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

ANNUAL REPORT FOR 1990

Prepared For

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1. INTRODUCTION

This report presents the 1990 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 1990 survey was the fourth conducted by RMC following 10 years of monitoring by Ichthyological Associates, Inc., and 3 years by EA Engineering, Science, and Technology, Inc.

The objectives of the aquatic monitoring studies were to obtain a comprehensive data base necessary to establish the baseline conditions, evaluate natural fluctuations of various parameters within the ecosystem, 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 1990 studies were the fifth 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 reservoir 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. 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.

This report is divided into chapters. The first section contains descriptions of sampling stations, methods, and schedules. The next section contains statistical and analytical results of the 1990 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 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, as 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 1990. Program elements consisted of benthic macroinvertebrates, ichthyoplankton, seine, electrofishing, creel surveys, and water quality. This is the 17th annual report of aquatic monitoring studies at TMINS, and the fourth prepared by RMC Environmental Services, Inc.

Benthic Macroinvertebrates

Macroinvertebrates were collected monthly from April through November 1990. A total of 35,347 specimens of 80 taxa was taken. Nine taxa comprised nearly 90% of the benthic organisms. Limnodrilus hoffmeisteri and Chironomus decorus group were the most abundant organisms collected. Hexagenia had the greatest biomass.

In 1990, a total of 1,704 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 9B1, and identical at 11A1 and 1A2. Relative abundance of individuals among the taxa and their composition between stations was also similar, as reflected by indices of diversity and percent similarity. Total station density and biomass were variable and highest at Station 9B1; density and biomass at Stations 1A2 and 11A1 were similar.

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 abundances of a few taxa. Monthly and station densities of Limnodrilus hoffmeisteri, historically the most abundant taxon, were significantly different. Densities at Stations 1A2 and 11A1 were similar and significantly lower than that at Station 9B1.

Multiple year comparisons of number of taxa, diversity, and similarity showed variation among stations and years. 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 increase from 1989, due principally to substantial increases of Limnodrilus hoffmeisteri densities. 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 1990. A total of 5,433 individuals of at least 26 taxa was taken. Eight taxa comprised over 91% of the total catch; pumpkinseed/bluegill and common carp were most common.

Larvae were first collected in early April, and were abundant from late April through early May and late May through August. Early season spawners were dominated by cyprinids, catostomids, and percids. Members of the 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 eight most common taxa. Stations located upstream (13A2 and 16A1) and downstream (11A1 and 9B1) of the TMINS discharge were statistically undifferentiated. Densities were significantly higher on 7 May, 4 to 18 June, and 2 July and at Station 14B1.

Community composition was evaluated by diversity and percent similarity indices. Diversity values ranged from 2.44 to 3.10 for the eight stations. The results were influenced by the extreme abundance of the common carp and/or pumpkinseed/bluegill compared to the other taxa taken at a station. Percent similarity values ranged from 19.0 to 89.0%. Stations near TMINS exhibited high diversity and percent similarity values, indicating a similar community composition.

The 1990 data were compared to data collected from 1977 through 1989. Generally, the number, density, and common species of ichthyoplankton collected in 1990 were below ranges reported previously. Significant differences in ichthyoplankton densities were noted among years, dates, and stations over the study period. 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 were conducted once in April, July, October, and November and semimonthly May, June, August, and September 1990. A total of 31,470 fish of 35 species was collected. The most fish and greatest biomass occurred at Station 13B5, while the most species were taken at Station 4A2. Temporally, the most fish were captured on 15 June, while biomass peaked on 18 July.

Minnows ranked first in family composition, and comprised 71.0% of the total catch. The mimic shiner comprised 32.7% of the catch and was the most abundant species in 1990. Other common fishes were spotfin shiner (24.8%), channel catfish (10.4%), and tessellated darter (9.2%).

The length-weight measure of fish condition (K) was calculated for spotfin shiner, mimic shiner, and channel catfish. There was a general trend of increasing K factor with increasing length for spotfin shiner and mimic shiner.

Community composition among stations was compared by diversity and percent similarity indices. Diversity values at stations immediately upstream (16A1) and downstream (10A2) of the TMINS discharge were similar, also the percent similarity of community composition at these stations was high. Examination of both diversity and percent similarity over time (1976 through 1990) revealed no pattern which differentiated TMINS operational periods from non-operational periods.

The 1990 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 22 species. Black spot (fluke cysts), pugheadedness, and skin infections were the most prevalent. Patterns of parasitic infection and morphological anomalies observed in 1990 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 were conducted once in April, July, October, and November, and semimonthly in May, June, August, and September 1990. A total of 5,606 fish of 36 species was taken. No consistent pattern of temporal abundance was evident.

Sunfishes ranked first in family composition at all stations, comprising 73.1% of the catch. The pumpkinseed comprised 20.7% of the catch and was the most abundant species in 1990. Other common fishes were redbreast sunfish (18.5%) and smallmouth bass (11.8%).

Analysis of the spatial and temporal differences in the 1990 catch-per-minute data revealed significant differences among seasons and stations. The seasonal catch-per-minute data at the individual stations were variable and revealed only minor differences. Thus, the 1990 distribution of fish in York Haven Pond appeared unrelated to TMINS operation.

The length-weight measure of fish condition (K) was calculated for redbreast sunfish, pumpkinseed, and smallmouth bass. In general, K factors for these species were highest in May or June and were probably associated with the reproductive condition of the fish. The K factors for these species were similar to those reported from other water bodies. A comparison of annual K factors for redbreast sunfish, pumpkinseed, and smallmouth bass revealed year to year differences for each species, which were related to the natural variation in their populations.

Community composition was compared among stations by diversity and percent similarity indices. Diversity ranged from 2.97 to 3.61. Pairwise station comparisons of percent similarity ranged from 26.2 to 78.2%. For stations upstream and downstream of the TMINS discharge, station diversity and percent similarity were generally within the upper portion of their historic ranges.

Annual, monthly, and spatial trends in fish abundance were analyzed; all factors were significantly different. Substantial year to year variation in catch rates obscured any trend. The 1990 catch ranked fourth among all years (1976 through 1990). 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 20 fishes in 1990. The most prevalent were leeches, skin infections, and anchor worms (Lernaea spp.). Patterns of parasitic infection and morphological anomalies observed in 1990 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 from April through November 1990. A total of 2,639 anglers was interviewed. They fished for 6,341.71 hours and caught 6,019 fish of which 1,129 were harvested. The resultant catch and harvest per hour was 0.95 and 0.18 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 area. Fishes most frequently caught were smallmouth bass, channel catfish, walleye, and rock bass.

Analysis of variance revealed that fishing pressure and success varied among creel survey areas in 1990, but months were not significantly different in terms of fish caught, fish kept, and hours fished. The General Reservoir supported the highest number of anglers, fish caught, and hours fished. Harvest was higher at the York Haven Generating Station, but was undifferentiated Statistically from the General Reservoir.

The number of anglers interviewed in 1990 and their hours fished were among the highest recorded in the 16 year study period. Analysis of the multiple year data set identified the General Reservoir and York Haven Generating Station areas as supporting higher levels for all measures of effort and success than the East and West Dam areas. Yearly rankings for number of fish caught and kept between 1990 and all other years were undifferentiated.

Channel catfish, rock bass, smallmouth bass, and walleye have been the most abundant fishes caught and harvested over the study period. Fluctuations in the catch and harvest of these species over time were likely related to changes in angler objectives, size structure of the fish population sought, and/or production of strong year classes. Most anglers were fishing as a means of recreation and their habits appeared unaffected by the presence of TMINS or the 1979 accident.

Water Quality

Selected water quality parameters were measured at specific locations throughout York Haven Pond in 1990. 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 values were limited to areas outside the influence of the TMINS discharge.

The water quality data collected in 1990 was largely influenced by high river flow, but some typical seasonal patterns were evident for a number of parameters. Generally, mean values for river flow, surface and bottom velocities, and Secchi disc transparency tended to be higher in the spring or fall than in the summer. The water temperature, TDS, pH, and conductivity readings were lower in the spring or fall and higher in the summer. DO was inversely related to water temperature. Analysis of temporal and spatial differences in water temperature, pH, DO, and TDS revealed significant differences among months. Only TDS exhibited 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 1990 was high but slightly below the record flow of 1989. Water temperature, pH, DO, and TDS data for the macroinvertebrate stations revealed some year to year differences, yet the 1990 data fell within the ranges observed previously.

Individual measurements of water temperature, pH, DO, and TDS differed significantly among years (1974 through 1990) and months. Sampling station differences were significant only for TDS. Significant yearly differences were unrelated to years of TMINS operation or non-operation.

Based on analysis of 17 years of data for water temperature, pH, and DO, and 13 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.

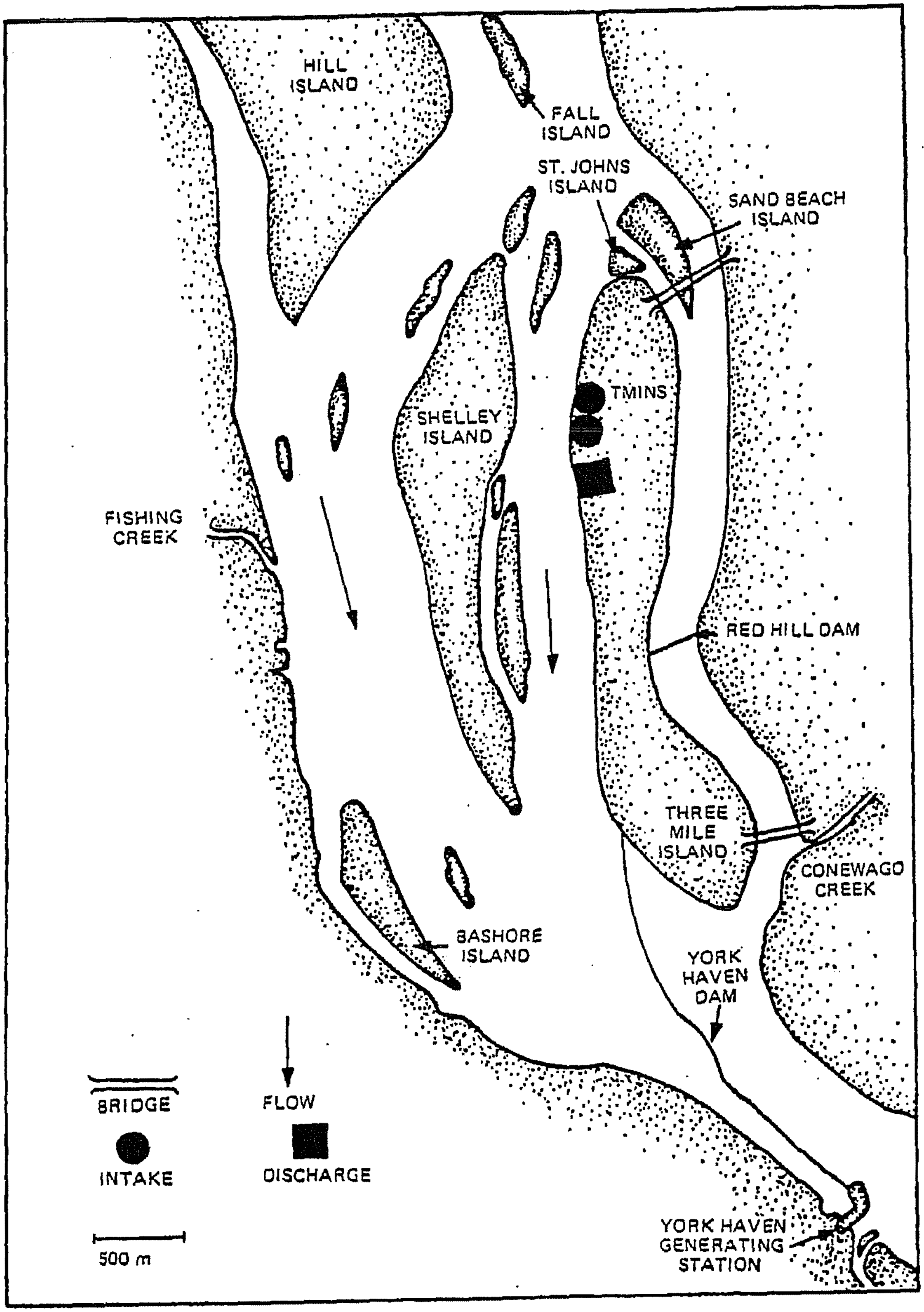

Figure 1-1. Map of Three Mile Island Nuclear Station aquatic study area.

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 1990. 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 an 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 a measure of the distribution of organisms among the taxa collected, two communities made up of completely different species assemblages may have identical diversity values. Therefore, an estimate of community similarity in conjunction with the diversity estimate is desirable. 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 comparison of the relative similarity of the community composition and species abundance between two samples (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 1990 dates, stations, or replicates were significant. ANOVAs were performed on logarithmic transformed densities [$\log_e$ (density+1)] as was done in previous years (EA 1985, 1986, 1987; RMC 1988a, 1989, 1990). 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: 1990

Results of 1990 macroinvertebrate collections are presented in Appendix A. A total of 35,347 specimens of 80 taxa was taken in 96 collections (Table 2-2). An oligochaete, Limnodrilus hoffmeisteri (18,140 specimens, 51.3%) and a chironomid, Chironomus decorus group (4,875, 13.8%), together comprised 65.1% of the total macroinvertebrate abundance. Seven other taxa comprised an additional 24.4% of the benthic abundance. These were Pisidium (3,093, 8.8%), Hexagenia (1,287, 3.6%), Procladius (1,069, 3.0%), Musculium transversum (964, 2.7%), Phaenosectra (756, 2.1%), Cryptochironomus fulvus group (745, 2.1%), and Bothrioneurum vejdovskyanum (722, 2.0%). The remaining 71 taxa accounted for less than 11% of the total abundance; 46 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 1990 benthic and fisheries surveys, a total of 1,704 C. fluminea was collected (Table 2-3). Specimens were taken at nine separate locations throughout York Haven Pond. The benthic surveys accounted for 315 specimens, and represented a substantial increase of C. fluminea over that reported in 1989 (RMC 1990). Although 870 specimens were collected from stations below the TMINS discharge nearly as many (834) were taken from stations above and outside the influence of the discharge. Most

(78.6%) were collected in the fall (September through November) as a result of spawning in late spring and summer. Standard shell lengths ranged from 1.1 to 22.0 mm, with a mean of 5.4 mm. Over 98% were juveniles (≤10.0 mm), while the others were considered adults of one to two years old. Age classifications followed RMC (1988b).

2.2.1 Spatial Distribution

During 1990, 51 taxa were collected at Stations 1A2 and 11A1; 54 were collected at 9B1 (Table 2-4). Total station density was similar for Stations 1A2 and 11A1; density at Station 9B1 was a third higher than at the other two stations (Table 2-5). The oligochaete, _Limnodrilus hoffmeisteri_ was numerically dominant at all stations (Table 2-6); it comprised over 60% of the total benthic abundance at Station 9B1, and 47.7 and 41.9% at 1A2 and 11A1, respectively. _L. hoffmeisteri_ density at Station 9B1 was double that of Stations 1A2 and 11A1. The midge, _Chironomus decorus_ group was second in total benthic abundance; density was greatest at Station 1A2 (1,420 organism/m^2). The overall density at 11A1 was slightly less (1,028/m^2) and substantially lower at 9B1 (432/m^2).

Among the other macroinvertebrates, the mollusc, _Pisidium_, was the second most abundant taxa at Station 9B1

($860/m^2$), and ranked third at Stations 11A1 ($624/m^2$) and 1A2 ($343/m^2$). The mayfly, Hexagenia, was the third most abundant taxa at Station 9B1 ($540/m^2$) and was common at 11A1 ($171/m^2$). The midge, Procladius, was most abundant at Station 11A1 ($259/m^2$); although less, densities at the other stations were similar. The mollusc, Musculium transversum, was abundant at Station 9B1 ($377/m^2$); its abundance at Stations 1A2 and 11A1 was substantially less. The midges, Phaenopsectra and Cryptochironomus fulvus group, were most abundant at Stations 1A2 ($255/m^2$) and 9B1 ($217/m^2$), respectively. The oligochaete, Bothrioneurum vejdovskyanum was abundant at Station 1A2 ($274/m^2$), but was scarce elsewhere.

Biomass trends for the three stations were similar to those observed for density (Table 2-7). The total biomass was highest at Station 9B1 (4,106.7 mg/m^2), intermediate at Station 11A1 (2,229.6 mg/m^2), and lowest at Station 1A2 (1,504.2 mg/m^2). Five taxa (Hexagenia, Limnodrilus hoffmeisteri, Chironomus decorus group, Pisidium, and Corbicula fluminea) made up 83.2% of the biomass at Station 1A2, 79.0% at Station 11A1, and 89.8% at Station 9B1.

The mayfly, Hexagenia, the fourth ranked taxon numerically, was the dominant taxon in terms of biomass (1,091.2 mg/m^2) (Table 2-8). It was the dominant taxon at Stations 11A1 and 9B1 and ranked third at 1A2. The numerically dominant taxa, Limnodrilus hoffmeisteri (592.8 mg/m^2) and Chironomus decorus group (351.5 mg/m^2), also made up a substantial portion of the annual biomass. L. hoffmeisteri comprised a large portion of the biomass at all stations; it ranked second at each station, ranging from 381.8 mg/m^2 at 11A1 to 1004.2 mg/m^2 at 9B1. C. decorus group ranked first at Station 1A2, and comprised a large portion of the biomass at Station 11A1. Pisidium contributed substantially to the annual biomass at all stations, particularly Station 9B1. The Asiatic clam, Corbicula fluminea, comprised a substantial portion of the annual biomass at Station 11A1.

2.2.2 Temporal Distribution

Numbers of macroinvertebrate taxa collected at each station varied among sampling dates; no discernible seasonal trend was evident (Table 2-4). Monthly, the number of taxa collected ranged from 31 in July to 42 in August and October. Variation in the number of taxa was least at Station 11A1, ranging from 24 (July) to 29 (April), and greatest at Stations 1A2 and 9B1 (range 17 to 27). The number of taxa was highest at Station 11A1 on each sample date.

Monthly densities in 1990 increased from April to a peak in June, declined through August, and increased to a second peak in October (Table 2-5). Generally, individual station densities followed similar trends, peaking in June (11A1 and 9B1) or July (1A2), then decreasing, only to increase to a second and larger peak in September (9B1) or October (1A2 and 11A1). 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 peaked in July at Station 1A2, August at 11A1, and September at 9B1. Differences in periods of peak abundance indicated that the L. hoffmeisteri breeding cycles were not synchronous among the stations. C. decorus group was more limited in its abundance; most (42.7%) were collected in October, when populations peaked at all stations.

Monthly biomass values increased from April to a peak in June, declined through August, and reached a secondary peaked in November (Table 2-7). Individual station biomass values followed similar trends, reflecting the bimodal nature of macroinvertebrate abundance. High biomass values in June were primarily due to Hexagenia, which comprised over 62% of the monthly biomass (Table 2-10). The secondary peak in November resulted mostly from Limnodrilus hoffmeisteri, Chironomus decorus group, and Hexagenia nymphs, which accounted for 68.0% of the monthly biomass. Biomass trends for C. decorus group were similar to density trends; peak biomass occurred in the spring (April through June) followed by a second peak in the fall (October or November). L. hoffmeisteri biomass values paralleled density trends observed at Stations 1A2 and 9B1; highest values occurred in July at Station 1A2 and September at Station 9B1. In contrast, the biomass at Station 11A1 was low during the peak abundance in August. 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 1A2. However, biomass at Stations 11A1 and 9B1 was low during the peak abundance in April, also indicative of 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 that April and November ranked lowest and October 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 at Stations 11A1 and 1A2 were similar and significantly different from Station 9B1. 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 1990 was calculated with the Shannon-Wiener Index (H′). Annual station values were very similar at Stations 1A2 (2.57) and 9B1 (2.42) (Table 2-13). Monthly station H′ values were variable and ranged from 1.72 in August at 9B1 to 3.47 in April at 11A1. Overall, diversity was high in the spring and low in the summer and fall (July 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. For example, the low diversity value observed in August was attributed to a substantial increase in the abundance of Limnodrilus hoffmeisteri at all stations, especially 9B1 where it comprised over 86% of the organisms among 22 taxa. Higher H′ values in the spring were the result of a more even distribution of individuals among the taxa.

In addition, spatial variations in diversity may also 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) typically provides a more diverse habitat and an increase in available niches for a greater number of taxa.

Substantial seasonal variability in community composition characterized the 1990 benthic macroinvertebrate collections. Monthly percent similarity indices (PSc) among station pairs varied from 49.7% between Stations 1A2 and 9B1 in April, to 83.3% between Stations 1A2 and 11A1 in August (Table 2-14). The low PSc between Stations 1A2 and 9B1 in April was due to the high proportion of <u>Hexagenia</u> and <u>Procladius</u> at Station 9B1 relative to Station 1A2. Pair-wise station comparisons for 1990 indicate that stations paired with the TMINS discharge (11A1) had higher PSc values (74.4% and 78.8%) than the other station pair. Benthic communities at Stations 1A2 and 9B1 were least similar (69.1%). The differences among PSc values in 1990 were probably attributed to microhabitat differences among stations.

2.4 MULTIPLE-YEAR COMPARISON

To determine if differences existed between the 1990 benthic community data and data collected previously (1976 through 1989), 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 15-year period has been highly variable, especially at Station 1A2 (Figure 2-2). Number of taxa in 1990 was within the range observed previously at all stations. Compared to 1989, the number of taxa in 1990 was slightly higher at Station 9B1 and noticeably lower at 1A2 and 11A1. Number of taxa collected in 1990 was generally comparable to that collected from 1984 through 1989, which represented a period of reduced taxa richness at all stations. However, the 1990 spatial trends in number of taxa differed from those of 1984 to 1986. Station 9B1 supported the greatest number of taxa in 1990, followed by Stations 1A2 and 11A1. In 1988 and 1989, Station 1A2 yielded the greatest number of taxa, as well as most previous years (1976 through 1983).

Comparison of 1990 Shannon-Wiener diversity values (H′) with those for 1976 through 1989 indicated that the 1990 values were among the highest observed in the 15-year period (Figure 2-3). In fact, diversity at Station 11A1 was the highest to date. The H′ values have steadily increased at Station 11A1 since 1984. Diversity at Station 1A2 declined in 1990 but was still within the historical range. The 1990 values at all stations were most similar to the higher values recorded prior to 1984. Diversity relationships among stations for 1990 were similar to those observed for non-operational years (1979 through 1985). Diversity at Station 1A2 was higher during the operational years, 1976 through 1978 and 1988 and 1989, 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 1990 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 15-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 (82 percent), while the least similarity (77 percent) occurred between the upstream control station (1A2) and the station located 1,975 m downstream of TMINS (9B1).

In 1990, percent similarity between all station pairs generally decreased from the values reported in 1989, yet was within the ranges reported previously. 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 at all stations decreased from the period of plant operation (1976 to 1978) to the period following TMINS shutdown. Total macroinvertebrate density in 1990 increased over that reported in 1989, except at Station 11A1. This increase was primarily due to a large gain in <u>Limnodrilus</u> <u>hoffmeisteri</u> abundance. The increase in density likely resulted from favorable water temperatures which resulted in several successful breeding cycles. Spatial density trends for 1990 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 among the dominant benthic macroinvertebrates in the TMINS collections, comprising 31 to 84% of the total abundance from 1976 through 1989. In 1990, *L. hoffmeisteri* ranked first and comprised 51.3% 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 1990, densities were comparable to those collected during 1981 to 1984. Density at Station 1A2 (upstream of the TMINS discharge) in 1990 was the highest since 1986 and represented a 75.6% increase over that reported in 1989. Densities at Stations 11A1 and 9B1, were also noticeably above those reported in 1989, yet were within their historical ranges.

The increase in *L. hoffmeisteri* density in 1990 suggested a natural response to favorable environmental conditions. High densities of *L. hoffmeisteri* may be due to reduced scouring of the bottom sediment, favorable river flow, and/or warmer water temperatures in the spring and summer which may afford better breeding conditions resulting in a population increase.

The midge, *Chironomus decorus* group, second in annual abundance prior to 1989, was the second most abundant taxa in 1990, accounting for 13.8% 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 1990, C. decorus group densities decreased sharply at all stations. In fact, density at Station 9B1 declined 83.6% from that reported in 1989, while density at 1A2 and 11A1 declined 25.3 and 58.2%, respectively. Although reduced from peak densities reported in 1989, all values were within the range of previous years.

None of the station abundance data for benthic macroinvertebrate communities suggest influence 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 1990.

TAXA	NUMBER	PERCENT	CUMULATIVE TOTAL	CUMULATIVE PERCENT
Limnodrilus hoffmeisteri	18140	51.3	18140	51.3
Chironomus decorus	4875	13.8	23015	65.1
Pisidium	3093	8.8	26108	73.9
Hexagenia	1287	3.6	27395	77.5
Procladius	1069	3.0	28464	80.5
Musculium transversum	964	2.7	29428	83.3
Phaenopsectra	756	2.1	30184	85.4
Cryptochironomus fulvus	745	2.1	30929	87.5
Bothrioneurum vejdovskyanum	722	2.0	31651	89.5
Gammarus fasciatus	584	1.7	32235	91.2
Hydrolimax grisea	480	1.4	32715	92.6
Arcteonais lomondi	418	1.2	33133	93.7
Corbicula fluminea	315	0.9	33448	94.6
Tubificidae	262	0.7	33710	95.4
Ilyodrilus templetoni	247	0.7	33957	96.1
Chironomid pupae	166	0.5	34123	96.5
Coelotanypus	153	0.4	34276	97.0
Helobdella elongata	145	0.4	34421	97.4
Ceratopogonidae	139	0.4	34560	97.8
Limnodrilus udekemianus	118	0.3	34678	98.1
Polypedilum scalaenum	109	0.3	34787	98.4
Ablabesmyia	107	0.3	34894	98.7
Manayunkia speciosa	66	0.2	34960	98.9
Stenelmis	42	0.1	35002	99.0
Nematoda	41	0.1	35043	99.1
Tanytarsus	30	0.1	35073	99.2
Branchiura sowerbyi	28	0.1	35101	99.3
Musculium	25	0.1	35126	99.4
Limnodrilus claparedianus	23	0.1	35149	99.4
Helobdella stagnalis	14	0.0	35163	99.5
Epoicocladius	13	0.0	35176	99.5
Dubiraphia	12	0.0	35188	99.6
Demicryptochironomus	12	0.0	35200	99.6
Erpobdellidae	11	0.0	35211	99.6
Prostoma	9	0.0	35220	99.6
Optioservus	9	0.0	35229	99.7
Oecetis	8	0.0	35237	99.7
Anodonta cataracta	8	0.0	35245	99.7
Actinobdella inequiannulata	8	0.0	35253	99.7
Stylurus	7	0.0	35260	99.8
Dicrotendipes neomodestus	7	0.0	35267	99.8
Fossaria	6	0.0	35273	99.8
Quistadrilus multisetosus	6	0.0	35279	99.8
Eudochironomus	6	0.0	35285	99.8
Aulodrilus pluriseta	5	0.0	35290	99.8
Nectopsyche	4	0.0	35294	99.9
Sialis	3	0.0	35297	99.9
Cricotopus	3	0.0	35300	99.9
Corixidae	3	0.0	35303	99.9
Potamanthus	3	0.0	35306	99.9
Lumbriculidae	3	0.0	35309	99.9
Nematomorpha	3	0.0	35312	99.9
Hydropsyche	2	0.0	35314	99.9

TABLE 2-2 CONTINUED.

TAXA	NUMBER	PERCENT	CUMULATIVE TOTAL	CUMULATIVE PERCENT
Chaoborus	2	0.0	35316	99.9
Polypedium illinoense	2	0.0	35318	99.9
Dero	2	0.0	35320	99.9
Enchytraeidae	2	0.0	35322	99.9
Chrysops	2	0.0	35324	99.9
Placobdella papillifera	2	0.0	35326	99.9
Baetis	1	0.0	35327	99.9
Orthocladius	1	0.0	35328	99.9
Harnischia	1	0.0	35329	99.9
Psychomyiidae	1	0.0	35330	100
Microchironomus	1	0.0	35331	100
Tricorythodes	1	0.0	35332	100
Stenonema	1	0.0	35333	100
Eukiefferiella	1	0.0	35334	100
Orconectes	1	0.0	35335	100
Dugesia tigrina	1	0.0	35336	100
Mystacides	1	0.0	35337	100
Macronychus	1	0.0	35338	100
Sigara	1	0.0	35339	100
Cryptotendipes	1	0.0	35340	100
Centroptilum	1	0.0	35341	100
Amnicola	1	0.0	35342	100
Sparganophilus	1	0.0	35343	100
Ephemerella	1	0.0	35344	100
Baetisca	1	0.0	35345	100
Cladopelma	1	0.0	35346	100
Natarsia	1	0.0	35347	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, April through November 1990. Station prefix for seine (TM-SE-) and benthos (TM-MI-) was deleted from table.

Length	Seine						Benthos			Total	Age
(mm)	13B5	10B5	16A1	10A2*	9B3*	4A2	1A2	11A1*	9B1*		(Years)
0-5.0	267	11	78	113	121	3	69	71	64	797	<0.5
5.1-10.0	298	5	65	268	130	4	11	69	25	875	0.5-1.0
10.1-15.0	12	-	4	2	2	-	1	1	1	23	1.0
15.1-20.0	4	-	-	-	-	-	1	-	1	6	1.1-1.5
20.1-25.0	-	-	-	1	-	1	-	1	-	3	1.6-2.0
Total	581	16	147	384	253	8	82	142	91	1704	

* Stations located at or below the TMINS discharge.

TABLE 2-4

Number of macroinvertebrate taxa collected each month at stations near TMINS, April through November 1990.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
TM-MI-1A2	26	23	25	21	22	18	27	17	51
TM-MI-11A1	29	26	28	24	27	25	28	24	51
TM-MI-9B1	22	23	24	19	22	25	27	24	54
Total	41	37	37	31	42	36	42	34	80

TABLE 2-5

Monthly density (number/m^2) of benthic macroinvertebrates collected at the sampling stations near TMINS, April through November 1990.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
TM-MI-1A2	2547	4272	9400	10279	4008	3431	10884	2306	5891
TM-MI-11A1	5312	4834	7462	5014	5269	6555	8596	5695	6092
TM-MI-9B1	5057	6493	8171	5676	9858	14527	9702	11696	8898
Total Mean	4305	5200	8344	6990	6378	8171	9727	6566	6960

TABLE 2-6 DENSITY (NUMBER/m2) AND PERCENT COMPOSITION OF MACROINVERTEBRATES COLLECTED AT EACH STATION NEAR TMINS, APRIL THROUGH NOVEMBER, 1990.

Species	1A2		11A1		9B1	
	Density	Percent	Density	Percent	Density	Percent
Ablabesmyia	12	0.2	32	0.5	19	0.2
Actinobdella inequiannulata	1	0.0	1	0.0	2	0.0
Amnicola	.	.	.	.	1	0.0
Anodonta cataracta	.	.	3	0.0	2	0.0
Arcteonais lomondi	3	0.1	145	2.4	99	1.1
Aulodrilus pluriseta	3	0.1	.	.	.	.
Baetis	.	.	1	0.0	.	.
Baetisca	1	0.0	.	.	.	.
Bothrioneurum vejdovskyanum	274	4.7	73	1.2	80	0.9
Branchiura sowerbyi	16	0.3	1	0.0	.	.
Centroptilum	1	0.0	.	.	.	.
Ceratopogonidae	18	0.3	35	0.6	28	0.3
Chaoborus	.	.	.	.	1	0.0
Chironomid pupae	54	0.9	21	0.3	23	0.3
Chironomus decorus	1420	24.1	1028	16.9	432	4.9
Chrysops	.	.	1	0.0	.	.
Cladopelma	.	.	.	.	1	0.0
Coelotanypus	18	0.3	26	0.4	46	0.5
Corbicula fluminea	48	0.8	84	1.4	54	0.6
Corixidae	1	0.0	.	.	1	0.0
Cricotopus	1	0.0	1	0.0	.	.
Cryptochironomus fulvus	64	1.1	159	2.6	217	2.4
Cryptotendipes	1	0.0	.	.	.	.
Demicryptochironomus	.	.	6	0.1	1	0.0
Dero	1	0.0	.	.	1	0.0
Dicrotendipes neomodestus	4	0.1	.	.	.	.
Dubiraphia	3	0.1	1	0.0	3	0.0
Dugesia tigrina	.	.	1	0.0	.	.
Enchytraeidae	1	0.0	.	.	.	.
Ephemerella	.	.	.	.	1	0.0
Epoicocladius	1	0.0	2	0.0	5	0.1
Erpobdellidae	.	.	6	0.1	.	.
Eudochironomus	.	.	.	.	4	0.0
Eukiefferiella	1	0.0	.	.	.	.
Fossaria	.	.	.	.	4	0.0
Gammarus fasciatus	17	0.3	197	3.2	131	1.5
Harnischia	.	.	.	.	1	0.0
Helobdella elongata	6	0.1	53	0.9	27	0.3
Helobdella stagnalis	.	.	8	0.1	.	.
Hexagenia	49	0.8	171	2.8	540	6.1
Hydrolimax grisea	55	0.9	156	2.6	73	0.8
Hydropsyche	.	.	1	0.0	1	0.0
Ilyodrilus templetoni	55	0.9	58	1.0	32	0.4
Limnodrilus claparedianus	4	0.1	10	0.2	.	.
Limnodrilus hoffmeisteri	2810	47.7	2553	41.9	5353	60.2
Limnodrilus udekemianus	57	1.0	.	.	12	0.1
Lumbriculidae	2	0.0	.	.	.	.
Macronychus	.	.	1	0.0	.	.
Manayunkia speciosa	1	0.0	38	0.6	.	.
Microchironomus	.	.	.	.	1	0.0
Musculium	10	0.2	5	0.1	.	.
Musculium transversum	53	0.9	139	2.3	377	4.2
Mystacides	1	0.0	.	.	.	.

TABLE 2-6 CONTINUED.

Species	1A2		11A1		9B1	
	Density	Percent	Density	Percent	Density	Percent
Natarsia	1	0.0	.	.	.	.
Nectopsyche	.	.	1	0.0	1	0.0
Nematoda	5	0.1	17	0.3	3	0.0
Nematomorpha	.	.	.	.	2	0.0
Oecetis	1	0.0	.	.	4	0.0
Optioservus	1	0.0	2	0.0	2	0.0
Orconectes	.	.	.	.	1	0.0
Orthocladius	.	.	1	0.0	.	.
Phaenopsectra	255	4.3	118	1.9	74	0.8
Pisidium	343	5.8	624	10.2	860	9.7
Placobdella papillifera	.	.	1	0.0	1	0.0
Polypedilum scalaenum	23	0.4	18	0.3	24	0.3
Polypedium illinoense	.	.	1	0.0	1	0.0
Potamanthus	1	0.0	1	0.0	1	0.0
Procladius	178	3.0	259	4.2	195	2.2
Prostoma	1	0.0	4	0.1	.	.
Psychomyiidae	.	.	.	.	1	0.0
Quistadrilus multisetosus	2	0.0	2	0.0	.	.
Sialis	.	.	.	.	2	0.0
Sigara	.	.	.	.	1	0.0
Sparganophilus	1	0.0	.	.	.	.
Stenelmis	9	0.2	14	0.2	2	0.0
Stenonema	.	.	1	0.0	.	.
Stylurus	2	0.0	1	0.0	1	0.0
Tanytarsus	5	0.1	10	0.2	3	0.0
Tricorythodes	.	.	.	.	1	0.0
Tubificidae	.	.	5	0.1	150	1.7

TABLE 2-7

Monthly biomass (mg/m^2) of benthic macroinvertebrates collected at the sampling stations near TMINS, April through November 1990.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
TM-MI-1A2	667.3	1669.2	3130.4	2254.7	576.1	820.9	2463.6	451.3	1504.2
TM-MI-11A1	3819.5	1914.9	3814.3	1337.9	666.4	1445.6	2269.8	2568.0	2229.6
TM-MI-9B1	2938.1	4241.5	10510.4	4337.9	1437.6	2638.9	2328.0	4421.1	4106.7
Total Mean	2475.0	2608.5	5818.4	2643.5	893.4	1635.2	2353.8	2480.2	2613.5

TABLE 2-8 BIOMASS (mg/m2) AND PERCENT COMPOSITION OF MACROINVERTEBRATES COLLECTED AT EACH STATION NEAR TMINS, APRIL THROUGH NOVEMBER, 1990.

Species	1A2 Biomass	1A2 Percent	11A1 Biomass	11A1 Percent	9B1 Biomass	9B1 Percent
Ablabesmyia	2.5	0.2	9.4	0.4	2.7	0.1
Actinobdella inequiannulata	5.6	0.4	0.3	0.0	1.6	0.0
Amnicola	.	.	.	.	M	M
Anodonta cataracta	.	.	4.1	0.2	8.2	0.2
Arcteonais lomondi	M	M	4.0	0.2	3.5	0.1
Aulodrilus pluriseta	M	M	.	.	.	.
Baetis	.	.	0.1	0.0	.	.
Baetisca	M	M	.	.	.	.
Bothrioneurum vejdovskyanum	25.6	1.7	14.4	0.6	10.3	0.3
Branchiura sowerbyi	29.3	1.9	0.7	0.0	.	.
Centroptilum	M	M	.	.	.	.
Ceratopogonidae	2.2	0.1	4.5	0.2	2.5	0.1
Chaoborus	.	.	.	.	0.1	0.0
Chironomid pupae	19.0	1.3	7.7	0.3	12.5	0.3
Chironomus decorus	525.5	34.9	358.0	16.1	171.0	4.2
Chrysops	.	.	0.1	0.0	.	.
Cladopelma	.	.	.	.	M	M
Coelotanypus	1.7	0.1	2.9	0.1	3.0	0.1
Corbicula fluminea	71.5	4.8	141.0	6.3	73.8	1.8
Corixidae	0.4	0.0	.	.	M	M
Cricotopus	M	M	M	M	.	.
Cryptochironomus fulvus	6.2	0.4	17.2	0.8	27.7	0.7
Cryptotendipes	M	M	.	.	.	.
Demicryptochironomus	.	.	0.5	0.0	0.1	0.0
Dero	M	M	.	.	M	M
Dicrotendipes neomodestus	0.8	0.1	.	.	.	.
Dubiraphia	0.4	0.0	0.1	0.0	0.6	0.0
Dugesia tigrina	.	.	0.1	0.0	.	.
Enchytraeidae	M	M	.	.	.	.
Ephemerella	.	.	.	.	M	M
Epoicocladius	0.1	0.0	0.1	0.0	0.4	0.0
Erpobdellidae	.	.	156.0	7.0	.	.
Eudochironomus	.	.	.	.	0.2	0.0
Eukiefferiella	M	M	.	.	.	.
Fossaria	.	.	.	.	M	M
Gammarus fasciatus	1.3	0.1	67.5	3.0	81.0	2.0
Harnischia	.	.	.	.	M	M
Helobdella elongata	1.6	0.1	23.9	1.1	12.8	0.3
Helobdella stagnalis	.	.	3.3	0.1	.	.
Hexagenia	135.3	9.0	807.9	36.2	2331	56.7
Hydrolimax grisea	9.5	0.6	15.4	0.7	6.6	0.2
Hydropsyche	.	.	0.1	0.0	2.5	0.1
Ilyodrilus templetoni	0.8	0.1	1.1	0.0	0.2	0.0
Limnodrilus claparedianus	1.2	0.1	1.5	0.1	.	.
Limnodrilus hoffmeisteri	392.4	26.1	381.8	17.1	1004	24.5
Limnodrilus udekemianus	9.6	0.6	.	.	2.9	0.1
Lumbriculidae	1.5	0.1	.	.	.	.
Macronychus	.	.	M	M	.	.
Manayunkia speciosa	0.1	0.0	1.8	0.1	.	.
Microchironomus	.	.	.	.	M	M
Musculium	2.0	0.1	0.5	0.0	.	.
Musculium transversum	8.2	0.5	40.2	1.8	131.4	3.2
Mystacides	M	M	.	.	.	.

TABLE 2-8 CONTINUED.

Species	1A2		11A1		9B1	
	Biomass	Percent	Biomass	Percent	Biomass	Percent
Natarsia	M	M	.	.	.	.
Nectopsyche	.	.	M	M	2.0	0.0
Nematoda	0.5	0.0	2.2	0.1	0.3	0.0
Nematomorpha	.	.	.	.	0.2	0.0
Oecetis	0.1	0.0	.	.	0.4	0.0
Optioservus	0.5	0.0	0.4	0.0	0.7	0.0
Orconectes	.	.	.	.	M	M
Orthocladius	.	.	M	M	.	.
Phaenopsectra	36.0	2.4	9.2	0.4	25.5	0.6
Pisidium	126.4	8.4	74.2	3.3	106.1	2.6
Placobdella papillifera	.	.	3.4	0.2	M	M
Polypedilum scalaenum	2.1	0.1	1.2	0.1	2.1	0.1
Polypedium illinoense	.	.	M	M	M	M
Potamanthus	0.1	0.0	M	M	0.1	0.0
Procladius	15.1	1.0	43.8	2.0	28.9	0.7
Prostoma	0.1	0.0	0.4	0.0	.	.
Psychomyiidae	.	.	.	.	M	M
Quistadrilus multisetosus	0.1	0.0	M	M	.	.
Sialis	.	.	.	.	0.4	0.0
Sigara	.	.	.	.	0.4	0.0
Sparganophilus	M	M	.	.	.	.
Stenelmis	3.4	0.2	6.7	0.3	0.9	0.0
Stenonema	.	.	0.1	0.0	.	.
Stylurus	65.7	4.4	21.4	1.0	22.3	0.5
Tanytarsus	0.1	0.0	M	M	M	M
Tricorythodes	.	.	.	.	0.1	0.0
Tubificidae	.	.	0.6	0.0	26.1	0.6

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 1990. Dashes indicate taxa not present.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
<u>Limnodrilus hoffmeisteri</u>									
TM-MI-1A2	874	1791	3809	6205	2594	1923	4154	1129	2810
TM-MI-11A1	1007	2117	3180	3232	3554	2358	2542	2429	2552
TM-MI-9B1	1276	3544	4853	2490	6621	9811	6200	8029	5353
<u>Chironomus decorus</u> group									
TM-MI-1A2	524	827	3483	775	123	558	5019	47	1420
TM-MI-11A1	917	326	1583	61	38	1158	3530	610	1028
TM-MI-9B1	369	227	165	14	47	336	1300	1002	432
<u>Pisidium</u>									
TM-MI-1A2	104	298	865	865	61	123	232	198	343
TM-MI-11A1	250	302	487	562	496	1408	884	605	624
TM-MI-9B1	397	232	1115	1044	1158	2221	619	90	860
<u>Hexagenia</u>									
TM-MI-1A2	19	5	33	-	-	137	194	5	49
TM-MI-11A1	435	132	203	52	9	151	269	118	171
TM-MI-9B1	1333	562	1115	175	5	184	354	591	540
<u>Procladius</u>									
TM-MI-1A2	28	5	5	421	548	317	94	5	178
TM-MI-11A1	855	99	19	113	628	269	52	33	259
TM-MI-9B1	619	113	9	47	80	510	156	24	195
<u>Musculium transversum</u>									
TM-MI-1A2	9	19	14	38	9	-	-	336	53
TM-MI-11A1	33	19	47	354	14	33	165	449	139
TM-MI-9B1	132	61	198	1186	364	354	156	562	377
<u>Phaenopsectra</u>									
TM-MI-1A2	732	832	477	-	-	-	-	-	255
TM-MI-11A1	666	132	142	-	-	-	-	-	118
TM-MI-9B1	307	274	9	-	-	-	-	-	74
<u>Cryptochironomus fulvus</u> group									
TM-MI-1A2	66	47	9	132	90	28	128	9	64
TM-MI-11A1	284	180	52	128	61	14	284	274	159
TM-MI-9B1	189	165	128	109	94	165	255	628	217
<u>Bothrioneurum vejdovskyanum</u>									
TM-MI-1A2	19	24	227	1347	340	33	198	5	274
TM-MI-11A1	71	99	113	28	-	5	9	255	73
TM-MI-9B1	24	109	142	5	42	241	9	66	80
All Other Taxa									
TM-MI-1A2	170	425	477	496	241	312	865	572	445
TM-MI-11A1	794	1427	1635	482	468	1158	860	922	968
TM-MI-9B1	411	1205	435	605	1446	704	652	704	770

TABLE 2-10

Monthly biomass (mg/m^2) of key macroinvertebrate taxa (>1.8% of the total biomass) collected from stations near TMINS, April through November 1990. Dashes indicate taxa not present.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Mean
Hexagenia									
TM-MI-1A2	85.1	5.7	199.0	-	-	156.9	618.1	17.5	135.3
TM-MI-11A1	1733.9	885.6	2074.2	541.1	31.2	332.7	301.5	562.8	807.9
TM-MI-9B1	1943.8	2529.8	8654.1	2802.4	14.6	157.8	549.1	1992.4	2330.5
Limnodrilus hoffmeisteri									
TM-MI-1A2	166.8	358.7	543.0	684.8	384.2	245.7	551.0	204.6	392.4
TM-MI-11A1	164.0	268.4	684.3	330.3	329.4	209.8	458.4	609.6	381.8
TM-MI-9B1	294.0	937.1	1275.5	416.4	962.7	1700.4	1245.7	1202.3	1004.2
Chironomus decorus group									
TM-MI-1A2	345.9	708.9	2093.1	146.0	39.2	229.7	613.4	27.4	525.5
TM-MI-11A1	819.9	319.5	463.6	7.1	3.8	265.6	597.8	387.0	358.0
TM-MI-9B1	155.5	270.8	73.2	-	11.3	120.0	201.3	535.4	171.0
Pisidium									
TM-MI-1A2	12.3	242.0	104.0	578.4	7.6	14.6	27.9	24.1	126.4
TM-MI-11A1	29.8	38.3	56.7	67.1	57.6	168.7	106.3	69.0	74.2
TM-MI-9B1	47.7	50.1	134.2	125.7	138.9	266.5	74.7	10.9	106.1
Corbicula fluminea									
TM-MI-1A2	-	-	-	42.1	-	99.7	353.5	77.0	71.5
TM-MI-11A1	-	-	79.9	166.8	9.0	192.8	219.3	460.3	141.0
TM-MI-9B1	-	-	-	-	-	111.5	53.9	424.8	73.8
Musculium transversum									
TM-MI-1A2	0.9	15.6	3.8	4.2	0.9	-	-	39.7	8.2
TM-MI-11A1	12.3	4.7	18.4	124.8	7.6	64.7	35.0	54.3	40.2
TM-MI-9B1	25.5	40.6	138.5	512.3	47.2	98.3	105.4	83.6	131.4
Erpobdellidae									
TM-MI-1A2	-	-	-	-	-	-	-	-	-
TM-MI-11A1	629.5	119.1	-	-	59.5	85.5	208.4	145.6	156.0
TM-MI-9B1	-	-	-	-	-	-	-	-	-
Gammarus fasciatus									
TM-MI-1A2	-	-	2.4	2.4	2.4	-	-	3.3	1.3
TM-MI-11A1	7.6	89.3	352.1	33.6	-	3.3	4.2	50.1	67.5
TM-MI-9B1	-	14.2	90.7	461.7	1.9	-	0.9	78.9	81.0
All Other Taxa									
TM-MI-1A2	56.2	338.4	185.2	796.8	141.8	74.2	299.6	57.6	243.7
TM-MI-11A1	422.5	190.0	85.1	67.1	168.2	122.4	338.8	229.2	202.9
TM-MI-9B1	471.6	398.9	144.1	19.4	260.9	184.3	96.9	92.6	208.6

TABLE 2-11

Three-factor analysis of variance test results for Limnodrilus hoffmeisteri collected from stations near TMINS, April through November 1990. Test was performed on $\log_e$ (density +1).

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2=0.840)	53	86.195	1.626	4.15	0.0001*
Month	7	24.847	3.550	9.07	0.0001*
Station	2	13.960	6.980	17.83	0.0001*
Replicate	3	0.670	0.223	0.57	0.6377
Month-Station	14	34.248	2.446	6.25	0.0001*
Month-Replicate	21	10.083	0.480	1.23	0.2799
Station-Replicate	6	2.387	0.398	1.02	0.4279
Error	42	16.445	0.392		
Corrected Total	95	102.640			

* Significant at $P \leq 0.01$.

TABLE 2-12

Summary of Tukey's studentized range tests for Limnodrilus hoffmeisteri collected near TMINS, April through November 1990. Underlined means are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest transformed [$\log_e$ (density+1)] mean. Means are listed parenthetically.

Month	Oct (8.28)	Jun (8.23)	Aug (8.18)	Sep (8.13)	Jul (8.13)	May (7.66)	Nov (7.20)	Apr (6.84)
Station	TM-MI-9B1 (8.34)	TM-MI-11A1 (7.73)	TM-MI-1A2 (7.42)					

TABLE 2-13

Monthly diversity indices for the macroinvertebrates collected at stations near TMINS, April through November 1990.

Station	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual Diversity
TM-MI-1A2	2.56	2.51	2.16	2.07	1.94	2.26	2.06	2.30	2.57
TM-MI-11A1	3.47	2.91	2.60	2.13	1.85	2.64	2.52	2.94	3.10
TM-MI-9B1	3.09	2.59	2.07	2.23	1.72	1.82	2.07	1.87	2.42
Monthly Diversity	3.38	2.89	2.53	2.38	2.00	2.25	2.35	2.41	2.79

TABLE 2-14

Percent similarity indices for the macroinvertebrate communities collected at stations near TMINS, April through November 1990.

Station Pairs	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
1A2-11A1*	61.3	63.3	75.4	77.4	83.3	67.7	82.3	70.2	78.8
1A2-9B1	49.7	59.1	55.9	56.3	71.3	72.1	61.8	60.3	69.1
11A1-9B1	67.5	79.4	60.5	68.6	82.4	63.7	62.1	69.7	74.4

* Station prefix TM-MI- deleted from table.

TABLE 2-15

Percent similarity indices for the macroinvertebrate communities collected at stations near TMINS, 1976 through 1990.

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
1990	79	69	74
Mean	79	77	82

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

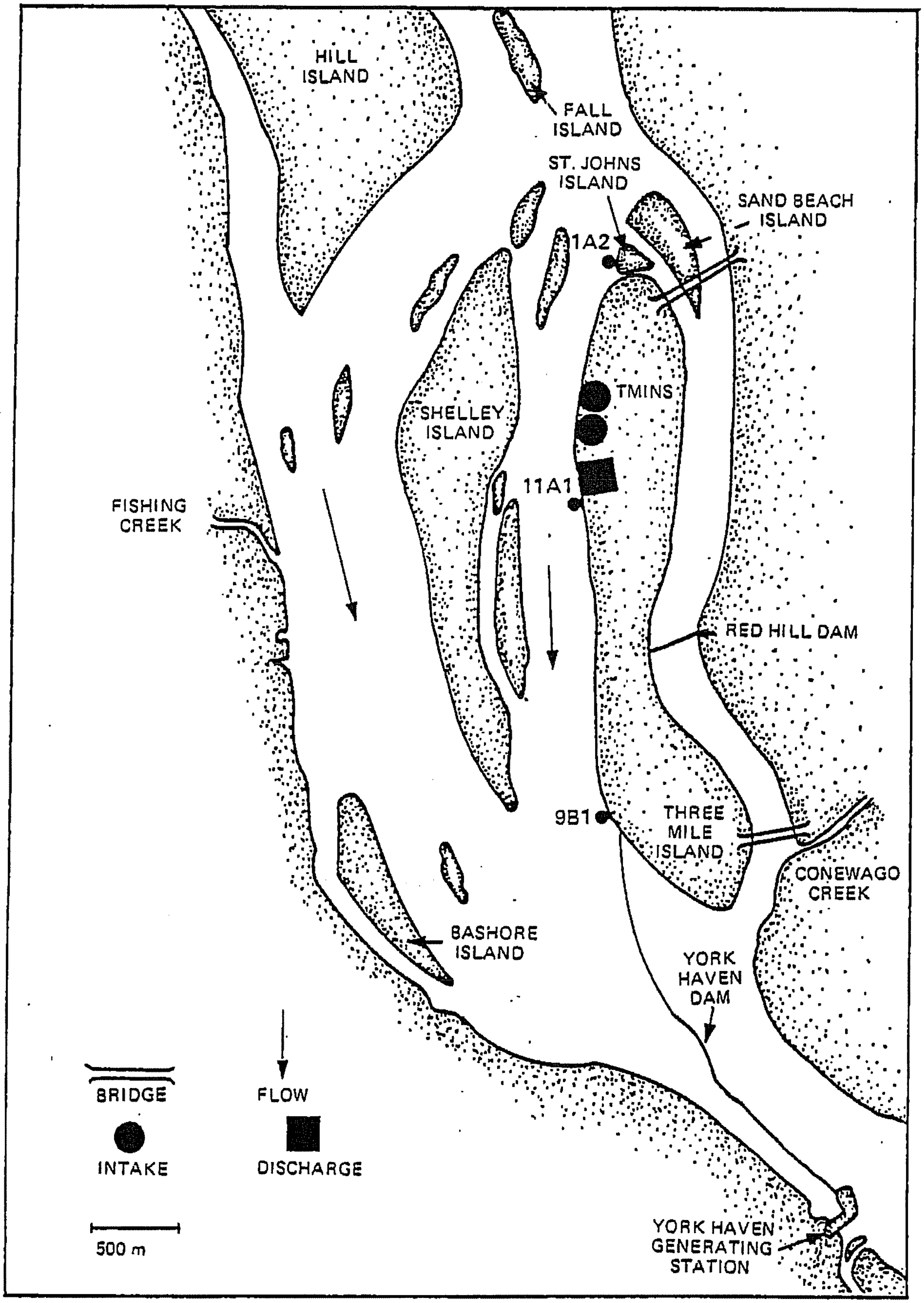

Figure 2-1. Location of benthic macroinvertebrate stations sampled in the Susquehanna River near TMINS (station prefix TM-MI- deleted).

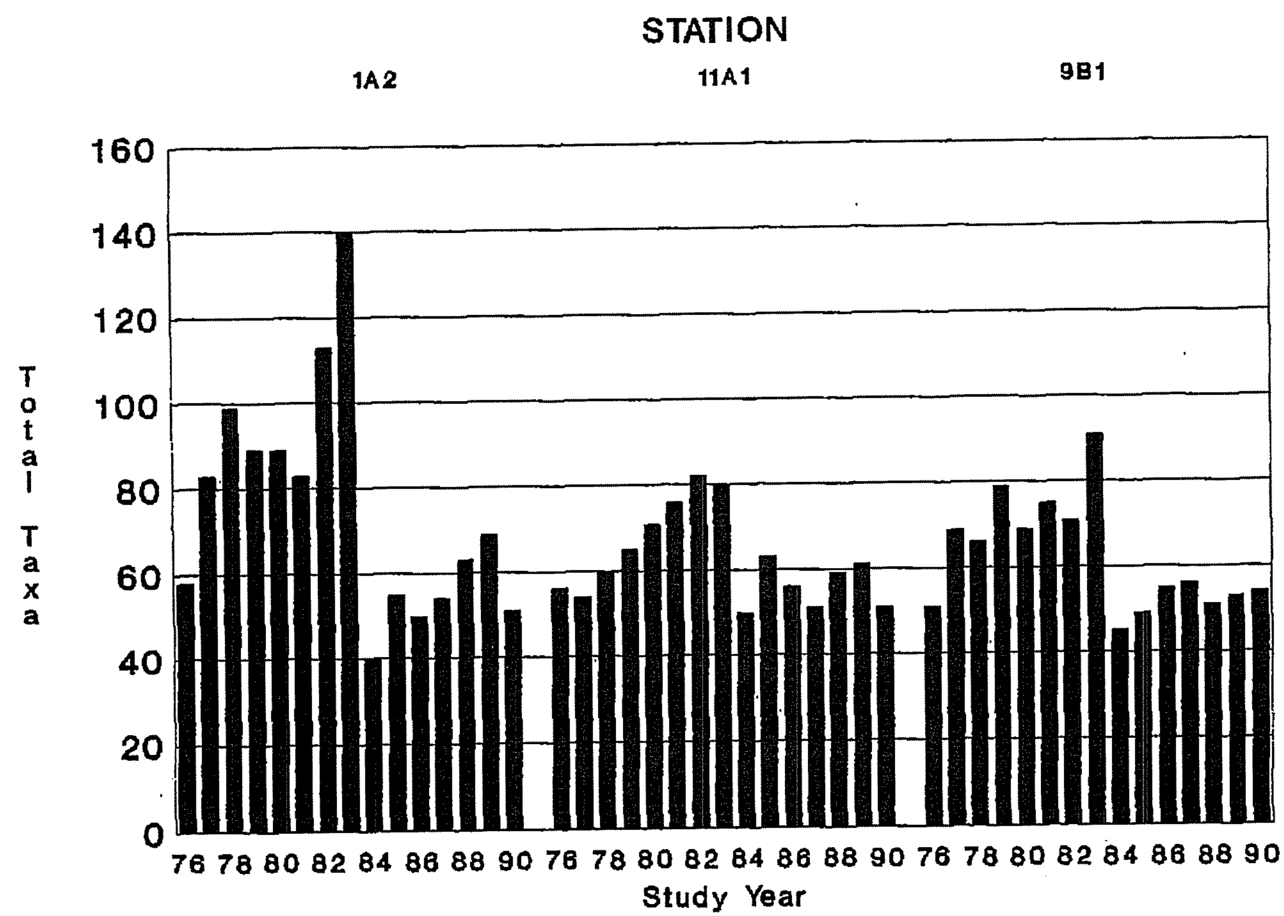

Figure 2-2. Total taxa collected at the benthic macroinvertebrate stations near TMINS, 1976 through 1990.

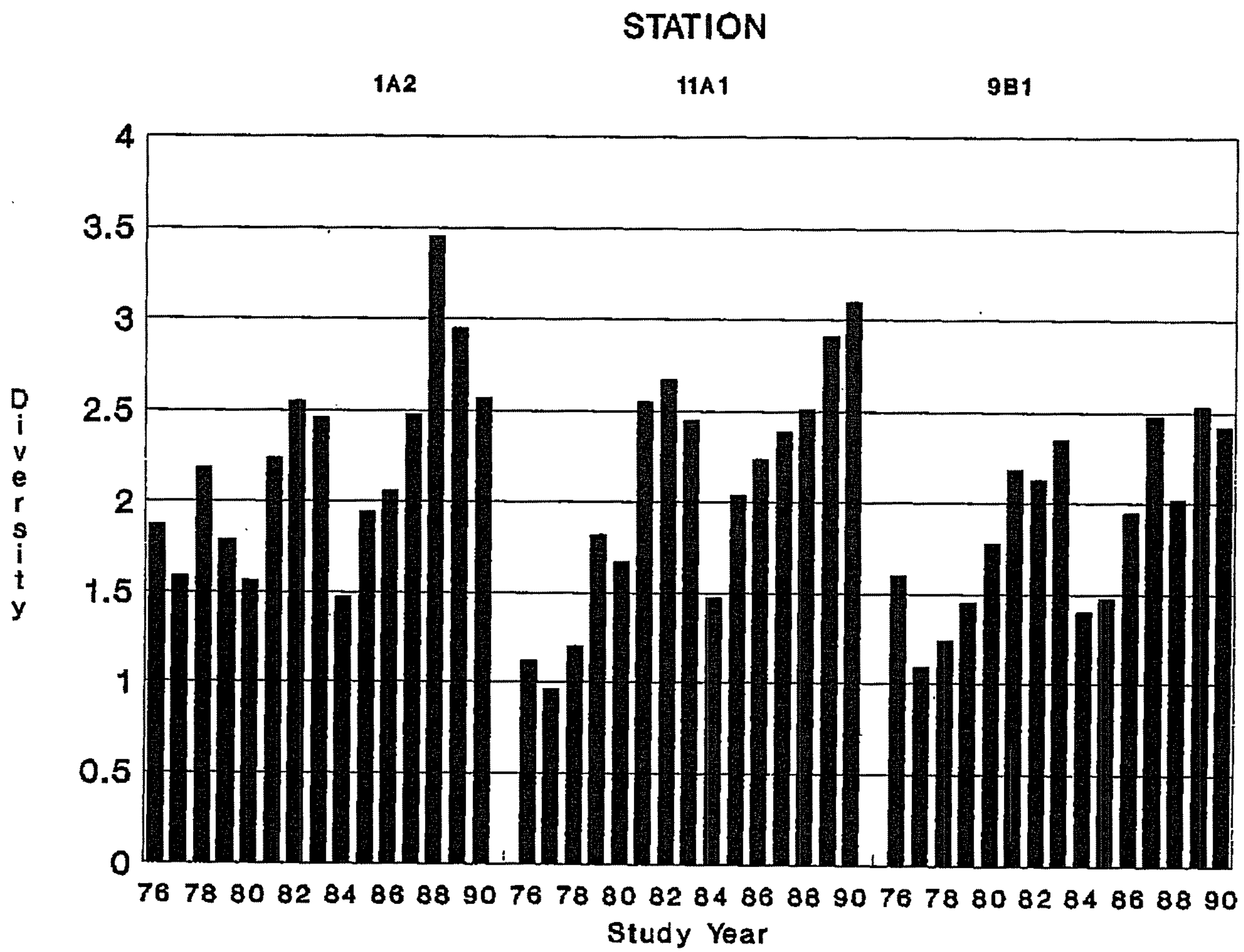

Figure 2-3. Diversity values for the macroinvertebrate communities near TMINS, 1976 through 1990.

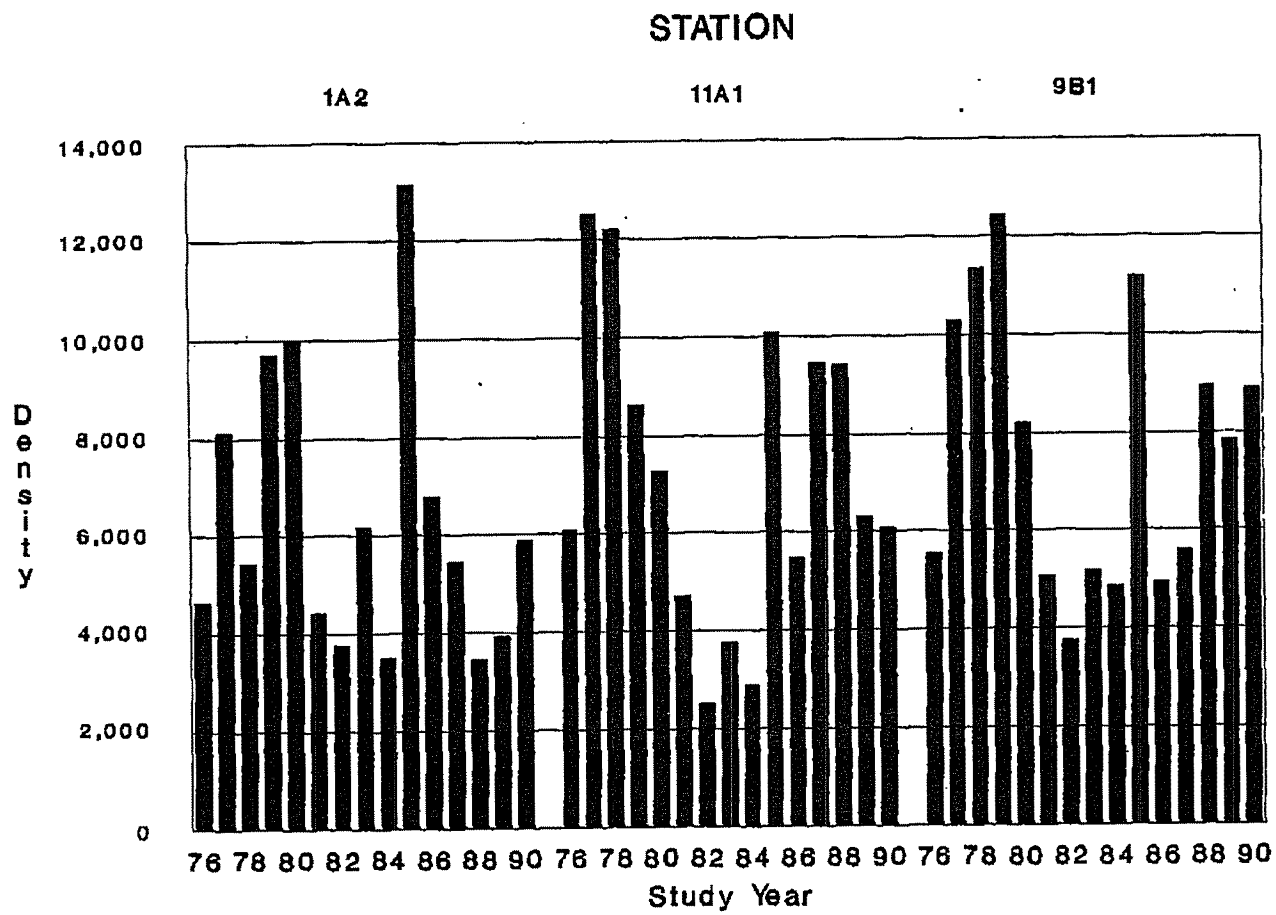

Figure 2-4. Annual mean total macroinvertebrate density (No./sq.m.) from stations near TMINS, 1976 through 1990.

