SAND MOUNTAIN WATERSHED PROJECT

MACROINVERTEBRATE BIOASSESSMENT

JUNE 1-2, 1993

SPECIAL STUDIES SECTION
FIELD OPERATIONS DIVISION
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

JANUARY 11, 1994

REPORT
AQUATIC MACROINVERTEBRATE BIOASSESSMENT
SAND MOUNTAIN/LAKE GUNTERSVILLE WATERSHED PROJECT

INTRODUCTION

The purpose of the Sand Mountain/Lake Guntersville Watershed Project is to demonstrate proper management of animal waste to farmers, scientists, and agricultural professionals and to improve water quality through various kinds of assistance to selected producers and comprehensive educational efforts within the Sand Mountain/Lake Guntersville project area.

The stream water quality monitoring portion of the Sand Mountain/Lake Guntersville watershed project was initiated in April of 1988 by the ADEM. The basic monitoring plan consists of 11 sampling sites on 7 streams within the watershed which are monitored using chemical/physical parameters and bacteriological studies in order to examine trends in water quality within the watershed.

Biological monitoring of a selected portion of the sampling sites was incorporated into the final phase of the project as part of the continued water quality sampling. Macroinvertebrate data were collected at 7 sites during June of 1988, May of 1989 and June of 1992. In June of 1993, at the request of the Mining and Nonpoint Source Section of the Water Division, Special Studies Section Personnel from Field Operations Division completed in-stream bioassessments utilizing aquatic macroinvertebrates to document current water quality. A proposed ecoregional reference site, chosen from sites visited on April 13 - 14, 1993, was also sampled during this study to better assess changes in water quality.

The multiple-habitat sampling methodology utilized during the 1992 amd 1993 sampling events (RBP-Multihabitat) was a modification of the EPA Rapid Bioassessment Protocol (Plafkin 1989). This method was more rigorous than the One Person-Hour method utilized by EPA in 1988 and 1989 and allowed for a more detailed analysis of the biological community. Because data gathered using the two methods are not directly comparable, only the 1992 and 1993 data were discussed in this report.

MATERIALS AND METHODS

Study Area

The Sand Mountain watershed is located in the Tennessee River Basin and occupies parts of DeKalb, Etowah, Jackson and Marshall counties in northeast Alabama. This study of the benthic macroinvertebrates in the Sand Mountain watershed focuses on seven streams: Shoal Creek, Little Shoal Creek, Scarham Creek, Short Creek, South Sauty Creek, Town Creek and Bryant Creek.

Aquatic macroinvertebrate samples, field parameters and stream flows were collected at the following stations. The station numbers are those utilized in the Macroinvertebrate Database. The numbers in parentheses () are the station numbers utilized by the Mining and Nonpoint Source Section. The stream orders were taken from the "Sand Mountain - Lake Guntersville Supplemental Water Quality Plan, February 1988" and from topographic maps:

BYTJ1	Bryant Creek *(Ecoregional reference site)* Jackson County. fourth order stream
TCD1	Town Creek at Dekalb Hwy 40 (*Control Station*) (T5S R9E S11 SE¼ SE¼) third order stream
TCD3 (T3)	Town Creek at DeKalb County Road 50 (T7S R7E S14 NW¼ SE¼) third order stream
SCD3 (SC3)	Scarham Creek at DeKalb County Road 1 (T8S R5E S34 NE¼ SW¼) third order stream
SHM3A (SH3a)	Short Creek Marshall County (T9S R5E S9 SW¼ SW¼) fourth order stream
SSD3 (SS3)	South Sauty Creek at Dekalb County Road 47 (T6S R7E S20 NW¼ SE¼) second order stream
SLM1	Shoal Creek at Marshall County Road 372 (T8S R5E S9 SW¼ SW¼) second order stream
LSLM1	Little Shoal Creek at Marshall County Road 372 (T8S R5E S9 SW¼ SW¼) second order stream

Sampling Methodology

Macroinvertebrates were collected using the "RBP-Multihabitat" method outlined in the Field Operations Standard Operating Procedures Manual Volume II - Macroinvertebrate Section. Habitat Assessments and Physical Characterization Data collection were completed after the method of Plafkin, et al (1989), as outlined in the above referenced document. Stream flows, using a "AA" or Pygmy current meter, were measured at all stations. Grab samples from each stream were collected for field parameter analysis utilizing standard procedures as outlined in the Field Operations Standard Operating Procedures Manual Volume I - Physical/Chemical.

Chain of Custody

Sample handling and chain-of-custody for all macroinvertebrate samples collected were as per the appropriate section in the Field Operations Standard Operating Procedures Manual Volume II - Macroinvertebrate Section.

Data Analysis

All macroinvertebrate data were entered into the mainframe PACE Macroinvertebrate Database where tabulation of taxa and calculation of biometrics were completed. Appropriate Quality Assurance/Quality Control procedures were followed to assure accuracy of data output.

DISCUSSION

The Sand Mountain area is located within the Interior Plateau Ecoregion (71). Seven streams (eight stations) were assessed over a two day period using a multiple-habitat methodology to collect aquatic macroinvertebrates. These streams were generally characterized as having substrates of boulder and cobble, with lesser amounts of bedrock and gravel. This stream bed composition provided excellent habitat for colonization by macroinvertebrates. All sites had deposits of sand and silt to varying degrees in the run and pool areas.

It should be noted that the control site for the study was located in the upper most part of the watershed to minimize the degree of adverse impact from nonpoint source pollution. The reference site was chosen to represent the quality of a least impacted stream in the Sand Mountain area of Ecoregion 71. Due to the large numbers of agricultural operations (poultry production, livestock) in the watershed, no unimpacted sites were found to utilize as control or ecoregional reference site. This should be considered when comparisons are made between the study sites and the reference site.

Habitat assessments were completed at all sites to determine if the study sites had the habitat available to support a biological community comparable to the control or reference site. The quality of the habitat found in 1993, as illustrated in Figure 1, ranged from "Good" with a score of 97 (Good 71-103) to "Excellent" with a score of 112 (Excellent 104-135). Since no score varied more that 20 percent from the control or reference station score, all study stations during 1993 were comparable to the control and reference station in terms of habitat. Short Creek at SHM3a showed improvement in the habitat quality from 1992 to 1993 where three beaver dams found in 1992 were no longer present, allowing increased flow through the sampling reach (Figure 2). This was the only station where the stream flow increased between sampling dates.

Field parameter measurements were taken at all stations during the 1992 and 1993 field studies (Table 1). Water temperatures were generally cooler during the 1993 study. Dissolved oxygen, pH and conductivity values showed little variation between sampling dates. Turbidity measurements showed no change with the exception of station SHM3a which had a noticeable increase in turbidity from 3.8 to 18 nephelometric titration units (ntu). Stream flows were greatly reduced in 1993, generally dropping to less than half of the 1992 flow.

A list of macroinvertebrate taxa collected at each station is located in Tables 2 and 3. The biometrics used to analyse macroinvertebrate data can be calculated for each of the study stations and compared to the control or reference station (single station metrics) or they can be calculated using data from the control or reference station (comparison metrics). All biometrics utilized in this report are located in Tables 4 - 15. "Interpretation of Biometrics" - Table 16, may be referred to in the following discussion. When comparing macroinvertebrate data from different stations, the samples must be composed of comparable habitats. The data from all stations utilized in this report are composed of macroinvertebrates samples from the riffle, rock/log, CPOM and sand habitats. These are the habitats that were available and collected at all stations in both 1992 and 1993. Therefore, the data presented in the 1992 Sand Mountain Bioassessment Report may differ slightly from that utilized here.

Single Station Metrics

- The total taxa richness biometric is the total number of taxa collected from comparable habitats at a station (Figure 3). In 1993, total taxa richness ranged from 44 to 66 with an average of 53. At the control station (TCD1) 58 taxa were collected and at the proposed reference station (BYTJ1) 49 taxa were collected. As illustrated in Figure 3, total taxa richness decreased from 1992 to 1993 for all stations with the exception of station TCD3. In general, a decrease in taxa richness suggests a decrease in water quality. However, natural variation in taxa richness due to changes in annual weather patterns may account for this trend.

- In 1993, the EPT taxa richness (Figure 4), which is the total number of the generally pollution intolerant Ephemeroptera, Plecoptera and Trichoptera taxa, ranged from 11 to 24 with a mean of 17. The control station sample had 24 and the proposed reference station had 13 EPT taxa. Stations TCD3 and SSD3 had the largest change in the number of EPT taxa gaining six and losing seven taxa, respectively. The remaining stations gained or lost either one or two taxa suggesting no change in water quality.

- Chironomidae, in general are considered a pollution tolerant group. There are exceptions, but in most circumstances this family should not dominate the taxa composition. The portion of the taxa collected representing the Chironomidae Family ranged from 14 to 20 taxa with a mean of 18 during the 1993 study. The control (TCD1) and study (BYTJ1) stations had 17 and 20 taxa, respectively. The Chironomidae taxa richness (Figure 5) generally showed little change, gaining or losing from one to three taxa, when comparing the 1992 and 1993 samples. The exception to this is Shoal Creek (SLM1) which lost 5 taxa and Town creek at TCD3 which gained 13 taxa.

- In 1993, the percent contribution of taxa from the Chironomidae family (Figure 6) ranged from 29 to 41 percent. The Control station (TCD1) had 29 percent and the proposed reference site (BYTJ1) had 41 percent of the taxa collected belonging to the Chironomidae family. This compares with the 1992 collections ranging from 16 to 33 percent Chironomidae.

- The Biotic Index (Figure 7) considers the overall tolerance to pollution of each taxa identified on a scale of 0 to 10 (intolerant to tolerant) and weights it based on its dominance in the sample. In general, a change of 1.0 (Penrose, personal communication) indicates a change in water quality. In 1993, this metric ranged from 3.99 to 5.11 with a study station mean of 4.62. The control station biotic index was 3.99 and the proposed reference site value was 4.93. All study station biotic indices for 1993 were similar (within 1.0) to the control station and proposed reference station with two exceptions. South Sauty Creek at SSD3 and Short Creek at SHM3a had differences of +1.12 and +1.02, respectively, as compared to the control TCD1. The 1992 biotic indices were all within 1.0 of the control station biotic index; the average study station biotic index was 5.10.

  When comparing the 1992 and 1993 data, only the control site (TCD1) had a change in the biotic index of 1.0 or greater (-1.34). This generally indicates an improvement in water quality at station TCD1 over the 1992 data. Hilsenhoff (1987) established guidelines for evaluating the biotic index in Wisconsin. Utilizing that method of evaluation all stations had "good" water quality with "some" degree of pollution. It should be noted that this guideline may not be directly applicable to Alabama Waters.

- The percent contribution of the numerically dominant taxon is an indication of community balance at the lowest positive taxonomic level. These values were low for each station sampled during this study. In general, least impacted streams often have the dominant taxon comprising less than 30 to 35 percent of the sample. Streams having values much larger than this would indicate environmental stress.

  As shown in Figure 8, all study stations during 1992 and 1993 had percentages far below this level (range 9% - 22% for 1992 and 14% - 21% for 1993). The proposed reference site had a dominant taxon comprising 27 percent of the sample. The dominant taxon made up 38 percent of the control station sample in 1992 and 13 percent in 1993.

- The metric EPT / (EPT + Chironomidae) expresses the relationship between the generally pollution intolerant EPT organisms and the generally pollution tolerant Chironomidae organisms (Figure 9). This ratio uses the relative abundances of these indicator groups as a measure of community balance. A good biotic condition is reflected in communities having a fairly even distribution among all four major groups and with substantial representation in the sensitive EPT groups (values 0.75 or greater). Skewed populations having a disproportionate number of the generally tolerant Chironomidae relative to the more sensitive EPT insect groups may indicate environmental stress. All stations, with the exception of TCD3 during 1993, have some degree of stress based on this metric.

- The percent contribution of the functional feeding groups indicates that all of the stations collected during 1992 and 1993 were dominated by the collector feeding type and most often the filtering collector (Figures 14 - 17). This indicates that the dominant food source is located within the water column, in the form of algae and suspended solids. This may be the result of increased nutrient loading during rainfall events.

Station Comparison Metrics

Several metrics were utilized to compare the study stations to the control or reference station.

- Shackleford's Indicator Assemblage Index (IAI) (Figure 10) uses the relative abundances of the generally pollution intolerant Ephemeroptera, Plecoptera and Trichoptera, and the generally pollution tolerant Chironomidae and Annelida for the control or reference station and the study station. Values range from 0 to >1 and are inversely proportional to the degree of environmental stress. The evaluation criteria utilized by Shackleford (Arkansas) are as follows:

  IAI >0.80 No impairment as compared to control
  IAI 0.65-0.80 Minimal impairment as compared to control
  IAI 0.50-0.64 Substantial impairment as compared to control
  IAI <0.50 Excessive impairment as compared to control

  Utilizing these criteria to evaluate the study data indicates that there is "no impairment" in the study stations "as compared to the control" or reference site. However, it should be noted that neither the control nor reference stations are unimpacted stream sites.

- The Sorenson's Community Similarity Index (Figure 11) utilizes a ratio of the number of taxa from the study station that are similar to the control/reference station, to the total number of taxa at both stations. Values at all study stations were greater than 0.4. Values greater than or equal to 0.4 indicate that the stations being compared are similar.

- The Community Similarity Index (QSI-Taxa) (Figure 12) compares two communities in terms of presence or absence, and the relative abundances of the individual taxa. For the 1992 study as compared to the control, the stations ranged from 12 to 36 percent similar, and average 28 percent. Station TCD3 had the lowest similarity with 12 percent. The remaining stations were more similar and ranged from 29 to 36 percent. Quality assurance work on an unrelated stream indicates that data collected on the same day at the same station by two different field crews had a community similarity index for taxa composition of approximately 70 percent.

  For the 1993 study as compared to the control, the stations ranged from 35 to 60 percent similar, and average 46 percent. Station LSLM1 had the highest similarity with 60 percent. The remaining stations were less similar and ranged from 35 to 48 percent. When the proposed reference site was utilized for comparison, the similarity index ranged from 29 to 43 percent. Station LSLM1 and the Control station TCD1 had the highest percent similarities with 43 and 42 percent, respectively.

