SAND MOUNTAIN WATERSHED PROJECT

MACROINVERTEBRATE BIOASSESSMENT

JUNE 16-18, 1992

SPECIAL STUDIES SECTION
FIELD OPERATIONS DIVISION
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

FEBRUARY 24, 1993

REPORT

AQUATIC MACROINVERTEBRATE BIOASSESSMENT

SAND MOUNTAIN/LAKE GUNTERSVILLE WATERSHED PROJECT

INTRODUCTION

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

The basic monitoring plan consists of 11 sampling sites on 7 streams within the watershed which are monitored on a monthly basis using chemical/physical parameters and bacteriological studies in order to provide long term water quality data and to demonstrate improvements (if any).

Study Purpose

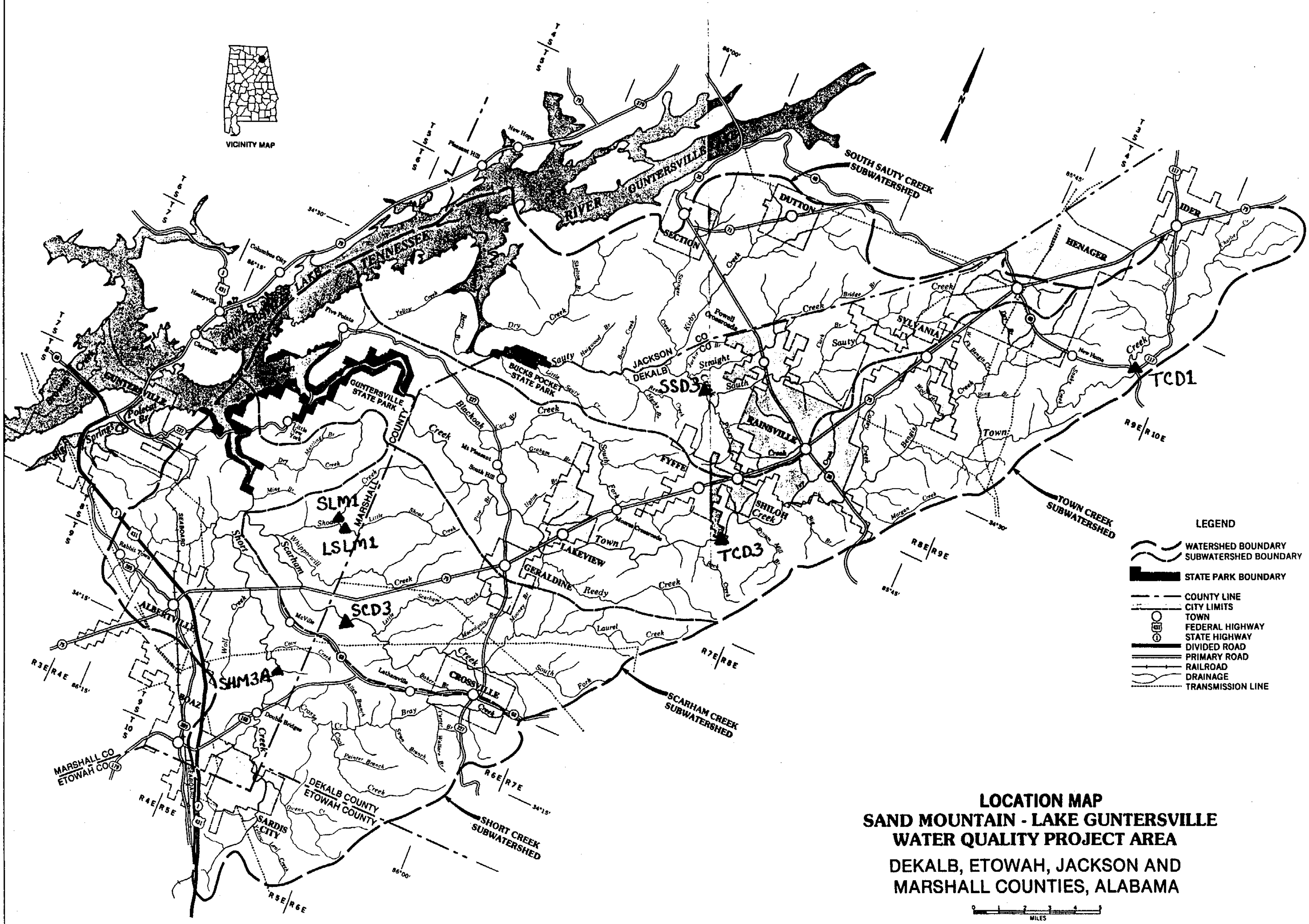
The stream water quality monitoring portion of the Sand Mountain/Lake Guntersville watershed project was initiated in April of 1988 by the ADEM. Biological monitoring of a selected portion of the sampling sites was incorporated into the final phase of the project as part of the continued water quality sampling. Macroinvertebrate data was collected at 7 sites during June of 1988 and May of 1989. In June of 1992, at the request of the Mining and Nonpoint Source Section of the Water Division, Special Studies Section Personnel from Field Operations Division completed instream bioassessments utilizing aquatic macroinvertebrates to document current water quality. Where appropriate this data was compared to the previous years' data.

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 six streams: Shoal Creek, Little Shoal Creek, Scarham Creek, Short Creek, South Sauty Creek, and Town Creek.

U.S. DEPARTMENT OF AGRICULTURE



LOCATION MAP
SAND MOUNTAIN - LAKE GUNTERSVILLE WATER QUALITY PROJECT AREA
DEKALB, ETOWAH, JACKSON AND MARSHALL COUNTIES, ALABAMA

SOURCE:
BASE MAP COMPILED FROM LATEST AVAILABLE COUNTY GENERAL HIGHWAY MAPS.
TRANSVERSE MERCATOR PROJECTION.

JANUARY 1988 1003223-01

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1987

Study Area, Cont.

The following stations were utilized to collect aquatic macroinvertebrate samples and stream flows. 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".:

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 Rd 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
TCD1	Town Creek at Dekalb Hwy 40 (Control Station) (T5S R9E S11 SE¼ SE¼) third 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.

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 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 were assessed over a three day period using a multiple-habitat methodology to collect aquatic macroinvertebrates. These streams can generally be characterized as having substrates of boulder and cobble, with lesser amounts of bedrock and gravel. This stream bed composition provides excellent habitat for colonization by macroinvertebrates. All sites had deposits of sand and silt to varying degrees in the run areas.

The multiple-habitat sampling methodology utilized during this study (RBP-Multihabitat) is a modification of the EPA Rapid Bioassessment Protocol (Plafkin 1989). This method is more rigorous than the One Person-Hour Method utilized by EPA in 1988 and 1989 and allows for a more detailed analysis of the biological community. Data gathered using the two methods are not directly comparable (Table 7). However, utilizing the comparison metrics (discussed later), any changes in the quality of the macroinvertebrate community at the study sites may be compared to the control site for that year.

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. However, due to the large numbers of agricultural operations (poultry production, livestock) in the watershed, no <u>un</u>impacted sites were found to utilize as control.

Habitat assessments were completed at all sites. The purpose of the habitat assessment is to determine whether the study site has the potential to support a biological community comparable to the control site. The quality of the habitat, as illustrated in Figure 1, ranged from "Good" with a score of 89 (Good 71-103) to "Excellent" with a score of 117 (Excellent 104-135). Based on habitat assessment scores TCD3, SSD3, SCD3 and LSLM1 are all comparable to the control station in terms of habitat. SLM1 has better habitat and SHM3A has a lower quality of habitat. However, Short Creek at SHM3A is capable of supporting an acceptable level of biological health (Habitat Assessment within 75% of control value (Plafkin 1989)). The stream flow (Figure 1) at Short Creek station SHM3A was restricted by several beaver dams; at least one above the sampling reach and two below the reach. This may have been a contributing factor to the lower score for this station .

Analysis of macroinvertebrate data utilizes tools called biometrics. A list of macroinvertebrates collected, along with the biometrics calculated for each station is located in Tables 1 and 2. The biometrics from each of the study stations can be compared to the control station (single station metrics) or are calculated using data from the control station (comparison metrics). The comparison metrics are located in Tables 3 - 5. "Interpretation of Biometrics" - Table 6, may be referred to in the following discussion.

Single Station Metrics

- The Taxa Richness (Figure 2) biometric is the total number of taxa collected at a station and ranged from 50 to 86 with mean of 71 (Control Station = 73).