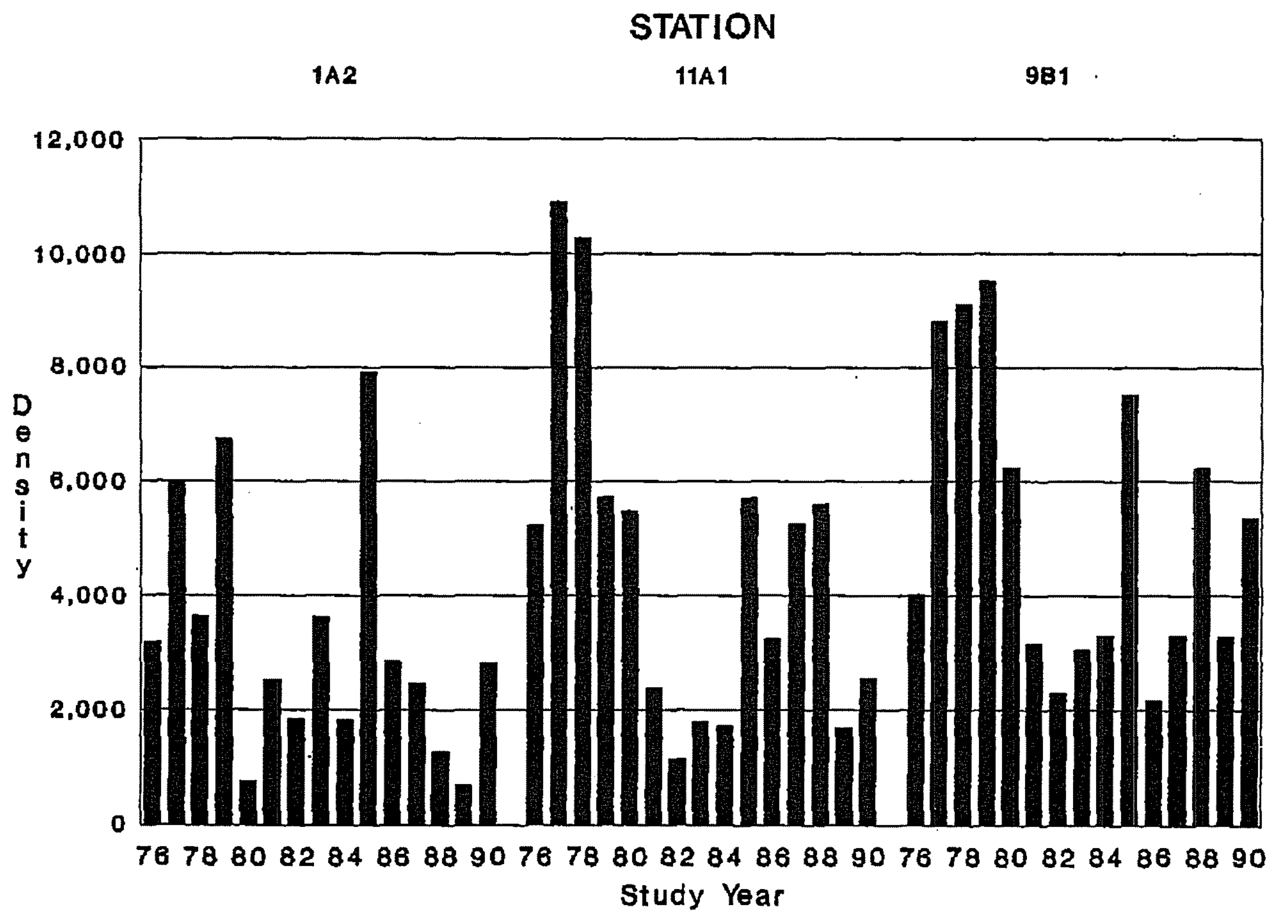

Figure 2-5. Annual mean densities (No./sq. m.) of Limnodrilus hoffmeisteri at the macroinvertebrate stations near TMINS, 1976 through 1990.

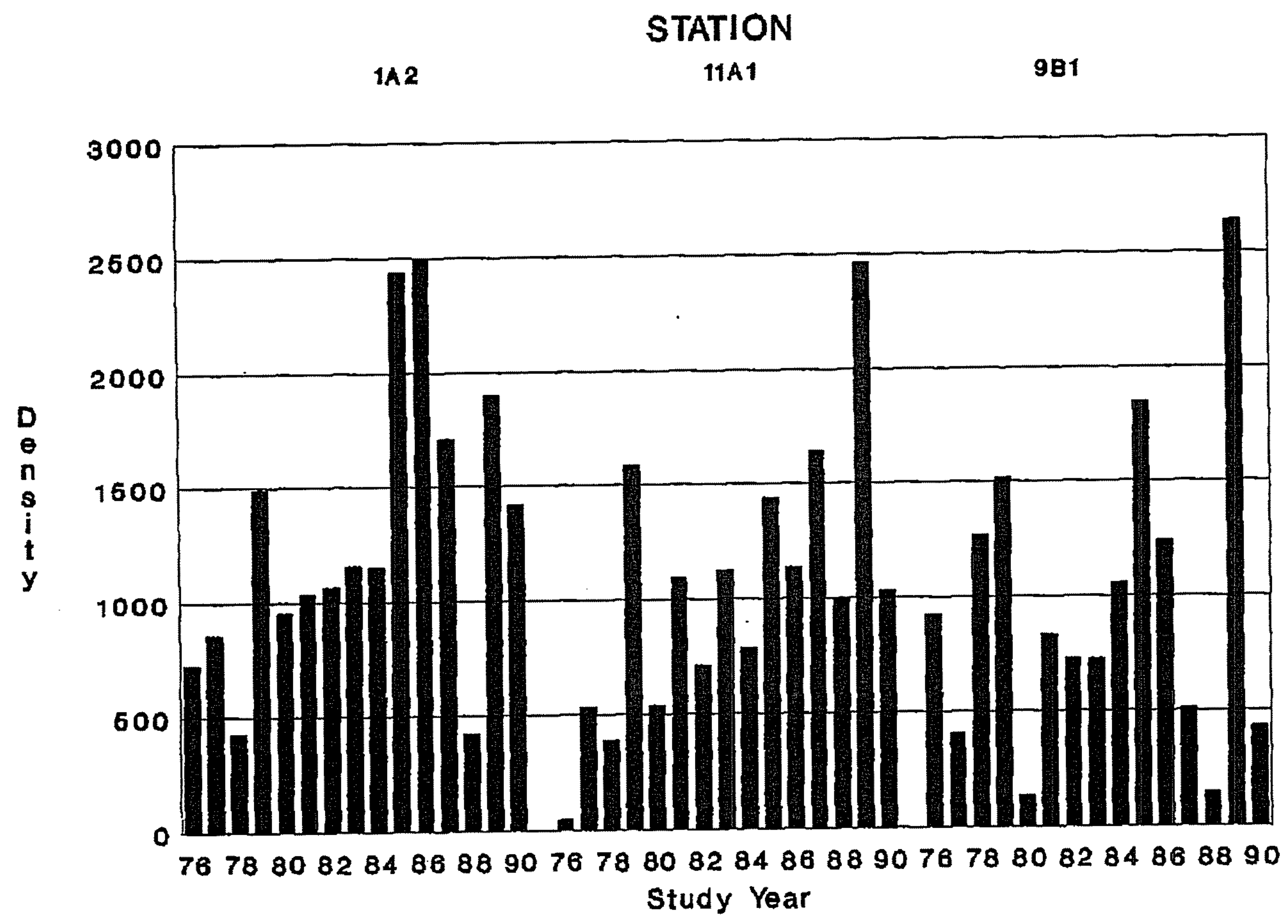

Figure 2-6. Annual mean densities (No./sq. m.) of Chironomus decorus group at the macroinvertebrate stations near TMINS, 1976 through 1990.

3. ICHTHYOPLANKTON

3.1 METHODS

Ichthyoplankton samples were collected weekly at eight stations in York Haven Pond, April through August 1990 (Table 3-1 and Figure 3-1). On each date, stations were sampled randomly at night 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, 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*, indistinguishable to species, were categorized as sunfishes. 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 1990 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. Larvae were defined as the early stage of 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, 1990), 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 1990, and among years (1977 through 1990). 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 11 and 16 April; therefore, these dates were excluded from most tables and figures. A total of 5,433 individuals of at least 26 taxa was distributed among seven families (Table 3-3). Eight taxa accounted for 91.6% of the catch. These were pumpkinseed/bluegill (23.9%), common carp (23.2%), quillback (14.2%), channel catfish (9.2%), spotfin shiner (8.9%), banded darter (4.8%), tessellated darter (4.1%), and mimic shiner (3.3%). The dominant families were cyprinids (8 species) and centrarchids (5 species), which comprised 37.6 and 25.4% of the total catch, respectively. Five of the seven families were represented by one or more of the dominant taxa.

Temporal distribution of ichthyoplankton collected in 1990 is shown in Table 3-4. Few larvae were taken before 30 April. Early spring (April) spawning activity was sporadic due to high river flow during mid-April. In May, larvae of the early season spawners in the cyprinid, catostomid, and percid families were abundant, accounting for 95.7% of the catch. The most numerous taxa collected were common carp, quillback, tessellated darter, and banded darter.

Ichthyoplankton abundance in June was variable. Larvae of the late spring and early summer spawners dominated, typically members of the cyprinid, catostomid, centrarchid, and percid families. Peak seasonal abundance occurred on 9 July, and coincided with the collection of the largest number of taxa. The predominant summer spawners (July and August) were cyprinids, ictalurids, and centrarchids; most were spotfin shiner, mimic shiner, channel catfish, and pumpkinseed/bluegill.

The temporal distribution of the most abundant taxa is shown in Figure 3-2. The late April through mid-June samples were dominated by common carp, quillback, tessellated darter, and banded darter. The channel catfish, collected from 25 June through 1 August, was most abundant in mid-July. The pumpkinseed/bluegill was collected from mid-June through late August; its abundance peaked on 9 July. Spotfin shiner and mimic shiner were collected from 4 June through 27 August. Spotfin shiner were most abundant throughout August.

Temporal distribution/length frequencies of the most abundant taxa collected in 1990 are presented in Tables 3-6 through 3-13. All but one common carp were protolarvae; over 86% were collected on 7 May and 18 June. Spotfin shiner were represented by all life stages; mean length of larvae was 7.6 mm TL. The largest portion of the spotfin shiner catch was protolarvae (61.2%), and their abundance in July and August was indicative of a recent spawn. Most mimic shiner (70.8%) were protolarvae or young from the mid-June and early July samples. The mean length of mimic shiner was 9.2 mm TL. Quillback were primarily protolarvae and averaged 8.3 mm TL. Channel catfish were exclusively young; they were most common on 2 and 16 July, and averaged 17.4 mm TL. The pumpkinseed/bluegill were predominantly protolarvae and mesolarvae (90.2%); most were caught from late June through mid-July. Mean larval length was 7.0 mm TL, as most were between 4.6 and 7.5 mm TL. Tessellated darter were primarily protolarvae (95.4%) taken from 30 April through 25 June. Mean larval length was 5.7 mm TL;

most spawning occurred in early to mid-May and early to mid-June. Banded darter were collected from late April through July, and were most (80.5%) common between 7 May and 12 June. Most were protolarvae, with a mean length of 6.8 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 was 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 is influenced by water temperature, river flow, and weather conditions. The low ichthyoplankton densities recorded in 1990 may have been the result of near record high 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-April, mid-May, and mid-July were coincident with low ichthyoplankton densities. Ichthyoplankton densities peaked several times in 1990 as river temperature increased. High river flow immediately after these peaks 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 water temperature and interrupting spawning activity. Each peak in 1990 occurred as river temperature began to exceed 20 C consistently and/or 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 14B1, located along the northwest shore of York Haven Pond (Tables 3-3 and 3-5); it also supported the most taxa. Station 4A1 ranked second in number and density. Pumpkinseed/bluegill were the most abundant larva at both stations, and comprised nearly 50% of the catch at each. The lowest number of specimens collected at any station, as well as the lowest annual density, was recorded at Station 10B2, 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 all but Stations 14B1 and 4A1 were 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 values in 1990 were recorded at Stations 14B1 and 4A1 which are characterized by slow currents and a variety of substrates. In contrast, Station 10B2, with the lowest annual density, was usually characterized by moderate currents and a predominantly mud substrate. Recreational activity around Station 10B2 was much heavier than that observed near Stations 14B1 and 4A1.

The temporal distribution of ichthyoplankton, differences among stations, and between replicates were examined by a three-factor ANOVA (Table 3-14). 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 in early May and from June through mid-July than in April, mid-May, or late July through August (Table 3-15).

Densities on 7 May, 4 to 18 June, and 2 July were similar and ranked highest, 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 densities 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 2.44 to 3.10 for the eight stations, and 0.00 to 2.81 for sample dates (Tables 3-3 and 3-4). Diversity values were variable among sample dates, with higher values occurring in June. The highest H′ value occurred on 12 June. Conversely, a value of 0.00 was recorded on 4 and 23 April, as all specimens were of one taxon. The 9 July collection yielded the highest number of specimens, taxa, and total density, but ranked low in terms of diversity. These results were influenced by the overabundance of pumpkinseed/bluegill compared to the other taxa.

Ichthyoplankton community diversity was high and nearly equal at Stations 10B2 and 11A1 (Table 3-3). Diversity was low and similar at Stations 16A1 and 4A1. These results tend to demonstrate an inverse relationship between total number of larvae and community diversity. Stations 10B2 and 11A1 ranked low in number of individuals, yet had high diversity values. Conversely, Stations 16A1 and 4A1 ranked high in number of individuals and total density, but the species diversity was low. This low diversity value was attributable to an extreme abundance of common carp and/or pumpkinseed/bluegill.

Diversities at stations located along the west shore of Three Mile Island ranged from 2.44 to 3.08 (Table 3-3). Mean H′ values for stations located upstream (13A2 and 16A1) and downstream (9B1 and 11A1) of the TMINS discharge were 2.48 and 2.94, 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 3-16). PSc values ranged from 19.0 to 89.0%. The highest PSc occurred between Stations 12A1 and 10B2, located along the west shore of Shelley Island; Stations 12A1 and 4A1 were least similar. Stations 12A1 and 10B2 were also very similar in total specimens, total taxa, total density, and species diversity. The mean PSc value among all west TMI stations was 71.7%, indicating a similar species composition. Generally, stations closely related geographically and/or with similar habitats had high PSc values.

3.4 MULTIPLE-YEAR COMPARISON

The density of ichthyoplankton collected at each of the eight stations in 1990 was the lowest to date (Table 3-17). The number of larvae collected at individual stations was also the lowest with two exceptions, which were within the ranges recorded previously.

Ten taxa have dominated the catch either intermittently or consistently from 1977 through 1989 (Table 3-18); this trend continued in 1990. The total abundance of seven of the dominant taxa in the 1990 catch (common carp, spotfin shiner, quillback, channel catfish, pumpkinseed/bluegill, tessellated darter, and banded darter) was within their historic ranges. However, the annual density of spotfin shiner, quillback, channel catfish, and tessellated darter, and the abundance and density of mimic shiner was the lowest recorded. Densities of all other common fishes were within previously established ranges. Changes in the total number and/or total density of ichthyoplankton from year to year was 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 densities have also been associated with water temperature below 20 C. These trends in water temperature and river flow were demonstrated again in 1990 (Figure 3-3). The average river temperature first exceeded 20 C in mid-June and coincided with a peak in 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, 1984 to 1987, and 1989) (EA 1987; Nardacci and Associates 1983; RMC 1988a, 1990).

A second, late season (July) peak in ichthyoplankton density was noted in 1990, which corresponded to abundance peaks for spotfin shiner, mimic shiner, and pumpkinseed/bluegill. During and immediately preceding 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 also been noted previously (EA 1987; Nardacci and Associates 1980, 1983, 1984; RMC 1989, 1990).

Peak ichthyoplankton density in 1990 was similar to other years and generally was within established ranges. Comparisons of annual density showed 1990 to rank 13th among the 14 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 1990, average river flow exceeded 1,000 m^3/sec on eight sample dates, while average river temperature exceeded 20 C on 11 of the 22 dates. In contrast, 1988 (a high ichthyoplankton density year) saw average river flow exceed 1,000 m^3/sec on only three of 22 sample dates, while river temperature exceeded 20 C on 14 dates. The high river flow periods in 1988 were confined to early April and early May. In contrast, episodes of high flow in 1990 occurred over extensive portions of April, May, June, and July, periods critical to the spawning success of many Susquehanna River species.

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. The abundance of common carp provides an example of river flow/larval density effects. The common carp generally prefer shallow mud-bottomed areas characterized by submerged tree roots and aquatic vegetation for their adhesive eggs (Becker 1983; Wang and Kernehan 1979). The optimum spawning temperature for common carp is 19 to 23 C. High current velocities, such as those recorded during 1990, would limit the amount of spawning habitat available, and lead to a reduction or interruption in spawning activity. The density of common carp peaked on 7 May as a result of recent spawning. This peak was coincident with reduced river flow and water temperature in excess of 19.0 C. Torrential rains and the resultant increased river flow, depressed water temperature and interrupted spawning activity from 11 May through 4 June. River flow exceeded 1,000 m^3/sec throughout this period and water temperature ranged from 15.0 to 17.2 C. Becker (1983) reported that spawning was relatively low between 16 and 18 C and no spawning occurred below 16 C. As river flow subsided through June and river temperature increased steadily, spawning resumed and peaked for a second time on 18 June. Therefore, it appears that the interaction of the river flow and water temperature variables, not the sole influence of either one, determined the spawning times of fishes in the Susquehanna River in 1990.

The annual abundance of ichthyoplankton within York Haven Pond was assessed by a three-factor ANOVA (Table 3-19). All effects and their interactions were significant. However, the date and year-date interaction terms contributed over 64% of the total sum of squares; or 82% 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 3-20). Sample years 1981 and 1983 were similar and higher than all other years, whereas 1984 ranked lowest and was significantly different from all years. Densities in 1990 were undifferentiated from 1977, 1978, and 1989, and represented a continuation of declining densities observed since 1986.

Sample dates for all years were consolidated 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 3-20). Density recorded for 1-10 June ranked first and was 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 14 years, showed that Station 14B1 had the highest density (Table 3-20). The range test also indicated that Station 13A2, located upstream of the TMINS discharge, was undifferentiated from the downstream stations (11A1 and 9B1).

Ichthyoplankton abundances and statistical analyses for 1990 were consistent with historical data (EA 1985, 1986, 1987; Nardacci and Associates 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984; RMC 1988a, 1989, 1990). 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, 1990.

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
Rhinichthys atratulus (Hermann)	Blacknose dace
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
Cyprinodontidae	Killifishes
Fundulus diaphanus	Banded killifish
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
Percidae	Perches
Etheostoma olmstedi Storer	Tessellated darter
Etheostoma zonale (Cope)	Banded darter
Percina peltata (Stauffer)	Shield darter
Stizostedion vitreum vitreum (Mitchill)	Walleye

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 1990.

Species	TM-LF-14B1 Number	TM-LF-12A1 Number	TM-LF-13A2 Number	TM-LF-4A1 Number	TM-LF-10B2 Number	TM-LF-9B1 Number	TM-LF-11A1 Number	TM-LF-16A1 Number	Total Number	Total Density	Total Pct.
Gizzard shad	.	.	8	53	1	.	9	19	90	0.81	1.7
Common carp	186	5	257	253	7	86	98	369	1261	11.33	23.2
Golden shiner	1	.	.	.	.	.	.	.	1	0.01	0.0
Comely shiner	1	2	1	.	.	1	1	.	6	0.05	0.1
Spottail shiner	6	2	13	4	4	12	18	13	72	0.65	1.3
Swallowtail shiner	14	.	.	21	2	.	2	.	39	0.35	0.7
Spotfin shiner	196	83	12	37	75	23	24	33	483	4.34	8.9
Mimic shiner	63	7	19	39	9	14	18	10	179	1.61	3.3
Blacknose dace	1	.	.	.	.	.	.	.	1	0.01	0.0
Quillback	41	96	134	32	96	141	127	104	771	6.93	14.2
White sucker	22	8	3	2	16	6	.	3	60	0.54	1.1
Northern hogsucker	2	4	1	1	.	.	.	1	9	0.08	0.2
Shorthead redhorse	4	5	1	6	8	2	3	3	32	0.29	0.6
Yellow bullhead	.	.	.	1	.	.	.	1	2	0.02	0.0
Channel catfish	176	81	40	51	58	44	23	26	499	4.48	9.2
Banded killifish	.	.	.	.	1	.	.	.	1	0.01	0.0
Rock bass	29	11	3	2	7	.	3	2	57	0.51	1.0
Redbreast sunfish	2	1	1	.	1	.	.	.	5	0.04	0.1
Pumpkinseed	.	.	.	1	.	.	.	.	1	0.01	0.0
Bluegill	1	.	.	20	.	.	.	.	21	0.19	0.4
Sunfishes	689	3	21	512	5	6	18	42	1296	11.65	23.9
Tessellated darter	16	45	9	4	42	61	23	21	221	1.99	4.1
Banded darter	59	44	27	18	30	14	39	31	262	2.35	4.8
Shield darter	3	4	5	1	.	1	9	3	26	0.23	0.5
Walleye	.	1	1	.	.	1	3	1	7	0.06	0.1
Unidentifiable fish	3	4	1	5	10	3	1	4	31	0.28	0.6
Total number	1515	406	557	1063	372	415	419	686	5433	44.00	
Total taxa	21	18	19	20	17	15	17	18	26	26	
Diversity (H)	2.62	3.00	2.51	2.45	3.10	2.79	3.08	2.44	3.16	3.16	

Note: No fish were collected on 11 and 16 April.

TABLE 3-4 TEMPORAL DISTRIBUTION OF ICHTHYOPLANKTON NUMBER TAKEN AT EIGHT STATIONS IN YORK HAVEN POND, APRIL THROUGH AUGUST 1990.

	April			May				June				July				August				
Species	4	23	30	7	14	21	31	4	12	18	25	2	9	16	24	1	6	14	21	27
Gizzard shad	.	.	.	.	.	.	.	.	2	1	1	58	27	.	.	1	.	.	.	.
Common carp	.	.	35	575	.	8	1	.	115	518	4	2	2	.	.	.	1	.	.	.
Golden shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	2	3	.	1	.	.	.	.	.
Spottail shiner	.	.	18	8	.	.	1	10	21	10	2	.	1	.	1	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	1	.	1	15	.	2	19	1	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	4	3	27	21	21	78	7	22	117	76	68	25	14
Mimic shiner	.	.	.	.	.	.	.	.	34	24	4	13	67	3	1	16	5	5	6	1
Blacknose dace	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	4	67	49	98	159	307	48	31	5	1	1	.	1	.	.	.	.	.
White sucker	.	.	1	.	1	1	20	36	1	.	.	.	.	.	.	.	.	.	.	.
Northern hogsucker	.	.	.	.	.	.	2	5	2	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	1	1	3	11	14	2	.	.	.	.	.	.	.	.	.	.
Yellow bullhead	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	.	.	.	.	2	217	11	212	51	6	.	.	.	.
Banded killifish	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	21	10	16	7	2	.	.	1	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	6	13	109	176	856	1	1	91	41	1	1	.
Redbreast sunfish	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	2	.	.	.
Pumpkinseed	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	19	1	.	.	.	.	1	.
Tessellated darter	.	.	23	46	25	9	5	41	42	29	1	.	.	.	.	.	.	.	.	.
Banded darter	.	.	2	36	27	34	38	44	32	16	16	9	7	.	1	.	.	.	.	.
Shield darter	.	7	4	5	2	2	3	3	.	.	.	.	.	.	.	.	.	.	.	.
Walleye	5	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	1	.	.	5	4	4	4	1	2	3	3	2	1	1	.	.
Total	5	7	87	739	106	153	232	467	324	699	181	517	1099	230	84	252	128	75	33	15
Total taxa	1	1	7	7	7	7	9	11	13	14	13	12	17	8	10	7	8	4	4	2
Diversity (H)	0.00	0.00	2.11	1.20	1.81	1.53	1.51	1.82	2.81	1.65	2.15	2.10	1.38	0.59	1.70	1.79	1.47	0.55	1.06	0.35

Note: No fish were collected on 11 and 16 April.

TABLE 3-5 SUMMARY OF ICHTHYOPLANKTON DENSITIES (N/100m3) TAKEN AT EIGHT STATIONS IN YORK HAVEN POND, APRIL THROUGH AUGUST 1990.

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
04APR	.	.	.	4.50	.	1.59	.	1.38	0.93
11APR	.	.	.	.	.	.	.	.	.
16APR	.	.	.	.	.	.	.	.	.
23APR	.	.	.	6.37	1.72	.	.	3.17	1.44
30APR	.	12.66	6.25	11.58	24.78	11.90	67.59	3.06	16.49
07MAY	284.77	126.26	29.01	138.93	40.65	226.02	30.86	289.79	145.24
14MAY	3.70	53.65	35.78	16.10	18.46	16.27	14.93	13.93	22.31
21MAY	16.79	30.94	33.33	13.70	47.16	29.51	42.15	17.60	29.25
31MAY	12.43	99.49	63.41	51.81	60.03	48.28	26.93	33.27	49.99
04JUN	30.40	82.82	86.29	114.60	101.55	133.33	104.45	82.96	92.18
12JUN	73.17	76.79	49.52	74.72	50.17	56.25	44.70	98.78	65.72
18JUN	105.10	57.93	38.28	66.14	31.10	210.69	248.82	325.26	135.99
25JUN	159.59	9.93	12.29	30.69	12.76	22.65	20.75	35.95	37.69
02JUL	289.52	7.79	39.06	35.14	45.39	30.93	345.83	52.55	100.21
09JUL	556.52	11.24	14.47	22.88	16.50	24.96	1103.94	35.49	223.28
16JUL	57.38	38.46	75.41	18.32	93.15	37.65	37.77	18.46	46.09
24JUL	25.85	29.33	13.89	20.54	15.65	12.03	6.43	5.66	16.11
01AUG	95.47	12.29	41.40	11.61	18.81	6.80	204.97	4.68	49.44
06AUG	60.98	5.57	18.81	7.27	33.69	7.70	64.30	10.59	24.75
14AUG	6.67	1.54	12.47	.	34.12	.	59.41	2.73	14.31
21AUG	3.37	3.34	16.58	3.42	6.75	1.67	17.03	1.69	6.86
27AUG	.	5.15	3.35	.	3.10	1.56	3.18	7.09	2.92
Density	79.08	29.40	26.54	29.50	29.21	40.34	113.74	47.44	48.83

Note: No fish were collected on 11 and 16 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, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	.	4	.	.	.
4.6 - 5.0	3	38	.	1	.	.	3	52	1	.	.	.	.	.	.	.	.	.	98	.	.	.
5.1 - 5.5	16	286	.	3	.	.	32	185	.	.	.	.	.	.	.	.	.	.	522	.	.	.
5.6 - 6.0	11	248	.	4	.	.	62	198	.	.	1	.	.	.	1	.	.	.	525	.	.	.
6.1 - 6.5	4	1	.	.	.	.	10	65	.	.	1	.	.	.	.	.	.	.	81	.	.	.
6.6 - 7.0	1	.	.	.	1	.	.	4	.	2	.	.	.	.	.	.	.	.	8	.	.	.
7.1 - 7.5	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Total																			1238	1	0	0
Percent (%)																			99.92	0.08	0.00	0.00

TABLE 3-7 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF SPOTFIN SHINER TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	2	.	.	.
4.6 - 5.0	.	.	.	.	.	.	.	2	.	.	4	.	2	12	6	2	1	1	30	.	.	.
5.1 - 5.5	.	.	.	.	.	.	.	7	9	6	12	3	10	21	32	19	10	5	134	.	.	.
5.6 - 6.0	.	.	.	.	.	.	2	9	9	4	12	1	4	14	13	8	3	.	79	.	.	.
6.1 - 6.5	.	.	.	.	.	1	1	6	1	.	5	1	2	2	3	4	2	.	26	2	.	.
6.6 - 7.0	.	.	.	.	.	.	.	.	.	1	4	.	.	3	8	2	2	.	7	13	.	.
7.1 - 7.5	.	.	.	.	.	.	.	.	.	.	4	.	.	4	4	4	.	.	.	16	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	2	1	.	8	9	1	1	.	.	22	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	2	3	.	.	10	1	1	.	.	.	15	2	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	1	7	.	.	1	.	2	1	1	.	10	3	.
9.1 - 9.5	.	.	.	.	.	.	.	.	.	2	8	.	.	3	.	3	2	.	.	5	13	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	2	.	.	5	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	2	5	.	.	1	.	2	.	.	.	.	10	.
10.6 - 11.0	.	.	.	.	.	1	.	.	.	1	3	.	.	1	.	1	.	.	.	1	6	.
11.1 - 11.5	.	.	.	.	.	1	.	.	.	.	4	.	.	2	.	.	2	1	.	1	8	1
11.6 - 12.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	1	1
12.1 - 12.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.	.	.	2	2
12.6 - 13.0	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	1
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	1	2
13.6 - 14.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
14.1 - 14.5	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	2
14.6 - 15.0	.	.	.	.	.	.	.	.	.	.	1	.	.	4	.	.	.	.	.	.	.	5
15.1 - 15.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
15.6 - 16.0	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	2
16.1 - 16.5	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	5
16.6 - 17.0	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2
17.1 - 17.5	.	.	.	.	.	.	.	.	.	.	1	.	.	3	.	.	.	1	.	.	.	5
18.1 - 18.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2
19.6 - 20.0	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
20.1 - 20.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2
21.6 - 22.0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
23.1 - 23.5	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
24.1 - 24.5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2
Total																			278	85	52	39
Percent (%)																			61.23	18.72	11.45	8.59

TABLE 3-8 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF MIMIC SHINER TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	3	3	1	2	.	.	.	.	.	.	2	.	11	.	.	.
4.6 - 5.0	.	.	.	.	.	.	11	15	1	3	3	.	.	1	.	1	1	1	37	.	.	.
5.1 - 5.5	.	.	.	.	.	.	19	5	1	.	3	.	.	.	.	.	1	.	29	.	.	.
5.6 - 6.0	.	.	.	.	.	.	1	1	1	.	.	1	.	.	.	.	2	.	6	.	.	.
6.1 - 6.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	2	.	.	.
6.6 - 7.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	1	1	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	3	.	.	.	1	.	.	.	.	4	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	1	4	1	.	.	.	.	.	.	.	5	1	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	.	4	.	.
9.1 - 9.5	.	.	.	.	.	.	.	.	.	1	6	.	.	.	.	.	.	.	.	2	5	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	.	.	1	3	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	1	5	.	.	1	.	2	.	.	.	.	9	.
10.6 - 11.0	.	.	.	.	.	.	.	.	.	1	4	.	.	3	.	.	.	.	.	.	8	.
11.1 - 11.5	.	.	.	.	.	.	.	.	.	1	6	.	.	.	.	.	.	.	.	.	4	3
11.6 - 12.0	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	1	2
12.1 - 12.5	.	.	.	.	.	.	.	.	.	1	2	.	.	.	1	1	.	.	.	.	2	3
12.6 - 13.0	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	1	.	.	.	.	1	3
13.6 - 14.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
14.6 - 15.0	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	1	1
15.1 - 15.5	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	3
15.6 - 16.0	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	3
17.1 - 17.5	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	4
17.6 - 18.0	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	3
18.1 - 18.5	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	3
18.6 - 19.0	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	3
19.1 - 19.5	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	2
19.6 - 20.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	2
20.1 - 20.5	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	.	.	.	.	3
21.1 - 21.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
Total																			86	17	35	40
Percent (%)																			48.31	9.55	19.66	22.47

TABLE 3-9 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF QUILLBACK TAKEN BY PUSH NET IN YORK HAVEN POND, 1980. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
6.1 - 6.5	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	2	.	.	.
6.6 - 7.0	.	.	.	2	2	1	1	3	.	.	.	.	.	.	.	.	.	.	9	.	.	.
7.1 - 7.5	.	12	2	10	15	16	7	7	1	.	.	.	.	.	.	.	.	.	70	.	.	.
7.6 - 8.0	1	23	7	38	49	94	14	7	.	.	.	.	.	.	.	.	.	.	231	2	.	.
8.1 - 8.5	1	29	27	39	71	135	13	4	.	1	.	.	.	.	.	.	.	.	310	10	.	.
8.6 - 9.0	1	1	13	7	18	45	8	2	1	.	.	.	.	.	.	.	.	.	94	3	.	.
9.1 - 9.5	.	1	.	.	.	4	.	1	1	.	.	.	.	.	.	.	.	.	3	4	.	.
9.6 - 10.0	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.
11.1 - 11.5	.	:	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.
Total																			720	20	1	0
Percent (%)																			97.17	2.70	0.13	0.00

TABLE 3-10 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF CHANNEL CATFISH TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
13.6 - 14.0	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	2
14.1 - 14.5	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	2
14.6 - 15.0	.	.	.	.	.	.	.	.	.	5	3	5	.	1	.	.	.	.	.	.	.	14
15.1 - 15.5	.	.	.	.	.	.	.	.	.	12	1	5	6	2	.	.	.	.	.	.	.	26
15.6 - 16.0	.	.	.	.	.	.	.	.	2	21	.	8	4	.	.	.	.	.	.	.	.	35
16.1 - 16.5	.	.	.	.	.	.	.	.	.	26	2	34	10	.	.	.	.	.	.	.	.	72
16.6 - 17.0	.	.	.	.	.	.	.	.	.	52	1	20	12	1	.	.	.	.	.	.	.	86
17.1 - 17.5	.	.	.	.	.	.	.	.	.	57	3	54	9	.	.	.	.	.	.	.	.	123
17.6 - 18.0	.	.	.	.	.	.	.	.	.	20	1	24	5	.	.	.	.	.	.	.	.	50
18.1 - 18.5	.	.	.	.	.	.	.	.	.	17	.	14	2	.	.	.	.	.	.	.	.	33
18.6 - 19.0	.	.	.	.	.	.	.	.	.	5	.	12	.	.	.	.	.	.	.	.	.	17
19.1 - 19.5	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	5
19.6 - 20.0	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	7
20.1 - 20.5	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	6
20.6 - 21.0	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	3
21.1 - 21.5	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	4
21.6 - 22.0	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
22.1 - 22.5	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
22.6 - 23.0	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	3
23.1 - 23.5	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
23.6 - 24.0	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
24.1 - 24.5	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2
24.6 - 25.0	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	3
Total																			0	0	0	498
Percent (%)																			0.00	0.00	0.00	100.0

TABLE 3-11 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF PUMPKINSEED/BLUEGILL TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.1 - 4.5	.	.	.	.	.	.	.	1	1	2	1	.	.	.	.	.	.	.	5	.	.	.
4.6 - 5.0	.	.	.	.	.	.	.	3	27	31	19	.	.	5	2	.	.	.	87	.	.	.
5.1 - 5.5	.	.	.	.	.	.	5	9	45	57	40	.	1	28	16	1	.	.	202	.	.	.
5.6 - 6.0	.	.	.	.	.	.	1	.	28	21	39	.	.	53	5	.	.	.	147	.	.	.
6.1 - 6.5	.	.	.	.	.	.	.	.	4	12	21	.	.	2	4	.	1	.	44	.	.	.
6.6 - 7.0	.	.	.	.	.	.	.	.	1	9	22	.	.	2	6	.	.	.	37	3	.	.
7.1 - 7.5	.	.	.	.	.	.	.	.	2	6	45	.	.	.	6	.	.	.	24	35	.	.
7.6 - 8.0	.	.	.	.	.	.	.	.	.	.	39	.	.	.	2	.	.	.	.	41	.	.
8.1 - 8.5	.	.	.	.	.	.	.	.	.	2	43	.	.	.	.	.	.	.	9	36	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	8	44	.	.	.	.	.	.	.	.	52	.	.
9.1 - 9.5	.	.	.	.	.	.	.	.	.	5	49	.	.	.	.	.	.	.	.	35	19	.
9.6 - 10.0	.	.	.	.	.	.	.	.	.	4	39	.	.	.	.	.	.	.	.	14	29	.
10.1 - 10.5	.	.	.	.	.	.	.	.	.	6	13	.	.	.	.	.	.	.	.	6	13	.
10.6 - 11.0	.	.	.	.	.	.	.	.	.	2	11	1	.	.	.	.	.	.	.	3	11	.
11.1 - 11.5	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	1	2	.
11.6 - 12.0	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2	.
12.1 - 12.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.
Total																			555	226	78	0
Percent (%)																			64.61	26.31	9.08	0.00

TABLE 3-12 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF TESSELLATED DARTER TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.1 - 4.5	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.	.
4.6 - 5.0	2	1	.	.	2	2	10	11	.	.	.	.	.	.	.	.	.	.	28	.	.	.
5.1 - 5.5	8	31	13	5	2	16	14	13	1	.	.	.	.	.	.	.	.	.	100	3	.	.
5.6 - 6.0	11	13	12	4	1	9	14	3	.	.	.	.	.	.	.	.	.	.	64	3	.	.
6.1 - 6.5	1	1	.	.	.	8	1	.	.	.	.	.	.	.	.	.	.	.	10	1	.	.
6.6 - 7.0	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.
7.1 - 7.5	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
7.6 - 8.0	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
9.1 - 9.5	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Total																			208	8	2	0
Percent (%)																			95.41	3.67	0.92	0.00

TABLE 3-13 LENGTH FREQUENCY DISTRIBUTION (0.5 MM INTERVALS) AND LIFE STAGE OF BANDED DARTER TAKEN BY PUSH NET IN YORK HAVEN POND, 1990. LIFE STAGE IS DESIGNATED AS P(PROTOLARVAE), M(MESOLARVAE), T(METALARVAE), AND Y(YOUNG).

Length Interval (mm)	Apr 30	May 7	May 14	May 21	May 31	Jun 4	Jun 12	Jun 18	Jun 25	Jul 2	Jul 9	Jul 16	Jul 24	Aug 1	Aug 6	Aug 14	Aug 21	Aug 27	Total P	Total M	Total T	Total Y
4.6 - 5.0	.	1	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	3	.	.	.
5.1 - 5.5	1	1	2	.	4	.	.	5	4	2	.	.	.	.	.	.	.	.	19	.	.	.
5.6 - 6.0	.	12	5	16	9	4	8	7	4	2	.	.	1	.	.	.	.	.	68	.	.	.
6.1 - 6.5	1	13	10	12	14	12	9	1	4	.	.	.	.	.	.	.	.	.	75	1	.	.
6.6 - 7.0	.	6	7	5	8	20	7	2	2	.	.	.	.	.	.	.	.	.	43	14	.	.
7.1 - 7.5	.	1	2	1	.	6	7	.	.	.	.	.	.	.	.	.	.	.	11	6	.	.
7.6 - 8.0	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.
8.1 - 8.5	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.	.
8.6 - 9.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.
9.6 - 10.0	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.
11.6 - 12.0	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	2	.
12.6 - 13.0	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
13.1 - 13.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
13.6 - 14.0	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
14.1 - 14.5	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
15.1 - 15.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
16.1 - 16.5	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
16.6 - 17.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
20.6 - 21.0	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
Total																			221	25	3	8
Percent (%)																			85.99	9.73	1.17	3.11

TABLE 3-14

Three-factor analysis of variance test results for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1990. Test was performed on logarithmic transformed densities.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model ($r^2 = 0.969$)	204	1041.591	5.106	22.83	0.0001*
Date	21	771.081	36.718	164.21	0.0001*
Station	7	16.528	2.361	10.56	0.0001*
Replicate	1	0.012	0.012	0.05	0.8201
Date-Station	147	247.485	1.684	7.53	0.0001*
Date-Replicate	21	5.495	0.262	1.17	0.2857
Station-Replicate	7	0.991	0.142	0.63	0.7280
Error	147	32.870	0.224		
Corrected Total	351	1074.461			

* Significant at $P \leq 0.01$.

TABLE 3-15

Summary of Tukey's studentized range test for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1990. 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.

Date	7	18	4	12	2	9	31	16	21	25	1	14	6	24	30	14	21	27	23	4	16	11
	May	Jun	Jun	Jun	Jul	Jul	May	Jul	May	Jun	Aug	May	Aug	Jul	Apr	Aug	Aug	Aug	Apr	Apr	Apr	Apr
	(4.61)	(4.57)	(4.46)	(4.16)	(4.02)	(3.87)	(3.76)	(3.72)	(3.28)	(3.20)	(3.09)	(2.82)	(2.81)	(2.61)	(2.30)	(1.73)	(1.69)	(1.00)	(0.51)	(0.38)	(0.00)	(0.00)

Station*	14B1	4A1	12A1	10B2	16A1	11A1	9B1	13A2
	(3.17)	(2.78)	(2.72)	(2.61)	(2.56)	(2.50)	(2.48)	(2.48)

Replicate	A	B
	(2.67)	(2.66)

* Station prefix TH-LF- deleted from table.

TABLE 3-16

Percent similarity indices of species composition between the ichthyoplankton stations in York Haven Pond, April through August 1990. Station prefix TM-LF- deleted from table.

	12A1	13A2	4A1	10B2	9B1	11A1	16A1
14B1	40.7	38.8	76.9	42.7	42.9	41.9	38.0
12A1		46.7	19.0	89.0	61.8	57.0	37.7
13A2			45.8	48.5	67.8	74.7	83.8
4A1				21.6	40.5	48.8	48.4
10B2					66.0	59.7	39.1
9B1						80.1	57.6
11A1							66.1

TABLE 3-17

Annual summary of ichthyoplankton numbers and densities (n/100 m^3) taken by push net at eight stations in York Haven Pond, 1977 through 1990.

	TM-LF-14B1		TM-LF-12A1		TM-LF-13A2		TM-LF-4A1		TM-LF-10B2		TM-LF-9B1		TM-LF-11A1		TM-LF-16A1	
Year	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	11018	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
1990	1515	113.74	406	29.21	557	40.34	1063	79.08	372	26.54	415	29.40	419	29.50	686	47.44

TABLE 3-18

Annual summary of the most abundant ichthyoplankters taken by push net at eight stations in York Haven Pond, 1977 through 1990.

	Gizzard shad		Common carp		Spottail shiner		Spotfin shiner		Mimic shiner		Quillback		Channel catfish		Pumpkinseed bluegill		Tessellated darter		Banded darter	
Year	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	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
1990	-	-	1261	11.33	-	-	483	4.34	179	1.61	771	6.93	499	4.48	1296	11.65	221	1.99	262	2.35

TABLE 3-19

Three-factor analysis of variance test results for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1977 through 1990. Test was performed on logarithmic transformed densities.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model (r^2 = 0.804)	396	16118.597	40.704	43.40	0.0001*
Year	13	305.887	23.530	25.09	0.0001*
Date	14	10083.673	720.262	767.95	0.0001*
Station	7	586.614	83.802	89.35	0.0001*
Year-Date	173	2826.671	16.339	17.42	0.0001*
Year-Station	91	234.163	2.573	2.74	0.0001*
Date-Station	98	889.377	9.075	9.68	0.0001*
Error	4195	3934.489	0.938		
Corrected Total	4591	20053.086			

* Significant at P≤0.01.

TABLE 3-20

Summary of Tukey's studentized range test for ichthyoplankton densities collected at eight stations in York Haven Pond, April through August 1977 through 1990. Underlined means are not significantly different (P≤ 0.05) and are ranked from highest to lowest transformed [Log (density +1)] mean. Means are listed parenthetically.

Year	1981	1983	1986	1987	1988	1980	1985	1979	1982	1977	1989	1978	1990	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)	(2.66)	(2.40)

Date	1-10 Jun	21-31 May	11-20 Jun	11-20 May	11-20 Jul	21-31 Jun	1-10 Jul	21-31 Jul	1-10 Aug	11-20 Aug	1-10 May	21-31 Aug	21-31 Apr	1-10 Apr	11-20 Apr
	(5.07)	(4.79)	(4.60)	(4.33)	(4.02)	(4.01)	(3.86)	(3.82)	(3.17)	(2.82)	(2.22)	(2.10)	(0.67)	(0.07)	(0.04)

Station*	14B1	4A1	10B2	9B1	11A1	13A1	12A1	16A1
	(3.93)	(3.48)	(3.34)	(2.94)	(2.93)	(2.87)	(2.84)	(2.76)

*Station prefix TM-LF- deleted from table.

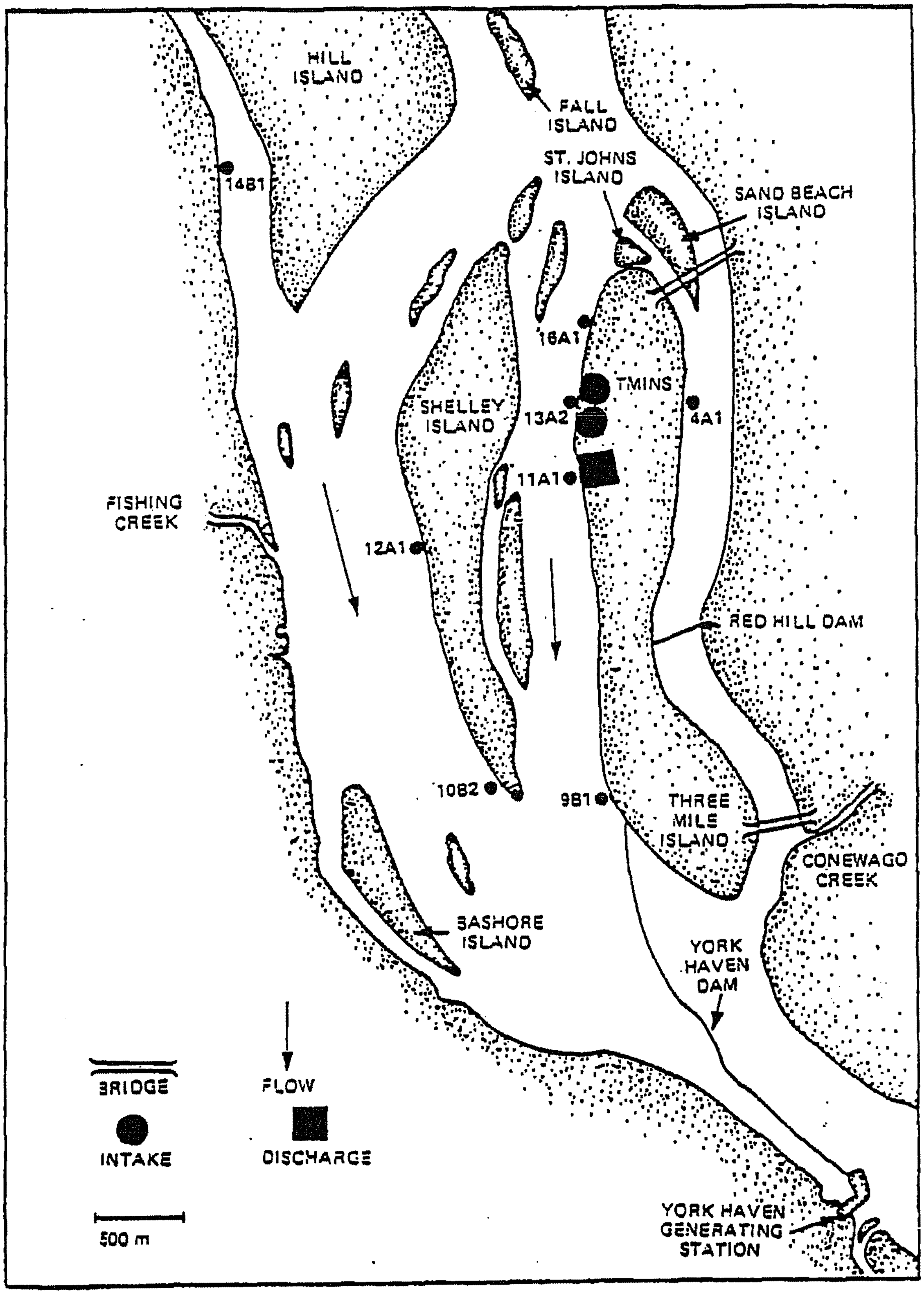

Figure 3-1. Location of ichthyoplankton stations sampled in York Haven Pond (station prefix TM-LF- deleted.

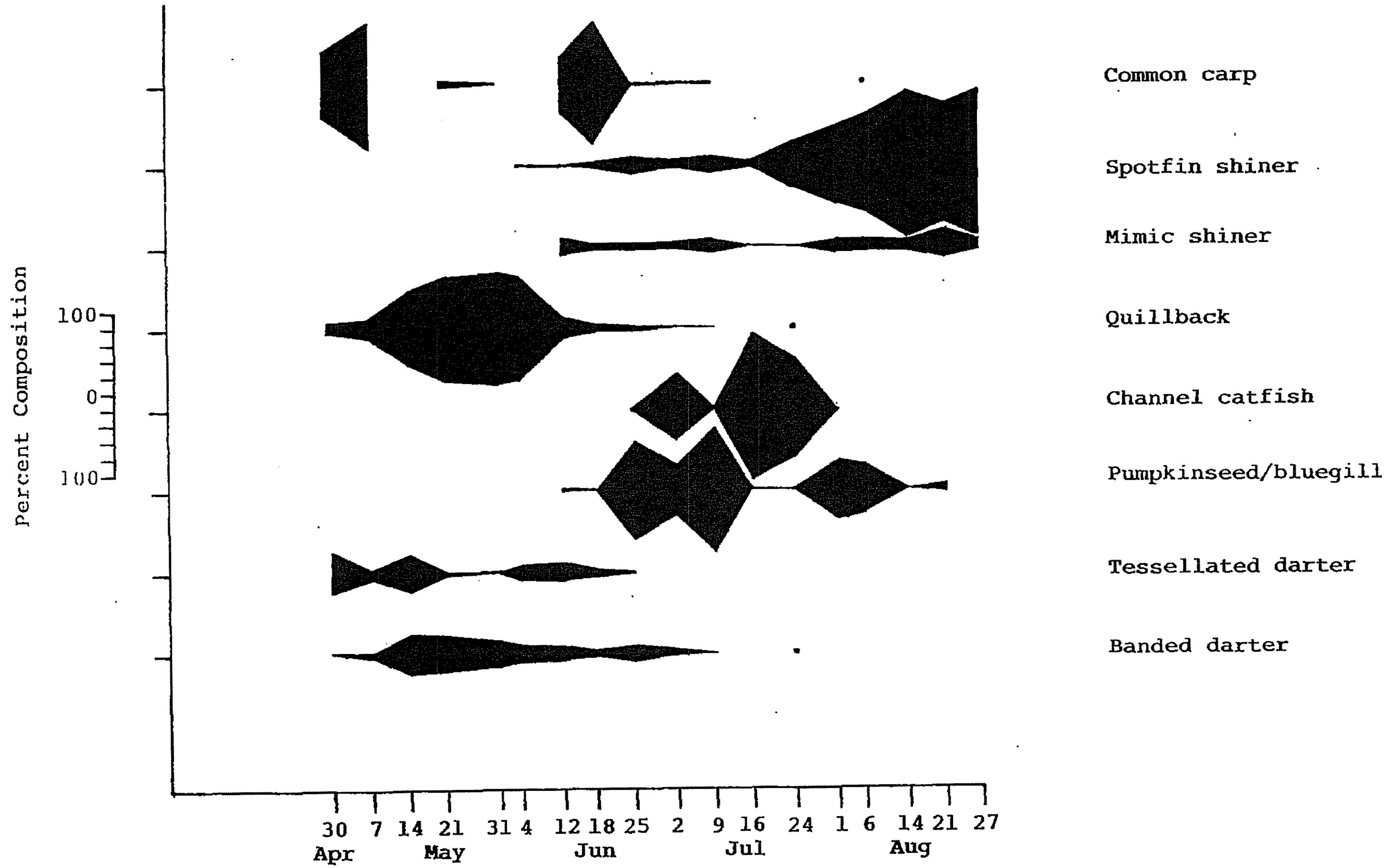

FIGURE 3-2

Percent composition by density of the eight most abundant ichthyoplankton taxa taken in York Haven Pond, April through August 1990.

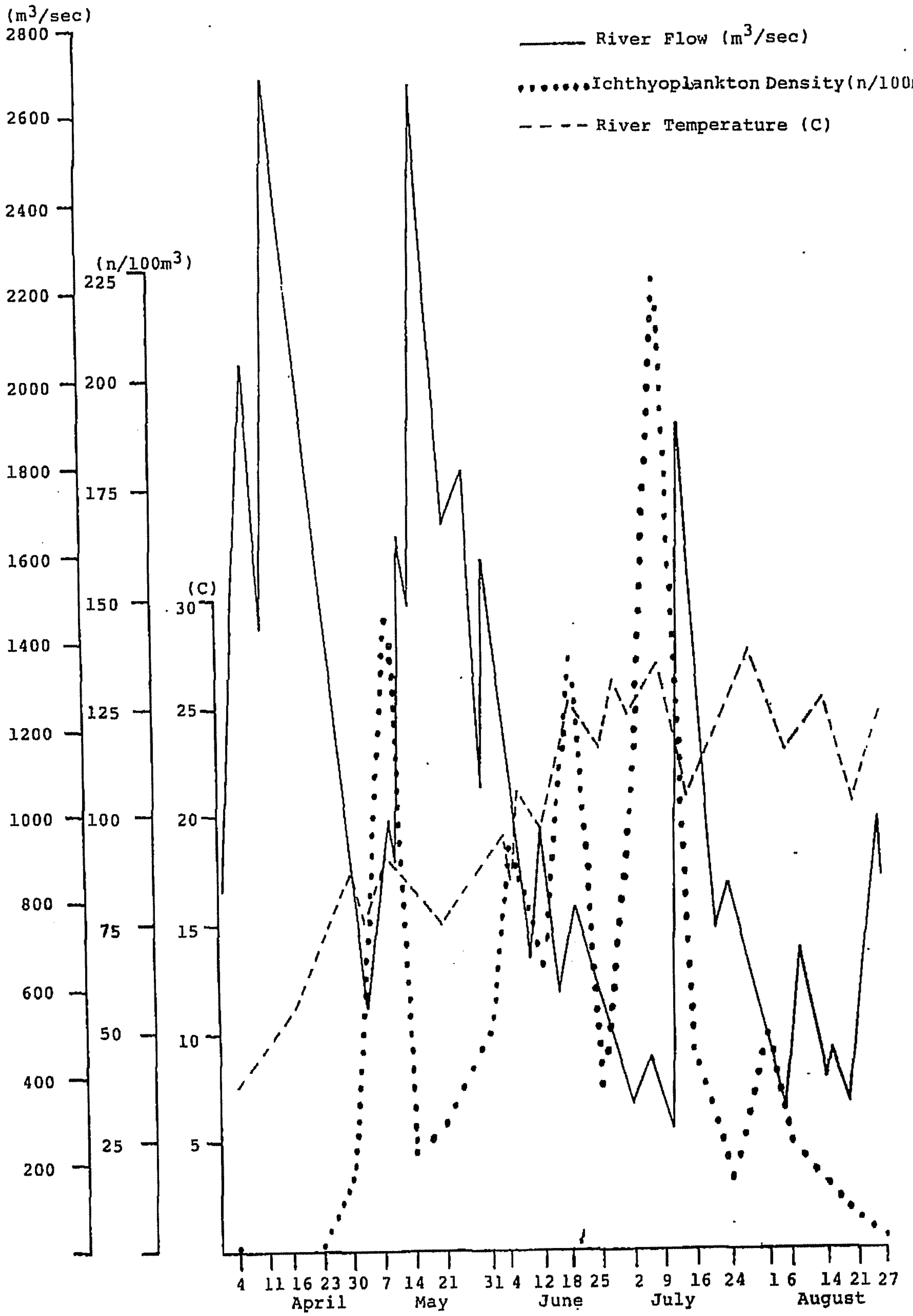

FIGURE 3-3

Mean river temperature (C), mean ichthyoplankton density (n/100m^3), and river flow (m^3/sec) recorded in York Haven Pond, April through August 1990.

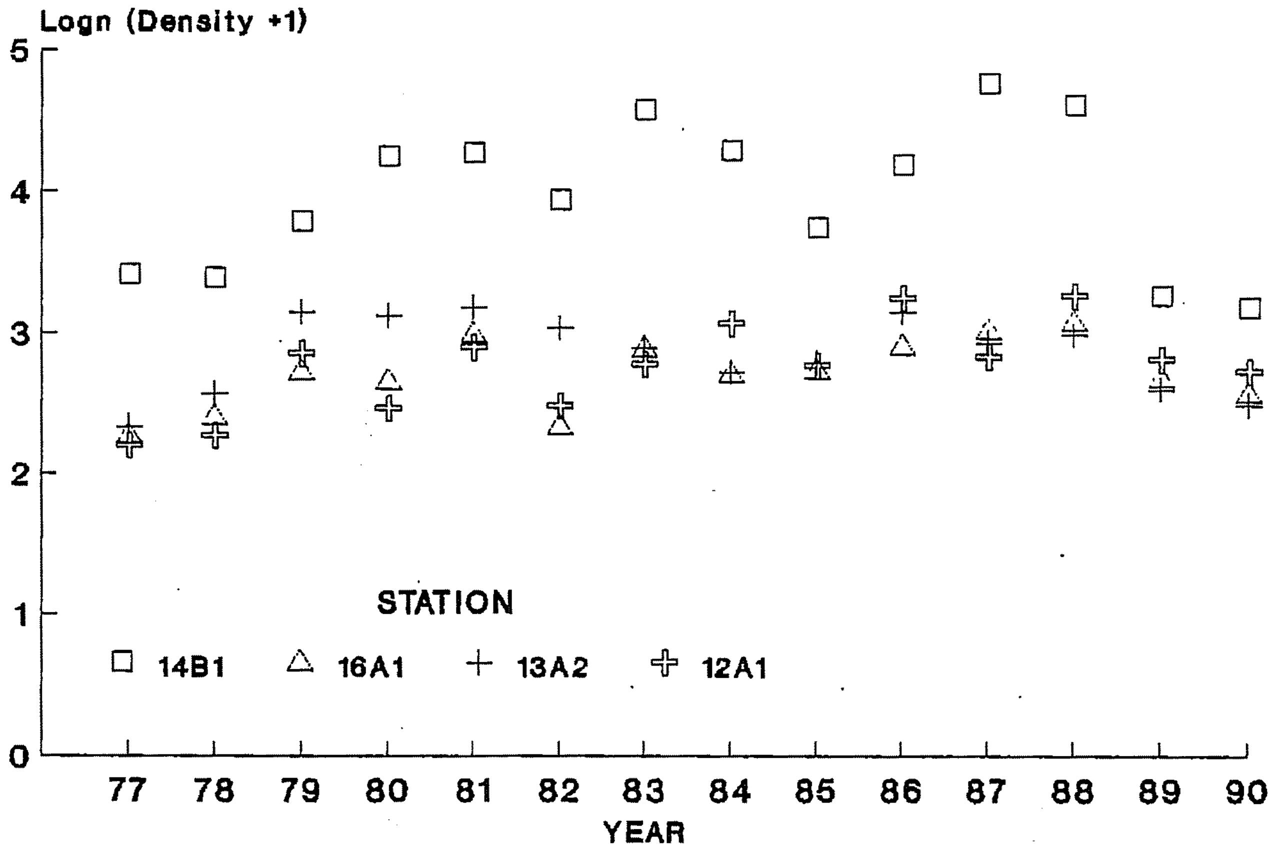

Figure 3-4. Annual variation in total ichthyoplankton density at selected stations near TMINS, 1977 through 1990.

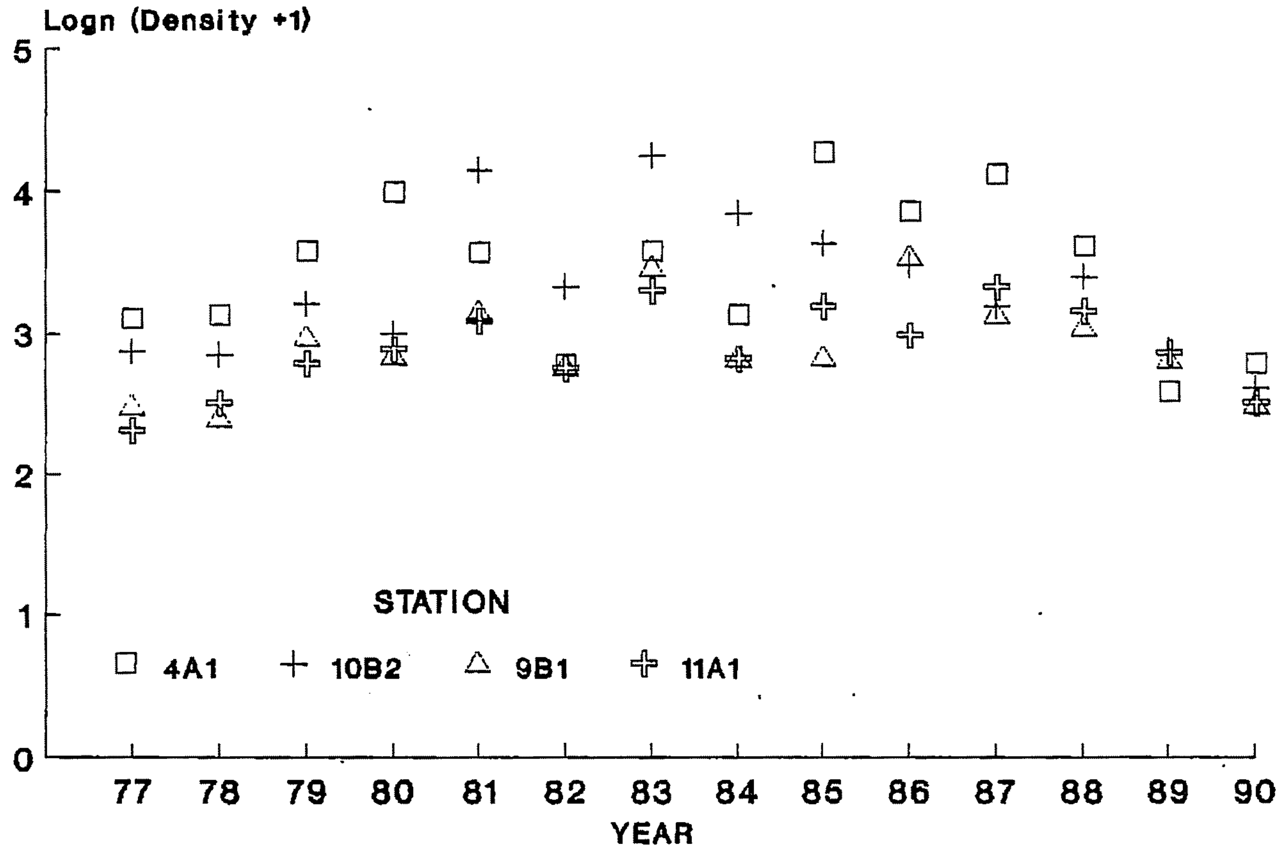

Figure 3-5. Annual variation in total ichthyoplankton density at selected stations near TMINS, 1977 through 1990.

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 1990.

Data recorded for each survey were weather, time, duration of sample (in minutes), air and surface water temperatures, surface dissolved oxygen and pH, Secchi disc transparency, estimated water depth, substrate type, and number of hauls. River stage was obtained from the River Forecast Center in Harrisburg, Pennsylvania for 0700 h. 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. Additional data analyses consisted of calculating condition factor (K), percent similarity (PSc) among sampling station catches, and species diversity by station and date. Calculation of PSc and diversity indices was identical to those described in Chapter 2.

Condition factor (Ricker 1975) for fishes that comprised more than 10% of the 1990 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, 1990).

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: 1990

Results of 1990 seine collections are presented in Appendix C and summarized in Tables 4-3 through 4-5. A total of 327 hauls yielded 31,470 fish of 35 species, representing eight families. Most fish (9,938) were taken at Station 13B5 and most species (27) at Station 4A2. The mean number of specimens per haul at individual stations ranged from 34.06 at Station 16A1 to 276.06 at Station 13B5.

Carps and minnows ranked first in family composition, comprised 71.0% of the total catch (Table 4-5), and included the top two species (spotfin shiner and mimic shiner) taken (Table 4-3). The mimic shiner comprised 32.7% of the total catch; it was the most abundant species in 1990, and ranked first at Station 13B5 (Table 4-4). The spotfin shiner ranked second in abundance (24.8%); it was most common at Stations 10A2, 16A1, and 10B5. The second most abundant family was bullhead catfishes which accounted for 10.4% of the total catch. The channel catfish (third ranked species) was the most common bullhead catfish, and ranked first at Station 9B3. The perch family was next in abundance and comprised 9.7% of the total catch. The tessellated darter was the most abundant percid taken, and was the fourth ranked species overall. Other common fishes were spottail shiner (6.6%), bluntnose minnow (4.9%), white sucker (4.7%), and pumpkinseed (2.0%). No other species accounted for more than 1.0% of the catch.

With the exception of the low catch (277 specimens) on 16 November, total catches varied moderately during the year (Table 4-3). The highest catch (4,521 specimens) occurred on 15 June. No pronounced seasonal trend was evident as the total catches oscillated throughout the year. However, over 65% of the catch occurred from April through July.

The temporal variability in the total catch was primarily influenced by spotfin shiner and mimic shiner abundance, and to a lesser extent by spottail shiner, bluntnose minnow, white sucker, channel catfish, and tessellated darter (Table 4-3). Spotfin shiner and mimic shiner were common throughout the sample period, but were most abundant from April through May when they comprised from 87.4 to 98.1% of the catch. Spotfin shiner and mimic shiner abundance declined steadily from June through November, with few exceptions. Among other species, spottail shiner and tessellated darter were abundant from June through early August. White sucker were common from May through September, but over 90% were taken from late May through June. Bluntnose minnow occurred throughout the sample period, but was most common in July and August. Channel catfish were most common in August and September, when 98.9% of their annual total occurred. Such temporal 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 16A1, above the TMINS Discharge. These catch differences were the result of the variability in the abundance 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 of sampling stations, except at Station 10A2 where more effort (hauls) yielded fewer fish per haul (Table 4-4).

Biomass totaled 10,380.8 g for the year (Table 4-6). Peak biomass occurred on 18 July (1,328.8 g). Station 13B5 had the highest biomass for a single station (2,432.9 g), while Station 16A1 had the lowest (1,241.6 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, mimic shiner, and channel catfish, the only fishes that comprised more than 10% of the 1990 catch, are presented in Tables 4-7 through 4-9. The mean weights for individual length intervals were similar per species among stations with large (>25 specimens) comparable catches. The K factors for different size groups of spotfin shiner ranged from 0.45 to 1.16. There was a general trend of increasing K factor with increasing length. Mimic shiner K factors ranged from 0.24 to 1.08 among the size groups. Similarly, 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. In contrast, K factors for channel catfish followed a trend which generally increased, and then decreased. These changes resulted when the rapid growth in length was not synchronized to weight increases.