- The Community Similarity Index for Functional Feeding Types compares two communities in terms of presence or absence, and the relative abundances, of the functional feeding types (Figure 13). For the 1992 study, as compares to the control, the stations ranged from 57 to 86 percent similar and averaged 73 percent similar as to the relative composition of the feeding types. Quality assurance work on an unrelated stream indicates that data collected on the same day at the same station by two different field crews had a community similarity index for functional feeding types of approximately 80 percent.

When compared to the control the 1993 study stations ranged from 86 to 93 percent similar. As compared to the reference stations, the study stations ranged from 70 to 83 percent similar. The control station was 87 percent similar.

In general, 1993 stations were more similar to the control station than were the same stations in 1992. All 1993 study stations were more similar to the control station than to the proposed reference station.

- The Biological Condition Category, advocated by EPA (Plafkin 1989) is assigned based on the percent comparability to a control or reference station. Each metric is given a score (Figure 18) based on the percent comparability to a reference/control station or on a preassigned range.

Metric	6	4	2	1
1. Taxa Richness [(a)]	>80%	60-80%	40-60%	<40%
2. Biotic Index [(b)]	>85%	70-85%	50-70%	<50%
3. EPT/EPT+Chiro [(a)]	>75%	50-75%	25-50%	<25%
4. %Contrib Dom. Taxon [(d)]	<20%	20-30%	30-40%	>40%
5. EPT index [(a)]	>90%	80-90%	70-80%	<70%

(a) Score is a ratio of study site to reference site X 100
(b) Score is a ratio of reference site to study site X 100
(d) Scoring criteria evaluate actual percent contribution, not percent comparability to the reference station.

Scores are totaled and a Biological Condition Category is assigned based on the percent comparability with the reference/control station score total.

% Comparibility to Reference Score	Condition Category
> 83%	Non-impaired
79% - 59%	slightly impaired
50% - 21%	moderately impaired
< 17%	severely impaired

An improvement in any of the control/reference metrics utilized in the scoring categories, with no change in the study station, would lower the score for that particular metric, leading to a possible drop in the condition category for that study station. The reverse is also true for a worsening of the control/reference metrics.

SUMMARY AND CONCLUSIONS

Analysis of the data collected during the 1993 in-stream bioassessment of selected streams within the Sand Mountain watershed indicates that all study stations are similar to the control and reference sites. However, neither the control nor the reference station were un-impacted sites. All stations had "good" or "excellent" habitat quality with little change in the numerical habitat assessments from 1992 to 1993 (except SHM3a). Stream flows were generally lower during 1993 (except SHM3a) and field parameters measured indicated little change in water quality from the 1992 study.

The biological metrics used to analyse the data indicated that the macroinvertebrate community of SHM3A continued to be of lower quality as compared to the control station, while station TCD3 showed general improvement. The data for all other stations showed only slight changes in the biological community indicating little change in the water quality since the 1992 report. All single station metrics indicated that the proposed ecoregional reference site was of lower quality than the control.

Using the Biological Condition Scoring Criteria with the 1993 data, stations SSD3 and SHM3a were in the "slightly impaired" and all other stations were "unimpaired" as compared to the control. When the reference site was utilized for comparison all stations were in the "non-impaired" category. The 1992 data placed TCD3 in the "slightly impaired" category as compared to the control. The apparent decrease in water quality at SSD3 and SHM3a over that reported in 1992 is, at least partially, the result of the improvement of the control station TCD1 as reflected by the biotic index and the percent contribution of the dominant taxon. A decrease in the total number of taxa, as well as the EPT taxa, collected at SSD3 also contributed to the lowering of the condition category for that station.

Further analysis of the data collected at station SHM3a indicates that the water quality improved since the 1992 study. The stream flow also increased from 1992 to 1993, most likely in response to the removal of at least three beaver dams, at or near the sampling reach, sometime between the two sampling events. An increase in turbidity (Table 1) indicated the possibility of a recent rain event or removal of the beaver dams. The habitat assessment at SHM3a showed a large improvement in numerical assessment and a change in the habitat quality category from "good" to "excellent".

In 1993, station TCD3 showed general improvement in biotic quality over the 1992 study. The stream bed may have been scoured from possible recent rains prior to the 1992 sampling event. This was suspected because of the dramatic decrease in the flow measured during the 1993 study.

Although all but one stream experienced a similar percent decrease in flow, because of the size, station TCD3 had the greatest net flow loss (nearly 90 cfs). Scouring of the stream bed would result in a lower number of total taxa, as well as EPT and Chironomidae taxa, available for collection. Improvements in all three of these categories during 1993 would be consistent with improved sampling conditions. However, the general improvement in biotic quality may also be related to a decrease in the NPS impacts from stormwater runoff due to lesser amounts of rainfall (indicated by generally lower water levels at all sites).

The ecoregional reference site proposed for use during this study was found to be of lower biological community quality than the control site. Further effort should be expended to locate a more appropriate ecoregional reference site. This would assist in determining the true quality of the biological communities found in the Sand Mountain watershed area rather than the relative quality as compared to another impacted site. Additional bioassessments are recommended to further document the water quality of the Sand Mountain Watershed.

FIGURE 1

STATION	BYTJ1 (R	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		101	111	99	89	106	107	117
1993	97	110	112	109	111	108	106	109

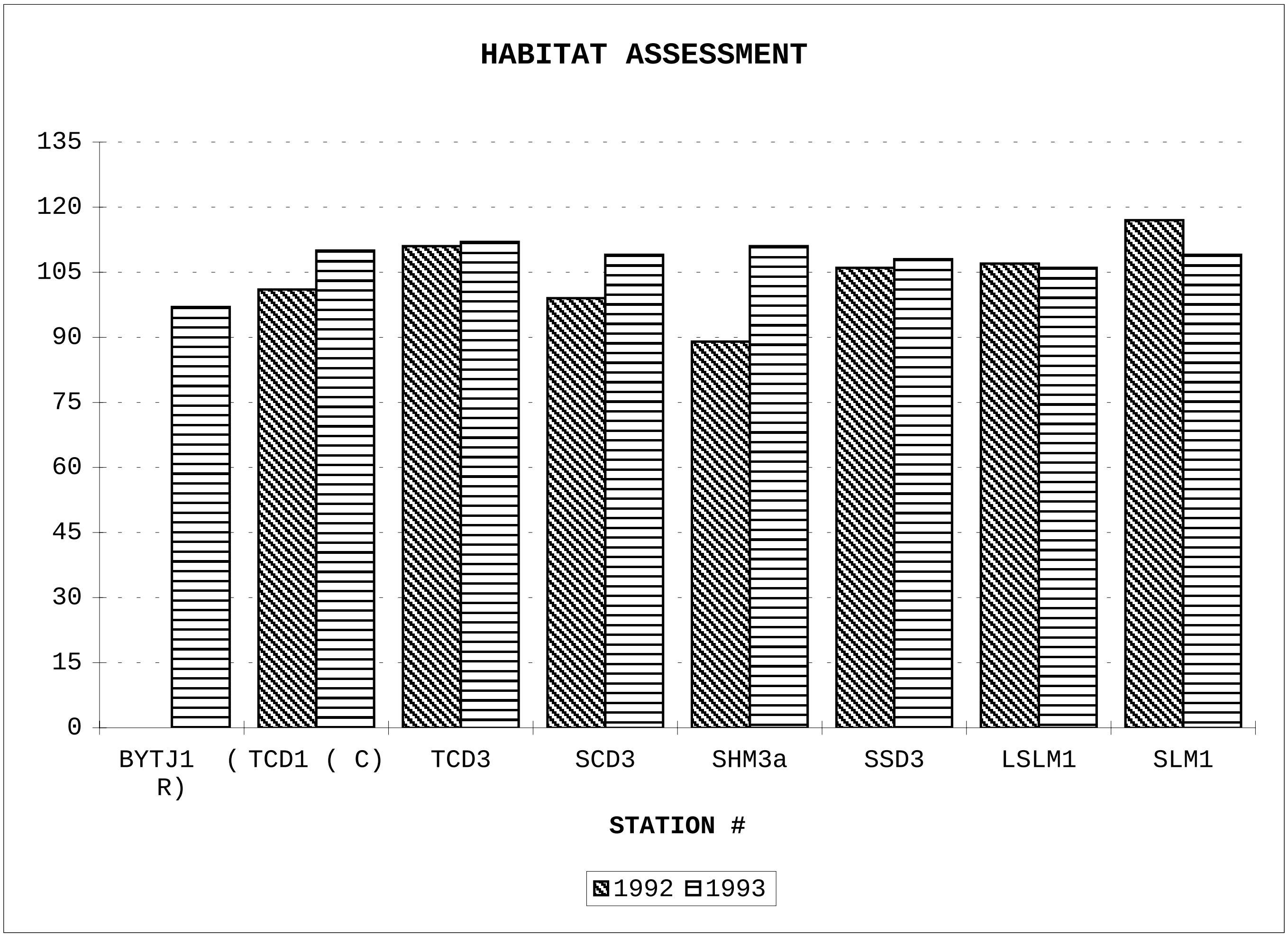


FIGURE 2

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		29.3	137.5	26.4	8.4	38.5	5.2	3.5
1993	11.6	12.3	44.9	18.4	32.7	7.9	2	1.5

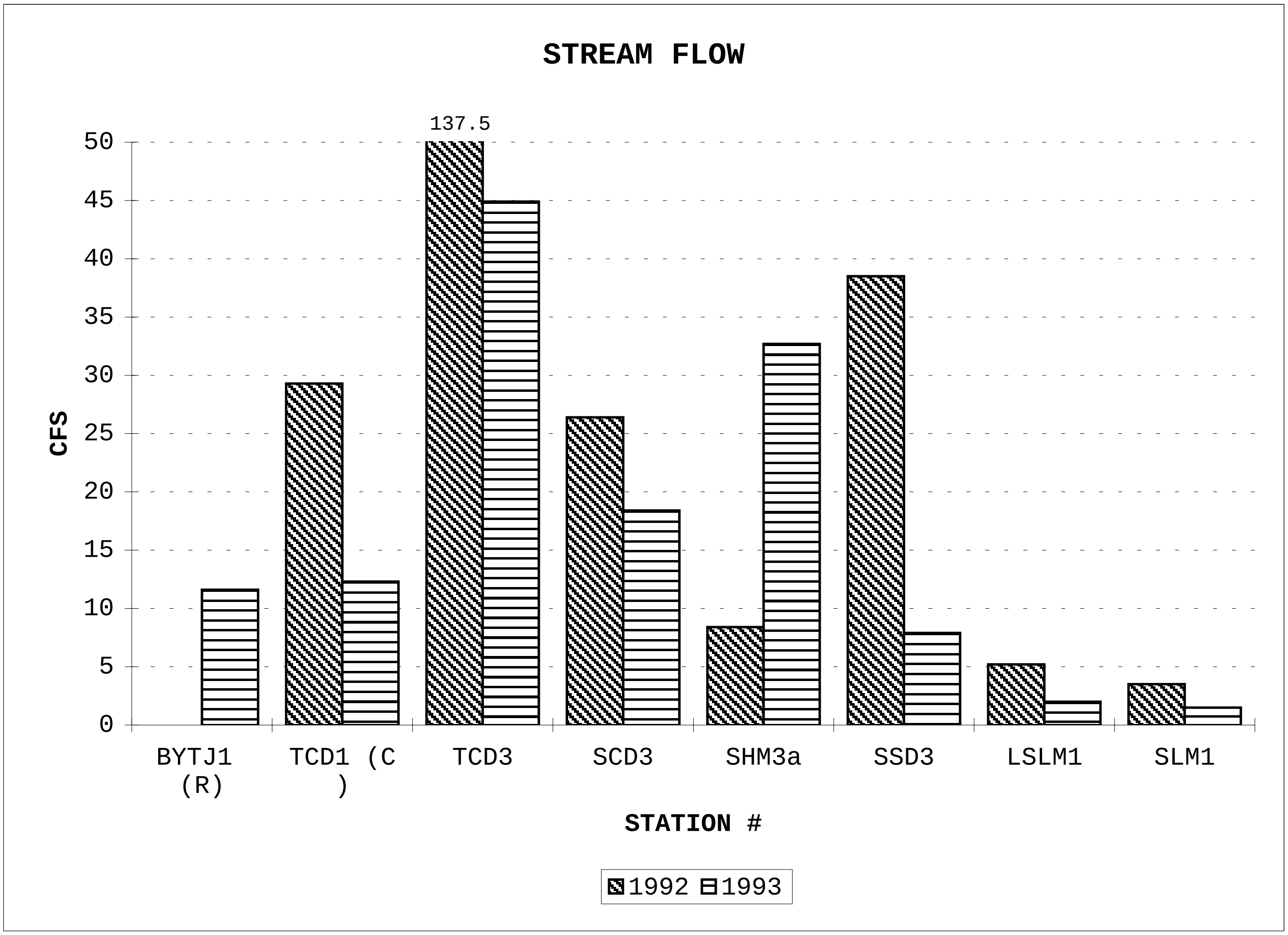


FIGURE 3

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		60	45	77	57	69	63	60
1993	49	58	57	66	44	50	54	49

