TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

June 22, 2001

Mr. Paul E. Davis Director
Tennessee Department of Environment & Conservation
Division of Water Pollution Control
Annual Maintenance Fee
Sixth Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

Dear Mr. Davis:

WATTS BAR NUCLEAR PLANT (WBN) - NATIONAL POLLUTANT DISCHARGE ELIMNATION SYSTEM (NPDES) PERMIT NO. TN0020168 - SUPPLEMENTAL CONDENSER COOLING WATER (SCCW) SYSTEM PROJECT NUMBER 98-1092 - FISH MONITORING PROGRAM STUDIES

Enclosed are two copies of the report "Results of Biological Monitoring in the Vicinity of Watts Bar Nuclear Plant, 2000." This report provides results of TVA's Vital Signs fisheries monitoring program from 1993 through the fall of 2000. This report is not required in accordance with Part III, Section I of the WBN NPDES Permit but was a recommendation in the "Watts Bar Nuclear Plant Supplemental Condenser Cooling Water System Fish Monitoring Program, 2001" report to be consistent with other required annual monitoring programs at Tennessee and Alabama Nuclear Plants.

If you have any comments or questions, please contact me at (423) 365-8005.

Sincerely,

Robert J. Crawford
Environmental Supervisor

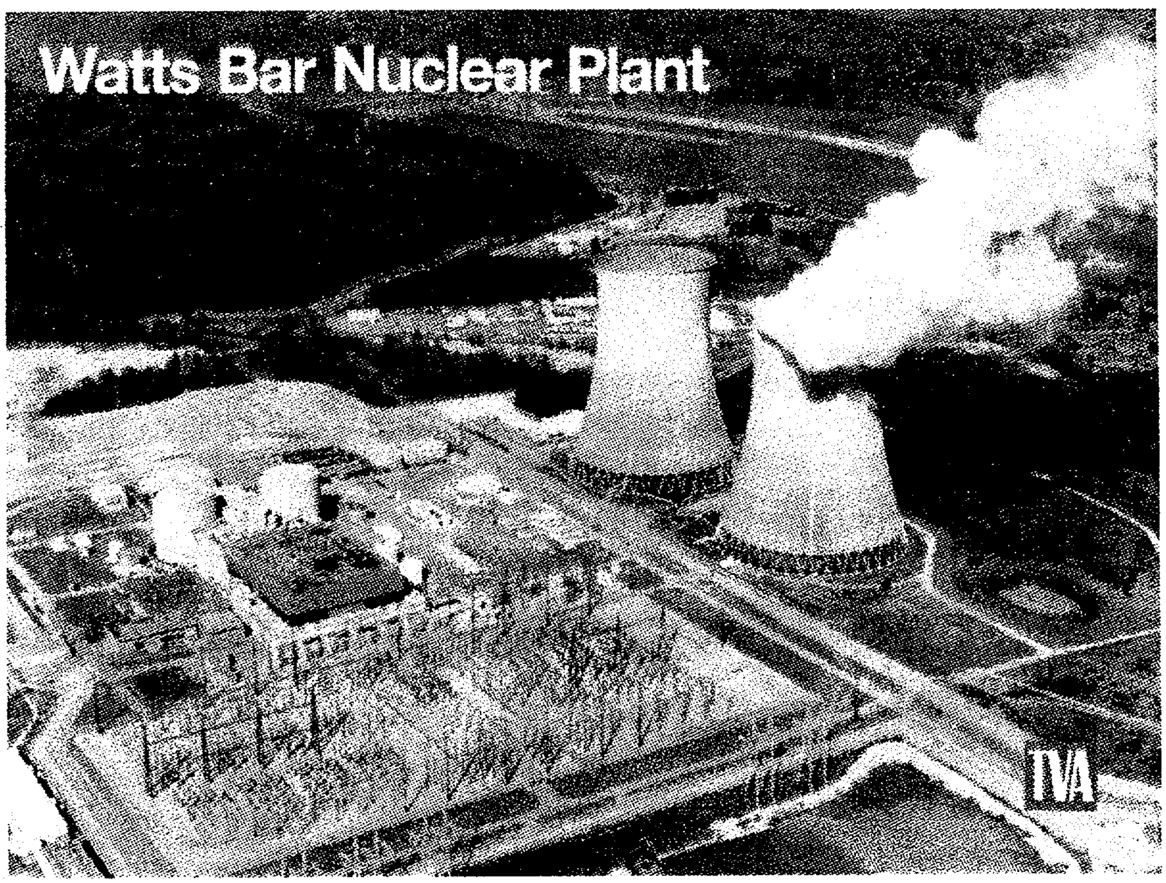
Enclosures
cc (Enclosures):
Mr. Philip L. Stewart, Manager
Division of Water Pollution Control
Tennessee Department of Environment & Conservation
Chattanooga Field Office
Suite 550, 540 McCallie Avenue
Chattanooga, Tennessee 37402-2013

Mr. Clarence Coffey
Tennessee Wildlife Resources Agency
464 Industrial Boulevard
Crossville, Tennessee 38555

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

IE25

Results of Biological Monitoring in the Vicinity of Watts Bar Nuclear Plant 2000



Final Report
June 2001

Table of Contents

	Page
Introduction	1
Methods	2
Fish Community	2
Benthic Macroinvertebrate Community	3
Sport Fishing Index	4
Results and Discussion	4
Fish Community	4
Benthic Macroinvertebrate Community	5
Sport Fishing Index	5
Literature Cited	7

List of Tables

Table 1. Scoring Results for the Twelve Metrics and Overall Reservoir Fish Assemblage Index for Chickamauga Reservoir 2000. 8

Table 2. Species Listing and Catch Per Unit Effort during the Fall Electrofishing and Gill Netting on Chickamauga Reservoir 2000 (Electrofishing Effort = 300 Meters of Shoreline and Gill Netting Effort = Net-Nights). 9

Table 3. Recent (1993-2000) RFAI Scores Collected as Part of the Vital Signs Monitoring Program Downstream of Watts Bar Nuclear Plant. 11

Table 4. Individual Metric Ratings and the Overall Benthic Community Index Score for Upstream and Downstream Sites Near Watts Bar Nuclear Plant, Watts Bar and Chickamauga Reservoirs, November 2000. 11

