Quarterly Progress Report

October 18, 2000

Biological Monitoring Program for East Fork Poplar Creek

Submitted to

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1. INTRODUCTION

In May 1985, a National Pollutant Discharge Elimination System (NPDES) permit was issued for the Oak Ridge Y-12 Plant. As a condition of the permit, a Biological Monitoring and Abatement Program (BMAP) was developed to demonstrate that the effluent limitations established for the Y-12 Plant protect the classified uses of the receiving stream (East Fork Poplar Creek; EFPC), in particular, the growth and propagation of aquatic life (Loar et al. 1989). A second objective of the BMAP is to document the ecological effects resulting from the implementation of a water pollution control program designed to eliminate direct discharges of wastewaters to EFPC and to minimize the inadvertent release of pollutants to the environment. Because of the complex nature of the discharges to EFPC and the temporal and spatial variability in the composition of the discharges, a comprehensive, integrated approach to biological monitoring was developed. A new permit was issued to the Y-12 Plant on April 28, 1995 and became effective on July 1, 1995. Biological monitoring continues to be required under the new permit. The BMAP consists of four major tasks that reflect different but complementary approaches to evaluating the effects of the Y-12 Plant discharges on the aquatic integrity of EFPC. These tasks are (1) toxicity monitoring, (2) biological indicator studies, (3) bioaccumulation studies, and (4) ecological surveys of the periphyton, benthic macroinvertebrate, and fish communities.

Monitoring is currently being conducted at five primary EFPC sites, although sites may be excluded or added depending upon the specific objectives of the various tasks. Criteria used in selecting the sites include: (1) location of sampling sites used in other studies, (2) known or suspected sources of downstream impacts, (3) proximity to U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) boundaries, (4) concentration of mercury in the adjacent floodplain, (5) appropriate habitat distribution, and (6) access. The primary sampling sites include upper EFPC at kilometers (EFKs) 24.4 and 23.4 [upstream and downstream of Lake Reality (LR) respectively]; EFK 18.7 (also EFK 18 and 19), located off the ORR and below an area of intensive commercial and light industrial development; EFK 13.8 (also EFK 14), located upstream from the Oak Ridge Wastewater Treatment Facility (ORWTF); and EFK 6.3 located approximately 1.4 km below the ORR boundary (Fig. 1.1). Brushy Fork (BF) at kilometer (BFK) 7.6 is used as a reference stream in most tasks of the BMAP. Additional sites off the ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Hinds Creek, Paint Rock Creek, and the Emory River in Watts Bar Reservoir (Fig. 1.2).

2. TOXICITY MONITORING (*M. S. Greeley, Jr., and A. J. Stewart*)

2.1. Introduction

Toxicity monitoring uses U.S. Environmental Protection Agency (EPA) approved methods with *Ceriodaphnia dubia* and fathead larvae to provide systematic information that can be used to determine changes in the biological quality of EFPC through time. Toxicity monitoring at EFK 24.1, a site just upstream of Lake Reality, is conducted quarterly. Monitoring of EFK 23.8, immediately downstream of Lake Reality, has been discontinued as the bypass of Lake Reality made this site nearly synonymous with EFK 24.1. As required by the Y-12 Plant's National Pollutant Discharge Elimination System (NPDES) permit, quarterly toxicity tests with fathead minnows and *Ceriodaphnia* are conducted at Outfall 201 (an instream NPDES location in upper EFPC). The Outfall 201 tests meet the intent of the BMAP Plan to conduct quarterly toxicity tests at a nearby location, EFK 25.1. The results of the Outfall 201 tests are