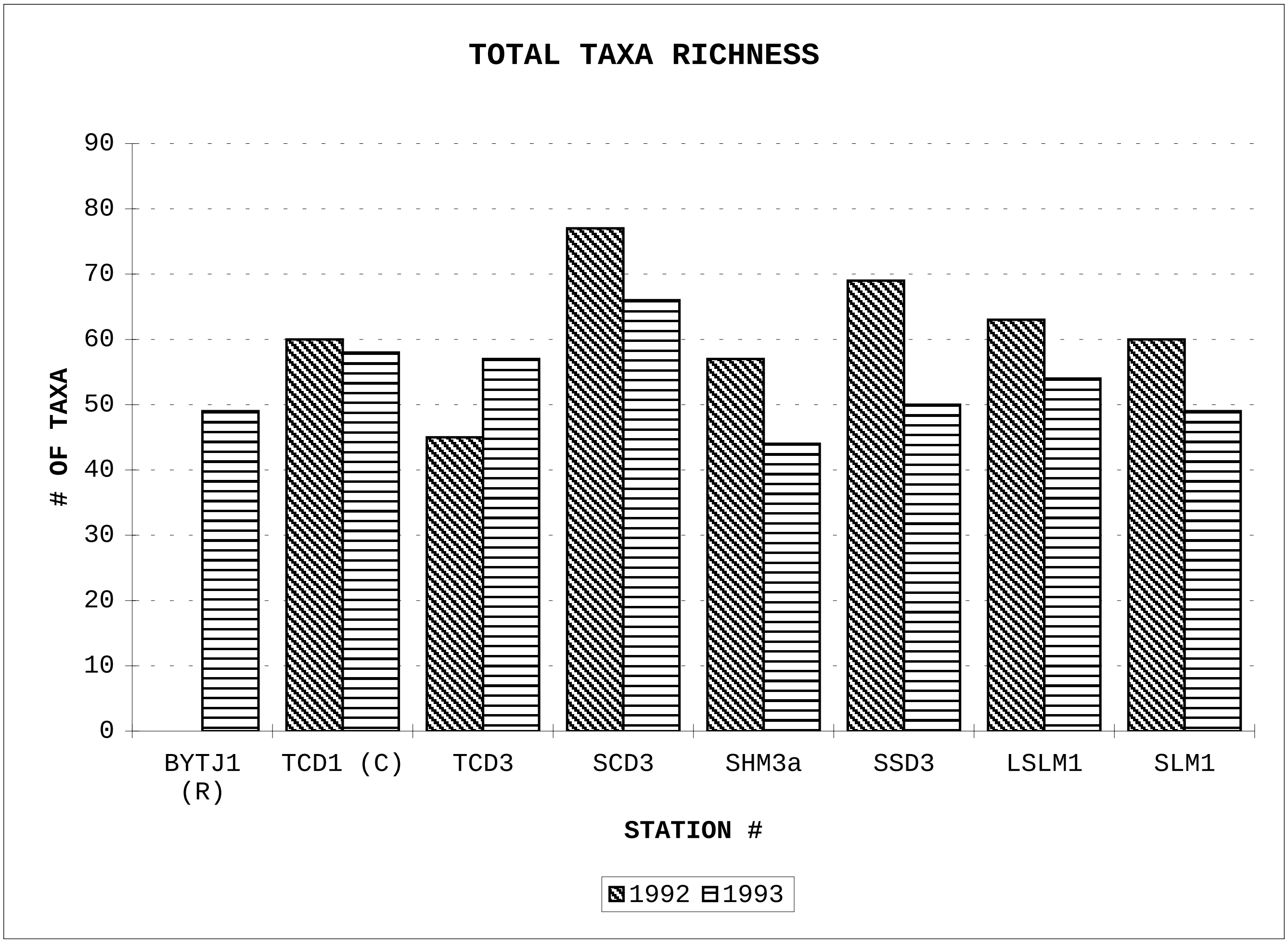


FIGURE 4

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		22	12	22	13	24	16	17
1993	13	24	18	24	11	17	15	16

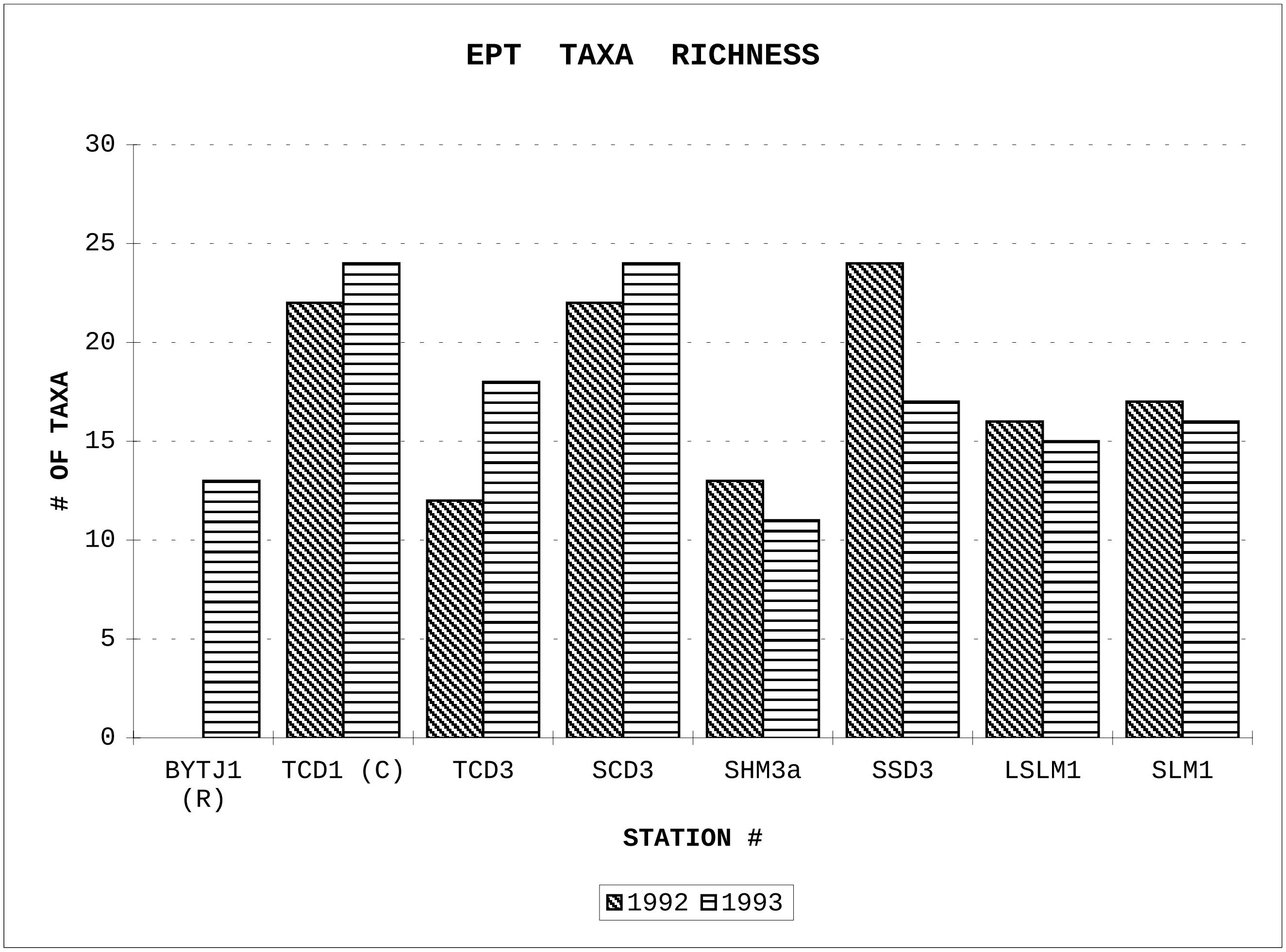


FIGURE 5

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		16	7	21	15	19	21	19
1993	20	17	20	20	16	17	19	14

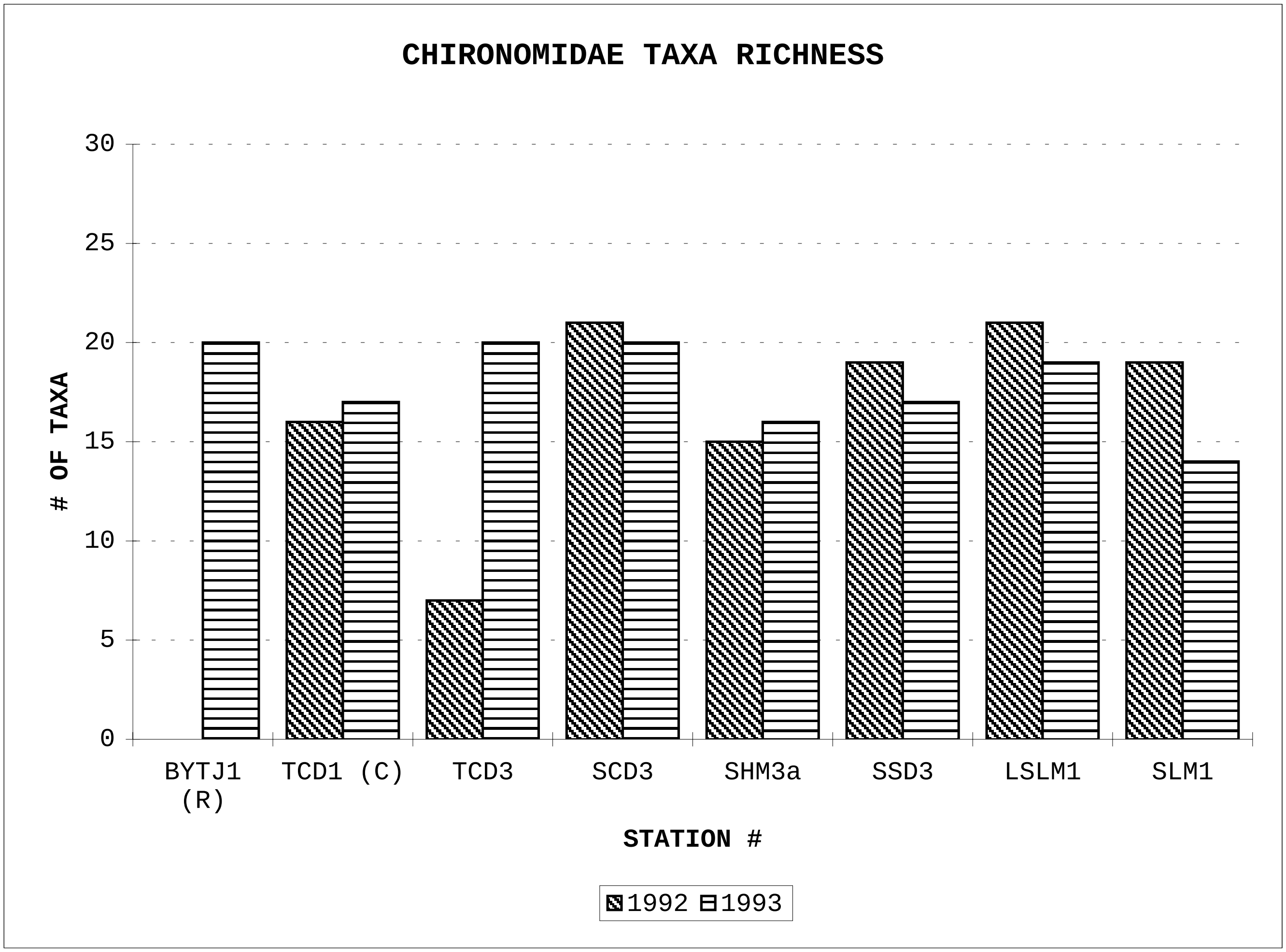


FIGURE 6

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		27	16	27	26	27	33	32
1993	41	29	35	30	36	34	35	29

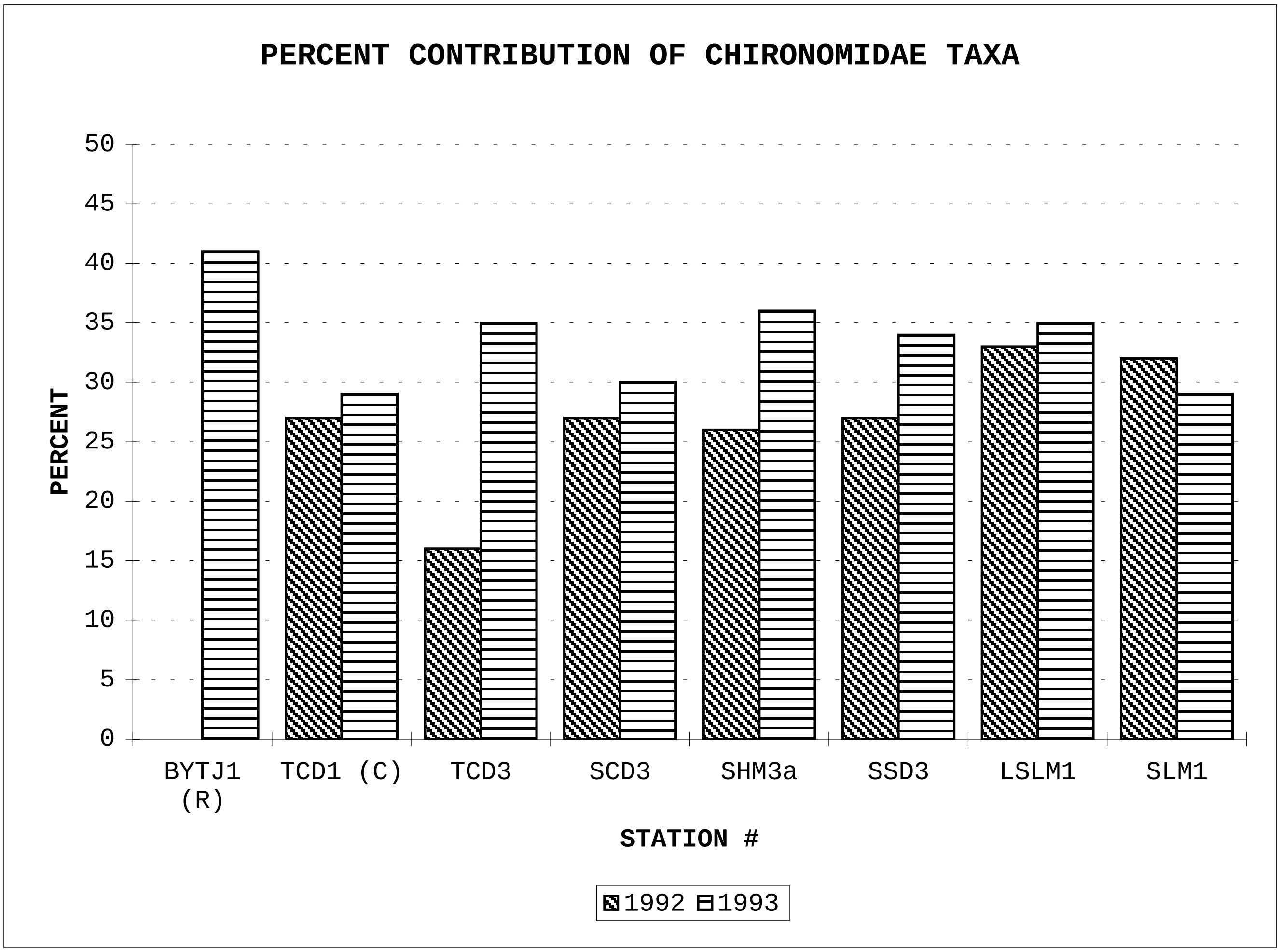


FIGURE 7

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		5.33	4.96	5.12	5.20	5.36	5.13	4.82
1993	4.93	3.99	4.00	4.80	5.01	5.11	4.14	4.68