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 (2.3% of the total catch) (Table 4-7). Young and juvenile mimic shiners were common at all stations, particularly Stations 13B5 and 10A2. Only two adults were taken (Table 4-8). Young channel catfish were common at Stations 9B3 and 10B5; juveniles and adults were rare (Table 4-9).

4.4 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

The 1990 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 1.72 at Station 13B5 to 3.00 at Station 4A2. The low H′ at Station 13B5 resulted from the large catch of spotfin shiner and mimic shiner (85.8% of the catch) relative 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 1.14 on 12 April to 2.98 on 18 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, mimic shiner, and channel catfish entered the catch. Low diversities result from the overabundance of one or two species which are a natural phenomena (Hocutt 1981).

Seine diversity in 1990 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). Overall monthly diversity values decreased from 1977 through 1985 and increased thereafter (Figure 4-3). Although, the 1990 monthly data decreased slightly from 1989 the values generally continued to reflect the increase observed since 1986. A similar trend was evident for station diversity. 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 increase in station H′ values in 1990 was coincident with a reduction in spotfin shiner and mimic shiner (57.5% of the total catch) abundance, coupled with substantial increases of comely shiner, spottail shiner, bluntnose minnow, fallfish, white sucker, channel catfish, smallmouth bass, and tessellated darter compared to the 1989 catch.

Percent similarity (PSc) compares the station catches in terms of species composition, and provides another measure of the fish community. Similarity values for pairwise station comparisons are presented in Table 4-10. Low values indicate relatively dissimilar communities between two stations, while higher values indicate similar communities. Like many of the community and abundance parameters discussed above, the similarity data appeared to be substantially influenced by the abundance of several key species. For example, the lowest PSc (28.4%) occurred between Stations 13B5 and 9B3 and resulted from the extreme dominance of mimic shiner and spotfin shiner at Station 13B5, compared to the dominance of spottail shiner, channel catfish, and tessellated darter at Station 9B3 (Table 4-4). In contrast, the relative abundance of these species was similar between Stations 10B5 and 16A1, thus the PSc was high (81.2%). There was no pattern to suggest any influence of the TMINS discharge. Sampling Station 10A2 (downstream of the discharge) was similar (79.0%) to Station 16A1 (upstream of the discharge).

Previous studies (EA 1985, 1986, 1987) used the percent similarity at stations upstream and downstream of the TMINS discharge to investigate differences between operational (1976 to 1978 and 1986 to 1990) and non-operational (1979 to 1985) years (Figure 4-4). The PSc values for both pairwise station comparisons were within the historical range. 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 total seine catches and catch per seine haul of common species were examined for the study period (Table 4-11). Although the total 1990 catch represented a 31.6% decrease from the 1989 catch, it was within the historic range. As in all previous years, the total catch was largely influenced by the abundance of spotfin shiner, spottail shiner, and mimic shiner (since 1987). Compared to 1989, there were substantial decreases in spotfin shiner and mimic shiner abundance. The spotfin shiner decreased by 39.6% to its lowest total since 1978, while mimic shiner decreased 62.7% after increasing steadily since 1985. Also showing marked reductions in 1990 were pumpkinseed (33.2%) and bluegill (89.8%). However, these decreases were offset by large increases in the catch of spottail shiner, white sucker, and bluntnose minnow. In fact, the total catch of bluntnose minnow was the highest since 1981. Many other fishes showed substantial increases over 1989 levels. Among these, smallmouth bass increased to its highest total since 1979, and walleye increased to its highest total since 1985. Record catches for the study period were noted for channel catfish, tessellated darter, and banded darter.

The seine catches in 1990 appeared to further reflect the effect of natural population cycles. While strong year classes were indicated for several species, spotfin shiner, mimic shiner, pumpkinseed, and bluegill suffered weak year classes, as evidenced by steep downturns in their abundances. EA (1986, 1987) reported 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 1990 and lower water temperature, particularly July through August, favored the success of early spawning fishes.

Seasonal Susquehanna River flow patterns, normally characterized by high spring flows and lower flows in summer and fall, generally 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 in 1990 were variable and caused water temperature to fluctuate. These factors jeopardized the spawning success of spotfin shiner. Consequently, young spotfin shiner were less abundant during the fall. In contrast, spottail shiner and white sucker spawn in May and June, therefore their reproductive success is normally subject to high and/or rapidly fluctuating river flow. River flow in June 1990 remained relatively stable and water temperature steadily increased. This may explain the increase 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. Decreased 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, 1990) 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 annual abundance of spotfin shiner, spottail shiner, and white sucker is presented in Figures 4-5 through 4-7. For 1990, spottail shiner and spotfin shiner catches were similar at stations immediately upstream (16A1) and downstream (10A2 and/or 9B3) of the TMINS discharge. Unlike spotfin shiner and white sucker, catches of spottail shiner at Station 10A2 were slightly below those at the other stations. Yet, all values were within previously established ranges. 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 1990, a total of 16,522 fish was examined; 1,590 specimens of 22 fishes had one or more types of parasites, infections, and/or morphological anomalies (Table 4-12). With the exception of black spot (fluke cysts), pugheadedness, and skin infections, affliction rates were less than 1.0%. Black spot was most prevalent on spotfin shiner (8.1% of those examined), bluntnose minnow (3.3%), and tessellated darter (2.6%). Skin infections (which included fin rot, damaged fins, fungus, and/or tumors) were observed on 18 fishes, mostly on spotfin shiner and mimic shiner. Other parasites included anchor worms (Lernaea spp.), observed on 15 fishes, leeches, noted almost exclusively on tessellated darter, and glochidia (larvae of freshwater mussels), most prevalent on spotfin shiner and tessellated darter. 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 485 fish exhibited morphological anomalies. Pugheadedness (abnormal formation of the skull) was most common and occurred primarily on spotfin shiner (84), and mimic shiner (337). Scoliosis (lateral spinal curvature) was observed on three different fishes. Five spotfin shiner, three mimic shiner, and two spottail shiner exhibited mouth (mandibular) deformity.

Patterns of parasitic infection and morphological anomalies observed in 1990 were similar to those reported previously (EA 1985, 1986, 1987; Nardacci and Associates 1980, 1981, 1982, 1983, 1984; RMC 1988a, 1989, 1990). 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 (<u>Justicia americana</u>) and wild celery (<u>Vallisneria americana</u>) 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 1990.

Scientific Name	Common Name
Clupeidae	Herrings
Alosa sapidissima (Wilson)	American shad
Dorosoma cepedianum (Lesueur)	Gizzard shad
Esocidae	Pikes
Esox niger Lesueur	Chain pickerel
Cyprinidae	Carps and Minnows
Campostoma anomalum (Rafinesque)	Central stoneroller
Nocomis micropogon (Cope)	River chub
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 spilopterus (Cope)	Spotfin shiner
Notropis volucellus (Cope)	Mimic shiner
Pimephales notatus (Rafinesque)	Bluntnose minnow
Rhinichthys cataractae (Valenciennes)	Longnose dace
Semotilus atromaculatus (Mitchill)	Creek chub
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 nebulosus (Lesueur)	Brown bullhead
Ictalurus punctatus (Rafinesque)	Channel catfish
Cyprinodontidae	Killifishes
Fundulus diaphanus (Lesueur)	Banded killifish
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
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 THINS in 1990.

	12 Apr	4 May	23 May	15 Jun	28 Jun	18 Jul	14 Aug	30 Aug	7 Sep	24 Sep	30 Oct	16 Nov	Total	% Catch
American shad	-	-	-	1	-	5	-	-	-	-	-	-	6	+
Gizzard shad	-	-	-	-	-	23	1	1	-	-	-	-	25	0.1
Chain pickerel	-	-	-	1	-	-	-	-	-	-	-	-	1	+
Central stoneroller	-	-	-	-	-	1	-	-	-	-	-	-	1	+
River chub	-	-	1	-	-	-	-	-	-	-	-	-	1	+
Golden shiner	1	-	2	-	-	12	-	-	-	-	-	-	15	+
Comely shiner	5	2	2	-	14	129	-	-	-	2	-	-	154	0.5
Common shiner	-	-	-	-	-	-	1	-	-	-	1	-	2	+
Spottail shiner	-	-	-	251	1067	263	164	62	27	133	101	8	2076	6.6
Swallowtail shiner	19	79	52	41	22	7	16	9	15	16	11	-	287	0.9
Spotfin shiner	1043	1029	960	1059	483	376	350	886	558	472	445	151	7812	24.8
Mimic shiner	1273	2115	2026	1294	454	875	44	188	294	134	1524	62	10283	32.7
Bluntnose minnow	4	42	7	19	12	640	393	147	71	53	155	5	1548	4.9
Longnose dace	-	-	-	-	1	-	-	-	-	-	-	-	1	+
Creek chub	-	-	-	1	-	-	-	-	-	-	-	-	1	+
Fallfish	-	-	-	45	33	25	12	24	5	6	11	-	161	0.5
Quillback	-	-	-	-	2	4	-	-	-	-	-	-	6	+
White sucker	-	5	257	797	282	92	19	15	6	3	-	-	1476	4.7
Northern hog sucker	-	-	-	7	3	6	8	14	13	4	-	-	55	0.2
Shorthead redhorse	-	-	6	2	5	-	9	5	17	5	-	-	49	0.2
Brown bullhead	-	-	-	-	16	1	-	-	-	-	-	-	17	+
Channel catfish	-	-	-	17	20	-	1445	42	1724	10	-	-	3258	10.4
Banded killifish	-	1	2	-	-	1	-	1	-	-	-	-	5	+
Rock bass	-	1	-	3	22	12	-	2	7	34	7	2	90	0.3
Redbreast sunfish	-	21	1	14	7	10	5	8	5	4	1	-	76	0.2
Green sunfish	-	6	-	15	5	1	3	2	5	-	2	-	39	0.1
Pumpkinseed	1	222	8	99	8	123	15	11	62	45	48	5	647	2.0
Bluegill	-	6	-	14	11	36	3	3	25	11	7	2	118	0.4
Lepomis hybrid	-	-	-	2	1	-	-	-	-	-	-	-	3	+
Smallmouth bass	-	-	2	1	23	97	25	12	15	20	16	-	211	0.7
Largemouth bass	-	-	-	-	1	-	-	-	1	-	-	-	2	+
White crappie	-	-	-	-	-	-	-	-	1	1	1	-	3	+
Tessellated darter	14	10	56	817	392	1021	140	77	86	98	158	40	2909	9.2
Banded darter	-	5	29	-	3	34	4	1	3	-	15	2	96	0.3
Shield darter	-	-	-	4	1	1	-	-	1	2	-	-	9	+
Walleye	-	-	4	17	6	-	-	-	-	-	-	-	27	0.1
No. of Specimens	2360	3544	3415	4521	2894	3795	2657	1510	2941	1053	2503	277	31470	
No. of Species	8	14	16	22	25	25	19	20	21	19	16	9	35	
No. of Hauls	27	24	21	24	25	24	26	33	32	31	29	31	327	
No. of Fish/Haul	87.41	147.67	162.62	188.38	115.76	158.12	102.19	45.76	91.91	33.97	86.31	8.94	96.24	
Diversity Index	1.14	1.55	1.59	2.60	2.66	2.98	2.19	2.21	2.02	2.70	1.90	1.87	2.85	

+ Less than 0.05%.

TABLE 4-4

Distribution of fishes taken by seine at the stations sampled near TMINS in 1990. Station prefix TM-SE- deleted from table.

	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
American shad	-	-	3	3	-	-	6	+
Gizzard shad	3	2	1	5	3	11	25	0.1
Chain pickerel	-	-	-	-	-	1	1	+
Central stoneroller	1	-	-	-	-	-	1	+
River chub	-	-	-	1	-	-	1	+
Golden shiner	-	1	-	-	1	13	15	+
Comely shiner	127	2	16	2	2	5	154	0.5
Common shiner	-	-	-	-	1	1	2	+
Spottail shiner	72	161	235	214	888	506	2076	6.6
Swallowtail shiner	110	7	8	100	1	61	287	0.9
Spotfin shiner	2294	2158	964	1413	691	292	7812	24.8
Mimic shiner	6238	1064	465	1166	751	599	10283	32.7
Bluntnose minnow	134	410	5	89	23	887	1548	4.9
Longnose dace	-	-	1	-	-	-	1	+
Creek chub	-	-	-	-	-	1	1	+
Fallfish	9	11	51	44	39	7	161	0.5
Quillback	4	2	-	-	-	-	6	+
White sucker	382	269	102	452	254	17	1476	4.7
Northern hog sucker	19	4	11	17	3	1	55	0.2
Shorthead redhorse	22	10	9	3	2	3	49	0.2
Brown bullhead	-	-	-	-	16	1	17	+
Channel catfish	8	69	1	5	3175	-	3258	10.4
Banded killifish	2	1	-	-	-	2	5	+
Rock bass	5	25	3	25	2	30	90	0.3
Redbreast sunfish	2	8	20	1	7	38	76	0.2
Green sunfish	1	-	-	-	-	38	39	0.1
Pumpkinseed	5	54	2	5	14	567	647	2.0
Bluegill	4	62	-	-	1	51	118	0.4
<u>Lepomis</u> hybrid	-	-	-	-	-	3	3	+
Smallmouth bass	58	34	47	46	2	24	211	0.7
Largemouth bass	-	-	-	-	-	2	2	+
White crappie	-	2	-	-	-	1	3	+
Tessellated darter	423	181	180	232	1618	275	2909	9.2
Banded darter	-	2	19	74	1	-	96	0.3
Shield darter	1	1	3	4	-	-	9	+
Walleye	14	3	-	-	8	2	27	0.1
No. of Specimens	9938	4543	2146	3901	7503	3439	31470	
No. of Species	24	25	21	21	23	27	35	
No. of Hauls	36	53	63	72	43	60	327	
No. of Fish/Haul	276.06	85.72	34.06	54.18	174.49	57.32	96.24	
Diversity Index	1.72	2.38	2.47	2.56	2.33	3.00	2.85	

+ Less than 0.05%.

TABLE 4-5

Percent family composition at the seine stations sampled in York Haven Pond, April through November 1990. Station prefix TM-SE- deleted from table.

Family	Station 13B5	10B5	16A1	10A2	9B3	4A2	Total
Herrings	+	+	0.2	0.2	+	0.3	0.1
Pikes	-	-	-	-	-	+	+
Carps and Minnows	90.4	84.0	81.3	77.6	31.9	69.0	71.0
Suckers	4.3	6.3	5.7	12.1	3.4	0.6	5.0
Bullhead catfishes	0.1	1.5	+	0.1	42.5	+	10.4
Killifishes	+	+	-	-	-	+	+
Sunfishes	0.8	4.1	3.4	2.0	0.3	21.9	3.8
Perches	4.4	4.1	9.4	7.9	21.7	8.0	9.7

+ Less than 0.05%.

TABLE 4-6

Summary by date of fish biomass (g) at the seine stations sampled near TMINS in 1990. Station prefix TM-SE- deleted from table.

	13B5	10B5	16A1	10A2	9B3	4A2	Total
12 Apr	119.9	41.6	43.3	41.5	0.5	17.0	263.8
4 May	196.8	143.1	51.9	43.9	52.8	195.3	683.8
23 May	216.0	61.8	79.9	118.7	30.4	22.3	529.1
15 Jun	281.9	151.8	112.3	215.3	105.1	155.5	1021.9
28 Jun	252.0	164.2	105.0	199.2	158.0	65.9	944.3
18 Jul	281.7	138.8	255.4	278.7	202.2	172.0	1328.8
14 Aug	148.4	203.5	98.6	190.0	237.9	156.3	1034.7
30 Aug	112.4	153.4	90.2	320.8	101.2	82.1	860.1
7 Sep	262.8	218.0	96.0	135.2	387.6	101.3	1200.9
24 Sep	139.8	339.0	158.6	291.9	84.4	103.0	1116.7
30 Oct	398.7	76.5	133.5	141.2	261.6	253.9	1265.4
16 Nov	22.5	5.1	16.9	36.9	12.5	37.4	131.3
TOTAL	2432.9	1696.8	1241.6	2013.3	1634.2	1362.0	10380.8

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 1990.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
TM-AQF-4A2					
11 - 15	22	0.34	0.02	0.46	Y
16 - 20	156	6.70	0.04	0.54	Y
21 - 25	57	4.30	0.08	0.48	Y
26 - 30	20	3.60	0.18	0.67	Y
31 - 35	12	3.70	0.31	0.72	Y
36 - 40	9	5.10	0.57	0.89	Y
41 - 45	6	4.80	0.80	0.88	J
46 - 50	4	4.80	1.20	0.96	J
51 - 55	4	6.60	1.65	0.99	J
56 - 60	1	2.10	2.10	0.97	J
61 - 65	1	2.70	2.70	0.98	A
TM-AQF-9B3					
11 - 15	40	0.61	0.02	0.45	Y
16 - 20	168	7.34	0.04	0.55	Y
21 - 25	151	15.25	0.10	0.65	Y
26 - 30	120	23.40	0.19	0.72	Y
31 - 35	67	21.60	0.32	0.75	Y
36 - 40	27	13.60	0.50	0.79	Y
41 - 45	22	17.60	0.80	0.88	J
46 - 50	15	17.00	1.13	0.91	J
51 - 55	5	7.90	1.58	0.95	J
56 - 60	5	10.20	2.04	0.94	J
61 - 65	1	2.30	2.30	0.84	A
71 - 75	1	3.70	3.70	0.88	A
TM-AQF-10A2					
11 - 15	5	0.12	0.02	0.71	Y
16 - 20	64	3.16	0.05	0.62	Y
21 - 25	190	20.20	0.11	0.68	Y
26 - 30	222	43.00	0.19	0.72	Y
31 - 35	147	51.20	0.35	0.81	Y
36 - 40	98	55.40	0.57	0.88	Y
41 - 45	85	71.00	0.84	0.92	J
46 - 50	87	103.30	1.19	0.95	J
51 - 55	51	82.50	1.62	0.97	J
56 - 60	28	60.40	2.16	1.00	J
61 - 65	18	50.80	2.82	1.03	A
66 - 70	11	41.50	3.77	1.10	A
71 - 75	8	38.80	4.85	1.15	A
76 - 80	10	55.50	5.55	1.08	A
81 - 85	3	18.30	6.10	0.99	A
86 - 90	1	7.70	7.70	1.06	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-10B5			
11 - 15	43	0.75	0.02	0.52	Y
16 - 20	150	6.60	0.04	0.55	Y
21 - 25	266	27.00	0.10	0.65	Y
26 - 30	295	57.00	0.19	0.72	Y
31 - 35	153	52.00	0.34	0.79	Y
36 - 40	121	66.70	0.55	0.86	Y
41 - 45	50	40.80	0.82	0.90	J
46 - 50	32	38.30	1.20	0.96	J
51 - 55	9	14.50	1.61	0.97	J
56 - 60	8	17.30	2.16	1.00	J
61 - 65	4	10.50	2.62	0.96	A
71 - 75	1	4.90	4.90	1.16	A
		TM-AQF-13B5			
11 - 15	15	0.34	0.02	0.67	Y
16 - 20	227	10.43	0.05	0.57	Y
21 - 25	360	32.70	0.09	0.58	Y
26 - 30	218	41.00	0.19	0.70	Y
31 - 35	156	50.80	0.33	0.76	Y
36 - 40	84	43.00	0.51	0.80	Y
41 - 45	49	39.40	0.80	0.88	J
46 - 50	40	44.10	1.10	0.88	J
51 - 55	27	42.70	1.58	0.95	J
56 - 60	24	49.10	2.05	0.95	J
61 - 65	8	21.90	2.74	1.00	A
66 - 70	6	20.70	3.45	1.01	A
71 - 75	2	8.20	4.10	0.97	A
76 - 80	2	11.50	5.75	1.12	A
		TM-AQF-16A1			
11 - 15	17	0.28	0.02	0.49	Y
16 - 20	41	2.12	0.05	0.65	Y
21 - 25	157	17.00	0.11	0.69	Y
26 - 30	155	31.50	0.20	0.75	Y
31 - 35	123	41.90	0.34	0.79	Y
36 - 40	85	47.00	0.55	0.86	Y
41 - 45	75	63.60	0.85	0.93	J
46 - 50	40	47.00	1.17	0.94	J
51 - 55	24	38.00	1.58	0.95	J
56 - 60	27	57.20	2.12	0.98	J
61 - 65	21	58.50	2.79	1.01	A
66 - 70	8	27.80	3.47	1.01	A
71 - 75	8	36.00	4.50	1.07	A
76 - 80	2	11.50	5.75	1.12	A
81 - 85	3	18.40	6.13	1.00	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 1990.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
		TM-AQF-4A2			
11 - 15	25	0.55	0.02	0.65	Y
16 - 20	312	15.00	0.05	0.60	Y
21 - 25	183	17.00	0.09	0.59	Y
26 - 30	23	5.30	0.23	0.85	Y
31 - 35	37	14.30	0.39	0.90	Y
36 - 40	15	8.00	0.53	0.83	J
41 - 45	1	0.80	0.80	0.88	J
46 - 50	1	1.00	1.00	0.80	J
		TM-AQF-9B3			
11 - 15	26	0.50	0.02	0.57	Y
16 - 20	156	8.30	0.05	0.67	Y
21 - 25	174	17.60	0.10	0.65	Y
26 - 30	81	16.40	0.20	0.75	Y
31 - 35	75	27.80	0.37	0.86	Y
36 - 40	30	16.10	0.54	0.84	J
41 - 45	8	6.50	0.81	0.89	J
		TM-AQF-10A2			
11 - 15	2	0.03	0.02	0.44	Y
16 - 20	148	7.90	0.05	0.67	Y
21 - 25	211	22.20	0.11	0.67	Y
26 - 30	173	36.60	0.21	0.78	Y
31 - 35	154	57.30	0.37	0.87	Y
36 - 40	82	46.40	0.57	0.88	J
41 - 45	8	6.90	0.86	0.95	J
46 - 50	3	3.40	1.13	0.91	J
51 - 55	1	1.80	1.80	1.08	J
		TM-AQF-10B5			
11 - 15	8	0.14	0.02	0.52	Y
16 - 20	73	3.70	0.05	0.63	Y
21 - 25	173	19.80	0.11	0.73	Y
26 - 30	142	30.30	0.21	0.79	Y
31 - 35	68	25.00	0.37	0.86	Y
36 - 40	41	23.10	0.56	0.88	J
41 - 45	2	1.40	0.70	0.77	J
46 - 50	1	1.00	1.00	0.80	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-13B5			
11 - 15	7	0.15	0.02	0.63	Y
16 - 20	207	11.10	0.05	0.67	Y
21 - 25	300	31.00	0.10	0.66	Y
26 - 30	274	55.40	0.20	0.75	Y
31 - 35	194	66.80	0.34	0.80	Y
36 - 40	68	35.90	0.53	0.82	J
41 - 45	14	12.00	0.86	0.94	J
46 - 50	10	11.80	1.18	0.94	J
51 - 55	2	3.00	1.50	0.90	J
		TM-AQF-16A1			
6 - 10	9	0.04	0.00	0.44	Y
11 - 15	15	0.12	0.01	0.24	Y
16 - 20	36	2.03	0.06	0.70	Y
21 - 25	156	16.90	0.11	0.69	Y
26 - 30	80	16.30	0.20	0.75	Y
31 - 35	67	25.10	0.37	0.87	Y
36 - 40	33	20.70	0.63	0.98	J
41 - 45	30	27.30	0.91	1.00	J
46 - 50	13	16.80	1.29	1.03	J
51 - 55	4	6.10	1.52	0.92	J
56 - 60	1	2.00	2.00	0.93	A
61 - 65	1	2.90	2.90	1.06	A

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

TABLE 4-9 LENGTH FREQUENCY, TOTAL AND MEAN WEIGHT, CONDITION FACTOR (K), AND REPRODUCTIVE STATUS (R) PER 5 MM FL INTERVAL OF CHANNEL CATFISH COLLECTED BY SEINE NEAR TMINS IN 1990.

Fork length (5 mm intervals)	Number	Total Weight (g)	Mean Weight (g)	K	R*
TM-AQF-9B3					
21 - 25	2	0.30	0.15	0.96	Y
26 - 30	36	10.80	0.30	1.11	Y
31 - 35	68	29.90	0.44	1.03	Y
36 - 40	40	28.50	0.71	1.11	Y
41 - 45	54	56.40	1.04	1.15	Y
46 - 50	54	79.00	1.46	1.17	Y
51 - 55	28	54.00	1.93	1.16	Y
56 - 60	22	47.80	2.17	1.01	Y
61 - 65	11	24.90	2.26	0.82	Y
66 - 70	7	15.50	2.21	0.65	Y
71 - 75	4	.	.	.	Y
76 - 80	3	.	.	.	Y
81 - 85	2	.	.	.	Y
86 - 90	1	.	.	.	J
TM-AQF-10A2					
36 - 40	2	1.30	0.65	1.02	Y
41 - 45	1	1.10	1.10	1.21	Y
46 - 50	1	1.30	1.30	1.04	Y
56 - 60	1	2.90	2.90	1.34	Y
TM-AQF-10B5					
26 - 30	3	1.00	0.33	1.23	Y
31 - 35	8	4.10	0.51	1.20	Y
36 - 40	27	20.10	0.74	1.16	Y
41 - 45	24	24.00	1.00	1.10	Y
46 - 50	5	6.90	1.38	1.10	Y
56 - 60	1	2.40	2.40	1.11	Y
61 - 65	1	3.00	3.00	1.09	Y
TM-AQF-13B5					
36 - 40	2	1.40	0.70	1.09	Y
41 - 45	3	3.40	1.13	1.24	Y
46 - 50	2	2.60	1.30	1.04	Y
56 - 60	1	2.40	2.40	1.11	Y
TM-AQF-16A1					
46 - 50	1	1.30	1.30	1.04	Y

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

TABLE 4-10

Percent similarity indices of species composition between seine stations near TMINS, April through November 1990. Station prefix TM-SE- deleted from table.

	10B5	16A1	10A2	9B3	4A2
13B5	58.0	56.2	65.5	28.4	35.0
10B5		81.2	77.7	32.8	47.6
16A1			79.0	43.2	48.4
10A2				35.5	43.9
9B3					39.9

TABLE 4-11

Relative contribution of key species to the annual seine catches near TMINS, 1977 through 1990.

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
1990	31,470	24	6	5	31	4

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

TABLE 4-12

Incidence of parasites, diseases, and/or morphological anomalies on fishes captured by seine near TMINS, April through November 1990.

	Black Spot	Lernaea	Leech	Argulus	Glochidia	Pughead	Scoliosis	Mouth Deformity	Popeye	Skin Infection*	Emaciation	Total Afflicted	Total Examined	Percent Incidence
River chub	1	-	-	-	-	-	-	-	-	1	-	2	1	200.0
Golden shiner	1	-	-	-	-	-	-	-	-	1	-	2	15	13.3
Comely shiner	2	-	-	-	1	-	-	-	-	1	-	4	154	2.6
Spottail shiner	5	8	-	-	1	12	-	2	-	17	-	45	1322	3.4
Swallowtail shiner	1	1	-	-	-	3	-	-	-	2	-	7	287	2.4
Spotfin shiner	411	19	-	-	41	84	10	5	1	62	3	636	5078	12.5
Mimic shiner	2	30	2	-	14	337	3	3	-	53	1	445	3960	11.2
Bluntnose minnow	33	30	-	-	6	23	1	-	1	13	-	107	999	10.7
Fallfish	4	3	-	-	-	1	-	-	-	1	-	9	161	5.6
Quillback	2	-	-	-	-	-	-	-	-	-	-	2	6	33.3
White sucker	14	12	1	2	-	-	-	-	-	22	-	51	1198	4.2
Northern hog sucker	2	-	-	-	-	-	-	-	-	1	-	3	55	5.4
Shorthead redhorse	9	2	-	-	-	-	-	-	-	4	-	15	49	30.6
Channel catfish	1	15	1	-	-	-	-	-	1	11	1	30	397	7.6
Rock bass	4	2	-	-	-	-	-	-	-	3	-	9	79	11.4
Redbreast sunfish	-	1	2	-	1	-	-	-	-	4	-	8	72	11.1
Green sunfish	5	-	-	-	-	-	-	-	-	-	-	5	14	35.7
Pumpkinseed	-	8	-	-	1	-	-	-	-	12	-	21	532	3.9
Bluegill	-	1	-	-	1	-	-	-	-	-	-	2	111	1.8
Smallmouth bass	1	7	1	-	-	1	-	-	-	5	-	15	178	8.4
Tessellated darter	46	10	42	-	59	-	-	-	-	14	-	171	1758	9.7
Banded darter	-	-	1	-	-	-	-	-	-	-	-	1	96	1.0
Total	544	149	50	2	125	461	14	10	3	227	5	1590	16522	9.6
Percent	3.3	0.9	0.3	+	0.8	2.8	0.1	0.1	+	1.4	+			

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

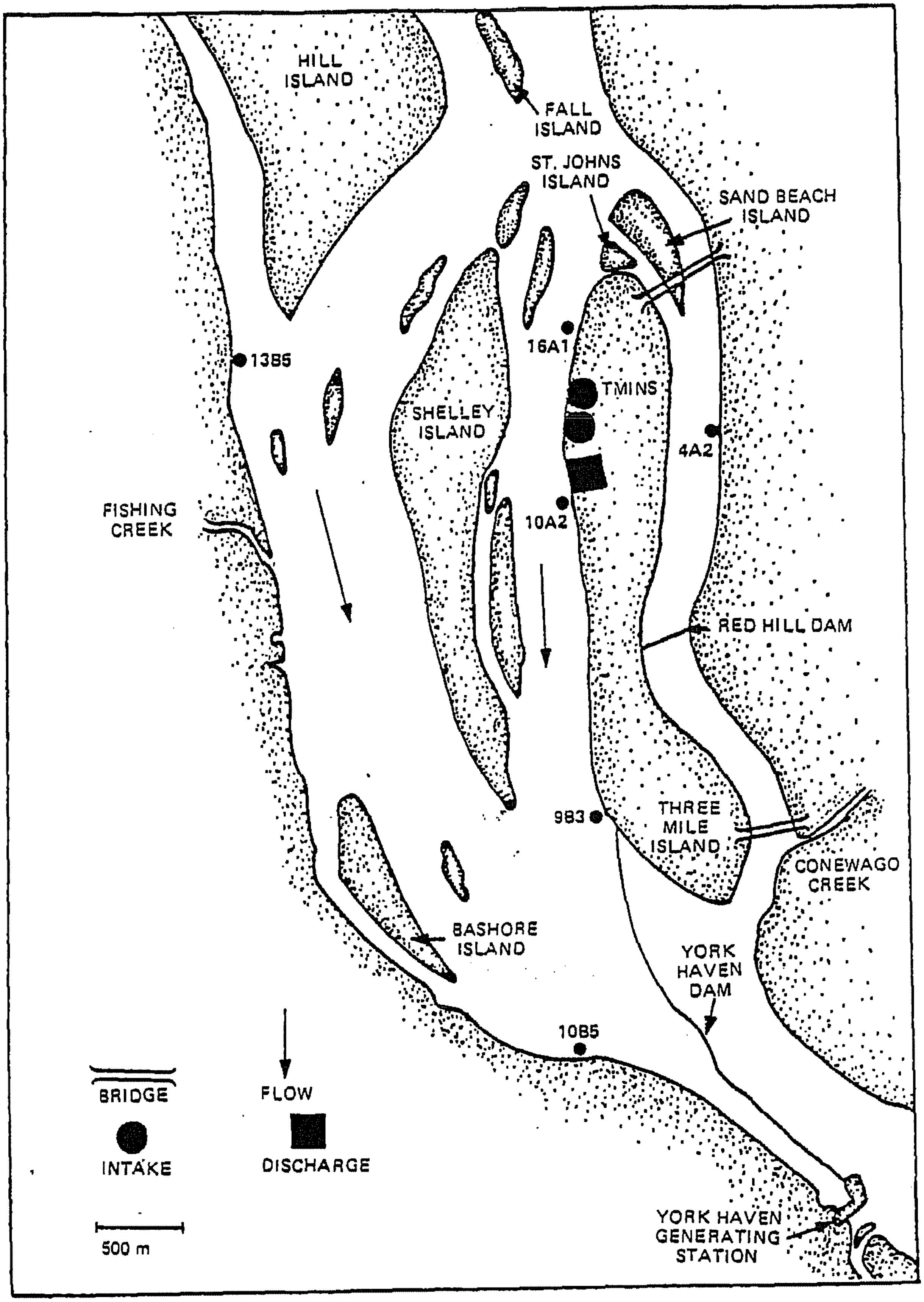

Figure 4-1. Location of seine stations sampled in York Haven Pond (station prefix TM-SE- deleted).

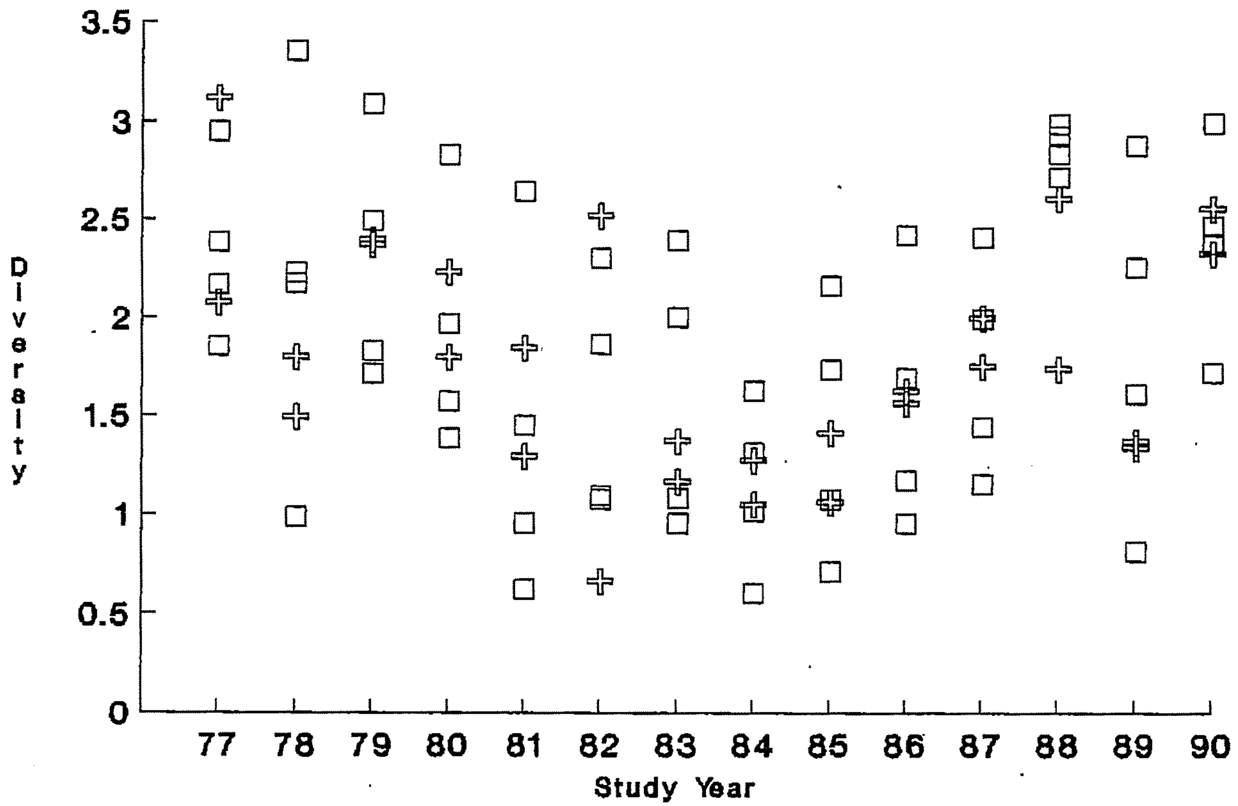

Figure 4-2. Annual range of sampling station diversity values, months combined, for seine catches, TMINS aquatic studies (open boxes are station values and crosses represent stations 10A2 and 9B3). Identical diversity values may result in less than six symbols.

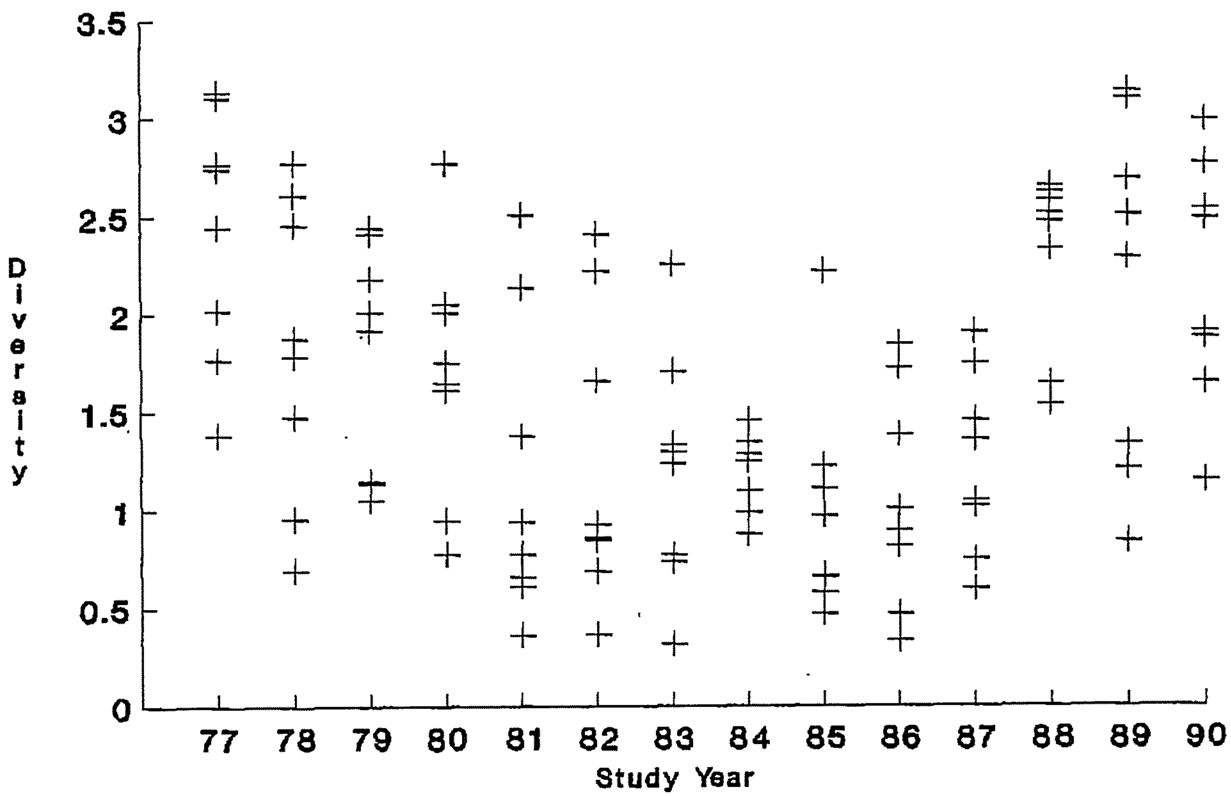

Figure 4-3. Annual range of monthly (April-November) diversity values, stations combined, for seine catches, TMINS aquatic studies. Identical diversity values may result in less than eight symbols.

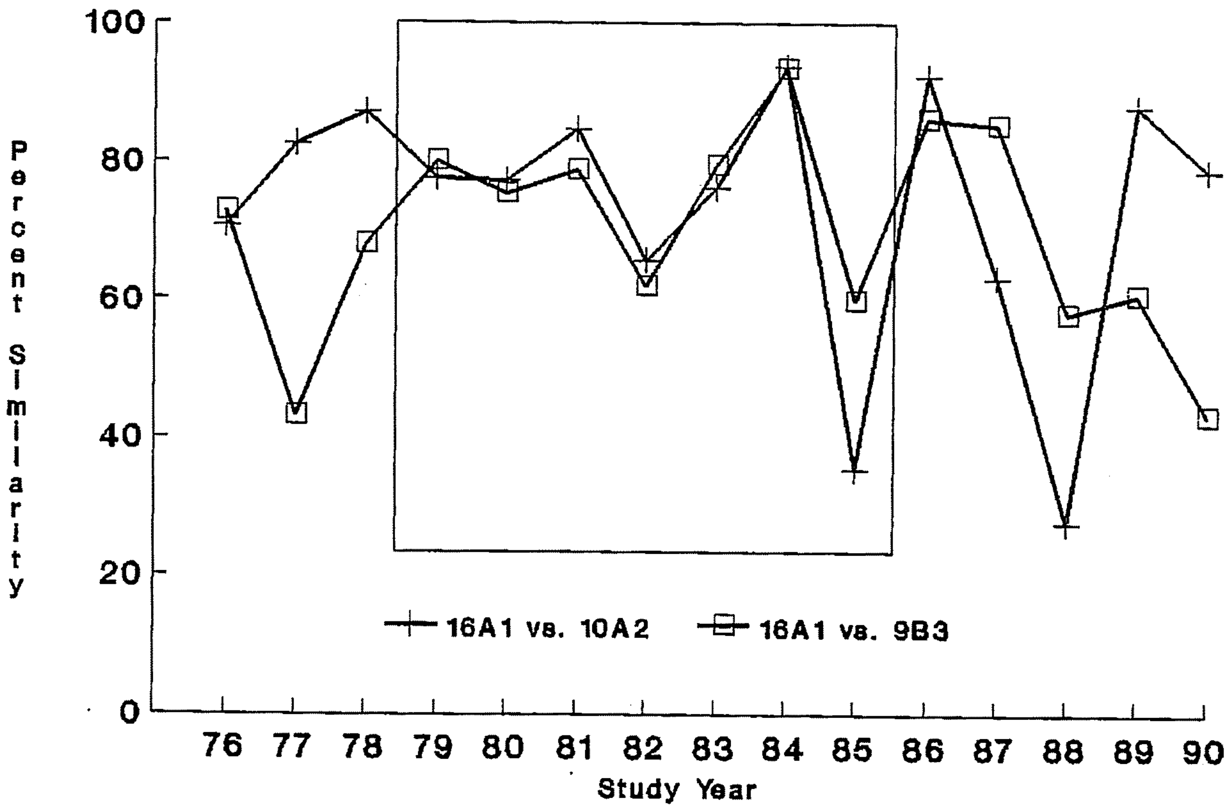

Figure 4-4. Annual variation in percent similarity values for selected seine station comparisons, TMINS aquatic studies. Years of non-operation of TMINS are represented within the large square.

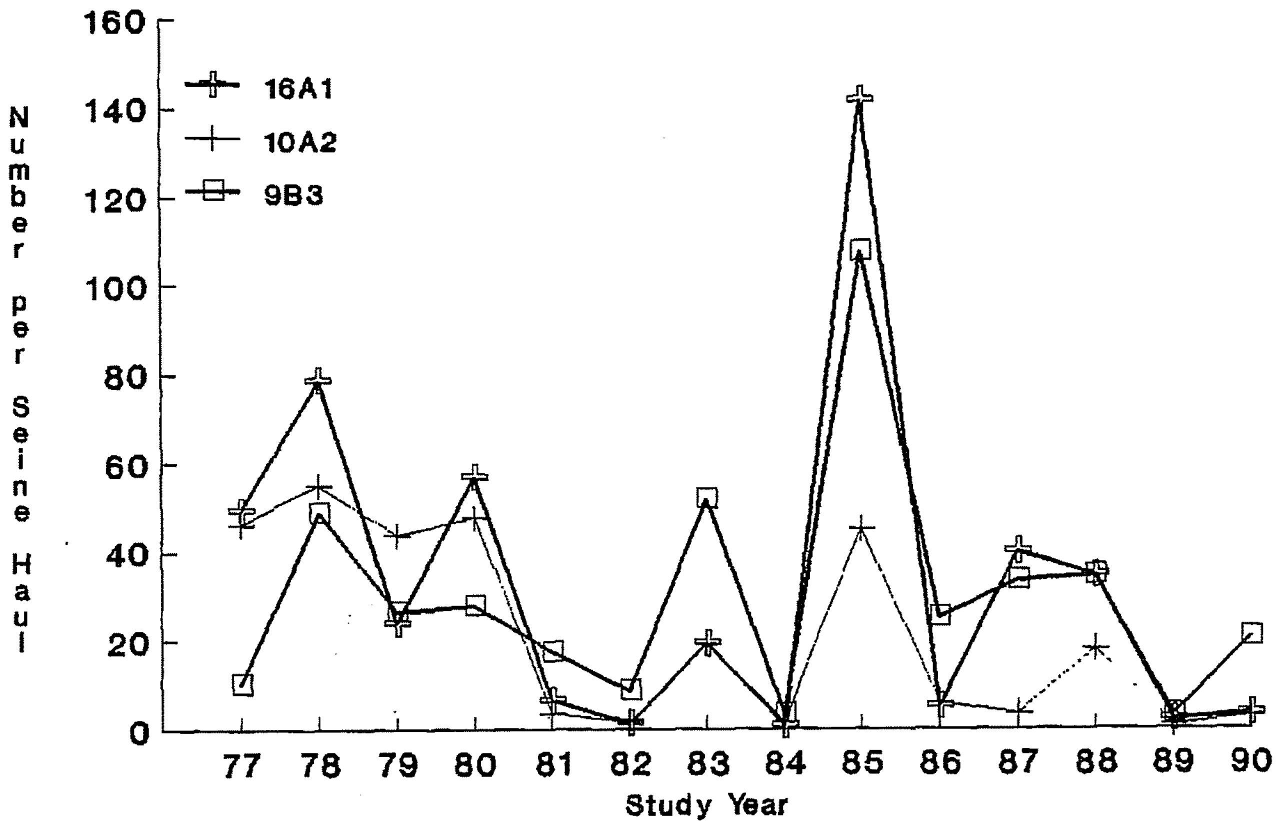

Figure 4-5. Annual abundance (number per seine haul) of spottail shiner in seine catches near TMINS.

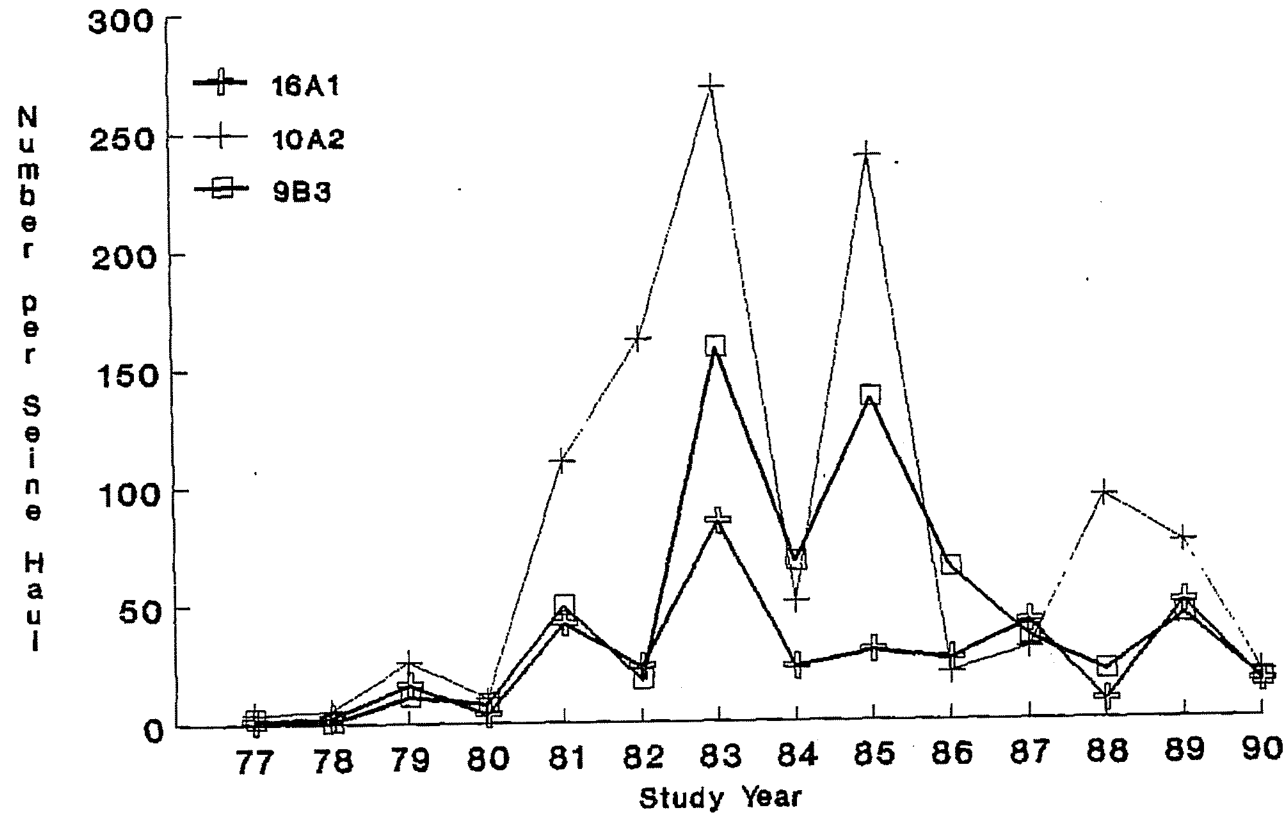

Figure 4-6. Annual abundance (number per seine haul) of spotfin shiner in seine catches near TMINS.

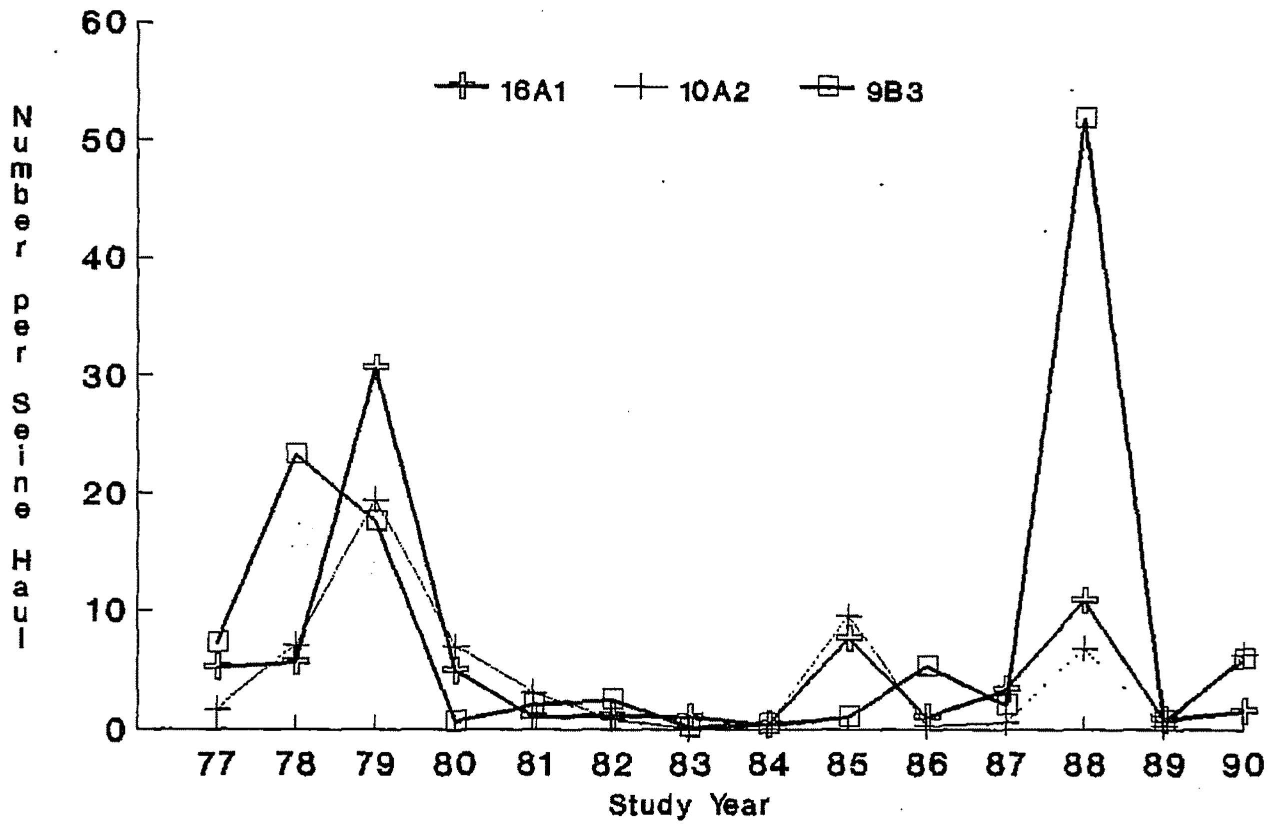

Figure 4-7. Annual abundance (number per seine haul) of white sucker in seine catches near TMINS.

5. ELECTROFISHING

5.1 METHODS

Nighttime 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 1990.

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 equipped with bow-mounted flood lamps. 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.

Data recorded for each survey were time, duration of sample (in minutes), air and surface water temperatures, surface dissolved oxygen 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 mm FL; weighed to the nearest g; and inspected for diseases, parasites, and morphological anomalies. If a collection contained 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 1990 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 methods 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 1990 catch.

The 1990 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 7 June; summer, 20 June through 29 August; and fall, 5 September through 9 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).

In addition, Cochran's Q-statistic and M-statistic (Hendrickson 1978) were applied to 1990 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: 1990

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 5,606 specimens of 36 fishes, representing seven families, was taken in 72 collections. Sunfishes, the largest family numerically, were represented by nine species, while carps and minnows (cyprinids) were represented by 11. All other families consisted of four or fewer species.

Sunfishes comprised 73.1% of the total catch (Table 5-5), and included the top six species (rock bass, redbreast sunfish, green sunfish, pumpkinseed, bluegill, and smallmouth bass) taken (Table 5-3). The second most abundant family was cyprinids which accounted for 9.9% of the total catch. The spottail shiner (ninth ranked species) and spotfin shiner (tenth ranked species) were the most common cyprinids. Suckers, the third most abundant family, comprised 7.6% of the total catch; their abundance was due to large catches of quillback (eighth ranked species) and white sucker. Percids were next in abundance and comprised 5.2% of the total catch. The walleye (seventh ranked species) was the most abundant percid taken. Together, the sunfish, cyprinid, sucker, and perch families accounted for 95.9% 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. Catches increased steadily from the lowest catch in April to the highest catch in early August. Catch rates were variable from late August through November, but generally remained high. Fluctuations in the total catch over the year were almost entirely due to the abundance of redbreast sunfish, pumpkinseed, and smallmouth bass. The seasonal pattern which emerged was characterized by low, similar-sized catches in the spring (April through early June), followed by a period of high and more variable catches in the summer and fall (late June through November). The spring catches were predominantly rock bass, redbreast sunfish, pumpkinseed, and smallmouth bass, which accounted for 62.6% of the total catch. The summer and fall catch was dominated by redbreast sunfish, green sunfish, pumpkinseed, bluegill, smallmouth bass, and walleye, which comprised 69.5% of the catch.

Spatial differences in abundance and number of species among stations is presented in Table 5-4. The total catch was high at Stations 13A1 (1,282 specimens), moderate at Stations 10A3 and 11B1 (1,069 and 993, respectively), and low but quite similar at Stations 10B3, 9B5, and 4A1 (776, 749, and 737, respectively). Total catch and number of species collected per station (range 23 to 25) were inversely related. The high catch at Station 13A1 had the lowest species total, whereas the low catch at Station 10B3 had the highest species total. Variations in the annual station catches reflected the spatial differences in the abundance of several key species. The high catch at Station 13A1 was dominated by rock bass, redbreast sunfish, pumpkinseed, and smallmouth bass, which comprised over 80% of the catch. Among those stations with moderate catches, redbreast sunfish, pumpkinseed, bluegill, and smallmouth bass were most abundant. Although these species were common at Stations 10B3, 9B5, and 4A1 their abundance was reduced.

The results of the two-factor ANOVA provide a quantitative evaluation of spatial and temporal differences in the catch-per-minute (Table 5-6). Significant differences were identified for stations and 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 a high catch rate in the fall. The catch rates at Stations 13A1, 10A3, and 9B1 were high in the summer and relatively low in the spring and fall.

Station 10B3 was intermediate with high catch rates in the spring and lower catch rates in the summer and fall. This variation among seasonal catch rates at individual stations indicated that the rate at Station 13A1 was similar to 10A3, but significantly higher than the rates at the other stations (Table 5-8). The catch rates at Stations 10A3, 11B1, 10B3, 9B5, and 4A1 were undifferentiated. The low mean catch rate in the spring was significantly different from the higher and undifferentiated rates in the summer and fall. Catch rates at individual stations were largely influenced by the abundance of redbreast sunfish, pumpkinseed, and smallmouth bass, and to a lesser extent by green sunfish, bluegill, and walleye. Catches of these fishes in the summer and fall were 1.5 times the spring catch. Since the 1990 electrofishing catch rates at stations located below the TMINS discharge (10A3 and 9B5) were undifferentiated from stations outside the influence of the discharge (11B1, 10B3, and 4A1) there was no evidence to suggest that activities at 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 (redbreast sunfish, pumpkinseed, and smallmouth bass).

The mean length and weight of redbreast sunfish declined from April through September, and increased thereafter (Table 5-9). 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 abundance declined in the summer as smaller (juvenile) fish became more common.

Mean K of redbreast sunfish increased from April (2.33) to a peak in June (2.80), declined through September, and increased again through November (Table 5-9). The high K factor in June was likely due to the reproductive condition of females.

The growth of pumpkinseed declined from April through June, fluctuated July through September, and increased through November (Table 5-9). 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 through September). The subsequent increase in growth in October and November resulted from the continued growth and dominance of these juvenile fish.

Mean K of pumpkinseed, unlike that of redbreast sunfish, peaked in May (2.74) and remained high in June (2.72); values in others months ranged from 2.66 in August to 2.41 in October (Table 5-9). Mean K declined steadily from May through October, except for a minor increase in August. The decline in condition was likely the result of the discharge or reabsorption of gametes.

The mean length and weight (growth) of smallmouth bass declined steadily from April through October before increasing in November (Table 5-9). 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 through the summer as smaller (juvenile and young) fish became common. The increased growth in November was related to an increase in numbers of adult fish.

The mean K for smallmouth bass was highest in June (1.58) and lowest in April (1.38) (Table 5-9). Generally, mean K increased from April through June, remained high through August, and fluctuated thereafter. 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 redbreast sunfish, pumpkinseed, 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 Susquehanna 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.

Redbreast sunfish condition factors for the 1990 TMINS study (range of monthly means, 2.33 to 2.80) (Table 5-9) were similar to data presented by Carlander (1977) for other redbreast sunfish populations (range of means 1.90 to 4.21). The pumpkinseed condition data (range 2.41 to 2.74) were also similar to data presented in Carlander (1977) (range 1.79 to 3.03), and were within the median of the reported range. Similarly, the range of mean K for Susquehanna River smallmouth bass (1.38 to 1.77) 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 to 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 redbreast sunfish (Nardacci and Associates 1983; RMC 1988a, 1989) pumpkinseed (EA 1987; RMC 1988a, 1989, 1990) and smallmouth bass (EA 1986; RMC 1988a, 1989, 1990) were compared to the 1990 data. Calculation of these means obscured differences due to sex and maturity, season, age, sample size, and thus are general in nature. The range of annual means through 1989 was 2.36 to 2.76 for redbreast sunfish, 2.40 to 3.09 for pumpkinseed, and 1.42 to 1.72 for smallmouth bass. Values for 1990 (2.54, 2.63, and 1.56 for redbreast sunfish, pumpkinseed, and smallmouth bass, respectively) fell within their respective historical ranges. Since data varied from year to year, there was no grouping of condition data by the operational (1976 through 1978 and 1986 through 1990) or non-operational (1979 through 1985) status of TMINS.

Condition factors for these fishes in 1990 were at or near the mid-point of their reported ranges, and represented an increase in condition from those determined in 1989 (RMC 1990). 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 the natural variation in fish populations rather than any influence of TMINS.

5.4 COMMUNITY ANALYSIS: DIVERSITY AND SIMILARITY

The 1990 fish community in York Haven Pond was examined with measures of species diversity and percent similarity. Shannon-Wiener mean diversity (H′) was calculated for the annual catch at each station (Table 5-4) and for each date (Table 5-3). Mean diversity values ranged from 2.97 to 3.61 among stations and from 2.76 to 3.98 among dates. Diversity was high (>3.00) at Stations 4A1, 13A1, 10A3, 9B5, and 10B3 reflecting both higher numbers of species and/or greater evenness of individuals among the taxa. Diversity was low (<3.00) at Station 11B1 due to the numerical dominance of pumpkinseed and bluegill which comprised over 60% of the catch.

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 (>3.30) occurred in April, early June, late August, September, and October, while the lowest value (<2.80) occurred in 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 1990) 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 increased over those reported in 1989 (RMC 1990), establishing new highs, yet the minimum 1990 diversity value was within the historic range. 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 26.2 (low similarity) to 78.2 (high similarity) (Table 5-10). Two groupings of stations were evident. Stations 13A1, 10A3, and 9B5 were consistently similar to each other (mean similarity = 74.6), as were Stations 4A1 and 10B3 (similarity = 71.0), while similarity between these two groups was generally low (mean similarity = 57.9). Similarity values for Station 11B1 indicated that species composition was quite dissimilar to all the other stations (mean similarity = 43.9).

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 had 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, rock bass, redbreast sunfish, green sunfish, pumpkinseed, bluegill, and smallmouth bass.

Pairwise similarity values for electrofishing catches at sampling stations were examined for a 15-year period (Table 5-11). In general, station pairs with high similarity values in previous years exhibited high similarity in 1990 (e.g., 13A1 vs. 10A3, 10A3 vs. 9B5). Station pairs with low PSc values in 1990 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, 1990). Many station pairs were near their historic mean. All were within their historic ranges, except Stations 13A1 and 11B1 which established a new low.

To examine possible effects of the TMINS discharge on fish community similarity, PSc values for pairwise comparisons of Station 13A1 (500 m upstream of the discharge), 10A3 (immediately downstream of the discharge), and 9B5 (1,500 m downstream of the discharge) were plotted (Figure 5-4). The similarity of stations downstream of TMINS discharge with 13A1 in 1990 showed an increase from those reported in 1989. 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 and non-operational years. The similarity of these stations with 13A1 indicates that the species composition was unaffected by the operation of TMINS.

In addition, Cochran's Q-statistic was not significant ($Q = 0.617$, $DF = 5$) and indicated homogeneity in the total number of species per station. The M-statistic showed no significant difference ($M = 3.408$, $DF = 10$) 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 any differences in PSc among individual stations was due to the abundance of several key 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 years, months, and stations (Table 5-12). Variance due to interaction between factors (year, month, station) was significant in all cases, so the effects of single factors on catch rate were 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, followed by substantial increases which peaked in 1988. The catch rate in 1990 showed the continuation of the slight decrease noted in 1989 (RMC 1990). This decrease may be related to a reduction in the abundances of key species from that reported in RMC (1990). The 1990 catch rate ranked fourth among all years, was similar to 1989, 1987, and 1978, and significantly different from all other years (Table 5-13).

Monthly catch rates were highest in October and May, and were significantly different from all other months except September over the period (Table 5-13).

Catch rates among stations near TMINS were significantly different (Table 5-13). Since 1976, the highest catch rates occurred at Stations 10A3, 11B1, and 13A1; these were significantly different from the other stations. Station 10B3 was undifferentiated statistically from Station 4A1. 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 study period. 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, 1990) 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, 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 in 1990.

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 1990, a total of 4,992 fish was examined; 696 specimens of 20 fishes had one or more types of external parasites, infections, and/or morphological anomalies (Table 5-14). The most prevalent conditions were the presence of leeches, skin infections, and anchor worms (Lernaea spp.). These occurred on 254, (5.1%), 234 (4.7%), and 132 (2.6%) individuals, respectively. Skin infections included damaged fins, fin rot, fungus, tumors, and/or cysts. Skin infections occurred on 16 different fishes; anchor worms were observed on 13 fishes; and leeches occurred on 8 fishes. Skin infections occurred mostly on redbreast sunfish, pumpkinseed, and smallmouth bass. Anchor worms and leeches occurred almost exclusively among sunfishes (67.4% and 96.8%, respectively). Black spot (fluke cysts) and eye injuries, although infrequent, primarily afflicted the walleye and smallmouth bass, respectively. Mouth injuries, suspected to be caused by angling, were mostly observed on smallmouth bass. All other conditions occurred at very low frequency.

The overall incidence of diseases, parasites, and morphological anomalies for all fishes was 13.9% (Table 5-14). 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. These were redbreast sunfish, pumpkinseed, and smallmouth bass. The incidence rates for these fishes ranged from 10.2 to 21.6%.

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 removing black spot, anchor worms, leeches, and mouth injuries from consideration, the overall incidence rate of disease and physical anomalies was 5.27%. EA (1987) and RMC (1988a, 1989, 1990) estimated incidence rates ranging from 1.60 to 7.09% for 1984 through 1989. The incidence rate for 1990 decreased from that reported in 1989 and was within the established range. In addition, diseased and parasitized fish were encountered throughout York Haven Pond and were not limited to areas immediately below the TMINS discharge. Thus, the incidence of diseases and physical anomalies appeared unrelated to TMINS operation.

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.

Station 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 1990.

