AN ECOLOGICAL STUDY OF THE SUSQUEHANNA RIVER NEAR THE THREE MILE ISLAND NUCLEAR STATION

ANNUAL REPORT FOR 1989

Prepared For

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1. INTRODUCTION

This report presents the 1989 results of aquatic monitoring studies conducted in York Haven Pond, a mainstem impoundment on the Susquehanna River near the Three Mile Island Nuclear Station (TMINS) (Figure 1-1). Monitoring was executed by personnel of RMC Environmental Services, Inc. under contract to GPU Nuclear Corporation. These monitoring studies were mandated by the TMINS Environmental Technical Specification (ETS) for Unit 2, dated 6 May 1983. All field and laboratory procedures followed specifications provided in the TMI Environmental Controls Policy and Procedures Manual (GPU 1987). The 1989 survey was the third conducted by RMC following 10 years of monitoring by Ichthyological Associates, Inc., and 3 years by EA Engineering, Science, and Technology, Inc.

The objective of the aquatic monitoring studies, as detailed in the Unit 2 ETS, is to obtain a comprehensive data base necessary to establish the natural fluctuations and baseline conditions of various parameters within the ecosystem and on site, and thereby identify any significant biological alterations resulting from the operation of TMINS. The studies focus on water quality, benthic macroinvertebrates, and fish populations; the latter include angler use, harvest, and attitudes. The 1989 studies were the fourth conducted during TMINS (Unit 1) operation following shutdown in 1979.

The TMINS is located on Three Mile Island about 275 m from the east bank of the Susquehanna River in Londonderry Township, Dauphin County, Pennsylvania (Figure 1-1). The site is at river kilometer 90, about 16 km southeast of Harrisburg, Pennsylvania. The Station is surrounded, except along its southern border, by a small reservoir formed by York Haven and Red Hill dams. The (York Haven) pond created by the dams extends about 6 km upstream. At the site, the Susquehanna River is about 2,135 m wide and divided by islands into three channels (west, center, and east). The Intake and Discharge structures for TMINS are located along the west shore of TMI and utilize water from the center channel. The aquatic studies program is conducted within the impounded area, except for creel survey interviews below both dams.

The format of this report is generally consistent for all disciplines studied, and is divided into chapters. The first section in each chapter contains descriptions of sampling stations, methods, and schedules. The next section contains statistical and analytical results of the 1989 studies. Sections on community analysis and multiple-year comparisons form important components of most chapters. Depending on the discipline, other sections cover fish condition, parasites/anomalies, and comparisons with state water quality criteria. Tables and figures are located at the end of each chapter. All references were combined and appear in Chapter 8, which precedes the appendices. Each appendix corresponds to a discipline and contains, at a minimum, individual data points by date, station, taxon, and/or replicate.

SUMMARY

Aquatic monitoring was conducted in York Haven Pond (Susquehanna River) near TMINS between 1 April and 30 November 1989. Program elements consisted of benthic macroinvertebrates, ichthyoplankton, seine, electrofishing, creel surveys, and water quality. This is the 16th annual report of aquatic monitoring studies at TMINS, and the second prepared by RMC Environmental Services, Inc.

Benthic Macroinvertebrates

Macroinvertebrates were collected monthly at three stations, April through November 1989. A total of 30,588 specimens of 101 taxa was taken. Seven taxa comprised over 87% of the benthic organisms. Chironomus decorus group and Limnodrilus hoffmeisteri were the most abundant organisms collected. Chironomus decorus group also had the greatest biomass.

In 1989, a total of 356 Asiatic clams (Corbicula fluminea) was collected throughout York Haven Pond; most were juveniles.

The community composition at the three stations was compared by number of taxa, diversity and percent similarity indices, density, and biomass. The number of taxa was highest at Station 1A2, followed by 11A1 and 9B1. Relative abundance of individuals among the taxa was also similar, as reflected in diversity values of 2.95, 2.91, and 2.53 for Stations 1A2, 11A1, and 9B1, respectively. The percent similarity between stations downstream of the TMINS discharge (11A1 and 9B1) was more similar than comparisons with the control station upstream (1A2). Total station density and biomass were variable and highest at Station 9B1; density and biomass at 1A2 was lowest, and Station 11A1 was intermediate.

The monthly number of taxa, density, and biomass was variable. Values tended to be high in the spring (April through June) and fall (September through November) and low in the summer (July and August). These differences were attributed to the variable abundance of Chironomus decorus group, Limnodrilus hoffmeisteri, and to a lesser extent Pisidium and Hexagenia. Because L. hoffmeisteri has historically been the most abundant taxa at TMINS, its 1989 densities were subjected to analysis of variance. Monthly and station densities were significantly different. The densities of _L. hoffmeisteri_ at the stations were significantly different from each other.

The community measures of number of taxa, diversity, and similarity were also examined from 1976 through 1989. Each measure showed variation among stations and years, but no consistent trends were evident to suggest any influence of TMINS.

In general, macroinvertebrate densities were within the ranges observed previously, but showed a slight decrease from 1988, due principally to decreased densities of _Limnodrilus hoffmeisteri_. Trends in macroinvertebrate densities were suggestive of natural fluctuations in environmental variables, especially river flow and water temperature, rather than TMINS operation.

Ichthyoplankton

Ichthyoplankton samples were collected weekly from April through August 1989. A total of 9,537 individuals of at least 26 taxa was taken. Six families were represented; cyprinids were the most abundant. Nine taxa comprised over 93% of the total catch; common carp and quillback were most common.

Larvae were first collected in mid-April, and were abundant from mid-May through mid-June and mid-July through August. Early season spawners were dominated by cyprinids, catostomids, and percids. Members of the clupeid, cyprinid, ictalurid, and centrarchid families dominated the summer spawn.

Peak densities at individual stations were variable and keyed to the local abundance of one or more of the nine most common taxa. Stations located upstream (13A2) and downstream (11A1) of the TMINS discharge had similar densities. Statistical analysis revealed significant difference for dates, stations, and the date-station interaction. Densities were significantly higher on 6 June and at Station 14B1. Stations near TMINS were statistically undifferentiated.

Community composition was evaluated by diversity and percent similarity indices. Diversity values ranged from 1.47 to 3.24 for the eight stations. The results were influenced by the extreme abundance of the common carp compared to the other taxa taken at a station. Percent similarity values ranged from 20.9 to 88.1%. Stations near TMINS exhibited high diversity and percent similarity values, indicating a similar community compositon.

The 1989 data were compared to data collected from 1977 through 1988. Generally, the number, density, and common species of ichthyoplankton collected in 1989 were within ranges reported previously. Analysis of variance of ichthyoplankton densities for the study period revealed significant differences among years, dates, and stations.

The fluctuations within the ichthyoplankton community were attributed to natural variation in the physical and/or environmental conditions in York Haven Pond.

Seine

Seine surveys at six shoreline stations were conducted once in April, July, October, and November and semimonthly May, June, August, and September 1989. A total of 45,980 fish of 33 species was collected. Most fish (19,616) and greatest biomass (2,974.3 g) occurred at Station 13B5, while most species (26) were taken at Station 16A1. Most fish (11,821) were captured on 18 September. Peak biomass (1,836.3 g) occurred on 21 June.

Minnows ranked first in family composition, and comprised 91.5% of the total catch. The mimic shiner comprised 59.9% of the catch and was the most abundant species. Other common species were the spotfin shiner (28.1%), bluegill (2.5%), pumpkinseed (2.1%), bluntnose minnow (1.6%), gizzard shad (1.2%), spottail shiner (1.1%), and tessellated darter (1.0%).

The length-weight measure of fish condition (K) was calculated for spotfin shiner and mimic shiner. The mean weights for each species were similar among stations. There was a general trend of increasing K factor with increasing length for each species.

Community composition among stations was compared by diversity and percent similarity indices. Diversity values ranged from 0.88 to 2.88. Diversity values at stations immediately upstream (16A1) and downstream (10A2) of the TMINS discharge were similar. Percent similarity values ranged from 20.0 to 88.3%. The similarity of community composition at stations immediately above and below the TMINS discharge was also high. Examination of both diversity and percent similarity over time (1976 through 1989) revealed no pattern which differentiated TMINS operational periods from non-operational periods.

The 1989 catch abundance was within the range observed since 1977. Patterns of annual abundance of spotfin shiner, spottail shiner, and white sucker at stations near TMINS were suggestive of natural spatial and temporal variation rather than any influence of TMINS.

Occurrence of parasites, diseases, and morphological anomalies was identified on 24 species. Black spot (fluke cysts), glochidia, pugheadedness, and skin infections were most prevalent. Patterns of parasitic infection and morphological anomalies observed in 1989 were similar to those reported previously, and reflected natural trends in parasite life cycles, water temperature, and natural conditions in York Haven Pond.

Electrofishing

Electrofishing surveys at six nearshore stations were conducted once in April, July, October, and November, and semimonthly in May, June, August, and September 1989. A total of 6,299 fish of 28 species was taken. Most fish (1,234) were taken at Station 10A3, while species ranged from 18 to 22 among the stations. No consistent pattern of temporal abundance was evident.

Sunfishes ranked first in family composition at all stations, comprising at least 75.1% of the catch. The pumpkinseed comprised 32.4% of the catch and was the most abundant species in 1989. Other common fishes were smallmouth bass (14.8%) and bluegill (12.0%).

Analysis of the spatial and temporal differences in the 1989 catch-per-minute data revealed no significant differences among seasons, yet stations were significantly different. The seasonal catch-per-minute data at the individual stations were variable and revealed only minor differences. Thus, the 1989 distribution of fish in York Haven Pond appeared unrelated to TMINS operation.

The length-weight measure of fish condition (K) was calculated for pumpkinseed, bluegill, and smallmouth bass. The monthly mean length and weight for pumpkinseed decreased from April through August, and fluctuated thereafter. The monthly mean length and weight for bluegill declined from

April through July, fluctuated in August and September, before increasing through November. The mean length and weight for smallmouth bass fluctuated throughout the study period. In general, K factors for these species were highest in May and were probably associated with the reproductive condition of the fish. The K factors of these species were similar to those reported from other water bodies. A comparison of annual K factors for pumpkinseed and smallmouth bass revealed year to year differences for each species, which were related to the natural variation in the populations of these fishes.

Community composition was compared among stations by diversity and percent similarity indices. Diversity ranged from 2.60 to 3.21. Pairwise station comparisons of percent similarity ranged from 41.0 to 82.8%. For stations upstream and downstream of the TMINS discharge, station diversity and percent similarity were generally within historic ranges.

Annual, monthly, and spatial trends in fish abundance were analyzed by ANOVA; all factors were significant. Substantial year to year variation in catch rates obscured any trend. The 1989 catch ranked second highest among all years (1976 through 1989). There was no statistical grouping of operational and non-operational years. Stations immediately above and below the TMINS discharge were undifferentiated statistically for the study period. This suggested that fish abundance was affected by natural fluctuations in fish populations and environmental factors.

A variety of parasites, diseases, and/or morphological anomalies was observed on 22 fishes in 1989. The most prevalent were skin infections, anchor worms (*Lernaea* spp.), and leeches. Patterns of parasitic infection and morphological anomalies observed in 1989 were similar to those reported previously. The low frequencies of affliction encountered on fishes in York Haven Pond reflected natural conditions.

Creel Surveys

Roving creel surveys were conducted on two weekend days and two weekdays each month, April through November 1989. A total of 2,535 anglers was interviewed. They fished for 5,751.00 hours and caught 9,607 fish of which 2,018 were harvested. The resultant catch and harvest per hour was 1.67 and 0.35 fish, respectively. The angler community was made up primarily of middle-aged York County residents who fished from boats or from shore on weekends. No angler reported a change in catch usage as a result of the 1979 TMINS accident. Most angler effort and success took place in the General Reservoir creel area. Fishes most frequently caught were smallmouth bass, rock bass, sunfishes (*Lepomis* spp.), and channel catfish.

Analysis of variance revealed that fishing pressure and success varied among creel survey areas in 1989, but months were not significant in terms of number of anglers, fish caught, fish kept, and hours fished. The General Reservoir supported the highest number of anglers, fish caught, and hours fished. Harvest was slightly higher at the York Haven Generating Station, but was statistically undifferentiated from the General Reservoir and East Dam areas.

Creel data from 1975 through 1989 were examined to identify any trends in the York Haven Pond sport fishery. The number of anglers interviewed in 1989, their hours fished, and the fish caught and harvested were among the highest for the study period. Analysis of variance of the multiple-year data set identified the General Reservoir and York Haven Generating Station creel areas as supporting higher levels for all measures of effort and success than the East and West Dam areas. Yearly ranking for number of anglers, fish caught and kept, and hours fished placed 1989 second highest for all variables.

Channel catfish, rock bass, smallmouth bass, and walleye have been the most abundant fishes caught and harvested over the study period. Relative to other years, 1989 produced slight decreases in percent catch of channel catfish and walleye, and a slight increase for rock bass and smallmouth bass. The percent of harvest for rock bass and smallmouth bass increased slightly, while channel catfish and walleye harvest decreased.

Water Quality

Selected water quality parameters were measured at specific locations throughout York Haven Pond in 1989. Values determined for water temperature, pH, dissolved oxygen (DO), and total dissolved solids (TDS) were compared to specific water quality criteria established by the Pennsylvania Department of Environmental Resources for the Susquehanna River. Only pH exceeded the specified criteria, but no adverse effects were observed that were related to the operational status of TMINS.

The water quality data collected in 1989 was largely influenced by the high river flow, but some typical seasonal patterns were evident for a number of parameters. Generally, mean values for water temperature, surface and bottom velocities, and river flow tended to be higher in the spring or summer than in the fall. The TDS, pH, and conductivity readings were lower in the spring or summer and higher in the fall. DO was inversely related to water temperature. Seasonal and spatial differences in water temperature, pH, DO, and TDS were analyzed. All parameters exhibited significant differences among months. Only pH and

TDS produced significant differences among sampling zones, but they were considered biologically insignificant.

Water quality and physical characteristics measured at the stations along the west shore of TMI appeared quite homogeneous. Mean river flow in 1989 was the highest to date. Water temperature, pH, DO, and TDS data for the macroinvertebrate stations were examined for 1974 through 1989. Although some year to year differences were evident, the 1989 data generally fell within the ranges observed previously.

Individual measurements of water temperature, pH, DO, and TDS were analyzed to evaluate annual differences (1974 through 1989). Years and months differed significantly for all parameters. Sampling station differences were significant only for TDS. Statistically significant year-group differences were unrelated to years of TMINS operation or non-operation.

Based on analysis of 16 years of data for water temperature, pH, and DO, and 12 years for TDS, there is no evidence of significant influence of the TMINS discharge on these parameters. Annual and spatial trends appear to be natural and related to meteorological and/or hydrological cycles.

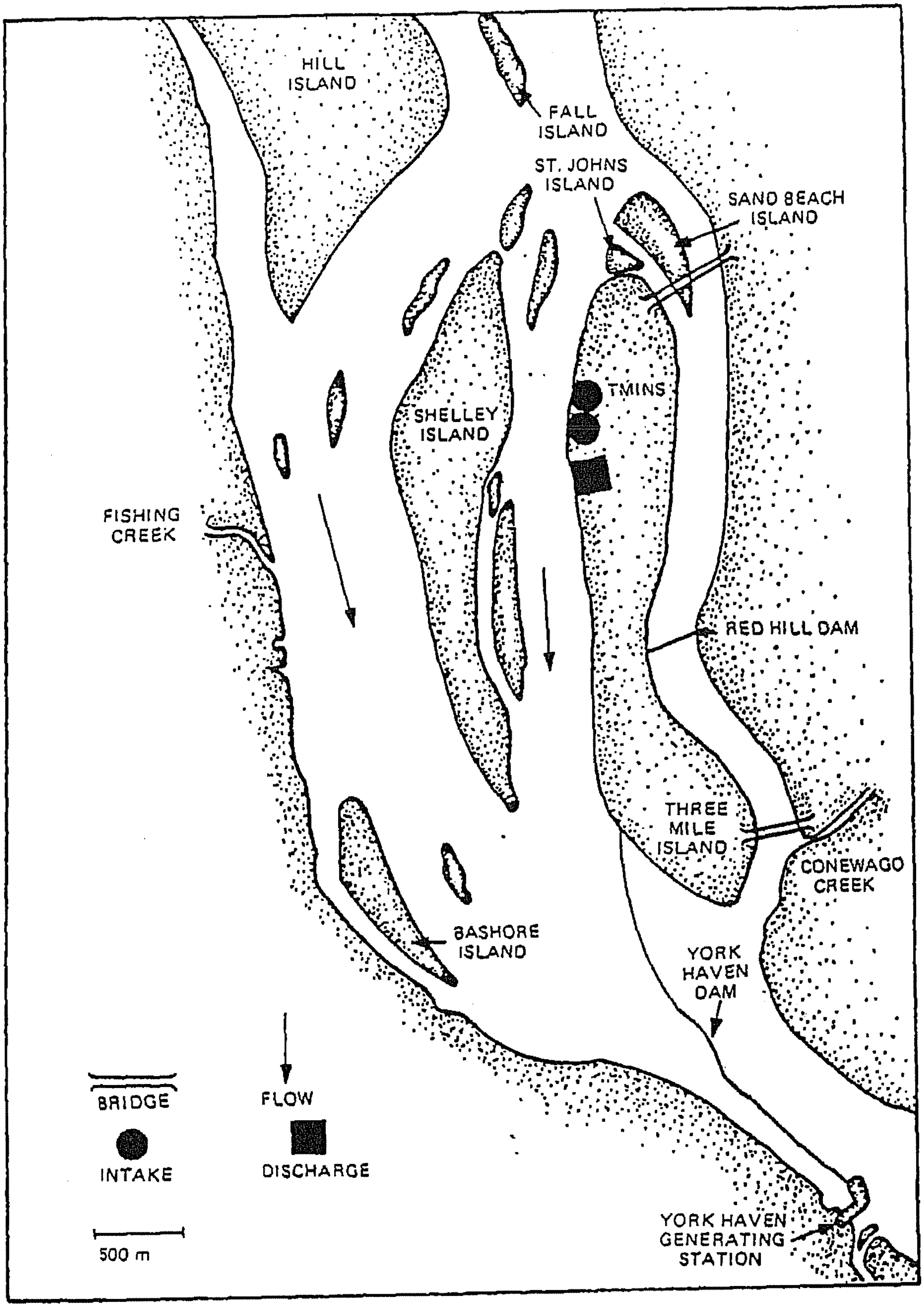

Figure 1-1. Map of Three Mile Island Nuclear Station aquatic study area.

2. BENTHIC MACROINVERTEBRATES

2.1 METHODS

Benthic macroinvertebrate samples were collected at three nearshore stations in the Susquehanna River near Three Mile Island Nuclear Station (TMINS) (Figure 2-1). Specific locations and habitat characteristics are described in Table 2-1. Samples were collected monthly at each station, April through November 1989. Benthic macroinvertebrate field and laboratory methods followed GPU (1987).

Four replicate samples were collected at each station on each sampling date with a standard Ponar grab sampler (529 cm^2). Samples were washed through a U. S. Standard No. 30 sieve in the field to remove excess mud, placed in one or more sample containers, and preserved in a mixture of 70 to 80% isopropanol and rose bengal stain. The stain facilitated sorting of macroinvertebrates from the detritus and sediment present in the sample. Samples were labeled, data sheets completed, and water quality measurements taken in accordance with GPU (1987).

In the laboratory, stained samples were washed through a U. S. Standard No. 30 sieve to remove excess dye and isopropanol. A portion of the sample was placed into a white enamel pan and all macroinvertebrates removed; this procedure was repeated until all macroinvertebrates had been removed from the entire sample. Organisms were placed in vials with 70 to 80% isopropanol according to taxonomic group (i.e., Mollusca, Oligochaeta, Chironomidae). Specimens damaged beyond identification were not enumerated. Every tenth oligochaete was placed into a separate vial for species identification. After completing a sample, the remaining detritus was preserved in 70 to 80% isopropanol and retained for quality control purposes.

All specimens from each sample were enumerated and identified to the lowest possible taxon using taxonomic keys, reference collections, and pertinent literature, with the exception of the chironomid and oligochaete groups. Only portions of these two groups were used for identification in order to retain a sufficient number of organisms for biomass estimates (mg/m^2). The subsampling protocol for chironomids and oligochaetes is discussed in GPU (1987). The oligochaetes and chironomids used in weight determinations were not identified directly. Identifications were inferred from the subsamples mounted for species determinations. After the molluscs were identified, they were placed in a 7 M solution of HCl to dissolve the calcareous shells, and rinsed in water. This was necessary to permit biomass comparisons with the other taxonomic groups collected. Once identified, organisms were dried at 55 C for 24 hours to determine weight.

Macroinvertebrate counts were converted to density ($number/m^2$) for all analyses. All weights are presented as biomass (mg/m^2). Temporal and spatial comparisons were made using analysis of variance (ANOVA) and indices of diversity and percent similarity. Diversity values were computed using the Shannon-Wiener diversity index (H'). This index is expressed as:

$$H' = -\sum_{i=1}^{s} \left(\frac{n_i}{N}\right) \log_2 \left(\frac{n_i}{N}\right)$$

where

H' = information per individual,

n_i = total number of individuals in i^{th} species, and

N = total number of individuals.

This index takes both total abundance and number of taxa into account when arriving at an estimate of diversity (Brower and Zar 1977).

Since diversity is primarily concerned with the distribution of organisms among the taxa collected, two communities made up of completely different species assemblages may have identical diversity values. Therefore, it is desirable to estimate community similarity in conjunction with the diversity estimation. Similarity in community composition among stations was investigated by an index of percent similarity, which is expressed as:

$$PSc = 100 - 0.5 \sum |A-B|$$

where

PSc = the percent similarity and

|A-B| = absolute value of the difference between the percentage of a species in samples A and B.

This is a quantitative measure of the relative similarity of the community composition and species abundance between two samples being compared (Whittaker and Fairbanks 1958). Values of this index range from 0 (no similarity) to 100 (identical communities).

Analysis of variance (ANOVA) was used to determine whether any observed variations in Limnodrilus hoffmeisteri densities among dates, stations, or replicates were significant in 1989. ANOVAs were performed on logarithmic transformed densities $|\log_e(\text{density}+1)|$ as was done in previous years (EA 1985, 1986, 1987; RMC 1988a, 1989). If ANOVA indicated significant differences, Tukey's studentized range test was used to determine which data group(s) differed significantly. The ANOVAs were conducted using SAS software, Version 6 (SAS Institute, Inc., Cary, NC).

2.2 TEMPORAL AND SPATIAL DISTRIBUTION: 1989

Results of 1989 macroinvertebrate collections are presented in Appendix A. A total of 30,588 specimens of 101 taxa was taken in 96 collections (Table 2-2). A chironomid, Chironomus decorus group (11,845 specimens, 38.7%) and an oligochaete, Limnodrilus hoffmeisteri (9,539, 31.2%), together comprised 69.9% of the total macroinvertebrate abundance. Five other taxa: Pisidium (1,721, 5.6%), Hexagenia (1,252, 4.1%), Procladius (1,092, 3.6%), Gammarus fasciatus (685, 2.2%), and Cryptochironomus fulvus group (619, 2.0%) comprised an additional 17.5% of the benthic abundance. The remaining 94 taxa accounted for less than 13% of the total abundance; 64 taxa contributed less than 10 specimens each.

Following collection of an Asiatic clam, Corbicula fluminea, by seine in 1984, special effort was made to look for this species during routine collections for all study disciplines. During the 1989 benthic and fisheries surveys, a total of 356 C. fluminea was collected (Table 2-3). The benthic surveys accounted for 195 specimens, and represented the first collection of C. fluminea since the inception of the program. Standard shell lengths ranged from 1.0 to 19.3 mm. Over 96% were juveniles ($\leq$10.0 mm), while the others were considered adults about one to two years old. Age structure followed RMC (1988b). Most (92.4%) were taken at fisheries seine Station 13B5 (along the west shore of York Haven Pond) and macroinvertebrate Station 1A2 (upstream of the TMINS discharge). However, additional specimens were taken at six other locations throughout York Haven Pond.

2.2.1 Spatial Distribution

During 1989, 69 taxa were collected at Station 1A2 and 61 and 53 were collected at 11A1 and 9B1, respectively (Table 2-4). Total station density was variable ranging from 3,918 organisms/m^2 at Station 1A2 to 7,849/m^2 at Station 9B1 (Table 2-5). The midge, Chironomus decorus group and the oligochaete, Limnodrilus hoffmeisteri were numerically dominant at all stations (Table 2-6). These two taxa accounted for over 65% of the total benthic abundance at Stations 1A2 and 11A1, and 75.3% at 9B1. C. decorus group density was greatest at Stations 9B1 (2,635/m^2) and 11A1 (2,462/m^2); the overall density at 1A2 was slightly less (1,900/m^2). L. hoffmeisteri was second in total benthic abundance; density was highest at Station 9B1 (3,270/m^2). The mollusc, Pisidium, was the third most abundant taxa at Station 11A1 (532/m^2), and was common at Stations 9B1 (286/m^2) and 1A2 (199/m^2). The mayfly, Hexagenia, was the third most abundant taxa at Stations 9B1 (298/m^2) and 1A2 (228/m^2). The midge, Procladius, was most abundant at Station 11A1 (302/m^2), and was also numerous at Station 9B1 (239/m^2). The amphipod, Gammarus fasciatus, was abundant at Stations 11A1 (179/m^2) and 9B1 (162/m^2). The midge, Cryptochironomus fulvus group was abundant at Stations 9B1

(162/m^2) and 11A1 (151/m^2), but occurred less frequently at Station 1A2 (53/m^2).

Biomass trends for the three stations were similar to those observed for density (Table 2-7). The total biomass was highest at Station 9B1 (1,796.8 mg/m^2), intermediate at Station 11A1 (1,624.4 mg/m^2), and lowest at Station 1A2 (1,379.0 mg/m^2). Three taxa (Chironomus decorus group, Limnodrilus hoffmeisteri, and Hexagenia) made up 82.8% of the biomass at Station 1A2, 76.4% at Station 11A1, and 86.8% at Station 9B1. The midge, C. decorus group, the most dominant taxon in terms of annual density was also the dominant taxon in terms of biomass (580.0 mg/m^2) (Table 2-8). It was also the dominant taxon at each station, comprising from 33.6 to 40.3% of the individual station biomass. The numerically abundant taxon, L. hoffmeisteri (273.2 mg/m^2) and the mayfly, Hexagenia (460.6 mg/m^2) also made up a large portion of the annual biomass. L. hoffmeisteri comprised a large portion of the biomass at Stations 9B1 and 11A1; it ranked second at Station 9B1 (473.7 mg/m^2), and third at Station 11A1 (264.5 mg/m^2). Hexagenia composed a large portion of the biomass at all stations, and ranked second at Staions 1A2 and 11A1. Among stations, biomass at Station 9B1 supported the most even distribution of these three taxa.

2.2.2 Temporal Distribution

Numbers of macroinvertebrate taxa collected at each station varied with sampling date, but were generally highest in the fall. Monthly, the number of taxa collected ranged from 34 in July to 52 in November. Variation in number of taxa was least at Station 11A1, ranging from 24 (August) to 32 (May), and greatest at Stations 1A2 and 9B1 (range 16 to 40). However, the number of taxa collected from August through November were similar at Stations 11A1 and 9B1 (Table 2-4).

Monthly densities in 1989 increased from April to a peak in June, declined in July, and increased to a secondary peak in September (Table 2-5). Generally, individual station densities followed similar trends, peaking in June, then decreasing only to increase to a secondary peak in September (1A2 and 11A1) or November (9B1). These peaks were largely attributable to increased densities of Chironomus decorus group and Limnodrilus hoffmeisteri, and to a lesser extent, Pisidium and Hexgenia (Table 2-9). L. hoffmeisteri densities showed two peaks of abundance: in September at Stations 1A2 and 11A1 and May at 9B1. Differences in periods of peak abundance may indicate that the L. hoffmeisteri breeding cycles were not synchronous among the stations. C. decorus group were more limited in their abundance, as most (64.0%) were collected in June.

Populations of *C. decorus* group peaked in June at all stations.

Monthly biomass values increased from April to a minor peak in June, declined through August, and peaked in November (Table 2-7). Individual station biomass values followed similar trends. High biomass values in June were primarily due to *Chironomus decorus* group, which comprised nearly 67% of the monthly biomass (Table 2-10). The elevated biomass in November resulted mostly from *C. decorus* group and *Hexagenia* nymphs, which accounted for 80.9% of the monthly biomass. Biomass trends for *C. decorus* group were similar to density trends; peak biomass occurred in June and November, and represented 63.6% of its annual biomass. *L. hoffmeisteri* biomass values generally followed density trends; high in the spring (May at Stations 1A2 and 11A1 or June at 9B1), low during the summer (July and August), and increasing in the fall (September at Stations 11A1 and 9B1 or November at 1A2). The slight difference between density and biomass peaks at the stations indicated the presence of smaller individuals. Biomass trends for *Hexagenia* were similar to those for density at Station 9B1. However, biomass at Stations 1A2 and 11A1 was low during peak abundance in September, indicating that these, too, were smaller individuals.

A three-factor ANOVA was performed on log-transformed densities of *Limnodrilus hoffmeisteri*, to assess trends with respect to sampling month and station (Table 2-11). *L. hoffmeisteri* was selected because of its historical abundance at all stations. The ANOVA indicated significant differences among stations and months. Tukey's studentized range test was used to determine which stations and months were significantly different (Table 2-12). Comparison of the monthly means showed June to rank lowest and September highest; they were significantly different from each other. However, mean densities for all other months were similar. The Tukey's studentized range test for station differences indicated that densities of *L. hoffmeisteri* were significantly different from each other. Interaction of station and month differences was also significant. Thus, densities for the three stations did not exhibit the same trends from one sample month to another, which weakens any meaningful interpretation of these differences.

2.3 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

Diversity of benthic macroinvertebrates in 1989 was calculated with the Shannon-Wiener Index (H'). Annual station values were very similar at Stations 1A2 (2.95) and 11A1 (2.91) (Table 2-13). Monthly station H' values were variable and ranged from 0.97 in June at 1A2 to 3.35 in November at 11A1. Overall, diversity was low in the spring and summer and high in the fall (September through November). This generally reflected the evenness component (distribution of individuals within taxa) rather than richness (number of taxa). Lower diversity values were usually associated with the numerical dominance of a particular taxon. The low diversity value observed in June was attributed to a substantial increase in the abundance of Chironomus decorus group at all stations, especially 1A2 where it comprised over 86% of the organisms (21 taxa). Higher H' values in the fall were the result of a more even distribution of individuals amont the taxa.

Such variability in diversity probably reflect a relatively low habitat complexity (Poole 1974). The primarily silt and clay substrate at all three stations limits community composition to predominantly infaunal species. A more varied substrate composition, including greater amounts of other substrate components (i.e., cobble, gravel, coarse detritus) may provide a more diverse habitat and increase available niches for a greater number of taxa.

Substantial seasonal variability in community composition characterized the 1989 benthic macroinvertebrate collections. Monthly percent similarity indices (PSc) among station pairs varied from 44.1% between Stations 1A2 and 9B1 in April, to 90.3% between Stations 11A1 and 9B1 in June (Table 2-14). The low PSc between Stations 1A2 and 9B1 in April was due to the high proportion of Limnodrilus hoffmeisteri at Station 9B1 relative to its proportion at 1A2. Pair-wise station comparisons for 1989 indicate that the stations downstream of the TMINS discharge (11A1 and 9B1) has a higher percent similarity (81.8%) than the other station pairs. Benthic communities at Stations 1A2 and 9B1 were least similar to each other (70.0%). The differences among PSc values in 1989 were probably attributed to microhabitat differences among stations.

2.4 MULTIPLE-YEAR COMPARISON

To determine differences between the 1989 benthic community data and data collected previously (1976 through 1988), comparisons were made of the number of taxa, diversity and percent similarity indices, total macroinvertebrate density, and density of key taxa.

Total number of macroinvertebrate taxa collected at each station over the 14-year period has been highly variable, especially at Station 1A2 (Figure 2-2). Number of taxa in 1989 was within the range observed previously at all stations. Compared to 1988, the number of taxa in 1989 was higher at each station. Number of taxa collected in 1989 was generally comparable to that collected from 1984 through 1988, which was a period of reduced taxa at all stations. The 1989 spatial trends in number of taxa differed from those of 1984 to 1986, with Station 1A2 having the greatest number of taxa, followed by Stations 11A1 and 9B1. In previous years (1984 to 1986), Station 11A1 yielded the greatest number of taxa; Station 1A2 was greatest in 1976 through 1983 and 1988; and Station 9B1 was greatest in 1987.

Comparison of 1989 Shannon-Wiener diversity values (H') with those for 1976 through 1988 indicated that the 1989 values were among the highest observed in the 14-year period (Figure 2-3). In fact, the H' values at Stations 11A1 and 9B1 were the highest to date. The H' values have steadily increased since 1984 at Station 11A1. Diversity at Station 1A2 declined slightly in 1989 but was still within the range observed previously. The 1989 values were most similar to the higher values recorded prior to 1984. Diversity relationships among stations for 1989 were similar to those observed for operational years (1976 to 1978). Diversity at Station 1A2 was higher during the operational years, 1976 through 1978 and 1988, than those years following the TMINS shutdown (1979), when diversity at Stations 11A1 and 9B1 was comparable to Station 1A2.

The PSc values for 1976 through 1989 ranged from 57 to 95% (Table 2-15). Percent similarity for the three station pairs was usually greater than 75%, indicating a high degree of similarity among station communities. The 14-year PSc data, for each station pair, indicated that similarity between each of the station pairs was comparable. The two downstream stations, 11A1 and 9B1, exhibited the greatest similarity (83 percent), while the least similarity (78 percent) occurred between the upstream control station (1A2) and the station located 1,975 m downstream of TMINS (9B1). In 1989, percent similarity between all station pairs increased from the values reported in 1988, and were within the ranges reported prior to 1988. The differences that existed were attributable to minor shifts in current velocity and substrate composition. Generally, the same type of benthic community existed at all three stations.

Total macroinvertebrate density (number/m^2) at all stations was highly variable over the years, suggesting the effect of variable environmental conditions (Figure 2-4). Past reports have cited fluctuating river flow (resulting from flood or drought), water temperature trends, substrate differences, and insect life cycles as some of the sources for the long-term fluctuations observed at the TMINS stations. Generally, overall densities decreased from the period of plant operation (1976 to 1978) to the period following TMINS shutdown at all stations. Total benthic density in 1989 decreased over that reported in 1988, especially at Station 11A1. This was primarily due to a large decrease in Limnodrilus hoffmeisteri abundance. The decrease in density likely resulted from the higher river flow (noted in Chapter 7) in 1989 which increased scouring of the bottom sediment transporting organisms downstream. Spatial density trends for 1989 showed a pattern reminiscent of that observed during non-operational years. Prior to the TMINS shutdown in 1979, densities were greatest at Station

11A1; after shutdown, Stations 1A2 or 9B1 had the greatest benthic abundance.

Limnodrilus hoffmeisteri has consistently been the dominant benthic macroinvertebrate in the TMINS collections, comprising 47 to 84% of the total abundance from 1976 through 1988. Density of L. hoffmeisteri in 1989 ranked second and comprised 31.2% of the total abundance. Generally, L. hoffmeisteri densities were high during the period 1976 through 1980, and much reduced from 1981 through 1984 (Figure 2-5). Since 1985, L. hoffmeisteri densities have been variable. In 1989 densities declined to a level comparable to that collected during 1981 to 1984. Density at Station 1A2 (upstream of the TMINS discharge) in 1989 was the lowest to date and represented an 82.9% decrease from that reported in 1988. Densities at Stations 11A1 and 9B1, although reduced substantially from 1988 levels, were within the range of previous years.

The decrease in L. hoffmeisteri density in 1989 suggested a natural depression in the population. Low densities of L. hoffmeisteri may be due to scouring of the bottom sediment from the high river flow and/or to deposition of recently transported silt and mud. Some increase in L. hoffmeisteri density occurred from August through October when river flow decreased. Cooler water temperatures in the spring and summer may have also affected the population decrease. Thus, this taxon was likely responding to natural environmental conditions.

The midge, Chironomus decorus group, second in annual abundance prior to 1989, was the most abundant taxa accounting for 38.7% of the total density. Annual station densities of C. decorus group have varied by an order of magnitude over the study period (Figure 2-6). No consistent pattern among stations was evident. In 1989, C. decorus group densities increased sharply at all stations. In fact, densities at Stations 11A1 and 9B1 were the highest recorded to date, while density at 1A2 was the highest since 1986.

None of the station abundance data for the benthic macroinvertebrate taxa appear to have been influenced by TMINS. Fluctuations in environmental variables, especially river flow and water temperature, seem to exert the predominant influence on the benthic communities in York Haven Pond.

TABLE 2-1.

Location and description of benthic macroinvertebrate stations sampled in the Susquehanna River near Three Mile Island Nuclear Station.

Station Number	Location and Description
TM-MI-1A2*	Southwest St. Johns Island at mouth of channel between Three Mile Island and St. Johns Island, 1 to 15 m offshore. Water depth varied from 0.3 to 3.5 m. Substrate sometimes stratified ranging from silt and clay to gravel. In the absence of stratification, most substrate composed of silt, clay, fine sands, and organic detritus.
TM-MI-11A1	West shore of Three Mile Island, 10 to 25 m downstream from discharge, 1 to 15 m offshore. Water depth ranged from 0.25 to 2.0 m. Substrate composed of silt, clay, fine sands, gravel, and organic detritus.
TM-MI-9B1	West shore of Three Mile Island, 1975 m downstream from discharge, 1 to 15 m offshore. Water depth varied from 0.5 to 2.25 m. Substrate composed of silt, clay, fine sands, and organic detritus.

* Prefix TM-MI- deleted from station number for discussion in text.

TABLE 2-2 NUMBER AND PERCENT ABUNDANCE OF MACROINVERTEBRATES COLLECTED FROM STATIONS NEAR TMINS, APRIL THROUGH NOVEMBER 1989.

TAXA	NUMBER	PERCENT	CUMULATIVE TOTAL	CUMULATIVE PERCENT
Chironomus decorus	11845	38.7	11845	38.7
Limnodrilus hoffmeisteri	9539	31.2	21384	69.9
Pisidium	1721	5.6	23105	75.5
Hexagenia	1252	4.1	24357	79.6
Procladius	1092	3.6	25449	83.2
Gammarus fasciatus	685	2.2	26134	85.4
Cryptochironomus fulvus	619	2.0	26753	87.5
Arcteonais lomondi	367	1.2	27120	88.7
Musculium transversum	345	1.1	27465	89.8
Phaenopsectra	302	1.0	27767	90.8
Bothrioneurum vejdovskyanum	289	0.9	28056	91.7
Hydrolimax grisea	268	0.9	28324	92.6
Tanytarsus	235	0.8	28559	93.4
Corbicula fluminea	195	0.6	28754	94.0
Coelotanypus	167	0.5	28921	94.6
Chironomid pupae	161	0.5	29082	95.1
Helobdella elongata	161	0.5	29243	95.6
Limnodrilus claparedianus	153	0.5	29396	96.1
Ceratopogonidae	150	0.5	29546	96.6
Ablabesmyia	140	0.5	29686	97.1
Ilyodrilus templetoni	134	0.4	29820	97.5
Nematoda	117	0.4	29937	97.9
Polypedilum scalaenum	96	0.3	30033	98.2
Limnodrilus udekemianus	66	0.2	30099	98.4
Dubiraphia	47	0.2	30146	98.6
Manayunkia speciosa	45	0.1	30191	98.7
Branchiura sowerbyi	42	0.1	30233	98.8
Stenelmis	32	0.1	30265	98.9
Helobdella stagnalis	25	0.1	30290	99.0
Musculium	23	0.1	30313	99.1
Tubificidae	16	0.1	30329	99.2
Quistadrilus multisetosus	15	0.0	30344	99.2
Rheotanytarsus	13	0.0	30357	99.2
Pristina synclites	13	0.0	30370	99.3
Caenis	11	0.0	30381	99.3
Cricotopus	11	0.0	30392	99.4
Aulodrilus pluriseta	11	0.0	30403	99.4
Prodiamesa	10	0.0	30413	99.4
Dugesia tigrina	8	0.0	30421	99.5
Erpobdellidae	8	0.0	30429	99.5
Sialis	7	0.0	30436	99.5
Oecetis	7	0.0	30443	99.5
Ferrissia	7	0.0	30450	99.5
Stylurus	7	0.0	30457	99.6
Cryptotendipes	6	0.0	30463	99.6
Epoicocladius	6	0.0	30469	99.6
Lumbriculidae	6	0.0	30475	99.6
Thienemanimyia	6	0.0	30481	99.7
Harnischia	5	0.0	30486	99.7
Prostoma	5	0.0	30491	99.7
Polypedium illinoense	5	0.0	30496	99.7
Nais	5	0.0	30501	99.7
Tendipedidae=chironomidae	4	0.0	30505	99.7

TABLE 2-2 CONTINUED.

TAXA	NUMBER	PERCENT	CUMULATIVE TOTAL	CUMULATIVE PERCENT
Glyptotendipes	4	0.0	30509	99.7
Polypedilum fallax	4	0.0	30513	99.8
Demicryptochironomus	4	0.0	30517	99.8
Brachycerus	4	0.0	30521	99.8
Polypedilum convitum	4	0.0	30525	99.8
Hydropsyche	3	0.0	30528	99.8
Optioservus	3	0.0	30531	99.8
Actinobdella inequiannulata	3	0.0	30534	99.8
Nematomorpha	3	0.0	30537	99.8
Physa	2	0.0	30539	99.8
Cheumatopsyche	2	0.0	30541	99.8
Microchironomus	2	0.0	30543	99.9
Physidae	2	0.0	30545	99.9
Tricorythidae	2	0.0	30547	99.9
Macrumia sp	2	0.0	30549	99.9
Zavrelia group	2	0.0	30551	99.9
Centroptilum	2	0.0	30553	99.9
Nanocladius	2	0.0	30555	99.9
Labrundinia	2	0.0	30557	99.9
Amnicola	2	0.0	30559	99.9
Elimia virginica	2	0.0	30561	99.9
Dugesia	1	0.0	30562	99.9
Hirudinea	1	0.0	30563	99.9
Neureclipsis	1	0.0	30564	99.9
Leptoceridae	1	0.0	30565	99.9
Anodonta cataracta	1	0.0	30566	99.9
Tricorythodes	1	0.0	30567	99.9
Stenonema	1	0.0	30568	99.9
Gomphidae	1	0.0	30569	99.9
Tipulidae	1	0.0	30570	99.9
Potamia	1	0.0	30571	99.9
Chaoborus	1	0.0	30572	99.9
Potamanthus	1	0.0	30573	100
Polycentropus sp	1	0.0	30574	100
Petrophila	1	0.0	30575	100
Protoptila	1	0.0	30576	100
Enchytraeidae	1	0.0	30577	100
Cecidomyiidae	1	0.0	30578	100
Hydrobaenus	1	0.0	30579	100
Promoresia	1	0.0	30580	100
Paratanytarsus	1	0.0	30581	100
Leptophlebiidae	1	0.0	30582	100
Dromogomphus	1	0.0	30583	100
Hemerodromia	1	0.0	30584	100
Lepidostoma	1	0.0	30585	100
Dolichopodidae	1	0.0	30586	100
Zavrelimyia	1	0.0	30587	100
Chrysops	1	0.0	30588	100

TABLE 2-3

Shell length frequency (5 mm groups) and relative age (years) of *Corbicula fluminea* collected by seine and Ponar grab near TMINS, May through November 1989.

Length (mm)	Seine*					Benthos+			Total	Age (years)
	13B5	10B5	16A1	10A2	9B3	1A2	11A1	9B1		
0-5.0	91	1	1	1	1	183	2	1	281	<0.5
5.1-10.0	39	-	7	3	5	7	-	-	61	0.5-1.0
10.1-15.0	3	-	-	2	3	2	-	-	10	1.1-1.5
15.1-20.0	4	-	-	-	-	-	-	-	4	1.6-2.0
Total	137	1	8	6	9	192	2	1	356	

* Station prefix TM-SE- deleted from table.
\+ Station prefix TM-MI- deleted from table.

TABLE 2-4

Number of macroinvertebrate taxa collected each month at stations near TMINS, April through November 1989.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
TM-MI-1A2	22	22	21	17	23	38	21	40	69
TM-MI-11A1	27	32	29	25	24	27	25	27	61
TM-MI-9B1	18	16	26	16	25	26	26	27	53
Total	39	37	39	34	37	46	39	52	101

TABLE 2-5

Monthly density (number/m^2) of benthic macroinvertebrates collected at the sampling stations near TMINS, April through November 1989.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
TM-MI-1A2	813	1692	8001	1262	2060	7538	3596	6385	3918
TM-MI-11A1	3043	3818	14910	4532	2486	8672	6144	6810	6302
TM-MI-9B1	5619	5884	23748	2297	5548	6446	6526	6725	7849
Total Mean	3158	3798	15553	2697	3365	7552	5422	6640	6023

TABLE 2-6 DENSITY (NUMBER/m2) AND PERCENT COMPOSITION OF MACROINVERTEBRATES COLLECTED AT EACH STATION NEAR TMINS, APRIL THROUGH NOVEMBER, 1989.

Species	1A2		11A1		9B1	
	Density	Percent	Density	Percent	Density	Percent
Ablabesmyia	12	0.3	52	0.8	18	0.2
Actinobdella inequiannulata	1	0.0	1	0.0	.	.
Amnicola	.	.	1	0.0	.	.
Anodonta cataracta	.	.	.	.	1	0.0
Arcteonais lomondi	12	0.3	81	1.3	124	1.6
Aulodrilus pluriseta	5	0.1	1	0.0	.	.
Bothrioneurum vejdovskyanum	61	1.6	30	0.5	80	1.0
Brachycerus	.	.	1	0.0	1	0.0
Branchiura sowerbyi	24	0.6	1	0.0	.	.
Caenis	6	0.2	1	0.0	.	.
Cecidomyiidae	.	.	.	.	1	0.0
Centroptilum	.	.	.	.	1	0.0
Ceratopogonidae	26	0.7	30	0.5	32	0.4
Chaoborus	.	.	.	.	1	0.0
Cheumatopsyche	.	.	1	0.0	.	.
Chironomid pupae	26	0.7	34	0.5	35	0.5
Chironomus decorus	1900	48.5	2462	39.1	2635	33.6
Chrysops	1	0.0	.	.	.	.
Coelotanypus	7	0.2	19	0.3	73	0.9
Corbicula fluminea	113	2.9	1	0.0	1	0.0
Cricotopus	.	.	6	0.1	1	0.0
Cryptochironomus fulvus	53	1.3	151	2.4	162	2.1
Cryptotendipes	.	.	4	0.1	.	.
Demicryptochironomus	.	.	1	0.0	1	0.0
Dolichopodidae	1	0.0	.	.	.	.
Dromogomphus	1	0.0	.	.	.	.
Dubiraphia	18	0.5	6	0.1	3	0.0
Dugesia	.	.	1	0.0	.	.
Dugesia tigrina	2	0.1	2	0.0	.	.
Elimia virginica	.	.	1	0.0	.	.
Enchytraeidae	1	0.0	.	.	.	.
Epoicocladius	.	.	.	.	4	0.0
Erpobdellidae	.	.	5	0.1	.	.
Ferrissia	4	0.1	1	0.0	.	.
Gammarus fasciatus	64	1.6	179	2.8	162	2.1
Glyptotendipes	.	.	.	.	2	0.0
Gomphidae	.	.	.	.	1	0.0
Harnischia	1	0.0	1	0.0	1	0.0
Helobdella elongata	24	0.6	44	0.7	27	0.3
Helobdella stagnalis	.	.	15	0.2	.	.
Hemerodromia	.	.	.	.	1	0.0
Hexagenia	228	5.8	214	3.4	298	3.8
Hirudinea	.	.	1	0.0	.	.
Hydrobaenus	1	0.0	.	.	.	.
Hydrolimax grisea	6	0.2	71	1.1	81	1.0
Hydropsyche	1	0.0	.	.	1	0.0
Ilyodrilus templetoni	22	0.6	21	0.3	35	0.5
Labrundinia	1	0.0	.	.	.	.
Lepidostoma	1	0.0	.	.	.	.
Leptoceridae	.	.	1	0.0	.	.
Leptophlebiidae	1	0.0	.	.	.	.
Limnodrilus claparedianus	18	0.5	17	0.3	56	0.7
Limnodrilus hoffmeisteri	686	17.5	1679	26.6	3270	41.7

TABLE 2-6 CONTINUED.

Species	1A2 Density	1A2 Percent	11A1 Density	11A1 Percent	9B1 Density	9B1 Percent
Limnodrilus udekemianus	19	0.5	.	.	19	0.2
Lumbriculidae	2	0.0	.	.	2	0.0
Macrumia sp	1	0.0	.	.	.	.
Manayunkia speciosa	.	.	26	0.4	1	0.0
Microchironomus	.	.	.	.	1	0.0
Musculium	1	0.0	12	0.2	.	.
Musculium transversum	24	0.6	76	1.2	103	1.3
Nais	1	0.0	2	0.0	.	.
Nanocladius	1	0.0	.	.	.	.
Nematoda	24	0.6	39	0.6	6	0.1
Nematomorpha	.	.	1	0.0	1	0.0
Neureclipsis	.	.	1	0.0	.	.
Oecetis	1	0.0	1	0.0	2	0.0
Optioservus	.	.	.	.	2	0.0
Paratanytarsus	.	.	.	.	1	0.0
Petrophila	1	0.0	.	.	.	.
Phaenopsectra	61	1.6	105	1.7	12	0.2
Physa	1	0.0	1	0.0	.	.
Physidae	1	0.0	1	0.0	.	.
Pisidium	199	5.1	532	8.4	286	3.6
Polycentropus sp	.	.	.	.	1	0.0
Polypedilum convitum	2	0.1	.	.	.	.
Polypedilum fallax	2	0.1	.	.	.	.
Polypedilum scalaenum	32	0.8	11	0.2	13	0.2
Polypedium illinoense	1	0.0	2	0.0	.	.
Potamanthus	.	.	1	0.0	.	.
Potamia	.	.	1	0.0	.	.
Pristina synclites	8	0.2	.	.	.	.
Procladius	104	2.7	302	4.8	239	3.0
Prodiamesa	6	0.2	.	.	.	.
Promoresia	.	.	.	.	1	0.0
Prostoma	2	0.1	1	0.0	.	.
Protoptila	1	0.0	.	.	.	.
Quistadrilus multisetosus	1	0.0	7	0.1	1	0.0
Rheotanytarsus	4	0.1	3	0.0	1	0.0
Sialis	1	0.0	.	.	4	0.0
Stenelmis	12	0.3	6	0.1	1	0.0
Stenonema	1	0.0	.	.	.	.
Stylurus	2	0.1	2	0.0	.	.
Tanytarsus	69	1.7	34	0.5	37	0.5
Tendipedidae=chironomidae	1	0.0	1	0.0	.	.
Thienemanimyia	2	0.1	1	0.0	.	.
Tipulidae	.	.	.	.	1	0.0
Tricorythidae	1	0.0	.	.	.	.
Tricorythodes	1	0.0	.	.	.	.
Tubificidae	.	.	.	.	9	0.1
Zavrelia group	1	0.0	.	.	.	.
Zavrelimyia	1	0.0	.	.	.	.

TABLE 2-7

Monthly biomass (mg/m^2) of benthic macroinvertebrates collected at the sampling stations near TMINS, April though November 1989.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
TM-MI-1A2	174.8	545.8	820.9	259.0	347.8	2066.2	1687.6	5130.0	1379.0
TM-MI-11A1	914.9	1200.8	2653.1	1145.6	369.6	1772.2	1668.7	3270.3	1624.4
TM-MI-9B1	1263.7	1310.5	4958.8	509.0	506.1	1176.3	1473.1	3150.3	1796.8
Total Mean	784.5	1019.1	2819.9	637.8	407.8	1671.6	1609.8	3850.2	1600.1

TABLE 2-8 BIOMASS (mg/m2) AND PERCENT COMPOSITION OF MACROINVERTEBRATES COLLECTED AT EACH STATION NEAR TMINS, APRIL THROUGH NOVEMBER, 1989.

Species	1A2		11A1		9B1	
	Biomass	Percent	Biomass	Percent	Biomass	Percent
Ablabesmyia	1.4	0.1	11.2	0.7	5.2	0.3
Actinobdella inequiannulata	2.0	0.1	1.5	0.1	.	.
Amnicola	.	.	0.2	0.0	.	.
Anodonta cataracta	.	.	.	.	5.8	0.3
Arcteonais lomondi	0.2	0.0	5.6	0.3	3.0	0.2
Aulodrilus pluriseta	M	M	0.1	0.0	.	.
Bothrioneurum vejdovskyanum	2.8	0.2	1.1	0.1	2.5	0.1
Brachycerus	.	.	0.5	0.0	0.3	0.0
Branchiura sowerbyi	43.1	3.1	0.2	0.0	.	.
Caenis	0.7	0.1	0.2	0.0	.	.
Cecidomyiidae	.	.	.	.	0.2	0.0
Centroptilum	.	.	.	.	0.2	0.0
Ceratopogonidae	2.8	0.2	3.3	0.2	4.4	0.2
Chaoborus	.	.	.	.	0.1	0.0
Cheumatopsyche	.	.	0.2	0.0	.	.
Chironomid pupae	8.0	0.6	14.2	0.9	20.0	1.1
Chironomus decorus	556.4	40.3	544.8	33.6	638.7	35.5
Chrysops	0.1	0.0	.	.	.	.
Coelotanypus	0.4	0.0	1.4	0.1	11.2	0.6
Corbicula fluminea	43.1	3.1	0.1	0.0	M	M
Cricotopus	.	.	0.3	0.0	M	M
Cryptochironomus fulvus	6.2	0.4	17.5	1.1	21.6	1.2
Cryptotendipes	.	.	0.2	0.0	.	.
Demicryptochironomus	.	.	0.1	0.0	0.1	0.0
Dolichopodidae	0.2	0.0	.	.	.	.
Dromogomphus	0.6	0.0	.	.	.	.
Dubiraphia	1.9	0.1	1.1	0.1	0.4	0.0
Dugesia	.	.	0.3	0.0	.	.
Dugesia tigrina	0.1	0.0	0.8	0.1	.	.
Elimia virginica	.	.	2.1	0.1	.	.
Enchytraeidae	M	M	.	.	.	.
Epoicocladius	.	.	.	.	0.5	0.0
Erpobdellidae	.	.	49.7	3.1	.	.
Ferrissia	0.5	0.0	0.1	0.0	.	.
Gammarus fasciatus	21.0	1.5	34.0	2.1	30.0	1.7
Glyptotendipes	.	.	.	.	0.8	0.0
Gomphidae	.	.	.	.	0.1	0.0
Harnischia	M	M	M	M	M	M
Helobdella elongata	5.0	0.4	19.4	1.2	8.2	0.5
Helobdella stagnalis	.	.	3.2	0.2	.	.
Hemerodromia	.	.	.	.	0.1	0.0
Hexagenia	504.7	36.6	429.9	26.5	447.1	24.9
Hirudinea	.	.	0.8	0.1	.	.
Hydrobaenus	M	M	.	.	.	.
Hydrolimax grisea	1.4	0.1	11.3	0.7	16.1	0.9
Hydropsyche	0.5	0.0	.	.	0.1	0.0
Ilyodrilus templetoni	0.4	0.0	M	M	0.4	0.0
Labrundinia	M	M	.	.	.	.
Lepidostoma	0.1	0.0	.	.	.	.
Leptoceridae	.	.	0.9	0.1	.	.
Leptophlebiidae	0.1	0.0	.	.	.	.
Limnodrilus claparedianus	2.4	0.2	3.6	0.2	5.8	0.3
Limnodrilus hoffmeisteri	81.6	5.9	264.5	16.3	473.7	26.4

TABLE 2-8 CONTINUED.

Species	1A2 Biomass	1A2 Percent	11A1 Biomass	11A1 Percent	9B1 Biomass	9B1 Percent
Limnodrilus udekemianus	2.4	0.2	.	.	2.1	0.1
Lumbriculidae	1.6	0.1	.	.	M	M
Macrumia sp	3.0	0.2	.	.	.	.
Manayunkia speciosa	.	.	1.1	0.1	0.1	0.0
Microchironomus	.	.	.	.	0.1	0.0
Musculium	0.3	0.0	4.5	0.3	.	.
Musculium transversum	7.4	0.5	31.3	1.9	18.4	1.0
Nais	M	M	M	M	.	.
Nanocladius	M	M	.	.	.	.
Nematoda	2.1	0.1	3.8	0.2	0.5	0.0
Nematomorpha	.	.	0.1	0.0	0.2	0.0
Neureclipsis	.	.	0.1	0.0	.	.
Oecetis	0.1	0.0	0.1	0.0	0.4	0.0
Optioservus	.	.	.	.	0.6	0.0
Paratanytarsus	.	.	.	.	M	M
Petrophila	0.1	0.0	.	.	.	.
Phaenopsectra	4.8	0.4	17.6	1.1	0.9	0.1
Physa	0.1	0.0	0.5	0.0	.	.
Physidae	0.1	0.0	0.1	0.0	.	.
Pisidium	24.8	1.8	64.0	3.9	36.2	2.0
Polycentropus sp	.	.	.	.	0.1	0.0
Polypedilum convitum	0.2	0.0	.	.	.	.
Polypedilum fallax	0.1	0.0	.	.	.	.
Polypedilum scalaenum	2.3	0.2	1.4	0.1	0.2	0.0
Polypedium illinoense	M	M	0.6	0.0	.	.
Potamanthus	.	.	0.2	0.0	.	.
Potamia	.	.	0.1	0.0	.	.
Pristina synclites	0.1	0.0	.	.	.	.
Procladius	7.2	0.5	36.2	2.2	31.2	1.7
Prodiamesa	8.6	0.6	.	.	.	.
Promoresia	.	.	.	.	0.2	0.0
Prostoma	0.1	0.0	0.1	0.0	.	.
Protoptila	0.1	0.0	.	.	.	.
Quistadrilus multisetosus	M	M	0.5	0.0	0.1	0.0
Rheotanytarsus	0.3	0.0	0.1	0.0	M	M
Sialis	0.1	0.0	.	.	4.6	0.3
Stenelmis	5.3	0.4	3.5	0.2	0.4	0.0
Stenonema	0.1	0.0	.	.	.	.
Stylurus	13.4	1.0	31.1	1.9	.	.
Tanytarsus	6.3	0.5	2.1	0.1	2.8	0.2
Tendipedidae=chironomidae	M	M	M	M	.	.
Thienemanimyia	M	M	M	M	.	.
Tipulidae	.	.	.	.	0.4	0.0
Tricorythidae	0.3	0.0	.	.	.	.
Tricorythodes	0.2	0.0	.	.	.	.
Tubificidae	.	.	.	.	1.2	0.1
Zavrelia group	M	M	.	.	.	.
Zavrelimyia	M	M	.	.	.	.

Note: (.) indicates that no individuals were collected
(M) indicates that individuals were collected but the weight was less than the sensitivity of the balance, or individuals were not weighed.

TABLE 2-9

Monthly density (number/m^2) of the dominant macroinvertebrate taxa (>2% of the total organisms) collected from stations near TMINS, April through November 1989. Dashes indicate taxa not present.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
<u>Chironomus decorus</u> group									
TM-MI-1A2	236	80	6890	402	775	3488	312	3020	1900
TM-MI-11A1	572	312	11460	1266	487	2448	1583	1564	2462
TM-MI-9B1	539	326	17495	293	695	378	524	832	2635
<u>Limnodrilus hoffmeisteri</u>									
TM-MI-1A2	208	572	61	501	666	1612	1092	775	686
TM-MI-11A1	1649	1654	1640	2283	1309	3379	784	737	1679
TM-MI-9B1	4050	4230	4064	1616	3280	3426	3606	1886	3270
<u>Pisidium</u>									
TM-MI-1A2	52	61	42	142	85	213	458	539	199
TM-MI-11A1	9	113	397	123	109	326	2018	1158	532
TM-MI-9B1	90	80	170	85	302	487	520	553	286
<u>Hexagenia</u>									
TM-MI-1A2	-	-	5	-	-	865	553	402	228
TM-MI-11A1	-	5	28	19	24	685	392	558	214
TM-MI-9B1	5	-	19	9	5	354	695	1295	298
<u>Procladius</u>									
TM-MI-1A2	19	-	47	-	80	232	227	227	104
TM-MI-11A1	76	236	52	146	47	553	317	992	302
TM-MI-9B1	340	340	71	-	128	250	118	662	239
<u>Gammarus fasciatus</u>									
TM-MI-1A2	-	9	232	33	14	9	28	184	64
TM-MI-11A1	9	222	378	175	42	151	47	406	179
TM-MI-9B1	-	-	950	66	38	137	38	66	162
<u>Cryptochironomus fulvus</u> group									
TM-MI-1A2	-	24	19	9	66	118	71	113	53
TM-MI-11A1	52	123	19	118	198	146	274	274	151
TM-MI-9B1	90	33	19	42	515	246	104	250	162
All Other Taxa									
TM-MI-1A2	298	945	704	175	373	1002	855	1125	685
TM-MI-11A1	676	1153	936	402	269	983	728	1120	783
TM-MI-9B1	506	874	959	184	586	1167	922	1181	797

TABLE 2-10

Monthly biomass (mg/m^2) of key macroinvertebrate taxa (>1.6% of the total biomass) collected from stations near TMINS, April through November 1989. Dashes indicate taxa not present.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
Chironomus decorus group									
TM-MI-1A2	137.0	86.5	638.0	160.7	136.6	1109.2	6.6	2176.7	556.4
TM-MI-11A1	622.9	314.3	1542.5	303.9	70.9	667.3	157.8	679.1	544.8
TM-MI-9B1	538.3	368.1	3479.7	43.5	107.8	132.3	109.2	330.8	638.7
Hexagenia									
TM-MI-1A2	-	-	104.0	-	-	487.7	1233.0	2213.1	504.7
TM-MI-11A1	-	11.8	296.8	237.2	8.0	263.2	752.4	1869.6	429.9
TM-MI-9B1	169.6	-	276.0	70.4	26.0	210.3	746.2	2078.0	447.1
Limnodrilus hoffmeisteri									
TM-MI-1A2	3.8	169.2	-	47.2	47.7	124.8	106.8	153.6	81.6
TM-MI-11A1	217.4	311.9	485.3	191.9	156.9	413.5	254.7	84.1	264.5
TM-MI-9B1	404.5	626.6	986.8	333.2	223.5	472.1	441.9	300.6	473.7
Pisidium									
TM-MI-1A2	6.1	14.2	5.2	17.0	10.9	25.5	55.3	64.3	24.8
TM-MI-11A1	0.9	18.9	51.5	14.6	12.8	39.2	238.2	135.6	64.0
TM-MI-9B1	13.2	21.3	20.3	10.9	36.4	58.6	62.4	66.2	36.2
Gammarus fasciatus									
TM-MI-1A2	-	12.3	14.2	5.7	0.5	0.5	2.8	131.8	21.0
TM-MI-11A1	0.5	30.2	21.3	57.2	2.4	35.0	18.9	106.3	34.0
TM-MI-9B1	-	-	119.1	14.2	4.7	46.8	18.9	35.9	30.0
Procladius									
TM-MI-1A2	0.9	-	2.8	-	4.7	30.2	4.2	14.6	7.2
TM-MI-11A1	10.4	35.4	10.9	11.3	4.7	90.3	33.1	93.1	36.2
TM-MI-9B1	64.7	73.7	10.9	-	8.0	39.2	12.3	40.6	31.2
All Other Taxa									
TM-MI-1A2	26.9	263.7	56.7	28.4	147.4	288.3	278.8	375.7	183.2
TM-MI-11A1	62.8	478.3	244.8	329.4	113.9	263.7	213.6	302.4	251.1
TM-MI-9B1	73.2	220.7	93.1	36.9	99.7	216.9	82.2	298.2	140.1

TABLE 2-11

Three-factor analysis of variance test results for *Limnodrilus hoffmeisteri* collected from stations near TMINS, April through November 1989. Test was performed on $\log_e$ (density +1).

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2 = 0.893)	53	113.421	2.140	6.62	0.0001*
Month	7	12.610	1.801	5.57	0.0001*
Station	2	61.619	30.809	95.33	0.0001*
Replicate	3	0.040	0.013	0.04	0.9885
Month-Station	14	31.232	2.231	6.90	0.0001*
Month-Replicate	21	7.728	0.368	1.14	0.3501
Station-Replicate	6	0.192	0.032	0.10	0.9961
Error	42	13.574	0.323		
Corrected Total	95	126.995			

* Significant at P≤0.01.

TABLE 2-12

Summary of Tukey's studentized range test for *Limnodrilus hoffmeisteri* collected near TMINS, April through November 1989. Underlined means are not significantly different (P≤0.05) and are ranked from highest to lowest transformed [$\log_e$ (density + 1)] mean. Means are listed parenthetically.

Month	Sep (7.82)	May (7.25)	Aug (7.21)	Oct (7.16)	Apr (6.92)	Nov (6.89)	Jul (6.83)	Jun (6.51)
	____	____	____	____				
		____	____	____	____	____	____	
			____	____	____	____	____	____

Station	TM-MI-9B1 (7.97)	TM-MI-11A1 (7.23)	TM-MI-1A2 (6.03)

TABLE 2-13

Monthly diversity values (H') for the macroinvertebrates collected at stations near TMINS, April through November 1989.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual Diversity(H')
TM-MI-1A2	3.27	2.82	0.97	2.42	2.74	2.71	2.99	3.04	2.95
TM-MI-11A1	2.44	3.15	1.47	2.28	2.42	2.64	2.89	3.35	2.91
TM-MI-9B1	1.63	1.75	1.34	1.70	2.24	2.71	2.48	3.19	2.53
Monthly Diversity (H')	2.23	2.73	1.40	2.29	2.53	2.89	3.09	3.45	2.85

TABLE 2-14

Percent similarity indices for the macroinvertebrate communities collected at stations near TMINS, April through November 1989.

Station Pairs	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
1A2-11A1*	54.6	52.6	83.7	77.3	66.1	68.7	51.4	60.6	78.4
1A2-9B1	44.1	46.3	80.6	62.8	62.0	45.5	63.2	49.3	70.0
11A1-9B1	74.3	63.5	90.3	72.7	83.3	70.9	44.8	65.4	81.8

* Station prefix TM-MI- deleted from table.

TABLE 2-15

Percent similarity indices for the macroinvertebrate communities collected at stations near TMINS, 1976 through 1989.

Year	Station Pair Comparisons		
	1A2-11A1*	1A2-9B1	11A1-9B1
1976	70	91	76
1977	83	83	95
1978	79	81	91
1979	92	88	86
1980	92	87	89
1981+	95	85	85
1982	85	79	82
1983	77	84	78
1984	70	74	80
1985	77	75	76
1986	57	63	72
1987	80	72	85
1988	68	57	81
1989	78	70	82
Mean	79	78	83

* Station prefix TM-MI- deleted from table.
\+ Approximated from Nardacci and Associates (1982).

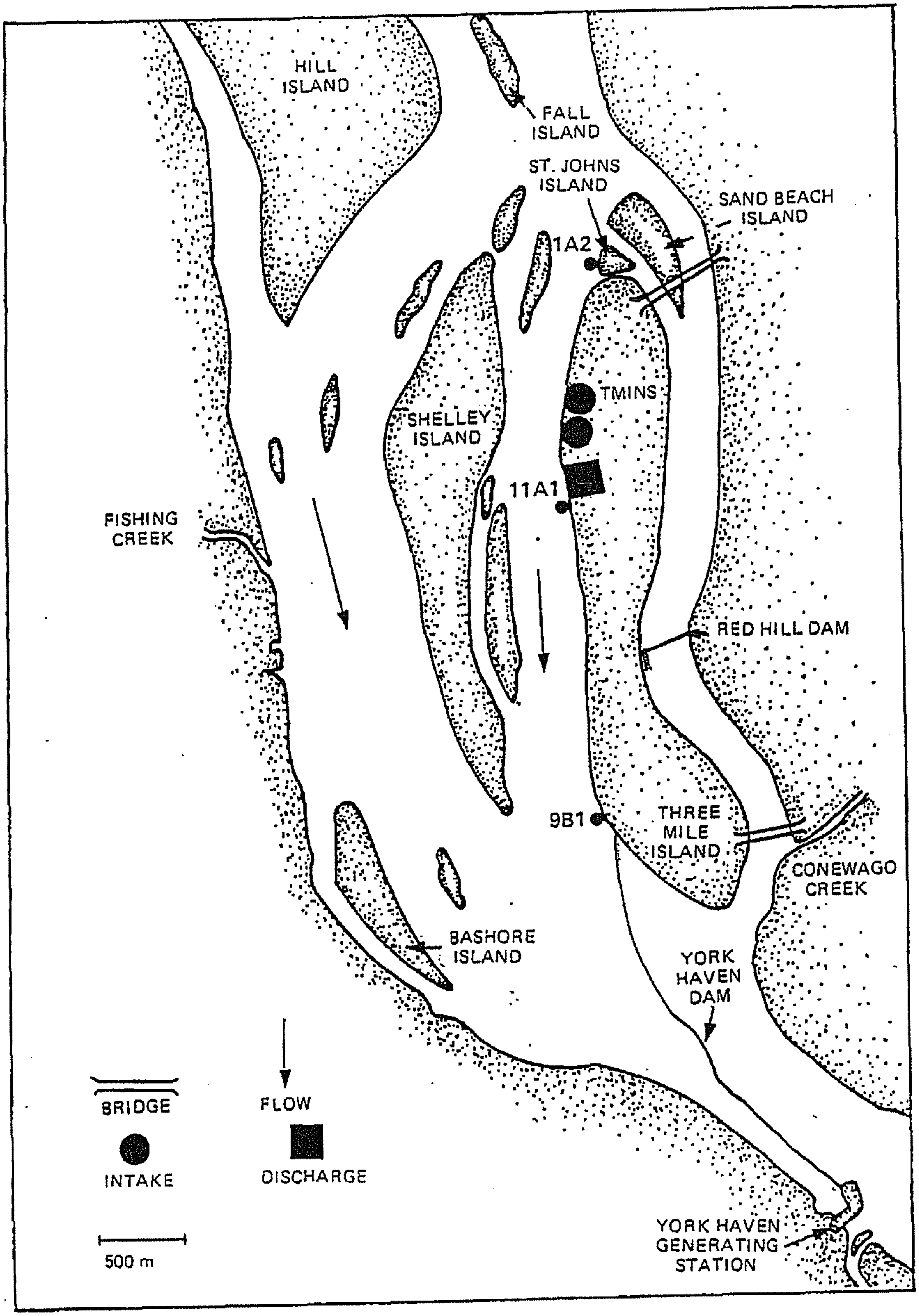

Figure 2-1. Location of benthic macroinvertebrate stations sampled in the Susquehanna River near TMINS (station prefix TM-MI- deleted).

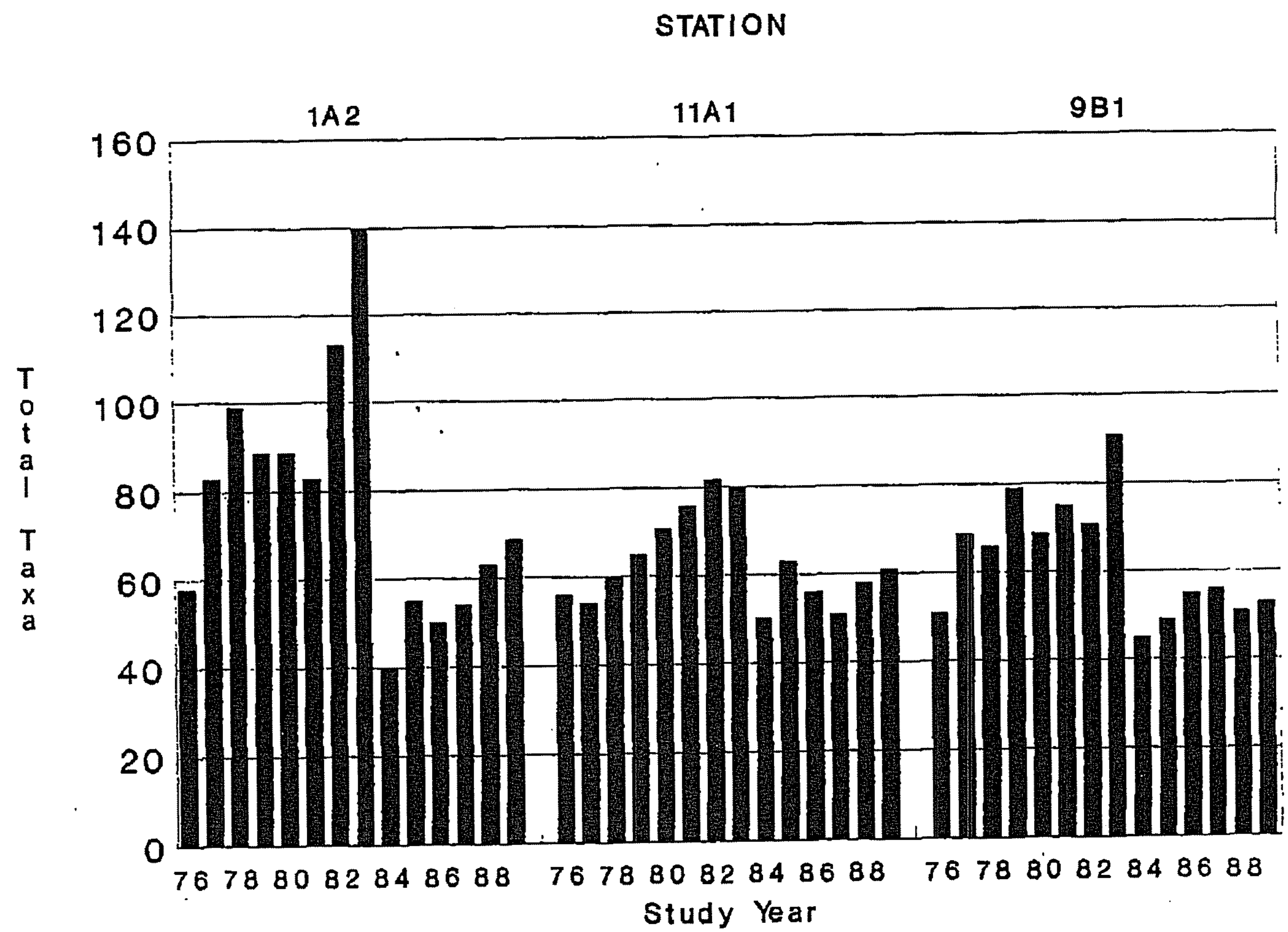

Figure 2-2. Total taxa collected at the benthic macroinvertebrate stations near TMINS, 1976 through 1989.