Table 5. Average Mean Density Per Square Meter of Benthic Taxa Collected at the Downstream Site Near Watts Bar Nuclear Plant, Chickamauga Reservoir, and the Next Lab-Processed Site (Transition Zone) Upstream of Watts Bar Nuclear Plant, Watts Bar Reservoir, November 2000. 12

Table 6. Recent (1994-2000) Benthic Index Scores Collected as Part of the Vital Signs Monitoring Program at Watts Bar Reservoir Transition and Forebay Zone Sites (Upstream), and Chickamauga Reservoir Inflow (Upstream) and Transition (Downstream) Sites. 14

List of Figures

Figure 1. Annual RFAI scores between the years 1993 and 1999 compared to the year 2000 RFAI score. 15

Table of Contents (Continued)

		Page
Figure 2.	Annual RFAI scores between the years 1993 and 1999 compared to the year 2000 RFAI score.	16
Figure 3.	Sport Fishing Index results and valley-wide averages for six sport fish in Chickamauga Reservoir, 2000	17
Figure 4.	Sport Fishing Index results and valley-wide averages for six sport fish in Watts Bar Reservoir, 2000.	18

Introduction

The Watts Bar Nuclear Plant (WBN) Supplemental Condenser Cooling Water (SCCW) system, designed to augment the makeup water supply system for WBN, became operational July 19, 1999. As required by the National Pollutant Discharge Elimination System permit (TN0020168) issued to the Tennessee Valley Authority (TVA) for SCCW operation, TVA evaluated impacts of the newly installed SCCW system on aquatic communities in the vicinity of WBN and Watts Bar Reservoir forebay. It was concluded that the SCCW and WBN operation had no effect on the fish and benthic macroinvertebrate communities in the vicinity of WBN and Watts Bar Reservoir forebay. In addition to WBN special studies, monitoring initiated in Chickamauga and Watts Bar Reservoirs in 1993 as part of TVA's Vital Signs (VS) Monitoring Program (Dycus and Meinert 1993) provided an added measure of quality. Since then, VS monitoring determined that no adverse effects on the fish and macroinvertebrate communities has occurred as a result of WBN operation.

Section 316(a) of the Clean Water Act allows point-source discharges of heated water to obtain a variance from state water quality standards if the point source can demonstrate maintenance of balanced indigenous populations of aquatic life. Baxter et al. (2001) recommended WBN to use TVA's VS Monitoring Program's Reservoir Fish Assemblage Index (RFAI), Benthic Macroinvertebrate Index and Sport Fishing Index (SFI) to assess Chickamauga and Watts Bar Reservoirs' aquatic community health and quality. The purpose of this document is to briefly summarize and provide Tennessee Department of Environment and Conservation the results of the Calendar Year 2000 monitoring and comparisons with historical VS monitoring data.

Prior to 1990, TVA reservoir studies focused on reservoir ecological assessments to meet specific needs as they arose. In 1990, TVA instituted a valley-wide VS monitoring program which is a broad-based evaluation of the overall ecological conditions in major reservoirs. Data is evaluated with a multi-metric approach utilizing five environmental indicators: dissolved oxygen, chlorophyll, sediment quality, benthic macroinvertebrate community, and the fish community. When this program was initiated, specific evaluation techniques had to be developed for each indicator, and these techniques were fine-tuned in order to better represent ecological conditions. The outcome of this effort was development of a multi-metric evaluation techniques for the fish assemblage and the benthic community, as described below. These multi-metric evaluation techniques have proven successful in TVA's monitoring efforts as well as other federal and state monitoring programs. Therefore, they will form the basis of evaluating these monitoring results. For consistency, only RFAI analyses between 1993 and 2000 will be utilized.

SFI was developed by a team of TVA and state fishery agency biologists in the Tennessee Valley to quantify sport fishing quality for individual sport fish species (Hickman 2000). The SFI provides biologists with a reference point to measure the quality of the fishery. Comparison of the population sampling parameters and creel results for a particular sport fish species with expectations of these parameters from a high quality fishery (reference conditions) allows determination of fishing quality. Indices have been developed for black bass (largemouth, smallmouth and spotted bass), striped bass, sauger, and channel catfish. Each SFI relies on measurements of quantity and quality aspects of angler success and fish population characteristics.

In recent years, SFI information has been used to describe the quality of the resident fishery in conjunction with compliance monitoring, thermal variance requests, and other regulatory issues at TVA nuclear power plants in Tennessee. The SFI was used in support of a thermal variance request at SQN Plant (TVA 1996), and in the Environmental Assessment for the WBN SCCW system (TVA 1997). An analysis of the SFI indicated a high quality fishery for sauger, the most likely sport fish species to be adversely impacted as a result of plant operation.

Methods

Fish Community

Reservoirs are typically divided into three zones for VS monitoring – inflow, transition and forebay. The inflow zone is generally in the upper reaches of the reservoir and is riverine in nature; the transition zone or mid-reservoir is the area where water velocity decreases due to increased cross-sectional area, and the forebay is the lacustrine area near the dam. The Chickamauga Reservoir inflow zone is located at Tennessee River Mile (TRM) 518.0; the transition zone is located at TRM 490.5, and the forebay zone is located at TRM 472.3. The VS inflow zone, which is located approximately 9.6 river miles downstream of the WBN discharge (TRM 527.6), will be used to provide downstream data for the 316(a) thermal variance studies performed in 1993, 1994, 1995, 1997, and 1999. Since the WBN discharge is located above the Chickamauga Reservoir inflow zone, no upstream control station data is available for comparison. Watts Bar Reservoir forebay will be used to document any notable changes in Tennessee River ecological conditions above the WBN discharge but will not be used for upstream/downstream comparisons of RFAI scores.

Fish samples consisted of fifteen 300-meter electrofishing runs (approximately 10 minutes duration) and ten experimental gill net sets (five 6.1 meter panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm) per station. Attained values for each of the 12 metrics were compared to reference conditions for transition zones of lower mainstream Tennessee River reservoirs and assigned scores based upon three categories hypothesized to represent relative degrees of degradation: least degraded -5; intermediate -3; and most degraded -1. These categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment. Individual metric scores for a station are summed to obtain the RFAI score.