Scientific Name	Common Name
Clupeidae	Herrings
Alosa _pseudoharengus_ (Wilson)	Alewife
Alosa _sapidissima_ (Wilson)	American shad
Dorosoma _cepedianum_ (Lesueur)	Gizzard shad
Esocidae	Pikes
Esox _lucius_ Linnaeus	Northern pike
Esox _masquinongy_ Mitchill	Muskellunge
Cyprinidae	Carps and Minnows
Campostoma _anomalum_ (Rafinesque)	Central stoneroller
Cyprinus _carpio_ Linnaeus	Common carp
Notemigonus _crysoleucas_ (Mitchill)	Golden shiner
Nocomis _micropogon_ (Cope)	River chub
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 _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
Etheostoma _olmstedi_ Storer	Tessellated darter
Perca _flavescens_ (Mitchill)	Yellow perch
Percina _peltata_ (Stauffer)	Shield darter
Stizostedion _vitreum_ _vitreum_ (Mitchill)	Walleye

TABLE 5-3
Temporal distribution of fishes taken by the AC electrofisher near TMINS in 1990.

	18-19 Apr	9-10 May	30-31 May	6-7 Jun	20-21 Jun	30-31 Jul	8-9 Aug	28-29 Aug	5-6 Sep	25-26 Sep	3-4 Oct	8-9 Nov	Total	% Catch
Alewife	-	-	-	1	-	-	-	-	-	-	-	-	1	+
American shad	-	-	-	-	-	-	-	-	1	8	8	-	17	0.3
Gizzard shad	1	1	1	-	-	6	2	53	7	13	18	10	112	2.0
Northern pike	-	-	-	-	-	-	2	1	1	-	-	-	4	0.1
Muskellunge	-	-	-	-	-	-	-	1	1	-	2	1	5	0.1
Tiger muskie	1	-	-	-	-	-	-	-	-	-	-	-	1	+
Central stoneroller	1	-	-	-	-	-	-	-	-	-	-	-	1	+
Common carp	12	8	20	2	2	7	4	-	3	3	3	2	66	1.2
River chub	-	-	-	-	-	-	-	-	-	-	1	-	1	+
Golden shiner	1	2	2	6	4	16	5	4	3	14	11	3	71	1.3
Comely shiner	1	-	-	-	-	-	-	-	-	1	-	-	2	+
Spottail shiner	45	14	12	10	12	1	4	27	10	34	15	26	210	3.7
Swallowtail shiner	-	-	-	1	-	-	-	1	-	-	-	-	2	+
Spotfin shiner	-	1	7	30	1	45	47	14	12	9	12	1	179	3.2
Mimic shiner	-	1	-	-	-	-	-	-	-	-	2	-	3	+
Bluntnose minnow	-	-	1	-	-	-	-	1	1	-	1	-	4	0.1
Fallfish	2	1	2	1	1	-	-	-	-	2	8	-	17	0.3
Quillback	12	13	36	21	9	9	24	26	28	24	27	19	248	4.4
White sucker	-	-	-	-	-	7	10	22	48	19	49	-	155	2.8
Northern hog sucker	-	-	-	-	-	-	-	-	-	-	10	-	10	0.2
Shorthead redhorse	2	2	2	1	-	-	-	-	4	2	2	-	15	0.3
Yellow bullhead	-	-	-	-	-	2	1	-	-	-	3	-	6	0.1
Brown bullhead	1	-	-	-	-	-	1	1	1	-	1	-	5	0.1
Channel catfish	2	9	10	4	1	3	4	6	11	14	14	1	79	1.4
Rock bass	31	10	38	28	35	30	13	21	13	47	24	45	335	6.0
Redbreast sunfish	21	55	72	56	64	108	235	138	91	62	90	47	1039	18.5
Green sunfish	13	7	6	49	20	42	38	16	32	33	67	23	346	6.2
Pumpkinseed	78	77	53	98	55	108	128	109	53	138	100	162	1159	20.7
Bluegill	19	29	6	42	47	47	49	26	33	32	23	37	390	7.0
Lepomis hybrid	2	1	-	5	1	1	10	5	4	1	6	3	39	0.7
Smallmouth bass	38	63	109	30	149	11	46	60	33	41	47	32	659	11.8
Largemouth bass	3	5	1	3	2	1	7	7	6	15	14	19	83	1.5
White crappie	4	-	1	-	-	1	1	4	-	3	3	3	20	0.4
Black crappie	1	-	-	-	2	-	6	-	2	11	3	5	30	0.5
Tessellated darter	1	-	-	-	-	1	-	-	-	-	4	-	6	0.1
Yellow perch	-	-	-	-	-	-	-	-	-	1	-	-	1	+
Shield darter	-	-	-	-	-	-	-	-	1	-	-	-	1	+
Walleye	2	1	1	5	-	35	26	39	49	45	56	25	284	5.1
No. of Specimens	294	300	380	393	405	481	663	582	448	572	624	464	5606	
No. of Species	22	18	19	18	15	19	21	21	24	23	29	18	36	
No. of Collections	6	6	6	6	6	6	6	6	6	6	6	6	72	
No. of Fish/Collection	49.00	50.00	63.33	65.50	67.50	80.17	110.50	97.00	74.67	95.33	104.00	77.33	77.86	
No. of Fish/Minute	1.92	2.27	2.50	2.38	2.65	3.10	3.95	3.57	2.95	3.16	3.88	3.01	2.97	
Diversity Index	3.37	3.09	3.07	3.32	2.76	3.27	3.10	3.47	3.69	3.76	3.98	3.22	3.67	

* Less than 0.05%.

TABLE 5-4

Distribution of fishes taken by the AC electrofisher at stations sampled near TMINS in 1990. Station prefix TM-EL- deleted from table.

	4A1	13A1	10A3	9B5	10B3	11B1	Total	% Catch
Alewife	-	-	-	-	-	1	1	+
American shad	1	13	-	3	-	-	17	0.3
Gizzard shad	8	9	10	9	6	70	112	2.0
Northern pike	-	-	-	-	3	1	4	0.1
Muskellunge	-	-	2	-	1	2	5	0.1
Tiger muskie	-	-	-	-	-	1	1	+
Central stoneroller	-	-	-	1	-	-	1	+
Common carp	9	12	13	5	6	21	66	1.2
River chub	-	1	-	-	-	-	1	+
Golden shiner	5	3	29	-	7	27	71	1.3
Comely shiner	-	-	1	-	1	-	2	+
Spottail shiner	38	7	39	62	50	14	210	3.7
Swallowtail shiner	-	-	1	-	1	-	2	+
Spotfin shiner	26	50	45	27	19	12	179	3.2
Mimic shiner	3	-	-	-	-	-	3	+
Bluntnose minnow	1	-	-	1	-	2	4	0.1
Fallfish	-	2	7	4	4	-	17	0.3
Quillback	37	41	26	37	68	39	248	4.4
White sucker	21	4	21	68	23	18	155	2.8
Northern hog sucker	-	9	1	-	-	-	10	0.2
Shorthead redhorse	3	-	5	3	4	-	15	0.3
Yellow bullhead	5	1	-	-	-	-	6	0.1
Brown bullhead	2	-	1	-	-	2	5	0.1
Channel catfish	3	21	22	17	11	5	79	1.4
Rock bass	23	135	98	42	31	6	335	6.0
Redbreast sunfish	54	402	342	159	75	7	1039	18.5
Green sunfish	101	101	38	46	8	52	346	6.2
Pumpkinseed	220	90	149	90	173	437	1159	20.7
Bluegill	53	15	18	34	109	161	390	7.0
Lepomis hybrid	21	10	1	2	2	3	39	0.7
Smallmouth bass	30	308	122	87	99	13	659	11.8
Largemouth bass	23	-	-	2	4	54	83	1.5
White crappie	-	-	3	3	1	13	20	0.4
Black crappie	-	2	1	1	15	11	30	0.5
Tessellated darter	1	4	-	1	-	-	6	0.1
Yellow perch	-	-	-	-	1	-	1	+
Shield darter	-	1	-	-	-	-	1	+
Walleye	49	41	74	45	54	21	284	5.1
No. of Specimens	737	1282	1069	749	776	993	5606	
No. of Species	23	23	24	23	25	23	36	
No. of Collections	12	12	12	12	12	12	72	
No. of Fish/Collection	61.42	106.83	89.08	62.42	64.67	82.75	77.86	
No. of Fish/Minute	2.27	4.39	3.40	2.55	2.54	2.76	2.97	
Diversity Index	3.53	3.04	3.32	3.61	3.55	2.97	3.67	

+ Less than 0.05%.

TABLE 5-5

Percent family composition at the AC electrofishing stations sampled in York Haven Pond, April through November 1990. Station prefix TM-EL- deleted from table.

Family	Station 4A1	13A1	10A3	9B5	10B3	11B1	Total
Herrings	1.2	1.7	0.9	1.6	0.8	7.2	2.3
Pikes	-	-	0.2	-	0.5	0.4	0.2
Carps and Minnows	11.1	5.8	12.6	13.4	11.3	7.6	9.9
Suckers	8.3	4.2	5.0	14.4	12.2	5.7	7.6
Bullhead catfishes	1.4	1.7	2.2	2.3	1.4	0.7	1.6
Sunfishes	71.2	82.9	72.2	62.2	66.6	76.2	73.1
Perches	6.8	3.6	6.9	6.1	7.1	2.1	5.2

TABLE 5-6

Spatial and temporal catch-per-minute data (all species combined) for fishes taken by the AC electrofisher near TMINS in 1990. Station prefix TM-EL- deleted from table.

Date	Season	Station 4A1	13A1	10A3	9B5	10B3	11B1	Total Mean
18-19 Apr	Spring	0.73	2.48	1.22	1.50	1.77	3.20	1.92
9-10 May		1.00	4.22	1.60	0.60	3.75	2.40	2.27
30-31 May		1.55	3.38	1.96	2.89	4.18	1.03	2.50
6-7 Jun		1.64	3.56	3.20	2.14	2.62	1.40	2.38
Seasonal Mean		1.24	3.41	2.09	1.85	3.11	2.02	2.27
20-21 Jun	Summer	0.72	6.48	3.50	1.87	2.77	1.07	2.65
30-31 Jul		2.13	4.21	5.60	2.96	1.95	1.78	3.10
8-9 Aug		2.52	7.26	5.63	4.29	2.10	2.13	3.95
28-29 Aug		1.85	4.71	4.33	4.21	3.27	3.03	3.57
Seasonal Mean		1.83	5.65	4.77	3.39	2.53	2.00	3.33
5-6 Sep	Fall	4.18	3.30	3.88	2.69	2.21	1.44	2.95
25-26 Sep		2.88	3.12	3.59	2.23	2.53	4.59	3.16
3-4 Oct		4.94	5.40	3.44	2.91	2.27	4.00	3.88
8-9 Nov		1.90	4.12	1.76	1.71	0.96	6.77	3.01
Seasonal Mean		3.47	4.00	3.18	2.39	2.04	4.28	3.25
Annual Mean		2.27	4.39	3.40	2.55	2.54	2.76	2.97

TABLE 5-7

Two-factor analysis of variance test results for electrofishing catch-per-minute data collected near TMINS, April through November 1990.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model(r^2=0.579)	17	1.1866	0.0698	4.38	0.0001*
Station	5	0.4788	0.0958	6.00	0.0002*
Season	2	0.2332	0.1166	7.31	0.0015*
Interaction	10	0.4745	0.0474	2.97	0.0047*
Error	54	0.8614	0.0160		
Corrected Total	71	2.0479			

* Significant at P≤0.01.

TABLE 5-8

Summary of Tukey's studentized range test for electrofishing catch-per-minute data collected near TMINS, April through November 1990. Underlined means are not significantly different (P≤0.05) and are ranked from highest to lowest transformed (4th root) mean. Means are listed parenthetically.

Station*	13A1	10A3	11B1	10B3	9B5	4A1
	(1.43)	(1.32)	(1.25)	(1.25)	(1.23)	(1.18)
Season	Summer	Fall	Spring			
	(1.32)	(1.31)	(1.20)			

* Station prefix TM-EL- deleted from table.

TABLE 5-9 MIMIMUM, MEAN, AND MAXIMUM LENGTH, WEIGHT, AND CONDITION FACTOR (K) OF REDBREAST SUNFISH, PUMPKINSEED, AND SMALLMOUTH BASS CAPTURED BY THE AC ELECTROSHOCKER NEAR TMINS, 1990.

		Fork Length (mm)			Weight (g)			K		
Month	N	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Redbreast sunfish										
APR	21	78	158	196	10	101.1	200	2.00	2.33	2.69
MAY	127	77	147	200	11	102.4	250	1.37	2.75	3.61
JUN	120	52	137	195	2	85.6	258	1.03	2.80	4.23
JUL	108	55	129	192	1	73.6	205	0.46	2.67	3.82
AUG	287	45	122	211	2	57.1	277	0.62	2.45	4.96
SEP	153	42	94	185	1	26.2	160	1.35	2.34	3.50
OCT	90	59	101	191	2	32.6	169	0.22	2.35	4.44
NOV	47	70	140	220	8	88.0	298	1.67	2.63	3.50
Pumpkinseed										
APR	64	81	155	193	16	107.7	220	2.13	2.67	3.11
MAY	130	71	123	205	6	61.3	229	1.37	2.74	4.49
JUN	153	44	109	188	2	42.7	194	0.93	2.72	4.03
JUL	108	57	117	182	3	49.1	168	1.09	2.65	4.20
AUG	235	63	123	189	5	54.4	184	1.61	2.66	3.65
SEP	175	41	122	187	2	56.7	213	1.39	2.62	3.55
OCT	100	43	97	162	1	31.1	108	0.85	2.41	4.00
NOV	94	40	130	191	1	60.8	179	1.29	2.42	3.91
Smallmouth Bass										
APR	38	177	245	337	72	229.4	562	1.14	1.38	1.78
MAY	172	95	212	410	16	169.8	910	0.64	1.52	1.97
JUN	132	92	209	340	14	161.8	542	0.71	1.58	2.02
JUL	11	45	200	251	1	150.1	248	1.10	1.56	1.73
AUG	104	58	189	412	2	149.0	1060	0.93	1.56	2.67
SEP	74	66	151	348	1	98.7	681	0.32	1.53	2.43
OCT	47	65	120	278	4	54.7	320	1.26	1.77	2.68
NOV	32	77	210	329	10	209.7	585	1.22	1.68	2.62

TABLE 5-10

Percent similarity indices of species composition between the AC electrofishing stations near TMINS, April through November 1990. Station prefix TM-EL- deleted from table.

	13A1	10A3	9B5	10B3	11B1
4A1	44.8	55.8	63.2	71.0	62.5
13A1		78.0	67.7	49.0	26.2
10A3			78.2	64.6	36.9
9B5				70.2	38.5
10B3					55.6

TABLE 5-11

Comparison of percent similarity indices of species composition between the electrofishing stations near TMINS, 1976 through 1989 vs. 1990. Station prefix TM-EL- deleted from table.

Station	1976 through 1989		1990
	Range	Mean	
4A1-13A1	37.4-76.4	57.6	44.8
4A1-10A3	44.5-75.7	60.9	55.8
4A1-9B5	52.5-74.9	64.4	63.2
4A1-10B3	43.5-77.7	65.3	71.0
4A1-11B1	41.7-82.8	61.4	62.5
13A1-10A3	68.5-84.3	77.5	78.0
13A1-9B5	36.5-78.6	63.9	67.7
13A1-10B3	46.2-74.1	61.1	49.0
13A1-11B1	27.9-44.9	35.5	26.2
10A3-9B5	44.8-87.2	71.4	78.2
10A3-10B3	52.6-83.3	67.6	64.6
10A3-11B1	35.0-56.0	43.2	36.9
9B5-10B3	43.4-82.8	69.4	70.2
9B5-11B1	32.0-66.0	50.4	38.5
10B3-11B1	48.8-73.9	60.6	55.6

TABLE 5-12

Three-factor analysis of variance test results for electrofishing catch-per-minute data collected near TMINS, April through November 1976 through 1990.

Source	df	Sum of Squares	Mean Square	F Value	P Value
Model(r^2=0.617)	229	52.8272	0.2307	7.19	0.0001*
Year	14	17.3982	1.2427	38.71	0.0001*
Month	7	3.6178	0.5168	16.10	0.0001*
Station	5	3.3692	0.6738	20.99	0.0001*
Year-Month	98	13.7954	0.1408	4.38	0.0001*
Year-Station	70	4.5278	0.0647	2.01	0.0001*
Month-Station	35	7.6754	0.2193	6.83	0.0001*
Error	1020	32.7469	0.0321		
Corrected Total	1249	85.5741			

* Significant at $P \leq 0.01$.

TABLE 5-13

Summary of Tukey's studentized range test for electrofishing catch-per-minute data collected near TMINS, April through November 1976 through 1990. Underlined means are not significantly different ($P \leq 0.05$) and are ranked from highest to lowest transformed (4th root) mean. Means are listed parenthetically.

Year	1988	1989	1987	1990	1978	1979	1981	1977	1983	1976	1984	1982	1980	1985	1986
	(1.40)	(1.37)	(1.29)	(1.28)	(1.18)	(1.15)	(1.14)	(1.12)	(1.10)	(1.10)	(1.05)	(1.05)	(1.04)	(1.02)	(0.90)

Month	Oct	May	Sep	Aug	Apr	Nov	Jul	Jun
	(1.22)	(1.22)	(1.20)	(1.13)	(1.11)	(1.08)	(1.08)	(1.07)

Station*	10A3	11B1	13A1	10B3	4A1	9B5
	(1.20)	(1.19)	(1.18)	(1.12)	(1.10)	(1.06)

* Station prefix TM-EL- deleted from table.

TABLE 5-14

Incidence of parasites, diseases, and/or morphological anomalies on fishes captures by the AC electrofisher near THINS, April through Novemer 1990.

	Black Spot	Lernaea	Leech	Scoliosis	Popeye	Mouth Injury	Eye Injury	Skin Infection*	Emaciation	Total Afflicted	Total Examined	Percent Incidence
Gizzard shad	-	-	-	-	-	-	1	-	-	1	112	0.9
Muskellunge	-	3	-	-	-	-	-	-	-	3	5	60.0
Golden shiner	-	2	-	-	-	-	-	2	-	4	71	5.6
Spottail shiner	1	2	-	-	-	-	-	6	-	9	209	4.3
Spotfin shiner	-	2	-	-	-	-	-	5	-	7	179	3.9
Fallfish	-	-	-	-	-	-	-	1	-	1	17	5.9
White sucker	-	33	-	-	-	-	-	5	-	38	155	24.5
Shorthead redhorse	-	-	-	-	-	-	-	2	-	2	15	13.3
Channel catfish	-	-	8	1	-	1	1	12	1	24	79	30.4
Rock bass	-	6	12	-	-		2	11	1	32	335	9.6
Redbreast sunfish	2	11	131	-	-	2	2	39	3	190	953	19.9
Green sunfish	-	4	28	1	-	-	-	16	-	49	346	14.2
Pumpkinseed	1	35	11	1	1	1	-	58	-	108	1059	10.2
Bluegill	-	22	7	-	-	3	-	15	1	48	390	12.3
Lepomis hybrid	1	-	5	-	-	1	-	4	-	11	39	28.2
Smallmouth bass	-	9	50	-	1	26	7	37	2	132	610	21.6
Largemouth bass	2	2	2	-	-	1	1	16	-	24	83	28.9
White crappie	-	-	-	-	-	-	1	2	-	3	20	15.0
Black crappie	-	-	-	-	-	-	1	1	-	2	30	6.7
Yellow perch	-	1	-	-	-	-	-	-	-	1	1	100.0
Walleye	5	-	-	-	-	-	-	2	-	7	284	2.5
Total	12	132	254	3	2	35	16	234	8	696	4992	13.9
Percent	0.2	2.6	5.1	0.1	+	0.7	0.3	4.7	0.2			

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

\+ Less than 0.05%.

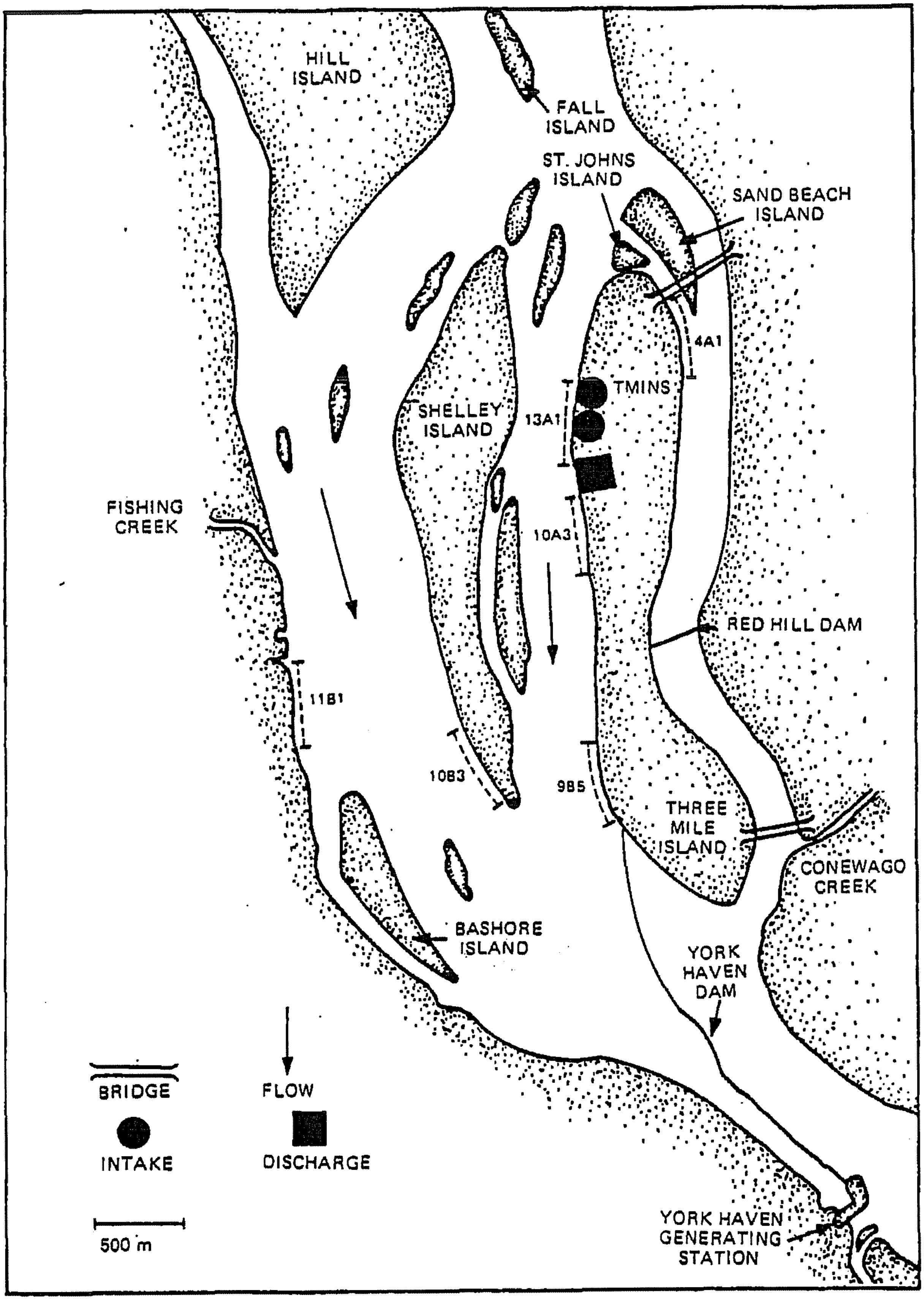

Figure 5-1. Location of electrofishing stations sampled in York Haven Pond (station prefix TM-EL- deleted).

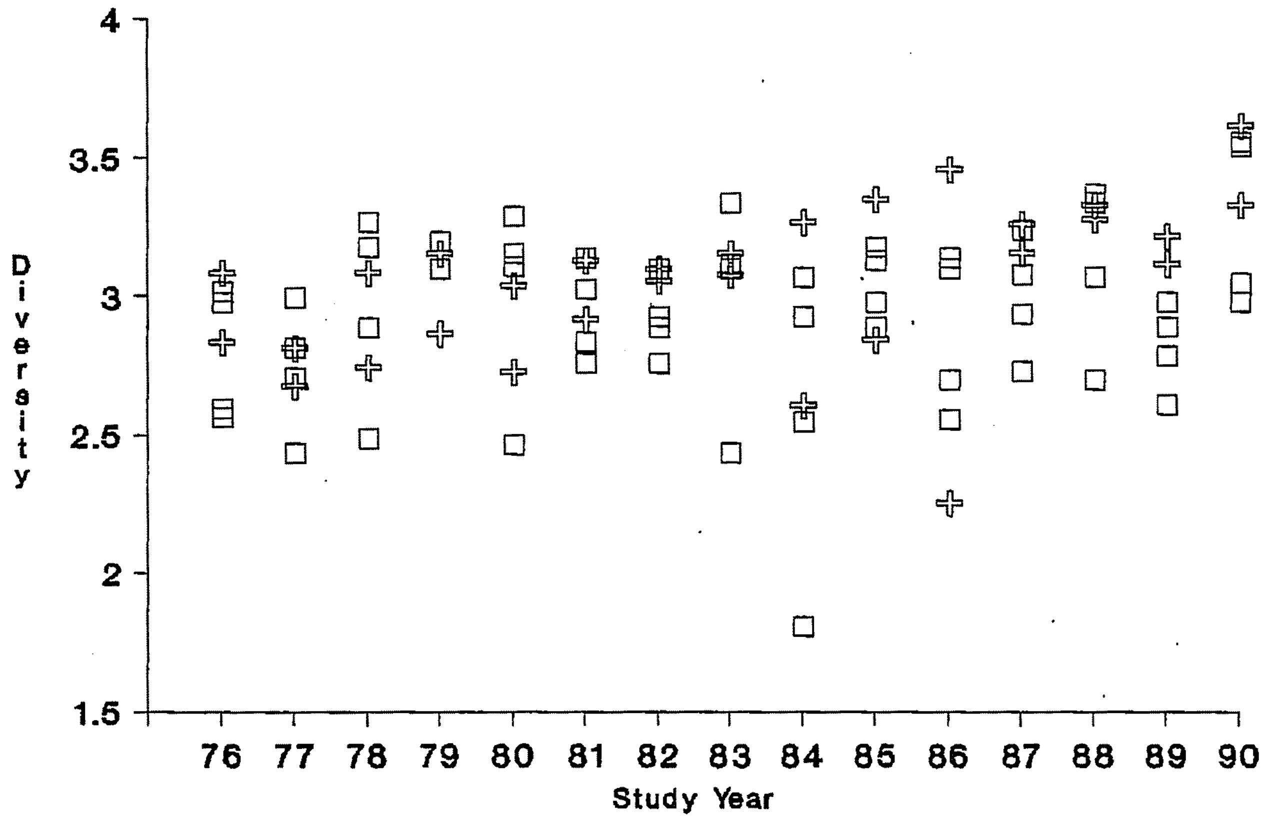

Figure 5-2. Annual range of sampling station diversity values, months combined, for electrofishing catches, TMINS aquatic studies (open boxes are station values, and crosses represent stations 10A3 and 9B5). Identical diversity values may result in less than six symbols.

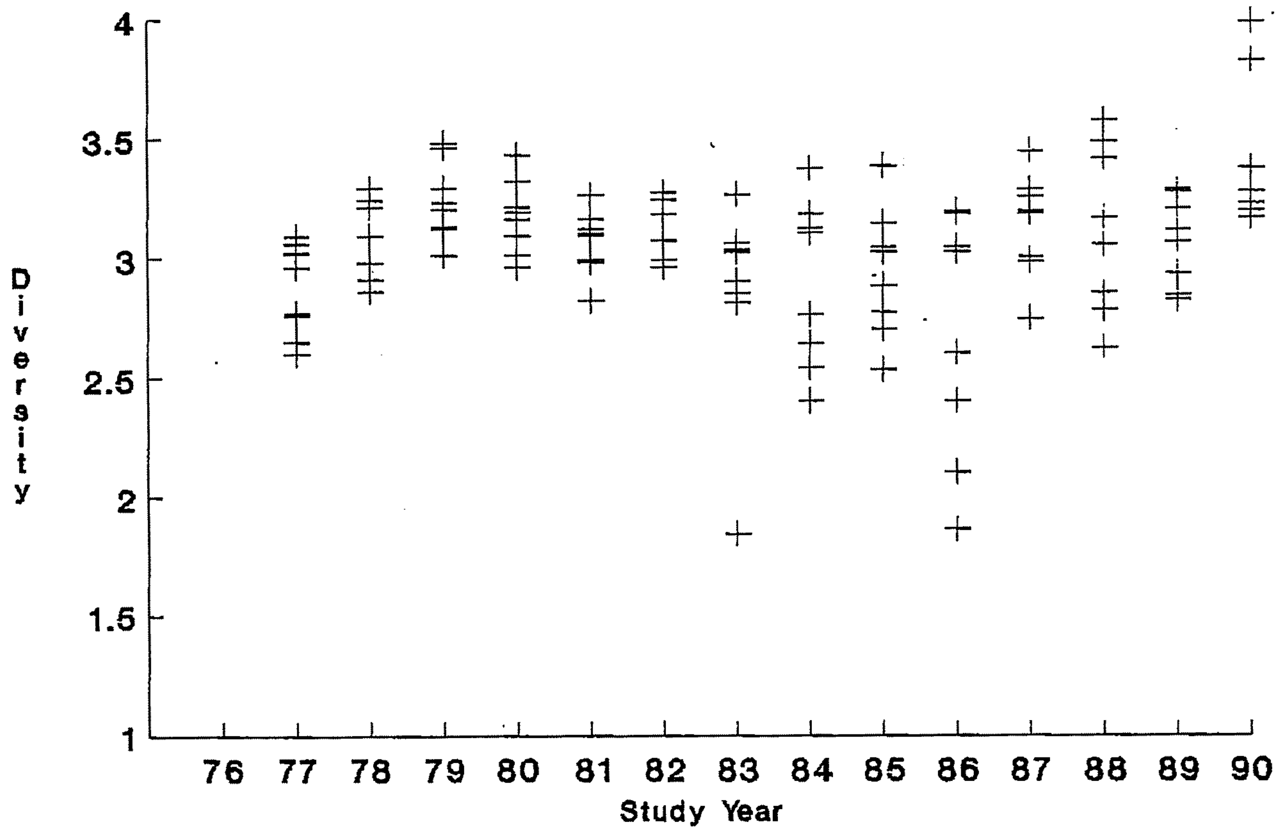

Figure 5-3. Annual range of monthly (April-November) diversity values, stations combined, for electrofishing catches, TMINS aquatic studies. Identical diversity values may result in less than eight symbols.

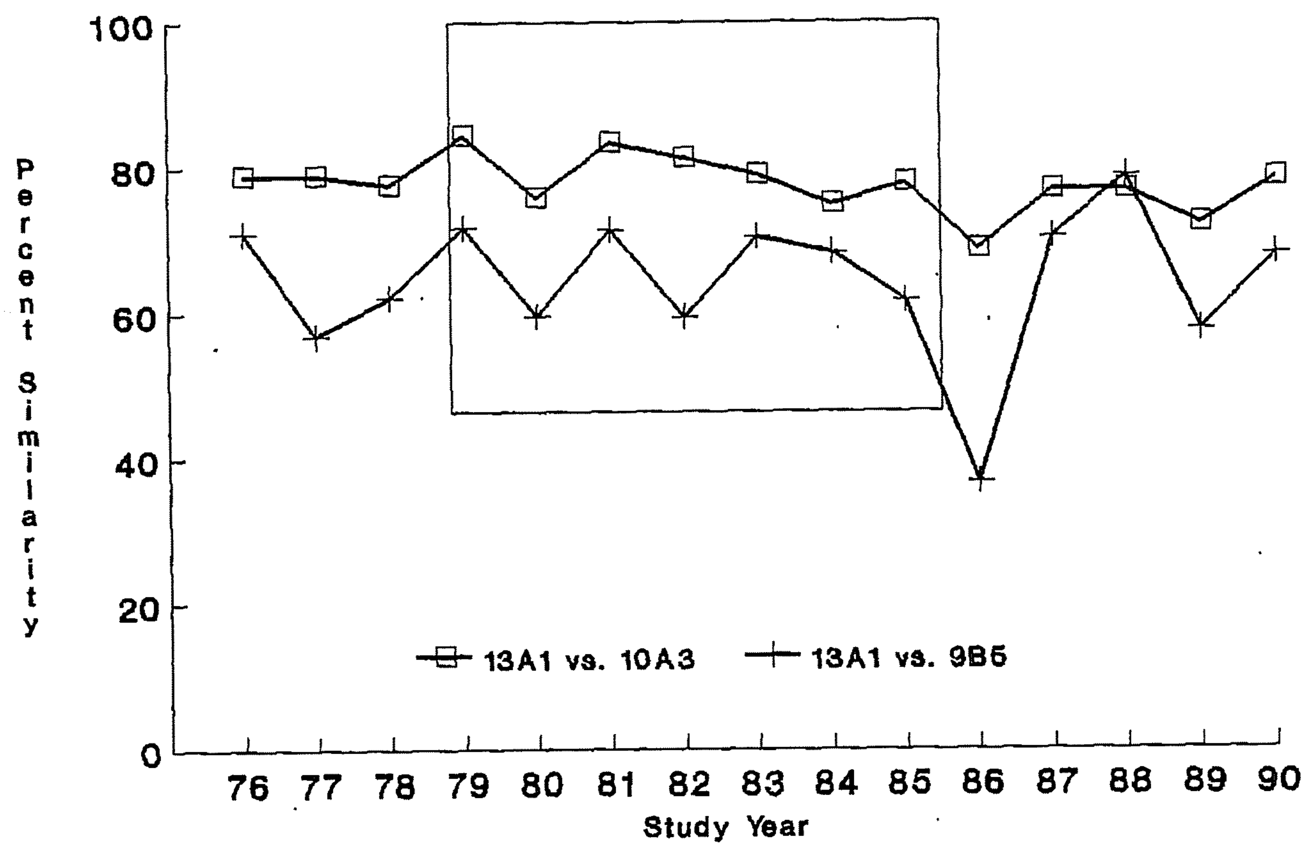

Figure 5-4. Annual variation in percent similarity (PSc) values for selected station comparisons, TMINS aquatic studies. Years of non-operation of TMINS are represented within the large square.

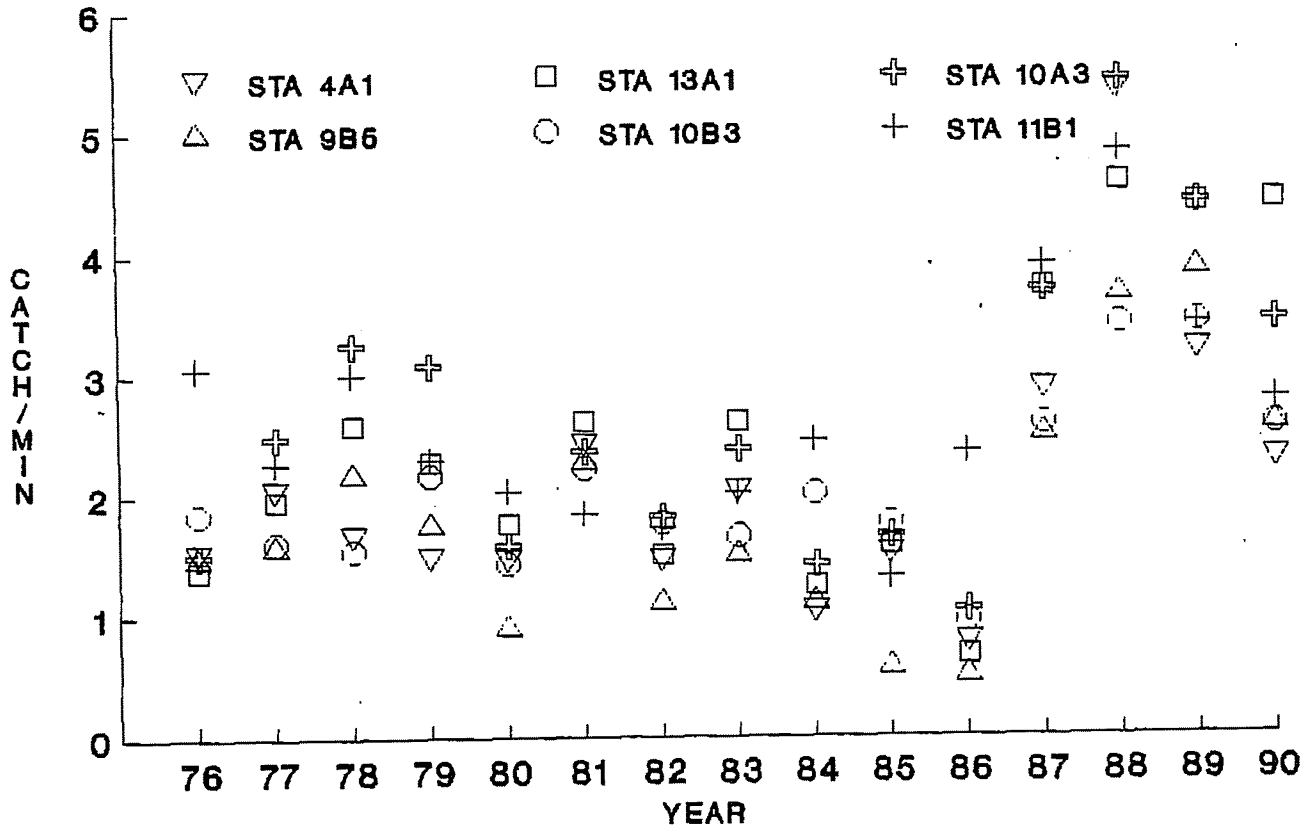

Figure 5-5. Mean annual catch-per-minute data for electrofishing stations near TMINS.

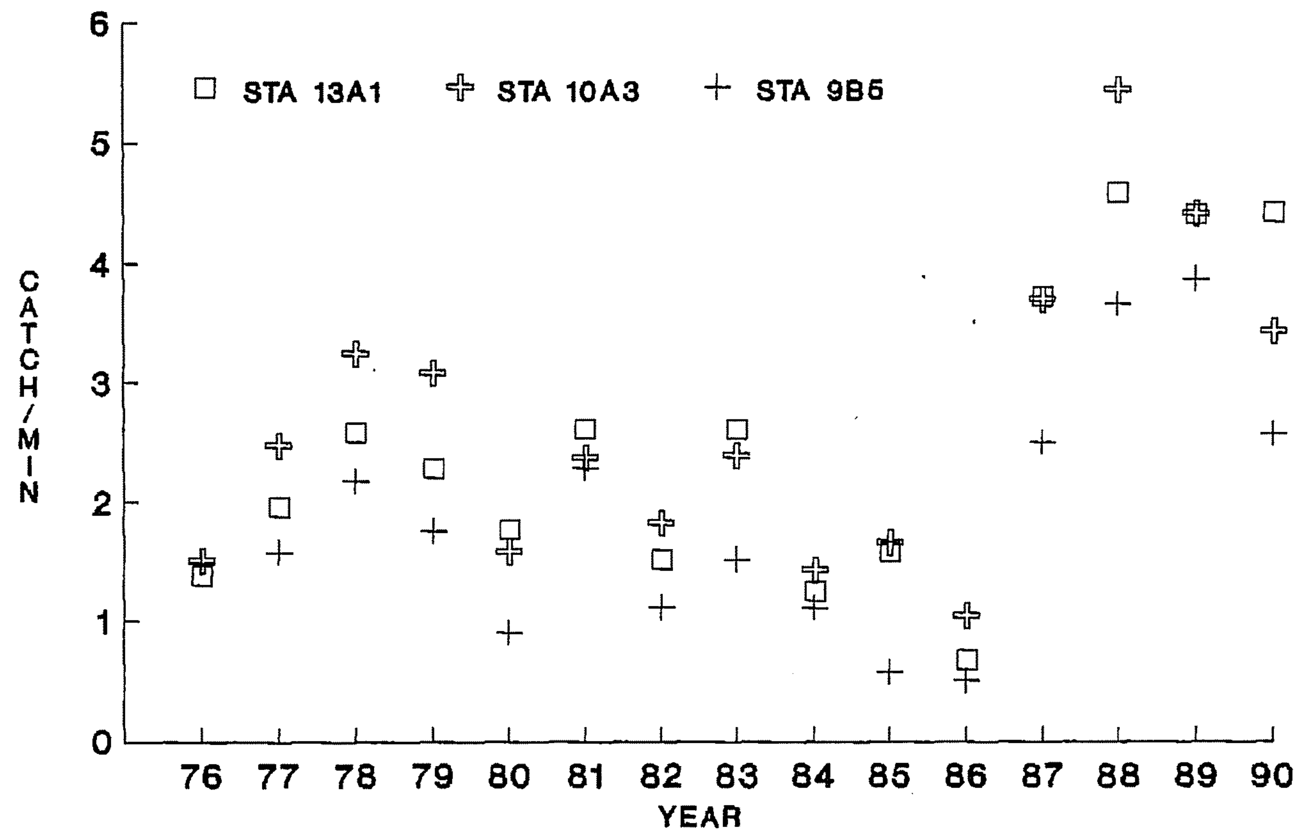

Figure 5-6. Mean annual catch-per-minute data for electrofishing stations nearest the TMINS discharge.

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 along 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 1990. 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, weather, air and surface water temperatures, and time were recorded at each area. River stage; obtained from River Forecast Center in 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 1990, and among years and areas (1975 through 1990). 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 1990 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 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 described 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 ($\bar{x}$) 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):

$$\bar{x} = x/y$$

where

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 1956; 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 1990 creel survey-day are presented in Appendix E. A total of 2,639 anglers was interviewed (Table 6-2). They fished for 6,341.71 hours and caught 6,019 fish of which 1,129 were harvested. The resultant mean annual catch (c/e) and harvest per unit effort (h/e) were 0.95 and 0.18 fish per hour, respectively. The total number of anglers, the number of fish caught and harvested, and hours fished peaked in June and again in August or September before fluctuating the remainder of the year. Monthly c/e and h/e values were highest in September.

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 was related to the relative ease of access for both boat and shore anglers. The higher percentage of fish caught at these areas was a reflection of the large number of anglers. In contrast, angler number and effort values were lower at the East and West dams than at the other areas due to limited access. The only public access to the West Dam, for example, was via boat. Although number of anglers, fish caught, and hours fished were highest in the General Reservoir, and most fish were kept from YHGS; c/e and h/e were highest at the West Dam. During periods of high or low river flow, access and/or fishing at the dams was impeded. However, the dams create a physical barrier to the movements of fish, serving to concentrate fish near their bases at certain times of the year. Assuming this occurred, fish would be more available to anglers near the dams, which may result in higher c/e and h/e ratios.

The two-factor ANOVA tests indicated significant differences in number of anglers, fish caught, fish kept, and hours fished among creel survey areas (Table 6-3). No significant differences were found for fish caught, fish kept, and hours fished among survey months. However, monthly differences for number of anglers were noted. Tukey's studentized range test (not shown) revealed that June anglers ranked highest, and were significantly different from October and November. All other months were similar. Tukey's studentized range test among survey areas indicated similarity between the East and West dam areas for all test variables (Table 6-4). The General Reservoir and

General Reservoir and YHGS areas were not significantly different from each other for fish caught and fish kept, yet were different from each other, as well as from the dams, for number of anglers 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 over 70% of all anglers interviewed and total hours fished, and nearly 60% of the fish caught and 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 in Zone 11, a reflection of high angler use. The highest c/e and h/e was recorded from Zone 2 (West Channel, East Shore) and Zone 5 (South Center Channel, East Shore), respectively. Relatively high c/e and h/e values were also recorded for Zone 11. Additional high h/e values were also noted at Zones 1, 2, 3, and 9. In general, annual c/e and h/e values were variable between zones with access an important determinant.

Over 83% 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, 1990). General Reservoir survey results from 1990 indicated that c/e values were highest for boat anglers on an annual basis and during five of the eight survey months. The high annual c/e value for boat anglers resulted from a relatively high c/e from July through September and November.

Additionally, the h/e values were higher for boat anglers than for shore anglers in four of the survey months (Table 6-7). Over 80% of the fish harvested by both boat and shore anglers occurred between June and September. Shore anglers harvested 15.9% of their catch while boat anglers harvested 10.6% of their catch. This suggests that although boat anglers enjoyed greater success, due in part to their mobility, neither group fished primarily for food.

Anglers interviewed near TMINS caught 6,019 fish of at least 25 species in 1990 (Table 6-8). Four fishes formed the bulk of the catch (83.8%) and harvest (71.6%). Smallmouth bass (58.8%) dominated the angler catch and harvest, and ranked first in the catch in all survey months; it ranked first in angler harvest in four months. Over 32% of the smallmouth bass caught were of legal size, and 25.4% of those were kept. Most smallmouth bass were caught and harvested from the General Reservoir (Table 6-9). Channel catfish ranked second in abundance and were commonly caught and harvested from the YHGS. Channel catfish were most abundant from June through September, when over 83% were caught and harvested. Walleye ranked third in abundance and were most frequently caught and harvested from the East Dam and YHGS areas. Walleye were common in angler creels during the spring (April through June) and fall (September). Rock bass ranked fourth, and were principally caught and harvested at the YHGS. Most rock bass were taken in the spring (April through June). Other species of local importance were the largemouth bass, white crappie, and black crappie, which were taken infrequently, comprising less than 2.0% of the annual catch.

General Reservoir anglers primarily caught and harvested smallmouth bass (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 nearly 70% of the fishes caught and 53.2% of those harvested were rock bass, smallmouth bass, and walleye. The YHGS yielded primarily channel catfish, rock bass, smallmouth bass, and walleye (72.4% of the total catch and 62.9% of the harvest).

The relative similarity of catch composition among survey areas was examined by PSc (Table 6-10). Comparisons of PSc among survey areas for fishes caught were all above 48%, 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.

To estimate annual fishing pressure various authors (DiCostanzo 1956; Groen and Schmulbach 1978) have assumed that anglers were interviewed at the midpoint of their fishing trip. This method was further validated by Frisbie and Ritchie (1963), Nardacci et al. (1976), and Plosila (1961) who reported that the average time fished per angler, when doubled, corresponded with complete fishing trip data. In 1990, an estimate of the fishing pressure near TMINS was 16,647 anglers who fished for 39,953 hours (average 2.40 hours), caught 37,955 fish, and harvested 7,158 fish.

Doubling the average time fished provided an estimate of 4.80 hours. In contrast, a total of 5.0% of all anglers interviewed in 1990 had completed their fishing trip, which averaged 3.09 hours. Thus, these results imply that the first estimate (without doubling trip length) provided a better indicator of fishing pressure and angler impact in the TMINS area for 1990.

6.3 CHARACTERIZATION OF ANGLER COMMUNITY

All but 20 anglers interviewed in 1990 were residents of Pennsylvania. Over 67% of the anglers resided in York or Dauphin counties (Figure 6-2), which encompass the TMINS survey area. Most General Reservoir, YHGS, and West Dam anglers were York County residents. However, most anglers from the East Dam were residents of Dauphin County. The remaining anglers were residents of 24 other Pennsylvania counties (primarily Cumberland, Lancaster, Adams, Lebanon, and Franklin), as well as seven other states. Over 83% of all anglers were between the ages of 18 and 65 (20.2% and 63.0% were 18 to 29 and 30 to 65, respectively).

A total of 2,639 anglers was questioned as to how they use the fish that they catch (Table 6-11). Nearly 60% indicated that they ate at least a portion of their catch, 38.3% released all they caught, and 1.0% 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 indicates that the accident at TMINS is no longer a factor in what these anglers do with their catch.

6.4 MULTIPLE-YEAR COMPARISON

The 1990 creel survey data indicated that the number of anglers and total hours fished were among the highest recorded in 16 years (Table 6-12). Although the annual numbers of fish caught and kept along with corresponding c/e and h/e values were substantially reduced from those reported in 1989, all were within their historic ranges. 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 or success. Weather conditions that might discourage anglers from fishing were encountered during 12.2% of the survey periods in 1990. In addition, fishing below both dams may cease during periods of extremely low river flow. However, average river flow in 1990 was among the highest reported since 1980 (Chapter 7). Although weather conditions on most survey dates may have been favorable for fishing, heavy spring rains as well as spates from thunderstorms in the summer and fall produced unfavorable river conditions frequently in 1990. The subsequent high river flow and turbid water conditions presented anglers with poor fishing conditions during much of the year. This resulted in the poor fishing success.

Comparison of 1990 individual survey area totals with those of previous years (EA 1985, 1986, 1987; Nardacci and Associates 1984; RMC 1988a, 1989, 1990) indicated a record number of hours fished at the East Dam and the lowest h/e ever recorded from the General Reservoir. Other values from all areas were within the ranges of those reported previously (1975 through 1989). Generally, the 1990 values for anglers and hours fished increased in all areas over those reported in 1989. However, the numbers of fish caught and kept decreased in all areas, resulting in reduced catch and harvest rates.

Two-factor ANOVA tests indicated significant differences among areas, years, and their interactions (except for fish kept) 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 among survey areas 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 differentiated from each other for all variables. A range test for the 16 survey years showed that the mean values for all test variables were ranked highest in 1988 and lowest in 1977. The mean values for 1990 were significantly different from 1977 for anglers and hours fished. Values for fish caught and kept in 1990 were undifferentiated from other survey years.

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 comprised at least 21% of the catch from 1975 through 1978. Since 1979, channel catfish have declined in importance; the percentage of total catch has been generally stable, fluctuating between 5.5 and 14.8%. Nearly half of all channel catfish caught have been harvested each year. The percent contributed by rock bass to the catch and harvest has remained relatively stable throughout the 16 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 catch every year. The proportion of smallmouth bass harvested, however, remained relatively low, despite the large catches. In fact, the harvest of smallmouth bass in 1990 was the second lowest to date despite the high catch. Walleye, another popular game species, has been caught frequently by anglers; however, only 25.0% 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 since fluctuated. The percent harvest of walleye has increased steadily since 1987.

Specific reasons for these fluctuations in species catch and harvest trends were not apparent. Changes in angler objectives, size structure of fish populations, or production of strong (or weak) 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 subsequent years. In 1990, over 67% of all smallmouth bass caught were sublegal.

Catch rates 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 and 1990, when the lowest harvest rates 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 were caught; 2) anglers were fishing primarily for recreation rather than as a source of food; and/or 3) some anglers were species-specific or selective as to the size of fish chosen for harvest. The large number of anglers throughout the 16 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 as no anglers reported changing their catch usage in either 1989 or 1990. In addition most anglers reported that they eat at least a portion of their catch although the percentage has decreased since 1985.

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, 1990.

Scientific Name	Common Name
Clupeidae	Herrings
Dorosoma cepedianum (Lesueur)	Gizzard 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
Catostomus commersoni (Lacepede)	White sucker
Ictaluridae	Bullhead catfishes
Ictalurus natalis (Rafinesque)	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)	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, 1990.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent Total
Angler										
GR*	185	153	271	203	236	202	76	77	1403	53.2
West Dam	10	7	37	23	5	9	2	9	102	3.9
East Dam	56	54	54	46	34	8	19	31	302	11.4
YHGS+	104	174	161	98	122	90	34	49	832	31.5
Total	355	388	523	370	397	309	131	166	2639	
Fish Caught										
GR	144	87	327	542	751	833	162	308	3154	52.4
West Dam	16	18	196	111	35	81	3	22	482	8.0
East Dam	217	228	205	137	23	16	19	43	888	14.8
YHGS	194	292	338	161	109	184	100	117	1495	24.8
Total	571	625	1066	951	918	1114	284	490	6019	
Fish Kept										
GR	9	6	35	44	69	134	15	36	348	30.8
West Dam	0	0	27	20	5	38	1	2	93	8.2
East Dam	22	68	22	14	12	0	13	3	154	13.6
YHGS	49	131	154	37	33	62	25	43	534	47.3
Total	80	205	238	115	119	234	54	84	1129	
Hours Fished										
GR	527.34	359.92	640.92	464.10	762.93	534.60	287.50	181.51	3758.82	59.3
West Dam	6.68	10.00	64.99	48.59	17.00	23.50	2.00	10.00	182.76	2.9
East Dam	113.50	133.26	114.99	85.92	67.93	9.24	46.25	48.25	619.34	9.8
YHGS	232.17	315.78	423.99	228.83	208.51	187.50	68.76	115.25	1780.79	28.1
Total	879.69	818.96	1244.89	827.44	1056.37	754.84	404.51	355.01	6341.71	
Catch/Effort										
GR	0.27	0.24	0.51	1.17	0.98	1.56	0.56	1.70	0.84	
West Dam	2.40	1.80	3.02	2.28	2.06	3.45	1.50	2.20	2.64	
East Dam	1.91	1.71	1.78	1.59	0.34	1.73	0.41	0.89	1.43	
YHGS	0.84	0.92	0.80	0.70	0.52	0.98	1.45	1.02	0.84	
Total	0.65	0.76	0.86	1.15	0.87	1.48	0.70	1.38	0.95	
Harvest/Effort										
GR	0.02	0.02	0.05	0.09	0.09	0.25	0.05	0.20	0.09	
West Dam	0.00	0.00	0.42	0.41	0.29	1.62	0.50	0.20	0.51	
East Dam	0.19	0.51	0.19	0.16	0.18	0.00	0.28	0.06	0.25	
YHGS	0.21	0.41	0.36	0.16	0.16	0.33	0.36	0.37	0.30	
Total	0.09	0.25	0.19	0.14	0.11	0.31	0.13	0.24	0.18	

* Denotes General Reservoir.

\+ Denotes York Haven Generating Station.

TABLE 6-3

Two-factor analysis of variance test results for anglers, fish caught, fish kept, and hours fished near TMINS, April though November 1990.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Anglers	Model (r^2 = 0.859)	10	156211.312	15621.131	12.78	0.0001**
	Area	3	127645.094	42548.364	34.82	0.0001**
	Month	7	28566.219	4080.888	3.34	0.0150*
	Error	21	25664.656	1222.126		
	Corrected Total	31	181875.969			
Fish Caught	Model (r^2 = 0.550)	10	676653.312	67665.331	2.56	0.0332*
	Area	3	518314.844	172771.614	6.55	0.0027**
	Month	7	158338.469	22619.781	0.86	0.5547
	Error	21	554155.406	26388.353		
	Corrected Total	31	1230808.719			
Fish Kept	Model (r^2 = 0.505)	10	24458.812	2445.881	2.14	0.0681
	Area	3	14995.594	4998.531	4.38	0.0153*
	Month	7	9463.219	1351.888	1.18	0.3539
	Error	21	23991.656	1142.460		
	Corrected Total	31	48450.469			
Hours Fished	Model (r^2 = 0.850)	10	1114615.022	111461.502	11.92	0.0001**
	Area	3	957825.330	319275.110	34.15	0.0001**
	Month	7	156789.693	22398.528	2.40	0.0537
	Error	21	196334.161	9349.246		
	Corrected Total	31	1310949.183			

* 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, 1990. 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* (175)	YHGS* (104)	East Dam (38)	West Dam (13)
Fish Caught	GR (394)	YHGS (187)	East Dam (111)	West Dam (60)
Fish Kept	YHGS (67)	GR (44)	East Dam (19)	West Dam (12)
Hours Fished	GR (470)	YHGS (223)	East Dam (77)	West Dam (23)

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

TABLE 6-5

Comparison of weekday and weekend day creel surveys from each area near TMINS, 1990.

	General Reservoir	West Dam	East Dam	York Haven Generating Station	Total
Anglers					
Weekday	393	38	111	248	790
Weekend Day	1010	64	191	584	1849
Fish Caught					
Weekday	1065	191	490	631	2377
Weekend Day	2089	291	398	864	3642
Fish Kept					
Weekday	181	47	47	223	498
Weekend Day	167	46	107	311	631
Hours Fished					
Weekday	897.41	69.50	206.84	497.79	1671.54
Weekend Day	2861.41	113.26	412.50	1283.00	4670.17
Catch/Effort(h)					
Weekday	1.19	2.75	2.37	1.27	1.42
Weekend Day	0.73	2.57	0.96	0.67	0.78
Harvest/Effort(h)					
Weekday	0.20	0.68	0.23	0.45	0.30
Weekend	0.06	0.41	0.26	0.24	0.14

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, 1990.

Zone*	Anglers	Fish Caught	Fish Kept	Hours Fished	Catch/ Effort(h)	Harvest/ Effort(h)
1 West Channel, West Shore	298	601	83	785.19	0.76	0.10
2 West Channel, East Shore	48	158	15	113.60	1.39	0.13
3 West/Center Channel Confluence	134	408	51	420.00	0.97	0.12
4 South Center Channel, West Shore	32	65	3	107.50	0.60	0.03
5 South Center Channel, East Shore	42	110	16	110.92	0.99	0.14
6 North Center Channel, West Shore	49	78	1	153.01	0.51	0.01
7 North Center Channel, East Shore	53	57	2	114.66	0.50	0.02
8 East Channel, West Shore	26	46	6	77.33	0.59	0.08
9 East Channel, East Shore	75	81	17	153.00	0.53	0.11
10 East of Fall Island, Northeastern Shore	125	265	18	364.93	0.73	0.05
11 West of Fall Island, East of Hill Island	332	1030	117	937.02	1.10	0.12
12 West of Hill Island, Northwest Shore	189	255	19	421.66	0.60	0.04

* 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, 1990.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent Total
Anglers										
Boat	147	109	236	166	206	169	70	63	1166	83.1
Shore	38	44	35	37	30	33	6	14	237	16.9
Fish Caught										
Boat	141	61	288	487	714	770	153	294	2908	92.2
Shore	3	26	39	55	37	63	9	14	246	7.8
Fish Kept										
Boat	8	4	28	40	65	116	15	33	309	88.8
Shore	1	2	7	4	4	18	0	3	39	11.2
Hours Fished										
Boat	486.93	278.01	586.18	395.84	701.34	462.01	276.75	166.00	3353.06	89.2
Shore	40.41	81.91	54.74	68.26	61.59	72.59	10.75	15.51	405.76	10.8
Catch/Effort(h)										
Boat	0.29	0.22	0.49	1.23	1.02	1.67	0.55	1.77	0.87	
Shore	0.07	0.32	0.71	0.80	0.60	0.87	0.84	0.90	0.61	
Harvest/Effort(h)										
Boat	0.02	0.01	0.05	0.10	0.09	0.25	0.05	0.20	0.09	
Shore	0.02	0.02	0.13	0.06	0.06	0.25	0.00	0.19	0.10	

TABLE 6-8

Monthly summary of fishes caught and kept by anglers in the Susquehanna River near TMINS, 1990.

	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
Gizzard shad	-	-	-	-	30	-	-	-	-	-	-	-	1	1	-	-	31	1	0.5	0.1
Rainbow trout	-	-	1	1	1	1	-	-	-	-	-	-	1	1	-	-	3	3	+	0.3
Brown trout	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	+	-
Brook trout	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	3	3	+	0.3
Muskellunge	2	-	1	-	1	-	-	-	-	-	-	-	1	-	-	-	5	-	0.1	-
Common carp	28	2	18	-	135	61	16	3	13	6	4	-	3	-	-	-	217	72	3.6	6.4
Fallfish	1	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	3	-	+	-
Quillback	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	0.1	-
White sucker	2	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3	2	+	0.2
Yellow bullhead	-	-	1	1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	+	0.2
Channel catfish	5	1	53	37	169	74	109	45	104	27	148	51	14	1	4	1	606	237	10.1	21.0
Catfishes (Ictalurus spp.)*	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	+	0.1
Rock bass	70	36	173	95	73	33	51	5	26	8	29	10	15	4	11	3	448	194	7.4	17.2
Redbreast sunfish	2	2	7	7	15	15	1	1	10	8	10	9	-	-	2	2	47	44	0.8	3.9
Green sunfish	-	-	1	1	1	1	-	-	-	-	1	1	-	-	-	-	3	3	+	0.3
Pumpkinseed	7	7	7	7	5	1	5	1	1	-	1	1	-	-	1	-	27	17	0.4	1.5
Bluegill	26	17	18	12	21	5	9	3	32	2	27	17	10	8	5	-	148	64	2.4	5.7
Sunfishes (Lepomis spp.)*	12	2	43	21	63	13	113	16	50	1	56	6	14	2	7	-	358	61	5.9	5.4
Smallmouth bass	319	8	190	1	442	18	620	32	661	57	707	106	188	17	412	61	3539	300	58.8	26.6
Largemouth bass	4	-	5	-	4	-	4	3	3	1	-	-	2	-	9	3	31	7	0.5	0.6
White crappie	-	-	6	6	9	3	1	1	-	-	1	1	3	3	5	5	25	19	0.4	1.7
Black crappie	2	2	-	-	-	-	-	-	1	1	4	4	3	3	-	-	10	10	0.2	0.9
Crappies (Pomoxis spp.)*	14	-	2	-	8	1	-	-	8	6	7	-	2	2	-	-	41	9	0.7	0.8
Yellow perch	1	1	2	-	1	-	-	-	3	1	-	-	-	-	1	1	8	3	0.1	0.3
Walleye	72	-	94	16	83	8	22	5	5	-	118	28	27	12	31	8	452	77	7.5	6.8
Total	571	80	625	205	1066	238	951	115	918	119	1114	234	284	54	490	84	6019	1129		

* 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 1990.

	General Reservoir				West Dam				East Dam				YHGS*				Total	
	Caught		Kept		Caught		Kept		Caught		Kept		Caught		Kept		Caught	Kept
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Gizzard shad	-	-	-	-	-	-	-	-	31	3.5	1	0.6	-	-	-	-	31	1
Rainbow trout	1	+	1	0.3	-	-	-	-	2	0.2	2	1.3	-	-	-	-	3	3
Brown trout	-	-	-	-	-	-	-	-	1	0.1	-	-	-	-	-	-	1	-
Brook trout	-	-	-	-	-	-	-	-	3	0.3	3	1.9	-	-	-	-	3	3
Muskellunge	2	0.1	-	-	-	-	-	-	3	0.3	-	-	-	-	-	-	5	-
Common carp	4	0.1	-	-	20	4.1	-	-	21	2.4	1	0.6	172	11.5	71	13.3	217	72
Fallfish	1	+	-	-	-	-	-	-	2	0.2	-	-	-	-	-	-	3	-
Quillback	-	-	-	-	3	0.6	-	-	-	-	-	-	3	0.2	-	-	6	-
White sucker	-	-	-	-	-	-	-	-	-	-	-	-	3	0.2	2	0.4	3	2
Yellow bullhead	-	-	-	-	1	0.2	-	-	1	0.1	1	0.6	1	0.1	1	0.2	3	2
Channel catfish	184	5.8	39	11.2	156	32.4	68	73.1	37	4.2	11	7.1	229	15.3	119	22.3	606	237
Catfishes (<u>Ictalurus</u> spp.)**	1	+	1	0.3	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Rock bass	113	3.6	22	6.3	19	3.9	4	4.3	106	11.9	46	29.9	210	14.0	122	22.8	448	194
Redbreast sunfish	3	0.1	1	0.3	-	-	-	-	1	0.1	1	0.6	43	2.9	42	7.9	47	44
Green sunfish	-	-	-	-	-	-	-	-	2	0.2	2	1.3	1	0.1	1	0.2	3	3
Pumpkinseed	3	0.1	-	-	1	0.2	-	-	16	1.8	15	9.7	7	0.5	2	0.4	27	17
Bluegill	68	2.2	17	4.9	-	-	-	-	32	3.6	13	8.4	48	3.2	34	6.4	148	64
Sunfishes (<u>Lepomis</u> spp.)**	169	5.4	16	4.6	12	2.5	5	5.4	86	9.7	11	7.1	91	6.1	29	5.4	358	61
Smallmouth bass	2547	80.8	228	65.5	213	44.2	4	4.3	344	38.7	12	7.8	435	29.1	56	10.5	3539	300
Largemouth bass	12	0.4	2	0.6	1	0.2	-	-	11	1.2	3	1.9	7	0.5	2	0.4	31	7
White crappie	8	0.2	8	2.3	-	-	-	-	9	1.0	5	3.2	8	0.5	6	1.1	25	19
Black crappie	2	0.1	2	0.6	-	-	-	-	3	0.3	3	1.9	5	0.3	5	0.9	10	10
Crappies (<u>Pomoxis</u> spp.)**	16	0.5	8	2.3	-	-	-	-	5	0.6	-	-	20	1.3	1	0.2	41	9
Yellow perch	4	0.1	1	0.3	-	-	-	-	1	0.1	-	-	3	0.2	2	0.4	8	3
Walleye	16	0.5	2	0.6	56	11.6	12	12.9	171	19.2	24	15.6	209	14.0	39	7.3	452	77
Total	3154		348		482		93		888		154		1495		534		6019	1129

* YHGS, York Haven Generating Station.

** 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, 1990.

Caught				Harvested		
West Dam	East Dam	YHGS*		YHGS	East Dam	West Dam
57.0	56.3	48.2	General Reservoir	40.9	35.3	25.0
	63.8	67.3	West Dam	43.6	34.0	
		73.6	East Dam	61.4		

* York Haven Generating Station.

TABLE 6-11

Use of catch by anglers interviewed near TMINS in 1990.

Use of Catch	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Eat	82	102	165	104	127	124	35	46	785
Release	168	120	189	160	169	77	58	71	1012
Give Away	3	-	7	2	15	-	-	-	27
Eat-Release	100	145	145	89	65	98	36	42	720
Eat-Give Away	-	6	1	10	17	-	2	4	40
Release-Give Away	2	11	3	4	1	1	-	-	22
Eat-Release-Give Away	-	4	13	1	3	9	-	3	33
Total	355	388	523	370	397	309	131	166	2639

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 1990.