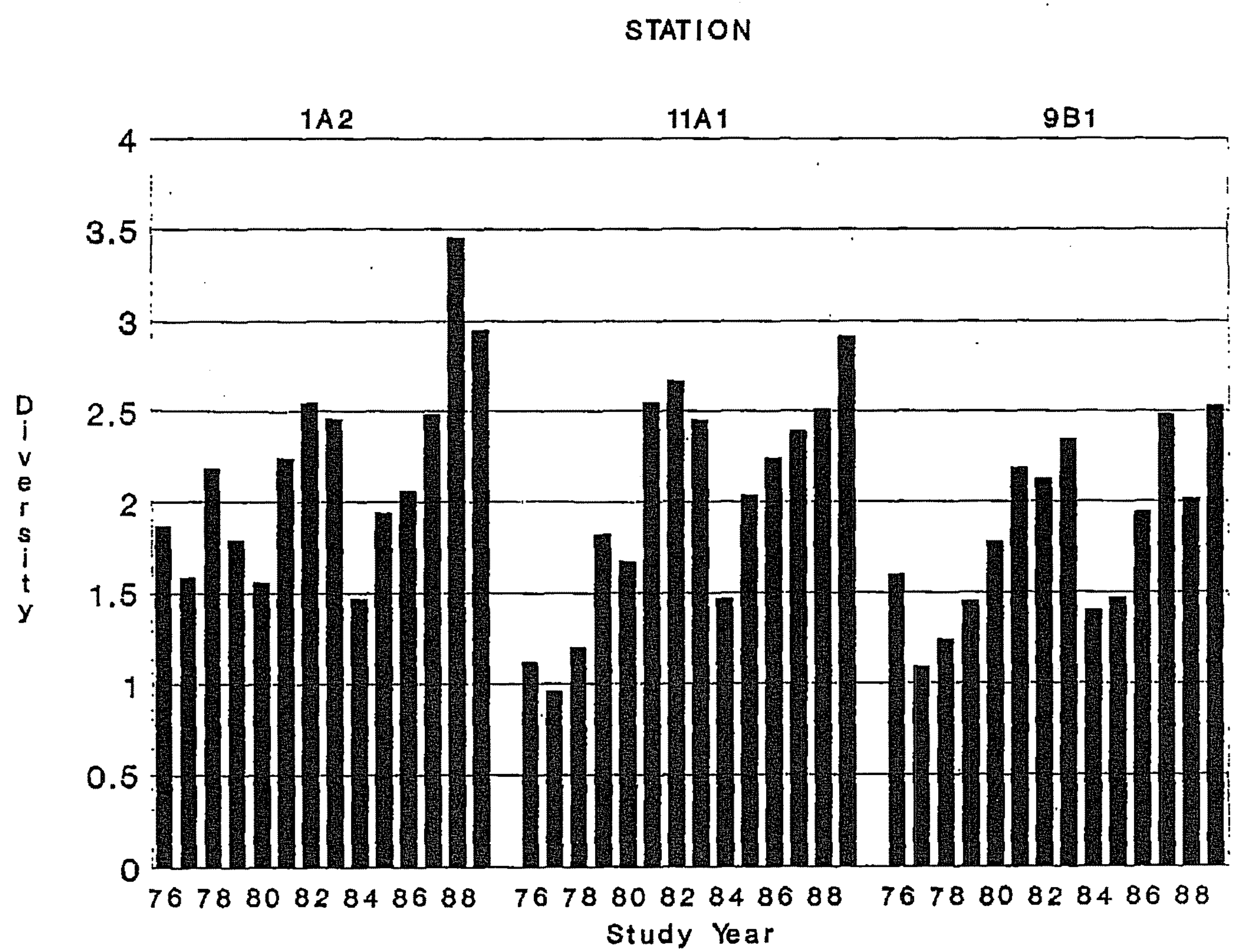

Figure 2-3. Diversity values for the macroinvertebrate communities near TMINS, 1976 through 1989.

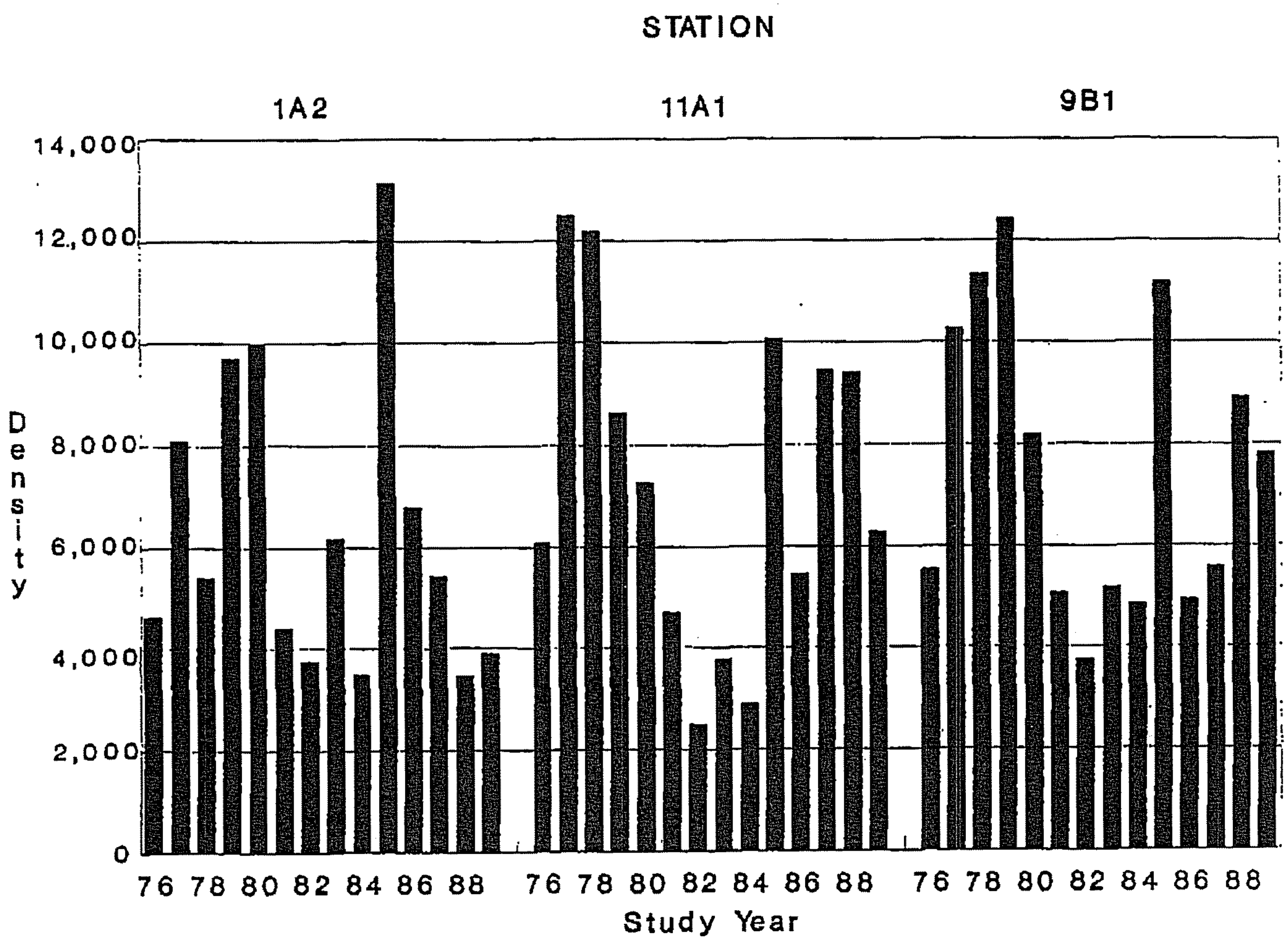

Figure 2-4. Annual mean total macroinvertebrate density (No./sq.m.) from stations near TMINS, 1976 through 1989.

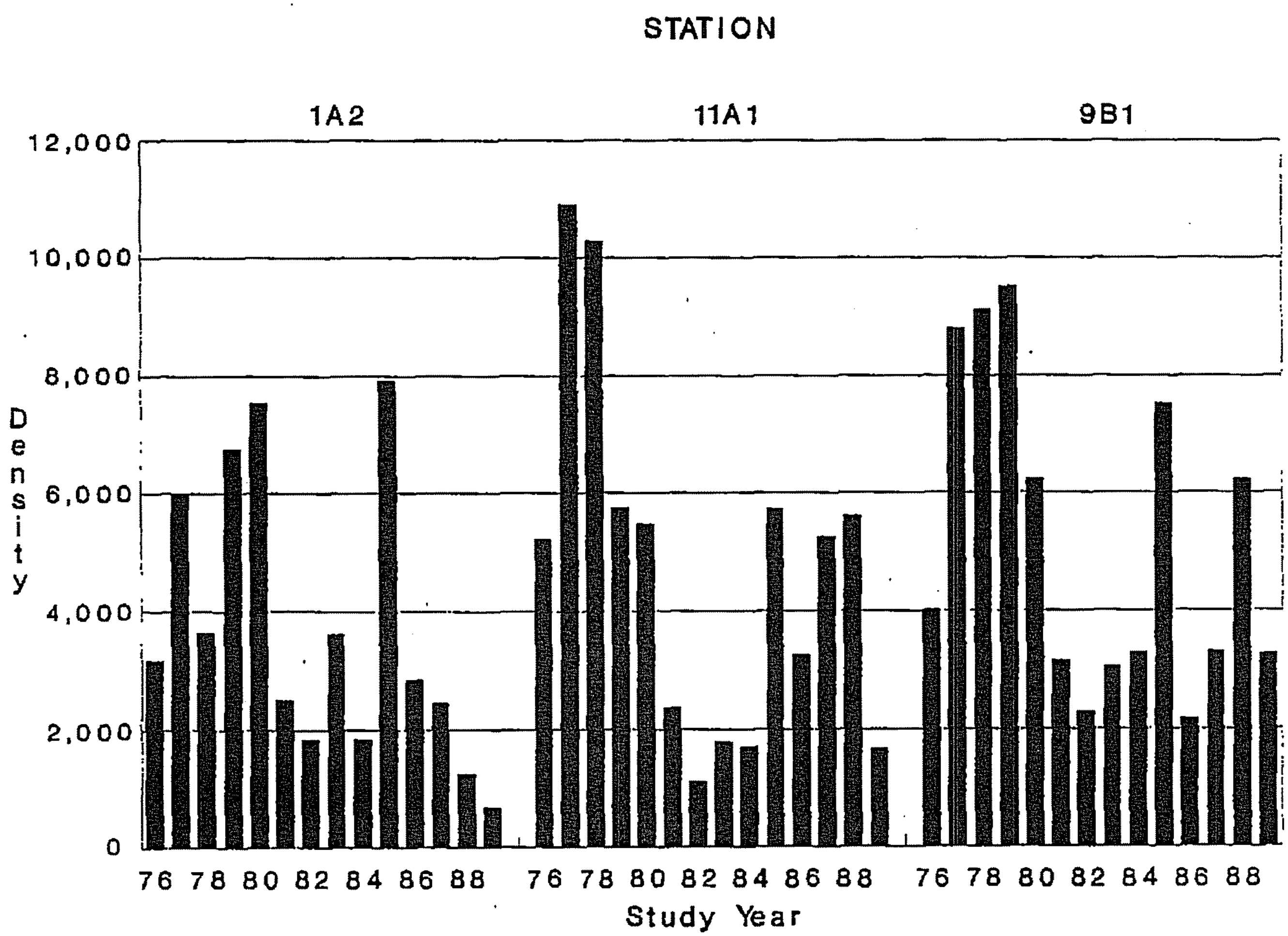

Figure 2-5. Annual mean densities (No./sq. m.) of Limnodrilus hoffmeisteri at the macroinvertebrate stations near TMINS, 1976 through 1989.

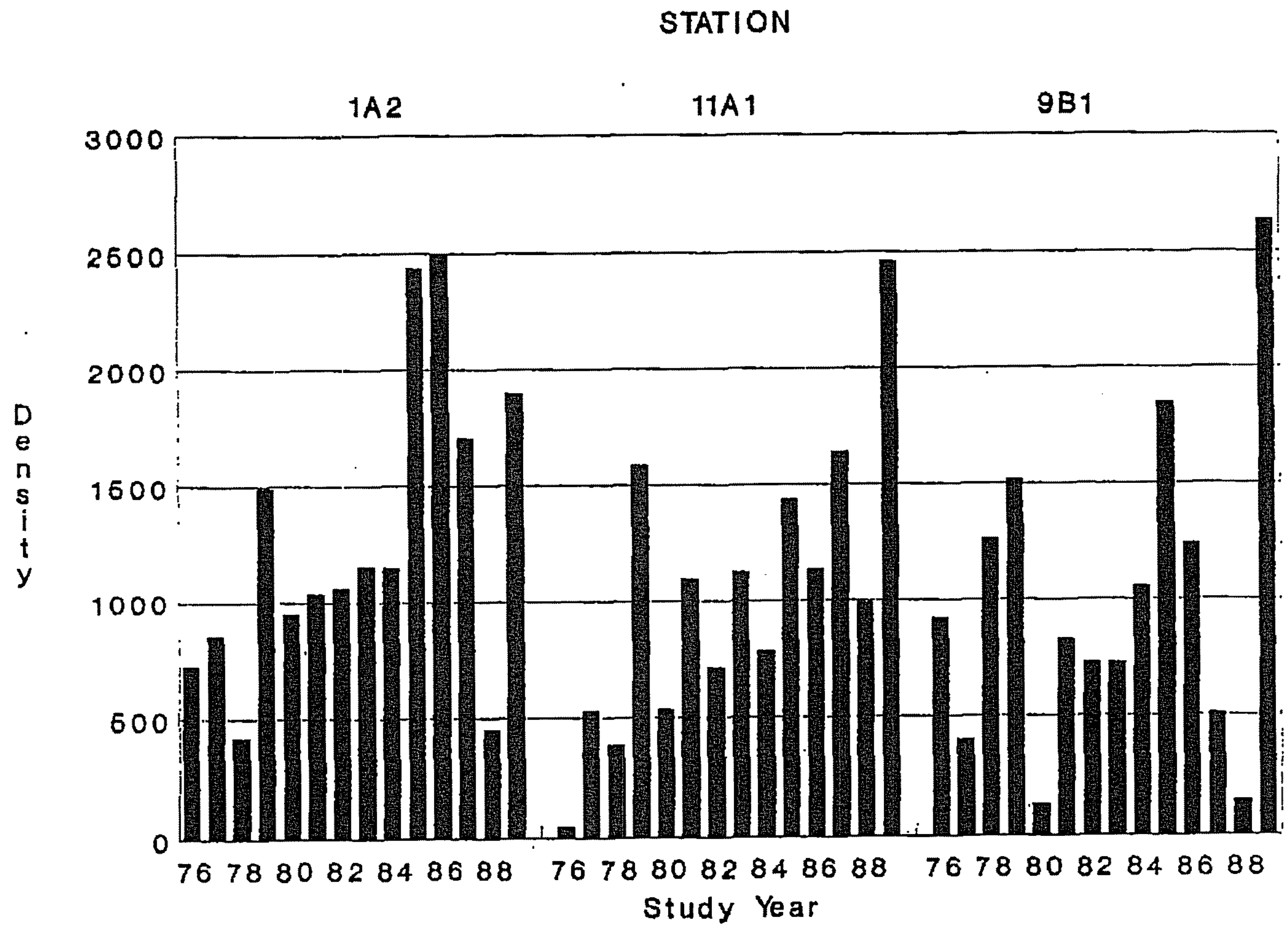

Figure 2-6. Annual mean densities (No./sq. m.) of Chironomus decorus group at the macroinvertebrate stations near TMINS, 1976 through 1989.

3. ICHTHYOPLANKTON

3.1 METHODS

Ichthyoplankton samples were collected weekly at eight stations in York Haven Pond, April through August 1989 (Table 3-1 and Figure 3-1). Stations were sampled at night and in a random order on each date to minimize any time bias (Nardacci and Associates 1979).

Two replicate samples were taken at each station with a pair of 0.5 m (0.5 mm mesh) plankton nets mounted to square frames. A detachable cup was fastened to the cod end of each net to facilitate removal of the sample. The nets were deployed off the bow of a boat, and set immediately beneath the water surface. The boat was maneuvered upstream, 10 to 20 m offshore, for four minutes. This allowed coverage of about 200 m of shoreline at each station; actual distance covered varied with river flow conditions. The volume of water filtered through each net was measured with a General Oceanics digital flowmeter (Model 2030) mounted in the center of each net mouth. Flowmeters were calibrated in accordance with GPU (1987).

At the end of each sample run, nets were rinsed three times and replicate filtrates were poured into separate sample jars. Samples were immediately preserved in 20% formalin and transported to the laboratory. Physicochemical data recorded for all collections were time, air and surface water temperatures, dissolved oxygen concentration, pH, and surface water velocity. On each date, river flow (at 0700 h) was obtained from the River Forecast Center in Harrisburg, Pennsylvania.

In the laboratory, samples were rinsed; specimens sorted; and the ichthyoplankton stored in 40% isopropanol. Specimens were examined under a binocular dissecting microscope and identified to the lowest feasible taxon using various taxonomic references (Auer 1982; Buynak and Mohr 1978a, 1978b, 1979a, 1979b, 1979c, 1980; Hardy 1978; Jones et al. 1978; Lathrop 1982; Nardacci and Associates 1978; Snyder et al. 1977; Wang and Kernehan 1979).

Larvae that were damaged beyond recognition or too distorted to identify were tabulated as unidentifiable. Larvae of the genus Lepomis and Pomoxis, indistinguishable to species, were categorized as sunfishes or crappies. The category "sunfishes", previously (EA 1985, 1986, 1987) referred to as Lepomis gibbosus/macrochirus (pumpkinseed/bluegill), refers to the same here.

A list of fishes collected in 1989 is presented in Table 3-2. Scientific and common names and taxonomic order of presentation followed Robins et al. (1980).

Following identification, specimens were measured to the nearest 0.5 mm interval (total length, TL or fork length, FL when applicable) with an ocular micrometer or a dial caliper. All specimens were counted; a maximum of 100 individuals of any one species was measured per replicate. Length data for each species were categorized into larvae or young. The larval stage was defined as the early development after hatching during which the yolk sac and larval finfold were absorbed, and the fins and fin rays were formed. The larval stage was subdivided into protolarva, mesolarva, and metalarva after Snyder (1976). The term young was used to designate fish spawned during the current season which were fully transformed larvae. Young were characterized by the attainment of the adult compliment of rays and/or spines in all fins. Fish greater than 25.0 mm FL were not included in ichthyoplankton data tabulations and consequently are not reported herein.

A quantitative expression of the ichthyoplankton catch converted the number of larvae to density. Density was defined as the number of larvae per 100 cubic meters of water (No./100 m^3). As in previous reports (EA 1985, 1986, 1987; RMC 1988a, 1989), most statistical tests used log-transformed densities in order to linearize and normalize the data, and to reduce differences in catch density variances.

The similarity of species composition among stations was determined by calculating percentage similarity index (PSc), as described in Chapter 2. The ichthyoplankton community diversity was evaluated by calculating the Shannon-Wiener diversity index (H') for each station and date (Chapter 2).

High diversity values indicate an even distribution of individuals among species. Low values are indicative of high abundance of a few species and low abundance of the remainder.

Ichthyoplankton densities were used in a three-factor analysis of variance (ANOVA) to evaluate differences among stations, dates, and replicates within 1989, and among years (1977 through 1989). When significant differences were indicated by the ANOVA ($p \leq 0.05$), Tukey's studentized range test was used to identify significantly different means (SAS Institute, Inc., Cary, NC).

3.2 COMPOSITION, ABUNDANCE, AND SIZE DISTRIBUTION

Results of weekly ichthyoplankton collections are presented in Appendix B. No fish were taken on 6, 11, and 24 April; therefore, these dates were excluded from most tables and figures. A total of 9,537 individuals of at least 26 taxa was distributed among six families (Table 3-3). Nine taxa accounted for 93.1% of the catch: common carp (45.2%), quillback (13.5%), pumpkinseed/bluegill (7.8%), channel catfish (6.3%), mimic shiner (5.9%), spotfin shiner (4.4%), tessellated darter (3.6%), spottail shiner (3.2%), and banded darter (3.2%). The dominant families were cyprinids (9 species) and catostomids (4 species), which comprised 61.3 and 13.8% of the total catch, respectively.

Temporal distribution of ichthyoplankton collected in 1989 is shown in Table 3-4. Early spring (April) spawning activity was virtually nonexistent as unusually high river flow resulted in only one larvae being taken. In May, larvae of the early season spawners in the cyprinid, catostomid, and percid families were abundant, accounting for 99.4% of the catch. The most numerous taxa collected were spottail shiner, quillback, tessellated darter, and banded darter.

Peak seasonal abundance occurred on 6 June; the largest number of taxa was collected on 6 and 12 June. Larvae of the late spring and early summer spawners dominated, typically members of the cyprinid and catostomid families. Although taken infrequently, members of the centrarchid and percid families were also present in June. The predominant summer spawners (July and August) were clupeids, cyprinids, ictalurids, and centrarchids; most of which were gizzard shad, spotfin shiner, mimic shiner, channel catfish, and pumpkinseed/bluegill.

The temporal distribution of the most abundant taxa is shown in Figure 3-2. The May through mid-June samples were dominated by common carp, spottail shiner, quillback, tessellated darter, and banded darter. The channel catfish was collected from 21 June through 21 August, but was most abundant from mid- to late July. The pumpkinseed/bluegill was collected intermittently from June through August, but was most abundant on 16 August. Spotfin shiner and mimic shiner, collected from 6 June through 29 August, were most abundant from late July through August.

Temporal distribution/length frequencies of the most abundant taxa collected in 1989 are presented in Tables 3-6 through 3-14. Most common carp (99.8%) were protolarvae collected on 6 June. Most spottail shiner (99.0%) were protolarvae; mean length of larvae was 5.2 mm TL. Spotfin shiner were represented by all life stages; mean length of larvae was 7.8 mm TL. The largest portion of the spotfin shiner catch was protolarvae (58.1%), and their abundance in July and August was indicative of spawning. Most mimic shiner (88.0%) were protolarvae or mesolarvae from the August samples. The mean length of mimic shiner was 7.4 mm TL. Quillback were primarily protolarvae and averaged 8.3 mm TL. Channel catfish were exclusively young; they were most common on 17 and 24 July, and averaged 16.7 mm TL. The pumpkinseed/bluegill were predominantly protolarvae (88.6%); most were caught in June and August. Mean larval length was 6.2 mm TL, as most were between 4.6 and 6.5 mm TL. Tessellated darter were primarily protolarvae (97.3%) taken from 3 May through 24 July. Mean larval length was 5.6 mm TL; most spawning occurred from late May through mid-June. Banded darter were collected from May through August, and were most (70.9%) common between 22 May and 21 June. Most were protolarvae, with a mean length of 6.2 mm TL.

The actual spawning date for all species collected was assumed to be 5 to 10 days prior to the collection of protolarvae (Nardacci and Associates 1984). Most fish eggs hatch 3 to 10 days after fertilization. The hatching time is variable and depends on season, water temperature, and species (Hardy 1978; Jones et al. 1978). Therefore, protolarvae collected represented a relatively recent spawn and/or hatch.

Ichthyoplankton abundance appears to be influenced by water temperature, river flow, and weather conditions. The low ichthyoplankton densities recorded in 1989 may have been the result of record river flow conditions (Chapter 7) coupled with low water temperature which suppressed spawning activity (Figure 3-3). The effects of river flow and water temperature on ichthyoplankton densities may not be evident until 7 to 10 days after a change in these variables occurs. The relationship between river flow and ichthyoplankton densities appears inverse. Peaks in river flow in mid-May and late June were coincident with low ichthyoplankton densities. Ichthyoplankton densities peaked in early June as river temperature began to increase. High river flow immediately after this early peak depressed densities and water temperature. These density decreases may have resulted either from the flushing effect of increased river flow, or from high flow depressing spawning activity. A secondary peak occurred in mid-August as river temperature began to exceed 20 C consistently and river flow remained low. The influence of temperature on spawning (and hence ichthyoplankton abundance) was similar to findings of Nardacci and Associates (1984), where spawning increased during the spring as water temperature increased.

Ichthyoplankton abundance, expressed in terms of number and density, was greatest at Station 16A1, located along the west shore of TMI (Tables 3-3 and 3-5). Stations 4A1 and 14B1 ranked second and third in number and density. The common carp was the most abundant larvae at Stations 16A1 and 4A1, and comprised over 72% of the catch at each station. Larvae at Station 14B1 were principally mimic shiner, quillback, and pumpkinseed/bluegill. The lowest number of specimens collected at any station, as well as the lowest annual density, was recorded at Station 12A1, along the west shore of Shelley Island. Peak densities at individual stations were variable and keyed to the local abundance of one or more of the most common taxa. The ichthyoplankton densities at Station 13A2 (located upstream of the TMINS discharge) and Stations 11A1 (downstream of the TMINS discharge) appeared quite similar.

Differences in ichthyoplankton abundance among stations are related to a variety of factors, including: the availability/suitability of habitat for spawning adults immediately upriver of each station; the effects of river flow on the station area; water velocities within the station; and recreational activity (i.e., boating, swimming, and camping) at or adjacent to the station. The highest density value in 1989 was recorded at Station 16A1, which is characterized by swift currents and a variety of substrates. In contrast, Station 12A1, with the lowest annual density, was usually characterized by moderate currents and a predominantly mud substrate. Recreational activity around Station 12A1 was much heavier than that observed near Station 16A1.

The temporal distribution of ichthyoplankton, differences among stations, and between replicates were examined by a three-factor ANOVA (Table 3-15). Differences among sample dates, stations, and the date-station interaction were significant. The significance of the date-station interaction was expected because of the spatial and temporal variability among species, habitats, and/or spawning times. Tukey's studentized range test results generally indicated that densities were significantly higher from late May through August than in April and early May (Table 3-16). Densities on 6 June were highest and significantly different from all other dates, while all April dates were similar and ranked lowest. The range test of individual station densities indicated that Station 14B1 was ranked highest and was significantly different from all other stations. The stations located upstream (13A2 and 16A1) and downstream (11A1 and 9B1) of the TMINS discharge were similar to each other. These analyses suggest that the operation of TMINS had no detectable effect on ichthyoplankton in York Haven Pond.

3.3 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

The ichthyoplankton community was assessed by indices of species diversity and percent similarity. Shannon-Wiener diversity values (H') ranged from 1.47 to 3.29 for the eight stations, and 0.92 to 2.84 for sample dates (Tables 3-3 and 3-4). Diversity values were variable among sample dates, with higher values occurring in June and August. The highest H' value occurred on 12 June. Conversely, a value of 0.92 was recorded on 17 April, as only three specimens of two taxa were collected. The 6 June collection yielded the highest number of specimens and total density, but ranked low in terms of diversity. These results were influenced by the overabundance of the common carp compared to the other taxa.

Ichthyoplankton community diversity was high and nearly equal at Stations 12A1 and 10B2, which are located along the west shore of Shelley Island (Table 3-3). The lowest H' value occurred at Station 16A1. These results demonstrate an inverse relationship between total number of larvae and community diversity. Stations 12A1 and 10B2 ranked low in number of individuals, yet had the highest diversity values. Conversely, Station 16A1 ranked highest in number of individuals and total density, but the species diversity was lowest. This low diversity value was attributable to an extreme abundance of common carp.

Diversities at stations located along the west shore of Three Mile Island ranged from 1.47 to 2.50 (Table 3-3). Mean H' values of the stations located upstream (13A2 and 16A1) and downstream (9B1 and 11A1) of the TMINS discharge were 1.90 and 2.48, respectively. These results indicate a similar community diversity among the stations along the west shore of Three Mile Island.

Another measure of the York Haven Pond ichthyoplankton community compared species composition among stations by the percent similarity index (PSc) (Table 3-17). PSc values ranged from 20.9 to 88.1%. The highest PSc occurred between Stations 13A2 and 11A1, located upstream and downstream, respectively, of the TMINS discharge; Stations 12A1 and 4A1 were least similar. The former stations (13A2 and 11A1) were also very similar in total specimens, total taxa, total density, and species diversity. The mean PSc value among all west TMI stations was 77.7%, indicating a similar species composition. Generally, stations closely related geographically and/or with similar habitats had similar PSc values.

3.4 MULTIPLE-YEAR COMPARISON

The relative density of ichthyoplankton collected at seven stations in 1989 was within the ranges noted in previous years (1977 through 1988) (Table 3-18). The density calculated for Station 16A1 was the highest to date. The number of larvae collected at individual stations was also within the ranges recorded previously with two exceptions. Station 16A1 yielded the highest number of individuals to date, while Station 14B1 yielded the fewest.

Ten taxa have dominated the catch either intermittently or consistently from 1977 through 1988 (Table 3-19); this trend continued in 1989. The total abundance of six of the dominant taxa in the 1989 catch (common carp, spottail shiner, quillback, pumpkinseed/bluegill, tessellated darter, and banded darter) was within their historical ranges. However, the density of spottail shiner, quillback, and pumpkinseed/bluegill, and the abundance and density of spotfin shiner was the lowest recorded in 13 years. Densities of all other common fishes were within previously established ranges. In addition, the abundance and density of mimic shiner and channel catfish was the highest to date. Changes in the total number and/or density of ichthyoplankton from year to year was likely related to the spawning success of one or more of the common taxa.

Annual changes in the relative abundance and density of predominant species were reflections of variable spawning success modified by environmental factors such as water temperature and river flow (Nardacci and Associates 1984). Historically, river flow has been inversely related to ichthyoplankton density. When river flow exceeded 1,000 m^3/sec, low ichthyoplankton densities resulted (Nardacci and Associates 1983). Low density values have also been associated with water temperature below 20 C. These trends in temperature and river flow were demonstrated again in 1989 (Figure 3-3). The average river temperature first exceeded 20C in early June and coincided with peak density. The density subsequently declined as river flow increased and depressed river temperature (Figure 3-3). Similar high density peaks from late May to early June occurred during most sample years (1977 to 1981 and 1984 to 1987) (EA 1987; Nardacci and Associates 1983; RMC 1988a).

A second, late season (August) peak in ichthyoplankton density was noted in 1989, which corresponded to abundance peaks for spotfin shiner, mimic shiner, and pumpkinseed/bluegill. During and immediately preceeding this period of high density, average river temperature exceeded 20 C and river flow remained low (Figure 3-3). Similar late season density peaks have been noted previously (EA 1987; Nardacci and Associates 1980, 1983, 1984; RMC 1989).

Peak ichthyoplankton density in 1989 was similar to other years and generally was within established ranges. Comparisons of annual density showed 1989 to rank 11th among the 13 sample years. This low ranking suggests that high river flow conditions (Chapter 7) coupled with relatively low, unstable river temperatures resulted in reduced spawning success of many fishes. During 1989, average river flow exceeded 1,000 m^3/sec on ten sample dates, while average river temperature exceeded 20 C on 12 of the 20 sample dates.

As noted earlier, high velocities adversely affect all ichthyoplankton. Fish larvae are vulnerable because their small size limits their ability to withstand swift water currents. However, low velocities would have the opposite effect on larvae, and would also benefit spawning adults. Pumpkinseed/bluegill abundances provide an example of river flow/larval density effects. Pumpkinseed and bluegill generally prefer slow water areas with sand, gravel, or mud substrates for spawning and nest-building (Scott and Crossman 1973). High current velocities, such as those recorded during 1989, would limit the amount of spawning habitat available, and lead to a reduction in spawning success. The substantial decrease in pumpkinseed/bluegill abundance in 1989 was attributed to the increase in average river flow. The higher velocties would flush phytoplankton and zooplankton out of the system. These organisms are important components in the ichthyoplankton diet. With the decreased availability of food, spawning sites, and nursery areas, a decrease in abundance and survival of larvae may be expected.

The annual abundance of ichthyoplankton within York Haven Pond was assessed by a three-factor ANOVA (Table 3-20). All effects and their interactions were significant. However, date and date-year interaction terms contributed nearly 65% of the total sum of squares; or 80% of the total explained variance. Since station densities followed similar annual trends (Figures 3-4 and 3-5), significant differences among stations and years were not confounded by the interactions.

Tukey's studentized range test was used to isolate specific differences among annual ichthyoplankton densities (Table 3-21). Sample years 1981 and 1983 were similar and higher than all other years, whereas 1984 ranked lowest and was significantly different from all years. All other years were similar and not significantly different from each other.

Sample dates were consolidated (all years combined) for statistical analyses, and categorized as those within the first to the tenth, the eleventh to the twentieth, or the twenty-first to thirty-first of a given month. Range test results indicated that April and August densities, as well as 1-10 May densities, were significantly lower than all other sample dates (Table 3-21). Densities recorded for 1-10 June and 21-31 May ranked first and second, respectively, and were significantly greater than all other sample date groups. These results reinforce density trends mentioned previously.

Tukey's studentized range test, applied to ichthyoplankton station densities over the past 13 years, showed that Station 14B1 had the highest density (Table 3-21). The range test also indicated that Station 13A2, located upstream of the TMINS discharge, was not statistically distinguishable from the downstream stations (11A1 and 9B1).

Ichthyoplankton abundances and statistical analyses for 1989 were consistent with historical data (EA 1985, 1986, 1987; Nardacci and Associates 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984; RMC 1988a, 1989). The ichthyoplankton community was not influenced by the operation of TMINS. Fluctuations within the ichthyoplankton community appear related to dynamic physical (e.g., spawning habitat/nursery area availability) and/or environmental conditions (e.g., river flow, water temperature) within the Susquehanna River rather than the operation of TMINS.

TABLE 3-1

Location and description of ichthyoplankton stations sampled in York Haven Pond.

Station Number	Location and Description
TM-LF-14B1*	Beginning from a point 500 m downstream from the fall line riffles along the west shore of York Haven Pond. Water depth varied from 1.0 to 1.5 m. Substrate was mostly boulders, cobbles, pebbles, and some mud. Current velocities+ were generally moderate to slow.
TM-LF-12A1	Beginning from a point on the west shore of Shelley Island. Water depth varied from 1.0 to 1.5 m. Bottom was mostly mud with some pebbles and gravel. Current velocities were moderate.
TM-LF-13A2	Beginning from a point upstream from the Three Mile Island Nuclear Station Unit 2 intake to a point upstream of Unit 1 intake. Water depth varied from 2.0 to 3.0 m with depths to 8.0 m in front of intake structures. Bottom type was mostly boulders and mud. Current was usually swift.
TM-LF-4A1	Beginning at a point along the east shore of Three Mile Island opposite the Unit 2 cooling tower A. Water depth varied from 1.0 to 1.5 m. Bottom was mud with some tree stumps. Current velocities were slow to still.
TM-LF-10B2	Beginning at the southwestern tip of Shelley Island. Water depth varied from 1.0 to 1.5 m. Bottom was mostly mud. Current velocities were moderate.
TM-LF-9B1	Beginning at a point 200 m upstream from the York Haven Dam along the southwestern shore of Three Mile Island. Water depth was about 1 m. Bottom type was mostly mud. Current velocities were moderate.
TM-LF-11A1	Beginning at a point 200 m downstream from the Three Mile Island Nuclear Station discharge. Water depth was about 1 m. Bottom was mostly mud. Current velocities were moderate.
TM-LF-16A1	Beginning at a point 500 m downstream from the north tip of Three Mile Island along the west shore. Water depth varied from 1.0 to 1.5 m. Bottom type was mostly boulders, cobbles, pebbles, and some mud. Current velocities were swift to moderate.

* Prefix TM-LF- deleted from station numbers for discussion in text.

\+ Current velocities were surface measurements taken during summer river flow <566 m^3/sec (20,000 cfs) and defined as low (<15 cm/sec), moderate (16-40 cm/sec), and swift (>40 cm/sec).

TABLE 3-2

List of scientific and common names of ichthyoplankton collected from the Susquehanna River near TMINS, 1989.

Scientific Name	Common Name
Clupeidae	Herrings
Dorosoma cepedianum (Lesueur)	Gizzard shad
Cyprinidae	Carps and Minnows
Cyprinus carpio Linnaeus	Common carp
Notemigonus crysoleucas (Mitchill)	Golden shiner
Notropis amoenus (Abbott)	Comely shiner
Notropis hudsonius (Clinton)	Spottail shiner
Notropis procne (Cope)	Swallowtail shiner
Notropis spilopterus (Cope)	Spotfin shiner
Notropis volucellus (Cope)	Mimic shiner
Pimephales notatus (Rafinesque)	Bluntnose minnow
Semotilus corporalis (Mitchill)	Fallfish
Catostomidae	Suckers
Carpiodes cyprinus (Lesueur)	Quillback
Catostomus commersoni (Lacepede)	White sucker
Hypentelium nigricans (Lesueur)	Northern hog sucker
Moxostoma macrolepidotum (Lesueur)	Shorthead redhorse
Ictaluridae	Bullhead catfishes
Ictalurus natalis (Lesueur)	Yellow bullhead
Ictalurus punctatus (Rafinesque)	Channel catfish
Centrarchidae	Sunfishes
Ambloplites rupestris (Rafinesque)	Rock bass
Lepomis auritus (Linnaeus)	Redbreast sunfish
Lepomis cyanellus Rafinesque	Green sunfish
Lepomis gibbosus (Linnaeus)	Pumpkinseed
Lepomis macrochirus Rafinesque	Bluegill
Micropterus dolomieui Lacepede	Smallmouth bass
Micropterus salmoides (Lacepede)	Largemouth bass
Pomoxis annularis Rafinesque	White crappie
Pomoxis nigromaculatus (Lesueur)	Balck crappie
Percidae	Perches
Etheostoma olmstedi Storer	Tessellated darter
Etheostoma zonale (Cope)	Banded darter
Perca flavescens (Mitchill)	Yellow perch
Percina peltata (Stauffer)	Shield darter

TABLE 3-3 SPATIAL DISTRIBUTION OF ICHTHYOPLANKTON NUMBERS, AND DIVERSITY (H)TAKEN BY PUSH NET AT EIGHT STATIONS IN YORK HAVEN POND, APRIL THROUGH AUGUST 1989.

	TM-LF-14B1	TM-LF-12A1	TM-LF-13A2	TM-LF-4A1	TM-LF-10B2	TM-LF-9B1	TM-LF-11A1	TM-LF-16A1	Total		
Species	Number	Number	Number	Number	Number	Number	Number	Number	Number	Density	Pct.
Gizzard shad	68	.	7	141	.	1	5	11	233	2.51	2.4
Common carp	39	35	563	1181	62	520	496	1417	4313	46.48	45.2
Golden shiner	.	.	1	.	.	.	.	.	1	0.01	0.0
Comely shiner	39	3	1	3	7	11	5	4	73	0.79	0.8
Spottail shiner	54	7	52	26	35	43	52	37	306	3.30	3.2
Swallowtail shiner	4	1	1	.	.	4	2	.	12	0.13	0.1
Spotfin shiner	97	58	27	22	116	37	39	24	420	4.53	4.4
Mimic shiner	338	10	34	15	53	23	72	22	567	6.11	5.9
Bluntnose minnow	10	8	.	13	104	6	12	3	156	1.68	1.6
Creek chub	.	.	.	.	1	.	.	.	1	0.01	0.0
Quillback	166	116	148	48	115	311	193	192	1289	13.89	13.5
White sucker	3	1	.	1	1	.	1	.	7	0.08	0.1
Northern hog sucker	.	.	.	2	.	.	1	.	3	0.03	0.0
Shorthead redhorse	1	4	2	2	1	1	2	.	13	0.14	0.1
Yellow bullhead	1	.	2	.	.	.	.	.	3	0.03	0.0
Channel catfish	36	62	104	45	69	100	79	105	600	6.47	6.3
Rock bass	36	12	.	2	2	2	2	1	57	0.61	0.6
Redbreast sunfish	1	18	.	.	3	1	.	.	23	0.25	0.2
Sunfishes	600	4	11	98	13	4	4	11	745	8.03	7.8
Smallmouth bass	1	.	.	1	.	.	.	.	2	0.02	0.0
Largemouth bass	1	.	.	.	.	.	.	.	1	0.01	0.0
Crappies	2	.	.	.	.	.	.	.	2	0.02	0.0
Tessellated darter	22	36	24	3	78	139	27	10	339	3.65	3.6
Banded darter	75	44	55	7	25	25	33	37	301	3.24	3.2
Yellow perch	.	.	1	.	.	.	.	.	1	0.01	0.0
Shield darter	1	7	.	1	3	1	.	4	17	0.18	0.2
Unidentifiable fish	6	1	7	9	3	9	5	7	47	0.51	0.5
Unidentified (eggs)	2	2	.	.	.	.	1	.	5	0.05	0.1
Total number	1603	429	1040	1620	691	1238	1031	1885	9537	100.0	
Total taxa	24	19	17	19	18	18	19	15	28	28	
Diversity (H)	2.92	3.27	2.32	1.64	3.29	2.47	2.50	1.47	2.83	2.83	

TABLE 3-4 TEMPORAL DISTRIBUTION OF ICHTHYOPLANKTON NUMBER TAKEN AT EIGHT STATIONS IN YORK HAVEN POND, APRIL THROUGH AUGUST 1989.

Species	April 17	May 3	May 22	May 29	June 6	June 12	June 21	June 27	July 6	July 10	July 17	July 24	August 1	August 7	August 16	August 21	August 29
Gizzard shad	.	.	.	2	3	10	.	1	.	4	.	.	1	36	7	5	164
Common carp	.	.	.	.	4224	5	3	2	2	64	3	.	4	3	1	2	.
Golden shiner	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	13	2	.	.	.	1	1	.	5	4	.	.	47
Spottail shiner	.	2	4	42	231	23	2	.	1	.	.	.	.	1	.	.	.
Swallowtail shiner	.	.	.	.	.	10	1	.	.	.	.	.	.	.	.	1	.
Spotfin shiner	1	.	.	.	5	4	3	1	3	81	19	15	14	57	95	90	32
Mimic shiner	.	.	.	.	8	1	.	.	3	3	21	4	3	64	219	43	198
Bluntnose minnow	.	.	.	.	3	1	.	.	.	.	.	2	14	.	41	23	72
Creek chub	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	8	53	521	540	124	23	11	7	2	.	.	.	.	.	.	.
White sucker	.	.	.	5	2	.	.	.	.	.	.	.	.	.	.	.	.
Northern hog sucker	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	3	3	5	1	1	.	.	.	.	.	.	.	.
Yellow bullhead	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	1	1	5	11	422	131	13	14	.	2	.
Rock bass	.	.	.	.	10	22	17	.	.	.	3	2	.	1	.	1	1
Redbreast sunfish	.	.	.	.	.	.	.	.	.	.	5	.	.	16	2	.	.
Sunfishes	.	.	.	.	54	149	1	.	.	2	10	.	17	9	466	14	23
Smallmouth bass	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Largemouth bass	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Crappies	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
Tessellated darter	.	9	33	84	133	59	5	2	4	8	1	1	.	.	.	.	.
Banded darter	.	6	78	7	30	53	43	15	16	28	13	7	1	.	.	3	1
Yellow perch	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shield darter	.	7	3	5	2	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	2	.	25	13	1	2	.	1	.	1	1	.	1	.	.
Unidentified (eggs)	2	1	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.
Total	3	33	174	666	5287	483	107	38	43	206	501	164	73	205	832	184	538
Total taxa	2	6	7	7	17	17	14	11	10	12	12	9	10	10	8	10	R
Diversity (H)	0.92	2.33	1.84	1.11	1.16	2.84	2.61	2.55	2.76	2.29	1.07	1.19	2.78	2.50	1.65	2.11	2.22

Note: No fish were collected on 06, 11, and 24 April.

TABLE 3-5 SUMMARY OF ICHTHYOPLANKTON DENSITIES (N/100m3) TAKEN AT EIGHT STATIONS IN YORK HAVEN POND, APRIL THROUGH AUGUST 1989.

Date	TM-LF-4A1	TM-LF-9B1	TM-LF-10B2	TM-LF-11A1	TM-LF-12A1	TM-LF-13A2	TM-LF-14B1	TM-LF-16A1	Total
06 APR	.	.	.	.	.	.	.	.	.
11 APR	.	.	.	.	.	.	.	.	.
17 APR	.	.	1.70	.	3.44	.	.	.	0.65
24 APR	.	.	.	.	.	.	.	.	.
03 MAY	1.86	16.39	.	3.09	15.80	6.20	5.23	5.57	6.91
22 MAY	8.76	38.98	28.91	29.41	26.26	33.84	110.12	27.03	37.81
29 MAY	69.08	258.32	127.45	200.64	124.57	78.74	124.16	105.88	137.12
06 JUN	2135.82	1181.09	328.18	991.57	151.26	1138.05	333.90	2680.48	1115.40
12 JUN	41.97	137.76	38.25	96.15	87.46	90.30	243.33	76.92	102.81
21 JUN	12.74	13.13	17.99	15.20	10.26	46.08	63.97	16.42	23.48
27-28 JUN	.	9.66	5.07	3.57	8.10	11.22	23.26	1.69	7.94
06 JUL	1.71	12.59	8.16	10.40	19.30	3.32	14.81	6.69	9.52
10 JUL	14.55	51.36	48.24	63.24	43.63	60.30	16.25	63.33	44.43
17 JUL	63.27	178.76	89.53	120.07	67.29	143.35	75.70	145.79	110.67
24 JUL	25.41	23.81	27.03	10.03	34.54	83.19	13.40	63.49	34.97
01 AUG	29.46	11.08	21.49	19.45	31.56	.	1.78	6.83	15.24
07 AUG	30.86	41.20	28.07	55.96	55.16	32.99	97.65	29.11	46.39
16 AUG	36.59	3.50	131.94	15.28	30.46	5.23	1340.38	10.87	182.98
21 AUG	27.03	5.21	95.55	67.80	21.28	3.50	84.11	14.34	39.97
29 AUG	287.80	37.77	175.86	35.90	5.01	13.18	444.22	6.47	115.95
Density	143.72	104.97	59.70	86.08	36.80	87.97	145.52	161.53	102.79

Note: No fish were collected on 06, 11, and 24 April.

TABLE 3-6 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF COMMON CARP TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
3.6 - 4.0	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.
4.1 - 4.5	.	.	.	.	2	.	2	.	.	.	.	.	.	.	.	.	.	4	.	.	.
4.6 - 5.0	.	.	.	.	176	.	.	.	.	19	2	.	1	.	.	.	.	198	.	.	.
5.1 - 5.5	.	.	.	.	446	.	1	.	2	35	1	.	2	.	.	.	.	487	.	.	.
5.6 - 6.0	.	.	.	.	436	1	.	.	.	8	.	.	1	3	.	1	.	450	.	.	.
6.1 - 6.5	.	.	.	.	57	.	.	.	.	.	.	.	.	.	1	.	.	58	.	.	.
6.6 - 7.0	.	.	.	.	4	3	.	1	.	.	.	.	.	.	.	.	.	7	1	.	.
7.1 - 7.5	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.
7.6 - 8.0	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.
Total																		1207	2	0	0
Percent (%)																		99.83	0.17	0.00	0.00

TABLE 3-7 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF SPOTTAIL SHINER TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
< 3.6	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
3.6 - 4.0	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
4.1 - 4.5	.	.	.	2	15	4	.	.	.	.	.	.	.	.	.	.	.	21	.	.	.
4.6 - 5.0	.	1	1	24	115	5	.	.	1	.	.	.	.	.	.	.	.	147	.	.	.
5.1 - 5.5	.	1	2	13	78	8	.	.	.	.	.	.	.	.	.	.	.	102	.	.	.
5.6 - 6.0	.	.	.	3	16	2	.	.	.	.	.	.	.	.	.	.	.	20	1	.	.
6.1 - 6.5	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
6.6 - 7.0	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
9.1 - 9.5	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.
9.6 - 10.0	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Total																		298	3	0	0
Percent (%)																		99.00	1.00	0.00	0.00

TABLE 3-8 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF SPOTFIN SHINER TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.	.
4.6 - 5.0	.	.	.	.	.	.	.	.	.	13	4	.	2	16	4	2	.	41	.	.	.
5.1 - 5.5	.	.	.	.	.	1	1	.	1	42	12	9	6	23	19	6	2	121	1	.	.
5.6 - 6.0	.	.	.	.	5	1	1	.	2	23	2	5	1	1	14	2	2	59	.	.	.
6.1 - 6.5	.	.	.	.	.	2	.	.	.	2	.	.	1	2	13	.	2	17	5	.	.
6.6 - 7.0	.	.	.	.	.	.	.	.	.	.	1	.	.	3	6	4	1	1	14	.	.
7.1 - 7.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	4	.	.	.	6	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	.	.	.	5	2	5	.	.	12	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	.	.	.	2	1	3	5	.	.	11	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	6	1	.	13	.	.
9.1 - 9.5	.	.	.	.	.	.	1	.	.	.	.	1	.	.	7	2	1	.	12	.	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	2	.	7	.	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	6	2	.	7	6	.
10.6 - 11.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	6	1	.	4	5	.
11.1 - 11.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	10	4	.	2	14	1
11.6 - 12.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	3	.	1	7	.
12.1 - 12.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	8	1	.	1	11	.
12.6 - 13.0	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	4	1	.	.	.	7
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	2	.	.	1	4
13.6 - 14.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	4
14.1 - 14.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
15.1 - 15.5	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	1	2
15.6 - 16.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
16.6 - 17.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
17.1 - 17.5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2
17.6 - 18.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	4
18.1 - 18.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
18.6 - 19.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
19.1 - 19.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
21.1 - 21.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total																		241	96	45	33
Percent (%)																		58.07	23.13	10.84	7.95

TABLE 3-9 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF MIMIC SHINER TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	M	T	Y
4.1 - 4.5	.	.	.	.	.	.	.	.	.	.	.	.	.	29	1	3	2	35	.	.	.
4.6 - 5.0	.	.	.	.	5	.	.	.	.	2	13	2	.	21	8	9	25	85	.	.	.
5.1 - 5.5	.	.	.	.	3	1	.	.	1	1	8	1	1	10	26	1	3	56	.	.	.
5.6 - 6.0	.	.	.	.	.	.	.	.	1	.	.	.	1	.	42	1	1	46	.	.	.
6.1 - 6.5	.	.	.	.	.	.	.	.	1	.	.	1	.	.	49	.	1	50	2	.	.
6.6 - 7.0	.	.	.	.	.	.	.	.	.	.	.	.	.	2	39	.	6	28	19	.	.
7.1 - 7.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	10	4	31	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	9	2	23	.	35	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	4	25	.	32	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	24	.	27	.	.
9.1 - 9.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	5	19	.	24	2	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	5	12	.	15	5	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	4	12	.	4	14	.
10.6 - 11.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	7	.	.	12	.
11.1 - 11.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	6	.	.	9	.
11.6 - 12.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	4	.
12.1 - 12.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	2	2
12.6 - 13.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3
13.6 - 14.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	3
14.1 - 14.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
14.6 - 15.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
15.1 - 15.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	3
15.6 - 16.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
16.6 - 17.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
17.1 - 17.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
23.6 - 24.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total																		304	189	49	18
Percent (%)																		54.29	33.75	8.75	3.21

TABLE 3-10 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF QUILLBACK TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	M	T	Y
6.1 - 6.5	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
6.6 - 7.0	.	.	2	28	5	1	7	.	.	.	.	.	.	.	.	.	.	43	.	.	.
7.1 - 7.5	.	3	5	81	32	12	9	5	1	.	.	.	.	.	.	.	.	156	2	.	.
7.6 - 8.0	.	2	16	190	132	31	4	1	1	1	.	.	.	.	.	.	.	372	6	.	.
8.1 - 8.5	.	3	16	154	235	50	3	3	2	1	.	.	.	.	.	.	.	412	55	.	.
8.6 - 9.0	.	.	2	34	107	12	.	1	3	.	.	.	.	.	.	.	.	119	40	.	.
9.1 - 9.5	.	.	2	.	11	7	.	.	.	.	.	.	.	.	.	.	.	4	16	.	.
9.6 - 10.0	.	.	.	.	1	6	.	.	.	.	.	.	.	.	.	.	.	1	6	.	.
10.1 - 10.5	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
10.6 - 11.0	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
14.1 - 14.5	.	.	4	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	4	.	.
15.6 - 16.0	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
17.1 - 17.5	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Total																		1111	135	0	0
Percent (%)																		89.17	10.83	0.00	0.00

TABLE 3-11 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF CHANNEL CATFISH TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
13.6 - 14.0	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	2
14.1 - 14.5	.	.	.	.	.	.	.	.	.	.	7	1	.	1	.	.	.	.	.	.	9
14.6 - 15.0	.	.	.	.	.	.	.	.	.	1	8	5	1	.	.	1	.	.	.	.	16
15.1 - 15.5	.	.	.	.	.	.	.	1	.	3	22	12	2	3	.	.	.	.	.	.	43
15.6 - 16.0	.	.	.	.	.	.	1	.	.	2	86	19	1	4	.	.	.	.	.	.	113
16.1 - 16.5	.	.	.	.	.	.	.	.	1	2	113	25	4	3	.	.	.	.	.	.	148
16.6 - 17.0	.	.	.	.	.	.	.	.	.	.	102	28	2	.	.	.	.	.	.	.	132
17.1 - 17.5	.	.	.	.	.	.	.	.	4	1	46	21	.	2	.	.	.	.	.	.	74
17.6 - 18.0	.	.	.	.	.	.	.	.	.	2	21	7	1	1	.	.	.	.	.	.	32
18.1 - 18.5	.	.	.	.	.	.	.	.	.	.	4	6	2	.	.	.	.	.	.	.	12
18.6 - 19.0	.	.	.	.	.	.	.	.	.	.	6	1	.	.	.	.	.	.	.	.	7
19.1 - 19.5	.	.	.	.	.	.	.	.	.	.	5	1	.	.	.	.	.	.	.	.	6
19.6 - 20.0	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	.	.	4
21.6 - 22.0	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
22.1 - 22.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
Total																		0	0	0	600
Percent (%)																		0.00	0.00	0.00	100.0

TABLE 3-12 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF PUMPKINSEED/BLUEGILL TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	3	.	.	.
4.6 - 5.0	.	.	.	.	29	4	.	.	.	.	7	.	7	1	2	.	.	48	2	.	.
5.1 - 5.5	.	.	.	.	24	33	.	.	.	2	1	.	9	6	29	.	1	101	4	.	.
5.6 - 6.0	.	.	.	.	.	78	.	.	.	.	1	.	1	1	72	.	.	153	.	.	.
6.1 - 6.5	.	.	.	.	.	33	.	.	.	.	.	.	.	.	76	.	.	109	.	.	.
6.6 - 7.0	.	.	.	.	.	1	.	.	.	.	.	.	.	.	14	.	.	15	.	.	.
7.1 - 7.5	.	.	.	.	.	.	1	.	.	.	.	.	.	.	7	2	1	5	6	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	6	5	3	.	15	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6	3	.	11	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	.	6	.	.
9.1 - 9.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	.	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.
10.6 - 11.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	3	.
11.1 - 11.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.
11.6 - 12.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.
12.1 - 12.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	3	.
Total																		434	47	9	0
Percent (%)																		88.57	9.59	1.84	0.00

TABLE 3-13 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF TESSELLATED DARTER TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
4.6 - 5.0	.	3	.	4	44	4	1	1	.	5	.	.	.	.	.	.	.	62	.	.	.
5.1 - 5.5	.	4	3	55	64	30	3	.	2	3	1	1	.	.	.	.	.	166	.	.	.
5.6 - 6.0	.	2	23	24	15	22	1	.	1	.	.	.	.	.	.	.	.	85	3	.	.
6.1 - 6.5	.	.	6	1	7	2	.	.	.	.	.	.	.	.	.	.	.	12	4	.	.
6.6 - 7.0	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
13.6 - 14.0	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
Total																		327	8	0	1
Percent (%)																		97.32	2.38	0.00	0.30

TABLE 3-14 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF BANDED DARTER TAKEN BY PUSH NET IN YORK HAVEN POND, 1989. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 17	May 3	May 22	May 29	Jun 6	Jun 12	Jun 21	Jun 27	Jul 6	Jul 10	Jul 17	Jul 24	Aug 1	Aug 7	Aug 16	Aug 21	Aug 29	Total P	Total M	Total T	Total Y
4.6 - 5.0	.	1	.	.	2	2	2	.	.	3	2	.	.	.	.	1	.	13	.	.	.
5.1 - 5.5	.	.	3	4	9	9	16	1	.	6	6	3	.	.	.	.	.	57	.	.	.
5.6 - 6.0	.	1	28	.	7	16	13	.	4	14	4	4	.	.	.	.	.	91	.	.	.
6.1 - 6.5	.	2	32	2	7	17	5	6	4	4	1	.	1	.	.	1	1	83	.	.	.
6.6 - 7.0	.	.	13	1	4	8	5	6	3	1	.	.	.	.	.	.	.	30	11	.	.
7.1 - 7.5	.	1	.	.	1	1	.	.	2	.	.	.	.	.	.	.	.	3	2	.	.
7.6 - 8.0	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
17.6 - 18.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
Total																		278	13	0	1
Percent (%)																		95.21	4.45	0.00	0.34

TABLE 3-15

Three-factor analysis of variance test results for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1989. Test was performed on logarithmic transformed densities.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2 = 0.982)	186	1228.340	6.604	38.98	0.0001*
Date	19	999.620	52.612	310.54	0.0001*
Station	7	13.053	1.865	11.01	0.0001*
Replicate	1	0.370	0.370	2.18	0.1418
Date-Station	133	209.842	1.578	9.31	0.0001*
Date-Replicate	19	4.022	0.212	1.25	0.2285
Station-Replicate	7	1.433	0.205	1.21	0.3027
Error	133	22.533	0.169		
Corrected Total	319	1250.874			

* Significant at $P \leq 0.01$.

TABLE 3-16

Summary of Tukey's studentized range test for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1989. Underlined means are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest transformed [$\log_n$ (density+1)] mean. Means are lised parenthetically.

Date	6 Jun (6.65)	29 May (4.83)	17 Jul (4.64)	12 Jun (4.46)	29 Aug (3.81)	7 Aug (3.75)	10 Jul (3.68)	22 May (3.43)	16 Aug (3.40)	24 Jul (3.35)	21 Aug (3.16)	21 Jun (2.98)	1 Aug (2.24)	6 Jul (2.06)	27-28 Jun (1.78)	3 May (1.61)	17 Apr (0.22)	11 Apr (0.00)	6 Apr (0.00)	24 Apr (0.00)
Station*	14B1 (3.25)	10B2 (2.88)	11A1 (2.85)	12A1 (2.80)	9B1 (2.80)	16A1 (2.67)	13A2 (2.59)	4A1 (2.57)												
Replicate	B (2.84)		A (2.77)																	

* Station prefix TM-LF- deleted from table.

TABLE 3-17

Percent similarity indices of species composition between the ichthyoplankton stations in York Haven Pond, 1989. Station prefix TM-LF- deleted from table.

	12A1	13A2	4A1	10B2	9B1	11A1	16A1
14B1	36.6	32.7	24.0	41.6	29.4	36.7	23.8
12A1		48.1	20.9	69.5	60.6	51.2	31.9
13A2			66.9	51.7	77.9	88.1	78.4
4A1				22.9	54.1	61.1	85.1
10B2					57.8	57.8	33.2
9B1						83.6	65.9
11A1							72.4

TABLE 3-18

Annual summary of ichthyoplankton numbers and densities (n/100 m^3) taken by push net at eight stations in York Haven Pond, 1977 through 1989.

Year	TM-LF-14B1		TM-LF-12A1		TM-LF-13A2		TM-LF-4A1		TM-LF-10B2		TM-LF-9B1		TM-LF-11A1		TM-LF-16A1	
	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density
1977	2249	138.50	546	30.84	1273	64.30	4555	273.12	2187	133.93	1570	90.15	821	47.43	870	49.24
1978	2642	210.29	833	58.86	2272	181.10	3745	305.65	1039	78.19	2028	138.05	1506	126.67	1671	141.08
1979	3221	245.77	1299	89.46	1286	98.77	2373	192.54	1289	84.47	1284	93.30	1121	79.79	1282	94.37
1980	3252	284.26	900	61.39	1132	90.33	4457	415.87	1926	138.64	1538	115.72	849	67.02	798	68.16
1981	3241	233.04	1170	79.55	1520	105.00	3030	220.21	3314	234.14	2181	152.30	1256	88.88	1544	104.52
1982	5981	528.80	424	32.76	1069	84.57	1692	150.73	1083	87.87	1303	101.50	974	71.81	841	63.84
1983	11081	870.34	1172	93.53	1191	95.42	5507	436.24	3946	304.18	3896	299.80	1636	130.42	1332	109.91
1984	2402	219.47	837	74.68	550	50.94	1196	113.00	1690	155.92	1039	93.46	1028	95.53	915	87.98
1985	2310	188.06	741	57.12	583	47.41	6131	542.51	1364	104.96	967	72.27	790	61.39	809	63.84
1986	5494	422.00	1575	106.39	2069	138.90	8280	662.10	1905	129.90	3077	204.12	1403	96.06	1569	106.61
1987	4450	382.66	379	31.01	788	64.70	4086	355.12	556	44.05	854	67.36	1112	88.89	838	67.46
1988	24667	2047.73	818	62.48	993	76.82	8681	687.22	1020	78.14	992	73.40	986	74.35	905	68.44
1989	1603	145.52	429	36.80	1040	87.97	1620	143.72	691	59.70	1238	104.97	1031	86.08	1885	161.53

TABLE 3-19

Annual summary of the most abundant ichthyoplankters taken by push net at eight stations in York Haven Pond, 1977 through 1989.

Year	Gizzard shad		Common carp		Spottail shiner		Spotfin shiner		Mimic shiner		Quillback		Channel catfish		Pumpkinseed/ Bluegill		Tessellated darter		Banded darter	
	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density	Number	Density
1977	-	-	4464	41.08	1722	21.03	1006	9.64	-	-	1007	14.62	-	-	3808	33.32	475	6.35	147	1.70
1978	-	-	5156	79.06	2115	32.04	642	9.46	-	-	3283	62.40	-	-	1910	28.94	180	2.49	1355	18.42
1979	-	-	2460	32.52	1345	13.63	624	7.19	-	-	2587	37.99	-	-	3841	52.43	1048	12.51	419	4.76
1980	-	-	3024	37.77	667	15.70	1262	18.20	-	-	1997	37.38	-	-	5784	91.50	974	15.28	525	7.23
1981	-	-	317	4.40	4987	100.13	4180	47.77	-	-	2111	35.37	-	-	2935	37.37	1127	14.36	402	4.10
1982	-	-	2374	33.92	769	10.93	1472	19.30	-	-	1040	20.06	-	-	6630	89.20	197	3.00	308	4.26
1983	-	-	2758	48.13	1821	26.49	3452	44.64	-	-	5298	104.18	-	-	12109	181.55	1219	17.12	729	10.86
1984	-	-	2089	57.80	273	7.23	2224	30.38	-	-	2655	54.92	-	-	644	17.19	301	4.99	292	4.47
1985	-	-	697	15.12	731	15.57	2242	27.23	365	4.59	759	20.85	-	-	6661	96.51	1162	22.02	-	-
1986	-	-	1084	20.48	3887	80.69	3004	27.84	-	-	2181	41.84	-	-	9042	122.91	1735	28.98	1764	29.19
1987	560	5.73	972	9.94	588	6.01	1313	13.43	-	-	1057	10.81	481	4.92	6532	66.81	-	-	-	-
1988	-	-	906	8.73	405	3.90	1044	10.06	-	-	1442	13.90	-	-	33221	320.20	513	4.94	426	4.11
1989	-	-	4313	46.48	306	3.30	420	4.53	567	6.11	1289	13.89	600	6.47	745	8.03	339	3.65	301	3.24

TABLE 3-20

Three-factor analysis of variance test results for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1977 through 1989. Test was performed on logarithmic transformed densities.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2 = 0.806)	374	15219.440	40.694	42.81	0.0001*
Year	12	268.392	22.366	23.53	0.0001*
Date	14	9657.912	689.851	725.80	0.0001*
Station	7	582.552	83.222	87.56	0.0001*
Year-Date	159	2564.352	16.128	16.97	0.0001*
Year-Station	84	215.740	2.568	2.70	0.0001*
Date-Station	98	829.735	8.467	8.91	0.0001*
Error	3865	3673.571	0.950		
Corrected Total	4239	18893.011			

* Significant at $P \leq 0.01$.

TABLE 3-21

Summary of Tukey's studentized range test for ichtyoplankton densities collected at eight stations in York Haven Pond, April through August 1977 through 1989. Underlined means are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest transformed [$\log_n$ (density+1)] mean. Means are listed parenthetically.

Year	1981	1983	1986	1987	1988	1980	1985	1979	1982	1977	1989	1978	1984
	(3.69)	(3.66)	(3.42)	(3.40)	(3.38)	(3.34)	(3.24)	(3.23)	(3.08)	(2.88)	(2.80)	(2.79)	(2.40)

Date	1-10 Jun	21-31 May	11-20 Jun	11-20 May	21-31 Jun	11-20 Jul	21-31 Jul	1-10 Jul	1-10 Aug	11-20 Aug	21-31 Aug	1-10 May	21-31 Apr	11-20 Apr	1-10 Apr
	(5.11)	(4.93)	(4.63)	(4.42)	(4.05)	(4.04)	(3.89)	(3.85)	(3.19)	(2.89)	(2.18)	(2.07)	(0.59)	(0.05)	(0.04)

Station*	14B1	4A1	10B2	9B1	11A1	13A2	12A1	16A1
	(4.00)	(3.54)	(3.40)	(2.98)	(2.97)	(2.90)	(2.85)	(2.77)

* Station prefix TM-LF- deleted from table.

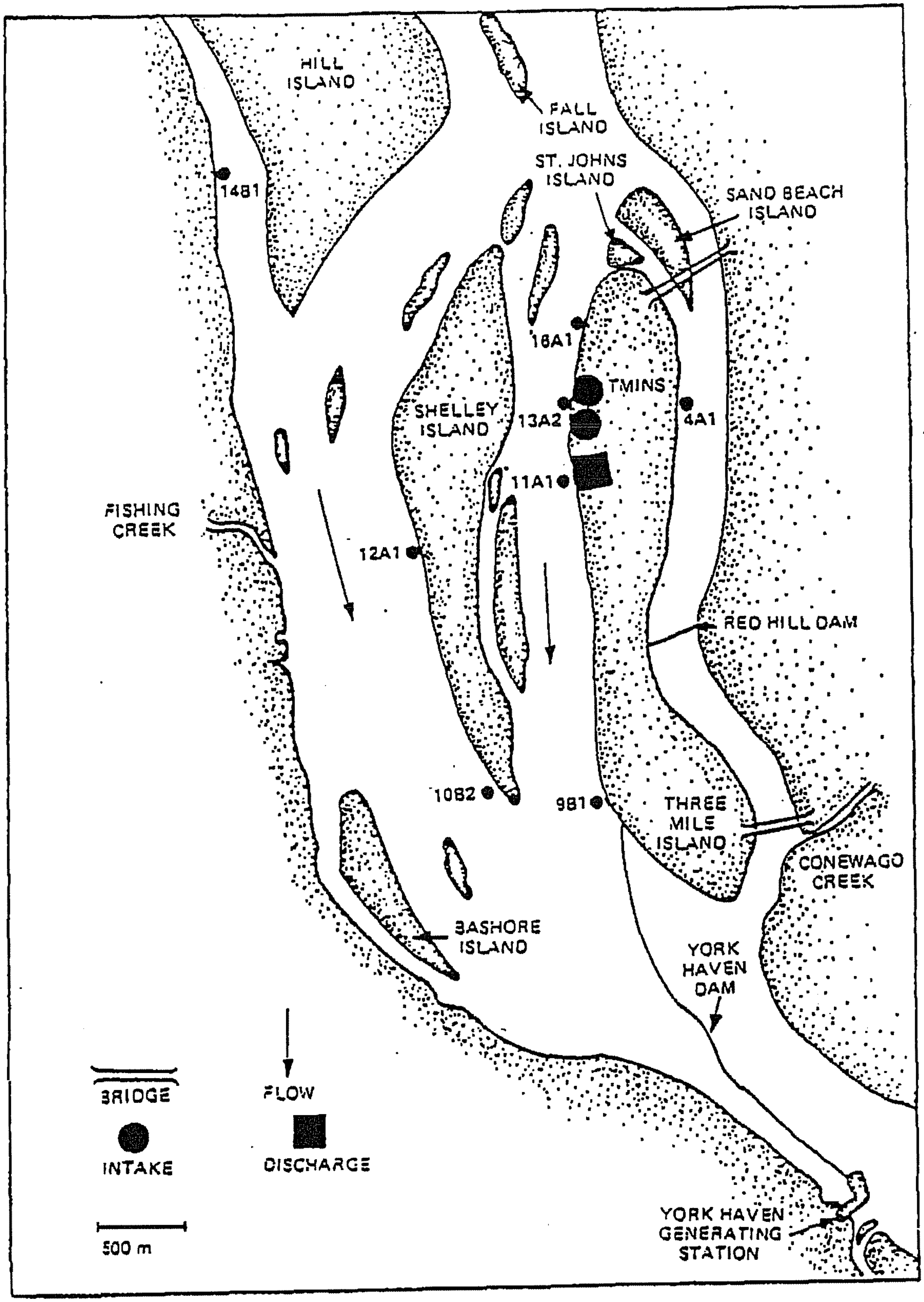

Figure 3-1. Location of ichthyoplankton stations sampled in York Haven Pond (station prefix TM-LF- deleted.

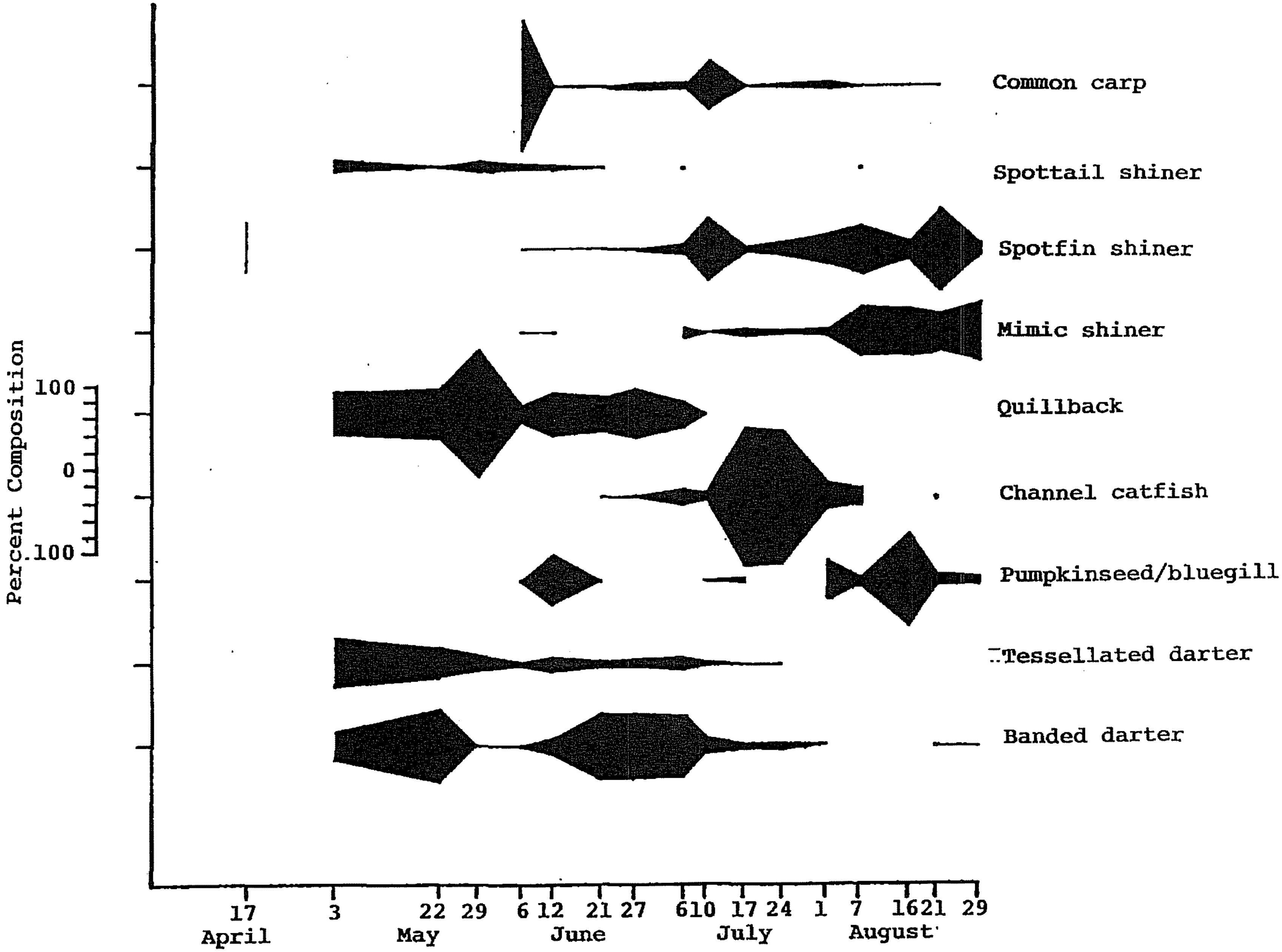

FIGURE 3-2

Percent composition by density of the nine most abundant ichthyoplankton taxa taken in York Haven Pond, April through August 1989.