Comparison of the attained RFAI score from the potential impact zone to a predetermined criterion has been suggested as a method useful in identifying the presence of normal community structure and function and hence existence of a balanced indigenous population. For multi-metric indices, two criteria have been suggested to ensure a conservative screening for a balanced indigenous population. First, if an RFAI score reaches 70% of the highest attainable score (adjusted upward to include sample variability), and second, if fewer than half of RFAI metrics potentially influenced by thermal discharge receive a low (1) or moderate (3) score, then normal community structure and function would be present indicating that a balanced indigenous population existed. Under these conditions the heated discharge would meet screening criteria and no further evaluation would be needed.

The range of RFAI scores possible is from 12 to 60. As discussed in detail below, the average variance for RFAI scores in TVA reservoirs is 6 ($\pm$ 3). Therefore, any location that attains an RFAI score of 45 (42 + our sample variance of 3) or higher would be considered to demonstrate a balanced indigenous population. It must be stressed that scores below this endpoint do not necessarily reflect an adversely impacted fish community. The endpoint is used to serve as a conservative screening level; for example, any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level would require a more in depth look to determine if a balanced indigenous population exist. If a score below this criterion is obtained, an inspection of individual RFAI metric results would be an initial step to help identify if WBN operation is a contributing factor. This approach is appropriate if a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

Upstream/downstream stations comparisons can be used to identify if WBN operation is adversely impacting the downstream fish community. A similar or higher RFAI score at the downstream station compared to the upstream (control) station is used as one basis for determining presence/absence of WBN operational impacts on the resident fish community. Definition of "similar" is integral to accepting the validity of these interpretations.

The Quality Assurance (QA) component of VS monitoring deals with how well the RFAI scores can be repeated and is accomplished by collecting a second set of samples at 15-20% of the stations each year. Experience to date with the QA component of VS shows that the comparison of RFAI index scores from these 54 paired sample sets collected over the past seven years range from 0 to 18 points, the 75th percentile is 6, the 90th percentile is 12. The mean difference between these 54 paired scores is 4.6 points with 95% confidence limits of 3.4 and 5.8. Based on these results, a difference of 6 points or less is the value selected for defining "similar" scores between upstream and downstream fish communities. That is, if the downstream RFAI score is within 6 points of the upstream score, the communities will be considered similar. It is important to bear in mind that differences greater than 6 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). When this occurs, a metric-by-metric examination will be conducted to determine what caused the difference in scores and the potential for the difference to be thermally related.

As mentioned in the introduction, modifications in the metrics used in RFAI are continually being evaluated in order to make the index even more indicative of reservoir conditions. Future versions of the RFAI will likely include the refined metrics. Comparisons will be made between present and improved RFAI scores.

Benthic Macroinvertebrate Community

Ten benthic grab samples were collected at equally spaced points along the upstream and downstream transects. A Ponar sampler was used for most samples but a Peterson sampler was used when heavier substrate was encountered. Collection and processing techniques followed standard VS procedures. Bottom sediments were washed on a 533μ screen; organisms were then picked from the screen and remaining substrate and identified to Order or Family level using the naked eye while in the field. Benthic community results were evaluated using seven community characteristics or metrics. Results for each metric were assigned a rating of 1, 3, or 5 depending upon how they scored based on reference conditions developed for VS inflow sample sites. The ratings for the seven metrics were summed to produce a benthic score for each sample site. Potential scores ranged from 7 to 35.

A similar or higher benthic index score at the downstream site compared to the upstream site is used as basis for determining absence of impact of WBN on the benthic community. The QA component of VS monitoring shows that the comparison of benthic index scores from 49 paired sample sets collected over the past seven years range from 0 to 14 points, the 75th percentile is 4, the 90th percentile is 6. The mean difference between these 49 paired scores is 3.1 points with 95% confidence limits of 2.2 and 4.1. Based on these results, a difference of 4 points or less is the value selected for defining "similar" scores between upstream and downstream benthic communities. That is, if the downstream benthic score is within 4 points of the upstream score, the communities will be considered similar. Once again, it is important to bear in mind that differences greater than 4 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). When this occurs, a metric-by-metric examination will be conducted to determine what caused the difference in scores and the potential for the difference to be thermally related.

Sport Fishing Index

Calculations described by Hickman (2000) were used to compare SFI values for selected quantity and quality parameters from creel and population samples to expected values that would occur in a good or high quality fishery. Quantity parameters include angler success and catch per unit effort from standard population samples (electrofishing, trap and experimental gill netting). Population quality is based on measurement of five aspects of each resident sport fish community. Four of these aspects address size structure (proportional number of fish in each length group) of the community, Proportional Stock Density (PSD), Relative Stock Density of Preferred-sized fish (RSDP), Relative Stock Density of Memorable-sized fish (RSDM), and Relative Stock Density of Trophy-sized fish (RSDT) and the fifth, relative weight (Wr), measures the average condition of individual fish.

As described by Hickman (2000), observed values were compared to reference ranges and assigned a corresponding numerical value. The SFI value is calculated by quantity and quality scores from existing data and multiplying by two when only creel or population data are available. Species received a low score when insufficient numbers of individuals were captured to reliably determine proportional densities or relative weights for particular parameters.

Results and Discussion

Fish Community

In the autumn of 2000, RFAI results from the downstream station exceeded the RFAI score of 45, indicating that resident fish community below the WBN discharge was above the screening level and considered to have balanced indigenous populations (Table 1). In fact, the inflow station exceeded the RFAI score of 45 balanced indigenous populations criteria for four of the last seven sample years (Table 2). Based on the RFAI overall scores for the past seven sample years, the Chickamauga inflow station has remained in the good to excellent ecological health range for all but one sample season (Figure 1). Watts Bar Reservoir forebay data collected between 1993 and 2000 reflect little change in the overall ecological health of the fish communities at this station (Figure 2). Four of the six sample seasons scored in the good range; the other two sample seasons were only slightly below the good range illustrating only slight variability in ecological health (Figure 2). To further support these balanced indigenous population findings, Watts Bar Reservoir forebay reached 75% of its highest potential RFAI score and Chickamauga inflow reached 80% of its highest potential score in sample year 2000. Based on these observations and the defining characteristics for balanced indigenous populations, it can be concluded that the WBN thermal effluent is not adversely impacting the Tennessee River resident fish community in the vicinity of the plant discharge. Electrofishing and gill netting catch rates for individual species from the downstream station are listed in Table 3. VS monitoring data and TVA's Regional Natural Heritage Program most recent data set indicate no state- or federal-protected fish species were recently collected, or are currently known to occur in the vicinity of WBN.

