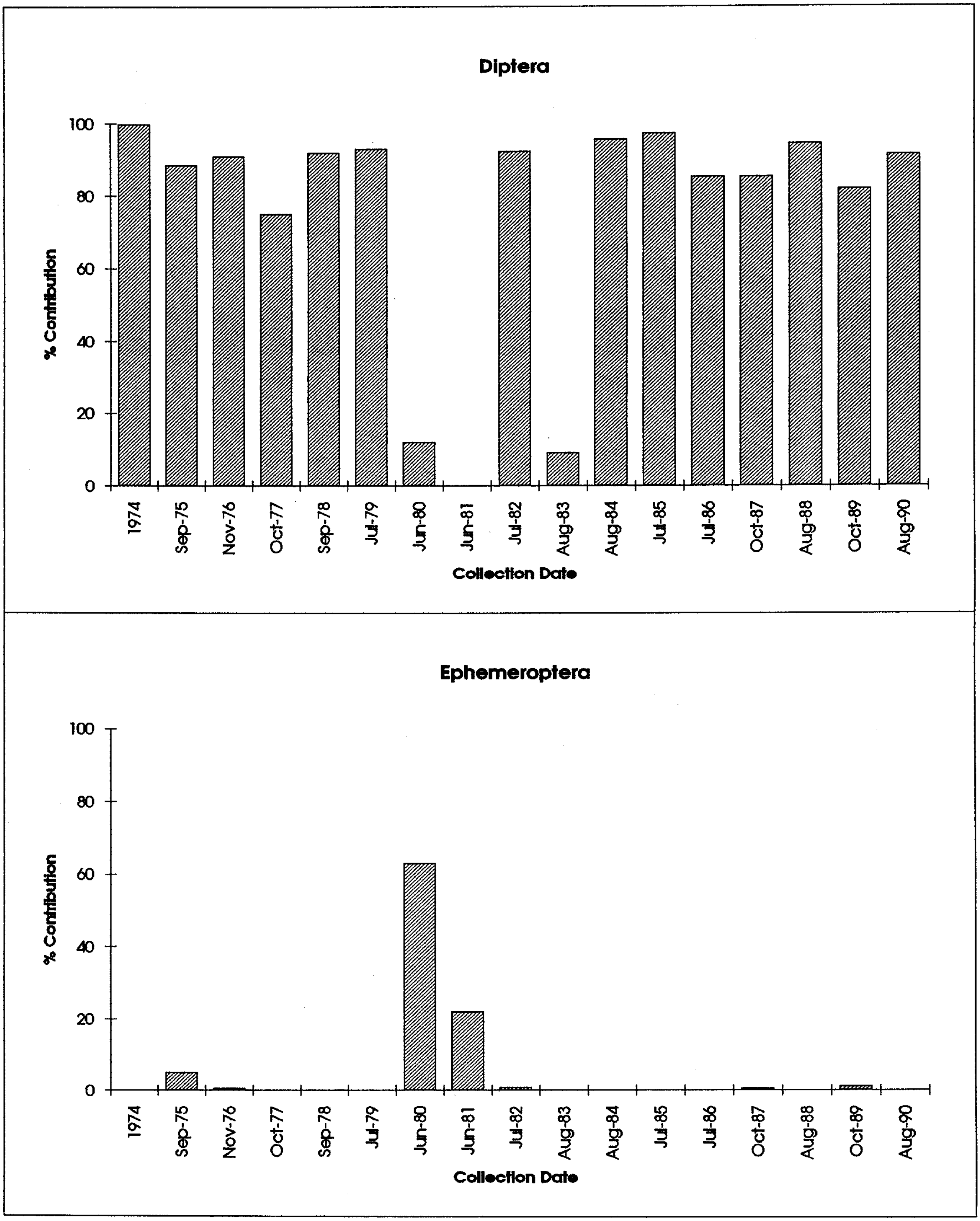
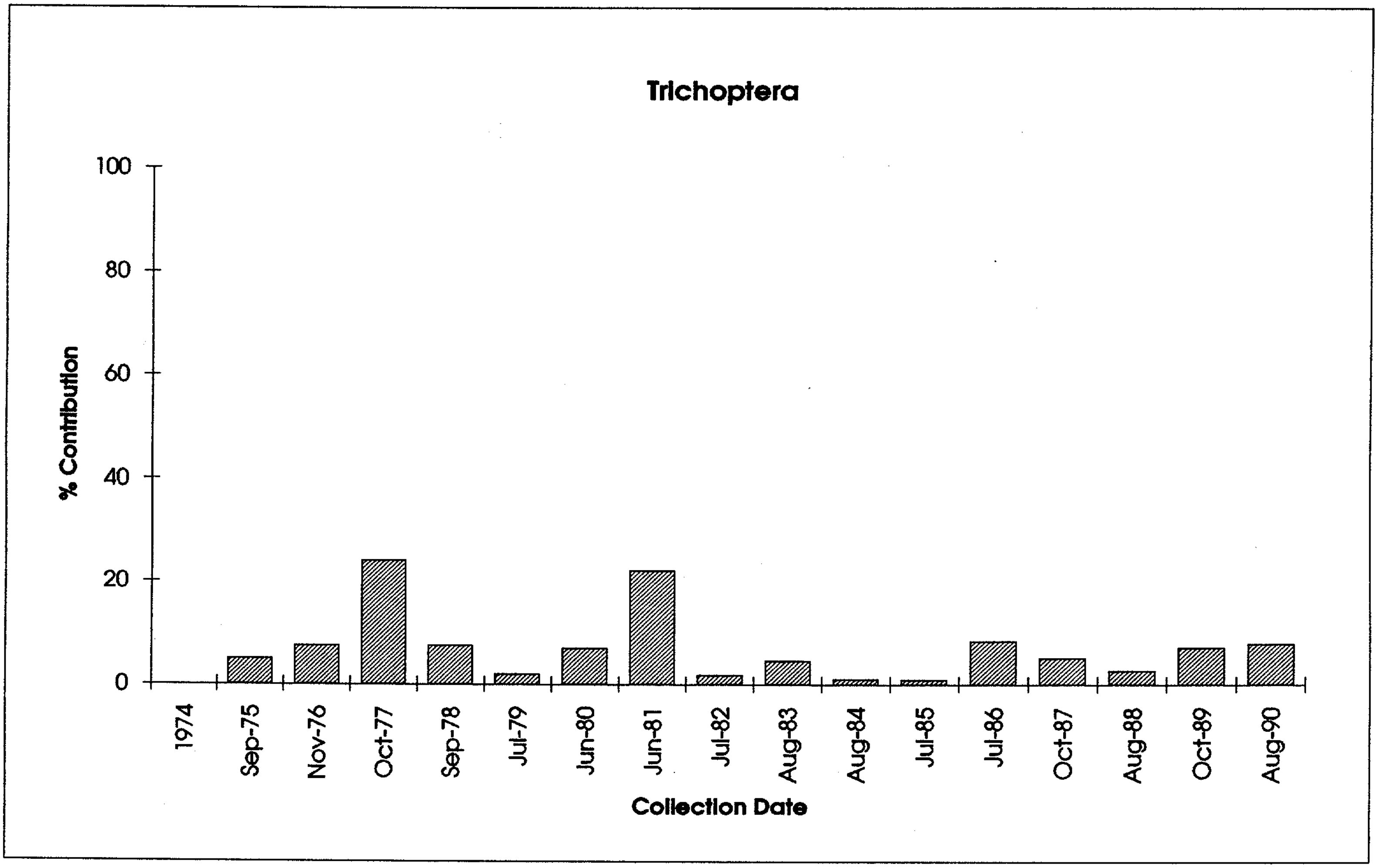
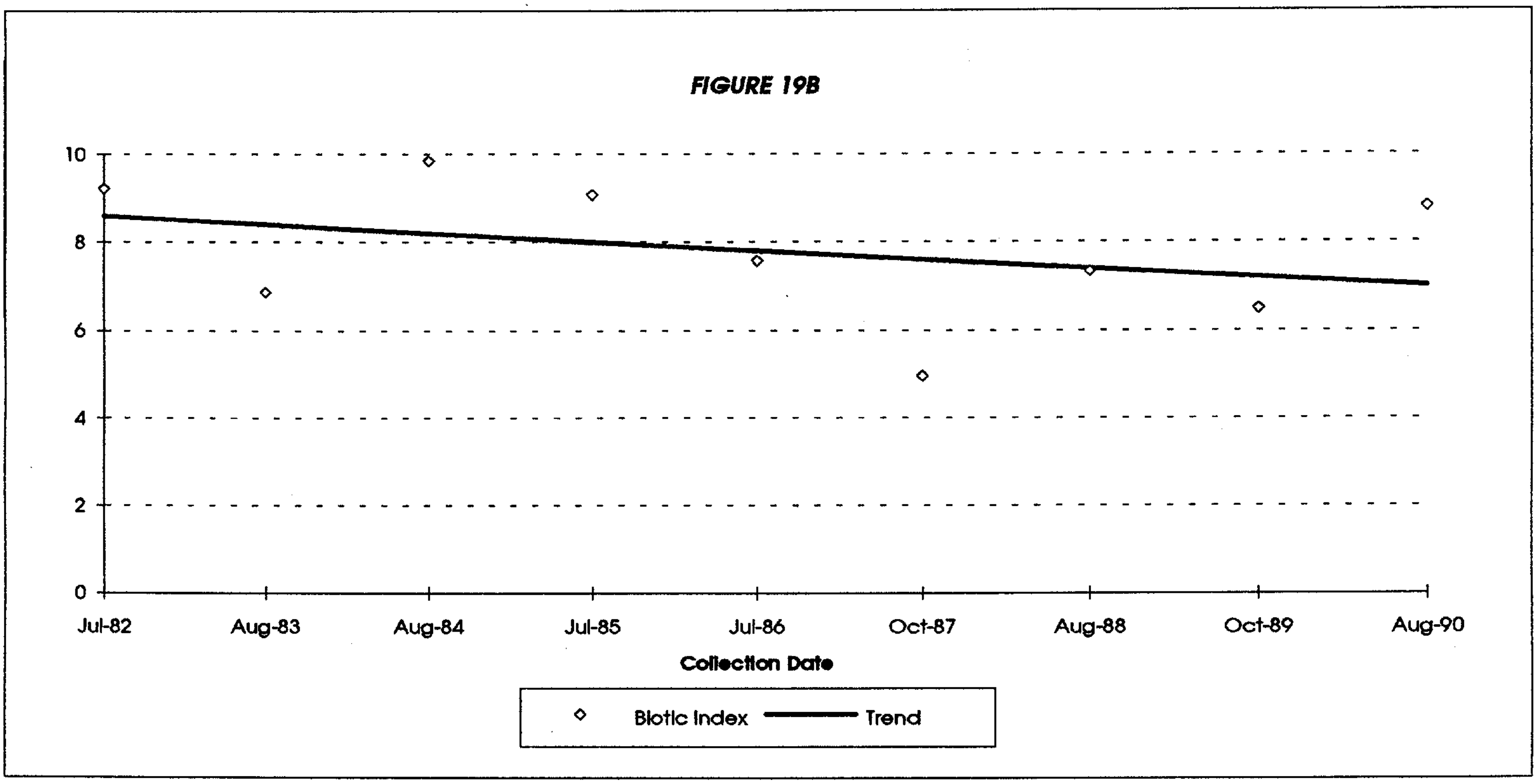


Figure 19A
% Contribution of Dominant Orders
AMBIENT MONITORING STATION: LF-001 & LF-001a 1974-1990



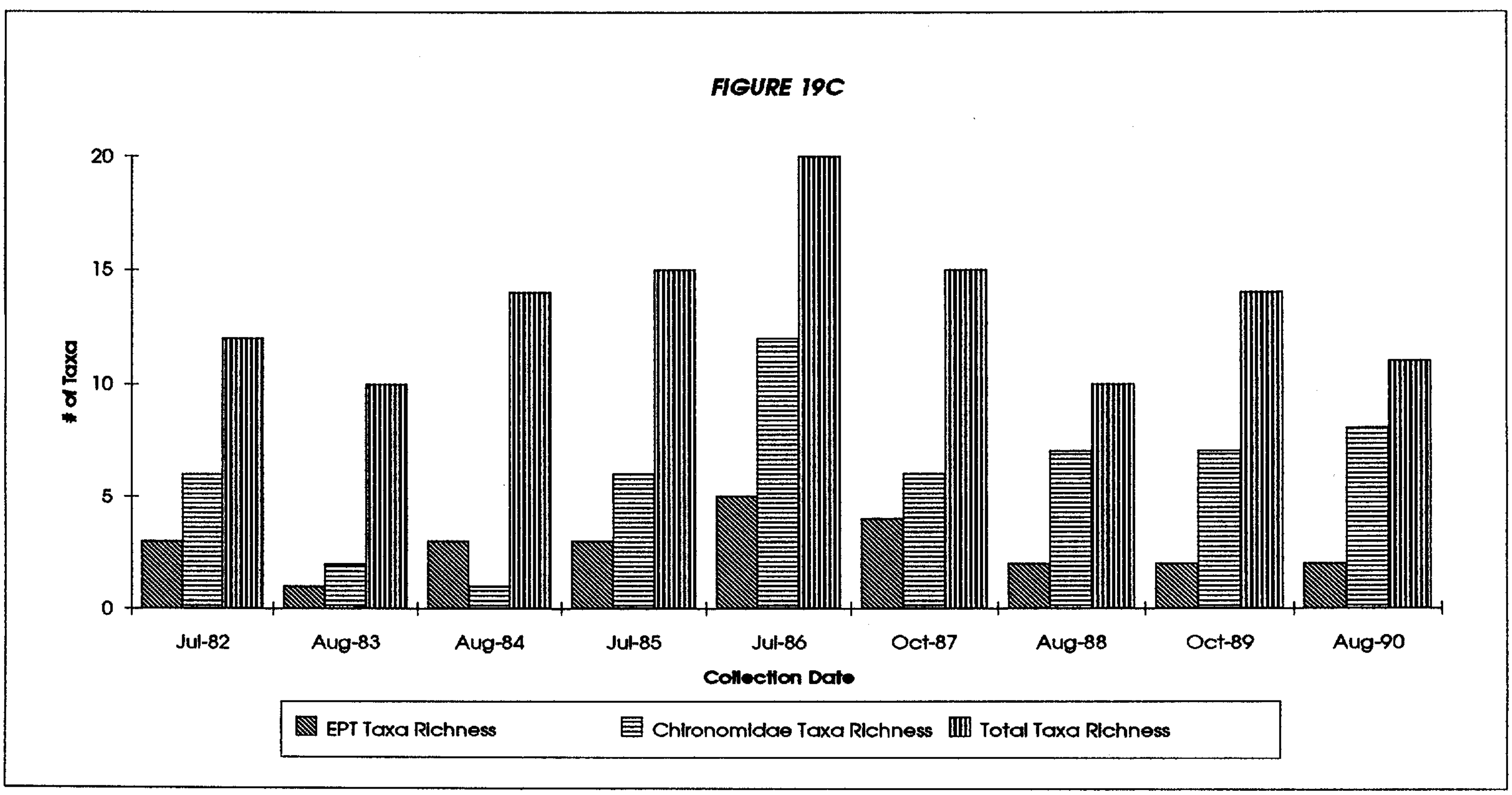
BIOTIC INDEX

AMBIENT MONITORING STATION: LF-001 & LF-001a 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: LF-001 & LF-001a 1982-1990



PART III

TIDALLY INFLUENCED STREAMS

MOBILE RIVER DRAINAGE BASIN

CHICKASAW CREEK CS-1

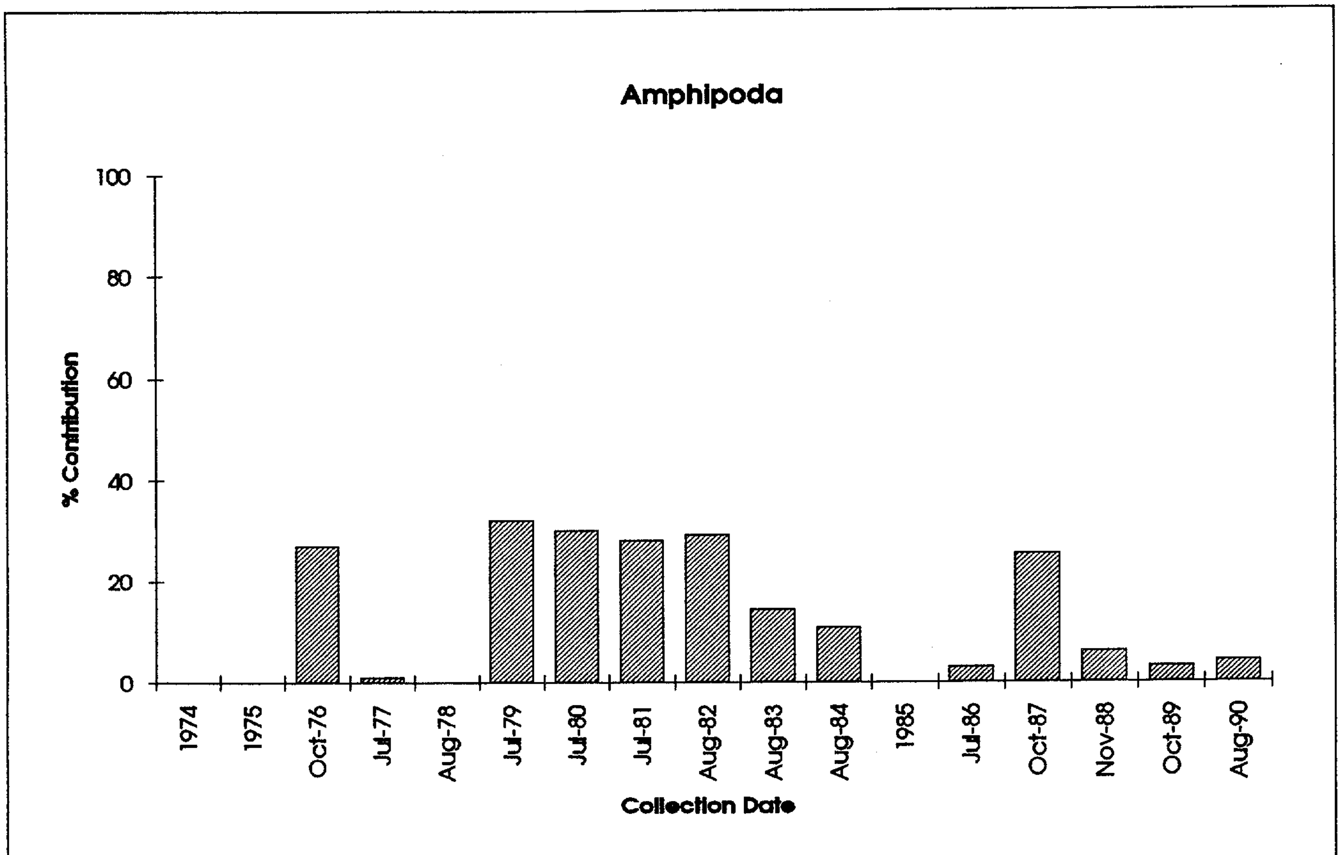
Station CS-1 is located on Chickasaw Creek at the Highway 43 bridge near Chickasaw. The Mobile County site is located upstream from industrial discharges. This section of Chickasaw Creek has water use classifications of 'Swimming and Other Whole body Water-Contact Sports' and 'Fish and Wildlife'.

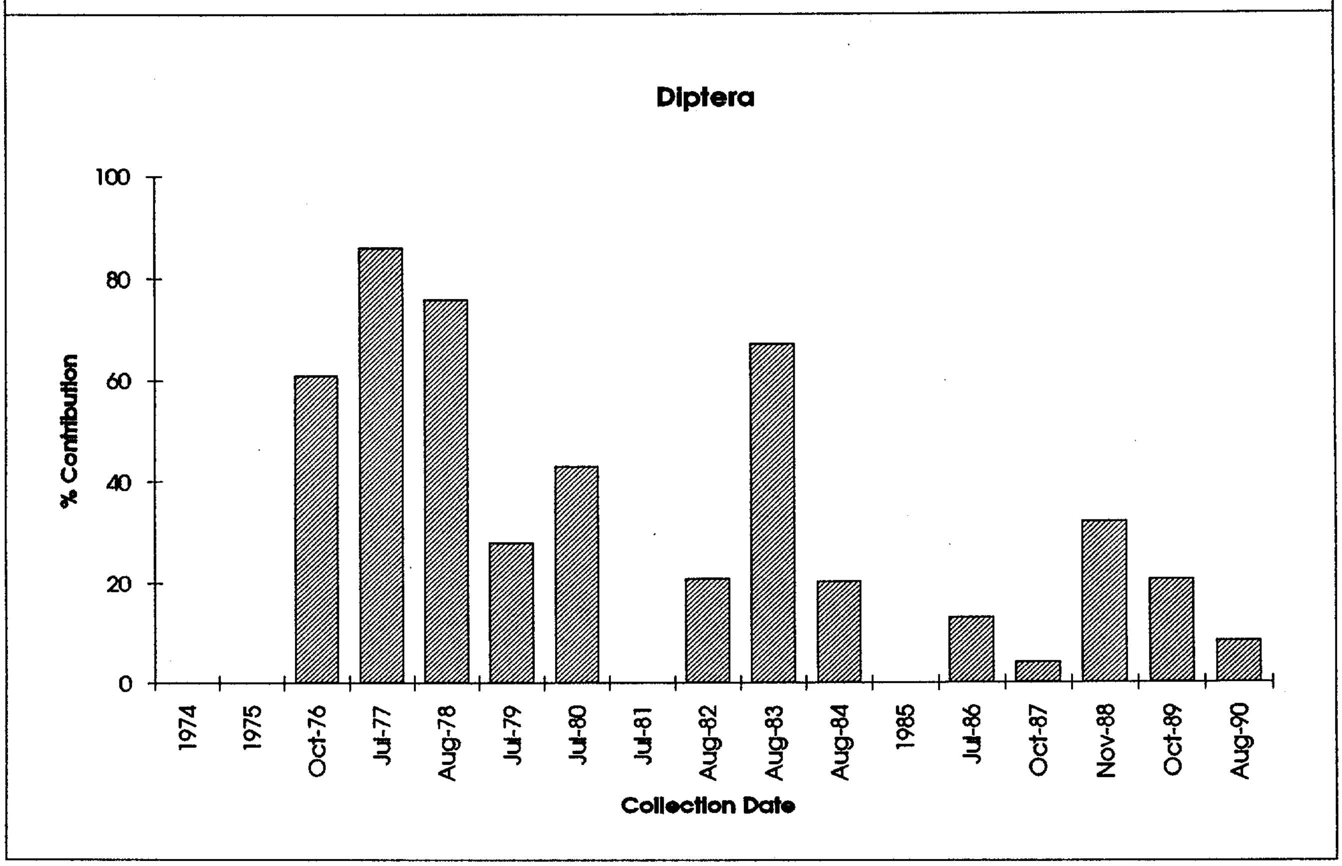
Beginning in 1976, the sampled community was dominated by the generally pollution-tolerant Diptera group (Figure 20A). Samples collected in 1979 to 1982 were more evenly distributed between taxa groups with no group dominating the sample. From 1984 to 1990 the sampled community was dominated by the genus *Geukensia* of the Mollusca group. This particular organism is often found in estuarine conditions.