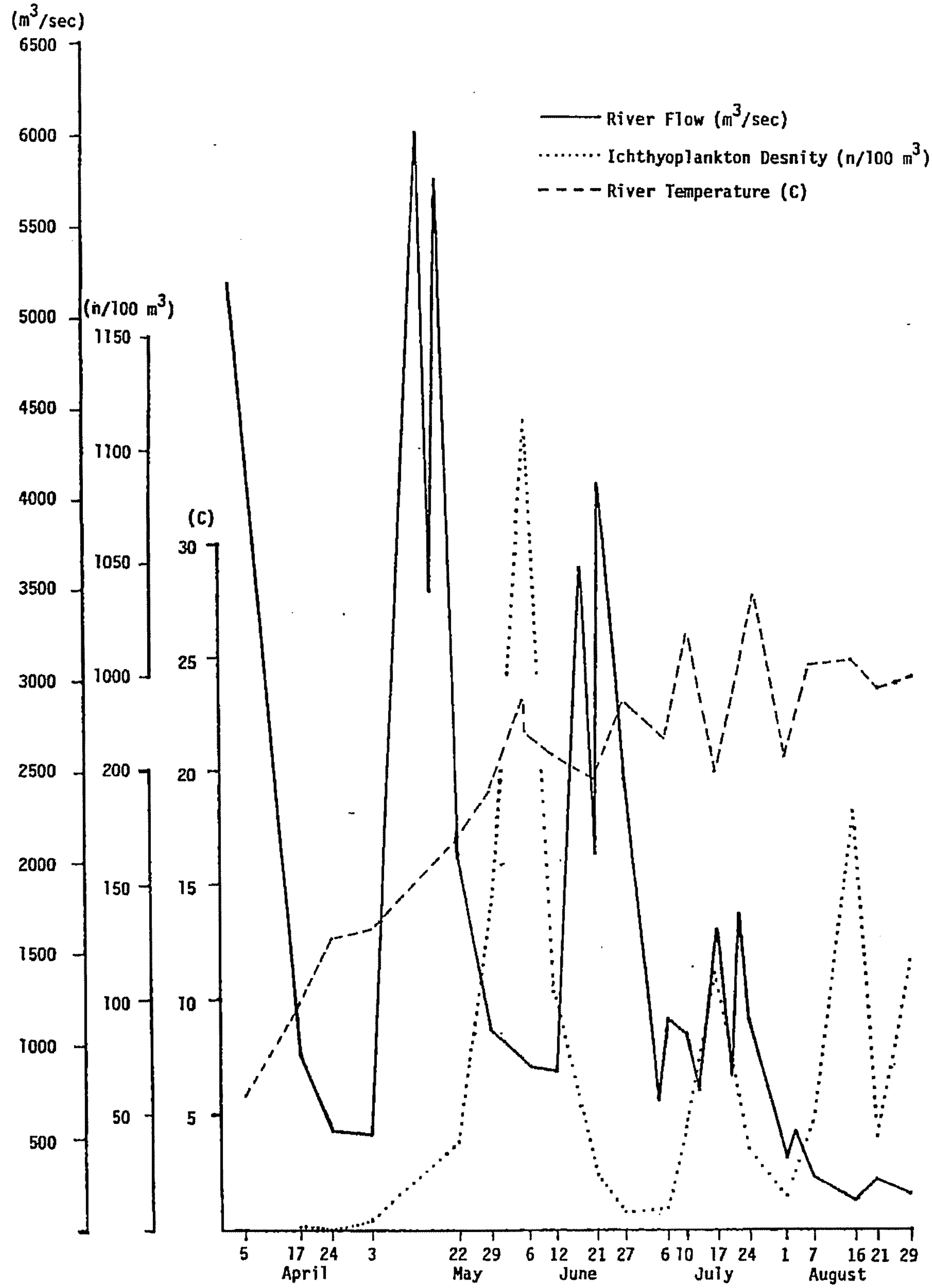

FIGURE 3-3

Mean river temperature (C), mean ichthyoplankton density (n/100 m^3), and river flow (m^3/sec) recorded in York Haven Pond, April through August 1989.

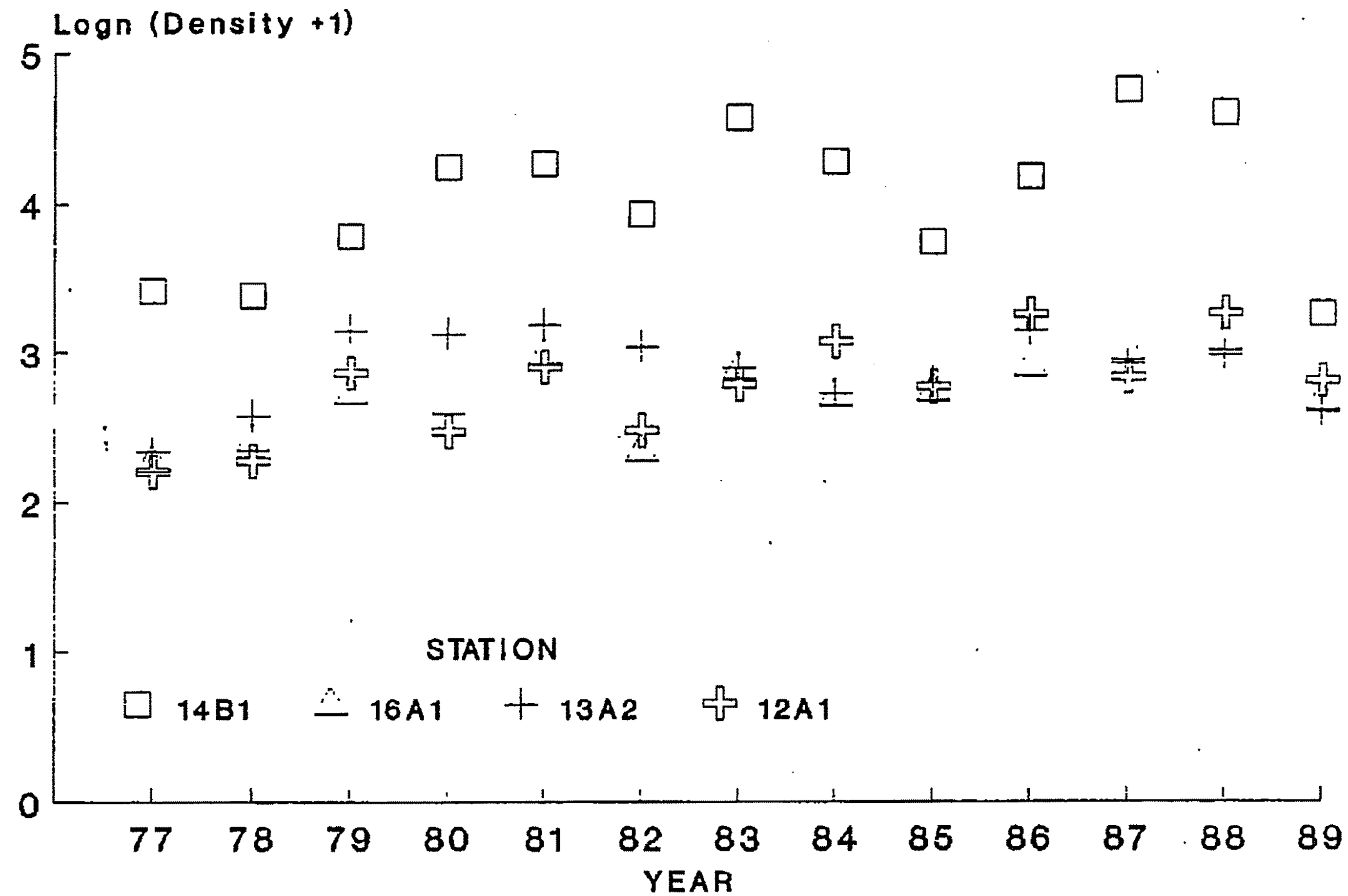

Figure 3-4. Annual variation in total ichthyoplankton density at selected stations near TMINS, 1977 through 1989.

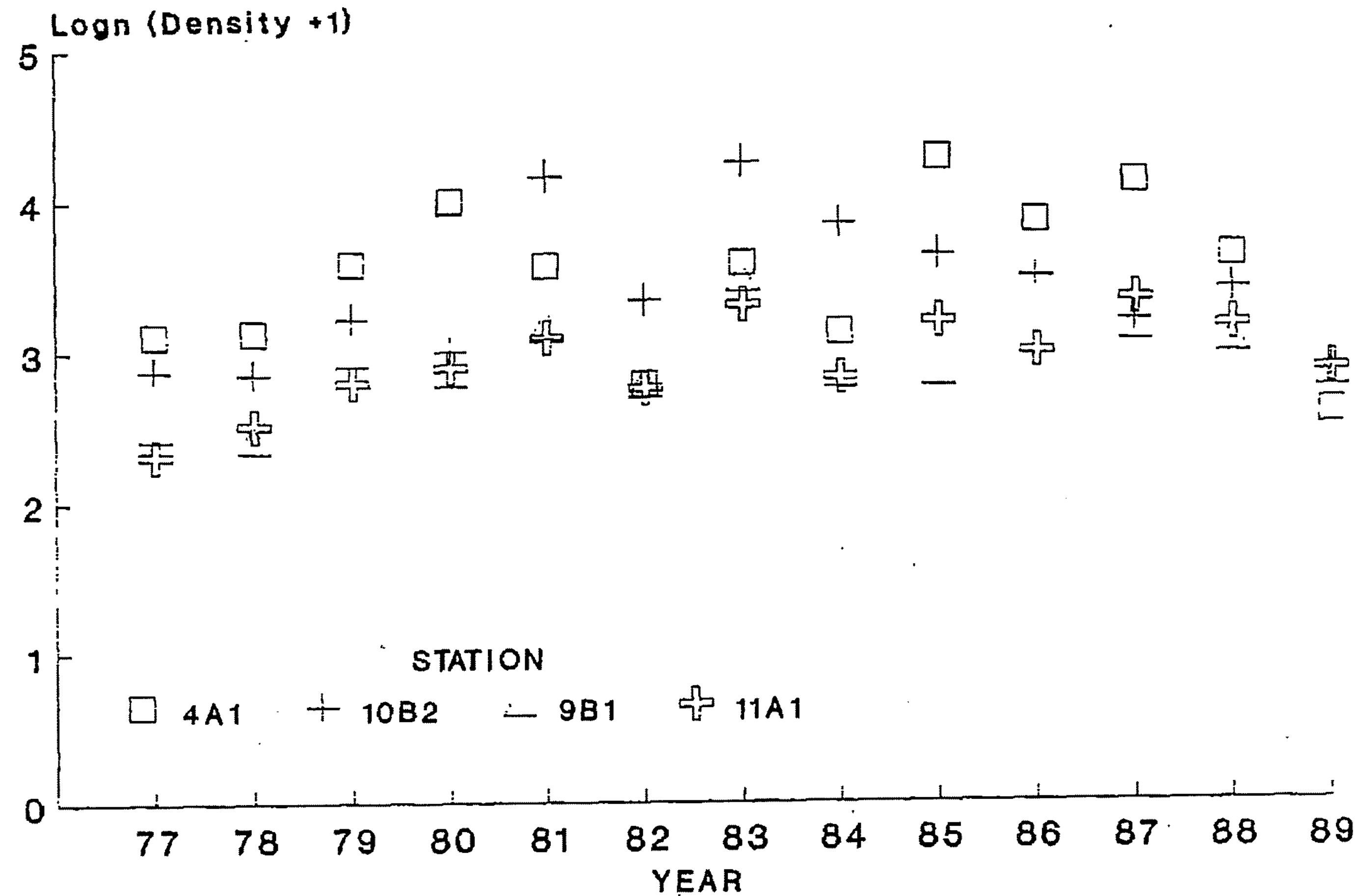

Figure 3-5. Annual variation in total ichthyoplankton density at selected stations near TMINS, 1977 through 1989.

4. SEINE

4.1 METHODS

Seine surveys were conducted at six shoreline stations in York Haven Pond (Figure 4-1). Specific locations and habitat characteristics are described in Table 4-1. Surveys were conducted twice each month in May, June, August, and September, and once each in April, July, October, and November 1989.

Data recorded for each survey were weather, time, duration of sample (in minutes), air and surface water temperatures, surface dissolved oxygen concentration and pH, Secchi disc, estimated water depth, substrate type, and number of hauls. River stage was obtained from the River Forecast Center in Harrisburg, Pennsylvania for 0700 hour. Instrumentation and procedures are described in Chapter 7 and GPU (1987), respectively.

A 3.05 m by 1.22 m straight seine with 0.32 cm mesh was used. The seine was deployed and moved parallel to shore for a short distance, then moved into shore to trap fish. Since size and habitat of seine stations varied (Table 4-1), effort was made to collect a representative qualitative sample (Hocutt 1981) based on complete coverage of all available habitats, rather than a specified number of hauls at each station.

All specimens collected at a station were fixed in 10% formalin except for large fish (>150 mm fork length, FL) which were identified, measured, and released near the site of capture. In the laboratory, the fish were removed from formalin, rinsed twice in water, and preserved in 40% isopropanol.

Specimens in each collection were identified and measured to within a 5 mm FL interval. Specimens within these length intervals were weighed together to the nearest 0.1 g. For collections that contained more than 125 fish of one species, a subsample of 125 fish of that species was removed for length and weight analysis; all specimens were counted. Specimens weighed and measured were also examined for the presence of external parasites, disease, or morphological anomalies.

Primary taxonomic aids were Cooper (1983), Moore (1968), and Trautman (1981). Scientific and common names of fishes and taxonomic order of presentation (Table 4-2) followed Robins et al. (1980).

Family composition at individual stations was computed by summing the percentage contributed by fishes within each family.

Data analyses consisted of calculating condition factor (K), percent similarity (PSc) among sampling station catches, and species diversity by station and date. The percent similarity (PSc) index of Whittaker and Fairbanks

(1958), and Shannon-Wiener (Shannon-Weaver) index of diversity (H') are described in Chapter 2.

Condition factor (Ricker 1975) for fishes that comprised more than 10% of the 1989 catch was calculated from the formula:

$$K = \frac{W \times 10^5}{FL^3}$$

where

K = condition factor of the 5 mm FL group and

W = mean weight in grams per 5 mm FL group.

The upper limit of each 5 mm FL group and the mean weight for that group were used for the calculation of condition factor as was done previously (EA 1985, 1986, 1987; Nardacci and Associates 1983, 1984; RMC 1988a, 1989).

Number per seine haul was calculated by dividing the total number of fish captured by date or station by the number of hauls executed on the date or station. For species accounting for more than 10% of the catch, reproductive status was classified as follows: young were spawned during the current calendar year; juveniles were spawned in a previous calendar year but were, as yet, incapable of reproduction; and adults were capable of reproduction. Classifications were based on information in the literature (Carlander 1953, 1969, 1977; Miller and Buss

1963; Scott and Crossman 1973; Trautman 1981) and were confirmed in the field when possible.

4.2 COMPOSITION, RELATIVE ABUNDANCE, AND DISTRIBUTION: 1989

Results of 1989 seine collections are presented in Appendix C and summarized in Tables 4-3 through 4-5. A total of 305 hauls yielded 45,980 fish of 33 species (Table 4-4). Most fish (19,616) were taken at Station 13B5 and most species (27) at Station 16A1. The mean number of specimens per haul at individual stations ranged from 46.44 at Station 10B5 to 502.97 at Station 13B5.

Carps and minnows (cyprinids) ranked first in family composition, and comprised 91.5% of the total catch (Table 4-5). Other common families were sunfishes, second in abundance (5.5% of the total catch); herrings (1.2%); and perches (1.0%). The mimic shiner comprised 59.9% of the total catch; it was the most abundant species in 1989, and ranked first at Stations 13B5 and 9B3 (Table 4-4). The spotfin shiner ranked second in abundance (28.1%); it was most common at Stations 10A2, 16A1, and 10B5. Other common fishes were the bluegill (2.5%), pumpkinseed (2.1%), bluntnose minnow (1.6%), gizzard shad (1.2%), spottail shiner (1.1%), and tessellated darter (1.0%). No other species accounted for more than 1.0% of the catch.

Total catches varied widely during the year (Table 4-3). The lowest catch occurred on 3 August when only 640 specimens were collected; the highest catch (11,821 specimens) occurred on 18 September. Generally, the seine catch decreased from 13 April through 3 August, increased sharply to a peak on 18 September, and then declined through November.

The temporal distribution of total catches was primarily influenced by spotfin shiner and mimic shiner abundance (Table 4-3). Spotfin shiner and mimic shiner were common throughout the sample period, but were most abundant from September through November when they comprised from 88.1% to 96.9% of the catch. Spotfin shiner abundance peaked on 18 October, while mimic shiner peaked on 18 September. Among other species, spottail shiner and tessellated darter were abundant from April through July. Pumpkinseed and bluegill were common throughout the sample period, but were most abundant in the spring (April through June) and fall (September through November), respectively. Bluntnose minnow occurred throughout the sample period, but was most common in April, May, and November. Gizzard shad were most common in September, when 99.4% of their annual total occurred. This variation in species abundance generally reflected the different spawning times of fishes, and the ensuing period when young inhabit inshore areas and become vulnerable to seine capture.

Spatial distribution of fishes in the catch is presented in Table 4-4. Station 13B5, on the west shore of York Haven Pond, produced the largest catch. The smallest catch occurred at Station 4A2, in the east channel. These catch differences were the result of the variability in the abundances of the spotfin shiner and mimic shiner.

Seine catches were also evaluated in terms of fish per seine haul. This provided a more realistic assessment of the fish encountered during any given sampling episode. Because the total number of hauls for the year was generally similar among sampling dates, the fish per haul paralleled the temporal distribution (Table 4-3). This was generally true for the sampling stations, excepting at Station 10B5 where more effort (hauls) resulted in fewer fish per haul (Table 4-4).

Biomass totaled 12,554.3 g for the year (Table 4-6). Peak biomass occurred on 21 June (1,386.3 g). Station 13B5 had the highest biomass for a single station (2,974.3 g), while Station 10B5 had the lowest (1,450.8 g). The distribution of biomass among sampling stations and dates varied as the number and size of the specimens varied.

4.3 CONDITION FACTOR (K) AND REPRODUCTIVE STATUS

Condition factors and reproductive status for spotfin shiner and mimic shiner, the only fishes that comprised more than 10% of the 1989 catch, are presented in Tables 4-7 and 4-8. The mean weights for individual length intervals were similar per species among stations with large (>25 specimens) comparable catches. The K factor for spotfin shiner ranged from 0.35 to 1.74. There was a general trend of increasing K factor with increasing length. Mimic shiner K factors ranged from 0.52 to 1.20. Like the spotfin shiner, K factors for mimic shiner increased as length increased. The increasing K factor for these species reflected the tendency for increased body depth with increased length.

There was no discernible pattern of K factors among sampling stations that would suggest any positive or negative influences of TMINS. Because of the mobility of these small schooling fishes, it is doubtful that they stay in any location long enough to be affected by conditions at that location. Thus, the K factors reflect general conditions in York Haven Pond.

Young and juvenile spotfin shiners were abundant at all stations, except 4A2, while adults were uncommon (1.3% of the total catch) (Table 4-7). Young mimic shiners were common at all stations, particularly Stations 13B5 and 9B3, while juveniles were most common at Station 16A1. Only one adult was taken (Table 4-8).

4.4 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

The 1989 fish community was examined by measures of diversity and percent similarity. The Shannon-Wiener function for diversity (H') was calculated for the annual catch at each station (Table 4-3) and for each date with stations combined (Table 4-4). Annual station diversity ranged from 0.81 at Station 13B5 to 2.88 at Station 4A2. The low H' at Station 13B5 resulted from the large catch of spotfin shiner and minic shiner (96.9% of the catch) in relation to the numbers caught among the other species. In contrast, the high H' at Station 4A2 reflects a more even distribution of individuals among species. Sampling date diversity ranged from 0.83 on 2 November to 3.09 on 14 July. There was a general trend towards increased diversity from April through July, followed by a decline through November as large numbers of young spotfin shiner and mimic shiner entered the catch. Low diversities resulting from the collection of vast numbers of gregarious young fishes are a natural phenomena (Hocutt 1981).

Seine diversity in 1989 was compared to previous study years by plotting annual station H' values with months combined (Figure 4-2), and monthly H' values with stations combined (Figure 4-3). Compared to 1988, the 1989 monthly data increased slightly. The decreasing trend noted (EA 1987) from 1977 through 1985 was reversed trend from 1986 through 1989 (Figure 4-3). A similar trend was evident for station diversity, but it appeared to stop in 1984 and began a steady increase through 1988. In 1989, this trend was reversed again and decreased slightly. EA (1985, 1986, 1987) postulated that the decrease in diversity was related to the increased dominance of spotfin shiners. It was further suggested (EA 1986) that the increase in the trend was related to the subsequent reduction in the proportion of spotfin shiners in the total catch. The decrease in station H' values in 1989 was coincident with the dramatic increase of mimic shiner (59.9% of the total catch), and the drastic reduction of spottail shiner, bluntnose minnow, fallfish, white sucker, pumpkinseed, bluegill, and tessellated darter from their relative importance in the 1988 catch.

Percent similarity (PSc) compares the station catches in terms of species composition, and provides another type of comparison of the fish community. Similarity values for pairwise station comparisons are presented in Table 4-9. Low values indicate relatively dissimilar communities between two stations, while higher values indicate similar communities. Like many of the community and abundance parameters discussed previously, the similarity data appeared to be much influenced by the abundance of spotfin shiner and mimic shiner. For example, the lowest PSc (20.0%) occurred between Stations 13B5 and 4A2 and resulted from the extreme dominance of mimic shiner and spotfin shiner at Station 13B5 (Table 4-4). Relative abundance of these species was similar between Stations 13B5 and 9B3, and resulted in the high PSc (86.7%). There was no pattern to suggest any influence of the TMINS discharge. Sampling Station 10A2 (downstream of the discharge) was quite similar (88.3%) to Station 16A1 (upstream of the discharge).

Previously (EA 1985, 1986, 1987), the percent similarity at stations upstream and downstream of the TMINS discharge was used to investigate differences between operational (1976 to 1978 and 1986 to 1989) and non-operational (1979 to 1985) years (Figure 4-4). The PSc values for both pairwise station comparisons were within the range observed previously. There was no pattern that distinguished operational and non-operational years, and consequently no indication that the TMINS discharge influenced the community of smaller fishes.

4.5 MULTIPLE-YEAR COMPARISONS: RELATIVE ABUNDANCE

The seine catches were examined for the study period with catch per seine haul of common species (Table 4-10). The total 1989 catch (45,980 fish) represented a minor increase over the 1988 catch (44,691). However, since 44 additional hauls were taken in 1989, the catch in terms of fish per haul was slightly lower (171.23/haul in 1988 vs. 150.75/haul in 1989). The total 1989 catch was within the range observed previously, and was largely influenced by the abundance of spotfin shiner, spottail shiner, and mimic shiner (since 1987). Compared to 1988, there were substantial decreases in many important species. Among these, spottail shiner decreased 93.6% to its lowest total since 1984. Decreases were also noted for bluntnose minnow (42.0%), fallfish (94.6%), white sucker (95.8%), pumpkinseed (62.3%), bluegill (54.3%), and tessellated darter (53.5%). However, these decreases were compensated by a major increase in mimic shiner abundance (139.1% over its 1988 total), which attained its highest total to date. The catch of spotfin shiner also increased slightly (28.8%).

The seine catches in 1989 appeared to further reflect the effect of natural population cycles. A strong year class was indicated for mimic shiner and spotfin shiner, but several other species suffered weak year classes as evidenced by steep downturns in their abundances. EA (1986, 1987) pointed out that a number of factors can affect the abundance of fishes from year to year, including river flow, water temperature, food availability, and competition. Substantially higher river flow in 1989 and lower water temperature, particularly April through July, favored the success of late summer spawning fishes.

Seasonal Susquehanna River flow patterns, normally characterized by high spring flows and lower flows in summer and fall, favor the intermittent spawning of spotfin shiner

(Gale and Gale 1976) throughout July and August. Intermittent spawning prolongs the spawning season and protects the species against the destruction of entire year classes (Nikolsky 1963). July and August river flows are normally low and stable, as occurred in 1989, and afford optimal spotfin shiner spawning conditions. Consequently, spotfin shiner were very abundant during September and October. In contrast, spottail shiner and white sucker spawn in May and June, therefore their reproductive success is subject to high and/or rapidly fluctuating river flow. Heavy rains in May and June 1989 greatly increased river flow and depressed water temperature and may explain the downward trend in spottail shiner and white sucker numbers. Starrett (1951) documented the negative effects of similar high water on the spawning success and subsequent abundances of minnows in the Des Moines River, where the spotfin shiner and sand shiner (*Notropis stramineus*), another late spawner, dominated. Increased catches of the mimic shiner, a species closely related to *N. stramineus*, are also likely due to its July and August spawning period.

Previous reports (EA 1985, 1986, 1987; RMC 1988a, 1989) examined the annual seine catch (number per haul) of dominant fishes at stations upstream (16A1) and downstream (10A2 and 9B3) of the TMINS discharge to determine differences. The annnual abundance of spotfin shiner, spottail shiner, and white sucker are presented in Figures

4-5 through 4-7. For 1989, all species catches were similar at stations immediately upstream (16A1) and downstream (9B3) of the TMINS discharge. Unlike spotfin shiner, catches of spottail shiner and white sucker at Station 10A2 were below those at either Station 16A1 or 9B3. Yet, all values were within previously established ranges, except for spottail shiner at 10A2 and 9B3 which established new lows for the study. Therefore, the variability in station catches was attributed to natural spatial and temporal distribution of these species rather than to any influence of the TMINS discharge.

4.6 PARASITES, DISEASE, AND MORPHOLOGICAL ANOMALIES

Fishes collected during routine seine surveys were examined for external parasites, diseases, or morphological anomalies. Although none of these conditions are unusual in natural fish populations, a high frequency of any affliction in one or more species may be evidence of stress.

In 1989, a total of 12,872 fish was examined; 1,711 specimens of 24 fishes had one or more types of parasites, infections, and/or morphological anomalies (Table 4-11). With the exception of black spot (fluke cysts), glochidia (larvae of freshwater mussels), pugheadedness, and skin infections, affliction rates were less than 1.0%. Black spot was most prevalent on spotfin shiner (8.3% of those examined) and bluntnose minnow (14.8%). Glochidia were most common on cyprinids (27.1%) and sunfishes (53.2%). Skin infections (which included fin rot, fin damage, fungus, and tumors) were observed on 17 fishes, mostly on spottail shiner, spotfin shiner, mimic shiner, redbreast sunfish, pumpkinseed, and bluegill. The gregarious nature of young fishes, particularly spotfin shiner in slow-moving waters, allows close proximity of parasite and host, and may explain the relatively high incidences of black spot parasitism.

A total of 342 fish exhibited morphological anomalies. Pugheadedness (abnormal formation of the skull) was most common and occurred primarily on spotfin shiner (72), and mimic shiner (202). Scoliosis (lateral spinal curvature) was observed on seven different fishes. Ten spotfin shiner, 8 mimic shiner, and 1 each of the bluntnose minnow and bluegill exhibited mouth (mandibular) deformity.

Patterns of parasitic infection and morphological anomalies observed in 1989 were similar to those reported previously (EA 1985, 1986, 1987; Nardacci and Associates 1980, 1981, 1982, 1983, 1984; RMC 1988a, 1989). It appears the patterns were most affected by natural trends in parasite life cycles, water temperature, and natural conditions rather than influences associated with TMINS operation.

TABLE 4-1

Location and description of seine stations sampled in York Haven Pond.

Station Number	Location and Description
TM-SE-13B5[a]	Boat launch along northwest shore of York Haven Pond just downstream from southernmost Pennsylvania Fish Commission boat ramp. Bottom consisted of mud interspersed with a few large boulders. A small backwater sometimes receiving runoff was also seined. About 20 m of shoreline was sampled; depth averaged 0.7 m.
TM-SE-10B5	Southwest shore of York Haven Pond just upstream from York Haven Generating Station race. The station extended from a mud-bottomed beach interspersed with debris and rubble to a bedrock enclosed backwater about 100 m downstream. Water willow (Justicia americana) and wild celery (Vallisneria americana) were common. The beach averaged 0.7 m in depth; the backwater averaged 1.0 m.
TM-SE-16A1	West shore of TMI near Gate 19 about 500 m upstream from discharge. The station extended from a rubble and boulder shoreline to a mud-bottomed run about 25 m downstream. Coal dirt and gravel were also common along the shoreline, which supported water willow. Average depth was 0.8 m.
TM-SE-10A2	West shore of TMI, 150 m downstream from discharge. The station extended about 75 m along a gravel beach that averaged 0.7 m in depth. Gravel, mud, and coal dirt were common substrates. Water willow covered the shoreline and was often partially submerged.
TM-SE-9B3	West shore of TMI, 2,000 m downstream from discharge. Most sampling was done along a gravel beach and boat ramp. Offshore, the bottom changed to mud. About 20 m of shoreline was sampled; average depth was 0.7 m. Large trees lined the shoreline upstream from the boat ramp and were sometimes partially submerged. The York Haven Dam marked the downstream end of the station and created a backwater.
TM-SE-4A2	East shore of east channel. Main substrate was mud, but rubble and some boulders were also common. About 25 m of shoreline was sampled; the bottom dropped abruptly to a depth of about 0.9 m. The beach was supported by submerged railroad ties.

(a) Prefix TM-SE- deleted from station numbers for discussion in text.

TABLE 4-2

List of scientific and common names of fishes collected by seine from the Susquehanna River near TMINS in 1989.

Scientific Name	Common Name
Clupeidae	Herrings
Alosa sapidissima (Wilson)	American shad
Dorosoma cepedianum (Lesueur)	Gizzard shad
Osmeridae	Smelts
Osmerus mordax (Mitchill)	Rainbow smelt
Cyprinidae	Carps and Minnows
Cyprinus carpio Linnaeus	Common carp
Notemigonus crysoleucas (Mitchill)	Golden shiner
Notropis amoenus (Abbott)	Comely shiner
Notropis cornutus (Mitchill)	Common shiner
Notropis hudsonius (Clinton)	Spottail shiner
Notropis procne (Cope)	Swallowtail shiner
Notropis rubellus (Agassiz)	Rosyface shiner
Notropis spilopterus (Cope)	Spotfin shiner
Notropis volucellus (Cope)	Mimic shiner
Pimephales notatus (Rafinesque)	Bluntnose minnow
Rhinichthys atratulus (Hermann)	Blacknose dace
Semotilus corporalis (Mitchill)	Fallfish
Catostomidae	Suckers
Catostomus commersoni (Lacepede)	White sucker
Hypentelium nigricans (Lesueur)	Northern hog sucker
Moxostoma macrolepidotum (Lesueur)	Shorthead redhorse
Ictaluridae	Bullhead catfishes
Ictalurus punctatus (Rafinesque)	Channel catfish
Cyprinodontidae	Killifishes
Fundulus diaphanus (Lesueur)	Banded killifish

TABLE 4-2

Continued.

Scientific Name	Common Name
Centrarchidae	Sunfishes
Ambloplites rupestris (Rafinesque)	Rock bass
Lepomis auritus (Linnaeus)	Redbreast sunfish
Lepomis cyanellus Rafinesque	Green sunfish
Lepomis gibbosus (Linnaeus)	Pumpkinseed
Lepomis macrochirus Rafinesque	Bluegill
Micropterus dolomieui Lacepede	Smallmouth bass
Micropterus salmoides (Lacepede)	Largemouth bass
Pomoxis annularis Rafinesque	White crappie
Pomoxis nigromaculatus (Lesueur)	Black crappie
Percidae	Perches
Etheostoma olmstedi Storer	Tessellated darter
Etheostoma zonale (Cope)	Banded darter
Percina peltata (Stauffer)	Shield darter
Stizostedion vitreum vitreum (Mitchill)	Walleye

TABLE 4-3

Temporal distribution of fishes taken by seine near TMINS in 1989.

	13 Apr	22 May	30 May	8 Jun	21 Jun	14 Jul	3 Aug	16 Aug	7 Sep	18 Sep	18 Oct	2 Nov	Total	% Catch
American shad	-	-	-	-	7	2	-	-	-	-	-	-	9	+
Gizzard shad	-	-	-	-	-	3	-	-	267	275	-	-	545	1.2
Rainbow smelt	-	-	1	-	-	-	-	-	-	-	-	-	1	+
Common carp	-	-	-	1	-	-	-	-	-	1	-	-	2	+
Golden shiner	3	-	2	1	1	1	-	-	2	1	1	-	12	+
Comely shiner	-	2	1	-	-	1	6	21	6	2	3	-	42	0.1
Common shiner	1	-	-	-	-	-	-	-	-	-	-	-	1	+
Spottail shiner	33	38	96	73	56	77	47	13	10	-	2	47	492	1.1
Swallowtail shiner	27	19	12	12	14	1	14	11	4	33	29	66	242	0.5
Rosyface shiner	-	-	1	-	-	-	-	-	-	-	-	-	1	+
Spotfin shiner	716	649	282	180	297	211	86	406	2431	2794	4062	826	12940	28.1
Mimic shiner	715	188	192	209	323	36	236	745	4162	8518	6316	5920	27560	59.9
Bluntnose minnow	197	115	32	57	31	49	27	50	21	23	18	118	738	1.6
Blacknose dace	-	-	-	-	-	-	-	-	-	1	-	-	1	+
Fallfish	-	3	3	17	16	11	-	2	-	-	-	-	52	0.1
White sucker	-	-	10	154	11	1	-	1	-	-	-	-	177	0.4
Northern hog sucker	-	-	-	-	2	-	-	-	-	-	-	-	2	+
Shorthead redhorse	-	-	-	-	1	-	2	-	-	-	-	-	3	+
Channel catfish	3	-	-	34	-	-	121	1	-	-	-	-	159	0.3
Banded killifish	3	1	1	1	2	2	1	-	-	-	-	-	11	+
Rock bass	3	-	-	-	6	6	-	-	1	2	2	5	25	+
Redbreast sunfish	11	45	24	14	9	8	6	5	6	2	-	3	133	0.3
Green sunfish	45	23	14	8	9	11	1	5	4	4	5	5	134	0.3
Pumpkinseed	115	93	135	80	91	60	64	53	124	53	93	7	968	2.1
Bluegill	196	97	63	21	27	30	11	12	430	97	163	16	1163	2.5
Lepomis hybrid	-	1	-	-	1	3	2	-	-	-	-	-	7	+
Smallmouth bass	-	19	8	2	18	2	2	1	1	1	-	-	54	0.1
Largemouth bass	-	-	-	-	1	1	-	1	-	1	6	-	10	+
White crappie	2	2	-	-	1	11	-	-	1	2	-	-	19	+
Black crappie	-	1	-	-	-	3	-	-	-	-	-	-	4	+
Tessellated darter	88	13	2	6	156	138	14	14	11	11	6	1	460	1.0
Banded darter	2	1	-	-	-	-	-	-	-	-	-	-	3	+
Shield darter	-	-	-	-	6	3	-	-	-	-	-	-	9	+
Walleye	-	-	-	-	-	1	-	-	-	-	-	-	1	+
No. of Specimens	2160	1310	879	870	1086	672	640	1341	7481	11821	10706	7014	45980	
No. of Species	17	17	18	17	22	24	15	16	16	18	13	11	33	
No. of Hauls	23	26	26	26	22	30	31	32	25	20	20	24	305	
No. of Fish/Haul	93.91	50.38	33.81	33.46	49.36	22.40	20.64	41.91	299.24	591.05	535.30	292.25	150.75	
Diversity Index	2.50	2.50	2.79	3.05	2.89	3.09	2.75	1.80	1.59	1.12	1.20	0.83	1.73	

+ Less than 0.05%.

TABLE 4-4

Distribution of fishes taken by seine at the stations sampled near TMINS in 1989. Station prefix TM-SE- deleted from table.

	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
American shad	-	2	2	5	-	-	9	+
Gizzard shad	-	29	1	1	2	512	545	1.2
Rainbow smelt	-	-	-	1	-	-	1	+
Common carp	-	1	1	-	-	-	2	+
Golden shiner	-	3	3	1	-	5	12	+
Comely shiner	2	17	8	5	10	-	42	0.1
Common shiner	1	-	-	-	-	-	1	+
Spottail shiner	105	61	132	47	137	10	492	1.1
Swallowtail shiner	112	20	19	34	19	38	242	0.5
Rosyface shiner	-	-	-	1	-	-	1	+
Spotfin shiner	2287	1632	2836	4033	1818	334	12940	28.1
Mimic shiner	16716	274	1857	1779	6774	160	27560	59.9
Bluntnose minnow	136	97	10	47	72	376	738	1.6
Blacknose dace	-	-	-	-	-	1	1	+
Fallfish	8	7	10	18	8	1	52	0.1
White sucker	55	25	48	15	31	3	177	0.4
Northern hog sucker	-	-	-	1	1	-	2	+
Shorthead redhorse	-	-	2	-	1	-	3	+
Channel catfish	-	-	1	-	156	2	159	0.3
Banded killifish	8	-	1	1	-	1	11	+
Rock bass	-	9	3	11	1	1	25	+
Redbreast sunfish	16	31	46	16	13	11	133	0.3
Green sunfish	3	11	11	2	5	102	134	0.3
Pumpkinseed	81	237	38	74	142	396	968	2.1
Bluegill	13	311	10	3	15	811	1163	2.5
Lepomis hybrid	-	-	-	-	1	6	7	+
Smallmouth bass	11	4	14	13	6	6	54	0.1
Largemouth bass	-	1	1	-	-	8	10	+
White crappie	1	4	4	3	-	7	19	+
Black crappie	-	-	1	-	-	3	4	+
Tessellated darter	56	57	92	73	151	31	460	1.0
Banded darter	-	-	1	1	1	-	3	+
Shield darter	4	-	1	3	1	-	9	+
Walleye	1	-	-	-	-	-	1	+
No. of Specimens	19616	2833	5153	6188	9365	2825	45980	
No. of Species	19	21	27	25	21	22	33	
No. of Hauls	39	61	58	54	42	51	305	
No. of Fish/Haul	502.97	46.44	88.84	114.59	222.98	55.39	150.75	
Diversity Index	0.81	2.26	1.61	1.37	1.34	2.88	1.73	

+ Less than 0.05%.

TABLE 4-5

Percent family composition at the seine stations sampled in York Haven Pond, April through November 1989. Station prefix TM-SE- deleted from table.

Family	Station 13B5	10B5	16A1	10A2	9B3	4A2	Total
Herrings	-	1.1	+	0.1	+	18.1	1.2
Smelts	-	-	-	+	-	-	+
Carps and Minnows	98.7	74.5	94.6	96.4	94.4	32.7	91.5
Suckers	0.3	0.9	1.0	0.2	0.4	0.1	0.4
Bullhead catfishes	-	-	+	-	1.7	0.1	0.3
Killifishes	+	-	+	+	-	+	+
Sunfishes	0.6	21.5	2.5	2.0	2.0	47.8	5.5
Perches	0.3	2.0	1.8	1.2	1.6	1.1	1.0

+ Less than 0.05%.

TABLE 4-6

Summary by date of fish biomass (g) at the seine stations sampled near TMINS in 1989. Station prefix TM-SE- deleted from table.

	13B5	10B5	16A1	10A2	9B3	4A2	Total
13 Apr	259.6	18.1	55.0	45.5	188.6	389.8	956.6
22 May	288.3	113.3	119.6	181.7	103.8	300.4	1107.1
30 May	178.6	134.2	217.1	179.1	122.3	140.8	972.1
8 Jun	167.4	279.9	282.4	151.4	79.8	118.3	1079.2
21 Jun	103.6	231.0	405.3	312.7	157.4	176.3	1386.3
14 Jul	104.9	201.6	231.5	151.7	68.7	205.5	963.9
3 Aug	77.8	50.8	120.9	149.3	294.8	109.6	803.2
16 Aug	102.2	110.1	256.2	47.5	229.7	46.0	791.7
7 Sep	117.5	103.5	202.5	49.8	298.8	36.1	808.2
18 Sep	510.0	115.0	205.8	217.4	190.2	33.0	1271.4
18 Oct	655.5	48.8	147.6	158.9	148.4	95.6	1254.8
2 Nov	408.9	44.5	8.2	97.3	515.5	85.4	1159.8
Total	2974.3	1450.8	2252.1	1742.3	2398.0	1736.8	12554.3

TABLE 4-7 LENGTH FREQUENCY, TOTAL AND MEAN WEIGHT, CONDITION FACTOR (K), AND REPRODUCTIVE STATUS (R), PER 5 MM FL INTERVAL OF SPOTFIN SHINER COLLECTED BY SEINE NEAR TMINS IN 1989.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-4A2			
11 - 15	1	0.02	0.02	0.59	Y
16 - 20	54	2.79	0.05	0.65	Y
21 - 25	38	3.60	0.09	0.61	Y
26 - 30	38	7.60	0.20	0.74	Y
31 - 35	47	15.70	0.33	0.78	Y
36 - 40	22	11.00	0.50	0.78	Y
41 - 45	8	5.80	0.72	0.80	J
46 - 50	4	4.60	1.15	0.92	J
51 - 55	1	1.40	1.40	0.84	J
56 - 60	1	2.40	2.40	1.11	J
61 - 65	1	2.70	2.70	0.98	A
		TM-AQF-9B3			
11 - 15	26	0.48	0.02	0.55	Y
16 - 20	251	12.84	0.05	0.64	Y
21 - 25	211	20.90	0.10	0.63	Y
26 - 30	185	35.70	0.19	0.71	Y
31 - 35	90	29.60	0.33	0.77	Y
36 - 40	66	34.00	0.52	0.80	Y
41 - 45	52	40.60	0.78	0.86	J
46 - 50	21	23.60	1.12	0.90	J
51 - 55	12	18.40	1.53	0.92	J
56 - 60	2	3.90	1.95	0.90	J
61 - 65	1	3.60	3.60	1.31	A
		TM-AQF-10A2			
11 - 15	5	0.09	0.02	0.53	Y
16 - 20	211	11.83	0.06	0.70	Y
21 - 25	255	25.40	0.10	0.64	Y
26 - 30	91	17.30	0.19	0.70	Y
31 - 35	91	30.70	0.34	0.79	Y
36 - 40	39	20.00	0.51	0.80	Y
41 - 45	37	30.80	0.83	0.91	J
46 - 50	23	26.70	1.16	0.93	J
51 - 55	7	10.90	1.56	0.94	J
56 - 60	13	29.10	2.24	1.04	J
61 - 65	5	14.90	2.98	1.09	A
66 - 70	4	17.00	4.25	1.24	A
71 - 75	1	5.30	5.30	1.26	A
76 - 80	2	13.90	6.95	1.36	A
81 - 85	2	15.80	7.90	1.29	A

* Y=young, J=juvenile, A=adult

TABLE 4-7 CONTINUED.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-1085			
6 - 10	23	0.10	0.00	0.43	Y
11 - 15	110	1.30	0.01	0.35	Y
16 - 20	210	11.23	0.05	0.67	Y
21 - 25	259	25.70	0.10	0.64	Y
26 - 30	150	28.20	0.19	0.70	Y
31 - 35	79	25.90	0.33	0.76	Y
36 - 40	54	28.50	0.53	0.82	Y
41 - 45	34	26.80	0.79	0.87	J
46 - 50	18	20.20	1.12	0.90	J
51 - 55	20	30.20	1.51	0.91	J
56 - 60	13	27.50	2.12	0.98	J
61 - 65	2	4.80	2.40	0.87	A
71 - 75	2	9.70	4.85	1.15	A
76 - 80	1	5.70	5.70	1.11	A
86 - 90	1	8.40	8.40	1.15	A
91 - 95	1	11.30	11.30	1.32	A
		TM-AQF-1385			
11 - 15	15	0.26	0.02	0.51	Y
16 - 20	192	9.70	0.05	0.63	Y
21 - 25	268	26.80	0.10	0.64	Y
26 - 30	167	29.40	0.18	0.65	Y
31 - 35	82	24.70	0.30	0.70	Y
36 - 40	59	29.40	0.50	0.78	Y
41 - 45	42	32.70	0.78	0.85	J
46 - 50	26	30.10	1.16	0.93	J
51 - 55	19	31.20	1.64	0.99	J
56 - 60	7	14.60	2.09	0.97	J
61 - 65	6	16.10	2.68	0.98	A
66 - 70	4	14.90	3.72	1.09	A
71 - 75	5	24.50	4.90	1.16	A
86 - 90	1	9.70	9.70	1.33	A

*
Y=young, J=juvenile, A=adult

TABLE 4-7 CONTINUED.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-16A1			
11 - 15	27	0.45	0.02	0.49	Y
16 - 20	144	7.90	0.05	0.69	Y
21 - 25	292	30.90	0.11	0.68	Y
26 - 30	143	28.00	0.20	0.73	Y
31 - 35	54	18.00	0.33	0.78	Y
36 - 40	59	34.60	0.59	0.92	Y
41 - 45	56	45.40	0.81	0.89	J
46 - 50	46	54.50	1.18	0.95	J
51 - 55	18	28.70	1.59	0.96	J
56 - 60	11	24.30	2.21	1.02	J
61 - 65	3	8.70	2.90	1.06	A
66 - 70	6	23.70	3.95	1.15	A
71 - 75	3	16.50	5.50	1.30	A
76 - 80	4	25.60	6.40	1.25	A
81 - 85	1	7.60	7.60	1.24	A
86 - 90	3	23.20	7.73	1.06	A
91 - 95	1	14.90	14.90	1.74	A

* Y=young, J=juvenile, A=adult

TABLE 4-8 LENGTH FREQUENCY, TOTAL AND MEAN WEIGHT, CONDITION FACTOR (K), AND REPRODUCTIVE STATUS (R) PER 5 MM FL INTERVAL OF MIMIC SHINER COLLECTED BY SEINE NEAR TMINS IN 1989.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-4A2			
11 - 15	3	0.07	0.02	0.69	Y
16 - 20	36	2.00	0.06	0.69	Y
21 - 25	67	8.00	0.12	0.76	Y
26 - 30	28	5.90	0.21	0.78	Y
31 - 35	20	6.80	0.34	0.79	Y
36 - 40	5	2.90	0.58	0.91	J
41 - 45	1	0.80	0.80	0.88	J
		TM-AQF-9B3			
11 - 15	43	0.95	0.02	0.65	Y
16 - 20	266	15.00	0.06	0.70	Y
21 - 25	278	30.00	0.11	0.69	Y
26 - 30	93	18.80	0.20	0.75	Y
31 - 35	88	32.60	0.37	0.86	Y
36 - 40	52	30.40	0.58	0.91	J
41 - 45	12	9.90	0.83	0.91	J
46 - 50	3	3.30	1.10	0.88	J
51 - 55	1	1.10	1.10	0.66	J
		TM-AQF-10A2			
11 - 15	37	0.94	0.03	0.75	Y
16 - 20	206	11.40	0.06	0.69	Y
21 - 25	214	24.50	0.11	0.73	Y
26 - 30	73	15.20	0.21	0.77	Y
31 - 35	51	20.10	0.39	0.92	Y
36 - 40	82	50.60	0.62	0.96	J
41 - 45	77	69.90	0.91	1.00	J
46 - 50	11	14.10	1.28	1.03	J

*Y=young, J=juvenile, A=adult

TABLE 4-8 CONTINUED.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-10B5			
6 - 10	6	0.05	0.01	0.83	Y
11 - 15	65	1.21	0.02	0.55	Y
16 - 20	113	5.16	0.05	0.57	Y
21 - 25	36	4.10	0.11	0.73	Y
26 - 30	15	3.00	0.20	0.74	Y
31 - 35	16	6.20	0.39	0.90	Y
36 - 40	14	8.20	0.59	0.92	J
41 - 45	7	5.80	0.83	0.91	J
46 - 50	2	2.30	1.15	0.92	J
		TM-AQF-13B5			
11 - 15	12	0.30	0.03	0.74	Y
16 - 20	273	14.84	0.05	0.68	Y
21 - 25	373	38.70	0.10	0.66	Y
26 - 30	152	29.80	0.20	0.73	Y
31 - 35	129	44.70	0.35	0.81	Y
36 - 40	83	46.60	0.56	0.88	J
41 - 45	65	57.10	0.88	0.96	J
46 - 50	18	20.90	1.16	0.93	J
51 - 55	3	4.50	1.50	0.90	J
56 - 60	1	2.60	2.60	1.20	A
		TM-AQF-16A1			
11 - 15	4	0.07	0.02	0.52	Y
16 - 20	106	6.53	0.06	0.77	Y
21 - 25	198	22.40	0.11	0.72	Y
26 - 30	54	11.80	0.22	0.81	Y
31 - 35	20	8.10	0.40	0.94	Y
36 - 40	63	41.50	0.66	1.03	J
41 - 45	203	194.50	0.96	1.05	J
46 - 50	77	102.80	1.34	1.07	J
51 - 55	8	13.90	1.74	1.04	J

* Y=young, J=juvenile, A=adult

TABLE 4-9

Percent similarity indices of species composition between seine stations near TMINS, April through November 1989. Station prefix TM-SE- deleted from table.

	10B5	16A1	10A2	9B3	4A2
13B5	24.5	50.1	43.4	86.7	20.0
10B5		72.9	73.1	35.6	44.8
16A1			88.3	60.7	21.7
10A2				53.0	22.3
9B3					22.1

TABLE 4-10

Relative contribution of key species to the annual seine catches near TMINS, 1977 through 1989.

Study Year	Total Catch[a]	Catch Per Seine-Haul				
		Spotfin Shiner	Spottail Shiner	Bluntnose Minnow	Mimic Shiner	White Sucker
1977	25,683	9	38	7	<1	4
1978	29,414	7	42	3	<1	10
1979	39,068	35	20	4	1	21
1980	37,920	31	40	2	<1	4
1981	57,117	107	13	4	6	1
1982	67,051	136	8	3	9	2
1983	67,041	175	24	4	21	<1
1984	29,524	80	1	4	9	2
1985	56,672	103	63	5	4	3
1986	26,775	66	9	1	8	2
1987	31,383	65	20	2	27	1
1988	44,691	38	30	5	44	16
1989	45,980	42	2	2	90	<1

(a) Includes all species, not just those listed.

TABLE 4-11

Incidence of parasites, diseases, and/or morphological anomalies on fishes captured by seine near TMINS, April through November 1989.

	Black Spot	Lernaea	Leech	Glochidia	Pughead	Scoliosis	Mouth Deformity	Popeye	Skin* Infection	Emaciation	Total Afflicted	Total Examined	Percent Incidence
American shad	-	-	-	-	-	1	-	-	-	-	1	9	11.1
Golden shiner	2	1	-	1	-	-	-	-	1	-	5	12	41.7
Comely shiner	-	-	-	-	-	-	-	-	-	1	1	42	2.4
Common shiner	1	-	-	-	-	-	-	-	-	-	1	1	100.0
Spottail shiner	14	4	-	29	6	2	-	1	22	3	81	492	16.5
Swallowtail shiner	1	-	-	7	7	1	-	1	4	-	21	242	8.7
Spotfin shiner	388	5	-	65	72	5	10	1	39	3	588	4659	12.6
Mimic shiner	2	47	-	16	202	3	8	-	39	1	318	3863	8.2
Bluntnose minnow	102	8	-	2	18	1	1	-	16	-	148	691	21.4
Blacknose dace	1	-	-	-	-	-	-	-	-	-	1	1	100.0
Fallfish	18	2	-	-	-	-	-	-	-	-	20	52	38.5
Shorthead redhorse	1	-	-	-	-	-	-	-	-	-	1	3	33.3
Channel catfish	-	-	-	-	-	-	-	-	2	-	2	20	10.0
Banded killifish	-	-	-	-	-	-	-	-	1	-	1	11	9.1
Rock bass	-	-	-	2	-	-	-	3	1	-	6	22	27.3
Redbreast sunfish	-	2	1	11	-	-	-	4	24	-	42	132	31.8
Green sunfish	-	2	-	38	-	-	-	-	10	-	50	121	41.3
Pumpkinseed	-	37	-	85	1	-	-	-	31	-	154	907	17.0
Bluegill	16	6	-	97	-	2	1	2	22	-	146	1071	13.6
Smallmouth bass	-	2	1	-	-	-	-	-	7	-	10	44	22.7
Largemouth bass	1	-	-	-	-	-	-	-	2	-	3	6	50.0
White crappie	-	-	-	2	-	-	-	-	-	-	2	8	25.0
Tessellated darter	5	5	8	86	1	-	-	-	2	-	107	460	23.3
Banded darter	-	-	-	1	-	-	-	-	1	-	2	3	66.7
Total	552	121	10	442	307	15	20	12	224	8	1711	12872	13.3
Percent	4.3	0.9	0.1	3.4	2.4	0.1	0.2	0.1	1.7	0.1			

* Includes fish with fin rot, fungus, tumors, or cysts.

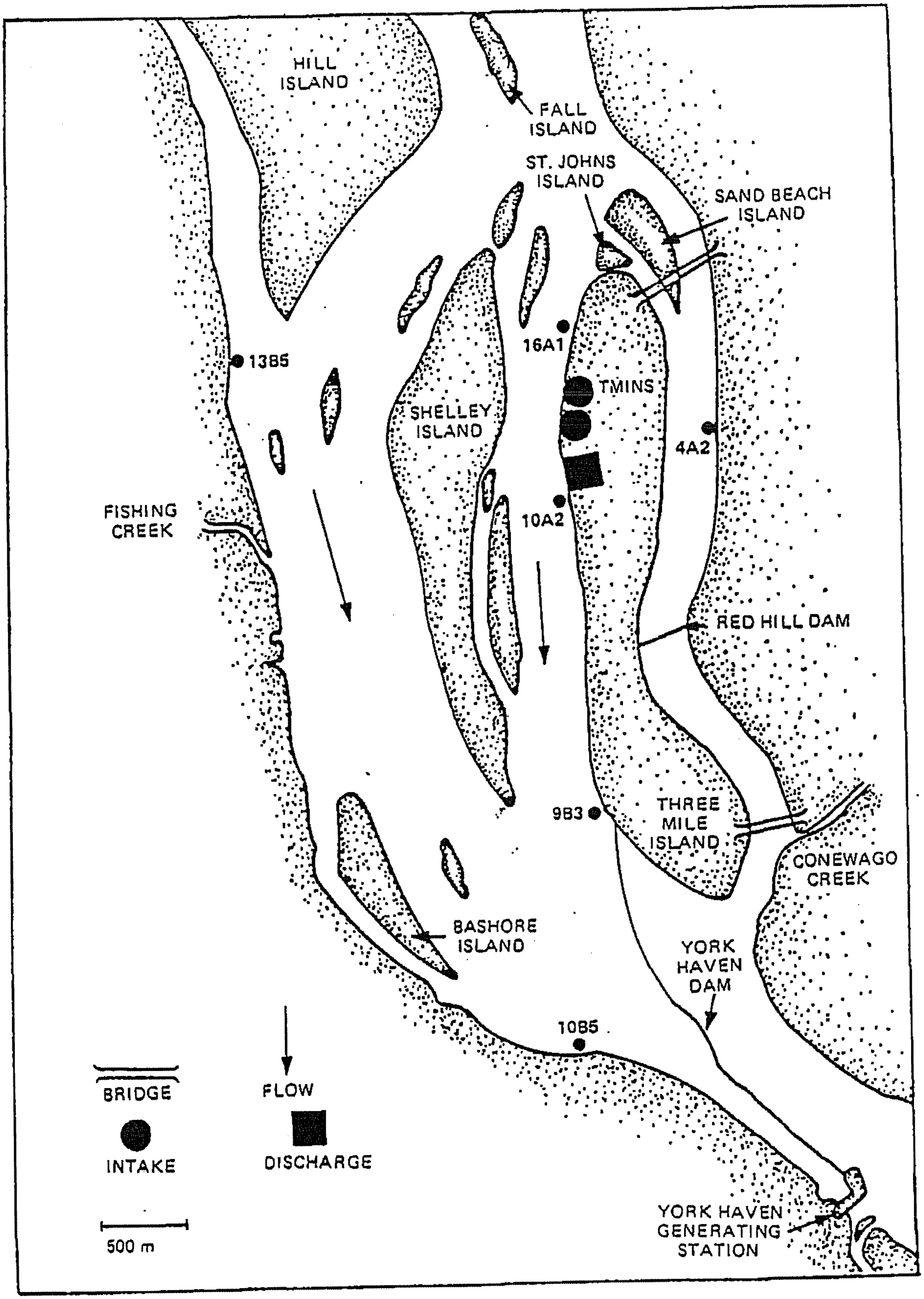

Figure 4-1. Location of seine stations sampled in York Haven Pond (station prefix TM-SE- deleted).

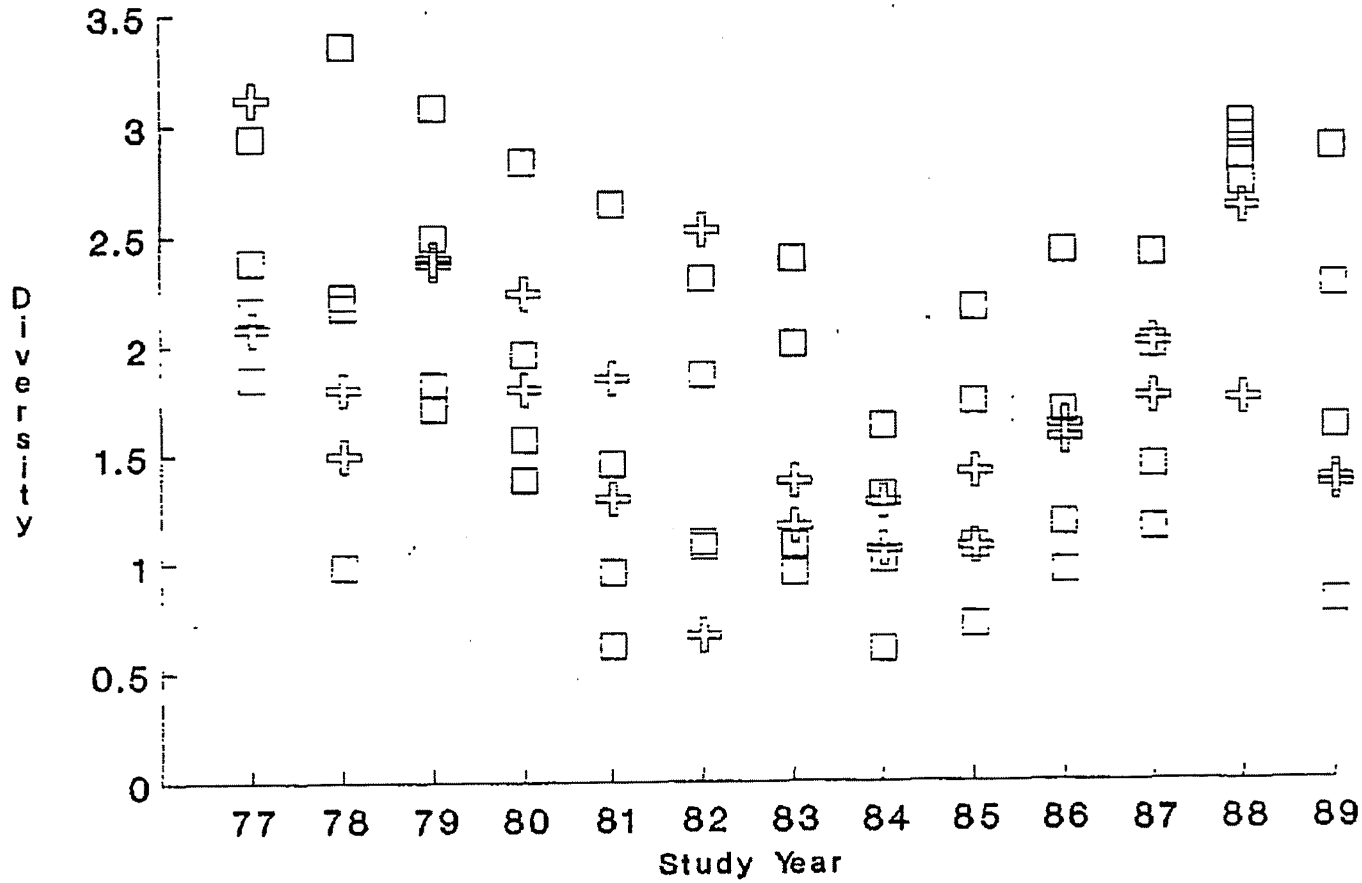

Figure 4-2. Annual range of sampling station diversity values, months combined, for seine catches, TMINS aquatic studies (open boxes are station values and crosses represent stations 10A2 and 9B3). Identical diversity values may result in less than six symbols.

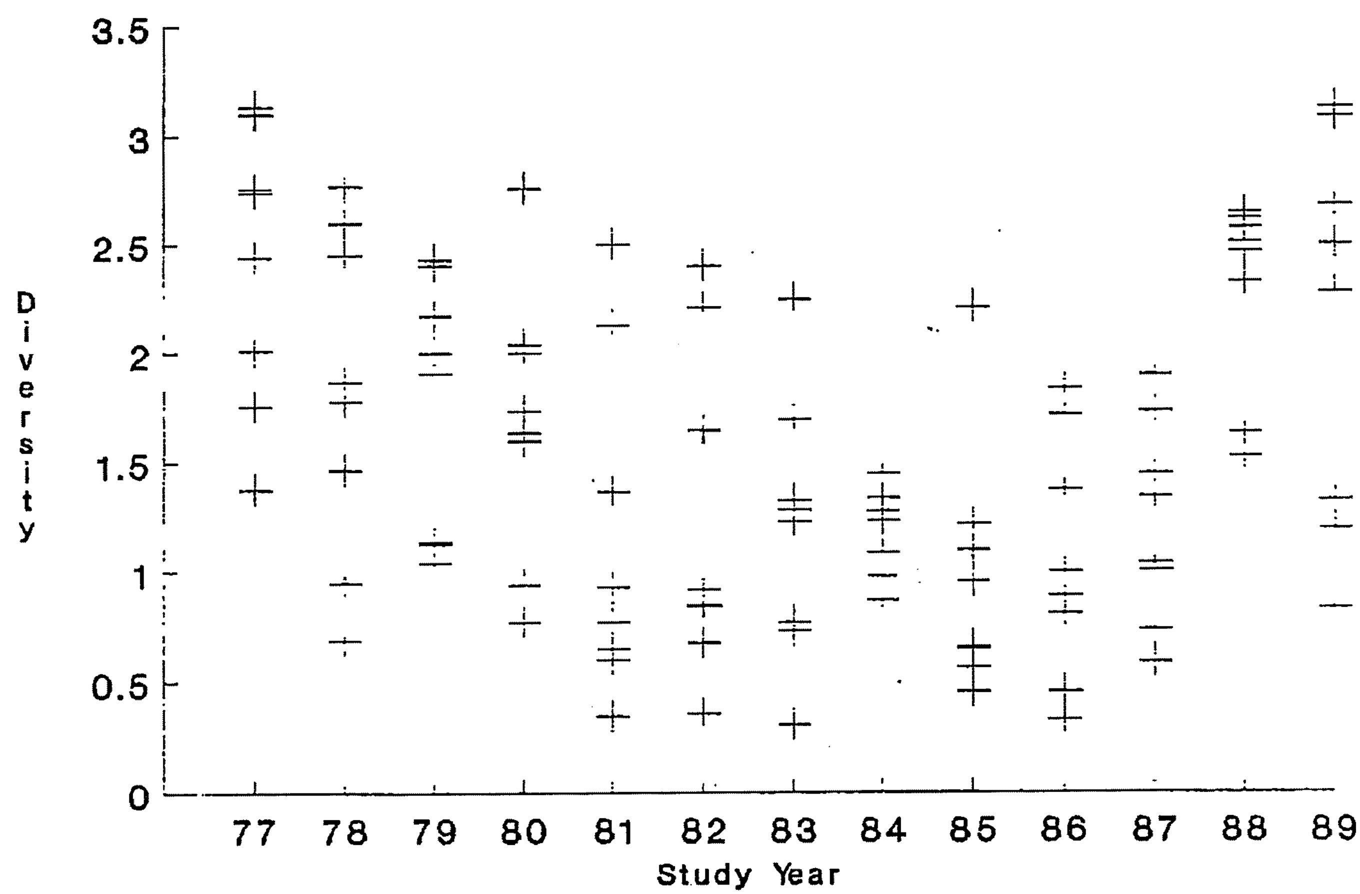

Figure 4-3. Annual range of monthly (April-November) diversity values, stations combined, for seine catches, TMINS aquatic studies. Identical diversity values may result in less than eight symbols.

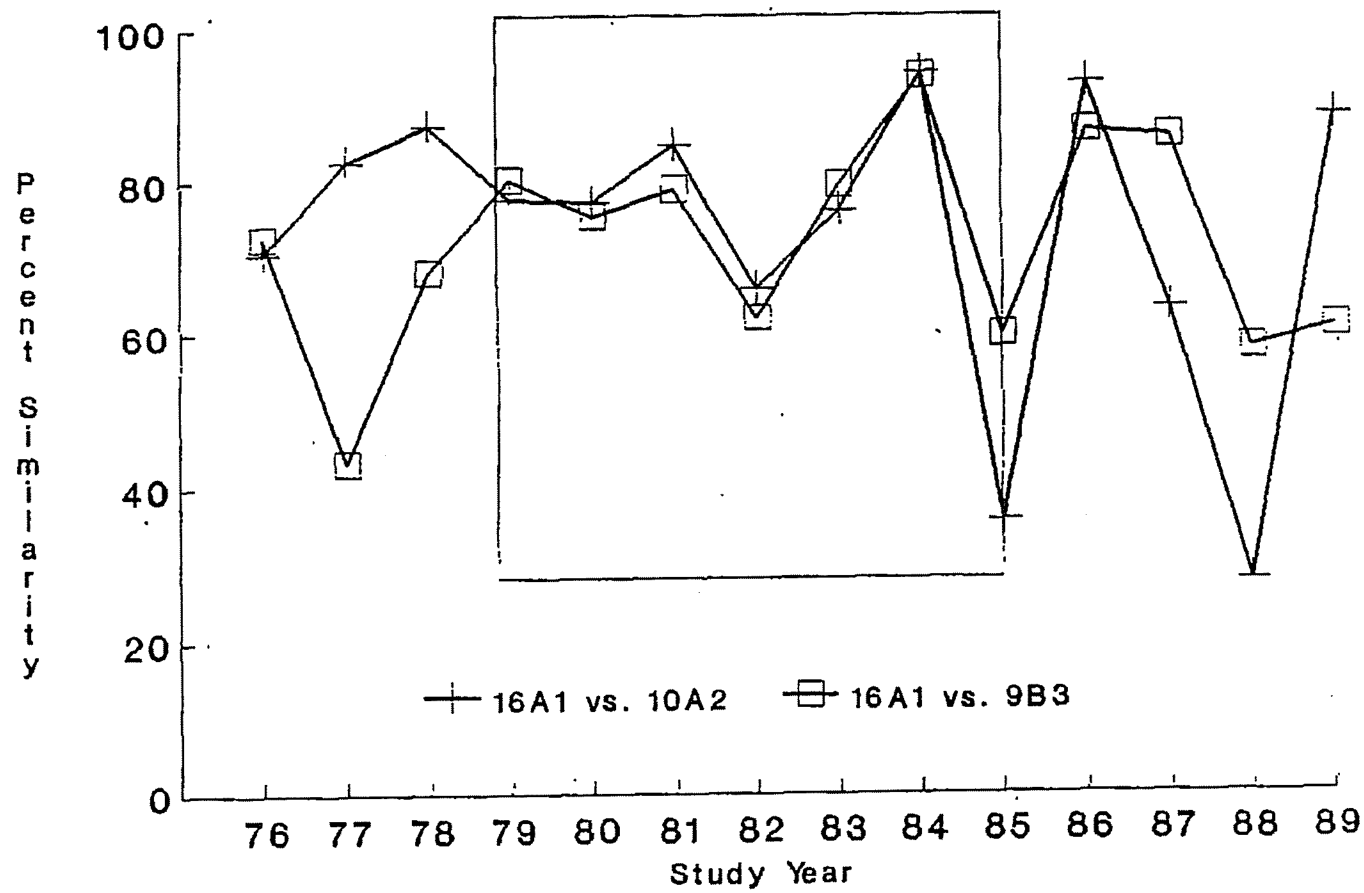

Figure 4-4. Annual variation in percent similarity values for selected seine station comparisons, TMINS aquatic studies. Years of non-operation of TMINS are represented within the large square.

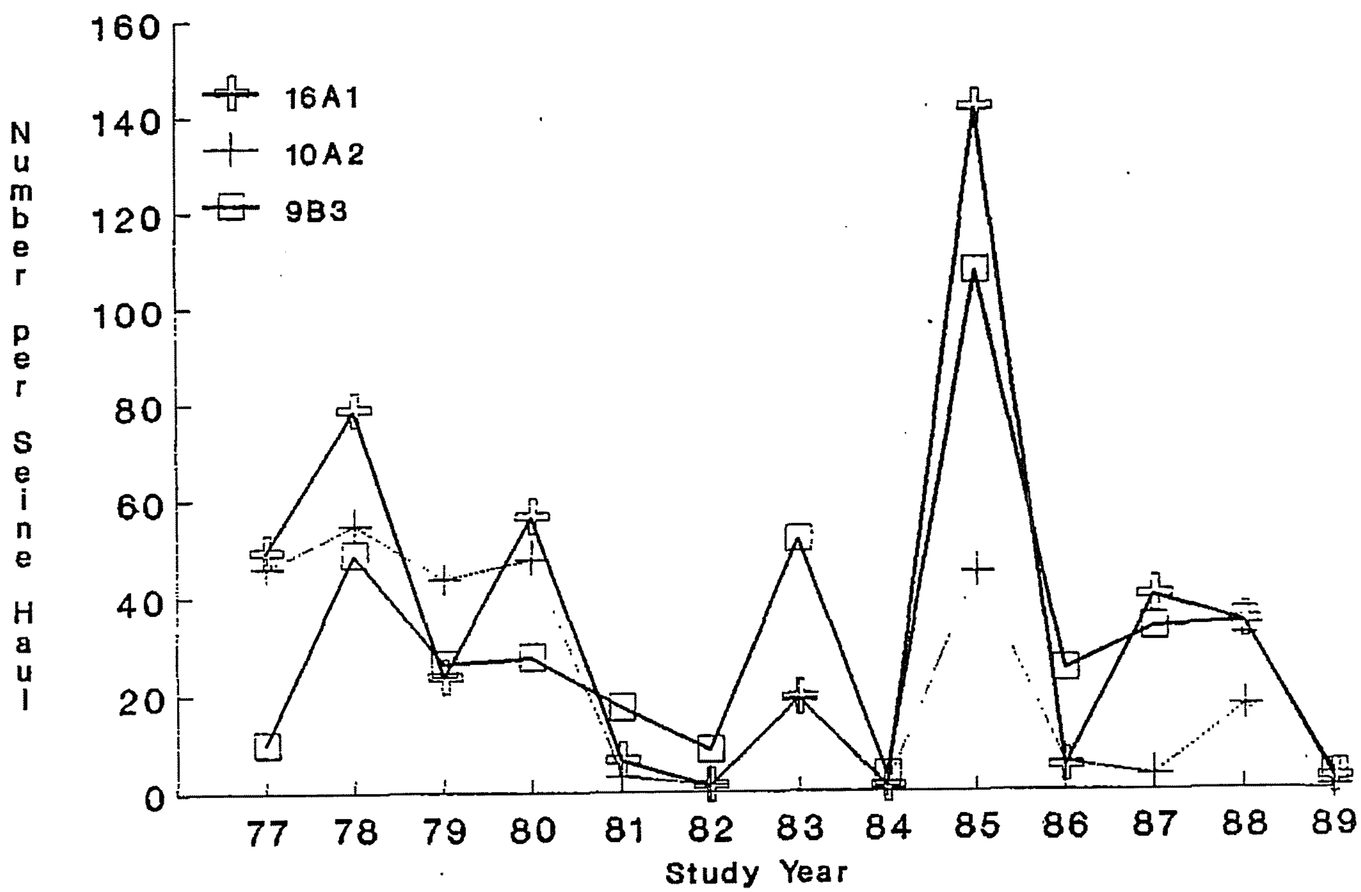

Figure 4-5. Annual abundance (number per seine haul) of spottail shiner in seine catches near TMINS.

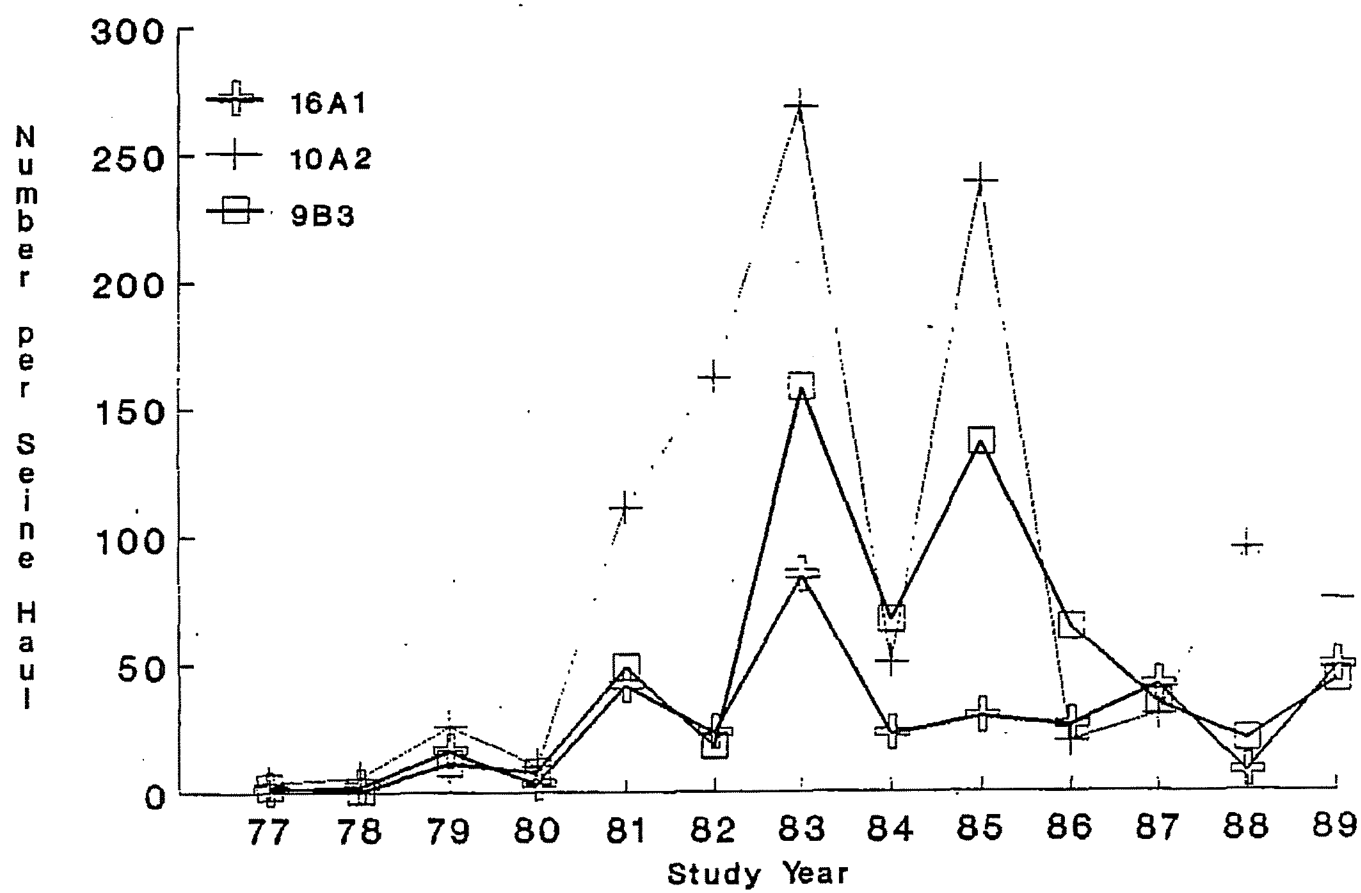

Figure 4-6. Annual abundance (number per seine haul) of spotfin shiner in seine catches near TMINS.