	Anglers	Fish Caught	Fish Kept	Hours 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
1990	2639	6019	1129	6341.71	0.95	0.18

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 1990.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Anglers	Model (r^2 = 0.593)	63	1382568.305	21945.529	10.37	0.0001**
	Area	3	1071475.508	357158.503	168.78	0.0001**
	Year	15	114297.742	7619.849	3.60	0.0001**
	Interaction	45	196795.055	4373.223	2.07	0.0001**
	Error	448	948038.750	2116.158		
	Corrected Total	511	2330607.055			
Fish Caught	Model (r^2 = 0.400)	63	8125500.625	128976.200	4.74	0.0001**
	Area	3	3290723.484	1096907.828	40.27	0.0001**
	Year	15	2584689.312	172312.621	6.33	0.0001**
	Interaction	45	2250087.828	50001.952	1.84	0.0012**
	Error	448	12202587.250	27237.918		
	Corrected Total	511	20328087.875			
Fish Kept	Model (r^2 = 0.351)	63	473713.805	7519.267	3.85	0.0001**
	Area	3	363629.164	121209.721	62.03	0.0001**
	Year	15	59797.867	3986.524	2.04	0.0118*
	Interaction	45	50286.773	1117.484	0.57	0.9887
	Error	448	875479.250	1954.195		
	Corrected Total	511	1349193.055			
Hours Fished	Model (r^2 = 0.604)	63	6818269.625	108226.502	10.87	0.0001**
	Area	3	4815518.908	1605172.969	161.15	0.0001**
	Year	15	708798.244	47253.216	4.74	0.0001**
	Interaction	45	1293952.473	28754.499	2.89	0.0001**
	Error	448	4462525.092	9960.994		
	Corrected Total	511	11280794.717			

* 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 1990. Areas and years underlined are not significantly different (P≤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				Year															
Anglers	GR*	YHGS*	East Dam	West Dam	1988	1982	1981	1990	1989	1987	1980	1978	1979	1983	1986	1984	1985	1976	1975	1977
	(122)	(105)	(30)	(17)	(93)	(86)	(84)	(82)	(79)	(77)	(75)	(69)	(69)	(67)	(65)	(57)	(55)	(55)	(49)	(35)
Fish Caught	GR	YHGS	East Dam	West Dam	1988	1989	1987	1981	1982	1990	1980	1986	1983	1979	1978	1984	1985	1976	1975	1977
	(291)	(196)	(109)	(89)	(324)	(300)	(239)	(211)	(203)	(188)	(175)	(162)	(159)	(152)	(140)	(138)	(115)	(99)	(74)	(58)
Fish Kept	YHGS	GR	East Dam	West Dam	1988	1989	1987	1982	1986	1981	1978	1985	1980	1983	1975	1979	1984	1990	1976	1977
	(79)	(64)	(27)	(13)	(63)	(63)	(58)	(56)	(54)	(53)	(47)	(45)	(44)	(44)	(39)	(38)	(38)	(35)	(32)	(26)
Hours Fished	GR	YHGS	East Dam	West Dam	1988	1990	1989	1987	1982	1981	1978	1986	1980	1983	1979	1985	1984	1976	1975	1977
	(262)	(196)	(51)	(31)	(210)	(198)	(180)	(153)	(149)	(145)	(139)	(137)	(129)	(125)	(124)	(108)	(103)	(96)	(92)	(68)

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

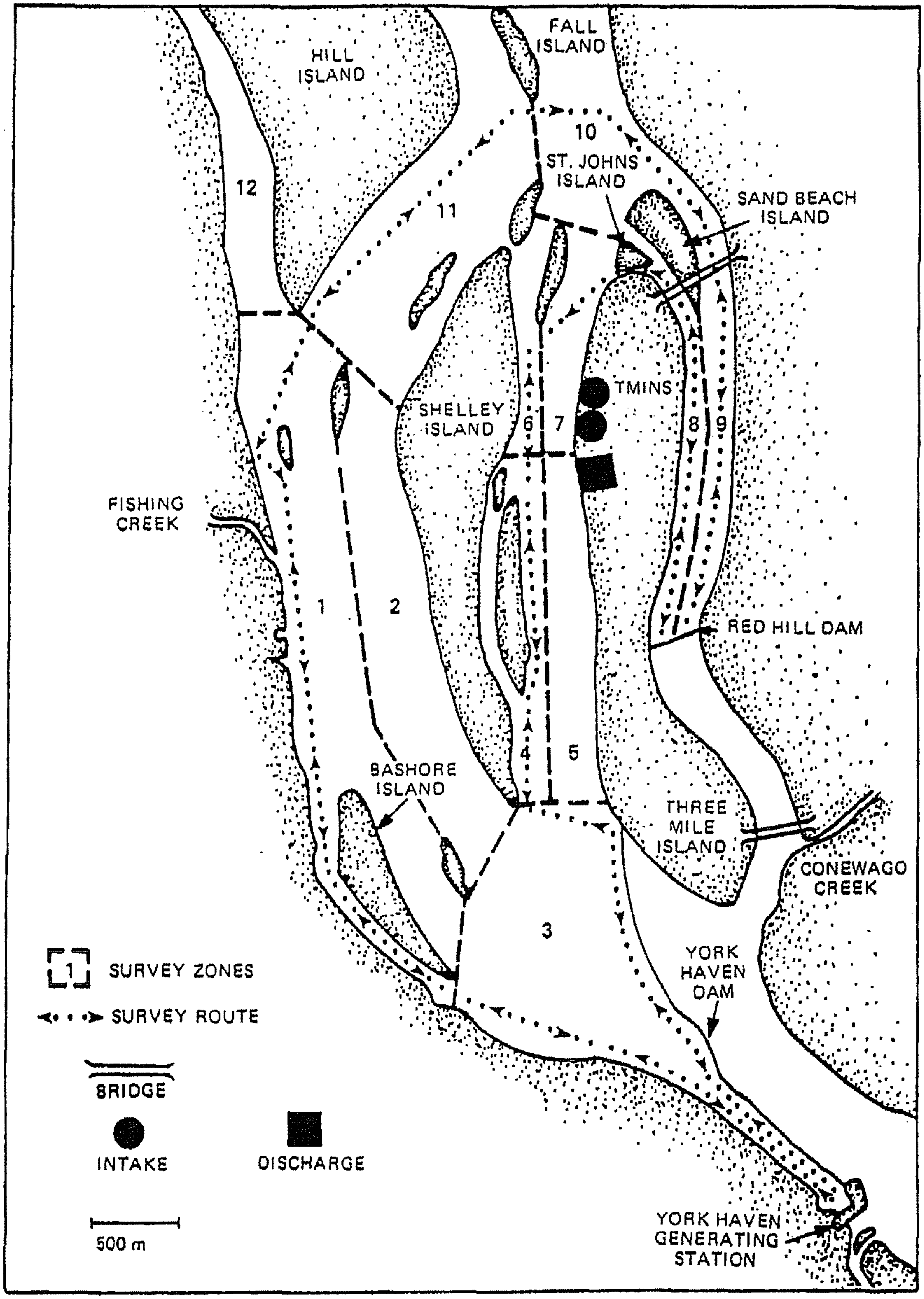

Figure 6-1. TMINS creel survey area showing survey route and General Reservoir zones.

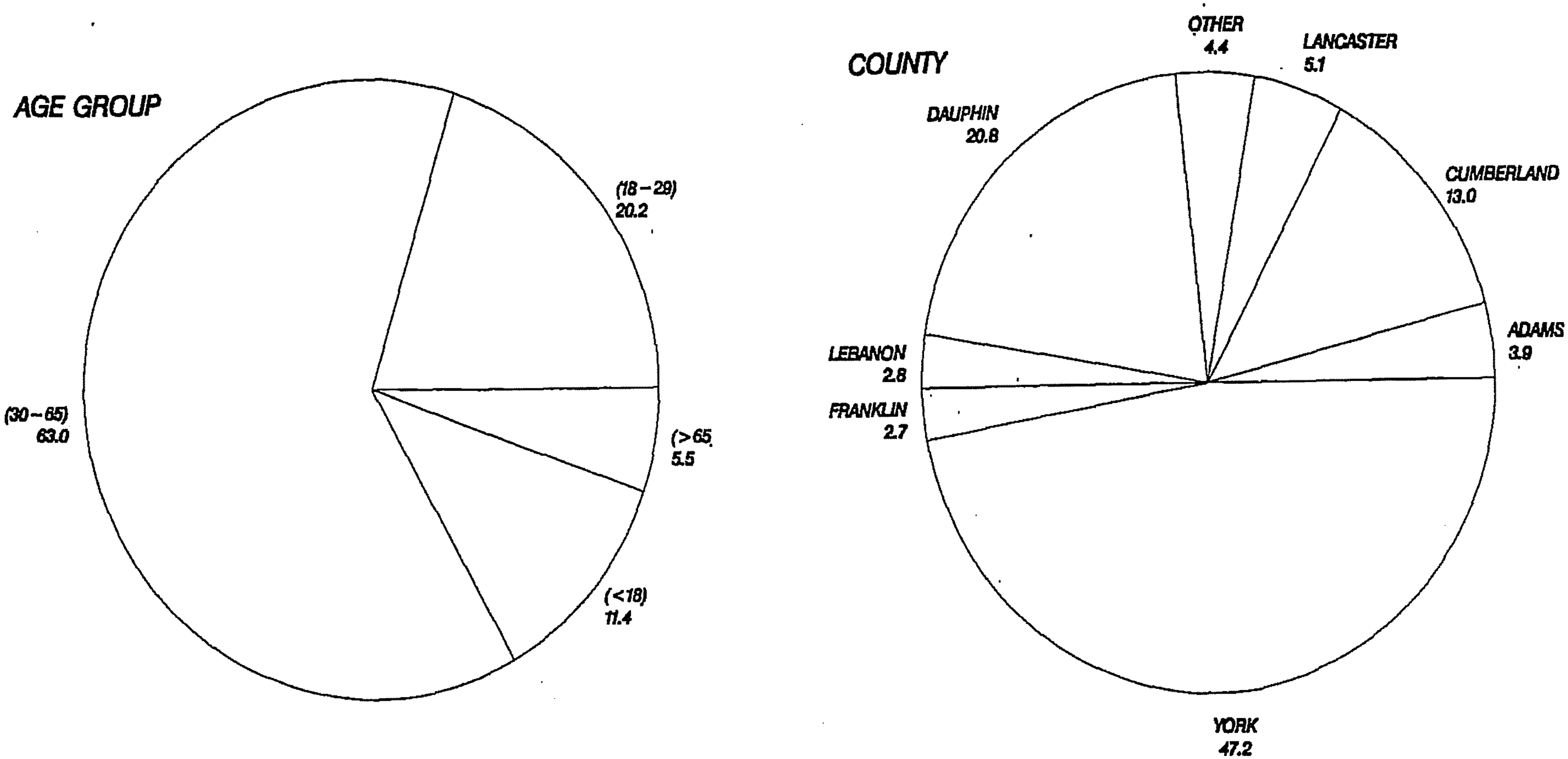

FIGURE 6-2

Percent of anglers by age and county interviewed on the Susquehanna River near TMINS in 1990.

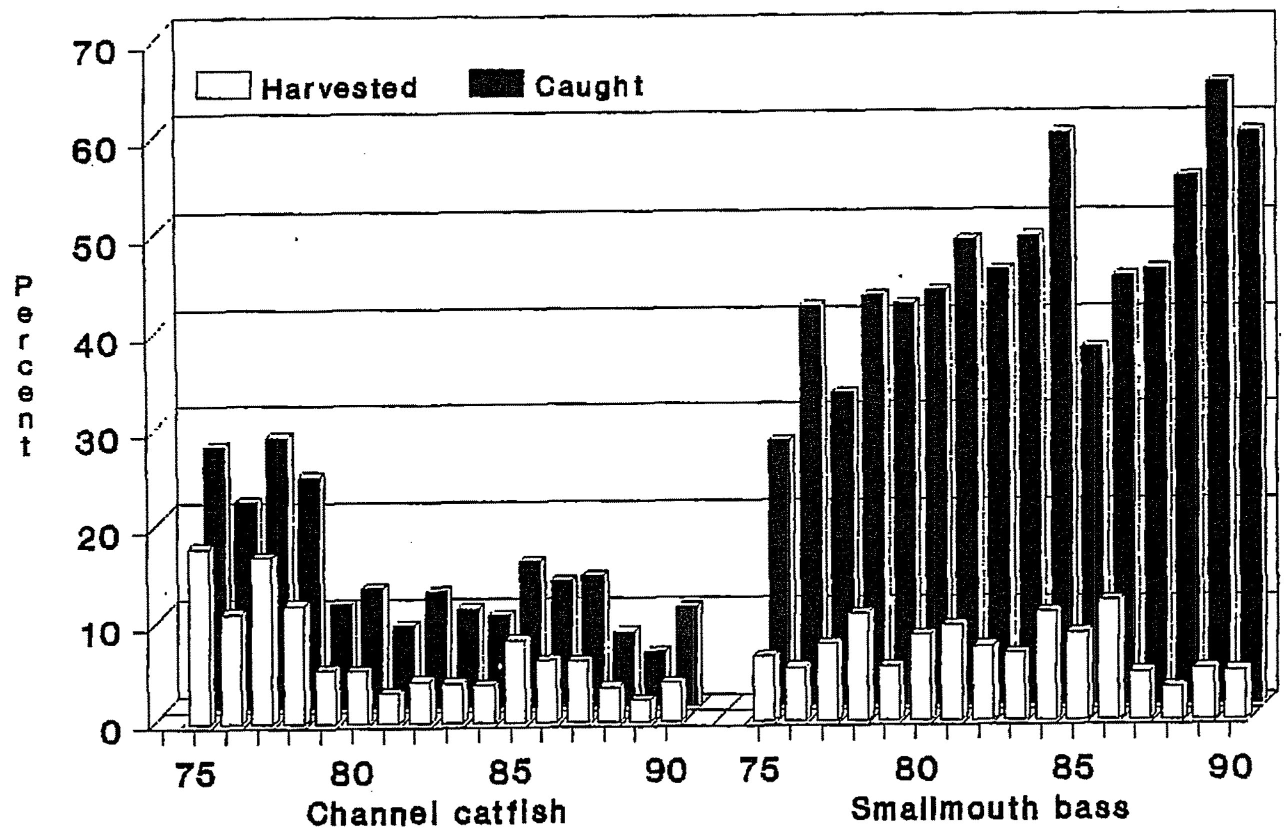

Figure 6-3. The percent composition of channel catfish and smallmouth bass in the catch and the portion which was harvested by anglers near TMINS, 1975 through 1990.

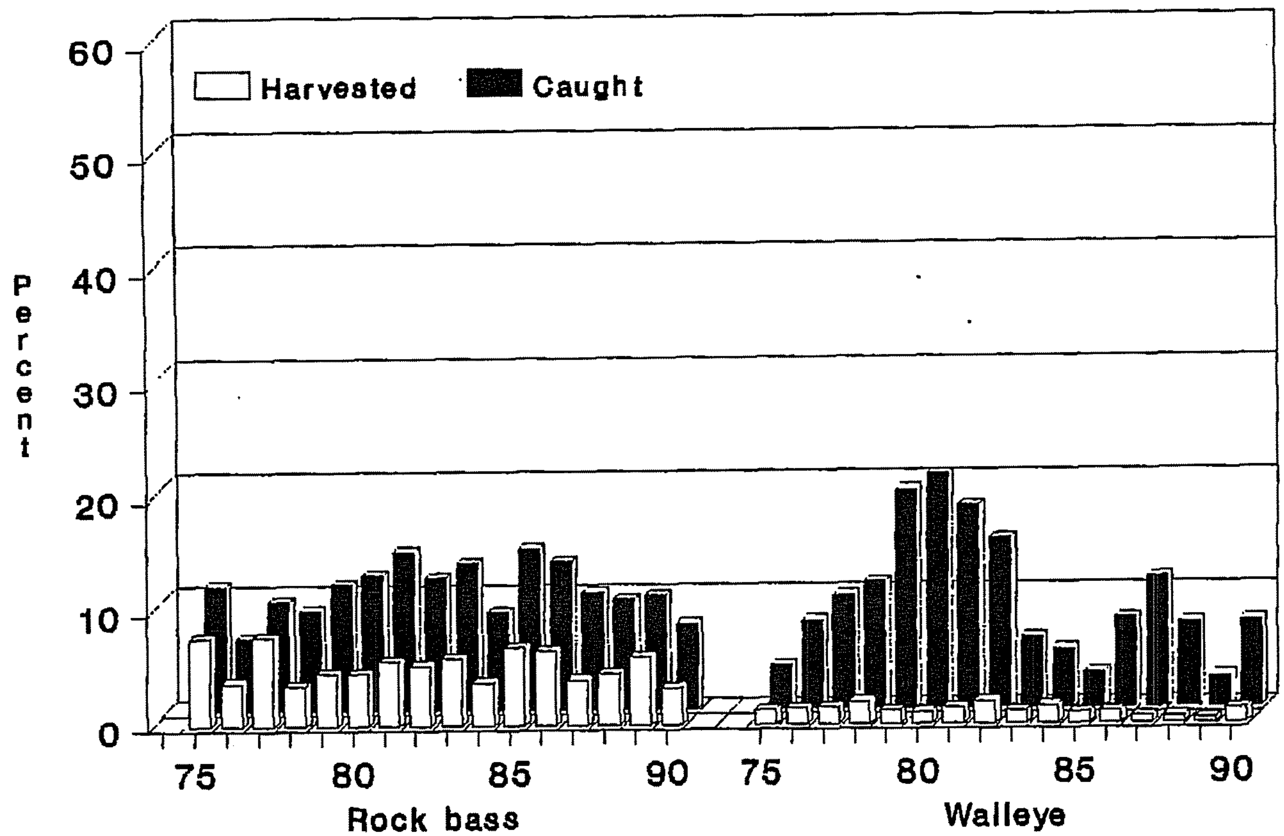

Figure 6-4. The percent composition of rock bass and walleye in the catch and the portion which was harvested by anglers near TMINS, 1975 through 1990.

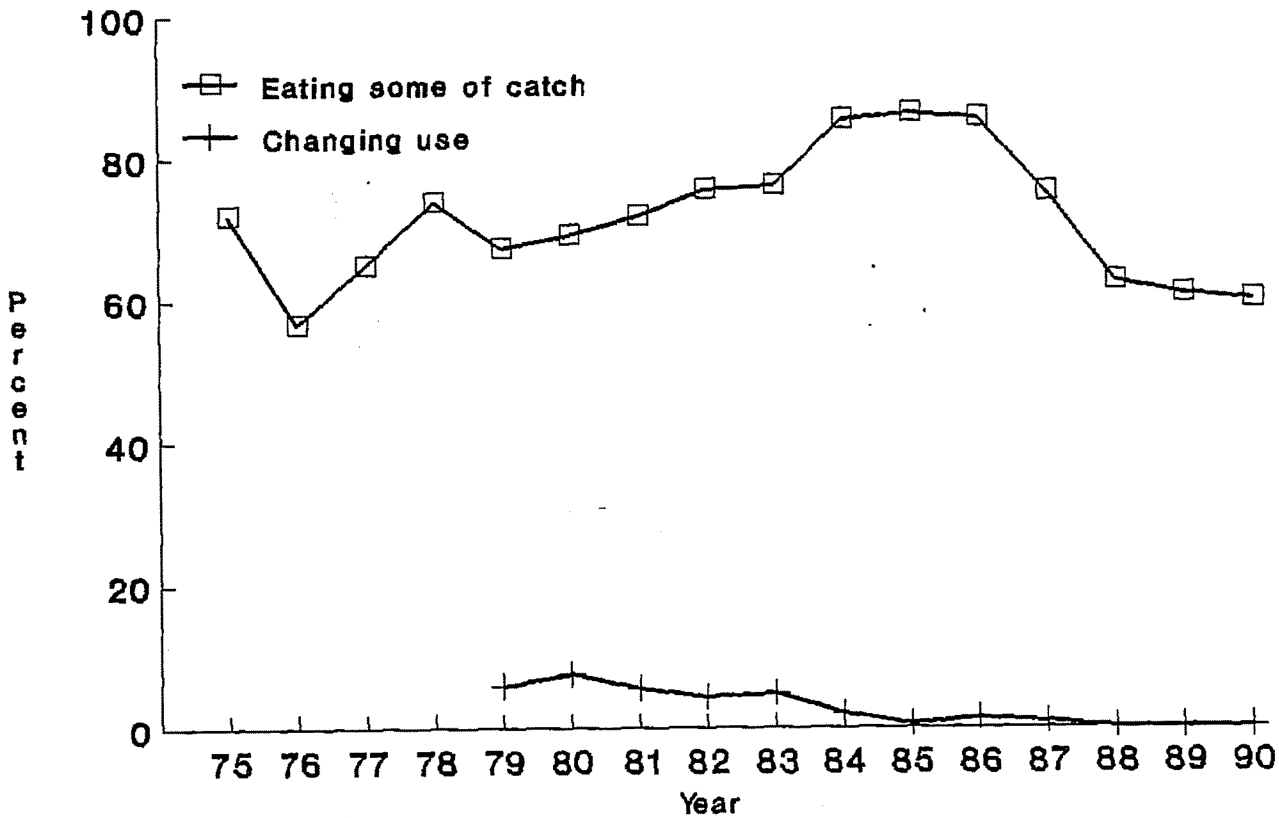

Figure 6-5. Annual trends in the percent of anglers eating at least some of their catch and those indicating a change in their use of catch due to the 1979 TMINS accident.

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, 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 grab 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 1990 water temperature, DO, pH, and TDS data. These same parameters in the multiple-year database were subjected to a three-factor ANOVA with years, months, and sampling stations (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 1990 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 1990 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 1990 values met the specified criteria, except for pH. The highest water temperature recorded was 28.2 C in June and July, well below the upper limit of 30.6 C. Values for pH equalled or exceeded the upper limit (9.0) in June. The high pH values in June were limited to areas within zones 1 and 4 (Figure 7-1), which were outside the influence of the TMINS discharge. TDS values were always well below the specified upper limit. The lowest DO value recorded was 7.2 mg/l in June, considerably above the lowest permissible limit for a single measurement (4.0 mg/l).

Based on the 1990 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: 1990

The water quality data collected in 1990 (Table 7-2) revealed some typical seasonal patterns for a number of variables. Mean water temperature increased from April to a peak in July, and then decreased through November. With minor deviations, mean river flow decreased through September, and fluctuated thereafter. The surface and bottom velocities generally followed a similar pattern, reflecting the high river flow in 1990. Conductivity and TDS followed a pattern, which increased through the summer, peaked in September or October, and then declined through the fall. Secchi disc transparency generally decreased through June, increased to a peak in September, and decreased through November.

DO and pH can be affected by water temperature, biological activity, and/or river flow. Mean DO in York

Haven Pond exhibited an inverse relationship with water temperature (Table 7-2). Mean pH values were lower in the spring (April through May) than in the summer or fall.

To provide a more quantitative assessment of the overall water quality in York Haven Pond, a two-factor ANOVA was used to analyze the 1990 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 pooled. Although all parameters exhibited significant differences among months, due to normal seasonal variations, only TDS exhibited a significant difference among sampling zones (Table 7-3). Tukey's studentized range test (not shown) demonstrated that the mean TDS at zone 8 (198.43) was significantly different from the undifferentiated means at zones 9 (184.86) and 7 (176.86). 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 were quickly 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 7-4. 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 were quite homogeneous among the three stations. However, there was a slight decrease in Secchi disc transparency at Station 11A1 (the TMINS discharge), which was likely related to the increased turbulence and turbidity created by the discharged water. In addition, surface and bottom current velocities were higher at Station 9B1, probably the result of the physical configuration of the shoreline. The increase in TDS at Station 11A1 was discussed above.

7.4 MULTIPLE-YEAR COMPARISON

Historically, river flow has influenced both biological and water quality parameters. Mean river flow was calculated for the April through November portion of each of the last 11 years (Table 7-5). Mean river flow increased 62% from 1980 to 1984, decreased 91% from 1985 through 1988, and then increased 105% in 1989 to its highest value to date. Mean river flow in 1990 decreased slightly from 1989, yet remained among the highest for the period.

To evaluate annual (1974 through 1990) 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 summarized in Table 7-6. Although some year-to-year differences were evident, the 1990 data fell within the historic ranges.

Individual measurements of water temperature, DO, pH, and TDS from 1974 through 1989 were combined with the 1990 data and subjected to a three-factor ANOVA (Table 7-7). The results were similar for all four parameters; 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.

If the TMINS discharge affected water quality, substantial sampling station differences would be expected. However, as shown in Table 7-7, only TDS produced significant differences ($P \leq 0.05$) among stations. That is, Station 11A1 (TMINS discharge) was differentiated from Stations 1A2 and 9B1. The mean TDS at Station 11A1 was 207 mg/l, whereas the means at Stations 1A2 and 9B1 were 194 and 201 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 (11A1 and 9B1) may be related to the concentration of dissolved solids during TMINS operation and subsequent discharge. However, these differences were slight, and the downstream values were well below the state water quality criteria.

The annual means, which were significantly different for all parameters (Table 7-7), were examined for statistical groupings that could be related to years of TMINS operation (1974 to 1978 and 1986 to 1990) versus non-operation (1979 to 1985) (Table 7-8). 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 align with lower values, but 1990, an operational year, was undifferentiated from 1979 to 1982, 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, 1989, and 1990. Generally, pH values increased from 1974 through 1982, decreased through 1987, rose in 1988, and have remained similar through 1990. TDS, available for six operational years, could not be differentiated from non-operational years.

Based on analysis of 17 years of data for water temperature, pH, and DO, and 13 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, 1990.

PARAMETER	MONTH								ALL MONTHS
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	
WATER TEMPERATURE (C)									
MEAN	11.4	16.0	22.1	24.9	24.3	20.4	13.9	8.4	19.1
MINIMUM	7.1	14.2	16.8	20.0	19.0	14.6	8.3	5.6	5.6
MAXIMUM	17.5	18.6	28.2	28.2	26.9	26.2	17.5	11.8	28.2
N	55	59	59	47	67	27	15	15	344
PH									
MEAN	7.8	7.6	8.0	7.9	8.0	8.1	8.1	8.0	7.9
MINIMUM	6.6	6.7	6.7	7.0	7.3	7.5	7.6	7.4	6.6
MAXIMUM	8.7	8.7	9.1	8.7	8.7	8.9	8.5	8.9	9.1
N	55	59	59	47	67	27	15	15	344
DISSOLVED OXYGEN (MG/L)									
MEAN	10.9	10.2	10.0	9.1	9.7	10.1	10.3	11.2	10.1
MINIMUM	10.0	8.5	7.2	7.4	7.3	8.0	8.5	9.9	7.2
MAXIMUM	11.6	12.4	15.4	11.5	14.5	12.2	11.0	12.3	15.4
N	55	59	59	47	67	27	15	15	344
SECCHI DEPTH (CM)									
MEAN	89.1	81.6	72.5	78.6	94.3	96.4	91.1	89.4	86.5
MINIMUM	63.5	25.4	17.8	50.8	53.3	50.8	22.9	38.1	17.8
MAXIMUM	132.1	203.2	106.7	165.1	149.9	210.8	261.6	167.6	261.6
N	15	27	27	15	27	27	15	15	168
TOTAL DISSOLVED SOLIDS (MG/L)									
MEAN	136.7	164.3	146.3	225.7	NA	235.7	232.7	165.7	186.7
MINIMUM	122.0	150.0	143.0	224.0	NA	218.0	228.0	149.0	122.0
MAXIMUM	151.0	184.0	149.0	228.0	NA	260.0	240.0	183.0	260.0
N	3	3	3	3	0	3	3	3	21
CONDUCTIVITY (UMHOS/CM)									
MEAN	185.0	210.8	245.4	302.5	273.8	299.4	315.8	229.2	257.6
MINIMUM	150.0	160.0	200.0	190.0	200.0	190.0	210.0	200.0	150.0
MAXIMUM	210.0	250.0	275.0	350.0	325.0	350.0	360.0	250.0	360.0
N	6	12	12	6	12	12	6	6	72
SURFACE VELOCITY (CM/SEC)									
MEAN	25.5	32.8	19.1	16.5	14.1	4.0	1.3	5.0	20.6
MINIMUM	3.0	3.0	2.0	0.0	0.0	2.0	0.0	1.0	0.0
MAXIMUM	52.0	58.0	43.0	45.0	30.0	5.0	2.0	10.0	58.0
N	43	35	35	35	43	3	3	3	200
BOTTOM VELOCITY (CM/SEC)									
MEAN	8.0	6.3	4.0	3.3	3.7	2.0	4.0	2.7	4.2
MINIMUM	4.0	2.0	2.0	3.0	3.0	1.0	3.0	1.0	1.0
MAXIMUM	10.0	12.0	6.0	4.0	4.0	3.0	5.0	4.0	12.0
N	3	3	3	3	3	3	3	3	24
RIVER FLOW (M^3/SEC)									
MEAN	1317.2	1373.0	726.7	690.3	506.8	424.2	1895.7	1256.3	1025.3
MINIMUM	699.4	555.0	373.8	274.7	282.6	297.3	303.0	756.9	274.7
MAXIMUM	2681.6	2664.6	1543.3	1897.2	988.3	597.3	6034.4	3281.9	6034.4
N	30	31	30	31	31	30	31	30	244

NA = Not available.

TABLE 7-3

Two-factor analysis of variance test results for selected water quality parameters collected near TMINS, April through November 1990.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value.
Water Temperature	Model (r^2=0.814)	55	10014.784	182.087	22.88	0.0001*
	Zone	6	19.149	3.192	0.40	0.8781
	Month	7	8102.417	1157.488	145.46	0.0001*
	Interaction	42	98.542	2.346	0.29	1.0000
	Error	288	2291.748	7.957		
	Corrected Total	343	12306.532			
Dissolved Oxygen	Model(r^2=0.275)	55	169.726	3.086	1.99	0.0002*
	Zone	6	9.701	1.617	1.04	0.3978
	Month	7	81.300	11.614	7.49	0.0001*
	Interaction	42	39.686	0.945	0.61	0.9733
	Error	288	446.649	1.551		
	Corrected Total	343	616.375			
pH	Model(r^2=0.185)	55	12.411	0.226	1.19	0.1833
	Zone	6	1.232	0.205	1.08	0.3723
	Month	7	6.396	0.914	4.82	0.0001*
	Interaction	42	3.779	0.090	0.48	0.9978
	Error	288	54.558	0.189		
	Corrected Total	343	66.970			
Total Dissolved Solids	Model(r^2=0.972)	8	34978.476	4372.310	51.75	0.0001*
	Zone	2	1664.857	832.428	9.85	0.0029*
	Month	6	33313.619	5552.270	65.72	0.0001*
	Error	12	1013.810	84.484		
	Corrected Total	20	35992.286			

* Significant at $P \leq 0.01$.

TABLE 7-4

Mean, minimum, and maximum values of water quality and physical parameters taken at the macroinvertebrate stations near TMINS, April through November 1990.

Parameter	Station		
	TM-MI-1A2	TM-MI-11A1	TM-MI-9B1
Water Temperature(C)			
Mean	17.6	17.5	17.5
Min	8.1	8.3	8.1
Max	26.5	25.9	26.2
pH			
Mean	7.8	7.6	7.7
Min	7.4	7.4	7.4
Max	8.5	8.1	8.0
Dissolve Oxygen(mg/l)			
Mean	9.2	9.3	9.2
Min	7.3	7.7	7.5
Max	11.2	11.4	11.2
Total Dissolved Solids(mg/l)			
Mean	177	198	185
Min	122	147	137
Max	228	260	230
Secchi Disc(cm)			
Mean	95.3	75.9	86.4
Min	66.0	55.9	66.0
Max	149.9	116.8	139.7
Surface Current Velocity(cm/sec)			
Mean	3.4	2.2	9.1
Min	1.0	0.0	2.0
Max	5.0	5.0	17.0
Bottom Current Velocity(cm/sec)			
Mean	3.2	3.9	5.6
Min	1.0	1.0	3.0
Max	10.0	5.0	12.0

TABLE 7-5

Range and mean river flow (m^3/sec) obtained from the River Forecast Center (Harrisburg, Pennsylvania) for April through November 1980 through 1990.

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
1990	244	275-6034	1025

TABLE 7-6

Mean, minimum, and maximum values of water quality parameters taken at the macroinvertebrate stations near through November, 1974 through 1990. 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
1990												
Mean	17.6	17.5	17.5	7.8	7.6	7.7	9.2	9.3	9.2	177	198	185
Min	8.1	8.3	8.1	7.4	7.4	7.4	7.3	7.7	7.5	122	147	137
Max	26.5	25.9	26.2	8.5	8.1	8.0	11.2	11.4	11.2	228	260	230
1974-1989												
Mean	17.4	17.7	17.9	8.0	8.0	7.9	9.2	9.4	9.3	195	208	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	382	355

TABLE 7-7

Three-factor analysis of variance test results for selected water quality parameters collected near TMINS, 1974 through 1990.

Dependent Variable	Source	df	Sum of Squares	Mean Square	F Value	P Value
Water Temperature	Model(r^2=0.921)	183	24303.739	132.807	28.16	0.0001*
	Year	16	531.295	33.206	7.04	0.0001*
	Month	7	19334.701	2762.100	585.62	0.0001*
	Station	2	15.940	7.970	1.69	0.1857
	Year-Month	112	2131.957	19.035	4.04	0.0001*
	Year-Station	32	20.821	0.651	0.14	1.0000
	Month-Station	14	5.044	0.360	0.08	1.0000
	Error	443	2089.428	4.716		
	Corrected Total	626	26393.167			
Dissolved Oxygen	Model(r^2=0.853)	183	1518.561	8.298	13.63	0.0001*
	Year	16	231.392	14.462	23.76	0.0001*
	Month	7	556.636	79.520	130.65	0.0001*
	Station	2	2.549	1.274	2.09	0.1244
	Year-Month	112	607.193	5.421	8.91	0.0001*
	Year-Station	32	19.190	0.600	0.99	0.4929
	Month-Station	14	1.352	0.096	0.16	0.9998
	Error	431	262.319	0.609		
	Corrected Total	614	1780.880			
pH	Model(r^2=0.763)	182	114.988	0.632	7.57	0.0001*
	Year	16	63.907	3.994	47.83	0.0001*
	Month	7	2.316	0.331	3.96	0.0003*
	Station	2	0.207	0.103	1.24	0.2907
	Year-Month	111	44.132	0.398	4.76	0.0001*
	Year-Station	32	1.843	0.058	0.69	0.8999
	Month-Station	14	0.646	0.046	0.55	0.9005
	Error	427	35.655	0.084		
	Corrected Total	609	150.644			
Total Dissolved Solids	Model(r^2=0.933)	142	1673147.177	11782.727	28.51	0.0001*
	Year	12	141113.810	11759.484	28.46	0.0001*
	Month	7	882944.242	126134.890	305.25	0.0001*
	Station	2	15089.723	7544.862	18.26	0.0001*
	Year-Month	83	527094.377	6350.535	15.37	0.0001*
	Year-Station	24	16199.851	674.994	1.63	0.0336+
	Month-Station	14	3325.549	237.539	0.57	0.8840
	Error	289	119421.302	413.222		
	Corrected Total	431	1792568.479			

* Significant at $P\leq0.01$.
\+ Significant at $P\leq0.05$.

TABLE 7-8

Summary of Tukey's studentized range test for selected water quality parameters collected near TMINS, 1974 through 1990. Underlined means are not significantly different (P≤0.05) and are ranked from highest to lowest mean. Means are listed parenthetically.

Dependent Variable	Year																
Water Temperature	1985	1984	1987	1980	1986	1979	1977	1988	1974	1990	1978	1981	1982	1983	1975	1976	1989
	(21.1)	(18.8)	(18.5)	(18.2)	(18.0)	(18.0)	(17.9)	(17.9)	(17.8)	(17.5)	(17.4)	(17.3)	(17.2)	(17.1)	(17.0)	(16.4)	(16.1)
Dissolved Oxygen	1984	1986	1983	1985	1988	1987	1982	1989	1976	1980	1990	1979	1978	1981	1977	1974	1975
	(10.3)	(10.3)	(10.2)	(10.1)	(9.9)	(9.7)	(9.7)	(9.5)	(9.4)	(9.3)	(9.2)	(9.2)	(9.0)	(8.9)	(8.6)	(8.4)	(8.0)
pH	1982	1981	1980	1978	1977	1979	1976	1985	1983	1984	1989	1990	1988	1975	1974	1986	1987
	(8.4)	(8.3)	(8.3)	(8.2)	(8.2)	(8.1)	(8.0)	(7.8)	(7.8)	(7.8)	(7.7)	(7.7)	(7.7)	(7.7)	(7.6)	(7.3)	(7.2)
Total Dissolved Solids	1980	1987	1985	1982	1986	1988	1983	1989	1984	1990	1978	1981	1979				
	(234)	(224)	(212)	(208)	(208)	(208)	(205)	(199)	(198)	(187)	(183)	(182)	(178)				

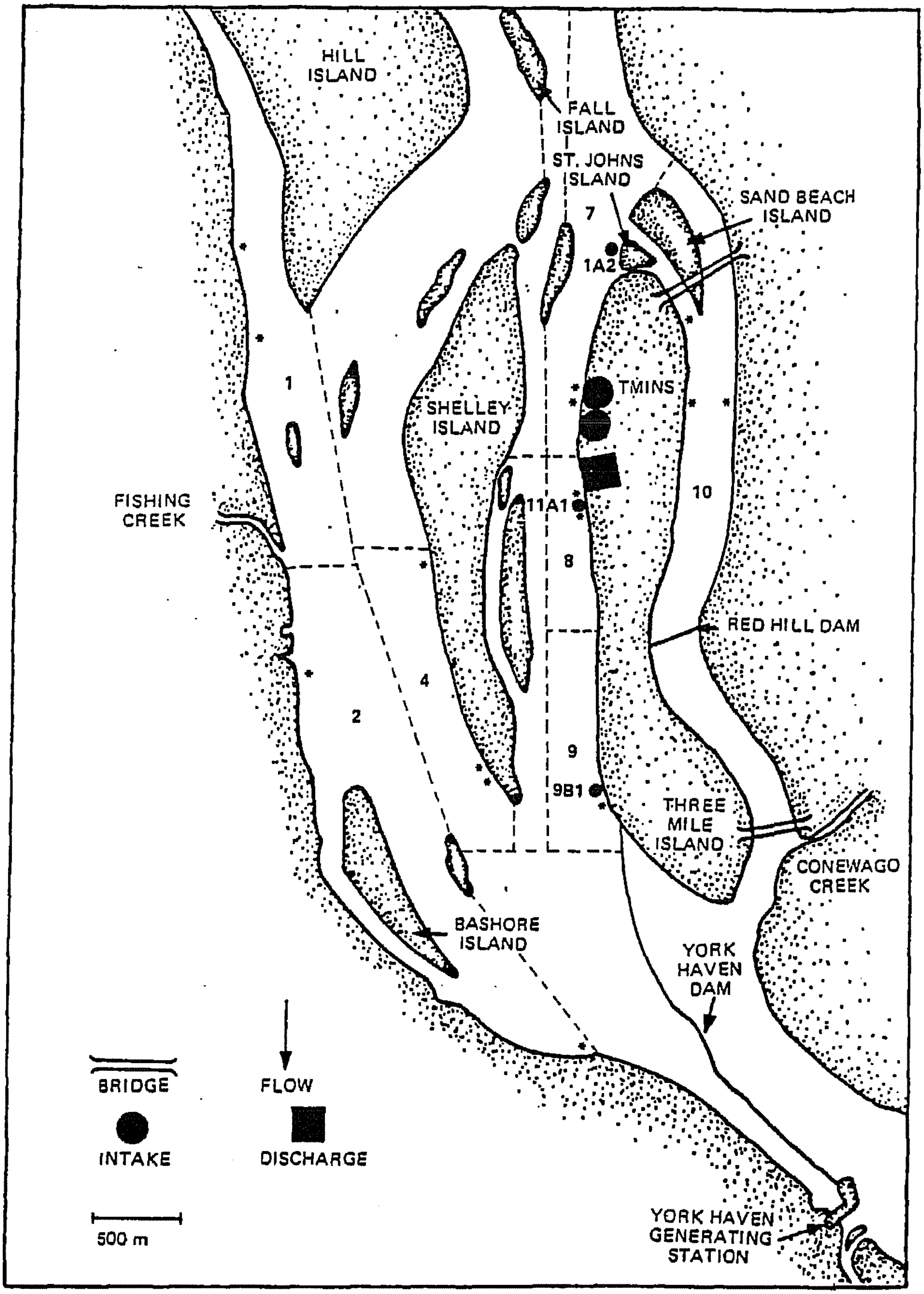

Figure 7-1. York Haven Pond showing numbered water quality zones, macroinvertebrate sampling stations, and the remaining biological sampling stations (asterisks). Only zones containing biological sampling stations are numbered.

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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, 1990.

Date=04APR 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	.	.	.
Bothrioneurum vejdovskyanum		2	.	1	.	.	.	1	.
Branchiura sowerbyi		1	.	.	.	1	.	.	.
Ceratopogonidae	Larvae	3	0.3	2	0.2	1	0.1	.	.
Chironomid pupae	Pupae	3	0.3	.	.	.	.	.	.
Chironomus decorus	Larvae	75	47.5	13	9.9	20	15.8	3	.
Cricotopus	Larvae	1	.	.	.	.	.	1	.
Cryptochironomus fulvus	Larvae	13	2.0	1	.	.	.	.	.
Dero		.	.	.	.	.	.	1	.
Enchytraeidae		.	.	.	.	.	.	1	.
Eukiefferiella	Larvae	1	.	.	.	.	.	.	.
Hexagenia	Larvae	.	.	2	18.0	.	.	2	.
Hydrolimax grisea		1	0.2	.	.	.	.	.	.
Ilyodrilus templetoni		2	.	.	.	.	.	5	1.2
Limnodrilus hoffmeisteri		93	17.6	35	8.3	35	5.8	22	3.6
Musculium transversum		1	0.1	.	.	1	0.1	.	.
Nematoda		.	.	1	0.1	.	.	.	.
Phaenopsectra	Larvae	114	5.4	18	0.4	14	0.6	9	0.1
Pisidium		16	1.9	.	.	1	0.1	5	0.6
Polypedilum scalaenum	Larvae	2	.	.	.	1	.	.	.
Potamanthus	Larvae	1	0.1	.	.	.	.	.	.
Procladius	Larvae	1	.	1	.	3	0.3	1	.
Prostoma		2	0.2	.	.	.	.	.	.
Sparganophilus		.	.	.	.	1	.	.	.
Stenelmis	Larvae	.	.	.	.	1	0.4	.	.
Tanytarsus	Larvae	1	.	.	.	.	.	.	.
TOTAL		333	75.6	75	36.9	80	23.2	51	5.5

TABLE A-1 CONTINUED.

Date=04APR and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	6	0.3	23	7.6	9	4.3	.	.
Anodonta cataracta		1	.	.	.	.	.	.	.
Arcteonais lomondi		10	0.1	22	0.2	3	.	.	.
Bothrioneurum vejdovskyanum		9	0.7	1	.	4	.	1	.
Ceratopogonidae	Larvae	2	0.2	9	0.8	1	0.2	4	0.1
Chironomid pupae	Pupae	.	.	.	.	1	1.1	.	.
Chironomus decorus	Larvae	42	35.2	49	39.9	85	84.1	18	14.3
Coelotanypus	Larvae	.	.	.	.	.	.	1	.
Cryptochironomus fulvus	Larvae	26	1.3	18	0.4	13	1.5	3	.
Dubiraphia	Larvae	.	.	.	.	1	.	.	.
Erpobdellidae		.	.	3	133.2	.	.	.	.
Gammarus fasciatus		5	1.0	2	0.2	2	0.4	.	.
Helobdella elongata		1	0.8	2	2.0	6	3.0	1	0.5
Hexagenia	Larvae	31	90.8	30	142.7	16	82.2	15	51.2
Ilyodrilus templetoni		1	.	1	.	1	.	.	.
Limnodrilus claparedianus		.	.	.	.	17	2.6	.	.
Limnodrilus hoffmeisteri		45	12.8	69	8.2	66	10.4	33	3.3
Manayunkia speciosa		3	0.1	6	0.2	1	0.1	2	0.2
Musculium transversum		4	0.5	3	2.1	.	.	.	.
Nematoda		3	0.1	1	0.1	2	0.2	1	0.1
Optioservus	Larvae	1	0.2	.	.	1	.	1	0.4
Phaenopsectra	Larvae	37	1.4	38	2.2	64	5.2	2	.
Pisidium		23	2.8	25	3.0	1	.	4	0.5
Polypedilum scalaenum	Larvae	5	0.2	.	.	.	.	2	.
Potamanthus	Larvae	.	.	1	.	.	.	.	.
Procladius	Larvae	26	6.5	63	16.0	76	24.8	16	3.5
Prostoma		1	.	.	.	.	.	.	.
Stenelmis	Larvae	.	.	.	.	1	0.2	.	.
Tanytarsus	Larvae	.	.	.	.	1	.	.	.
TOTAL		282	155.0	366	358.8	372	220.3	104	74.1

TABLE A-1 CONTINUED.

Date=04APR and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	5	1.3	3	0.3	8	2.6	1	.
Arcteonais lomondi		6	0.1	2	0.1	3	.	2	0.1
Bothrioneurum vejdovskyanum		2	0.1	2	0.1	1	.	.	.
Ceratopogonidae	Larvae	4	0.3	.	.	11	0.6	.	.
Chironomid pupae	Pupae	1	0.2	.	.	.	.	.	.
Chironomus decorus	Larvae	24	17.6	10	0.1	39	11.7	5	3.5
Coelotanypus	Larvae	.	.	.	.	1	.	2	.
Cryptochironomus fulvus	Larvae	8	0.5	22	23.7	8	1.1	2	.
Dubiraphia	Larvae	.	.	1	0.1	.	.	.	.
Epoicocladius	Larvae	.	.	1	0.2	1	.	1	.
Eudochironomus	Larvae	2	0.1	.	.	4	0.2	.	.
Helobdella elongata		2	0.2	.	.	4	1.0	2	0.8
Hexagenia	Larvae	101	120.0	70	65.9	74	180.0	37	45.4
Hydrolimax grisea		.	.	.	.	4	0.6	.	.
Limnodrilus hoffmeisteri		49	14.1	30	5.0	117	24.9	74	18.2
Limnodrilus udekemianus		.	.	.	.	13	2.7	.	.
Musculium transversum		12	2.6	4	0.5	8	1.8	4	0.5
Phaenopsectra	Larvae	15	0.6	15	0.9	34	1.6	1	.
Pisidium		19	2.3	10	1.2	51	6.1	4	0.5
Procladius	Larvae	31	4.9	28	4.7	44	7.6	28	4.7
Psychomyiidae	Pupae	1	.	.	.	.	.	.	.
Stylurus	Larvae	.	.	2	37.8	.	.	.	.
TOTAL		282	164.9	200	140.6	425	242.5	163	73.7

TABLE A-2 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, MAY, 1990.

Date=02MAY and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Baetisca	Larvae	.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		2	.	1	0.1	1	.	1	0.1
Branchiura sowerbyi		1	2.4	.	.	2	0.4	2	2.0
Ceratopogonidae	Larvae	.	.	1	0.1	2	0.2	3	0.3
Chironomid pupae	Pupae	9	7.2	2	1.4	11	4.3	8	2.0
Chironomus decorus	Larvae	7	7.4	69	59.4	53	42.4	46	40.8
Cryptochironomus fulvus	Larvae	4	1.2	.	.	2	0.6	4	0.1
Cryptotendipes	Larvae	1	.	.	.	.	.	.	.
Dicrotendipes neomodestus	Larvae	.	.	.	.	.	.	6	1.3
Helobdella elongata		.	.	.	.	3	0.1	.	.
Hexagenia	Larvae	.	.	1	1.2	.	.	.	.
Limnodrilus claparedianus		6	2.1	.	.	.	.	.	.
Limnodrilus hoffmeisteri		48	17.4	70	10.3	166	28.1	95	20.1
Musculium		5	0.5	.	.	2	0.3	1	.
Musculium transversum		1	1.6	3	1.7	.	.	.	.
Nematoda		.	.	1	0.1	2	0.2	1	0.1
Phaenopsectra	Larvae	9	2.6	37	10.5	80	14.7	50	10.3
Pisidium		15	1.8	4	0.4	34	47.8	10	1.2
Polypedilum scalaenum	Larvae	1	.	4	1.2	3	0.3	9	1.6
Procladius	Larvae	.	.	.	.	.	.	1	.
Stenelmis	Larvae	.	.	.	.	.	.	1	0.3
Stylurus	Larvae	.	.	.	.	.	.	1	3.0
Tanytarsus	Larvae	1	.	.	.	.	.	.	.
TOTAL		110	44.2	194	86.4	361	139.4	239	83.2

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.
Ablabesmyia	Larvae	2	.	.	.	.	.	.	.
Anodonta cataracta		1	0.1	.	.	.	.	.	.
Arcteonais lomondi		32	0.9	69	2.6	30	0.2	60	2.3
Bothrioneurum vejdovskyanum		14	0.5	.	.	6	0.4	1	0.1
Branchiura sowerbyi		.	.	.	.	1	1.2	.	.
Ceratopogonidae	Larvae	.	.	.	.	2	0.2	1	0.3
Chironomid pupae	Pupae	1	0.5	3	2.6	3	1.1	5	3.0
Chironomus decorus	Larvae	28	26.6	5	4.7	27	27.2	9	9.1
Cryptochironomus fulvus	Larvae	11	1.5	8	2.1	10	0.6	9	1.1
Epoicocladius	Larvae	.	.	1	.	.	.	.	.
Erpobdellidae		2	25.2	.	.	.	.	.	.
Gammarus fasciatus		6	1.8	11	16.9	1	0.1	1	0.1
Helobdella elongata		8	7.2	.	.	.	.	2	1.0
Hexagenia	Larvae	16	111.7	7	53.6	2	7.1	3	15.0
Hydrolimax grisea		.	.	.	.	1	0.3	.	.
Ilyodrilus templetoni		6	.	1	.	.	.	5	.
Limnodrilus hoffmeisteri		188	24.9	83	6.7	87	12.0	90	13.2
Manayunkia speciosa		5	0.1	8	0.2	1	0.1	12	0.6
Musculium transversum		2	0.2	1	0.2	.	.	1	0.6
Nematoda		.	.	1	0.1	.	.	.	.
Phaenopsectra	Larvae	20	4.4	.	.	6	0.6	2	0.2
Pisidium		22	2.6	15	1.7	9	1.1	18	2.7
Polypedilum scalaenum	Larvae	5	0.8	4	0.4	2	0.2	2	0.2
Procladius	Larvae	7	.	5	0.9	3	.	6	1.6
Quistadrilus multisetosus		1	.	.	.	.	.	.	.
Tanytarsus	Larvae	1	.	2	.	1	.	2	.
TOTAL		378	209.0	224	92.7	192	52.4	229	51.1

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.
Ablabesmyia	Larvae	2	.	2	.	.	.	3	.
Arcteonais lomondi		1	.	.	.	.	.	144	5.6
Bothrioneurum vejdovskyanum		1	.	.	.	10	2.6	12	1.0
Ceratopogonidae	Larvae	3	0.1	1	0.1	1	0.1	6	1.0
Chironomid pupae	Pupae	8	4.8	1	1.3	2	2.1	10	6.2
Chironomus decorus	Larvae	6	3.4	.	.	1	1.2	41	52.7
Coelotanypus	Larvae	.	.	.	.	.	.	3	.
Corixidae	Larvae	.	.	.	.	.	.	1	.
Cryptochironomus fulvus	Larvae	7	0.7	5	.	1	.	22	2.6
Ephemerella	Larvae	1	.	.	.	.	.	.	.
Epoicocladius	Larvae	1	.	.	.	.	.	.	.
Gammarus fasciatus		1	0.1	1	0.1	.	.	25	2.8
Helobdella elongata		1	2.0	.	.	.	.	4	4.2
Hexagenia	Larvae	52	246.8	24	116.2	18	41.6	25	130.7
Ilyodrilus templetoni		.	.	.	.	.	.	15	.
Limnodrilus hoffmeisteri		92	28.5	99	36.2	157	41.7	402	91.9
Musculium transversum		6	4.2	.	.	3	0.4	4	4.0
Optioservus	Larvae	.	.	.	.	.	.	3	0.7
Phaenopsectra	Larvae	44	27.8	10	11.9	2	.	2	0.2
Pisidium		9	1.1	4	0.4	6	0.7	30	8.4
Polypedilum scalaenum	Larvae	.	.	.	.	.	.	14	1.4
Procladius	Larvae	9	2.9	3	.	6	2.4	6	2.7
Tanytarsus	Larvae	1	.	.	.	.	.	.	.
TOTAL		245	322.4	150	166.2	207	92.8	772	316.1

TABLE A-3 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, JUNE, 1990.

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	.	.	.	.	.	.	1	.
Arcteonais lomondi		.	.	.	.	.	.	1	.
Bothrioneurum vejdovskyanum		8	.	13	.	11	.	16	0.2
Branchiura sowerbyi		1	0.1	.	.	1	5.1	.	.
Ceratopogonidae	Larvae	3	0.3	2	0.2	1	.	2	0.2
Chironomid pupae	Pupae	10	3.2	5	1.7	.	.	13	4.5
Chironomus decorus	Larvae	200	109.9	179	102.1	91	115.0	267	115.9
Cryptochironomus fulvus	Larvae	1	0.1	1	0.1	.	.	.	.
Dubiraphia	Larvae	4	0.1	.	.	.	.	1	0.5
Epoicocladius	Larvae	1	0.1	.	.	.	.	.	.
Gammarus fasciatus		6	0.1	4	0.4	.	.	.	.
Helobdella elongata		1	0.1	.	.	.	.	.	.
Hexagenia	Larvae	5	33.6	1	2.2	.	.	1	6.3
Ilyodrilus templetoni		12	.	.	.	4	.	7	.
Limnodrilus hoffmeisteri		214	43.4	253	22.9	142	16.1	197	32.5
Lumbriculidae		1	0.5	.	.	.	.	1	0.1
Musculium transversum		3	0.8	.	.	.	.	1	0.1
Nematoda		.	.	.	.	.	.	.	.
Optioservus	Larvae	.	.	1	0.5	.	.	.	.
Phaenopsectra	Larvae	35	9.5	28	3.3	6	0.1	32	3.5
Pisidium		55	6.6	45	5.4	15	1.8	68	8.2
Polypedilum scalaenum	Larvae	.	.	2	0.2	.	.	3	.
Procladius	Larvae	.	.	.	.	.	.	1	.
Quistadrilus multisetosus		.	.	.	.	1	0.1	1	.
Stenelmis	Larvae	6	2.8	1	0.5	1	0.5	2	1.0
TOTAL		566	211.2	535	139.5	273	138.7	615	173.0

TABLE A-3 CONTINUED.

Date=05JUN and Station 11A1

Taxa	Life Stage	A		B		C		D	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Ablabesmyia	Larvae	.	.	.	.	1	.	.	.
Anodonta cataracta		.	.	.	.	.	.	1	2.0
Arcteonais lomondi		3	.	4	0.2	6	0.2	1	.
Bothrioneurum vejdovskyanum		14	.	8	0.3	.	.	2	.
Ceratopogonidae	Larvae	.	.	1	0.1	1	0.1	1	0.1
Chironomid pupae	Pupae	1	0.1	2	0.4	2	0.1	3	0.1
Chironomus decorus	Larvae	52	10.2	153	50.3	72	21.1	58	16.5
Corbicula fluminea		.	.	1	16.9	.	.	.	.
Cryptochironomus fulvus	Larvae	4	2.4	5	0.2	.	.	2	0.4
Demicryptochironomus	Larvae	.	.	2	0.1	6	0.6	.	.
Dugesia tigrina		.	.	.	.	1	0.1	.	.
Gammarus fasciatus		19	6.3	60	14.5	114	37.4	59	16.3
Helobdella elongata		1	0.5	.	.	5	2.7	2	0.8
Hexagenia	Larvae	2	47.9	13	109.4	14	181.6	14	100.0
Ilyodrilus templetoni		5	.	8	.	3	.	.	.
Limnodrilus hoffmeisteri		146	26.3	213	48.9	181	42.4	133	27.2
Manayunkia speciosa		.	.	2	0.1	2	0.1	2	0.1
Musculium transversum		2	1.4	2	0.3	5	1.9	1	0.3
Nematoda		1	0.1	1	0.1	6	0.4	.	.
Orthocladius	Larvae	.	.	1	.	.	.	.	.
Phaenopsectra	Larvae	10	0.7	9	0.4	2	.	9	0.5
Pisidium		27	3.2	54	6.2	15	1.8	7	0.8
Polypedilum scalaenum	Larvae	.	.	1	.	1	.	.	.
Procladius	Larvae	.	.	1	.	.	.	3	.
Prostoma		1	0.1	1	0.1	.	.	.	.
Quistadrilus multisetosus		.	.	.	.	1	.	.	.
Stenelmis	Larvae	.	.	.	.	6	3.3	1	0.5
Tanytarsus	Larvae	2	.	1	.	2	.	1	.
TOTAL		290	99.2	543	248.5	446	293.8	300	165.6

TABLE A-3 CONTINUED.

Date=05JUN and Station 981

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Amnicola		1	.	.	.	.	.	.	.
Anodonta cataracta		2	4.1	1	9.7	.	.	.	.
Arcteonais lomondi		.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		1	.	25	4.2	1	0.1	3	.
Ceratopogonidae	Larvae	2	0.1	2	0.1	2	0.1	.	.
Chironomid pupae	Pupae	.	.	2	0.8	.	.	.	.
Chironomus decorus	Larvae	7	1.0	5	1.8	18	12.6	5	0.1
Coelotanypus	Larvae	1	.	4	0.9	1	0.5	.	.
Cryptochironomus fulvus	Larvae	11	0.2	8	0.6	5	0.5	3	0.3
Gammarus fasciatus		1	0.1	14	6.8	15	7.8	11	4.5
Helobdella elongata		2	1.2	1	0.1	.	.	1	0.1
Hexagenia	Larvae	50	351.2	69	569.1	53	408.4	64	502.5
Ilyodrilus templetoni		.	.	3	.	.	.	.	.
Limnodrilus hoffmeisteri		149	43.1	404	101.1	275	84.8	199	40.9
Musculium transversum		5	6.9	10	12.3	18	5.4	9	4.7
Nectopsyche	Larvae	2	3.4	.	.	.	.	1	0.1
Nematoda		1	0.1	.	.	.	.	.	.
Nematomorpha		1	0.1	.	.	1	0.2	.	.
Optioservus	Larvae	.	.	1	0.5	.	.	.	.
Phaenopsectra	Larvae	.	.	.	.	2	0.2	.	.
Pisidium		88	10.6	21	2.5	98	11.8	29	3.5
Polypedilum scalaenum	Larvae	5	0.5	5	0.5	4	0.4	3	0.3
Procladius	Larvae	.	.	.	.	.	.	2	0.1
Stenelmis	Larvae	.	.	1	0.5	.	.	.	.
TOTAL		329	422.6	577	711.5	493	532.8	330	557.1

TABLE A-4 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, JULY, 1990.

Date=10JUL and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Arcteonais lomondi		.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		10	.	139	18.6	6	.	130	17.7
Branchiura sowerbyi		1	0.3	4	15.8	.	.	4	15.5
Chironomid pupae	Pupae	1	0.4	4	0.1	2	0.1	3	0.2
Chironomus decorus	Larvae	24	1.6	36	10.6	40	6.4	64	12.3
Coelotanypus	Larvae	.	.	1	.	.	.	.	.
Corbicula fluminea		.	.	.	.	2	8.9	.	.
Cryptochironomus fulvus	Larvae	10	0.7	6	.	2	.	10	0.5
Gammarus fasciatus		2	0.1	9	0.2	2	0.1	2	0.1
Helobdella elongata		1	0.1	.	.	.	.	.	.
Hydrolimax grisea		5	0.1	6	0.1	2	0.1	.	.
Ilyodrilus templetoni		2	.	8	.	7	.	10	.
Limnodrilus hoffmeisteri		251	42.4	292	39.0	484	24.4	286	39.1
Musculium		.	.	.	.	3	2.3	6	0.3
Musculium transversum		3	0.4	5	0.5	.	.	.	.
Pisidium		93	111.6	49	5.9	10	1.2	31	3.7
Polypedilum scalaenum	Larvae	4	0.3	2	.	3	.	2	.
Procladius	Larvae	34	1.6	32	1.9	9	0.2	14	0.8
Stenelmis	Larvae	.	.	2	0.2	.	.	1	0.1
Stylurus	Larvae	.	.	1	90.5	.	.	.	.
Tanytarsus	Larvae	2	0.1	.	.	.	.	.	.
TOTAL		443	159.7	597	183.4	572	43.7	563	90.3

TABLE A-4 CONTINUED.

Date=10JUL 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	.	.	.	1	.
Bothrioneurum vejdovskyanum		2	.	2	.	2	.	.	.
Ceratopogonidae	Larvae	.	.	.	.	.	.	1	0.5
Chironomid pupae	Pupae	.	.	1	0.1	.	.	1	0.1
Chironomus decorus	Larvae	3	0.6	5	0.1	1	.	4	0.8
Coelotanypus	Larvae	.	.	2	0.1	.	.	1	0.5
Corbicula fluminea		.	.	.	.	.	.	1	35.3
Cryptochironomus fulvus	Larvae	6	0.1	6	1.4	8	0.2	7	0.2
Gammarus fasciatus		4	1.6	6	2.8	1	0.5	6	2.2
Helobdella elongata		5	0.5	6	2.2	1	0.2	6	0.3
Helobdella stagnalis		3	0.1	2	0.1	.	.	1	0.1
Hexagenia	Larvae	4	50.8	1	15.9	1	4.9	5	42.9
Hydrolimax grisea		.	.	13	0.1	5	0.1	2	0.1
Ilyodrilus templetoni		1	.	1	.	1	.	2	.
Limnodrilus hoffmeisteri		171	18.3	250	25.1	142	13.0	121	13.5
Musculium		.	.	5	0.1	.	.	2	0.3
Musculium transversum		22	4.3	19	13.1	3	0.6	31	8.4
Nectopsyche	Larvae	.	.	.	.	.	.	2	.
Nematoda		.	.	.	.	.	.	3	0.3
Pisidium		27	3.2	55	6.6	11	1.3	26	3.1
Polypedilum scalaenum	Larvae	2	0.2	.	.	.	.	.	.
Procladius	Larvae	10	0.1	6	0.1	2	0.4	6	0.2
Stenelmis	Larvae	1	0.2	1	0.1	.	.	9	5.1
Stenonema	Larvae	.	.	1	0.1	.	.	.	.
TOTAL		261	80.0	384	68.0	178	21.2	238	113.9

TABLE A-4 CONTINUED.

Date=10JUL and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Bothrioneurum vejdovskyanum		.	.	1	.	.	.	.	.
Chironomus decorus	Larvae	1	.	.	.	.	.	2	.
Coelotanypus	Larvae	.	.	.	.	.	.	1	.
Cryptochironomus fulvus	Larvae	8	0.8	7	0.2	.	.	8	0.7
Demicryptochironomus	Larvae	2	0.2	.	.	.	.	.	.
Epoicocladius	Larvae	.	.	1	.	.	.	.	.
Gammarus fasciatus		43	30.2	19	12.5	8	6.0	43	49.0
Hexagenia	Larvae	14	244.8	10	100.2	1	20.4	12	227.6
Hydrolimax grisea		1	0.1	.	.	.	.	.	.
Ilyodrilus templetoni		1	.	.	.	.	.	1	.
Limnodrilus hoffmeisteri		214	40.8	172	32.6	40	2.5	101	12.2
Musculium transversum		70	42.7	97	38.8	40	12.7	44	14.2
Nematoda		.	.	1	0.1	.	.	1	0.1
Orconectes		.	.	1	.	.	.	.	.
Pisidium		89	10.7	78	9.4	33	4.0	21	2.5
Polypedilum scalaenum	Larvae	.	.	1	.	.	.	.	.
Procladius	Larvae	2	.	5	0.4	.	.	3	.
Sialis	Larvae	1	0.6	.	.	.	.	1	0.1
Stenelmis	Larvae	1	0.5	1	0.3	.	.	.	.
TOTAL		447	371.4	394	194.5	122	45.6	238	306.4

TABLE A-5 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, AUGUST, 1990.

Date=07AUG and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Aulodrilus pluriseta		.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		8	.	6	0.7	47	3.8	11	0.6
Branchiura spwerbyi		1	0.5	.	.	1	1.3	2	1.0
Ceratopogonidae	Larvae	.	.	.	.	.	.	1	0.3
Chironomid pupae	Pupae	1	0.5	1	0.4	1	0.5	1	0.5
Chironomus decorus	Larvae	3	1.2	7	1.6	14	4.9	2	0.6
Coelotanypus	Larvae	4	0.4	3	.	3	0.3	.	.
Corixidae	Larvae	1	0.5	.	.	.	.	.	.
Cryptochironomus fulvus	Larvae	3	0.2	8	1.4	6	0.6	2	.
Dicrotendipes neomodestus	Larvae	.	.	1	.	.	.	.	.
Gammarus fasciatus		.	.	1	0.5	.	.	.	.
Helobdella elongata		.	.	2	1.2	1	0.5	1	0.2
Hydrolimax grisea		5	0.7	1	0.1	.	.	3	0.3
Ilyodrilus templetoni		1	.	.	.	1	.	.	.
Limnodrilus hoffmeisteri		78	14.5	78	16.9	248	20.5	145	29.4
Limnodrilus udekemianus		.	.	9	1.9	.	.	.	.
Musculium transversum		.	.	.	.	2	0.2	.	.
Nematoda		.	.	.	.	1	0.1	.	.
Pisidium		4	0.5	4	0.5	4	0.5	1	0.1
Polypedilum scalaenum	Larvae	1	.	.	.	1	.	.	.
Procladius	Larvae	36	4.3	30	2.9	25	2.2	25	2.1
Quistadrilus multisetosus		1	.	.	.	.	.	.	.
TOTAL		147	23.3	152	28.1	355	35.4	194	35.1

TABLE A-5 CONTINUED.