Estuarine and marine organisms are not included in the calculation of the biotic index due to a lack of tolerance values available in the literature. Therefore, the biotic index values found in Table 20B are derived from only those freshwater organisms with tolerance values. No trend in the calculated biotic index is discernible.

The EPT taxa richness reflects changes in water quality in freshwater environments. However the EPT taxa richness will not reflect these water quality changes in saline conditions since these generally pollution-intolerant organisms are usually not found in estuarine or marine environments. This makes interpretation of this metric difficult at the tidally influenced stations where the water may be either fresh, saline or some gradient in between. Therefore, since the dominant taxon from 1986 to 1990 was an estuarine organism (*Geukensia*), this suggested that the decrease in EPT taxa richness over the same time period (Figure 20C) may not be an indication of a degradation in water quality but of differences in salinity. Total taxa richness over the period of 1982 to 1990 decreases slightly, however this may also be reflecting the saline conditions during sampling periods from 1986 to 1990. Analysis of the data collected at CS-1 indicate little discernible change in water quality.

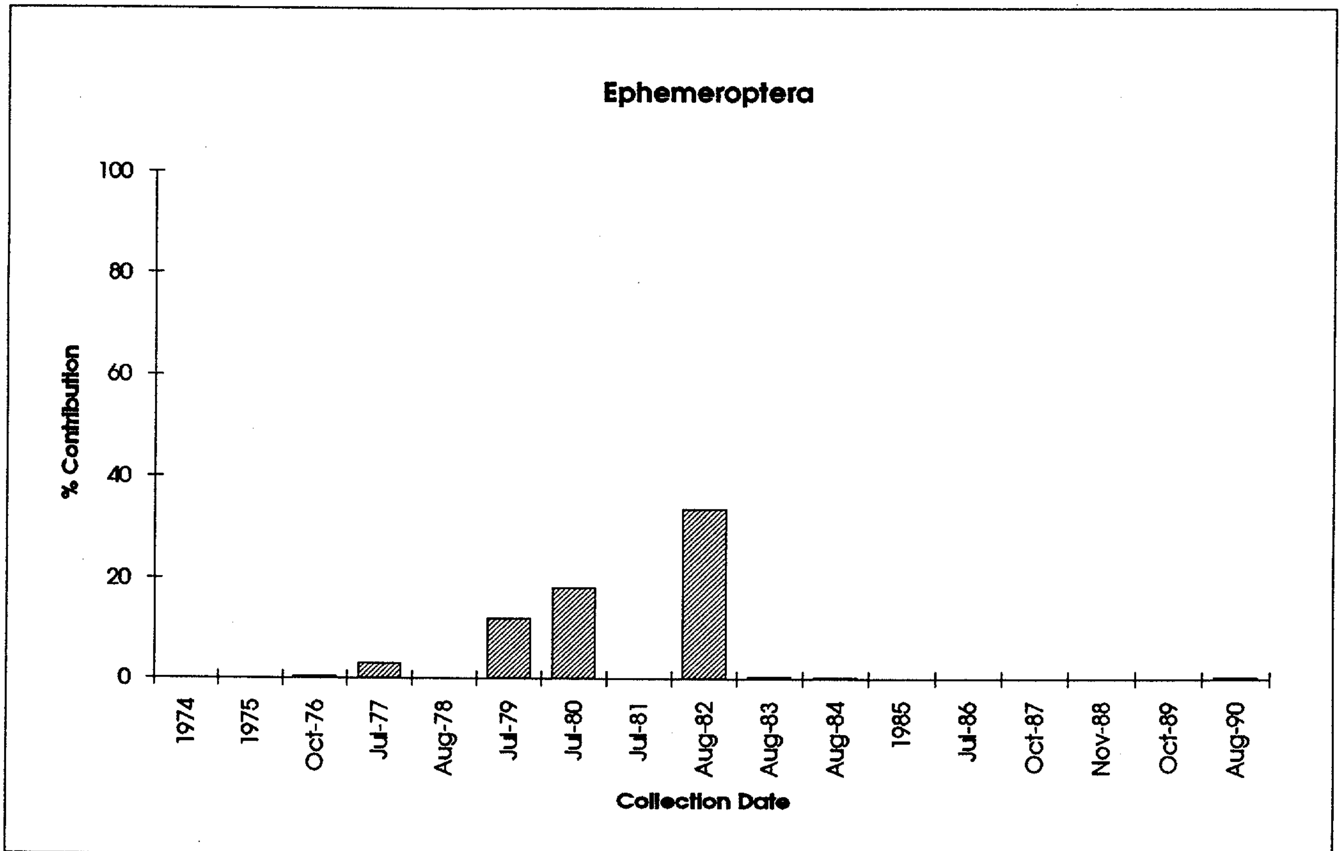
Figure 20A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: CS-001 1974-1990

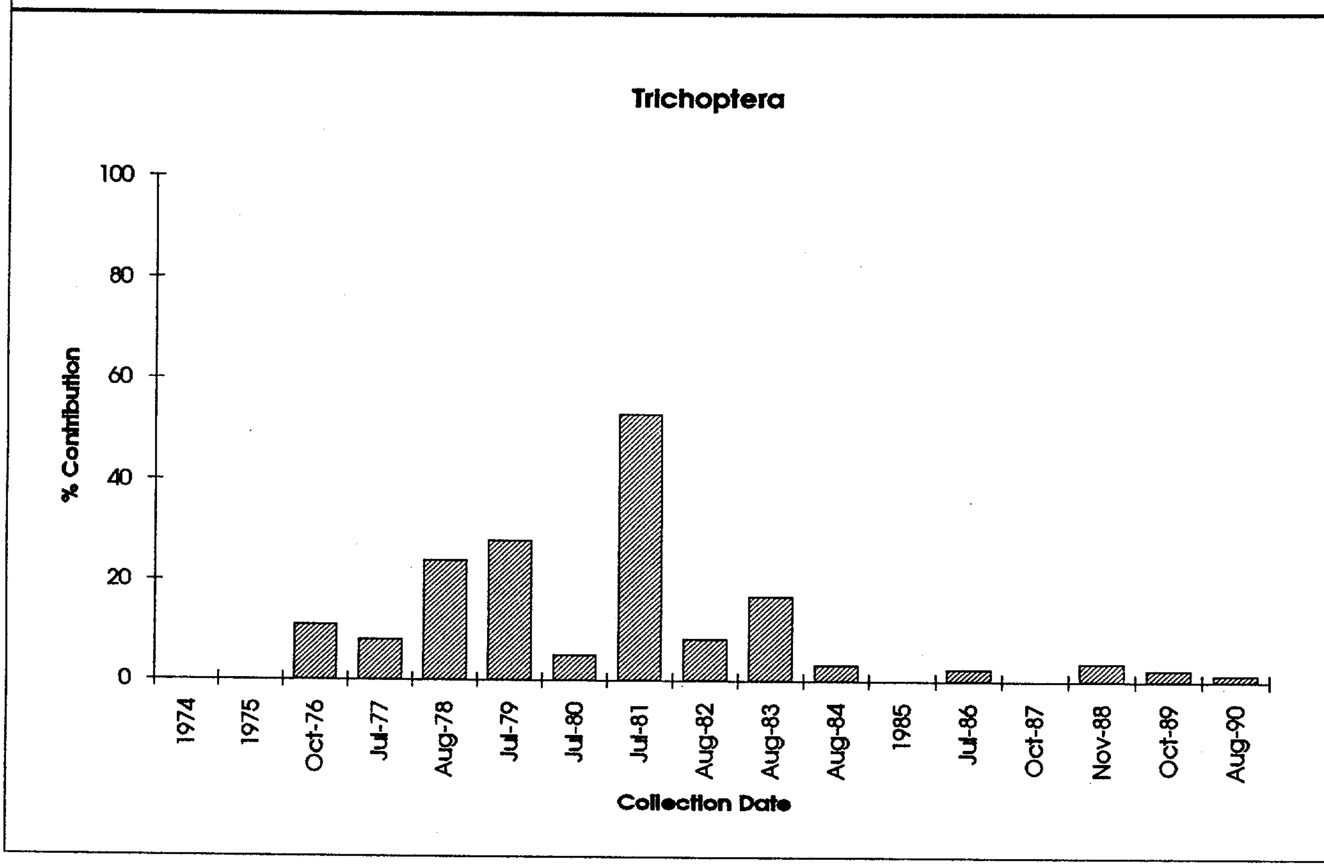




*-Data was not collected during 1974, 1975, and 1985.

Figure 20A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: CS-001 1974-1990

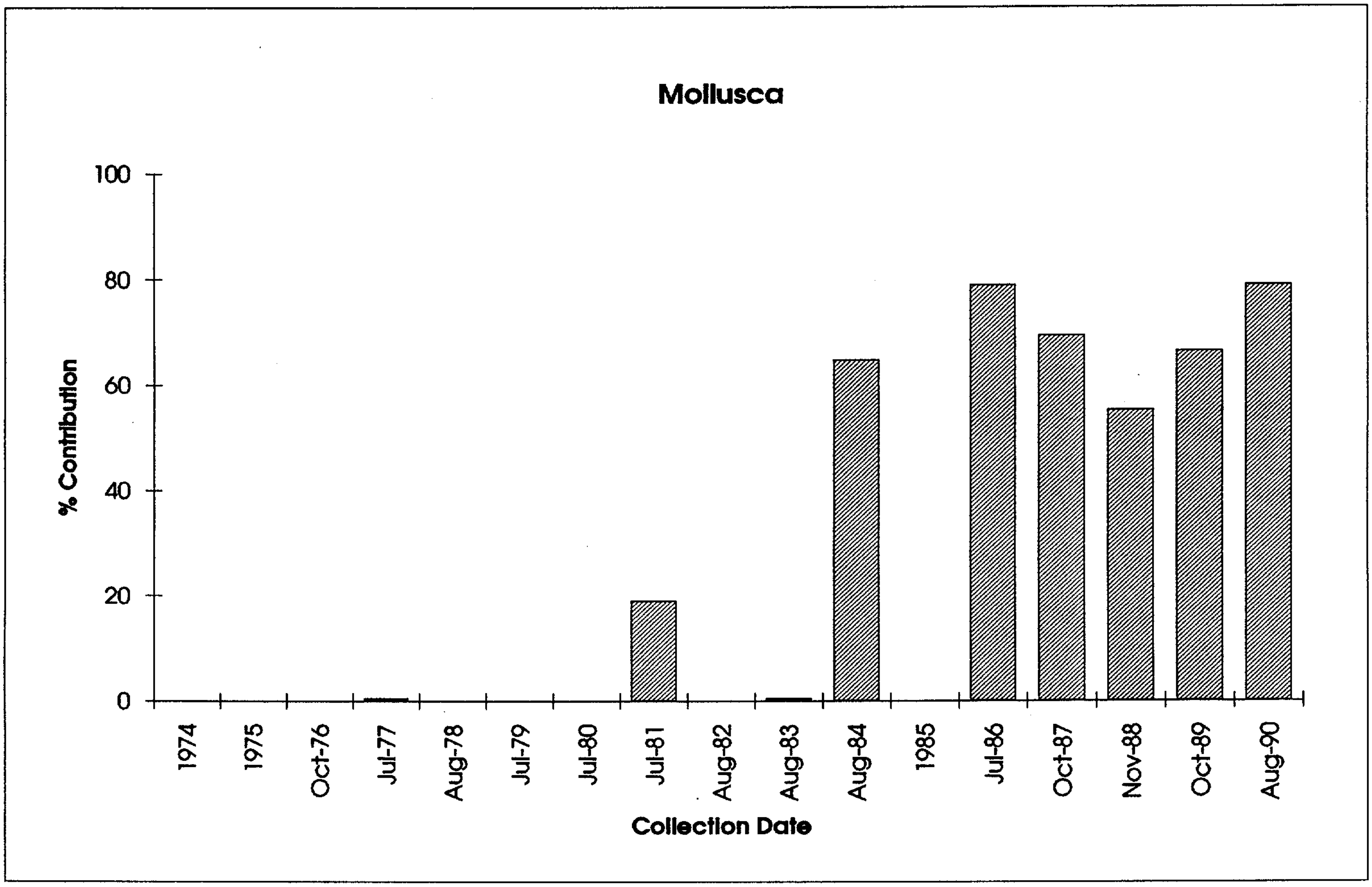




*-Data was not collected during 1974, 1975, and 1985.

Figure 20A
% Contribution of Dominant Orders*

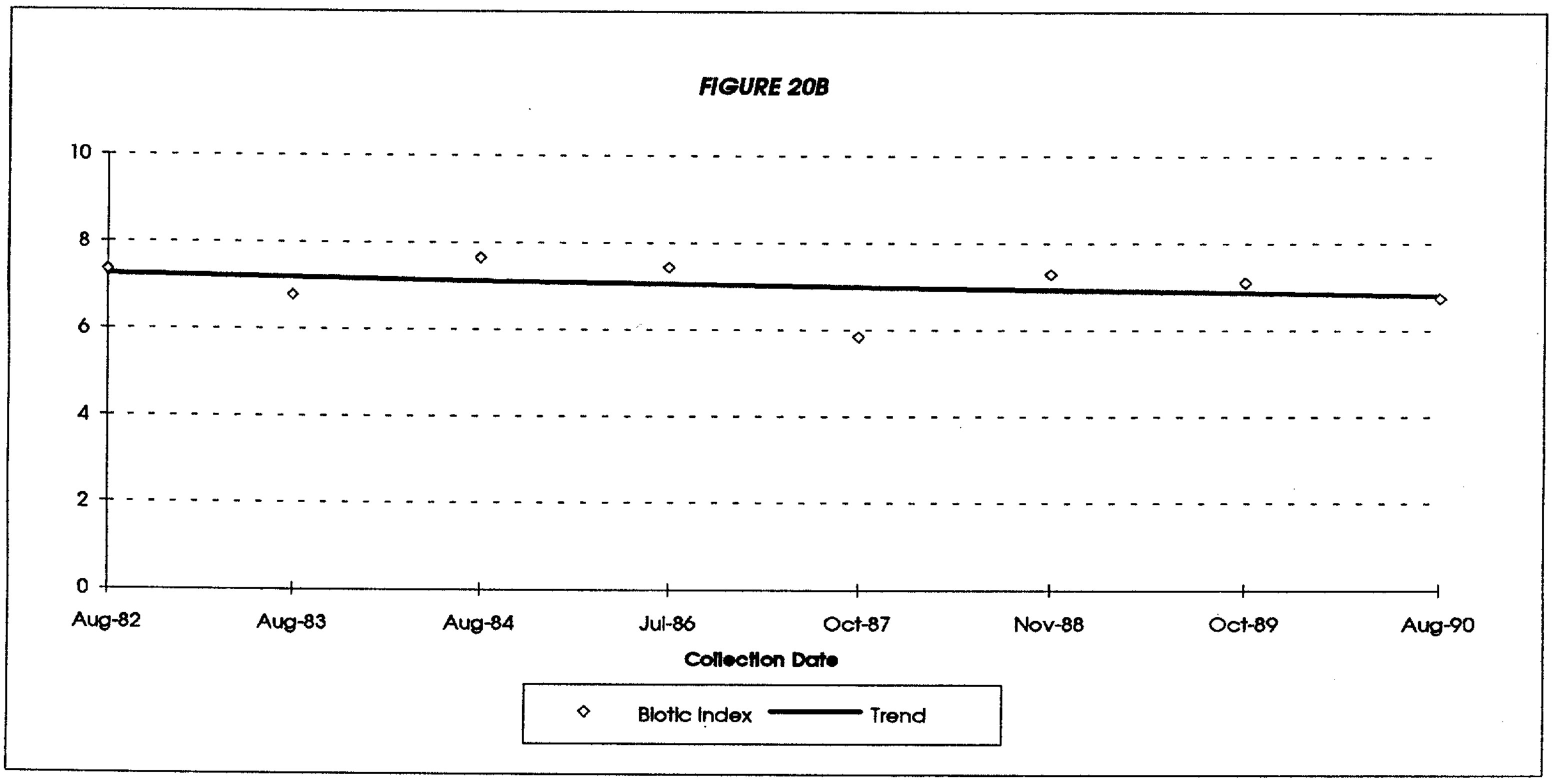
AMBIENT MONITORING STATION: CS-001 1974-1990



*-Data was not collected during 1974, 1975, and 1985.

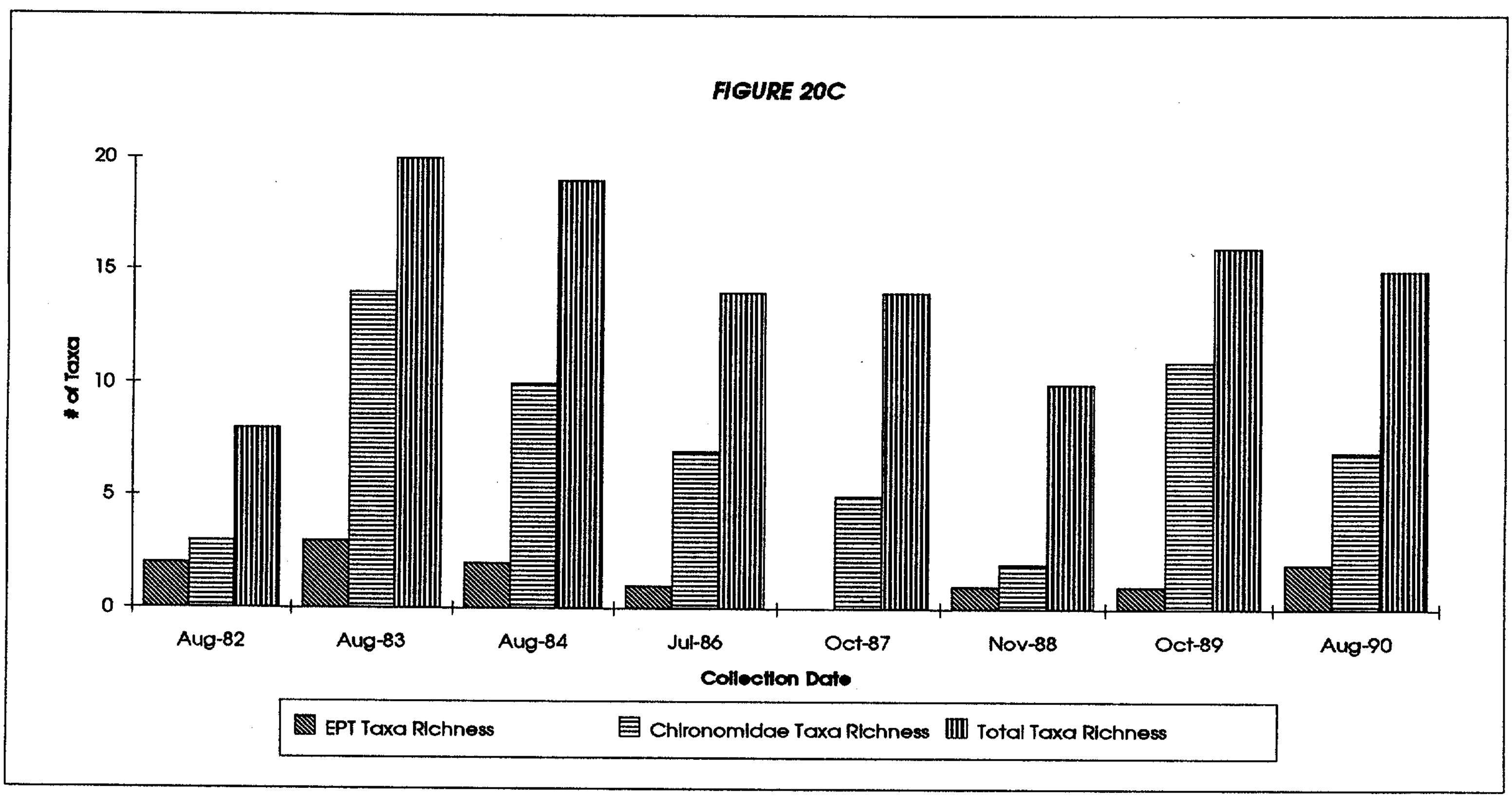
BIOTIC INDEX

AMBIENT MONITORING STATION: CS-001 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: CS-001 1982-1990



CHICKASAW CREEK CS-2

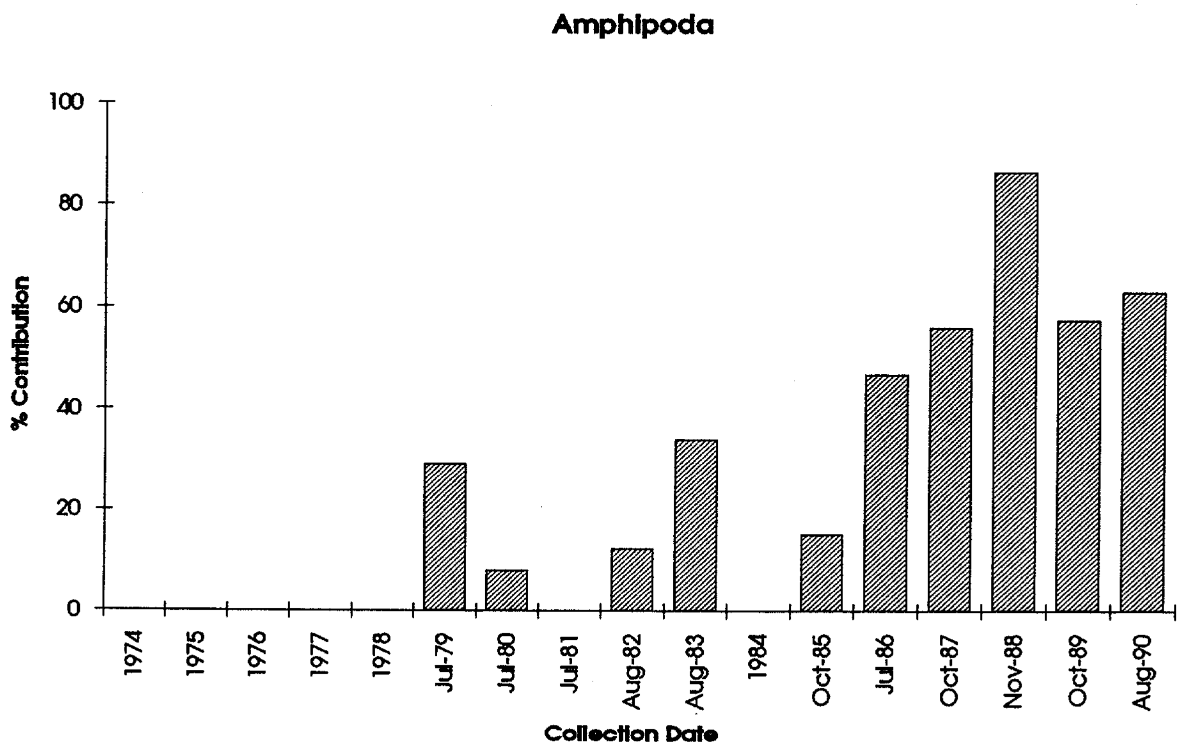
Station CS-2 is located on Chickasaw Creek at the L&N Railroad Bridge at the confluence with the Mobile River. The Mobile County site is located downstream from paper mill discharges. The water use classification for this section of Chickasaw Creek is 'Fish and Wildlife'.