  EPT Taxa Richness, the total number of the generally pollution intolerant Ephemeroptera, Plecoptera and Trichoptera taxa, ranged from 12 to 26 with a mean of 19 (Control Station = 22) (Figure 2).

  All Stations were similar to the control station with the exceptions of TCD3 and SHM3A. Station TCD3 had less than 70 percent of taxa richness and less than 55 percent of the EPT taxa richness collected at the control station. Station SHM3A had 86 percent of the taxa richness, however the pollution sensitive EPT taxa were only 59 percent of the control station.

- The Chironomidae Taxa Richness (Figure 2) ranged from 7 to 23 with a mean of 19 (Control = 20). Station T-3 (TCD3) had the lowest number of Chironomidae taxa. The other stations ranged from 18 to 23.

  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 percent contribution of the Chironomidae family ranges from 14 to 33 percent (27% control) with an average of 27 percent.

- The Biotic Index (Figure 3) 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. This metric ranged from 4.82 to 5.41 with a mean of 5.12 (Control = 5.34). In general, a change of 1.0 (D. Penrose, personal communication) indicates a change in water quality.

  All study station biotic indices were similar to the control station. 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. (Please note that this guideline may not be directly applicable to Alabama Waters.)

Single Station Metrics, Cont.

- 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.. As shown in Figure 4, all study stations (range 9% to 24%) had percentages lower than the Control station (36%). 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. However, compared to the study stations, this biometric indicates that the control station may be adversely impacted.

- The metric EPT / (EPT + Chironomidae), expresses the relationship between the generally pollution intolerant EPT organisms and the generally pollution tolerant Chironomidae organisms. 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. Skewed populations having a disproportionate number of the generally tolerant Chironomidae relative to the more sensitive insect groups may indicate environmental stress. All stations, with the exception of TCD3, have some degree of stress based on this metric.

- The percent contributions of the functional feeding groups (Table 2) indicates that all of the samples collected were dominated by the collector feeding type, and most often the filtering collector. This indicates that the dominant food source is located within the water column, in the form of algae and suspended solids. This may be a result of increased nutrient loading during rainfall events.

Station Comparison Metrics

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

- The Dominants in Common (DIC-5) metric (Figure 5) utilizes the five most abundant taxa at each station and is defined as the number of "Dominants" common to both the Control and the Study Station. The closer this number is to five, the more similar the two stations.

  At least one Dominant is in common with the control station for each of the study stations with the exception of TCD3 which has none in common. Two other stations SSD-3 and SLM1 have two and three in common, respectively.

Station Comparison Metrics, Cont

- Shackleford's Indicator Assemblage Index (IAI) (Figure 6) uses the relative abundances of the generally pollution intolerant Ephemeroptera, Plecoptera and Trichoptera, and the generally pollution tolerant Chironomidae and Annelida. 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 indicate that there is "no impairment in the study stations as compared to the control". However, it should be noted that the control station is not an unimpacted stream.

- The Sorenson's Community Similarity Index (Figure 7) utilizes a ratio of the number of taxa from the study station that are similar to the control 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 Loss Index (Figure 8) measures the loss of benthic taxa between a control station and the study station. This index is a measure of dissimilarity with the value increasing as the degree of dissimilarity from the control increases. This metric also shows a similar pattern as the Sorenson's Index (above).

- The Community Similarity Index (QSI-Taxa) (Figure 9) compares two communities in terms of presence or absence, and the relative abundances of the individual taxa. For this study the values ranged from 14 to 38 percent similar, and average 32 percent. Station TCD3 had the lowest similarity with 14 percent. The remaining stations were more similar and ranged from 33 to 38 percent.

SUMMARY AND CONCLUSIONS

Earlier studies, conducted in 1988 during drought conditions and in 1989 during normal rainfall, indicated that the benthic macroinvertebrate populations at all study stations were quite similar. The Benthic Macroinvertebrates of the Sand Mountain/Lake Guntersville Watershed assessment report from May of 1989 (H. Howard) stated that "degradation of the benthic fauna is not evident in the tributaries examined in 1988 or 1989".

The macroinvertebrate bioassessments conducted during June of 1992 also indicated similarity in all of the study stations as compared to the control station. However, as stated earlier, the control station is not an unimpacted site; but is located at the upper end of the watershed to minimize any adverse impact. The biological metrics used to analyze the data indicated that stations TCD3 and SHM3A consistently were of lower biological community quality as compared to the control station. Using the Biological Condition Scoring Criteria advocated by EPA (Plafkin 1989), all study stations were found to be "non-impaired" as compared to the control station with the exception of TCD3 and SHM3A which were "slightly impaired" as compared to the control. The quality of the macroinvertebrate community collected at Station SHM3A may have been degraded, at least in part, by the flow restriction caused by the numerous beaver dams located at the sampling reach. Station TCD3 had flows which were nearly 100 cubic feet per second (cfs) higher than the next lower flow of 38.5 cfs. This may be due to an isolated rainfall event, however no historical flow data were available for comparison. Recent higher than normal flows could have caused scouring of the substrate resulting in a lower number of organisms (and also taxa) being collected.

The historical data (Table 7) shows the metrics calculated on the data collected using the previous sampling methodology (1988 and 1989) were for the most part different than those calculated for the 1992 data. The current qualitative multi-habitat sampling methodology provides a more intensive standardized assessment of the benthic macroinvertebrate community than did the previous qualitative one-person-hour method. Therefore, based on data collected to date, differences in the metrics are attributed to methodology rather than changes in water quality.

The use of an ecoregional reference site(s) from a similar stream found elsewhere in the ecoregion would assist in determining the true quality of the biological communities found in the Sand Mountain watershed area rather than on their quality as compared to another less impacted site. Additional bioassessments in the future are recommended to further document the water quality of the Sand Mountain Watershed.

TABLE 1
TAXA LIST
SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TCD 1 92-06-17	TCD 3 92-06-16	SSD 3 92-06-16	SHM 3 A 92-06-18	SCD 3 92-06-17	LSLM 1 92-06-17	SLM 1 92-06-17
ANNELIDA	2				31	10	
OLIGOCHAETA	28	39	63	93	241	45	16
ARTHROPODA							
MALACOSTRACA							
AMPHIPODA							
Amphipoda UNID dif						1	
DECAPODA		2		1		1	3
ISOPODA							
Asellidae							
Asellus	1						
Lirceus	12					3	
INSECTA							
COLEOPTERA							
Dryopidae							
Helichus	2	1	7		10	1	
Dytiscidae							
Hydroporus			1	1	2	3	
Elmidae							
Ancyronyx	1	4	18	11	46		
Dubiraphia	22	9	6	34	36	7	4
Gonielmis				7		9	1
Macronychus	1	31	55	3	28		
Microcylloepus		3					
Promoresia	56	3	42	1	7	15	
Stenelmis	3	7	3		30	1	
Elmidae UNID dif	1						
Elmidae UNID					1		
Eubriidae							
Ectopria	3						1
Haliplidae							
Peltodytes		4	3	2	5		
Helodidae							
Scirtes							1

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Hydrophilidae							
Berosus		4	5		1		1
Enochrus				3			
Helochares					1		
Helophorus					2		
Hydrobiomorpha							1
Tropisternus					1		
Noteridae							
Hydrocanthus						1	1
Psephenidae							
Psephenus						2	8
COLEOPTERA UNID	1						
DIPTERA							1
Ceratopogonidae							
Atrichopogon				5			
Bezzia	13	3		1	6	1	4
CHIRONOMIDAE							
Chironominae							
Chironomini							
Chironomus				11			1
Cryptochironomus	5		23	9	5		8
Cryptotendipes						3	1
Demicryptochironomus			3				
Dicrotendipes			12	4	25	1	
Endochironomus						10	1
Microtendipes	5		3	32	5	16	4
Nilothauma			6		8	1	
Paratendipes				2		1	
Phaenopsectra			13	183	28	14	6

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Polypedilum	80	48	310	73	64	20	109
Stenochironomus			6	125	15	4	8
Stictochironomus	2				21		1
Chironomini UNID				1	1		1
Tanytarsini							
Cladotanytarsus						11	
Microspectra			16				
Rheotanytarsus	901	3	34	171	133	4	50
Stempellinella	3		2		4	7	26
Tanytarsus	362	11	206	173	231	31	83
Tanytarsini UNID				7			
Orthocladinae							
Brillia	1						
Corynoneura					1	2	4
Cricotopus	3		31		4		
Eukiefferiella	4		1		4	1	
Limnophyes	2						
Nanocladius	60						
Orthocladius	27	5	15			1	
Parametriocnemus	146		45	46	68	15	165
Rheocricotopus		102	31	30	3	1	4
Synorthocladius					12	1	
Thienemanniella			2				12
Tvetnia		5	24	6		4	50
Xylotopus					5		