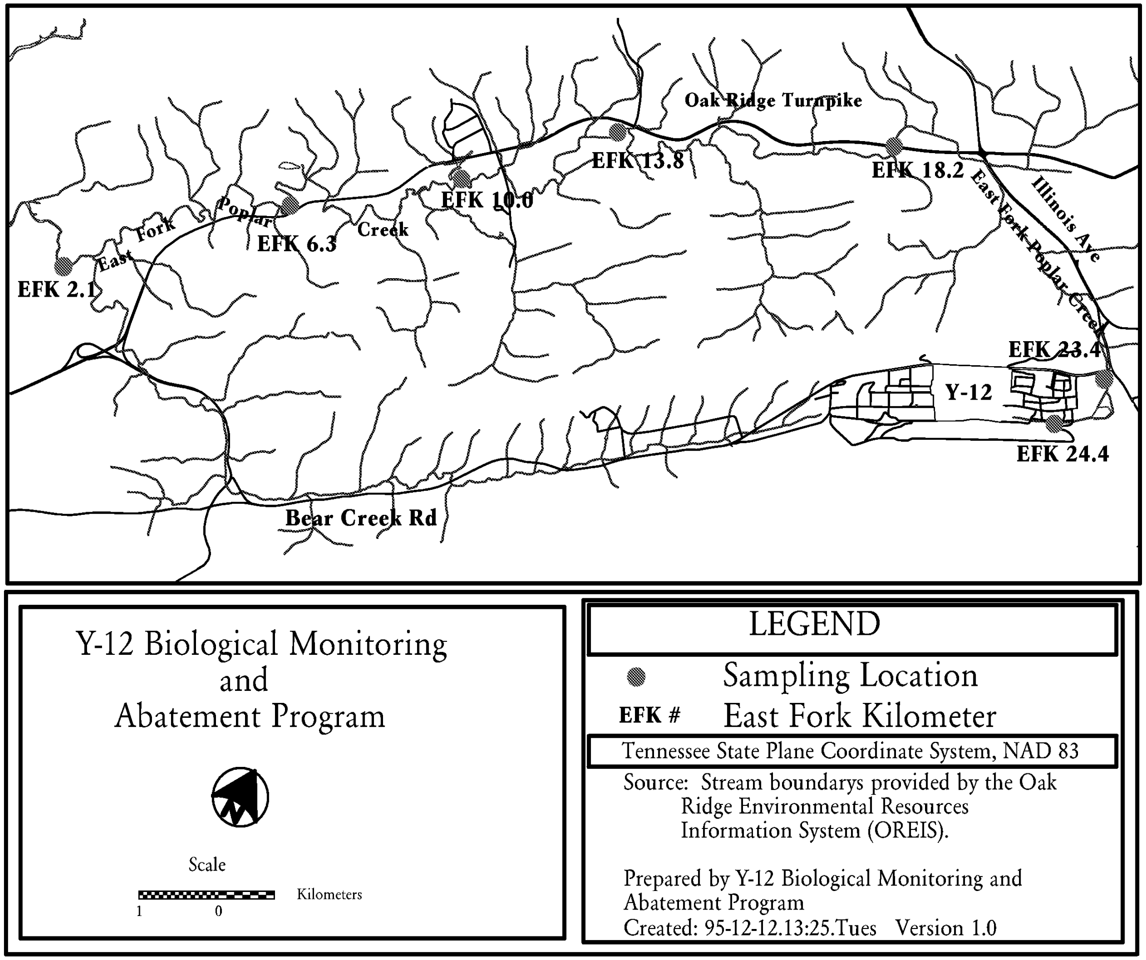

Figure 1.1. Location of biological monitoring sites on East Fork Poplar Creek in relation to the Oak Ridge Y-12 National Security Complex.

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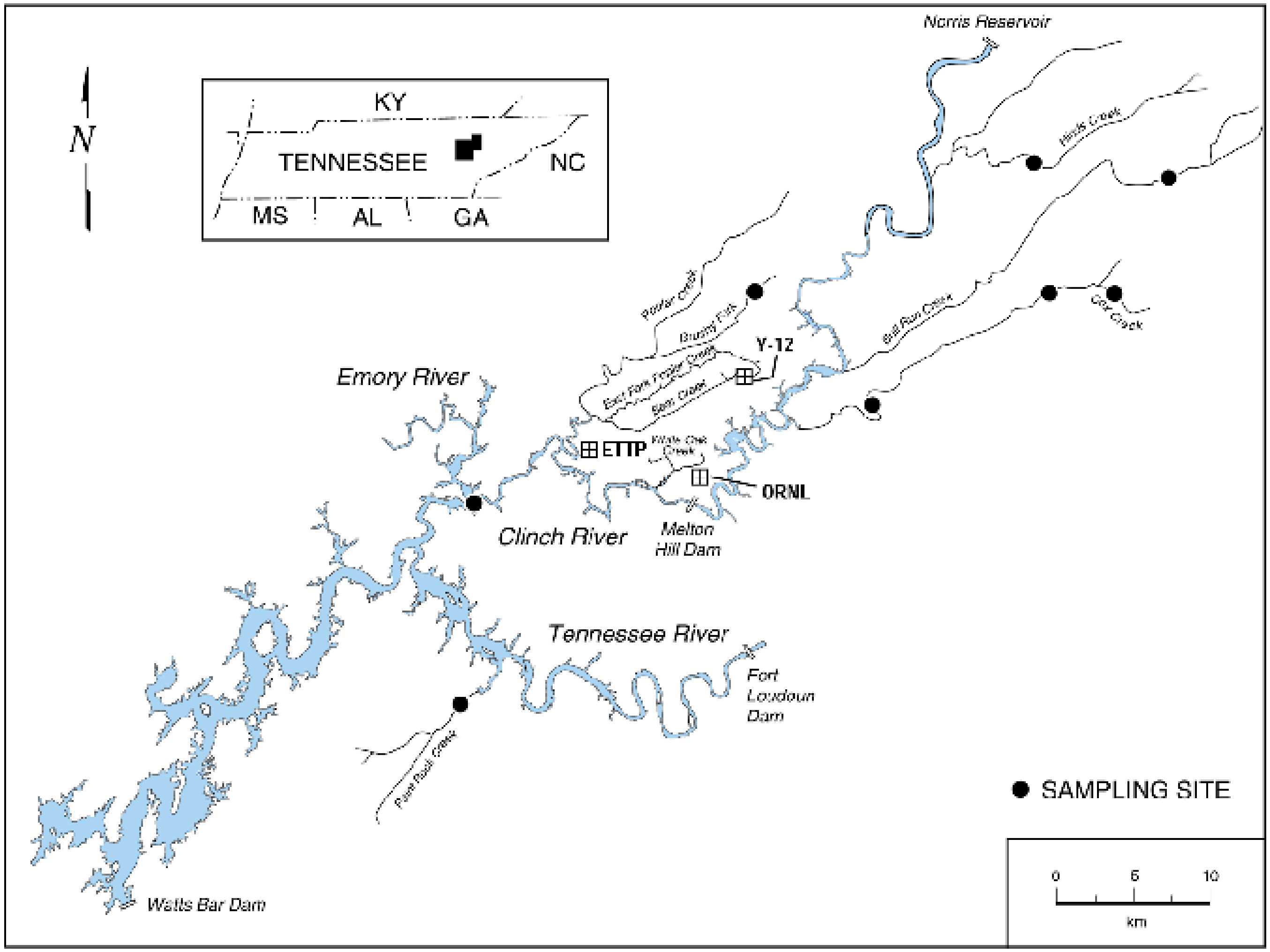

Figure 1.2. Location of biological monitoring reference sites in relation to the Oak Ridge Y-12 National Security Complex.

reported both here and on Discharge Monitoring Reports issued by the Y-12 Plant to the Tennessee Department of Environment and Conservation.

2.2 Results/Progress

2.2.1 Toxicity monitoring

Ambient water samples from EFK 24.1 and effluent samples from Outfall 201 were evaluated for toxicity to *Ceriodaphnia dubia* during July12–18, 2000. On each sampling day, grab samples of stream water or 24-h time-proportional composite samples from Outfall 201 were collected for testing. Results of the toxicity tests and attendant water-quality chemical analyses are shown in Tables 2.1 and 2.2.