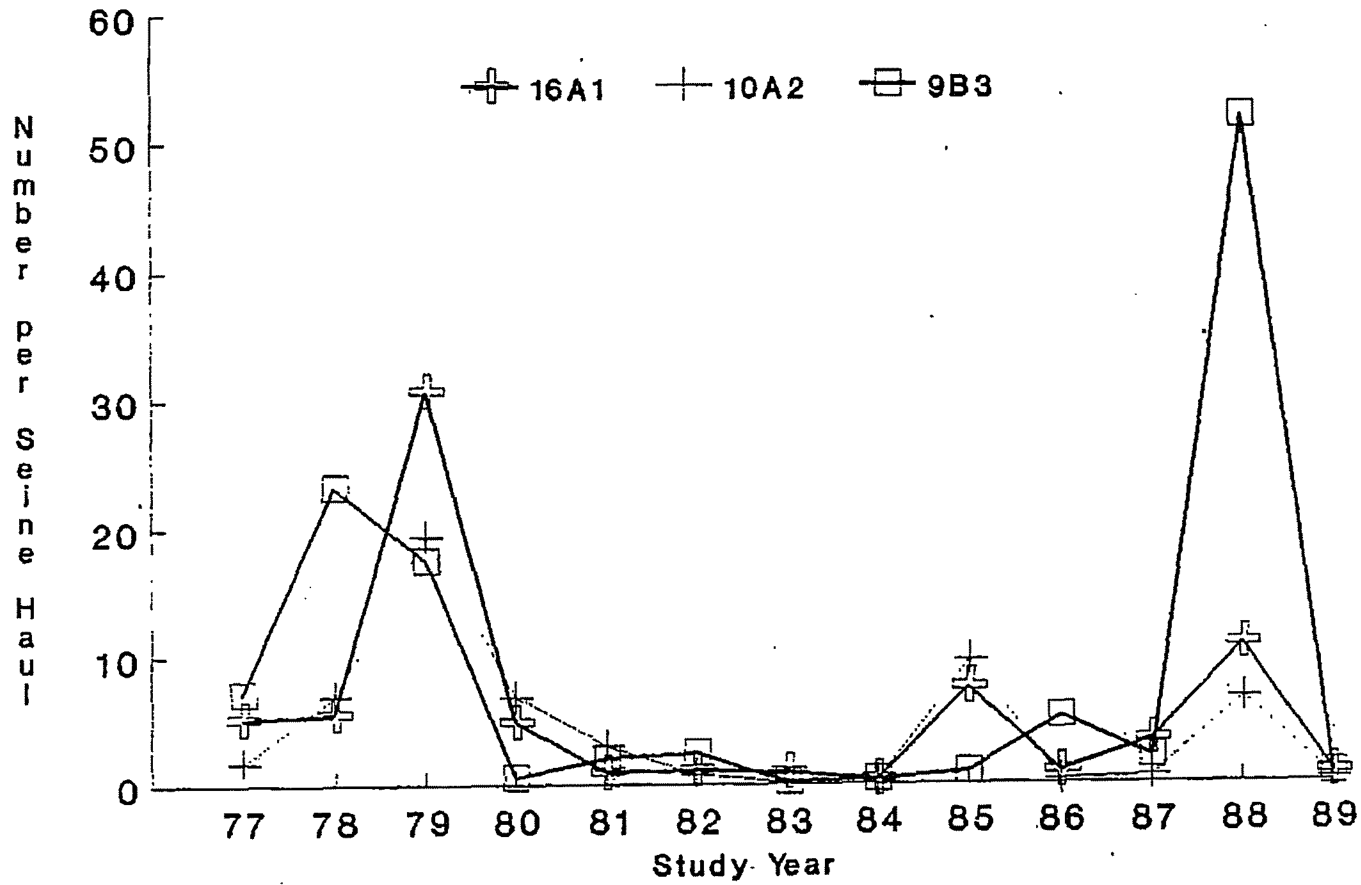

Figure 4-7. Annual abundance (number per seine haul) of white sucker in seine catches near TMINS.

5. ELECTROFISHING

5.1 METHODS

Electrofishing surveys were conducted at six nearshore stations in York Haven Pond (Figure 5-1). Specific locations and habitat characteristics are described in Table 5-1. Surveys were conducted twice each month in May, June, August, and September, and once each in April, July, October, and November 1989.

The electrofishing system consisted of a Coffelt VVP-10 variable voltage pulsator, powered by a 5.0 kw alternator, and mounted in a 6.4 m aluminum boat. Positive and negative electrodes of 1.2 m lengths of flexible conduit were suspended from two 0.9 m diameter aluminum hoops; these were suspended from aluminum booms about 2.0 m in front of the boat. The electric circuit was controlled by a foot-activated switch on the bow of the boat; alternating current was used for all surveys. Sampling was conducted at night with the aid of bow-mounted flood lamps.

Data recorded for each survey were time, duration of sample (in minutes), air and surface water temperatures, surface dissolved oxygen concentration and pH, Secchi disc, conductivity, output voltage, and amperage. Instrumentation and procedures for these measurements are described in Chapter 7 and follow GPU (1987). To sample, the boat was maneuvered slowly downstream through the station, as close to shore as possible (1 to 10 m offshore). Stunned fish were netted at the bow and placed in holding tubs containing water treated with the anesthetic TMS (tricaine methanesulfonate) to facilitate handling and reduce injury. Larger stunned specimens of common carp and quillback (>250 mm FL) were not placed in the tubs but were counted by the netting crew. At the end of a sampling run, the boat was returned to the center of the station, and the catch was processed.

Each fish was identified to species; measured to the nearest millimeter FL; weighed to the nearest gram; and inspected for diseases, parasites, and morphological anomalies. If a collection consisted of more than 50 specimens of a single species, a subsample of 50 specimens was selected for individual processing, and the remainder counted. Normally, fish were released after processing. Periodically, however, some specimens were retained for radiological analysis as part of the Radiological Environmental Monitoring Program.

Scientific and common names of fishes captured during the 1989 electrofishing surveys are presented in Table 5-2. Taxonomic order of presentation followed Robins et al. (1980).

Data analysis consisted of calculating percent similarity (PSc) among sampling station catches; species diversity by station and date; condition factors; and analysis of variance (ANOVA) to analyze catch differences among stations, months (or seasons), and years. Calculation of PSc and diversity indices was identical to those described in Chapter 2. Mean lengths, weights, and condition factors (described in Chapter 4) were determined for fishes that comprised more than 10% of the 1989 catch.

The 1989 catch was transformed to catch-per-minute and subjected to a two-factor ANOVA with stations and seasons as factors. Seasons were defined as follows: spring, 19 April through 14 June; summer, 28 June through 23 August; and fall, 12 September through 7 November. A three-factor ANOVA (year, month, station) was used to evaluate multiple year catch-per-minute data. In both analyses, catch-per-minute data were transformed to the 4th root to stabilize variance. When significant differences ($p \leq 0.05$) were identified among stations, months, seasons, or years, Tukey's studentized range test was used to identify significantly different means. The ANOVAs were conducted using SAS software, Version 6 (SAS Institute, Inc., Cary, NC).

Also, Cochran's Q-statistic and M-statistic (Hendrickson 1978) were applied to 1989 station totals. The Q-statistic compared the number of species per station, while the M-statistic tested for differences in species composition based on the number of species in common at each station. Results were compared at the 95% probability level to values in the chi-square distribution.

5.2 COMPOSITION, RELATIVE ABUNDANCE, AND DISTRIBUTION: 1989

Numbers of fishes collected by the electrofisher during each survey are presented in Appendix D and summarized in Tables 5-3 through 5-5. A total of 6,299 specimens of 28 fishes, representing six families, was taken in 72 collections. Sunfishes, the largest family, were represented by nine species, while carps and minnows (cyprinids) were represented by eight. All other families consisted of three or fewer species.

Sunfishes were the most abundant group numerically; 5,123 specimens comprised 81.3% of the total catch (Table 5-5), and included the top five species (redbreast sunfish, green sunfish, pumpkinseed, bluegill, and smallmouth bass) taken (Table 5-3). The second most abundant family was cyprinids which accounted for 9.6% of the total catch. The spottail shiner (seventh ranked species) and spotfin shiner (ninth ranked species) were the most common cyprinids taken. Suckers were the third most abundant family and comprised 6.7% of the total catch. The abundance of the sucker family was largely due to the quillback catch (sixth ranked species). Together, the sunfish, cyprinid, and sucker families accounted for 97.6% of the total catch.

The temporal distribution of the electrofishing catch is presented in Table 5-3. Total catch varied considerably among individual sample dates. Fluctuations in total catch were almost entirely due to the abundance of the redbreast sunfish, green sunfish, pumpkinseed, bluegill, and smallmouth bass. A generalized seasonal pattern emerged that was characterized by high catches in the spring (April through early June), followed by a period of variable and slightly lower catches in the summer (late June through August), and increased catches in the fall (September through November). The high spring catches were predominantly redbreast sunfish, pumpkinseed, and smallmouth bass, which accounted for 63.7% of the total catch. The fall catch was dominated by green sunfish, pumpkinseed, and bluegill, which comprised 62.1% of the catch.

Spatial differences in abundance and number of species among stations is presented in Table 5-4. The total catch was high and quite similar at Stations 10A3, 11B1, and 13A1 (1,234, 1,136, and 1,127 specimens; respectively), moderate at Station 9B5 (1,044), and low at Stations 10B3 and 4A1 (885 and 873, respectively). The total catch and number of species were closely associated. Stations with high catches had the most species (10A3, 11B1, and 13A1; 22 species each), while stations with low to moderate catches had fewer species (9B5, 10B3, and 4A1; 20, 20, and 18 species, respectively). Variations in the annual station catches may reflect the spatial differences in the abundance of several key species. Among those stations with large catches, quillback, pumpkinseed, and bluegill were most abundant at

Station 11B1 (comprising over 77% of the catch), while redbreast sunfish, pumpkinseed, and smallmouth bass were abundant at 13A1 and 10A3. The moderate catch at Station 9B1 was dominated by spottail shiner, green sunfish, pumpkinseed, and smallmouth bass. Although these species were common at Stations 4A1 and 10B3 their abundance was reduced.

The results of the two-factor analysis of variance provide a quantitative evaluation of spatial and temporal differences in the catch-per-minute (Table 5-6). Significant differences were identified for stations, but not for seasons (Table 5-7). The variance due to the interaction between these factors was also significant, so the effect of single factors on the catch rate was not independent. An examination of the seasonal mean catch rates at each station revealed low catch rates at Stations 4A1 and 11B1 in the spring and summer followed by an unexpected high catch rate in the fall. The catch rates at Stations 13A1, 10A3, and 9B1 were high in the spring and summer and relatively low in the fall. Station 10B3 was intermediate with high catch rates in the spring and lower catch rates in the summer and fall. This variation in seasonal catch rates at individual stations resulted in the overall average showing no differences in Tukey's range test among seasonal or station means. Thus, the small differences noted above had little, if any, effect on the catch rates over the study period. The 1989 electrofishing catch rates revealed no evidence to suggest that the operation of TMINS had any influence on the distribution of fish populations (total catch) in York Haven Pond.

5.3 GROWTH AND CONDITION FACTOR (K)

Growth (mean lengths and weights) and condition factors (K) were determined for those species comprising at least 10% of the total catch (pumpkinseed, bluegill, and smallmouth bass).

The mean length and weight of pumpkinseed declined from April through August, and fluctuated thereafter (Table 5-8). The decline in the mean length and weight resulted from recruitment of young and juvenile fish into the sample. Larger (adult) fish were common in the spring; their importance declined in the summer as smaller (juvenile) fish became common.

Mean K of pumpkinseed increased from April (2.51) to a peak in May (2.74), declined through July, and remained relatively unchanged through November (Table 5-8). The high K factor in May was likely due to the reproductive condition of females.

The growth of bluegill declined from April through July, fluctuated during August and September, before increasing through November (Table 5-8). The decline in mean length and weight resulted from a change in the catch from larger (adult) fish in the spring (April through June) to smaller (juvenile) fish in the summer (July and August). The subsequent increase in growth resulted from the continued growth and dominance of these juvenile fish in the fall (September through November).

Mean K of bluegill, like that of pumpkinseed, peaked in May (2.70); values in other months ranged from 2.57 in June to 2.09 in November (Table 5-8). Mean K declined steadily from June through November, except for a minor increase in October. The decline in condition was likely the result of the discharge or reabsorption of gametes.

The mean length and weight (growth) of smallmouth bass fluctuated substantially over the study period; highest values occurred in August while the lowest values were recorded in May (Table 5-8). No discernible temporal trend in growth was evident. The reason for this fluctuation may be related to the dominance of either juvenile or adult fish in the catch.

The mean K for smallmouth bass was highest in May and June (1.51) and lowest in July (1.39) (Table 5-8). Generally, mean K increased from April through May, remained high in June, and declined through November. The changes in mean K are probably reflective of the reproductive status of the population.

The condition factors presented herein were compared with published condition data for other water bodies. Carlander (1977) compiled condition data for pumpkinseed, bluegill, and smallmouth bass from a number of different lakes and streams in the United States and Canada. Because K factors can vary with season, sex, sexual maturity, and age, comparisons are general and are not strictly quantitative. In addition, certain "average" conversions (Carlander 1977) were used to convert published data from standard and total lengths to fork lengths for comparison to the Susuqehanna River data. Thus, cross-population comparisons are gross in nature, but nonetheless may be used to assess the well-being or fitness of a fish population.

Pumpkinseed condition factors for the 1989 TMINS study (range of monthly means, 2.31 to 2.74) (Table 5-8) were similar to data presented by Carlander (1977) for other pumpkinseed populations (range of means 1.79 to 3.03), and were near the upper end of the reported range. The bluegill condition data (range 2.09 to 2.70) were also similar to data presented in Carlander (1977) (range 1.11 to 3.27), and were within the median of the reported range. Similarly, the range of mean K for Susquehanna River smallmouth bass (1.39 to 1.51) also fell within the reported range (1.08 to 2.12). Thus, the condition of these fishes from the Susquehanna River near TMINS was comparable those from other systems.

When data are available, as in the present case, it is useful to compare condition factors for the same populations across time. Annual mean K factors for pumpkinseed (EA 1987; RMC 1988a, 1989) and smallmouth bass (EA 1986; RMC 1988a, 1989) were compared to the 1989 data. Calculation of these means obscured differences due to sex and maturity, season, age, sample size, and thus are general in nature. The annual means ranged from 2.40 (1981) to 3.09 (1985) for pumpkinseed, and 1.42 (1978) to 1.72 (1985) for smallmouth bass. Values for 1989 (2.46 and 1.48 for pumpkinseed and smallmouth bass, respectively) fell within their respective ranges. Since data varied from year to year, there was no grouping of condition data by operational (1976 through 1978 and 1986 through 1989) or non-operational (1979 through 1985) years.

Condition factors for these fishes in 1989 were near the lower end of their reported ranges, and represented a decline in condition from those determined in 1987 and 1988. Various authors (Carlander 1977; Latta 1963; Reynolds 1965) have postulated that changes in water level (river flow), precipitation, water temperature, and turbidity may be negetatively correlated to smallmouth bass growth. Data presented in Chapter 7.0 (Water Quality) revealed that 1989 had significantly higher river flow than that reported in either 1987 or 1988. Also, the water temperature regime was lower throughout 1989, particularly June through August when production (spawning) and growth are most critical. It is possible that the reduced condition of smallmouth bass and, to an extent, pumpkinseed in 1989 may be related to higher river flow and lower water temperature. If the operation of TMINS were exerting some detrimental effect on the condition of these fishes in York Haven Pond, the respective K factors would be consistently higher in the years following shutdown. This was not the case as the differences were related to environmental and natural variation in fish populations rather than any influence of TMINS.

5.4 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

The 1989 fish community in York Haven Pond was examined with measures of species diversity and percent similarity. Shannon-Wiener mean diversity (H') was calculated for annual catch at each station (Table 5-4) and for each date (Table 5-3). Mean diversity values ranged from 2.60 to 3.21 among stations and from 2.45 to 3.24 among dates. Diversity was high (>2.90) at Stations 13A1, 10A3, and 9B5, reflecting both higher numbers of species and/or greater evenness of individuals among the taxa. Diversity was low (<2.90) at Stations 4A1, 10B3, and 11B1 due to the numerical dominance of pumkinseed and bluegill which comprised over 48% of the catch at each station.

Spatial patterns of diversity appeared to be associated with habitat complexity. Stations characterized by a variety of substrate types and an abundance of cover in the form of fallen trees, boulders, and/or aquatic macrophytes, typically had higher diversity values. Those stations exhibiting a singleness of substrate with little cover had lower diversities. Species diversity has been shown to be strongly associated with habitat diversity (Gorman and Karr 1978).

Diversity values were variable among sampling dates, with no discernible trend over time (Table 5-3). The highest H' values (>3.20) occurred in April, late May, and early September, while the lowest values (<2.80) occurred in early May and late June. The lower diversity values resulted when the electrofishing catch contained fewer species and/or an overabundance of one or two species, notably pumpkinseed or smallmouth bass.

The annual (1976 through 1989) fish community diversity was plotted by station with months combined (Figure 5-2), and by month with stations combined (Figure 5-3). Monthly and station diversities fluctuated over the years with no clear pattern exhibited. Monthly and station diversity values were similar to those reported in RMC (1988), and were within their historical range. The minimum diversity value for 1989 was within the range reported previously.

Neither monthly nor station diversity appeared to be influenced by the operational status of TMINS.

Percent similarity compares station catches on the basis of species composition. Similarity values ranged from 41.0 (low similarity) to 82.8 (high similarity) (Table 5-9). Two groupings of stations were evident. Stations 10A3, 9B5, and 10B3 were consistently similar to each other (mean similarity = 79.1), as were 4A1 and 11B1 (similarity = 82.8), while similarity between these two groups was consistently low (mean similarity = 61.0). Similarity values for Station 13A1 indicated that species composition and abundance were similar to 10A3 (71.8), but quite dissimilar to all the other stations (mean similarity = 45.3).

Similarity of sites was influenced by differences in habitat and species abundance. Stations 13A1, 10A3, and 9B5; located along the west shore of TMI above and below the TMINS discharge; generally have higher velocities, a wide variety of substrate types, and abundant cover. Stations 4A1 and 11B1 share a diverse habitat characterized by mud bottoms, extensive beds of aquatic macrophytes (particularly 11B1), and other cover such as submerged trees. Habitat at Station 10B3 was intermediate between these types. Differences in similarity among stations also resulted from an uneven distribution of several key species, principally, spottail shiner, redbreast sunfish, green sunfish, pumpkinseed, bluegill, and smallmouth bass.

Pairwise similarity values for electrofishing catches at sampling stations were examined for a 14-year period (Table 5-10). In general, station pairs with high similarity values in previous years exhibited high similarity in 1989 (e.g., 13A1 vs. 10A3, 10A3 vs. 9B5). Station pairs with low PSc values in 1989 also were low in previous years (e.g., 13A1 vs. 11B1, 10A3 vs. 11B1). Generally, there appears to be a continuation of the trend towards increasing fish community similarity as reported in RMC (1988a, 1989). Many station pairs were at or above their historic mean. In fact, the similarity between Stations 4A1 and 11B1 was the highest to date.

To examine possible effects of the TMINS discharge on fish community similarity, PSc values for pairwise comparisons of Station 13A1 (immediately upstream of discharge), 10A3 (immediately downstream of discharge), and 9B5 (2,000 m downstream of discharge) were plotted (Figure 5-4). The similarity of stations downstream of TMINS discharge with 13A1 in 1989 showed a decrease from those reported in 1988. If the TMINS discharge were to influence the downstream fish community, station similarities would be expected to change between operational and non-operational years. The PSc values between Stations 13A1 and 10A3 and 13A1 and 9B5 were within the range established for operational years, but below the range for non-operational years. These differences in similarity may reflect not so much a change in species composition as the extreme dominance of a single species. The dissimilarity of these stations with 13A1 may also be related to natural environmental conditions in 1989 which was characterized by high river flow and turbidity.

Cochran's Q-statistic was not significant (Q = 5.318. DF = 5) and indicated homogeneity in the total number of fishes per station. The M-statistic showed no significant difference (M = 2.698, DF = 10) in the number of species common to each station. The non-significance of the M-statistic and Q-statistic was indicative of a homogeneous population, and suggests that differences in PSc among individual stations was not due to a change in species composition, but simply the overabundance of a single species.

5.5 MULTIPLE-YEAR COMPARISON OF FISH ABUNDANCE

To assess trends in total fish abundance in York Haven Pond over the study period, and to investigate the possible influence of TMINS on total fish abundance, total catch-per-minute (catch rate) was analyzed by a three-factor ANOVA. Total catch rates were significantly different among months, years, and stations (Table 5-11). Variance due to interaction between factors (year, month, station) was significant in all cases, so the effects of single factors on catch rate are not independent of the other factors, and ANOVA results must be interpreted with caution.

Mean annual catch rates were plotted for each station to illustrate trends (Figure 5-5). Substantial year-to-year variation in catch rates obscured any consistent trend in catch rate over the study period. There was a general decline in the catch rate from 1978 through 1986. The catch rate in 1989 showed a slight decrease from that reported in 1988 (RMC 1989). This decrease may be related to a 19.4% increase in effort and not to declines in the catch rates of key species. Consequently, the 1989 catch rate ranked second among all years, was similar to 1988 and 1987, and significantly different from all other years (Table 5-12).

Monthly catch rates in May, October, and September were similar to each other and significantly different from all other months for the period of record (Table 5-12).

Catch rates among stations near TMINS were significantly different (Table 5-12). The lowest catch rates occurred at Stations 4A1 and 9B5 for the study period, and these were significantly lower than Stations 11B1, 10A3, and 13A1. Station 10B3 was differentiated statistically from Stations 11B1, 10A3, and 9B5. The size and temporal variation of catch rates at stations upstream and downstream of the TMINS discharge (Figure 5-6) were very similar for the period of record. This latter pattern suggests that the natural variation in fish populations or variation in sampling efficiency was the factor affecting catch size, rather than any effect of the TMINS discharge.

Historical electrofishing data for York Haven Pond (EA 1985, 1986, 1987; Nardacci and Associates 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984; RMC 1988a, 1989) were examined to determine trends in specific species populations that may have influenced the multiple-year ANOVA results. As expected, common species such as quillback, pumpkinseed, and smallmouth bass exhibited annual population fluctuations that influenced the total catch-per-minute values (Figures 5-5 and 5-6). Rock bass, redbreast sunfish, bluegill, and walleye also contributed to this pattern, but to a lesser extent. Catches of quillback, pumpkinseed, and smallmouth bass at stations near the TMINS discharge also were examined for any differences in relative abundance prior to and after the shutdown. No consistent patterns emerged that would implicate the TMINS discharge as influencing station catches. Fish abundance was affected by seasonal changes in river flow and water temperature, habitat differences, and the natural fluctuations inherent in fish populations. There was little evidence that TMINS had any effect on the distribution and/or abundance of fishes sampled by the AC electrofisher in 1989.

5.6 PARASITES, DISEASE, AND MORPHOLOGICAL ANOMALIES

Fishes collected during routine electrofishing surveys were examined for the presence of external parasites, diseases, or morphological anomalies. Although these conditions occur naturally at low incidence in healthy fish populations, a high frequency of occurrence may indicate stress in the environment.

During the April through November period, a total of 5,613 fish was examined; 708 specimens of 22 fishes had one or more types of external parasites, infections, and/or morphological anomalies (Table 5-13). The most prevalent conditions were the presence of skin infections, anchor worms (Lernaea spp.), and leeches. These occurred on 305 (5.4%), 211 (3.8%), and 64 (1.1%) individuals, respectively. Skin infections included damaged fins, fin rot, fungus, tumors, and cysts. Skin infections occurred on 17 different fishes; anchor worms were observed on 14 fishes; and leeches occurred on 8 fishes. Skin infections occurred mostly on green sunfish, pumpkinseed, bluegill, and smallmouth bass. Anchor worms and leeches occurred almost exclusively among sunfishes (95.3% and 98.4%, respectively). Black spot (fluke cysts) and eye injuries, although infrequent, primarily afflicted the redbreast sunfish, green sunfish, smallmouth bass, and largemouth bass. Mouth injuries, suspected to be caused by angling, were mostly observed on smallmouth bass. All other conditions occurred in very low frequency.

The overall incidence of diseases, parasites and morphological anomalies for all fishes was 12.6% (Table 5-13). Incidence rates for individual species varied considerably. However, small sample sizes likely yield a large degree of error in estimating the true incidence rate. Sample sizes were probably sufficient for those fishes that comprised 10% of the total catch and were collected throughout the year: pumpkinseed, bluegill, and smallmouth bass. The incidence rates for these fishes ranged from 10.0 to 14.2%.

Some anomalies encountered in York Haven Pond can be considered unrelated to environmental stress (i.e. mouth injuries caused by angling). Light infestations of parasites are not generally considered indicative of stress (Snieszko 1970). After omitting black spot, anchor worm (Lernaea spp.), leeches, and mouth injuries from consideration, the overall incidence rate of disease and physical anomalies was 6.6%. EA (1987) estimated incidence rates of 1.60, 3.98, and 7.09%, for 1984, 1985, and 1986, respectively. EA (1987) observed a trend toward increasing incidence of disease and anomalies from 1984 to 1986; this was not observed in 1987 or 1988. Although the incidence rate in 1989 nearly doubled that observed in 1987 or 1988, it was still within the range established by EA (1987). The reason for this increase was unknown, but appeared unrelated to TMINS operation. Diseased and parasitized fish were encountered throughout York Haven Pond and not limited to areas immediately below the TMINS discharge.

The incidence of poor health in fishes has been shown to reflect environmental degradation. Indicators of poor health include tumors, fin damage or other deformities, heavy infestations of parasites, discoloration, excessive mucus, "redness", and hemorrhaging (Karr et al. 1986). The presence of low frequencies of parasitic infection, disease, and/or morphological anomalies is common in natural fish populations. The low frequencies of affliction encountered on fishes in York Haven Pond suggest a natural condition, and provide no evidence of environmental stress caused by TMINS operation.

TABLE 5-1

Location and description of AC electrofishing stations sampled in York Haven Pond.

Zone Number	Location and Description
TM-EL-4A1*	Along east shore of TMI, north bridge to 500 m downstream. Mud bottom and a few fallen trees along the length of the zone. When the water ceases to flow over Red Hill Dam (<435 m^3/sec), the current reverses and flows north in the zone. Extensive plankton blooms are present during the summer months.
TM-EL-13A1	Along west shore of TMI, 500 m downstream from north tip to discharge. Many boulders and riprap above Unit 2 intake; below Unit 2 intake, shallow, with a mud bottom, a few boulders, and some patches of water willow. Swift current, except when river flow is low[a].
TM-EL-10A3	Along west shore of TMI, discharge to 500 m downstream. The upper 200 m is shallow with a mud bottom and some patches of emergent vegetation (water willow). There is an eddy along shore due to the discharge. The lower 300 m has some boulders and fallen trees, with rubble and gravel on the bottom.
TM-EL-9B5	Along west shore of TMI, 1,500-2,000 m downstream of discharge. Shallow with a mud bottom, a few boulders and fallen trees. There is usually an eddy in the lower 100 m due to York Haven Dam.
TM-EL-10B3	Along west shore of Shelley Island, 500 m upstream to south tip. There are a few fallen trees and boulders; the bottom consists of mud and gravel. There are extensive beds of water weed (Elodea sp.) along the length of the zone with many floating docks present during the summer and fall months.
TM-EL-11B1	Along west shore of York Haven Pond from a small unnamed creek 500 m below the mouth of Fishing Creek to 500 m downstream. Shallow, with a mud bottom and a few fallen trees. There are extensive beds of wild celery (Vallisneria americana) and curly pondweed (Potamogeton crispus) in summer and fall.

* Prefix TM-EL- deleted from station numbers for discussion in text.
(a) River flow was defined as low (<170 m^3/sec) or moderate (170-1,000 m^3/sec).

TABLE 5-2

List of scientific and common names of fishes collected by the AC electrofisher from the Susquehanna River near TMINS in 1989.

Scientific Name	Common Name
Clupeidae	Herrings
Alosa sapidissima (Wilson)	American shad
Dorosoma cepedianum (Lesueur)	Gizzard shad
Cyprinidae	Carps and Minnows
Cyprinus carpio Linnaeus	Common carp
Notemigonus crysoleucas (Mitchill)	Golden shiner
Notropis cornutus (Mitchill)	Common shiner
Notropis hudsonius (Clinton)	Spottail shiner
Notropis spilopterus (Cope)	Spotfin shiner
Notropis volucellus (Cope)	Mimic shiner
Pimephales notatus (Rafinesque)	Bluntnose minnow
Semotilus corporalis (Mitchill)	Fallfish
Catostomidae	Suckers
Carpiodes cyprinus (Lesueur)	Quillback
Catostomus commersoni (Lacepede)	White sucker
Moxostoma macrolepidotum (Lesueur)	Shorthead redhorse
Ictaluridae	Bullhead catfishes
Ictalurus natalis (Lesueur)	Yellow bullhead
Ictalurus nebulosus (Lesueur)	Brown bullhead
Ictalurus punctatus (Rafinesque)	Channel catfish
Centrarchidae	Sunfishes
Ambloplites rupestris (Rafinesque)	Rock bass
Lepomis auritus (Linnaeus)	Redbreast sunfish
Lepomis cyanellus Rafinesque	Green sunfish
Lepomis gibbosus (Linnaeus)	Pumpkinseed
Lepomis macrochirus Rafinesque	Bluegill
Micropterus dolomieui Lacepede	Smallmouth bass
Micropterus salmoides (Lacepede)	Largemouth bass
Pomoxis annularis Rafinesque	White crappie
Pomoxis nigromaculatus (Lesueur)	Black crappie
Percidae	Perches
Perca flavescens (Mitchill)	Yellow perch
Etheostoma olmstedi Storer	Tessellated darter
Stizostedion vitreum vitreum (Mitchill)	Walleye

TABLE 5-3

Temporal distribution of fishes taken by the AC electrofisher near TMINS in 1989.

	19-20 Apr	24-25 May	30-31 May	13-14 Jun	28-29 Jun	25-26 Jul	9-10 Aug	22-23 Aug	12-13 Sep	26-27 Sep	4-5 Oct	7 Nov	Total	% Catch
American shad	-	-	-	-	-	-	-	-	-	1	-	-	1	+
Gizzard shad	2	3	6	2	6	9	-	13	2	8	10	6	67	1.1
Common carp	5	10	18	7	10	3	8	4	2	7	3	2	79	1.2
Golden shiner	2	-	2	1	-	2	4	6	3	7	9	12	48	0.8
Common shiner	-	-	-	-	-	-	-	-	1	2	1	-	4	0.1
Spottail shiner	33	11	23	25	3	34	11	13	25	19	49	109	355	5.6
Spotfin shiner	-	6	10	13	5	15	9	25	14	4	2	2	105	1.7
Mimic shiner	-	1	-	-	-	-	-	-	-	1	-	-	2	+
Bluntnose minnow	-	-	-	-	1	1	-	-	1	-	-	-	3	+
Fallfish	-	1	2	-	-	1	5	3	-	-	-	-	12	0.2
Quillback	36	42	81	29	25	23	31	41	12	2	10	43	375	6.0
White sucker	2	5	1	1	3	1	-	-	-	1	-	-	14	0.2
Shorthead redhorse	12	2	7	1	2	10	-	1	-	-	-	-	35	0.6
Yellow bullhead	-	-	-	1	-	-	-	-	1	1	1	-	4	0.1
Brown bullhead	-	1	-	-	1	-	1	1	-	-	-	-	4	0.1
Channel catfish	1	-	2	5	1	5	4	3	4	7	2	-	34	0.5
Rock bass	32	17	30	16	7	5	17	5	18	10	11	8	176	2.8
Redbreast sunfish	79	70	69	74	17	74	41	17	48	15	10	20	534	8.5
Green sunfish	17	4	15	30	3	12	100	63	52	29	46	74	445	7.1
Pumpkinseed	122	186	130	174	44	205	188	163	111	165	244	306	2038	32.4
Bluegill	28	23	40	51	4	19	155	97	117	66	82	76	758	12.0
Lepomis hybrid	1	2	-	7	-	1	7	3	13	6	7	2	49	0.8
Smallmouth bass	85	173	133	87	151	78	30	32	19	51	51	42	932	14.8
Largemouth bass	6	1	2	11	-	6	15	7	21	12	13	11	105	1.7
White crappie	4	1	6	8	-	4	3	-	2	7	6	17	58	0.9
Black crappie	3	-	1	1	-	-	4	-	2	6	2	9	28	0.4
Tessellated darter	-	-	-	-	-	-	1	-	-	-	-	-	1	+
Yellow perch	-	-	-	-	-	1	-	-	-	-	-	-	1	+
Walleye	6	1	6	4	2	2	1	-	3	1	1	5	32	0.5
No. of Specimens	476	560	584	548	285	511	635	497	471	428	560	744	6299	
No. of Species	18	19	20	20	17	21	19	17	20	22	19	16	28	
No. of Collections	6	6	6	6	6	6	6	6	6	6	6	6	72	
No. of Fish/Collection	79.33	93.33	97.33	91.33	47.50	85.17	105.83	82.83	78.50	71.33	93.33	124.00	87.49	
No. of Fish/Minute	3.78	4.34	4.32	3.86	2.06	3.68	5.00	3.38	3.18	3.27	3.52	4.56	3.74	
Diversity Index	3.20	2.64	3.21	3.18	2.45	2.93	2.99	3.03	3.24	3.12	2.82	2.84	3.24	

+ Less than 0.05%.

TABLE 5-4

Distribution of fishes taken by the AC electrofisher at stations sampled near TMINS in 1989. Station prefix TM-EL- deleted from table.

	4A1	13A1	10A3	9B5	10B3	11B1	Total	% Catch
American shad	-	1	-	-	-	-	1	+
Gizzard shad	10	11	9	3	13	21	67	1.1
Common carp	10	24	14	7	10	14	79	1.2
Golden shiner	-	1	3	-	4	40	48	0.8
Common shiner	-	-	-	-	-	4	4	0.1
Spottail shiner	12	11	81	147	91	13	355	5.6
Spotfin shiner	12	26	40	16	1	10	105	1.7
Mimic shiner	-	-	2	-	-	-	2	+
Bluntnose minnow	2	-	1	-	-	-	3	+
Fallfish	-	2	8	2	-	-	12	0.2
Quillback	61	33	34	70	68	109	375	6.0
White sucker	2	5	5	1	-	1	14	0.2
Shorthead redhorse	-	15	16	3	-	1	35	0.6
Yellow bullhead	1	3	-	-	-	-	4	0.1
Brown bullhead	2	-	-	-	1	1	4	0.1
Channel catfish	2	16	7	5	3	1	34	0.5
Rock bass	9	65	51	28	14	9	176	2.8
Redbreast sunfish	23	172	165	96	67	11	534	8.5
Green sunfish	69	98	109	142	13	14	445	7.1
Pumpkinseed	386	162	365	284	298	543	2038	32.4
Bluegill	156	31	97	109	135	230	758	12.0
Lepomis hybrid	28	5	6	6	-	4	49	0.8
Smallmouth bass	23	429	203	111	145	21	932	14.8
Largemouth bass	55	4	5	3	5	33	105	1.7
White crappie	4	3	2	3	7	39	58	0.9
Black crappie	4	4	1	2	2	15	28	0.4
Tessellated darter	-	-	-	1	-	-	1	+
Yellow perch	-	-	-	-	-	1	1	+
Walleye	2	6	10	5	8	1	32	0.5
No. of Specimens	873	1127	1234	1044	885	1136	6299	
No. of Species	20	22	22	20	18	22	28	
No. of Collections	12	12	12	12	12	12	72	
No. of Fish/ Collection	72.75	93.92	102.83	87.00	73.75	94.67	87.49	
No. of Fish/Minute	3.17	4.37	4.38	3.84	3.39	3.38	3.74	
Diversity Index	2.78	2.97	3.21	3.11	2.88	2.60	3.24	

+ Less than 0.05%.

TABLE 5-5

Percent family composition at the AC electrofishing stations sampled in York Haven Pond, April through November 1989. Station prefix TM-EL- deleted from table.

Family	Station						
	4A1	13A1	10A3	9B5	10B3	11B1	Total
Herrings	1.1	1.1	0.7	0.3	1.6	1.8	1.1
Carps and Minnows	4.1	5.7	12.1	16.5	11.9	7.1	9.6
Suckers	7.2	4.7	4.4	7.1	7.7	9.8	6.7
Bullhead catfishes	0.6	1.7	0.6	0.5	0.4	0.2	0.7
Sunfishes	86.7	86.3	81.4	75.1	77.5	80.9	81.3
Perches	0.2	0.5	0.8	0.6	0.9	0.2	0.5

TABLE 5-6

Spatial and temporal catch-per-minute data (all species combined) for fishes taken by the AC electrofisher near TMINS in 1989. Station prefix TM-EL- deleted from table.

Date	Season	Station						Total Mean
		4A1	13A1	10A3	9B5	10B3	11B1	
19-20 Apr	Spring	2.05	5.76	4.68	2.22	3.75	4.21	3.78
24-25 May		1.75	4.35	4.04	5.04	7.15	3.80	4.34
30-31 May		1.50	6.36	5.41	4.33	5.00	3.52	4.32
13-14 Jun		3.64	4.60	4.83	5.54	2.65	2.27	3.86
Seasonal Mean		2.30	5.30	4.74	4.29	4.64	3.38	4.08
28-29 Jun	Summer	0.90	4.21	2.95	1.44	1.73	1.60	2.06
25-26 Jul		1.90	6.00	5.88	5.23	2.82	1.10	3.68
9-10 Aug		4.74	5.33	8.12	5.50	3.38	2.92	5.00
22-23 Aug		3.54	3.56	4.74	2.91	3.54	1.84	3.38
Seasonal Mean		2.77	4.72	5.45	3.65	2.89	1.82	3.50
12-13 Sep	Fall	5.20	3.04	2.83	3.00	3.16	1.92	3.18
26-27 Sep		4.13	3.00	4.12	3.63	1.59	2.72	3.27
4-5 Oct		3.50	3.44	2.73	2.82	3.71	4.51	3.52
7 Nov		4.10	3.50	2.32	4.68	2.48	8.74	4.56
Seasonal Mean		4.21	3.25	3.00	3.56	2.79	4.79	3.66
Grand Mean		3.17	4.37	4.38	3.84	3.39	3.38	3.74

TABLE 5-7

Two-factor analysis of variance test results for electrofishing catch-per-minute data collected near TMINS, April through November 1989.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2=0.441)	17	0.7258	0.0427	2.51	0.0054*
Station	5	0.2319	0.0464	2.73	0.0287**
Season	2	0.0538	0.0269	1.58	0.2150
Interaction	10	0.4401	0.0440	2.59	0.0122**
Error	54	0.9186	0.0170		
Corrected Total	71	1.6443			

* Significant at $P \leq 0.01$.
** Significant at $P \leq 0.05$.

TABLE 5-8. MIMIMUM, MEAN, AND MAXIMUM LENGTH, WEIGHT, AND CONDITION FACTOR (K) OF PUMPKINSEED, BLUEGILL, AND SMALLMOUTH BASS CAPTURED BY THE AC ELECTROSHOCKER NEAR TMINS, 1989.

		Fork Length (mm)			Weight (g)			K		
Month	N	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Pumpkinseed										
APR	108	64	143	183	4	81.1	174	1.53	2.51	3.17
MAY	278	47	140	220	2	85.8	318	1.51	2.74	3.37
JUN	208	49	116	180	2	54.6	161	0.94	2.65	4.17
JUL	183	45	107	186	2	41.4	158	1.07	2.31	15.4
AUG	351	50	86	187	2	22.6	188	0.54	2.35	5.13
SEP	273	54	100	175	4	29.4	152	0.78	2.39	3.72
OCT	204	60	99	179	5	28.7	160	0.98	2.36	4.17
NOV	143	65	114	194	5	49.2	210	1.29	2.38	3.06
Bluegill										
APR	28	57	164	213	3	126.0	270	1.62	2.37	2.82
MAY	63	40	154	212	1	114.1	286	1.42	2.70	8.13
JUN	55	50	127	213	3	66.2	286	1.68	2.57	3.25
JUL	19	63	105	174	6	38.8	170	1.86	2.41	3.23
AUG	252	52	105	205	2	40.2	236	0.76	2.41	4.58
SEP	183	27	99	210	1	28.7	258	1.26	2.38	7.34
OCT	82	52	102	198	3	30.2	210	0.91	2.47	17.6
NOV	67	61	122	230	3	59.9	290	0.87	2.09	2.86
Smallmouth Bass										
APR	85	82	190	308	6	135.0	452	0.90	1.42	1.77
MAY	284	72	175	410	5	112.8	1070	0.66	1.51	2.55
JUN	224	81	205	418	8	172.9	1120	0.97	1.51	2.17
JUL	78	103	189	369	14	115.4	735	1.08	1.39	1.83
AUG	62	65	232	440	6	246.5	1090	1.13	1.48	2.18
SEP	70	94	203	394	12	157.0	925	1.17	1.49	1.90
OCT	51	81	182	379	8	118.8	860	0.99	1.45	1.74
NOV	42	83	215	325	12	164.1	509	0.97	1.44	2.10

TABLE 5-9

Percent similarity indices of species composition between the electrofishing stations near TMINS, 1989. Station prefix TM-EL- deleted from table.

	13A1	10A3	9B5	10B3	11B1
4A1	41.0	60.9	64.1	69.3	82.8
13A1		71.8	57.4	52.1	30.7
10A3			80.8	77.8	50.5
9B5				78.6	53.6
10B3					67.6

TABLE 5-10

Comparison of percent similarity indices of species composition between the electrofishing stations near TMINS, 1976 through 1988 vs. 1989. Station prefix TM-EL- deleted from table.

Station Pairs	1976 through 1988		1989
	Range	Mean	
4A1-13A1	37.4-76.4	58.8	40.9
4A1-10A3	44.5-75.7	60.9	60.9
4A1-9B5	52.5-74.9	64.5	64.1
4A1-10B3	43.5-77.7	65.0	69.3
4A1-11B1	41.7-76.5	59.8	82.8
13A1-10A3	68.5-84.3	77.9	71.8
13A1-9B5	36.5-78.6	64.4	57.4
13A1-10B3	46.2-74.1	61.8	52.1
13A1-11B1	27.9-44.9	35.9	30.7
10A3-9B5	44.8-87.2	70.7	80.7
10A3-10B3	52.6-83.3	66.9	77.8
10A3-11B1	35.0-56.0	42.7	50.5
9B5-10B3	43.4-82.8	68.7	78.6
9B5-11B1	32.0-66.0	50.1	53.6
10B3-11B1	48.8-73.9	60.1	67.6

TABLE 5-11

Three-factor analysis of variance test results for electrofishing catch-per-minute data collected near TMINS, April through November 1976 through 1989.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2=0.612)	216	50.2695	0.2327	7.02	0.0001*
Year	13	16.1588	1.2430	37.49	0.0001*
Month	7	3.7291	0.5327	16.07	0.0001*
Station	5	3.2274	0.6455	19.47	0.0001*
Year-Month	91	13.2523	0.1456	4.39	0.0001*
Year-Station	65	4.2467	0.0653	1.97	0.0001*
Month-Station	35	7.3986	0.2114	6.38	0.0001*
Error	961	31.8629	0.0332		
Corrected Total	1177	82.1324			

* Significant at $P \leq 0.01$.

TABLE 5-12

Summary of Tukey's studentized range test for electrofishing catch-per-minute data collected near TMINS, April through November 1976 through 1989. Underlined means are not significantly different (P≤0.05) and are ranked from highest to lowest transformed (4th root) mean. Means are listed parenthetically.

Year	1988	1989	1987	1978	1979	1981	1977	1983	1976	1984	1982	1980	1985	1986
	(1.40)	(1.37)	(1.29)	(1.18)	(1.15)	(1.14)	(1.12)	(1.10)	(1.10)	(1.05)	(1.05)	(1.04)	(1.02)	(0.90)
	—	—												
		—	—											
				—	—	—	—	—	—					
						—	—	—	—	—	—			
							—	—	—	—	—	—		
								—	—	—	—	—	—	

Month	May	Oct	Sep	Aug	Apr	Nov	Jul	Jun
	(1.22)	(1.22)	(1.19)	(1.12)	(1.10)	(1.07)	(1.07)	(1.06)
	—	—	—					
				—	—	—	—	—

Station*	11B1	10A3	13A1	10B3	4A1	9B5
	(1.19)	(1.19)	(1.16)	(1.12)	(1.09)	(1.05)
	—	—	—			
			—	—		
				—	—	
					—	—

* Station prefix TM-EL- deleted from table.

TABLE 5-13

Incidence of parasites, diseases, and/or morphological anomalies on fishes captured by the AC electrofisher near TMINS, April through November 1989.

	Black Spot	*Lernaea*	Leech	Glochidia	*Argulus*	Scoliosis	Popeye	Mouth Injury	Eye Injury	Skin* Infection	Emaciation	Total Afflicted	Total Examined	Percent Incidence
Gizzard shad	-	-	-	-	-	-	-	-	-	4	1	5	68	7.4
Common carp	-	-	-	-	-	-	-	1	-	-	-	1	6	16.7
Golden shiner	-	-	-	-	-	-	-	-	-	3	-	3	48	6.2
Common shiner	1	-	-	-	-	-	-	-	-	-	-	1	4	25.0
Spottail shiner	1	6	-	-	-	-	-	-	-	7	-	14	348	4.0
Spotfin shiner	-	1	-	-	-	-	-	-	-	-	-	1	105	1.0
Fallfish	-	1	-	-	-	-	-	-	-	1	-	2	12	16.7
Quillback	3	1	-	-	-	1	-	-	-	21	-	26	115	22.6
White sucker	1	-	-	-	-	-	-	-	-	1	-	2	14	14.3
Shorthead redhorse	-	1	-	-	-	-	-	-	1	5	-	7	35	20.0
Brown bullhead	-	-	1	-	-	-	-	-	-	-	-	1	4	25.0
Channel catfish	-	-	-	-	-	-	-	-	1	4	-	5	34	14.7
Rock bass	-	1	3	-	-	-	-	4	2	11	5	26	176	14.8
Redbreast sunfish	-	16	12	1	-	2	1	5	2	23	3	65	534	12.2
Green sunfish	-	19	24	-	-	-	-	1	-	41	-	85	445	19.1
Pumpkinseed	-	71	3	-	-	-	10	-	4	80	7	175	1748	10.0
Bluegill	-	53	2	-	1	1	1	3	1	43	-	105	749	14.0
Lepomis hybrid	-	-	6	-	-	-	-	-	-	2	-	8	49	16.3
Smallmouth bass	-	32	9	-	3	-	-	24	12	44	3	127	896	14.2
Largemouth bass	10	6	4	-	-	-	-	9	1	11	-	41	105	39.0
White crappie	-	2	-	-	-	-	-	-	-	1	-	3	58	5.2
Black crappie	-	1	-	-	-	-	-	-	-	3	-	4	28	14.3
Walleye	1	-	-	-	-	-	-	-	-	-	-	1	32	3.1
Total	17	211	64	1	4	4	12	47	24	305	19	708	5613	12.6
Percent	0.3	3.8	1.1	+	0.1	0.1	0.2	0.8	0.4	5.4	0.3			

* Includes fish with fin rot, damaged fins, fungus, tumors, or cysts.
+ Less than 0.05%.

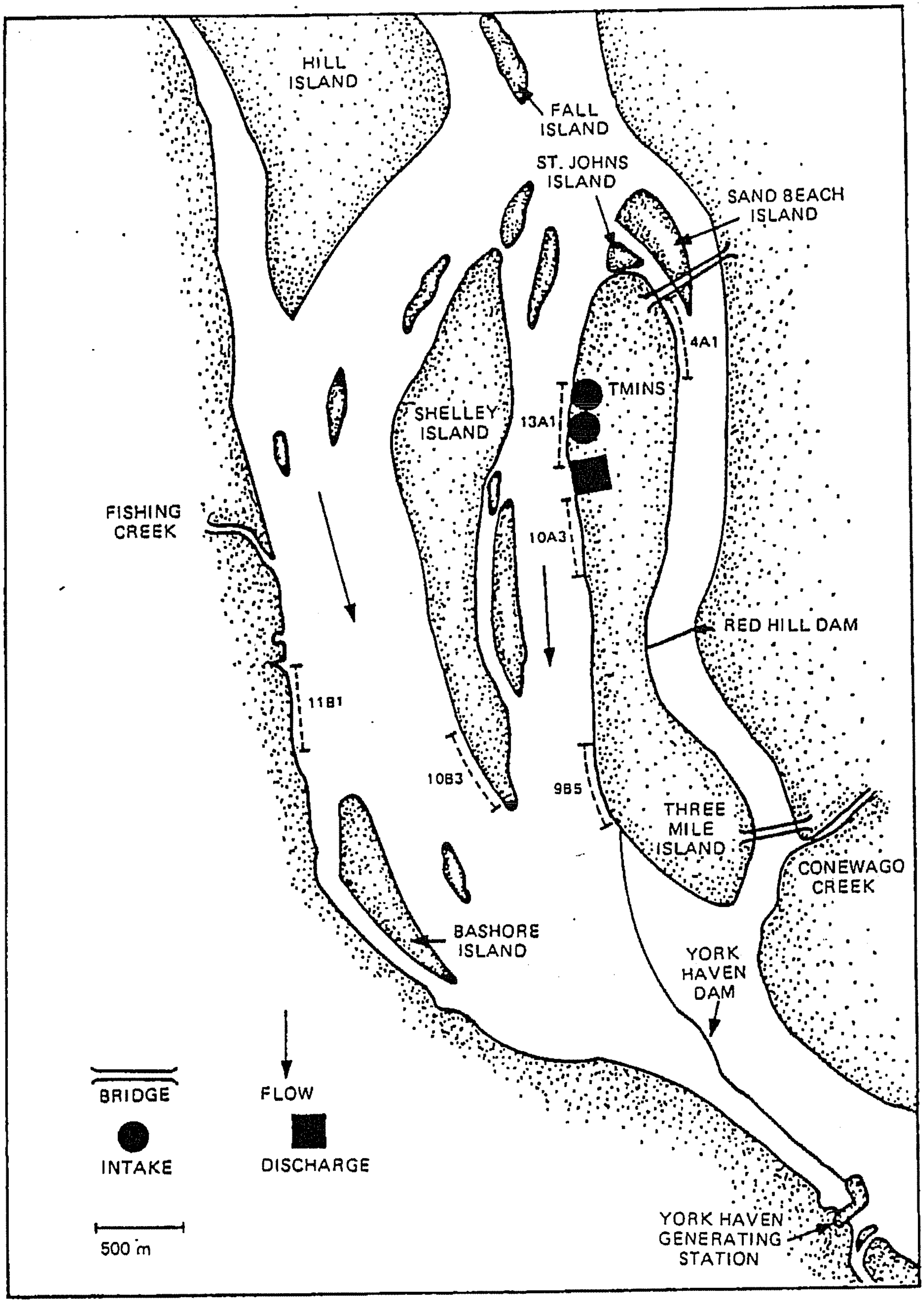

Figure 5-1. Location of electrofishing stations sampled in York Haven Pond (station prefix TM-EL- deleted).

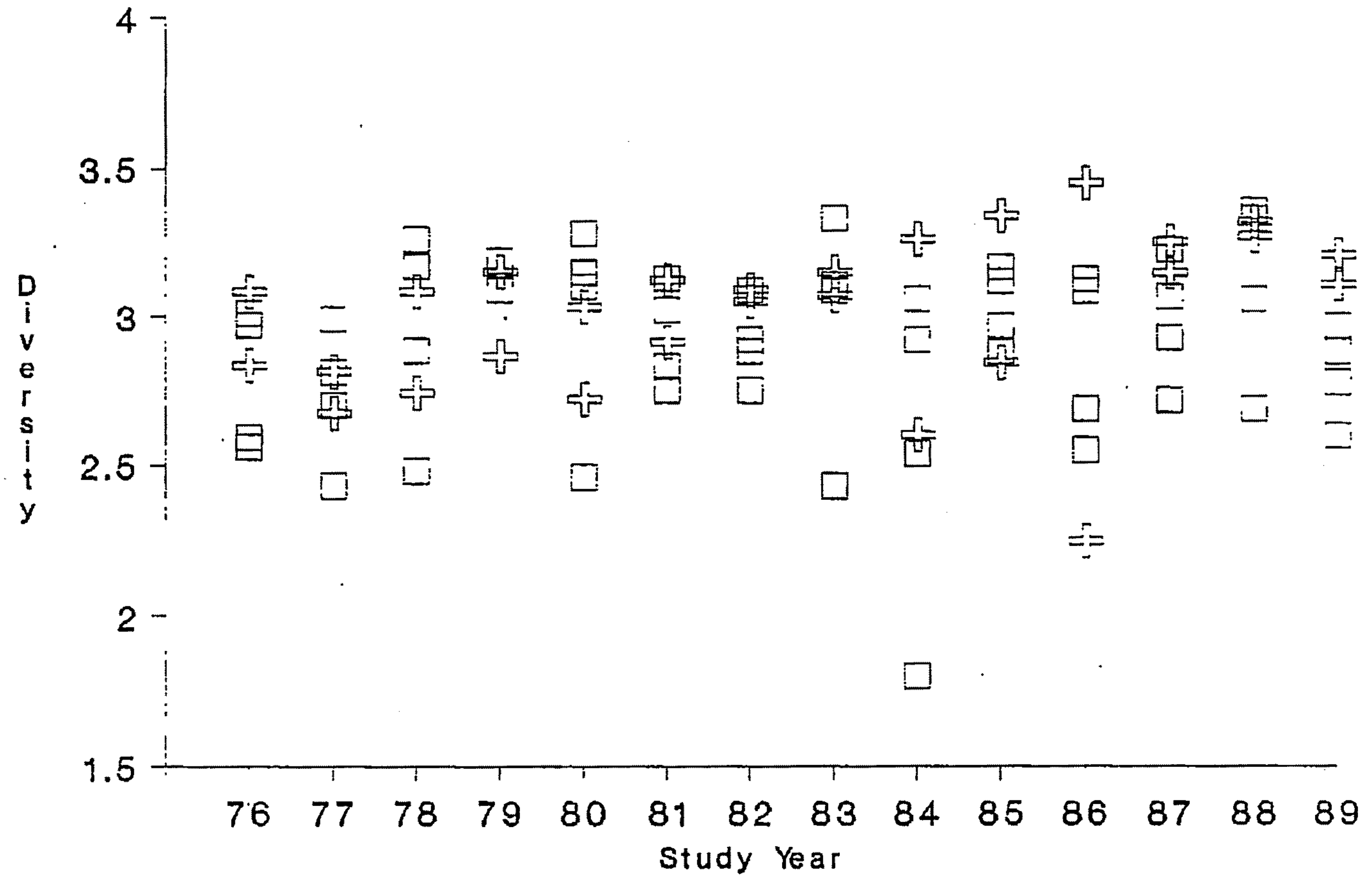

Figure 5-2. Annual range of sampling station diversity values, months combined, for electrofishing catches, TMINS aquatic studies (open boxes are station values, and crosses represent stations 10A3 and 9B5). Identical diversity values may result in less than six symbols.

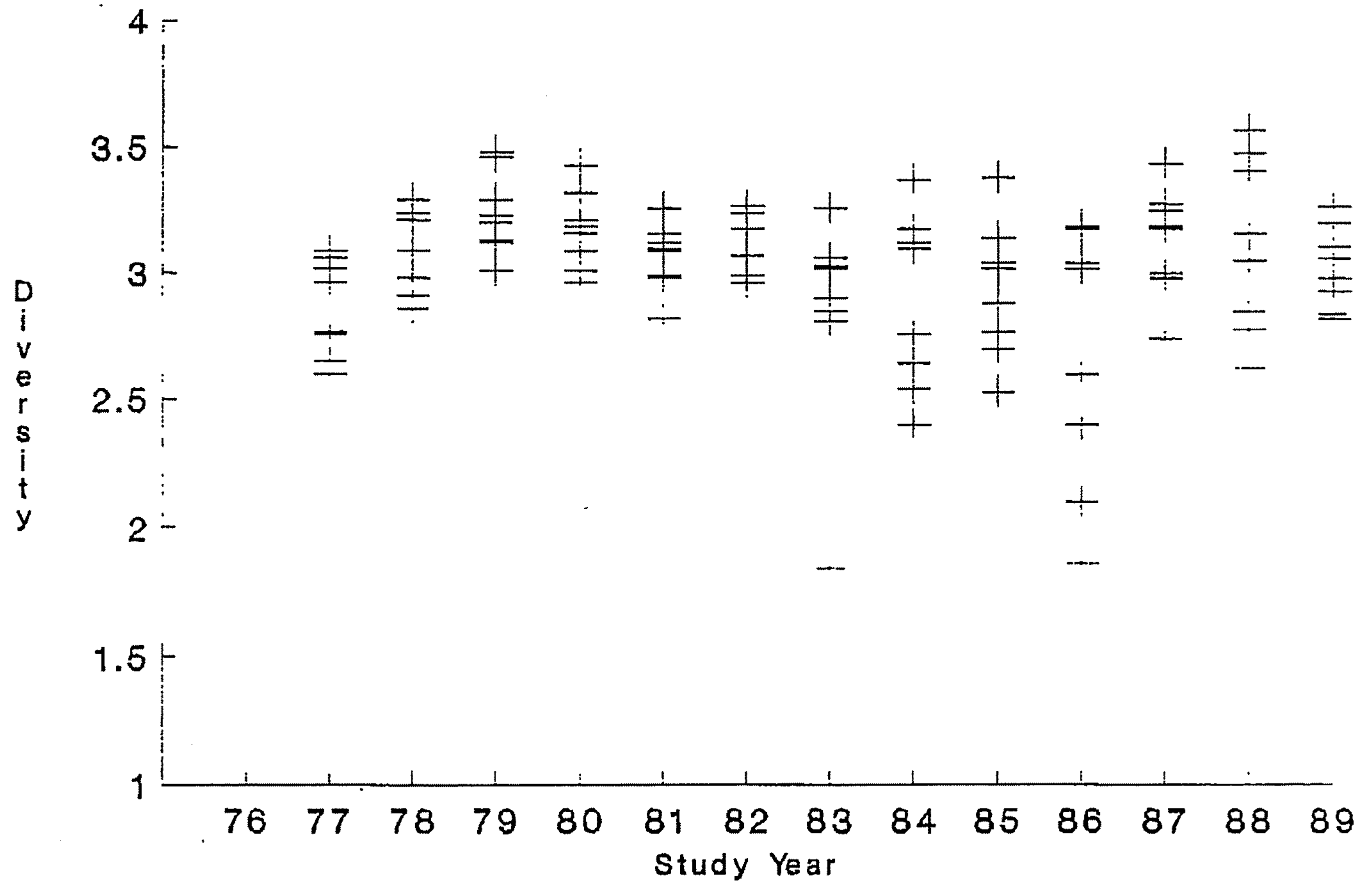

Figure 5-3. Annual range of monthly (April-November) diversity values, stations combined, for electrofishing catches, TMINS aquatic studies. Identical diversity values may result in less than eight symbols.

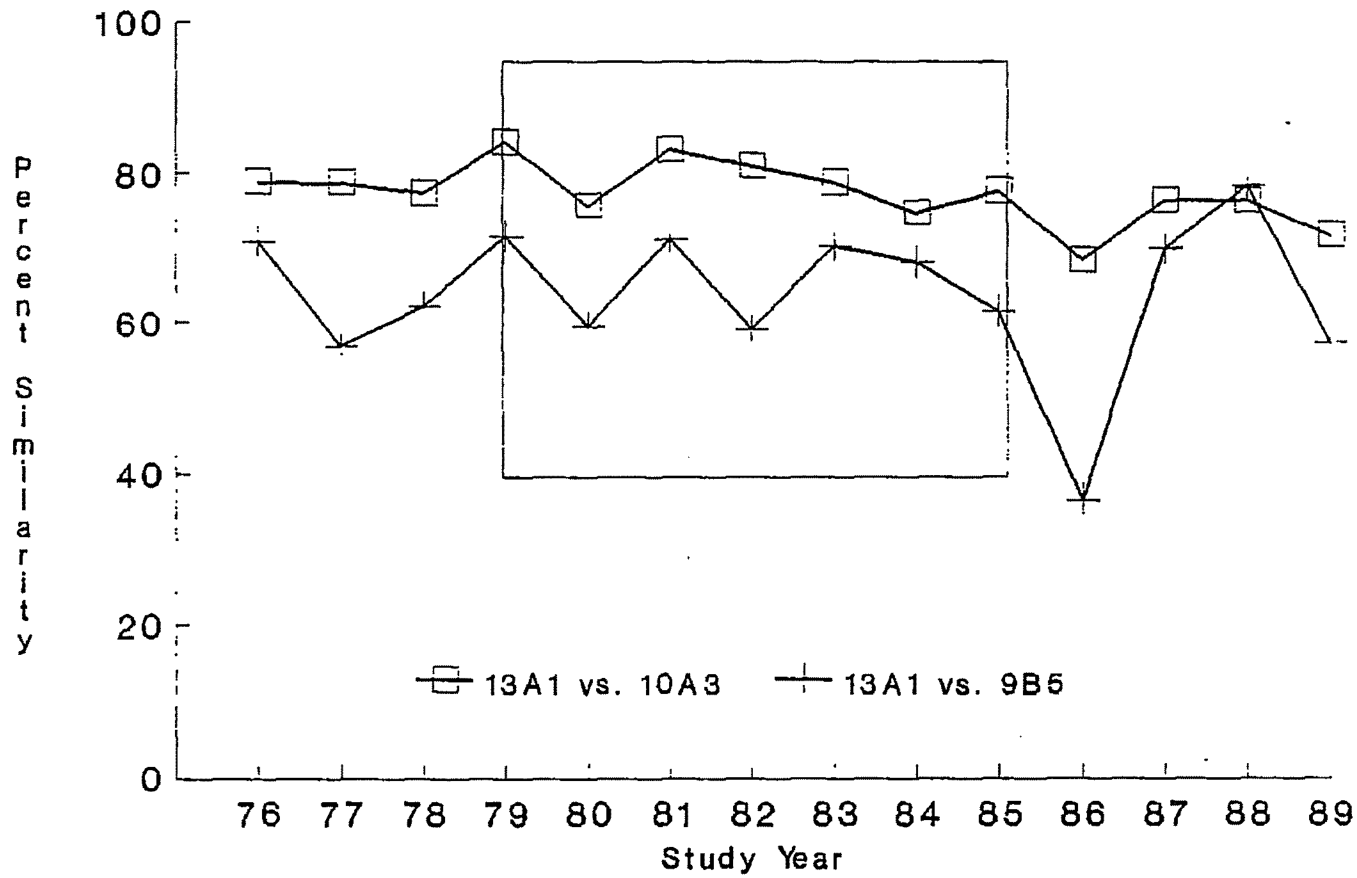

Figure 5-4. Annual variation in percent similarity (PSc) values for selected station comparisons, TMINS aquatic studies. Years of non-operation of TMINS are represented within the large square.

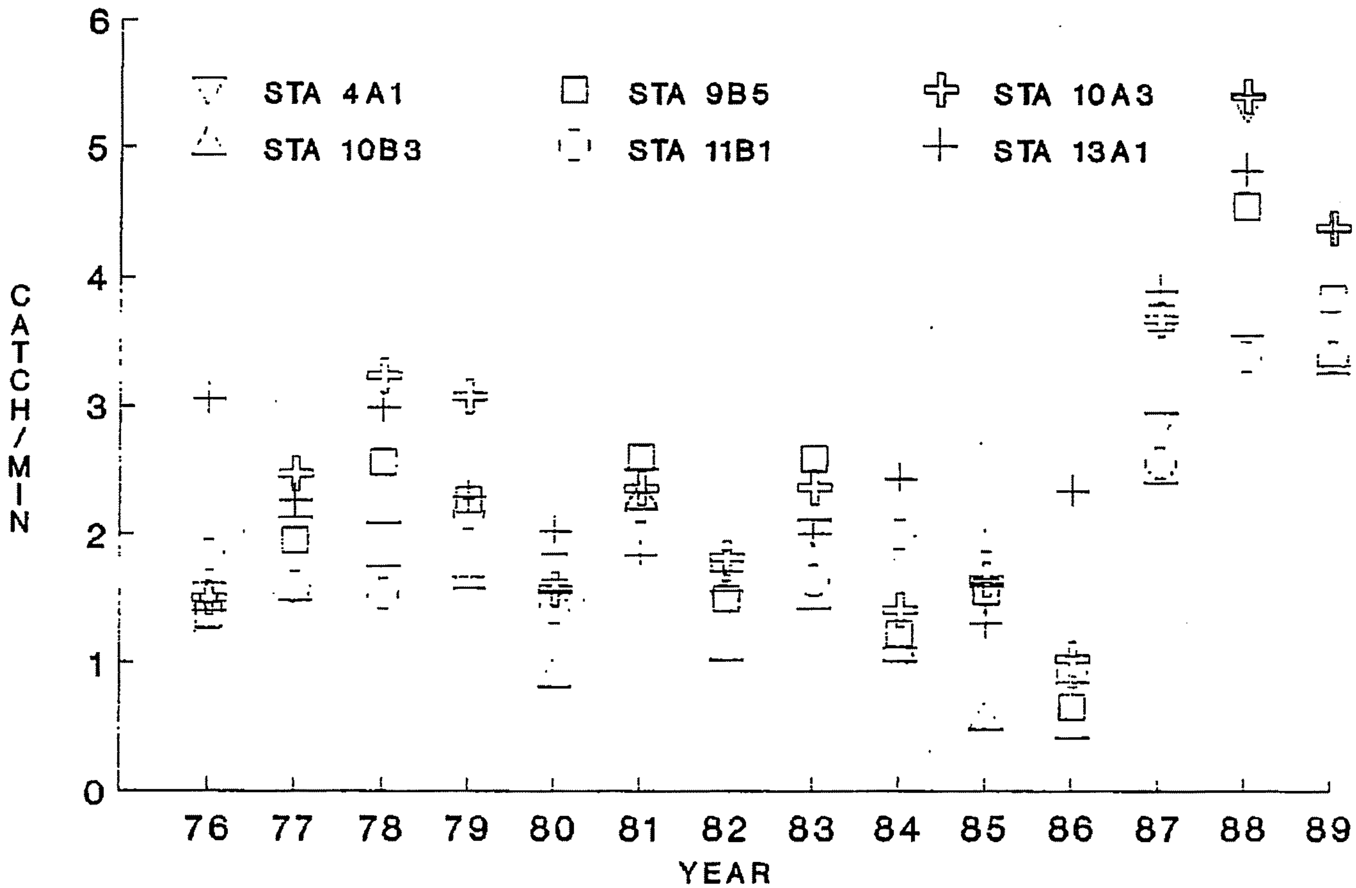

Figure 5-5. Mean annual catch-per-minute data for electrofishing stations near TMINS.

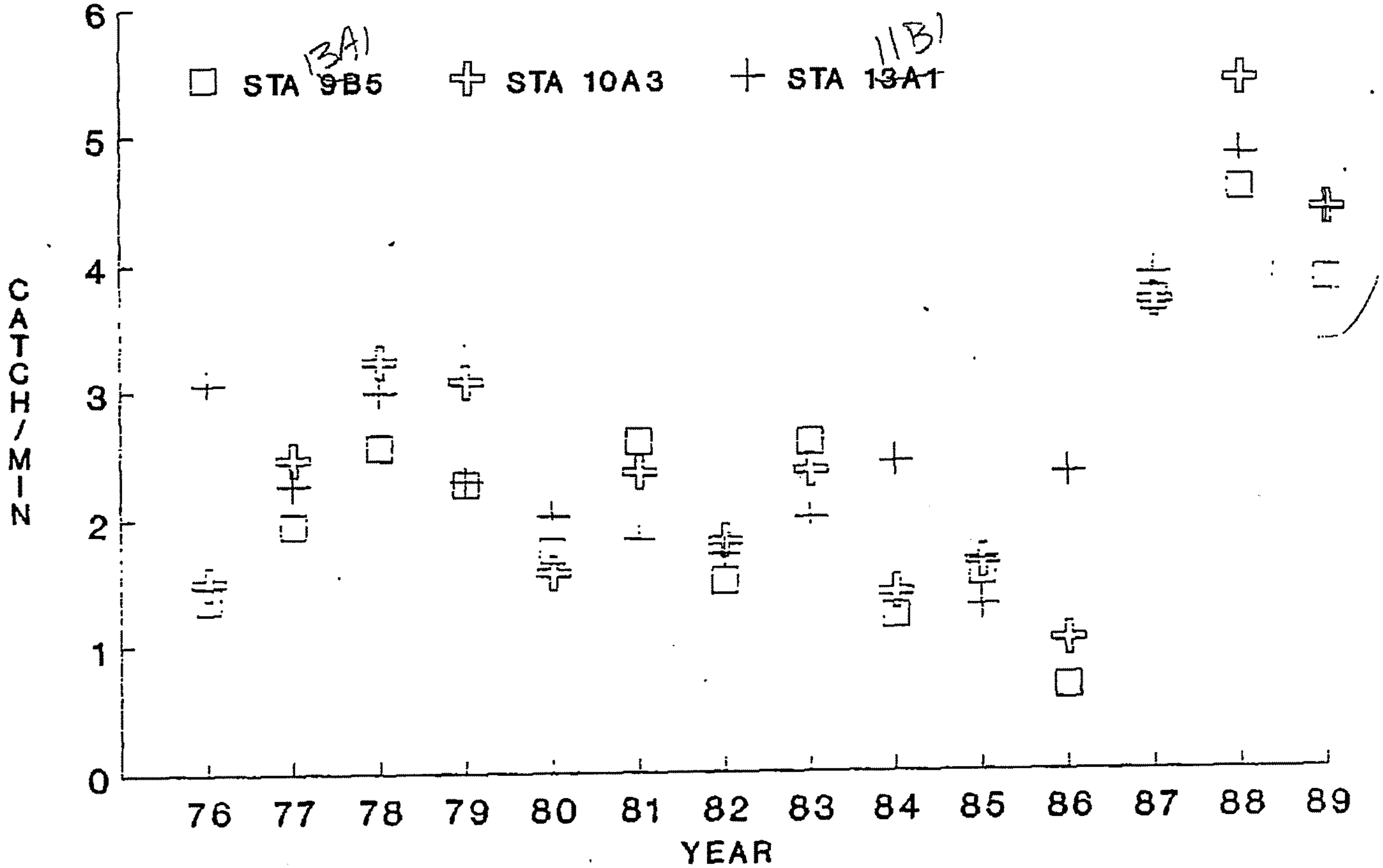

Figure 5-6. Mean annual catch-per-minute data for electrofishing stations nearest the TMINS discharge.

6. CREEL SURVEYS

6.1 METHODS

The survey area included over 793 hectares of the Susquehanna River immediately upstream and downstream of the York Haven and Red Hill dams (Figure 6-1). This section of river was partitioned into four areas: General Reservoir, West Dam (York Haven Dam), East Dam (Red Hill Dam), and York Haven Generating Station (YHGS); the General Reservoir was further subdivided into 12 zones. The first three areas were surveyed on a 16 km circuit by boat. All anglers fishing from boats (except those trolling) and along the shore were interviewed. The YHGS area was surveyed on foot; therefore, anglers fishing from boats were interviewed only if they were near shore or had completed fishing.

Creel surveys were conducted on two weekend days and two weekdays each month, April through November 1989. Survey dates were preselected to equally represent each weekend day and weekday. Each survey-day was divided into three 4-hour interview periods (0900-1300, 1301-1700, and 1701-2100 hours). During each period, air and surface water temperatures, weather conditions, and time were recorded at each area. River stage; obtained from River Forecast Center, Harrisburg, Pennsylvania; was recorded on each survey-day.

Anglers were interviewed concerning their residence, total time fished (to the nearest five minutes), composition of catch, use of catch (kept, released, given away, or other), and whether their use of catch was affected by the 1979 accident at Unit 2 of the Three Mile Island Nuclear Station (TMINS). Anglers interviewed during more than one survey period were considered separate anglers; however, use of catch and residence information was recorded only during their first interview. Other data recorded were whether fishing trips were complete or incomplete, estimated angler age (categorized as <18, 18 to 29, 30 to 65, and >65 years), whether anglers fished from boat or shore (General Reservoir only), and zone fished (Figure 6-1).

Survey results (numbers of anglers, fish caught, fish kept, and hours fished) were used in a two-factor analysis of variance (ANOVA) to analyze differences among months and areas in 1989, and among years and areas (1975 through 1989). When significant differences were indicated by ANOVA, Tukey's studentized range test was used to determine differences between means (SAS Institute, Inc., Cary, NC).

Fishes caught by anglers in 1989 are listed in Table 6-1 with taxonomic order and scientific and common names following Robins et al. (1980). When anglers were unsure of species identification or reluctant to have their catch examined, general identifications such as suckers (Catostomidae), bullhead catfishes (Ictalurus spp.), sunfishes (Lepomis spp.), or crappies (Pomoxis spp.) were used.

The relative similarity of species composition among survey areas for total catch and harvest was determined by calculating a percent similarity index (PSc), as decribed in Chapter 2.

Creel survey data were accepted with the assumptions that the rate of catch before and after the interview was the same, and that catch per unit effort for incomplete fishing trips was an unbiased estimator of catch per unit effort for completed trips. These assumptions were validated by DiCostanzo (1956), Frisbie and Ritchie (1963), Groen and Schmulbach (1978), Malvestuto et al. (1978), and Nardacci et al. (1976).

Catch per unit effort (c/e = catch per hour) and harvest per unit effort (h/e = harvest per hour) values were calculated for specific time periods, e.g., weekend day, weekday, monthly, and annually for each survey area. Mean values ($\overline{x}$) of fish caught, fish kept (harvested), and hours fished per angler also were calculated for these time periods from the equation in Nardacci et al. (1976):

$$\overline{x} = \frac{x}{y}$$

where

$\overline{x}$ = surveyed number of fish caught, fish harvested, or hours fished, and

y = surveyed number of anglers.

Data from the creel surveys were used to estimate monthly and annual angling totals. The average number of anglers were calculated without extrapolating for missed survey periods (e.g., due to equipment failure, darkness) and used in the equation (Nardacci et al. 1976):

$$E = \sum_{i=mo}^{n} (Awe)(Twe) + (Awd)(Twd)$$

where

E = estimate of total anglers,

Awe = mean number of anglers per weekend day each month,

Twe = total number of weekend days each month,

Awd = mean number of anglers per weekday each month, and

Twd = total number of weekdays each month.

Estimates of total fish caught, fish harvested, and hours fished were obtained by multiplying the surveyed mean values ($\overline{x}$) by the estimated number of anglers (E).

Another creel survey estimate was the computation of completed trips by assuming that anglers were interviewed during the midpoint of their fishing trip. Doubling the time from the start of the angler's trip to the time of interview produced an estimate of the completed fishing trip (DiCostanzo 1976; Groen and Schmulbach 1978).

All creel survey estimates were considered valid only with the assumptions that anglers not interviewed during a survey-day (e.g., trolling, inaccessible) approximated those that were interviewed more than once that day; and that anglers fishing for a brief time had a chance of being interviewed equal to those fishing for an extended period of time.