Date=07AUG and Station 11A1

Taxa	Life Stage	A		B		C		D	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Ablabesmyia	Larvae	2	0.7	.	.	.	.	.	.
Actinobdella inequiannulata		1	.	1	0.5	.	.	.	.
Arcteonais lomondi		1	.	.	.	.	.	.	.
Chironomid pupae	Pupae	.	.	1	0.5	.	.	.	.
Chironomus decorus	Larvae	2	.	.	.	4	.	2	0.8
Chrysops	Larvae	.	.	1	0.2	.	.	.	.
Coelotanypus	Larvae	3	.	.	.	3	.	2	0.2
Corbicula fluminea		5	1.9	.	.	.	.	.	.
Cryptochironomus fulvus	Larvae	3	.	7	0.7	.	.	3	0.5
Epoicocladius	Larvae	1	0.1	.	.	.	.	.	.
Erpobdellidae		.	.	1	12.6	.	.	.	.
Helobdella elongata		7	2.7	9	2.5	7	2.2	5	0.7
Helobdella stagnalis		.	.	1	0.5	1	0.5	1	0.9
Hexagenia	Larvae	.	.	.	.	2	6.6	.	.
Hydrolimax grisea		.	.	11	0.5	.	.	4	0.4
Ilyodrilus templetoni		3	.	.	.	6	.	5	.
Limnodrilus hoffmeisteri		333	27.3	71	8.8	164	16.2	184	17.4
Musculium		1	0.5	.	.	.	.	.	.
Musculium transversum		1	0.5	.	.	.	.	2	1.1
Nematoda		1	0.1	1	0.1	.	.	.	.
Pisidium		50	6.0	21	2.5	4	0.1	30	3.6
Polypedilum scalaenum	Larvae	2	.	.	.	.	.	1	0.1
Polypedium illinoense	Larvae	.	.	.	.	1	.	.	.
Procladius	Larvae	58	7.1	37	3.3	5	0.5	33	2.7
Stenelmis	Larvae	.	.	1	0.5	.	.	.	.
Stylurus	Larvae	.	.	1	5.4	.	.	.	.
Tubificidae		.	.	8	1.0	.	.	.	.
TOTAL		474	46.9	172	39.6	197	26.1	272	28.4

TABLE A-5 CONTINUED.

Date=07AUG and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Actinobdella inequiannulata		1	.	.	.	1	0.4	.	.
Bothrioneurum vejdovskyanum		1	.	.	.	5	.	3	0.3
Chaoborus	Larvae	1	0.2	1	.	.	.	.	.
Chironomus decorus	Larvae	6	2.4	.	.	3	.	1	.
Coelotanypus	Larvae	2	0.4	.	.	2	0.4	1	0.2
Cryptochironomus fulvus	Larvae	6	0.6	.	.	11	1.0	3	0.5
Dero		.	.	.	.	.	.	1	.
Dubiraphia	Larvae	.	.	.	.	1	0.3	.	.
Gammarus fasciatus		1	0.2	.	.	.	.	1	0.2
Helobdella elongata		9	2.9	1	1.4	4	.	.	.
Hexagenia	Larvae	.	.	.	.	1	3.1	.	.
Hydrolimax grisea		5	0.4	4	0.2	10	1.0	7	0.4
Limnodrilus hoffmeisteri		433	82.2	299	39.1	235	39.8	434	42.6
Musculium transversum		25	4.0	8	0.8	32	3.8	12	1.4
Oecetis	Larvae	.	.	.	.	.	.	1	.
Pisidium		72	8.6	50	6.0	68	8.2	55	6.6
Polypedilum scalaenum	Larvae	1	.	1	.	4	0.4	1	.
Polypedium illinoense	Larvae	.	.	.	.	1	.	.	.
Potamanthus	Larvae	.	.	.	.	.	.	1	0.2
Procladius	Larvae	7	0.8	1	.	4	0.8	5	0.5
Sialis	Larvae	.	.	.	.	1	.	.	.
Tubificidae		108	20.6	33	4.3	101	17.0	.	.
TOTAL		678	123.3	398	51.8	484	76.2	526	52.9

TABLE A-6 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, SEPTEMBER, 1990.

Date=10SEP and Station 1A2

Taxa	Life Stage	A		B		C		D	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Ablabesmyia	Larvae	1	.	1	.	2	.	1	.
Aulodrilus pluriseta		.	.	1	.	.	.	.	.
Bothrioneurum vejdovskyanum		1	.	1	.	4	.	1	.
Branchiura sowerbyi		.	.	1	0.1	1	1.7	.	.
Ceratopogonidae	Larvae	.	.	2	0.1	.	.	.	.
Chironomid pupae	Pupae	2	0.5	3	0.8	4	1.6	2	0.1
Chironomus decorus	Larvae	29	13.0	41	15.4	29	12.1	19	8.1
Coelotanypus	Larvae	2	.	8	0.7	.	.	3	.
Corbicula fluminea		.	.	.	.	.	.	2	21.1
Cryptochironomus fulvus	Larvae	2	.	4	0.2	.	.	.	.
Hexagenia	Larvae	6	10.0	6	4.2	13	15.6	4	3.4
Hydrolimax grisea		2	0.1	10	1.4	4	0.2	6	0.3
Ilyodrilus templetoni		1	.	4	.	1	.	.	.
Limnodrilus hoffmeisteri		40	9.6	144	17.9	109	12.0	114	12.5
Lumbriculidae		.	.	.	.	1	2.0	.	.
Nematoda		.	.	.	.	1	0.2	.	.
Pisidium		10	1.2	11	1.3	3	0.4	2	0.2
Procladius	Larvae	20	2.5	16	1.2	20	1.6	11	0.4
TOTAL		116	36.9	253	43.3	192	47.4	165	46.1

TABLE A-6 CONTINUED.

Date=10SEP and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	.	.	.	.	2	.
Anodonta cataracta		.	.	1	1.6	.	.	1	3.2
Bothrioneurum vejdovskyanum		.	.	.	.	1	.	.	.
Ceratopogonidae	Larvae	1	0.1	2	0.1	3	0.1	6	0.2
Chironomid pupae	Pupae	1	0.3	.	.	2	0.1	1	0.1
Chironomus decorus	Larvae	73	11.1	63	14.4	65	16.6	44	14.1
Coelotanypus	Larvae	5	0.2	3	.	.	.	3	.
Corbicula fluminea		.	.	10	16.2	22	21.3	3	3.3
Cryptochironomus fulvus	Larvae	.	.	2	.	.	.	1	.
Dubiraphia	Larvae	1	0.1	.	.	.	.	.	.
Epoicocladius	Larvae	.	.	.	.	1	.	.	.
Erpobdellidae		1	9.2	1	8.9	.	.	.	.
Gammarus fasciatus		.	.	.	.	1	0.1	1	0.6
Helobdella elongata		.	.	6	3.0	.	.	3	0.8
Helobdella stagnalis		.	.	1	0.8	2	0.8	1	0.7
Hexagenia	Larvae	12	0.8	8	8.6	4	59.0	8	2.0
Hydrolimax grisea		96	3.6	26	2.4	25	2.2	6	0.8
Ilyodrilus templetoni		1	.	1	.	1	.	.	.
Limnodrilus hoffmeisteri		120	12.5	146	15.6	138	9.8	95	6.5
Macronychus	Larvae	.	.	.	.	1	.	.	.
Musculium transversum		1	0.1	4	13.4	2	0.2	.	.
Nematoda		2	0.2	.	.	.	.	.	.
Pisidium		55	6.6	62	7.4	96	11.5	85	10.2
Procladius	Larvae	20	2.3	16	0.9	11	0.1	10	1.1
Prostoma		1	0.1	.	.	.	.	.	.
TOTAL		390	47.2	352	93.3	375	121.8	270	43.6

TABLE A-6 CONTINUED.

Date=10SEP and Station 9B1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	2	0.1	.	.	1	.
Actinobdella inequiannulata		.	.	.	.	.	.	1	1.2
Bothrioneurum vejdovskyanum		1	.	47	9.0	1	.	2	.
Ceratopogonidae	Larvae	1	0.1	3	0.4	1	0.2	3	0.1
Chironomid pupae	Larvae	.	.	.	.	4	2.4	2	0.6
Chironomid pupae	Pupae	2	1.3	.	.	.	.	.	.
Chironomus decorus	Larvae	7	4.6	27	10.2	28	7.8	9	2.8
Cladopelma	Larvae	1	.	.	.	.	.	.	.
Coelotanypus	Larvae	4	.	8	0.2	11	0.2	3	.
Corbicula fluminea		7	6.4	8	6.6	4	8.5	15	2.1
Cryptochironomus fulvus	Larvae	4	0.3	8	0.3	16	0.7	7	0.7
Dubiraphia	Larvae	.	.	1	0.1	.	.	.	.
Helobdella elongata		.	.	2	1.0	2	0.7	2	0.3
Hexagenia	Larvae	8	2.2	8	8.0	9	17.5	14	5.7
Hydrolimax grisea		17	1.5	9	1.1	12	0.9	15	0.9
Ilyodrilus templetoni		1	.	.	.	.	.	1	.
Limnodrilus hoffmeisteri		506	81.6	415	79.1	687	128.7	468	70.4
Microchironomus	Larvae	.	.	.	.	.	.	1	.
Musculium transversum		26	10.1	8	2.8	37	4.4	4	3.5
Oecetis	Larvae	.	.	.	.	.	.	1	0.1
Pisidium		93	11.2	105	12.6	86	10.3	186	22.3
Polypedilum scalaenum	Larvae	1	.	.	.	.	.	.	.
Procladius	Larvae	24	4.1	21	3.2	40	3.9	23	2.6
Sigara	Larvae	1	0.7	.	.	.	.	.	.
Tanytarsus	Larvae	1	.	.	.	.	.	.	.
Tricorythodes	Larvae	1	0.1	.	.	.	.	.	.
TOTAL		706	124.2	672	134.7	938	186.2	758	113.3

TABLE A-7 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, OCTOBER, 1990.

Date=01OCT 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	.	5	1.8	6	2.4
Actinobdella inequiánnulata		1	6.2	.	.	.	.	1	3.2
Arcteonais lomondi		.	.	3	.	.	.	.	.
Aulodrilus pluriseta		.	.	2	.	1	.	.	.
Bothrioneurum vejdovskyanum		14	.	19	0.9	6	0.5	3	0.2
Branchiura sowerbyi		2	2.6	1	0.8	.	.	.	.
Centroptilum	Larvae	.	.	.	.	1	.	.	.
Ceratopogonidae	Larvae	3	0.3	5	1.1	.	.	.	.
Chironomid pupae	Pupae	2	0.8	.	.	2	0.2	2	0.9
Chironomus decorus	Larvae	277	32.6	254	33.8	267	31.1	264	32.3
Coelotanypus	Larvae	.	.	3	.	2	0.2	2	1.2
Corbicula fluminea		8	52.0	5	6.5	4	13.4	10	2.9
Cryptochironomus fulvus	Larvae	11	1.1	4	.	9	0.9	3	.
Helobdella elongata		.	.	.	.	1	0.5	.	.
Hexagenia	Larvae	3	10.2	3	1.7	21	76.4	14	42.5
Hydrolimax grisea		15	4.8	6	1.7	15	2.9	10	2.9
Ilyodrilus templetoni		8	.	13	.	4	.	1	0.1
Limnodrilus hoffmeisteri		222	30.4	302	31.5	159	28.7	196	26.0
Limnodrilus udekemianus		26	3.5	1	.	1	.	.	.
Natarsia	Larvae	.	.	.	.	1	.	.	.
Oecetis	Larvae	.	.	.	.	.	.	1	0.1
Optioservus	Larvae	1	0.4	.	.	.	.	.	.
Pisidium		6	0.7	30	3.6	3	0.4	10	1.2
Polypedilum scalaenum	Larvae	.	.	1	.	.	.	.	.
Procladius	Larvae	.	.	4	.	4	.	12	3.3
Stylurus	Larvae	.	.	.	.	1	17.8	.	.
Tanytarsus	Larvae	1	.	.	.	2	.	1	0.1
TOTAL		600	145.6	658	81.6	509	174.8	536	119.3

TABLE A-7 CONTINUED.

Date=01OCT and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	4	1.0	2	0.6	.	.	1	0.3
Baetis	Larvae	1	0.1	.	.	.	.	.	.
Bothrioneurum vejdovskyanum		.	.	.	.	2	.	.	.
Ceratopogonidae	Larvae	7	1.3	1	0.3	3	0.6	1	0.2
Chironomid pupae	Pupae	2	0.7	2	0.1	3	2.0	.	.
Chironomus decorus	Larvae	346	56.7	115	16.6	184	35.9	102	17.3
Chrysops	Larvae	.	.	.	.	.	.	1	.
Coelotanypus	Larvae	4	0.9	8	1.6	4	0.7	2	0.4
Corbicula fluminea		1	2.8	9	10.0	4	18.4	7	15.2
Cricotopus	Larvae	.	.	.	.	1	.	.	.
Cryptochironomus fulvus	Larvae	15	3.4	13	1.3	16	1.4	16	1.6
Demicryptochironomus	Larvae	.	.	.	.	2	0.2	.	.
Erpobdellidae		.	.	.	.	2	44.1	.	.
Gammarus fasciatus		4	0.6	1	0.2	.	.	1	0.1
Helobdella elongata		1	2.9	1	1.0	2	1.3	.	.
Helobdella stagnalis		.	.	.	.	.	.	1	1.1
Hexagenia	Larvae	17	11.3	16	27.1	6	9.4	18	16.0
Hydrolimax grisea		13	2.5	31	5.3	16	3.1	5	1.0
Ilyodrilus templetoni		8	.	3	.	7	.	3	.
Limnodrilus hoffmeisteri		205	31.9	117	20.9	128	23.1	88	21.1
Musculium transversum		11	3.9	10	1.2	13	1.6	1	0.7
Nematoda		2	0.2	.	.	.	.	2	1.6
Pisidium		91	10.9	28	3.4	24	2.9	44	5.3
Procladius	Larvae	3	.	2	0.4	5	.	1	0.3
Quistadrilus multisetosus		.	.	.	.	.	.	1	.
Stenelmis	Larvae	1	0.4	.	.	1	0.5	1	0.5
Stylurus	Larvae	.	.	1	30.9	.	.	.	.
Tanytarsus	Larvae	2	.	1	.	1	.	.	.
TOTAL		738	131.5	361	120.9	424	145.2	296	82.7

TABLE A-7 CONTINUED.

Date=01OCT 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	.	.	.	.	.
Actinobdella inequiannulata		.	.	.	.	1	1.1	.	.
Arcteonais lomondi		3	.	4	.	2	.	.	.
Bothrioneurum vejdovskyanum		1	.	1	.	.	.	.	.
Ceratopogonidae	Larvae	.	.	2	0.2	.	.	2	0.4
Chironomid pupae	Pupae	2	0.2	3	0.5	.	.	1	0.2
Chironomus decorus	Larvae	50	9.0	115	11.9	49	10.6	61	11.1
Coelotanypus	Larvae	10	0.9	3	.	6	0.6	4	0.2
Corbicula fluminea		.	.	8	4.9	5	2.5	7	4.0
Cryptochironomus fulvus	Larvae	22	0.2	20	1.0	6	0.1	6	0.1
Epoicocladius	Larvae	.	.	.	.	.	.	1	0.1
Gammarus fasciatus		3	0.2	.	.	.	.	.	.
Harnischia	Larvae	1	.	.	.	.	.	.	.
Helobdella elongata		5	3.3	.	.	1	0.5	1	0.3
Hexagenia	Larvae	24	32.9	12	10.6	13	16.3	26	56.4
Hydrolimax grisea		15	1.9	4	0.4	7	0.5	1	0.1
Ilyodrilus templetoni		2	.	2	.	.	.	1	.
Limnodrilus hoffmeisteri		304	83.2	304	54.3	349	58.1	355	68.0
Limnodrilus udekemianus		8	2.2	.	.	.	.	.	.
Musculium transversum		16	1.9	6	1.7	.	.	11	18.7
Nematoda		.	.	.	.	.	.	1	0.1
Nematomorpha		.	.	1	0.1	.	.	.	.
Oecetis		4	0.4	.	.	.	.	.	.
Oecetis	Larvae	.	.	1	0.1	.	.	.	.
Pisidium		44	5.3	55	6.6	19	2.3	13	1.6
Procladius	Larvae	10	0.2	10	0.7	4	0.2	9	1.5
Tanytarsus	Larvae	2	.	1	.	.	.	.	.
Tubificidae		8	2.2	3	.	.	.	.	.
TOTAL		535	144.0	556	93.0	462	92.8	500	162.8

TABLE A-8 NUMBER AND BIOMASS (mg) OF BENTHIC MACROINVERTEBRATES BY STATION, REPLICATE (A,B,C,D), AND LIFE STAGE TAKEN NEAR TMINS, NOVEMBER, 1990.

Date=05NOV and Station 1A2

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Bothrioneurum vejdovskyanum		.	.	.	.	1	.	.	.
Chironomus decorus	Larvae	1	0.5	6	3.6	3	1.7	.	.
Corbicula fluminea		16	2.4	8	6.5	19	6.4	8	1.0
Corixidae	Larvae	1	0.1	.	.	.	.	.	.
Cryptochironomus fulvus	Larvae	.	.	2	0.8	.	.	.	.
Enchytraeidae		.	.	.	.	.	.	1	.
Gammarus fasciatus		.	.	2	0.7	.	.	.	.
Hexagenia	Larvae	.	.	.	.	.	.	1	3.7
Hydrolimax grisea		.	.	1	0.1	1	0.1	.	.
Ilyodrilus templetoni		.	.	2	.	.	.	.	.
Limnodrilus hoffmeisteri		2	.	232	43.3	2	.	3	.
Limnodrilus udekemianus		.	.	58	10.8	.	.	2	.
Manayunkia speciosa		.	.	1	0.1	.	.	.	.
Musculium transversum		2	0.1	59	7.1	4	0.5	6	0.7
Mystacides	Larvae	1	.	.	.	.	.	.	.
Pisidium		5	0.6	15	1.8	14	1.7	8	1.0
Procladius	Larvae	.	.	1	0.2	.	.	.	.
TOTAL		28	3.7	387	75.0	44	10.4	29	6.4

TABLE A-8 CONTINUED.

Date=05NOV and Station 11A1

Taxa	Life Stage	A No.	A Wt.	B No.	B Wt.	C No.	C Wt.	D No.	D Wt.
Ablabesmyia	Larvae	.	.	2	1.1	.	.	.	.
Arcteonais lomondi		.	.	.	.	1	.	.	.
Bothrioneurum vejdovskyanum		44	22.3	2	.	4	.	4	.
Ceratopogonidae	Larvae	5	0.4	6	1.0	1	0.2	1	0.5
Chironomus decorus	Larvae	19	11.3	39	29.3	35	18.3	36	23.0
Coelotanypus	Larvae	.	.	.	.	.	.	3	0.3
Corbicula fluminea		22	23.5	27	43.7	6	1.8	24	28.4
Cryptochironomus fulvus	Larvae	14	2.1	10	1.8	11	1.1	23	1.8
Erpobdellidae		.	.	.	.	.	.	1	30.8
Gammarus fasciatus		12	3.2	3	0.1	9	3.1	5	4.2
Helobdella elongata		1	1.3	1	0.3	.	.	.	.
Hexagenia		6	48.2	.	.	.	.	.	.
Hexagenia	Larvae	.	.	10	25.7	4	29.7	5	15.5
Hydrolimax grisea		1	0.5	5	1.4	1	1.5	3	0.3
Hydropsyche	Larvae	.	.	1	0.1	.	.	.	.
Ilyodrilus templetoni		6	.	3	.	12	1.8	4	.
Limnodrilus hoffmeisteri		97	52.4	142	26.9	55	8.3	.	.
Limnodrilus hoffmeisteri	Larvae	.	.	.	.	.	.	220	41.4
Manayunkia speciosa		2	0.1	2	0.1	3	0.2	14	0.7
Musculium transversum		19	2.3	8	1.0	14	1.7	54	6.5
Nematoda		1	0.1	.	.	.	.	.	.
Pisidium		28	2.6	40	4.8	10	1.2	50	6.0
Placobdella papillifera		.	.	.	.	1	5.8	.	.
Polypedilum scalaenum	Larvae	.	.	.	.	.	.	3	.
Procladius	Larvae	3	0.4	1	0.3	1	0.3	2	0.4
Prostoma		2	0.2	.	.	1	0.1	.	.
TOTAL		282	170.9	302	137.6	169	75.1	452	159.8

TABLE A-8 CONTINUED.

Date=05NOV 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	0.3	.	.	1	.	1	.
Bothrioneurum vejdovskyanum		.	.	3	.	9	.	2	.
Ceratopogonidae	Larvae	4	0.3	.	.	.	.	.	.
Chironomid pupae	Pupae	1	0.5	.	.	.	.	.	.
Chironomus decorus'	Larvae	52	29.0	34	16.1	55	27.4	71	40.8
Coelotanypus	Larvae	4	0.5	2	.	2	.	3	.
Corbicula fluminea		6	13.5	6	13.3	17	53.3	8	9.8
Cryptochironomus fulvus	Larvae	41	3.4	23	0.7	32	3.2	37	2.2
Dubiraphia	Larvae	.	.	.	.	1	0.3	1	0.2
Epoicocladius	Larvae	2	0.4	.	.	1	.	.	.
Fossaria	Larvae	.	.	4	.	1	.	1	.
Gammarus fasciatus		9	4.0	3	1.0	18	8.6	6	3.1
Helobdella elongata		2	1.6	.	.	.	.	.	.
Hexagenia		.	.	.	.	.	.	30	61.7
Hexagenia	Larvae	28	170.3	22	54.8	45	134.8	.	.
Hydrolimax grisea		8	0.7	.	.	2	0.2	2	0.2
Hydropsyche	Larvae	.	.	.	.	.	.	1	4.3
Ilyodrilus templetoni		8	.	2	.	18	0.4	.	.
Limnodrilus hoffmeisteri		462	62.2	504	77.3	432	60.8	301	54.1
Musculium transversum		41	4.9	25	6.5	36	4.3	17	2.0
Pisidium		4	0.5	2	0.2	8	1.0	5	0.6
Placobdella papillifera		.	.	.	.	.	.	1	.
Procladius	Larvae	.	.	2	.	2	.	1	.
Stenelmis	Larvae	.	.	.	.	.	.	1	0.2
Tubificidae		.	.	.	.	.	.	1	.
TOTAL		673	292.1	632	169.9	680	294.3	490	179.2

APPENDIX B

ICHTHYOPLANKTON DATA

TABLE B-1 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 04 APRIL 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	36.30		34.90		36.80		35.60		32.00		30.90		33.70		32.60	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Walleye	.	.	.	.	1	2.72	.	.	.	.	1	3.24	.	.	.	.
Total	0	0.00	0	0.00	1	2.72	0	0.00	0	0.00	1	3.24	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)	33.90		32.70		31.50		29.70		36.20		35.00		33.50		32.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Walleye	1	2.95	2	6.12	.	.	.	.	.	.	.	.	.	.	.	.
Total	1	2.95	2	6.12	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 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.60		30.30		34.90		33.70		33.10		31.60		32.90		31.80	
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-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)	33.80		32.70		31.40		30.00		31.10		30.00		32.90		31.40	
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-3 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 16 APRIL 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	33.20		32.30		33.40		32.70		29.50		28.40		33.00		32.40	
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-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)	33.80		33.00		33.30		32.20		32.40		31.60		36.10		35.20	
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-4 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 23 APRIL 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.90		28.30		32.20		30.90		31.40		30.30		27.00		25.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Shield darter	1	3.34	.	.	1	3.11	1	3.24	.	.	.	.	.	.	.	.
Total	1	3.34	0	0.00	1	3.11	1	3.24	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)	32.10		30.70		31.20		30.10		32.40		31.00		31.80		30.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Shield darter	3	9.35	1	3.26	.	.	.	.	.	.	.	.	.	.	.	.
Total	3	9.35	1	3.26	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 30 APRIL 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	35.00		33.60		33.50		31.90		34.20		33.00		32.80		31.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	4	11.70	2	6.06	.	.	.	.
Quillback	1	2.86	.	.	.	.	.	.	1	2.92	.	.	.	.	.	.
White sucker	.	.	.	.	1	2.99	.	.	.	.	.	.	.	.	.	.
Tessellated darter	6	17.14	7	20.83	.	.	.	.	.	.	.	.	.	.	.	.
Shield darter	.	.	1	2.98	.	.	1	3.13	.	.	1	3.03	.	.	.	.
Banded darter	2	5.71	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	9	25.71	8	23.81	1	2.99	1	3.13	5	14.62	3	9.09	0	0.00	0	0.00

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)	35.30		33.80		29.60		28.10		32.80		31.20		36.20		34.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	22	74.32	13	46.26	.	.	.	.	.	.	.	.
Spottail shiner	3	8.50	3	8.88	.	.	.	.	.	.	.	.	4	11.05	2	5.73
Quillback	.	.	.	.	.	.	1	3.56	.	.	1	3.21	.	.	.	.
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	1	2.83	.	.	3	10.14	.	.	2	6.10	1	3.21	2	5.52	1	2.87
Shield darter	.	.	1	2.96	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	4	11.33	4	11.83	25	84.46	14	49.82	2	6.10	2	6.41	6	16.57	3	8.60

TABLE B-6 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 07 MAY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.30		30.20		33.90		32.70		31.40		30.10		30.60		29.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	1	3.31	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Common carp	.	.	1	3.31	72	212.4	94	287.5	59	187.9	58	192.7	86	281.0	72	241.6
Spottail shiner	.	.	.	.	.	.	1	3.06	1	3.18	1	3.32	.	.	.	.
Quillback	3	9.58	4	13.25	12	35.40	3	9.17	6	19.11	4	13.29	7	22.88	5	16.78
Tessellated darter	6	19.17	2	6.62	4	11.80	5	15.29	.	.	3	9.97	1	3.27	.	.
Shield darter	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.	.	.
Walleye	1	3.19	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	4	12.78	3	9.93	2	5.90	.	.	3	9.55	3	9.97	.	.	1	3.36
Total	14	44.73	11	36.42	90	265.5	103	315.0	69	219.7	70	232.6	94	307.2	78	261.7

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)	35.20		33.90		33.10		31.70		33.30		32.20		30.30		29.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Common carp	29	82.39	29	85.55	1	3.02	7	22.08	.	.	2	6.21	33	108.9	31	106.5
Spottail shiner	.	.	5	14.75	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	5	14.20	3	8.85	1	3.02	1	3.15	3	9.01	3	9.32	5	16.50	2	6.87
Tessellated darter	9	25.57	4	11.80	.	.	2	6.31	4	12.01	3	9.32	.	.	3	10.31
Shield darter	2	5.68	1	2.95	.	.	1	3.15	.	.	.	.	.	.	.	.
Walleye	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.44
Banded darter	5	14.20	4	11.80	2	6.04	5	15.77	.	.	4	12.42	.	.	.	.
Total	50	142.0	46	135.7	4	12.08	16	50.47	7	21.02	12	37.27	38	125.4	37	127.1

TABLE B-7 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 14 MAY 1990.

	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		29.20		32.60		32.00		27.80		27.50		27.50		26.60	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Quillback	2	6.58	4	13.70	2	6.13	3	9.38	.	.	1	3.64	2	7.27	.	.
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	1	3.42	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	2	6.58	1	3.42	.	.	3	9.38	.	.	.	.	.	.	.	.
Shield darter	.	.	.	.	.	.	.	.	2	7.19	.	.	.	.	.	.
Banded darter	.	.	1	3.42	1	3.07	.	.	2	7.19	4	14.55	.	.	.	.
Total	4	13.16	7	23.97	3	9.20	6	18.75	4	14.39	5	18.18	2	7.27	0	0.00

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)	31.40		30.70		27.10		26.50		29.80		28.90		33.90		33.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Unidentifiable fish	.	.	.	.	.	.	.	.	1	3.36	.	.	.	.	.	.
Larvae																
Quillback	1	3.18	3	9.77	.	.	2	7.55	6	20.13	9	31.14	7	20.65	7	21.08
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.01
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	3	9.55	.	.	.	.	.	.	1	3.36	1	3.46	5	14.75	9	27.11
Shield darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	3	9.77	2	7.38	4	15.09	2	6.71	1	3.46	2	5.90	5	15.06
Total	4	12.74	6	19.54	2	7.38	6	22.64	10	33.56	11	38.06	14	41.30	22	66.27

TABLE B-8 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 21 MAY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	36.60		35.50		31.70		30.80		30.90		30.10		33.30		32.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	1	3.25	1	3.24	.	.	3	9.01	3	9.32
Quillback	13	35.52	17	47.89	4	12.62	4	12.99	10	32.36	4	13.29	1	3.00	2	6.21
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.	.	.
Tessellated darter	.	.	1	2.82	.	.	2	6.49	.	.	.	.	1	3.00	.	.
Shield darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.11
Banded darter	1	2.73	2	5.63	.	.	.	.	2	6.47	.	.	.	.	.	.
Total	14	38.25	20	56.34	4	12.62	7	22.73	13	42.07	5	16.61	5	15.02	6	18.63

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)	33.40		32.30		34.80		34.00		33.50		32.50		31.30		30.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	4	11.98	5	15.48	1	2.87	1	2.94	7	20.90	8	24.62	5	15.97	12	39.87
White sucker	.	.	.	.	1	2.87	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	2	5.97	2	6.15	1	3.19	.	.
Shield darter	.	.	.	.	.	.	1	2.94	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	8	22.99	17	50.00	1	2.99	2	6.15	.	.	1	3.32
Total	4	11.98	5	15.48	10	28.74	19	55.88	10	29.85	12	36.92	6	19.17	13	43.19

TABLE B-9 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 31 MAY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.60		28.70		29.00		28.10		29.60		28.40		28.50		27.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spottail shiner	1	3.38	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	5	16.89	14	48.78	6	20.69	8	28.47	9	30.41	11	38.73	2	7.02	1	3.60
White sucker	.	.	4	13.94	.	.	.	.	1	3.38	.	.	1	3.51	1	3.60
Northern hogsucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	2	6.97	1	3.45	.	.	.	.	1	3.52	.	.	.	.
Shield darter	1	3.38	.	.	.	.	.	.	.	.	1	3.52	.	.	.	.
Banded darter	5	16.89	3	10.45	3	10.34	1	3.56	3	10.14	2	7.04	1	3.51	1	3.60
Total	12	40.54	23	80.14	10	34.48	9	32.03	13	43.92	15	52.82	4	14.04	3	10.79

B-9

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)	29.50		28.40		28.20		27.50		31.20		30.30		29.90		29.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	1	3.30	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	10	33.90	15	52.82	2	7.09	3	10.91	12	38.46	8	26.40	28	93.65	25	85.03
White sucker	.	.	.	.	4	14.18	3	10.91	2	6.41	3	9.90	1	3.34	.	.
Northern hogsucker	.	.	.	.	2	7.09	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	.	.	.	.	3	9.90	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	1	3.30	.	.	.	.
Shield darter	.	.	.	.	.	.	.	.	.	.	.	.	1	3.34	.	.
Banded darter	1	3.39	4	14.08	1	3.55	.	.	3	9.62	6	19.80	1	3.34	3	10.20
Total	11	37.29	19	66.90	9	31.91	6	21.82	17	54.49	22	72.61	31	103.7	28	95.24

TABLE B-10 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 04 JUNE 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	29.10		29.00		33.40		32.90		34.00		33.50		31.60		30.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	.	.	1	3.45	2	5.99	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	2	6.33	2	6.47
Larvae																
Spottail shiner	.	.	.	.	.	.	2	6.08	.	.	2	5.97	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blacknose dace	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	13	44.67	7	24.14	23	68.86	22	66.87	36	105.9	43	128.4	4	12.66	4	12.94
White sucker	3	10.31	1	3.45	1	2.99	1	3.04	1	2.94	1	2.99	.	.	.	.
Northern hogsucker	.	.	3	10.34	.	.	.	.	.	.	1	2.99	.	.	1	3.24
Shorthead redhorse	.	.	2	6.90	.	.	.	.	.	.	.	.	2	6.33	3	9.71
Tessellated darter	5	17.18	6	20.69	1	2.99	.	.	2	5.88	2	5.97	.	.	1	3.24
Shield darter	1	3.44	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	5	17.18	11	37.93	2	5.99	1	3.04	1	2.94	1	2.99	.	.	.	.
Young																
Spotfin shiner	.	.	1	3.45	.	.	.	.	.	.	.	.	.	.	.	.
Total	27	92.78	32	110.3	29	86.83	26	79.03	40	117.6	50	149.3	8	25.32	11	35.60

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)	32.20		31.50		29.30		29.10		32.70		32.20		32.80		32.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Quillback	.	.	.	.	.	.	.	.	.	.	1	3.11	1	3.05	1	3.09
Unidentifiable fish	.	.	.	.	.	.	.	.	1	3.06	.	.	.	.	.	.
Larvae																
Spottail shiner	1	3.11	.	.	2	6.83	2	6.87	.	.	.	.	1	3.05	.	.
Spotfin shiner	.	.	.	.	2	6.83	1	3.44	.	.	.	.	.	.	.	.
Blacknose dace	.	.	.	.	.	.	1	3.44	.	.	.	.	.	.	.	.
Quillback	36	111.8	30	95.24	4	13.65	12	41.24	17	51.99	9	27.95	22	67.07	19	58.64
White sucker	.	.	.	.	9	30.72	5	17.18	4	12.23	6	18.63	3	9.15	1	3.09
Northern hogsucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	.	.	.	.	1	3.44	1	3.06	1	3.11	.	.	1	3.09
Tessellated darter	1	3.11	.	.	5	17.06	2	6.87	6	18.35	5	15.53	4	12.20	1	3.09
Shield darter	.	.	1	3.17	.	.	1	3.44	.	.	.	.	.	.	.	.
Banded darter	2	6.21	2	6.35	6	20.48	8	27.49	3	9.17	2	6.21	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	40	124.2	33	104.8	28	95.56	33	113.4	32	97.86	24	74.53	31	94.51	23	70.99

TABLE B-11 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 12 JUNE 1990.

	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		29.40		33.30		32.50		32.40		31.60		31.10		30.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	2	6.43	.	.
Quillback	1	3.29	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	1	3.00	1	3.08	.	.	.	.	.	.	1	3.29
Larvae																
Gizzard shad	.	.	.	.	.	.	1	3.08	1	3.09	.	.	.	.	.	.
Common carp	.	.	.	.	17	51.05	19	58.46	10	30.86	12	37.97	13	41.80	14	46.05
Spottail shiner	.	.	.	.	4	12.01	1	3.08	1	3.09	1	3.16	2	6.43	.	.
Spotfin shiner	1	3.29	1	3.40	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	2	6.58	2	6.80	2	6.01	3	9.23	5	16.43	1	3.16	.	.	.	.
Quillback	7	23.03	2	6.80	2	6.01	5	15.38	1	3.09	2	6.33	.	.	2	6.58
White sucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern hogsucker	.	.	1	3.40	1	3.00	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	2	6.58	.	.	2	6.01	.	.	.	.	.	.	.	.	1	3.29
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	5	16.08	1	3.29
Tessellated darter	.	.	4	13.61	1	3.00	1	3.08	.	.	1	3.16	1	3.22	.	.
Banded darter	2	6.58	5	17.01	3	9.01	1	3.08	1	3.09	.	.	3	9.65	.	.
Total	15	49.34	16	51.02	33	99.10	32	98.46	19	58.64	17	53.80	26	83.60	19	62.50

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)	31.90		31.00		30.60		29.80		31.80		30.80		28.10		27.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	1	3.56	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	13	40.75	9	29.03	.	.	1	3.36	.	.	.	.	3	10.68	2	7.17
Spottail shiner	2	6.27	3	9.68	1	3.27	1	3.36	.	.	3	9.74	1	3.56	1	3.58
Spotfin shiner	.	.	.	.	.	.	1	3.36	.	.	.	.	.	.	.	.
Mimic shiner	4	12.54	1	3.23	1	3.27	1	3.36	1	3.14	3	9.74	5	17.79	3	10.75
Quillback	5	15.67	3	9.68	5	16.34	4	13.42	2	6.29	3	9.74	3	10.68	1	3.58
White sucker	.	.	.	.	.	.	.	.	1	3.14	.	.	.	.	.	.
Northern hogsucker	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shorthead redhorse	.	.	2	6.45	2	6.54	1	3.36	1	3.14	2	6.49	.	.	1	3.58
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	2	6.45	1	3.27	2	6.71	1	3.14	8	25.97	8	28.47	12	43.01
Banded darter	2	6.27	1	3.23	3	9.80	3	10.07	5	15.72	1	3.25	2	7.12	.	.
Total	26	81.50	21	67.74	13	42.48	14	46.98	11	34.59	20	64.84	23	81.85	20	71.68

TABLE B-12 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 18 JUNE 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.20		32.10		33.20		32.90		32.00		31.60		32.40		32.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	1	3.12	3	9.04	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	1	3.01	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	1	3.12	.	.	.	.	.	.
Tessellated darter	.	.	1	3.12	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	2	6.23	.	.	1	3.04	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	1	3.12	100	301.2	62	188.4	61	190.6	55	174.1	33	101.9	27	83.59
Spottail shiner	1	3.11	.	.	2	6.02	3	9.12	.	.	1	3.16	.	.	.	.
Spotfin shiner	1	3.11	3	9.35	6	18.07	5	15.20	.	.	2	6.33	1	3.09	.	.
Mimic shiner	.	.	.	.	1	3.01	2	6.08	5	15.63	3	9.49	1	3.09	.	.
Quillback	.	.	1	3.12	2	6.02	3	9.12	3	9.38	2	6.33	.	.	1	3.10
Shorthead redhorse	.	.	.	.	.	.	1	3.04	.	.	.	.	.	.	.	.
Rock bass	2	6.21	5	15.58	.	.	2	6.08	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	1	3.12	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	4	12.05	5	15.20	.	.	.	.	3	9.26	1	3.10
Tessellated darter	1	3.11	.	.	1	3.01	2	6.08	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	6	18.07	3	9.12	1	3.12	.	.	.	.	1	3.10
Young																
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	5	15.53	15	46.73	126	379.5	89	270.5	71	221.9	63	199.4	38	117.3	30	92.88

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)	31.90		31.60		31.60		31.90		31.40		31.30		32.90		32.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	1	3.19	.	.	.	.
Larvae																
Gizzard shad	.	.	1	3.16	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	12	37.62	6	18.99	80	253.2	60	188.1	3	9.55	.	.	8	24.32	6	18.35
Spottail shiner	.	.	.	.	.	.	.	.	.	.	1	3.19	1	3.04	1	3.06
Spotfin shiner	.	.	.	.	2	6.33	2	6.27	3	9.55	1	3.19	.	.	.	.
Mimic shiner	3	9.40	4	12.66	.	.	.	.	.	.	1	3.19	2	6.08	2	6.12
Quillback	2	6.27	4	12.66	1	3.16	3	9.40	2	6.37	3	9.58	1	3.04	2	6.12
Shorthead redhorse	.	.	1	3.16	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	1	3.13	.	.	2	6.33	5	15.67	2	6.37	2	6.39	.	.	.	.
Redbreast sunfish	.	.	.	.	1	3.16	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tessellated darter	.	.	3	9.49	1	3.16	.	.	3	9.55	2	6.39	9	27.36	6	18.35
Banded darter	3	9.40	2	6.33	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	.	.	.	.	1	3.16	.	.	.	.	.	.	.	.	.	.
Total	21	65.83	21	66.46	88	278.5	70	219.4	13	41.40	11	35.14	21	63.83	17	51.99

TABLE B-13 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 25 JUNE 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	31.60		31.10		31.00		30.20		31.20		30.60		29.70		29.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	1	3.21	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	1	3.27	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.37	.	.
Spotfin shiner	3	9.49	.	.	2	6.45	2	6.62	.	.	2	6.54	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	1	3.21	.	.	.	.	.	.
Quillback	.	.	.	.	2	6.45	1	3.31	.	.	.	.	.	.	.	.
Rock bass	2	6.33	.	.	.	.	.	.	2	6.41	1	3.27	1	3.37	.	.
Lepomis sp	.	.	.	.	3	9.68	3	9.93	1	3.21	4	13.07	37	124.6	53	181.5
Tessellated darter	.	.	1	3.22	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	5	16.13	3	9.93	1	3.21	.	.	1	3.37	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Yellow bullhead	.	.	.	.	.	.	1	3.31	.	.	.	.	.	.	1	3.42
Channel catfish	1	3.16	1	3.22	.	.	.	.	.	.	.	.	.	.	.	.
Total	6	18.99	2	6.43	12	38.71	10	33.11	6	19.23	8	26.14	40	134.7	54	184.9

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)	31.50		30.40		24.00		24.20		32.70		32.40		30.60		29.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.36
Unidentifiable fish	.	.	.	.	.	.	.	.	2	6.12	.	.	1	3.27	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	2	6.54	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.36
Spotfin shiner	2	6.35	2	6.58	1	4.17	3	12.40	.	.	3	9.26	.	.	1	3.36
Mimic shiner	1	3.17	1	3.29	.	.	1	4.13	.	.	.	.	.	.	.	.
Quillback	.	.	1	3.29	.	.	.	.	1	3.06	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	3	12.40	.	.	1	3.09	.	.	.	.
Lepomis sp	1	3.17	5	16.45	1	4.17	1	4.13	.	.	.	.	.	.	.	.
Tessellated darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	4	12.70	2	6.58	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	1	3.09	.	.	.	.
Young																
Yellow bullhead	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	8	25.40	11	36.18	2	8.33	8	33.06	3	9.17	5	15.43	3	9.80	3	10.07

TABLE B-14 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 02 JULY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	33.30		32.80		33.40		33.20		33.90		34.00		30.00		30.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	5	16.67	.	.
Lepomis sp	.	.	.	.	.	.	1	3.01	.	.	.	.	5	16.67	2	6.64
Unidentifiable fish	.	.	.	.	.	.	.	.	1	2.95	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	4	11.98	5	15.06	.	.	4	11.76	16	53.33	17	56.48
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Comely shiner	1	3.00	1	3.05	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	3	9.15	.	.	.	.	.	.	.	.	.	.	1	3.32
Mimic shiner	.	.	.	.	1	2.99	.	.	1	2.95	.	.	1	3.33	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32
Rock bass	1	3.00	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	1	3.00	.	.	5	14.97	6	18.07	2	5.90	4	11.76	56	186.7	63	209.3
Banded darter	.	.	.	.	.	.	.	.	1	2.95	1	2.94	.	.	1	3.32
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	1	2.95	.	.	.	.	.	.
Channel catfish	9	27.03	14	42.68	8	23.95	5	15.06	5	14.75	1	2.94	1	3.33	1	3.32
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	2	6.67	1	3.32
Total	12	36.04	18	54.88	18	53.89	17	51.20	11	32.45	10	29.41	86	286.7	88	292.4

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)	34.20		34.10		29.20		29.50		32.10		31.90		32.30		31.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	1	3.12	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	4	11.70	2	5.87	.	.	.	.	.	.	1	3.13	.	.	.	.
Common carp	.	.	.	.	.	.	2	6.78	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	1	3.42	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	1	2.92	.	.	4	13.70	6	20.34	1	3.12	1	3.13	2	6.19	1	3.13
Mimic shiner	1	2.92	1	2.93	3	10.27	3	10.17	1	3.12	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	1	2.92	.	.	5	17.12	7	23.73	.	.	1	3.13	.	.	.	.
Lepomis sp	3	8.77	6	17.60	10	34.25	9	30.51	.	.	1	3.13	1	3.10	.	.
Banded darter	.	.	3	8.80	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	1	3.13	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	2	5.87	81	277.4	72	244.1	10	31.15	7	21.94	.	.	1	3.13
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	10	29.24	14	41.06	104	356.2	99	335.6	13	40.50	12	37.62	3	9.29	2	6.27

TABLE B-15 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 09 JULY 1990.

	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		30.20		32.80		32.00		30.50		29.60		29.20		28.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	1	3.42	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	21	71.92	29	102.5
Larvae																
Gizzard shad	.	.	.	.	5	15.24	4	12.50	1	3.28	1	3.38	3	10.27	11	38.87
Common carp	.	.	1	3.31	1	3.05	.	.	.	.	.	.	.	.	.	.
Golden shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	2	6.58	4	13.25	.	.	.	.	1	3.28	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	1	3.28	.	.	2	6.85	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	13	44.52	.	.
Lepomis sp	.	.	1	3.31	7	21.34	6	18.75	5	16.39	3	10.14	100	342.5	100	353.4
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	1	3.42	1	3.53
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Comely shiner	.	.	.	.	.	.	.	.	.	.	1	3.38	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.42	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	3	10.27	3	10.60
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	2	6.85	2	7.07
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	6	20.55	10	35.34
Channel catfish	.	.	2	6.62	.	.	.	.	.	.	1	3.38	.	.	.	.
Pumpkinseed	.	.	.	.	.	.	.	.	.	.	.	.	1	3.42	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	1	3.42	5	17.67
Banded darter	.	.	.	.	.	.	.	.	1	3.28	.	.	3	10.27	1	3.53
Total	2	6.58	8	26.49	13	39.63	10	31.25	9	29.51	6	20.27	158	541.1	162	572.4

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)	31.10		30.10		32.20		31.30		31.50		30.70		31.40		30.90	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	172	534.2	202	645.4	.	.	.	.	.	.	1	3.24
Larvae																
Gizzard shad	1	3.22	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Golden shiner	.	.	.	.	.	.	1	3.19	.	.	.	.	.	.	.	.
Comely shiner	.	.	.	.	1	3.11	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	1	3.11	3	9.58	.	.	.	.	.	.	.	.
Spotfin shiner	3	9.65	3	9.97	31	96.27	25	79.87	3	9.52	1	3.26	1	3.18	.	.
Mimic shiner	1	3.22	.	.	12	37.27	27	86.26	.	.	.	.	.	.	.	.
Quillback	.	.	.	.	.	.	.	.	.	.	1	3.26	.	.	.	.
Rock bass	.	.	1	3.32	1	3.11	5	15.97	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	.	.	.	.	1	3.19	.	.	.	.	.	.	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	3	9.65	.	.	100	310.6	100	319.5	3	9.52	.	.	1	3.18	2	6.47
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	1	3.22	.	.	.	.	.	.	.	.	.	.	.	.	1	3.24
Young																
Comely shiner	.	.	1	3.32	.	.	.	.	.	.	.	.	.	.	.	.
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	3	9.32	2	6.39	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	8	24.84	.	.	.	.	.	.	.	.	.	.
Channel catfish	.	.	.	.	3	9.32	3	9.58	1	3.17	.	.	.	.	1	3.24
Pumpkinseed	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	9	28.94	5	16.61	332	1031	369	1179	7	22.22	2	6.51	2	6.37	5	16.18

TABLE B-16 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 16 JULY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	28.90		28.00		32.80		32.20		33.70		32.70		30.80		30.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	1	3.57	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Spotfin shiner	1	3.46	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	1	3.46	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded killifish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Channel catfish	26	89.97	24	85.71	7	21.34	5	15.53	13	38.58	12	36.70	19	61.69	15	49.67
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.31
Total	28	96.89	25	89.29	7	21.34	5	15.53	13	38.58	12	36.70	19	61.69	16	52.98

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)	33.00		32.50		28.10		27.50		30.90		30.10		34.20		33.40	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	1	3.32	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	2	6.64	.	.	.	.
Larvae																
Spotfin shiner	.	.	1	3.08	1	3.56	1	3.64	.	.	2	6.64	.	.	.	.
Mimic shiner	.	.	.	.	.	.	1	3.64	1	3.24	.	.	.	.	.	.
Banded killifish	.	.	.	.	.	.	.	.	1	3.24	.	.	.	.	.	.
Rock bass	.	.	.	.	1	3.56	.	.	.	.	1	3.32	.	.	.	.
Lepomis sp	.	.	.	.	1	3.56	.	.	.	.	.	.	.	.	.	.
Young																
Channel catfish	4	12.12	7	21.54	8	28.47	8	29.09	19	61.49	19	63.12	14	40.94	12	35.93
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	4	12.12	8	24.62	11	39.15	10	36.36	21	67.96	25	83.06	14	40.94	12	35.93

TABLE B-17 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 24 JULY 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.20		31.70		35.50		35.20		33.20		33.30		31.10		30.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Spottail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	3	9.32	2	6.31	2	5.63	1	2.84	.	.	.	.	.	.	.	.
Quillback	.	.	1	3.15	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.25
Banded darter	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	1	3.11	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	2	6.43	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.25
Channel catfish	1	3.11	2	6.31	1	2.82	.	.	3	9.04	5	15.02	6	19.29	6	19.48
Total	5	15.53	5	15.77	3	8.45	1	2.84	3	9.04	5	15.02	8	25.72	8	25.97

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)	32.10		31.20		31.30		30.90		32.60		32.20		34.00		34.20	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	1	3.11	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	2	6.21	.	.	.	.
Larvae																
Spottail shiner	1	3.12	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	.	.	1	3.21	4	12.78	.	.	3	9.20	1	3.11	1	2.94	3	8.77
Quillback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banded darter	1	3.12	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Comely shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2.92
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel catfish	6	18.69	4	12.82	.	.	.	.	2	6.13	.	.	7	20.59	8	23.39
Total	8	24.92	5	16.03	4	12.78	0	0.00	5	15.34	4	12.42	8	23.53	12	35.09

TABLE B-18 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 01 AUGUST 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.40		31.40		32.40		31.70		29.80		29.00		31.10		30.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.26
Spotfin shiner	4	12.35	4	12.74	2	6.17	.	.	.	.	3	10.34	12	38.59	11	35.83
Mimic shiner	1	3.09	.	.	.	.	.	.	.	.	.	.	1	3.22	2	6.51
Lepomis sp	1	3.09	.	.	1	3.09	.	.	1	3.36	.	.	2	6.43	1	3.26
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	4	12.86	8	26.06
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	2	6.43	4	13.03
Mimic shiner	1	3.09	.	.	.	.	.	.	.	.	.	.	8	25.72	.	.
Channel catfish	.	.	1	3.18	.	.	.	.	.	.	.	.	1	3.22	2	6.51
Total	7	21.60	5	15.92	3	9.26	0	0.00	1	3.36	3	10.34	30	96.46	29	94.46

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)	34.60		34.30		32.40		32.00		31.80		31.00		32.80		32.30	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Unidentifiable fish	.	.	.	.	1	3.09	.	.	.	.	.	.	.	.	.	.
Larvae																
Gizzard shad	1	2.89	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	4	11.56	2	5.83	11	33.95	10	31.25	6	18.87	13	41.94	1	3.05	4	12.38
Mimic shiner	.	.	.	.	.	.	1	3.12	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	43	132.7	41	128.1	.	.	.	.	1	3.05	.	.
Unidentifiable fish	.	.	.	.	.	.	1	3.12	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	1	2.89	.	.	.	.	3	9.38	.	.	2	6.45	.	.	.	.
Spotfin shiner	.	.	.	.	12	37.04	6	18.75	4	12.58	1	3.23	1	3.05	.	.
Mimic shiner	.	.	.	.	.	.	2	6.25	.	.	.	.	.	.	.	.
Channel catfish	.	.	.	.	.	.	1	3.12	.	.	.	.	1	3.05	.	.
Total	6	17.34	2	5.83	67	206.8	65	203.1	10	31.45	16	51.61	4	12.20	4	12.38

TABLE B-19 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 06 AUGUST 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.90		32.40		33.10		33.00		32.70		32.20		28.60		28.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spotfin shiner	12	36.47	9	27.78	3	9.06	3	9.09	2	6.12	1	3.11	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	2	6.99	2	6.94
Rock bass	1	3.04	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	.	.	.	.	.	.	.	.	1	3.11	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	1	3.06	.	.	18	62.94	13	45.14
Unidentifiable fish	.	.	.	.	.	.	1	3.03	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	13	39.51	9	27.78	3	9.06	4	12.12	3	9.17	2	6.21	20	69.93	15	52.08

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)	34.70		34.10		29.60		29.50		32.10		31.70		36.00		35.80	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Common carp	.	.	.	.	.	.	.	.	.	.	1	3.15	.	.	.	.
Spotfin shiner	4	11.53	.	.	15	50.68	13	44.07	3	9.35	7	22.08	2	5.56	2	5.59
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rock bass	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Redbreast sunfish	.	.	.	.	.	.	.	.	.	.	1	3.15	.	.	.	.
Lepomis sp	.	.	.	.	6	20.27	3	10.17	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Swallowtail shiner	1	2.88	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	1	3.39	.	.	.	.	.	.	.	.
Total	5	14.41	0	0.00	21	70.95	17	57.63	3	9.35	9	28.39	2	5.56	2	5.59

TABLE B-20 NUMBER (N) AND DENSITY (N/100m^3) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 14 AUGUST 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	33.70		33.70		38.60		34.60		32.70		32.60		29.90		30.10	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Spotfin shiner	8	23.74	15	44.51	.	.	.	.	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	1	2.59	.	.	.	.	.	.	1	3.34	.	.
Lepomis sp	.	.	.	.	1	2.59	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.34	1	3.32
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.32
Total	8	23.74	15	44.51	2	5.18	0	0.00	0	0.00	0	0.00	2	6.69	2	6.64

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)	30.20		30.30		30.20		30.40		36.10		36.10		32.50		32.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	5	16.56	7	23.03	.	.	.	.	.	.	.	.
Unidentifiable fish	.	.	.	.	.	.	1	3.29	.	.	.	.	.	.	.	.
Larvae																
Spotfin shiner	.	.	.	.	13	43.05	7	23.03	3	8.31	6	16.62	.	.	1	3.08
Mimic shiner	.	.	.	.	.	.	1	3.29	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	1	3.29	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	1	3.31	.	.	.	.	.	.	.	.	.	.
Total	0	0.00	0	0.00	19	62.91	17	55.92	3	8.31	6	16.62	0	0.00	1	3.08

TABLE B-21 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 21 AUGUST 1990.

	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		29.10		29.60		29.60		30.30		29.50		29.80		29.50	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spotfin shiner	1	3.31	3	10.31	.	.	1	3.38	.	.	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	1	3.39	1	3.36	.	.
Bluegill	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3.39
Total	1	3.31	3	10.31	0	0.00	1	3.38	0	0.00	1	3.39	1	3.36	1	3.39

TABLE B-21 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)	29.40		29.10		32.20		32.40		30.30		30.00		29.80		30.00	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Larvae																
Spotfin shiner	1	3.40	.	.	4	12.42	6	18.52	3	9.90	5	16.67	.	.	1	3.33
Mimic shiner	.	.	1	3.44	.	.	.	.	.	.	2	6.67	1	3.36	.	.
Bluegill	.	.	.	.	1	3.11	.	.	.	.	.	.	.	.	.	.
Lepomis sp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	1	3.40	1	3.44	5	15.53	6	18.52	3	9.90	7	23.33	1	3.36	1	3.33

TABLE B-22 NUMBER (N) AND DENSITY ($N/100m^3$) OF ICHTHYOPLANKTON COLLECTED FROM YORK HAVEN POND ON 27 AUGUST 1990.

	TM-LF-12A1				TM-LF-16A1				TM-LF-13A2				TM-LF- 4A1			
	A		B		A		B		A		B		A		B	
Volume Sampled (m^3)	32.40		32.20		35.30		35.20		32.10		32.00		33.80		33.70	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larvae																
Spotfin shiner	2	6.17	.	.	2	5.67	2	5.68	1	3.12	.	.	.	.	.	.
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	1	2.84	.	.	.	.	.	.	.	.
Total	2	6.17	0	0.00	2	5.67	3	8.52	1	3.12	0	0.00	0	0.00	0	0.00

TABLE B-22 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)	33.60		33.10		31.40		31.40		29.80		29.90		29.30		29.00	
Taxa	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.	N	Dens.
Spotfin shiner	.	.	.	.	.	.	.	.	1	3.36	.	.	.	.	1	3.45
Larvae																
Spotfin shiner	.	.	.	.	1	3.18	1	3.18	1	3.36	.	.	.	.	1	3.45
Mimic shiner	.	.	.	.	.	.	.	.	.	.	.	.	1	3.41	.	.
Young																
Spotfin shiner	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	0	0.00	0	0.00	1	3.18	1	3.18	2	6.71	0	0.00	1	3.41	2	6.90

APPENDIX C

SEINE DATA

TABLE C-1

Fishes taken by seine on 12 April 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	%Catch
Time	1145	0815	1000	0925	0850	1050		
Air Temp(C)	6.5	3.0	5.0	5.0	3.5	6.5		
Water Temp(C)	10.3	9.7	8.3	8.4	8.3	9.3		
Dissolved Oxygen(mg/l)	11.1	10.8	11.4	11.6	11.4	10.9		
pH	7.5	7.8	6.6	7.6	7.7	7.3		
Secchi Disc(cm)	132.1	104.1	99.1	96.5	96.5	76.2		
River Stage(m)	1.81	1.81	1.81	1.81	1.81	1.81		
Weather	Partly Cloudy	Snow	Partly Cloudy	Partly Cloudy	Partly Cloudy	Over-cast		
No. of Specimens	1445	184	179	238	7	307	2360	
No. of Species	4	4	4	4	2	6	8	
No. of Hauls	3	4	5	6	5	4	27	
Golden shiner	-	1	-	-	-	-	1	+
Comely shiner	1	1	1	-	-	2	5	0.2
Swallowtail shiner	10	-	-	5	-	4	19	0.8
Spotfin shiner	590	72	143	172	5	61	1043	44.2
Mimic shiner	844	110	27	55	2	235	1273	53.9
Bluntnose minnow	-	-	-	-	-	4	4	0.2
Pumpkinseed	-	-	-	-	-	1	1	+
Tesselated darter	-	-	8	6	-	-	14	0.6

+ Less than 0.05%

TABLE C-2

Fishes taken by seine on 4 May 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0845	1225	1015	1040	1150	0935		
Air Temp(C)	13.0	14.0	13.0	13.0	15.0	13.0		
Water Temp(C)	14.8	15.5	14.9	15.2	15.2	15.3		
Dissolved Oxygen(mg/l)	9.0	11.0	9.3	9.7	9.9	9.3		
pH	8.0	7.7	7.4	7.2	7.4	7.4		
Secchi Disc(cm)	127.0	106.7	124.5	127.0	106.7	203.2		
River Stage(m)	1.30	1.30	1.30	1.30	1.30	1.30		
Weather	Over-cast	Over-cast	Over-cast	Over-cast	Over-cast	Over-cast		
No. of Specimens	1342	884	277	257	368	416	3544	
No. of Species	7	4	5	8	6	10	14	
No. of Hauls	3	3	4	6	4	4	24	
Comely shiner	1	-	1	-	-	-	2	+
Swallowtail shiner	9	1	3	20	1	45	79	2.2
Spotfin shiner	300	200	232	138	152	7	1029	29.0
Mimic shiner	1024	682	40	90	207	72	2115	59.7
Bluntnose minnow	5	1	-	1	2	33	42	1.2
White sucker	2	-	-	1	2	-	5	0.1
Banded killifish	1	-	-	-	-	-	1	+
Rock bass	-	-	-	-	-	1	1	+
Redbreast sunfish	-	-	-	1	-	20	21	0.6
Green sunfish	-	-	-	-	-	6	6	0.2
Pumpkinseed	-	-	-	-	-	222	222	6.3
Bluegill	-	-	-	-	-	6	6	0.2
Tessellated darter	-	-	1	1	4	4	10	0.3
Banded darter	-	-	-	5	-	-	5	0.1

+ Less than 0.05%.

TABLE C-3

Fishes taken by seine on 23 May 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1210	1115	0905	0945	1025	0820		
Air Temp(C)	20.0	18.5	15.0	16.5	17.0	15.0		
Water Temp(C)	16.9	17.1	15.1	15.1	15.3	14.5		
Dissolved Oxygen(mg/l)	9.1	9.2	11.1	11.5	9.5	10.8		
pH	7.1	7.2	7.8	7.8	6.7	8.1		
Secchi Disc(cm)	68.6	66.0	48.3	50.8	55.9	58.4		
River Stage(m)	1.93	1.93	1.93	1.93	1.93	1.93		
Weather	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy		
No. of Specimens	1850	194	352	515	311	193	3415	
No. of Species	7	9	7	8	7	8	16	
No. of Hauls	2	3	4	4	3	5	21	
River chub	-	-	-	1	-	-	1	+
Golden shiner	-	-	-	-	1	1	2	+
Comely shiner	2	-	-	-	-	-	2	+
Swallowtail shiner	5	1	1	34	-	11	52	1.5
Spotfin shiner	292	132	181	259	68	28	960	28.1
Mimic shiner	1447	26	123	171	129	130	2026	59.3
Bluntnose minnow	1	2	-	-	-	4	7	0.2
White sucker	91	26	30	32	69	9	257	7.5
Shorthead redhorse	-	-	6	-	-	-	6	0.2
Banded killifish	-	-	-	-	-	2	2	+
Redbreast sunfish	-	1	-	-	-	-	1	+
Pumpkinseed	-	-	-	-	-	8	8	0.2
Smallmouth bass	-	-	1	1	-	-	2	+
Tessellated darter	12	1	-	1	42	-	56	1.6
Banded darter	-	2	10	16	1	-	29	0.8
Walleye	-	3	-	-	1	-	4	0.1

+ Less than 0.05%.

TABLE C-4

Fishes taken by seine on 15 June 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1330	1230	0905	1040	1135	0950		
Air Temp(C)	22.5	21.0	18.0	19.5	20.0	18.5		
Water Temp(C)	23.2	22.7	21.6	21.7	22.1	21.3		
Dissolved Oxygen(mg/l)	8.9	10.0	8.9	9.0	9.2	8.0		
pH	7.9	7.8	7.7	7.6	7.7	7.4		
Secchi Disc(cm)	81.3	78.7	88.9	78.7	68.6	96.5		
River Stage(m)	1.35	1.35	1.35	1.35	1.35	1.35		
Weather	Partly Cloudy	Over-cast	Over-cast	Over-cast	Over-cast	Over-cast		
No. of Specimens	1714	666	325	886	645	285	4521	
No. of Species	7	10	10	11	9	13	22	
No. of Hauls	2	4	5	5	3	5	24	
American shad	-	-	-	1	-	-	1	+
Chain pickerel	-	-	-	-	-	1	1	+
Spottail shiner	-	31	45	35	105	35	251	5.6
Swallowtail shiner	3	-	-	38	-	-	41	0.9
Spotfin shiner	206	364	123	301	64	1	1059	23.4
Mimic shiner	1022	49	51	165	7	-	1294	28.6
Bluntnose minnow	4	4	-	7	-	4	19	0.4
Creek chub	-	-	-	-	-	1	1	+
Fallfish	-	8	20	4	8	5	45	1.0
White sucker	210	140	66	302	79	-	797	17.6
Northern hog sucker	-	-	-	6	-	1	7	0.2
Shorthead redhorse	-	1	-	-	1	-	2	+
Channel catfish	-	-	-	-	17	-	17	0.4
Rock bass	-	-	3	-	-	-	3	0.1
Redbreast sunfish	-	-	6	-	-	8	14	0.3
Green sunfish	-	-	-	-	-	15	15	0.3
Pumpkinseed	-	3	-	-	-	96	99	2.2
Bluegill	-	-	-	-	-	14	14	0.3
Lepomis hybrid	-	-	-	-	-	2	2	+
Smallmouth bass	-	-	1	-	-	-	1	+
Tessellated darter	260	65	9	25	358	100	817	18.1
Shield darter	-	1	1	2	-	-	4	0.1
Walleye	9	-	-	-	6	2	17	0.4

* Less than 0.05%.

TABLE C-5

Fishes taken by seine on 28 June 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1310	0850	0943	1127	1205	1030		
Air Temp(C)	30.0	25.0	26.5	29.0	30.0	27.0		
Water Temp(C)	28.2	26.3	23.9	24.9	28.2	25.8		
Dissolved Oxygen(mg/l)	12.4	14.2	9.2	9.4	8.1	11.9		
pH	8.2	8.7	7.5	7.5	7.2	7.9		
Secchi Disc(cm)	96.5	78.7	66.0	71.1	55.9	106.7		
River Stage(m)	1.19	1.19	1.19	1.19	1.19	1.19		
Weather	Partly Cloudy	Clear	Clear	Clear	Partly Cloudy	Clear		
No. of Specimens	576	374	207	276	1017	444	2894	
No. of Species	11	10	12	9	10	14	25	
No. of Hauls	3	5	5	5	3	4	25	
Comely shiner	1	-	12	-	-	1	14	0.5
Spottail shiner	-	13	40	7	671	336	1067	36.9
Swallowtail shiner	20	-	-	2	-	-	22	0.8
Spotfin shiner	58	216	100	104	3	2	483	16.7
Mimic shiner	388	-	31	30	-	5	454	15.7
Bluntnose minnow	1	1	-	7	-	3	12	0.4
Longnose dace	-	-	1	-	-	-	1	+
Fallfish	3	1	4	1	24	-	33	1.1
Quillback	-	2	-	-	-	-	2	0.1
White sucker	14	76	2	99	90	1	282	9.7
Northern hog sucker	-	-	-	-	3	-	3	0.1
Shorthead redhorse	2	-	2	-	1	-	5	0.2
Brown bullhead	-	-	-	-	16	-	16	0.6
Channel catfish	-	-	-	-	20	-	20	0.7
Rock bass	-	20	-	-	-	2	22	0.8
Redbreast sunfish	-	-	2	-	-	5	7	0.2
Green sunfish	-	-	-	-	-	5	5	0.2
Pumpkinseed	-	1	-	-	-	7	8	0.3
Bluegill	-	-	-	-	-	11	11	0.4
Lepomis hybrid	-	-	-	-	-	1	1	+
Smallmouth bass	-	12	1	-	-	10	23	0.8
Largemouth bass	-	-	-	-	-	1	1	+
Tessellated darter	83	32	10	25	188	54	392	13.5
Banded darter	-	-	2	1	-	-	3	0.1
Shield darter	1	-	-	-	-	-	1	+
Walleye	5	-	-	-	1	-	6	0.2

* Less than 0.05%.