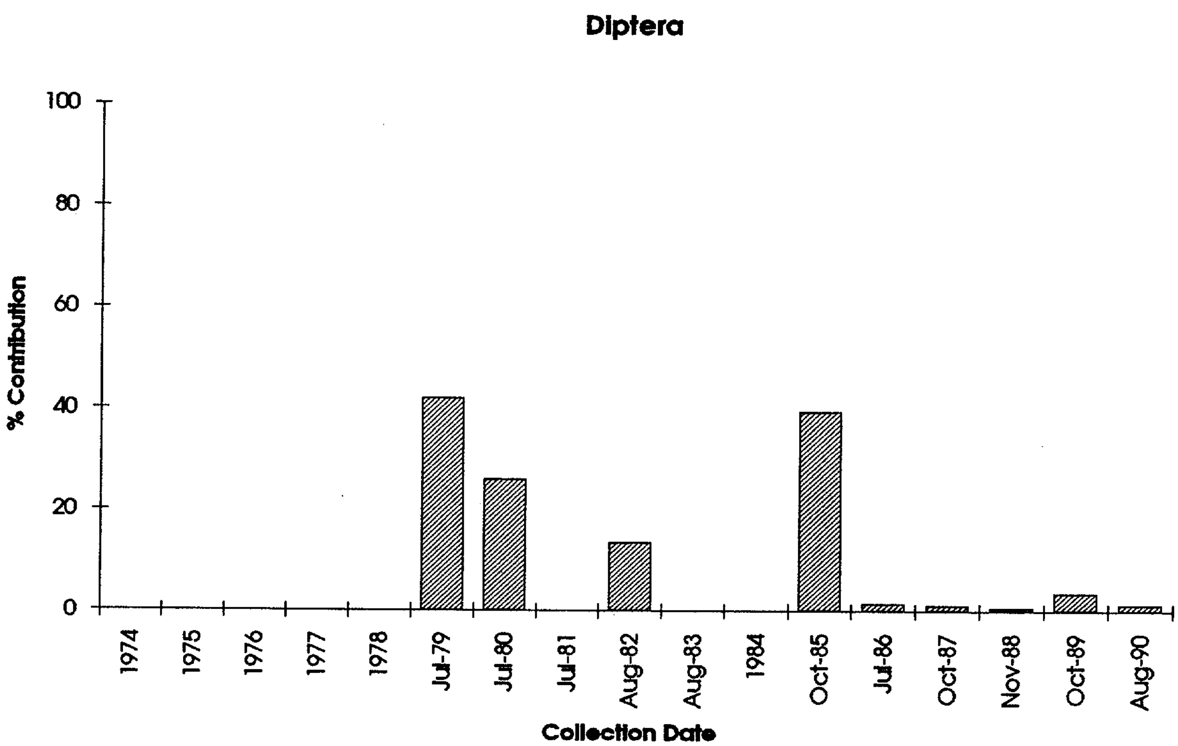
The collections made over the 1979 to 1990 sampling period consisted primarily of four groups of organisms: the polychaetes (Annelida), the crustaceans (Amphipoda, Isopoda, and Decapoda), molluscs, and dipterans (Appendix A-21). The first three are the major groups of marine and estuarine macroinvertebrates of the tidal marshes of the northern Gulf (Heard 1979) Due to the greater magnitude of tidal influence at CS-2 compared to CS-1 the community structure should reflect the effects of more frequent and prolonged exposure to saline water. This is evident in the dominance of the crustaceans and molluscs and the near absence of immature aquatic insects. Most of the genera collected from each of these groups were typical of the estuarine organisms. Therefore, each year the samplers were apparently tidally influenced during their colonization period. However, in general, the samples (Figure 21A) were not overly dominated by any one particular group and showed a slight increase in the number of taxa groups represented. Improvement in the diversity of the community structure generally indicates improvement in water quality.

The lack of EPT taxa appeared to confirm saline influences on the community collected. Taxa richness appears to have improved slightly during the 1982 to 1990 sampling period.

The biotic index, based entirely on the pollution tolerance values of the freshwater organisms (Estuarine and marine organisms are not included for lack of tolerance values), indicated no change in water quality (Figure 21B). Analysis of the data collected at CS-2 indicated a slight improvement in water quality.

Figure 21A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: CS-002 1974-1990

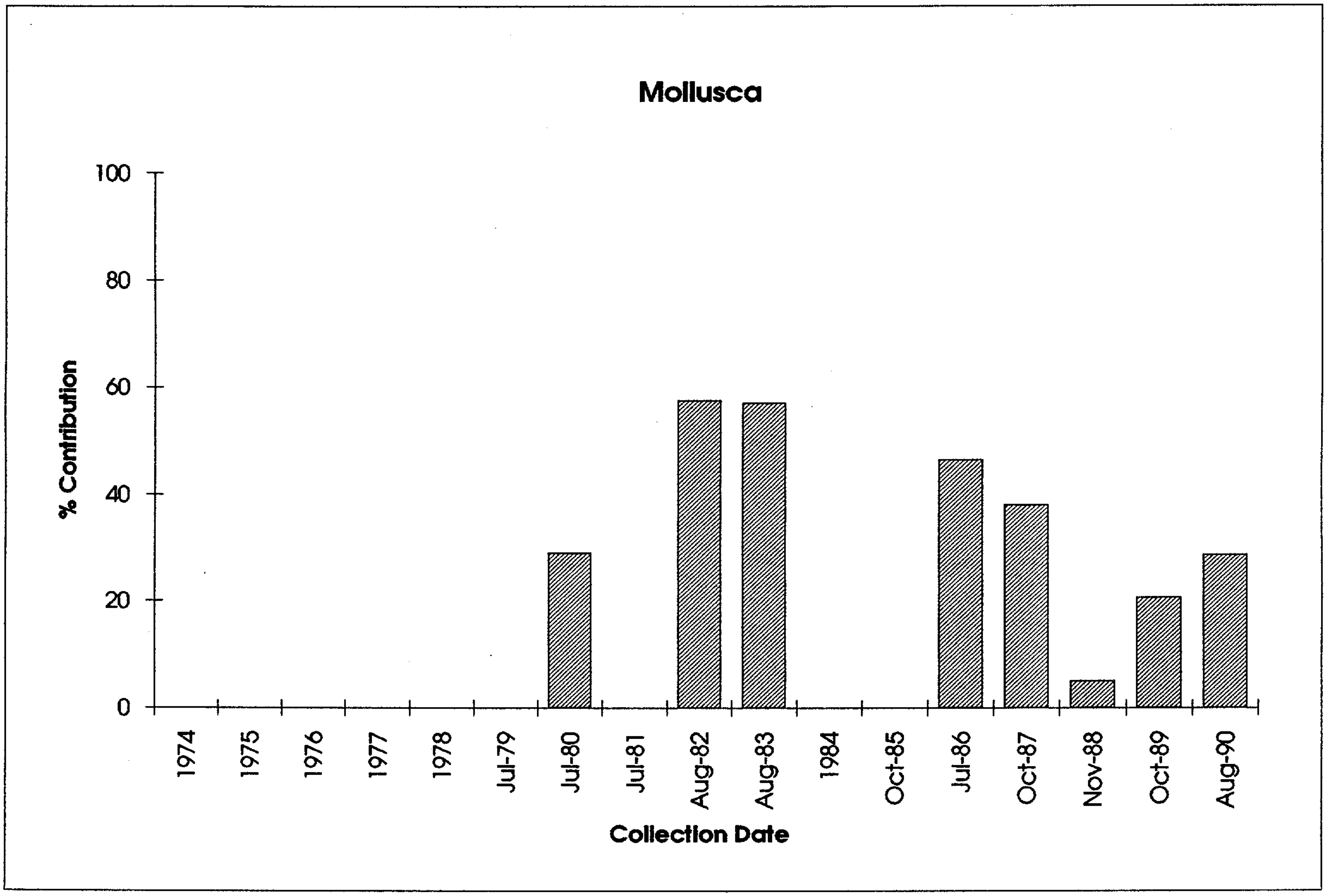




*-Data was not collected during 1974, 1975, 1976, 1977, 1978, and 1984.

Figure 21A
% Contribution of Dominant Orders*

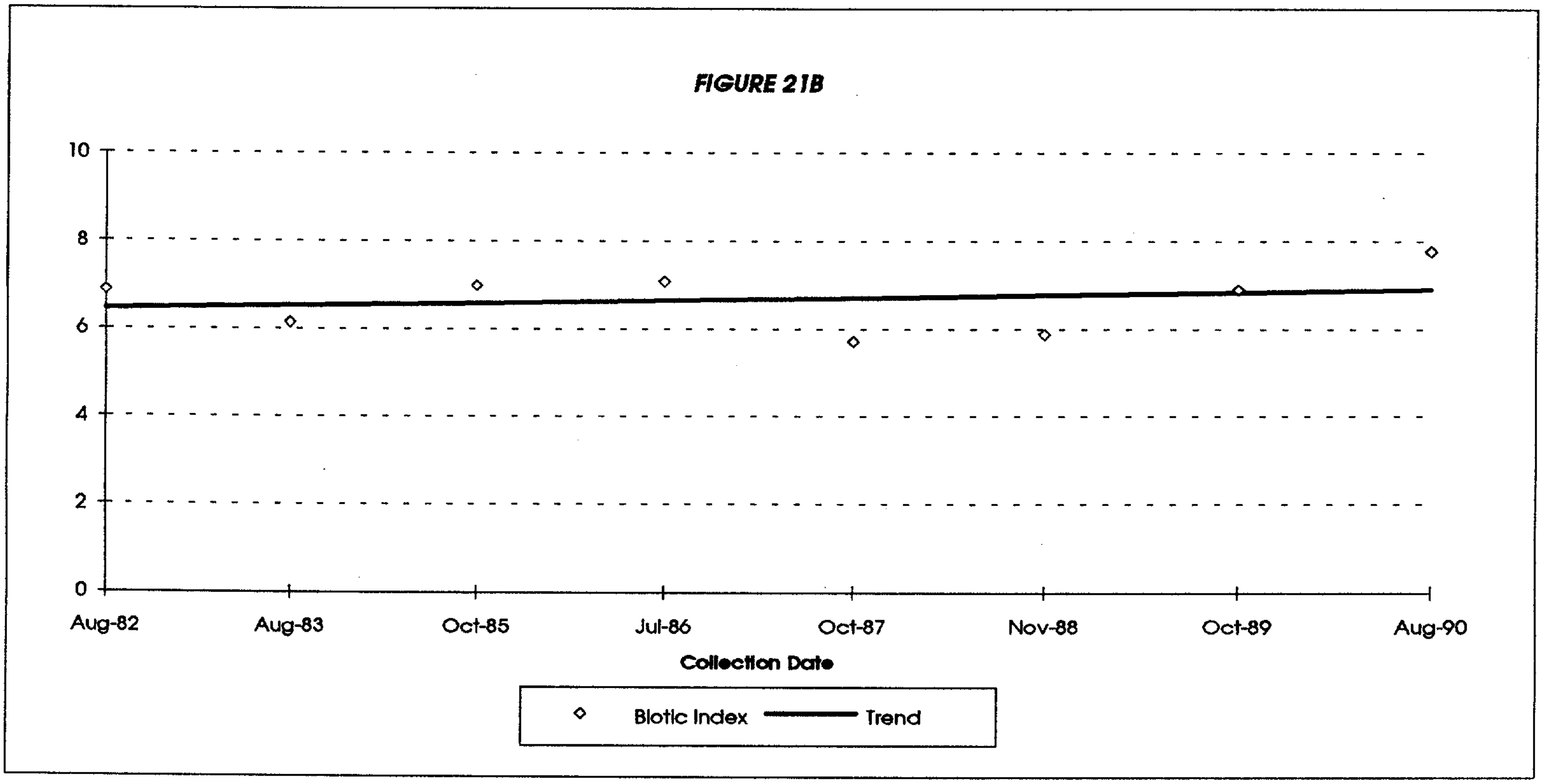
AMBIENT MONITORING STATION: CS-002 1974-1990



*-Data was not collected during 1974, 1975, 1976, 1977, 1978, and 1984.

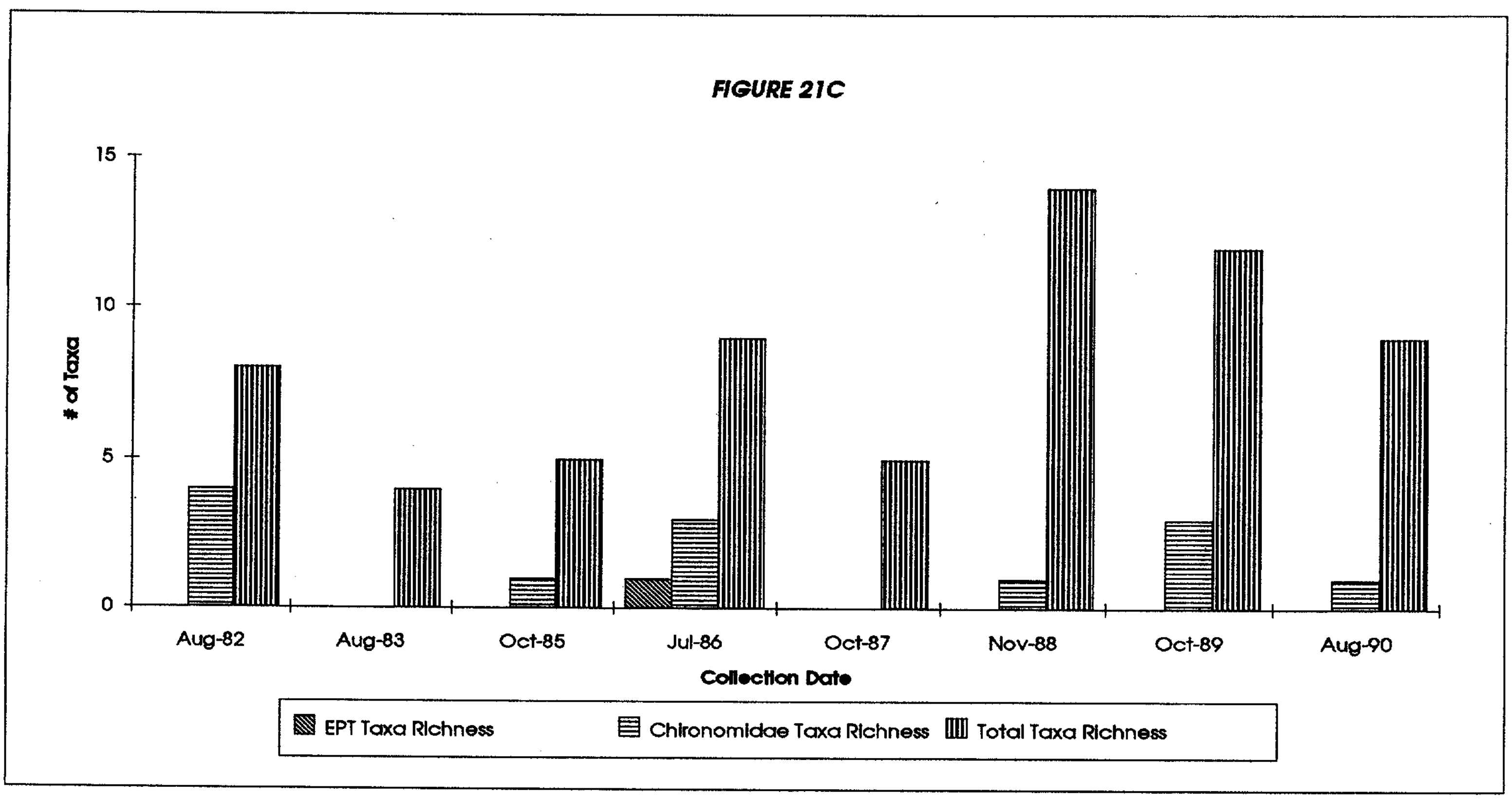
BIOTIC INDEX

AMBIENT MONITORING STATION: CS-002 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: CS-002 1982-1990

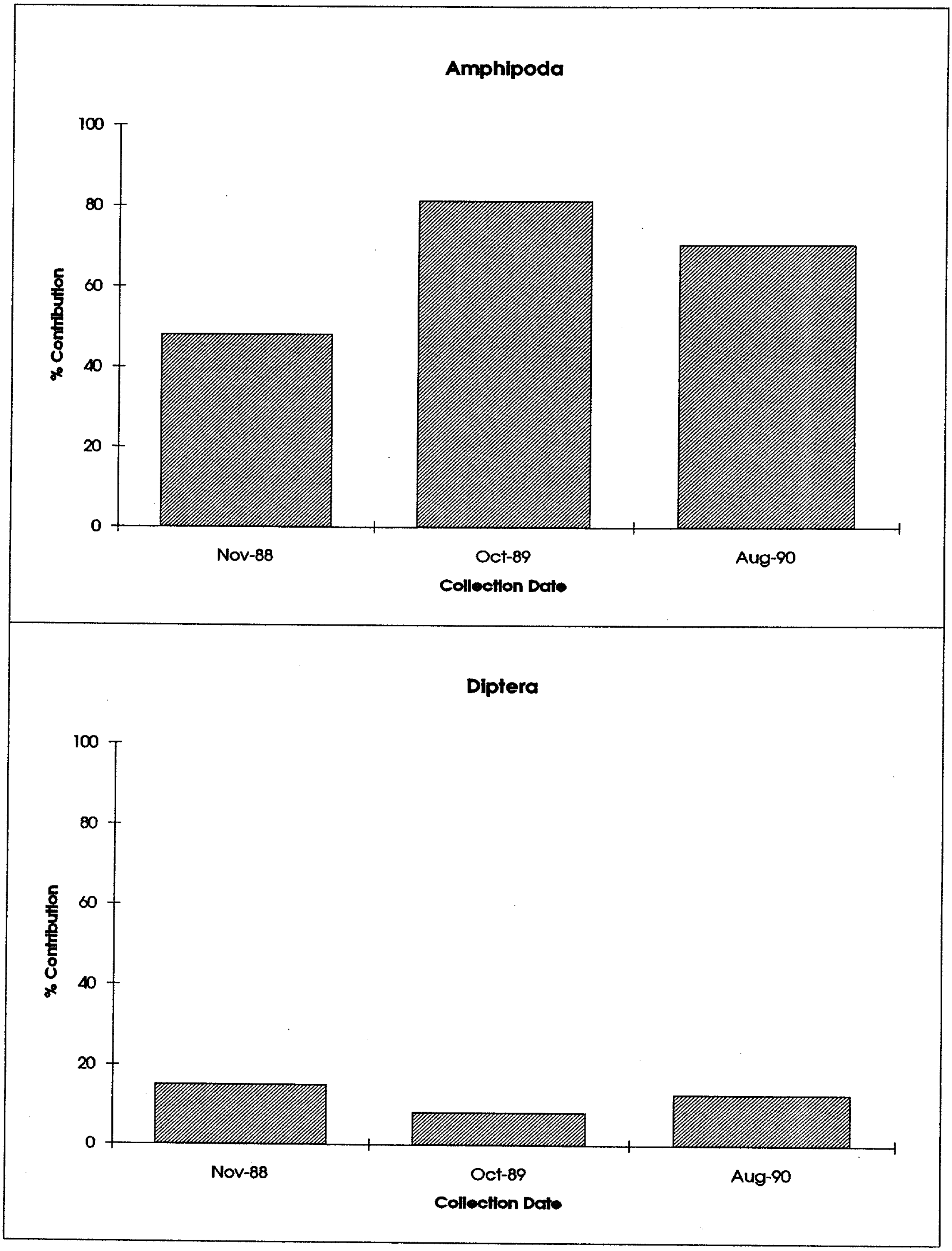


HOG BAYOU HB-1

Station HB-1 is located on Hog Bayou ½ mile upstream of the mouth. The Mobile County site is located to monitor changes in water quality following removal of a major industrial discharge. This section of Hog Bayou has a water use classification of 'Agricultural and Industrial Water Supply'.