6.2 EVALUATION OF EFFORT, CATCH, AND HARVEST

Summaries of each 1989 creel survey-day are presented in Appendix E. A total of 2,535 anglers was interviewed (Table 6-2). They fished for 5,751.00 hours and caught 9,607 fish of which 2,018 were harvested. The resultant mean annual catch (c/e) and harvest per unit effort (h/e) were 1.67 and 0.35 fish per hour, respectively. The total number of anglers, the number of fish caught, and the hours fished peaked in July and again in October before declining through November. Monthly c/e and h/e values were highest in May.

The survey areas receiving the heaviest fishing pressure and yielding the most fish were the General Reservoir and YHGS (Table 6-2). Increased fishing pressure at these areas anglers, fish caught, and fish kept. However, the General Reservoir differed from the dams with respect to number of anglers, fish caught, and hours fished. Ranking of survey area means indicated that the General Reservoir was highest for number of anglers, fish caught, and hours fished. Collectively, the General Reservoir and YHGS means ranked highest for all test variables.

Creel survey investigations elsewhere have shown that angler effort was greatest on weekends (Thuemler 1981; Von Geldern and Tomlinson 1973). Similarly, TMINS survey data showed angler effort (number of anglers and hours fished), catch, and harvest to be greatest on weekend days at all survey areas (Table 6-5). Weekend anglers accounted for 73.5% of all anglers interviewed, 77.1% of total hours fished, 70.4% of fish caught, and 70.3% of fish harvested. In contrast, average c/e and h/e values were consistently higher for weekdays than for weekend days at all areas.

General Reservoir anglers fished primarily along the west shore of Fall Island, east of Hill Island (Zone 11), and in the area along the west shore of the West Channel (Zone 1) (Table 6-6). The increased occurrence of anglers in these zones may be related to the proximity of several public and private boat launch and access areas. The highest catch and harvest within the General Reservoir occurred at Zones 11 and 1, respectively, a reflection of high angler use. The highest c/e and h/e was recorded from

Zone 5 (South Center Channel, East shore) and Zone 7 (North Center Channel, East Shore), respectively. A relatively high c/e value was also recorded for Zone 11, while h/e values were also high at Zone 8.

Over 84% of the General Reservoir anglers fished from boats (Table 6-7). Boat anglers fished for more hours, and caught and harvested more fish than shore anglers. The greater fishing success achieved by boat anglers was due to their increased mobility, allowing them to cover a larger area, and fish a wider variety of habitats (EA 1985, 1986, 1987; Nardacci and Associates 1984; RMC 1988a, 1989). General Reservoir survey results from 1989 indicated that c/e values were highest for boat anglers on an annual basis and during four of the eight survey months. The high annual c/e value for boat anglers resulted from a relatively high c/e from June through October.

In contrast, the h/e values were higher for shore anglers than for boat anglers in seven of the survey months (Table 6-7). In fact, over 75% of the fish harvested from shore occurred from April to July. Shore anglers harvested 38.6% of their catch, while boat anglers harvested only 13.3% of their catch. This suggests shore anglers fish primarily for food rather than for sport. Although boat anglers enjoyed greater success, due in part to their mobility, they seemed more likely to fish for the sport or for a specific species.

Anglers fishing near TMINS caught 9,607 fish of 21 species in 1989 (Table 6-8). Four fishes formed the bulk of the catch (87.7%) and harvest (77.0%). Smallmouth bass (63.8%) dominated the angler catch, and ranked first in all survey months; it ranked second in angler harvest. Over 29% of the smallmouth bass caught were of legal size, and 27% of those were kept. Most smallmouth bass were caught and harvested from the General Reservoir (Table 6-9). Rock bass ranked second in abundance and were commonly caught and harvested from the YHGS. Sunfishes (Lepomis spp.) ranked third in abundance and were most frequently caught in the General Reservoir. Channel catfish ranked fourth, and were principally caught and harvested at YHGS. Channel catfish were most abundant in July through September with 75.0% being caught and over 63% harvested during these months. Over 59% of the rock bass and 39% of all channel catfish caught were harvested in 1989. Other species of local importance were the largemouth bass, white crappie, black crappie, and walleye which were primarily caught in either the General Reservoir or YHGS.

General Reservoir anglers primarily caught and harvested smallmouth bass and sunfishes (Lepomis spp.) (Table 6-9). The West Dam catch was dominated by smallmouth bass and channel catfish; channel catfish was the most frequently harvested species. At the East Dam over 81% of the fishes caught and 76.0% of those harvested were rock bass, bluegill, sunfishes (Lepomis spp.), and smallmouth bass. The YHGS yielded primarily channel catfish, rock bass, and smallmouth bass (76.8% of the total catch and 68.1% of the harvest).

The relative similarity of species composition among survey areas was expressed by PSc (Table 6-10). Comparisons of PSc among survey areas for fishes caught were all above 52%, and were generally higher than comparisons for species harvested. The greatest similarity in composition of fishes caught and harvested was between the East Dam and YHGS.

An estimate of the 1989 fishing pressure near TMINS indicated that 15,592 anglers fished for 35,862 hours (average 2.30 hours), caught 59,250 fish, and harvested 12,474 fish. This translated to annual c/e and h/e values of 1.65 and 0.35 fish per hour, respectively. Less than 3% of all anglers interviewed in 1989 indicated that they had completed their fishing trip. These anglers fished an average of 2.82 hours. A creel survey estimating procedure given in DiCostanzo (1956) and Groen and Schmulbach (1978) assumes that anglers were interviewed at the midpoint of their fishing trip. Applying this estimate to the 1989 data resulted in 118,500 fish caught and 24,948 fish harvested in 71,724 hours. Frisbie and Ritchie (1963), Nardacci et al. (1976), and Plosila (1961) found that the average time fished per angler, when doubled, corresponded with complete fishing trip data. Average fishing time for the first estimate was 2.30 hours, and 4.60 hours for the doubled fishing trip estimate, differing from the completed trip value (2.82 hours) by -0.52 and +1.78 hours, respectively. However, the number of anglers, c/e, and h/e remain the same for both estimates. These results imply that the first estimate (without doubling trip length) may be a better indicator of fishing pressure and angler impact in the TMINS area for 1989.

6.3 CHARACTERIZATION OF ANGLER COMMUNITY

All but 23 of the anglers interviewed in 1989 were residents of Pennsylvania. Over 72% of the anglers resided in York or Dauphin counties (Figure 6-2), which encompass the TMINS survey area. Most General Reservoir and YHGS anglers were York County residents. However, most anglers from the West and East dams were residents of Dauphin County. The remaining anglers were residents of 21 other Pennsylvania counties (primarily Cumberland, Lancaster, Lebanon, and Adams), as well as six other states. About 83% of all anglers were between the ages of 18 and 65 (27.7% and 55.5% were 18 to 29 and 30 to 65, respectively).

A total of 2,535 anglers was questioned as to how they use the fish that they catch (Table 6-11). Over 60% indicated that they ate at least a portion of their catch, 38.2% released all they caught, and 0.2% gave away all of their catch. No anglers reported a change in the use of their catch as a result of the 1979 accident at TMINS. This may indicate that the accident at TMINS is no longer a factor in what these anglers do with their catch.

6.4 MULTIPLE-YEAR COMPARISON

The 1989 creel survey data indicated that the number of anglers, hours fished, fish caught, and fish harvested were among the highest recorded in 15 survey years (Table 6-12). The annual c/e was the second highest to date, while the average h/e was within the range of previous years. EA (1986, 1987) indicated that fishing may be impeded by inclement weather conditions (e.g., thunderstorms, heavy rain, wind, and fog) and/or unusually high or low river flow conditions, which would result in decreased angler effort and success. For example, fishing below both dams may cease during periods of extremely low river flow. Weather conditions that might discourage anglers from fishing were encountered infrequently (<8% of survey periods) in 1989. However, average river flow in 1989 was more than double that reported in 1988 (Chapter 7). Although weather conditions on survey dates may have been favorable for fishing, heavy spring rains produced unfavorable river conditions in May and June. Historically, these months generally support high angler numbers, but the high river flow and turbid water conditions in May and June presented anglers with the poorest fishing conditions of the year. This resulted in the poorest angler effort in recent years for May and June.

Comparison of 1989 individual survey area totals with those of previous years (EA 1985, 1986, 1987; Nardacci and Associates 1984; RMC 1988a, 1989) indicated a record number of fish kept, and the second highest number of anglers, fish caught, and hours fished reported from the General Reservoir. Similarly, the YHGS area had the highest total of fish caught and fish kept to date. The c/e at the YHGS and the General Reservoir was the highest for these areas since the inception of the program. In contrast, the h/e at the General Reservoir was the second lowest to date, and the h/e at the West Dam was the lowest. All other values from all areas were within the ranges of those reported previously (1975 through 1988).

Two-factor ANOVA tests indicated significant differences among areas, years, and their interactions for all test variables (Table 6-13). Tukey's studentized range test, when applied to survey areas, showed that the mean number of anglers, fish caught, fish kept, and hours fished were significantly higher at the General Reservoir and YHGS areas than at the West and East dams (Table 6-14). The West Dam ranked lowest for all mean values; however, there were no significant differences between the West and East dams for all test variables. The General Reservoir and YHGS were similar for number of anglers and fish kept, but differences were noted for fish caught and hours fished. A range test for the 15 survey years showed the mean values for all test variables were ranked lowest in 1977 . The mean values for 1989 ranked second in each category except anglers, and were significantly different from 1977 for all variables except fish kept.

Creel surveys have generally indicated that the four most abundant fishes caught and harvested have been the channel catfish, rock bass, smallmouth bass, and walleye (Figures 6-3 and 6-4). The channel catfish, one of the most commonly caught (>21%) fishes from 1975 through 1978, has declined in importance. Since 1979, channel catfish percentage of total catch has been generally stable, ranging from 5.5 to 14.8%. However, nearly half of all channel catfish caught have been harvested each year. The percent composition of rock bass caught and harvested has remained relatively stable throughout the 15 survey years, with nearly half of the catch harvested each year. Smallmouth bass, the most popular game fish in the survey area, has dominated the percent composition of fishes caught every year. The proportion of smallmouth bass harvested, however, remained relatively low, despite the large catches. In fact, the 1989 percent harvest of smallmouth bass was the second lowest to date despite the catch being the highest.

Walleye, another popular game species, has been reported frequently by anglers; however, few were of legal size and could be harvested. The percent composition of walleye caught increased from 1975 through 1979, peaked in 1980, declined from 1981 through 1985, increased to a secondary peak in 1987, and has declined through 1989.

Specific reasons for these fluctuations, regarding species catch and harvest trends, were not apparent. Changes in angler objectives, size structure of fish populations, or production of strong year classes may have been involved. For the smallmouth bass, the 1987 change in the Pennsylvania Fish Commission harvest regulations to a trophy bass season (381.0 mm minimum size and two fish per day from mid-April through mid-June), may have resulted in the reduced harvest observed since 1987. In addition, strong year classes were produced in 1987 and 1988 which yielded many sublegal fish in 1988 and 1989.

Values of c/e appeared related to the number of anglers (Table 6-12). Generally, as the number of anglers increased the c/e also increased. Harvest rates, however, did not exhibit a similar trend. Except in 1986 when the lowest harvest rate occurred, values in all other years were quite similar. These trends may result from several factors: 1) in some years a relatively large number of sublegal fish are caught by anglers; 2) the fact that anglers were fishing primarily for recreation rather than as a source of food;

and 3) the observation that some anglers were species-specific or selective as to the size of fish chosen for harvest. The large number of anglers throughout the 15 survey years who have indicated that they release or give away all, or at least a portion of their catch, tends to reflect an interest in fishing for recreation. Similar findings of primarily recreational angling have been documented by Baur and Rodgers (1983), Denoncourt (1984), Harmon (1978), and Rodgers (1980) for other water bodies.

The impact of the 1979 TMINS accident was assessed by examining changes in utilization of fish caught by anglers. However, angler response to questioning the use of their catch could be biased by the legal status (size) of fishes sought and/or caught. To elicit a more specific response, anglers were subsequently asked whether they use their catch differently now than they did prior to the 1979 accident. During the year immediately following the TMINS accident (1980), 7.6 percent of the anglers interviewed indicated that they had changed their use of catch due to the accident (Figure 6-5). The proportion of anglers expressing a change in catch usage has steadily declined and no anglers reported a change in catch usage in 1989. In addition most anglers reported that they eat at least a portion of their catch although the percentage has decreased since 1986.

Creel survey information was accepted with the assumption that angler responses were accurate and objective; therefore, some uncertainty attends any creel data set. However, these data generally indicate that (1) there was a consistent trend in that most anglers reported eating at least a portion of their catch, and (2) the proportion of anglers indicating a change in catch usage due to the TMINS accident was never large, and has generally decreased since 1980. There is no evidence of a dramatic decline in fishing effort (number of anglers and amount of time spent fishing) resulting from the accident. Since 1986, the number of anglers and hours fished have been among the highest for the study period. This would indicate that the local recreational fishery was only minimally affected by TMINS and the 1979 accident.

TABLE 6-1

List of scientific and common names of fishes observed during creel survey interviews from the Susquehanna River near TMINS, 1989.

Scientific Name	Common Name
Clupeidae	Herrings
Alosa sapidissima(Wilson)	American shad
Salmonidae	Trouts
Salmo gairdneri Richardson	Rainbow trout
Salmo trutta Linnaeus	Brown trout
Salvelinus fontinalis (Wilson)	Brook trout
Esocidae	Pikes
Esox masquinongy Mitchill	Muskellunge
Cyprinidae	Carps and Minnows
Cyprinus carpio Linnaeus	Common carp
Semotilus corporalis(Mitchill)	Fallfish
Catostomidae	Suckers
Carpiodes cyprinus(Lesueur)	Quillback
Ictaluridae	Bullhead catfishes
Ictalurus punctatus(Rafinesque)	Channel catfish
Percichthyidae	Temperate Basses
Morone saxatilis(Walbaum)	Striped bass
Centrarchidae	Sunfishes
Ambloplites rupestris(Rafinesque)	Rock bass
Lepomis auritus(Linnaeus)	Redbreast sunfish
Lepomis cyanellus Rafinesque	Green sunfish
Lepomis gibbosus(Linnaeus)	Pumpkinseed
Lepomis macrochirus Rafinesque	Bluegill
Micropterus dolomieui Lacepede	Smallmouth bass
Micropterus salmoides(Lacepede)	Largemouth bass
Pomoxis annularis Rafinesque	White crappie
Pomoxis nigromaculatus(Lesueur)	Black crappie
Percidae	Perches
Perca flavescens(Mitchill)	Yellow perch
Stizostedion vitreum vitreum(Mitchill)	Walleye

TABLE 6-2

Monthly summary of anglers, fish caught, fish kept, hours fished, catch/effort, and harvest/effort from areas near TMINS, 1989.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent Total
Angler										
GR*	184	39	168	240	316	138	274	56	1415	55.8
West Dam	18	3	17	8	9	10	5	4	74	2.9
East Dam	43	37	36	59	28	8	24	9	244	9.6
YHGS+	102	142	148	200	64	65	62	19	802	31.6
Total	347	221	369	507	417	221	365	88	2535	
Fish Caught										
GR	417	135	666	845	1134	403	1050	120	4770	49.7
West Dam	82	31	142	65	86	58	10	37	501	5.2
East Dam	86	390	208	320	204	42	92	1	1343	13.9
YHGS	476	910	464	511	250	155	211	6	2983	31.1
Total	1061	1466	1480	1741	1674	658	1363	164	9607	
Fish Kept										
GR	145	51	63	120	147	58	150	31	765	37.9
West Dam	0	0	0	6	0	18	0	6	30	1.4
East Dam	13	151	92	67	33	13	34	1	404	20.0
YHGS	96	276	142	160	47	59	37	2	819	40.6
Total	254	478	297	353	227	148	221	40	2018	
Hours Fished										
GR	373.30	104.50	396.30	579.00	747.50	271.40	718.00	123.70	3313.70	57.6
West Dam	42.25	5.25	40.75	25.00	21.75	17.25	6.75	15.75	174.75	3.0
East Dam	58.00	89.50	77.50	132.80	85.50	15.00	37.25	5.75	501.30	8.7
YHGS	230.30	354.80	334.30	389.30	134.30	146.50	149.50	22.25	1761.25	30.6
Total	703.85	554.05	848.85	1126.10	989.05	450.15	911.50	167.45	5751.00	
Catch/Effort										
GR	1.12	1.29	1.68	1.46	1.52	1.48	1.46	0.97	1.44	
West Dam	1.94	5.90	3.48	2.60	3.95	3.36	1.48	2.35	2.87	
East Dam	1.48	4.36	2.68	2.41	2.39	2.80	2.47	0.17	2.68	
YHGS	2.07	2.56	1.39	1.31	1.86	1.06	1.41	0.27	1.69	
Total	1.51	2.65	1.74	1.55	1.69	1.46	1.50	0.92	1.67	
Harvest/Effort										
GR	0.39	0.49	0.16	0.21	0.20	0.21	0.21	0.25	0.23	
West Dam	0.00	0.00	0.00	0.24	0.00	1.04	0.00	0.38	0.17	
East Dam	0.22	1.67	1.19	0.50	0.39	0.87	0.91	0.17	0.81	
YHGS	0.42	0.78	0.42	0.41	0.35	0.40	0.25	0.09	0.46	
Total	0.36	0.86	0.35	0.31	0.23	0.33	0.24	0.24	0.35	

* Denotes General Reservoir.
\+ Denotes York Haven Generating Station.

TABLE 6-3

Two-factor analysis of variance test restuls for anglers, fish caught, fish kept, and hours fished near TMINS, April through November 1989.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Anlgers	Model ($r^2 = 0.882$)	10	168705.812	16870.581	5.52	0.0005**
	Area	3	137985.594	45995.198	15.05	0.0001**
	Month	7	30720.219	4388.603	1.44	0.2437
	Error	21	64193.656	3056.841		
	Corrected Total	31	232899.469			
Fish Caught	Model ($r^2 = 0.765$)	10	1850157.562	185015.756	3.12	0.0134*
	Area	3	1330293.344	443431.114	7.49	0.0014**
	Month	7	519864.219	74266.317	1.25	0.3194
	Error	21	1244083.906	59242.091		
	Corrected	31	3094241.469			
Fish Kept	Model ($r^2 = 0.539$)	10	80415.500	8041.550	2.83	0.0215*
	Area	3	50252.625	16750.875	5.89	0.0044**
	Month	7	30162.875	4308.982	1.52	0.2160
	Error	21	59706.375	2843.161		
	Corrected Total	31	140121.875			
Hours Fished	Model ($r^2 = 0.887$)	10	936050.287	93605.029	5.04	0.0009**
	Area	3	761971.762	253990.587	13.68	0.0001**
	Month	7	174078.525	24868.361	1.34	0.2812
	Error	21	389812.382	18562.494		
	Corrected Total	31	1325862.670			

* Significant at $P \leq 0.05$.
** Significant at $P \leq 0.01$.

TABLE 6-4

Summary of Tukey's studentized range test for creel survey data (anglers, fish caught, fish kept, and hours fished) by area, 1989. Areas underlined are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest mean number. Means are listed parenthetically and rounded to the nearest whole number.

Dependent Variable	Area			
Anglers	GR* (177)	YHGS* (100)	East Dam (30)	West Dam (9)
Fish Caught	GR (596)	YHGS (373)	East Dam (168)	West Dam (64)
Fish Kept	YHGS (102)	GR (96)	East Dam (50)	West Dam (4)
Hours Fished	GR (414)	YHGS (220)	East Dam (63)	West Dam (22)

* GR, General Reservoir; YHGS, York Haven Generating Station.

TABLE 6-5

Comparison of weekday and weekend day creel surveys from each area ner TMINS, 1989.

	General Reservoir	West Dam	East Dam	York Haven Generating Station	Total
Anglers					
Weekday	299	18	79	275	671
Weekend Day	1116	56	165	527	1864
Fish Caught					
Weekday	966	140	444	1290	2840
Weekend Day	3804	371	899	1693	6767
Fish Kept					
Weekday	149	14	141	296	600
Weekend Day	616	16	263	523	1418
Hours Fished					
Weekday	611.25	37.25	152.00	517.00	1318.00
Weekend Day	2702.42	137.00	349.25	1244.01	4432.68
Catch/Effort(h)					
Weekday	1.58	3.71	2.92	2.50	2.15
Weekend Day	1.41	2.71	2.57	1.36	1.53
Harvest/Effort(h)					
Weekday	0.24	0.37	0.93	0.57	0.45
Weekend Day	0.23	0.12	0.75	0.42	0.32

TABLE 6-6

Comparison of anglers, fish caught, fish kept, hours fished, catch/effort, and harvest/effort between creel survey zones in the General Reservoir, 1989.

Zone*	Anglers	Fish Caught	Fish Kept	Hours Fished	Catch/ Effort(h)	Harvest/ Effort(h)
1 West Channel, West Shore	304	955	165	642.42	1.49	0.26
2 West Channel, East Shore	36	57	11	88.75	0.64	0.12
3 West/Center Channel Confluence	172	485	97	403.50	1.20	0.24
4 South Center Channel, West Shore	27	74	2	64.75	1.14	0.30
5 South Center Channel, East Shore	67	318	52	165.50	1.92	0.31
6 North Center Channel, West Shore	42	111	22	118.25	0.94	0.19
7 North Center Channel, East Shore	73	238	12	171.25	1.39	0.70
8 East Channel, West Shore	44	131	70	112.25	1.17	0.62
9 East Channel, East shore	112	288	110	256.75	1.12	0.43
10 East of Fall Island, Northeast Shore	79	264	25	165.75	1.59	0.15
11 West of Fall Island, East of Hill Island	328	1513	118	832.00	1.82	0.14
12 West of Hill Island, Northwest Shore	131	336	81	292.50	1.15	0.28

* Numbered zones correspond to those in Figure 6-1.

TABLE 6-7

Comparison of the General Reservoir boat and shore anglers by fish caught, fish kept, hours fished, catch/effort, and harvest/effort, 1989.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent Total
Anglers										
Boat	144	26	139	177	294	119	243	53	1195	84.4
Shore	40	13	29	63	22	19	31	3	220	15.5
Fish Caught										
Boat	332	60	608	721	1074	380	976	111	4252	89.1
Shore	95	75	58	124	60	23	74	9	518	10.9
Fish Kept										
Boat	84	11	42	91	129	49	128	31	565	73.8
Shore	61	40	21	29	18	9	22	0	200	26.1
Hours Fished										
Boat	296.75	74.75	356.50	455.75	703.75	242.00	667.25	116.50	2913.25	87.9
Shore	76.50	29.75	39.75	123.25	43.75	29.42	50.75	7.25	400.42	12.1
Catch/Effort(h)										
Boat	1.08	0.80	1.70	1.58	1.53	1.57	1.46	0.95	1.46	
Shore	1.24	2.52	1.46	1.01	1.37	0.78	1.46	1.24	1.29	
Harvest/Effort(h)										
Boat	0.28	0.15	0.12	0.20	0.18	0.20	0.19	0.27	0.19	
Shore	0.80	1.34	0.53	0.23	0.41	0.31	0.43	0.00	0.50	

TABLE 6-8

Monthly summary of fishes caught and kept by anglers in the Susquehanna River near TMINS, 1989.

	Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Total		Percent	
	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept	Caught	Kept
American shad	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-	-	4	-	+	-
Rainbow trout	-	-	1	1	-	-	2	2	-	-	-	-	-	-	-	-	3	3	+	0.2
Brown trout	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1	+	+
Brook trout	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	+	+
Muskellunge	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	+	-
Pikes (Esocidae)*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	+	-
Common carp	21	2	28	2	39	1	9	-	23	-	29	4	21	-	-	-	170	9	1.8	0.4
Fallfish	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	+	-
Quillback	-	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	0.2	-
Suckers (Catostomidae)*	-	-	3	-	-	-	2	1	-	-	-	-	-	-	-	-	5	1	+	+
Channel catfish	8	6	23	22	69	33	105	53	168	39	121	41	28	15	3	-	525	209	5.5	10.3
Striped bass	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	+	-
Rock bass	135	80	477	336	115	65	76	38	61	11	34	20	55	21	1	-	954	571	9.9	28.3
Redbreast sunfish	1	1	4	3	55	55	19	18	3	2	8	4	1	-	-	-	91	83	0.9	4.1
Green sunfish	-	-	4	4	-	-	5	5	-	-	-	-	-	-	-	-	9	9	0.1	0.4
Pumpkinseed	-	-	2	2	12	10	2	2	-	-	-	-	20	13	-	-	36	27	0.4	1.3
Bluegill	7	2	12	10	55	20	45	11	75	28	21	18	34	18	-	-	249	107	2.6	5.3
Sunfishes (Lepomis spp.)*	122	81	154	63	224	73	118	15	88	18	49	12	64	13	2	-	821	275	8.5	13.6
Smallmouth bass	584	4	653	6	869	27	1273	174	1230	125	368	37	1048	112	105	13	6130	498	63.8	24.7
Largemouth bass	6	-	5	-	4	-	6	2	5	-	3	1	7	-	2	-	38	3	0.4	0.2
White crappie	32	30	4	4	4	4	25	19	1	1	1	1	2	2	-	-	69	61	0.7	3.0
Black crappie	26	26	1	1	2	2	3	3	-	-	-	-	-	-	-	-	32	32	0.3	1.6
Crappies (Pomoxis spp.)*	61	21	19	5	11	4	11	7	10	1	11	5	29	15	20	20	172	78	1.8	3.9
Yellow perch	-	-	11	11	-	-	1	-	1	1	2	2	-	-	-	-	15	14	0.2	0.7
Walleye	56	-	38	8	20	2	36	3	5	1	11	3	54	12	31	7	251	36	2.6	1.8
Total	1061	254	1466	478	1400	297	1741	353	1674	227	658	148	1363	221	164	40	9607	2018		

* General identification.
\+ Less than 0.05%.

TABLE 6-9

Number and percent composition of fishes caught and kept from areas near TMINS, April through November 1989.

	General Reservoir				West Dam				East Dam				York Haven Generating Sta.				Total	
	Caught		Kept		Caught		Kept		Caught		Kept		Caught		Kept		Caught	Kept
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
American shad	-	-	-	-	-	-	-	-	-	-	-	-	4	0.1	-	-	4	-
Rainbow trout	-	-	-	-	-	-	-	-	-	-	-	-	3	0.1	3	0.4	3	3
Brown trout	-	-	-	-	-	-	-	-	1	0.1	1	0.2	-	-	-	-	1	1
Brook trout	1	+	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Muskellunge	-	-	-	-	-	-	-	-	-	-	-	-	2	0.1	-	-	2	-
Pikes (Esocidae)*	1	+	-	-	-	-	-	-	-	-	-	-	1	+	-	-	2	-
Common carp	6	0.1	1	0.1	6	1.2	-	-	14	1.0	-	-	144	4.8	8	1.0	170	9
Fallfish	2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Quillback	-	-	-	-	-	-	-	-	-	-	-	-	24	0.8	-	-	24	-
Suckers (Catostomidae)*	-	-	-	-	-	-	-	-	-	-	-	-	5	0.2	1	0.1	5	1
Channel catfish	139	2.9	51	6.7	86	16.8	15	50.0	56	4.2	9	2.2	244	8.2	134	16.4	525	209
Striped bass	1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Rock bass	201	4.2	69	9.0	5	1.0	-	-	262	19.5	170	42.1	486	16.3	332	40.5	954	571
Redbreast sunfish	8	0.2	3	0.4	-	-	-	-	37	2.8	36	8.9	46	1.5	44	5.4	91	83
Green sunfish	-	-	-	-	-	-	-	-	9	0.7	9	2.2	-	-	-	-	9	9
Pumpkinseed	10	0.2	8	1.0	-	-	-	-	26	1.9	19	4.7	-	-	-	-	36	27
Bluegill	72	1.5	21	2.7	3	0.6	-	-	113	8.4	52	12.9	61	2.0	34	4.2	249	107
Sunfishes (<u>Lepomis</u> spp.)*	437	9.2	172	22.5	9	1.8	-	-	194	14.4	36	8.9	181	6.1	67	8.2	821	275
Smallmouth bass	3716	77.9	349	45.6	331	64.8	8	26.7	523	38.9	49	12.1	1560	52.3	92	11.2	6130	498
Largemouth bass	28	0.6	2	0.3	-	-	-	-	7	0.5	-	-	3	0.1	1	0.1	38	3
White crappie	34	0.7	26	3.4	-	-	-	-	6	0.4	6	1.5	29	1.0	29	3.5	69	61
Black crappie	22	0.5	22	2.9	-	-	-	-	4	0.3	4	1.0	6	0.2	6	0.7	32	32
Crappies (<u>Pomoxis</u> spp.)*	89	1.9	38	5.0	3	0.6	2	6.7	29	2.2	6	1.5	51	1.7	32	3.9	172	78
Yellow perch	3	0.1	2	0.3	-	-	-	-	2	0.1	2	0.5	10	0.3	10	1.2	15	14
Walleye	-	-	-	-	68	13.3	5	16.7	60	4.5	5	1.2	123	4.1	26	3.2	251	36
Total	4770		765		511		30		1343		404		2983		819		9607	2018

* General identification.

\+ Less than 0.05%.

TABLE 6-10

Percent similarity indices of species composition of fishes caught and harvested from the creel survey areas near TMINS, 1989.

Caught				Harvested		
West Dam	East Dam	YHGS*		YHGS	East Dam	West Dam
71.7	60.4	70.1	General Reservoir	46.8	40.7	38.3
	52.5	69.7	West Dam	34.7	17.1	
		76.8	East Dam	77.1		

* York Haven Generating Station.

TABLE 6-11

Use of catch by anglers interviewed near TMINS in 1989.

Use of Catch	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Eat	110	67	66	152	67	49	83	17	611
Release	119	52	157	182	177	85	149	48	969
Give Away	-	2	3	-	-	-	-	-	5
Eat-Release-Give Away	3	8	2	-	-	-	-	-	13
Eat-Release	115	91	138	159	162	77	132	22	896
Eat-Give Away	-	-	2	4	5	5	-	1	17
Release-Give Away	-	1	1	10	6	5	1	-	24
Total	347	221	369	507	417	221	365	88	2535

TABLE 6-12

Summary of annual creel survey totals for anglers, fish caught, fish kept, hours fished, catch/effort, and harvest/effort near TMINS, 1975 through 1989.

	Anglers	Fish Caught	Fish Kept	Fished	Catch/ Effort (h)	Harvest/ Effort (h)
1975	1560	2386	1255	2953.75	0.81	0.42
1976	1750	3170	1026	3114.29	1.04	0.34
1977	1126	1857	820	2186.88	0.85	0.37
1978	2221	4483	1517	4455.85	1.01	0.34
1979	2215	4861	1205	3966.15	1.23	0.30
1980	2399	5611	1421	4131.65	1.36	0.34
1981	2672	6764	1684	4627.65	1.46	0.36
1982	2751	6499	1808	4776.26	1.36	0.38
1983	2145	5102	1395	3997.73	1.28	0.35
1984	1815	4423	1200	3285.40	1.35	0.36
1985	1750	3671	1447	3458.61	1.06	0.42
1986	2093	5191	1732	4374.87	2.02	0.14
1987	2469	7656	1852	4892.44	1.56	0.38
1988	2964	10371	2020	6731.43	1.54	0.30
1989	2535	9597	2018	5751.00	1.67	0.35

TABLE 6-13

Two-factor analysis of variance test results for creel survey data (anglers, fish caught, fish kept, and hours fished) near TMINS, 1975 through 1989.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Anglers	Model (r^2 = 0.553)	59	1248303.823	21157.692	9.94	0.0001**
	Area	3	962238.273	320746.091	150.72	0.0001**
	Year	14	107678.354	7691.311	3.61	0.0001**
	Interaction	42	178387.196	4247.314	2.00	0.0004**
	Error	420	893807.875	2128.114		
	Corrected Total	479	2142111.698			
Fish Caught	Model (r^2 = 0.284)	59	7597483.773	128770.911	4.71	0.0001**
	Area	3	2860794.073	953598.024	34.86	0.0001**
	Year	14	2574987.304	183927.664	6.72	0.0001**
	Interaction	42	2161702.396	51469.105	1.88	0.0011**
	Error	420	11490093.375	27357.365		
	Corrected Total	479	19087577.148			
Fish Kept	Model (r^2 = 0.362)	59	454827.956	7708.948	3.85	0.0001**
	Area	3	350319.623	166773.208	58.25	0.0001**
	Year	14	55907.612	3993.401	1.99	0.0172*
	Interaction	42	48600.721	1157.160	0.58	0.9847
	Error	420	842024.375	2004.820		
	Corrected Total	479	1296852.331			
Hours Fished	Model (r^2 = 0.531)	59	5723112.595	97001.908	9.91	0.0001**
	Area	3	4103123.086	1367707.695	139.79	0.0001**
	Year	14	517466.543	40819.039	4.17	0.0001**
	Interaction	42	1048522.966	24964.833	2.55	0.0001**
	Error	420	4109401.238	9784.289		
	Corrected Total	479	9832513.833			

* Significant at $P \leq 0.05$.
** Significant at $P \leq 0.01$.

TABLE 6-14

Summary of Tukey's studentized range test for creel survey data (anglers, fish caught, fish kept, and hours fished) by area and year, 1975 through 1989. Areas and years underlined are not significantly different (P≤0.05) and area ranked from highest to lowest mean number. Means are listed parenthetically and rounded to the nearest whole number.

Dependent Variable					Year														
Anglers	GR* (118)	YHGS* (105)	East Dam (30)	West Dam (17)	1988 (93)	1982 (86)	1981 (84)	1989 (79)	1987 (77)	1980 (75)	1978 (69)	1979 (69)	1983 (67)	1986 (65)	1984 (57)	1985 (55)	1976 (55)	1975 (49)	1977 (35)
Fish Caught	GR (285)	YHGS (196)	East Dam (109)	West Dam (91)	1988 (324)	1989 (300)	1987 (239)	1981 (211)	1982 (203)	1980 (175)	1986 (162)	1983 (159)	1979 (152)	1978 (140)	1984 (138)	1985 (115)	1976 (99)	1975 (75)	1977 (58)
Fish Kept	YHGS (80)	GR (66)	East Dam (28)	West Dam (13)	1988 (63)	1989 (63)	1987 (58)	1982 (56)	1986 (54)	1981 (53)	1978 (47)	1985 (45)	1980 (44)	1983 (44)	1975 (39)	1979 (38)	1984 (38)	1976 (32)	1977 (26)
Hours Fished	GR (248)	YHGS (194)	East Dam (49)	West Dam (32)	1988 (210)	1989 (180)	1987 (153)	1982 (149)	1981 (145)	1978 (139)	1986 (137)	1980 (129)	1983 (125)	1979 (124)	1985 (108)	1984 (103)	1976 (96)	1975 (92)	1977 (68)

* GR, General Reservoir; YHGS, York Haven Generating Station.

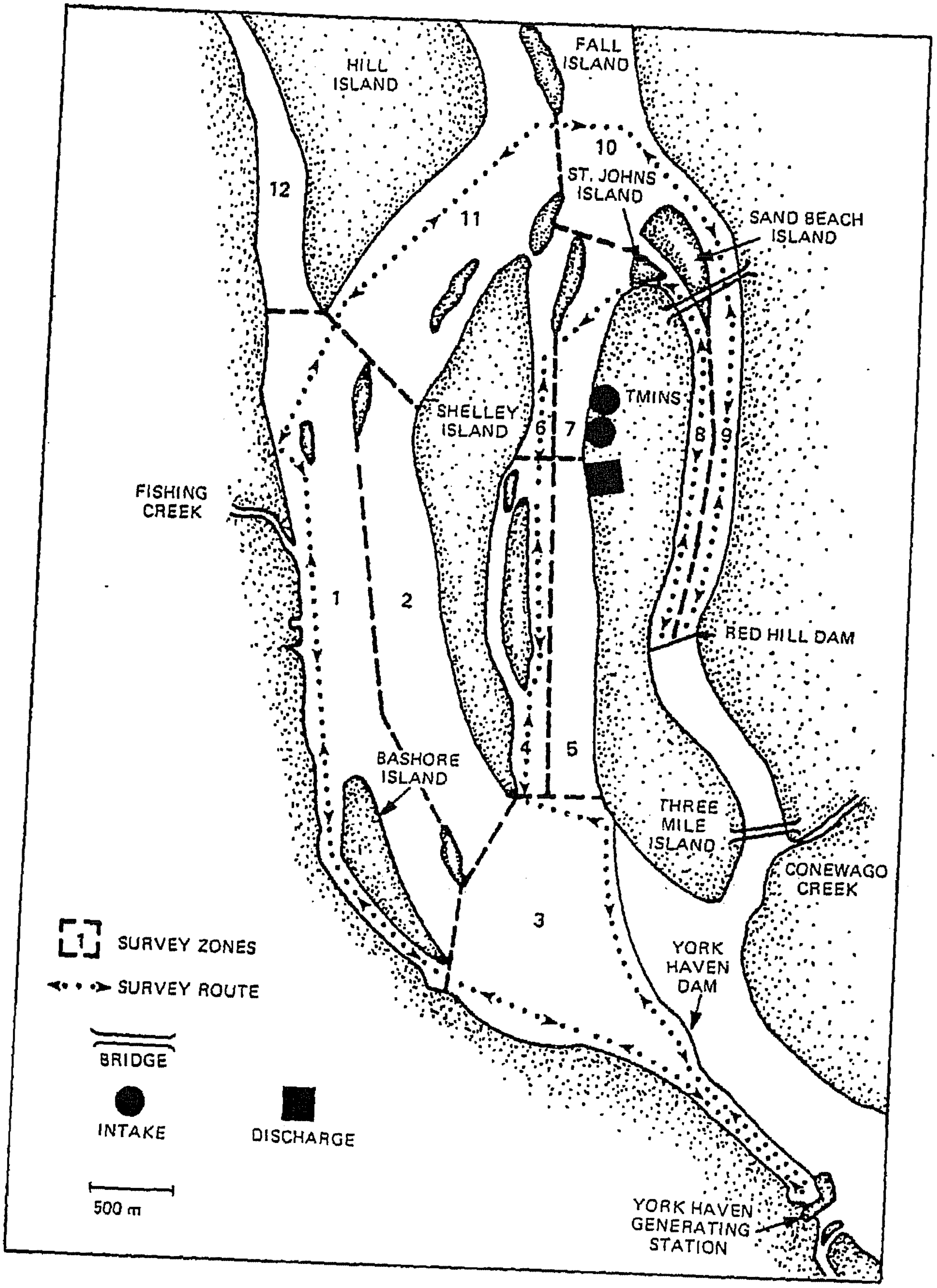

Figure 6-1. TMINS creel survey area showing survey route and General Reservoir zones.

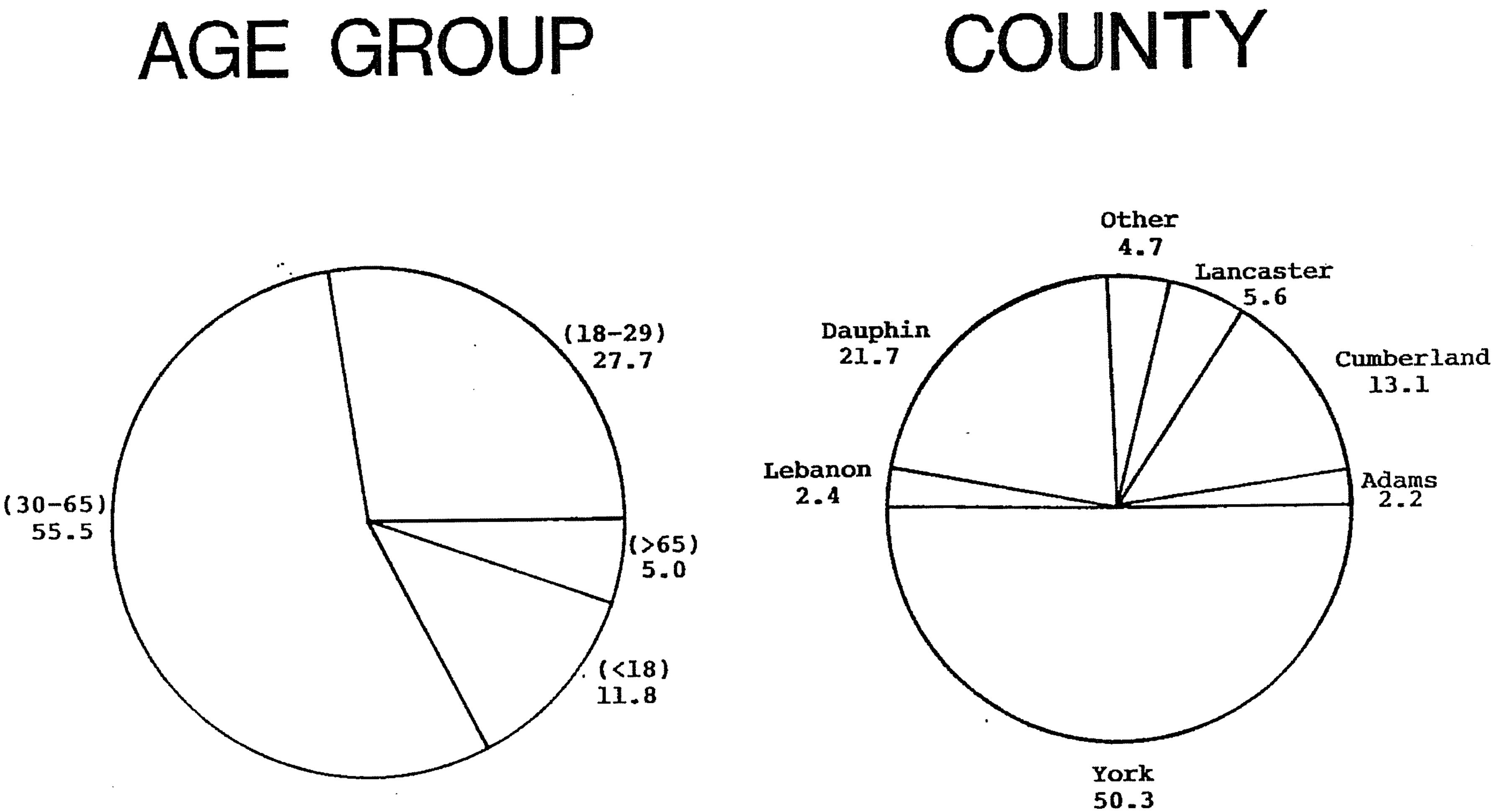

FIGURE 6-2

Percent of anglers by age and county interviewed in the Susquehanna River near TMINS in 1989.

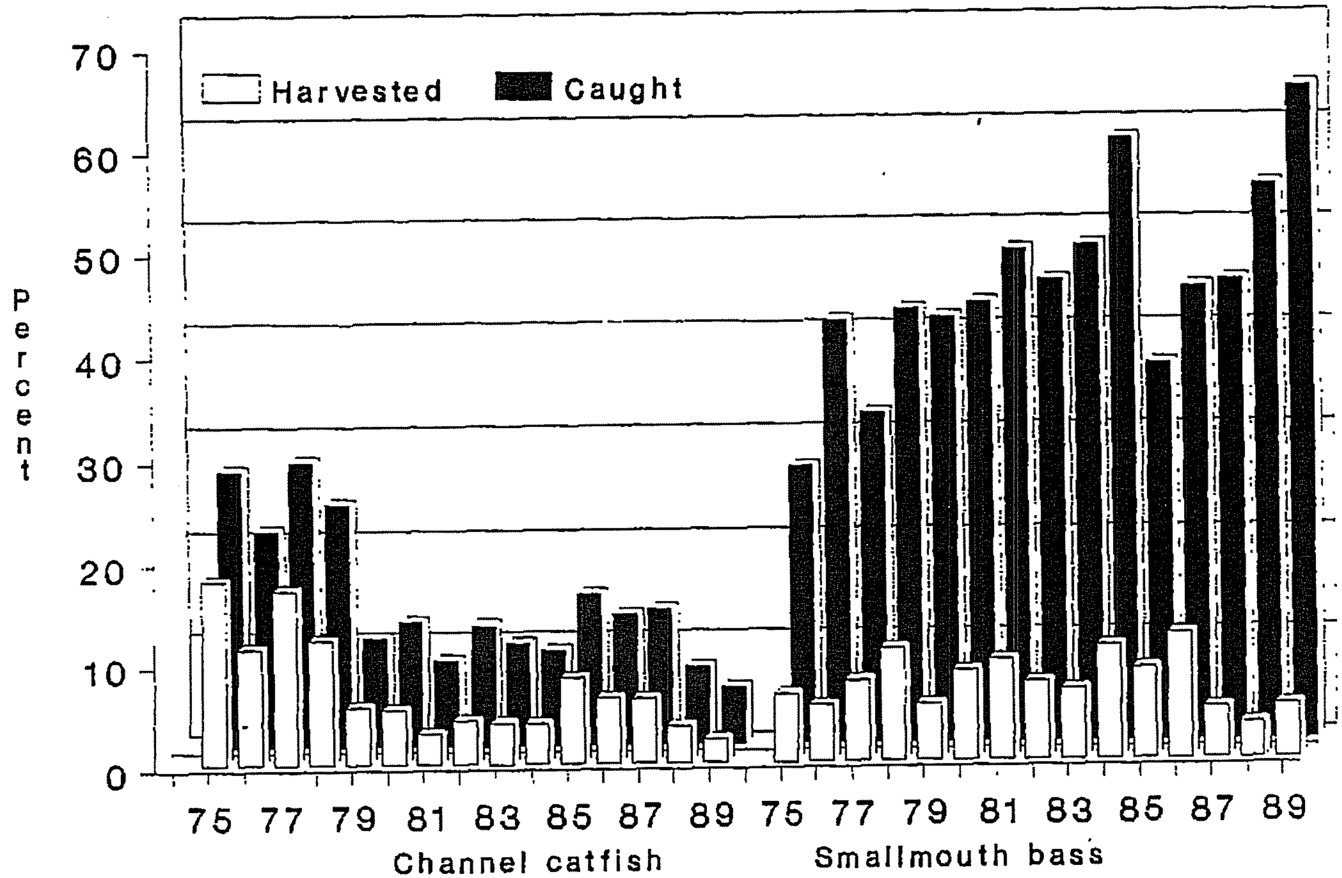

Figure 6-3. Percent composition of channel catfish and smallmouth bass caught and harvested by anglers near TMINS, 1975 through 1989.

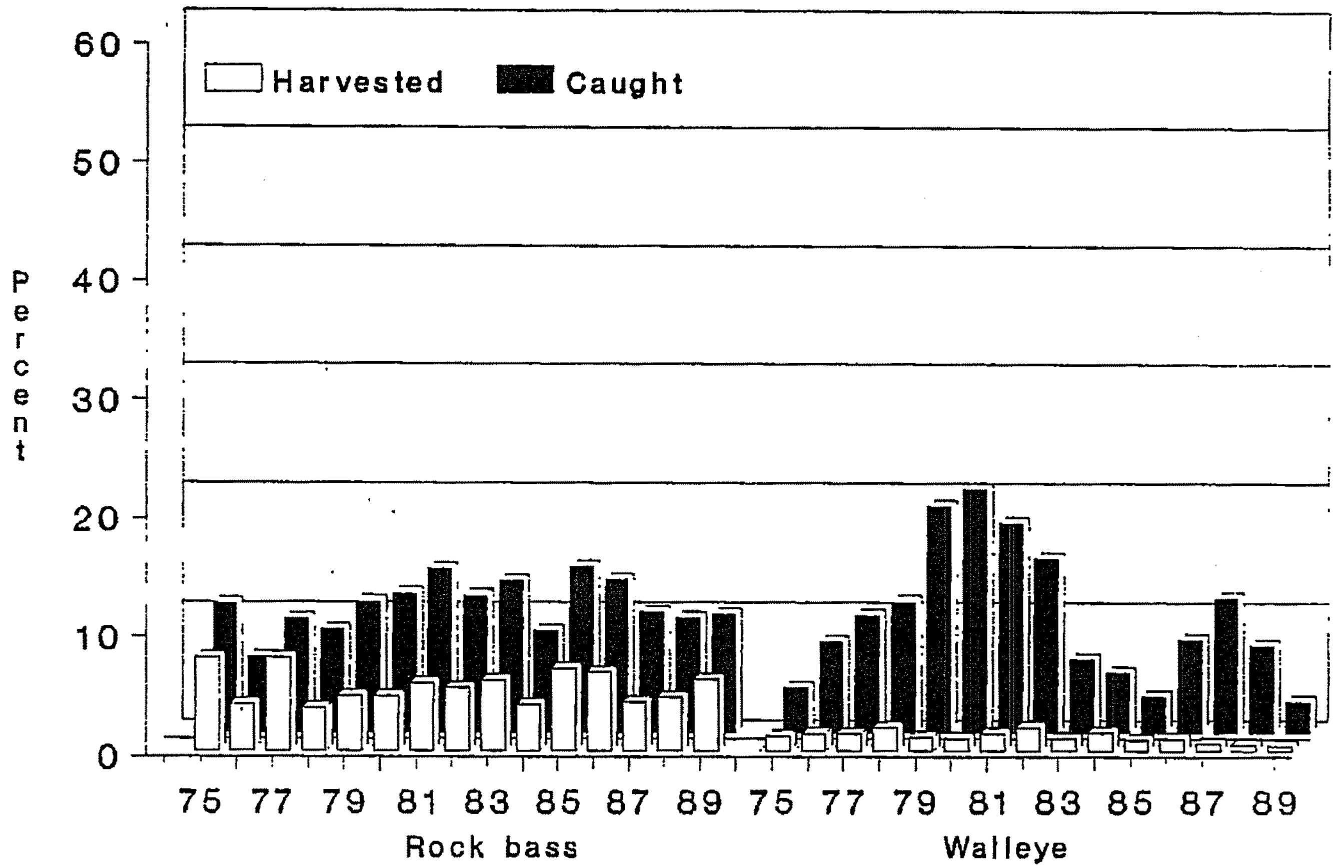

Figure 6-4. Percent composition of rock bass and walleye caught and harvested by anglers near TMINS, 1975 through 1989.

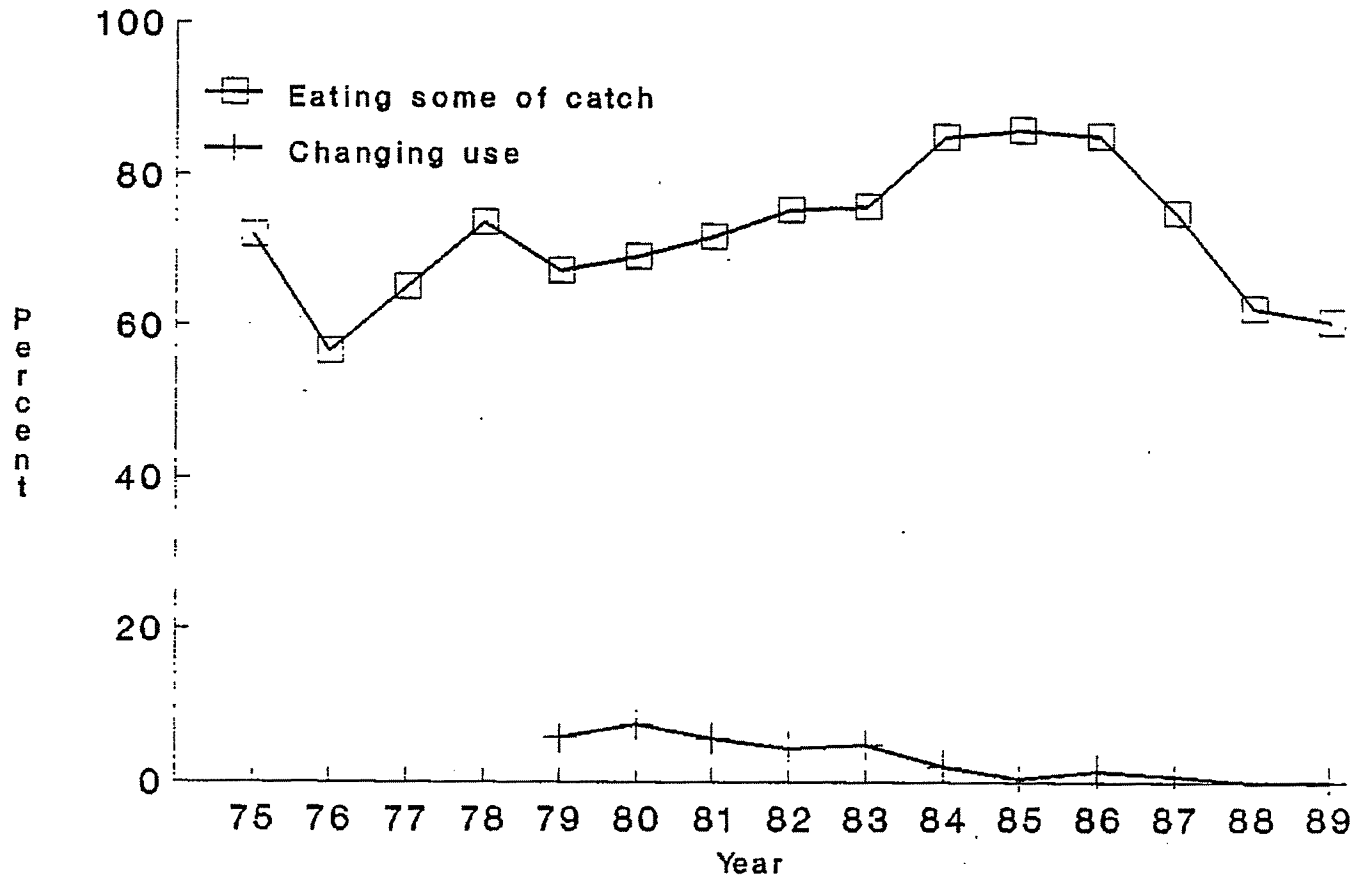

Figure 6-5. Annual trends in the percent of anglers eating at least some of their catch and those indicating a change in their use of catch due to the 1979 TMINS accident.

7. WATER QUALITY

7.1 METHODS

Water quality and physical data were collected at all stations in conjunction with biological sampling (Figure 7-1). Details of procedures and instrumentation are provided in GPU (1987) and are summarized below.

Surface water temperature, pH, and dissolved oxygen (DO) were measured at all sampling stations with a Taylor Pocket Thermometer Model 21432-2, a Photovolt Model 126A pH meter or an Orion Model 05702-25 pH meter, and a YSI Model 57 Dissolved Oxygen meter, respectively. Conductivity was measured at all electrofishing stations by means of a Hach Model 16300 portable conductivity meter. Measurements of velocities at macroinvertebrate and ichthyoplankton stations were made with a Marsh-McBirney Model 201 portable water current meter.

Surface water samples were collected at each of the three macroinvertebrate stations and delivered to GPU personnel for analysis. Laboratory analysis of total dissolved solids (TDS) was performed by analytical methods defined in U. S. EPA (1979).

Data analyses consisted of tabulations of mean, minimum and maximum, and analysis of variance (ANOVA). Two-factor ANOVAs, with sampling zones and months as main effects, were implemented on 1989 water temperature, DO, pH, and TDS data.

These same parameters in the multiple-year database were subjected to a three-factor ANOVA with year, month, and sampling station (1A2, 11A1, or 9B1) as main effects. When main effects were shown to be significantly different ($p \leq 0.05$), the differences were investigated by Tukey's studentized range test. ANOVAs were conducted using SAS software, Version 6 (SAS Institute, Inc., Cary, NC).

7.2 COMPARISON WITH STATE WATER QUALITY CRITERIA

The Pennsylvania state water quality criteria for parameters measured during the 1989 TMINS aquatic studies are presented in Table 7-1. These criteria consist of upper and/or lower limits designed to protect a designated water use. The portion of the lower Susquehanna River which includes TMINS (York Haven Pond) is designated as a warmwater fishery.

The water quality data collected in 1989 are tabulated in Appendix F and summarized in Table 7-2. A comparison of the data in Table 7-2 with the criteria in Table 7-1 revealed that all 1989 values met the specified criteria, except for pH. The highest water temperature recorded was 28.0 C in July, well below the upper limit of 30.6 C. Values for pH equalled or exceeded the upper limit (9.0) in August and October, and the lower limit (6.0) in June. The high pH values in August and October were limited to areas within zones 2, 4, 7, and 10 (Figure 7-1), which were unaffected by the discharge from TMINS. The low pH values occurred on 8 June, and ranged from 5.4 to 5.6 in zones 8 and 9, respectively. Since these zones are located below the TMINS discharge some aspect in the discharged water may have caused the reduced pH. The pH values immediately upstream and throughout York Haven Pond on this date ranged from 7.0 to 7.4. The pH values within a week after this occurrence ranged from 7.1 to 7.5 at zones 8 and 9. As revealed in analysis of fisheries and macroinvertebrate data (Chapters 2, 3, and 5), no adverse effects were observed. TDS was always well below the specified upper limit. The lowest DO value recorded was 6.4 mg/l in September, considerably above the lowest permissible limit for a single measurement (4.0 mg/l).

Based on the 1989 water quality data from the TMINS aquatic studies, the designated use category of the Susquehanna River as a warmwater fishery was not compromised by the operation of TMINS.

7.3 SPATIAL AND TEMPORAL DESCRIPTION: 1989

The water quality data collected in 1989 (Table 7-2) revealed some typical seasonal patterns for a number of variables. Mean water temperature increased from April to a peak in August, and then decreased through November. With minor deviations, mean river flow decreased through September and increased thereafter. The surface and bottom velocities were high through July, reflecting the high river flow in 1989, and generally decreased through November. Conductivity and TDS followed a similar trend, declining through the summer, increasing to a peak in September, and declining through the fall. Secchi disc readings generally decreased throughout the summer and increased in the fall.

Dissolved oxygen can be affected by water temperature, biological activity, and river flow. Mean DO in York Haven Pond exhibited an inverse relationship with water temperature (Table 7-2). Mean pH values were higher in the fall (September through November) than in the spring or summer.

To provide a more quantitative assessment of the overall water quality in York Haven Pond, a two-factor ANOVA was used to analyze the 1989 water temperature, DO, pH, and TDS by month and water quality zone. All data collected at the various biological sampling stations within a zone (Figure 7-1) were combined for analysis of that zone. Although all parameters exhibited significant differences among months; as expected because of typical seasonal variations; only pH and TDS produced a significant difference among sampling zones (Table 7-3). Tukey's studentized range test (Table 7-4) revealed that the mean pH at zone 4 was significantly different from the means at zones 8 and 9. The reasons for these differences were unknown, but were considered biologically insignificant as values measured throughout the year generally met established state criteria. The Tukey's test also showed that the mean TDS at zone 8 was significantly different from the means at zones 9 and 7. The increased TDS in zone 8 may reflect the increased concentration of dissolved solids in the discharge water created through evaporation and condenser cooling blowdown. The higher TDS values became diluted as values at zone 9 (downstream) were near ambient (zone 7).

Water quality and physical characteristics measured at the three macroinvertebrate sampling stations are summarized in Table 7-5. Although many of these parameters were measured at the other sampling stations, the macroinvertebrate stations are important because of their proximity to the TMINS discharge, their consistent use over previous study years, and because TDS was measured only at these stations. The data appear to be quite homogeneous among the three stations. However, there was a slight decrease in secchi disc readings Station 11A1 (the TMINS discharge), which may be related to effluent from TMINS. The surface and bottom current velocities were also higher at Station 9B1 and were probably the result of the physical configuration of the shoreline. The increase in TDS at Station 11A1 was discussed previously.

7.4 MULTIPLE-YEAR COMPARISON

River flow can influence both biological and water quality parameters. Mean river flow was calculated for the

April through November portion of each of the last ten years (Table 7-6). Mean river flow increased 62% from 1980 to 1984, decreased 91% from 1985 through 1988, and then increased 105% in 1989 to the highest value to date.

To evaluate annual trends in water quality for York Haven Pond, water temperature, DO, pH, and TDS data for the macroinvertebrate stations were examined. Mean, minimum and maximum values for these parameters are displayed in Table 7-7. Although some year-to-year differences have been evident, the 1989 data fell within the ranges observed previously. However, the maximum TDS value was exceeded at Station 11A1.

Individual measurements of water temperature, DO, pH, and TDS from previous years' reports were combined with the 1989 data and subjected to a three-factor ANOVA (Table 7-8). The results were similar for all four parameters in that years and months were significantly different, but there was no difference among stations except for TDS. Significant differences among months were expected, given the natural seasonal cycles exhibited by these variables. Significant differences among years for water temperature, DO, pH, and TDS were not unusual, because of the annual variation in precipitation, river flow, and air temperature cycles. The significant interaction of year and month was also attributable to these weather cycles.

In terms of possible influence of the TMINS discharge on water quality, sampling station differences would be the first order of examination. However, as shown in Table 7-8, only TDS produced significant differences ($p \leq 0.05$) among stations. That is, stations downstream of the discharge (11A1, 9B1) were differentiated from the upstream station (1A2). The mean TDS at Station 1A2 was 195 mg/l, whereas the means at Stations 11A1 and 9B1 were 208 and 202 mg/l, respectively. The Tukey's test showed that Station 1A2 was significantly different from Stations 11A1 and 9B1. The increase in TDS at the downstream stations may be related to the concentration of dissolved solids during TMINS operation and subsequent discharge. However, the downstream values were still far below the state water quality criteria.

The annual means, which were significantly different for all parameters, were examined for statistical groupings that could be related to years of TMINS operation (1974 to 1978 and 1986 to 1989) versus non-operation (1979 to 1985) (Table 7-9). For water temperature, only 1985 was distinguishable from all other years. There was a tendency for DO means in operational years (1974 to 1978) to group together with lower values, but 1989, an operational year, was undifferentiated from 1979 to 1982 and 1985, a non-operational period. Values of pH exhibited no grouping that could be related to TMINS operational status. The last three non-operational years (1983 to 1985), for example, were not differentiated from operational years 1974, 1975, 1988, and 1989. Generally, pH values increased from 1974 through 1982, decreased through 1987, and rose slightly in

1988 and 1989. Total dissolved solids, available for four operational years, could not be differentiated from non-operational years.

Based on analysis of 16 years of data for water temperature, pH, and DO, and 12 years for TDS, there is no evidence of significant influence of the TMINS discharge on these parameters. Annual and spatial trends appear natural and related to meteorological cycles and river flow. Also, most water quality parameters reflect the influences of the varied geology, land, and water use practices throughout the Susquehanna River basin rather than TMINS.

TABLE 7-1

Water quality criteria for selected physicochemical parameters analyzed near Three Mile Island.

Parameter	Criteria
Dissolved oxygen	Minimum daily average 5.0 mg/L; no values less than 4.0 mg/L. For the epilimnion of lakes, ponds, and impoundments, minimum daily average of 5.0 mg/L, no value less than 4.0 mg/L.
pH	Not less than 6.0 and not more than 9.0.
Temperature (water)	No rise when ambient temperature is 87 F (30.6 C) or above; not more than a 5 F (2.8 C) rise above ambient temperature until stream temperature reaches 87 F; not to be changed by more than 2 F during any 1-hour period.
Total dissolved solids	Not more than 500 mg/L as a monthly average value; not more than 750 mg/L at any time.

Source: Pennsylvania Code, Title 25, Chapter 93.

TABLE 7-2 MONTHLY MEAN, MINIMUM, AND MAXIMUM VALUES OF WATER QUALITY PARAMETERS AT ALL YORK HAVEN POND BIOLOGICAL STATIONS, THREE MILE ISLAND NUCLEAR STATION, 1989.

PARAMETER	MONTH: APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	ALL MONTHS
WATER TEMPERATURE (C)									
MEAN	8.9	17.0	21.1	23.2	23.6	21.4	15.6	11.2	18.8
MINIMUM	5.1	13.0	18.0	18.1	18.8	15.5	14.3	9.3	5.1
MAXIMUM	13.8	20.0	23.2	28.0	27.4	26.2	17.5	13.0	28.0
N	47	51	59	47	67	27	15	15	328
PH									
MEAN	7.5	7.5	7.1	7.5	8.5	8.2	8.5	8.1	7.7
MINIMUM	6.5	6.7	5.4	6.6	7.7	7.0	7.8	7.6	5.4
MAXIMUM	8.8	8.9	8.4	8.5	9.3	8.9	9.0	8.8	9.3
N	47	51	59	47	61	21	15	15	316
DISSOLVED OXYGEN (MG/L)									
MEAN	12.0	9.9	9.0	8.9	10.4	9.6	9.7	10.9	10.0
MINIMUM	10.3	8.0	7.4	7.3	8.0	6.4	7.9	9.0	6.4
MAXIMUM	15.0	14.6	11.0	11.8	19.0	13.2	12.4	12.6	19.0
N	47	51	59	47	67	27	15	15	328
SECCHI DEPTH (CM)									
MEAN	100.9	81.5	70.7	55.4	134.8	77.1	94.8	141.6	93.6
MINIMUM	25.4	53.3	10.2	15.2	86.4	50.8	71.1	101.6	10.2
MAXIMUM	167.6	124.5	139.7	101.6	203.2	106.7	127.0	195.6	203.2
N	15	27	27	15	27	27	15	15	168
TOTAL DISSOLVED SOLIDS (MG/L)									
MEAN	102.0	191.0	179.7	140.7	222.0	331.7	238.7	184.7	198.8
MINIMUM	101.0	181.0	171.0	138.0	205.0	289.0	201.0	171.0	101.0
MAXIMUM	103.0	206.0	195.0	145.0	244.0	382.0	297.0	198.0	382.0
N	3	3	3	3	3	3	3	3	24
CONDUCTIVITY (UMHOS/CM)									
MEAN	218.3	217.5	210.8	268.3	312.1	396.7	354.2	274.2	282.4
MINIMUM	190.0	160.0	150.0	180.0	250.0	325.0	300.0	210.0	150.0
MAXIMUM	240.0	250.0	260.0	300.0	450.0	500.0	425.0	310.0	500.0
N	6	12	12	6	12	12	6	6	72
SURFACE VELOCITY (CM/SEC)									
MEAN	26.5	24.0	28.6	28.2	10.4	3.3	8.7	4.0	22.1
MINIMUM	5.0	2.0	4.0	5.0	1.0	2.0	4.0	3.0	1.0
MAXIMUM	58.0	62.0	70.0	53.0	27.0	6.0	12.0	6.0	70.0
N	35	27	35	35	43	3	3	3	184
BOTTOM VELOCITY (CM/SEC)									
MEAN	14.3	13.7	10.7	13.0	5.7	3.0	6.0	6.0	9.0
MINIMUM	6.0	7.0	5.0	8.0	4.0	2.0	2.0	2.0	2.0
MAXIMUM	20.0	18.0	19.0	23.0	8.0	4.0	12.0	9.0	23.0
N	3	3	3	3	3	3	3	3	24
RIVER FLOW (M /SEC)									
MEAN	1626.3	2585.6	1741.6	1028.9	312.5	228.8	609.6	809.4	1118.1
MINIMUM	470.1	453.1	705.1	484.2	179.0	136.8	164.2	475.7	136.8
MAXIMUM	5182.0	6020.2	4185.2	1704.7	523.9	436.1	2339.0	1750.0	6020.2
N	30	31	30	31	31	30	31	30	244

TABLE 7-3

Two-factor analysis of variance test results for selected water quality parameters collected near TMINS, April through November 1989.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Water Temperature	Model (r^2=0.843)	55	8796.868	159.934	26.58	0.0001**
	Zone	6	11.428	1.905	0.32	0.9281
	Month	7	6594.421	942.060	156.55	0.0001**
	Interaction	42	86.452	2.058	0.34	1.0000
	Error	272	1636.767	6.018		
	Corrected Total	327	10433.635			
Dissolved Oxygen	Model (r^2=0.436)	55	431.490	7.845	3.83	0.0001**
	Zone	6	13.961	2.327	1.14	0.3414
	Month	7	289.585	41.369	20.20	0.0001**
	Interaction	42	74.193	1.766	0.86	0.7124
	Error	272	557.031	2.048		
	Corrected Total	327	988.521			
pH	Model (r^2=0.581)	55	91.174	1.658	6.54	0.0001**
	Zone	6	4.204	0.701	2.77	0.0127*
	Month	7	74.300	10.614	41.91	0.0001**
	Interaction	42	2.833	0.067	0.27	1.0000
	Error	260	65.854	0.253		
	Corrected Total	315	157.028			
Total Dissolved Solids	Model (r^2=0.949)	9	105354.208	11706.023	28.86	0.0001**
	Zone	2	5881.583	2940.792	7.25	0.0069**
	Month	7	99472.625	14210.375	35.04	0.0001**
	Error	14	5677.750	405.554		
	Corrected Total	23	111031.958			

* Significant at P $\leq$0.05.
** Significant at P $\leq$0.01.

TABLE 7-4

Summary of Tukey's studentized range test for selected water quality parameters collected in York Haven Pond, April through November 1989. Underlined means are not significantly different (P≤0.05) and are ranked from highest to lowest mean. Means are listed parenthetically.

Dependent Variable	Water Quality Zones*						
pH	4 (7.94)	1 (7.79)	2 (7.79)	10 (7.73)	7 (7.67)	9 (7.62)	8 (7.58)
Total Dissolved Solids	8 (220)	9 (193)	7 (183)				

* Refer to Figure 7-1 for location.

TABLE 7-5

Mean, minimum, and maximum values of water quality and physical parameters taken at the macroinvertebrate stations near TMINS, April through November 1989.

Parameter	Station		
	TM-M1-1A2	TM-M1-11A1	TM-M1-9B1
Water temperature(C)			
Mean	16.0	16.2	16.2
Min	5.4	6.5	5.5
Max	23.2	23.0	23.0
pH			
Mean	7.7	7.7	7.8
Min	7.1	7.1	7.1
Max	9.0	8.6	8.5
Dissolved oxygen(mg/l)			
Mean	9.4	9.7	9.4
Min	8.2	8.5	8.1
Max	12.0	12.1	12.2
Total dissolved solids(mg/l)			
Mean	183	220	193
Min	102	101	103
Max	289	382	324
Secchi disc(cm)			
Mean	98.4	69.8	87.0
Min	27.9	25.4	27.9
Max	195.6	114.3	154.9
Surface current velocity(cm/sec)			
Mean	7.0	5.9	14.4
Min	2.0	2.0	3.0
Max	13.0	15.0	25.0
Bottom current velocity(cm/sec)			
Mean	7.6	6.4	13.1
Min	2.0	2.0	4.0
Max	17.0	12.0	23.0

TABLE 7-6

Range and mean river flow (m^3/sec) obtained from the River Forecast Center (Harrisburg, Pennsylvania) for April through November 1980 through 1989.

Year	N (days)	Range	Mean
1980	244	90-5411	643
1981	244	119-2455	646
1982	244	101-5354	674
1983	244	86-6824	905
1984	244	137-10110	1044
1985	244	120-4416	591
1986	244	138-4800	713
1987	244	129-6230	726
1988	244	106-5298	546
1989	244	137-6020	1118

TABLE 7-7

Mean, minimum, and maximum values of water quality parameters taken at the macroinvertebrate stations near TMINS, April through November, 1974 through 1989. Station prefix TM-MI- deleted from table.

Year	Water Temperature(C)			pH			Dissolved Oxygen(mg/l)			Total Dissolved Solids(mg/l)		
	1A2	11A1	9B1	1A2	11A1	9B1	1A2	11A1	9B1	1A2	11A1	9B1
1989												
Mean	16.0	16.2	16.2	7.7	7.7	7.8	9.4	9.7	9.4	183	220	193
Min	5.4	6.5	5.5	7.1	7.1	7.1	8.2	8.5	8.1	102	101	103
Max	23.2	23.0	23.0	9.0	8.6	8.5	12.0	12.1	12.2	289	382	324
1974-1988												
Mean	17.5	17.8	18.0	8.0	8.0	8.0	9.2	9.3	9.3	196	207	202
Min	3.0	3.0	3.0	6.3	6.3	6.2	3.3	3.8	3.2	85	70	87
Max	30.0	30.0	30.5	9.4	9.1	9.0	13.2	14.4	14.0	332	362	355

TABLE 7-8

Three-factor analysis of variance test results for selected water quality parameters collected near TMINS, 1974 through 1989.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Water Temperature	Model (r^2=0.919)	173	23580.816	136.305	27.99	0.0001*
	Year	15	530.067	35.338	7.26	0.0001*
	Month	7	18946.958	2706.708	555.90	0.0001*
	Station	2	17.679	8.839	1.82	0.1640
	Year-Month	105	2005.433	19.099	3.92	0.0001*
	Year-Station	30	19.826	0.661	0.14	1.0000
	Month-Station	14	5.070	0.362	0.07	1.0000
	Error	429	2088.828	4.869		
	Corrected Total	602	25669.644			
Dissolved Oxygen	Model (r^2=0.850)	173	1484.675	8.582	13.69	0.0001*
	Year	15	231.349	15.423	24.60	0.0001*
	Month	7	536.694	76.670	122.29	0.0001*
	Station	2	2.567	1.284	2.05	0.1304
	Year-Month	105	596.910	5.685	9.07	0.0001*
	Year-Station	30	19.116	0.637	1.02	0.4451
	Month-Station	14	1.212	0.086	0.14	0.9999
	Error	417	261.441	0.627		
	Corrected Total	590	1746.116			
pH	Model (r^2=0.762)	172	112.440	0.654	7.69	0.0001*
	Year	15	62.318	4.154	48.87	0.0001*
	Month	7	2.644	0.378	4.44	0.0001*
	Station	2	0.184	0.092	1.08	0.3404
	Year-Month	104	43.117	0.414	4.88	0.0001*
	Year-Station	30	1.796	0.060	0.70	0.8786
	Month-Station	14	0.605	0.043	0.51	0.9283
	Error	413	35.107	0.085		
	Corrected Total	585	147.547			
Total Dissolved Solids	Model (r^2=0.932)	133	1633982.128	12285.580	28.77	0.0001*
	Year	11	138618.689	12601.698	29.51	0.0001*
	Month	7	871094.130	124442.010	291.44	0.0001*
	Station	2	13526.772	6763.386	15.84	0.0001*
	Year-Month	77	518009.923	6727.402	15.76	0.0001*
	Year-Station	22	15902.358	722.834	1.69	0.0290**
	Month-Station	14	3457.316	246.951	0.58	0.8812
	Error	277	118275.726	426.988		
	Corrected Total	410	1752257.854			

* Significant at $P \leq 0.01$.
** Significant at $P \leq 0.05$.

TABLE 7-9

Summary of Tukey's studentized range test for selected water quality parameters collected near TMINS, 1974 through 1989. Underlined means are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest mean. Means are listed parenthetically.