Table 2.1. Results of *Ceriodaphnia dubia* toxicity tests of ambient sites from East Fork Poplar Creek and Outfall 201 conducted July 12–18, 2000

Sample	Concentration (%)	Survival (%)	Mean Reproduction (offspring/surviving female ± SD)
		Ambient sites	
Control	100	100	21.6 ± 3.9
EFK 24.1	100	100	23.5 ± 3.8
		Outfall 201	
Control	100	100	21.6 ± 3.9
Outfall 201	100	100	22.2 ± 8.6
Outfall 201	80	100	24.3 ± 3.1

Note: EFK = East Fork Poplar Creek kilometer. SD = standard deviation.

Table 2.2. Summary (mean ± SD) of water chemistry analyses conducted during *Ceriodaphnia dubia* toxicity tests of ambient samples from East Fork Poplar Creek, April 12-18, 2000

Sample	pH (su)	Alkalinity (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (µS/cm)
Control	8.1 ± 0.1	85.2 ± 1.6	98.7 ± 2.4	200.7 ± 3.1
Outfall 201	7.9 ± 0.1	119.0 ± 1.6	154.0 ± 6.7	330.0 ± 11.9
EFK 24.1	7.92 ± 0.13	125.7 ± 2.7	160.3 ± 5.3	359.7 ± 5.7

Note: EFK = East Fork Poplar Creek kilometer. SD = standard deviation.

During the test period, *Ceriodaphnia* survival was 100% in all samples. *Ceriodaphnia* reproduction in the stream water or effluent samples was not significantly different from the control. Samples from Outfall 201 were also evaluated for toxicity to fathead minnows (*Pimephales promelas*). Mean survival was $\geq$95% in both 100% and 80% concentrations of Outfall 201 effluent, and growth in both concentrations (0.70 mg/larvae) exceeded growth of minnows in the control water (0.56 mg/larvae).

3. BIOLOGICAL INDICATOR MONITORING

3.1 Bioindicators of Fish Health (*S. M. Adams*)

3.1.1 Introduction

This task involves the use and application of bioindicators of fish health, in addition to other investigative approaches, to evaluate the effects of water quality and other environmental variables on fish in EFPC. A suite of diverse bioindicators of fish health has been monitored since fall 1985 to evaluate the health of a sentinel species, the redbreast sunfish (*Lepomis auritus*), as a component of the BMAP program.

3.1.2 Results/Progress

Analysis of blood, tissue and scale samples collected from redbreast sunfish (*Lepomis auritus)* during the spring/summer sampling period continue to be analyzed for seriological indicators, detoxification enzyme activities, and age and growth analysis, respectively.

Quality control analysis was performed on a representative sampling of fish scales collected during the spring/summer sampling period to verify that the reading and interpretation of these samples provided accurate assessment of the age and growth of different size classes of redbreast sunfish. Data verified by an independent assessor resulted in less than 5% of the samples being misread on the first reading.

Primary activities for the next quarter will include continued laboratory processing/analysis of the 2000 samples and validation of the 1999 and 2000 data sets.

3.2 Bioindicators of Reproductive Competence (*M. S. Greeley, Jr.)*

3.2.1 Introduction

Successful reproduction of fish populations requires that adult fish be capable of producing and spawning viable gametes. To address the reproductive competence of fish in EFPC, various reproductive indicators, representing several different levels of reproductive organization related to gamete production, have been routinely examined in redbreast sunfish sampled from EFPC and reference streams at the beginning of each annual breeding season since 1988. Establishment and maintenance of stable fish populations also require that offspring be able to develop normally into subsequent reproductive cohorts. Beginning in 1990, water samples from several sites in EFPC and other streams on and about the ORR have been tested for their effects on fish developmental processes utilizing a variation of an EPA-standard medaka (*Oryzias latipes*) fish embryo-larval test (Benoit et al., 1991).

3.2.2 Results/Progress

Tissue and blood samples from the annual monitoring of fish health and reproductive competence conducted during May and June 2000 continue to be analyzed. Results of these analyses will be presented in the next quarterly report. A medaka test for developmental toxicity is scheduled for EFPC sites during the last week in October 2000.

4. BIOACCUMULATION MONITORING

4.1 Routine Bioaccumulation Monitoring (*M. J. Peterson and G. R. Southworth*)

4.1.1 Introduction

Bioaccumulation monitoring of EFPC has identified mercury and polychlorinated biphenyls (PCBs) as substances that accumulate to concentrations in fish that may pose health concerns to human consumers. Redbreast sunfish are collected twice annually from the mid to upper reaches of EFPC to evaluate spatial and temporal trends in mercury and PCB contamination. On an annual basis, largemouth bass (*Micropterus salmoides*) are collected to evaluate the maximum human health risks in EFPC and stoneroller minnows (*Campostoma anomalum*) are collected to evaluate the potential ecological concerns due to metal accumulation.

4.1.2 Results/Progress

Mean mercury concentrations in redbreast sunfish collected from EFPC sites and Lake Reality in May and June of 2000 are presented in Table 4.1. Mercury concentrations in sunfish averaged from 0.66 to 0.85 µg/g at all EFPC sites except EFK 6.3, where the average was 0.37. Average mercury concentrations in fish from stream sites nearest Y-12 were similar to levels historically reported (lower-than-normal values were observed in the fall of 1999). Eighty three percent of sunfish collected from upstream of Lake Reality (EFK 24.8) to EFK 13.8 in the spring of 2000 exceeded the 0.5 ppm level, the level typically cited by the Tennessee Department of Environment and Conservation (TDEC) in issuing fish consumption advisories.