This station as been sampled only between 1988 and 1990. The crustacean group Amphipoda dominated the organisms collected all three years (Figure 22A). The number of estuarine taxa increased from 1988 to 1990. This may be explained by the differences in the sampling month; the greater flow in the later fall months preventing the intrusion of the bay water to the same degree as the summer low-flow months. This would also explain the loss of the generally pollution-intolerant EPT taxa from the late summer and early fall samples (Figure 22C). The November 1988 sample also had a higher number of total taxa than the other two samples. The biotic index trend line shows a degradation in water quality, however, the freshwater organisms that are remaining in the partially saline waters would necessarily be those organisms that have the highest tolerance to environmental adversity (Figure 22B). Therefore, the increase in the biotic index is most likely due to changes in salinity and not water quality. Analysis of data collected indicates that the water quality of Hog Bayou at the HB-1 ambient monitoring station has been maintained during the monitoring period.

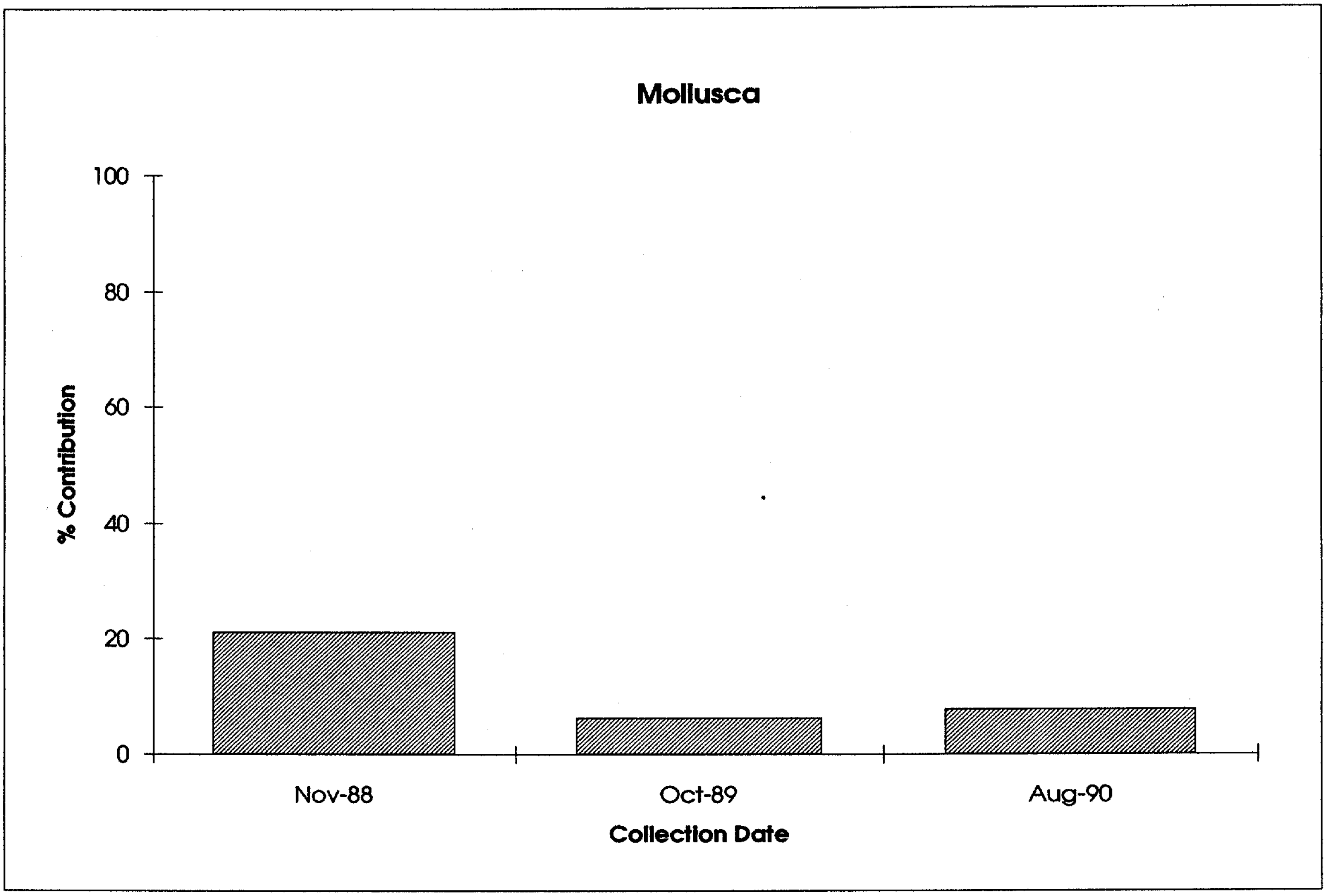
Figure 22A
% Contribution of Dominant Orders
AMBIENT MONITORING STATION: HB-001 1988-1990



*-Data was not collected during 1974, 1975, 1976, 1977, 1978, and 1984.

Figure 22A
% Contribution of Dominant Orders

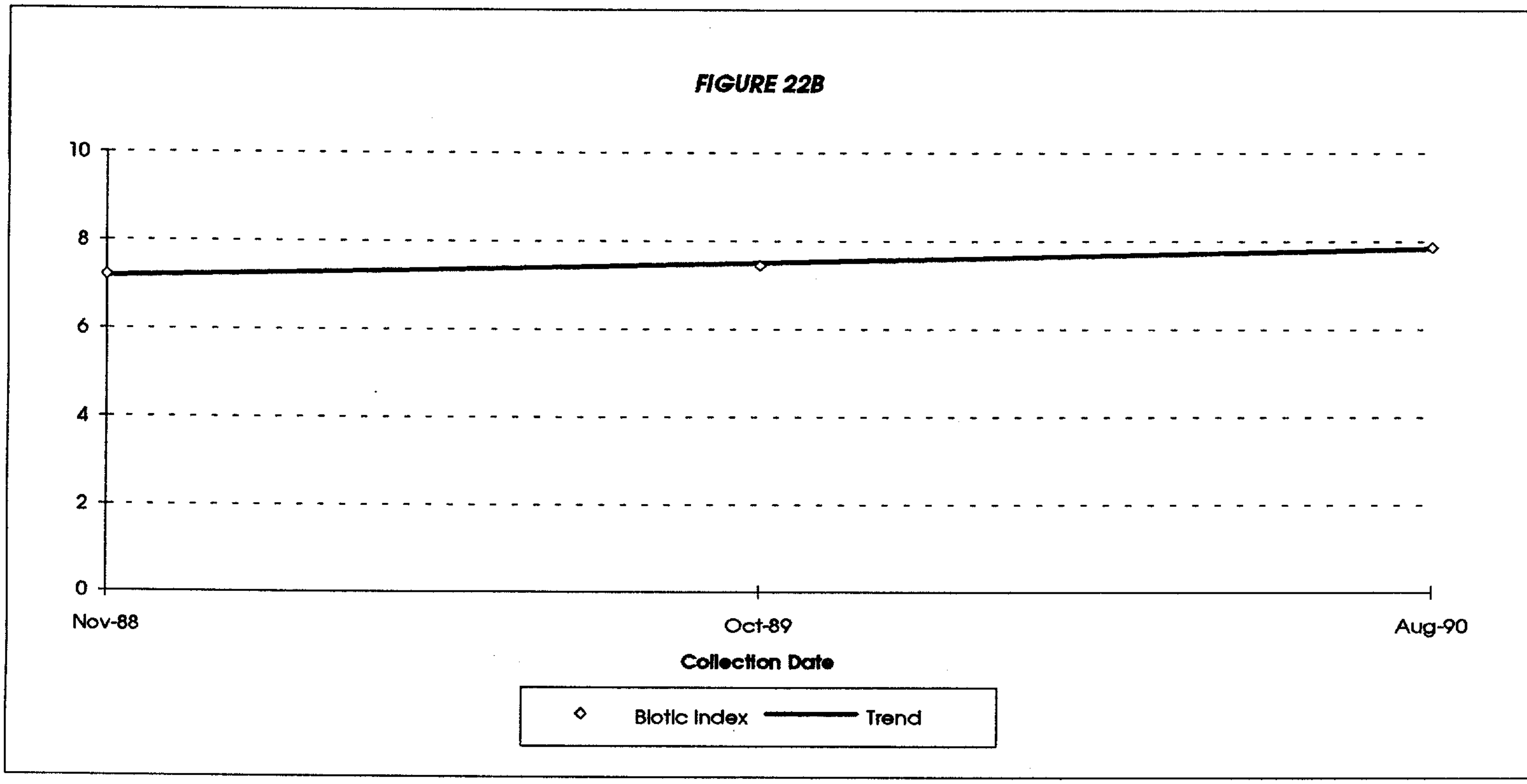
AMBIENT MONITORING STATION: HB-001 1988-1990



*-Data was not collected during 1974, 1975, 1976, 1977, 1978, and 1984.

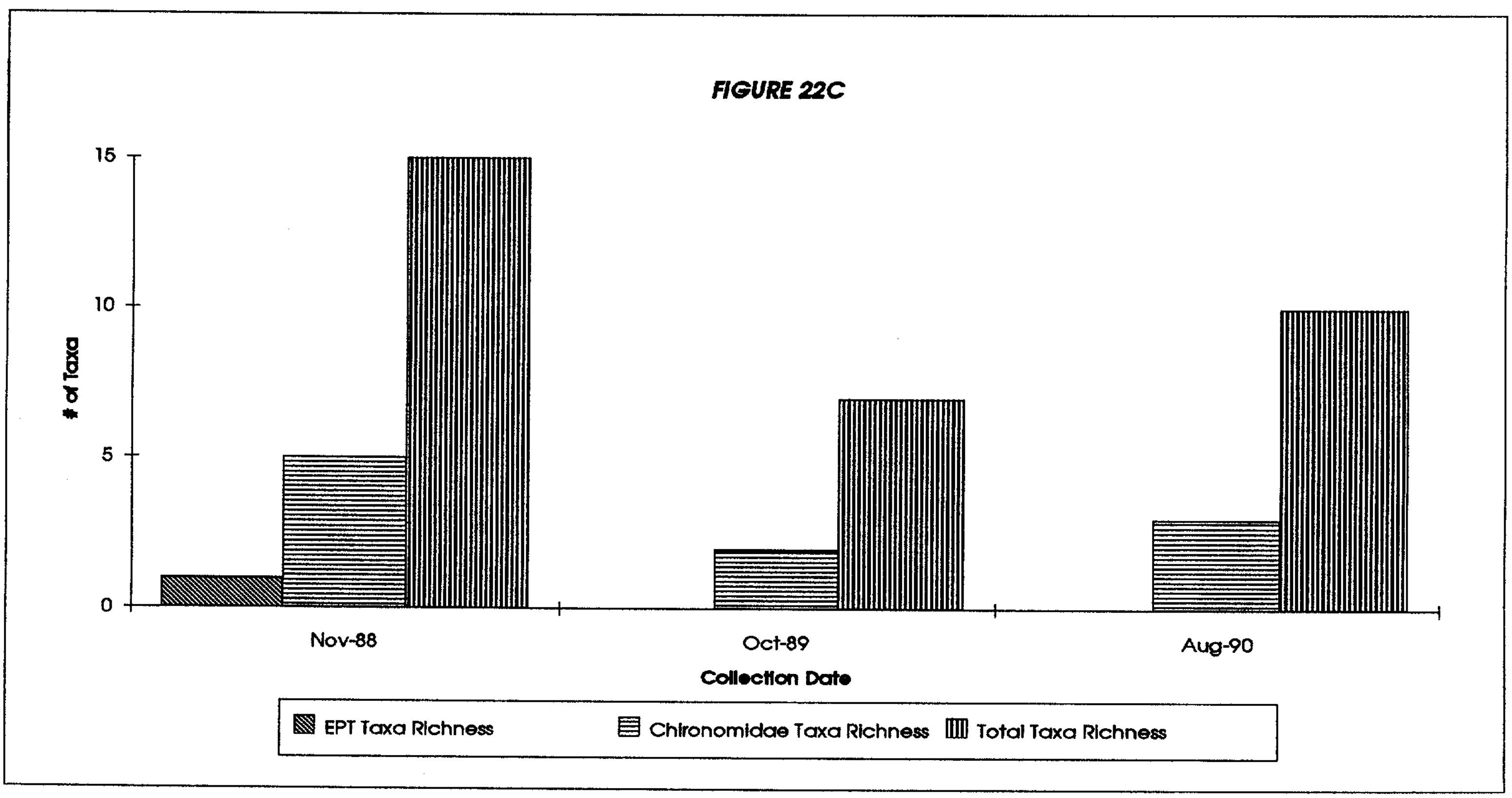
BIOTIC INDEX

AMBIENT MONITORING STATION: HB-001 1988-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: HB-001 1988-1990



MOBILE RIVER MO-1a

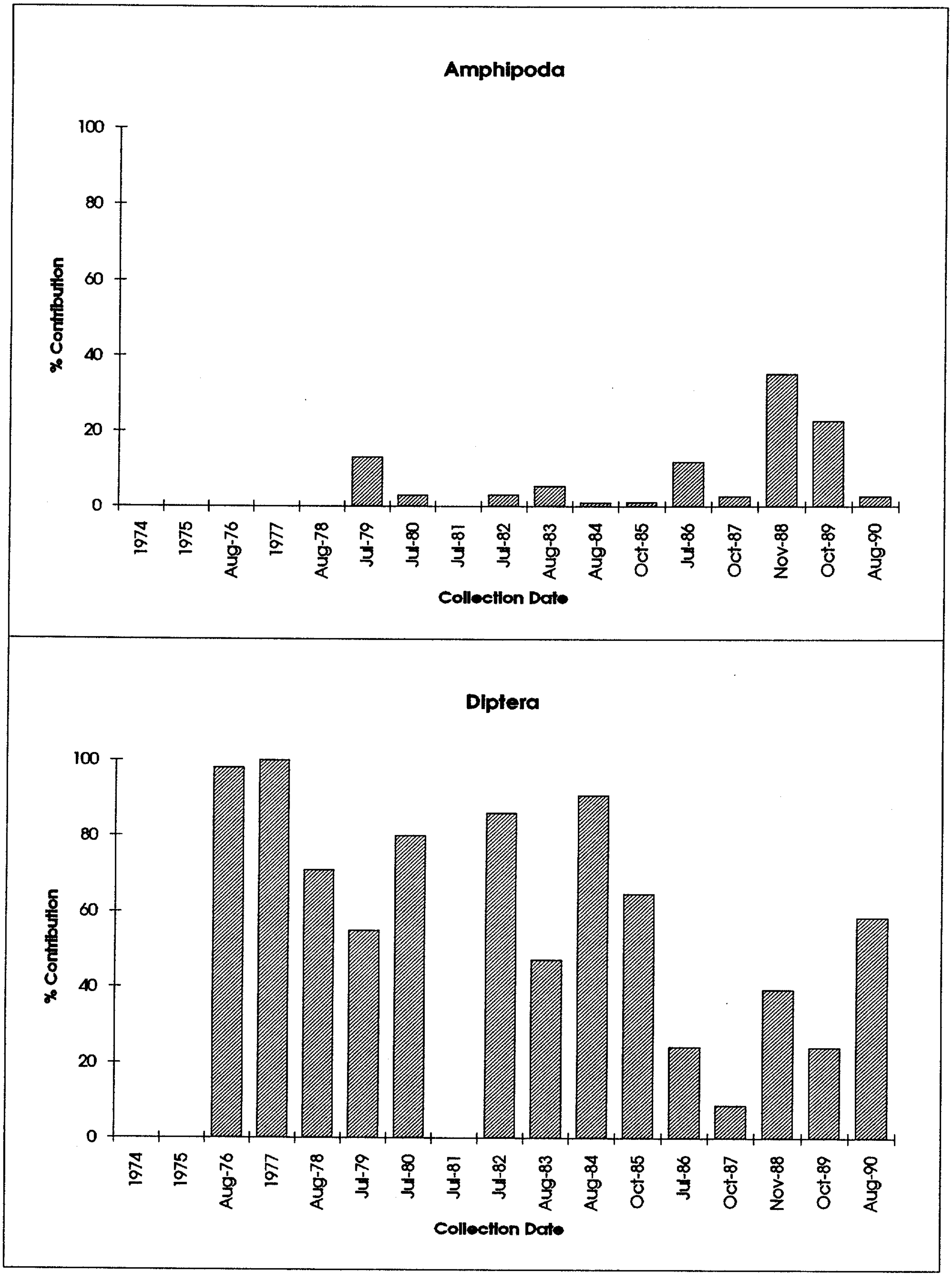
Station MO-1a is located on the Mobile River at the L&N Railroad Bridge in Mobile County. The site is downstream from several industrial discharges north of the City of Mobile. The water use classification for this section of the Mobile River is 'Fish and Wildlife'.

This station was first sampled for macroinvertebrates in 1976. As shown in Figure 23A, the community structure, from 1976 to 1985, was generally dominated by the pollution-tolerant Diptera group. In 1986 and 1987 the community was dominated by the estuarine mollusc genus *Geukensia*. This organism was collected during 1985 to 1990. There was a noticeable improvement in the diversity of the groups collected after 1978 and an improvement in the distribution of the organisms within the groups after 1987 (Appendix 23A).

Total taxa richness (Figure 23C) showed improvement from 1988 to 1990 over the previous six years. The EPT taxa richness and the Chironomidae taxa richness show no pattern of change. The higher number of EPT taxa found at this site indicate that it may not be as tidally influenced as some of the other sites in the coastal area or it is of higher water quality. Of the tidally influenced streams this station and TE-1 are a greater distance from Mobile Bay than any of the other stations.

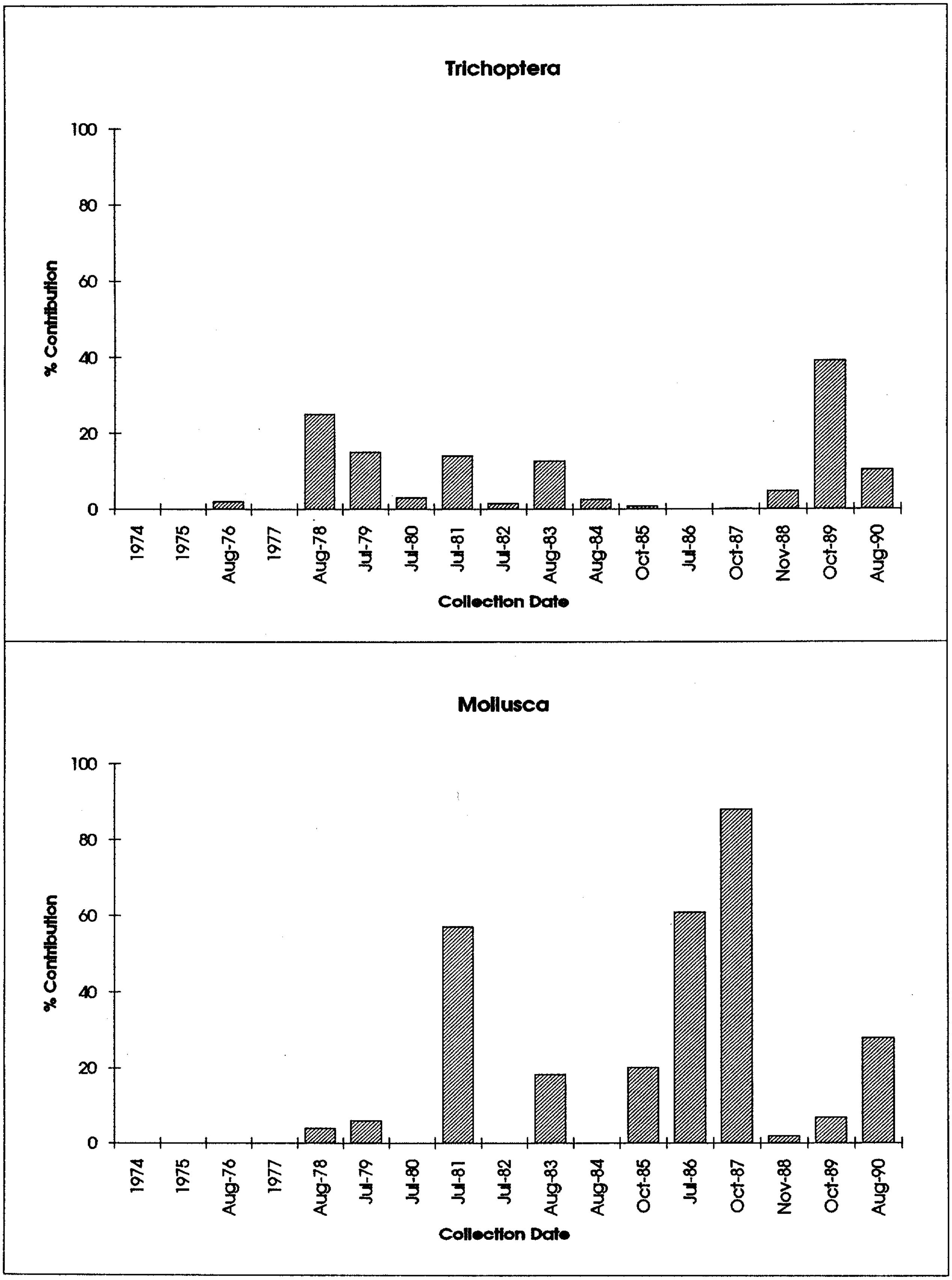
The biotic index, based entirely on the pollution tolerance values of the freshwater organisms (Estuarine and marine organisms are not included for lack of tolerance values), indicated no change in water quality (Figure 23B). Analysis of the macroinvertebrate data collected at MO-1a indicated a slight improvement in water quality.