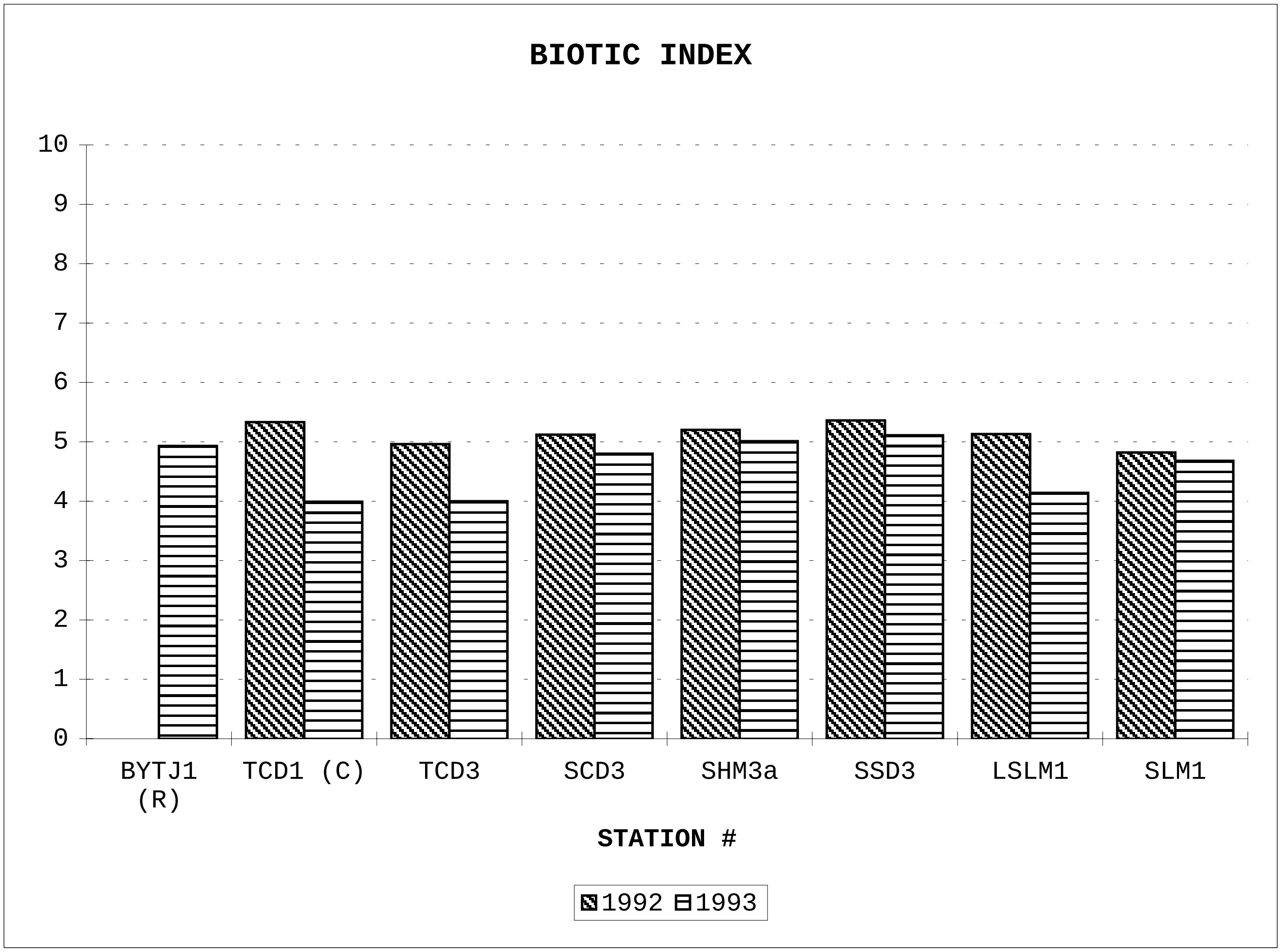


FIGURE 8

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		38	22	9	15	19	19	16
1993	27	13	14	14	21	21	18	16

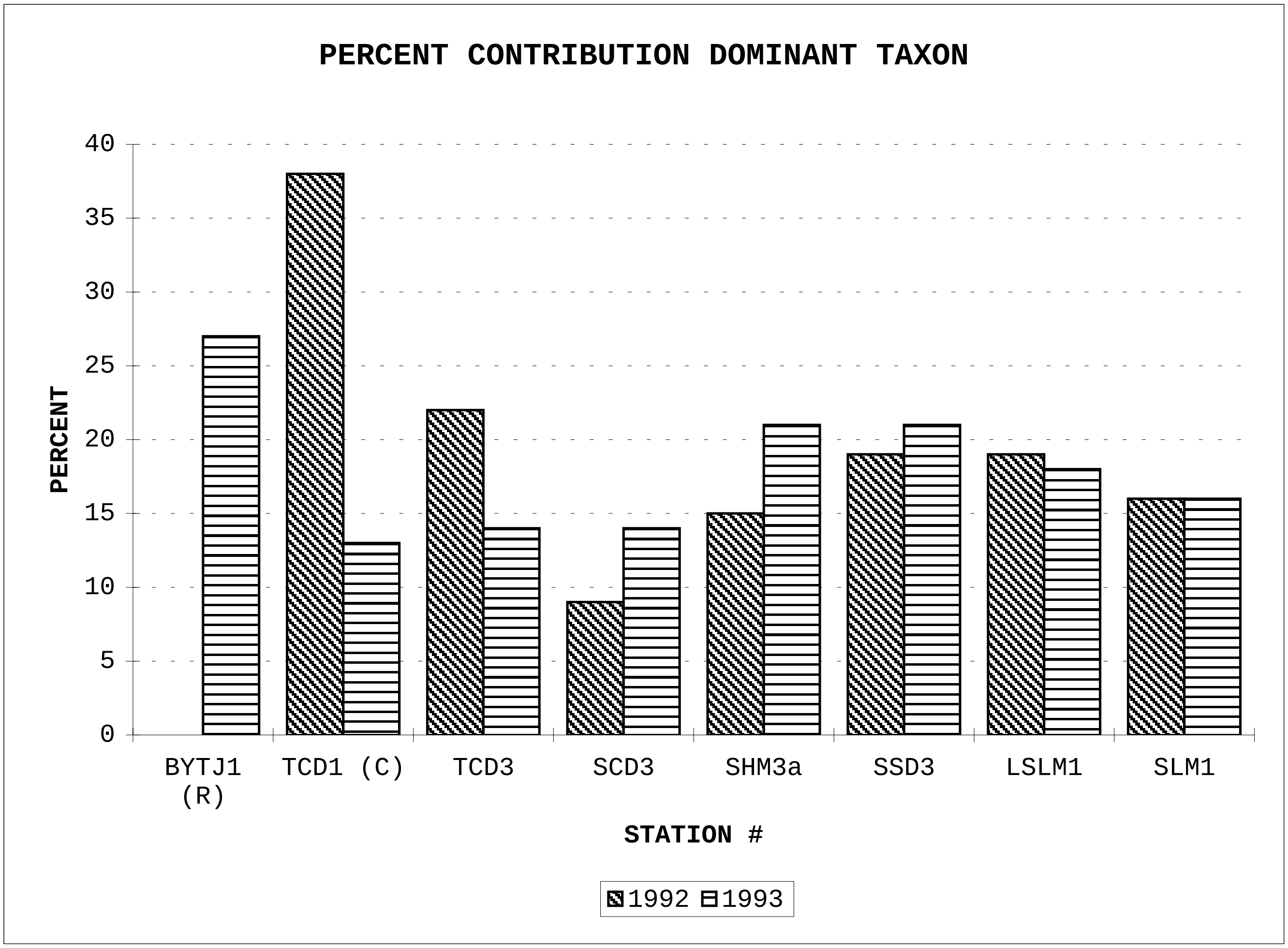


FIGURE 9

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992		0.16	0.70	0.56	0.41	0.40	0.43	0.34
1993	0.38	0.52	0.89	0.67	0.63	0.50	0.54	0.48

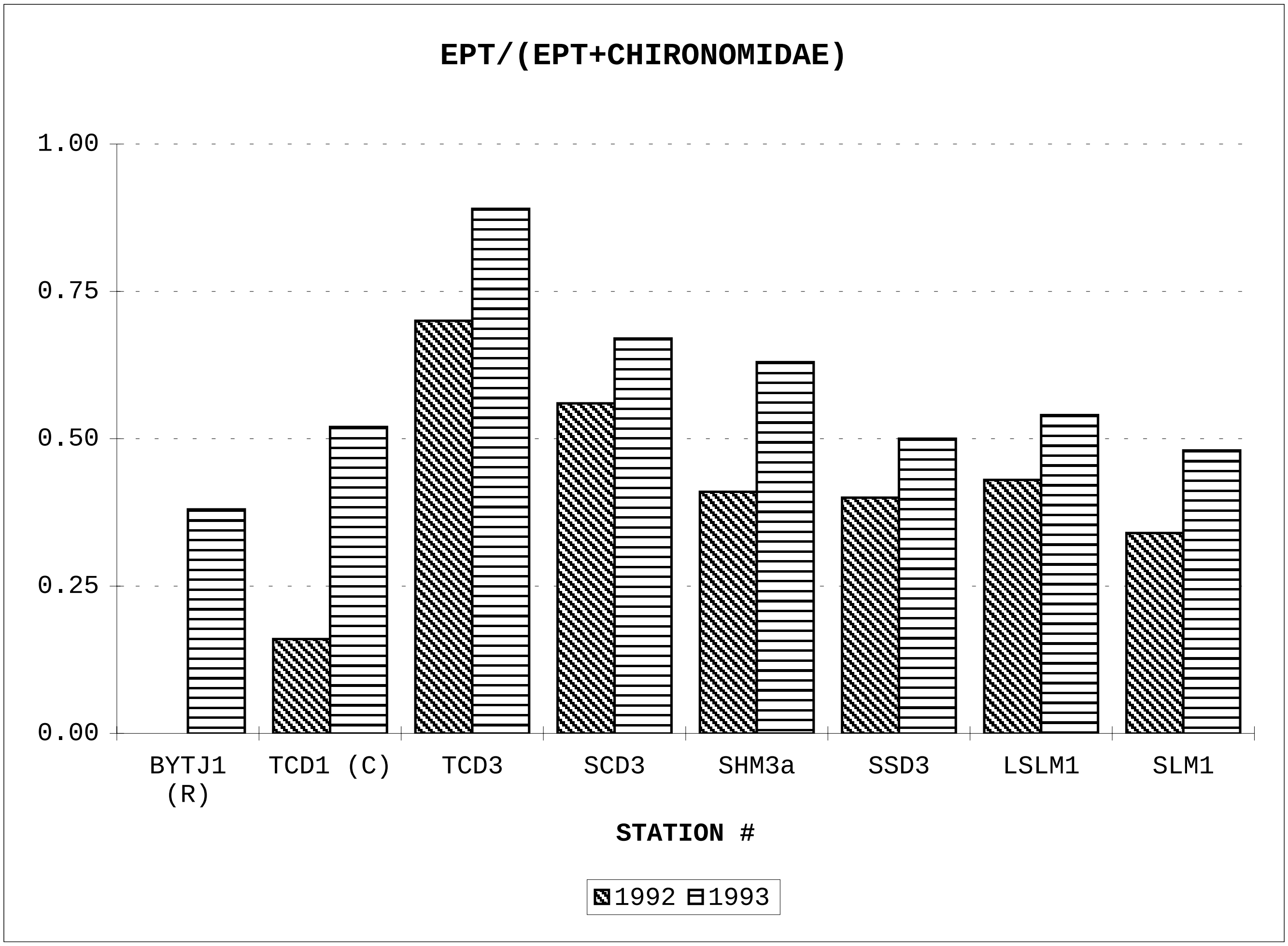


FIGURE 10

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992 v C			3.37	2.19	1.90	1.82	1.82	1.68
1993 v C			2.94	1.33	1.23	0.99	1.05	0.92
1993 v R		1.34	4.02	1.77	1.65	1.34	1.41	1.23

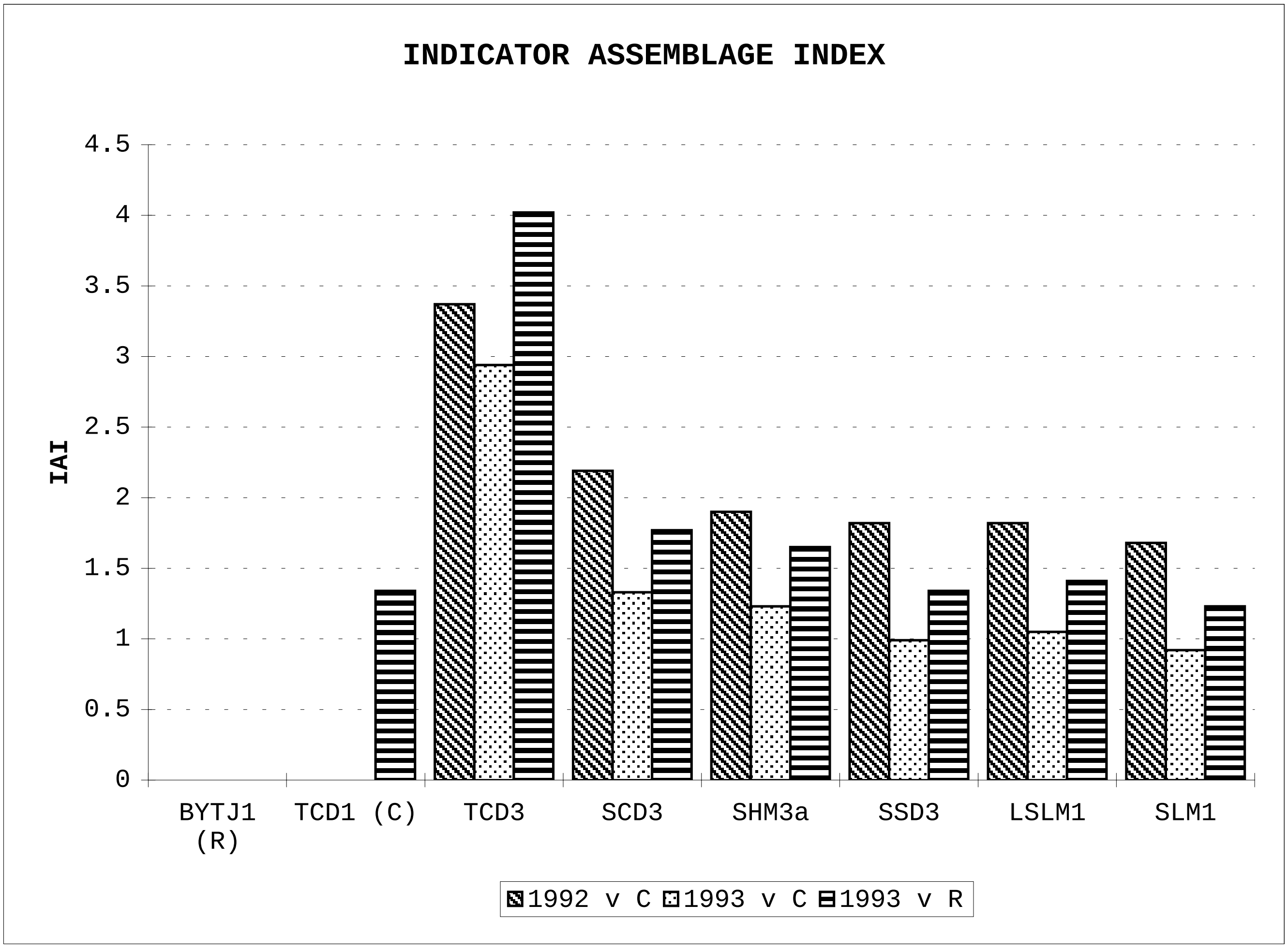


FIGURE 11

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992 v C			0.46	0.61	0.51	0.51	0.62	0.50
1993 v C			0.54	0.58	0.53	0.48	0.64	0.60
1993 v R		0.52	0.57	0.54	0.54	0.55	0.62	0.53