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Orthocladinae UNID dif	1				1		
Orthocladinae UNID				1		1	1
Tanypodinae							
Ablabesmyia	8		2	64	35	16	10
Clinotanypus	1						
Labrundinia				4			
Natarsia				4			1
Nilotanypus	24						1
Procladius	1		2	6	3	8	3
Thienemannimyia Grp	190	19	19	24	5	10	42
Tanypodinae UNID	1		1				
CHIRONOMIDAE UNID						1	
Dolichopodidae							
Dolichopodidae UNID dif			1				
Empididae							
Hemerdromia			1	36	20		18
Empididae UNID dif			1				
Muscidae							
Muscidae UNID dif		1					
Pelecorhynchidae							
Glutops				2			
Simulidae							
Simulium	3	37	10	354	98	8	56
Simulidae UNID					144		
Tipulidae							
Hexatoma	1	1	1				2
Limonia			3			1	
Tipula	4	5	47	10	12	5	1

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Tipulidae UNID dif							2
Tipulidae UNID					1		
EPHEMEROPTERA							
Baetidae							
Acentrella			7				
Acerpenna	9		1	5	18		1
Baetis	3	64	14	69	17	3	37
Centroptilum							5
Paracloeodes	13		1	2	7	4	
Baetidae UNID dif			20				
Baetidae UNID	42			239	102	15	12
Caenidae							
Caenis			1		2		
Ephemerellidae							
Attenella	57		3	4	16	1	
Danella	12					1	
Ephemerella			6	1			6
Eurylophella	12						
Serratella	1					5	
Ephemerellidae UNID dif			1				
Heptageniidae							
Heptagenia	2		1			1	2
Stenacron	2				12		
Stenonema	31	41	114	131	170	8	34
Heptageniidae UNID dif	1		1				
Heptageniidae UNID	2			15	26	2	
Leptophlebiidae							

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Habrophlebiodes	5					11	4
Paraleptophlebia	1						4
Leptophlebiidae UNID dif					1		
Leptophlebiidae UNID						1	
Oligoneuridae							
Isonychia			3		50		
Tricorythidae							
Tricorythodes		62	4				
HEMIPTERA							
Corixidae							
Corixidae UNID dif							2
Gerridae							
Rheumatobates					1		
Trepobates			3				2
Veliidae							
Microvelia			1		2		
Rhagovelia		3	4	7	1		
MEGALOPTERA							
Corydalidae							
Nigronia	20		2	13	39	13	39
Sialidae							
Sialis	6	1	6	14	6		3
ODONATA							
Aeshnidae							
Boyeria	6	11	8	20	11	6	17
Calopterygidae							
Calopteryx	1						
Hetaerina		2					
Coenagrionidae							
Argia		1					1
Enallagma					1		

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Coenagrionidae UNID				1			
Corduliidae							
Neurocordulia				1			
Somatochlora					5		2
Gomphidae							
Dromogomphus			1			2	
Erpetogomphus		1					
Hagenius			1				
Gomphus					1		
Progomphus	2	1		1			
Stylogomphus							1
Stylurus	1						
Stylurus		1					
Gomphidae UNID dif	1						
Libellulidae							
Libellula					2		
Perithemis					1		
Sympetrum				7		2	
Libellulidae UNID				1			
Macromiidae							
Didymops				1			
Macromia	4	4	2	1	1	1	2
ODONATA UNID				1		1	
PLECOPTERA							
Nemouridae							
Amphinemura		5			6	1	1
Perlidae							
Perlesta	11	69	108	75	172	10	17

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Perlidae UNID	1				1		
Perlodidae							
Isoperla	13				7	34	19
TRICHOPTERA							
Brachycentridae							
Micrasema			15	16	69		
Hydropsychidae							
Ceratopsyche		166	1	6	4	1	24
Cheumatopsyche	18				2	1	
Hydropsyche	70		147	52	24	17	94
Macronema		45					
Hydropsychidae UNID	36		25	6		2	
Hydroptilidae							
Hydroptila			7		1		
Ochrotrichia		1					
Orthotrichia							6
Oxyethira					1		
Leptoceridae							
Mystacides		6	16	16	56	3	18
Nectopsyche			1				2
Oecetis	3	1	1		1		
Leptoceridae UNID						5	
Limnephilidae							
Hydatophylax			4				
Molannidae							
Molanna			2	5	22	2	7
Philopotamidae							
Chimarra	2	10	3	13	6		
Polycentropodidae							

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Cernotina					1		
Cyrnellus		1					
Polycentropus	1				2	2	4
Polycentropodidae UNID dif			1				
Polycentrodpodidae UNID				1			
Psychomyiidae							
Lype	2						
Rhyacophilidae							
Rhyacophila	14					9	
MOLLUSCA							
GASTROPODA							
LIMNOPHILA							
Ancylidae							
Ferrissia			9				9
Laevapex	7			48	2	9	
Physidae							
Physella	8		2	30	42	5	1
Planorbidae							
Helisoma		15	1	34	19	12	17
Menetus	16				168	28	
Planorbella				6			
Planorbula		24	1		2		
MESOGASTROPODA							
Hydrobiidae							
Amnicola							1
Somatogyrus		1					
PELECYPODA							
HETERODONTA							
Corbiculidae							
Corbicula	13	286	369	174	105	20	7
Sphaeriidae *	54	13	2	4	165	110	7

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ISCELLANEOUS							
Acari (Hydracarina)	2				3		
Collembola					1		
Nematoda						1	
Planaria	2	13	9	5	21		1

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

METRIC	TCD 1 92-06-17	TCD 3 92-06-16	SSD 3 92-06-16	SHM 3 A 92-06-18	SCD 3 92-06-17	LSLM 1 92-06-17	SLM 1 92-06-17
TAXA RICHNESS	73	50	81	63	86	70	73
# ORGANISMS	2488	1195	2003	2565	2799	647	1122
EPT TAXA RICHNESS	22	12	26	13	24	18	18
# CHIRONOMIDAE TAXA	20	7	22	18	22	23	22
BIOTIC INDEX	5.34	5.04	5.37	5.26	5.20	5.16	4.79
# CHIRONOMIDAE TAXA / TOTAL TAXA	.27	.14	.27	.29	.26	.33	.30
# EPT / # EPT + # CHIRONOMIDAE	.17	.71	.39	.40	.54	.43	.33
PERCENT SCRAPERS	3.38	5.44	7.64	17.62	18.90	14.68	8.11
PERCENT SHREDDERS	3.54	5.19	20.67	3.94	5.82	5.87	10.34
PERCENT FILTERING COLLECTORS	57.32	46.69	40.14	38.56	28.80	17.16	30.66
PERCENT COLLECTOR GATHERERS	18.13	24.69	17.32	24.02	17.01	17.47	29.41
PERCENT PREDATORS	13.26	10.04	9.44	11.46	12.00	18.39	17.83
PERCENT MACROPHYTE PIERCERS	.00	.33	.60	.12	.11	.00	.62
PERCENT OTHERS	4.38	7.62	4.19	4.29	17.36	26.43	3.03

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

TCD 001 92-06-17	TCD 003 92-06-16	SSD 003 92-06-16	SHM 003 A 92-06-18	SCD 003 92-06-17	LSLM 001 92-06-17	SLM 001 92-06-17
Rheotanytarsus	Corbicula	Corbicula	Simulium	OLIGOCHAETA	Sphaeriidae	Parametriocnemus
36.21	23.93	18.42	13.80	8.61	* 17.00	14.71

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

FIVE DOMINANT TAXA AND PERCENT CONTRIBUTION

TCD 001 92-06-17	TCD 003 92-06-16	SSD 003 92-06-16	SHM 003 A 92-06-18	SCD 003 92-06-17	LSLM 001 92-06-17	SLM 001 92-06-17
Rheotanytarsus	Corbicula	Corbicula	Simulium	OLIGOCHAETA	Sphaeriidae	Parametriocnemus
36.21	23.93	18.42	13.80	8.61	* 17.00	14.71
Tanytarsus	Ceratopsyche	Polypedilum	Baetidae UNID	Tanytarsus	OLIGOCHAETA	Polypedilum
14.55	13.89	15.48	9.32	8.25	6.96	9.71
Thienemannimyia Grp	Rheocricotopus	Tanytarsus	Phaenopsectra	Perlesta	Isoperla	Hydropsyche
7.64	8.54	10.28	7.13	6.15	5.26	8.38
Parametriocnemus	Perlesta	Hydropsyche	Corbicula	Stenonema	Tanytarsus	Tanytarsus
5.87	5.77	7.34	6.78	6.07	4.79	7.40
Polypedilum	Baetis	Stenonema	Tanytarsus	Menetus	Menetus	Simulium
3.22	5.36	5.69	6.74	6.00	4.33	4.99