Figure 23A
% Contribution of Dominant Orders
AMBIENT MONITORING STATION: MO-001a 1974-1990



*- Data was not collected during 1974 and 1975.

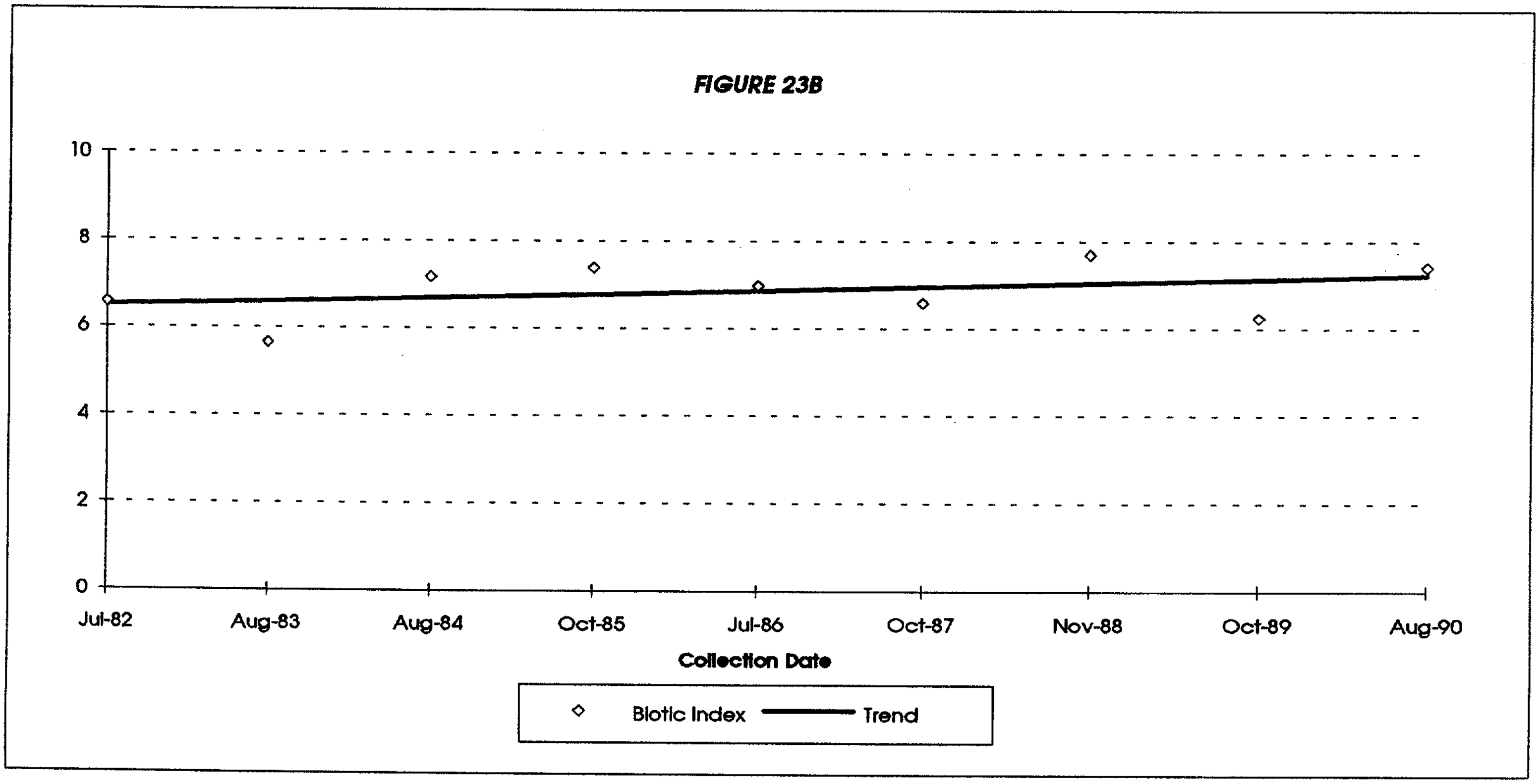
Figure 23A
% Contribution of Dominant Orders
AMBIENT MONITORING STATION: MO-001a 1974-1990



*- Data was not collected during 1974 and 1975.

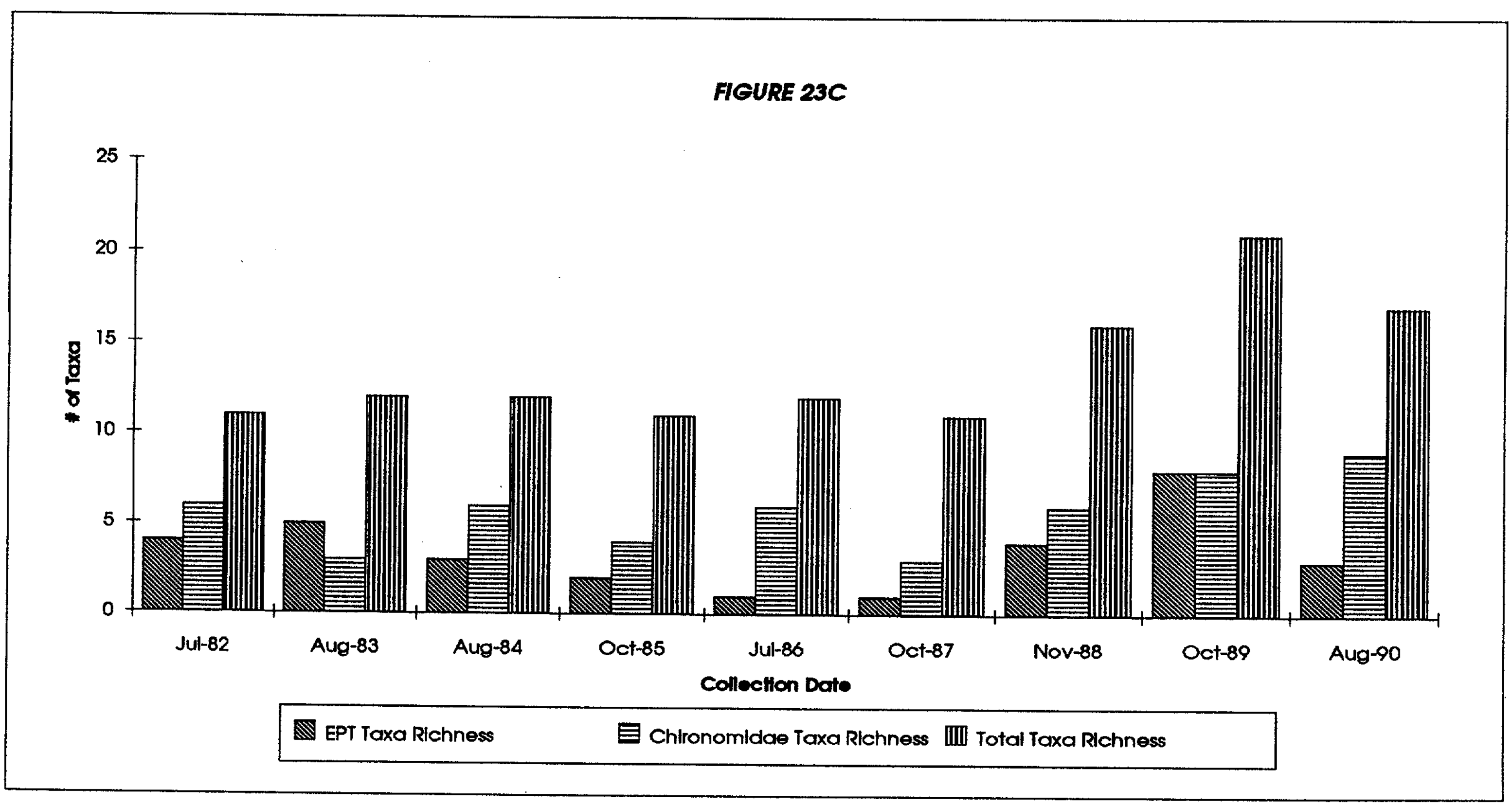
BIOTIC INDEX

AMBIENT MONITORING STATION: MO-001a 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: MO-001a 1982-1990



TENSAW RIVER TE-1

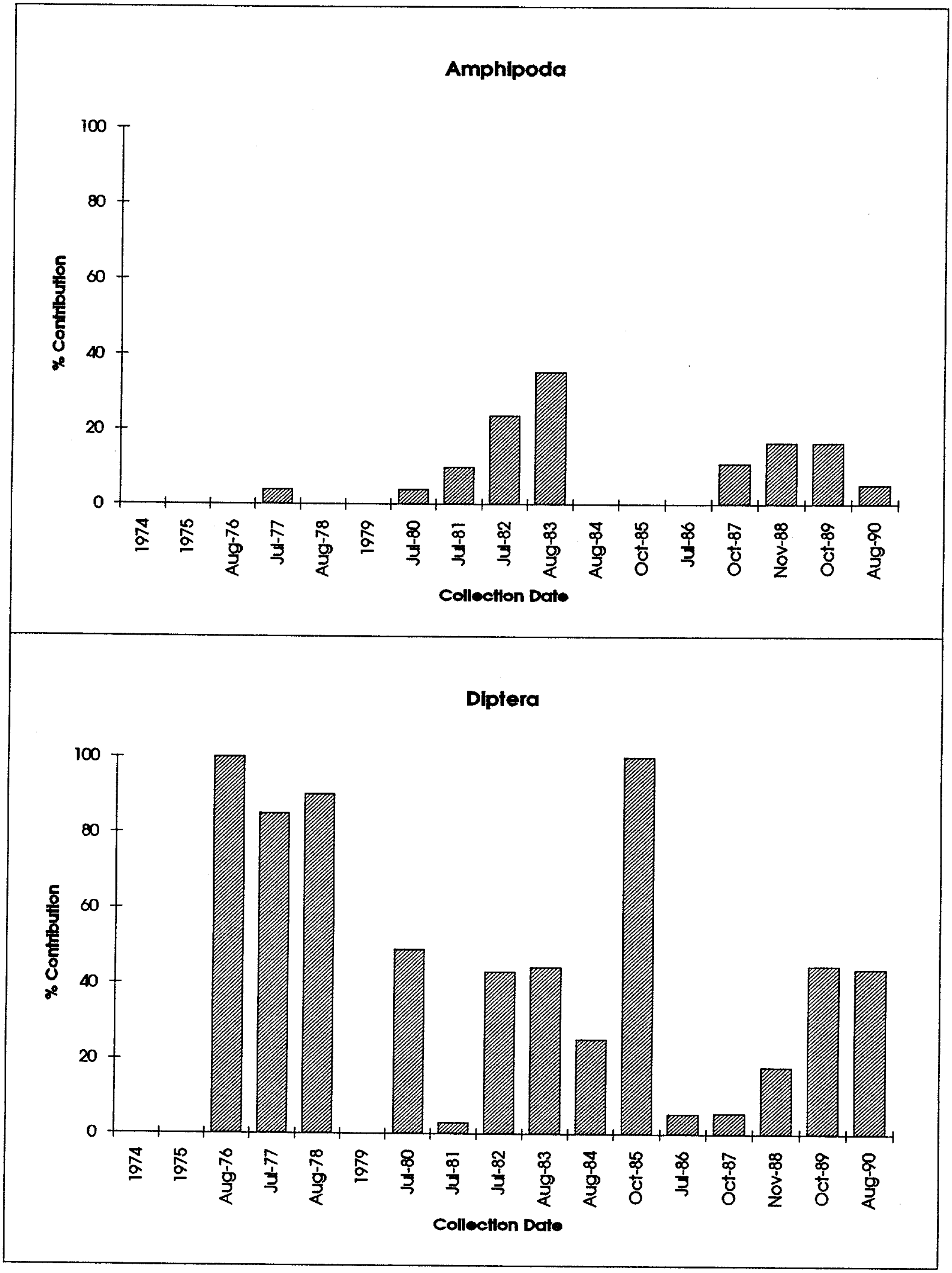
Station TE-1 is located on the Tensaw River at the L&N Railroad bridge. This site was selected as an ambient monitoring station to collect background data. The water use classification for this section of the Tensaw River is 'Fish and Wildlife' (F&W).

Beginning in 1976, the sampled community was dominated by the generally pollution-tolerant dipteran group (Figure 24A). Samples collected in 1980 - 1984 were more evenly distributed between taxa groups with no group dominating the sample (In 1981 the pollution-intolerant Trichoptera group represented sixty-one percent (61%) of the sample). From 1985 to 1987 the samples were again dominated by one taxonomic group, although it was a different group each year (Figure 24A). The samples collected from 1988 - 1990 were more evenly distributed over a larger number of taxonomic groups. Beginning in 1987 crustacean and molluscan genera typical of at least temporary estuarine influences were collected. They may also have been present in years prior to 1984, however, the level of identification makes it impossible to determine.

Total taxa richness showed improvement in 1989 and 1990 over the previous four years (Figure 24B). The EPT taxa richness and the Chironomidae taxa richness show no pattern of change. The generally higher number of EPT taxa found at this site indicate that it may not be as tidally influenced as some of the other sites in the coastal area (it is the station most distant from Mobile Bay) and/or it is of higher water quality.

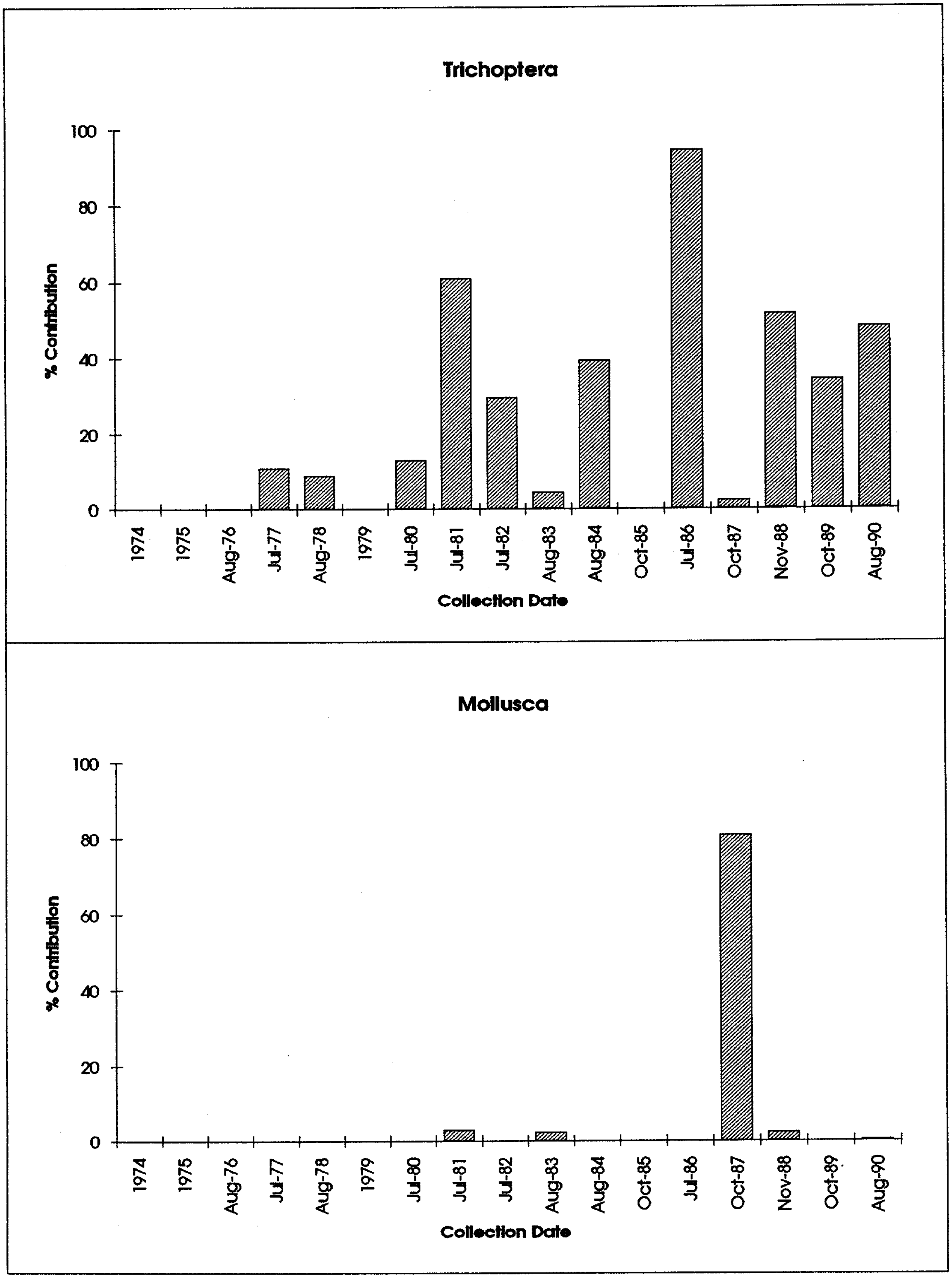
The biotic index, based entirely on the pollution tolerance values of the organisms collected, indicated a degradation of water quality. However, estuarine and marine organisms are not included in the calculation of the biotic index for lack of tolerance values. Therefore, the biotic index values found in Figure 24B are derived from only the freshwater organisms with tolerance values. It should also be noted that the freshwater organisms capable of tolerating the presence of various degrees of salinity would most likely also be more pollution-tolerant. Analysis of the data collected at TE-1 indicated a slight improvement in water quality.

Figure 24A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: TE-001 1974-1990



*-Data was not collected during 1974, 1975, and 1979.

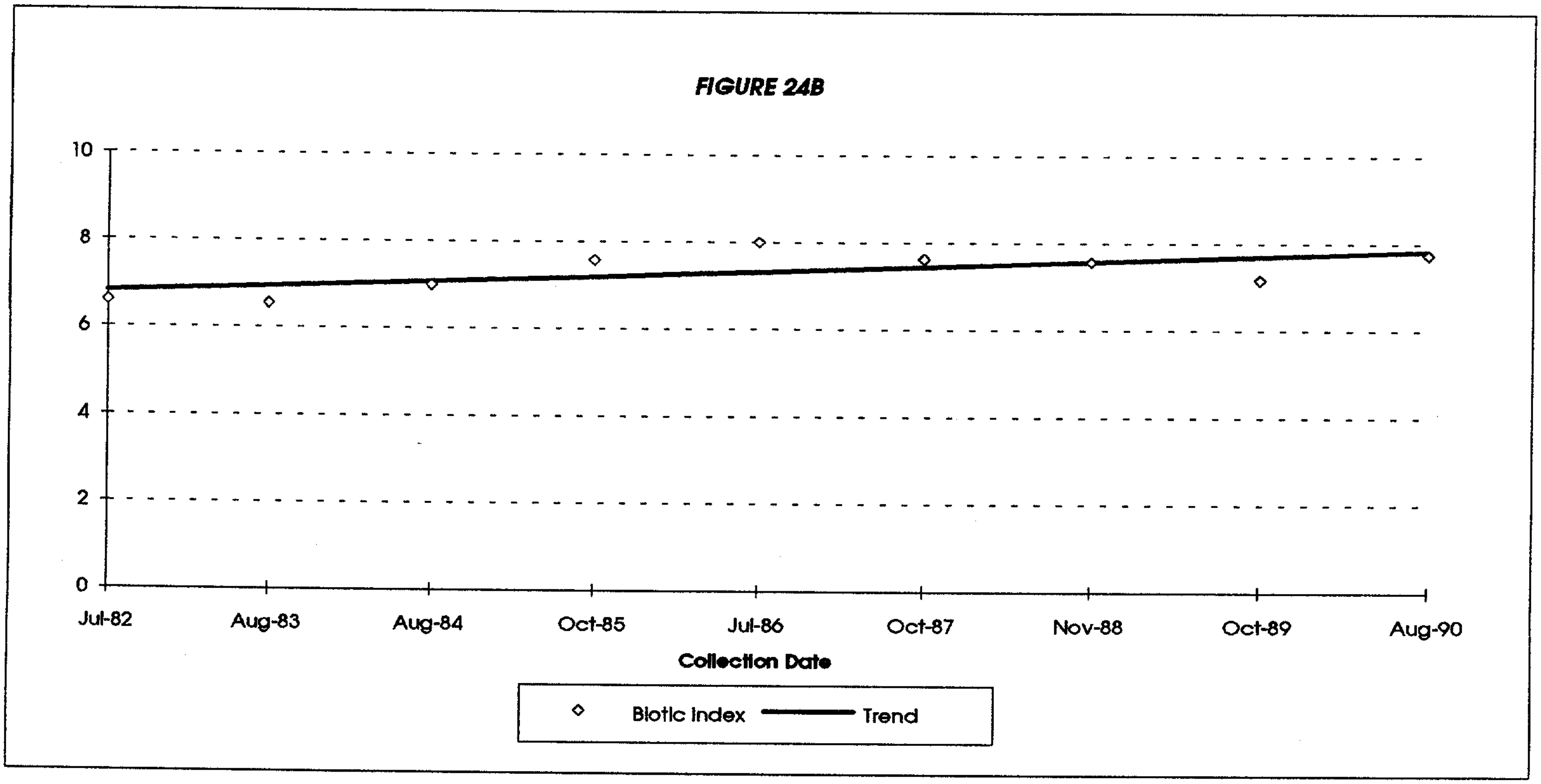
Figure 24A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: TE-001 1974-1990



*-Data was not collected during 1974, 1975, and 1979.