At Lake Reality, mean mercury concentrations in sunfish were exceptional low, averaging just 0.12 µg/g. This value is very similar to background concentrations in stream fish. A comparison of mercury concentrations in sunfish in Lake Reality before and after bypass is shown in Fig 4.1. The response of mercury in fish in Lake Reality to bypassing the flow of EFPC was striking, although there was little change in mercury concentrations in fish in the first six months after the bypass. A time lag would be expected, because the slow excretion rate of mercury in fish means that contaminated fish would have to be replaced in the population by younger, less contaminated fish or dilute their mercury burden by growing larger in order for average concentrations in the population to change substantially. Mean mercury concentrations in sunfish (bluegill and redbreast sunfish) dropped from 0.6 - 0.8 Fg/g before bypass to 0.17 Fg/g in fall 1999 and 0.12 Fg/g in spring 2000. The decrease in mercury concentration in fish in Lake Reality is especially remarkable given the high concentrations of mercury (> 50 ppm) that remain in the sediments of Lake Reality.

The annual collection of catfish from the Clinch River was completed in August. The next sampling of EFPC fish will occur in November 2000.

Table 4.1 Concentrations of mercury (mean ± SE, µg/g wet wt.) in fillets of redbreast sunfish from East Fork Poplar Creek in Spring of 2000, in comparison to concentrations in fish in the Fall of 1999. The second row (in parentheses) is the range of values at each site

Site	Fall 1999	Spring 2000
EFK 24.8	0.40 ± 0.07	0.74 ± 0.20
	(0.23 - 0.67)	(0.27 - 1.59)
Lake Reality	0.17 ± 0.04*	0.12 ± 0.02**
	(0.10 - 0.36)	(0.08 - 0.26)
EFK 23.4	0.48 ± 0.08	0.66 ± 0.05
	(0.35 - 0.87)	(0.48 - 0.74)
EFK 18.2	0.45 ± 0.05	0.85 ± 0.15
	(0.29 - 0.65)	(0.46 - 1.31)
EFK 13.8	0.76 ± 0.10	0.73 ± 0.08
	(0.55 - 1.14)	(0.53 - 1.10)
EFK 6.3	0.57 ± 0.13	0.37 ± 0.04
	(0.35 - 1.13)	(0.26 - 0.50)
Hinds Creek	0.08 ± 0.03	0.10 ± 0.02
	(0.05 - 0.13)	(0.04 - 0.22)

* bluegill ** 3 bluegill, 4 redbreast sunfish

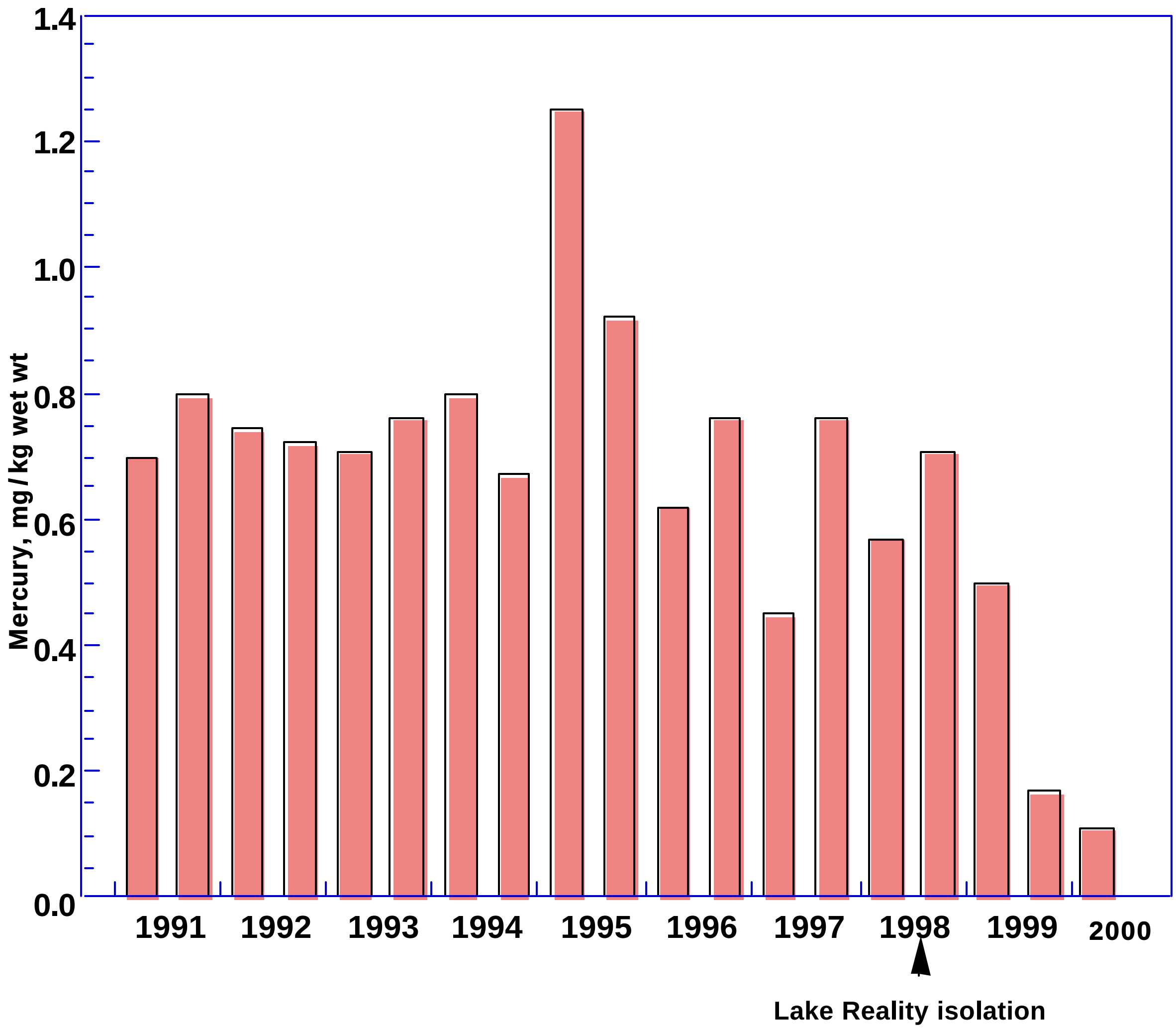

Fig. 4.1. Mean mercury concentrations in sunfish (bluegill and redbreast sunfish) from Lake Reality before and after bypassing EFPC around the pond