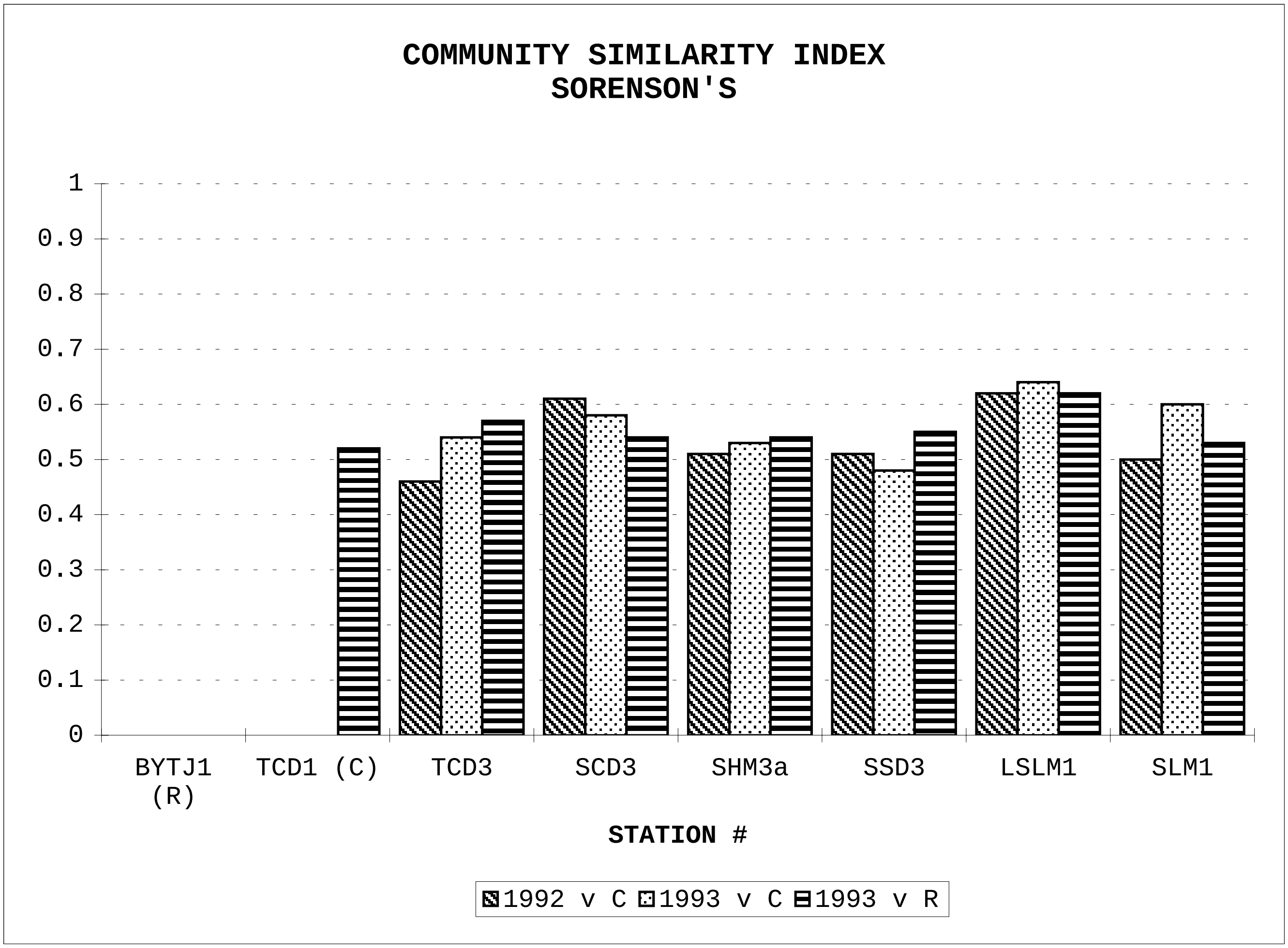


FIGURE 12

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992 v C			12	31	29	29	29	36
1993 v C			35	48	46	41	60	44
1993 v R		42	33	38	36	29	43	34

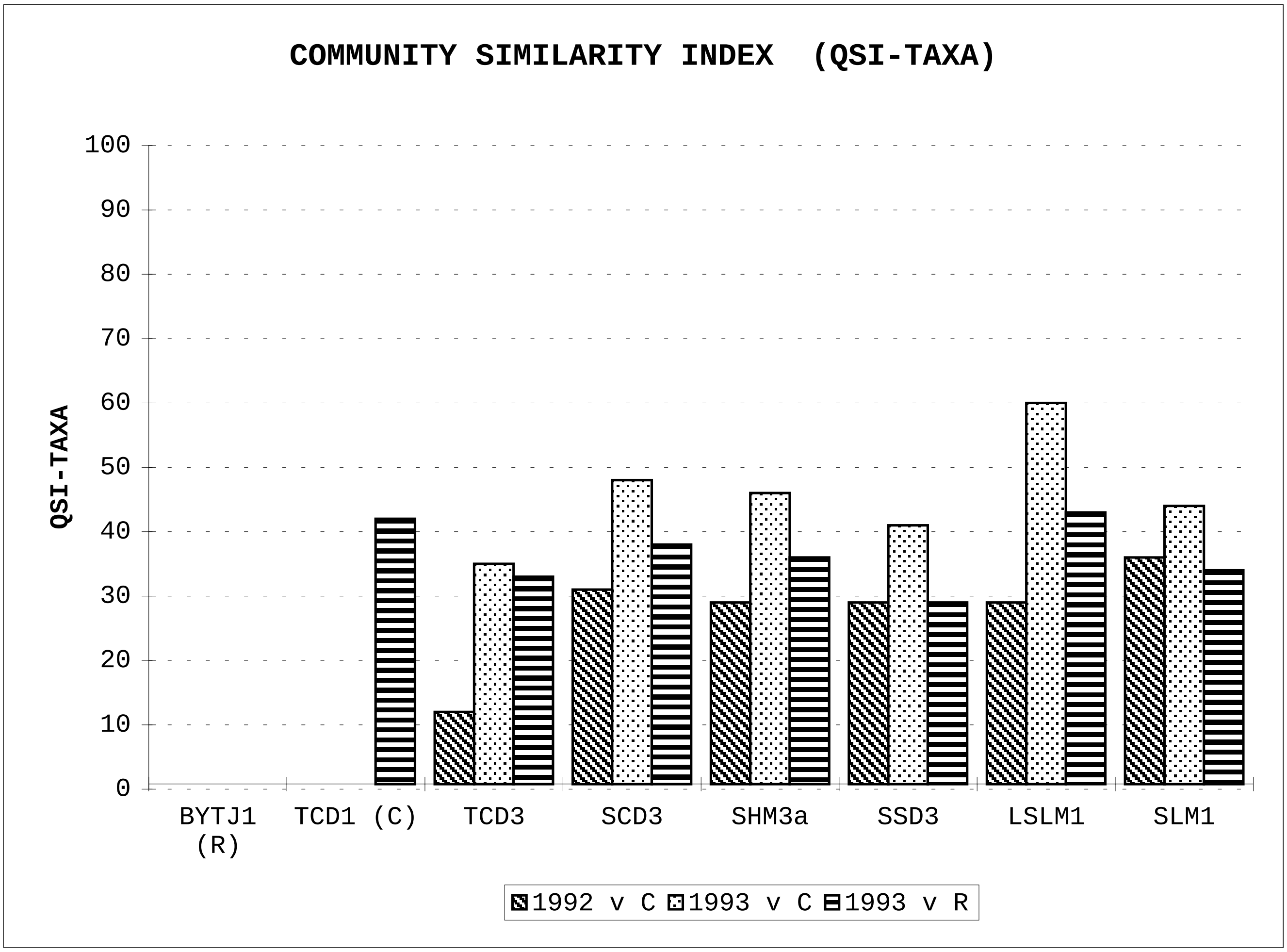


FIGURE 13

STATION	BYTJ1 (R)	TCD1 (C)	TCD3	SCD3	SHM3a	SSD3	LSLM1	SLM1
1992 v C			86	67	78	76	57	71
1993 v C			82	91	88	87	86	93
1993 v R		87	70	79	80	73	83	82

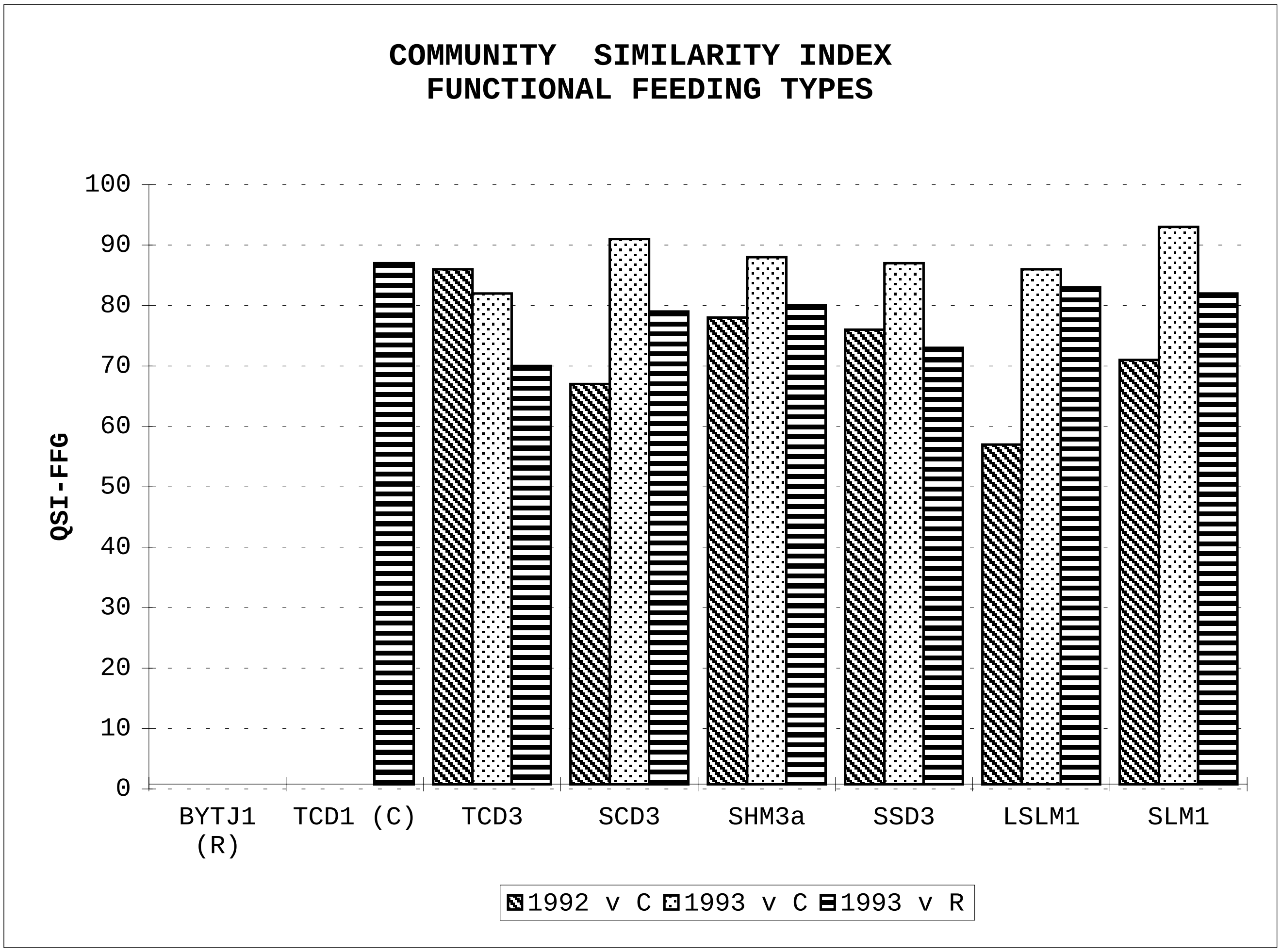


FIGURE 14

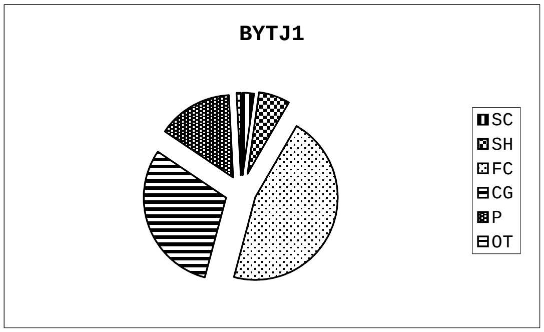
FUNCTIONAL FEEDING GROUP COMPOSITION

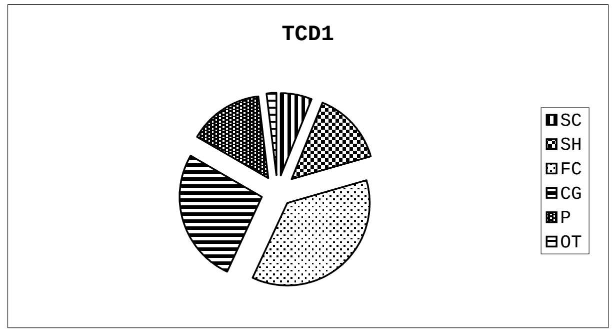
BYTJ1 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	2.21	6.04	46.03	30.18	14.74	0.80