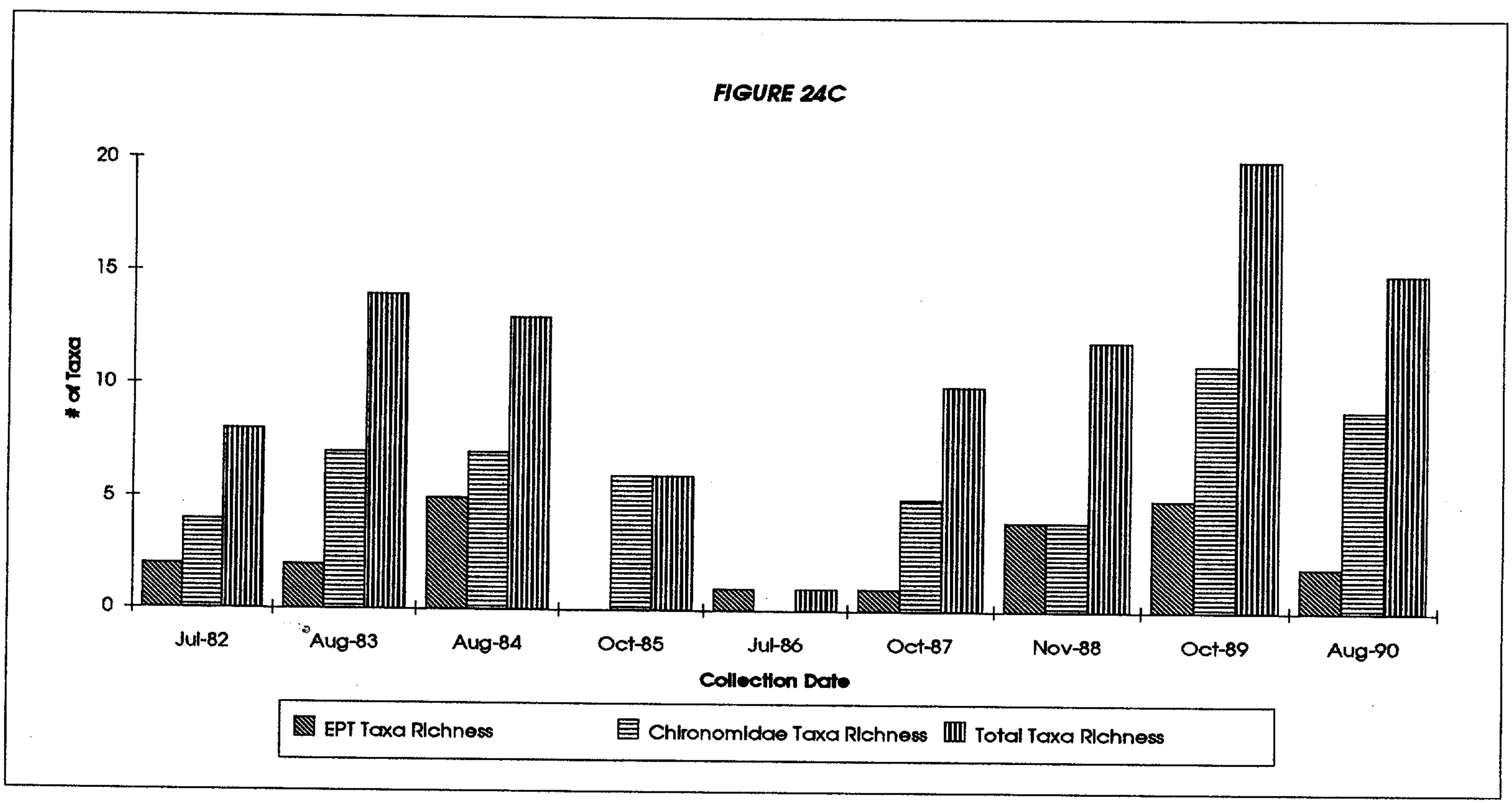
BIOTIC INDEX

AMBIENT MONITORING STATION: TE-001 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: TE-001 1982-1990



TENSAW RIVER TE-2

Station TE-2 is located on the Tensaw River just below Gravine Island. This site was also selected as an ambient monitoring station to collect background data. The water use classification for this section of the Tensaw River is 'Fish and Wildlife' (F&W).

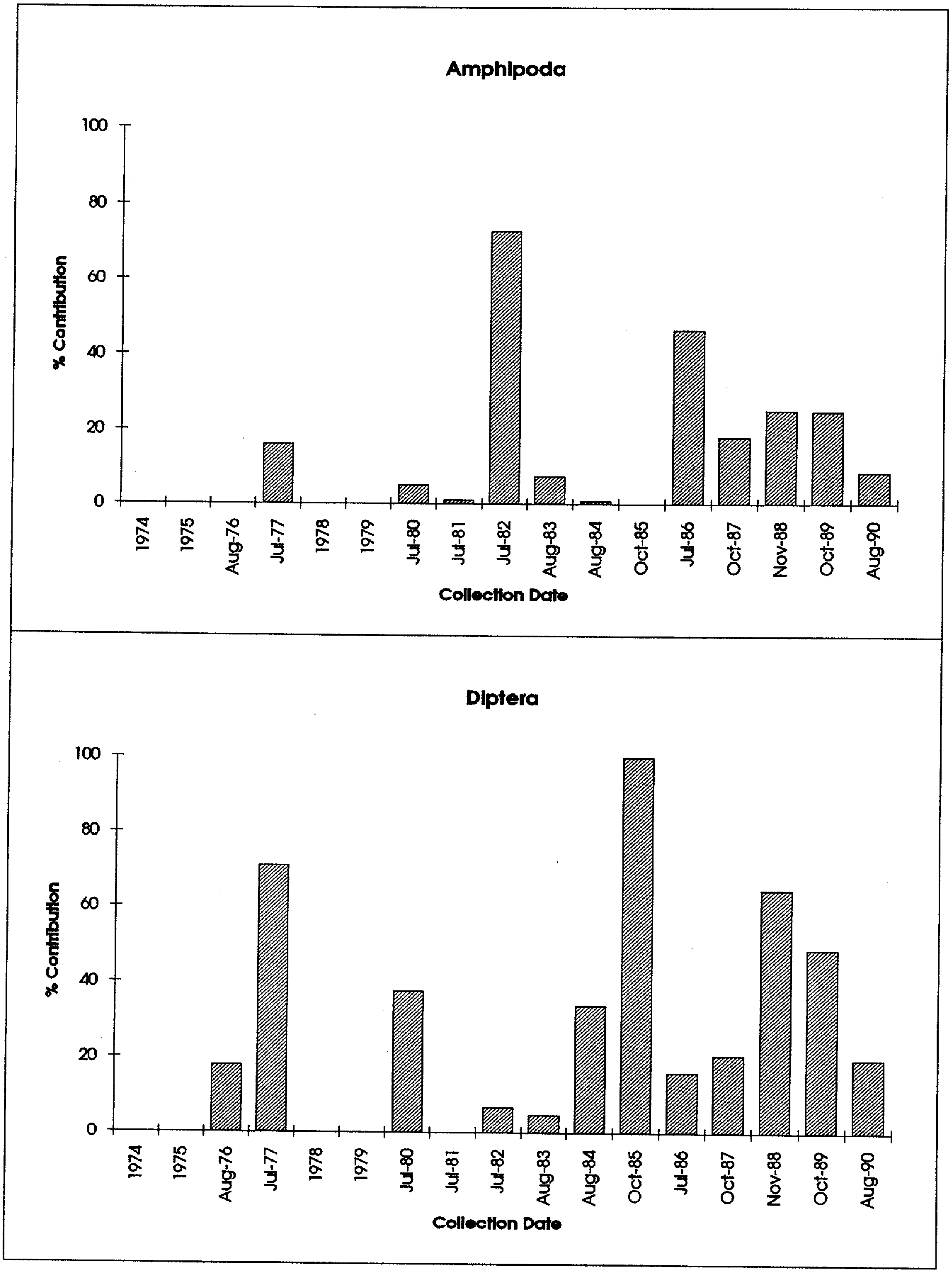
Samples were first collected from this station in 1976 and 1977, then again from 1980 to 1990 (Figure 25A). The collections made over the entire sampling period consisted primarily of three groups of organisms: the crustaceans (Amphipoda, Isopoda, and Decapoda), molluscs, and dipterans (Appendix A-25). The crustaceans and the molluscs are the common representatives of marine and estuarine macroinvertebrates of the tidal marshes of the northern Gulf (Heard 1979). Most of the genera collected from each of these groups were typical of the estuarine organisms. Therefore, it could be concluded that each year the samplers had been tidally influenced at some time during their colonization period. The majority of sampling years were dominated by a representative group of either molluscs or dipterans. However, the diversity of the taxa groups represented appears to have improved after 1978. An increase in the diversity of the community structure generally indicates improvement in water quality or a more stable degree of salinity.

Total taxa richness, Chironomidae, and EPT taxa richness show no discernible pattern in their numbers (Figure 25C). The biotic index, based entirely on the pollution tolerance values of the freshwater organisms collected, indicated no change in water quality. Analysis of the data collected at TE-2 indicated a slight improvement in water quality.

Figure 25A

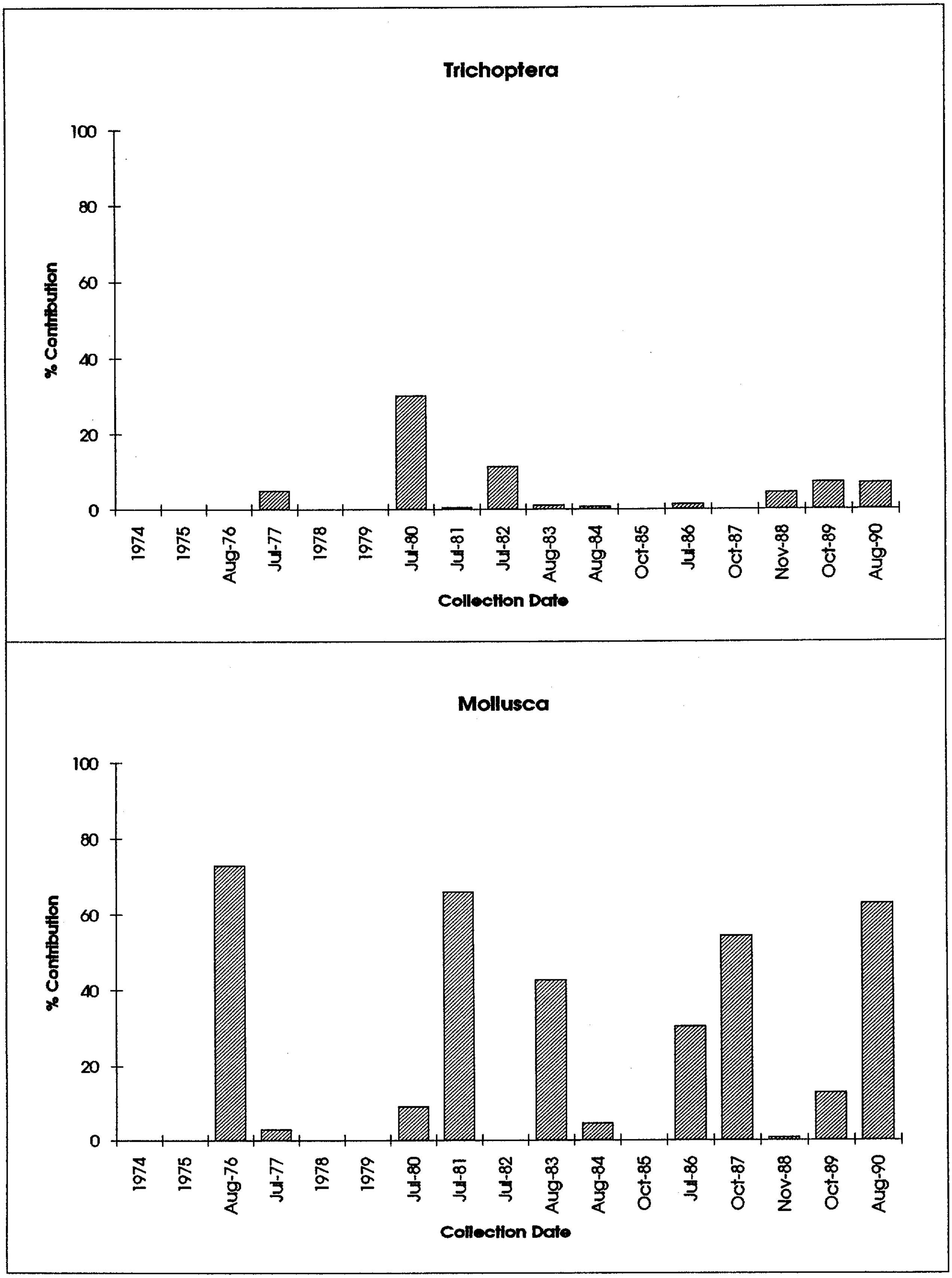
% Contribution of Dominant Orders*

AMBIENT MONITORING STATION: TE-002 1974-1990



*-Data was not collected during 1974, 1975, 1978, and 1979.

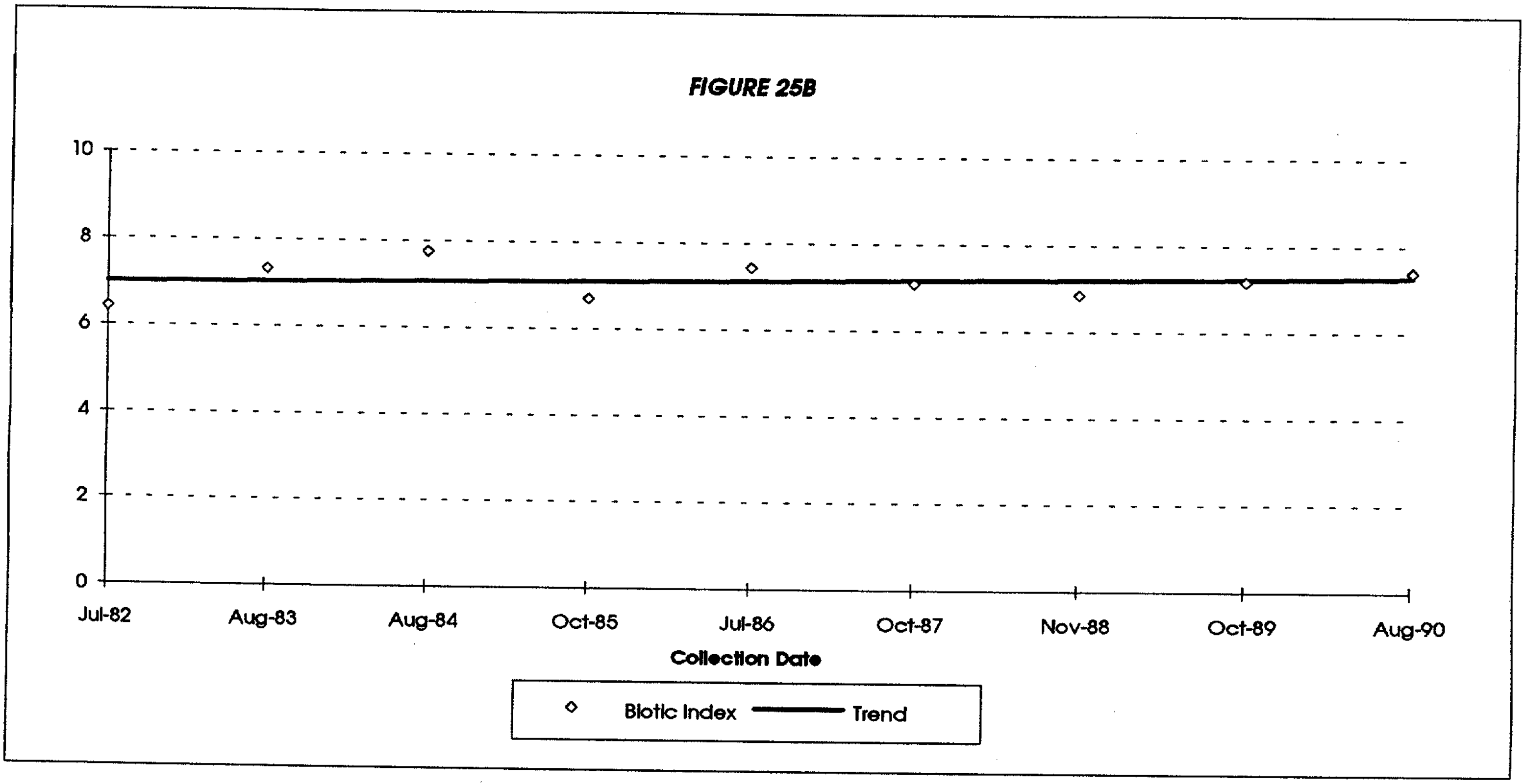
Figure 25A
% Contribution of Dominant Orders*
AMBIENT MONITORING STATION: TE-002 1974-1990



*-Data was not collected during 1974, 1975, 1978, and 1979.

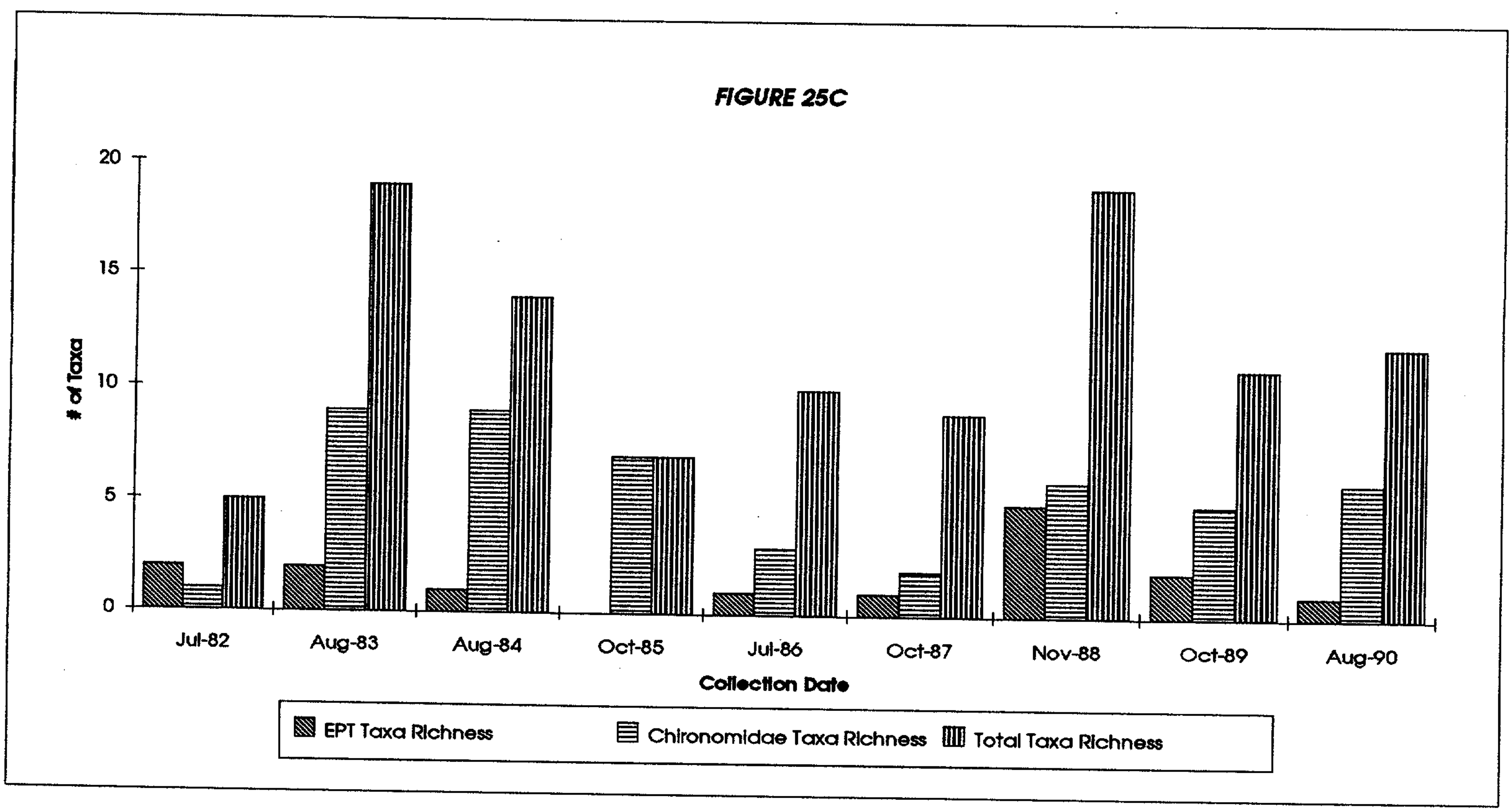
BIOTIC INDEX

AMBIENT MONITORING STATION: TE-002 1982-1990



TAXA RICHNESS

AMBIENT MONITORING STATION: TE-002 1982-1990



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APPENDIX

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 1
AMBIENT MONITORING STATION: B-001 1974-1991