5. COMMUNITY STUDIES

5.1 Periphyton (*W. R. Hill*)

5.1.1 Introduction

Periphyton monitoring in EFPC occurs four times a year (as close to a quarterly sampling regime as environmental conditions will allow). Rocks and their associated periphyton are collected from three sites on EFPC (EFKs 24.4, 23.4, 6.3) and one site on Brushy Fork (BFK 7.6). Four rocks from each site are used in determining algal biomass (chlorophyll *a* or chl*a*) and the rate of photosynthesis (^{14}C incorporation). To compare photosynthesis (PS) rates for periphyton among sites with different areal biomass, the PS data are divided by the chlorophyll *a* amounts. The resulting chlorophyll-specific photosynthetic rates provide an index of the health of the algal component of the periphyton**.**

5.1.2 Results/Progress

Periphyton biomass and photosynthesis was measured August 28, 2000. The results of these measurements appear in Table 5.1. Chlorophyll *a*, photosynthesis, and chlorophyll-specific photosynthesis in EFPC and Brushy Fork (reference) periphyton were similar to previous measurements made recently and well within the range of historical values. The next sampling for biomass and photosynthesis will occur in December or January; the specific date will depend on flow conditions.

Periphyton collected September 19-20 are currently being processed for metals analysis.

Table 5.1. Means and standard errors for biomass, photosynthesis, and chlorophyll-specific photosynthesis rates of periphyton collected from EFPC and Brushy Fork, August 28, 2000

Site	Algal biomass (FgChla/cm^2)	Photosynthesis (FgC/cm^2/h)	Chlorophyll-specific photosynthesis (FgC/FgChla/h)
EFK 24.4	60.5 ± 8.2	12.6 ± 0.8	0.22 ± 0.03
EFK 23.4	37.3 ± 3.9	9.4 ± 0.3	0.26 ± 0.02
EFK 6.3	36.2 ± 2.4	7.1 ± 0.5	0.20 ± 0.01
BFK 7.6	13.4 ± 4.3	3.9 ± 0.9	0.34 ± 0.05

Note: EFK = East Fork kilometer, BFK = Brushy Fork kilometer

5.2 Benthic Macroinvertebrate Community (*J. G. Smith*)

5.2.1 Introduction

The objectives of the benthic macroinvertebrate task are to monitor the benthic macroinvertebrate community in EFPC in order to provide information on the ecological condition of the stream, and to evaluate the responses of macroinvertebrates to operational changes, abatement activities, or remedial actions at the Y-12 Plant as a measure of the effectiveness of these actions. To meet these objectives, quantitative benthic macroinvertebrate samples have been collected at least twice each year (April and October) since 1985 from four sites in EFPC (EFKs 24.4, 23.4, 18.7, and 13.8), although only EFKs 24.4, 23.4, and 13.8 samples are routinely processed. Additionally, samples are collected once annually from EFK 6.3 (in April) and processed. Since 1986, up to two reference sites unimpacted by industrial discharges have also been monitored, including one site each on Brushy Fork (BFK 7.6) and Hinds Creek (HCK 20.6) (Figs.1.1 and 1.2). In addition to routine benthic macroinvertebrate community studies, an *in situ* bioassay, using a locally available clam as the test organism, is also conducted periodically.

5.2.2 Results/Progress

Benthic macroinvertebrate community studies **–** Average values for total taxonomic richness (number of taxa/sample) and richness of the Ephemeroptera, Plecoptera, and Trichoptera (number of EPT taxa/sample) for samples collected during the April and October sampling periods from 1985 through 2000 are presented in Fig. 5.1. These two metrics have generally been dependable for evaluating the condition of the macroinvertebrate community in EFPC and identifying temporal changes indicative of improving conditions. EPT richness is particularly useful because the three major insect orders that this metric comprises are generally intolerant of poor environmental conditions.

From October 1985 through April 2000, total and EPT richness values were clearly low at EFK 24.4 and EFK 23.4 compared to reference sites. However, total and EPT richness have shown a gradual increase through time at these two sites, while at the reference sites no persistent long-term trends (i.e., no evidence of persistent increases or decreases) in change have occurred. Persistent increases in total richness to $ 3X in total richness have been observed at EFK 24.4 and EFK 23.4 in both sampling seasons, and since 1990, EPT taxa richness has also shown a similar increase at these sites. From 1989 through April 2000, total taxonomic richness at EFK 13.8 has generally fallen within or near the range exhibited by the reference sites, while EPT richness dropped below the reference range after April 1996 and has not yet returned.

These results indicate that the macroinvertebrate community at EFK 23.4 and EFK 24.4 remained significantly degraded through April 2000. However, subtle but persistent increases in total richness and richness of pollution intolerant taxa at these sites, particularly since the early 1990s, indicate that conditions continue to improve in upper EFPC. Within a distance of about 10 km further downstream of EFK 23.4 (i.e., EFK 13.8), the macroinvertebrate community, as judged from total and EPT richness only, exhibits characteristics that indicate only slight impact relative to reference sites. While only subtle differences now appear to exist between EFK 24.4 and EFK 23.4, these two sites will be critical in the future for evaluating the effects of any changes implemented in flow management.