<u>Benthic Macroinvertebrate Community</u>

Table 4 provides results and ratings for each metric as well as the overall benthic index score for both monitoring sites. Table 5 summarizes density by taxon at the downstream (TRM 518) collection site. The sample from the upstream site (TRM 532.5) was field processed and no lower level taxonomic identifications were made; however, the Watts Bar transition zone sample was laboratory processed and those results are included in Table 5. In 2000 samples, the upstream site (WB forebay) had a benthic index score of 15 (poor) while the downstream site scored 23 (fair). Therefore, it appears that WBN has not had an effect on the benthic macroinvertebrate community immediately downstream of the plant. Table 6 provides benthic index scores from VS monitoring at the forebay, inflow, and transition zone sites from 1994 to 2000. The Chickamauga transition zone sample site (TRM 490.5) is of sufficient distance downstream (37 miles) that results would not be expected to reflect plant effects. The relatively high scores there indicate that this is the case.

<u>Sport Fishing Index</u>

Figure 3 illustrates SFI results for sport fish in Chickamauga Reservoir. Table 8 and 9 illustrates sport fish index scoring criteria for population metrics and creel quantity and quality.
Of the three black bass (largemouth, smallmouth, and spotted bass), spotted bass was above average with a value of 40 exceeding the valley-wide average (29.9). Largemouth bass had a score of 32 which was slightly below the valley-wide average (35.6). Smallmouth bass, however, was below the valley-wide average (29.9) with a score of 22.

During drought conditions, which the region is currently experiencing, both spotted and largemouth bass seem to be more competitive and their populations normally increase due to an increase of aquatic vegetation in the reservoir. Smallmouth bass prefer a more clear water habitat like tributary reservoirs and tailwaters below dams and typically don't do well in turbid reservoirs.

Channel catfish, sauger and striped bass rated above the valley-wide average with scores of 29, 39, and 30, respectively. This information correlates well with angling effort results (Baxter et al. 1998) where these species were most sought by fisherman fishing in the vicinity of WBN.

Similar SFI results in the autumn of 2000 were concluded for Watts Bar Reservoir where largemouth bass, spotted bass, sauger and striped bass exceeded the valley-wide average with scores of 43, 38, 34 and 39, respectively (Figure 4).

SFI results for Chickamauga and Watts Bar Reservoirs indicate that a quality fishery exists for the species that rated above or near the valley-wide average.

Literature Cited

Baxter, D. S., J. P. Buchanan, G. D. Hickman, J. J. Jenkinson, J. D. Milligan, and C. J. O'Bara. 1998. Aquatic environmental conditions in the vicinity of Watts Bar Nuclear Plant during two years of operation, 1996-1997. Tennessee Valley Authority, Resource Group, Water Management, Norris, Tennessee. 258pp.

Baxter, D. S., K. D. Gardner, and G. D. Hickman. 2001. Watts Bar Nuclear Plant supplemental condenser cooling water system fish monitoring program. Tennessee Valley Authority, Resource Stewardship, Norris, Tennessee. 33pp.

Dycus, D. L. and D. L. Meinert. 1993. Reservoir monitoring, monitoring and evaluation of aquatic resource health and use suitability in Tennessee Valley Authority reservoirs. Tennessee Valley Authority, Water Resources, Chattanooga, Tennessee, TVA/WM-93/15.

Hickman, G. D. 2000. Sport Fish Index (SFI), A method to quantify sport fishing quality. Environmental Science & Policy 3 (2000) S117-S125.

Tennessee Valley Authority. 1996. A supplemental 316(a) demonstration for alternative thermal discharge limits for Sequoyah Nuclear Plant, Chickamauga Reservoir, Tennessee. Tennessee Valley Authority, Engineering Laboratory, Norris, TN. WR96-1-45-145. 87 pp.

Tennessee Valley Authority. 1997. Watts Bar Nuclear Plant supplemental condenser cooling water project draft environmental assessment. Tennessee Valley Authority, Engineering Laboratory, Norris, TN. 53 pp.

Table 1. Scoring Results for the Twelve Metrics and Overall Reservoir Fish Assemblage Index for Chickamauga Reservoir 2000.

Metric		Embayment Obs	Embayment Score	Forebay Obs	Forebay Score	Transition Obs	Transition Score	Inflow Obs	Inflow Score
A. Species richness and composition									
1. Number of species		30	5	27	3	26	3	27	3
2. Piscivore species		10	5	10	5	10	5	7	3
3. Sunfish species		5	5	6	5	5	5	7	5
4. Sucker species		2	1	1	1	1	1	3	3
5. Intolerant species		2	3	3	3	3	3	3	3
6. Percent tolerant species	electrofishing	15.1	2.5	14.5	2.5	17.8	2.5	16.5	5
	gill netting	3.8	2.5	26.9	1.5	4.4	2.5	0	0
7. Dominance*	electrofishing	21.9	2.5	25.2	2.5	25.1	2.5	38.5	5
	gill netting	26.9	2.5	26.5	2.5	25.5	2.5	0.0	0
B. Trophic composition									
8. Percent omnivores	electrofishing	14.6	2.5	5.1	2.5	20.5	2.5	14.7	5
	gill netting	12.5	2.5	35.7	1.5	4.4	2.5	0	0
9. Percent insectivores	electrofishing	52.5	1.5	84.3	2.5	55.0	1.5	61.8	5
	gill netting	45.2	2.5	9.9	1.5	17.5	2.5	0	0
C. Reproductive composition									
10. Lithophilic spawning species		6	3	5	3	5	3	5	3
D. Fish abundance and health									
11. Average number of individuals	electrofishing	54.5	1.5	43.3	0.5	22.1	0.5	61.5	3
	gill netting	10.4	0.5	28.3	1.5	13.7	0.5	0	0
12. Percent anomalies		4.1	3	1.5	5	2.6	3	0.9	5
RFAI			**46 Good**		**44 Good**		**43 Good**		**48 Good**

* Percent composition of the most abundant species

Table 2. Species Listing and Catch Per Unit Effort During the Fall Electrofishing and Gill Netting on Chickamauga Reservoir, 2000 (Electrofishing Effort = 300 Meters of Shoreline and Gill Netting Effort = Net-Nights).