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	0	0	0	98.6	0.5	0	0	0	0	0.9	0
Oct-75	0	4	0	0	12	56	4	0	0	12	8	4	0
1976	*No Sample Collected*												
1977	*No Sample Collected*												
Sep-78	0	0	0	0	0	97	2	0	0	0	1	0	0
Jul-79	0	0	0	0	2	42	28	0	0	13	15	0	0
Jun-80	0.5	0	0	0	0.5	55	18	0	0.5	0.5	16.5	8	0.5
Jun-81	0	0	1	0	0	0	13	0	5	1	1	79	0
Jul-82	0	0	0	0	0	0	61.54	0	3.08	0	30.77	4.62	0
Aug-83	1.79	0	0	0	6.25	22.32	46.43	0	0	4.46	6.25	12.5	0
Jul-84	3.13	0	0	2.08	1.04	13.54	8.33	0	1.04	1.04	2.08	66.67	1.04
Jul-85	6.41	0	0.64	0.64	0.64	8.97	2.56	0	0	0.64	0	79.49	0
Jul-86	6.13	0	0	0.66	0	2.84	0	0	0	1.75	0	57.33	31.3
Oct-87	7.14	0	0	0.79	0	3.97	15.08	0	0	10.32	0	60.32	2.38
Aug-88	20.96	0	0	0.37	0	3.31	9.92	0	0	2.94	0	62.13	0.37
Oct-89	4.66	0	0	6.09	0	0	2.15	0	0	7.17	0	78.85	1.08
Jul-90	28.13	0.07	2.37	0.22	0.72	7.84	4.53	0.07	0.94	3.09	0.65	51.08	0.29
Jul-91	23.11	0	0.38	3.03	3.79	4.93	3.41	0	1.52	7.2	0	52.65	0

TABLE 2
AMBIENT MONITORING STATION: C-002 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
1976													
Oct-77	0	0	0	1.5	1.5	82	3	0	1.5	0	9	1.5	0
1978	*No Sample Collected*												
1979	*No Sample Collected*												
Jun-80	0	0	0	0	0	50	50	0	0	0	0	0	0
Jun-81	3	3	0	0	15	0	37	0	0	10	0	30	2
Jul-82	0	0	0	0	3.13	0	85.41	0	0	4.17	2.08	3.13	2.08
Aug-83	0	0	0	6.06	0	6.06	30.3	0	0	18.18	6.06	33.33	0
1984	*No Sample Collected*												
Jun-85	0.21	0	0	0	3.96	8.75	18.33	0	0.63	0.21	14.58	50	3.33
Jul-86	0.23	0	0	0	2.41	63.53	0.38	0	0	0.38	2.03	1.51	29.5
Oct-87	6.31	0	0	0	0.81	35.68	0.49	0	0.16	2.27	27.59	5.91	20.8
Aug-88	1.3	0	0	0	0.81	68.6	0.14	0	0.09	1.12	4.53	2.06	21.4
Oct-89	0	0	0	0	0	23.21	64.29	0	0	0	1.79	10.71	0
Jul-90	0.46	0	0.01	0	2.24	25.53	0.96	0.03	0.34	0.14	58.34	6.85	5.1

TABLE 3
AMBIENT MONITORING STATION: C-003 1974-1990

Date	Annelida	Amphipoda	Plecoptera	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	9	0	0	85	5	0	0	1	0	0	0
Oct-75	0	0	4	0	2	63	7	0	0	0	24	0	0
Dec-76	0	0	45	0	0	55	0	0	0	0	0	0	0
Oct-77	0	0	0	0	0	97	0	0	0	0	2	1	0
1978	*No Sample Collected*												
Jul-79	0	0	0	0	2	2	90	0	0	2	4	0	0
Jun-80	0	1.45	0	0	11.59	7.25	71.01	0	0	0	7.25	1.45	0
Jun-81	3	0	0	0	4	86	0	0	0	0	6	1	0
Jul-82	0	0	0	0	9.68	2.15	87.1	0	0	0	0	1.08	0
Aug-83	0	0	0	0	6.54	26.16	59.81	0	0.93	5.61	0	0.93	0
Jul-84	0	0	0	0.47	10.33	4.69	70.89	0	1.41	0.94	0.47	8.45	2.35
Jun-85	0	0	0	0	9.76	7.32	58.54	0	0	2.44	0	21.95	0
Jul-86	0	0	0	0.63	16.46	20.89	51.9	0	0	4.43	0.63	4.43	0.63
Oct-87	0	0	0	0	6.94	23.61	41.67	0	0	22.22	2.78	2.78	0
Aug-88	1.68	0	0	0	3.91	19.55	64.25	0	0	3.91	0	5.59	1.12
Oct-89	0	0	0	0	2.5	20.83	66.67	0	0.83	5	2.5	1.67	0
Jul-90	1.27	0	0	0	2.53	6.97	19.85	0.32	3.7	1.06	24.29	38.54	1.48

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 4

AMBIENT MONITORING STATION: LC-001 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	39.8	0	0	0	0	59.9	0.3	0	0	0	0	0	0
Oct-75	0	0	0	0	0	36	0	0	0	9	9	46	0
Dec-76	0	0	0	0	0	100	0	0	0	0	0	0	0
Oct-77	0	0	0	0	17	83	0	0	0	0	0	0	0
Sep-78	0	0	0	0	0	99	0.5	0	0.3	0.2	0	0	0
Jul-79	0	0	0	0	11	67	22	0	0	0	0	0	0
Jun-80	0	5	0	0	9	23	0	0	9	0	0	50	4
Jun-81	0	34	6	9	0	0	0	0	0	9	0	40	2
Jul-82	0	2.53	0	0	0	3.8	31.65	0	2.53	6.33	0	53.16	0
1983						*No Sample Collected*							
Jul-84	2.27	4.55	0	2.27	2.27	63.64	0	0	0	11.36	0	13.64	0.
Jun-85	0	5.19	0	2.6	2.6	66.23	14.29	0	0	2.6	0	6.49	0
Jul-86	0	28.38	0	1.35	4.05	28.38	20.27	0	0	2.7	4.05	9.46	1.35
Oct-87	0	0	1.02	0	0	51.02	31.63	0	1.02	6.12	0	9.18	0
Aug-88	0	0	0	0	4	36	10	0	2	6	0	42	0
Oct-89	0	0	0.41	0.41	0.83	23.65	60.58	0	0.83	4.56	0.41	8.3	0
Jul-90	1.55	0	0.03	0.27	41.47	10.36	9.54	0.03	4.07	0.54	20.98	10.88	0.29

TABLE 5

AMBIENT MONITORING STATION: SH-001 & SH-001a 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	1	0	6	0	93	0	0	0	0	0	0	0
Oct-75	0	0	0	0	0	100	0	0	0	0	0	0	0
Nov-76	0	2	0	33	0	65	0	0	0	0	0	0	0
Oct-77	0	23	0	0	0	77	0	0	0	0	0	0	0
Sep-78	0	0	0	16	0	84	0	0	0	0	0	0	0
Jul-79	1	0	0	36	0	56	0	0	0	0	0	7	0
Jun-80	0.5	0.5	0	66	0	21	0	0	0	0	0	12	0
Jun-81	0	0	0	100	0	0	0	0	0	0	0	0	0
Jul-82	2.13	0	0	41.49	0	56.38	0	0	0	0	0	0	0
Aug-83	1.09	0	0	80.43	0	1.09	0	0	0	0	0	17.39	0
Jul-84	10.09	0	0	33.03	0.46	55.96	0	0	0	0	0	0.46	0
Jun-85	30.21	0	0	33.33	0	29.17	0	0	0	0	0	7.29	0
Jul-86	0	0	0	7.81	0.78	39.84	44.53	0	0	7.03	0	0	0
Oct-87	4.76	0	0	0	6.35	39.69	11.11	0	0	26.98	0	6.35	4.76
Aug-88	63.87	0.78	0	0.59	4.88	22.07	1.17	0	0.39	4.1	0.2	0.2	1.76
Oct-89	1.28	0	0	0	4.49	44.23	39.74	0	1.28	7.05	0	0	1.92
Jul-90	6.35	0.23	0	2.37	5.52	40.21	14.75	0.05	0.7	1.53	16.28	11.69	0.32

TABLE 6

AMBIENT MONITORING STATION: S-001 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	0	0	0	90.9	9.1	0	0	0	0	0	0
Nov-75	0	0	0	0	0	96	0	0	0	0	0	4	0
Sep-76	2	0	0	0	0	96	0	0	0	0	0	0	2
Jul-77	0	0	0	0	0	0	0	0	0	0	0	100	0
1978						*No Sample Collected*							
Aug-79	0	0	0	7	0	93	0	0	0	0	0	0	0
1980						*No Sample Collected*							
1981						*No Sample Collected*							
1982						*No Sample Collected*							
1983						*No Sample Collected*							
Aug-84	14.58	0	0	0	0	83.33	0	0	0	2.08	0	0	0
Jun-85	7.02	0	0	0	0	69.3	0	0	0.88	14.04	0	8.77	0
Jul-86	0	0	0	0	0	82.35	0	0	0	14.71	2.94	0	0
1987						*No Sample Collected*							
Aug-88	3.74	0	0	0	0	91.44	0	0	0	4.81	0	0	0
Sep-89	0.55	0	0	0	0	96.84	0	0	0	2.6	0	0	0
Jun-90	39.61	0	0	0	0.3	42.34	0	0	0	0.83	0.38	16.53	0

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 7
AMBIENT MONITORING STATION: SO-001 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	1.2	0	0	0.2	0	98.5	0	0	0	0	0	0.1	0
Nov-75	0	0	0	0.3	0.1	88.7	0	0	0	0	0.9	10	0
Sep-76	0	0	0	0	0	99.6	0.2	0	0	0	0	0.2	0
1977						*No Sample Collected*							
Aug-78	9.7	0	0	0	0	88	0	0	0	0	0	2.3	0
Aug-79	58.5	0	0	0	0	1.7	0	0	0	3.4	0	36.4	0
Jun-80	0	0	0	1.3	1.3	7.3	0	0	0	0	0	90.1	0
Jul-81	41.5	0	0	0	0	0	0	0	0	2	0	56.4	0
Jun-82	0	0	0	0	0	12.5	0	0	0	50	0	37.5	0
1983						*No Sample Collected*							
Aug-84	52.72	0	0.59	0.29	0	15.32	0	0	0	5.74	0	23.86	1.47
Jun-85	60.94	0	0	0	0	38.43	0	0	0	0	0	0.63	0
Jul-86	1.02	0	0.15	0.29	0.15	96.08	0	0	0	0.44	0	1.89	0
Sep-87	2.22	0	1.11	0	1.11	87.41	0	0	1.11	2.59	0	4.07	0.37
Aug-88	12.74	0	0	0	4.72	64.62	0.47	0	0	5.19	0	12.26	0
Sep-89	30.53	0.28	0	0	1.96	36.13	10.92	0	0.28	4.48	0	10.92	4.48
Jun-90	0.36	0.01	0	0.02	0.21	65.35	0.51	0.01	0.02	0.11	0	33.13	0.28

TABLE 8
AMBIENT MONITORING STATION: VA-001 1974-1991

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974						*No Sample Collected*							
1975						*No Sample Collected*							
1976						*No Sample Collected*							
Oct-77	0.6	0	0	0	0	78.5	0	0	0	6.7	0	14.2	0
Sep-78	0	0	0	0	0	100	0	0	0	0	0	0	0
Jul-79	0	0	0	0	0	84.6	0	0	0	15.4	0	0	0
Jun-80	0	0	0	0	0	50.8	0	0	0	0	0	49.2	0
Jul-81	0	0	0	0	0	0	0	0	0	66.7	0	33.3	0
Jul-82	0	0	7.14	7.14	14.29	0	0	0	0	57.14	0	14.29	0
Aug-83	0	0	0	0	0	80.65	3.23	0	3.23	8.06	1.61	3.23	0
Aug-84	0	0	0	0	0	71.83	7.04	0	16.9	0	4.23	0	0
Jun-85	0.49	1.46	0	0	0	48.55	30.58	0	1.46	0	6.8	9.22	1.46
Jul-86	0	0.28	0.55	0	0.28	58.29	3.59	0	2.49	1.1	0.83	32.6	0
Oct-87	3.23	3.23	3.23	0	6.45	9.68	4.84	0	1.61	19.35	1.61	46.77	0
Sep-88	1.92	0.32	0.32	0.96	1.28	63.78	0.64	0	1.6	3.21	6.41	19.55	0
Oct-89	0	0.47	0	0	1.42	54.02	0	0	1.42	8.06	3.79	30.33	0.47
Jul-90	0.64	0.49	0.08	0.82	0.78	58.69	0.08	0.02	2.21	2.25	30.58	3.36	0
Jul-91	0.99	0.49	0	0.6	1.55	79.45	0.32	0	2.82	1.38	5.05	5.54	1.8

TABLE 9
AMBIENT MONITORING STATION: VI-001 1974-1991

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974						*No Sample Collected*							
Oct-75	12	1.1	0	0	0	6.5	0.4	0	0	1.4	0	78.6	0
Nov-76	0	0	0	0	0	99	0	0	0	1	0	0	0
Oct-77	0	0	0	0	0	31.5	0	0	0	0	0	68.5	0
Sep-78	0.3	0	0	0	0	99.4	0	0	0	0.3	0	0	0
Jul-79	0	0	0	0	0	42.4	33.3	0	0	3.4	20.7	0	0
Jun-80	0	2.8	0	0	0	89	3.7	0	0	1.8	0	2.8	0
Jun-81	0	0	0	0	1.2	0	3.3	0	0	2.2	0	93.3	0
Jul-82	0	0	0	0	0	28.13	0	0	21.88	12.5	31.25	0	6.25
Aug-83	0.71	7.8	0	0	8.51	44.68	0.71	0	0	9.93	12.06	14.18	1.42
1984						*No Sample Collected*							
Jun-85	0.92	0	0	0	0	11.01	1.83	0	0	1.83	50.46	32.11	1.83
Jul-86	0	0	0	0	0.56	56.27	0.97	0	0	4.32	5.99	29.81	2.09
Oct-87	0.18	0	0	0	1.07	20.54	27.14	0	0.18	16.61	1.25	32.5	0.54
Oct-88	0	0	0	0	2.63	35.62	45.79	0	0.35	3.51	8.95	2.98	0.18
Oct-89	0	0	0	0	1.57	58.22	14.62	0	1.31	1.83	14.62	7.83	0
Jul-90	1.18	0	0	0.05	5.14	26.59	8.82	0.14	2.45	0.09	39.93	15.56	0.05
Oct-91	0.31	0	0	0	6.05	41.72	13.68	0	1.74	1.55	32.01	1.43	1.52

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 10

AMBIENT MONITORING STATION: A-001 & A-001a 1974-1990

Date	Annelida	Amphipoda	Coleoptera	Diptera	hemeropte	emipter	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	0	40.4	4.3	0	0	53.2	2.1	0
Aug-75	0	0	0	35	40	0	0	22	0	4
1976					*No Sample Collected*					
1977					*No Sample Collected*					
1978					*No Sample Collected*					
Aug-79	0	0	0	7	5	0	0	88	0	0
Jul-80	0	0	0	46	0	0	0	54	0	0
Jul-81	0	0	0	32	0	0	0	68	0	0
Jun-82	0	0	0	39	0	0	0	61	0	0
Jun-83	0	1.3	0	40.26	24.7	0	0	32.47	1.3	0
1984					*No Sample Collected*					
1985					*No Sample Collected*					
Jul-86	0	0	0.36	72.83	0	0	0	26.81	0	0
Oct-87	0	0	0	76.56	0.4	0	0.39	22.66	0	0
Aug-88	29.16	0	0	57.23	0	0	0	13.39	0	0.2
Sep-89	0.43	0	0	57.45	0	0	0.43	41.7	0	0
Aug-90	0.35	0	0	69.98	0.18	0.17	0.7	28.27	0.17	0.17

TABLE 11

AMBIENT MONITORING STATION: A-002 1974-1990

Date	Annelida	Amphipoda	Isopoda	oleopter	Diptera	emerop	Hemiptera	Megalopter	Odonata	richopter	Mollusca	Misc
1974	0	0	0	0	64.7	19.6	0	0	0	15.7	0	0
Aug-75	0	0	0	0	21	21	0	0	0	58	0	0
1976							*No Sample Collected*					
1977							*No Sample Collected*					
Jul-78	0	0	0	0	69	6	0	0	0	25	0	0
Aug-79	0	0	0	0	24	3	0	0	0	73	0	0
Jul-80	0	0	0	0	44	10	0	0	3	38	5	0
Jul-81	0	0	0	0	0	11	0	0	28	61	0	0
Jun-82	0	0	1.52	0	62.12	7.58	0	0	0	16.67	10.61	1.52
Jun-83	0	0	0	0	6.83	47.12	0	0	0	44.6	1.44	0
1984							*No Sample Collected*					
1985							*No Sample Collected*					
Jul-86	0	0	0.46	0	50.92	2.29	0	0	0	46.33	0	0
Nov-87	3.05	0	0.51	0	55.84	9.13	0	0	0.51	20.3	10.15	0.51
Aug-88	0.86	0	0	0	65.73	0.43	0	0	0.43	32.54	0	0
Sep-89	0	0	0	0	57.49	0.22	0	0	0	42.28	0	0
Aug-90	0	0	0	0.16	69.52	2.4	0	0.16	0.65	25.81	0.65	0.65

TABLE 12

AMBIENT MONITORING STATION: A-003 1974-1990

Date	Annelida	Amphipoda	Isopoda	oleopter	Diptera	emerop	Hemiptera	Plecoptera	Odonata	richopter	Mollusca	Misc
1974	0	0	0	0	52.6	8.1	0	0	0	39.3	0	0
1975							*No Sample Collected*					
1976							*No Sample Collected*					
Oct-77	0	0	0	0	43	4	0	0	1	52	0	0
Aug-78	0	0	0	0	75.5	0	0	0.5	0.5	23	0.5	0
Aug-79	0	0	0	0	27	0	0	0	6	67	0	0
Jul-80	0	0	0	0	45	2	0	0	0	46	7	0
Jul-81	0	0	0	0	0	24	0	0	3	72	1	0
Jul-82	0	0	0	0	70.49	6.56	3.28	0	0	8.2	11.48	0
Jun-83	0	0	0	0.98	22.55	62.74	0	0	0	13.73	0	0
Oct-84	0	0.41	0	1.23	50.81	18.85	0	0	1.64	22.13	4.92	0
Jun-85	5.33	0.67	0	2	28.67	4	0	0	2	51.33	3.33	2.67
Jul-86	0	0	0	2.7	69.37	1.13	0	0	0.23	16.22	8.78	1.58
Sep-87	0.69	0	0	0	69.1	1.39	0.35	0	1.04	26.74	0.69	0
Aug-88	1.23	0	2.22	0	75.37	0.74	0	0	0.25	19.7	0.49	0
Sep-89	0	1.14	0	0.28	63.54	9.4	0	0	1.42	23.93	0.28	0
Jul-90	0.17	0.51	0	0.34	77.24	0.84	0	0	0.17	19.9	0.84	0

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 13
AMBIENT MONITORING STATION: C-004 1974-1990

Date	Annelida	Amphipoda	Isopoda	oleopter	Diptera	emerop	Megaloptera	Plecoptera	Odonata	richopter	Mollusca	Misc
1974	0	0	0	0.4	78.4	2.2	0	6.9	0.4	11.7	0	0
1975							*No Sample Collected*					
1976							*No Sample Collected*					
Sep-77	0	0	0	0	32.5	1.3	0	0	0	66.2	0	0
1978							*No Sample Collected*					
Jul-79	0	0	0	0	68.7	15.3	0	0	14.5	1.5	0	0
Jul-80	0	0	0	5	11.67	60	0	0	6.67	1.67	15	0
Jul-81	0	0	0	3.8	0	60.7	2.5	0	16.5	0	16.5	0
Jun-82	0	0	0	8.77	29.83	56.14	0	0	5.26	0	0	0
Jun-83	0	0	0	5.2	5.2	85.6	0	0	0	4	0	0
Oct-84	2.88	0	0	0.48	32.21	34.62	0	0	8.17	12.98	8.17	0.48
Jun-85	0	0	0	1	68	12.75	0	0	0.25	17.5	0	0
Oct-86	0	0	0.5	3	38	13.5	0.5	0.5	4.5	39.5	0	0
Sep-87	0	0	0	0	49.02	29.41	0	0	4.9	15.69	0.98	0
Sep-88	2.95	0.42	0	1.27	23.63	37.55	0.42	0	0.84	32.49	0.42	0
Sep-89	0.85	0	0	0.57	42.49	42.21	0.28	0	1.13	9.63	0	2.83
Jul-90	0	0	0	1.94	38.35	32.52	0	0	1.94	25.24	0	0