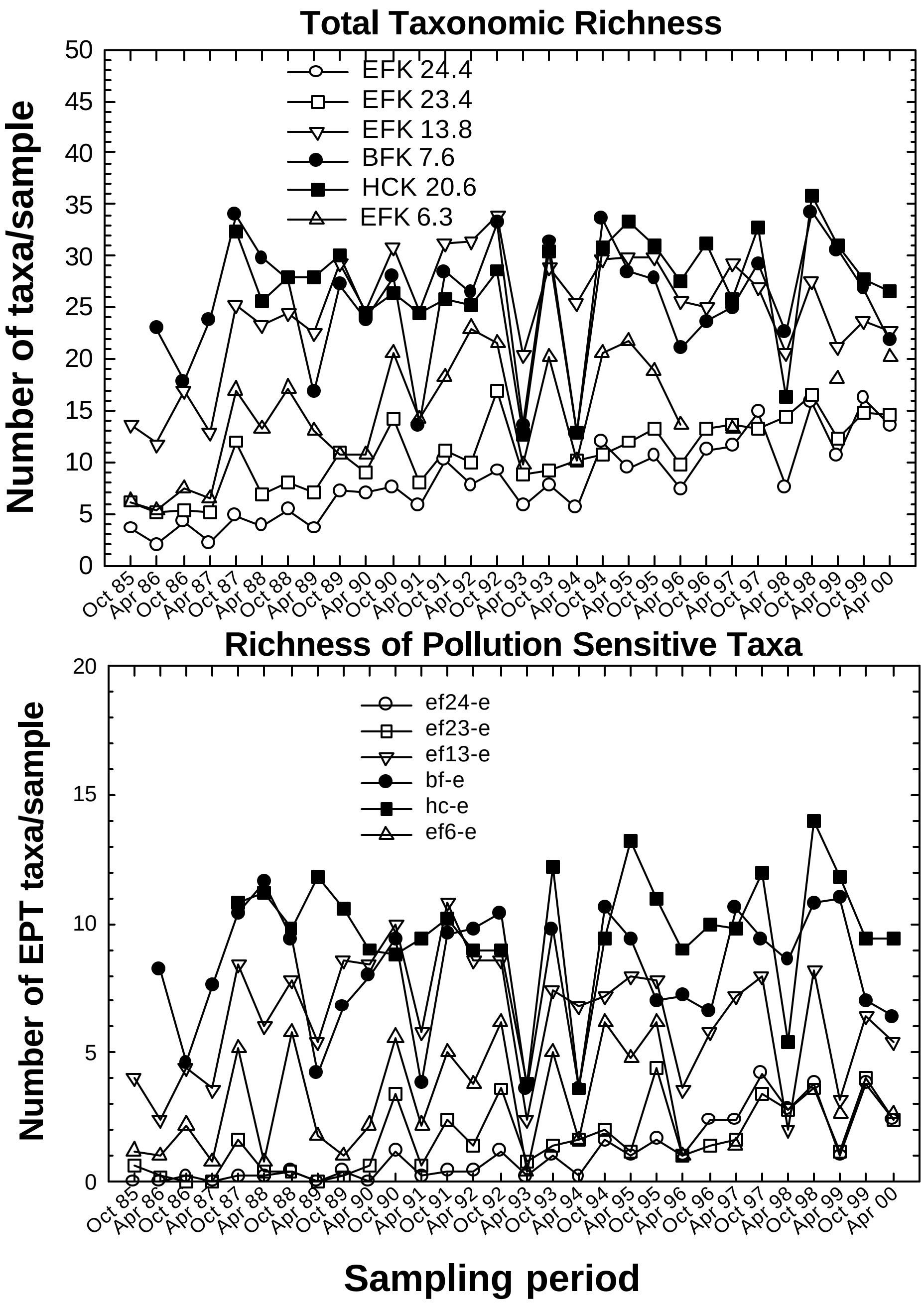

Fig. 5.1. Mean values for total taxonomic richness (number of taxa/sample) and taxonomic richness of pollution sensitive Ephemeroptera, Plecoptera, and Trichoptera (number of EPT taxa/sample) of the benthic macroinvertebrate communities in EFPC and reference sites in Brushy Fork (BFK 7.6) and Hinds Creek (HCK 20.6) from October 1985 - April 2000.

In situ clam bioassay **–** An *in situ* bioassay using a locally available clam (*Sphaerium fabale*) was initiated in late June 2000 and lasted through the end of August 2000, for a 12-week exposure period. Clams were placed in cages at three sites in EFPC (EFK 24.4, EFK 23.4, and EFK 13.8) and one site each in three reference streams: Brushy Fork (BFK 7.6), Cox Creek (CXK 0.2), and Hinds Creek (HCK 20.6). Clams were retrieved at intervals of 21 days, at which time their lengths were measured (growth), and mortality was noted.

The results from the *in situ* clam bioassay are presented in Fig. 5.2. As in past *in situ* bioassays, survival and growth of clams was poor at EFPC sites. Clams exhibited virtually no growth in upper EFPC, and, at the end of the 12-week exposure period, only 28 % and 16 % of the clams were still alive at EFK 24.4 and EFK 23.4 respectively. While mortality was significant at these sites, the results were marginally better than in 1999 when survival at these sites dropped below 10 %.

Patterns in growth and survival of clams at EFK 13.8 were also similar to past studies, with survival not differing significantly from the reference sites but growth being significantly decreased. Growth at 12 weeks in the EFK 13.8 clams was similar to growth in 3-week clams at the reference sites.

5.3 Fish Community (*M. G. Ryon)*

5.3.1 Introduction

Fish population and community studies can be used to assess the ecological effects of water quality and/or habitat degradation. Fish communities, for example, include several trophic levels and species that are at or near the end of food chains. Consequently, they integrate the direct effects of water quality and habitat degradation on primary producers (periphyton) and consumers (benthic invertebrates) that are utilized for food. Because of these trophic interrelationships, the well-being of fish populations has often been used as an index of water quality. Moreover, statements about the condition of the fish community are easily understood by the general public.