Dependent Variable	Year															
Water Temperature	1985 (21.1)	1984 (18.8)	1987 (18.5)	1980 (18.2)	1986 (18.0)	1979 (18.0)	1977 (17.9)	1988 (17.9)	1974 (17.8)	1978 (17.4)	1981 (17.3)	1982 (17.2)	1983 (17.1)	1975 (17.0)	1976 (16.4)	1989 (16.1)
Dissolved Oxygen	1984 (10.3)	1986 (10.3)	1983 (10.2)	1985 (10.1)	1988 (9.9)	1987 (9.7)	1982 (9.7)	1989 (9.5)	1976 (9.4)	1980 (9.3)	1979 (9.2)	1978 (9.0)	1981 (8.9)	1977 (8.6)	1974 (8.4)	1975 (8.0)
pH	1982 (8.4)	1981 (8.3)	1980 (8.3)	1978 (8.2)	1977 (8.2)	1979 (8.1)	1976 (8.0)	1985 (7.8)	1983 (7.8)	1984 (7.8)	1989 (7.7)	1988 (7.7)	1975 (7.7)	1974 (7.6)	1986 (7.3)	1987 (7.2)
Total Dissolved Solids	1980 (234)	1987 (224)	1985 (212)	1982 (208)	1986 (208)	1988 (208)	1983 (205)	1989 (199)	1984 (198)	1978 (183)	1981 (182)	1979 (178)				

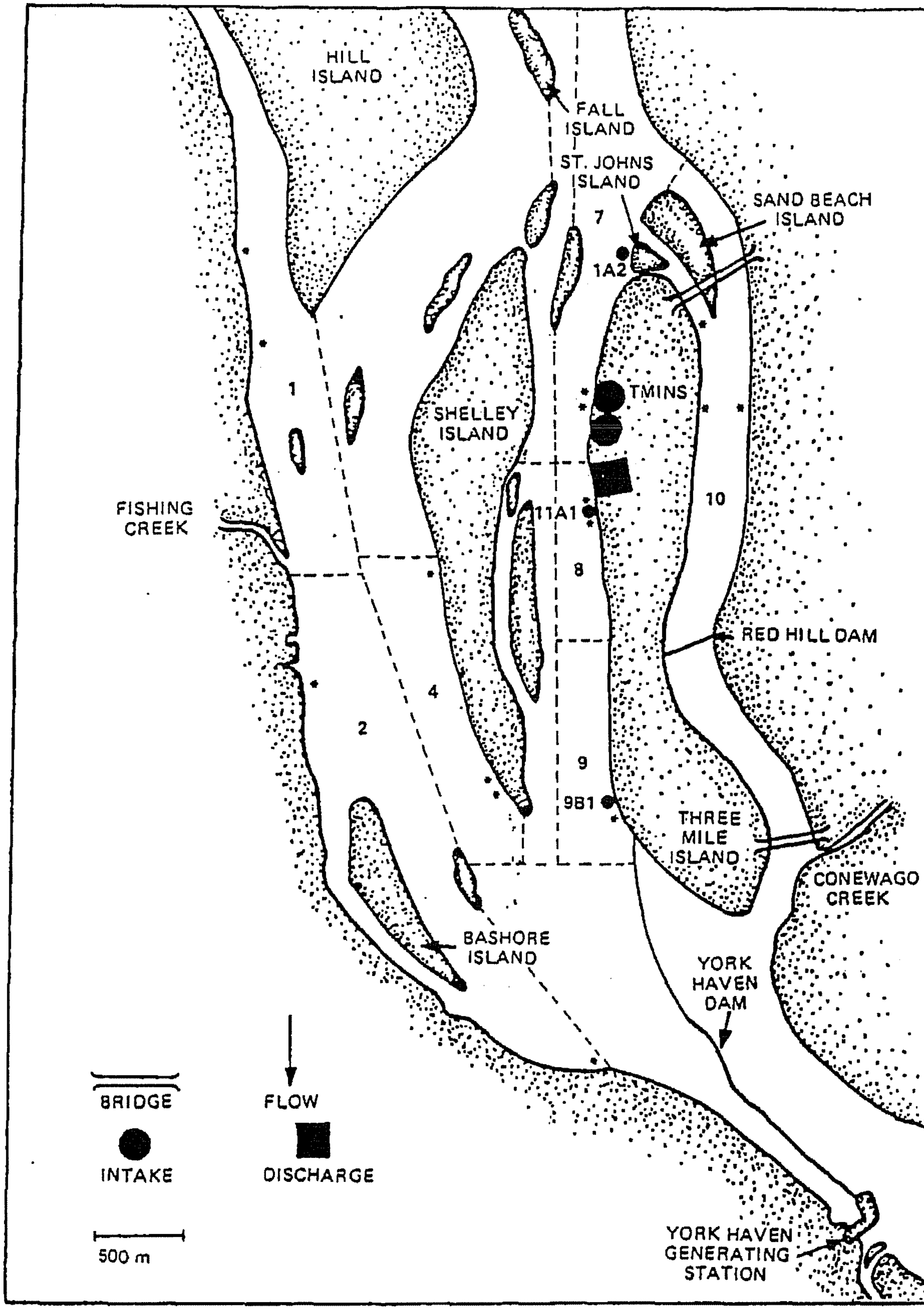

Figure 7-1. York Haven Pond showing numbered water quality zones, macroinvertebrate sampling stations, and the remaining biological sampling stations (asterisks). Only zones containing biological sampling stations are numbered.

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APPENDIX A

BENTHIC MACROINVERTEBRATE DATA

TABLE A-1 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, APRIL, 1989.

Date=05APR and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		.	.	.	.	1	.	.	.
Ceratopogonidae	Larvae	1	0.1	4	0.1	.	.	1	0.1
Chironomus decorus	Larvae	20	6.7	17	14.2	3	0.3	10	7.8
Coelotanypus	Larvae	4	0.4	3	0.2	2	.	.	.
Dubiraphia	Larvae	.	.	2	0.2	.	.	.	.
Ferrissia		3	0.2	.	.	.	.	.	.
Hydrobaenus	Larvae	.	.	1	.	.	.	.	.
Limnodrilus hoffmeisteri		14	0.3	18	0.5	6	.	6	.
Limnodrilus udekemianus		.	.	2	0.1	1	.	.	.
Lumbriculidae		.	.	1	2.5	.	.	.	.
Musculium transversum		3	0.3	3	0.4	.	.	2	0.2
Nanocladius	Larvae	2	.	.	.	.	.	.	.
Nematoda		2	0.2	5	0.1	5	0.1	1	0.1
Oecetis	Larvae	.	.	1	0.1	1	0.1	.	.
Pisidium		8	1.0	1	0.1	.	.	2	0.2
Polypedilum convitum	Larvae	.	.	1	.	.	.	.	.
Procladius	Larvae	.	.	3	0.2	.	.	1	.
Rheotanytarsus	Larvae	.	.	1	.	1	.	1	0.1
Stenelmis	Larvae	.	.	.	.	1	0.1	.	.
Tendipedidae=chironomidae	Larvae	.	.	2	.	.	.	.	.
Thienemanimyia	Larvae	1	.	3	.	.	.	.	.
TOTAL		58	9.2	69	18.7	21	0.6	24	8.5

TABLE A-1 CONTINUED.

Date=05APR and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	1	.	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		.	.	.	.	.	.	1	.
Ceratopogonidae	Larvae	2	0.1	.	.	1	0.1	1	0.1
Cheumatopsyche	Larvae	.	.	.	.	.	.	1	0.2
Chironomid pupae	Pupae	1	0.1	1	0.1	.	.	.	.
Chironomus decorus	Larvae	25	34.8	36	34.2	20	20.4	40	42.4
Coelotanypus	Larvae	1	.	3	0.1	.	.	.	.
Cricotopus	Larvae	1	.	5	0.1	.	.	4	0.4
Cryptochironomus fulvus	Larvae	6	0.4	3	.	.	.	2	.
Gammarus fasciatus		2	0.1	.	.	.	.	.	.
Helobdella elongata		.	.	1	0.1	.	.	1	0.4
Hirudinea		1	1.4	.	.	.	.	.	.
Ilyodrilus templetoni		4	.	2	.	3	.	3	.
Limnodrilus claparedianus		.	.	.	.	.	.	18	3.6
Limnodrilus hoffmeisteri		152	13.1	70	9.3	90	16.4	37	7.2
Musculium transversum		7	0.8	6	0.7	.	.	11	1.3
Nais		3	.	.	.	.	.	.	.
Nematoda		1	0.1	2	0.2	2	0.2	3	0.3
Neureclipsis	Larvae	1	0.1	.	.	.	.	.	.
Phaenopsectra	Larvae	30	0.8	2	0.1	4	0.4	5	0.5
Pisidium		2	0.2	.	.	.	.	.	.
Potamia	Larvae	1	0.2	.	.	.	.	.	.
Procladius	Larvae	5	0.8	7	1.2	.	.	4	0.2
Prostoma		.	.	1	0.2	.	.	.	.
Quistadrilus multisetosus		.	.	.	.	.	.	1	.
Rheotanytarsus	Larvae	1	.	2	.	.	.	2	0.2
Tendipedidae=chironomidae	Larvae	.	.	.	.	.	.	2	.
TOTAL		247	53.0	141	46.3	120	37.5	136	56.8

TABLE A-1 CONTINUED.

Date=05APR and Station 981

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ceratopogonidae	Larvae	1	0.1	2	0.2	2	0.2	.	.
Chironomid pupae	Pupae	.	.	.	.	.	.	1	0.1
Chironomus decorus	Larvae	19	19.6	28	34.0	45	40.1	22	20.2
Coelotanypus	Larvae	7	1.0	11	1.1	12	1.8	8	1.2
Cricotopus	Larvae	.	.	1	.	.	.	.	.
Cryptochironomus fulvus	Larvae	4	1.1	1	.	13	0.6	1	0.1
Helobdella elongata		.	.	1	0.5	.	.	.	.
Hexagenia	Larvae	1	35.9	.	.	.	.	.	.
Hydrolimax grisea		.	.	.	.	.	.	1	0.1
Ilyodrilus templetoni		3	.	.	.	1	.	3	.
Limnodrilus claparedianus		36	3.1	.	.	.	.	.	.
Limnodrilus hoffmeisteri		328	28.2	161	14.0	179	18.9	189	24.5
Musculium transversum		4	0.6	3	2.8	6	0.7	1	0.1
Nematoda		.	.	.	.	1	0.1	.	.
Pisidium		9	1.1	3	0.4	6	1.2	1	0.1
Procladius	Larvae	30	6.4	20	3.0	8	1.8	14	2.5
Quistadrilus multisetosus		.	.	.	.	1	.	.	.
Rheotanytarsus	Larvae	.	.	.	.	1	.	.	.
TOTAL		442	97.1	231	56.0	275	65.4	241	48.9

TABLE A-2 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, MAY, 1989.

Date=02MAY and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	.	.	1	.	1	.
Arcteonais lomondi		.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		.	.	.	.	6	.	.	.
Branchiura sowerbyi		.	.	2	1.1	3	30.5	.	.
Ceratopogonidae	Larvae	.	.	.	.	.	.	1	0.4
Chironomid pupae	Pupae	3	0.1	2	0.1	9	3.0	7	4.2
Chironomus decorus	Larvae	1	0.1	1	1.0	2	4.6	13	12.6
Cryptochironomus fulvus	Larvae	3	0.2	.	.	2	0.7	.	.
Enchytraeidae		.	.	.	.	1	.	.	.
Gammarus fasciatus		.	.	.	.	1	0.1	1	2.5
Helobdella elongata		.	.	1	1.3	.	.	.	.
Limnodrilus hoffmeisteri		7	2.7	29	8.0	60	16.5	25	8.6
Musculium transversum		.	.	1	0.1	.	.	4	0.4
Nais		.	.	1	.	.	.	.	.
Nematoda		1	0.1	2	0.2	3	0.2	.	.
Phaenopsectra	Larvae	.	.	1	.	1	.	.	.
Pisidium		1	0.2	2	0.4	8	1.7	2	0.7
Polypedilum fallax	Larvae	4	0.2	.	.	.	.	.	.
Polypedilum scalaenum	Larvae	7	0.5	2	.	13	0.9	10	1.2
Polypedium illinoense	Larvae	.	.	.	.	1	.	.	.
Tanytarsus	Larvae	28	1.7	31	2.1	38	5.2	12	1.4
Zavrelia group	Larvae	2	.	.	.	.	.	.	.
TOTAL		57	5.8	76	14.3	149	63.4	76	32.0

TABLE A-2 CONTINUED.

Date=02MAY and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Arcteonais lomondi		2	.	6	.	.	.	.	.
Bothrioneurum vejdovskyanum		11	0.3	2	0.2	1	0.1	1	.
Branchiura sowerbyi		.	.	1	0.3	.	.	.	.
Ceratopogonidae	Larvae	4	0.3	2	0.2	4	0.7	.	.
Chironomid pupae	Pupae	6	5.2	3	2.0	7	8.4	.	.
Chironomus decorus	Larvae	23	21.5	18	18.3	21	21.5	4	5.2
Coelotanypus	Larvae	1	.	.	.	1	0.3	1	.
Cryptochironomus fulvus	Larvae	7	1.2	7	0.2	8	1.4	4	0.8
Dubiraphia	Larvae	1	0.1	1	0.1	1	0.3	1	0.3
Dugesia tigrina		1	0.5	1	0.3	.	.	.	.
Gammarus fasciatus		5	0.4	26	3.2	14	2.6	2	0.2
Helobdella elongata		7	4.0	1	0.2	.	.	.	.
Helobdella stagnalis		.	.	1	3.5	.	.	.	.
Hexagenia	Larvae	.	.	1	2.5	.	.	.	.
Hydrolimax grisea		2	0.4	1	0.1	1	0.3	2	0.5
Ilyodrilus templetoni		4	.	3	.	1	.	1	.
Limnodrilus claparedianus		.	.	11	2.5	.	.	.	.
Limnodrilus hoffmeisteri		111	16.5	101	22.3	96	16.2	42	11.0
Manayunkia speciosa		.	.	.	.	1	0.1	.	.
Musculium transversum		4	2.9	3	0.4	1	0.1	4	0.5
Nematoda		2	0.2	1	0.1	1	0.1	.	.
Phaenopsectra	Larvae	24	4.8	23	5.4	30	7.6	29	8.3
Physidae		.	.	.	.	1	0.1	.	.
Pisidium		9	2.3	2	0.2	11	1.3	2	0.2
Polypedilum scalaenum	Larvae	3	0.5	1	.	3	0.9	4	1.0
Polypedium illinoense	Larvae	.	.	.	.	.	.	4	1.0
Procladius	Larvae	22	2.8	7	1.2	4	0.4	17	3.1
Quistadrilus multisetosus		.	.	1	0.1	2	.	1	.
Stenelmis	Larvae	1	0.2	.	.	.	.	1	0.4
Stylurus	Larvae	.	.	1	30.2	.	.	.	.
Tanytarsus	Larvae	.	.	2	.	1	0.1	.	.
Thienemanimyia	Larvae	.	.	.	.	1	.	.	.
TOTAL		250	64.1	227	93.5	211	62.5	120	32.5

TABLE A-2 CONTINUED.

Date=02MAY and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ceratopogonidae	Larvae	.	.	.	.	.	.	3	0.3
Chironomid pupae	Pupae	6	4.0	16	14.9	2	0.7	2	2.6
Chironomus decorus	Larvae	10	8.9	41	51.6	6	5.7	12	11.7
Coelotanypus	Larvae	19	3.3	4	1.2	14	1.2	5	1.2
Cryptochironomus fulvus	Larvae	1	0.4	6	2.4	.	.	.	.
Helobdella elongata		1	0.6	.	.	1	1.4	.	.
Hydrolimax grisea		1	0.4	3	0.4	.	.	1	0.3
Ilyodrilus templetoni		2	.	3	.	2	.	.	.
Limnodrilus claparedianus		29	2.8	29	4.0	.	.	.	.
Limnodrilus hoffmeisteri		263	25.3	291	39.7	188	21.6	153	46.0
Musculium transversum		4	0.7	9	1.1	3	0.4	.	.
Nematoda		1	0.1	.	.	.	.	.	.
Phaenopsectra	Larvae	.	.	2	.	.	.	.	.
Pisidium		8	2.1	7	1.4	2	1.0	.	.
Procladius	Larvae	43	8.5	7	2.0	21	4.8	1	0.3
Tanytarsus	Larvae	10	0.8	10	1.4	2	.	1	0.1
TOTAL		398	57.9	428	120.1	241	36.8	178	62.5

TABLE A-3 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, JUNE, 1989.

Date=05JUN and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	2	.	1	.	.	.
Arcteonais lomondi		1	.	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		5	.	4	0.1	5	0.8	8	0.4
Ceratopogonidae	Larvae	1	0.1	.	.	.	.	.	.
Chironomid pupae	Pupae	.	.	5	0.3	.	.	1	0.2
Chironomus decorus	Larvae	378	27.7	406	52.5	329	27.5	345	27.3
Cryptochironomus fulvus	Larvae	3	0.3	.	.	1	.	.	.
Gammarus fasciatus		5	0.2	19	1.2	14	1.4	11	0.2
Helobdella elongata		1	0.4	.	.	.	.	.	.
Hexagenia	Larvae	1	22.0	.	.	.	.	.	.
Limnodrilus hoffmeisteri		1	.	4	.	3	.	5	.
Limnodrilus udekemianus		.	.	2	.	.	.	.	.
Musculium		.	.	.	.	1	0.3	1	0.2
Nematoda		.	.	.	.	1	0.1	2	0.2
Phaenopsectra	Larvae	9	0.4	40	3.6	18	1.6	34	2.6
Physidae		.	.	.	.	1	0.1	.	.
Pisidium		.	.	1	0.1	.	.	8	1.0
Polypedilum scalaenum	Larvae	2	0.1	.	.	.	.	.	.
Procladius	Larvae	.	.	1	.	5	0.2	4	0.4
Sialis	Larvae	1	0.1	.	.	.	.	.	.
Tanytarsus	Larvae	.	.	1	.	1	.	1	0.1
TOTAL		408	51.3	485	57.8	380	32.0	420	32.6

TABLE A-3 CONTINUED

Date=05JUN and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Arcteonais lomondi		1	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		4	.	8	0.4	.	.	3	0.3
Ceratopogonidae	Larvae	2	0.3	.	.	1	0.1	4	0.1
Chironomid pupae	Pupae	.	.	5	0.6	2	0.8	5	0.4
Chironomus decorus	Larvae	715	93.1	479	95.1	607	71.9	624	66.3
Coelotanypus	Larvae	.	.	.	.	1	.	1	0.5
Cryptochironomus fulvus	Larvae	.	.	.	.	2	.	2	0.6
Cryptotendipes	Larvae	.	.	.	.	.	.	4	0.2
Dubiraphia	Larvae	2	0.2	1	0.2	.	.	1	0.1
Dugesia tigrina		.	.	1	0.4	.	.	.	.
Erpobdellidae		.	.	1	14.7	2	0.3	.	.
Gammarus fasciatus		10	1.9	22	0.4	7	0.6	41	1.6
Helobdella elongata		.	.	1	0.2	.	.	.	.
Helobdella stagnalis		.	.	22	1.7	.	.	.	.
Hexagenia	Larvae	.	.	2	33.9	1	12.4	3	16.5
Hydrolimax grisea		4	0.4	10	0.3	2	0.2	4	0.4
Ilyodrilus templetoni		.	.	3	.	2	.	.	.
Leptoceridae	Larvae	.	.	.	.	1	1.5	.	.
Limnodrilus hoffmeisteri		77	39.0	170	36.9	42	12.6	58	14.2
Manayunkia speciosa		.	.	.	.	.	.	2	0.2
Musculium		15	2.9	1	0.1	1	1.6	3	2.3
Musculium transversum		.	.	6	5.1	2	4.2	2	2.0
Nematoda		2	0.2	6	0.4	1	0.1	3	0.3
Phaenopsectra	Larvae	10	1.0	5	0.5	2	.	14	0.4
Pisidium		4	1.3	27	3.2	24	2.9	29	3.5
Procladius	Larvae	.	.	5	1.5	3	0.4	3	0.4
Quistadrilus multisetosus		2	0.2	.	.	.	.	1	.
Stenelmis	Larvae	.	.	4	2.9	2	1.1	.	.
Tanytarsus	Larvae	5	0.5	6	0.6	1	.	3	0.3
TOTAL		853	141.0	786	199.1	706	110.7	810	110.6

TABLE A-3 CONTINUED.

Date=05JUN and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	1	.	.	.	1	.
Arcteonais lomondi		2	0.2	17	0.6	6	.	10	.
Bothrioneurum vejdovskyanum		4	.	42	1.9	12	0.4	20	1.0
Cecidomyiidae	Larvae	.	.	.	.	.	.	1	0.3
Ceratopogonidae	Larvae	3	0.3	2	0.5	5	0.7	1	0.2
Chironomid pupae	Pupae	2	0.9	6	3.2	6	3.6	1	0.1
Chironomus decorus	Larvae	871	145.8	1005	228.5	596	154.3	1230	207.7
Coelotanypus	Larvae	1	.	.	.	.	.	.	.
Cryptochironomus fulvus	Larvae	1	.	1	.	2	0.3	.	.
Gammarus fasciatus		51	8.2	12	0.9	29	6.3	109	9.8
Gomphidae	Larvae	.	.	1	0.1	.	.	.	.
Hexagenia	Larvae	.	.	1	0.4	2	31.0	1	27.0
Hydrolimax grisea		.	.	.	.	.	.	2	0.2
Ilyodrilus templetoni		1	.	8	.	2	.	3	.
Limnodrilus hoffmeisteri		242	80.8	277	48.1	197	38.8	144	41.1
Microchironomus	Larvae	2	0.2	.	.	.	.	.	.
Nematoda		.	.	.	.	.	.	1	0.1
Optioservus	Larvae	1	0.4	1	0.4	.	.	1	0.2
Phaenopsectra	Larvae	8	0.6	1	.	.	.	7	0.7
Pisidium		12	1.4	6	0.7	4	0.5	14	1.7
Polypedilum scalaenum	Larvae	.	.	1	.	.	.	.	.
Procladius	Larvae	1	.	11	1.5	3	0.8	.	.
Promoresia	Larvae	.	.	.	.	.	.	1	0.3
Sialis	Larvae	.	.	.	.	2	0.2	.	.
Stenelmis	Larvae	.	.	.	.	.	.	1	0.6
Tanytarsus	Larvae	.	.	9	0.9	2	0.1	5	0.5
TOTAL		1202	238.8	1402	287.7	868	237.0	1553	291.5

TABLE A-4 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, JULY, 1989.

Date=06JUL and Station 1A2

Taxa	Life Stage	A		B		C		D	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Bothrioneurum vejdovskyanum		7	.	1	0.2	.	.	.	.
Chironomid pupae	Pupae	1	0.2	.	.	.	.	.	.
Chironomus decorus	Larvae	44	13.2	18	11.4	16	8.3	7	1.1
Cryptochironomus fulvus	Larvae	1	0.2	.	.	.	.	1	0.3
Dubiraphia	Larvae	2	0.2	.	.	.	.	.	.
Gammarus fasciatus		5	0.8	1	0.3	.	.	1	0.1
Helobdella elongata		.	.	.	.	.	.	1	0.5
Ilyodrilus templetoni		1	.	.	.	.	.	.	.
Labrundinia	Larvae	.	.	.	.	2	.	.	.
Limnodrilus claparedianus		10	1.0	.	.	.	.	.	.
Limnodrilus hoffmeisteri		83	7.3	4	0.6	8	1.1	11	1.0
Limnodrilus udekemianus		.	.	.	.	.	.	3	0.4
Musculium transversum		1	1.6	.	.	.	.	.	.
Nematoda		.	.	.	.	2	0.2	.	.
Pisidium		19	2.3	7	0.8	.	.	4	0.5
Polypedilum scalaenum	Larvae	1	.	1	.	2	.	.	.
Stenelmis	Larvae	1	0.7	.	.	1	0.5	.	.
TOTAL		176	27.5	32	13.3	31	10.1	28	3.9

TABLE A-4 CONTINUED.

Date=06JUL and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	1	.	.	.	.	.	.	.
Amnicola		1	0.2	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		3	.	3	0.1	2	0.1	4	0.2
Brachycerus	Larvae	.	.	.	.	1	0.6	1	0.3
Ceratopogonidae	Larvae	2	0.3	.	.	.	.	.	.
Cheumatopsyche	Pupae	.	.	1	0.2	.	.	.	.
Chironomid pupae	Pupae	2	0.6	4	1.1	1	0.2	2	1.1
Chironomus decorus	Larvae	30	5.2	58	16.3	96	24.5	84	18.3
Cryptochironomus fulvus	Larvae	4	0.4	7	1.4	9	1.2	5	0.2
Dugesia tigrina		.	.	1	0.2	.	.	.	.
Erpobdellidae		1	28.3	1	23.3	1	1.4	.	.
Gammarus fasciatus		18	8.2	5	2.8	5	0.7	9	0.4
Helobdella elongata		7	1.4	6	1.5	3	1.2	1	0.1
Helobdella stagnalis		1	0.2	1	0.1	.	.	.	.
Hexagenia	Larvae	2	31.9	2	18.3	.	.	.	.
Hydrolimax grisea		3	0.1	3	0.1	.	.	7	0.5
Ilyodrilus templetoni		.	.	1	.	.	.	.	.
Limnodrilus hoffmeisteri		50	10.0	128	10.4	177	11.4	128	8.8
Manayunkia speciosa		1	0.1	.	.	.	.	.	.
Musculium transversum		1	0.1	.	.	2	0.2	4	0.5
Nematoda		2	0.2	2	0.2	4	0.4	1	0.1
Pisidium		13	1.6	1	0.1	5	0.6	7	0.8
Polypedilum scalaenum	Larvae	.	.	.	.	.	.	1	.
Procladius	Larvae	6	0.6	8	0.8	6	0.2	11	0.8
Stenelmis	Larvae	1	0.8	1	0.5	.	.	.	.
TOTAL		149	90.2	233	77.4	312	42.7	265	32.1

TABLE A-4 CONTINUED.

Date=06JUL and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Bothrioneurum vejdovskyanum		3	.	.	.	.	.	.	.
Chironomid pupae	Pupae	2	.	.	.	.	.	.	.
Chironomus decorus	Larvae	59	7.1	2	1.5	.	.	1	0.6
Coelotanypus	Larvae	1	.	.	.	.	.	.	.
Cryptochironomus fulvus	Larvae	5	0.8	.	.	2	0.2	2	0.5
Epoicocladius	Larvae	.	.	.	.	.	.	1	.
Gammarus fasciatus		14	3.0	.	.	.	.	.	.
Hexagenia	Larvae	1	4.6	.	.	.	.	1	10.3
Hydropsyche	Larvae	.	.	1	0.1	.	.	.	.
Limnodrilus hoffmeisteri		139	19.1	71	24.6	54	13.4	78	13.4
Limnodrilus udekemianus		.	.	8	2.7	.	.	.	.
Musculium transversum		2	1.1	.	.	.	.	1	0.2
Pisidium		8	1.0	6	0.7	2	0.2	2	0.4
Polypedilum scalaenum	Larvae	3	.	.	.	.	.	1	.
Quistadrilus multisetosus		1	0.1	.	.	.	.	.	.
Tubificidae		15	2.1	.	.	.	.	.	.
TOTAL		253	38.9	88	29.6	58	13.8	87	25.4

TABLE A-5 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, AUGUST, 1989.

Date=02AUG and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Aulodrilus pluriseta		3	.	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		4	.	3	0.1	4	.	.	.
Branchiura sowerbyi		2	0.2	2	18.0	1	0.9	.	.
Caenis	Larvae	1	0.1	.	.	3	0.4	.	.
Ceratopogonidae	Larvae	6	0.4	2	0.1	1	0.1	.	.
Chironomid pupae	Pupae	5	1.7	.	.	.	.	.	.
Chironomus decorus	Larvae	44	13.2	42	5.3	53	6.7	25	3.7
Coelotanypus	Larvae	2	.	.	.	.	.	.	.
Corbicula fluminea		.	.	.	.	1	.	.	.
Cryptochironomus fulvus	Larvae	3	.	3	0.5	8	2.2	.	.
Gammarus fasciatus		3	0.1	.	.	.	.	.	.
Harnischia	Larvae	.	.	.	.	.	.	1	.
Hydrolimax grisea		1	0.1	.	.	.	.	.	.
Ilyodrilus templetoni		7	0.5	.	.	.	.	.	.
Limnodrilus hoffmeisteri		47	3.4	44	2.6	31	2.0	19	2.1
Limnodrilus udekemianus		6	0.4	.	.	.	.	.	.
Lumbriculidae		.	.	.	.	1	0.1	.	.
Musculium transversum		1	3.2	.	.	2	0.2	.	.
Nematoda		.	.	2	0.6	2	0.2	.	.
Pisidium		1	0.3	2	0.2	15	1.8	.	.
Polypedilum scalaenum	Larvae	2	0.2	6	0.3	7	0.7	.	.
Procladius	Larvae	9	0.7	3	0.1	5	0.2	.	.
Quistadrilus multisetosus		1	.	.	.	.	.	.	.
TOTAL		148	24.5	109	27.8	134	15.5	45	5.8

TABLE A-5 CONTINUED.

Date=02AUG and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Arcteonais lomondi		1	.	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		1	.	1	.	3	0.1	.	.
Chironomus decorus	Larvae	45	7.4	29	3.2	21	4.2	8	0.2
Coelotanypus	Larvae	1	0.1	.	.	1	.	.	.
Corbicula fluminea		.	.	1	.	.	.	.	.
Cryptochironomus fulvus	Larvae	14	1.8	14	1.7	10	0.9	4	0.7
Erpobdellidae		1	14.9	.	.	.	.	.	.
Gammarus fasciatus		5	0.1	2	0.2	1	0.1	1	0.1
Harnischia	Larvae	1	.	.	.	1	.	.	.
Helobdella elongata		.	.	1	0.1	.	.	1	0.2
Hexagenia	Larvae	3	1.6	.	.	2	0.1	.	.
Hydrolimax grisea		10	0.7	6	0.3	.	.	1	0.1
Ilyodrilus templetoni		2	.	1	.	1	.	.	.
Limnodrilus hoffmeisteri		68	11.2	77	9.3	78	7.8	54	4.9
Manayunkia speciosa		1	0.1	1	0.1	.	.	.	.
Musculium		1	0.7	.	.	.	.	.	.
Nematoda		4	0.3	1	0.1	3	0.3	2	0.2
Nematomorpha		.	.	.	.	1	0.1	.	.
Pisidium		10	1.2	12	1.4	1	0.1	.	.
Polypedilum scalaenum	Larvae	1	.	1	.	.	.	.	.
Procladius	Larvae	4	0.4	5	0.5	1	0.1	.	.
Quistadrilus multisetosus		1	.	2	0.6	.	.	1	.
Tanytarsus	Larvae	.	.	1	.	.	.	.	.
Thienemanimyia	Larvae	.	.	.	.	1	.	.	.
TOTAL		174	40.5	155	17.5	125	13.8	72	6.4

TABLE A-5 CONTINUED.

Date=02AUG and Station 9B1

Taxa	Life Stage	A		B		C		D	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Ablabesmyia	Larvae	1	.	1	0.2	.	.	.	.
Arcteonais lomondi		.	.	1	.	2	.	1	.
Bothrioneurum vejdovskyanum		9	.	7	0.2	23	0.1	.	.
Brachycerus	Larvae	.	.	.	.	.	.	2	0.5
Ceratopogonidae	Larvae	1	0.1	.	.	1	0.2	.	.
Chironomid pupae	Pupae	.	.	.	.	4	1.5	1	0.1
Chironomus decorus	Larvae	23	3.7	70	7.1	35	9.2	19	2.8
Coelotanypus	Larvae	2	0.1	2	0.9	4	0.4	.	.
Corbicula fluminea		.	.	.	.	.	.	1	.
Cryptochironomus fulvus	Larvae	29	2.6	20	2.1	33	4.2	27	2.7
Dubiraphia	Larvae	.	.	1	0.2	.	.	.	.
Gammarus fasciatus		.	.	.	.	1	0.3	7	0.7
Harnischia	Larvae	.	.	.	.	.	.	1	.
Helobdella elongata		1	0.6	8	1.0	1	0.2	1	0.3
Hexagenia	Larvae	1	5.5	.	.	.	.	.	.
Hydrolimax grisea		.	.	1	0.1	1	0.2	.	.
Ilyodrilus templetoni		1	.	.	.	4	.	.	.
Limnodrilus hoffmeisteri		75	10.8	228	8.1	201	17.6	190	10.8
Limnodrilus udekemianus		.	.	25	0.9	.	.	.	.
Musculium transversum		.	.	1	0.1	3	0.5	3	1.0
Paratanytarsus		.	.	.	.	1	.	.	.
Pisidium		14	1.7	3	0.4	8	0.9	39	4.7
Polypedilum scalaenum	Larvae	.	.	3	.	1	.	2	.
Procladius	Larvae	7	0.2	12	0.9	8	0.6	.	.
Sialis	Larvae	2	0.1	.	.	.	.	.	.
TOTAL		166	25.4	383	22.2	331	35.9	294	23.6

TABLE A-6 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, SEPTEMBER, 1989.

Date=05SEP and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	.	.	1	.	2	1.0
Actinobdella inequiannulata		.	.	.	.	1	3.4	.	.
Arcteonais lomondi		.	.	2	.	11	0.3	2	.
Aulodrilus pluriseta		.	.	5	.	.	.	1	.
Bothrioneurum vejdovskyanum		1	.	2	.	16	2.5	8	0.4
Branchiura sowerbyi		.	.	6	5.8	1	0.7	2	1.0
Caenis	Larvae	.	.	.	.	1	0.1	1	0.3
Ceratopogonidae	Larvae	4	0.7	1	0.3	7	0.9	1	0.3
Chironomid pupae	Pupae	5	1.9	2	0.4	1	0.5	2	0.9
Chironomus decorus	Larvae	229	88.4	147	36.0	217	73.2	145	37.1
Coelotanypus	Larvae	1	.	.	.	.	.	.	.
Corbicula fluminea		14	1.7	.	.	3	0.4	4	0.5
Cryptochironomus fulvus	Larvae	8	1.4	7	0.8	4	0.4	6	0.9
Dromogomphus	Larvae	.	.	1	1.0	.	.	.	.
Dubiraphia	Larvae	1	0.3	1	0.2	6	0.6	3	0.4
Gammarus fasciatus		.	.	.	.	2	0.1	.	.
Helobdella elongata		1	1.2	4	1.0	24	2.9	1	0.1
Hexagenia	Larvae	44	14.0	22	25.1	68	36.8	49	27.3
Hydrolimax grisea		.	.	.	.	2	0.2	1	0.3
Ilyodrilus templetoni		.	.	2	.	9	0.2	.	.
Leptophlebiidae	Larvae	1	0.2	.	.	.	.	.	.
Limnodrilus hoffmeisteri		74	7.9	81	4.5	123	7.1	63	6.9
Limnodrilus udekemianus		8	0.9	.	.	.	.	.	.
Macrumia sp	Larvae	.	.	.	.	1	0.1	.	.
Musculium transversum		.	.	.	.	2	0.2	.	.
Nematoda		1	0.1	2	0.2	.	.	1	0.1
Pisidium		13	1.6	2	0.2	10	1.2	20	2.4
Polypedilum convitum	Larvae	3	0.4	.	.	.	.	.	.
Polypedilum scalaenum	Larvae	.	.	.	.	1	.	.	.
Pristina synclites		.	.	2	.	5	0.2	.	.
Procladius	Larvae	23	2.5	3	.	11	2.0	12	1.9
Rheotanytarsus	Larvae	4	0.4	.	.	.	.	.	.
Stenelmis	Larvae	.	.	.	.	4	2.0	4	2.3
Stenonema	Larvae	1	0.2	.	.	.	.	.	.
Stylurus	Larvae	.	.	.	.	.	.	2	16.8
Tanytarsus	Larvae	2	0.2	.	.	1	.	.	.
Tricorythidae	Larvae	2	0.5	.	.	.	.	.	.
Tricorythodes	Larvae	.	.	.	.	.	.	1	0.3
TOTAL		440	124.5	292	75.5	532	136.0	331	101.2

TABLE A-6 CONTINUED.

Date=05SEP and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	1	.	4	0.8	2	.	2	0.5
Actinobdella inequiannulata		.	.	.	.	1	0.2	.	.
Arcteonais lomondi		20	5.5	41	1.6	15	0.7	30	0.9
Aulodrilus pluriseta		.	.	.	.	2	0.1	.	.
Bothrioneurum vejdovskyanum		.	.	1	0.1	.	.	.	.
Caenis	Larvae	.	.	1	0.3	.	.	.	.
Ceratopogonidae	Larvae	2	0.3	2	0.4	2	0.4	.	.
Chironomid pupae	Pupae	2	0.2	1	0.8	.	.	4	1.6
Chironomus decorus	Larvae	112	31.6	116	32.3	115	27.2	175	50.1
Coelotanypus	Larvae	.	.	2	.	.	.	.	.
Cryptochironomus fulvus	Larvae	8	1.6	9	1.0	8	1.4	6	1.2
Dubiraphia	Larvae	.	.	.	.	.	.	1	0.3
Gammarus fasciatus		3	0.7	7	1.0	17	4.2	5	1.5
Helobdella elongata		2	1.4	1	0.9	3	2.5	2	1.3
Hexagenia		.	.	.	.	.	.	38	21.4
Hexagenia	Larvae	29	13.5	29	11.5	49	9.3	.	.
Hydrolimax grisea		4	1.1	3	1.1	8	2.0	4	0.9
Ilyodrilus templetoni		2	.	.	.	1	.	.	.
Limnodrilus hoffmeisteri		120	18.0	128	20.8	135	16.6	332	32.1
Manayunkia speciosa		1	0.1	.	.	4	0.1	9	0.3
Musculium transversum		.	.	1	0.1	.	.	.	.
Nematoda		.	.	3	0.3	4	0.4	5	0.5
Pisidium		8	1.0	19	2.3	30	3.6	12	1.4
Polypedilum scalaenum	Larvae	1	.	.	.	2	.	1	.
Potamanthus	Larvae	.	.	.	.	.	.	1	0.3
Procladius	Larvae	25	3.3	36	6.0	22	3.8	34	6.0
Stylurus	Larvae	1	22.0	.	.	.	.	.	.
Tanytarsus	Larvae	.	.	3	.	6	0.6	.	.
TOTAL		341	100.3	407	81.3	426	73.1	661	120.3

TABLE A-6 CONTINUED.

Date=05SEP and Station 981

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	2	.	1	1.2	.	.	2	0.8
Arcteonais lomondi		15	.	22	1.8	48	1.0	10	.
Bothrioneurum vejdovskyanum		.	.	1	.	5	0.2	2	0.2
Ceratopogonidae	Larvae	7	0.8	.	.	2	0.4	3	0.3
Chironomid pupae	Pupae	5	1.6	.	.	.	.	1	0.2
Chironomus decorus	Larvae	29	4.3	2	0.4	36	21.3	13	2.0
Coelotanypus	Larvae	1	.	1	0.3	.	.	1	0.2
Cryptochironomus fulvus	Larvae	14	2.0	12	3.2	18	6.3	8	1.7
Demicryptochironomus	Larvae	.	.	.	.	2	0.2	.	.
Epoicocladius	Larvae	.	.	.	.	.	.	1	.
Gammarus fasciatus		22	5.7	5	1.8	.	.	2	2.4
Helobdella elongata		2	1.1	5	1.9	1	0.5	9	0.5
Hemerodromia	Larvae	.	.	.	.	1	0.2	.	.
Hexagenia	Larvae	28	9.1	15	15.2	5	2.6	27	17.6
Hydrolimax grisea		13	1.4	3	0.3	7	0.7	11	10.7
Ilyodrilus templetoni		.	.	1	.	1	.	.	.
Limnodrilus hoffmeisteri		159	30.1	118	22.2	298	26.5	150	21.1
Musculium transversum		3	0.4	10	1.2	2	0.2	19	2.3
Nematoda		.	.	.	.	1	0.1	1	0.1
Nematomorpha		1	0.2	1	0.2	.	.	.	.
Phaenopsectra	Larvae	3	0.3	.	.	.	.	.	.
Pisidium		39	4.7	15	1.8	8	1.0	41	4.9
Polypedilum scalaenum	Larvae	3	0.3	1	.	4	.	.	.
Procladius	Larvae	13	1.5	15	3.9	4	0.8	21	2.1
Tanytarsus	Larvae	6	0.3	1	.	1	.	3	.
Tipulidae	Pupae	.	.	.	.	1	0.6	.	.
TOTAL		365	63.8	229	55.4	445	62.6	325	67.1

TABLE A-7 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTABRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, OCTOBER, 1989.

Date=04OCT and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	.	.	.	.	4	0.4
Bothrioneurum vejdovskyanum		1	.	.	.	2	.	3	.
Branchiura sowerbyi		3	0.3	2	0.1	1	0.2	4	1.5
Caenis	Larvae	2	0.2	.	.	.	.	2	0.1
Ceratopogonidae	Larvae	1	0.1	1	0.2	.	.	2	0.1
Chironomid pupae	Pupae	.	.	.	.	1	0.1	.	.
Chironomus decorus	Larvae	24	0.7	14	0.2	16	0.3	12	0.2
Chrysops	Larvae	.	.	1	0.1	.	.	.	.
Corbicula fluminea		27	12.7	50	19.0	26	4.4	23	9.6
Cryptochironomus fulvus	Larvae	2	0.2	10	0.8	1	.	2	.
Dubiraphia	Larvae	.	.	1	0.2	3	0.1	.	.
Gammarus fasciatus		2	0.3	1	0.1	.	.	3	0.2
Helobdella elongata		.	.	.	.	.	.	5	0.8
Hexagenia	Larvae	34	101.8	25	44.6	26	37.6	32	76.9
Hydrolimax grisea		.	.	1	0.3	.	.	2	0.2
Limnodrilus hoffmeisteri		57	1.9	53	3.2	45	2.1	76	15.4
Musculium transversum		10	1.9	.	.	.	.	.	.
Pisidium		20	2.4	13	1.6	29	3.5	35	4.2
Procladius	Larvae	17	0.2	14	0.2	6	0.3	11	0.2
Stenelmis	Larvae	1	0.1	.	.	1	0.1	.	.
Stylurus	Larvae	.	.	1	5.2	.	.	.	.
TOTAL		201	122.8	187	75.8	157	48.7	216	109.8

TABLE A-7 CONTINUED.

Date=04OCT and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	5	1.5	5	1.5	9	1.8	6	0.8
Amnicola		.	.	1	0.2	.	.	.	.
Ceratopogonidae	Larvae	.	.	.	.	1	0.1	1	0.1
Chironomid pupae	Larvae	4	0.4	.	.	.	.	.	.
Chironomid pupae	Pupae	.	.	1	0.1	4	0.2	2	0.2
Chironomus decorus	Larvae	25	1.6	86	6.5	135	15.9	89	9.4
Coelotanypus	Larvae	.	.	4	0.8	3	.	.	.
Cryptochironomus fulvus	Larvae	8	0.8	12	0.1	21	2.7	17	3.2
Cryptotendipes	Larvae	2	0.2	.	.	.	.	.	.
Dubiraphia	Larvae	.	.	.	.	.	.	1	0.2
Dugesia		.	.	.	.	1	0.5	.	.
Elimia virginica		.	.	.	.	1	0.2	.	.
Erpobdellidae		1	1.3	.	.	.	.	.	.
Gammarus fasciatus		8	2.7	1	0.2	.	.	1	1.1
Helobdella elongata		1	0.9	2	2.0	4	3.5	14	5.6
Hexagenia	Larvae	17	37.0	25	40.3	26	57.9	15	24.0
Hydrolimax grisea		9	1.5	4	0.6	11	2.1	7	2.2
Limnodrilus hoffmeisteri		40	10.7	38	9.8	17	18.7	71	14.7
Manayunkia speciosa		.	.	.	.	1	0.1	1	0.1
Musculium transversum		2	0.2	.	.	.	.	11	6.4
Nematoda		.	.	.	.	2	0.2	5	0.6
Oecetis	Larvae	1	0.1	.	.	.	.	.	.
Physa		.	.	1	0.9	.	.	.	.
Pisidium		61	7.3	174	20.1	122	14.6	70	8.4
Procladius	Larvae	18	1.1	20	1.0	16	3.2	13	1.7
Tanytarsus	Larvae	3	0.3	16	1.0	3	.	4	.
TOTAL		205	67.6	390	85.1	377	121.7	328	78.7

TABLE A-7 CONTINUED.

Date=04OCT and Station 981

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	1	.	.	.	.	.	2	0.1
Arcteonais lomondi		.	.	1	.	6	.	53	1.1
Bothrioneurum vejdovskyanum		.	.	2	.	3	.	.	.
Centroptilum	Larvae	.	.	.	.	.	.	2	0.4
Ceratopogonidae	Larvae	.	.	.	.	.	.	4	0.4
Chironomid pupae	Pupae	.	.	.	.	2	0.1	3	0.3
Chironomus decorus	Larvae	15	3.9	9	1.8	9	2.0	78	15.4
Coelotanypus	Larvae	.	.	4	1.4	4	0.5	3	0.8
Cryptochironomus fulvus	Larvae	3	.	4	0.2	6	0.6	9	0.4
Dubiraphia	Larvae	.	.	.	.	1	0.1	.	.
Gammarus fasciatus		1	2.4	.	.	2	0.2	5	1.4
Harnischia	Larvae	1	.	.	.	.	.	.	.
Helobdella elongata		1	0.3	1	0.1	1	0.1	.	.
Hexagenia	Larvae	48	65.7	37	32.0	40	32.3	22	27.9
Hydrolimax grisea		1	0.3	3	0.3	13	1.2	32	4.4
Ilyodrilus templetoni		.	.	.	.	2	.	19	0.6
Limnodrilus hoffmeisteri		70	9.0	109	9.0	169	29.6	415	45.9
Lumbriculidae		.	.	1	.	2	.	.	.
Musculium transversum		1	1.2	1	0.6	5	0.6	1	0.2
Nematoda	Larvae	.	.	.	.	2	0.1	.	.
Oecetis	Larvae	.	.	1	0.3	1	0.1	.	.
Pisidium		24	2.9	10	1.2	24	2.9	52	6.2
Polypedilum scalaenum	Larvae	.	.	.	.	2	.	.	.
Procladius	Larvae	3	0.4	7	1.2	11	0.9	4	0.1
Tanytarsus	Larvae	1	.	2	.	6	0.6	3	.
Tubificidae		.	.	.	.	.	.	1	.
TOTAL		170	86.1	192	48.1	311	71.9	708	105.6

TABLE A-8 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, NOVEMBER, 1989.

Date=06NOV and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	2	.	1	.	.	.	5	1.0
Arcteonais lomondi		2	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		7	.	4	0.1	7	0.1	4	0.1
Branchiura sowerbyi		7	8.0	2	0.1	3	4.5	.	.
Ceratopogonidae	Larvae	3	0.1	2	0.1	2	0.1	3	0.4
Chironomus decorus	Larvae	211	307.2	150	57.9	239	71.4	39	24.1
Corbicula fluminea		10	13.1	9	6.6	19	3.7	6	1.3
Cryptochironomus fulvus	Larvae	14	0.4	4	0.2	5	0.7	1	0.3
Dolichopodidae	Larvae	.	.	.	.	1	0.3	.	.
Dubiraphia	Larvae	2	0.1	4	0.1	4	0.7	2	0.1
Dugesia tigrina		4	0.2	.	.	.	.	.	.
Ferrissia		.	.	.	.	3	0.7	.	.
Gammarus fasciatus		28	20.9	8	5.5	1	0.1	2	1.4
Helobdella elongata		1	0.1	.	.	2	0.1	.	.
Hexagenia	Larvae	36	227.2	16	103.5	3	1.0	30	136.6
Hydrolimax grisea		4	1.2	.	.	.	.	.	.
Hydropsyche	Larvae	.	.	.	.	2	0.9	.	.
Ilyodrilus templetoni		4	.	7	.	7	.	1	.
Lepidostoma	Larvae	1	0.1	.	.	.	.	.	.
Limnodrilus claparedianus		.	.	20	3.1	.	.	.	.
Limnodrilus hoffmeisteri		60	10.7	30	4.6	45	9.4	29	7.8
Limnodrilus udekemianus		8	1.3	.	.	.	.	3	0.9
Lumbriculidae		1	0.1	.	.	.	.	.	.
Macrumia sp	Larvae	.	.	.	.	1	4.9	.	.
Musculium transversum		7	2.8	3	0.4	.	.	2	0.9
Nais		.	.	1	.	.	.	.	.
Nematoda		3	0.3	3	0.2	1	0.1	2	0.2
Petrophila	Larvae	.	.	.	.	1	0.1	.	.
Physa		1	0.1	.	.	.	.	.	.
Pisidium		72	8.6	20	2.4	15	1.8	7	0.8
Polypedilum scalaenum	Larvae	1	.	.	.	.	.	.	.
Pristina synclites		3	.	3	.	.	.	.	.
Procladius	Larvae	13	0.2	3	0.1	29	2.4	3	0.4
Prodiamesa	Larvae	10	14.6	.	.	.	.	.	.
Prostoma		3	0.1	1	0.1	.	.	.	.
Protoptila	Larvae	.	.	.	.	1	0.1	.	.
Stenelmis		1	.	.	.	.	.	.	.
Stenelmis	Larvae	5	1.7	.	.	.	.	2	1.4
Stylurus	Larvae	1	0.6	.	.	.	.	.	.
Zavrelimyia	Larvae	.	.	.	.	1	.	.	.
Tanytarsus	Larvae	.	.	1	.	.	.	.	.
TOTAL		525	619.7	293	185.0	392	103.1	141	177.7

TABLE A-8 CONTINUED

Date=06NOV and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	17	4.2	12	2.9	13	3.8	10	1.1
Actinobdella inequiannulata		.	.	1	2.3	.	.	.	.
Arcteonais lomondi		.	.	2	.	16	0.8	2	.
Bothrioneurum vejdovskyanum		.	.	.	.	.	.	1	.
Ceratopogonidae	Larvae	4	0.8	4	0.9	6	0.2	6	0.1
Chironomus decorus	Larvae	146	59.8	104	47.8	33	15.3	48	20.8
Coelotanypus	Larvae	3	.	1	0.3	5	0.1	3	0.1
Corbicula fluminea		.	.	1	0.2	.	.	.	.
Cryptochironomus fulvus	Larvae	14	1.2	18	2.4	11	0.9	15	0.2
Demicryptochironomus	Larvae	2	0.2	.	.	.	.	.	.
Dubiraphia	Larvae	.	.	.	.	.	.	1	0.1
Elimia virginica		1	3.4	.	.	.	.	.	.
Ferrissia		1	0.2	.	.	.	.	.	.
Gammarus fasciatus		23	5.6	6	0.5	32	8.1	25	8.3
Helobdella elongata		4	1.4	2	0.7	4	2.8	6	0.5
Hexagenia	Larvae	39	133.6	24	74.4	32	184.0	23	3.6
Hydrolimax grisea		2	0.3	.	.	10	2.8	2	0.1
Ilyodrilus templetoni		.	.	1	.	1	.	.	.
Limnodrilus hoffmeisteri		29	5.3	22	5.2	48	5.2	57	2.1
Manayunkia speciosa		.	.	2	0.1	8	0.2	12	0.2
Musculium transversum		19	2.3	6	0.7	19	2.9	18	21.6
Nematoda		.	.	1	0.1	1	0.1	2	0.2
Pisidium		49	5.9	35	4.2	78	8.6	83	10.0
Polypedilum scalaenum	Larvae	.	.	.	.	.	.	1	.
Procladius	Larvae	32	2.9	29	2.4	83	7.8	66	6.6
Stylurus	Larvae	.	.	.	.	.	.	1	0.4
Tanytarsus	Larvae	1	.	.	.	1	0.2	1	.
TOTAL		386	227.1	271	145.1	401	243.8	383	76.0

TABLE A-8 CONTINUED.

Date=06NOV and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	8	3.0	.	.	11	3.5	.	.
Anodonta cataracta		.	.	.	.	1	9.9	.	.
Arcteonais lomondi		7	0.1	1	.	4	.	4	0.2
Bothrioneurum vejdovskyanum		2	0.2	.	.	1	.	.	.
Ceratopogonidae	Larvae	2	0.1	1	0.1	10	1.9	5	0.6
Chaoborus	Larvae	.	.	1	0.1	.	.	.	.
Chironomus decorus	Larvae	32	16.4	27	6.3	79	35.9	38	11.4
Coelotanypus	Larvae	1	.	3	0.4	3	0.2	12	1.8
Cryptochironomus fulvus	Larvae	13	1.1	10	0.6	12	1.6	18	0.8
Dubiraphia	Larvae	1	0.1	1	0.1	1	0.2	.	.
Epoicocladius	Larvae	2	0.8	.	.	.	.	2	0.1
Gammarus fasciatus		10	5.3	1	0.5	2	1.5	1	0.3
Glyptotendipes	Larvae	.	.	.	.	.	.	4	1.3
Helobdella elongata		5	1.0	4	1.8	2	1.9	.	.
Hexagenia	Larvae	55	121.7	58	64.1	67	125.6	94	128.3
Hydrolimax grisea		4	0.2	3	0.2	37	5.9	.	.
Ilyodrilus templetoni		.	.	.	.	4	.	.	.
Limnodrilus hoffmeisteri		119	14.2	88	8.3	118	26.1	74	15.0
Manayunkia speciosa		.	.	.	.	.	.	1	0.1
Musculium transversum		26	4.1	42	6.4	17	3.6	8	1.0
Nematoda		2	0.2	.	.	.	.	1	0.1
Oecetis	Larvae	.	.	1	0.1	.	.	1	0.1
Pisidium		45	5.4	7	0.8	34	4.1	31	3.7
Polycentropus sp	Larvae	1	0.1	.	.	.	.	.	.
Polypedilum scalaenum	Larvae	1	.	.	.	.	.	.	.
Procladius	Larvae	36	2.9	20	2.1	35	3.5	49	0.1
Sialis	Larvae	1	3.9	1	3.6	.	.	.	.
TOTAL		373	180.8	269	95.5	438	225.4	343	164.9

APPENDIX B

ICHTHYOPLANKTON DATA

TABLE B-1 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 06 APRIL 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	27.30		26.70		29.00		28.40		25.60		25.70		28.00		27.60	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-1 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.00		28.80		20.10		20.10		25.20		24.70		29.00		28.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-2 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 11 APRIL 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	28.60		28.10		33.00		32.60		30.80		30.40		32.10		31.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-2 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.70		32.70		30.80		30.10		32.00		31.90		27.30		27.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-3 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 17 APRIL 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.30		28.90		29.30		29.70		26.70		25.60		27.10		26.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Young Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Egg Unidentified (eggs)	2	6.83	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	2	6.83	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-3 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.20		29.80		29.90		29.20		29.80		29.10		31.10		30.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Young Spotfin shiner	.	.	.	.	.	.	.	.	.	.	1	3.44	.	.	.	.
Egg Unidentified (eggs)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	3.44	0	0.00	0	0.00

TABLE B-4 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 24 APRIL 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.50		29.70		28.40		27.90		30.20		29.50		25.90		25.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-4 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.30		29.60		28.80		28.20		28.60		27.60		30.60		29.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Total	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

TABLE B-5 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 03 MAY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.10		31.20		27.40		26.50		32.60		31.90		27.40		26.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spottail shiner	.	.	.	.	.	.	.	.	1	3.07	1	3.13	.	.	.	.
Quillback	1	3.12	1	3.21	.	.	1	3.77	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	1	3.65	.	.	1	3.07	1	3.13	.	.	.	.
Shield darter	.	.	4	12.82	.	.	.	.	.	.	.	.	.	.	1	3.77
Banded darter	3	9.35	1	3.21	1	3.65	.	.	.	.	.	.	.	.	.	.
Egg																
Unidentified (eggs)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	4	12.46	6	19.23	2	7.30	1	3.77	2	6.13	2	6.27	0	0.00	1	3.77

TABLE B-5 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	33.00		31.80		28.80		28.60		29.80		29.00		31.10		29.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	1	3.03	.	.	.	.	.	.	.	.	.	.	1	3.22	3	10.03
Tessellated darter	.	.	.	.	.	.	1	3.50	.	.	.	.	3	9.65	2	6.69
Shield darter	.	.	.	.	.	.	1	3.50	.	.	.	.	1	3.22	.	.
Banded darter	.	.	.	.	.	.	1	3.50	.	.	.	.	.	.	.	.
Egg																
Unidentified (eggs)	.	.	1	3.14	.	.	.	.	.	.	.	.	.	.	.	.
Total	1	3.03	1	3.14	0	0.00	3	10.49	0	0.00	0	0.00	5	16.08	5	16.72

TABLE B-6 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 22 MAY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	25.00		24.50		30.00		29.20		30.20		28.90		29.00		28.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	1	3.31	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	1	3.31	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	1	3.46	.	.	.	.
Larvae																
Spottail shiner	.	.	.	.	1	3.33	.	.	.	.	.	.	.	.	.	.
Quillback	2	8.00	.	.	2	6.67	1	3.42	5	16.56	2	6.92	3	10.34	2	7.12
Tessellated darter	3	12.00	4	16.33	.	.	2	6.85	2	6.62	2	6.92	.	.	.	.
Yellow perch	.	.	.	.	.	.	.	.	.	.	1	3.46	.	.	.	.
Shield darter	.	.	1	4.08	1	3.33	1	3.42	.	.	.	.	.	.	.	.
Banded darter	2	8.00	1	4.08	3	10.00	4	13.70	1	3.31	4	13.84	.	.	.	.
Unidentifiable fish	.	.	.	.	1	3.33	.	.	.	.	.	.	.	.	.	.
Total	7	28.00	6	24.49	8	26.67	8	27.40	10	33.11	10	34.60	3	10.34	2	7.12

TABLE B-6 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.00		30.20		28.30		28.00		29.80		29.00		30.10		28.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.
Banded darter	.	.	.	.	.	.	1	3.57	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	2	6.64	.	.
Quillback	2	6.45	8	26.49	2	7.07	6	21.43	1	3.36	1	3.45	5	16.61	9	31.14
Tessellated darter	3	9.68	2	6.62	1	3.53	1	3.57	3	10.07	7	24.14	2	6.64	1	3.46
Yellow perch	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shield darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	2	6.45	1	3.31	22	77.74	29	103.6	.	.	5	17.24	1	3.32	1	3.46
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	7	22.58	11	36.42	25	88.34	37	132.1	4	13.42	13	44.83	12	39.87	11	38.06

TABLE B-7 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 29 MAY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.80		28.80		30.30		29.20		32.60		30.90		29.10		28.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	1	3.36	.	.	1	3.30	3	10.27	1	3.07	.	.	.	.	1	3.47
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spottail shiner	1	3.36	1	3.47	.	.	1	3.42	2	6.13	1	3.24	9	30.93	4	13.89
Quillback	29	97.32	19	65.97	26	85.81	31	106.2	18	55.21	22	71.20	11	37.80	15	52.08
White sucker	1	3.36	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	5	16.78	10	34.72	1	3.30	.	.	4	12.27	2	6.47	.	.	.	.
Shield darter	2	6.71	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	3	10.07	1	3.47	.	.	.	.	.	.	.	.	.	.	.	.
Total	42	140.9	31	107.6	28	92.41	35	119.9	25	76.69	25	80.91	20	68.73	20	69.44

TABLE B-7 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.50		30.80		30.40		29.20		31.20		30.00		32.40		30.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	3	9.52	2	6.49	.	.	.	.	2	6.41	1	3.33	2	6.17	3	9.77
Larvae																
Gizzard shad	.	.	.	.	2	6.58	.	.	.	.	.	.	.	.	.	.
Spottail shiner	3	9.52	5	16.23	5	16.45	2	6.85	1	3.21	2	6.67	2	6.17	3	9.77
Quillback	63	200.0	47	152.6	32	105.3	18	61.64	23	73.72	21	70.00	72	222.2	54	175.9
White sucker	1	3.17	.	.	.	.	3	10.27	.	.	.	.	.	.	.	.
Tessellated darter	.	.	1	3.25	5	16.45	5	17.12	18	57.69	6	20.00	14	43.21	13	42.35
Shield darter	.	.	.	.	.	.	.	.	2	6.41	1	3.33	.	.	.	.
Banded darter	.	.	.	.	1	3.29	1	3.42	.	.	1	3.33	.	.	.	.
Total	70	222.2	55	178.6	45	148.0	29	99.32	46	147.4	32	106.7	90	277.8	73	237.8

TABLE B-8 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 06 JUNE 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.30		29.20		29.40		28.50		30.00		29.40		30.00		28.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	598	2034	588	2063	179	596.7	164	557.8	498	1660	476	1647
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.46
Quillback	2	6.60	.	.	.	.	.	.	1	3.33	.	.	.	.	1	3.46
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.46
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	3	10.20	.	.	.	.	3	10.20	2	6.67	3	10.38
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	1	3.33	1	3.40	.	.	.	.
Common carp	20	66.01	12	41.10	100	340.1	100	350.9	100	333.3	100	340.1	100	333.3	100	346.0
Comely shiner	1	3.30	.	.	2	6.80	1	3.51	.	.	.	.	.	.	.	.
Spottail shiner	1	3.30	2	6.85	10	34.01	22	77.19	20	66.67	19	64.63	6	20.00	6	20.76
Spotfin shiner	.	.	.	.	2	6.80	.	.	.	.	.	.	.	.	.	.
Bluntnose minnow	.	.	.	.	.	.	1	3.51	.	.	.	.	.	.	.	.
Creek chub	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	1	3.40	3	10.53	.	.	.	.	.	.	.	.
Quillback	16	52.81	24	82.19	66	224.5	43	150.9	37	123.3	33	112.2	4	13.33	5	17.30
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.46
Shorthead redhorse	2	6.60	1	3.42	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	1	3.30	4	13.70	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	35	116.7	18	62.28
Tessellated darter	2	6.60	2	6.85	3	10.20	1	3.51	4	13.33	2	6.80	.	.	1	3.46
Shield darter	.	.	.	.	.	.	2	7.02	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	5	17.01	1	3.51	6	20.00	6	20.41	.	.	.	.
Total	45	148.5	45	154.1	790	2687	762	2674	348	1160	328	1116	645	2150	613	2121

TABLE B-8 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.10		29.20		29.70		28.70		29.70		28.50		31.80		30.60	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	169	561.5	119	407.5	.	.	.	.	1	3.37	3	10.53	153	481.1	155	506.5
Spottail shiner	2	6.64	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	2	6.85	1	3.37	3	10.45	2	6.73	.	.	3	9.43	2	6.54
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6.54
Unidentifiable fish	.	.	2	6.85	3	10.10	3	10.45	2	6.73	.	.	2	6.29	2	6.54
Larvae																
Gizzard shad	1	3.32	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	100	332.2	100	342.5	15	50.51	16	55.75	24	80.81	34	119.3	100	314.5	100	326.8
Comely shiner	.	.	3	10.27	1	3.37	1	3.48	2	6.73	.	.	1	3.14	1	3.27
Spottail shiner	21	69.77	17	58.22	17	57.24	22	76.66	14	47.14	17	59.65	14	44.03	20	65.36
Spotfin shiner	.	.	.	.	1	3.37	2	6.97	.	.	.	.	.	.	.	.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	2	6.29	.	.
Creek chub	.	.	.	.	.	.	.	.	1	3.37	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	3	10.45	.	.	1	3.51	.	.	.	.
Quillback	20	66.45	12	41.10	44	148.1	50	174.2	26	87.54	21	73.68	62	195.0	60	196.1
White sucker	.	.	.	.	.	.	.	.	1	3.37	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	.	.	.	.	4	13.47	1	3.48	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	5	16.61	6	20.55	3	10.10	4	13.94	24	80.81	17	59.65	35	110.1	22	71.90
Shield darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	6	19.93	3	10.27	.	.	1	3.48	.	.	1	3.51	.	.	1	3.27
Total	324	1076	264	904.1	89	299.7	106	369.3	97	326.6	94	329.8	372	1170	365	1193

TABLE B-9 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 12 JUNE 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.70		29.90		29.90		28.60		30.60		29.20		27.90		26.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	1	3.34	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	2	6.99	1	3.27	2	6.85	1	3.58	3	11.15
Larvae																
Gizzard shad	.	.	.	.	4	13.38	.	.	.	.	2	6.85	.	.	.	.
Common carp	.	.	.	.	.	.	1	3.50	1	3.27	.	.	1	3.58	1	3.72
Comely shiner	.	.	.	.	.	.	.	.	.	.	1	3.42	.	.	.	.
Spottail shiner	2	6.51	.	.	2	6.69	.	.	3	9.80	4	13.70	.	.	.	.
Swallowtail shiner	.	.	1	3.34	.	.	.	.	.	.	1	3.42	.	.	.	.
Spotfin shiner	.	.	1	3.34	.	.	1	3.50	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	9	29.32	6	20.07	6	20.07	9	31.47	13	42.48	5	17.12	2	7.17	2	7.43
Northern hog sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	7.43
Shorthead redhorse	.	.	.	.	.	.	.	.	1	3.27	.	.	.	.	1	3.72
Rock bass	3	9.77	2	6.69	.	.	1	3.50	.	.	.	.	.	.	1	3.72
Smallmouth bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.72
Sunfishes	.	.	.	.	5	16.72	5	17.48	6	19.61	3	10.27	3	10.75	4	14.87
Tessellated darter	3	9.77	1	3.34	.	.	.	.	3	9.80	.	.	.	.	1	3.72
Banded darter	12	39.09	13	43.48	4	13.38	4	13.99	2	6.54	6	20.55	.	.	.	.
Total	29	94.46	24	80.27	22	73.58	23	80.42	30	98.04	24	82.19	7	25.09	16	59.48

TABLE B-9 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.00		30.40		30.60		29.40		27.80		27.10		30.10		28.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Bluntnose minnow	.	.	.	.	.	.	1	3.40	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	1	3.27	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	2	6.58	.	.	.	.	.	.	.	.	.	.	2	6.97
Larvae																
Gizzard shad	1	3.12	2	6.58	.	.	.	.	.	.	.	.	.	.	1	3.48
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.
Comely shiner	.	.	.	.	.	.	.	.	1	3.60	.	.	.	.	.	.
Spottail shiner	1	3.12	3	9.87	3	9.80	4	13.61	1	3.60	.	.	.	.	.	.
Swallowtail shiner	2	6.25	.	.	2	6.54	1	3.40	.	.	.	.	2	6.64	1	3.48
Spotfin shiner	.	.	.	.	.	.	2	6.80	.	.	.	.	.	.	.	.
Mimic shiner	.	.	1	3.29	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	15	46.88	14	46.05	2	6.54	.	.	4	14.39	6	22.14	18	59.80	11	38.33
Northern hog sucker	.	.	1	3.29	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	1	3.12	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	.	.	2	6.58	6	19.61	5	17.01	1	3.60	.	.	.	.	1	3.48
Smallmouth bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	2	6.58	58	189.5	61	207.5	.	.	.	.	.	.	2	6.97
Tessellated darter	2	6.25	5	16.45	.	.	.	.	.	.	3	11.07	18	59.80	23	80.14
Banded darter	3	9.38	3	9.87	.	.	.	.	1	3.60	4	14.76	.	.	1	3.48
Total	25	78.12	35	115.1	72	235.3	74	251.7	8	28.78	13	47.97	39	129.6	42	146.3

TABLE B-10 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 21 JUNE 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.00		28.50		31.30		29.60		30.40		28.20		31.90		30.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Banded darter	.	.	.	.	.	.	1	3.38	.	.	.	.	1	3.13	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Golden shiner	.	.	.	.	.	.	.	.	.	.	1	3.55	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	3	10.53	1	3.19	.	.	2	6.58	5	17.73	.	.	2	6.47
Shorthead redhorse	1	3.33	.	.	.	.	.	.	1	3.29	.	.	.	.	.	.
Rock bass	.	.	1	3.51	.	.	.	.	.	.	.	.	.	.	.	.
Smallmouth bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	1	3.33	.	.	.	.	.	.	1	3.29	.	.	1	3.13	.	.
Banded darter	.	.	.	.	3	9.58	5	16.89	9	29.61	8	28.37	2	6.27	2	6.47
Young																
Channel catfish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	2	6.67	4	14.04	4	12.78	6	20.27	13	42.76	14	49.65	4	12.54	4	12.94

TABLE B-10 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.30		28.90		23.70		23.20		28.60		27.00		27.60		25.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	1	3.46	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Common carp	.	.	.	.	1	4.22	2	8.62	.	.	.	.	.	.	.	.
Golden shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spottail shiner	.	.	.	.	.	.	1	4.31	.	.	.	.	.	.	1	3.89
Swallowtail shiner	.	.	.	.	.	.	1	4.31	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	1	4.22	1	4.31	.	.	1	3.70	.	.	.	.
Quillback	1	3.30	1	3.46	.	.	.	.	1	3.50	6	22.22	.	.	1	3.89
Shorthead redhorse	.	.	1	3.46	.	.	1	4.31	1	3.50	.	.	.	.	.	.
Rock bass	.	.	.	.	9	37.97	6	25.86	1	3.50	.	.	.	.	.	.
Smallmouth bass	.	.	.	.	.	.	1	4.31	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	1	4.31	.	.	.	.	.	.	.	.
Tessellated darter	1	3.30	.	.	.	.	.	.	.	.	.	.	1	3.62	.	.
Banded darter	2	6.60	1	3.46	2	8.44	3	12.93	.	.	.	.	.	.	4	15.56
Young																
Channel catfish	1	3.30	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	5	16.50	4	13.84	13	54.85	17	73.28	3	10.49	7	25.93	1	3.62	6	23.35

TABLE B-11 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 27-28 JUNE 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.70		30.00		30.00		29.00		32.50		29.90		29.70		28.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	.	.	.	.	.	.	.	.	.	.	1	3.34	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	1	3.15	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentified (eggs)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	1	3.33	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	1	3.15	.	.	.	.	.	.	1	3.08	1	3.34	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Yellow bullhead	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	1	3.08	.	.	.	.	.	.
Banded darter	.	.	1	3.33	.	.	1	3.45	2	6.15	1	3.34	.	.	.	.
Young																
Channel catfish	.	.	1	3.33	.	.	.	.	.	.	.	.	.	.	.	.
Total	2	6.31	3	10.00	0	0.00	1	3.45	4	12.31	3	10.03	0	0.00	0	0.00

TABLE B-11 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	28.30		27.70		30.90		29.30		30.60		28.60		31.90		30.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	1	3.27	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.31
Unidentified (eggs)	.	.	.	.	.	.	1	3.41	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	1	3.41	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	1	3.41	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	1	3.50	.	.	.	.
Quillback	1	3.53	.	.	3	9.71	1	3.41	.	.	.	.	1	3.13	1	3.31
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.31
Yellow bullhead	.	.	.	.	1	3.24	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	1	3.61	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	3	9.71	3	10.24	1	3.27	.	.	2	6.27	.	.
Young																
Channel catfish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	1	3.53	1	3.61	7	22.65	7	23.89	2	6.54	1	3.50	3	9.40	3	9.93

TABLE B-12 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 06 JULY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.40		27.60		30.90		28.90		31.10		29.10		30.10		28.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Banded darter	.	.	1	3.62	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Common carp	.	.	.	.	1	3.24	.	.	.	.	.	.	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	1	3.44	.	.	.	.
Spotfin shiner	.	.	2	7.25	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	1	3.44	.	.	.	.
Quillback	1	3.40	1	3.62	1	3.24	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.52
Tessellated darter	1	3.40	1	3.62	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	1	3.40	2	7.25	1	3.24	.	.	.	.	.	.	.	.	.	.
Young																
Channel catfish	1	3.40	.	.	.	.	1	3.46	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Egg																
Unidentified (eggs)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	4	13.61	7	25.36	3	9.71	1	3.46	0	0.00	2	6.87	0	0.00	1	3.52

TABLE B-12 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.60		28.10		27.80		26.20		25.50		23.50		28.80		26.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Banded darter	.	.	.	.	.	.	1	3.82	.	.	.	.	.	.	.	.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	1	3.47	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	1	3.38	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	1	3.92	.	.	.	.	1	3.73
Quillback	.	.	1	3.56	1	3.60	1	3.82	.	.	.	.	1	3.47	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	1	3.60	.	.	.	.	.	.	.	.	.	.
Banded darter	2	6.76	1	3.56	.	.	2	7.63	2	7.84	1	4.26	1	3.47	1	3.73
Young																
Channel catfish	1	3.38	.	.	.	.	.	.	.	.	.	.	2	6.94	.	.
Tessellated darter	.	.	.	.	.	.	1	3.82	.	.	.	.	.	.	.	.
Egg																
Unidentified (eggs)	.	.	.	.	1	3.60	.	.	.	.	.	.	.	.	.	.
Total	4	13.51	2	7.12	3	10.79	5	19.08	3	11.76	1	4.26	5	17.36	2	7.46

TABLE B-13 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 10 JULY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.20		28.10		30.80		29.20		30.60		29.10		27.90		27.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	1	3.58	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	2	6.85	.	.	1	3.44	.	.	.	.
Common carp	1	3.42	.	.	16	51.95	12	41.10	11	35.95	8	27.49	1	3.58	3	11.07
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	7	23.97	11	39.15	2	6.49	1	3.42	2	6.54	8	27.49	.	.	1	3.69
Mimic shiner	.	.	.	.	.	.	1	3.42	.	.	2	6.87	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	1	3.58	.	.
Tessellated darter	1	3.42	2	7.12	2	6.49	.	.	.	.	1	3.44	.	.	.	.
Banded darter	2	6.85	1	3.56	2	6.49	.	.	.	.	1	3.44	.	.	1	3.69
Young																
Yellow bullhead	.	.	.	.	.	.	.	.	1	3.27	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	.	.	.	.	1	3.44	.	.	.	.
Total	11	37.67	14	49.82	22	71.43	16	54.79	14	45.75	22	75.60	3	10.75	5	18.45

TABLE B-13 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.60		29.50		28.40		27.00		27.70		26.20		32.00		30.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.30
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	5	16.34	2	6.78	1	3.52	.	.	.	.	.	.	3	9.38	1	3.30
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.12	.	.
Spotfin shiner	6	19.61	10	33.90	1	3.52	3	11.11	10	36.10	9	34.35	3	9.38	7	23.10
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	1	3.70	.	.	.	.	1	3.12	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	1	3.82	.	.	.	.
Tessellated darter	.	.	1	3.39	.	.	.	.	.	.	.	.	1	3.12	.	.
Banded darter	2	6.54	2	6.78	3	10.56	.	.	2	7.22	3	11.45	3	9.38	6	19.80
Young																
Yellow bullhead	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	2	6.54	2	6.78	.	.	.	.	.	.	1	3.82	1	3.12	4	13.20
Total	15	49.02	17	57.63	5	17.61	4	14.81	12	43.32	14	53.44	13	40.63	19	62.71

TABLE B-14 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 17 JULY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	27.40		26.10		27.10		26.40		29.50		28.40		28.90		28.00	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	2	7.38	.	.	2	6.78	4	14.08	1	3.46	1	3.57
Mimic shiner	.	.	.	.	1	3.69	2	7.58	6	20.34	8	28.17	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	1	3.46	.	.
Redbreast sunfish	3	10.95	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Largemouth bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	1	3.65	.	.	.	.	.	.	2	6.78	.	.	1	3.46	.	.
Crappies	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	1	3.79	4	13.56	2	7.04	.	.	1	3.57
Young																
Channel catfish	16	58.39	16	61.30	29	107.0	43	162.9	28	94.92	27	95.07	14	48.44	17	60.71
Total	20	72.99	16	61.30	32	118.1	46	174.2	42	142.4	41	144.4	17	58.82	19	67.86

TABLE B-14 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.70		28.60		25.30		24.90		33.70		32.20		28.70		27.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	1	3.95	.	.	.	.	.	.	.	.	2	7.19
Comely shiner	.	.	1	3.50	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	1	3.50	.	.	.	.	2	5.93	.	.	2	6.97	4	14.39
Mimic shiner	.	.	1	3.50	.	.	.	.	.	.	.	.	2	6.97	1	3.60
Rock bass	.	.	.	.	.	.	1	4.02	.	.	.	.	1	3.48	.	.
Redbreast sunfish	.	.	.	.	.	.	1	4.02	.	.	1	3.11	.	.	.	.
Largemouth bass	.	.	.	.	.	.	1	4.02	.	.	.	.	.	.	.	.
Sunfishes	.	.	1	3.50	.	.	.	.	1	2.97	4	12.42	.	.	.	.
Crappies	.	.	.	.	2	7.91	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.60
Banded darter	.	.	.	.	.	.	.	.	1	2.97	1	3.11	2	6.97	1	3.60
Young																
Channel catfish	28	94.28	38	132.9	15	59.29	17	68.27	20	59.35	29	90.06	42	146.3	43	154.7
Total	28	94.28	42	146.9	18	71.15	20	80.32	24	71.22	35	108.7	49	170.7	52	187.1

TABLE B-15 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 24 JULY 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.00		29.80		28.80		27.90		30.10		28.80		28.00		27.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spotfin shiner	.	.	.	.	.	.	4	14.34	.	.	3	10.42	.	.	.	.
Bluntnose minnow	.	.	.	.	2	6.94	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	3	10.42	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	1	3.58	.	.	1	3.47	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Yellow bullhead	.	.	.	.	.	.	.	.	1	3.32	.	.	.	.	.	.
Channel catfish	12	38.71	9	30.20	22	76.39	7	25.09	24	79.73	17	59.03	7	25.00	7	25.83
Total	12	38.71	9	30.20	24	83.33	12	43.01	25	83.06	24	83.33	7	25.00	7	25.83

TABLE B-15 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.20		29.60		30.50		29.20		30.40		28.80		29.80		29.00	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spotfin shiner	2	6.62	.	.	.	.	.	.	.	.	.	.	6	20.13	.	.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.45
Rock bass	.	.	.	.	.	.	2	6.85	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	1	3.36	.	.
Banded darter	1	3.31	1	3.38	1	3.28	1	3.42	.	.	.	.	.	.	1	3.45
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	1	3.36	.	.
Young																
Yellow bullhead	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	1	3.31	1	3.38	2	6.56	2	6.85	10	32.89	6	20.83	2	6.71	2	6.90
Total	4	13.25	2	6.76	3	9.84	5	17.12	10	32.89	6	20.83	10	33.56	4	13.79

TABLE B-16 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 01 AUGUST 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.60		29.60		29.80		28.80		30.90		29.90		29.30		28.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Gizzard shad	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.52
Comely shiner	1	3.27	1	3.38	.	.	1	3.47	.	.	.	.	.	.	.	.
Spotfin shiner	2	6.54	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bluntnose minnow	5	16.34	3	10.14	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	1	3.38	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	1	3.47	.	.	.	.	5	17.06	11	38.73
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	1	3.27	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	1	3.27	4	13.51	.	.	.	.	.	.	.	.	.	.	.	.
Total	10	32.68	9	30.41	2	6.71	2	6.94	0	0.00	0	0.00	5	17.06	12	42.25

TABLE B-16 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.30		30.40		28.40		27.80		30.60		29.90		32.10		31.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	1	3.29	.	.	.	.	.	.	.	.	1	3.12	1	3.22
Comely shiner	1	3.19	.	.	.	.	.	.	1	3.27	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	1	3.60	5	16.34	3	10.03	2	6.23	.	.
Bluntnose minnow	2	6.39	1	3.29	.	.	.	.	2	6.54	.	.	1	3.12	.	.
Mimic shiner	1	3.19	.	.	.	.	.	.	1	3.27	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	1	3.29	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	3	9.58	2	6.58	.	.	.	.	.	.	1	3.34	2	6.23	.	.
Total	7	22.36	5	16.45	0	0.00	1	3.60	9	29.41	4	13.38	6	18.69	1	3.22

TABLE B-17 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 07 AUGUST 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	28.40		27.80		29.80		28.60		29.40		28.20		24.40		24.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	3	12.30	7	28.93
Common carp	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4.13
Spottail shiner	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	12	42.25	.	.	4	13.42	2	6.99	2	6.80	2	7.09	1	4.10	2	8.26
Mimic shiner	.	.	3	10.79	1	3.36	4	13.99	2	6.80	6	21.28	.	.	.	.
Rock bass	1	3.52	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Redbreast sunfish	6	21.13	8	28.78	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	1	4.10	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	1	3.60	2	6.71	1	3.50	3	10.20	4	14.18	.	.	.	.
Total	19	66.90	12	43.17	10	33.56	7	24.48	7	23.81	12	42.55	5	20.49	10	41.32

TABLE B-17 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	28.20		27.20		27.90		27.40		28.90		28.10		27.10		26.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	15	53.76	10	36.50	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	2	7.38	.	.
Comely shiner	.	.	.	.	.	.	.	.	3	10.38	.	.	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	4	14.18	2	7.35	4	14.34	9	32.85	1	3.46	5	17.79	3	11.07	3	11.41
Mimic shiner	11	39.01	12	44.12	10	35.84	4	14.60	.	.	.	.	7	25.83	3	11.41
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	.	.	.	.	.	.	2	6.92	.	.	.	.	.	.
Sunfishes	1	3.55	.	.	.	.	1	3.65	2	6.92	2	7.12	.	.	2	7.60
Young																
Spotfin shiner	.	.	.	.	.	.	1	3.65	.	.	.	.	.	.	.	.
Mimic shiner	.	.	1	3.68	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	.	.	.	.	1	3.56	1	3.69	1	3.80
Total	16	56.74	15	55.15	29	103.9	25	91.24	8	27.68	8	28.47	13	47.97	9	34.22

TABLE B-18 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 16 AUGUST 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.20		28.90		28.10		27.10		29.10		28.30		29.10		28.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	1	3.69	.	.	.	.	.	.	.	.
Common carp	1	3.31	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	5	16.56	5	17.30	2	7.12	1	3.69	1	3.44	1	3.53	7	24.05	.	.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	1	3.31	2	6.92	1	3.56	1	3.69	1	3.44	.	.	1	3.44	5	17.67
Redbreast sunfish	.	.	1	3.46	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	3	10.38	.	.	.	.	.	.	.	.	4	13.75	3	10.60
Young																
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.53
Total	7	23.18	11	38.06	3	10.68	3	11.07	2	6.87	1	3.53	12	41.24	9	31.80

TABLE B-18 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.70		29.20		26.30		25.70		29.40		28.20		29.10		28.00	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	2	7.78	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	4	15.56	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	112	425.9	142	552.5	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	1	3.40	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	3	11.41	3	11.67	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	1	3.37	.	.	24	91.25	21	81.71	11	37.41	14	49.65	.	.	.	.
Bluntnose minnow	.	.	.	.	3	11.41	3	11.67	20	68.03	15	53.19	.	.	.	.
Mimic shiner	4	13.47	4	13.70	83	315.6	98	381.3	9	30.61	3	10.64	1	3.44	.	.
Redbreast sunfish	.	.	.	.	.	.	.	.	.	.	.	.	1	3.44	.	.
Sunfishes	.	.	.	.	99	376.4	100	389.1	2	6.80	1	3.55	.	.	.	.
Young																
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	5	16.84	4	13.70	324	1232	373	1451	43	146.3	33	117.0	2	6.87	0	0.00

TABLE B-19 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 21 AUGUST 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.20		29.90		28.60		27.20		29.30		27.90		28.40		27.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	1	3.50	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	2	6.41	7	23.41	.	.	1	3.68	.	.	1	3.58	4	14.08	.	.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	2	7.04	1	3.69
Mimic shiner	.	.	2	6.69	2	6.99	3	11.03	.	.	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	1	3.52	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	1	3.34	.	.	1	3.68	1	3.41	.	.	1	3.52	1	3.69
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	2	7.04	3	11.07
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	1	3.34	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	2	6.41	11	36.79	3	10.49	5	18.38	1	3.41	1	3.58	10	35.21	5	18.45

TABLE B-19 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.20		28.80		27.10		26.40		30.90		29.80		29.30		28.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Bluntnose minnow	.	.	1	3.47	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	1	3.69	3	11.36	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	1	3.69	1	3.79	.	.	.	.	.	.	.	.
Spotfin shiner	3	9.93	.	.	11	40.59	7	26.52	15	48.54	18	60.40	1	3.41	1	3.53
Bluntnose minnow	.	.	.	.	1	3.69	.	.	1	3.24	3	10.07	.	.	.	.
Mimic shiner	13	43.05	13	45.14	4	14.76	2	7.58	1	3.24	1	3.36	.	.	.	.
Rock bass	.	.	.	.	1	3.69	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	5	18.45	8	30.30	.	.	.	.	.	.	.	.
Banded darter	1	3.31	.	.	.	.	.	.	.	.	1	3.36	.	.	.	.
Young																
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.53
Spotfin shiner	1	3.31	2	6.94	.	.	.	.	3	9.71	8	26.85	.	.	.	.
Bluntnose minnow	2	6.62	2	6.94	.	.	.	.	.	.	5	16.78	.	.	.	.
Mimic shiner	.	.	1	3.47	.	.	.	.	1	3.24	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	.	.	1	3.24	.	.	.	.	.	.
Banded darter	.	.	1	3.47	.	.	.	.	.	.	.	.	.	.	.	.
Total	20	66.23	20	69.44	24	88.56	21	79.55	22	71.20	36	120.8	1	3.41	2	7.07

TABLE B-20 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 29 AUGUST 1989.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	30.40		29.50		31.20		30.60		30.70		30.00		27.50		27.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	1	3.27	1	3.26	1	3.33	58	210.9	72	262.8
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.64	1	3.65
Spotfin shiner	1	3.29	1	3.39	1	3.21	.	.	.	.	.	.	2	7.27	1	3.65
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	7.30
Mimic shiner	1	3.29	.	.	1	3.21	.	.	2	6.51	3	10.00	3	10.91	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	.	.	.	.	.	.	.	.	8	29.09	2	7.30
Banded darter	.	.	.	.	.	.	.	.	1	3.26	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bluntnose minnow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	10.95
Mimic shiner	.	.	.	.	1	3.21	.	.	.	.	.	.	5	18.18	.	.
Total	2	6.58	1	3.39	3	9.62	1	3.27	4	13.03	4	13.33	77	280.0	81	295.6

TABLE B-20 CONTINUED.