Common name	Electrofishing SQN	Gill Netting SQN	Electrofishing Catch Rate Per Hour SQN	Electrofishing Trans	Gill Netting Trans	Electrofishing Catch Rate Per Hour Trans	Electrofishing Inflow	Gill Netting Inflow	Electrofishing Catch Rate Per Hour Inflow
Skipjack herring	0	0	0.30	0	0	0.80			
Gizzard shad	9.00	54.22	0	2.27	13.39	0.60	6.07	34.73	0
Threadfin shad	0	0	0	0	0	0	1.80	10.31	0
Common carp	0.07	0.40	0	0.87	5.12	0	2.53	14.50	0
Golden shiner	0.73	4.42	0				0.07	0.38	0
Emerald shiner	5.53	33.33	0	1.73	10.24	0	0.27	1.53	0
Spotfin shiner	1.20	7.23	0				1.53	8.78	0
Bluntnose minnow	0.80	4.82	0						
Bullhead minnow	0.07	0.40	0						
Northern hog sucker							0.07	0.38	0
Spotted sucker	0.07	0.40	0.80	0.33	1.97	1.00	0.33	1.91	0
Golden redhorse							0.27	1.53	0
Blue catfish	0.67	4.02	0.80				0.07	0.38	0
Channel catfish	0.53	3.21	0.10	1.40	8.27	0	0.20	1.15	0
Flathead catfish	0	0	0.10	0	0	0.10	0.33	1.91	0
White bass	0	0	0.10	0	0	0.30	0.40	2.29	0
Yellow bass	0.40	2.41	0.90	0.27	1.57	3.40	2.27	12.98	0
Striped bass	0	0	0.10	0	0	0.50	0.07	0.38	0
Warmouth	0.27	1.61	0.10	0.53	3.15	0.10	0.60	3.44	0
Redbreast sunfish	2.00	12.05	0	0.80	4.72	0	1.07	6.11	0
Green sunfish	0.13	0.80	0				0.27	1.53	0
Bluegill	20.73	124.90	0.30	5.53	32.68	0.40	23.67	135.50	0
Longear sunfish	3.00	18.07	0	0.47	2.76	0	0.60	3.44	0
Redear sunfish	4.00	24.10	0.30	2.33	13.78	0.80	9.13	52.29	0
Hybrid sunfish							0.13	0.76	0
Smallmouth bass	0.47	2.81	0.10	0.27	1.57	0.60	1.27	7.25	0
Spotted bass	3.13	18.88	1.40	0.87	5.12	3.50	2.33	13.36	0

Table 2. (Continued)

Common name	Electrofishing SQN	Gill Netting SQN	Electrofishing Catch Rate Per Hour SQN	Electrofishing Trans	Gill Netting Trans	Electrofishing Catch Rate Per Hour Trans	Electrofishing Inflow	Gill Netting Inflow	Electrofishing Catch Rate Per Hour Inflow
Largemouth bass	2.07	12.45	0	2.53	14.96	0	3.13	17.94	0
White crappie				0	0	0.10			
Black crappie	0.13	0.80	0.20	1.20	7.09	0.90	2.87	16.41	0
Yellow perch	0.07	0.40	0	0.13	0.79	0			
Sauger	0	0	0.30	0	0	0.50			
Freshwater drum	0	0	0.20	0.20	1.18	0.10	0.07	0.38	0
Brook silverside	0.13	0.80	0	0.07	0.39	0			
Chestnut lamprey	0.07	0.40	0	0.27	1.57	0			
Total	**55.27**	**332.93**	**6.1**	**22.07**	**130.32**	**13.7**	**61.42**	**351.55**	**0**
Number of samples	**15**		**10**	**15**		**10**	**15**		**0**
Number collected	**829**		**61**	**331**		**137**	**923**		**0**
Species collected	**24**		**16**	**19**		**16**	**27**		**0**

* Only Young of Year Collected

Table 3. Recent (1993-2000) RFAI Scores Collected as Part of the Vital Signs Monitoring Program Downstream of Watts Bar Nuclear Plant.

			Year							
Station	**Reservoir**	**Location**	**1993**	**1994**	**1995**	**1996**	**1997**	**1999**	**1993-1999 Average**	**2000**
Downstream	Chickamauga	TRM 518	56	52	44	38	52	44	45	48

Table 4. Individual Metric Ratings and the Overall Benthic Community Index Score for Upstream and Downstream Sites Near Watts Bar Nuclear Plant, Watts Bar and Chickamauga Reservoirs, November 2000.

	TRM 532.5		TRM 518	
Metric	**Obs**	**Rating**	**Obs**	**Rating**
1. Average number of taxa	2.8	3	5.3	3
2. Proportion of samples with long-lived organisms	0%	1	60%	3
3. Average number of EPT taxa	0	1	0.2	1
4. Average proportion of oligochaete individuals	26.5%	3	2%	5
5. Average proportion of total abundance comprised by the two most abundant taxa	98.6%	1	70.9%	5
6. Average density excluding chironomids and oligochaetes	11.7	1	388.3	1
7. Zero-samples - proportion of samples containing no organisms	0	5	0	5
Benthic Index Score		**15 Poor**		**23 Fair**

TRM 532.5 scored with forebay criteria, TRM 518 scored with inflow criteria.

Table 5. Average Mean Density Per Square Meter of Benthic Taxa Collected at the Downstream Site Near Watts Bar Nuclear Plant, Chickamauga Reservoir, and the Next Lab-Processed Site (Transition Zone) Upstream of WBN, Watts Bar Reservoir, November 2000.