TABLE C-6

Fishes taken by seine on 18 July 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1325	0955	1245	1050	0910	1150		
Air Temp(C)	28.5	26.5	27.0	27.0	24.5	27.5		
Water Temp(C)	24.5	23.2	23.4	23.1	22.2	23.2		
Dissolved Oxygen(mg/l)	7.7	9.3	8.3	8.0	7.8	7.4		
pH	7.2	7.7	7.0	7.1	7.2	7.2		
Secchi Disc(cm)	53.2	63.5	50.8	50.8	50.8	61.0		
River Stage(m)	1.80	1.80	1.80	1.80	1.80	1.80		
Weather	Partly Cloudy	Clear	Partly Cloudy	Clear	Clear	Partly Cloudy		
No. of Specimens	479	489	372	729	1043	683	3795	
No. of Species	19	12	15	13	12	13	25	
No. of Hauls	3	4	4	5	3	5	24	
American shad	-	-	3	2	-	-	5	0.1
Gizzard shad	2	2	-	5	3	11	23	0.6
Central stoneroller	1	-	-	-	-	-	1	+
Golden shiner	-	-	-	-	-	12	12	0.3
Comely shiner	122	1	2	2	-	2	129	3.4
Spottail shiner	2	12	79	40	43	87	263	6.9
Swallowtail shiner	2	1	4	-	-	-	7	0.2
Spotfin shiner	109	19	44	131	32	41	376	9.9
Mimic shiner	92	49	146	426	85	77	875	23.0
Bluntnose minnow	18	315	2	5	7	293	640	16.9
Fallfish	3	-	14	3	5	-	25	0.6
Quillback	4	-	-	-	-	-	4	0.1
White sucker	53	24	1	5	9	-	92	2.4
Northern hog sucker	-	1	3	2	-	-	6	0.2
Brown bullhead	-	-	-	-	-	1	1	+
Banded killifish	1	-	-	-	-	-	1	+
Rock bass	5	-	-	-	1	6	12	0.3
Redbreast sunfish	1	-	3	-	6	-	10	0.3
Green sunfish	1	-	-	-	-	-	1	+
Pumpkinseed	4	-	-	-	-	119	123	3.2
Bluegill	3	23	-	-	1	9	36	0.9
Smallmouth bass	49	16	9	9	2	12	97	2.6
Tessellated darter	7	26	56	70	849	13	1021	26.9
Banded darter	-	-	5	29	-	-	34	0.9
Shield darter	-	-	1	-	-	-	1	+

+ Less than 0.05%.

TABLE C-7

Fishes taken by seine on 14 August 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1240	1145	0935	1007	1047	0855		
Air Temp(C)	25.5	25.5	23.0	23.0	25.0	22.5		
Water Temp(C)	26.9	26.8	24.1	23.6	24.3	24.4		
Dissolved Oxygen(mg/l)	9.9	13.1	8.3	8.6	8.5	11.3		
pH	8.2	8.4	7.7	7.7	8.3	8.2		
Secchi Disc(cm)	81.3	86.4	71.1	81.3	88.9	94.0		
River Stage(m)	1.19	1.19	1.19	1.19	1.19	1.19		
Weather	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy		
No. of Specimens	189	452	99	114	1425	378	2657	
No. of Species	13	14	12	13	5	10	19	
No. of Hauls	4	5	5	6	2	4	26	
Gizzard shad	1	-	-	-	-	-	1	+
Common shiner	-	-	-	-	-	1	1	+
Spottail shiner	30	24	30	30	18	32	164	6.2
Swallowtail shiner	14	2	-	-	-	-	16	0.6
Spotfin shiner	37	279	3	28	3	-	350	13.2
Mimic shiner	27	11	4	2	-	-	44	1.6
Bluntnose minnow	32	37	-	3	-	321	393	14.8
Fallfish	-	1	3	8	-	-	12	0.4
White sucker	6	2	3	6	-	2	19	0.7
Northern hog sucker	6	-	1	1	-	-	8	0.3
Shorthead redhorse	4	1	1	2	-	1	9	0.3
Channel catfish	7	63	-	1	1374	-	1445	54.4
Redbreast sunfish	-	1	4	-	-	-	5	0.2
Green sunfish	-	-	-	-	-	3	3	0.1
Pumpkinseed	1	1	1	1	1	10	15	0.6
Bluegill	-	2	-	-	-	1	3	0.1
Smallmouth bass	6	3	9	6	-	1	25	0.9
Tessellated darter	18	25	39	23	29	6	140	5.3
Banded darter	-	-	1	3	-	-	4	0.2

+ Less than 0.05%.

TABLE C-8

Fishes taken by seine on 30 August 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0905	0947	1230	1300	1040	1140		
Air Temp(C)	22.5	22.7	25.0	25.0	23.5	24.7		
Water Temp(C)	23.5	24.3	24.2	24.2	23.7	24.5		
Dissolved Oxygen(mg/l)	7.9	8.7	9.9	9.6	8.4	9.0		
pH	7.7	7.6	7.9	7.9	7.5	8.1		
Secchi Disc(cm)	88.9	101.6	68.6	68.6	73.7	81.3		
River Stage(m)	1.31	1.31	1.31	1.31	1.31	1.31		
Weather	Clear	Clear	Partly Cloudy	Partly Cloudy	Clear	Clear		
No. of Specimens	108	487	67	414	208	226	1510	
No. of Species	12	13	11	13	8	10	20	
No. of Hauls	4	6	6	6	5	6	33	
Gizzard shad	-	-	1	-	-	-	1	0.1
Spottail shiner	7	8	8	36	-	3	62	4.1
Swallowtail shiner	6	2	-	1	-	-	9	0.6
Spotfin shiner	69	409	28	147	115	118	886	58.7
Mimic shiner	2	31	12	134	8	1	188	12.4
Bluntnose minnow	3	10	-	40	7	87	147	9.7
Fallfish	1	-	2	21	-	-	24	1.6
White sucker	4	-	-	6	5	-	15	1.0
Northern hog sucker	3	2	6	3	-	-	14	0.9
Shorthead redhorse	1	3	-	1	-	-	5	0.3
Channel catfish	-	5	1	3	33	-	42	2.8
Banded killifish	-	1	-	-	-	-	1	0.1
Rock bass	-	-	-	-	-	2	2	0.1
Redbreast sunfish	1	3	1	-	1	2	8	0.5
Green sunfish	-	-	-	-	-	2	2	0.1
Pumpkinseed	-	2	1	-	3	5	11	0.7
Bluegill	-	3	-	-	-	-	3	0.2
Smallmouth bass	2	-	4	5	-	1	12	0.8
Tessellated darter	9	8	3	16	36	5	77	5.1
Banded darter	-	-	-	1	-	-	1	0.1

TABLE C-9

Fishes taken by seine on 7 September 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1305	0905	1125	1043	0947	1210		
Air Temp(C)	30.0	24.7	27.0	25.0	24.0	29.0		
Water Temp(C)	25.6	24.7	24.3	24.2	24.3	26.2		
Dissolved Oxygen(mg/l)	11.8	10.2	8.9	8.5	8.6	11.2		
pH	8.2	8.3	8.1	7.7	7.8	8.1		
Secchi Disc(cm)	101.6	76.2	94.0	88.9	88.9	94.0		
River Stage(m)	1.14	1.14	1.14	1.14	1.14	1.14		
Weather	Partly Coudy	Over-cast	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy		
No. of Specimens	442	439	88	103	1809	60	2941	
No. of Species	10	14	6	10	6	10	21	
No. of Hauls	4	4	7	8	3	6	32	
Spottail shiner	13	5	-	9	-	-	27	0.9
Swallowtail shiner	15	-	-	-	-	-	15	0.5
Spotfin shiner	89	317	68	55	29	-	558	19.0
Mimic shiner	267	16	-	10	1	-	294	10.0
Bluntnose minnow	24	21	-	5	1	20	71	2.4
Fallfish	-	1	1	3	-	-	5	0.2
White sucker	2	-	-	1	-	3	6	0.2
Northern hog sucker	9	1	-	3	-	-	13	0.4
Shorthead redhorse	12	3	-	-	-	2	17	0.6
Channel catfish	1	-	-	-	1723	-	1724	58.6
Rock bass	-	2	-	-	-	5	7	0.2
Redbreast sunfish	-	2	2	-	-	1	5	0.2
Green sunfish	-	-	-	-	-	5	5	0.2
Pumpkinseed	-	39	-	-	10	13	62	2.1
Bluegill	-	23	-	-	-	2	25	0.8
Smallmouth bass	-	2	6	7	-	-	15	0.5
Largemouth bass	-	-	-	-	-	1	1	+
White crappie	-	1	-	-	-	-	1	+
Tessellated darter	10	6	10	7	45	8	86	2.9
Banded darter	-	-	-	3	-	-	3	0.1
Shield darter	-	-	1	-	-	-	1	+

+ Less than 0.05%.

TABLE C-10

Fishes taken by seine on 24 September 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1303	0918	1223	1042	1003	1153		
Air Temp(C)	18.0	14.0	16.5	15.0	14.7	16.5		
Water Temp(C)	16.3	15.5	15.6	14.6	14.7	17.0		
Dissolved Oxygen(mg/l)	9.8	9.1	10.0	10.0	9.9	10.3		
pH	8.1	7.8	8.2	7.6	7.7	8.5		
Secchi Disc(cm)	208.3	210.8	68.6	58.4	68.6	83.8		
River Stage(m)	1.25	1.25	1.25	1.25	1.25	1.25		
Weather	Clear	Partly Cloudy	Clear	Partly Cloudy	Partly Cloudy	Clear		
No. of Specimens	247	163	62	230	267	84	1053	
No. of Species	9	14	7	12	6	8	19	
No. of Hauls	3	5	5	8	4	6	31	
Comely shiner	-	-	-	-	2	-	2	0.2
Spottail shiner	8	65	10	36	6	8	133	12.6
Swallowtail shiner	16	-	-	-	-	-	16	1.5
Spotfin shiner	151	46	35	62	170	8	472	44.8
Mimic shiner	31	1	-	41	61	-	134	12.7
Bluntnose minnow	12	11	-	20	-	10	53	5.0
Fallfish	-	-	4	2	-	-	6	0.6
White sucker	-	1	-	-	-	2	3	0.3
Northern hog sucker	1	-	1	2	-	-	4	0.4
Shorthead redhorse	3	2	-	-	-	-	5	0.5
Channel catfish	-	1	-	1	8	-	10	0.9
Rock bass	-	3	-	25	-	6	34	3.2
Redbreast sunfish	-	1	1	-	-	2	4	0.4
Pumpkinseed	-	8	-	4	-	33	45	4.3
Bluegill	-	11	-	-	-	-	11	1.0
Smallmouth bass	1	1	10	8	-	-	20	1.9
White crappie	-	1	-	-	-	-	1	0.1
Tessellated darter	24	11	1	27	20	15	98	9.3
Shield darter	-	-	-	2	-	-	2	0.2

TABLE C-11

Fishes taken by seine on 30 October 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	1455	1005	1200	1300	1400	1055		
Air Temp(C)	15.5	10.0	12.5	15.0	15.0	11.0		
Water Temp(C)	9.3	8.7	8.8	9.6	9.9	8.3		
Dissolved Oxygen(mg/l)	10.8	10.6	10.7	10.9	10.6	10.4		
pH	7.9	8.5	7.8	8.5	8.0	7.9		
Secchi Disc(cm)	137.2	114.3	25.4	25.4	22.9	35.6		
River Stage(m)	2.05	2.05	2.05	2.05	2.05	2.05		
Weather	Clear	Clear	Clear	Clear	Clear	Clear		
No. of Specimens	1406	187	98	114	381	317	2503	
No. of Species	7	5	9	8	8	12	16	
No. of Hauls	2	5	6	7	4	5	29	
Common shiner	-	-	-	-	1	-	1	+
Spottail shiner	11	3	23	14	45	5	101	4.0
Swallowtail shiner	10	-	-	-	-	1	11	0.4
Spotfin shiner	292	87	5	13	42	6	445	17.8
Mimic shiner	1057	82	29	42	246	68	1524	60.9
Bluntnose minnow	33	8	2	1	6	105	155	6.2
Fallfish	2	-	3	2	2	2	11	0.4
Rock bass	-	-	-	-	1	6	7	0.3
Redbreast sunfish	-	-	1	-	-	-	1	+
Green sunfish	-	-	-	-	-	2	2	0.1
Pumpkinseed	-	-	-	-	-	48	48	1.9
Bluegill	1	-	-	-	-	6	7	0.3
Smallmouth bass	-	-	6	10	-	-	16	0.6
White crappie	-	-	-	-	-	1	1	+
Tessellated darter	-	7	28	18	38	67	158	6.3
Banded darter	-	-	1	14	-	-	15	0.6

+ Less than 0.05%.

TABLE C-12

Fishes taken by seine on 16 November 1990 near TMINS. Station prefix TM-SE- deleted from table.

Station	13B5	10B5	16A1	10A2	9B3	4A2	Total	% Catch
Time	0850	0925	1130	1205	0957	1045		
Air Temp(C)	8.0	7.5	12.5	17.0	8.0	10.0		
Water Temp(C)	6.4	6.3	5.6	7.6	5.7	6.1		
Dissolved Oxygen(mg/l)	11.8	11.7	12.3	12.0	12.2	12.0		
pH	8.2	8.0	8.2	7.9	7.7	8.9		
Secchi Disc(cm)	160.0	154.9	40.6	38.1	45.7	58.4		
River Stage(m)	2.00	2.00	2.00	2.00	2.00	2.00		
Weather	Clear	Clear	Clear	Clear	Clear	Clear		
No. of Specimens	140	24	20	25	22	46	277	
No. of Species	4	2	4	4	3	7	9	
No. of Hauls	3	5	7	6	4	6	31	
Spottail shiner	1	-	-	7	-	-	8	2.9
Spotfin shiner	101	17	2	3	8	20	151	54.5
Mimic shiner	37	7	2	-	5	11	62	22.4
Bluntnose minnow	1	-	1	-	-	3	5	1.8
Rock bass	-	-	-	-	-	2	2	0.7
Pumpkinseed	-	-	-	-	-	5	5	1.8
Bluegill	-	-	-	-	-	2	2	0.7
Tessellated darter	-	-	15	13	9	3	40	14.4
Banded darter	-	-	-	2	-	-	2	0.7

APPENDIX D

ELECTROFISHING DATA

TABLE D-1

Fishes taken by the AC electrofisher on 18-19 April 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1932	2025	2120	2213	2320	0020	
Duration(min)	22	23	23	28	22	35	
Air Temp(C)	8.5	8.5	7.0	5.0	5.0	2.0	
Water Temp(C)	9.9	9.8	9.8	9.8	9.9	11.4	
Dissolved Oxygen(mg/l)	11.2	11.2	11.2	11.2	11.2	11.6	
pH	8.2	7.3	7.4	8.0	7.5	7.8	
Conductivity(micromhos/cm)	190	180	200	180	150	210	
Secchi Disc(cm)	76.2	68.6	63.5	71.1	78.7	132.1	
Volts	210	215	215	215	215	210	
Amps	3.0	3.0	3.0	3.0	2.5	4.5	
Gizzard shad	-	-	-	-	-	1	1
Tiger muskie	-	-	-	-	-	1	1
Central stoneroller	-	-	-	1	-	-	1
Common carp	1	1	3	1	-	6	12
Golden shiner	-	-	-	-	-	1	1
Comely shiner	-	-	1	-	-	-	1
Spottail shiner	9	-	8	21	7	-	45
Fallfish	-	-	1	1	-	-	2
Quillback	1	2	1	1	4	3	12
Shorthead redhorse	-	-	1	-	1	-	2
Brown bullhead	-	-	-	-	-	1	1
Channel catfish	-	-	-	-	2	-	2
Rock bass	-	20	7	3	1	-	31
Redbreast sunfish	-	10	1	4	4	2	21
Green sunfish	-	7	1	3	1	1	13
Pumpkinseed	3	2	1	2	4	66	78
Bluegill	-	-	-	-	-	19	19
Lepomis hybrid	1	1	-	-	-	-	2
Smallmouth bass	1	13	3	4	14	3	38
Largemouth bass	-	-	-	-	-	3	3
White crappie	-	-	-	-	-	4	4
Black crappie	-	-	-	-	-	1	1
Tessellated darter	-	1	-	-	-	-	1
Walleye	-	-	-	1	1	-	2
No. of Specimens	16	57	28	42	39	112	294
No. of Species	5	8	11	11	10	13	22

TABLE D-2

Fishes taken by the AC electrofisher on 9-10 May 1990 near TMINS. Stations prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1950	2042	2200	2258	2355	0057	
Duration(min)	24	23	20	20	20	25	
Air Temp(C)	21.0	21.5	20.5	20.0	18.0	17.5	
Water Temp(C)	18.6	18.2	18.2	18.1	18.0	17.2	
Dissolved Oxygen(mg/l)	12.4	11.6	11.3	11.2	11.0	9.3	
pH	8.7	8.2	8.0	7.9	7.4	7.3	
Conductivity(micromhos/cm)	240	240	240	250	205	210	
Secchi Disc(cm)	81.3	73.7	68.6	66.0	106.7	88.9	
Volts	210	220	220	215	218	219	
Amps	6.0	6.5	6.0	6.0	6.0	5.5	
Gizzard shad	1	-	-	-	-	-	1
Common carp	-	1	4	-	-	3	8
Golden shiner	-	-	-	-	-	2	2
Spottail shiner	2	-	4	2	6	-	14
Spotfin shiner	1	-	-	-	-	-	1
Mimic shiner	1	-	-	-	-	-	1
Fallfish	-	-	1	-	-	-	1
Quillback	2	2	1	1	1	6	13
Shorthead redhorse	-	-	2	-	-	-	2
Channel catfish	-	3	2	3	1	-	9
Rock bass	-	9	1	-	-	-	10
Redbreast sunfish	-	40	7	-	7	1	55
Green sunfish	1	3	1	-	-	2	7
Pumpkinseed	8	3	5	1	29	31	77
Bluegill	5	-	-	-	15	9	29
Lepomis hybrid	1	-	-	-	-	-	1
Smallmouth bass	1	36	4	5	16	1	63
Largemouth bass	1	-	-	-	-	4	5
Walleye	-	-	-	-	-	1	1
No. of Specimens	24	97	32	12	75	60	300
No. of Species	10	8	11	5	7	10	18

TABLE D-3

Fishes taken by the AC electrofisher on 30-31 May 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2028	2115	2212	2312	0020	0140	
Duration(min)	20	21	25	28	28	30	
Air Temp(C)	15.0	15.3	14.0	12.0	12.5	7.5	
Water Temp(C)	16.0	16.2	16.0	16.0	17.0	14.2	
Dissolved Oxygen(mg/l)	9.6	9.8	9.3	10.0	9.1	8.8	
pH	7.9	7.6	7.2	8.0	7.8	7.3	
Conductivity(micromhos/cm)	200	200	195	200	160	190	
Secchi Disc(cm)	38.1	55.9	45.7	63.5	68.6	25.4	
Volts	220	220	220	220	218	215	
Amps	5.0	5.0	5.0	5.0	4.5	5.5	
Gizzard shad	1	-	-	-	-	-	1
Common carp	6	2	4	1	-	7	20
Golden shiner	-	-	2	-	-	-	2
Spottail shiner	3	1	1	5	2	-	12
Spotfin shiner	-	1	6	-	-	-	7
Bluntnose minnow	-	-	-	-	-	1	1
Fallfish	-	-	1	1	-	-	2
Quillback	10	6	2	5	5	8	36
Shorthead redhorse	-	-	-	1	1	-	2
Channel catfish	1	4	1	3	-	1	10
Rock bass	3	10	8	2	14	1	38
Redbreast sunfish	-	16	5	24	27	-	72
Green sunfish	-	2	-	2	1	1	6
Pumpkinseed	5	4	-	18	18	8	53
Bluegill	-	-	-	-	6	-	6
Smallmouth bass	2	25	18	19	43	2	109
Largemouth bass	-	-	-	-	-	1	1
White crappie	-	-	-	-	-	1	1
Walleye	-	-	1	-	-	-	1
No. of Specimens	31	71	49	81	117	31	380
No. of Species	8	10	11	11	9	10	19

TABLE D-4

Fishes taken by the AC electrofisher on 6-7 June 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2230	2330	0030	0142	2125	2020	
Duration(min)	28	25	30	21	26	35	
Air Temp(C)	21.5	24.0	22.5	22.0	22.5	23.0	
Water Temp(C)	21.0	21.0	21.0	20.9	21.8	20.7	
Dissolved Oxygen(mg/l)	11.4	11.2	11.2	11.0	10.7	9.2	
pH	7.9	7.7	7.7	7.6	8.3	7.9	
Conductivity(micromhos/cm)	250	225	225	225	200	250	
Secchi Disc(cm)	86.4	81.3	78.7	88.9	99.1	86.4	
Volts	220	220	220	220	220	220	
Amps	7.5	7.0	7.0	7.0	6.0	7.0	
Alewife	-	-	-	-	-	1	1
Common carp	-	-	-	-	2	-	2
Golden shiner	-	-	4	-	-	2	6
Spottail shiner	-	1	1	6	2	-	10
Swallowtail shiner	-	-	1	-	-	-	1
Spotfin shiner	6	7	10	-	7	-	30
Fallfish	-	1	-	-	-	-	1
Quillback	1	4	4	4	4	4	21
Shorthead redhorse	-	-	-	1	-	-	1
Channel catfish	1	1	1	1	-	-	4
Rock bass	-	17	7	3	1	-	28
Redbreast sunfish	-	21	23	8	3	1	56
Green sunfish	1	13	24	8	1	2	49
Pumpkinseed	27	5	13	12	22	19	98
Bluegill	7	-	2	1	16	16	42
Lepomis hybrid	2	2	-	-	-	1	5
Smallmouth bass	1	17	6	1	4	1	30
Largemouth bass	-	-	-	-	1	2	3
Walleye	-	-	-	-	5	-	5
No. of Specimens	46	89	96	45	68	49	393
No. of Species	7	10	12	10	12	9	18

TABLE D-5

Fishes taken by the AC electrofisher on 20-21 June 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2024	2113	2216	2323	0016	0115	
Duration(min)	25	23	26	23	26	30	
Air Temp(C)	21.0	21.0	22.0	20.0	19.5	19.0	
Water Temp(C)	23.9	23.9	23.8	23.8	24.4	23.9	
Dissolved Oxygen(mg/l)	7.9	8.1	7.4	7.2	8.8	7.6	
pH	7.5	7.2	7.1	6.7	7.1	7.1	
Conductivity(micromhos/cm)	275	260	275	260	250	250	
Secchi Disc(cm)	25.4	17.8	25.4	22.9	96.5	48.3	
Volts	200	215	215	200	217	217	
Amps	7.0	8.0	8.5	7.0	8.0	8.5	
Common carp	1	-	-	-	1	-	2
Golden shiner	-	-	1	-	-	3	4
Spottail shiner	4	-	4	1	3	-	12
Spotfin shiner	1	-	-	-	-	-	1
Fallfish	-	-	1	-	-	-	1
Quillback	-	2	2	-	4	1	9
Channel catfish	1	-	-	-	-	-	1
Rock bass	-	16	16	-	3	-	35
Redbreast sunfish	1	25	20	11	5	2	64
Green sunfish	-	7	2	6	-	5	20
Pumpkinseed	6	2	12	9	17	9	55
Bluegill	2	-	-	1	34	10	47
Lepomis hybrid	-	-	-	-	1	-	1
Smallmouth bass	1	97	33	15	2	1	149
Largemouth bass	1	-	-	-	-	1	2
Black crappie	-	-	-	-	2	-	2
No. of Specimens	18	149	91	43	72	32	405
No. of Species	9	6	9	6	9	8	15

TABLE D-6

Fishes taken by the AC electrofisher on 30-31 July 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	0056	2335	2222	2105	2011	0230	
Duration(min)	31	28	25	23	21	27	
Air Temp(C)	24.0	24.0	24.5	23.5	25.5	23.0	
Water Temp(C)	27.3	27.5	27.1	27.9	28.2	27.2	
Dissolved Oxygen(mg/l)	11.1	10.0	10.3	9.2	8.3	11.2	
pH	8.3	7.8	7.9	8.0	7.9	8.3	
Conductivity(micromhos/cm)	350	350	350	325	190	250	
Secchi Disc(cm)	109.2	121.9	83.8	106.7	165.1	66.0	
Volts	210	215	215	215	220	217	
Amps	11.0	11.0	13.0	11.5	6.5	8.5	
Gizzard shad	-	-	-	-	-	6	6
Common carp	-	3	2	-	1	1	7
Golden shiner	2	2	11	-	-	1	16
Spottail shiner	1	-	-	-	-	-	1
Spotfin shiner	3	23	7	8	2	2	45
Quillback	-	1	1	3	4	-	9
White sucker	-	-	2	5	-	-	7
Yellow bullhead	2	-	-	-	-	-	2
Channel catfish	-	-	-	2	1	-	3
Rock bass	3	7	15	3	2	-	30
Redbreast sunfish	9	42	43	7	7	-	108
Green sunfish	19	8	2	6	-	7	42
Pumpkinseed	14	20	37	14	8	15	108
Bluegill	8	5	4	9	10	11	47
Lepomis hybrid	-	-	-	1	-	-	1
Smallmouth bass	2	3	3	2	1	-	11
Largemouth bass	1	-	-	-	-	-	1
White crappie	-	-	-	-	-	1	1
Tessellated darter	-	-	-	1	-	-	1
Walleye	2	4	13	7	5	4	35
No. of Specimens	66	118	140	68	41	48	481
No. of Species	12	11	12	12	10	9	19

TABLE D-7

Fishes taken by the AC electrofisher on 8-9 August 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2009	2115	2239	2358	0108	0230	
Duration(min)	27	27	30	24	30	30	
Air Temp(C)	21.5	21.0	20.0	18.5	19.0	16.0	
Water Temp(C)	26.0	25.4	25.5	25.0	25.1	24.5	
Dissolved Oxygen(mg/l)	10.1	9.4	9.0	8.6	8.4	8.6	
pH	7.9	7.6	7.6	8.0	7.5	7.6	
Conductivity(micromhos/cm)	325	300	325	325	250	300	
Secchi Disc(cm)	127.0	111.8	114.3	119.4	124.5	101.6	
Volts	215	217	215	215	215	216	
Amps	9.5	10.0	10.0	11.0	8.0	9.0	
Gizzard shad	1	-	-	-	-	1	2
Northern pike	-	-	-	-	1	1	2
Common carp	1	1	-	-	1	1	4
Golden shiner	-	-	3	-	2	-	5
Spottail shiner	-	1	-	-	3	-	4
Spotfin shiner	4	14	16	7	2	4	47
Quillback	4	2	1	9	6	2	24
White sucker	-	-	1	7	-	2	10
Yellow bullhead	1	-	-	-	-	-	1
Brown bullhead	-	-	1	-	-	-	1
Channel catfish	-	1	1	1	1	-	4
Rock bass	3	5	5	-	-	-	13
Redbreast sunfish	7	99	87	31	11	-	235
Green sunfish	10	14	2	4	1	7	38
Pumpkinseed	16	23	33	13	14	29	128
Bluegill	2	2	9	17	12	7	49
Lepomis hybrid	7	2	1	-	-	-	10
Smallmouth bass	5	26	7	4	3	1	46
Largemouth bass	4	-	-	1	-	2	7
White crappie	-	-	-	1	-	-	1
Black crappie	-	-	-	-	3	3	6
Walleye	3	6	2	8	3	4	26
No. of Specimens	68	196	169	103	63	64	663
No. of Species	13	12	13	12	14	13	21

TABLE D-8

Fishes taken by the AC electrofisher on 28-29 August 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2150	2347	0054	0212	2038	1935	
Duration(min)	26	24	30	28	26	29	
Air Temp(C)	26.0	25.0	24.0	23.5	27.0	26.5	
Water Temp(C)	26.1	25.9	25.5	25.3	25.7	25.3	
Dissolved Oxygen(mg/l)	13.0	10.7	10.0	9.2	11.6	9.7	
pH	8.1	8.4	8.0	7.8	8.1	8.0	
Conductivity(micromhos/cm)	250	250	250	260	200	250	
Secchi Disc(cm)	55.9	53.3	55.9	58.4	137.2	94.0	
Volts	210	217	217	210	220	217	
Amps	8.0	8.0	9.0	8.0	6.0	8.5	
Gizzard shad	3	3	3	1	6	37	53
Northern pike	-	-	-	-	1	-	1
Muskellunge	-	-	1	-	-	-	1
Golden shiner	1	-	1	-	1	1	4
Spottail shiner	11	2	3	3	8	-	27
Swallowtail shiner	-	-	-	-	1	-	1
Spotfin shiner	7	1	3	3	-	-	14
Bluntnose minnow	-	-	-	1	-	-	1
Quillback	2	6	1	4	10	3	26
White sucker	-	1	2	16	2	1	22
Brown bullhead	1	-	-	-	-	-	1
Channel catfish	-	3	1	1	-	1	6
Rock bass	3	4	6	7	-	1	21
Redbreast sunfish	-	39	54	41	3	1	138
Green sunfish	1	6	1	3	-	5	16
Pumpkinseed	8	15	21	12	27	26	109
Bluegill	2	3	2	4	9	6	26
Lepomis hybrid	1	1	-	1	1	1	5
Smallmouth bass	1	25	15	15	3	1	60
Largemouth bass	2	-	-	1	2	2	7
White crappie	-	-	3	-	-	1	4
Walleye	5	4	13	5	11	1	39
No. of Specimens	48	113	130	118	85	88	582
No. of Species	13	13	16	15	13	14	21

TABLE D-9

Fishes taken by the AC electrofisher on 5-6 September 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1913	2030	2125	2228	2328	0030	
Duration(min)	28	23	24	26	24	27	
Air Temp(C)	24.0	25.0	24.5	24.5	23.0	21.0	
Water Temp(C)	24.2	24.1	23.9	24.1	24.5	23.9	
Dissolved Oxygen(mg/l)	11.0	10.1	10.1	9.9	9.2	10.6	
pH	8.4	8.1	7.9	8.4	7.8	8.3	
Conductivity(micromhos/cm)	325	325	340	310	190	275	
Secchi Disc(cm)	101.6	76.2	91.4	81.3	94.0	81.3	
Volts	215	215	215	210	220	215	
Amps	9.0	10.5	10.5	10.0	6.5	8.5	
American shad	-	1	-	-	-	-	1
Gizzard shad	2	-	-	2	-	3	7
Northern pike	-	-	-	-	1	-	1
Muskellunge	-	-	-	-	-	1	1
Common carp	-	-	-	-	1	2	3
Golden shiner	-	-	2	-	1	-	3
Spottail shiner	-	-	3	5	2	-	10
Spotfin shiner	3	3	-	5	-	1	12
Bluntnose minnow	-	-	-	-	-	1	1
Quillback	3	3	4	1	11	6	28
White sucker	4	3	11	25	4	1	48
Shorthead redhorse	2	-	2	-	-	-	4
Brown bullhead	1	-	-	-	-	-	1
Channel catfish	-	2	6	2	1	-	11
Rock bass	3	7	1	2	-	-	13
Redbreast sunfish	14	23	35	17	2	-	91
Green sunfish	20	7	-	3	-	2	32
Pumpkinseed	22	5	3	-	10	13	53
Bluegill	15	3	-	2	6	7	33
Lepomis hybrid	3	1	-	-	-	-	4
Smallmouth bass	10	11	7	2	3	-	33
Largemouth bass	5	-	-	-	1	-	6
Black crappie	-	-	1	1	-	-	2
Shield darter	-	1	-	-	-	-	1
Walleye	10	6	18	3	10	2	49
No. of Specimens	117	76	93	70	53	39	448
No. of Species	14	13	12	13	13	11	24

TABLE D-10

Fishes taken by the AC electrofisher on 25-26 September 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2302	0040	0141	2120	2006	1842	
Duration(min)	33	25	29	30	32	32	
Air Temp(C)	13.7	13.0	13.0	13.7	14.0	15.0	
Water Temp(C)	16.5	16.5	16.5	16.5	17.0	16.8	
Dissolved Oxygen(mg/l)	11.7	11.8	12.2	11.6	10.1	10.8	
pH	8.3	8.4	8.3	8.9	7.7	8.1	
Conductivity(micromhos/cm)	330	340	340	350	198	270	
Secchi Disc(cm)	58.4	50.8	63.5	61.0	182.9	177.8	
Volts	215	215	218	215	218	217	
Amps	7.5	5.5	6.0	9.5	5.5	7.5	
American shad	1	7	-	-	-	-	8
Gizzard shad	-	1	-	-	-	12	13
Common carp	-	1	-	2	-	-	3
Golden shiner	1	-	4	-	2	7	14
Comely shiner	-	-	-	-	1	-	1
Spottail shiner	4	-	5	7	14	4	34
Spotfin shiner	1	1	1	2	2	2	9
Fallfish	-	-	-	2	-	-	2
Quillback	9	7	-	4	4	-	24
White sucker	5	-	4	4	6	-	19
Shorthead redhorse	-	-	-	-	2	-	2
Channel catfish	-	2	5	3	4	-	14
Rock bass	5	9	17	13	3	-	47
Redbreast sunfish	6	21	26	6	3	-	62
Green sunfish	8	8	3	3	2	9	33
Pumpkinseed	28	3	22	2	16	67	138
Bluegill	5	1	-	-	-	26	32
<u>Lepomis</u> hybrid	1	-	-	-	-	-	1
Smallmouth bass	4	10	8	12	5	2	41
Largemouth bass	5	-	-	-	-	10	15
White crappie	-	-	-	-	1	2	3
Black crappie	-	-	-	-	10	1	11
Yellow perch	-	-	-	-	1	-	1
Walleye	12	7	9	7	5	5	45
No. of Specimens	95	78	104	67	81	147	572
No. of Species	14	13	11	13	17	12	23

TABLE D-11

Fishes taken by the AC electrofisher on 3-4 October 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	1830	2000	2113	2221	2329	0025	
Duration(min)	31	25	27	22	26	30	
Air Temp(C)	17.0	17.0	15.0	13.5	15.0	14.5	
Water Temp(C)	17.4	17.4	17.2	17.1	17.5	16.9	
Dissolved Oxygen(mg/l)	10.8	11.0	10.8	10.9	10.0	9.8	
pH	8.3	7.9	8.5	8.2	8.4	8.1	
Conductivity(micromhos/cm)	360	325	350	350	210	300	
Secchi Disc(cm)	114.3	83.8	88.9	94.0	261.6	111.8	
Volts	215	215	215	215	218	217	
Amps	9.5	9.5	9.5	10.0	6.0	7.0	
American shad	-	5	-	3	-	-	8
Gizzard shad	-	5	3	-	-	10	18
Muskellunge	-	-	1	-	1	-	2
Common carp	-	1	-	1	-	1	3
River chub	-	1	-	-	-	-	1
Golden shiner	-	-	1	-	1	9	11
Spottail shiner	3	2	4	5	1	-	15
Spotfin shiner	-	-	2	1	6	3	12
Mimic shiner	2	-	-	-	-	-	2
Bluntnose minnow	1	-	-	-	-	-	1
Fallfish	-	1	3	-	4	-	8
Quillback	5	5	-	2	11	4	27
White sucker	12	-	1	11	11	14	49
Northern hog sucker	-	9	1	-	-	-	10
Shorthead redhorse	1	-	-	1	-	-	2
Yellow bullhead	2	1	-	-	-	-	3
Brown bullhead	-	-	-	-	-	1	1
Channel catfish	-	5	5	1	1	2	14
Rock bass	3	6	5	6	3	1	24
Redbreast sunfish	14	39	36	1	-	-	90
Green sunfish	35	16	2	5	1	8	67
Pumpkinseed	42	8	2	7	6	35	100
Bluegill	7	1	1	-	-	14	23
Lepomis hybrid	5	1	-	-	-	-	6
Smallmouth bass	2	17	16	8	3	1	47
Largemouth bass	4	-	-	-	-	10	14
White crappie	-	-	-	2	-	1	3
Black crappie	-	1	-	-	-	2	3
Tessellated darter	1	3	-	-	-	-	4
Walleye	14	8	10	10	10	4	56
No. of Specimens	153	135	93	64	59	120	624
No. of Species	16	19	16	15	13	17	29

TABLE D-12

Fishes taken by the AC electrofisher on 8-9 November 1990 near TMINS. Station prefix TM-EL- deleted from table.

Station	4A1	13A1	10A3	9B5	10B3	11B1	Total
Time	2044	2200	2311	0007	1941	1757	
Duration(min)	29	25	25	21	24	30	
Air Temp(C)	0.0	0.3	1.0	-1.0	0.3	3.0	
Water Temp(C)	8.8	9.5	9.2	8.5	9.0	9.4	
Dissolved Oxygen(mg/l)	10.6	10.9	11.4	10.8	11.0	11.2	
pH	7.7	8.4	7.8	7.7	8.0	8.3	
Conductivity(micromhos/cm)	250	225	225	225	200	250	
Secchi Disc(cm)	94.0	68.6	78.7	73.7	147.3	167.6	
Volts	210	210	206	210	207	210	
Amps	4.0	4.0	5.0	4.5	3.0	5.5	
Gizzard shad	-	-	4	6	-	-	10
Muskellunge	-	-	-	-	-	1	1
Common carp	-	2	-	-	-	-	2
Golden shiner	1	1	-	-	-	1	3
Spottail shiner	1	-	6	7	2	10	26
Spotfin shiner	-	-	-	1	-	-	1
Quillback	-	1	9	3	4	2	19
Channel catfish	-	-	-	-	-	1	1
Rock bass	-	25	10	3	4	3	45
Redbreast sunfish	3	27	5	9	3	-	47
Green sunfish	6	10	-	3	1	3	23
Pumpkinseed	41	-	-	-	2	119	162
Bluegill	-	-	-	-	1	36	37
Lepomis hybrid	-	2	-	-	-	1	3
Smallmouth bass	-	28	2	-	2	-	32
Largemouth bass	-	-	-	-	-	19	19
White crappie	-	-	-	-	-	3	3
Black crappie	-	1	-	-	-	4	5
Walleye	3	6	8	4	4	-	25
No. of Specimens	55	103	44	36	23	203	464
No. of Species	6	9	7	8	9	12	18

TABLE E- 1 Creel data reported for each survey day in April 1980, at the General Reservoir.

Day	5 Thursday			8 Sunday			21 Saturday			25 Wednesday			
River Stage	1.73			2.12			1.56			1.50			
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	Clear	Prt cldy	Prt cldy	Fog	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	
Air Temp (C)	8.50	13.50	14.00	6.70	6.30	12.70	13.00	17.00	16.00	13.50	18.00	19.50	
Water Temp (C)	8.30	9.00	8.70	7.70	8.70	8.70	12.30	13.50	13.50	17.00	17.30	18.00	
Anglers	1	7	3	30	48	9	22	23	14	10	4	14	
Fish Caught	0	0	1	15	23	0	19	39	3	24	10	10	
Fish Kept	0	0	0	0	0	0	1	3	0	1	3	1	
Hours Fished	0.50	4.91	5.50	88.00	253.8	5.83	39.75	62.50	15.75	15.50	17.00	18.34	
Catch/Effort (h)	0.00	0.00	0.18	0.17	0.09	0.00	0.48	0.62	0.19	1.55	0.59	0.55	

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
																									1		1
Muskellunge									1															1		1	1
Ictalurus sp																				1						1	1
Channel catfish																					1				1		1
Rock bass													2		2							3			4	3	7
Bluegill					1		14		22				16	1	34	3	3		22		6		9		127	4	131
Smallmouth bass							1																		1		1
Largemouth bass																			1						1		1
Walleye																											

Totals Per Day

	5 Thursday	8 Sunday	21 Saturday	25 Wednesday	Totals
Anglers	11	87	59	28	185
Fish Caught	1	38	61	44	144
Fish Kept	0	0	4	5	9
Hours Fished	10.91	347.6	118.0	50.84	527.3
Catch/Effort (h)	0.09	0.11	0.52	0.87	0.27

K = Kept
R = Released
C = Total catch

TABLE E- 2 Creel data reported for each survey day in April 1990, at the West Dam.

Day River Stage	5 Thursday 1.73			8 Sunday 2.12			21 Saturday 1.56			25 Wednesday 1.50			
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	Prt cldy	Prt cldy	Prt cldy	Fog	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	
Air Temp (C)	8.30	13.00	13.00	6.50	8.00	10.70	13.00	15.00	16.00	14.00	18.00	24.70	
Water Temp (C)	7.50	8.00	8.00	7.30	7.30	7.50	11.00	12.50	13.50	15.50	16.00	17.50	
Anglers	0	0	0	0	0	0	0	4	2	1	0	3	
Fish Caught	.	.	.	.	.	.	.	2	8	2	.	4	
Fish Kept	.	.	.	.	.	.	.	.	.	.	.	.	
Hours Fished	.	.	.	.	.	.	.	0.68	3.00	1.50	.	1.50	
Catch/Effort (h)	.	.	.	.	.	.	.	2.94	2.67	1.33	.	2.67	

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																							1		1		1
Smallmouth bass															2		4		1				2		9		9
Largemouth bass																	1								1		1
Walleye																	3		1				1		5		5

Totals Per Day

	5 Thursday	8 Sunday	21 Saturday	25 Wednesday	Totals
Anglers	0	0	6	4	10
Fish Caught	.	.	10	6	16
Fish Kept	.	.	0	0	0
Hours Fished	.	.	3.68	3.00	6.68
Catch/Effort (h)	.	.	2.72	2.00	2.40

K = Kept
R = Released
C = Total catch

TABLE E- 3 Creel data reported for each survey day in April 1990, at the East Dam.

Day / River Stage	5 Thursday 1.73			8 Sunday 2.12			21 Saturday 1.56			25 Wednesday 1.50			
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	Prt cldy	Prt cldy	Clear	Fog	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	
Air Temp (C)	10.00	13.00	15.00	4.00	8.70	12.00	12.50	16.00	18.00	14.00	17.80	26.00	
Water Temp (C)	7.00	8.50	9.00	7.00	8.30	8.70	14.00	12.70	13.50	16.50	17.20	17.70	
Anglers	1	3	5	3	0	2	5	10	10	8	6	3	
Fish Caught	2	18	6	2	.	1	11	22	25	35	53	42	
Fish Kept	.	0	3	0	.	.	0	2	0	3	14	0	
Hours Fished	2.25	3.50	4.00	2.00	.	3.00	7.00	7.00	43.00	18.25	19.25	4.25	
Catch/Effort (h)	0.89	5.14	1.50	1.00	.	0.33	1.57	3.14	0.58	1.92	2.75	9.88	

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
Muskellunge			1																						1		1
Common carp					1						1												2		4		4
Fallfish																	1								1		1
Rock bass															1				3	3	2	10	21		27	13	40
Lepomis sp																2										2	2
Pumpkinseed						3																4				7	7
Bluegill													1												1		1
Smallmouth bass			5										4		15		16		25		33		13		111		111
Walleye	2		12		2		2						6		4		8		4		4		6		50		50

Totals Per Day

	5 Thursday	8 Sunday	21 Saturday	25 Wednesday	Totals
Anglers	9	5	25	17	56
Fish Caught	26	3	58	130	217
Fish Kept	3	0	2	17	22
Hours Fished	9.75	5.00	57.00	41.75	113.5
Catch/Effort (h)	2.67	0.60	1.02	3.11	1.91

K = Kept
R = Released
C = Total catch

TABLE E- 4 Creel data reported for each survey day in April 1990, at the York Haven Generating Station.

Day	5 Thursday			8 Sunday			21 Saturday			25 Wednesday			
River Stage	1.73			2.12			1.56			1.50			
	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	Prt cldy	Clear	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	
Air Temp (C)	12.00	16.00	14.00	7.50	11.50	11.50	14.00	17.00	16.30	16.00	21.00	26.00	
Water Temp (C)	8.70	8.70	9.00	8.00	9.00	9.50	14.00	15.00	14.70	17.30	18.50	18.00	
Anglers	1	1	6	8	4	8	3	22	23	12	8	6	
Fish Caught	1	1	14	2	0	4	1	20	47	41	54	9	
Fish Kept	-	-	1	0	0	1	1	2	10	19	15	0	
Hours Fished	1.50	5.50	15.50	6.75	5.83	5.84	1.50	41.75	73.75	21.75	40.00	12.50	
Catch/Effort (h)	0.67	0.18	0.90	0.30	0.00	0.68	0.67	0.48	0.64	1.89	1.35	0.72	

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				2								5		12				1	2			22	2	24
Quillback																					3				3		3
White sucker												1									1				1	1	2
Channel catfish											3														3		3
Rock bass					1												4	3		14		6	1		6	23	29
Lepomis sp															2		6				2				10		10
Redbreast sunfish																		2								2	2
Bluegill															1	2	1	5				7	2		4	14	18
Smallmouth bass					1									1	7		12		12	3	27		5		64	4	68
Largemouth bass																			1		1				2		2
Pomoxis sp															2				9		3				14		14
Black crappie																				2						2	2
Yellow perch						1																				1	1
Walleye					11										1		2				1		1		16		16

Totals Per Day

	5 Thursday	8 Sunday	21 Saturday	25 Wednesday	Totals
Anglers	8	20	48	28	104
Fish Caught	16	6	68	104	194
Fish Kept	1	1	13	34	49
Hours Fished	22.50	18.42	117.0	74.25	232.2
Catch/Effort (h)	0.71	0.33	0.58	1.40	0.84

K = Kept
R = Released
C = Total catch

TABLE E- 5 Creel data reported for each survey day in May 1990, at the General Reservoir.

Day / River Stage	3 Thursday 1.32			12 Saturday 1.91			15 Tuesday 1.90			20 Sunday 2.34			
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	Overcast	Overcast	Prt cldy	Overcast	Lt rain	Prt cldy	Prt cldy	Overcast	Overcast	Prt cldy	Overcast	
Air Temp (C)	13.00	14.00	11.50	12.70	15.00	14.70	19.00	25.00	18.00	16.00	23.50	19.50	
Water Temp (C)	17.00	17.00	17.00	15.00	16.00	14.80	17.50	17.50	17.50	17.00	17.50	17.80	
Anglers	6	5	7	29	18	9	8	13	0	29	14	15	
Fish Caught	7	17	12	7	6	2	1	7	.	11	15	2	
Fish Kept	.	0	1	0	1	1	0	1	.	1	1	0	
Hours Fished	9.66	7.50	10.08	81.00	23.00	20.00	10.25	22.00.	.	90.50	72.18	13.75	
Catch/Effort (h)	0.72	2.27	1.19	0.09	0.26	0.10	0.10	0.32	.	0.12	0.21	0.15	

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						1				1					1	4	5
Rock bass			4																		1	1			5	1	6
Lepomis sp	1		2						1		1				3								1		9		9
Smallmouth bass	6		10		11		7		3			1	1		3				9		13				63	1	64
Largemouth bass																			1						1		1
Yellow perch			1																						1		1
Walleye																							1		1		1

Totals Per Day

	3 Thursday	12 Saturday	15 Tuesday	20 Sunday	Totals
Anglers	18	56	21	58	153
Fish Caught	36	15	8	28	87
Fish Kept	1	2	1	2	6
Hours Fished	27.24	124.0	32.25	176.4	359.9
Catch/Effort (h)	1.32	0.12	0.25	0.16	0.24

K = Kept
R = Released
C = Total catch

TABLE E- 6 Creel data reported for each survey day in May 1990, at the West Dam.

Day	3 Thursday	12 Saturday	15 Tuesday	20 Sunday	
River Stage	1.32	1.91	1.90	2.34	

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	Overcast	Lt rain	Prt cldy	Overcast	Overcast	Prt cldy	Prt cldy	Overcast	Prt cldy	Prt cldy	Overcast	
Air Temp (C)	12.50	12.00	11.00	12.50	15.00	14.50	17.50	22.30	19.00	17.00	18.20	17.00	
Water Temp (C)	17.50	17.00	16.00	14.00	14.60	14.00	17.50	16.70	16.70	16.00	17.50	17.80	
Anglers	0	0	3	1	0	0	1	0	2	0	0	0	
Fish Caught	.	.	12	3	.	.	3	.	0	.	.	.	
Fish Kept	.	.	.	.	.	.	.	.	0	.	.	.	
Hours Fished	.	.	6.00	2.25	.	.	0.75	.	1.00	.	.	.	
Catch/Effort (h)	.	.	2.00	1.33	.	.	4.00	.	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
Quillback													3												3		3
Channel catfish							3																		3		3
Smallmouth bass					10																				10		10
Walleye					2																				2		2

Totals Per Day

	3 Thursday	12 Saturday	15 Tuesday	20 Sunday	Totals
Anglers	3	1	3	0	7
Fish Caught	12	3	3	.	18
Fish Kept	0	0	0	.	0
Hours Fished	6.00	2.25	1.75	.	10.00
Catch/Effort (h)	2.00	1.33	1.71	.	1.80

K = Kept
R = Released
C = Total catch

TABLE E- 7 Creel data reported for each survey day in May 1990, at the East Dam.

Day	3 Thursday			12 Saturday			15 Tuesday			20 Sunday			Totals
River Stage	1.32			1.91			1.90			2.34			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	
Weather	Overcast	Lt rain	Lt rain	Prt cldy	Overcast	Overcast	Prt cldy	Prt cldy	Overcast	Prt cldy	Prt cldy	Overcast	
Air Temp (C)	14.50	11.50	11.00	13.50	14.50	12.80	20.00	22.00	21.00	15.00	18.00	20.10	
Water Temp (C)	17.30	16.70	16.30	13.00	13.00	13.20	15.50	17.70	17.50	16.50	17.00	17.50	
Anglers	2	2	4	2	8	5	0	2	4	8	4	13	
Fish Caught	3	1	14	17	10	7	.	2	61	32	24	57	
Fish Kept	0	.	.	3	5	.	.	.	7	4	13	36	
Hours Fished	1.25	1.50	3.34	5.00	17.25	5.00	.	3.50	19.00	20.67	14.25	42.50	
Catch/Effort (h)	2.40	0.67	4.19	3.40	0.58	1.40	.	0.57	3.21	1.55	1.68	1.34	

Species

Species	Thu Morning R	K	Thu Midday R	K	Thu Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K
Rainbow trout												
Muskellunge												
Common carp							1					
Channel catfish							2				1	
Rock bass							2					
Lepomis sp												
Green sunfish										1		
Pumpkinseed										1		
Bluegill									2			
Smallmouth bass	3		1		14		2				4	
Largemouth bass									1			
Pomoxis sp												
White crappie												
Walleye							7	3	2	3	2	

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	Totals R	K	C
Rainbow trout												1		1	1
Muskellunge			1										1		1
Common carp													1		1
Channel catfish							1						4		4
Rock bass					5	3		1		6	2	22	9	32	41
Lepomis sp					5					1	4		9	1	10
Green sunfish														1	1
Pumpkinseed										1		5		7	7
Bluegill								1		4	2	6	4	11	15
Smallmouth bass					22		18		10		3		77		77
Largemouth bass					2								3		3
Pomoxis sp					2								2		2
White crappie								1		1		1		3	3
Walleye			1		18	4	9	1	1		10	1	50	12	62

Totals Per Day

	3 Thursday	12 Saturday	15 Tuesday	20 Sunday	Totals
Anglers	8	15	6	25	54
Fish Caught	18	34	63	113	228
Fish Kept	0	8	7	53	68
Hours Fished	6.09	27.25	22.50	77.42	133.3
Catch/Effort (h)	2.96	1.25	2.80	1.46	1.71

K = Kept
R = Released
C = Total catch

TABLE E- 8 Creel data reported for each survey day in May 1990. at the York Haven Generating Station.

Day / River Stage	3 Thursday 1.32			12 Saturday 1.91			15 Tuesday 1.90			20 Sunday 2.34			
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	Overcast	Overcast	Overcast	Overcast	Overcast	Prt cldy	Prt cldy	Overcast	Prt cldy	Lt rain	Lt rain	
Air Temp (C)	12.00	14.00	13.00	16.00	16.00	14.50	21.50	21.50	20.50	19.00	18.00	17.30	
Water Temp (C)	16.50	16.50	16.30	15.00	15.20	15.00	17.70	18.00	18.30	19.50	19.00	19.00	
Anglers	12	1	6	17	17	8	14	7	27	22	30	13	
Fish Caught	9	0	27	7	13	6	37	2	89	17	14	71	
Fish Kept	0	0	10	2	4	4	15	0	42	7	2	45	
Hours Fished	11.64	0.17	19.00	17.84	37.50	23.50	28.75	15.25	40.75	35.84	43.59	41.75	
Catch/Effort (h)	0.76	0.00	1.42	0.39	0.35	0.26	1.29	0.13	2.18	0.47	0.32	1.70	

Species

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						1				1		6		1		1		2		3				17		17
Yellow bullhead																								1		1	1
Channel catfish					2	10	1	2	3	3		4	1	1				10					1	3	8	33	41
Rock bass							1		4				6	9			39	26		5	4	2	8	20	64	62	126
Lepomis sp	1						2																1	20	4	20	24
Redbreast sunfish														2				4		1						7	7
Bluegill													1	1	1										2	1	3
Smallmouth bass					12				1				3				4		4				15		39		39
Largemouth bass	1																								1		1
White crappie														1				1		1						3	3
Yellow perch	1																								1		1
Walleye	4				3				1	1	1		3	1			3	1	4		5		1	1	25	4	29

Totals Per Day

	3 Thursday	12 Saturday	15 Tuesday	20 Sunday	Totals
Anglers	19	42	48	65	174
Fish Caught	36	26	128	102	292
Fish Kept	10	10	57	54	131
Hours Fished	31.01	78.84	84.75	121.2	315.8
Catch/Effort (h)	1.16	0.33	1.51	0.84	0.92

K = Kept
R = Released
C = Total catch

TABLE E-9 Creel data reported for each survey day in June 1980, at the General Reservoir.

Day	1 Friday			10 Sunday			18 Monday			30 Saturday			
River Stage	1.86			1.47			1.39			1.17			
Time - Morning (0800-1300), 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	Clear	Prt cldy	Prt cldy	Haze	Haze	Overcast	Clear	Prt cldy	Prt cldy	
Air Temp (C)	21.00	25.00	24.00	27.50	25.00	26.00	26.00	30.50	25.00	28.80	29.00	30.50	
Water Temp (C)	17.00	18.00	17.50	21.50	21.50	21.50	25.00	26.50	26.00	27.70	28.00	28.50	
Anglers	10	5	2	51	57	22	15	13	1	54	23	18	
Fish Caught	4	11	1	54	8	17	30	19	12	86	62	23	
Fish Kept	0	.	.	4	1	1	11	1	3	11	1	2	
Hours Fished	8.00	21.50	2.00	117.3	82.41	76.51	30.74	40.00	6.00	134.4	96.50	25.51	
Catch/Effort (h)	0.50	0.51	0.50	0.46	0.10	0.22	0.98	0.47	2.00	0.64	0.64	0.90	

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
Rainbow trout								1																		1	1
Common carp							1																		1		1
Channel catfish					1		1						1	3						4	6	1	1	1	10	9	19
Rock bass							4				2		3	4					1		2		2	1	14	5	19
Lepomis sp									1	1	3	1	4	3	6		5		2	2	3		5		29	7	36
Bluegill											1							1	3						4	1	5
Smallmouth bass	4		11				36	1	6		10		11	1	12	1	4	2	69	5	50		13		226	10	236
Walleye							8	2																	8	2	10

Totals Per Day

	1 Friday	10 Sunday	18 Monday	30 Saturday	Totals
Anglers	17	130	29	95	271
Fish Caught	16	78	61	171	327
Fish Kept	0	6	15	14	35
Hours Fished	31.50	276.3	76.74	256.4	640.9
Catch/Effort (h)	0.51	0.29	0.79	0.67	0.51

K = Kept
R = Released
C = Total catch

TABLE E-10 Creel data reported for each survey day in June 1990, at the West Dam.

Day	1 Friday			10 Sunday			18 Monday			30 Saturday			
River Stage	1.86			1.47			1.39			1.17			
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	Haze	Haze	Overcast	Clear	Prt cldy	Prt cldy	
Air Temp (C)	21.50	23.50	23.50	24.20	24.00	23.20	25.00	28.00	25.00	28.00	28.30	29.00	
Water Temp (C)	18.10	19.80	19.50	21.00	21.00	22.00	24.30	25.30	25.50	27.50	27.50	28.00	
Anglers	1	1	0	0	0	0	0	2	2	13	5	13	
Fish Caught	10	24	.	.	.	.	.	4	2	63	57	36	
Fish Kept	.	.	.	.	.	.	.	4	.	12	7	4	
Hours Fished	2.00	5.75	.	.	.	.	.	4.00	1.50	23.99	9.50	18.25	
Catch/Effort (h)	5.00	4.17	.	.	.	.	.	1.00	1.33	2.63	6.00	1.97	

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			20																						20		20
Yellow bullhead																	1								1		1
Channel catfish																4	1		19	10	23	6	14	2	57	22	79
Rock bass																				2	11		3		14	2	16
Lepomis sp																							1		1		1
Smallmouth bass	8		3																28		12	1	14	1	65	2	67
Walleye	2		1																4		4			1	11	1	12

Totals Per Day

	1 Friday	10 Sunday	18 Monday	30 Saturday	Totals
Anglers	2	0	4	31	37
Fish Caught	34	.	6	156	196
Fish Kept	0	.	4	23	27
Hours Fished	7.75	.	5.50	51.74	64.99
Catch/Effort (h)	4.39	.	1.09	3.02	3.02

K = Kept
R = Released
C = Total catch

TABLE E-11 Creel data reported for each survey day in June 1990, at the East Dam.

Day / River Stage	1 Friday 1.86			10 Sunday 1.47			18 Monday 1.39			30 Saturday 1.17			
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	Prt cldy	Prt cldy	Prt cldy	Haze	Haze	Overcast	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	19.00	24.00	24.00	23.50	25.00	23.30	23.50	25.50	28.50	25.00	27.00	27.50	
Water Temp (C)	15.50	17.00	19.00	20.30	20.50	20.30	23.70	25.00	26.00	27.70	29.00	31.50	
Anglers	4	2	0	6	12	9	3	2	3	8	0	5	
Fish Caught	79	0	.	3	7	12	20	24	7	37	.	16	
Fish Kept	3	0	.	0	4	8	1	1	.	5	.	.	
Hours Fished	9.75	0.75	.	5.00	18.91	22.25	4.83	8.00	7.50	27.00	.	11.00	
Catch/Effort (h)	8.10	0.00	.	0.60	0.37	0.54	4.14	3.00	0.93	1.37	.	1.45	

Species

Species	Fri Morning R	K	Fri Midday R	K	Fri Evening R	K	Sun Morning R	K	Sun Midday R	K	Sun Evening R	K	Mon Morning R	K	Mon Midday R	K	Mon Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Totals R	K	C
Gizzard shad	30																								30		30
Brook trout																				3						3	3
Muskellunge	1																								1		1
Common carp													4		4				2				1		11		11
Yellow bullhead												1														1	1
Channel catfish										2	3	6		1	5				3						11	9	20
Rock bass							2										4		1						7		7
Lepomis sp									2										5				5		12		12
Redbreast sunfish												1														1	1
Green sunfish										1																1	1
Pumpkinseed										1																1	1
Bluegill	1														1				3						5		5
Smallmouth bass	15						1		1		1		14		13	1			18	2			8		72	3	75
Largemouth bass	1																						1		2		2
Pomoxis sp																	2								2		2
White crappie	4																								4		4
Yellow perch	1																								1		1
Walleye	23	3											1				1								25	3	28

Totals Per Day

	1 Friday	10 Sunday	18 Monday	30 Saturday	Totals
Anglers	6	27	9	13	54
Fish Caught	79	22	51	53	205
Fish Kept	3	12	2	5	22
Hours Fished	10.50	46.16	20.33	38.00	115.0
Catch/Effort (h)	7.52	0.48	2.51	1.39	1.78

K = Kept
R = Released
C = Total catch

TABLE E-12 Creel data reported for each survey day in June 1990, at the York Haven Generating Station.

Day	1 Friday			10 Sunday			18 Monday			30 Saturday			
River Stage	1.66			1.47			1.39			1.17			
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	Prt cldy	Prt cldy	Prt cldy	Haze	Haze	Hvy rain	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	20.00	24.00	22.00	26.00	24.00	22.00	28.00	29.30	20.00	31.30	31.50	28.30	
Water Temp (C)	16.00	18.00	18.00	22.00	22.00	22.00	26.00	25.00	25.00	29.00	29.00	28.70	
Anglers	7	9	11	15	34	16	9	9	10	10	16	15	
Fish Caught	14	12	77	27	29	5	15	12	5	45	52	45	
Fish Kept	7	5	32	6	14	0	0	3	4	34	39	10	
Hours Fished	17.83	19.25	49.00	48.50	87.08	20.66	22.75	11.01	11.50	35.75	64.16	36.50	
Catch/Effort (h)	0.79	0.62	1.57	0.56	0.33	0.24	0.66	1.09	0.43	1.26	0.81	1.23	

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		5		7		8		2	1			9		4					21		39	4		42	61	103
Channel catfish						4	1	5	2	8										12	7		7	5	17	34	51
Rock bass		2		2	2	14		1		3			2		1			2		1				1	5	26	31
Lepomis sp		2	1		4				1							2							2	2	8	6	14
Redbreast sunfish				1		13																				14	14
Pumpkinseed																			2		2				4		4
Bluegill	3	2		1						1									2		2				7	4	11
Smallmouth bass		1	1		10		9		9				2		4	1		1	5		1		20		61	3	64
Largemouth bass							1		1																2		2
Pomoxis sp										1	5														5	1	6
White crappie						1	2																	2	2	3	5
Walleye	1			1	22								2				1	1	2		1		2		31	2	33

Totals Per Day

	1 Friday	10 Sunday	18 Monday	30 Saturday	Totals
Anglers	27	65	28	41	161
Fish Caught	103	61	32	142	338
Fish Kept	44	20	7	83	154
Hours Fished	86.08	156.2	45.26	136.4	424.0
Catch/Effort (h)	1.20	0.39	0.71	1.04	0.80

K = Kept
R = Released
C = Total catch

TABLE E-13 Creel data reported for each survey day in July 1990, at the General Reservoir.

Day	6 Friday			14 Saturday			23 Monday			29 Sunday			
River Stage	1.22			1.68			1.46			1.26			
Time - Morning (0800-1300), 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	Lt rain	Lt rain	Lt rain	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	26.00	27.50	28.00	18.50	20.00	21.50	29.00	30.00	25.20	24.50	29.00	28.00	
Water Temp (C)	27.00	28.50	28.50	19.50	19.50	20.00	27.00	26.00	27.00	26.00	27.50	27.80	
Anglers	17	13	25	4	11	8	13	7	3	49	23	30	
Fish Caught	52	59	43	6	26	18	14	12	1	201	40	70	
Fish Kept	1	4	4.	0	5	2	2	3	1	15	0	7	
Hours Fished	49.08	45.50	29.41	11.25	16.00	33.50	30.34	19.67	10.92	121.9	49.50	47.00	
Catch/Effort (h)	1.06	1.30	1.46	0.53	1.62	0.54	0.46	0.61	0.09	1.65	0.81	1.49	

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	5		2		1		5			2		2		1		1		1	4	1			4		21	8	29
Rock bass	4		1	1	5		1		6		6								13		1		2	4	39	5	44
Lepomis sp					17				1						3	2			2	1	1		11		35	3	38
Redbreast sunfish										1																1	1
Pumpkinseed																							2		2		2
Bluegill						1																				1	1
Smallmouth bass	42	1	51	3	18	3			14	2	10		12	1	6				167	13	38		44	3	400	26	426

Totals Per Day

	6 Friday	14 Saturday	23 Monday	29 Sunday	Totals
Anglers	55	23	23	102	203
Fish Caught	154	50	27	311	542
Fish Kept	8	7	6	22	44
Hours Fished	124.0	60.75	60.93	218.4	464.1
Catch/Effort (h)	1.24	0.82	0.44	1.42	1.17

K = Kept
R = Released
C = Total catch

TABLE E-14 Creel data reported for each survey day in July 1990, at the West Dam.

Day	6 Friday			14 Saturday			23 Monday			29 Sunday			
River Stage	1.22			1.68			1.46			1.26			
	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	Overcast	Lt rain	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	26.60	28.00	27.70	19.70	20.00	21.70	29.00	28.00	26.20	25.00	26.80	26.60	
Water Temp (C)	28.00	28.50	29.00	19.70	20.00	20.50	26.30	27.00	27.00	28.00	28.00	27.50	
Anglers	4	2	2	2	0	0	2	0	0	5	2	4	
Fish Caught	21	15	4	5	.	.	9	.	.	22	0	35	
Fish Kept	1	3	3	1	.	.	7	.	.	.	0	5	
Hours Fished	9.25	4.00	1.00	2.00	.	.	6.00	.	.	14.00	0.34	12.00	
Catch/Effort (h)	2.27	3.75	4.00	2.50	.	.	1.50	.	.	1.57	0.00	2.92	

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	7	3		3	1	1						7					1				3		12	15	27
Lepomis sp																								5		5	5
Smallmouth bass	20		5		1		3						2						21				27		79		79

Totals Per Day

	6 Friday	14 Saturday	23 Monday	29 Sunday	Totals
Anglers	8	2	2	11	23
Fish Caught	40	5	9	57	111
Fish Kept	7	1	7	5	20
Hours Fished	14.25	2.00	6.00	26.34	48.59
Catch/Effort (h)	2.81	2.50	1.50	2.16	2.28

K = Kept
R = Released
C = Total catch

TABLE E-15 Creel data reported for each survey day in July 1990, at the East Dam.