	TM-LF-11A1				TM-LF-14B1				TM-LF-10B2				TM-LF- 9B1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.70		28.80		25.20		24.10		29.40		28.60		30.80		30.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.25	.	.
Mimic shiner	.	.	.	.	.	.	1	4.15	.	.	1	3.50	.	.	.	.
Larvae																
Gizzard shad	1	3.37	.	.	19	75.40	11	45.64	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	37	146.8	.	.	.	.	.	.	7	22.73	.	.
Spotfin shiner	3	10.10	.	.	3	11.90	2	8.30	3	10.20	3	10.49	.	.	1	3.32
Bluntnose minnow	.	.	.	.	.	.	2	8.30	33	112.2	25	87.41	2	6.49	.	.
Mimic shiner	3	10.10	3	10.42	58	230.2	67	278.0	15	51.02	19	66.43	.	.	7	23.26
Rock bass	.	.	.	.	.	.	1	4.15	.	.	.	.	.	.	.	.
Sunfishes	.	.	.	.	10	39.68	3	12.45	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	2	6.73	1	3.47	1	3.97	.	.	2	6.80	1	3.50	2	6.49	2	6.64
Bluntnose minnow	.	.	4	13.89	.	.	.	.	.	.	.	.	.	.	1	3.32
Mimic shiner	4	13.47	.	.	.	.	4	16.60	.	.	.	.	.	.	.	.
Total	13	43.77	8	27.78	128	507.9	91	377.6	53	180.3	49	171.3	12	38.96	11	36.54

APPENDIX C

SEINE DATA

TABLE C-1

Fishes taken by seine on 13 April 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1237	1155	1000	1035	1117	0910		
Air Temp(C)	13.0	10.3	9.5	9.5	10.0	10.3		
Water Temp(C)	9.2	9.5	6.9	7.3	7.1	8.1		
Dissolved Oxygen(mg/l)	11.8	11.8	11.7	11.9	11.7	11.2		
pH	7.4	7.3	6.8	7.6	7.2	6.9		
Secchi Disc(cm)	152.4	149.9	86.4	88.9	78.7	104.1		
River Stage(m)	1.71	1.71	1.71	1.71	1.71	1.71		
Weather	Partly Cloudy	Partly Cloudy	Overcast	Overcast	Partly Cloudy	Partly Cloudy		
No. of Specimens	879	59	69	48	314	791	2160	
No. of Species	11	8	8	4	9	12	17	
No. of Hauls	3	4	5	4	4	3	23	
Golden shiner	-	-	-	-	-	3	3	0.1
Common shiner	1	-	-	-	-	-	1	+
Spottail shiner	11	1	4	3	9	5	33	1.5
Swallowtail shiner	19	1	-	-	3	4	27	1.2
Spotfin shiner	231	47	13	-	180	245	716	33.1
Mimic shiner	592	1	-	-	84	38	715	33.1
Bluntnose minnow	5	1	-	-	18	173	197	9.1
Channel catfish	-	-	1	-	-	2	3	0.1
Banded killifish	1	-	1	-	-	1	3	0.1
Rock bass	-	-	-	2	1	-	3	0.1
Redbreast sunfish	3	2	5	-	1	-	11	0.5
Green sunfish	1	-	3	-	1	40	45	2.1
Pumpkinseed	13	3	-	-	17	82	115	5.3
Bluegill	-	-	-	-	-	196	196	9.1
White crappie	-	-	-	-	-	2	2	0.1
Tessellated darter	2	3	41	42	-	-	88	4.1
Banded darter	-	-	1	1	-	-	2	0.1

+ Less than 0.05%.

TABLE C-2

Fishes taken by seine on 22 May 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0850	0930	1130	1050	1010	1210		
Air Temp(C)	19.0	20.0	23.0	22.0	21.5	25.0		
Water Temp(C)	17.0	17.0	17.6	17.4	17.5	17.0		
Dissolved Oxygen(mg/l)	8.5	8.6	8.8	9.1	9.2	8.9		
pH	6.9	6.9	6.9	7.4	6.7	6.9		
Secchi Disc(cm)	76.2	76.2	66.0	68.6	76.2	53.3		
River Stage(m)	2.13	2.13	2.13	2.13	2.13	2.13		
Weather	Partly Cloudy	Partly Cloudy	Over-cast	Partly Cloudy	Partly Cloudy	Partly Cloudy		
No. of Specimens	279	124	124	451	113	219	1310	
No. of Species	11	9	9	11	12	7	17	
No. of Hauls	3	5	5	5	4	4	26	
Comely shiner	1	-	-	-	1	-	2	0.2
Spottail shiner	19	6	9	2	2	-	38	2.9
Swallowtail shiner	12	3	-	-	4	-	19	1.4
Spotfin shiner	115	50	69	392	23	-	649	49.5
Mimic shiner	59	32	18	14	61	4	188	14.4
Bluntnose minnow	50	9	3	4	3	46	115	8.8
Fallfish	1	-	-	2	-	-	3	0.2
Banded killifish	-	-	-	1	-	-	1	0.1
Redbreast sunfish	9	16	14	3	3	-	45	3.4
Green sunfish	1	-	1	-	3	18	23	1.8
Pumpkinseed	6	5	2	23	3	54	93	7.1
Bluegill	-	2	-	2	-	93	97	7.4
Lepomis hybrid	-	-	-	-	-	1	1	0.1
Smallmouth bass	6	1	4	4	4	-	19	1.4
White crappie	-	-	-	-	-	2	2	0.2
Black crappie	-	-	-	-	-	1	1	0.1
Tessellated darter	-	-	4	4	5	-	13	1.0
Banded darter	-	-	-	-	1	-	1	0.1

TABLE C-3

Fishes taken by seine on 30 May 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0845	1140	1005	1035	1110	0925		
Air Temp(C)	18.0	22.0	20.0	21.0	20.5	18.0		
Water Temp(C)	18.4	19.2	18.6	18.8	18.8	17.3		
Dissolved Oxygen(mg/l)	8.3	9.0	9.6	9.6	10.2	8.4		
pH	7.2	7.0	7.0	7.1	7.0	7.2		
Secchi Disc(cm)	124.5	124.5	73.7	78.7	91.4	104.1		
River Stage(m)	1.59	1.59	1.59	1.59	1.59	1.59		
Weather	Over-cast	Over-cast	Partly Cloudy	Partly Cloudy	Over-cast	Over-cast		
No. of Specimens	136	199	160	189	105	90	879	
No. of Species	11	10	12	13	8	5	18	
No. of Hauls	4	5	5	4	4	4	26	
Rainbow smelt	-	-	-	1	-	-	1	0.1
Golden shiner	-	2	-	-	-	-	2	0.2
Comely shiner	-	-	-	1	-	-	1	0.1
Spottail shiner	18	1	32	32	13	-	96	10.9
Swallowtail shiner	9	-	-	3	-	-	12	1.4
Rosyface shiner	-	-	-	1	-	-	1	0.1
Spotfin shiner	6	131	61	55	28	1	282	32.1
Mimic shiner	50	1	40	82	19	-	192	21.8
Bluntnose minnow	13	4	1	5	-	9	32	3.6
Fallfish	1	-	1	1	-	-	3	0.3
White sucker	-	2	4	-	4	-	10	1.1
Banded killifish	1	-	-	-	-	-	1	0.1
Redbreast sunfish	1	3	13	5	2	-	24	2.7
Green sunfish	-	8	1	1	1	3	14	1.6
Pumpkinseed	31	36	1	-	33	34	135	15.4
Bluegill	3	11	1	-	5	43	63	7.2
Smallmouth bass	3	-	4	1	-	-	8	0.9
Tessellated darter	-	-	1	1	-	-	2	0.2

TABLE C-4

Fishes taken by seine on 8 June 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1135	1037	0845	0922	0955	0815		
Air Temp(C)	20.3	19.0	18.0	18.5	18.5	18.0		
Water Temp(C)	19.3	19.3	19.5	19.6	19.7	18.0		
Dissolved Oxygen(mg/l)	9.4	9.8	8.9	8.8	8.4	8.9		
pH	7.3	7.0	7.0	5.4	5.6	7.4		
Secchi Disc(cm)	139.7	124.5	94.0	88.9	91.4	124.5		
River Stage(m)	1.54	1.54	1.54	1.54	1.54	1.54		
Weather	Partly Cloudy	Overcast	Overcast	Overcast	Overcast	Overcast		
No. of Specimens	227	214	231	81	75	42	870	
No. of Species	10	11	10	11	9	6	17	
No. of Hauls	4	5	5	4	4	4	26	
Common carp	-	-	1	-	-	-	1	0.1
Golden shiner	-	-	1	-	-	-	1	0.1
Spottail shiner	4	17	48	3	1	-	73	8.4
Swallowtail shiner	5	6	-	1	-	-	12	1.4
Spotfin shiner	43	63	51	14	9	-	180	20.7
Mimic shiner	89	18	77	23	2	-	209	24.0
Bluntnose minnow	11	36	-	9	-	1	57	6.6
Fallfish	1	-	4	11	1	-	17	2.0
White sucker	55	22	41	9	25	2	154	17.7
Channel catfish	-	-	-	-	34	-	34	3.9
Banded killifish	1	-	-	-	-	-	1	0.1
Redbreast sunfish	-	3	5	2	1	3	14	1.6
Green sunfish	-	2	1	-	-	5	8	0.9
Pumpkinseed	16	39	2	5	1	17	80	9.2
Bluegill	2	4	-	-	1	14	21	2.4
Smallmouth bass	-	-	-	2	-	-	2	0.2
Tessellated darter	-	4	-	2	-	-	6	0.7

TABLE C-5

Fishes taken by seine on 21 June 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0840	0938	1200	1116	1023	1240		
Air Temp(C)	23.0	24.5	26.0	25.3	24.0	27.0		
Water Temp(C)	20.8	21.0	19.8	20.2	19.9	19.9		
Dissolved Oxygen(mg/l)	7.6	9.0	8.6	8.3	9.6	8.3		
pH	6.9	6.9	6.4	6.3	6.6	6.5		
Secchi Disc(cm)	71.1	73.7	33.0	33.0	38.1	40.6		
River Stage(m)	2.16	2.16	2.16	2.16	2.16	2.16		
Weather	Over-cast	Partly Cloudy	Partly Cloudy	Partly Cloudy	Over-cast	Partly Cloudy		
No. of Specimens	132	147	255	194	294	64	1086	
No. of Species	12	13	12	17	13	12	22	
No. of Hauls	4	4	4	4	3	3	22	
American shad	-	-	2	5	-	-	7	0.6
Golden shiner	-	-	-	-	-	1	1	0.1
Spottail shiner	12	26	10	4	2	2	56	5.2
Swallowtail shiner	6	1	-	6	1	-	14	1.3
Spotfin shiner	37	33	42	43	141	1	297	27.3
Mimic shiner	23	1	187	85	25	2	323	29.7
Bluntnose minnow	9	4	-	10	1	7	31	2.8
Fallfish	5	3	-	1	7	-	16	1.5
White sucker	-	1	2	6	2	-	11	1.0
Northern hog sucker	-	-	-	1	1	-	2	0.2
Shorthead redhorse	-	-	1	-	-	-	1	0.1
Banded killifish	2	-	-	-	-	-	2	0.2
Rock bass	-	-	-	6	-	-	6	0.6
Redbreast sunfish	1	1	-	3	-	4	9	0.8
Green sunfish	1	1	1	1	-	5	9	0.8
Pumpkinseed	-	49	2	13	14	13	91	8.4
Bluegill	-	5	1	-	3	18	27	2.5
Lepomis hybrid	-	-	-	-	-	1	1	0.1
Smallmouth bass	1	2	4	3	2	6	18	1.6
Largemouth bass	-	-	-	-	-	1	1	0.1
White crappie	-	-	-	1	-	-	1	0.1
Tessellated darter	33	20	2	4	94	3	156	14.4
Shield darter	2	-	1	2	1	-	6	0.6

TABLE C-6

Fishes taken by seine on 14 July 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1247	1155	0950	1030	1117	0907		
Air Temp(C)	25.5	23.0	22.5	23.0	24.0	22.0		
Water Temp(C)	20.0	22.0	20.7	21.1	21.2	18.1		
Dissolved Oxygen(mg/l)	8.2	8.3	7.7	8.2	8.0	7.3		
pH	7.4	6.6	7.0	6.8	6.9	7.4		
Secchi Disc(cm)	30.5	35.6	53.3	53.3	61.0	15.2		
River Stage(m)	1.59	1.59	1.59	1.59	1.59	1.59		
Weather	Partly Cloudy	Partly Cloudy	Clear	Partly Cloudy	Partly Cloudy	Partly Cloudy		
No. of Specimens	105	111	176	97	88	95	672	
No. of Species	11	15	13	12	5	13	24	
No. of Hauls	4	6	5	6	4	5	30	
American shad	-	2	-	-	-	-	2	0.3
Gizzard shad	-	3	-	-	-	-	3	0.4
Golden shiner	-	1	-	-	-	-	1	0.1
Comely shiner	-	-	1	-	-	-	1	0.1
Spottail shiner	28	9	15	3	20	2	77	11.4
Swallowtail shiner	-	1	-	-	-	-	1	0.1
Spotfin shiner	32	13	94	47	13	12	211	31.4
Mimic shiner	-	2	20	14	-	-	36	5.4
Bluntnose minnow	12	31	1	2	-	3	49	7.3
Fallfish	-	4	4	2	-	1	11	1.6
White sucker	-	-	-	-	-	1	1	0.1
Banded killifish	2	-	-	-	-	-	2	0.3
Rock bass	-	2	2	2	-	-	6	0.9
Redbreast sunfish	2	1	1	2	1	1	8	1.2
Green sunfish	-	-	-	-	-	11	11	1.6
Pumpkinseed	10	18	3	5	7	17	60	8.9
Bluegill	-	3	5	-	-	22	30	4.5
Lepomis hybrid	-	-	-	-	-	3	3	0.4
Smallmouth bass	1	-	-	1	-	-	2	0.3
Largemouth bass	-	-	-	-	-	1	1	0.1
White crappie	1	1	4	2	-	3	11	1.6
Black crappie	-	-	1	-	-	2	3	0.4
Tessellated darter	14	20	25	16	47	16	138	20.5
Shield darter	2	-	-	1	-	-	3	0.4
Walleye	1	-	-	-	-	-	1	0.1

TABLE C-7

Fishes taken by seine on 3 August 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1235	0835	1107	1030	0935	1150		
Air Temp(C)	30.0	27.5	28.0	27.0	26.7	29.7		
Water Temp(C)	22.4	21.7	23.5	23.2	22.9	22.5		
Dissolved Oxygen(mg/l)	8.5	10.5	8.8	8.5	9.0	8.4		
pH	8.0	8.3	8.1	8.1	8.2	8.1		
Secchi Disc(cm)	91.4	101.6	203.2	137.2	154.9	129.5		
River Stage(m)	1.28	1.28	1.28	1.28	1.28	1.28		
Weather	Partly Cloudy	Clear	Clear	Partly Cloudy	Clear	Partly Cloudy		
No. of Specimens	169	33	74	105	224	35	640	
No. of Species	8	8	8	6	9	8	15	
No. of Hauls	4	8	5	5	4	5	31	
Comely shiner	1	2	-	3	-	-	6	0.9
Spottail shiner	7	-	-	-	39	1	47	7.3
Swallowtail shiner	12	-	-	-	2	-	14	2.2
Spotfin shiner	10	10	30	21	9	6	86	13.4
Mimic shiner	129	3	30	60	14	-	236	36.9
Bluntnose minnow	5	4	2	1	3	12	27	4.2
Shorthead redhorse	-	-	1	-	1	-	2	0.3
Channel catfish	-	-	-	-	121	-	121	18.9
Banded killifish	1	-	-	-	-	-	1	0.2
Redbreast sunfish	-	1	3	-	-	2	6	0.9
Green sunfish	-	-	-	-	-	1	1	0.2
Pumpkinseed	-	4	4	18	33	5	64	10.0
Bluegill	-	4	2	-	-	5	11	1.7
Lepomis hybrid	-	-	-	-	1	1	2	0.3
Smallmouth bass	-	-	-	2	-	-	2	0.3
Tessellated darter	4	5	2	-	1	2	14	2.2

TABLE C-8

Fishes taken by seine on 16 August 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1322	1222	1016	1100	1137	0938		
Air Temp(C)	30.0	29.0	26.0	27.0	27.5	24.7		
Water Temp(C)	25.1	27.4	22.8	23.4	25.0	22.7		
Dissolved Oxygen(mg/l)	13.6	11.5	8.4	8.5	9.4	10.3		
pH	8.9	9.1	8.2	8.2	8.2	8.6		
Secchi Disc(cm)	167.6	127.0	157.5	152.4	167.6	147.3		
River Stage(m)	1.08	1.08	1.08	1.08	1.08	1.08		
Weather	Haze	Haze	Partly Cloudy	Clear	Clear	Partly Cloudy		
No. of Specimens	426	350	138	10	406	11	1341	
No. of Species	7	7	11	4	8	6	16	
No. of Hauls	4	7	6	6	4	5	32	
Comely shiner	-	15	-	-	6	-	21	1.6
Spottail shiner	6	1	3	-	3	-	13	1.0
Swallowtail shiner	11	-	-	-	-	-	11	0.8
Spotfin shiner	18	270	50	3	64	1	406	30.3
Mimic shiner	383	43	57	-	262	-	745	55.6
Bluntnose minnow	5	7	-	-	37	1	50	3.7
Fallfish	-	-	1	1	-	-	2	0.1
White sucker	-	-	1	-	-	-	1	0.1
Channel catfish	-	-	-	-	1	-	1	0.1
Redbreast sunfish	-	-	5	-	-	-	5	0.4
Green sunfish	-	-	3	-	-	2	5	0.4
Pumpkinseed	2	8	9	4	30	-	53	4.0
Bluegill	-	6	1	-	3	2	12	0.9
Smallmouth bass	-	-	1	-	-	-	1	0.1
Largemouth bass	-	-	-	-	-	1	1	0.1
Tessellated darter	1	-	7	2	-	4	14	1.0

TABLE C-9

Fishes taken by seine on 7 September 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1420	1315	1040	1125	1207	0945		
Air Temp(C)	25.0	25.0	23.5	24.5	25.0	22.0		
Water Temp(C)	25.2	26.2	22.8	22.9	25.0	22.2		
Dissolved Oxygen(mg/l)	11.1	12.0	9.5	9.2	10.3	13.2		
pH	8.7	8.9	8.1	8.2	8.4	8.7		
Secchi Disc(cm)	96.5	96.5	78.7	73.7	99.1	73.7		
River Stage(m)	0.99	0.99	0.99	0.99	0.99	0.99		
Weather	Partly Cloudy	Partly Cloudy	Clear	Partly Cloudy	Partly Cloudy	Clear		
No. of Specimens	1218	486	1343	792	2958	684	7481	
No. of Species	6	9	11	7	8	9	16	
No. of Hauls	3	4	5	5	3	5	25	
Gizzard shad	-	19	-	1	1	246	267	3.6
Golden shiner	-	-	1	-	-	1	2	+
Comely shiner	-	-	4	-	2	-	6	0.1
Spottail shiner	-	-	9	-	1	-	10	0.1
Swallowtail shiner	1	-	1	2	-	-	4	+
Spotfin shiner	489	251	1029	338	304	20	2431	32.5
Mimic shiner	721	32	282	440	2644	43	4162	55.6
Bluntnose minnow	1	-	1	7	1	11	21	0.3
Rock bass	-	1	-	-	-	-	1	+
Redbreast sunfish	-	2	-	-	4	-	6	0.1
Green sunfish	-	-	1	-	-	3	4	+
Pumpkinseed	2	37	8	3	-	74	124	1.6
Bluegill	4	142	-	1	-	283	430	5.7
Smallmouth bass	-	-	1	-	-	-	1	+
White crappie	-	1	-	-	-	-	1	+
Tessellated darter	-	1	6	-	1	3	11	0.1

+ Less than 0.05%.

TABLE C-10

Fishes taken by seine on 18 September 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1310	0825	1045	1130	1210	0955		
Air Temp(C)	19.0	18.0	17.5	17.5	18.0	17.5		
Water Temp(C)	20.3	20.0	19.7	19.9	20.3	21.3		
Dissolved Oxygen(mg/l)	8.0	7.1	8.5	8.6	8.4	6.4		
pH	7.9	7.1	7.4	7.6	7.0	7.7		
Secchi Disc(cm)	76.2	53.3	91.4	76.2	81.3	50.8		
River Stage(m)	1.02	1.02	1.02	1.02	1.02	1.02		
Weather	Over-cast	Over-cast	Over-cast	Over-cast	Over-cast	Over-cast		
No. of Specimens	5602	515	1380	1811	2185	328	11821	
No. of Species	7	12	10	4	8	10	18	
No. of Hauls	2	4	4	3	2	5	20	
Gizzard shad	-	7	1	-	1	266	275	2.3
Common carp	-	1	-	-	-	-	1	+
Golden shiner	-	-	1	-	-	-	1	+
Comely shiner	-	-	1	-	1	-	2	+
Swallowtail shiner	8	7	12	-	6	-	33	0.3
Spotfin shiner	454	275	320	1459	270	16	2794	23.6
Mimic shiner	5134	99	1033	348	1899	5	8518	72.0
Bluntnose minnow	1	-	2	3	3	14	23	0.2
Blacknose dace	-	-	-	-	-	1	1	+
Rock bass	-	2	-	-	-	-	2	+
Redbreast sunfish	-	1	-	-	-	1	2	+
Green sunfish	-	-	-	-	-	4	4	+
Pumpkinseed	1	32	6	1	3	10	53	0.4
Bluegill	2	84	-	-	2	9	97	0.8
Smallmouth bass	-	1	-	-	-	-	1	+
Largemouth bass	-	-	1	-	-	-	1	+
White crappie	-	2	-	-	-	-	2	+
Tessellated darter	2	4	3	-	-	2	11	0.1

+ Less than 0.05%.

TABLE C-11

Fishes taken by seine on 18 October 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1430	1335	1150	1240	0950	1115		
Air Temp(C)	9.7	10.3	11.0	10.3	10.2	10.3		
Water Temp(C)	16.5	17.5	16.8	16.5	17.5	16.2		
Dissolved Oxygen(mg/l)	9.4	8.4	7.9	8.3	8.0	12.4		
pH	8.2	8.2	7.8	7.8	8.2	8.5		
Secchi Disc(cm)	116.8	127.0	101.6	91.4	104.1	101.6		
River Stage(m)	1.10	1.10	1.10	1.10	1.10	1.10		
Weather	Over-cast	Over-cast	Over-cast	Over-cast	Light Rain	Over-cast		
No. of Specimens	5966	261	1112	1667	1482	218	10706	
No. of Species	5	6	7	8	6	7	13	
No. of Hauls	2	4	4	3	3	4	20	
Golden shiner	-	-	-	1	-	-	1	+
Comely shiner	-	-	2	1	-	-	3	+
Spottail shiner	-	-	2	-	-	-	2	+
Swallowtail shiner	19	-	6	3	1	-	29	0.3
Spotfin shiner	682	210	995	1562	611	2	4062	37.9
Mimic shiner	5248	2	105	95	866	-	6316	59.0
Bluntnose minnow	15	-	-	1	1	1	18	0.2
Rock bass	-	2	-	-	-	-	2	+
Green sunfish	-	-	-	-	-	5	5	+
Pumpkinseed	-	6	1	2	-	84	93	0.9
Bluegill	2	40	-	-	1	120	163	1.5
Largemouth bass	-	1	-	-	-	5	6	+
Tessellated darter	-	-	1	2	2	1	6	+

+ Less than 0.05%.

TABLE C-12

Fishes taken by seine on 2 November 1989 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0940	1400	1130	1200	1300	1045		
Air Temp(C)	11.5	11.5	11.7	12.7	13.0	12.0		
Water Temp(C)	12.7	13.0	12.2	12.2	12.3	12.6		
Dissolved Oxygen(mg/l)	10.1	10.1	9.6	10.3	9.9	9.0		
pH	8.8	8.2	8.0	7.9	8.0	8.2		
Secchi Disc(cm)	116.8	124.5	147.3	149.9	137.2	139.7		
River Stage(m)	1.27	1.27	1.27	1.27	1.27	1.27		
Weather	Partly Cloudy	Over-cast	Partly Cloudy	Partly Cloudy	Over-cast	Partly Cloudy		
No. of Specimens	4477	334	91	743	1121	248	7014	
No. of Species	4	7	3	6	8	8	11	
No. of Hauls	2	5	5	5	3	4	24	
Spottail shiner	-	-	-	-	47	-	47	0.7
Swallowtail shiner	10	1	-	19	2	34	66	0.9
Spotfin shiner	170	279	82	99	166	30	826	11.8
Mimic shiner	4288	40	8	618	898	68	5920	84.4
Bluntnose minnow	9	1	-	5	5	98	118	1.7
Rock bass	-	2	1	1	-	1	5	0.1
Redbreast sunfish	-	1	-	1	1	-	3	+
Green sunfish	-	-	-	-	-	5	5	0.1
Pumpkinseed	-	-	-	-	1	6	7	0.1
Bluegill	-	10	-	-	-	6	16	0.2
Tessellated darter	-	-	-	-	1	-	1	+

+ Less than 0.05%.

APPENDIX D

ELECTROFISHING DATA

TABLE D-1

Fishes taken by the AC electrofisher on 19-20 April 1989 near TMINS. Station prefix TM-EL deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1956	2046	2144	2243	2338	0040	
Duration(min)	19	21	19	23	20	24	
Air Temp(C)	10.0	11.5	11.0	10.3	10.0	5.0	
Water Temp(C)	12.5	11.9	12.0	11.8	11.5	13.8	
Dissolved Oxygen(mg/l)	10.6	10.9	10.4	10.3	10.4	10.7	
pH	7.5	7.1	7.1	7.0	7.1	7.8	
Conductivity(micromhos/cm)	240	210	210	220	190	240	
Secchi Disc(cm)	167.6	114.3	116.8	119.4	132.1	121.9	
Volts	215	215	215	215	220	210	
Amps	5.0	5.0	5.0	5.0	4.5	5.5	
Gizzard shad	-	-	-	-	-	2	2
Common carp	-	-	-	-	-	5	5
Golden shiner	-	-	1	-	-	1	2
Spottail shiner	1	2	13	13	4	-	33
Quillback	9	2	5	8	6	6	36
White sucker	-	-	1	-	-	1	2
Shorthead redhorse	-	3	9	-	-	-	12
Channel catfish	-	-	-	-	-	1	1
Rock bass	1	15	12	1	3	-	32
Redbreast sunfish	-	35	20	10	13	1	79
Green sunfish	2	10	1	4	-	-	17
Pumpkinseed	15	4	5	5	29	64	122
Bluegill	4	-	-	2	10	12	28
Lepomis hybrid	-	-	1	-	-	-	1
Smallmouth bass	2	49	19	6	9	-	85
Largemouth bass	3	-	-	1	1	1	6
White crappie	-	-	-	-	-	4	4
Black crappie	1	-	-	-	-	2	3
Walleye	1	1	2	1	-	1	6
No. of Specimens	39	121	89	51	75	101	476
No. of Species	10	9	11	10	8	13	18

TABLE D-2

Fishes taken by the AC electrofisher on 24-25 May 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2226	2315	0018	0121	2110	2008	
Duration(min)	20	20	22	22	20	25	
Air Temp(C)	14.0	14.0	13.0	12.0	14.5	15.0	
Water Temp(C)	16.1	16.4	16.2	16.2	16.7	15.2	
Dissolved Oxygen(mg/l)	9.3	9.3	9.0	9.1	9.4	9.4	
pH	6.9	6.7	7.0	7.0	7.1	7.4	
Conductivity(micromhos/cm)	210	210	200	200	160	240	
Secchi Disc(cm)	73.7	71.1	63.5	73.7	99.1	73.7	
Volts	210	215	215	205	220	215	
Amps	5.0	5.5	5.0	5.0	4.5	5.0	
Gizzard shad	1	2	-	-	-	-	3
Common carp	2	3	3	1	-	1	10
Spottail shiner	-	-	2	6	1	2	11
Spotfin shiner	-	1	5	-	-	-	6
Mimic shiner	-	-	1	-	-	-	1
Fallfish	-	-	-	1	-	-	1
Quillback	5	3	5	13	6	10	42
White sucker	2	1	2	-	-	-	5
Shorthead redhorse	-	-	1	1	-	-	2
Brown bullhead	-	-	-	-	1	-	1
Rock bass	-	2	8	4	2	1	17
Redbreast sunfish	-	17	16	21	14	2	70
Green sunfish	-	3	-	1	-	-	4
Pumpkinseed	19	2	8	19	72	66	186
Bluegill	1	1	-	2	9	10	23
Lepomis hybrid	-	-	1	-	-	1	2
Smallmouth bass	4	52	37	42	37	1	173
Largemouth bass	1	-	-	-	-	-	1
White crappie	-	-	-	-	-	1	1
Walleye	-	-	-	-	1	-	1
No. of Specimens	35	87	89	111	143	95	560
No. of Species	8	11	11	11	9	9	19

TABLE D-3

Fishes taken by the AC electrofisher on 30-31 May 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2007	2050	2158	2309	0017	0120	
Duration(min)	22	22	22	24	20	25	
Air Temp(C)	24.0	23.5	23.0	22.5	22.0	20.0	
Water Temp(C)	19.7	19.7	19.6	19.6	20.0	19.5	
Dissolved Oxygen(mg/l)	11.6	11.4	10.7	10.6	10.2	8.7	
pH	8.4	8.0	7.6	8.0	8.0	7.4	
Conductivity(micromhos/cm)	250	240	240	240	180	240	
Secchi Disc(cm)	81.3	76.2	78.7	88.9	101.6	101.6	
Volts	215	215	210	215	215	215	
Amps	6.5	6.0	6.0	6.5	5.0	6.5	
Gizzard shad	-	1	1	-	-	4	6
Common carp	-	3	3	4	8	-	18
Golden shiner	-	-	2	-	-	-	2
Spottail shiner	-	2	11	10	-	-	23
Spotfin shiner	-	2	8	-	-	-	10
Fallfish	-	1	1	-	-	-	2
Quillback	18	4	5	11	13	30	81
White sucker	-	-	1	-	-	-	1
Shorthead redhorse	-	2	3	1	-	1	7
Channel catfish	-	1	-	1	-	-	2
Rock bass	-	15	5	7	3	-	30
Redbreast sunfish	1	16	30	16	5	1	69
Green sunfish	1	6	2	4	1	1	15
Pumpkinseed	10	10	20	34	24	32	130
Bluegill	-	1	2	2	23	12	40
Smallmouth bass	2	72	22	14	22	1	133
Largemouth bass	1	-	-	-	-	1	2
White crappie	-	1	-	-	-	5	6
Black crappie	-	1	-	-	-	-	1
Walleye	-	2	3	-	1	-	6
No. of Specimens	33	140	119	104	100	88	584
No. of Species	6	17	16	11	9	10	20

TABLE D-4

Fishes taken by the AC electrofisher on 13-14 June 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2025	2130	2224	2329	0047	0140	
Duration(min)	25	20	23	24	20	30	
Air Temp(C)	20.2	21.0	21.0	21.5	20.0	19.0	
Water Temp(C)	20.7	20.7	20.7	20.7	21.0	21.0	
Dissolved Oxygen(mg/l)	10.7	10.6	10.6	10.4	11.0	10.1	
pH	7.7	7.3	7.4	7.5	7.5	7.5	
Conductivity(micromhos/cm)	250	250	250	250	200	260	
Secchi Disc(cm)	83.8	78.7	71.1	81.3	99.1	127.0	
Volts	215	215	200	215	215	215	
Amps	6.5	6.5	7.0	6.5	5.5	7.5	
Gizzard shad	-	2	-	-	-	-	2
Common carp	-	3	2	-	-	2	7
Golden shiner	-	-	-	-	-	1	1
Spottail shiner	2	-	8	13	1	1	25
Spotfin shiner	3	2	7	1	-	-	13
Quillback	3	-	2	6	3	15	29
White sucker	-	-	-	1	-	-	1
Shorthead redhorse	-	-	-	1	-	-	1
Yellow bullhead	1	-	-	-	-	-	1
Channel catfish	-	2	1	2	-	-	5
Rock bass	-	5	5	4	-	2	16
Redbreast sunfish	-	21	26	16	11	-	74
Green sunfish	5	2	4	16	1	2	30
Pumpkinseed	46	5	26	60	20	17	174
Bluegill	13	3	4	5	7	19	51
Lepomis hybrid	4	1	-	1	-	1	7
Smallmouth bass	4	45	23	7	8	-	87
Largemouth bass	9	-	-	-	-	2	11
White crappie	1	-	-	-	2	5	8
Black crappie	-	-	-	-	-	1	1
Walleye	-	1	3	-	-	-	4
No. of Specimens	91	92	111	133	53	68	548
No. of Species	10	11	12	12	8	11	20

TABLE D-5

Fishes taken by the AC electrofisher on 28-29 June 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2033	2118	2206	2258	2356	0043	
Duration(min)	20	19	22	25	22	30	
Air Temp(C)	23.0	23.0	21.0	21.0	20.0	18.7	
Water Temp(C)	22.8	22.9	22.8	22.8	22.4	22.8	
Dissolved Oxygen(mg/l)	7.9	7.9	7.9	7.9	8.3	7.8	
pH	7.0	7.4	7.5	7.3	7.2	7.2	
Conductivity(micromhos/cm)	190	175	175	180	150	200	
Secchi Disc(cm)	12.7	15.2	10.2	15.2	17.8	45.7	
Volts	220	220	220	220	220	220	
Amps	5.0	5.0	5.5	5.0	4.5	6.0	
Gizzard shad	2	-	2	-	-	2	6
Common carp	1	1	4	1	-	3	10
Spottail shiner	2	-	-	1	-	-	3
Spotfin shiner	1	3	1	-	-	-	5
Bluntnose minnow	1	-	-	-	-	-	1
Quillback	2	2	6	1	8	6	25
White sucker	-	3	-	-	-	-	3
Shorthead redhorse	-	-	2	-	-	-	2
Brown bullhead	1	-	-	-	-	-	1
Channel catfish	-	-	1	-	-	-	1
Rock bass	-	-	1	1	3	2	7
Redbreast sunfish	-	6	5	1	2	3	17
Green sunfish	-	1	-	2	-	-	3
Pumpkinseed	5	-	1	11	9	18	44
Bluegill	-	-	-	2	-	2	4
Smallmouth bass	2	64	42	16	15	12	151
Walleye	1	-	-	-	1	-	2
No. of Specimens	18	80	65	36	38	48	285
No. of Species	10	7	10	9	6	8	17

TABLE D-6

Fishes taken by the AC electrofisher on 25-26 July 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2308	0002	0109	0229	2204	2108	
Duration(min)	21	20	24	22	22	30	
Air Temp(C)	22.5	23.0	22.5	22.0	23.5	22.0	
Water Temp(C)	27.8	28.0	27.5	27.8	24.9	23.0	
Dissolved Oxygen(mg/l)	8.5	8.5	8.5	8.1	8.4	8.3	
pH	7.5	6.7	6.9	7.3	7.6	7.7	
Conductivity(micromhos/cm)	290	300	300	300	180	240	
Secchi Disc(cm)	101.6	99.1	96.5	101.6	43.2	40.6	
Volts	215	215	205	210	220	215	
Amps	9.0	10.0	10.0	9.5	5.5	7.0	
Gizzard shad	–	3	4	–	2	–	9
Common carp	3	–	–	–	–	–	3
Golden shiner	–	–	–	–	1	1	2
Spottail shiner	2	–	14	14	4	–	34
Spotfin shiner	4	8	1	2	–	–	15
Bluntnose minnow	1	–	–	–	–	–	1
Fallfish	–	–	–	1	–	–	1
Quillback	7	2	1	1	7	5	23
White sucker	–	–	1	–	–	–	1
Shorthead redhorse	–	9	1	–	–	–	10
Channel catfish	–	3	2	–	–	–	5
Rock bass	–	4	–	1	–	–	5
Redbreast sunfish	–	24	27	19	4	–	74
Green sunfish	–	1	3	8	–	–	12
Pumpkinseed	14	29	67	55	26	14	205
Bluegill	7	4	3	3	–	2	19
Lepomis hybrid	–	–	–	1	–	–	1
Smallmouth bass	–	30	15	10	17	6	78
Largemouth bass	2	–	2	–	–	2	6
White crappie	–	1	–	–	1	2	4
Yellow perch	–	–	–	–	–	1	1
Walleye	–	2	–	–	–	–	2
No. of Specimens	40	120	141	115	62	33	511
No. of Species	8	13	13	10	8	8	21

TABLE D-7

Fishes taken by the AC electrofisher on 9-10 August 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1958	2102	2151	2315	0020	0120	
Duration(min)	19	18	24	20	21	25	
Air Temp(C)	18.0	18.0	17.5	15.5	15.5	13.0	
Water Temp(C)	21.6	22.7	22.0	22.5	23.9	21.5	
Dissolved Oxygen(mg/l)	19.0	11.1	10.4	11.0	10.4	13.7	
pH	NA	NA	NA	NA	NA	NA	
Conductivity(micromhos/cm)	340	350	450	350	275	250	
Secchi Disc(cm)	162.6	175.3	111.8	165.1	139.7	119.4	
Volts	200	215	200	200	215	215	
Amps	7.0	11.0	11.0	10.0	9.0	7.5	
Common carp	1	5	2	-	-	-	8
Golden shiner	-	1	-	-	-	3	4
Spottail shiner	-	2	5	1	2	1	11
Spotfin shiner	-	1	5	2	-	1	9
Fallfish	-	1	4	-	-	-	5
Quillback	3	6	3	2	6	11	31
Brown bullhead	-	-	-	-	-	1	1
Channel catfish	-	2	1	1	-	-	4
Rock bass	1	5	9	-	2	-	17
Redbreast sunfish	6	15	12	1	7	-	41
Green sunfish	19	10	34	32	3	2	100
Pumpkinseed	26	28	66	28	17	23	188
Bluegill	23	10	45	34	20	23	155
Lepomis hybrid	1	-	3	2	-	1	7
Smallmouth bass	1	10	5	5	9	-	30
Largemouth bass	9	-	1	1	2	2	15
White crappie	-	-	-	-	1	2	3
Black crappie	-	-	-	-	1	3	4
Tessellated darter	-	-	-	1	-	-	1
Walleye	-	-	-	-	1	-	1
No. of Specimens	90	96	195	110	71	73	635
No. of Species	9	13	13	11	12	11	19

NA = Not available

TABLE D-8

Fishes taken by the AC electrofisher on 22-23 August 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2138	2241	2346	0101	2024	1933	
Duration(min)	24	23	27	22	26	25	
Air Temp(C)	25.0	25.0	24.5	24.3	25.3	25.5	
Water Temp(C)	25.0	25.0	25.0	25.0	26.5	25.2	
Dissolved Oxygen(mg/l)	12.2	11.0	11.5	11.2	13.0	13.4	
pH	8.6	8.4	8.3	8.2	8.8	8.8	
Conductivity(micromhos/cm)	255	275	420	275	255	250	
Secchi Disc(cm)	91.4	106.7	86.4	104.1	109.2	121.9	
Volts	210	210	210	210	215	215	
Amps	9.5	10.0	12.5	12.0	9.5	8.0	
Gizzard shad	6	-	-	-	5	2	13
Common carp	-	4	-	-	-	-	4
Golden shiner	-	-	-	-	1	5	6
Spottail shiner	1	1	3	1	7	-	13
Spotfin shiner	1	8	10	3	1	2	25
Fallfish	-	-	3	-	-	-	3
Quillback	9	13	1	2	4	12	41
Shorthead redhorse	-	1	-	-	-	-	1
Brown bullhead	1	-	-	-	-	-	1
Channel catfish	-	2	-	-	1	-	3
Rock bass	2	-	-	3	-	-	5
Redbreast sunfish	3	5	1	1	7	-	17
Green sunfish	10	4	30	13	2	4	63
Pumpkinseed	24	19	52	20	40	8	163
Bluegill	22	4	25	18	17	11	97
Lepomis hybrid	2	-	-	1	-	-	3
Smallmouth bass	2	19	3	1	7	-	32
Largemouth bass	2	2	-	1	-	2	7
No. of Specimens	85	82	128	64	92	46	497
No. of Species	12	12	9	10	11	8	17

TABLE D-9

Fishes taken by the AC electrofisher on 12-13 September 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1904	2018	2114	2209	2309	0015	
Duration(min)	25	24	23	24	25	27	
Air Temp(C)	22.0	22.0	22.5	20.5	21.5	19.7	
Water Temp(C)	25.1	26.1	26.0	26.1	25.9	25.9	
Dissolved Oxygen(mg/l)	10.2	10.6	9.7	10.4	9.2	8.8	
pH	8.5	8.7	8.5	8.7	8.9	8.6	
Conductivity(micromhos/cm)	450	450	500	450	350	325	
Secchi Disc(cm)	76.2	73.7	71.1	73.7	63.5	68.6	
Volts	210	210	205	205	215	215	
Amps	12.5	12.5	13.0	13.0	11.5	10.5	
Gizzard shad	-	1	-	-	1	-	2
Common carp	-	1	-	-	-	1	2
Golden shiner	-	-	-	-	-	3	3
Common shiner	-	-	-	-	-	1	1
Spottail shiner	2	-	2	1	20	-	25
Spotfin shiner	1	1	3	8	-	1	14
Bluntnose minnow	-	-	1	-	-	-	1
Quillback	1	-	-	1	3	7	12
Yellow bullhead	-	1	-	-	-	-	1
Channel catfish	-	2	-	-	2	-	4
Rock bass	4	10	4	-	-	-	18
Redbreast sunfish	8	20	10	7	3	-	48
Green sunfish	10	11	8	22	1	-	52
Pumpkinseed	46	10	22	8	16	9	111
Bluegill	32	5	8	21	28	23	117
Lepomis hybrid	12	-	1	-	-	-	13
Smallmouth bass	2	9	3	1	4	-	19
Largemouth bass	12	-	1	-	1	7	21
White crappie	-	1	-	1	-	-	2
Black crappie	-	1	1	-	-	-	2
Walleye	-	-	1	2	-	-	3
No. of Specimens	130	73	65	72	79	52	471
No. of Species	10	13	12	10	10	8	20

TABLE D-10

Fishes taken by the AC electrofisher on 26-27 September 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2051	2153	2247	0010	1952	1855	
Duration(min)	23	22	25	19	17	25	
Air Temp(C)	15.3	15.0	14.5	13.5	17.5	16.7	
Water Temp(C)	16.3	16.1	15.7	15.5	17.2	16.5	
Dissolved Oxygen(mg/l)	10.4	10.2	10.6	10.3	11.5	10.0	
pH	NA	NA	NA	NA	NA	NA	
Conductivity(micromhos/cm)	350	360	450	390	360	325	
Secchi Disc(cm)	86.4	63.5	58.4	71.1	81.3	106.7	
Volts	200	215	210	210	210	215	
Amps	8.0	10.0	10.0	10.0	10.5	8.5	
American shad	-	1	-	-	-	-	1
Gizzard shad	1	1	1	-	5	-	8
Common carp	2	4	-	-	-	1	7
Golden shiner	-	-	-	-	1	6	7
Common shiner	-	-	-	-	-	2	2
Spottail shiner	-	-	6	6	6	1	19
Spotfin shiner	-	-	-	-	-	4	4
Mimic shiner	-	-	1	-	-	-	1
Quillback	1	-	-	-	1	-	2
White sucker	-	1	-	-	-	-	1
Yellow bullhead	-	1	-	-	-	-	1
Channel catfish	1	3	2	1	-	-	7
Rock bass	1	1	3	5	-	-	10
Redbreast sunfish	3	5	6	1	-	-	15
Green sunfish	3	5	10	10	-	1	29
Pumpkinseed	44	14	54	23	5	25	165
Bluegill	25	-	6	15	5	15	66
Lepomis hybrid	5	-	-	-	-	1	6
Smallmouth bass	-	29	14	6	2	-	51
Largemouth bass	8	-	-	-	-	4	12
White crappie	-	-	-	1	1	5	7
Black crappie	1	1	-	1	-	3	6
Walleye	-	-	-	-	1	-	1
No. of Specimens	95	66	103	69	27	68	428
No. of Species	11	12	10	10	9	11	22

NA = Not available

TABLE D-11

Fishes taken by the AC electrofisher on 4-5 October 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1845	1953	2101	2200	2309	0010	
Duration(min)	28	27	26	22	21	35	
Air Temp(C)	11.5	10.5	9.7	10.3	10.5	9.0	
Water Temp(C)	15.2	15.1	15.0	15.0	14.5	14.5	
Dissolved Oxygen(mg/l)	10.2	10.3	10.0	10.1	10.4	10.8	
pH	8.9	8.7	8.6	8.4	8.9	8.7	
Conductivity(micromhos/cm)	350	325	425	375	300	350	
Secchi Disc(cm)	91.4	91.4	73.7	76.2	99.1	101.6	
Volts	210	210	210	210	215	213	
Amps	7.5	7.7	10.0	9.0	6.5	7.5	
Gizzard shad	-	1	1	3	-	5	10
Common carp	1	-	-	1	1	-	3
Golden shiner	-	-	-	-	1	8	9
Common shiner	-	-	-	-	-	1	1
Spottail shiner	2	-	-	24	21	2	49
Spotfin shiner	-	-	-	-	-	2	2
Quillback	3	1	1	-	5	-	10
Yellow bullhead	-	1	-	-	-	-	1
Channel catfish	1	1	-	-	-	-	2
Rock bass	-	4	1	2	-	4	11
Redbreast sunfish	-	2	4	1	-	3	10
Green sunfish	7	16	9	13	-	1	46
Pumpkinseed	51	33	32	8	30	90	244
Bluegill	22	3	4	4	15	34	82
Lepomis hybrid	2	4	-	1	-	-	7
Smallmouth bass	3	24	16	3	4	1	51
Largemouth bass	5	2	-	-	1	5	13
White crappie	1	-	2	1	-	2	6
Black crappie	-	1	-	1	-	-	2
Walleye	-	-	1	-	-	-	1
No. of Specimens	98	93	71	62	78	158	560
No. of Species	10	12	10	11	8	13	19

TABLE D-12

Fishes taken by the AC electrofisher on 7 November 1989 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1806	1911	2000	2052	2158	2300	
Duration(min)	29	22	25	25	27	35	
Air Temp(C)	13.0	13.0	13.0	12.0	12.0	12.0	
Water Temp(C)	10.5	10.5	11.9	10.7	10.8	10.3	
Dissolved Oxygen(mg/l)	11.7	11.8	11.3	11.6	12.6	12.4	
pH	8.3	7.9	7.8	7.7	8.5	8.6	
Conductivity(micromhos/cm)	290	260	310	275	210	300	
Secchi Disc(cm)	139.7	142.2	101.6	152.4	149.9	157.5	
Volts	210	215	215	215	215	215	
Amps	6.0	6.0	6.0	6.0	5.0	6.5	
Gizzard shad	-	-	-	-	-	6	6
Common carp	-	-	-	-	1	1	2
Golden shiner	-	-	-	-	-	12	12
Spottail shiner	-	4	17	57	25	6	109
Spotfin shiner	2	-	-	-	-	-	2
Quillback	-	-	5	25	6	7	43
Rock bass	-	4	3	-	1	-	8
Redbreast sunfish	2	6	8	2	1	1	20
Green sunfish	12	29	8	17	5	3	74
Pumpkinseed	86	8	12	13	10	177	306
Bluegill	7	-	-	1	1	67	76
Lepomis hybrid	2	-	-	-	-	-	2
Smallmouth bass	1	26	4	-	11	-	42
Largemouth bass	3	-	1	-	-	7	11
White crappie	2	-	-	-	2	13	17
Black crappie	2	-	-	-	1	6	9
Walleye	-	-	-	2	3	-	5
No. of Specimens	119	77	58	117	67	306	744
No. of Species	9	6	8	7	12	12	16

APPENDIX E

CREEL SURVEY DATA

TABLE E-1

Creel data reported for each survey day in April 1989, at the General Reservoir.

Day River Stage	11 Tuesday 1.92			16 Sunday 1.55			22 Saturday 1.41			27 Thursday 1.29			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	
Air Temp (C)	6.70	8.00	9.70	10.00	13.00	13.00	11.50	14.70	14.00	15.00	20.00	17.00	
Water Temp (C)	8.70	9.70	10.00	10.30	11.50	11.70	14.00	14.50	14.00	15.00	17.00	17.00	
Anglers	0	0	0	31	35	24	34	35	4	5	6	10	
Fish Caught	0	0	0	23	79	105	88	60	0	14	15	33	
Fish Kept	0	0	0	3	9	58	40	20	0	8	0	7	
Hours Fished	.	.	.	45.75	69.75	69.00	68.00	79.50	6.00	3.50	12.50	19.25	
Catch/Effort (h)	.	.	.	0.50	1.13	1.52	1.29	0.75	0.00	4.00	1.20	1.71	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Brook trout										1																1	1
Common carp							1		1																2		2
Channel catfish													1						1	1					2	1	3
Striped bass							1																		1		1
Rock bass															1								1	1	2	1	3
Sunfishes							3	2	14	3	15	58	1	1	6	14				1	2				41	79	120
Bluegill													2		3					2					5	2	7
Smallmouth bass							15	1	51		32		33	1	26				4		13		10.		184	2	186
Largemouth bass									2				2		1				1						6		6
Crappies										1			9		3					4			15	6	27	11	38
White crappie									2	4				19		3									2	26	28
Black crappie														19		3										22	22

Totals Per Day

	11 Tuesday	16 Sunday	22 Saturday	27 Thursday	Totals
Anglers	0	90	73	21	184
Fish Caught	0	207	148	62	417
Fish Kept	0	70	60	15	145
Hours Fished	.	184.5	153.5	35.25	373.3
Catch/Effort (h)	.	1.12	0.96	1.76	1.12

K = Kept
R = Released
C = Total catch

TABLE E-2

Creel data reported for each survey day in April 1989, at the West Dam.

Day	11 Tuesday			16 Sunday			22 Saturday			27 Thursday			
River Stage	1.92			1.55			1.41			1.29			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	
Air Temp (C)	3.00	6.70	8.00	10.30	13.30	15.00	7.00	14.00	13.00	15.00	21.00	18.50	
Water Temp (C)	7.50	8.00	8.70	9.00	11.00	11.00	12.00	12.50	13.00	14.50	15.30	16.50	
Anglers	0	0	0	0	0	2	3	13	0	0	0	0	
Fish Caught	0	0	0	0	0	1	5	76	0	0	0	0	
Fish Kept	0	0	0	0	0	.	.	.	0	0	0	0	
Hours Fished	.	.	.	.	.	0.50	2.00	39.75	.	.	.	.	
Catch/Effort (h)	.	.	.	.	.	2.00	2.50	1.91	.	.	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Smallmouth bass													5		43										48		48
Walleye											1				33										34		34

Totals Per Day

	11 Tuesday	16 Sunday	22 Saturday	27 Thursday	Totals
Anglers	0	2	16	0	18
Fish Caught	0	1	81	0	82
Fish Kept	0	0	0	0	0
Hours Fished	.	0.50	41.75	.	42.25
Catch/Effort (h)	.	2.00	1.94	.	1.94

K = Kept
R = Released
C = Total catch

TABLE E-3

Creel data reported for each survey day in April 1989, at the East Dam.

Day	11 Tuesday			16 Sunday			22 Saturday			27 Thursday			
River Stage	1.92			1.55			1.41			1.29			
	Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)												
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	Clear	Clear	Clear	Prt cldy	
Air Temp (C)	3.30	6.00	8.00	11.30	15.30	16.00	8.50	13.00	13.00	15.00	20.00	22.00	
Water Temp (C)	7.50	8.00	9.00	10.30	11.00	12.00	13.00	13.30	13.00	14.00	16.70	19.00	
Anglers	0	0	0	10	3	7	9	2	6	0	3	3	
Fish Caught	0	0	0	12	4	13	50	0	3	0	2	2	
Fish Kept	0	0	0	0	0	0	12	0	0	0	.	1	
Hours Fished	.	.	.	7.50	2.75	14.00	17.50	4.00	3.00	.	6.00	3.25	
Catch/Effort (h)	.	.	.	1.60	1.45	0.93	2.86	0.00	1.00	.	0.33	0.62	

Species

	Tue Morning R	K	Tue Midday R	K	Tue Evening R	K	Sun Morning R	K	Sun Midday R	K	Sun Evening R	K
Common carp							1					
Rock bass												
Smallmouth bass							3		3		4	
Crappies												
White crappie												
Black crappie												
Walleye							8		1		9	

	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Thu Morning R	K	Thu Midday R	K	Thu Evening R	K	Totals R	K	C
Common carp													1		1
Rock bass	2	6							2		1		5	6	11
Smallmouth bass	24				3								37		37
Crappies	12												12		12
White crappie		2										1		3	3
Black crappie		4												4	4
Walleye													18		18

Totals Per Day

	11 Tuesday	16 Sunday	22 Saturday	27 Thursday	Totals
Anglers	0	20	17	6	43
Fish Caught	0	29	53	4	86
Fish Kept	0	0	12	1	13
Hours Fished	.	24.25	24.50	9.25	58.00
Catch/Effort (h)	.	1.20	2.16	0.43	1.48

K = Kept
R = Released
C = Total catch

TABLE E-4

Creel data reported for each survey day in April 1989, at the York Haven Generating Station.

Day	11 Tuesday			16 Sunday			22 Saturday			27 Thursday			
River Stage	1.92			1.55			1.41			1.29			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Prt cldy	Clear	Clear	Clear	Prt cldy	
Air Temp (C)	4.50	11.50	7.50	12.50	15.00	13.00	15.00	13.00	10.00	17.70	20.00	16.50	
Water Temp (C)	9.00	10.00	10.70	11.00	12.70	12.50	14.00	14.00	13.70	15.50	16.70	17.00	
Anglers	3	7	2	5	11	10	13	17	3	7	6	18	
Fish Caught	3	7	4	1	2	2	31	57	2	74	91	202	
Fish Kept	0	1	2	0	0	0	0	15	0	2	16	60	
Hours Fished	6.50	21.75	3.00	11.50	30.25	16.25	21.00	46.75	3.00	11.00	13.25	46.00	
Catch/Effort (h)	0.46	0.32	1.33	0.09	0.07	0.12	1.48	1.22	0.67	6.73	6.87	4.39	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp	3		6						1		1		2		2	2			1						16	2	18
Channel catfish																								5		5	5
Rock bass													4			11	1			2	4	16	39	44	48	73	121
Sunfishes																2										2	2
Redbreast sunfish																								1		1	1
Smallmouth bass						2	1		1		1		25		40		1		71		70		101		311	2	313
Crappies																							1	10	1	10	11
White crappie				1																						1	1
Walleye					2																1		1		4		4

Totals Per Day

	11 Tuesday	16 Sunday	22 Saturday	27 Thursday	Totals
Anglers	12	26	33	31	102
Fish Caught	14	5	90	367	476
Fish Kept	3	0	15	78	96
Hours Fished	31.25	58.00	70.75	70.25	230.3
Catch/Effort (h)	0.45	0.09	1.27	5.22	2.07

K = Kept
R = Released
C = Total catch

TABLE E-5

Creel data reported for each survey day in May 1989, at the General Reservoir.

Day	4 Thursday			13 Saturday *			19 Friday *			21 Sunday			
River Stage	1.43			4.00			3.49			2.40			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Clear							Prt cldy	Clear	Clear	
Air Temp (C)	14.50	17.70	16.30							21.00	22.00	24.00	
Water Temp (C)	14.00	15.50	15.70							16.30	17.00	17.00	
Anglers	2	2	8							4	19	4	
Fish Caught	0	0	14							1	110	10	
Fish Kept	0	0	0							0	49	2	
Hours Fished	1.25	2.00	13.75							10.00	65.50	12.00	
Catch/Effort (h)	0.00	0.00	1.02							0.10	1.68	0.83	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp																						1				1	1
Rock bass																						8				8	8
Sunfishes					9																16	38	8	2	33	40	73
Bluegill																					2				2		2
Smallmouth bass					5														1		43	2			49	2	51

Totals Per Day

	4 Thursday	13 Saturday	19 Friday	21 Sunday	Totals
Anglers	12			27	39
Fish Caught	14			121	135
Fish Kept	0			51	51
Hours Fished	17.00			87.50	104.5
Catch/Effort (h)	0.82			1.38	1.29

K = Kept
R = Released
C = Total catch
* = Surveys were not conducted due to high river flow.

TABLE E-6

Creel data reported for each survey day in May 1989, at the West Dam.

Day	4 Thursday			13 Saturday*			19 Friday*			21 Sunday			
River Stage	1.43			4.00			3.49			2.40			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Clear							Prt cldy	Clear	Clear	
Air Temp (C)	12.00	15.70	17.00							19.00	23.00	22.70	
Water Temp (C)	13.00	14.70	15.30							17.00	18.00	18.00	
Anglers	2	1	0							0	0	0	
Fish Caught	5	26	0							0	0	0	
Fish Kept	.	.	0							0	0	0	
Hours Fished	1.50	3.75	.							.	.	.	
Catch/Effort (h)	3.33	6.93	.							.	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish			1																						1		1
Sunfishes	1																								1		1
Smallmouth bass	3		25																						28		28
Crappies	1																								1		1

Totals Per Day

	4 Thursday	13 Saturday	19 Friday	21 Sunday	Totals
Anglers	3			0	3
Fish Caught	31			0	31
Fish Kept	0			0	0
Hours Fished	5.25			.	5.25
Catch/Effort (h)	5.90			.	5.90

K = Kept
R = Released
C = Total catch
* = Surveys were not conducted due to high river flow.

TABLE E-7

Creel data reported for each survey day in May 1989, at the East Dam.

Day	4 Thursday			13 Saturday*			19 Friday*			21 Sunday			
River Stage	1.43			4.00			3.49			2.40			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Clear							Overcast	Clear	Clear	
Air Temp (C)	10.30	18.00	18.50							19.30	20.70	26.00	
Water Temp (C)	13.00	14.50	15.00							16.50	17.00	18.70	
Anglers	5	6	4							7	10	5	
Fish Caught	12	13	8							139	181	37	
Fish Kept	2	11	1							51	74	12	
Hours Fished	6.75	13.25	4.50							22.00	36.00	7.00	
Catch/Effort (h)	1.78	0.98	1.78							6.32	5.03	5.29	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Rock bass	2			3	6														20	50	37	58	5	12	70	123	193
Sunfishes																			10			5	20		30	5	35
Redbreast sunfish				2																						2	2
Green sunfish		1		3																						4	4
Pumpkinseed				2																						2	2
Bluegill																						10				10	10
Smallmouth bass	2		2		1														53		70				128		128
Largemouth bass																			5						5		5
Crappies	6					1																			6	1	7
White crappie		1		1																						2	2
Yellow perch																						1				1	1
Walleye																				1						1	1

Totals Per Day

	4 Thursday	13 Saturday	19 Friday	21 Sunday	Totals
Anglers	15			22	37
Fish Caught	33			357	390
Fish Kept	14			137	151
Hours Fished	24.50			65.00	89.50
Catch/Effort (h)	1.35			5.49	4.36

K = Kept
R = Released
C = Total catch
* = Surveys were not conducted due to high river flow.

TABLE E-8

Creel data reported for each survey day in May 1989, at the York Haven Generating Station.

Day River Stage	4 Thursday 1.43			13 Saturday 4.00			19 Friday 3.49			21 Sunday 2.40			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Clear	Prt cldy	Clear	Clear	
Air Temp (C)	16.00	19.00	18.00	13.00	16.50	17.00	21.00	25.00	24.00	21.00	24.50	24.70	
Water Temp (C)	14.30	15.30	15.50	10.00	10.50	10.50	14.50	15.00	15.30	17.00	18.00	18.00	
Anglers	11	12	11	10	23	15	9	3	2	18	15	13	
Fish Caught	83	91	88	25	29	32	32	14	4	100	183	229	
Fish Kept	8	14	12	9	11	7	3	2	0	12	64	134	
Hours Fished	28.25	31.75	14.75	18.75	31.50	43.00	12.75	5.00	0.75	50.75	55.50	62.00	
Catch/Effort (h)	2.94	2.87	5.97	1.33	0.92	0.74	2.51	2.80	5.33	1.97	3.30	3.69	

Species

Species	4 Thu Morning R	K	Midday R	K	Evening R	K	13 Sat Morning R	K	Midday R	K	Evening R	K
American shad												
Rainbow trout										1		
Muskellunge	2											
Common carp	4		13						1		1	
Suckers											1	
Quillback												
Channel catfish				1		1						
Rock bass	6	7	6	9	12	10		4	2	5	2	5
Sunfishes	6					1	2		2		4	
Redbreast sunfish				1								
Smallmouth bass	52	1	58	2	58		12	1	7		14	
Crappies				1					2		1	
White crappie								1		1		
Black crappie								1				
Yellow perch										1		
Walleye	5				6		2	2	4	3	2	2

Species	19 Fri Morning R	K	Midday R	K	Evening R	K	21 Sun Morning R	K	Midday R	K	Evening R	K	Totals R	K	C
American shad							1						1		1
Rainbow trout														1	1
Muskellunge													2	.	2
Common carp							6	1	1				26	1	27
Suckers	1										1		3		3
Quillback									12		12		24		24
Channel catfish												20		22	22
Rock bass		1	4	1	1		2	10	16	52	20	101	71	205	276
Sunfishes	1			1			5		7	8		8	27	18	45
Redbreast sunfish							1						1	1	2
Smallmouth bass	26		7		3		64		79		62		442	4	446
Crappies		2					2		2			1	7	4	11
White crappie														2	2
Black crappie														1	1
Yellow perch								1		4		4		10	10
Walleye	1		1				7		2				30	7	37

Totals Per Day

	4 Thursday	13 Saturday	19 Friday	21 Sunday	Totals
Anglers	34	48	14	46	142
Fish Caught	262	86	50	512	910
Fish Kept	34	27	5	210	276
Hours Fished	74.75	93.25	18.50	168.3	354.8
Catch/Effort (h)	3.51	0.92	2.70	3.04	2.56

K = Kept
R = Released
C = Total catch

TABLE E-9

Creel data reported for each survey day in June 1989, at the General Reservoir.

Day	3 Saturday			7 Wednesday			25 Sunday			30 Friday			
River Stage	1.42			1.54			2.73			1.85			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Clear	Prt cldy	Hvy rain	Overcast	Overcast	Prt cldy	Clear	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	23.50	27.00	23.00	17.70	17.00	17.00	23.70	26.30	23.30	19.30	25.00	23.00	
Water Temp (C)	23.30	24.50	24.70	21.00	20.50	20.00	19.50	20.00	20.00	21.00	22.00	22.00	
Anglers	72	17	26	0	10	3	9	4	7	11	6	3	
Fish Caught	434	44	70	0	24	23	2	2	9	14	13	31	
Fish Kept	32	0	5	0	3	0	1	1	6	3	3	9	
Hours Fished	183.5	50.00	59.50	.	20.50	19.50	10.75	5.25	14.50	10.75	9.00	13.00	
Catch/Effort (h)	2.37	0.88	1.18	.	1.17	1.18	0.19	0.38	0.62	1.30	1.44	2.38	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish	1	1	3		1	4			1				1	1				3		3					7	12	19
Rock bass	17	20	2		2														2						23	20	43
Sunfishes	31	10	2		15	1			1								2	2	2		2			9	55	22	77
Pumpkinseed										3											2	3			2	6	8
Bluegill	7	1			4														6						17	1	18
Smallmouth bass	345		37		39				19		23				1	1	1	1	1		6		22		494	2	496
Largemouth bass					2																				2		2
Crappies	1				2																				3		3

Totals Per Day

	3 Saturday	7 Wednesday	25 Sunday	30 Friday	Totals
Anglers	115	13	20	20	168
Fish Caught	548	47	13	58	666
Fish Kept	37	3	8	15	63
Hours Fished	293.0	40.00	30.50	32.75	396.3
Catch/Effort (h)	1.87	1.17	0.43	1.77	1.68

K = Kept
R = Released
C = Total catch

TABLE E-10

Creel data reported for each survey day in June 1989, at the West Dam.