Taxa	TRM 560.8	TRM 518
Turbellaria		
Tricladida		
Planaridae		
Dugesia tigrina		2
Nematoda	2	
Oligocheata		
Tubificidae	15	37
Limnodrilus hoffmeisteri	3	2
Hirudinea		
Erpobdellidae		2
Glossiphonidae		2
Helobdella sp.		2
Crustacea		
Amphipoda		
Gammaridae		
Gammarus sp.		185
Insecta		
Ephemeroptera		
Ephemeridae		
Hexagenia limbata <10mm	2	2
Hexagenia limbata >10mm	17	
Caenidae		
Caenis sp.		7
Trichoptera		
Polycentropodidae		
Cyrnellus fraternus		2
Diptera		
Chironomidae		
Ablabesmyia annulata	12	
Chironomus sp.	72	2
Coelotanypus tricolor	243	33
Cryptochironomus fulvus		10
Dicrotendipes sp.		2
Gastropoda		
Basommatomorpha		
Ancylidae		
Ferrisia rivularis		2

Table 5. (Continued)

Taxa	TRM 560.8	TRM 518
Physidae		
Physella sp.		3
Planorbidae		
Menetus dilatatus	2	
Neotaenioglossa		
Pleuroceridae		
Pleurocera canaliculata		13
Bivalvia		
Veneroida		
Dreissenidae		
Dreissena polymorpha		22
Corbiculidae		
Corbicula fluminea (<10mm)	5	132
Corbicula fluminea (>10mm)		23
Sphaeriidae		
Musculium transversum	97	93
Pisidium sp.		2
Number of samples	**10**	**10**
Sum	**468**	**577**
Sum of area sampled	**0.60**	**0.60**
Benthic Index score	**21**	**23**
	Fair	**Fair**

Table 6. Recent (1994-2000) Benthic Index Scores Collected as Part of the Vital Signs Monitoring Program at Watts Bar Reservoir Transition and Forebay Zone Sites (Upstream), and Chickamauga Reservoir Inflow (Upstream) and Transition (Downstream) Sites.

			Year								
Site	**Reservoir**	**Location**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Average**
Upstream	Watts Bar	TRM 560.8		29		25		23		21	24.5
Upstream	Watts Bar	TRM 531									
Upstream	Watts Bar	TRM 531 - 532.5		13		11		13		15	13
Downstream	Chickamauga	TRM 518		19	23		25		21	23	22.2
Downstream	Chickamauga	TRM 490.5		33	29		31		31	23	29.4

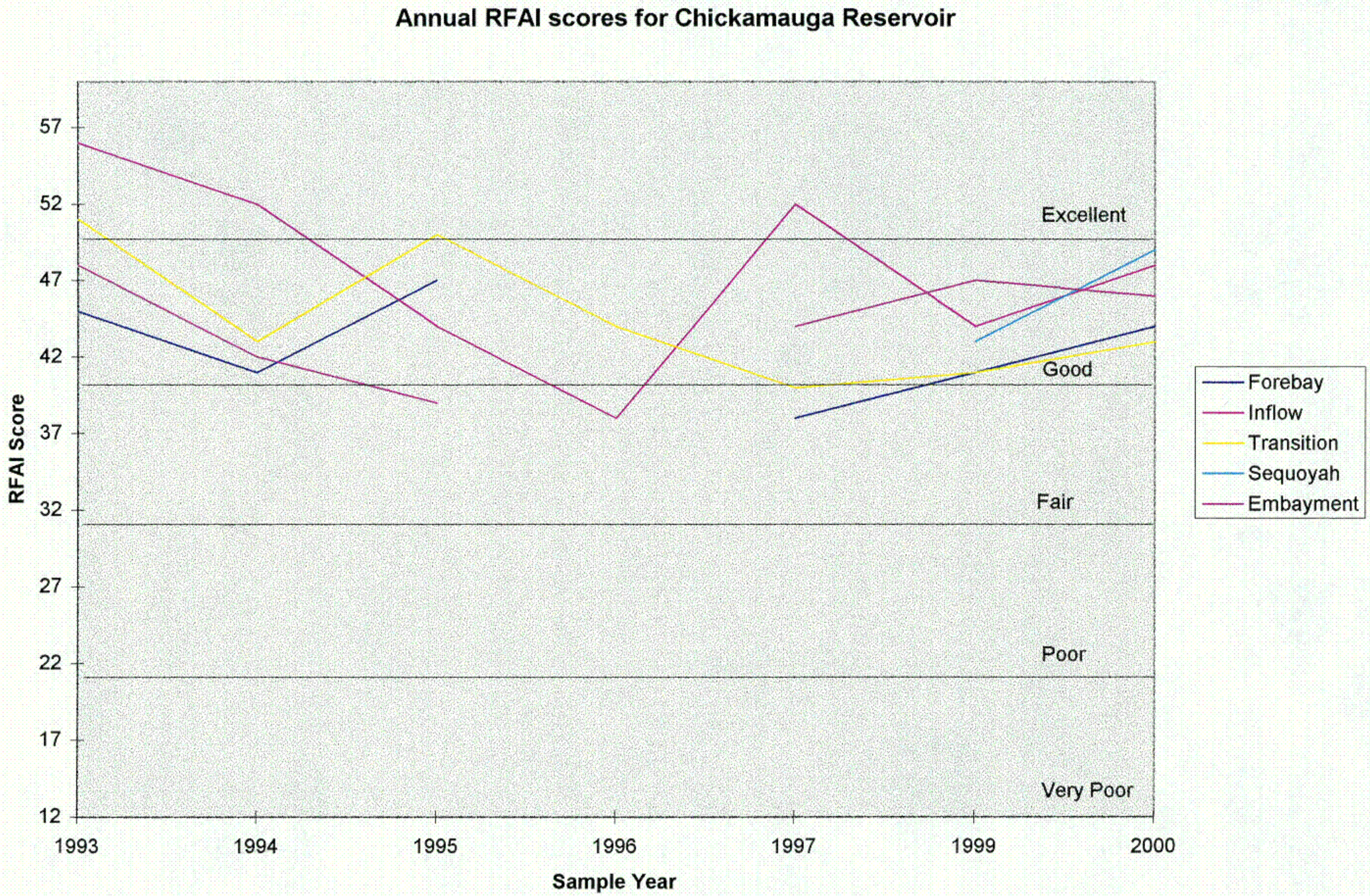


Figure 1. Annual RFAI scores between the years 1993 and 1999 compared to the year 2000 RFAI score.