TCD1 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	6.00	14.62	36.46	26.28	14.76	1.89



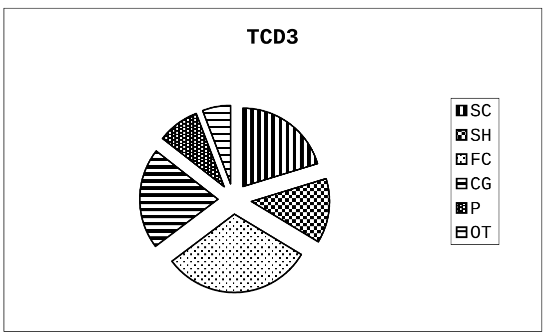


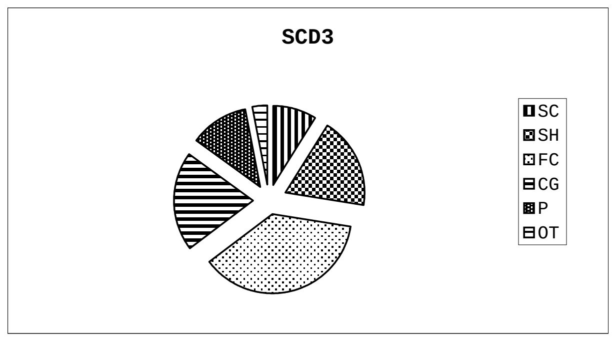
TCD3 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	20.19	13.34	31.17	20.80	8.70	5.80

SCD3 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	8.99	18.51	37.09	20.45	11.91	3.02





FEEDING TYPES

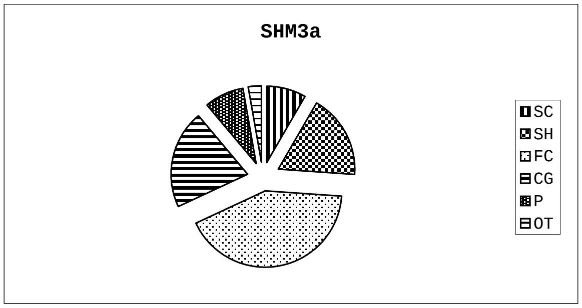
SC	SCRAPERS	FC	FILTERING COLLECTORS	P	PREDATORS
SH	SHREDDERS	CG	COLLECTOR GATHERERS	OT	OTHERS

FIGURE 15

FUNCTIONAL FEEDING GROUP COMPOSITION

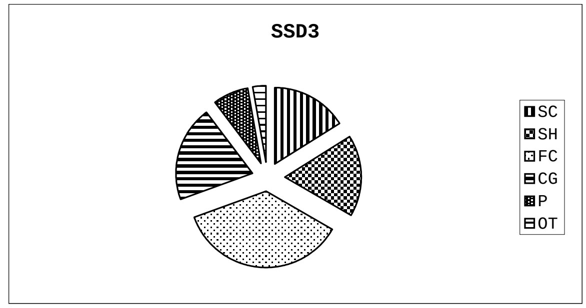
SHM3a 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	8.40	17.60	42.06	20.75	8.28	2.91



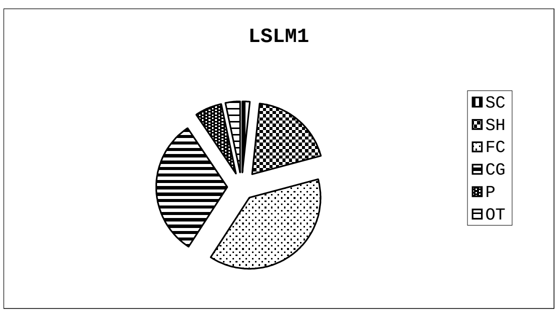
SSD3 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	16.16	17.11	36.22	20.27	7.55	2.69



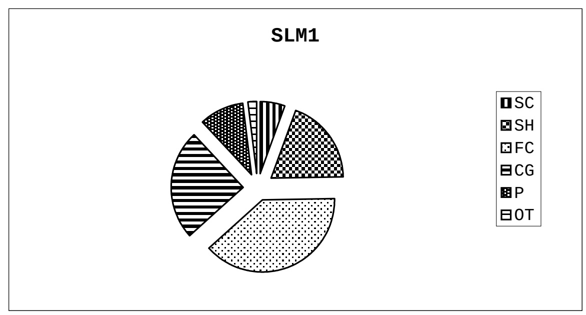
LSLM1 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	1.70	19.20	38.31	31.32	6.07	3.40



SLM1 1993

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	5.61	19.12	38.72	24.73	9.80	2.03



FEEDING TYPES

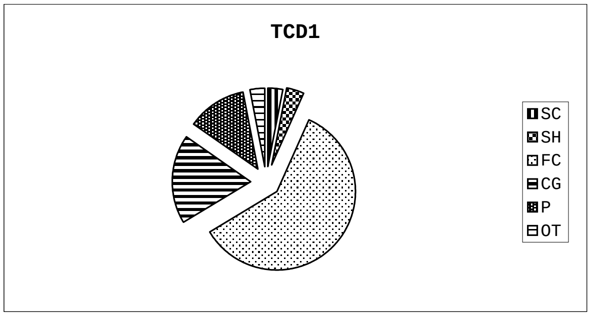
SC	SCRAPERS	FC	FILTERING COLLECTORS	P	PREDATORS
SH	SHREDDERS	CG	COLLECTOR GATHERERS	OT	OTHERS

FIGURE 16

FUNCTIONAL FEEDING GROUP COMPOSITION

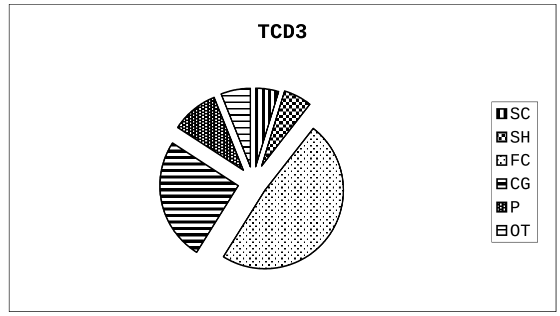
TCD1 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	3.14	3.48	59.81	18.31	12.19	3.06



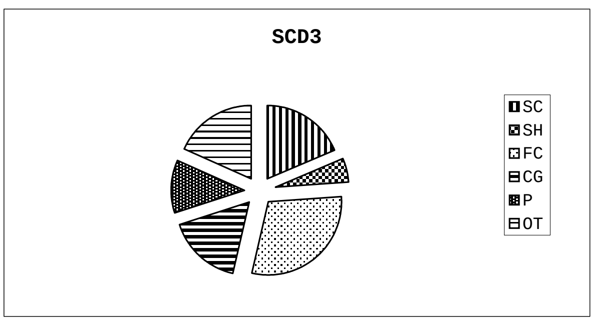
TCD3 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	4.85	5.73	48.35	25.34	9.51	6.21



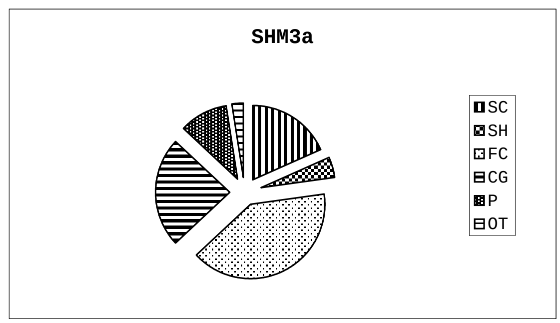
SCD3 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	18.57	5.28	29.80	16.36	11.62	18.38



SHM3a 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	18.37	4.34	40.33	24.02	10.35	2.59



FEEDING TYPES

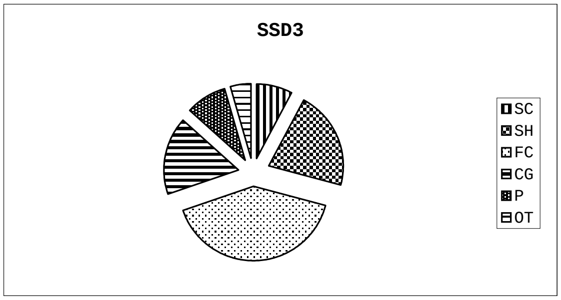
SC	SCRAPERS	FC	FILTERING COLLECTORS	P	PREDATORS
SH	SHREDDERS	CG	COLLECTOR GATHERERS	OT	OTHERS

FIGURE 17

FUNCTIONAL FEEDING GROUP COMPOSITION

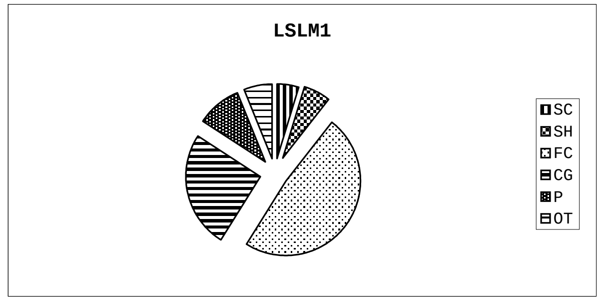
SSD3 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	7.91	21.33	40.41	17.10	8.93	4.33



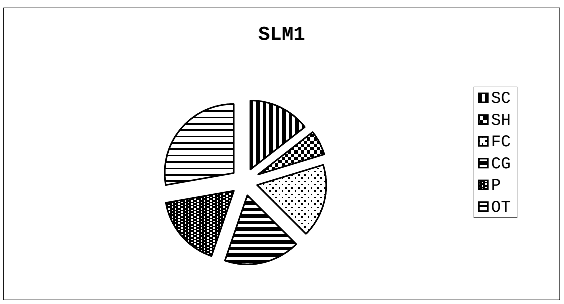
LSLM1 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	4.85	5.73	48.35	25.34	9.51	6.21



SLM1 1992

FEEDING TYPE	SC	SH	FC	CG	P	OT
PERCENT	14.41	5.80	17.40	17.57	17.05	27.77



FEEDING TYPES

SC	SCRAPERS	FC	FILTERING COLLECTORS	P	PREDATORS
SH	SHREDDERS	CG	COLLECTOR GATHERERS	OT	OTHERS

FIGURE 18

SCORING FOR BIOLOGICAL CONDITION CATEGORY

1993

STATION	**BYTJ1 (ref)**		**TCD1(Control)**		**TCD3**		**SCD3**		**SHM3a**		**SSD3**		**LSLM1**		**SLM1**	
METRIC	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE	% SIMILARITY TO REFERENCE	SCORE
TAXA RICHNESS	100	6	100	6	100	6	100	6	90	6	100	6	100	6	100	6
BIOTIC INDEX	100	6	100	6	100	6	100	6	98	6	96	6	100	6	100	6
EPT/(EPT+CHIRONOMIDAE)	100	6	100	6	100	6	100	6	100	6	100	6	100	6	100	6
% CONTRIBUTION DOMINANT TAXON	27	4	13	6	14	6	14	6	21	4	21	4	18	6	16	6
EPT TAXA RICHNESS	100	6	100	6	100	6	100	6	85	4	100	6	100	6	100	6
TOTAL SCORE		28		30		30		30		26		28		30		30
SIMILARITY OF TOTAL SCORE		100%		100%		100%		100%		100%		93%		100%		100%
CONDITION CATEGORY			UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED	

1993

STATION	**TCD1**		**TCD3**		**SCD3**		**SHM3a**		**SSD3**		**LSLM1**		**SLM1**	
METRIC	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE
TAXA RICHNESS	100	6	98	6	100	6	76	4	86	6	93	6	84	6
BIOTIC INDEX	100	6	100	6	83	4	80	4	78	4	96	6	85	6
EPT/(EPT+CHIRONOMIDAE)	100	6	100	6	100	6	100	6	100	6	100	6	48	6
% CONTRIBUTION DOMINANT TAXON	13	6	14	6	14	6	21	4	21	4	18	6	16	6
EPT TAXA RICHNESS	100	6	75	2	100	6	46	0	71	2	63	0	67	0
TOTAL SCORE		30		26		28		18		22		24		24
SIMILARITY OF TOTAL SCORE		100%		87%		93%		60%		73%		80%		73%
CONDITION CATEGORY	UNIMPACTED		UNIMPACTED		UNIMPACTED		SLIGHT IMPACT		SLIGHT IMPACT		UNIMPACTED		UNIMPACTED	

1992

STATION	**TCD1**		**TCD3**		**SCD3**		**SHM3a**		**SSD3**		**LSLM1**		**SLM1**	
METRIC	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE	% SIMILARITY TO CONTROL	SCORE
TAXA RICHNESS	100	6	75	4	100	6	95	6	100	6	100	6	100	6
BIOTIC INDEX	100	6	100	6	100	6	100	6	96	6	100	6	100	6
EPT/(EPT+CHIRONOMIDAE)	100	6	100	6	100	6	100	6	100	6	100	6	100	6
% CONTRIBUTION DOMINANT TAXON	38	2	22	4	9	6	15	6	19	6	19	6	16	6
EPT TAXA RICHNESS	100	6	55	0	100	6	59	0	100	6	73	2	77	2
TOTAL SCORE		26		20		30		24		30		26		26
SIMILARITY OF TOTAL SCORE		100%		77%		100%		80%		100%		87%		87%
CONDITION CATEGORY	UNIMPACTED		SLIGHT IMPACT		UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED		UNIMPACTED	