TABLE 14
AMBIENT MONITORING STATION: CL-001 1974-1990

Date	Annelida	Amphipoda	Isopoda	oleopter	Diptera	emerop	Megaloptera	Decapoda	Odonata	richopter	Mollusca	Misc
1974	0	0	0	0	72.7	0	0	18.2	0	0	9.1	0
Aug-75	0	0	0	0	8.3	83.3	0	0	6.3	2.1	0	0
Jul-76	4	0	0	0	28	56	0	0	12	0	0	0
1977							*No Sample Collected*					
Aug-78	0	0	0	7.8	9.8	66.7	0	0	5.9	0	9.8	0
Aug-79	0	0	0	0	40	57.4	0	0	1.3	0	1.3	0
Jun-80	0	0	0	1.19	0	47.62	0	2.38	2.38	0	46.43	0
Jul-81	0	0	0	0	0	100	0	0	0	0	0	0
Jun-82	0	1.25	0	40	1.25	30	2.5	0	5	1.25	18.75	0
1983							*No Sample Collected*					
Sep-84	1.17	0	0	2.73	23.44	66.02	0	0	0.39	3.91	2.34	0
Jul-85	0	0	0	1.49	65.85	11.88	0	0	1.49	12.87	6.44	0
Jul-86	0	0	0	13.01	3.35	80.48	0	0	0.56	0.93	1.67	0
Sep-87	11.61	0	0.45	1.79	66.07	7.59	0	0	3.13	0.45	8.48	0.45
Aug-88	5.8	0.97	0	3.38	29.47	43.96	0.48	0	5.31	1.45	8.21	0.97
Nov-89	5.48	0	1.37	2.74	32.88	47.95	0	0	1.37	5.48	2.74	0
Jul-90	0	0	0	1.47	34.41	57.94	0	0	0.29	3.53	1.47	0.88

TABLE 15
AMBIENT MONITORING STATION: CO-002 1974-1991

Date	Annelida	Amphipoda	Isopoda	oleopter	Diptera	emerop	Megaloptera	Plecoptera	Odonata	richopter	Mollusca	Misc
1974							*No Sample Collected*					
1975							*No Sample Collected*					
1976							*No Sample Collected*					
1977							*No Sample Collected*					
1978							*No Sample Collected*					
Aug-79	0	0	0	0	1.4	78.9	0	0	0	19.7	0	0
Jun-80	0	0	0	0	33.34	5.95	0	0	0	52.98	7.74	0
Jul-81	0	0	0	0	0	1.8	0	0	0	72.7	25.5	0
1982							*No Sample Collected*					
Jul-83	0.89	0	0	0.89	19.64	22.32	0	0	6.7	1.34	8.48	39.73
1984							*No Sample Collected*					
1985							*No Sample Collected*					
Jul-86	0.31	0	0	0.31	71.69	0.31	0	0	0.31	24.62	2.46	0
1987							*No Sample Collected*					
Aug-88	0.4	0	0.2	0	78.09	0	0	0	2.19	8.96	7.97	2.19
Nov-89	6.33	3.8	3.8	0	65.82	7.59	0	2.53	0	7.59	1.27	1.27
Jul-90	0	0	0	0.25	66.17	1	0	0	0	32.33	0.25	0
Aug-91	0	0	0	0	77.93	1.28	0	0	0	19.3	1.49	0

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 16
AMBIENT MONITORING STATION: T-002 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0.9	0	0	0	80.9	1.8	0	0	0	16.4	0	0
1975						*No Sample Collected*							
1976						*No Sample Collected*							
Oct-77	0	0	0	0	0	13	6	0	0	0	80.5	0.5	0
1978						*No Sample Collected*							
Jul-79	0	0	0	0	0	8	63	0	0	3	26	0	0
Jul-80	0	0	0	0	0	37	27	0	0	0	36	0	0
Jul-81	0	0	0	0	0	2	23	0	0	13	56	6	0
Jul-82	0	0	0	0	0	77.23	3.13	0	0	1.79	17.86	0	0
1983						*No Sample Collected*							
Aug-84	0	0	0	0	0.79	68.52	0.26	0	0	0.26	30.16	0	0
Jun-85	0	0	0	0	0.21	60.42	6.25	0	0	0.21	32.92	0	0
Oct-86	0	0	0	44.12	0.84	35.29	0	0	0	3.36	13.03	3.36	0
Sep-87	0	0	0	12.4	0	69.15	0	0	0	1.1	16.53	0.83	0
Aug-88	0	0	0	65.85	0	25.61	0	0	0	0.37	6.61	1.48	0.07
Sep-89	0	59.93	0	0	0	36.05	0	0	0	0.33	2.61	0.54	0.54
Aug-90	0	4.61	0	0.16	0.16	66.61	0	0	0	0.32	26.07	1.75	0.32

TABLE 17
AMBIENT MONITORING STATION: T-004 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974						*No Sample Collected*							
1975						*No Sample Collected*							
1976						*No Sample Collected*							
1977						*No Sample Collected*							
1978						*No Sample Collected*							
1979						*No Sample Collected*							
Jul-80	0	0	0	0	0	34	6	0	0	24	31	5	0
Jul-81	0	1	0	0	1	0	1	0	0	2	93	0	2
Jul-82	0	0	0	0	0	75.97	1.29	0	0	4.29	17.6	0.86	0
1983						*No Sample Collected*							
Aug-84	0.27	0.27	0	0	0	80.32	0.27	0	0	3.46	14.63	0	0.8
Jun-85	0	1.3	0	0	1.3	43.51	27.27	0	0	2.6	22.73	1.3	0
Jul-86	0	0	0	0	0.41	86.63	0.21	0	0	1.44	10.91	0.41	0
Sep-87	0.09	0.09	0	0	0	83.42	0	0	0	0.36	15.68	0.18	0.18
Aug-88	0.45	0	0	0	0	78.79	0.22	0	0	0	20.09	0	0.45
Sep-89	7.85	0	0	0	0	71.84	0	0	0	0.51	19.62	0	0.17
Jul-90	0	0	0	0	0	67.54	0	0	0	0	32.38	0.09	0

TABLE 18
AMBIENT MONITORING STATION: BL-001 1974-1992

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Neuroptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	0	0	0	83.7	9.3	0	0	0	2.3	4.7	0
Sep-75	0	0.5	0	0	0	83	0	0	0	0.5	16	0	0
1976						*No Sample Collected*							
Oct-77	0	0	0	0	0	93	1	0	0	0	6	0	0
Sep-78	0	0	0	7	0	36	44	0	0	11	2	0	0
Jul-79	0	0	0	0	0	72	9	0	0	2	17	0	0
Jun-80	0	16	0	0	0	40	17	0	0	0	15	12	0
Jun-81	0	31	0	0	0	0	19	0	0	1	35	14	0
1982						*No Sample Collected*							
Aug-83	0	19.09	0	0	0	49.09	4.55	0	0	5.45	4.55	17.27	0
Aug-84	0	3.67	0	0	0	87.9	0.43	0	0	1.73	3.24	3.02	0
Jul-85	0	6.02	0	0	0	91.57	0.15	0	0.08	0.38	1.05	0.75	0
Jul-86	0	0.74	0	0	0	94.75	0	0	0	0.14	4.37	0	0
Oct-87	0.22	6.66	0	0	0	86.9	0	0	0	0.44	3.93	1.42	0.44
Aug-88	4.74	1.07	0	0	0	89.36	0	0	0	0	4.8	0	0.03
Sep-89	4.53	0	0	0	0	76.27	0	0	0	0	18.99	0.11	0.11
Oct-89	0.24	1.82	0	0	0	85.09	0.24	0	0	0.24	12.36	0	0
Nov-89	9.38	0	0	0	0	85.15	1.07	0	0	0	4.16	0	0.24
Sep-90	0.23	0	0	0	0	92.57	0	0	0	0.49	6.22	0.26	0.23
Sep-91	1.63	0	0	0	0	91.59	0	0	0	0.23	6.56	0	0
Sep-92	0	0.17	0	0	0	70.39	0	0	0	0	27.24	0	2.2

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 19
AMBIENT MONITORING STATION: LF-001 & LF-001a 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Neuroptera	Odonata	Trichoptera	Mollusca	Misc
1974	0	0	0	0	0	99.8	0.1	0	0	0.1	0	0	0
Sep-75	0	0.5	0	0	0	88.5	5	0	0	1	5	0	0
Nov-76	0	0	0	0	0	91	0.5	0	0	0.5	7.5	0	0.5
Oct-77	0	0	0	0	0	75	0	0	0	1	24	0	0
Sep-78	0	0	0	0	0	92	0	0	0	0.5	7.5	0	0
Jul-79	0	0	0	0	0	93	0	0	0	3	2	2	0
Jun-80	0	0	0	0	1	12	63	0	0	14	7	3	0
Jun-81	0	32	0	0	0	0	22	0	10	7	22	7	0
Jul-82	0	0	0	0	0	92.32	0.82	0	0	3.59	1.8	1.47	0
Aug-83	0	34.09	0	0	6.82	9.09	0	0	4.55	11.36	4.55	29.55	0
Aug-84	0.12	0	0	0	0	95.7	0.06	0	0	1.61	1.02	1.14	0.24
Jul-85	0.06	0.17	0	0	0	97.3	0.11	0	0	1.12	0.96	0.22	0.06
Jul-86	0	5.17	0	0	0	85.2	0	0	0	0.7	8.38	0.56	0
Oct-87	0.53	4.76	0	0	0	85.19	0.53	0	0	0.79	5.03	2.38	0.79
Aug-88	2.82	0	0	0	0	94.52	0	0	0	0	2.66	0	0
Oct-89	4.72	0.79	0	0	0	81.89	1.18	0	0	2.36	7.09	0.39	1.57
Aug-90	0	0.63	0	0	0	91.48	0.11	0	0	0	7.78	0	0

TABLE 20
AMBIENT MONITORING STATION: CS-001 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
Oct-76	0	27	0	0	0	61	0.5	0	0	0.5	11	0	0
Jul-77	1	1	0	0	0	86	3	0	0	0	8	0.5	0.5
Aug-78	0	0	0	0	0	76	0	0	0	0	24	0	0
Jul-79	0	32	0	0	0	28	12	0	0	0	28	0	0
Jul-80	0	30	0	0	2	43	18	0	0	2	5	0	0
Jul-81	0	28	0	0	0	0	0	0	0	0	53	19	0
Aug-82	0	29.17	4.17	4.17	0	20.83	33.33	0	0	0	8.33	0	0
Aug-83	0	14.36	0.51	0	0	67.18	0.51	0	0	0	16.92	0.51	0
Aug-84	0	10.78	0.15	0.59	0	20.24	0.29	0	0	0	3.25	64.7	0
1985	*No Sample Collected*												
Jul-86	0	3.07	1.64	0.82	0	13.11	0	0	0	0	2.46	78.89	0
Oct-87	0	25.26	0.7	0.25	0	4.15	0	0	0	0	0	69.33	0.3
Nov-88	0.51	6.12	1.02	0	0	32.14	0	0	0	0	3.57	55.1	1.53
Oct-89	0.79	3.16	6.72	0	0	20.55	0	0	0	0	2.37	66.4	0
Aug-90	2.15	4.3	4.49	0	0	8.4	0.39	0	0	0	1.37	78.91	0

TABLE 21
AMBIENT MONITORING STATION: CS-002 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
1976	*No Sample Collected*												
1977	*No Sample Collected*												
1978	*No Sample Collected*												
Jul-79	0	29	29	0	0	42	0	0	0	0	0	0	0
Jul-80	3	8	34	0	0	26	0	0	0	0	0	29	0
Jul-81	11	0	84	0	0	0	0	0	0	0	5	0	0
Aug-82	0	12.33	15.07	1.37	0	13.7	0	0	0	0	0	57.53	0
Aug-83	0	33.91	8.37	0.64	0	0	0	0	0	0	0	57.08	0
1984	*No Sample Collected*												
Oct-85	0	15.15	21.21	24.24	0	39.39	0	0	0	0	0	0	0
Jul-86	2.79	46.75	1.86	0	0	1.55	0	0	0	0	0.62	46.44	0
Oct-87	2.45	55.92	2.45	0	0	1.22	0	0	0	0	0	37.96	0
Nov-88	3.85	86.42	0.53	0	0	0.64	0	0	0	0	0	5.03	3.53
Oct-89	10.53	57.37	7.89	0	0	3.68	0	0	0	0	0	20.53	0
Aug-90	5.99	63	0.3	0.3	0	1.27	0	0	0	0	0	28.61	0.52

*- % Contribution of Organisms within Orders.

Appendix A
Community Structure
% CONTRIBUTION OF ORDERS*

TABLE 22
AMBIENT MONITORING STATION: HB-001 1988-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Megaloptera	Odonata	Trichoptera	Mollusca	Misc
Nov-88	7.52	48.12	4.51	0.75	0	15.04	0	0	0	0	0.75	21.05	2.26
Oct-89	0	81.21	4.36	0	0	8.16	0	0	0	0	0	6.26	0
Aug-90	7.73	70.41	0.64	0	0	12.89	0	0	0	0	0	7.68	0.64

TABLE 23
AMBIENT MONITORING STATION: MO-001a 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Neuroptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
Aug-76	0	0	0	0	0	98	0	0	0	0	2	0	0
1977	0	0	0	0	0	100	0	0	0	0	0	0	0
Aug-78	0	0	0	0	0	71	0	0	0	0	25	4	0
Jul-79	0	13	0	0	0	55	9	0	0	2	15	6	0
Jul-80	0	3	0	0	0	80	11	0	0	3	3	0	0
Jul-81	0	0	26	3	0	0	0	0	0	0	14	57	0
Jul-82	0	3.13	0	0	0	85.94	9.38	0	0	0	1.56	0	0
Aug-83	0	5.45	3.64	0	0	47.27	12.73	0	0	0	12.73	18.18	0
Aug-84	0	1.03	1.55	2.58	0	90.72	1.55	0	0	0	2.58	0	0
Oct-85	0	1.14	0.76	12.12	0	64.77	0.38	0	0	0	0.76	20.08	0
Jul-86	0	11.83	1.78	0	0	24.26	0.59	0	0	0.59	0	60.95	0
Oct-87	0	2.74	0.04	0	0	8.82	0	0	0	0	0.16	88.15	0.08
Nov-88	15.38	35.1	0.96	0	0	39.42	0.48	0	0	0	4.81	1.92	1.92
Oct-89	0	22.58	0.4	0	0	24.19	6.85	0	0	0	39.11	6.85	0
Aug-90	0	2.79	0.42	0	0	58.64	0	0	0	0	10.31	27.86	0

TABLE 24
AMBIENT MONITORING STATION: TE-001 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Neuroptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
Aug-76	0	0	0	0	0	100	0	0	0	0	0	0	0
Jul-77	0	4	0	0	0	85	0	0	0	0	11	0	0
Aug-78	0	0	0	0	0	90	1	0	0	0	9	0	0
1979	*No Sample Collected*												
Jul-80	0	4	0	0	0	49	34	0	0	0	13	0	0
Jul-81	0	10	0	18	0	3	4	0	0	1	61	3	0
Jul-82	0	23.53	0	0	0	43.14	1.96	0	1.96	0	29.41	0	0
Aug-83	0	35.23	1.14	10.23	0	44.32	1.14	0	1.14	0	4.55	2.27	0
Aug-84	0	0	0	32.6	0	25.42	2.76	0	0	0	39.23	0	0
Oct-85	0	0	0	0	0	100	0	0	0	0	0	0	0
Jul-86	0	0	0	0	0	5.56	0	0	0	0	94.44	0	0
Oct-87	0	11	0	0	0	5.79	0	0	0	0	2.32	80.89	0
Nov-88	4.69	16.41	3.13	0	0	17.97	3.91	0	0	0	51.56	2.34	0
Oct-89	0.51	16.33	0.51	0	0	44.9	3.57	0	0	0	34.18	0	0
Aug-90	2.06	5.22	0.27	0	0	43.96	0	0	0	0	48.21	0.27	0

TABLE 25
AMBIENT MONITORING STATION: TE-002 1974-1990

Date	Annelida	Amphipoda	Decapoda	Isopoda	Coleoptera	Diptera	Ephemeroptera	Hemiptera	Neuroptera	Odonata	Trichoptera	Mollusca	Misc
1974	*No Sample Collected*												
1975	*No Sample Collected*												
Aug-76	0	0	0	0	0	18	0	0	0	9	0	73	0
Jul-77	0	16	0	0	0	71	0	0	0	0	5	3	5
1978	*No Sample Collected*												
1979	*No Sample Collected*												
Jul-80	0	5	0.5	7	0	37.5	11	0	0	0	30	9	0
Jul-81	0	1	3.5	29	0	0	0	0	0	0	0.5	66	0
Jul-82	0	72.73	6.82	0	0	6.82	2.27	0	0	0	11.36	0	0
Aug-83	0	7.38	1.55	41.94	0	4.85	0.39	0	0	0	1.17	42.72	0
Aug-84	0	0.76	0.25	59.8	0	33.84	0	0	0	0	0.76	4.58	0
Oct-85	0	0	0	0	0	100	0	0	0	0	0	0	0
Jul-86	0	46.23	5.82	0	0	16.1	0	0	0	0	1.37	30.48	0
Oct-87	0	17.83	2.48	0	0	20.77	0.23	0	0	0	0	54.18	4.51
Nov-88	3.92	25	0.37	0.75	0	64.55	0.19	0	0	0	4.48	0.75	0
Oct-89	0	24.8	6.4	0	0	48.8	0	0	0	0	7.2	12.8	0
Aug-90	0.3	8.47	1.84	0	0	19.62	0	0	0	0	7.02	62.75	0

*- % Contribution of Organisms within Orders.

APPENDIX B

ALABAMA WATER USE CLASSIFICATIONS

ADEM Administrative Code
Chapter 335-6-10-.09 (Without specific criteria)

(1) PUBLIC WATER SUPPLY

(a) Best usage of waters:

Source of water supply for drinking or food-processing purposes.*

(b) Conditions related to best usage:

The waters, if subjected to treatment approved by the Department equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, and which meet the requirements of the Department, will be considered safe for drinking or food-processing purposes.

(c) Other usage of waters:

It is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

***NOTE:** In determining the safety or suitability of waters for use as sources of water supply for drinking or food-processing purposes after approved treatment, the Commission will be guided by the physical and chemical standards specified by the Department.

(2) SWIMMING AND OTHER WHOLE BODY WATER-CONTACT SPORTS

(a) Best usage of waters:

Swimming and other whole body water-contact-sports.*

(b) Conditions related to best usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports. The quality of waters will also be suitable for the propagation of fish, wildlife and aquatic life. The quality of salt waters and estuarine waters to which this classification is assigned will be suitable for the propagation and harvesting of shrimp and crabs.

***NOTE**: In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wasters and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing.

(3) SHELLFISH HARVESTING

(a) Best usage of waters:

Propagation and harvesting of shellfish for sale or use as a food product.

(b) Conditions related to best usage:

Waters will meet the sanitary and bacteriological standards included in the latest edition of the National Shellfish Sanitation Program Manual of Operations, Sanitation of Shellfish Growing Areas (1965), published by the Food and Drug Administration, U.S. Department of Health and Human Services and the requirement s of the State Department of Public Health. The waters will also be of a quality suitable for the propagation of fish and other aquatic life, including shrimp and crabs.

(c) Other Usage of Waters:

It is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

(4) FISH AND WILDLIFE

(a) Best usage of waters:

Fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage:

The waters will be suitable for fish, aquatic life and wildlife propagation, The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters:

It is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

(5) AGRICULTURAL AND INDUSTRIAL WATER SUPPLY

(a) Best usage of waters:

Agricultural irrigation, livestock watering, industrial cooling and process water supplies, and any other usage, except fishing, bathing, recreational activities, including water-contact sports, or as source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage:

(i) The waters, except for natural impurities which may be present therein, will be suitable for agricultural irrigation, livestock watering, industrial cooling waters, and fish survival. The waters will be usable after special treatment, as may be needed under each particular circumstance, for industrial process water supplies. The waters will also be suitable for other uses for which waters of lower quality will be satisfactory.

(ii) This category includes watercourses in which natural flow is intermittent and non-existent during droughts and which may, of necessity, receive treated wastes from existing municipalities and industries, both now and in the future, In such instances, recognition must be given to the lack of opportunity for mixture of the treated wastes with the receiving stream for purposes of compliance It is also understood in considering waters for this classification that urban runoff or natural conditions may impact any waters so classified.

(6) INDUSTRIAL OPERATIONS

(a) Best usage of waters:

Industrial cooling and process water supplies, and any other usage, except fishing, bathing, recreational activities including water-contact sports or as a source of water supply for drinking or food-processing purposes

(b) Conditions related to best usage:

(i) The waters, except for natural impurities which may be present therein, will be suitable for industrial cooling waters and will be usable after special treatment, as may be needed under each particular circumstance, for industrial process water supplies. The waters will also be suitable for other uses for which waters of lower quality will be satisfactory.

(ii) This category includes watercourses in which natural flow is intermittent and non-existent during droughts and which may, of necessity, receive treated wastes from existing municipalities and industries, both now and in the future, In such instances, recognition must be given to the lack of opportunity for mixture of the treated wastes with the receiving stream for purposes of compliance It is also understood in considering waters for this classification that urban runoff or natural conditions may impact any waters so classified.

(7) NAVIGATION

(a) Best usage of waters:

Navigation and related activities.

(b) Conditions related to best usage:

(i) Waters will be of a quality suitable for navigation and, after special treatment as may be needed under each particular circumstance, could be usable for agricultural irrigation, livestock watering, industrial cooling and industrial process water supply.

(ii) This category includes watercourses in which natural flow is intermittent and non-existent during droughts and which may, of necessity, receive treated wastes from existing municipalities and industries, both now and in the future, In such instances, recognition must be given to the lack of opportunity for mixture of the treated wastes with the receiving stream for purposes of compliance It is also understood in considering waters for this classification that urban runoff or natural conditions may impact any waters so classified.

(8) OUTSTANDING ALABAMA WATER

(a) Best usage of waters:

Activities consistent with natural characteristics of the waters.

(b) Conditions related to best usage:

Waters that constitute an outstanding Alabama resource, such as waters of state parks and wildlife refuges and water of exceptional recreational or ecological significance, may be considered for classification as an Outstanding Alabama Water (OAW).