103

Annual RFAI score for Watts Bar Reservoir

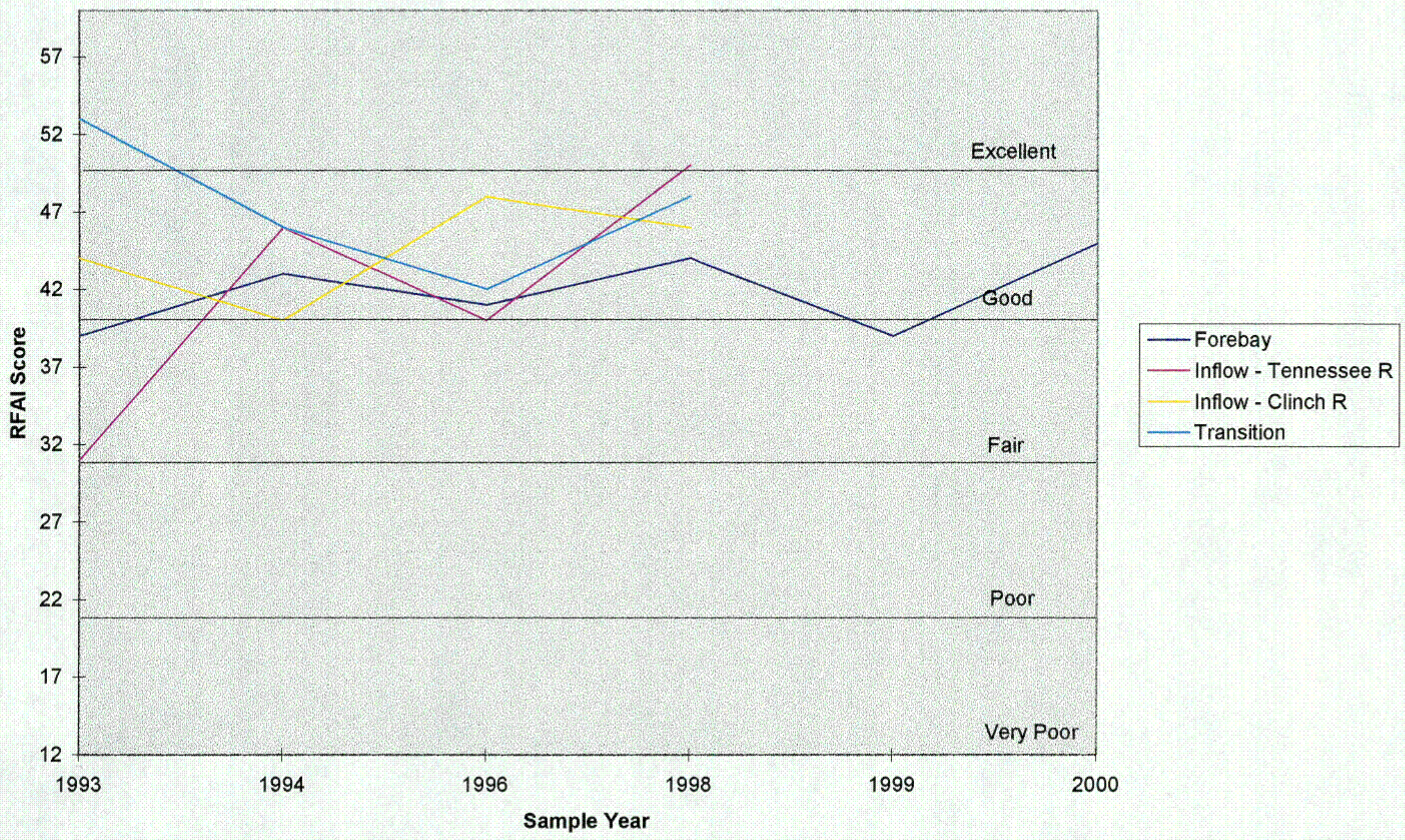


Figure 2. Annual RFAI scores between the years 1993 and 1999 compared to the year 2000 RFAI score.