TABLE 3

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS TCD 003 92-06-16	TCD 001 92-06-17 VERSUS SSD 003 92-06-16
DOMINANTS IN COMMON		<u>Tanytarsus</u> <u>Polypedilum</u>
NUMBER OF DOMINANTS IN COMMON	0	2
INDICATOR ASSEMBLAGE INDEX	3.27	1.73
SORENSON'S COMMUNITY SIMILARITY INDEX	.46	.55
COMMUNITY LOSS INDEX	.90	.38
QUANTITATIVE SIMILARITY INDEX		
TAXA	13.85	32.50

TABLE 4

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS SHM 003 A 92-06-18	TCD 001 92-06-17 VERSUS SCD 003 92-06-17
DOMINANTS IN COMMON	Tanytarsus	Tanytarsus
NUMBER OF DOMINANTS IN COMMON	1	1
INDICATOR ASSEMBLAGE INDEX	1.77	2.07
SORENSON'S COMMUNITY SIMILARITY INDEX	.51	.62
COMMUNITY LOSS INDEX	.60	.27
QUANTITATIVE SIMILARITY INDEX		
TAXA	33.91	36.36

TABLE 5

SAND MOUNTAIN WATERSHED PROJECT
MACROINVERTEBRATE DATA

	TCD 001 92-06-17 VERSUS LSLM 001 92-06-17	TCD 001 92-06-17 VERSUS SLM 001 92-06-17
)OMINANTS IN COMMON	Tanytarsus	Tanytarsus
		Parametriocnemus
		Polypedilum
NUMBER OF DOMINANTS IN COMMON	1	3
INDICATOR ASSEMBLAGE INDEX	1.75	1.60
SORENSON'S COMMUNITY SIMILARITY INDEX	.60	.51
COMMUNITY LOSS INDEX	.42	.49
QUANTITATIVE SIMILARITY INDEX		
TAXA	34.16	38.19

TABLE 6

BIOMETRIC INTERPRETATION TABLE

METRIC	RANGE	INTERPRETATION
HABITAT ASSESSMENT	104-135 71-103 35-70 0-34	EXCELLENT GOOD FAIR POOR
TAXA RICHNESS EPT INDEX SHANNON WEAVER DIVERSITY INDEX EQUITABILITY		GENERALLY INCREASES WITH WITH INCREASING WATER QUALITY
BIOTIC INDEX % DOMINANT TAXON TOLERANCE VALUE OF DOM. 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
SCRAPERS / SCRAPERS + COL. FIL. SHREDDERS / TOTAL HYDROPSYCHIDAE / TRICHOPTERA		NO SIGNIFICANT CHANGE AS COMPARED TO BACKGROUND
EPT / EPT + CHIRONOMIDAE		GENERALLY INCREASING WATER QUALITY AS APPROACHES 1.0

SIMILARITY INDICES

INDICATOR ASSEMBLAGE INDEX (IAI) JACCARD COEFFICIENT OF COMMUNITY SORENSON'S COMMUNITY INDEX	INCREASING SIMILARITY AS APPROACHES 1.0
DOMINANTS IN COMMON QUANTITATIVE SIMILARITY INDEX FOR FUNCTION FEEDING GROUPS (QSI-FFG QUANTITATIVE SIMILARITY INDEX FOR TAXA (QSI-TAXA)	GENERALLY INCREASES WITH INCREASING SIMILARITY
COMMUNITY LOSS INDEX	GENERALLY INCREASES WITH INCREASING DISSIMILARITY

TABLE 7
SAND MOUNTAIN HISTORICAL BIOLOGICAL DATA

SAMPLING DATES:			
	1988	May 31 - June 1	(Stream flows May 10-11)
	1989	May 3 - May 4	(Stream flows April 18-19)
	1992	June 15 - 17	(Stream flows June 15-17

CREEK		**TCD-1**			**TCD-3**			**LSLM-1**	
YEAR	1988	1989	1992	1988	1989	1992	1988	1989	1992
TAXA RICHNESS	37	23	73	38	24	50	48	20	70
EPT TAXA RICHNESS	12	11	22	8	13	12	10	9	18
CHIRONOMID TAXA RICHNESS	12	3	20	10	5	7	15	3	23
BIOTIC INDEX	4.07	2.52	5.34	4.66	3.44	5.04	4.06	3.24	5.16
PERCENT CHIRONOMIDAE	.32	.13	.27	.26	.21	.14	.31	.15	.33
EPT/EPT+CHIRONOMIDAE	.74	.95	.17	.82	.89	.71	.67	.91	.43
% SCRAPERS	8	14	3	21	21	5	11	20	15
% SHREDDERS	8	16	4	3	12	5	6	3	6
% FILTERING COLLECTORS	16	3	57	11	23	46	18	7	17
% COLLECTOR GATHERERS	33	45	18	33	28	25	31	36	17
% PREDATORS	32	21	13	28	15	10	27	31	18
% OTHERS	2	1	4	4	-	8	6	3	26
STREAM FLOW	-	-	29.3	-	-	137.5	-	*18.8	5.2

CREEK		**SCD-3**			**SHM-3A**			**SSD-3**	
YEAR	1988	1989	1992	1988	1989	1992	1988	1989	1992
TAXA RICHNESS	38	23	86	40	27	63	50	24	81
EPT TAXA RICHNESS	8	7	24	9	12	13	10	10	26
CHIRONOMIDAE TAXA RICHNESS	13	5	22	13	5	18	16	7	22
BIOTIC INDEX	5.14	4.26	5.20	5.02	3.84	5.26	5.04	3.46	5.37
PERCENT CHIRONOMIDAE	.34	.22	.26	.33	.19	.29	.32	.29	.27
EPT/EPT+CHIRONOMIDAE	.71	.77	.54	.76	.85	.40	.63	.80	.39
% SCRAPERS	23	27	19	17	9	18	19	17	8
% SHREDDERS	8	11	6	1	11	4	3	5	21
% FILTERING COLLECTORS	8	16	28	37	24	39	14	5	40
% COLLECTOR GATHERERS	42	11	17	21	27	24	31	38	17
% PREDATORS	12	32	12	20	29	11	23	22	9
% OTHERS	7	3	17	3	-	4	9	13	4
STREAM FLOW	*35.7	*98.7	26.4	-	-	8.4	*12.6	*40.0	38.5

CREEK		**SLM-1**	
YEAR	1988	1989	1992
TAXA RICHNESS	34	24	73
EPT TAXA RICHNESS	11	11	18
CHIRONOMIDAE TAXA RICHNESS	9	3	22
BIOTIC INDEX	4.26	3.38	4.79
PERCENT CHIRONOMIDAE	.26	.13	0.30
EPT/EPT+CHIRONOMIDAE	.74	.95	0.33
% SCRAPERS	13	28	8
% SHREDDERS	1	4	10
% FILTERING COLLECTORS	17	6	31
% COLLECTOR GATHERERS	34	28	29
% PREDATORS	28	30	17
% OTHERS	7	3	3
STREAM FLOW	*3.0	*17.2	3.5

*These flows were taken approximately 3 weeks prior to collection of macroinvertebrates