Day	6 Friday			14 Saturday			23 Monday			28 Sunday			
River Stage	1.22			1.68			1.46			1.26			
Time - Morning (0800-1300), 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	Overcast	Hvy rain	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	26.00	29.00	27.50	18.30	20.50	21.50	27.30	28.00	26.00	23.00	27.00	26.00	
Water Temp (C)	28.30	30.70	31.00	16.30	19.50	20.50	26.00	27.00	27.00	25.00	28.00	28.00	
Anglers	3	3	2	2	0	0	9	1	4	10	2	10	
Fish Caught	10	38	5	1	.	.	21	3	8	22	9	20	
Fish Kept	.	.	.	.	.	.	.	.	3	2	.	9	
Hours Fished	3.25	10.00	5.00	3.00	.	.	20.00	2.00	2.00	13.16	4.00	23.51	
Catch/Effort (h)	3.08	3.80	1.00	0.33	.	.	1.05	1.50	4.00	1.67	2.25	0.85	

Species

Species	Fri Morning R	K	Fri Midday R	K	Fri Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Mon Morning R	K	Mon Midday R	K	Mon Evening R	K	Sun Morning R	K	Sun Midday R	K	Sun Evening R	K	Totals R	K	C
Common carp															1				2				1		4		4
Channel catfish							1												1		2		2	1	6	1	7
Rock bass	1		4																1						6		6
Lepomis sp	2		19		5								7				3		5		4		5	8	50	8	58
Pumpkinseed													1												1		1
Bluegill													4		2			1							6	1	7
Smallmouth bass	7		15										9				2	1	10		3		3		49	1	50
Largemouth bass																			1	2					1	2	3
White crappie																		1								1	1

Totals Per Day

	6 Friday	14 Saturday	23 Monday	28 Sunday	Totals
Anglers	8	2	14	22	46
Fish Caught	53	1	32	51	137
Fish Kept	.	.	3	11	14
Hours Fished	18.25	3.00	24.00	40.67	85.92
Catch/Effort (h)	2.90	0.33	1.33	1.25	1.59

K = Kept
R = Released
C = Total catch

TABLE E-16 Creel data reported for each survey day in July 1990, at the York Haven Generating Station.

Day / River Stage	6 Friday 1.22			14 Saturday 1.68			23 Monday 1.46			29 Sunday 1.26			
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	Overcast	Lt rain	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	
Air Temp (C)	26.30	30.00	26.30	19.30	22.00	18.50	27.00	31.00	27.50	28.50	27.50	22.90	
Water Temp (C)	28.70	28.50	27.70	19.70	20.00	19.50	25.00	26.50	26.30	27.00	27.90	26.90	
Anglers	2	6	4	2	6	7	6	2	2	15	21	25	
Fish Caught	0	30	6	1	4	4	3	1	3	15	30	64	
Fish Kept	0	10	3	1	3	2	0	1	.	6	9	2	
Hours Fished	4.00	21.00	1.51	1.33	7.50	16.00	4.16	2.83	2.00	28.75	56.50	83.25	
Catch/Effort (h)	0.00	1.43	3.97	0.75	0.53	0.25	0.72	0.35	1.50	0.52	0.53	0.77	

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	1						1	1		1	4		8	3	11
Channel catfish				3	2	3		1		3		1	2			1				5		2	21	2	25	21	46
Rock bass											1														1		1
Lepomis sp																			6		1		5		12		12
Pumpkinseed				1															1						1	1	2
Bluegill				1																						1	1
Smallmouth bass			18	4	1												2		1		7	1	31		60	5	65
Largemouth bass				1																						1	1
Walleye			2														1				13	5	1		17	5	22

Totals Per Day

	6 Friday	14 Saturday	23 Monday	29 Sunday	Totals
Anglers	12	15	10	61	98
Fish Caught	36	9	7	109	161
Fish Kept	13	6	1	17	37
Hours Fished	26.51	24.83	8.99	168.5	228.8
Catch/Effort (h)	1.36	0.36	0.78	0.65	0.70

K = Kept
R = Released
C = Total catch

TABLE E-17 Creel data reported for each survey day in August 1990, at the General Reservoir.

Day	11 Saturday			16 Thursday			24 Friday			26 Sunday			
River Stage	1.28			1.21			1.43			1.55			
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	Clear	Prt cldy	Prt cldy	Prt cldy	Overcast	Overcast	Prt cldy	Haze	Prt cldy	Haze	
Air Temp (C)	25.00	27.50	24.00	26.00	25.00	27.00	20.00	22.00	23.00	25.50	28.00	28.00	
Water Temp (C)	23.50	24.50	24.00	26.50	26.80	27.50	19.00	19.50	19.70	22.00	24.00	24.00	
Anglers	34	13	20	25	16	18	0	5	1	66	20	18	
Fish Caught	167	38	45	59	130	35	.	6	0	186	76	8	
Fish Kept	0	.	8	11	27	14	.	1	0	7	0	0	
Hours Fished	79.09	49.75	44.50	61.50	71.09	39.16	.	9.00	2.00	251.8	122.0	33.09	
Catch/Effort (h)	2.11	0.76	1.01	0.96	1.83	0.89	.	0.67	0.00	0.74	0.62	0.27	

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	1		1		1	1	9		6	1	1	4				1			4	1			1		24	8	32
Rock bass	5						1		5	4									7	2					18	6	24
Lepomis sp	12		4		10						1								12		1				40		40
Redbreast sunfish	1																								1		1
Pumpkinseed									1																1		1
Bluegill	3		2		2		1												11	1	9		1		29	1	30
Smallmouth bass	143		31		23	2	37	11	91	22	17	10			5				143	2	86		6		562	47	609
Largemouth bass	2																								2		2
Pomoxis sp						8													1						1	6	7
Yellow perch											2									1					2	1	3
Walleye																							1		1		1

Totals Per Day

	11 Saturday	16 Thursday	24 Friday	26 Sunday	Totals
Anglers	67	59	6	104	236
Fish Caught	250	224	6	271	751
Fish Kept	9	52	1	7	69
Hours Fished	173.3	171.8	11.00	406.8	762.9
Catch/Effort (h)	1.44	1.30	0.55	0.67	0.98

K = Kept
R = Released
C = Total catch

TABLE E-18 Creel data reported for each survey day in August 1990, at the West Dam.

Day River Stage	11 Saturday 1.28			16 Thursday 1.21			24 Friday 1.43			26 Sunday 1.55			
Time - Morning (0800-1300), 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	Prt cldy	Prt cldy	Prt cldy	Overcast	Overcast	Prt cldy	Haze	Prt cldy	Haze	
Air Temp (C)	24.00	27.50	25.00	25.00	26.00	28.00	20.80	23.00	24.70	26.50	28.00	25.00	
Water Temp (C)	22.80	24.50	24.00	25.50	26.50	27.50	20.10	21.00	21.00	22.70	24.50	24.50	
Anglers	0	0	0	2	1	2	0	0	0	0	0	0	
Fish Caught	.	.	.	11	8	16	.	.	.	.	.	.	
Fish Kept	.	.	.	.	4	1	.	.	.	.	.	.	
Hours Fished	.	.	.	6.00	4.00	7.00	.	.	.	.	.	.	
Catch/Effort (h)	.	.	.	1.83	2.00	2.29	.	.	.	.	.	.	

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
Channel catfish							1			4	9	1													10	5	15
Smallmouth bass							10		4		4														18		18
Walleye											2														2		2

Totals Per Day

	11 Saturday	16 Thursday	24 Friday	26 Sunday	Totals
Anglers	0	5	0	0	5
Fish Caught	.	35	.	.	35
Fish Kept	.	5	.	.	5
Hours Fished	.	17.00	.	.	17.00
Catch/Effort (h)	.	2.06	.	.	2.06

K = Kept
R = Released
C = Total catch

TABLE E-19 Creel data reported for each survey day in August 1990, at the East Dam.

Day	11 Saturday			16 Thursday			24 Friday			26 Sunday			
River Stage	1.28			1.21			1.43			1.55			
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	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Overcast	Overcast	Prt cldy	Haze	Prt cldy	Haze	
Air Temp (C)	22.30	27.30	29.00	25.00	27.60	28.00	21.00	24.00	26.00	25.50	25.00	26.00	
Water Temp (C)	22.00	24.50	24.00	25.30	28.00	29.30	20.20	20.30	21.70	22.90	24.00	24.50	
Anglers	3	2	4	0	0	1	0	1	4	8	7	4	
Fish Caught	3	0	6	.	.	1	.	1	0	4	5	3	
Fish Kept	.	0	0	.	.	.	.	.	0	4	5	3	
Hours Fished	5.75	2.00	4.00	.	.	0.25	.	0.25	0.68	17.00	31.00	7.00	
Catch/Effort (h)	0.52	0.00	1.50	.	.	4.00	.	4.00	0.00	0.24	0.16	0.43	

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					1										1									1	2	1	3
Lepomis sp	2				1																				3		3
Bluegill	1																					1			1	1	2
Smallmouth bass					3						1									4		3		1	4	8	12
Largemouth bass																						1				1	1
Pomoxis sp					1																				1		1

Totals Per Day

	11 Saturday	16 Thursday	24 Friday	26 Sunday	Totals
Anglers	9	1	5	19	34
Fish Caught	9	1	1	12	23
Fish Kept	0	.	0	12	12
Hours Fished	11.75	0.25	0.93	55.00	67.93
Catch/Effort (h)	0.77	4.00	1.08	0.22	0.34

K = Kept
R = Released
C = Total catch

TABLE E-20 Creel data reported for each survey day in August 1990, at the York Haven Generating Station.

Day	11 Saturday			16 Thursday			24 Friday			26 Sunday			
River Stage	1.28			1.21			1.43			1.55			
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	Prt cldy	Prt cldy	Clear	Overcast	Overcast	Prt cldy	Prt cldy	Prt cldy	Clear	
Air Temp (C)	25.70	25.00	24.90	26.50	26.00	26.00	22.00	24.80	23.50	29.70	29.00	23.50	
Water Temp (C)	22.90	23.00	23.50	25.50	27.00	25.10	19.70	20.00	20.10	22.80	23.00	24.00	
Anglers	15	24	17	0	2	19	1	2	4	4	10	24	
Fish Caught	11	12	7	.	0	13	4	5	1	5	20	31	
Fish Kept	3	2	4	.	0	5	2	3	0	0	7	7	
Hours Fished	19.66	26.58	40.17	.	8.00	29.26	4.00	4.00	1.34	11.75	17.75	46.00	
Catch/Effort (h)	0.56	0.45	0.17	.	0.00	0.44	1.00	1.25	0.75	0.43	1.13	0.67	

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
Common carp	2		1	2	2	3															1				6	5	11
White sucker		1																								1	1
Channel catfish	4	2	3		1	1					5	5	2	2	1		1				8		16	3	41	13	54
Rock bass																								2		2	2
Lepomis sp	1		4								1													1	6	1	7
Redbreast sunfish																2					1	6			1	8	9
Smallmouth bass			2								2								5		3	1	8	1	20	2	22
Black crappie																1										1	1
Walleye	1														1										2		2

Totals Per Day

	11 Saturday	16 Thursday	24 Friday	26 Sunday	Totals
Anglers	56	21	7	38	122
Fish Caught	30	13	10	56	109
Fish Kept	9	5	5	14	33
Hours Fished	86.41	37.26	9.34	75.50	208.5
Catch/Effort (h)	0.35	0.35	1.07	0.74	0.52

K = Kept
R = Released
C = Total catch

TABLE E-21 Creel data reported for each survey day in September 1990, at the General Reservoir.

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

Day	4 Tuesday			9 Sunday			22 Saturday			27 Thursday			Totals
River Stage	1.22			1.12			1.23			1.23			
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	
Weather	Prt cldy	Prt cldy	Prt cldy	Lt rain	Overcast	Overcast	Lt rain	Overcast	Prt cldy	Fog	Prt cldy	Clear	
Air Temp (C)	20.50	24.50	23.00	16.00	18.90	18.90	17.00	18.50	18.50	17.00	19.50	19.00	
Water Temp (C)	25.00	25.20	25.20	23.00	23.00	22.20	18.00	18.00	18.20	16.20	17.00	17.00	
Anglers	16	12	4	22	13	17	7	26	24	16	17	28	
Fish Caught	40	76	5	77	25	51	14	144	135	46	78	142	
Fish Kept	6	19	1	18	4	11	0	12	20	13	23	9	
Hours Fished	29.34	52.16	10.00	77.75	18.84	38.50	10.50	71.01	81.50	17.00	48.00	80.00	
Catch/Effort (h)	1.36	1.46	0.60	0.99	1.33	1.32	1.33	2.03	1.66	2.71	1.62	1.77	

Species

	4 Tue Morning R	K	Midday R	K	Evening R	K	9 Sun Morning R	K	Midday R	K	Evening R	K	22 Sat Morning R	K	Midday R	K	Evening R	K	27 Thu Morning R	K	Midday R	K	Evening R	K	Totals R	K	C
Fallfish			1																						1		1
Channel catfish	1		5				12	3	3	1	4	1			50	1	12	3							87	9	95
Rock bass	1	1					3	1		1	1	1			1					1					6	5	11
Lepomis sp	9				2		1		4		4	3			4	2	2	1	1				1		28	6	34
Redbreast sunfish																			1						1		1
Bluegill	2								4	2		1			3			1		5		1		1	9	11	20
Smallmouth bass	18	3	51	19	2	1	39	11	10		31	5	14		74	9	101	15	31	7	54	22	132	8	557	100	657
Pomoxis sp	1						6																		7		7
White crappie								1																		1	1
Black crappie		2																								2	2
Walleye	2																				1				3		3

Totals Per Day

	4 Tuesday	9 Sunday	22 Saturday	27 Thursday	Totals
Anglers	32	52	57	61	202
Fish Caught	121	153	293	266	833
Fish Kept	26	31	32	45	134
Hours Fished	91.50	135.1	163.0	145.0	534.6
Catch/Effort (h)	1.32	1.13	1.80	1.83	1.56

K = Kept
R = Released
C = Total catch

TABLE E-22 Creel data reported for each survey day in September 1990, at the West Dam.

Day	4 Tuesday			9 Sunday			22 Saturday			27 Thursday			
River Stage	1.22			1.12			1.23			1.23			
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	Lt rain	Overcast	Overcast	Overcast	Overcast	Prt cldy	Fog	Prt cldy	Clear	
Air Temp (C)	21.00	27.70	25.20	15.00	18.00	19.00	16.50	18.30	20.00	16.80	19.00	20.00	
Water Temp (C)	24.50	26.50	26.50	22.00	22.20	22.00	18.20	18.20	18.20	15.90	17.30	18.50	
Anglers	0	0	2	0	4	0	0	0	3	0	0	0	
Fish Caught	.	.	35	.	13	.	.	.	33	.	.	.	
Fish Kept	.	.	21	.	8	.	.	.	9	.	.	.	
Hours Fished	.	.	2.50	.	12.00	.	.	.	9.00	.	.	.	
Catch/Effort (h)	.	.	14.0	.	1.08	.	.	.	3.67	.	.	.	

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						20			2	6							3								5	26	31
Rock bass					1					2															1	2	3
Lepomis sp					4				2																6		6
Smallmouth bass					9	1			1								1	1							11	2	13
Walleye																	20	8							20	8	28

Totals Per Day

	4 Tuesday	9 Sunday	22 Saturday	27 Thursday	Totals
Anglers	2	4	3	0	9
Fish Caught	35	13	33	.	81
Fish Kept	21	8	9	.	38
Hours Fished	2.50	12.00	9.00	.	23.50
Catch/Effort (h)	14.0	1.08	3.67	.	3.45

K = Kept
R = Released
C = Total catch

TABLE E-23 Creel data reported for each survey day in September 1990, at the East Dam.

Day	4 Tuesday			9 Sunday			22 Saturday			27 Thursday			
River Stage	1.22			1.12			1.23			1.23			
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	Hvy rain	Overcast	Overcast	Lt rain	Overcast	Prt cldy	Fog	Prt cldy	Clear	
Air Temp (C)	24.00	27.30	24.50	15.00	17.00	19.00	16.50	18.00	21.80	15.50	21.00	18.00	
Water Temp (C)	23.00	26.80	27.70	23.30	22.00	21.70	19.00	18.50	20.00	16.00	20.80	21.70	
Anglers	0	2	3	2	0	0	0	0	0	1	0	0	
Fish Caught	.	0	1	1	.	.	.	.	.	14	.	.	
Fish Kept	.	0	.	.	.	.	.	.	.	.	.	.	
Hours Fished	.	4.00	0.99	2.00	.	.	.	.	.	2.25	.	.	
Catch/Effort (h)	.	0.00	1.01	0.50	.	.	.	.	.	6.22	.	.	

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
Rock bass							1												10						11		11
Bluegill					1																				1		1
Smallmouth bass																			2						2		2

Totals Per Day

	4 Tuesday	9 Sunday	22 Saturday	27 Thursday	Totals
Anglers	5	2	0	1	8
Fish Caught	1	1	.	14	16
Fish Kept	0	0	.	.	0
Hours Fished	4.99	2.00	.	2.25	9.24
Catch/Effort (h)	0.20	0.50	.	6.22	1.73

K = Kept
R = Released
C = Total catch

TABLE E-24 Creel data reported for each survey day in September 1990, at the York Haven Generating Station.

Day	4 Tuesday			9 Sunday			22 Saturday			27 Thursday			
River Stage	1.22			1.12			1.23			1.23			
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	Overcast	Overcast	Overcast	Prt cldy	Prt cldy	Clear	Clear	
Air Temp (C)	20.90	24.00	18.30	16.00	20.00	19.50	17.30	19.30	18.50	18.50	22.30	15.10	
Water Temp (C)	23.70	23.90	23.30	21.70	22.00	21.50	17.80	16.50	18.20	16.60	18.00	16.70	
Anglers	0	5	7	6	26	16	1	7	20	0	0	2	
Fish Caught	.	2	7	6	64	87	0	1	17	.	.	0	
Fish Kept	.	1	5	1	26	20	0	0	8	.	.	0	
Hours Fished	.	3.34	15.60	4.50	67.00	50.17	0.50	6.66	39.00	.	.	0.83	
Catch/Effort (h)	.	0.60	0.45	1.33	0.86	1.73	0.00	0.15	0.44	.	.	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									3		1														4		4
Channel catfish				1		4			2	7		2			1			2							3	16	19
Rock bass										1							1	2							1	3	4
Lepomis sp							2		12								2								16		16
Redbreast sunfish										9																9	9
Green sunfish																		1								1	1
Pumpkinseed																		1								1	1
Bluegill										3		2						1								6	6
Smallmouth bass			1		2				5	2	23	2													31	4	35
Black crappie						1												1								2	2
Walleye							3	1	16	4	43	14					5	1							67	20	87

Totals Per Day

	4 Tuesday	9 Sunday	22 Saturday	27 Thursday	Totals
Anglers	12	48	28	2	90
Fish Caught	9	157	18	0	184
Fish Kept	6	47	8	0	62
Hours Fished	18.84	121.7	46.16	0.83	187.5
Catch/Effort (h)	0.48	1.29	0.39	0.00	0.98

K = Kept
R = Released
C = Total catch

E-25

TABLE E-25 Creel data reported for each survey day in October 1990, at the General Reservoir.

Day	2 Tuesday			13 Saturday			21 Sunday			31 Wednesday			
River Stage	1.17			1.47			2.30			1.86			
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	Lt rain	Prt cldy	Prt cldy	Clear	Prt cldy	Prt cldy	Prt cldy	Overcast		
Air Temp (C)	17.50	18.10	16.90	20.00	24.00	22.30	11.50	14.80	13.00	12.90	14.00		
Water Temp (C)	18.00	18.50	18.80	20.50	20.80	20.10	13.20	13.20	13.00	9.80	9.80		
Anglers	2	7	5	10	7	0	22	14	0	8	1		
Fish Caught	8	21	45	42	21	.	7	6	.	12	0		
Fish Kept	2	9	2	0	.	.	0	0	.	2	0		
Hours Fished	4.00	14.50	15.00	37.75	49.00	.	58.25	89.75	.	19.00	0.25		
Catch/Effort (h)	2.00	1.45	3.00	1.11	0.43	.	0.12	0.07	.	0.63	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
Muskellunge																			1						1		1
Common carp																			1						1		1
Rock bass					2		2																		4		4
Lepomis sp			3		6																				9		9
Bluegill																			1						1		1
Smallmouth bass	6	2	9	8	35	1	40		21				7		6				5						129	11	140
Largemouth bass																			2						2		2
Pomoxis sp																				2						2	2
White crappie				1		1																				2	2

Totals Per Day

	2 Tuesday	13 Saturday	21 Sunday	31 Wednesday	Totals
Anglers	14	17	36	9	76
Fish Caught	74	63	13	12	162
Fish Kept	13	0	0	2	15
Hours Fished	33.50	86.75	148.0	19.25	287.5
Catch/Effort (h)	2.21	0.73	0.09	0.62	0.56

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-26 Creel data reported for each survey day in October 1990, at the West Dam.

Day River Stage	2 Tuesday 1.17			13 Saturday 1.47			21 Sunday 2.30			31 Wednesday 1.86			
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	Lt rain	Prt cldy	Prt cldy	Clear	Prt cldy	Prt cldy	Prt cldy	Overcast		
Air Temp (C)	17.00	16.80	17.50	19.60	23.80	21.00	10.00	14.80	13.50	11.80	11.50		
Water Temp (C)	17.00	18.20	18.30	20.60	21.80	20.80	13.20	13.50	13.20	9.80	9.80		
Anglers	0	0	0	0	0	0	0	0	0	0	2		
Fish Caught	.	.	.	.	.	.	.	.	.	.	3		
Fish Kept	.	.	.	.	.	.	.	.	.	.	1		
Hours Fished	.	.	.	.	.	.	.	.	.	.	2.00		
Catch/Effort (h)	.	.	.	.	.	.	.	.	.	.	1.50		

Species

	Morning R	Morning K	Midday R	Midday K	Evening R	Evening K	Morning R	Morning K	Midday R	Midday K	Evening R	Evening K	Morning R	Morning K	Midday R	Midday K	Evening R	Evening K	Morning R	Morning K	Midday R	Midday K	Evening R	Evening K	Totals R	Totals K	Totals C
Smallmouth bass																					2				2		2
Walleye																						1				1	1

Totals Per Day

	2 Tuesday	13 Saturday	21 Sunday	31 Wednesday	Totals
Anglers	0	0	0	2	2
Fish Caught	.	.	.	3	3
Fish Kept	.	.	.	1	1
Hours Fished	.	.	.	2.00	2.00
Catch/Effort (h)	.	.	.	1.50	1.50

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-27 Creel data reported for each survey day in October 1990, at the East Dam.

Day River Stage	2 Tuesday 1.17			13 Saturday 1.47			21 Sunday 2.30			31 Wednesday 1.86			
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	Prt cldy	Prt cldy	Prt cldy	Clear	Prt cldy	Prt cldy	Prt cldy	Overcast		
Air Temp (C)	18.00	18.90	19.70	20.10	23.60	21.00	10.00	15.00	15.00	11.30	12.00		
Water Temp (C)	18.00	20.10	20.90	20.50	21.50	21.10	13.20	13.20	13.00	9.50	9.10		
Anglers	0	0	0	0	0	0	0	1	1	8	9		
Fish Caught	.	.	.	.	.	.	.	3	0	8	8		
Fish Kept	.	.	.	.	.	.	.	2	0	7	4		
Hours Fished	.	.	.	.	.	.	.	5.00	1.50	18.50	21.25		
Catch/Effort (h)	.	.	.	.	.	.	.	0.60	0.00	0.43	0.38		

Species

	Tue Morning R	K	Tue Midday R	K	Tue Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Sun Morning R	K	Sun Midday R	K	Sun Evening R	K	Wed Morning R	K	Wed Midday R	K	Wed Evening R	K	Totals R	K	C
Gizzard shad																1										1	1
Rainbow trout																				1						1	1
Rock bass																1										1	1
Lepomis sp															1										1		1
Smallmouth bass																					1				1		1
White crappie																				1						1	1
Black crappie																				3						3	3
Walleye																			1	2	3	4			4	6	10

Totals Per Day

	2 Tuesday	13 Saturday	21 Sunday	31 Wednesday	Totals
Anglers	0	0	2	17	19
Fish Caught	.	.	3	16	19
Fish Kept	.	.	2	11	13
Hours Fished	.	.	6.50	39.75	46.25
Catch/Effort (h)	.	.	0.46	0.40	0.41

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-28 Creel data reported for each survey day in October 1990, at the York Haven Generating Station.

Day / River Stage	2 Tuesday 1.17			13 Saturday 1.47			21 Sunday 2.30			31 Wednesday 1.86			
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	Prt cldy	Prt cldy	Overcast	Clear	Prt cldy	Prt cldy	Prt cldy	Prt cldy	Overcast	
Air Temp (C)	18.00	18.90	13.00	22.00	24.50	22.50	12.00	19.00	14.00	14.00	16.90	12.00	
Water Temp (C)	19.80	19.50	17.30	20.00	20.10	20.00	12.30	12.80	13.00	9.70	9.80	9.70	
Anglers	5	0	3	1	0	9	4	4	2	0	1	5	
Fish Caught	44	.	12	0	.	0	16	7	6	.	6	9	
Fish Kept	1	.	3	0	.	0	0	3	6	.	4	8	
Hours Fished	5.00	.	3.50	0.75	.	14.01	10.75	11.25	10.00	.	3.00	10.50	
Catch/Effort (h)	8.80	.	3.43	0.00	.	0.00	1.49	0.62	0.60	.	2.00	0.86	

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										2		2
Channel catfish	1												12					1							13	1	14
Rock bass	4												1					2			2	1			7	3	10
Lepomis sp	2															1		1							2	2	4
Bluegill																							1	8	1	8	9
Smallmouth bass	35	1			1										3	1		1				3			39	6	45
Walleye	1				8	3							2			1		1							11	5	16

Totals Per Day

	2 Tuesday	13 Saturday	21 Sunday	31 Wednesday	Totals
Anglers	8	10	10	6	34
Fish Caught	56	0	29	15	100
Fish Kept	4	0	9	12	25
Hours Fished	8.50	14.76	32.00	13.50	68.76
Catch/Effort (h)	6.59	0.00	0.91	1.11	1.45

K = Kept
R = Released
C = Total catch

TABLE E-29 Creel data reported for each survey day in November 1990, at the General Reservoir.

Day / River Stage	4 Sunday 1.50			7 Wednesday 1.44			17 Saturday 1.84			19 Monday 1.71			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Haze	Prt cldy		Prt cldy	Prt cldy		Overcast	Prt cldy		Clear	Clear		
Air Temp (C)	13.00	15.00		8.50	10.50		8.50	9.00		0.00	5.00		
Water Temp (C)	12.50	12.80		11.00	11.40		7.00	8.00		5.00	5.30		
Anglers	35	27		3	6		0	5		0	1		
Fish Caught	163	122		7	8		.	8		.	0		
Fish Kept	20	4		5	0		.	7		.	0		
Hours Fished	65.00	94.00		2.00	8.84		.	11.50		.	0.17		
Catch/Effort (h)	2.51	1.30		3.50	0.90		.	0.70		.	0.00		

Species

	Sun Morning R	K	Sun Midday R	K	Sun Evening R	K	Wed Morning R	K	Wed Midday R	K	Wed Evening R	K	Sat Morning R	K	Sat Midday R	K	Sat Evening R	K	Mon Morning R	K	Mon Midday R	K	Mon Evening R	K	Totals R	K	C
Channel catfish	1		1																						2		2
Rock bass	1		3																						4		4
Lepomis sp	1		1						1																3		3
Bluegill	4																								4		4
Smallmouth bass	132	18	113	4			2		7						1	7									255	29	284
Largemouth bass	4	2																							4	2	6
White crappie								5																		5	5

Totals Per Day

	4 Sunday	7 Wednesday	17 Saturday	19 Monday	Totals
Anglers	62	9	5	1	77
Fish Caught	285	15	8	0	308
Fish Kept	24	5	7	0	36
Hours Fished	159.0	10.84	11.50	0.17	181.5
Catch/Effort (h)	1.79	1.38	0.70	0.00	1.70

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-30 Creel data reported for each survey day in November 1990, at the West Dam.

Day / River Stage	4 Sunday 1.50			7 Wednesday 1.44			17 Saturday 1.84			19 Monday 1.71			
Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)													
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Haze	Prt cldy		Prt cldy	Prt cldy		Prt cldy	Prt cldy		Clear	Clear		
Air Temp (C)	14.10	15.80		10.50	10.00		9.00	10.00		0.50	6.00		
Water Temp (C)	11.80	12.20		10.50	9.80		6.00	6.50		4.70	5.00		
Anglers	3	3		3	0		0	0		0	0		
Fish Caught	0	14		8	.		.	.		.	.		
Fish Kept	0	.		2	.		.	.		.	.		
Hours Fished	2.25	4.00		3.75	.		.	.		.	.		
Catch/Effort (h)	0.00	3.50		2.13	.		.	.		.	.		

Species

	4 Sun Morning R	K	Midday R	K	Evening R	K	7 Wed Morning R	K	Midday R	K	Evening R	K	17 Sat Morning R	K	Midday R	K	Evening R	K	19 Mon Morning R	K	Midday R	K	Evening R	K	Totals R	K	C
Pumpkinseed			1																						1		1
Smallmouth bass			10				5																		15		15
Walleye			3				1	2																	4	2	6

Totals Per Day

	4 Sunday	7 Wednesday	17 Saturday	19 Monday	Totals
Anglers	6	3	0	0	9
Fish Caught	14	8	.	.	22
Fish Kept	0	2	.	.	2
Hours Fished	6.25	3.75	.	.	10.00
Catch/Effort (h)	2.24	2.13	.	.	2.20

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-31 Creel data reported for each survey day in November 1990, at the East Dam.

Day / River Stage	4 Sunday 1.50			7 Wednesday 1.44			17 Saturday 1.84			19 Monday 1.71			
	Time - Morning (0900-1300), Midday (1301-1700), Evening (1701-2100)												
	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Morning	Midday	Evening	Totals
Weather	Haze	Prt cldy		Prt cldy	Prt cldy		Prt cldy	Prt cldy		Clear	Clear		
Air Temp (C)	14.00	18.70		8.70	8.50		8.50	10.00		2.70	6.50		
Water Temp (C)	11.50	12.00		10.00	10.30		7.20	8.00		4.70	5.30		
Anglers	8	12		2	2		5	0		1	1		
Fish Caught	15	10		4	0		13	.		0	1		
Fish Kept	.	2		.	0		0	.		0	1		
Hours Fished	19.50	14.25		3.50	0.50		9.00	.		1.00	0.50		
Catch/Effort (h)	0.77	0.70		1.14	0.00		1.44	.		0.00	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
Brown trout													1												1		1
Fallfish	1																								1		1
Channel catfish			1																						1		1
Bluegill	1																								1		1
Smallmouth bass	10		3				2						1												16		16
Largemouth bass			2																						2		2
Walleye	3		2	2			2						11									1			18	3	21

Totals Per Day

	4 Sunday	7 Wednesday	17 Saturday	19 Monday	Totals
Anglers	20	4	5	2	31
Fish Caught	25	4	13	1	43
Fish Kept	2	0	0	1	3
Hours Fished	33.75	4.00	9.00	1.50	48.25
Catch/Effort (h)	0.74	1.00	1.44	0.67	0.89

K = Kept
R = Released
C = Total catch

NOTE: Evening creels were not done due to darkness.

TABLE E-32 Creel data reported for each survey day in November 1990, at the York Haven Generating Station.

Day	4 Sunday			7 Wednesday			17 Saturday			19 Monday			
River Stage	1.50			1.44			1.64			1.71			
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	Prt cldy	Prt cldy	Prt cldy	Overcast	Prt cldy	Clear	Clear	Clear	Clear	
Air Temp (C)	13.00	19.50	15.90	6.00	11.80	6.90	9.00	8.00	5.70	1.50	6.20	5.70	
Water Temp (C)	11.00	11.80	11.90	10.10	10.80	10.20	7.30	7.70	8.00	4.90	5.20	5.50	
Anglers	4	23	9	2	2	8	1	0	0	0	0	0	
Fish Caught	13	22	16	3	42	21	0	.	.	.	.	.	
Fish Kept	2	17	0	1	7	16	0	.	.	.	.	.	
Hours Fished	13.75	51.25	17.33	2.00	10.00	18.17	2.75	.	.	.	.	.	
Catch/Effort (h)	0.95	0.43	0.92	1.50	4.20	1.16	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																						1	1
Rock bass					2						2	3													4	3	7
Lepomis sp					2						2														4		4
Redbreast sunfish				2																						2	2
Smallmouth bass	11	2	4	12	12		2	1	35	7	1	10													65	32	97
Largemouth bass				1																						1	1
Yellow perch												1														1	1
Walleye			1	1								2													1	3	4

Totals Per Day

	4 Sunday	7 Wednesday	17 Saturday	19 Monday	Totals
Anglers	36	12	1	0	49
Fish Caught	51	66	0	.	117
Fish Kept	19	24	0	.	43
Hours Fished	82.33	30.17	2.75	.	115.2
Catch/Effort (h)	0.62	2.19	0.00	.	1.02

K = Kept
R = Released
C = Total catch

APPENDIX F

WATER QUALITY DATA

TABLE F-1 WATER QUALITY DATA COLLECTED AT ZONE 1 NEAR TMINS, 1990.

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
04APR	6.5	8.5	8.2	10.2	.	24.0	.	.	.	.	20:17
11APR	6.0	10.8	7.8	11.0	.	20.0	.	.	.	.	21:41
12APR	6.5	10.3	7.5	11.1	132.1	.	.	.	.	.	11:45
16APR	11.0	13.5	7.6	10.6	.	34.0	.	.	.	.	22:28
23APR	15.0	17.0	7.9	10.5	.	15.0	.	.	.	.	22:09
30APR	14.5	17.0	7.8	10.2	.	10.0	.	.	.	.	21:23
04MAY	13.0	14.8	8.0	9.0	127.0	.	.	.	.	.	8:45
07MAY	17.5	15.0	7.8	9.0	.	18.0	.	.	.	.	21:55
14MAY	12.5	15.6	7.3	8.5	.	27.0	.	.	.	.	23:17
21MAY	12.0	15.6	8.0	8.6	.	43.0	.	.	.	.	21:27
23MAY	20.0	16.9	7.1	9.1	68.6	.	.	.	.	.	12:10
31MAY	11.5	15.5	7.4	10.8	.	29.0	.	.	.	.	23:45
04JUN	14.0	18.4	7.9	8.0	.	15.0	.	.	.	.	21:45
12JUN	14.0	17.0	7.9	9.5	.	12.0	.	.	.	.	22:55
15JUN	22.5	23.2	7.9	8.9	81.3	.	.	.	.	.	13:30
18JUN	21.5	24.5	8.0	8.6	.	4.0	.	.	.	.	22:47
25JUN	20.5	23.5	9.1	15.4	.	3.0	.	.	.	.	21:33
28JUN	30.0	28.2	8.2	12.4	96.5	.	.	.	.	.	13:10
02JUL	18.5	24.5	8.4	11.5	.	2.0	.	.	.	.	23:41
09JUL	23.9	27.0	8.4	11.2	.	0.0	.	.	.	.	23:39
16JUL	22.0	21.0	7.4	7.7	.	34.0	.	.	.	.	21:57
18JUL	28.5	24.5	7.2	7.7	53.3	.	.	.	.	.	13:25
24JUL	20.4	25.0	8.0	9.2	.	6.0	.	.	.	.	23:05
01AUG	20.0	26.0	8.4	10.7	.	4.0	.	.	.	.	21:41
06AUG	22.0	24.1	7.3	7.5	.	2.0	.	.	.	.	22:31
14AUG	25.5	26.9	8.2	9.9	81.3	.	.	.	.	.	12:40
14AUG	20.0	25.5	8.3	10.0	.	4.0	.	.	.	.	23:08
21AUG	18.0	19.0	8.2	7.9	.	5.0	.	.	.	.	20:55
27AUG	22.0	24.2	7.6	8.0	.	5.0	.	.	.	.	22:49
30AUG	22.5	23.5	7.7	7.9	88.9	.	.	.	.	.	9:05
07SEP	30.0	25.6	8.2	11.8	101.6	.	.	.	.	.	13:05
24SEP	18.0	16.3	8.1	9.8	208.3	.	.	.	.	.	13:03
30OCT	15.5	9.3	7.9	10.8	137.2	.	.	.	.	.	14:55
16NOV	8.0	6.4	8.2	11.8	160.0	.	.	.	.	.	8:50

TABLE F-2 WATER QUALITY DATA COLLECTED AT ZONE 2 NEAR TMINS, 1990.

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
12APR	3.0	9.7	7.8	10.8	104.1	.	.	.	.	.	8:15
19APR	2.0	11.4	7.8	11.6	132.1	.	.	210	.	.	0:20
04MAY	14.0	15.5	7.7	11.0	106.7	.	.	.	.	.	12:25
10MAY	17.5	17.2	7.3	9.3	88.9	.	.	210	.	.	0:57
23MAY	18.5	17.1	7.2	9.2	66.0	.	.	.	.	.	11:15
31MAY	7.5	14.2	7.3	8.8	25.4	.	.	190	.	.	1:40
06JUN	23.0	20.7	7.9	9.2	86.4	.	.	250	.	.	20:20
15JUN	21.0	22.7	7.8	10.0	78.7	.	.	.	.	.	12:30
21JUN	19.0	23.9	7.1	7.6	48.3	.	.	250	.	.	1:15
28JUN	25.0	26.3	8.7	14.2	78.7	.	.	.	.	.	8:50
18JUL	26.5	23.2	7.7	9.3	63.5	.	.	.	.	.	9:55
31JUL	23.0	27.2	8.3	11.2	66.0	.	.	250	.	.	2:30
09AUG	16.0	24.5	7.6	8.6	101.6	.	.	300	.	.	2:30
14AUG	25.5	26.8	8.4	13.1	86.4	.	.	.	.	.	11:45
28AUG	26.5	25.3	8.0	9.7	94.0	.	.	250	.	.	19:35
30AUG	22.7	24.3	7.6	8.7	101.6	.	.	.	.	.	9:47
06SEP	21.0	23.9	8.3	10.6	81.3	.	.	275	.	.	0:30
07SEP	24.7	24.7	8.3	10.2	76.2	.	.	.	.	.	9:05
24SEP	14.0	15.5	7.8	9.1	210.8	.	.	.	.	.	9:18
25SEP	15.0	16.8	8.1	10.8	177.8	.	.	270	.	.	18:42
04OCT	14.5	16.9	8.1	9.8	111.8	.	.	300	.	.	0:25
30OCT	10.0	8.7	8.5	10.6	114.3	.	.	.	.	.	10:05
08NOV	3.0	9.4	8.3	11.2	167.6	.	.	250	.	.	17:57
16NOV	7.5	6.3	8.0	11.7	154.9	.	.	.	.	.	9:25

TABLE F-3 WATER QUALITY DATA COLLECTED AT ZONE 4 NEAR TMINS, 1990.

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
04APR	7.0	7.5	8.3	11.2	.	38.0	.	.	.	.	20:40
04APR	7.0	7.2	8.4	11.4	.	30.0	.	.	.	.	20:54
11APR	7.0	9.0	7.9	11.5	.	22.0	.	.	.	.	21:26
11APR	6.5	9.0	8.3	11.4	.	27.0	.	.	.	.	22:24
16APR	12.0	10.4	7.5	10.7	.	35.0	.	.	.	.	21:59
16APR	12.0	10.5	7.6	10.8	.	36.0	.	.	.	.	22:13
18APR	5.0	9.9	7.5	11.2	78.7	.	.	150	.	.	23:20
23APR	15.0	16.2	7.8	10.5	.	21.0	.	.	.	.	22:30
23APR	14.5	16.1	7.9	10.5	.	27.0	.	.	.	.	22:44
30APR	17.5	17.2	8.7	10.7	.	24.0	.	.	.	.	20:48
30APR	16.0	17.2	8.2	10.7	.	20.0	.	.	.	.	21:02
07MAY	16.5	16.0	7.9	10.2	.	26.0	.	.	.	.	22:12
07MAY	16.0	16.0	8.1	10.2	.	21.0	.	.	.	.	22:56
09MAY	18.0	18.0	7.4	11.0	106.7	.	.	205	.	.	23:55
14MAY	14.0	16.0	7.4	10.2	.	46.0	.	.	.	.	22:42
14MAY	14.0	16.0	7.4	10.1	.	41.0	.	.	.	.	22:56
21MAY	12.0	15.0	7.5	9.0	.	36.0	.	.	.	.	21:48
21MAY	12.0	15.0	7.2	9.2	.	48.0	.	.	.	.	22:03
31MAY	12.5	17.0	7.8	9.1	68.6	.	.	160	.	.	0:20
31MAY	15.5	18.0	7.8	11.5	.	36.0	.	.	.	.	21:27
31MAY	15.0	18.0	7.6	11.4	.	55.0	.	.	.	.	21:45
04JUN	16.0	19.5	8.6	9.5	.	26.0	.	.	.	.	21:26
04JUN	13.8	19.5	8.3	9.5	.	27.0	.	.	.	.	22:04
06JUN	22.5	21.8	8.3	10.7	99.1	.	.	200	.	.	21:25
12JUN	15.5	20.1	8.1	9.5	.	17.0	.	.	.	.	22:26
12JUN	15.5	19.1	8.1	9.5	.	23.0	.	.	.	.	22:40
18JUN	21.5	25.5	8.0	8.9	.	22.0	.	.	.	.	23:04
18JUN	21.0	25.8	8.1	8.8	.	18.0	.	.	.	.	23:17
21JUN	19.5	24.4	7.1	8.8	96.5	.	.	250	.	.	0:16
25JUN	20.5	23.6	9.0	12.2	.	17.0	.	.	.	.	21:54
25JUN	20.0	23.8	9.0	11.0	.	17.0	.	.	.	.	22:07
02JUL	20.5	25.0	8.1	9.8	.	12.0	.	.	.	.	23:19
02JUL	19.0	24.4	8.2	9.4	.	12.0	.	.	.	.	23:59
09JUL	25.0	27.0	8.5	9.5	.	9.0	.	.	.	.	22:43
09JUL	24.8	27.0	8.5	8.8	.	15.0	.	.	.	.	23:15
16JUL	21.5	20.0	8.1	8.5	.	30.0	.	.	.	.	21:34
16JUL	21.0	20.0	7.4	8.3	.	24.0	.	.	.	.	22:18
24JUL	20.0	25.0	7.7	8.4	.	18.0	.	.	.	.	23:23
24JUL	20.2	25.0	7.7	8.3	.	17.0	.	.	.	.	23:37
30JUL	25.5	28.2	7.9	8.3	165.1	.	.	190	.	.	20:11
01AUG	20.2	26.0	8.5	9.2	.	18.0	.	.	.	.	22:00
01AUG	20.5	25.5	8.2	9.5	.	12.0	.	.	.	.	22:15
06AUG	22.8	24.5	7.9	8.4	.	12.0	.	.	.	.	22:09
06AUG	22.0	24.0	7.7	8.5	.	18.0	.	.	.	.	22:53
09AUG	19.0	25.1	7.5	8.4	124.5	.	.	250	.	.	1:08

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
14AUG	20.5	26.0	8.5	9.8	.	15.0	.	.	.	.	22:35
14AUG	21.0	25.9	8.5	9.9	.	17.0	.	.	.	.	22:49
21AUG	17.5	20.8	8.2	9.5	.	14.0	.	.	.	.	21:21
21AUG	17.0	21.0	8.2	9.5	.	16.0	.	.	.	.	21:37
27AUG	23.0	25.0	7.6	9.5	.	21.0	.	.	.	.	22:14
27AUG	23.0	24.5	7.7	9.6	.	23.0	.	.	.	.	22:29
28AUG	27.0	25.7	8.1	11.6	137.2	.	.	200	.	.	20:38
05SEP	23.0	24.5	7.8	9.2	94.0	.	.	190	.	.	23:28
25SEP	14.0	17.0	7.7	10.1	182.9	.	.	198	.	.	20:06
03OCT	15.0	17.5	8.4	10.0	261.6	.	.	210	.	.	23:29
08NOV	0.3	9.0	8.0	11.0	147.3	.	.	200	.	.	19:41

TABLE F-4 WATER QUALITY DATA COLLECTED AT ZONE 7 NEAR TMINS, 1990.

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
04APR	6.5	8.1	8.5	11.2	81.3	4.0	10.0	.	122	1.5	9:00
04APR	6.5	7.1	8.1	11.0	.	35.0	.	.	.	.	21:34
04APR	6.5	7.5	7.8	11.2	.	52.0	.	.	.	.	21:47
11APR	7.0	9.5	7.9	11.5	.	40.0	.	.	.	.	20:59
11APR	7.0	9.2	7.6	11.4	.	30.0	.	.	.	.	21:10
12APR	5.0	8.3	6.6	11.4	99.1	.	.	.	.	.	10:00
16APR	13.0	10.5	7.7	10.9	.	33.0	.	.	.	.	20:35
16APR	12.0	10.5	7.4	10.7	.	46.0	.	.	.	.	21:31
18APR	8.5	9.8	7.3	11.2	68.6	.	.	180	.	.	20:25
23APR	17.0	16.0	7.7	10.2	.	28.0	.	.	.	.	21:08
23APR	16.5	16.0	7.6	10.1	.	33.0	.	.	.	.	21:48
30APR	14.0	17.2	7.9	10.7	.	24.0	.	.	.	.	22:40
30APR	13.5	17.1	8.0	10.4	.	27.0	.	.	.	.	23:08
02MAY	15.0	16.7	7.6	10.4	99.1	5.0	2.0	.	150	0.8	9:25
04MAY	13.0	14.9	7.4	9.3	124.5	.	.	.	.	.	10:15
07MAY	17.0	15.2	8.4	11.3	.	40.0	.	.	.	.	21:35
07MAY	16.5	15.2	8.2	11.2	.	44.0	.	.	.	.	22:29
09MAY	21.5	18.2	8.2	11.6	73.7	.	.	240	.	.	20:42
14MAY	15.0	15.0	7.6	9.6	.	38.0	.	.	.	.	21:30
14MAY	15.0	15.0	7.4	9.5	.	43.0	.	.	.	.	21:44
21MAY	12.0	15.0	7.2	9.0	.	58.0	.	.	.	.	22:38
21MAY	12.0	15.0	7.2	9.0	.	53.0	.	.	.	.	23:09
23MAY	15.0	15.1	7.8	11.1	48.3	.	.	.	.	.	9:05
30MAY	15.3	16.2	7.6	9.8	55.9	.	.	200	.	.	21:15
31MAY	14.5	17.0	7.5	11.8	.	46.0	.	.	.	.	22:22
31MAY	13.8	17.2	7.4	11.6	.	52.0	.	.	.	.	22:53
04JUN	13.5	18.9	8.0	9.5	.	40.0	.	.	.	.	22:43
04JUN	13.0	18.9	7.9	9.4	.	43.0	.	.	.	.	22:55
05JUN	15.0	17.3	8.0	9.9	91.4	4.0	2.0	.	143	1.0	9:10
06JUN	24.0	21.0	7.7	11.2	81.3	.	.	225	.	.	23:30
12JUN	16.0	19.8	8.3	10.2	.	34.0	.	.	.	.	21:48
12JUN	16.0	19.8	8.2	9.9	.	36.0	.	.	.	.	21:58
15JUN	18.0	21.6	7.7	8.9	88.9	.	.	.	.	.	9:05
18JUN	21.5	25.5	8.5	10.4	.	21.0	.	.	.	.	22:15
18JUN	21.5	25.5	8.4	10.0	.	24.0	.	.	.	.	22:27
20JUN	21.0	23.9	7.2	8.1	17.8	.	.	260	.	.	21:13
25JUN	19.0	22.5	8.5	11.7	.	19.0	.	.	.	.	23:10
25JUN	18.3	22.8	8.7	12.4	.	23.0	.	.	.	.	23:33
28JUN	26.5	23.9	7.5	9.2	66.0	.	.	.	.	.	9:43
02JUL	23.0	25.0	8.5	10.8	.	21.0	.	.	.	.	21:43
02JUL	21.0	25.0	8.6	10.8	.	21.0	.	.	.	.	22:09
09JUL	26.0	27.0	8.4	10.5	.	15.0	.	.	.	.	22:12
09JUL	25.5	27.0	8.4	10.5	.	15.0	.	.	.	.	22:22
10JUL	28.0	26.5	7.7	8.3	66.0	2.0	3.0	.	228	0.5	9:45
16JUL	21.0	21.2	7.2	7.8	.	43.0	.	.	.	.	22:23

TABLE F-4 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
16JUL	20.0	21.0	7.1	7.8	.	38.0	.	.	.	.	23:35
18JUL	27.0	23.4	7.0	8.3	50.8	.	.	.	.	.	12:45
24JUL	22.5	25.8	8.0	8.6	.	29.0	.	.	.	.	21:28
24JUL	22.0	25.8	7.5	8.3	.	34.0	.	.	.	.	21:41
30JUL	24.0	27.5	7.8	10.0	121.9	.	.	350	.	.	23:35
01AUG	21.0	25.2	8.2	10.5	.	21.0	.	.	.	.	22:33
01AUG	20.0	25.2	8.6	10.5	.	14.0	.	.	.	.	23:23
06AUG	22.8	23.8	7.6	8.2	.	20.0	.	.	.	.	21:38
06AUG	22.8	23.7	7.7	8.4	.	27.0	.	.	.	.	21:49
07AUG	23.5	22.9	7.5	7.3	149.9	4.0	3.0	.	.	0.8	9:05
08AUG	21.0	25.4	7.6	9.4	111.8	.	.	300	.	.	21:15
14AUG	23.0	24.1	7.7	8.3	71.1	.	.	.	.	.	9:35
14AUG	22.0	25.4	8.3	12.2	.	24.0	.	.	.	.	20:55
14AUG	21.5	25.8	8.6	11.8	.	18.0	.	.	.	.	21:39
21AUG	17.0	20.0	7.7	9.6	.	15.0	.	.	.	.	22:10
21AUG	17.5	20.0	7.8	10.5	.	14.0	.	.	.	.	22:38
27AUG	24.5	24.9	8.2	9.4	.	24.0	.	.	.	.	21:14
27AUG	24.5	24.9	8.2	9.3	.	30.0	.	.	.	.	21:28
28AUG	25.0	25.9	8.4	10.7	53.3	.	.	250	.	.	23:47
30AUG	25.0	24.2	7.9	9.9	68.6	.	.	.	.	.	12:30
05SEP	25.0	24.1	8.1	10.1	76.2	.	.	325	.	.	20:30
07SEP	27.0	24.3	8.1	8.9	94.0	.	.	.	.	.	11:25
10SEP	22.5	20.8	7.6	8.0	94.0	5.0	2.0	.	218	0.7	9:55
24SEP	16.5	15.6	8.2	10.0	68.6	.	.	.	.	.	12:23
26SEP	13.0	16.5	8.4	11.8	50.8	.	.	340	.	.	0:40
01OCT	15.3	16.7	7.9	8.5	94.0	2.0	3.0	.	228	0.8	8:55
03OCT	17.0	17.4	7.9	11.0	83.8	.	.	325	.	.	20:00
30OCT	12.5	8.8	7.8	10.7	25.4	.	.	.	.	.	12:00
05NOV	14.0	11.4	7.4	9.9	86.4	1.0	1.0	.	149	1.6	10:43
08NOV	0.3	9.5	8.4	10.9	68.6	.	.	225	.	.	22:00
16NOV	12.5	5.6	8.2	12.3	40.6	.	.	.	.	.	11:30

TABLE F-5 WATER QUALITY DATA COLLECTED AT ZONE 8 NEAR TMINS, 1990.

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
04APR	6.7	8.3	8.1	11.4	76.2	5.0	4.0	.	151	1.4	9:15
04APR	7.0	7.2	8.1	11.2	.	30.0	.	.	.	.	21:22
11APR	8.0	9.2	7.8	11.5	.	33.0	.	.	.	.	20:47
12APR	5.0	8.4	7.6	11.6	96.5	.	.	.	.	.	9:25
16APR	12.0	10.5	7.5	10.8	.	39.0	.	.	.	.	21:44
18APR	7.0	9.8	7.4	11.2	63.5	.	.	200	.	.	21:20
23APR	17.0	16.0	7.8	10.0	.	27.0	.	.	.	.	21:19
30APR	14.0	17.3	8.4	10.8	.	29.0	.	.	.	.	22:53
02MAY	15.3	16.9	7.5	10.0	78.7	4.0	5.0	.	184	1.1	9:10
04MAY	13.0	15.2	7.2	9.7	127.0	.	.	.	.	.	10:40
07MAY	17.5	15.5	8.3	11.4	.	21.0	.	.	.	.	21:21
09MAY	20.5	18.2	8.0	11.3	68.6	.	.	240	.	.	22:00
14MAY	14.0	15.1	7.3	9.5	.	22.0	.	.	.	.	21:57
21MAY	12.0	15.0	7.1	9.0	.	55.0	.	.	.	.	22:25
23MAY	16.5	15.1	7.8	11.5	50.8	.	.	.	.	.	9:45
30MAY	14.0	16.0	7.2	9.3	45.7	.	.	195	.	.	22:12
31MAY	14.5	17.0	7.7	11.5	.	43.0	.	.	.	.	22:08
04JUN	13.0	18.7	7.9	9.0	.	27.0	.	.	.	.	23:08
05JUN	16.5	16.8	7.8	9.9	66.0	2.0	4.0	.	147	1.2	9:30
07JUN	22.5	21.0	7.7	11.2	78.7	.	.	225	.	.	0:30
12JUN	16.0	19.9	8.2	10.1	.	30.0	.	.	.	.	22:10
15JUN	19.5	21.7	7.6	9.0	78.7	.	.	.	.	.	10:40
18JUN	22.0	25.0	8.3	10.1	.	21.0	.	.	.	.	21:44
20JUN	22.0	23.8	7.1	7.4	25.4	.	.	275	.	.	22:16
25JUN	19.0	22.6	8.6	12.2	.	17.0	.	.	.	.	23:20
28JUN	29.0	24.9	7.5	9.4	71.1	.	.	.	.	.	11:27
02JUL	21.5	25.0	8.5	10.5	.	7.0	.	.	.	.	21:55
09JUL	26.0	27.0	8.7	10.2	.	11.0	.	.	.	.	21:31
10JUL	27.0	25.9	7.6	7.7	63.5	1.0	4.0	.	224	0.8	9:30
16JUL	21.5	21.7	7.0	7.8	.	45.0	.	.	.	.	22:51
18JUL	27.0	23.1	7.1	8.0	50.8	.	.	.	.	.	10:50
24JUL	20.2	25.5	7.4	8.5	.	23.0	.	.	.	.	23:50
30JUL	24.5	27.1	7.9	10.3	83.8	.	.	350	.	.	22:22
01AUG	21.0	25.0	8.3	9.8	.	23.0	.	.	.	.	22:47
06AUG	22.5	23.5	7.9	8.1	.	21.0	.	.	.	.	21:08
07AUG	23.0	22.9	7.4	8.2	116.8	0.0	4.0	.	.	0.9	9:25
08AUG	20.0	25.5	7.6	9.0	114.3	.	.	325	.	.	22:39
14AUG	23.0	23.6	7.7	8.6	81.3	.	.	.	.	.	10:07
14AUG	22.5	25.2	8.4	11.6	.	18.0	.	.	.	.	21:10
21AUG	17.0	20.0	7.8	10.8	.	16.0	.	.	.	.	22:28
27AUG	24.5	24.7	8.1	9.2	.	24.0	.	.	.	.	21:43
29AUG	24.0	25.5	8.0	10.0	55.9	.	.	250	.	.	0:54
30AUG	25.0	24.2	7.9	9.6	68.6	.	.	.	.	.	13:00
05SEP	24.5	23.9	7.9	10.1	91.4	.	.	340	.	.	21:25
07SEP	25.0	24.2	7.7	8.5	88.9	.	.	.	.	.	10:43

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
10SEP	22.0	20.6	7.5	8.1	73.7	2.0	1.0	.	260	0.7	9:40
24SEP	15.0	14.6	7.6	10.0	58.4	.	.	.	.	.	10:42
26SEP	13.0	16.5	8.3	12.2	63.5	.	.	340	.	.	1:41
01OCT	16.0	16.6	7.7	9.2	76.2	0.0	5.0	.	240	0.7	9:10
03OCT	15.0	17.2	8.5	10.8	88.9	.	.	350	.	.	21:13
30OCT	15.0	9.6	8.5	10.9	25.4	.	.	.	.	.	13:00
05NOV	13.0	11.8	7.5	10.1	55.9	4.0	4.0	.	183	1.4	10:27
08NOV	1.0	9.2	7.8	11.4	78.7	.	.	225	.	.	23:11
16NOV	17.0	7.6	7.9	12.0	38.1	.	.	.	.	.	12:05

TABLE F-6 WATER QUALITY DATA COLLECTED AT ZONE 9 NEAR TMINS, 1990.

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
04APR	7.0	8.1	7.8	11.2	83.8	17.0	10.0	.	137	1.8	9:30
04APR	7.0	7.8	7.9	11.0	.	40.0	.	.	.	.	21:08
11APR	8.0	9.1	7.8	11.3	.	21.0	.	.	.	.	20:33
12APR	3.5	8.3	7.7	11.4	96.5	.	.	.	.	.	8:50
16APR	12.0	10.9	7.4	10.8	.	34.0	.	.	.	.	20:52
18APR	5.0	9.8	8.0	11.2	71.1	.	.	180	.	.	22:13
23APR	17.0	16.0	7.7	10.0	.	27.0	.	.	.	.	21:34
30APR	14.8	17.5	8.1	10.8	.	20.0	.	.	.	.	22:21
02MAY	16.5	16.9	7.9	9.9	99.1	12.0	12.0	.	159	1.7	8:45
04MAY	15.0	15.2	7.4	9.9	106.7	.	.	.	.	.	11:50
07MAY	16.5	15.8	8.4	11.2	.	24.0	.	.	.	.	22:44
09MAY	20.0	18.1	7.9	11.2	66.0	.	.	250	.	.	22:58
14MAY	16.0	15.1	7.8	9.5	.	37.0	.	.	.	.	21:14
21MAY	12.0	15.0	7.2	9.0	.	49.0	.	.	.	.	22:55
23MAY	17.0	15.3	6.7	9.5	55.9	.	.	.	.	.	10:25
30MAY	12.0	16.0	8.0	10.0	63.5	.	.	200	.	.	23:12
31MAY	14.0	17.2	7.3	11.8	.	43.0	.	.	.	.	22:37
04JUN	13.0	18.8	7.9	8.8	.	27.0	.	.	.	.	23:25
05JUN	16.5	17.1	7.7	9.6	76.2	15.0	6.0	.	149	1.8	9:50
07JUN	22.0	20.9	7.6	11.0	88.9	.	.	225	.	.	1:42
12JUN	16.0	20.0	8.7	10.2	.	29.0	.	.	.	.	21:32
15JUN	20.0	22.1	7.7	9.2	68.6	.	.	.	.	.	11:35
18JUN	22.0	25.5	8.4	10.2	.	23.0	.	.	.	.	22:00
20JUN	20.0	23.8	6.7	7.2	22.9	.	.	260	.	.	23:23
25JUN	19.5	22.6	8.7	12.3	.	18.0	.	.	.	.	22:55
28JUN	30.0	28.2	7.2	8.1	55.9	.	.	.	.	.	12:05
02JUL	20.5	24.8	8.5	10.4	.	13.0	.	.	.	.	22:25
09JUL	25.0	27.0	8.4	10.0	.	12.0	.	.	.	.	22:59
10JUL	26.7	26.2	7.8	8.1	66.0	5.0	3.0	.	225	2.0	8:45
16JUL	20.0	21.1	7.2	7.9	.	30.0	.	.	.	.	23:52
18JUL	24.5	22.2	7.2	7.8	50.8	.	.	.	.	.	9:10
24JUL	22.0	25.8	7.7	8.6	.	24.0	.	.	.	.	22:01
30JUL	23.5	27.9	8.0	9.2	106.7	.	.	325	.	.	21:05
01AUG	21.5	25.2	8.2	11.0	.	18.0	.	.	.	.	21:17
06AUG	22.5	24.0	7.7	8.0	.	18.0	.	.	.	.	21:23
07AUG	24.0	23.1	7.4	7.5	139.7	7.0	4.0	.	.	1.8	9:40
08AUG	18.5	25.0	8.0	8.6	119.4	.	.	325	.	.	23:58
14AUG	25.0	24.3	8.3	8.5	88.9	.	.	.	.	.	10:47
14AUG	21.0	25.2	8.6	11.6	.	21.0	.	.	.	.	21:25
21AUG	17.2	20.0	8.6	8.6	.	11.0	.	.	.	.	21:51
27AUG	23.0	25.0	7.5	10.1	.	23.0	.	.	.	.	21:59
29AUG	23.5	25.3	7.8	9.2	58.4	.	.	260	.	.	2:12
30AUG	23.5	23.7	7.5	8.4	73.7	.	.	.	.	.	10:40
05SEP	24.5	24.1	8.4	9.9	81.3	.	.	310	.	.	22:28
07SEP	24.0	24.3	7.8	8.6	88.9	.	.	.	.	.	9:47

TABLE F-6 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
10SEP	22.0	20.7	7.6	8.0	73.7	5.0	3.0	.	229	1.5	9:20
24SEP	14.7	14.7	7.7	9.9	68.6	.	.	.	.	.	10:03
25SEP	13.7	16.5	8.9	11.6	61.0	.	.	350	.	.	21:20
01OCT	18.0	16.6	7.6	9.0	81.3	2.0	4.0	.	230	1.8	9:45
03OCT	13.5	17.1	8.2	10.9	94.0	.	.	350	.	.	22:21
30OCT	15.0	9.9	8.0	10.6	22.9	.	.	.	.	.	14:00
05NOV	12.5	11.2	8.0	9.9	71.1	10.0	3.0	.	165	1.8	10:07
09NOV	-1.0	8.5	7.7	10.8	73.7	.	.	225	.	.	0:07
16NOV	8.0	5.7	7.7	12.2	45.7	.	.	.	.	.	9:57

TABLE F-7 WATER QUALITY DATA COLLECTED AT ZONE 10 NEAR TMINS. 1990.

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
04APR	6.0	7.2	7.8	11.0	.	6.0	.	.	.	.	22:05
11APR	6.0	9.2	7.8	11.5	.	11.0	.	.	.	.	22:04
12APR	6.5	9.3	7.3	10.9	76.2	.	.	.	.	.	10:50
16APR	11.5	10.5	7.4	10.8	.	12.0	.	.	.	.	21:15
18APR	8.5	9.9	8.2	11.2	76.2	.	.	190	.	.	19:32
23APR	18.0	16.5	8.3	10.4	.	6.0	.	.	.	.	20:47
30APR	15.0	17.2	8.0	10.4	.	3.0	.	.	.	.	21:55
04MAY	13.0	15.3	7.4	9.3	203.2	.	.	.	.	.	9:35
07MAY	17.5	16.0	8.4	11.6	.	3.0	.	.	.	.	21:02
09MAY	21.0	18.6	8.7	12.4	81.3	.	.	240	.	.	19:50
14MAY	15.0	14.5	7.3	9.5	.	12.0	.	.	.	.	22:19
21MAY	12.0	15.0	8.1	9.0	.	11.0	.	.	.	.	21:05
23MAY	15.0	14.5	8.1	10.8	58.4	.	.	.	.	.	8:20
30MAY	15.0	16.0	7.9	9.6	38.1	.	.	200	.	.	20:28
31MAY	13.5	17.0	7.4	11.7	.	8.0	.	.	.	.	23:19
04JUN	14.0	19.0	7.9	9.3	.	6.0	.	.	.	.	22:27
06JUN	21.5	21.0	7.9	11.4	86.4	.	.	250	.	.	22:30
12JUN	14.8	19.8	7.4	10.8	.	4.0	.	.	.	.	23:27
15JUN	18.5	21.3	7.4	8.0	96.5	.	.	.	.	.	9:50
18JUN	22.0	25.0	8.4	11.0	.	3.0	.	.	.	.	21:25
20JUN	21.0	23.9	7.5	7.9	25.4	.	.	275	.	.	20:24
25JUN	19.9	23.8	8.8	10.5	.	2.0	.	.	.	.	22:31
28JUN	27.0	25.8	7.9	11.9	106.7	.	.	.	.	.	10:30
02JUL	20.5	24.5	8.2	9.2	.	0.0	.	.	.	.	22:50
09JUL	26.0	27.2	8.5	10.3	.	0.0	.	.	.	.	21:52
16JUL	20.2	21.1	7.0	7.8	.	6.0	.	.	.	.	23:15
18JUL	27.5	23.2	7.2	7.4	61.0	.	.	.	.	.	11:50
24JUL	21.5	25.9	7.9	8.6	.	3.0	.	.	.	.	22:31
31JUL	24.0	27.3	8.3	11.1	109.2	.	.	350	.	.	0:56
01AUG	20.2	25.5	8.7	10.5	.	2.0	.	.	.	.	23:06
06AUG	22.0	25.0	7.5	7.8	.	3.0	.	.	.	.	23:19
08AUG	21.5	26.0	7.9	10.1	127.0	.	.	325	.	.	20:09
14AUG	22.5	24.4	8.2	11.3	94.0	.	.	.	.	.	8:55
14AUG	20.5	25.6	8.2	14.5	.	3.0	.	.	.	.	21:57
21AUG	17.0	22.8	8.1	14.5	.	0.0	.	.	.	.	22:56
27AUG	27.0	25.0	8.4	9.4	.	3.0	.	.	.	.	20:50
28AUG	26.0	26.1	8.1	13.0	55.9	.	.	250	.	.	21:50
30AUG	24.7	24.5	8.1	9.0	81.3	.	.	.	.	.	11:40
05SEP	24.0	24.2	8.4	11.0	101.6	.	.	325	.	.	19:13
07SEP	29.0	26.2	8.1	11.2	94.0	.	.	.	.	.	12:10
24SEP	16.5	17.0	8.5	10.3	83.8	.	.	.	.	.	11:53
25SEP	13.7	16.5	8.3	11.7	58.4	.	.	330	.	.	23:02
03OCT	17.0	17.4	8.3	10.8	114.3	.	.	360	.	.	18:30
30OCT	11.0	8.3	7.9	10.4	35.6	.	.	.	.	.	10:55
08NOV	0.0	8.8	7.7	10.6	94.0	.	.	250	.	.	20:44
16NOV	10.0	6.1	8.9	12.0	58.4	.	.	.	.	.	10:45