The two primary activities conducted by the Fish Community Studies task in EFPC are: (1) biannual, quantitative estimates of the fish community at six EFPC sites and two reference stream sites; and (2) investigative procedures in response to fish kills near the Y-12 Plant. The quantitative sampling of fish populations is conducted by electrofishing during the March–April and September–October periods. The resulting data are used to estimate population size (numbers and biomass per unit area), determine length frequency, estimate production, and calculate Index of Biotic Integrity values. Fish kill investigations are conducted in response to chemical spills, unplanned water releases, or when dead fish are observed in EFPC. The basic tool used for fish kill investigations is a survey of upper EFPC (above Bear Creek Road to the N/S Pipes) in which numbers and locations of dead, dying, and stressed fish are recorded. This baseline is supplemented by special toxicity tests, histopathological examinations, and water quality measurements in an effort to determine the cause(s) of the observed mortality.

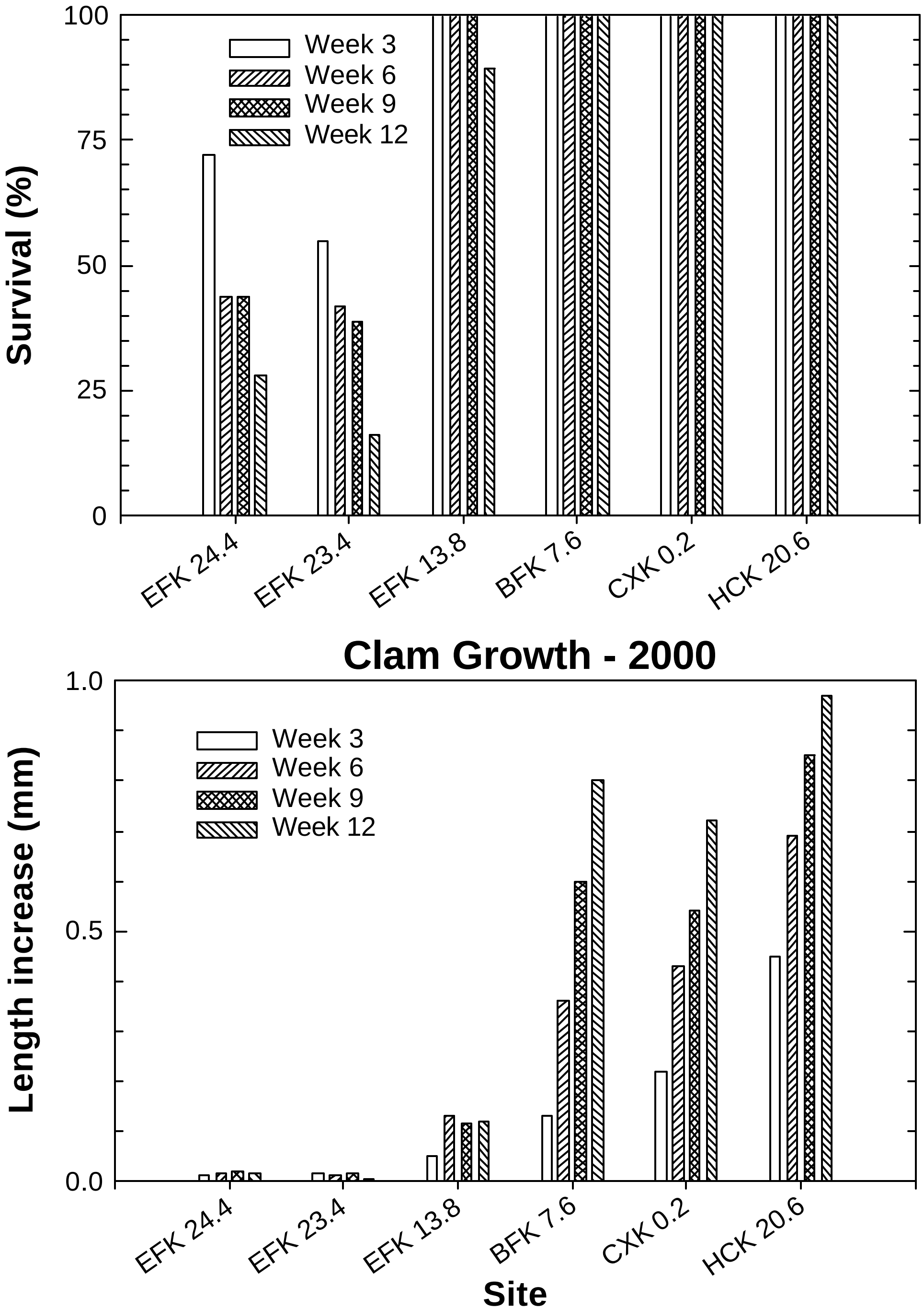

Fig. 5.2. Mean survival and growth of fingernail clams (*Sphaerium fabale)* in *in situ* bioassays in East Fork Poplar Creek, June through August 2000

5.3.2 Results/Progress

This quarter, data from the spring quantitative surveys of EFPC sites were entered into computer databases, processed through quality assurance procedures, and used to calculate estimates of population densities. These data were included in the annual State of the Creek address and are shown in Table 5.2. The data from the spring 2000 sample indicate continued presence of sensitive species in upper EFPC, below Lake Reality, but generally a lower number of species at most sites than seen in recent samples. The densities were as expected, with density at EFK 25.1 dropping from the extremely high level seen in fall 1999 to a level similar to that found just downstream at EFK 24.4. Since flow management, the trend has been for these two sites to become more similar in species density.

No reportable fish kills were investigated during this quarter.

During the last month of the quarter, field sampling was begun in EFPC as part of the fall sample.

6. DATA MANAGEMENT (*S. W. Christensen*)

6.1. Introduction

Environmental Compliance projects are required by provisions of the Oak Ridge Reservation Federal Facilities Agreement (FFA) and the State of Tennessee Oversight Agreement (TOA) to transmit their data to the Oak Ridge Environmental Information System (OREIS). BMAP data managers receive data packages from the PIs of the other tasks, transform the data into appropriate OREIS formats, and facilitate the data transfer to OREIS. This task also administers the BMAP workstation.