FIGURE 1

HABITAT ASSESSMENT - STREAM FLOW

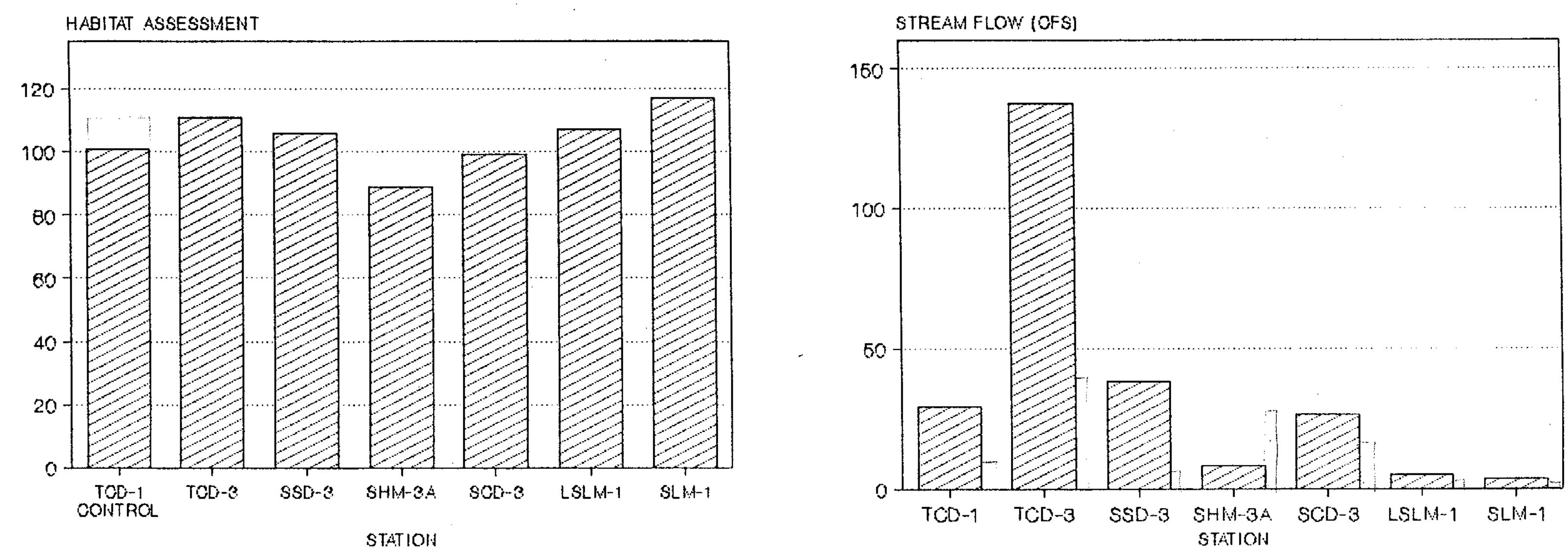


FIGURE 2
TAXA RICHNESS

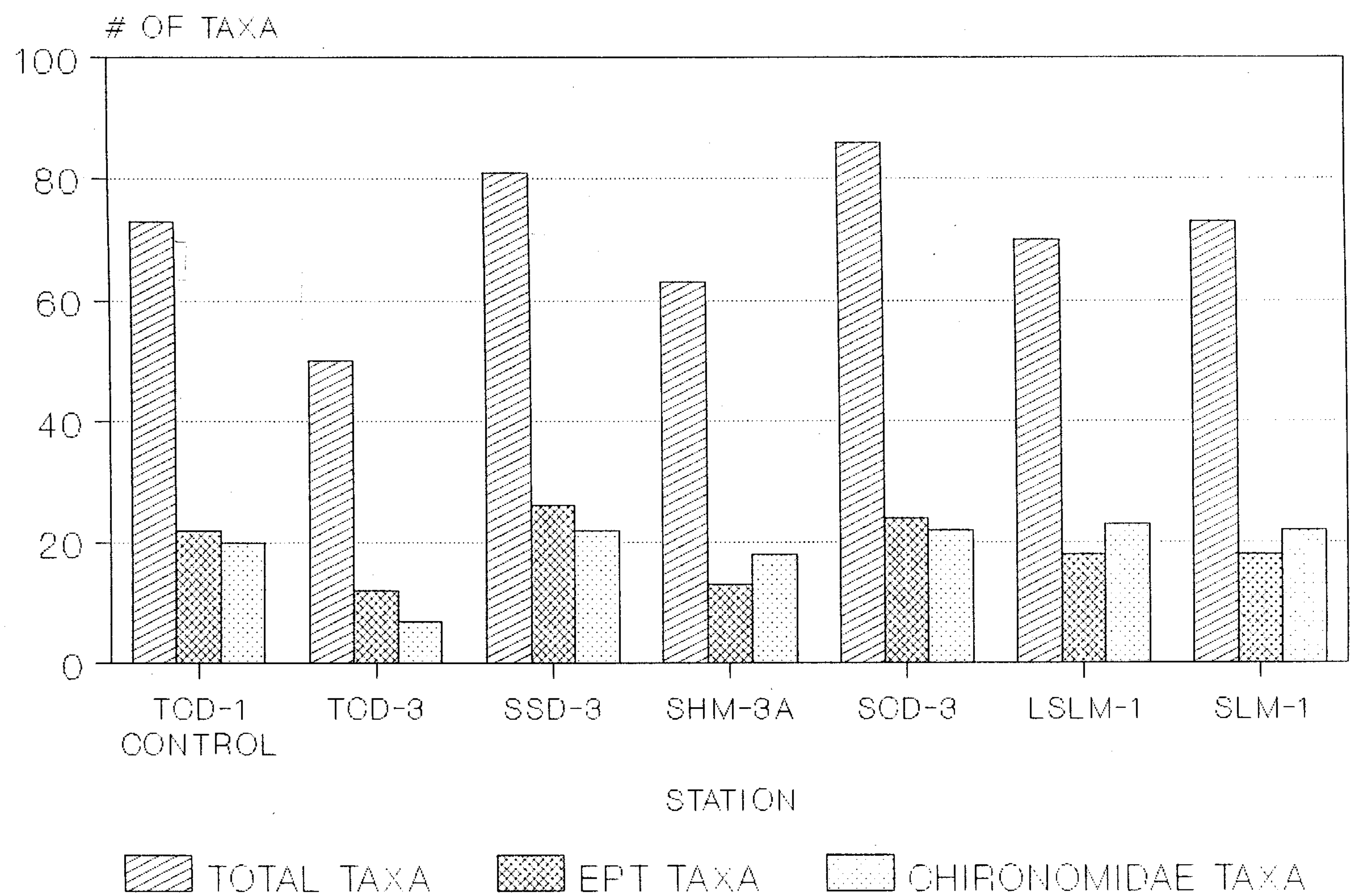


FIGURE 3
BIOTIC INDEX (BI)