C02

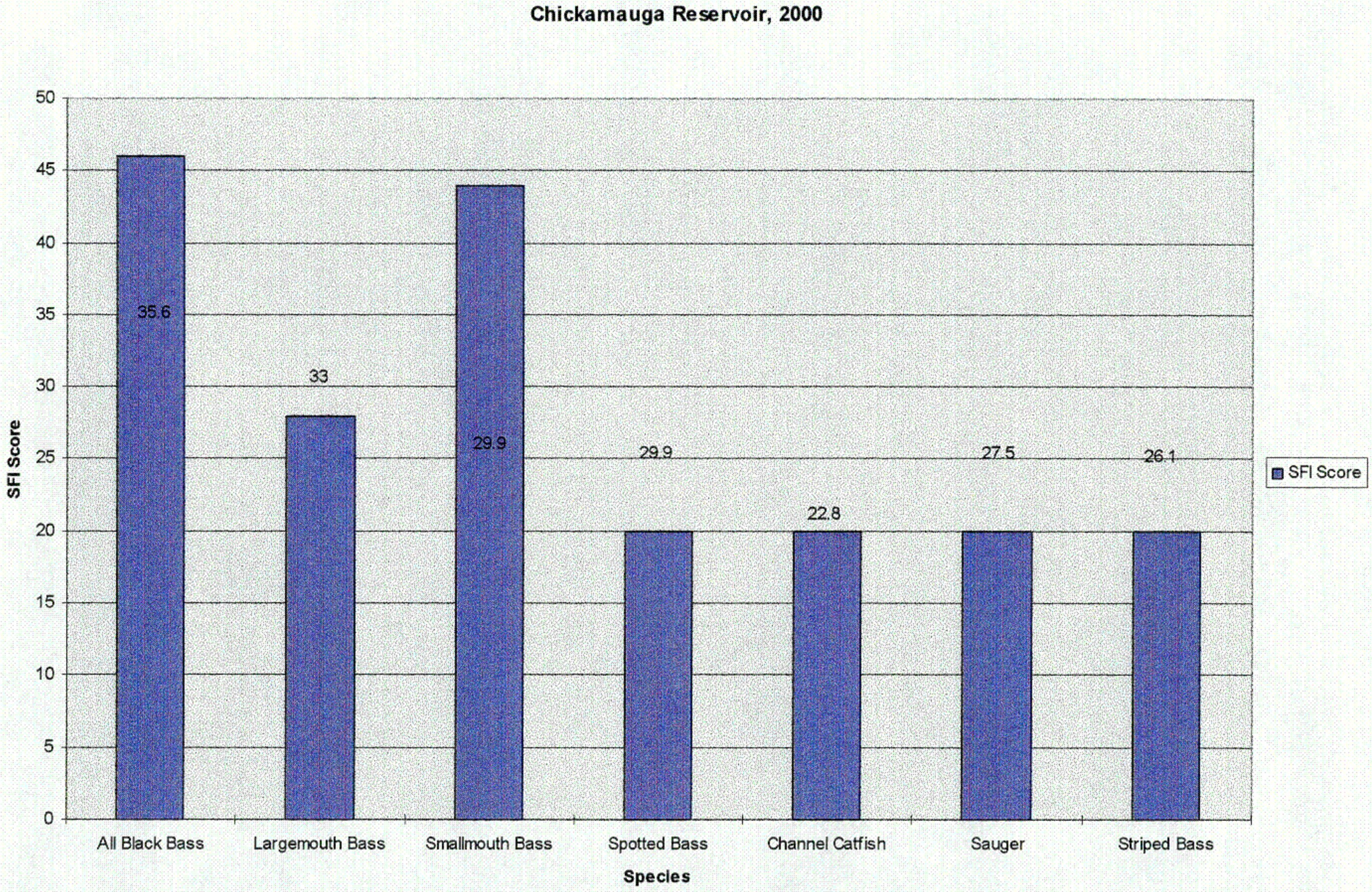


Figure 3. Sport Fishing Index results and valley-wide averages for six sport fish in Chickamauga Reservoir, 2000.

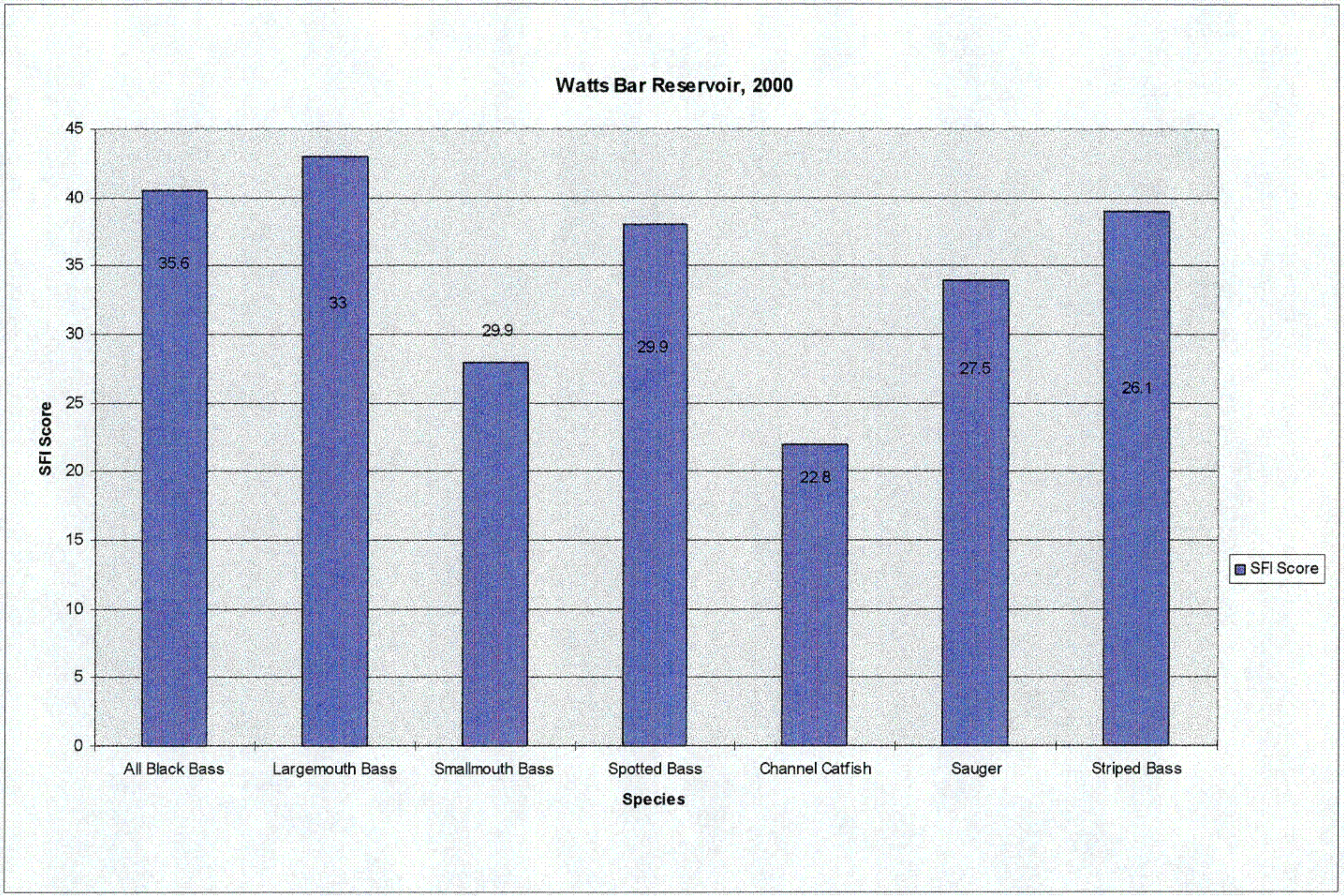


Figure 4. Sport Fishing Index results and valley-wide averages for six sport fish in Watts Bar Reservoir, 2000.

C04