6.2. Results/Progress

During the 3rd quarter 2000, data managers conducted routine system maintenance activities (e.g., backups), continued interactions with OREIS to determine solutions for issues associated with OREIS' revision of the Ready-to-Load (RTL) specifications for BMAP data, and continued development of infrastructure to provide custom-formatted data from the BMAP data base to BMAP principal investigators.

Table 5.2. Fish density (number of fish/m^2) and biomass (g/m^2, in parentheses) for March-May 2000 in East Fork Poplar Creek (EFK) and the reference sites, Brushy Fork (BF) and Hinds Creek (HCK).

Species	EFK 25.1[a]	EFK 24.4	EFK 23.4	EFK 18.7	EFK 13.8	EFK 6.3	HCK 20.6	BFK 7.6
American brook lamprey								0.02 (0.15)
Central stoneroller	2.88 (46.02)	1.23 (15.62)	4.17 (25.04)	0.41 (4.56)	0.69 (5.47)	<0.01 (0.04)	0.50 (3.23)	0.01 (0.15)
Spotfin shiner								<0.01 (<0.01)
Striped shiner	0.09 (0.79)	0.84 (3.06)	3.18 (10.98)	0.34 (1.83)	0.24 (2.70)	0.02 (0.62)	0.19 (1.32)	0.05 (0.55)
Rosefin shiner				0.01 (0.01)				0.01 (0.01)
Bigeye chub							0.01 (0.01)	<0.01 (<0.01)
Bluntnose minnow						<0.01 (<0.01)	0.05 (0.04)	
Blacknose dace	1.93 (5.53)	2.26 (3.99)	4.15 (6.51)	0.17 (0.35)	0.10 (0.26)	<0.01 (<0.01)	0.29 (0.45)	0.02 (0.04)
Creek chub				0.01 (0.10)	<0.01 (0.01)		0.03 (0.15)	
White sucker			<0.01 (0.09)				0.01 (0.85)	<0.01 (0.46)
Northern hog sucker			0.04 (3.37)	0.08 (2.43)	0.02 (0.23)	0.01 (0.76)	0.02 (0.42)	0.01 (0.46)
Spotted sucker					<0.01 (0.96)	<0.01 (0.01)		
Black redhorse								<0.01 (0.02)

Species	EFK 25.1[a]	EFK 24.4	EFK 23.4	EFK 18.7	EFK 13.8	EFK 6.3	HCK 20.6	BFK 7.6
Golden redhorse						<0.01 (0.15)	<0.01 (0.47)	
Rainbow trout							<0.01 (0.07)	
Yellow bullhead					<0.01 (0.21)			
Blackspotted topminnow								<0.01 (<0.01)
Western mosquitofish			<0.01 (<0.01)	<0.01 (<0.01)		<0.01 (<0.01)		<0.01 (<0.01)
Banded sculpin				0.01 (0.02)	0.04 (0.31)	0.07 (0.47)	0.70 (2.70)	0.17 (1.64)
Rock bass				0.01 (0.16)	0.01 (0.07)	<0.01 (0.01)	0.05 (0.33)	0.01 (0.87)
Redbreast sunfish			0.07 (1.69)	0.03 (1.40)	0.01 (0.35)	0.02 (0.26)	<0.01 (0.08)	<0.01 (0.13)
Green sunfish			0.01 (0.34)		<0.01 (0.04)	<0.01 (0.04)		
Bluegill			0.08 (0.85)	0.01 (0.05)		<0.01 (0.03)	0.02 (0.31)	0.03 (0.57)
Hybrid sunfish			<0.01 (0.01)					
Largemouth bass			0.01 (1.54)	<0.01 (0.01)		<0.01 (0.03)		<0.01 (0.01)
Greenside darter					0.01 (0.05)		0.01 (0.02)	<0.01 (<0.01)
Blueside darter						<0.01 (0.01)	0.03 (0.05)	0.01 (0.01)

Species	EFK 25.1[a]	EFK 24.4	EFK 23.4	EFK 18.7	EFK 13.8	EFK 6.3	HCK 20.6	BFK 7.6
Stripetail darter							0.05 (0.09)	<0.01 (0.01)
Redline darter					<0.01 (<0.01)		0.04 (0.07)	<0.01 (<0.01)
Snubnose darter			0.02 (0.07)	0.01 (0.03)	0.01 (0.02)	0.01 (0.02)	0.11 (0.14)	0.08 (0.08)
Logperch					<0.01 (0.02)	<0.01 (0.04)		
Species richness	3	3	11	13	14	17	19	22
Density	4.90	4.33	11.63	1.08	1.13	0.15	2.12	0.44
Biomass	52.34	22.67	50.85	10.95	9.76	3.73	10.80	5.17

[a]Site designated by stream kilometer.

7. FOURTH QUARTER 2000 FIELD ACTIVITIES

This section of the Y-12 BMAP quarterly report is meant to provide information to the Y-12 Environmental Compliance Office and other interested parties concerning BMAP plans for field activities in upper EFPC and adjacent environs during the upcoming calendar quarter.

Toxicity — Ambient water samples from EFK 24.1 and effluent samples from Outfall 201 will be evaluated for toxicity to *Ceriodaphnia dubia* during the 4th quarter 2000.

Bioindicators — A medaka embryo-larval test will be conducted on ambient water samples from EFPC during the 4th quarter 2000.

Bioaccumulation — Sampling of EFPC fish for bioaccumulation purposes will occur in November 2000.

Community Studies — The next sampling for periphyton biomass and photosynthesis will occur in December or January; the specific date will depend on flow conditions. Fall benthic invertebrate sampling will be conducted during the 4th quarter. Ongoing fall fish community sampling in the EFPC drainage will be completed during the 4th quarter.

8. REFERENCES

Benoit, D. A., G. W. Holcombe and R. L. Spehar. 1991. Guidelines for conducting early life stage toxicity tests with Japanese Medaka (*Oryzias latipes*). EPA/600/3-91/063. Environmental Research Laboratory - Duluth. Duluth, Minnesota.

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