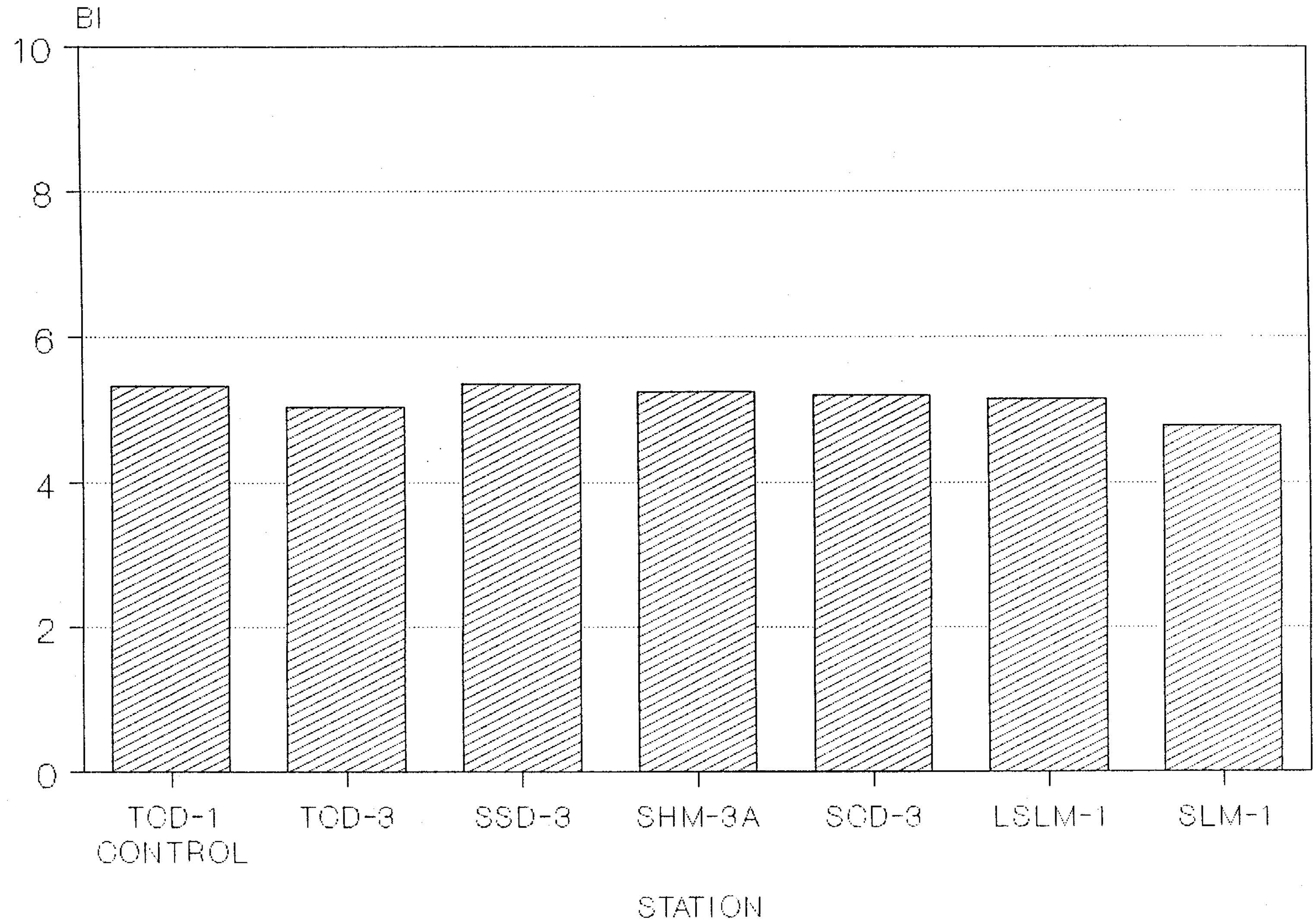


FIGURE 4
PERCENT CONTRIBUTION OF DOMINANT TAXON

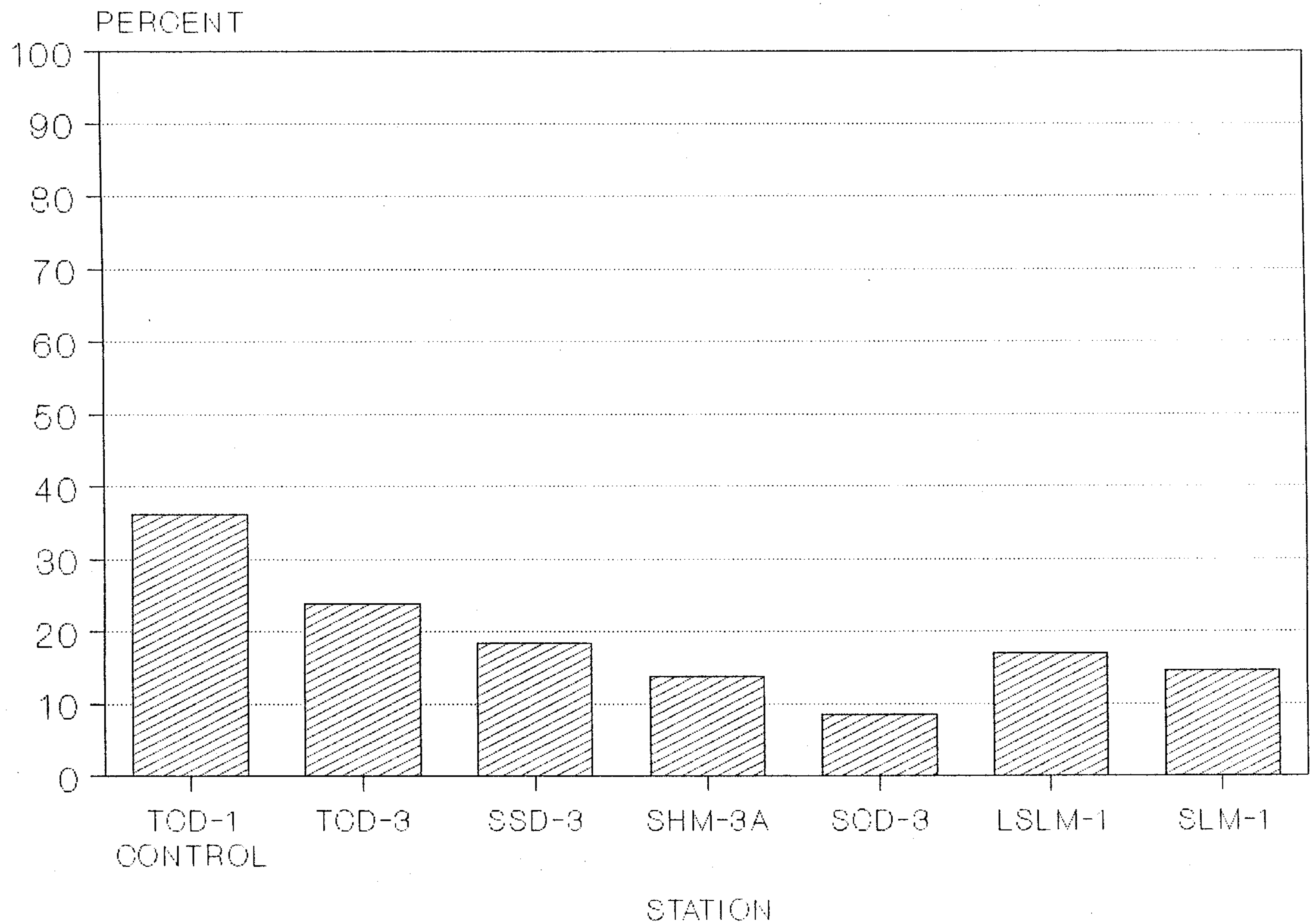
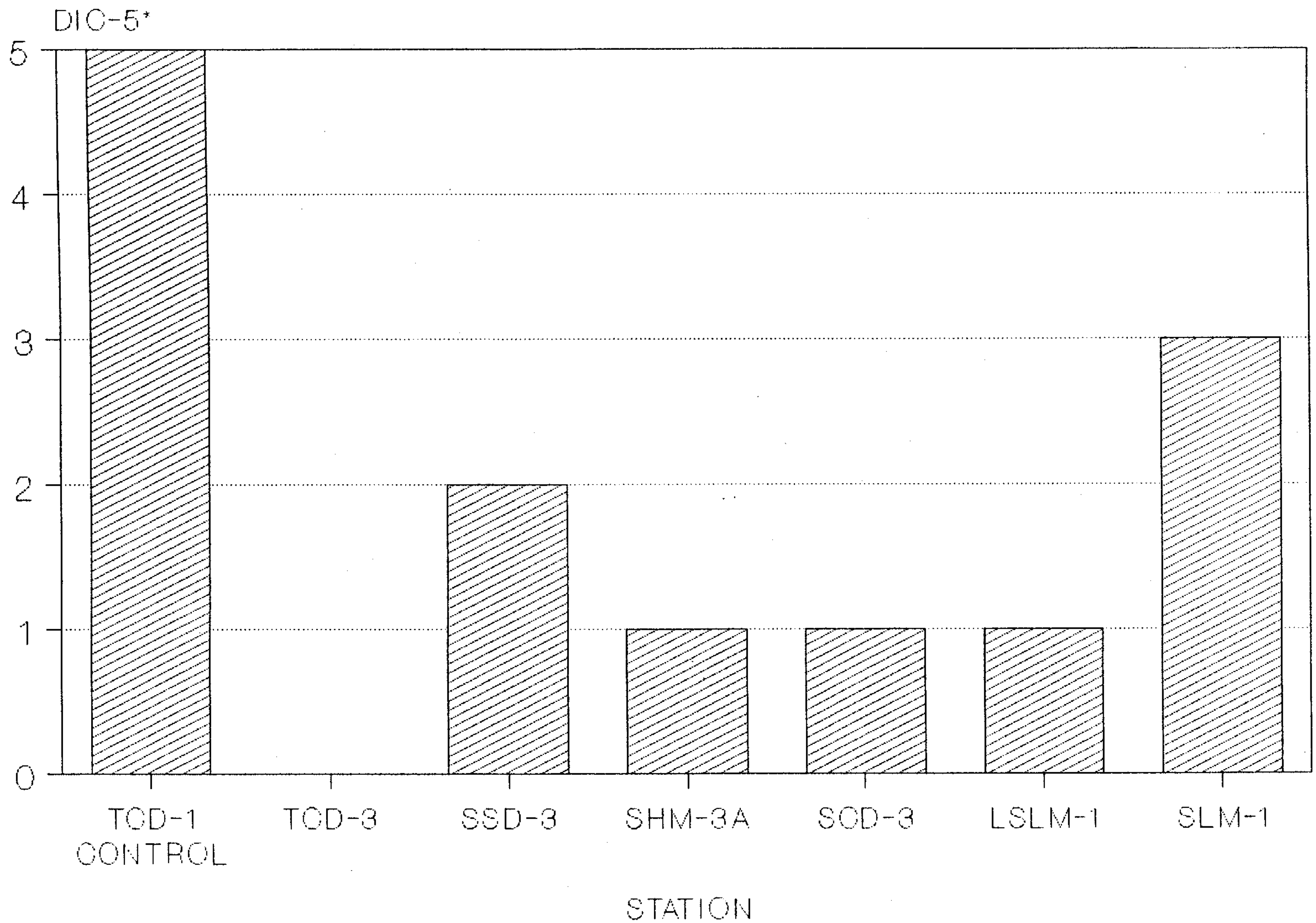
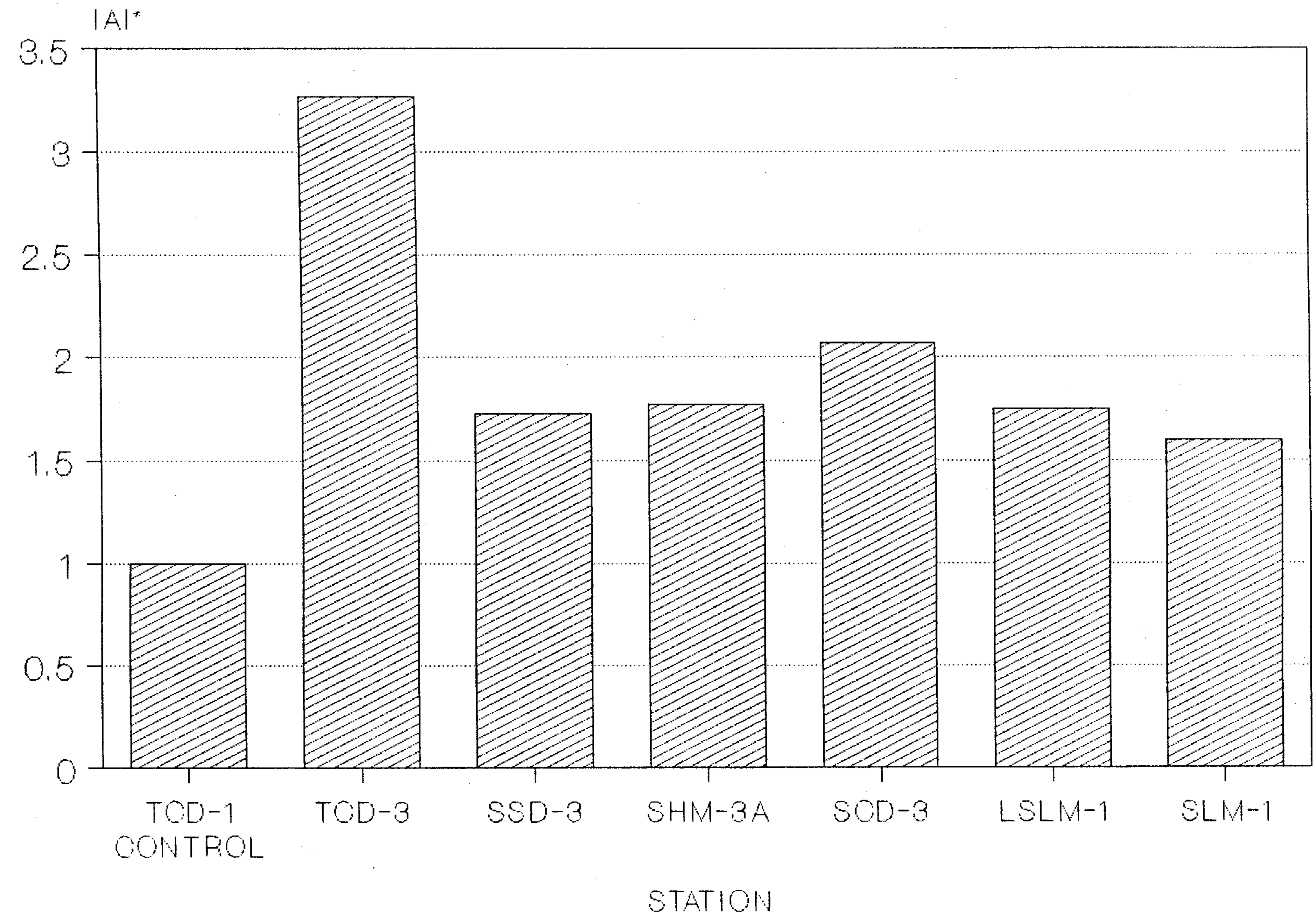