TABLE 1

SAND MOUNTAIN WATERSHED PROJECT
FIELD PARAMETER DATA SUMMARY

STATION NUMBER	YEAR	H2O TEMP °C	D.O. mg/l	pH s.u.	TURBID NTU	CONDUCT. umhos@25C	FLOW cfs
BYTJ1	1992	+	+	+	+	+	+
	1993	16.0	8.5	6.9	3.8	60	11.6
TCD1	1992	18.5	8.6	6.7	4.5	57	29.3
	1993	16.0	8.6	6.7	4.5	48	12.3
TCD3	1992	20.5	8.6	6.9	6.6	71	137.5
	1993	16.0	7.8	6.9	2.9	60	44.9
SSD3	1992	22.0	9.1	7.4	3.7	95	38.5
	1993	16.0	8.7	7.1	1.3	109	7.9
SCD3	1992	20.5	8.3	7.1	3.5	82	26.4
	1993	19.0	8.5	7.4	1.6	73	18.4
SHM3A	1992	20.0	6.2	6.9	3.8	83	8.4
	1993	17.0	7.2	7.0	18	83	32.7
SLM1	1992	21.0	7.8	7.1	5.1	70	3.5
	1993	19.0	8.0	7.3	2.1	68	1.5
LSLM1	1992	19.0	8.2	6.8	5.7	68	5.2
	1993	19.0	8.1	7.1	1.2	68	2.0

+ No data collected/no comparison available

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
ANNELIDA					
OLIGOCHAETA	16	3	37	59	42
ARTHROPODA					
MALACOSTRACA					
DECAPODA		1			
Astacidae			1		
INSECTA					
COLEOPTERA					
Dytiscidae					
Hydroporus	6				
Elmidae					
Ancyronyx	9	14	24	10	45
Dubiraphia	9	4		12	13
Gonielmis				4	
Macronychus			70	9	20
Microcylloepus			54	13	
Promoresia	61	113	91	13	
Stenelmis		6	151	9	2
Elmidae UNID			6		
Hydrophilidae					
Berosus			6		
Psephenidae					
Psephenus		1			
DIPTERA					
Athericidae					
Atherix				2	6
Ceratopogonidae					
Bezzia		1			1
CHIRONOMIDAE					
Chironominae					
Chironomini					
Cryptochironomus	1	6		1	12
Dicrotendipes			2	1	

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
Microtendipes	18	2			
Nilothauma	6	7			2
Paracladopelma				1	
Paratendipes				14	
Phaenopsectra	4	3	15	98	4
Polypedilum	93	198	34	269	236
Stenochironomus					10
Stictochironomus					2
Tribelos	20		4	1	36
Xestochironomus	10		1		
Chironomini UNID				1	
Tanytarsini					
Cladotanytarsus				8	
Microspectra	30				
Rheotanytarsus	536	120	13	114	65
Stempellinella	2	7		28	
Tanytarsus	62	53	2	35	
Diamesinae *					
Potthastia *		24			
Orthocladinae					
Brillia	1	13	15	14	8
Cardiocladius		6	12	18	
Cricotopus	12		51	82	20
Eukiefferiella	12	18	7	6	1
Nanocladius	10				
Orthocladius		6	2	7	20

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
Parametriocnemus		34	5	6	4
Rheocricotopus	151		2		15
Synorthocladius				6	
Thienemanniella			6		
Tvetnia	76	7	34		
Xylotopus	29		1		
Orthocladinae UNID		12			6
Tanypodinae					
Ablabesmyia	25		4	7	
Natarsia			2		3
Thienemannimyia Grp	61	96	3	34	11
Zavrelimyia		7			
Simulidae					
Simulium		35	18	6	37
Tipulidae					
Antocha		1	21	93	13
Hexatoma		2			
Tipula	2	1	6	1	2
EPHEMEROPTERA					
Baetidae					
Baetis	22	106	108	304	135
Centroptilum				5	
Heterocloeon			67		
Pseudocloeon	7		1	54	
Baetidae UNID	64	2	99	18	
Ephemerellidae					
Attenella	78	3		8	3

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
Danella		1		1	
Ephemerella	12	57		6	
Eurylophella		4			
Serratella				7	
Ephemerellidae UNID			1		
Heptageniidae					
Heptagenia		2	10	14	
Stenacron			2	7	
Stenonema	24	34	188	35	129
Heptageniidae UNID	2	2	86	12	
Leptophlebiidae					
Habrophlebiodes		1			
Oligoneuridae					
Isonychia			43	14	
EPHEMEROPTERA UNID			96		
HEMIPTERA					
Veliidae					
Rhagovelia	2			6	6
LEPIDOPTERA					
Pyralidae					
Pyralidae UNID dif					6
MEGALOPTERA					
Corydalidae					
Corydalus				1	
Nigronia	2	10			
Sialidae					
Sialis		2		1	
ODONATA					
Aeshnidae					
Boyeria		5	2	6	15
Calopterygidae					

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
Calopteryx		5			
Coenagrionidae					
Argia				2	
Corduliidae					
Neurocordulia			1		
Gomphidae					
Hagenius	3		5		1
Progomphus				3	
Stylurus				2	1
Gomphidae UNID dif			2		
Libellulidae					
Libellula	2				
Macromiidae					
Didymops			2		
Macromia	2			4	
PLECOPTERA					
Chloroperlidae					
Haploperla		1			
Leuctridae					
Leuctra		4			
Nemouridae					
Amphinemura	6		1	6	
Perlidae					
Acroneuria		2			
Perlesta	73	33	114	218	78
Perlidae UNID	1	2	1		
Perlodidae					
Isoperla	84	37	19		
Yugas				6	
PLECOPTERA UNID			6		

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
TRICHOPTERA					
Brachycentridae					
Micrasema	6		238	120	13
Glossosomatidae					
Glossosoma		38	1	10	
Hydropsychidae					
Ceratopsyche		81	108	157	
Cheumatopsyche	13	10	94	69	64
Hydropsyche	255	97	371	388	335
Hydropsychidae UNID	24	32	84		2
Hydroptilidae					
Hydroptila				12	
Ochrotrichia					9
Hydroptilidae UNID					4
Leptoceridae					
Mystacides					2
Nectopsyche				4	
Oecetis	24	2	57	8	
Leptoceridae UNID		1			
Limnephilidae					
Pycnopsyche		1			
Molannidae					
Molanna				2	1
Philopotamidae					
Chimarra		33	6	13	11
Dolophilodes		67			
Philopotamidae UNID		1			
Polycentropodidae					
Cernotina			1		

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
Cyrnellus		1			
Polycentropus		2			
Psychomyiidae					
Lype		1			
Rhyacophilidae					
Rhyacophila	7				
MOLLUSCA					
GASTROPODA					
LIMNOPHILA					
Ancylidae					
Laevapex	5				
Planorbidae					
Helisoma	2				
MESOGASTROPODA					
Hydrobiidae					
Somatogyrus			1		
PELECYPODA					
HETERODONTA					
Corbiculidae					
Corbicula	1	3	67	170	167
Sphaeriidae *					
Sphaerium *	4				
MISCELLANEOUS					
Nematoda	1				
Planaria			4	5	1

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
ANNELIDA			
OLIGOCHAETA	28	1	23
ARTHROPODA			
MALACOSTRACA			
DECAPODA			
Astacidae		6	
ISOPODA			
Asellidae			
Lirceus		7	
INSECTA			
COLEOPTERA			
Curculionidae			
Hyperodes	6		
Curculionidae UNID dif		6	
Dryopidae			
Helichus		1	
Elmidae			
Ancyronyx	23	1	
Dubiraphia	1	7	2
Macronychus	95		
Microcylloepus			1
Promoresia		355	
Stenelmis		18	4
Hydrophilidae			
Sperchopsis			1
Psephenidae			
Psephenus			29
DIPTERA			
Athericidae			
Atherix	1		
Ceratopogonidae			
Bezzia			1
CHIRONOMIDAE			
Chironominae			

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
Chironomini			
Cryptochironomus	6	2	17
Microtendipes		15	20
Nilothauma		9	
Paracladopelma	1		
Phaenopsectra	61	9	
Polypedilum	219	623	217
Stictochironomus	16	1	
Tribelos	21	9	153
Chironomini UNID	1		
Tanytarsini			
Microspectra	6		
Rheotanytarsus	123	118	18
Stempellinella		4	
Tanytarsus	15	22	21
Orthocladinae			
Brillia	32	12	35
Corynoneura		42	
Cricotopus	52		
Eukiefferiella		28	
Parametriocnemus	7	130	62
Rheocricotopus	13	21	
Synorthocladius	11		
Thienemanniella	6		18
Tvetnia		192	14
Tanypodinae			

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
Ablabesmyia		5	22
Natarsia	6	5	12
Procladius			6
Thienemannimyia Grp	7	89	40
Tanypodinae UNID		1	
CHIRONOMIDAE UNID		6	
Empididae			
Clinocera		6	
Simulidae			
Simulium	12	100	23
Tipulidae			
Antocha	86	1	70
Limonia			18
Pilaria		7	
Tipula		1	13
EPHEMEROPTERA	3		
Baetidae			
Baetis	71	56	19
Heterocloeon	20		
Paracloeodes			6
Pseudocloeon	109		18
Baetidae UNID	21	132	24
Ephemerellidae			
Attenella	6	6	
Danella		1	1
Ephemerella		79	1
Ephemerellidae UNID		12	
Heptageniidae			

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
Stenacron	1	2	
Stenonema	24	21	27
Heptageniidae UNID			2
HEMIPTERA			
Veliidae			
Rhagovelia			12
LEPIDOPTERA			
LEPIDOPTERA UNID dif			1
MEGALOPTERA			
Corydalidae			
Nigronia		6	1
Sialidae			
Sialis			1
ODONATA			
Aeshnidae			
Boyeria	7	21	3
Calopterygidae			
Calopteryx	1	1	
Coenagrionidae			
Argia	1		
Corduliidae			
Helocordulia		1	
Gomphidae			
Dromogomphus	1		
Hagenius	1		
Macromiidae			
Macromia	1		
ODONATA UNID	1		
PLECOPTERA			
Nemouridae			
Amphinemura		25	
Perlidae			
Attaneuria			6

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
Neoperla			1
Perlesta	93	13	9
Perlidae UNID	6		
Perlodidae			
Isoperla	6	52	4
PLECOPTERA UNID		12	
TRICHOPTERA			
Brachycentridae			
Micrasema	15		
Glossosomatidae			
Glossosoma	85		
Hydropsychidae			
Ceratopsyche		122	216
Cheumatopsyche	2	43	2
Hydropsyche	69	375	237
Hydropsychidae UNID	6	489	19
Hydroptilidae			
Neotrichia	6		
Orthotrichia	1		
Hydroptilidae UNID dif		93	
Leptoceridae			
Mystacides			1
Oecetis	4	2	9
Philopotamidae			
Chimarra	60	36	7
MOLLUSCA			
GASTROPODA			
LIMNOPHILA			
Ancylidae			
Ferrissia		8	3
PELECYPODA			

TABLE 2
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
HETERODONTA			
Corbiculidae			
Corbicula	399		3
Sphaeriidae *			
Sphaerium *			7
MISCELLANEOUS			
Nematoda		6	
Planaria	19		

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
ANNELIDA	1		27			3	
OLIGOCHAETA	18	23	240	45	55	40	8
ARTHROPODA							
MALACOSTRACA							
AMPHIPODA							
Amphipoda UNID dif						1	
DECAPODA				1		1	1
ISOPODA							
Asellidae							
Lirceus	12					3	
INSECTA							
COLEOPTERA							
Dryopidae							
Helichus		1	9		7	1	
Elmidae							
Ancyronyx	1	3	45	11	13		
Dubiraphia	17	6	30	22	2	7	2
Gonielmis				6		7	
Macronychus		27	27	2	53		
Microcylloepus		2					
Promoresia	56	3	7	1	42	14	
Stenelmis	2	6	30			1	
Elmidae UNID dif	1						
Elmidae UNID			1				
Eubriidae							
Ectopria	3						1
Haliplidae							
Peltodytes		2		1	3		
Hydrophilidae							
Berosus			1				1
Enochrus				3			
Helophorus			2				

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
Hydrobiomorpha							1
Tropisternus			1				
Psephenidae							
Psephenus						2	6
DIPTERA							1
Ceratopogonidae							
Atrichopogon				5			
Bezzia	13	2	6			1	1
CHIRONOMIDAE							
Chironominae							
Chironomini							
Chironomus				11			
Cryptochironomus	3		1	5	23		5
Cryptotendipes						3	
Demicryptochironomus					3		
Dicrotendipes			22		12	1	
Endochironomus						10	1
Microtendipes	5		5	23	3	16	4
Nilothauma			5		6	1	
Paratendipes				2			
Phaenopsectra			25	174	13	14	5
Polypedilum	75	48	46	73	296	16	103
Stenochironomus			15	125	6	4	8
Stictochironomus	2		21				1
Chironomini UNID			1	1			1
Tanytarsini							
Cladotanytarsus						11	
Microspectra					16		

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
Rheotanytarsus	901	2	127	145	32	3	46
Stempellinella	3		4			6	26
Tanytarsus	347	10	198	151	177	22	73
Tanytarsini UNID				7			
Orthocladinae							
Corynoneura			1			2	4
Cricotopus	3		4		31		
Eukiefferiella	4		4		1	1	
Limnophyes	2						
Nanocladius	60						
Orthocladius	27	5			15		
Parametriocnemus	146		65	24	45	15	162
Rheocricotopus		102		30	31	1	4
Synorthocladius			12			1	
Thienemanniella					2		12
Tvetnia		5		6	24	4	50
Xylotopus			5				
Orthocladinae UNID dif			1				
Orthocladinae UNID				1		1	1
Tanypodinae							
Ablabesmyia	3		26	55		10	6
Nilotanypus	24						1
Procladius			3	2		8	3
Thienemannimyia Grp	183	16	2	24	15	10	40
Tanypodinae UNID					1		

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
CHIRONOMIDAE UNID						1	
Dolichopodidae							
Dolichopodidae UNID dif					1		
Empididae							
Hemerdromia			20	35	1		18
Empididae UNID dif					1		
Simulidae							
Simulium	3	36	98	353	10	8	50
Simulidae UNID			144				
Tipulidae							
Hexatoma	1	1					
Limonia					3	1	
Tipula	4	4	8	9	46	4	
Tipulidae UNID dif							2
Tipulidae UNID			1				
EPHEMEROPTERA							
Baetidae							
Acentrella					7		
Acerpenna	8		17	4	1		1
Baetis	3	58	5	60	14	3	37
Centroptilum							1
Paracloeodes	3		2	1	1	4	
Baetidae UNID dif					10		
Baetidae UNID	35		89	222		11	12
Ephemerellidae							
Attenella	57		14	4	3		
Danella	12					1	
Ephemerella				1	6		6