Day River Stage	3 Saturday 1.42			7 Wednesday 1.54			25 Sunday 2.73			30 Friday 1.85			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Clear	Prt cldy	Hvy rain	Overcast	Overcast	Prt cldy	Clear	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	23.30	28.00	26.00	17.70	17.00	17.00	22.00	25.00	23.00	21.00	24.00	23.00	
Water Temp (C)	22.30	23.50	24.00	20.70	20.30	20.00	21.00	21.00	21.70	21.30	22.00	22.50	
Anglers	3	5	4	0	3	0	0	0	0	0	0	2	
Fish Caught	50	43	27	0	22	0	0	0	0	0	0	0	
Fish Kept	.	.	.	0	.	0	0	0	0	0	0	0	
Hours Fished	6.00	17.00	9.25	.	7.50	.	.	.	.	.	.	1.00	
Catch/Effort (h)	8.33	2.53	2.92	.	2.93	.	.	.	.	.	.	0.00	

Species

	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Wed Morning R	K	Wed Midday R	K	Wed Evening R	K	Sun Morning R	K
Common carp									6					
Channel catfish					2				6					
Rock bass					4									
Sunfishes					8									
Bluegill			2											
Smallmouth bass	50		41		13				10					

	Sun Midday R	K	Sun Evening R	K	Fri Morning R	K	Fri Midday R	K	Fri Evening R	K	Totals R	K	C
Common carp											6		6
Channel catfish											8		8
Rock bass											4		4
Sunfishes											8		8
Bluegill											2		2
Smallmouth bass											114		114

Totals Per Day

	3 Saturday	7 Wednesday	25 Sunday	30 Friday	Totals
Anglers	12	3	0	2	17
Fish Caught	120	22	0	0	142
Fish Kept	.	0	0	0	0
Hours Fished	32.25	7.50	.	1.00	40.75
Catch/Effort (h)	3.72	2.93	.	0.00	3.48

K = Kept
R = Released
C = Total catch

TABLE E-11

Creel data reported for each survey day in June 1989, at the East Dam.

Day	3 Saturday			7 Wednesday			25 Sunday			30 Friday			
River Stage	1.42			1.54			2.73			1.85			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Prt cldy	Clear	Lt rain	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	22.00	26.00	28.00	18.00	17.00	16.70	23.00	26.00	24.50	19.00	26.00	25.50	
Water Temp (C)	22.50	23.50	24.70	19.70	19.30	19.00	20.30	21.00	21.30	19.00	20.00	21.50	
Anglers	3	7	4	4	3	6	0	0	0	2	4	3	
Fish Caught	14	19	26	20	19	25	0	0	0	2	27	56	
Fish Kept	.	15	15	1	.	10	0	0	0	1	11	39	
Hours Fished	1.50	14.50	12.00	5.25	6.50	10.50	.	.	.	3.25	13.00	11.00	
Catch/Effort (h)	9.33	1.31	2.17	3.81	2.92	2.38	.	.	.	0.62	2.08	5.09	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Brown trout												1														1	1
Channel catfish									2																2		2
Rock bass				4	2	8						1										2		10	2	25	27
Sunfishes			2	7		7			5		13										10		3		33	14	47
Redbreast sunfish				1								4										2		20		27	27
Pumpkinseed												4														4	4
Bluegill	12			3			1																		13	3	16
Smallmouth bass	2		2		9		17		8		2									1	6	6	12	6	58	13	71
Crappies								1											1					2	1	3	4
White crappie																						1				1	1
Walleye							1		4														2	1	7	1	8

Totals Per Day

	3 Saturday	7 Wednesday	25 Sunday	30 Friday	Totals
Anglers	14	13	0	9	36
Fish Caught	59	64	0	85	208
Fish Kept	30	11	0	51	92
Hours Fished	28.00	22.25	.	27.25	77.50
Catch/Effort (h)	2.11	2.88	.	3.12	2.68

K = Kept
R = Released
C = Total catch

TABEL E-12

Creel data reported for each survey day in June 1989, at the York Haven Generating Station.

Day	3 Saturday			7 Wednesday			25 Sunday			30 Friday			
River Stage	1.42			1.54			2.73			1.85			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Prt cldy	Lt rain	Lt rain	Overcast	Clear	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	25.00	23.50	21.00	17.00	17.50	17.00	26.00	29.50	23.30	20.50	23.00	22.00	
Water Temp (C).	24.00	24.70	24.00	20.50	20.00	20.00	21.00	22.00	20.70	21.70	23.70	23.70	
Anglers	20	23	21	1	8	13	6	11	9	10	4	22	
Fish Caught	50	82	88	8	32	57	5	8	2	72	10	50	
Fish Kept	10	11	30	.	.	30	1	3	1	29	1	26	
Hours Fished	62.75	70.00	75.00	2.00	14.25	15.00	5.50	23.00	12.25	16.25	5.75	32.50	
Catch/Effort (h)	0.80	1.17	1.17	4.00	2.25	3.80	0.91	0.35	0.16	4.43	1.74	1.54	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp	9		11		1				5						4		1						1	1	32	1	33
Channel catfish		1			1	6	2				2	8		1		2		1	2		9	1	3	1	19	21	40
Rock bass		1	3		2	7			4		5	5							3	5			4	2	21	20	41
Sunfishes	2	4	1	5	6	6			1		10	17							31				4	5	55	37	92
Redbreast sunfish																				13				15		28	28
Bluegill	1		1	6	1	6														4					3	16	19
Smallmouth bass	26	4	54		42		6		22		10								6	6			10	2	176	12	188
Largemouth bass					2																				2		2
Crappies	1		1		1	1																			3	1	4
White crappie						2														1						3	3
Black crappie						2																				2	2
Walleye	1				2								4		1	1			1				2		11	1	12

Totals Per Day

	3 Saturday	7 Wednesday	25 Sunday	30 Friday	Totals
Anglers	64	22	26	36	148
Fish Caught	220	97	15	132	464
Fish Kept	51	30	5	56	142
Hours Fished	207.8	31.25	40.75	54.50	334.3
Catch/Effort (h)	1.06	3.10	0.37	2.42	1.39

K = Kept
R = Released
C = Total catch

TABLE E-13

Creel data reported for each survey day in July 1989, at the General Reservoir.

Day	9 Sunday			12 Wednesday			17 Monday			29 Saturday			
River Stage	1.62			1.49			1.91			1.31			
Time – Morning (0900–1300), Midday (1301–1700), Evening (1701–2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Overcast	Overcast	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Clear	
Air Temp (C)	23.50	30.00	24.70	22.00	22.30	20.70	21.00	23.30	24.00	21.50	24.00	22.00	
Water Temp (C)	23.00	23.50	24.00	25.00	25.00	25.00	19.30	20.00	20.00	24.00	25.30	25.00	
Anglers	46	18	9	19	9	11	4	1	13	62	21	27	
Fish Caught	97	44	9	104	35	111	5	0	10	308	92	30	
Fish Kept	19	.	0	9	8	0	0	0	10	52	12	10	
Hours Fished	111.0	54.50	13.50	47.00	26.00	31.75	12.00	2.00	20.50	154.8	67.50	38.50	
Catch/Effort (h)	0.87	0.81	0.67	2.21	1.35	3.50	0.42	0.00	0.49	1.99	1.36	0.78	

Species

Species	Sun Morning R	Sun Morning K	Sun Midday R	Sun Midday K	Sun Evening R	Sun Evening K	Wed Morning R	Wed Morning K	Wed Midday R	Wed Midday K	Wed Evening R	Wed Evening K	Mon Morning R	Mon Morning K	Mon Midday R	Mon Midday K	Mon Evening R	Mon Evening K	Sat Morning R	Sat Morning K	Sat Midday R	Sat Midday K	Sat Evening R	Sat Evening K	Totals R	Totals K	Totals C
Channel catfish	6	1	2		1						1		4					1	2		1				17	2	19
Rock bass	4	2	4				1	1	2		4							6	9	3	2		2	4	28	16	44
Sunfishes	5		12		6				8		4							1	3		3	1			41	2	43
Redbreast sunfish																				1				2		3	3
Pumpkinseed																								2		2	2
Bluegill	6		1					2										2	1	2	2				10	6	16
Smallmouth bass	50	15	25		2		94	5	17	8	102		1						239	45	72	11	17	2	619	86	705
Largemouth bass								1											2	1					2	2	4
Crappies	1	1																							1	1	2
White crappie	6																								6		6
Yellow perch																							1		1		1

Totals Per Day

	9 Sunday	12 Wednesday	17 Monday	29 Saturday	Totals
Anglers	73	39	18	110	240
Fish Caught	150	250	15	430	845
Fish Kept	19	17	10	74	120
Hours Fished	179.0	104.7	34.50	260.8	579.0
Catch/Effort (h)	0.84	2.39	0.43	1.65	1.46

K = Kept
R = Released
C = Total catch

TABLE E-14

Creel data reported for each survey day in July 1989, at the West Dam.

Day River Stage	9 Sunday 1.62			12 Wednesday 1.49			17 Monday 1.91			29 Saturday 1.31			
Time – Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Overcast	Overcast	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Clear	
Air Temp (C)	25.00	27.70	24.70	22.30	23.00	20.00	20.00	23.00	24.00	23.00	25.70	23.00	
Water Temp (C)	24.70	25.30	25.70	26.50	26.50	26.50	21.50	21.50	22.00	26.00	26.30	26.30	
Anglers	0	0	0	1	0	3	0	0	0	4	0	0	
Fish Caught	0	0	0	30	0	21	0	0	0	14	0	0	
Fish Kept	0	0	0	5	0	.	0	0	0	1	0	0	
Hours Fished	.	.	.	2.00	.	12.00	.	.	.	11.00	.	.	
Catch/Effort (h)	.	.	.	15.0	.	1.75	.	.	.	1.27	.	.	

Species

	Sun Morning R	Sun Morning K	Sun Midday R	Sun Midday K	Sun Evening R	Sun Evening K	Wed Morning R	Wed Morning K	Wed Midday R	Wed Midday K	Wed Evening R	Wed Evening K	Mon Morning R	Mon Morning K	Mon Midday R	Mon Midday K	Mon Evening R	Mon Evening K	Sat Morning R	Sat Morning K	Sat Midday R	Sat Midday K	Sat Evening R	Sat Evening K	Totals R	Totals K	Totals C
Channel catfish																			2						2		2
Smallmouth bass							25	5			21								9	1					55	6	61
Walleye																			2						2		2

Totals Per Day

	9 Sunday	12 Wednesday	17 Monday	29 Saturday	Totals
Anglers	0	4	0	4	8
Fish Caught	0	51	0	14	65
Fish Kept	0	5	0	1	6
Hours Fished	.	14.00	.	11.00	25.00
Catch/Effort (h)	.	3.64	.	1.27	2.60

K = Kept
R = Released
C = Total catch

TABLE E-15

Creel data reported for each survey day in July 1989, at the East Dam.

Day River Stage	9 Sunday 1.62			12 Wednesday 1.49			17 Monday 1.91			29 Saturday 1.31			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Overcast	Prt cldy	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Clear	
Air Temp (C)	25.00	27.00	25.00	23.30	23.30	22.50	19.00	20.30	25.70	22.00	21.30	24.00	
Water Temp (C)	24.70	25.70	25.00	26.00	26.00	26.00	17.50	18.70	19.30	24.30	25.00	25.30	
Anglers	3	5	10	1	7	8	0	0	1	10	6	8	
Fish Caught	43	18	20	10	64	100	0	0	1	30	26	8	
Fish Kept	4	.	13	2	11	17	0	0	.	14	2	4	
Hours Fished	7.00	9.00	5.50	1.00	14.00	18.00	.	.	0.25	45.00	19.50	13.50	
Catch/Effort (h)	6.14	2.00	3.64	10.0	4.57	5.56	.	.	4.00	0.67	1.33	0.59	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp					1																				1		1
Channel catfish																			4	4				1	4	5	9
Rock bass										4		1									1			1	1	6	7
Sunfishes	9	1			3				18		8						1			5	1		1		41	6	47
Redbreast sunfish						7																				7	7
Green sunfish						5																				5	5
Bluegill												2														2	2
Smallmouth bass	26	3	17		3	1	8	2	27	7	68	11							11	4	22	2	1	2	183	32	215
Largemouth bass																							2		2		2
Crappies												1														1	1
Walleye	4		1						8		7	2							1	1					21	3	24

Totals Per Day

	9 Sunday	12 Wednesday	17 Monday	29 Saturday	Totals
Anglers	18	16	1	24	59
Fish Caught	81	174	1	64	320
Fish Kept	17	30	0	20	67
Hours Fished	21.50	33.00	0.25	78.00	132.8
Catch/Effort (h)	3.77	5.27	4.00	0.82	2.41

K = Kept
R = Released
C = Total catch

TABLE E-16

Creel data reported for each survey day in July 1989, at the York Haven Generating Station.

Day / River Stage	9 Sunday 1.62			12 Wednesday 1.49			17 Monday 1.91			29 Saturday 1.31			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Clear	Prt cldy	Lt rain	Overcast	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	29.50	27.00	24.00	24.00	23.30	22.30	25.50	23.00	21.00	25.00	24.00	19.00	
Water Temp (C)	25.30	25.00	25.00	25.50	26.30	25.50	20.00	23.00	21.50	26.30	26.50	25.30	
Anglers	19	22	22	8	7	25	7	9	21	12	17	31	
Fish Caught	29	30	33	24	65	48	9	44	74	50	37	68	
Fish Kept	10	11	17	6	4	18	3	16	26	19	9	21	
Hours Fished	40.50	31.00	38.75	9.50	20.50	32.50	7.50	29.75	50.50	19.50	36.25	73.00	
Catch/Effort (h)	0.72	0.97	0.85	2.53	3.17	1.48	1.20	1.48	1.47	2.56	1.02	0.93	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
American shad									2								1								3		3
Rainbow trout				1		1																				2	2
Common carp	2														2								4		8		8
Suckers											1					1									1	1	2
Channel catfish	3	2		2	2	2	1	5	2	2				1		4	2	9	2	6		4	17	9	29	46	75
Rock bass			1			2	2		1		1	4				1	4	5		1				3	9	16	25
Sunfishes		1	1		6	1	1				3		1		1							1	8	4	21	7	28
Redbreast sunfish	1			1		1								2		4									1	8	9
Bluegill			1								1		1			2	20		1	1					24	3	27
Smallmouth bass	13	7	16	7	7	10	14	1	56	1	24	2	4		22	3	14	4	28	7	26	4	18	4	242	50	292
Crappies															1			1		4	2				3	5	8
White crappie										1		12				1		4						1		19	19
Black crappie																		3								3	3
Walleye					1										2		7								10		10

Totals Per Day

	9 Sunday	12 Wednesday	17 Monday	29 Saturday	Totals
Anglers	63	40	37	60	200
Fish Caught	92	137	127	155	511
Fish Kept	38	28	45	49	160
Hours Fished	110.2	62.50	87.75	128.8	389.3
Catch/Effort (h)	0.83	2.19	1.45	1.20	1.31

K = Kept
R = Released
C = Total catch

TABLE E-17

Creel data reported for each survey day in August 1989, at the General Reservoir.

Day	6 Sunday			15 Tuesday			26 Saturday			31 Thursday			
River Stage	1.19			1.10			1.04			1.00			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Prt cldy	Prt cldy	Fog	Overcast	Lt rain	Clear	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	29.00	32.30	31.50	22.00	24.50	24.00	20.70	26.70	26.00	23.50	25.00	23.50	
Water Temp (C)	27.00	28.70	29.00	24.00	25.50	25.50	24.70	27.00	27.00	25.00	26.70	27.70	
Anglers	61	23	21	21	8	5	75	25	42	18	7	10	
Fish Caught	331	110	49	51	28	3	281	48	150	51	8	24	
Fish Kept	32	5	10	11	6	1	38	5	29	10	0	0	
Hours Fished	151.8	60.25	68.00	34.00	14.50	8.25	187.3	60.00	96.00	45.25	4.00	18.25	
Catch/Effort (h)	2.18	1.83	0.72	1.50	1.93	0.36	1.50	0.80	1.56	1.13	2.00	1.32	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Pikes	1																								1		1
Common carp	1												1												2		2
Fallfish	2																								2		2
Channel catfish	5	2	1				1					1	7	8	2		15	1	6	1			2		39	13	52
Rock bass	12	2	1		5								10	8	5		4		10		1				48	10	58
Sunfishes	13	2	1		6		4	2					9		4		7	10		2					44	16	60
Redbreast sunfish							1																		1		1
Bluegill	1												4	3				1					1		6	4	10
Smallmouth bass	260	26	102	5	28	10	34	9	21	6	2		211	19	28	5	95	17	25	7	7		21		834	104	938
Largemouth bass	1								1				1		2										5		5
Crappies	3														2										5		5

Totals Per Day

	6 Sunday	15 Tuesday	26 Saturday	31 Thursday	Totals
Anglers	105	34	142	35	316
Fish Caught	490	82	479	83	1134
Fish Kept	47	18	72	10	147
Hours Fished	280.0	56.75	343.3	67.50	747.5
Catch/Effort (h)	1.75	1.44	1.40	1.23	1.52

K = Kept
R = Released
C = Total catch

TABLE E-18

Creel data reported for each survey day in August 1989, at the West Dam.

Day River Stage	6 Sunday 1.19			15 Tuesday 1.10			26 Saturday 1.04			31 Thursday 1.00			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Prt cldy	Prt cldy	Fog	Overcast	Overcast	Clear	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	27.00	33.00	30.30	21.30	25.00	24.00	20.00	27.00	24.00	23.00	26.30	26.00	
Water Temp (C)	27.30	29.00	29.00	24.30	25.00	25.00	24.00	26.00	27.00	24.00	25.00	27.30	
Anglers	2	0	0	2	1	0	1	3	0	0	0	0	
Fish Caught	20	0	0	1	0	0	2	63	0	0	0	0	
Fish Kept	.	0	0	.	0	0	.	.	0	0	0	0	
Hours Fished	5.50	.	.	0.50	0.25	.	2.00	13.50	.	.	.	.	
Catch/Effort (h)	3.64	.	.	2.00	0.00	.	1.00	4.67	.	.	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish	4												1		31										36		36
Smallmouth bass	16						1						1		32										50		50

Totals Per Day

	6 Sunday	15 Tuesday	26 Saturday	31 Thursday	Totals
Anglers	2	3	4	0	9
Fish Caught	20	1	65	0	86
Fish Kept	0	0	0	0	0
Hours Fished	5.50	0.75	15.50	.	21.75
Catch/Effort (h)	3.64	1.33	4.19	.	3.95

K = Kept
R = Released
C = Total catch

TABLE E-19

Creel data reported for each survey day in August 1989, at the East Dam.

Day	6 Sunday	15 Tuesday	26 Saturday	31 Thursday
River Stage	1.19	1.10	1.04	1.00

Time – Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)

	6 Sunday Morning	6 Sunday Midday	6 Sunday Evening	15 Tuesday Morning	15 Tuesday Midday	15 Tuesday Evening	26 Saturday Morning	26 Saturday Midday	26 Saturday Evening	31 Thursday Morning	31 Thursday Midday	31 Thursday Evening	Totals
Weather	Prt cldy	Prt cldy	Prt cldy	Fog	Prt cldy	Overcast	Clear	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	26.50	29.50	29.00	21.50	26.00	23.70	23.00	27.00	24.00	23.00	25.50	27.70	
Water Temp (C)	27.30	28.50	28.70	22.70	24.00	24.00	25.00	27.50	28.00	24.50	26.30	27.30	
Anglers	2	7	12	0	0	0	2	1	3	1	0	0	
Fish Caught	14	23	48	0	0	0	4	35	80	0	0	0	
Fish Kept	.	2	4	0	0	0	.	.	27	0	0	0	
Hours Fished	6.00	11.00	33.50	.	.	.	7.00	2.00	25.50	0.50	.	.	
Catch/Effort (h)	2.33	2.09	1.43	.	.	.	0.57	17.5	3.14	0.00	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp					12																				12		12
Channel catfish			2	1	10								1		25		1	2							39	3	42
Rock bass															2										2		2
Sunfishes			8	1	6										6										20	1	21
Bluegill			1														40	24							41	24	65
Smallmouth bass	14		8		11	3							3		1		12								49	3	52
Crappies					4	1																			4	1	5
Yellow perch																		1								1	1
Walleye			2		1										1										4		4

Totals Per Day

	6 Sunday	15 Tuesday	26 Saturday	31 Thursday	Totals
Anglers	21	0	6	1	28
Fish Caught	85	0	119	0	204
Fish Kept	6	0	27	0	33
Hours Fished	50.50	.	34.50	0.50	85.50
Catch/Effort (h)	1.68	.	3.45	0.00	2.39

K = Kept
R = Released
C = Total catch

TABLE E-20

Creel data reported for each survey day in August 1989, at the York Haven Generating Station.

Day	6 Sunday			15 Tuesday			26 Saturday			31 Thursday			
River Stage	1.19			1.10			1.04			1.00			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Prt cldy	Prt cldy	Overcast	Lt rain	Lt rain	Prt cldy	Prt cldy	Prt cldy	Clear	Clear	Clear	
Air Temp (C)	31.00	30.00	28.00	22.00	23.00	22.50	25.00	26.00	21.00	25.00	25.00	24.00	
Water Temp (C)	28.30	29.00	28.70	22.00	23.00	23.00	23.50	24.00	24.00	24.30	24.70	25.00	
Anglers	3	5	9	6	2	3	3	7	20	0	3	3	
Fish Caught	17	7	24	6	3	0	4	47	126	0	9	7	
Fish Kept	0	1	4	3	.	0	4	21	9	0	1	4	
Hours Fished	12.00	8.50	20.50	16.50	3.00	0.75	8.50	14.25	38.25	.	8.50	3.50	
Catch/Effort (h)	1.42	0.82	1.17	0.36	1.00	0.00	0.47	3.30	3.29	.	1.06	2.00	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Pikes																	1								1		1
Common carp									1						1		6				1				9		9
Channel catfish	2		2	1		1		1	2					4	1	6	5	6					3	4	15	23	38
Rock bass																		1								1	1
Sunfishes					6			1																	6	1	7
Redbreast sunfish						1										1										2	2
Smallmouth bass	15		4		14	2	3								24	14	105	1			7	1			172	18	190
White crappie								1																		1	1
Walleye																		1								1	1

Totals Per Day

	6 Sunday	15 Tuesday	26 Saturday	31 Thursday	Totals
Anglers	17	11	30	6	64
Fish Caught	48	9	177	16	250
Fish Kept	5	3	34	5	47
Hours Fished	41.00	20.25	61.00	12.00	134.3
Catch/Effort (h)	1.17	0.44	2.90	1.33	1.86

K = Kept
R = Released
C = Total catch

TABLE E-21

Creel data reported for each survey day in September 1989, at the General Reservoir.

Day River Stage	8 Friday 0.99			10 Sunday 0.99			23 Saturday 1.12			28 Thursday 1.22			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Fog	Overcast	Overcast	Haze	Prt cldy	Clear	Hvy rain	Hvy rain	Lt rain	Clear	Clear	Clear	
Air Temp (C)	19.30	23.00	23.70	27.00	32.50	28.30	21.00	15.00	11.50	11.00	17.00	16.00	
Water Temp (C)	22.50	24.70	24.70	25.70	28.00	28.50	22.00	21.00	20.50	16.00	17.00	16.30	
Anglers	14	8	6	36	13	13	13	12	0	13	8	2	
Fish Caught	47	75	18	96	25	32	41	20	0	14	35	0	
Fish Kept	9	12	5	6	2	2	4	5	0	3	10	0	
Hours Fished	24.25	30.00	12.00	76.75	19.50	18.50	35.17	15.00	.	13.50	22.75	4.00	
Catch/Effort (h)	1.94	2.50	1.50	1.25	1.28	1.73	1.17	1.33	.	1.04	1.54	0.00	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish	1		4	1	5	3	1		1		1		2			1						3			15	8	23
Rock bass	4	3	2	5	1		3						3												13	8	21
Sunfishes			6		1		6			2	2		1		2										18	2	20
Redbreast sunfish	2		2																						4		4
Bluegill		1			2	1																3			2	5	7
Smallmouth bass	31	5	49	6	4	1	72	6	22		27	2	31	4	13	4			11	2	25	3			285	33	318
Largemouth bass							2																		2		2
Crappies							6																		6		6
Yellow perch																				1		1				2	2

Totals Per Day

	8 Friday	10 Sunday	23 Saturday	28 Thursday	Totals
Anglers	28	62	25	23	138
Fish Caught	140	153	61	49	403
Fish Kept	26	10	9	13	58
Hours Fished	66.25	114.7	50.17	40.25	271.4
Catch/Effort (h)	2.11	1.33	1.22	1.22	1.48

K = Kept
R = Released
C = Total catch

TABLE E-22

Creel data reported for each survey day in September 1989, at the West Dam.

Day	8 Friday			10 Sunday			23 Saturday			28 Thursday			
River Stage	0.99			0.99			1.12			1.22			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Fog	Overcast	Overcast	Haze	Prt cldy	Clear	Overcast	Overcast	Overcast	Clear	Clear	Clear	
Air Temp (C)	18.00	23.30	22.00	28.00	31.50	30.00	22.70	14.70	11.50	11.00	16.00	17.30	
Water Temp (C)	22.30	24.00	24.30	25.00	28.50	29.50	22.00	21.00	19.70	15.70	16.30	16.50	
Anglers	0	1	2	1	2	3	1	0	0	0	0	0	
Fish Caught	0	21	14	16	1	1	5	0	0	0	0	0	
Fish Kept	0	.	9	6	.	1	2	0	0	0	0	0	
Hours Fished	.	5.25	4.00	3.00	1.00	1.50	2.50	.	.	.	.	.	
Catch/Effort (h)	.	4.00	3.50	5.33	1.00	0.67	2.00	.	.	.	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish			12		3	8	8	4				1		2											23	15	38
Rock bass			1																						1		1
Bluegill													1												1		1
Smallmouth bass			8		2	1	2		1																13	1	14
Crappies								2																		2	2
Walleye													2												2		2

Totals Per Day

	8 Friday	10 Sunday	23 Saturday	28 Thursday	Totals
Anglers	3	6	1	0	10
Fish Caught	35	18	5	0	58
Fish Kept	9	7	2	0	18
Hours Fished	9.25	5.50	2.50	.	17.25
Catch/Effort (h)	3.78	3.27	2.00	.	3.36

K = Kept
R = Released
C = Total catch

TABLE E-23

Creel data reported for each survey day in September 1989, at the East Dam.

Day	8 Friday			10 Sunday			23 Saturday			28 Thursday			
River Stage	0.99			0.99			1.12			1.22			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Fog	Overcast	Prt cldy	Haze	Prt cldy	Clear	Overcast	Overcast	Overcast	Clear	Clear	Clear	
Air Temp (C)	18.70	23.00	22.30	27.00	31.00	31.00	22.00	13.70	11.00	11.30	17.00	18.70	
Water Temp (C)	21.70	22.70	22.00	24.70	26.00	27.00	21.50	20.50	20.00	15.70	17.00	16.70	
Anglers	0	0	0	2	2	4	0	0	0	0	0	0	
Fish Caught	0	0	0	7	22	13	0	0	0	0	0	0	
Fish Kept	0	0	0	1	12	.	0	0	0	0	0	0	
Hours Fished	.	.	.	6.50	5.00	3.50	.	.	.	.	.	.	
Catch/Effort (h)	.	.	.	1.08	4.40	3.71	.	.	.	.	.	.	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish							2	1																	2	1	3
Rock bass										2																2	2
Sunfishes							4		10	10	3														17	10	27
Smallmouth bass											10														10		10

Totals Per Day

	8 Friday	10 Sunday	23 Saturday	28 Thursday	Totals
Anglers	0	8	0	0	8
Fish Caught	0	42	0	0	42
Fish Kept	0	13	0	0	13
Hours Fished	.	15.00	.	.	15.00
Catch/Effort (h)	.	2.80	.	.	2.80

K = Kept
R = Released
C = Total catch

TABLE E-24

Creel data reported for each survey day in September 1989, at the York Haven Generating Station.

Day	8 Friday			10 Sunday			23 Saturday			28 Thursday			
River Stage	0.99			0.99			1.12			1.22			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Overcast	Prt cldy	Prt cldy	Haze	Prt cldy	Clear	Overcast	Hvy rain	Overcast	Clear	Clear	Clear	
Air Temp (C)	20.00	21.70	21.00	28.50	31.50	26.00	20.00	12.00	10.30	15.00	17.30	13.00	
Water Temp (C)	21.50	22.50	22.70	24.50	25.70	26.00	22.00	20.30	20.00	16.00	16.50	16.50	
Anglers	4	0	0	8	5	18	17	0	3	4	2	4	
Fish Caught	31	0	0	31	10	24	42	0	2	3	5	7	
Fish Kept	3	0	0	3	5	15	29	0	1	0	1	2	
Hours Fished	10.25	.	.	17.50	15.50	51.50	29.76	.	4.00	2.00	4.25	11.75	
Catch/Effort (h)	3.02	.	.	1.77	0.65	0.47	1.41	.	0.50	1.50	1.18	0.60	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp	14						2	1	1	3	2		3								1		2		25	4	29
Channel catfish	12	3					25	1	1		1	6	1	7											40	17	57
Rock bass										1				9												10	10
Sunfishes											2														2		2
Redbreast sunfish												3		1												4	4
Bluegill												3		9				1								13	13
Smallmouth bass	2						1	1	3	1	3		6	1			1		3		1		3		23	3	26
Largemouth bass														1												1	1
Crappies												3														3	3
White crappie																								1		1	1
Walleye											1		3	1							2	1		1	6	3	9

Totals Per Day

	8 Friday	10 Sunday	23 Saturday	28 Thursday	Totals
Anglers	4	31	20	10	65
Fish Caught	31	65	44	15	155
Fish Kept	3	23	30	3	59
Hours Fished	10.25	84.50	33.76	18.00	146.5
Catch/Effort (h)	3.02	0.77	1.30	0.83	1.06

K = Kept
R = Released
C = Total catch

TABLE E-25

Creel data reported for each survey day in October 1989, at the General Reservoir.

Day / River Stage	2 Monday 1.12			14 Saturday 0.99			24 Tuesday 1.96			29 Sunday 1.39			
	Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)												
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening*	Totals
Weather	Lt rain	Overcast	Overcast	Overcast	Clear	Clear	Clear	Clear	Clear	Clear	Clear		
Air Temp (C)	19.30	20.50	19.70	14.00	20.00	17.00	9.50	16.30	14.70	16.30	16.00		
Water Temp (C)	17.00	17.70	17.70	16.30	17.50	17.00	10.70	11.50	11.00	13.70	13.70		
Anglers	4	8	6	47	51	18	8	13	6	74	39		
Fish Caught	17	16	45	164	203	132	32	29	5	255	152		
Fish Kept	2	5	5	24	35	11	4	2	3	28	31		
Hours Fished	8.00	9.25	23.00	105.7	152.3	78.50	12.75	31.50	12.50	188.3	96.25		
Catch/Effort (h)	2.12	1.73	1.96	1.55	1.33	1.68	2.51	0.92	0.40	1.35	1.58		

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp													1												1		1
Channel catfish	2			1	2	1				2	1	1		3				1		5	3	1			8	15	23
Rock bass	1		1		3		2			1	2				1						7	5			17	6	23
Sunfishes	1				15		1		2	1			1						1		10	10			31	11	42
Bluegill			2				1			3									4		2				9	3	12
Smallmouth bass	11	2	8	4	17	4	135	24	163	22	116	10	26	1	26	2	2	2	216	23	98	15			818	109	927
Largemouth bass											2								5						7		7
Crappies					3		1		3	6									1		1				9	6	15

Totals Per Day

	2 Monday	14 Saturday	24 Tuesday	29 Sunday	Totals
Anglers	18	116	27	113	274
Fish Caught	78	499	66	407	1050
Fish Kept	12	70	9	59	150
Hours Fished	40.25	336.5	56.75	284.5	718.0
Catch/Effort (h)	1.94	1.48	1.16	1.43	1.46

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness

TABLE E-26

Creel data reported for each survey day in October 1989, at the West Dam.

Day	2 Monday			14 Saturday			24 Tuesday			29 Sunday			
River Stage	1.12			0.99			1.96			1.39			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening*	Totals
Weather	Lt rain	Overcast	Overcast	Overcast	Clear	Clear	Clear	Clear	Clear	Clear	Clear		
Air Temp (C)	18.00	20.00	19.30	13.70	20.00	17.00	7.50	14.00	13.00	14.30	16.00		
Water Temp (C)	16.70	17.30	17.00	15.70	17.30	16.70	10.00	11.00	10.30	12.30	13.00		
Anglers	0	0	0	0	0	0	0	0	0	5	0		
Fish Caught	0	0	0	0	0	0	0	0	0	10	0		
Fish Kept	0	0	0	0	0	0	0	0	0	0	0		
Hours Fished	.	.	.	.	.	.	.	.	.	6.75	.		
Catch/Effort (h)	.	.	.	.	.	.	.	.	.	1.48	.		

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Smallmouth bass																			9						9		9
Walleye																			1						1		1

Totals Per Day

	2 Monday	14 Saturday	24 Tuesday	29 Sunday	Totals
Anglers	0	0	0	5	5
Fish Caught	0	0	0	10	10
Fish Kept	0	0	0	0	0
Hours Fished	.	.	.	6.75	6.75
Catch/Effort (h)	.	.	.	1.48	1.48

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness.

TABLE E-27

Creel data reported for each survey day in October 1989, at the East Dam.

Day	2 Monday			14 Saturday			24 Tuesday			29 Sunday			
River Stage	1.12			0.99			1.96			1.39			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening*	Totals
Weather	Lt rain	Overcast	Overcast	Overcast	Prt cldy	Clear	Clear	Clear	Clear	Clear	Clear		
Air Temp (C)	17.70	20.00	19.70	15.00	20.70	19.00	6.30	16.00	14.00	14.50	20.70		
Water Temp (C)	16.70	17.00	18.70	15.00	16.00	15.50	10.00	11.00	10.70	12.70	14.00		
Anglers	0	0	0	0	1	0	3	2	8	9	1		
Fish Caught	0	0	0	0	0	0	18	19	46	3	6		
Fish Kept	0	0	0	0	0	0	.	13	21	0	.		
Hours Fished	.	.	.	.	0.25	.	5.75	4.00	21.75	3.50	2.00		
Catch/Effort (h)	.	.	.	.	0.00	.	3.13	4.75	2.11	0.86	3.00		

Species

Species	Mon Morning R	K	Mon Midday R	K	Mon Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Tue Morning R	K	Tue Midday R	K	Tue Evening R	K	Sun Morning R	K	Sun Midday R	K	Sun Evening* R	K	Totals R	K	C
Rock bass													2			1	10	7							12	8	20
Sunfishes													12				5								17		17
Redbreast sunfish													1												1		1
Pumpkinseed															3	6	4	7							7	13	20
Bluegill															3	6	4	7							7	13	20
Smallmouth bass													1						2		6				9		9
Walleye													2				2		1						5		5

Totals Per Day

	2 Monday	14 Saturday	24 Tuesday	29 Sunday	Totals
Anglers	0	1	13	10	24
Fish Caught	0	0	83	9	92
Fish Kept	0	0	34	0	34
Hours Fished	.	0.25	31.50	5.50	37.25
Catch/Effort (h)	.	0.00	2.63	1.64	2.47

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness

TABLE E-28

Creel data reported for each survey day in October 1989, at the York Haven Generating Station.

Day	2 Monday			14 Saturday			24 Tuesday			29 Sunday			
River Stage	1.12			0.99			1.96			1.39			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Lt rain	Overcast	Prt cldy	Overcast	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	
Air Temp (C)	19.50	20.50	19.00	15.00	19.50	17.50	10.00	18.00	9.70	14.00	21.50	16.30	
Water Temp (C)	16.50	17.70	17.50	14.70	16.00	15.30	10.70	11.00	10.70	12.50	13.70	13.50	
Anglers	3	4	2	7	13	13	0	0	5	1	9	5	
Fish Caught	2	26	0	24	26	63	0	0	3	1	30	36	
Fish Kept	0	1	0	2	7	24	0	0	0	.	3	.	
Hours Fished	2.50	8.25	3.50	13.75	26.25	46.00	.	.	5.50	1.75	21.75	20.25	
Catch/Effort (h)	0.80	3.15	0.00	1.75	0.99	1.37	.	.	0.55	0.57	1.38	1.78	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Common carp	2		12				1		1												3		1		20		20
Channel catfish											5														5		5
Rock bass			2							1	1	6											2		5	7	12
Sunfishes			2				1					2													3	2	5
Bluegill				1																		1				2	2
Smallmouth bass			8				7		11	1	17	2							1		24		32		100	3	103
Crappies			1								3	9											1		5	9	14
White crappie																						2				2	2
Walleye							13	2	7	5	13	5					3								36	12	48

Totals Per Day

	2 Monday	14 Saturday	24 Tuesday	29 Sunday	Totals
Anglers	9	33	5	15	62
Fish Caught	28	113	3	67	211
Fish Kept	1	33	0	3	37
Hours Fished	14.25	86.00	5.50	43.75	149.5
Catch/Effort (h)	1.96	1.31	0.55	1.53	1.41

K = Kept
R = Released
C = Total catch

TABLE E-29

Creel data reported for each survey day in November 1989, at the General Reservoir.

Day	1 Wednesday			5 Sunday			18 Saturday			20 Monday			
River Stage	1.28			1.27			1.93			1.98			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Totals
Weather	Prt cldy	Prt cldy		Clear	Prt cldy		Prt cldy	Prt cldy		Prt cldy	Prt cldy		
Air Temp (C)	10.00	11.00		10.00	10.00		3.00	3.50		12.00	14.00		
Water Temp (C)	13.70	14.00		8.70	9.00		7.30	7.30		5.00	5.00		
Anglers	2	7		18	22		5	0		0	2		
Fish Caught	4	18		13	85		0	0		0	0		
Fish Kept	.	1		4	26		0	0		0	0		
Hours Fished	2.75	13.50		24.50	68.50		11.50	.		.	3.00		
Catch/Effort (h)	1.45	1.33		0.53	1.24		0.00	.		.	0.00		

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Rock bass									1																1		1
Sunfishes			1						1																2		2
Smallmouth bass	4		16	1			8	4	56	6															84	11	95
Largemouth bass							1		1																2		2
Crappies										20																20	20

Totals Per Day

	1 Wednesday	5 Sunday	18 Saturday	20 Monday	Totals
Anglers	9	40	5	2	56
Fish Caught	22	98	0	0	120
Fish Kept	1	30	0	0	31
Hours Fished	16.25	93.00	11.50	3.00	123.7
Catch/Effort (h)	1.35	1.05	0.00	0.00	0.97

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness

TABLE E-30

Creel data reported for each survey day in November 1989, at the West Dam.

Day	1 Wednesday			5 Sunday			18 Saturday			20 Monday			
River Stage	1.28			1.27			1.93			1.98			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Totals
Weather	Prt cldy	Prt cldy		Clear	Prt cldy		Prt cldy	Prt cldy		Prt cldy	Prt cldy		
Air Temp (C)	9.00	11.00		9.70	10.70		3.00	4.00		9.00	13.00		
Water Temp (C)	13.00	13.00		8.00	9.00		6.70	6.70		5.00	5.70		
Anglers	0	0		1	3		0	0		0	0		
Fish Caught	0	0		0	37		0	0		0	0		
Fish Kept	0	0		0	6		0	0		0	0		
Hours Fished	.	.		3.00	12.75		.	.		.	.		
Catch/Effort (h)	.	.		0.00	2.90		.	.		.	.		

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish									1																1		1
Smallmouth bass									6	1															6	1	7
Walleye									24	5															24	5	29

Totals Per Day

	1 Wednesday	5 Sunday	18 Saturday	20 Monday	Totals
Anglers	0	4	0	0	4
Fish Caught	0	37	0	0	37
Fish Kept	0	6	0	0	6
Hours Fished	.	15.75	.	.	15.75
Catch/Effort (h)	.	2.35	.	.	2.35

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness

TABLE E-31

Creel data reported for each survey day in November 1989, at the East Dam.

Day	1 Wednesday			5 Sunday			18 Saturday			20 Monday			
River Stage	1.28			1.27			1.93			1.98			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Morning	Midday	Evening*	Totals
Weather	Prt cldy	Prt cldy		Clear	Prt cldy		Prt cldy	Prt cldy		Prt cldy	Prt cldy		
Air Temp (C)	9.70	12.00		8.00	14.00		2.30	3.00		9.50	15.30		
Water Temp (C)	13.50	13.70		8.50	9.70		6.70	6.50		4.70	5.30		
Anglers	0	2		0	4		0	0		2	1		
Fish Caught	0	0		0	1		0	0		0	0		
Fish Kept	0	0		0	1		0	0		0	0		
Hours Fished	.	0.50		.	2.25		.	.		2.00	1.00		
Catch/Effort (h)	.	0.00		.	0.44		.	.		0.00	0.00		

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Smallmouth bass										1																1	1

Totals Per Day

	1 Wednesday	5 Sunday	18 Saturday	20 Monday	Totals
Anglers	2	4	0	3	9
Fish Caught	0	1	0	0	1
Fish Kept	0	1	0	0	1
Hours Fished	0.50	2.25	.	3.00	5.75
Catch/Effort (h)	0.00	0.44	.	0.00	0.17

K = Kept
R = Released
C = Total catch
* = Survey not completed due to darkness

TABLE E-32

Creel data reported for each survey day in November 1989, at the York Haven Generating Station.

Day	1 Wednesday			5 Sunday			18 Saturday			20 Monday			
River Stage	1.28			1.27			1.93			1.98			

Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)

	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Prt cldy	Overcast	Prt cldy	Prt cldy	Clear	Prt cldy	Clear	
Air Temp (C)	10.70	11.50	8.50	7.70	12.00	10.00	3.00	4.30	0.00	9.00	16.00	10.30	
Water Temp (C)	13.00	13.70	13.30	8.00	8.70	8.50	7.30	7.00	7.00	5.00	5.50	6.00	
Anglers	0	1	0	1	1	9	0	3	1	1	1	1	
Fish Caught	0	0	0	2	0	1	0	1	0	0	1	1	
Fish Kept	0	0	0	.	0	0	0	0	0	0	1	1	
Hours Fished	.	0.50	.	2.25	2.00	7.00	.	2.50	2.50	0.50	2.00	3.00	
Catch/Effort (h)	.	0.00	.	0.89	0.00	0.14	.	0.40	0.00	0.00	0.50	0.33	

Species

	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	R	K	C
Channel catfish							2																		2		2
Smallmouth bass											1				1										2		2
Walleye																						1		1		2	2

Totals Per Day

	1 Wednesday	5 Sunday	18 Saturday	20 Monday	Totals
Anglers	1	11	4	3	19
Fish Caught	0	3	1	2	6
Fish Kept	0	0	0	2	2
Hours Fished	0.50	11.25	5.00	5.50	22.25
Catch/Effort (h)	0.00	0.27	0.20	0.36	0.27

K = Kept
R = Released
C = Total catch

APPENDIX F

WATER QUALITY DATA

TABLE F-1 WATER QUALITY DATA COLLECTED AT ZONE 1 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
06APR	6.5	8.2	7.8	11.2	.	38.0	.	.	.	.	20:19
11APR	6.0	8.0	6.9	12.5	.	25.0	.	.	.	.	21:15
13APR	13.0	9.2	7.4	11.8	152.4	.	.	.	.	.	12:37
17APR	15.0	11.5	7.9	11.8	.	15.0	.	.	.	.	21:55
24APR	10.5	12.8	8.3	14.3	.	6.0	.	.	.	.	22:25
03MAY	9.0	13.2	8.0	10.5	.	8.0	.	.	.	.	20:53
22MAY	19.0	17.0	6.9	8.5	76.2	.	.	.	.	.	8:50
22MAY	18.0	16.5	7.5	8.4	.	25.0	.	.	.	.	21:33
29MAY	16.5	18.9	7.7	8.9	.	18.0	.	.	.	.	23:09
30MAY	18.0	18.4	7.2	8.3	124.5	.	.	.	.	.	8:45
06JUN	16.0	20.5	8.4	10.6	.	15.0	.	.	.	.	23:19
08JUN	20.3	19.3	7.3	9.4	139.7	.	.	.	.	.	11:35
12JUN	19.0	20.8	7.5	9.3	.	10.0	.	.	.	.	21:52
21JUN	23.0	20.8	6.9	7.6	71.1	.	.	.	.	.	8:40
21JUN	20.5	20.1	6.4	7.4	.	58.0	.	.	.	.	21:20
28JUN	20.0	22.8	6.7	7.7	.	40.0	.	.	.	.	1:41
06JUL	22.0	19.5	7.4	8.2	.	24.0	.	.	.	.	22:07
10JUL	26.5	24.0	7.6	8.0	.	17.0	.	.	.	.	23:30
14JUL	25.5	20.0	7.4	8.2	30.5	.	.	.	.	.	12:47
17JUL	19.6	19.0	7.0	8.8	.	30.0	.	.	.	.	21:31
24JUL	23.5	22.0	7.8	7.5	.	21.0	.	.	.	.	23:08
01AUG	22.0	18.8	8.6	9.4	.	1.0	.	.	.	.	21:09
03AUG	30.0	22.4	8.0	8.5	91.4	.	.	.	.	.	12:35
07AUG	18.0	24.2	8.8	8.0	.	4.0	.	.	.	.	22:46
16AUG	30.0	25.1	8.9	13.6	167.6	.	.	.	.	.	13:22
16AUG	24.0	25.0	8.9	17.8	.	2.0	.	.	.	.	22:45
21AUG	25.0	23.5	8.1	8.8	.	3.0	.	.	.	.	20:49
29AUG	23.5	24.2	8.4	11.2	.	3.0	.	.	.	.	22:23
07SEP	25.0	25.2	8.7	11.1	96.5	.	.	.	.	.	14:20
18SEP	19.0	20.3	7.9	8.0	76.2	.	.	.	.	.	13:10
18OCT	9.7	16.5	8.2	9.4	116.8	.	.	.	.	.	14:30
02NOV	11.5	12.7	8.8	10.1	116.8	.	.	.	.	.	9:40

TABLE F-2 WATER QUALITY DATA COLLECTED AT ZONE 2 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
13APR	10.3	9.5	7.3	11.8	149.9	.	.	.	.	.	11:55
20APR	5.0	13.8	7.8	10.7	121.9	.	.	240	.	.	0:40
22MAY	20.0	17.0	6.9	8.6	76.2	.	.	.	.	.	9:30
24MAY	15.0	15.2	7.4	9.4	73.7	.	.	240	.	.	20:08
30MAY	22.0	19.2	7.0	9.0	124.5	.	.	.	.	.	11:40
31MAY	20.0	19.5	7.4	8.7	101.6	.	.	240	.	.	1:20
08JUN	19.0	19.3	7.0	9.8	124.5	.	.	.	.	.	10:37
14JUN	19.0	21.0	7.5	10.1	127.0	.	.	260	.	.	1:40
21JUN	24.5	21.0	6.9	9.0	73.7	.	.	.	.	.	9:38
29JUN	18.7	22.8	7.2	7.8	45.7	.	.	200	.	.	0:43
14JUL	23.0	22.0	6.6	8.3	35.6	.	.	.	.	.	11:55
25JUL	22.0	23.0	7.7	8.3	40.6	.	.	240	.	.	21:08
03AUG	27.5	21.7	8.3	10.5	101.6	.	.	.	.	.	8:53
10AUG	13.0	21.5	.	13.7	119.4	.	.	250	.	.	1:20
16AUG	29.0	27.4	9.1	11.5	127.0	.	.	.	.	.	12:22
22AUG	25.5	25.2	8.8	13.4	121.9	.	.	250	.	.	19:33
07SEP	25.0	26.2	8.9	12.0	96.5	.	.	.	.	.	13:15
13SEP	19.7	25.9	8.6	8.8	68.6	.	.	325	.	.	0:15
18SEP	18.0	20.0	7.1	7.1	53.3	.	.	.	.	.	8:25
26SEP	16.7	16.5	.	10.0	106.7	.	.	325	.	.	18:55
05OCT	9.0	14.5	8.7	10.8	101.6	.	.	350	.	.	0:10
18OCT	10.3	17.5	8.2	8.4	127.0	.	.	.	.	.	13:35
02NOV	11.5	13.0	8.2	10.1	124.5	.	.	.	.	.	14:00
07NOV	12.0	10.3	8.6	12.4	157.5	.	.	300	.	.	23:00

TABLE F-3 WATER QUALITY DATA COLLECTED AT ZONE 4 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
06APR	8.8	6.0	8.2	12.0	.	35.0	.	.	.	.	20:37
06APR	8.8	5.8	7.3	15.0	.	40.0	.	.	.	.	20:51
11APR	7.0	6.5	7.7	12.6	.	30.0	.	.	.	.	20:39
11APR	6.0	6.5	6.7	12.5	.	30.0	.	.	.	.	20:52
17APR	15.0	9.5	7.9	11.3	.	24.0	.	.	.	.	22:09
17APR	14.5	10.0	7.8	11.5	.	19.0	.	.	.	.	22:22
19APR	10.0	11.5	7.1	10.4	132.1	.	.	190	.	.	23:38
24APR	13.5	12.5	8.8	13.0	.	14.0	.	.	.	.	21:11
24APR	10.0	12.4	7.9	12.5	.	14.0	.	.	.	.	22:43
03MAY	9.0	13.0	8.9	14.6	.	13.0	.	.	.	.	21:09
03MAY	9.0	13.0	8.2	12.0	.	18.0	.	.	.	.	23:13
22MAY	19.0	17.0	6.9	9.5	.	31.0	.	.	.	.	21:14
22MAY	17.5	17.0	7.7	9.3	.	29.0	.	.	.	.	21:51
24MAY	14.5	16.7	7.1	9.4	99.1	.	.	160	.	.	21:10
29MAY	17.0	19.5	8.0	10.5	.	26.0	.	.	.	.	22:37
29MAY	17.0	19.5	8.0	10.5	.	21.0	.	.	.	.	22:51
31MAY	22.0	20.0	8.0	10.2	101.6	.	.	180	.	.	0:17
06JUN	17.0	22.0	8.2	9.5	.	21.0	.	.	.	.	22:57
06JUN	17.0	22.0	8.3	9.6	.	23.0	.	.	.	.	23:39
12JUN	20.5	21.1	7.7	10.5	.	20.0	.	.	.	.	21:18
12JUN	19.0	21.2	7.7	10.8	.	14.0	.	.	.	.	21:32
14JUN	20.0	21.0	7.5	11.0	99.1	.	.	200	.	.	0:47
21JUN	20.5	18.7	6.4	8.8	.	27.0	.	.	.	.	23:22
21JUN	21.0	18.7	7.0	9.2	.	34.0	.	.	.	.	23:39
28JUN	20.0	22.0	6.7	8.3	.	41.0	.	.	.	.	1:02
28JUN	20.0	22.0	6.8	8.3	.	36.0	.	.	.	.	1:20
28JUN	20.0	22.4	7.2	8.3	17.8	.	.	150	.	.	23:56
06JUL	22.5	23.8	7.6	10.1	.	27.0	.	.	.	.	21:33
06JUL	23.0	24.0	8.0	10.2	.	27.0	.	.	.	.	21:49
10JUL	27.0	26.5	7.8	9.9	.	23.0	.	.	.	.	22:59
10JUL	27.0	26.5	7.8	10.0	.	22.0	.	.	.	.	23:12
17JUL	19.5	19.5	7.1	9.0	.	40.0	.	.	.	.	21:50
17JUL	19.0	19.0	7.3	9.0	.	42.0	.	.	.	.	23:31
24JUL	24.5	23.0	7.6	7.5	.	24.0	.	.	.	.	22:46
24JUL	23.0	23.0	8.0	7.5	.	34.0	.	.	.	.	23:26
25JUL	23.5	24.9	7.6	8.4	43.2	.	.	180	.	.	22:04
01AUG	22.5	21.2	8.6	9.1	.	2.0	.	.	.	.	21:34
01AUG	22.0	21.5	7.7	9.1	.	17.0	.	.	.	.	21:47
07AUG	18.5	26.0	8.8	8.8	.	14.0	.	.	.	.	22:30
07AUG	18.0	26.0	8.8	8.7	.	15.0	.	.	.	.	23:07
10AUG	15.5	23.9	.	10.4	139.7	.	.	275	.	.	0:20
16AUG	24.8	25.0	8.6	10.0	.	9.0	.	.	.	.	22:07
16AUG	23.5	26.8	8.8	11.0	.	12.0	.	.	.	.	23:05
21AUG	25.0	24.8	8.8	10.2	.	9.0	.	.	.	.	21:15
21AUG	24.5	25.0	8.8	9.6	.	9.0	.	.	.	.	21:28

TABLE F-3 CONTINUED.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
22AUG	25.3	26.5	8.8	13.0	109.2	.	.	255	.	.	20:24
29AUG	23.0	24.2	9.0	9.1	.	4.0	.	.	.	.	21:51
29AUG	23.0	25.0	9.3	10.5	.	9.0	.	.	.	.	22:04
12SEP	21.5	25.9	8.9	9.2	63.5	.	.	350	.	.	23:09
26SEP	17.5	17.2	.	11.5	81.3	.	.	360	.	.	19:52
04OCT	10.5	14.5	8.9	10.4	99.1	.	.	300	.	.	23:09
07NOV	12.0	10.8	8.5	12.6	149.9	.	.	210	.	.	21:58

TABLE F-4 WATER QUALITY DATA COLLECTED AT ZONE 7 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
05APR	12.0	5.4	7.1	12.0	27.9	13.0	17.0	.	102	2.0	9:00
06APR	6.8	5.2	6.9	12.4	.	45.0	.	.	.	.	21:40
06APR	6.0	5.1	7.3	12.7	.	58.0	.	.	.	.	21:56
11APR	4.5	6.2	7.2	12.5	.	30.0	.	.	.	.	21:56
11APR	3.5	6.1	7.2	12.8	.	45.0	.	.	.	.	22:26
13APR	9.5	6.9	6.8	11.7	86.4	.	.	.	.	.	10:00
17APR	17.5	9.2	7.6	11.5	.	30.0	.	.	.	.	20:36
17APR	15.5	9.5	7.4	11.3	.	34.0	.	.	.	.	21:14
19APR	11.5	11.9	7.1	10.9	114.3	.	.	210	.	.	20:46
24APR	13.0	12.5	7.9	12.2	.	20.0	.	.	.	.	21:37
24APR	12.5	12.8	8.8	12.5	.	24.0	.	.	.	.	21:48
02MAY	15.0	14.9	7.1	8.5	71.1	13.0	16.0	.	186	1.3	9:50
03MAY	9.5	13.2	7.7	10.6	.	22.0	.	.	.	.	21:29
03MAY	9.0	13.0	7.3	13.2	.	27.0	.	.	.	.	22:20
22MAY	23.0	17.6	6.9	8.8	66.0	.	.	.	.	.	11:30
22MAY	17.0	17.2	7.7	9.4	.	62.0	.	.	.	.	22:20
22MAY	16.0	17.2	7.7	8.4	.	54.0	.	.	.	.	22:54
24MAY	14.0	16.4	6.7	9.3	71.1	.	.	210	.	.	23:15
29MAY	19.0	19.1	7.9	11.0	.	27.0	.	.	.	.	21:40
29MAY	18.0	18.9	7.6	11.9	.	36.0	.	.	.	.	22:28
30MAY	20.0	18.6	7.0	9.6	73.7	.	.	.	.	.	10:05
30MAY	23.5	19.7	8.0	11.4	76.2	.	.	240	.	.	20:50
05JUN	22.0	23.2	7.3	8.2	101.6	4.0	8.0	.	171	1.5	9:15
06JUN	20.0	21.9	7.4	8.9	.	31.0	.	.	.	.	21:27
06JUN	18.0	21.6	7.9	8.8	.	31.0	.	.	.	.	21:54
08JUN	18.0	19.5	7.0	8.9	94.0	.	.	.	.	.	8:45
12JUN	17.5	20.5	7.6	10.1	.	26.0	.	.	.	.	23:05
12JUN	17.5	20.5	7.5	10.3	.	18.0	.	.	.	.	23:17
13JUN	21.0	20.7	7.3	10.6	78.7	.	.	250	.	.	21:30
21JUN	26.0	19.8	6.4	8.6	33.0	.	.	.	.	.	12:00
21JUN	22.0	19.3	6.7	8.5	.	61.0	.	.	.	.	22:18
21JUN	22.5	19.5	6.2	8.8	.	70.0	.	.	.	.	22:32
27JUN	23.7	23.0	6.7	8.2	.	43.0	.	.	.	.	21:43
27JUN	22.0	23.0	6.6	7.8	.	49.0	.	.	.	.	22:53
28JUN	23.0	22.9	7.4	7.9	15.2	.	.	175	.	.	21:18
06JUL	22.5	20.3	7.4	8.4	40.6	5.0	8.0	.	139	1.5	10:05
06JUL	22.0	21.2	8.2	10.0	.	44.0	.	.	.	.	23:21
06JUL	21.0	21.2	8.2	9.8	.	23.0	.	.	.	.	23:48
10JUL	27.0	26.2	8.5	10.4	.	34.0	.	.	.	.	22:20
10JUL	27.0	26.2	8.0	11.0	.	26.0	.	.	.	.	22:32
14JUL	22.5	20.7	7.0	7.7	53.3	.	.	.	.	.	9:50
17JUL	19.5	21.0	6.7	8.6	.	53.0	.	.	.	.	22:10
17JUL	19.5	20.5	6.9	8.8	.	53.0	.	.	.	.	22:40
24JUL	25.0	27.0	7.4	8.2	.	33.0	.	.	.	.	21:50
24JUL	25.0	26.5	7.2	8.2	.	29.0	.	.	.	.	22:03

TABLE F-4 CONTINUED.

DATE	TEMPERATURE (C) AIR	WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
26JUL	23.0	28.0	6.7	8.5	99.1	.	.	300	.	.	0:02
01AUG	20.5	20.5	8.8	8.5	.	27.0	.	.	.	.	22:30
01AUG	20.5	20.8	8.3	8.5	.	18.0	.	.	.	.	23:11
02AUG	24.0	20.9	8.1	8.2	175.3	6.0	5.0	.	205	1.8	9:20
03AUG	28.0	23.5	8.1	8.8	203.2	.	.	.	.	.	11:07
07AUG	19.0	24.5	8.8	8.8	.	16.0	.	.	.	.	21:57
07AUG	19.0	24.1	8.7	9.0	.	20.0	.	.	.	.	22:09
09AUG	18.0	22.7	.	11.1	175.3	.	.	350	.	.	21:02
16AUG	26.0	22.8	8.2	8.4	157.5	.	.	.	.	.	10:16
16AUG	25.5	25.2	8.7	12.8	.	14.0	.	.	.	.	21:38
16AUG	25.0	24.5	8.7	13.0	.	18.0	.	.	.	.	21:49
21AUG	24.0	23.0	8.0	10.2	.	15.0	.	.	.	.	22:00
21AUG	23.5	23.0	8.4	9.8	.	15.0	.	.	.	.	22:38
22AUG	25.0	25.0	8.4	11.0	106.7	.	.	275	.	.	22:41
29AUG	24.8	24.0	8.7	12.0	.	15.0	.	.	.	.	21:02
29AUG	24.5	24.0	8.7	11.5	.	12.0	.	.	.	.	21:13
05SEP	18.5	19.3	8.2	8.8	81.3	2.0	3.0	.	289	1.2	9:40
07SEP	23.5	22.8	8.1	9.5	78.7	.	.	.	.	.	10:40
12SEP	22.0	26.1	8.7	10.6	73.7	.	.	450	.	.	20:18
18SEP	17.5	19.7	7.4	8.5	91.4	.	.	.	.	.	10:45
26SEP	15.0	16.1	.	10.2	63.5	.	.	360	.	.	21:53
04OCT	10.0	14.9	9.0	9.7	94.0	10.0	2.0	.	201	1.3	8:45
04OCT	10.5	15.1	8.7	10.3	91.4	.	.	325	.	.	19:53
18OCT	11.0	16.8	7.8	7.9	101.6	.	.	.	.	.	11:50
02NOV	11.7	12.2	8.0	9.6	147.3	.	.	.	.	.	11:30
06NOV	13.5	9.3	7.6	11.2	195.6	3.0	2.0	.	171	1.3	10:45
07NOV	13.0	10.5	7.9	11.8	142.2	.	.	260	.	.	19:11

TABLE F-5 WATER QUALITY DATA COLLECTED AT ZONE 8 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
05APR	11.5	6.5	7.4	12.1	25.4	15.0	6.0	.	101	1.8	9:15
06APR	7.0	5.2	6.8	12.5	.	48.0	.	.	.	.	21:26
11APR	3.5	6.2	7.1	12.8	.	40.0	.	.	.	.	22:12
13APR	9.5	7.3	7.6	11.9	88.9	.	.	.	.	.	10:35
17APR	16.5	10.0	7.5	11.4	.	25.0	.	.	.	.	21:04
19APR	11.0	12.0	7.1	10.4	116.8	.	.	210	.	.	21:44
24APR	12.0	12.5	8.3	12.8	.	20.0	.	.	.	.	22:02
02MAY	15.0	14.8	7.1	10.0	55.9	4.0	7.0	.	206	1.3	9:35
03MAY	9.0	13.0	7.2	10.5	.	20.0	.	.	.	.	22:36
22MAY	22.0	17.4	7.4	9.1	68.6	.	.	.	.	.	10:50
22MAY	17.0	17.2	7.5	9.6	.	42.0	.	.	.	.	22:06
25MAY	13.0	16.2	7.0	9.0	63.5	.	.	200	.	.	0:18
29MAY	18.0	19.0	8.1	11.6	.	34.0	.	.	.	.	22:09
30MAY	21.0	18.8	7.1	9.6	78.7	.	.	.	.	.	10:35
30MAY	23.0	19.6	7.6	10.7	78.7	.	.	240	.	.	21:58
05JUN	22.0	23.0	7.3	8.5	88.9	5.0	5.0	.	195	1.0	9:00
06JUN	19.5	21.8	7.7	8.8	.	26.0	.	.	.	.	21:41
08JUN	18.5	19.6	5.4	8.8	88.9	.	.	.	.	.	9:22
12JUN	17.5	20.5	7.4	10.1	.	22.0	.	.	.	.	22:29
13JUN	21.0	20.7	7.4	10.6	71.1	.	.	250	.	.	22:24
21JUN	25.3	20.2	6.3	8.3	33.0	.	.	.	.	.	11:16
21JUN	21.5	19.5	6.4	8.5	.	59.0	.	.	.	.	22:50
27JUN	23.5	23.0	6.6	8.2	.	40.0	.	.	.	.	21:27
28JUN	21.0	22.8	7.5	7.9	10.2	.	.	175	.	.	22:06
06JUL	22.5	21.0	7.2	8.5	25.4	9.0	8.0	.	138	1.1	9:55
06JUL	21.0	21.5	7.9	9.8	.	46.0	.	.	.	.	23:36
10JUL	28.0	26.2	8.4	10.3	.	28.0	.	.	.	.	22:07
14JUL	23.0	21.1	6.8	8.2	53.3	.	.	.	.	.	10:30
17JUL	19.5	21.0	6.8	8.9	.	53.0	.	.	.	.	22:53
24JUL	26.5	26.5	7.5	8.3	.	29.0	.	.	.	.	21:17
26JUL	22.5	27.5	6.9	8.5	96.5	.	.	300	.	.	1:09
01AUG	20.5	21.0	8.0	8.5	.	24.0	.	.	.	.	22:43
02AUG	23.0	21.2	8.1	8.6	101.6	2.0	4.0	.	244	1.1	9:35
03AUG	27.0	23.2	8.1	8.5	137.2	.	.	.	.	.	10:30
07AUG	19.5	24.5	8.5	8.9	.	15.0	.	.	.	.	21:47
09AUG	17.5	22.0	.	10.4	111.8	.	.	450	.	.	21:51
16AUG	27.0	23.4	8.2	8.5	152.4	.	.	.	.	.	11:00
16AUG	28.0	25.1	8.6	12.2	.	6.0	.	.	.	.	21:00
21AUG	24.0	23.2	8.2	9.5	.	8.0	.	.	.	.	21:48
22AUG	24.5	25.0	8.3	11.5	86.4	.	.	420	.	.	23:46
29AUG	24.0	24.1	8.7	11.2	.	4.0	.	.	.	.	21:24
05SEP	18.3	19.1	8.0	8.6	76.2	2.0	2.0	.	382	0.8	9:25
07SEP	24.5	22.9	8.2	9.2	73.7	.	.	.	.	.	11:25
12SEP	22.5	26.0	8.5	9.7	71.1	.	.	500	.	.	21:14
18SEP	17.5	19.9	7.6	8.6	76.2	.	.	.	.	.	11:30

TABLE F-5 CONTINUED.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
26SEP	14.5	15.7	.	10.6	58.4	.	.	450	.	.	22:47
04OCT	9.0	14.3	8.6	10.2	71.1	4.0	12.0	.	297	0.9	9:00
04OCT	9.7	15.0	8.6	10.0	73.7	.	.	425	.	.	21:01
18OCT	10.3	16.5	7.8	8.3	91.4	.	.	.	.	.	12:40
02NOV	12.7	12.2	7.9	10.3	149.9	.	.	.	.	.	12:00
06NOV	12.5	10.0	7.8	11.2	114.3	6.0	7.0	.	198	1.2	10:35
07NOV	13.0	11.9	7.8	11.3	101.6	.	.	310	.	.	20:00

TABLE F-6 WATER QUALITY DATA COLLECTED AT ZONE 9 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
05APR	11.5	5.5	7.5	12.2	27.9	25.0	20.0	.	103	2.2	9:25
06APR	7.8	5.2	7.4	12.5	.	45.0	.	.	.	.	21:11
11APR	8.5	6.5	7.5	12.5	.	38.0	.	.	.	.	20:24
13APR	10.0	7.1	7.2	11.7	78.7	.	.	.	.	.	11:17
17APR	17.0	10.0	7.5	11.2	.	30.0	.	.	.	.	20:52
19APR	10.3	11.8	7.0	10.3	119.4	.	.	220	.	.	22:43
24APR	13.0	12.5	8.0	12.2	.	12.0	.	.	.	.	21:23
02MAY	14.0	14.8	7.3	8.7	76.2	11.0	18.0	.	181	1.8	8:30
03MAY	9.5	13.0	7.3	9.6	.	20.0	.	.	.	.	22:02
22MAY	21.5	17.5	6.7	9.2	76.2	.	.	.	.	.	10:10
22MAY	16.5	17.2	7.6	8.8	.	42.0	.	.	.	.	22:37
25MAY	12.0	16.2	7.0	9.1	73.7	.	.	200	.	.	1:21
29MAY	18.0	19.2	8.0	11.5	.	30.0	.	.	.	.	21:58
30MAY	20.5	18.8	7.0	10.2	91.4	.	.	.	.	.	11:10
30MAY	22.5	19.6	8.0	10.6	88.9	.	.	240	.	.	23:09
05JUN	22.0	23.0	7.5	8.1	109.2	23.0	19.0	.	173	1.5	8:50
06JUN	18.0	21.8	7.8	8.8	.	24.0	.	.	.	.	22:09
08JUN	18.5	19.7	5.6	8.4	91.4	.	.	.	.	.	9:55
12JUN	18.0	21.0	7.1	10.1	.	21.0	.	.	.	.	22:15
13JUN	21.5	20.7	7.5	10.4	81.3	.	.	250	.	.	23:29
21JUN	24.0	19.9	6.6	9.6	38.1	.	.	.	.	.	10:23
21JUN	21.0	19.2	6.4	8.5	.	49.0	.	.	.	.	23:07
27JUN	21.5	23.0	6.8	7.7	.	30.0	.	.	.	.	22:35
28JUN	21.0	22.8	7.3	7.9	15.2	.	.	180	.	.	22:58
06JUL	22.3	20.7	7.1	8.3	33.0	25.0	23.0	.	145	2.2	9:35
06JUL	21.0	21.0	7.5	10.0	.	34.0	.	.	.	.	23:05
10JUL	27.5	26.5	8.4	10.5	.	26.0	.	.	.	.	21:56
14JUL	24.0	21.2	6.9	8.0	61.0	.	.	.	.	.	11:17
17JUL	19.5	21.0	6.6	8.8	.	46.0	.	.	.	.	22:25
24JUL	26.0	27.0	7.7	8.2	.	24.0	.	.	.	.	21:34
26JUL	22.0	27.8	7.3	8.1	101.6	.	.	300	.	.	2:29
01AUG	20.0	21.0	8.0	8.6	.	21.0	.	.	.	.	22:58
02AUG	23.0	21.0	8.0	8.3	132.1	10.0	8.0	.	217	1.3	9:50
03AUG	26.7	22.9	8.2	9.0	154.9	.	.	.	.	.	9:35
07AUG	19.5	25.2	8.3	8.5	.	21.0	.	.	.	.	21:31
09AUG	15.5	22.5	.	11.0	165.1	.	.	350	.	.	23:15
16AUG	27.5	25.0	8.2	9.4	167.6	.	.	.	.	.	11:37
16AUG	24.5	25.5	8.7	12.0	.	12.0	.	.	.	.	22:22
21AUG	23.5	23.2	8.4	9.5	.	11.0	.	.	.	.	22:54
23AUG	24.3	25.0	8.2	11.2	104.1	.	.	275	.	.	1:01
29AUG	23.5	24.1	8.8	10.5	.	11.0	.	.	.	.	21:38
05SEP	18.0	20.1	8.1	8.7	81.3	6.0	4.0	.	324	1.3	9:08
07SEP	25.0	25.0	8.4	10.3	99.1	.	.	.	.	.	12:07
12SEP	20.5	26.1	8.7	10.4	73.7	.	.	450	.	.	22:09
18SEP	18.0	20.3	7.0	8.4	81.3	.	.	.	.	.	12:10

TABLE F-6 CONTINUED.

DATE	TEMPERATURE (C) AIR	WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
27SEP	13.0	15.5	.	10.3	71.1	.	.	390	.	.	0:10
04OCT	10.0	14.9	8.5	9.7	81.3	12.0	4.0	.	218	1.1	9:15
04OCT	10.3	15.0	8.4	10.1	76.2	.	.	375	.	.	22:00
18OCT	10.2	17.5	8.2	8.0	104.1	.	.	.	.	.	9:50
02NOV	13.0	12.3	8.0	9.9	137.2	.	.	.	.	.	13:00
06NOV	11.5	9.4	8.0	11.2	154.9	3.0	9.0	.	185	1.8	9:35
07NOV	12.0	10.7	7.7	11.6	152.4	.	.	275	.	.	20:52

TABLE F-7 WATER QUALITY DATA COLLECTED AT ZONE 10 NEAR TMINS, 1989.

DATE	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	PH	DISSOLVED OXYGEN (MG/L)	SECCHI DISC (CM)	CURRENT VELOCITY SURFACE (CM/SEC)	CURRENT VELOCITY BOTTOM (CM/SEC)	CONDUCTIVITY (UHMOS/SEC)	TOTAL DISSOLVED SOLIDS	SAMPLE DEPTH (M)	TIME OF COLLECTION
06APR	6.0	5.2	6.5	12.5	.	20.0	.	.	.	.	22:15
11APR	5.0	6.0	7.3	12.6	.	10.0	.	.	.	.	21:39
13APR	10.3	8.1	6.9	11.2	104.1	.	.	.	.	.	9:10
17APR	15.5	10.0	7.4	11.3	.	6.0	.	.	.	.	21:30
19APR	10.0	12.5	7.5	10.6	167.6	.	.	240	.	.	19:56
24APR	14.0	12.8	8.5	12.5	.	5.0	.	.	.	.	20:50
03MAY	9.0	13.0	7.0	8.0	.	2.0	.	.	.	.	22:53
22MAY	25.0	17.0	6.9	8.9	53.3	.	.	.	.	.	12:10
22MAY	15.5	16.5	7.6	9.5	.	9.0	.	.	.	.	23:15
24MAY	14.0	16.1	6.9	9.3	73.7	.	.	210	.	.	22:26
29MAY	19.0	19.1	7.7	11.1	.	5.0	.	.	.	.	21:23
30MAY	18.0	17.3	7.2	8.4	104.1	.	.	.	.	.	9:25
30MAY	24.0	19.7	8.4	11.6	81.3	.	.	250	.	.	20:07
06JUN	18.0	21.8	7.8	8.8	.	4.0	.	.	.	.	22:33
08JUN	18.0	18.0	7.4	8.9	124.5	.	.	.	.	.	8:15
12JUN	17.5	20.2	7.6	10.5	.	4.0	.	.	.	.	22:49
13JUN	20.2	20.7	7.7	10.7	83.8	.	.	250	.	.	20:25
21JUN	27.0	19.9	6.5	8.3	40.6	.	.	.	.	.	12:40
21JUN	22.0	19.3	6.6	8.4	.	12.0	.	.	.	.	21:55
27JUN	21.0	22.9	6.8	7.9	.	9.0	.	.	.	.	23:13
28JUN	23.0	22.8	7.0	7.9	12.7	.	.	190	.	.	20:33
06JUL	21.0	21.0	8.2	10.2	.	9.0	.	.	.	.	22:39
10JUL	28.0	26.2	7.9	11.8	.	5.0	.	.	.	.	21:33
14JUL	22.0	18.1	7.4	7.3	15.2	.	.	.	.	.	9:07
17JUL	19.5	20.2	7.0	8.8	.	15.0	.	.	.	.	23:11
24JUL	25.0	27.0	7.0	8.0	.	8.0	.	.	.	.	22:21
25JUL	22.5	27.8	7.5	8.5	101.6	.	.	290	.	.	23:08
01AUG	21.0	20.0	8.3	8.8	.	3.0	.	.	.	.	22:12
03AUG	29.7	22.5	8.1	8.4	129.5	.	.	.	.	.	11:50
07AUG	19.5	23.5	8.3	9.0	.	2.0	.	.	.	.	21:06
09AUG	18.0	21.6	.	19.0	162.6	.	.	340	.	.	19:58
16AUG	24.7	22.7	8.6	10.3	147.3	.	.	.	.	.	9:38
16AUG	26.0	25.0	9.0	15.2	.	3.0	.	.	.	.	21:19
21AUG	23.5	23.0	8.1	10.1	.	3.0	.	.	.	.	22:19
22AUG	25.0	25.0	8.6	12.2	91.4	.	.	255	.	.	21:38
29AUG	25.5	24.0	8.8	13.7	.	2.0	.	.	.	.	20:39
07SEP	22.0	22.2	8.7	13.2	73.7	.	.	.	.	.	9:45
12SEP	22.0	25.1	8.5	10.2	76.2	.	.	450	.	.	19:04
18SEP	17.5	21.3	7.7	6.4	50.8	.	.	.	.	.	9:55
26SEP	15.3	16.3	.	10.4	86.4	.	.	350	.	.	20:51
04OCT	11.5	15.2	8.9	10.2	91.4	.	.	350	.	.	18:45
18OCT	10.3	16.2	8.5	12.4	101.6	.	.	.	.	.	11:15
02NOV	12.0	12.6	8.2	9.0	139.7	.	.	.	.	.	10:45
07NOV	13.0	10.5	8.3	11.7	139.7	.	.	290	.	.	18:06