FIGURE 5
DOMINANTS IN COMMON (DIC-5)



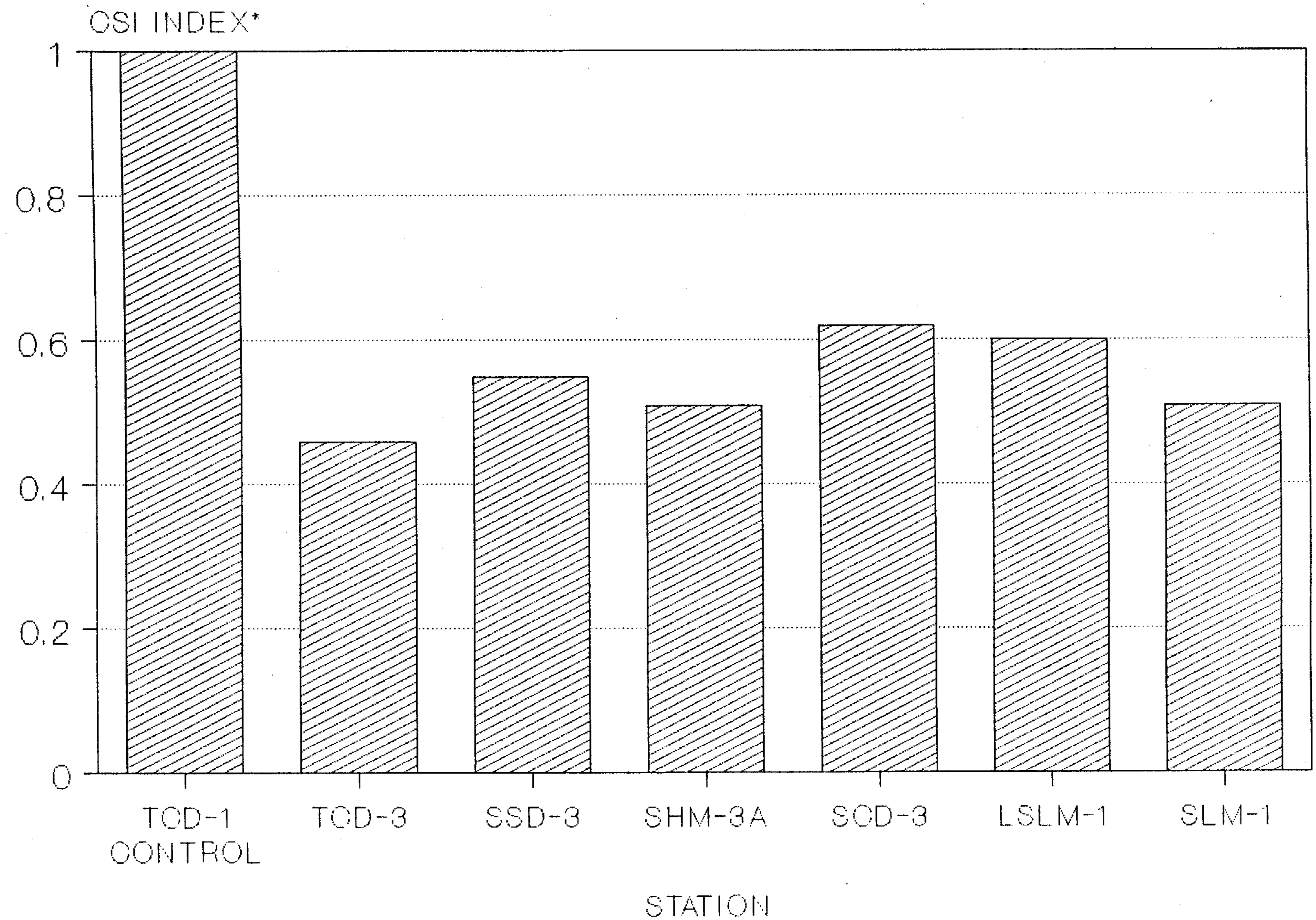
* AS COMPARED TO CONTROL STATION TCD-1

FIGURE 6
INDICATOR ASSEMBLAGE INDEX (IAI)