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
Eurylophella	6						
Serratella	1					5	
Heptageniidae							
Heptagenia	2				1	1	2
Stenacron	2		12				
Stenonema	30	37	169	116	113	8	32
Heptageniidae UNID dif	1				1		
Heptageniidae UNID	2		26	14		2	
Leptophlebiidae							
Habrophlebiodes	5					3	4
Paraleptophlebia	1						
Leptophlebiidae UNID						1	
Oligoneuridae							
Isonychia			50		3		
Tricorythidae							
Tricorythodes		44			3		
HEMIPTERA							
Corixidae							
Corixidae UNID dif							2
Gerridae							
Rheumatobates			1				
Trepobates					2		2
Veliidae							
Microvelia			1				
Rhagovelia		3	1	7	2		
MEGALOPTERA							
Corydalidae							
Nigronia	18		39	13	2	10	36
Sialidae							
Sialis			2	9			2

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
ODONATA							
Aeshnidae							
Boyeria	2	6	7	12	8	2	3
Calopterygidae							
Hetaerina		2					
Coenagrionidae							
Argia		1					
Corduliidae							
Neurocordulia				1			
Somatochlora			2				
Gomphidae							
Dromogomphus					1	2	
Gomphus			1				
Progomphus	2	1		1			
Stylurus		1					
Libellulidae							
Perithemis			1				
Sympetrum				2		1	
Macromiidae							
Didymops				1			
Macromia		2	1	1	1		1
ODONATA UNID				1			
PLECOPTERA							
Nemouridae							
Amphinemura		5	6			1	1
Perlidae							
Perlesta	6	61	172	67	108	9	17
Perlidae UNID	1		1				
Perlodidae							
Isoperla	13		7			34	19
TRICHOPTERA							

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
Brachycentridae							
Micrasema			69	16	15		
Hydropsychidae							
Ceratopsyche		166	4	6	1	1	24
Cheumatopsyche	17		2			1	
Hydropsyche	70		24	51	147	16	94
Macronema		45					
Hydropsychidae UNID	36			6	25	2	
Hydroptilidae							
Hydroptila			1		7		
Ochrotrichia		1					
Orthotrichia							6
Oxyethira			1				
Leptoceridae							
Mystacides		5	51	14	13		13
Nectopsyche					1		2
Oecetis	3	1	1		1		
Leptoceridae UNID						5	
Limnephilidae							
Hydatophylax					4		
Molannidae							
Molanna			22	5	2	2	7
Philopotamidae							
Chimarra	2	10	6	13	3		
Polycentropodidae							
Cernotina			1				
Cyrnellus		1					
Polycentropus	1		2			1	4

TABLE 3
TAXA LIST
SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
Polycentropodidae UNID dif					1		
Polycentropodidae UNID				1			
Psychomyiidae							
Lype	2						
Rhyacophilidae							
Rhyacophila	14					9	
MOLLUSCA							
GASTROPODA							
LIMNOPHILA							
Ancylidae							
Ferrissia					9		9
Laevapex	6		2	48		9	
Physidae							
Physella	5		31	25	1	3	1
Planorbidae							
Helisoma		5	12	34	1	12	17
Menetus	14		140			25	
Planorbella				3			
Planorbula		24	2		1		
MESOGASTROPODA							
Hydrobiidae							
Amnicola							1
Somatogyrus		1					
PELECYPODA							
HETERODONTA							
Corbiculidae							
Corbicula	12	229	105	164	354	20	7
Sphaeriidae *	41	5	160	1	2	109	7
MISCELLANEOUS							
Collembola			1				
Nematoda						1	
Planaria	1	12	21	4	7		

TABLE 4

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

METRIC	BYTJ 1 93-06-02	TCD 1 93-06-02	TCD 3 93-06-02	SCD 3 93-06-01	SHM 3 a 93-06-01
TAXA RICHNESS	49	58	57	66	44
EPT TAXA RICHNESS	13	24	18	24	11
# CHIRONOMIDAE TAXA	20	17	20	20	16
BIOTIC INDEX	4.93	3.99	4.00	4.80	5.01
# CHIRONOMIDAE TAXA / TOTAL TAXA	.41	.29	.35	.30	.36
# EPT / # EPT + # CHIRONOMIDAE	.38	.52	.89	.67	.63
PERCENT SCRAPERS	2.21	6.00	20.19	8.99	8.40
PERCENT SHREDDERS	6.04	14.62	13.34	18.51	17.60
PERCENT FILTERING COLLECTORS	46.03	36.46	31.17	37.09	42.06
PERCENT COLLECTOR GATHERERS	30.18	26.28	20.80	20.45	20.75
PERCENT PREDATORS	14.74	14.76	8.70	11.94	8.28
PERCENT MACROPHYTE PIERCERS	.00	.00	.23	.45	.25
PERCENT OTHERS	.80	1.89	5.57	2.57	2.66

TABLE 4

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

BYTJ 001 93-06-02	TCD 001 93-06-02	TCD 003 93-06-02	SCD 003 93-06-01	SHM 003 a 93-06-01
Rheotanytarsus	Polypedilum	Hydropsyche	Hydropsyche	Hydropsyche
26.96	13.34	14.35	14.48	20.69

TABLE 4

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

METRIC	SSD 3 93-06-02	LSLM 1 93-06-01	SLM 1 93-06-01
TAXA RICHNESS	50	54	49
EPT TAXA RICHNESS	17	15	16
# CHIRONOMIDAE TAXA	17	19	14
BIOTIC INDEX	5.11	4.14	4.68
# CHIRONOMIDAE TAXA / TOTAL TAXA	.34	.35	.29
# EPT / # EPT + # CHIRONOMIDAE	.50	.54	.48
PERCENT SCRAPERS	16.16	1.70	5.61
PERCENT SHREDDERS	17.11	19.20	19.12
PERCENT FILTERING COLLECTORS	36.22	38.31	38.72
PERCENT COLLECTOR GATHERERS	20.27	31.32	24.73
PERCENT PREDATORS	7.55	6.07	9.80
PERCENT MACROPHYTE PIERCERS	.05	2.68	.00
PERCENT OTHERS	2.64	.72	2.03

TABLE 4

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

SSD 003 93-06-02	LSLM 001 93-06-01	SLM 001 93-06-01
Corbicula	Polypedilum	Hydropsyche
21.07	17.93	16.01

TABLE 5

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

METRIC	TCD 1 92-06-17	TCD 3 92-06-16	SCD 3 92-06-17	SHM 3 A 92-06-18	SSD 3 92-06-16	LSLM 1 92-06-17	SLM 1 92-06-17
TAXA RICHNESS	60	45	77	57	69	63	60
EPT TAXA RICHNESS	22	12	22	13	24	16	17
# CHIRONOMIDAE TAXA	16	7	21	15	19	21	19
BIOTIC INDEX	5.33	4.96	5.12	5.20	5.36	5.13	4.82
# CHIRONOMIDAE TAXA / TOTAL TAXA	.27	.16	.27	.26	.28	.33	.32
# EPT / # EPT + # CHIRONOMIDAE	.16	.70	.56	.41	.40	.43	.34
PERCENT SCRAPERS	3.14	4.85	18.57	18.37	7.91	14.41	8.35
PERCENT SHREDDERS	3.48	5.73	5.28	4.34	21.33	5.80	10.71
PERCENT FILTERING COLLECTORS	59.81	48.35	29.80	40.33	40.41	17.40	31.83
PERCENT COLLECTOR GATHERERS	18.31	25.34	16.36	24.02	17.10	17.57	30.75
PERCENT PREDATORS	12.19	9.51	11.62	10.35	8.93	17.05	15.82
PERCENT MACROPHYTE PIERCERS	.00	.00	.12	.13	.37	.00	.69
PERCENT OTHERS	3.06	6.21	18.26	2.46	3.96	27.77	1.87

TABLE 5

SAND MOUNTAIN BIOASSESSMENT JUNE 1993
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

TCD 001 92-06-17	TCD 003 92-06-16	SCD 003 92-06-17	SHM 003 A 92-06-18	SSD 003 92-06-16	LSLM 001 92-06-17	SLM 001 92-06-17
<u>Rheotanytarsus</u>	<u>Corbicula</u>	OLIGOCHAETA	<u>Simulium</u>	<u>Corbicula</u>	Sphaeriidae	<u>Parametriocnemus</u>
38.28	22.23	9.32	15.48	18.92	* 19.16	15.91

TABLE 6

PROPOSED ECOREGIONAL REFERENCE SITE COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	BYTJ 001 93-06-02 VERSUS TCD 001 93-06-02	BYTJ 001 93-06-02 VERSUS TCD 003 93-06-02
INDICATOR ASSEMBLAGE INDEX	1.34	4.02
SORENSON'S COMMUNITY SIMILARITY INDEX	.52	.57
QUANTITATIVE SIMILARITY INDEX		
TAXA	41.93	33.47
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	86.53	69.72

TABLE 7

PROPOSED ECOREGIONAL REFERENCE SITE COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	BYTJ 001 93-06-02 VERSUS SCD 003 93-06-01	BYTJ 001 93-06-02 VERSUS SHM 003 a 93-06-01
INDICATOR ASSEMBLAGE INDEX	1.77	1.65
SORENSON'S COMMUNITY SIMILARITY INDEX	.54	.54
QUANTITATIVE SIMILARITY INDEX		
TAXA	38.00	35.75
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	78.53	80.14

TABLE 8

PROPOSED ECOREGIONAL REFERENCE SITE COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	BYTJ 001 93-06-02 VERSUS SSD 003 93-06-02	BYTJ 001 93-06-02 VERSUS LSLM 001 93-06-01
INDICATOR ASSEMBLAGE INDEX	1.34	1.41
SORENSON'S COMMUNITY SIMILARITY INDEX	.55	.62
QUANTITATIVE SIMILARITY INDEX		
TAXA	28.88	43.32
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	73.09	83.02

TABLE 9

PROPOSED ECOREGIONAL REFERENCE SITE COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	BYTJ 001 93-06-02 VERSUS SLM 001 93-06-01
INDICATOR ASSEMBLAGE INDEX	1.23
SORENSON'S COMMUNITY SIMILARITY INDEX	.53
QUANTITATIVE SIMILARITY INDEX	
TAXA	34.32
QUANTITATIVE SIMILARITY INDEX	
FUNCTIONAL FEEDING GROUP	82.30

TABLE 10

CONTROL STATION COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	TCD 001 93-06-02 VERSUS TCD 003 93-06-02	TCD 001 93-06-02 VERSUS SCD 003 93-06-01
INDICATOR ASSEMBLAGE INDEX	2.94	1.33
SORENSON'S COMMUNITY SIMILARITY INDEX	.54	.58
QUANTITATIVE SIMILARITY INDEX		
TAXA	35.17	47.76
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	81.90	91.36

TABLE 11

CONTROL STATION COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	TCD 001 93-06-02 VERSUS SHM 003 a 93-06-01	TCD 001 93-06-02 VERSUS SSD 003 93-06-02
INDICATOR ASSEMBLAGE INDEX	1.23	.99
SORENSON'S COMMUNITY SIMILARITY INDEX	.53	.48
QUANTITATIVE SIMILARITY INDEX		
TAXA	45.59	40.83
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	88.00	86.55

TABLE 12

CONTROL STATION COMPARED TO STUDY STATIONS 1993
MACROINVERTEBRATE DATA

	TCD 001 93-06-02 VERSUS LSLM 001 93-06-01	TCD 001 93-06-02 VERSUS SLM 001 93-06-01
INDICATOR ASSEMBLAGE INDEX	1.05	.92
SORENSON'S COMMUNITY SIMILARITY INDEX	.64	.60
QUANTITATIVE SIMILARITY INDEX		
TAXA	60.07	44.18
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	85.85	93.11

TABLE 13

CONTROL STATION COMPARED TO STUDY STATIONS 1992
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS TCD 003 92-06-16	TCD 001 92-06-17 VERSUS SCD 003 92-06-17
INDICATOR ASSEMBLAGE INDEX	3.37	2.19
SORENSON'S COMMUNITY SIMILARITY INDEX	.46	.61
QUANTITATIVE SIMILARITY INDEX		
TAXA	11.96	31.07
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	85.85	67.46

TABLE 14

CONTROL STATION COMPARED TO STUDY STATIONS 1992
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS SHM 003 A 92-06-18	TCD 001 92-06-17 VERSUS SSD 003 92-06-16
INDICATOR ASSEMBLAGE INDEX	1.90	1.82
SORENSON'S COMMUNITY SIMILARITY INDEX	.51	.51
QUANTITATIVE SIMILARITY INDEX		
TAXA	29.31	28.87
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	78.07	76.12

TABLE 15

CONTROL STATION COMPARED TO STUDY STATIONS 1992
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS LSLM 001 92-06-17	TCD 001 92-06-17 VERSUS SLM 001 92-06-17
INDICATOR ASSEMBLAGE INDEX	1.82	1.68
SORENSON'S COMMUNITY SIMILARITY INDEX	.62	.50
QUANTITATIVE SIMILARITY INDEX		
TAXA	28.90	35.65
QUANTITATIVE SIMILARITY INDEX		
FUNCTIONAL FEEDING GROUP	56.84	70.82

TABLE 16
BIOMETRIC INTERPRETATION TABLE

METRIC	RANGE	INTERPRETATION
Habitat Assessment	104-135 71-103 35-70 0-34	Excellent Good Fair Poor
Total Taxa Richness EPT Taxa Richness Chironomidae Taxa Richness		Generally Increases with Increasing Water Quality
Biotic Index % Dominant Taxon		Generally Increases With Decreasing Water Quality
%Shredders %Scrapers %Predators %Collector Gatherers %Collector Filterers %Macrophyte Piercers %Others		Percentages and Composition Should be similar to background station for similar stream sizes and habitat composition
EPT / EPT + Chironomidae		Generally increasing water Quality as approaches 1.0
SIMILARITY INDICES		
Indicator Assemblage Index (IAI) Sorenson's Community Index		Increasing Similarity as Approaches 1.0
Community Similarity Index for Functional Feeding Groups (QSI-FFG) Community Similarity Index for Taxa (QSI- Taxa)		Generally Increases with Increasing Similarity