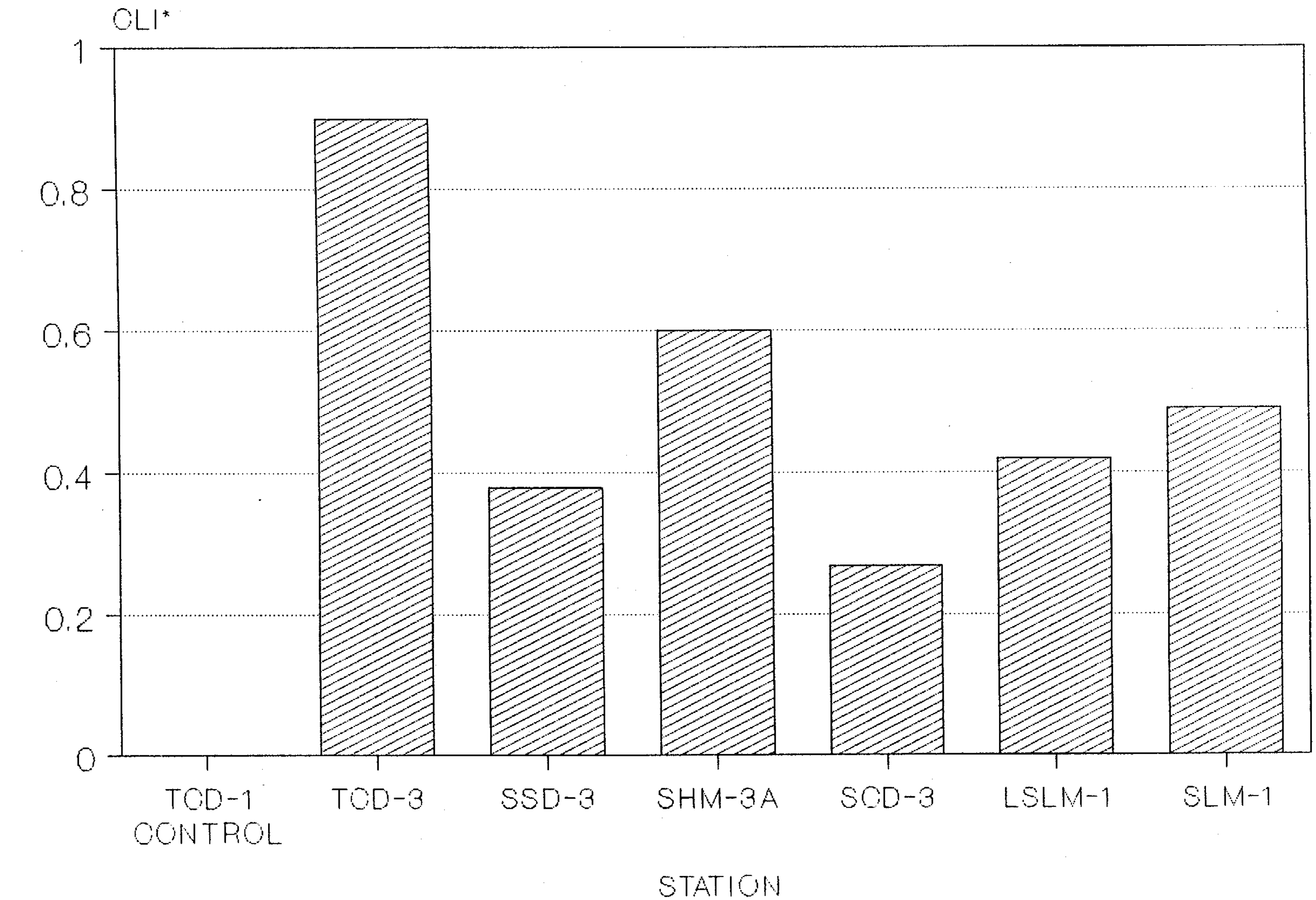
* AS COMPARED TO CONTROL STATION TCD-1

FIGURE 7
SORENSON'S COMMUNITY SIMILARITY INDEX



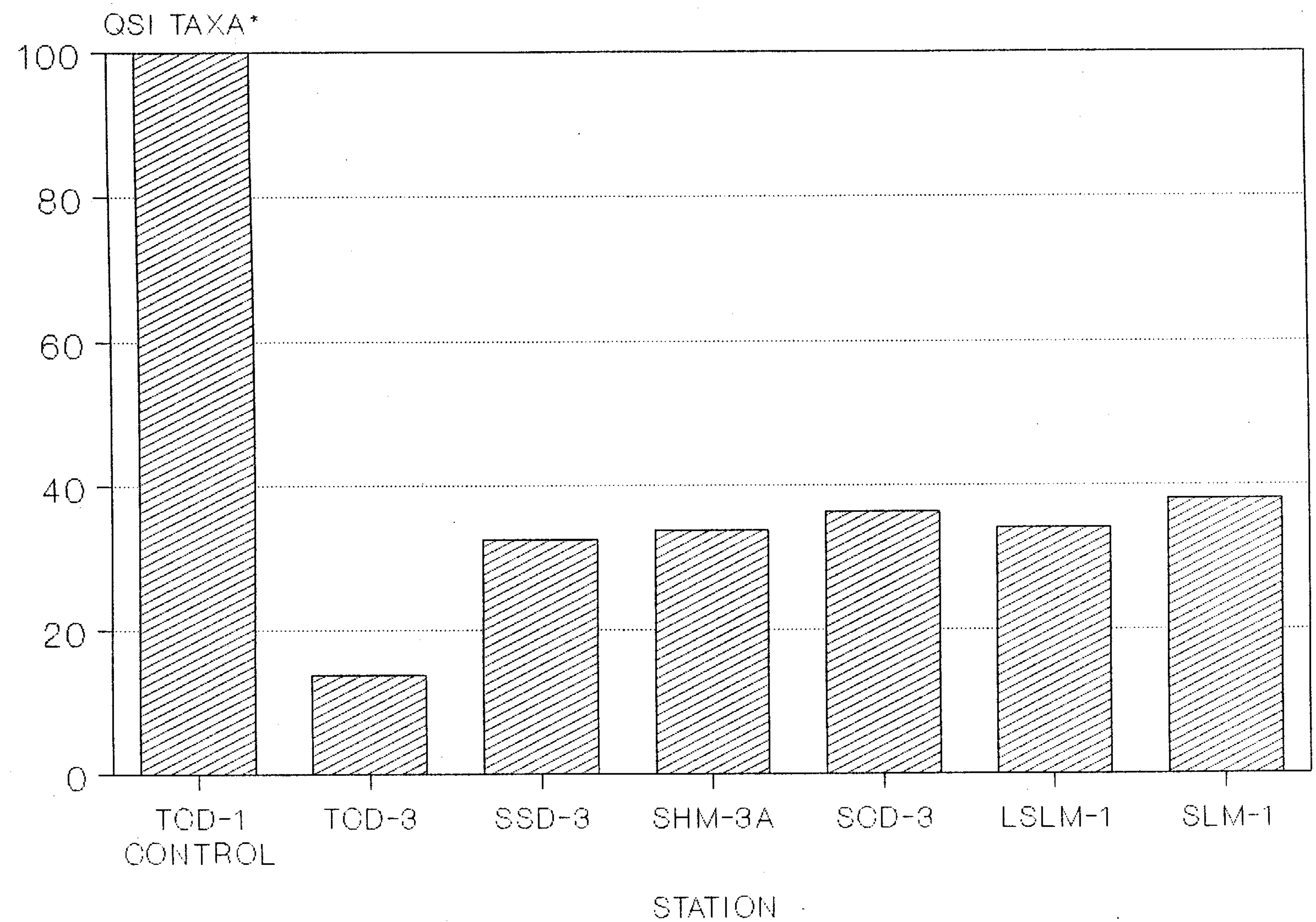
* AS COMPARED TO CONTROL STATION TCD-1

FIGURE 8
COMMUNITY LOSS INDEX (CLI)



* AS COMPARED TO CONTROL STATION TCD-1

FIGURE 9
COMMUNITY SIMILARITY INDEX (QSI-TAXA)



* AS COMPARED TO CONTROL STATION TCD-1