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OAK RIDGE Y-12 PLANT INFORMATION CONTROL FORM

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Author(s): J. M. Loar & R. L. Hinzman

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Assessment of the Ecological Recovery of East Fork Poplar Creek

J. M. Loar
R. L. Hinzman

Environmental Sciences Division
Oak Ridge National Laboratory[a]

Annual State-of-the-Creek Address
Oak Ridge Y-12 Plant

May 23, 1996

[a]Oak Ridge National Laboratory is managed by Lockheed Martin Energy Research Corporation for the U.S. Department of Energy under contract DE-AC05-96OR22464.

Objectives of the Y-12 Plant Biological Monitoring and Abatement Program (BMAP)

- Determine if the interim NPDES effluent limits protect the classified uses of the receiving stream (e.g., growth and propagation of fish and aquatic life)

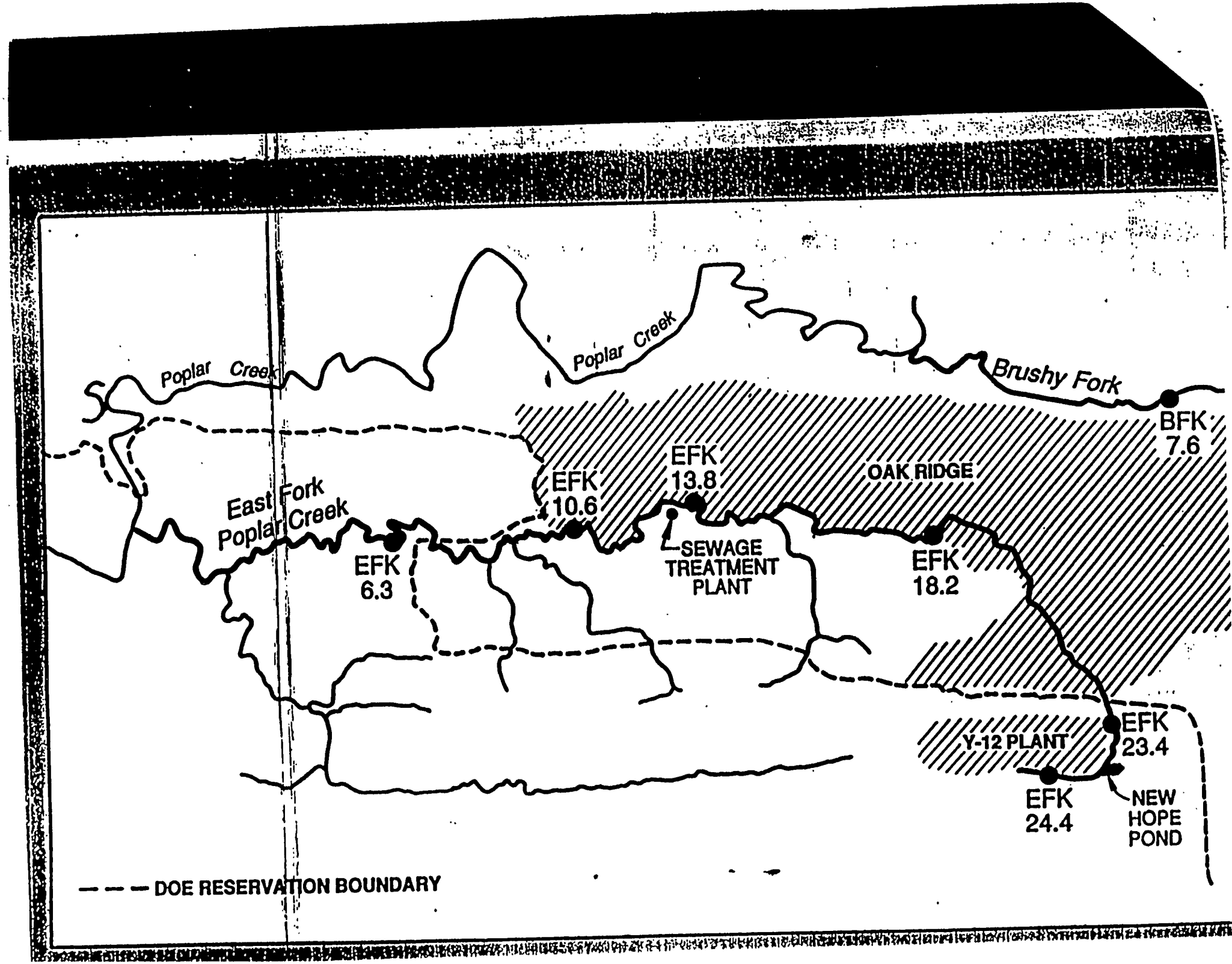
- Provide an ecological characterization of the receiving stream
  - To document ecological impacts
  - To identify contaminant sources that adversely affect stream biota

- Monitor ecological recovery during and after implementation of major remedial actions

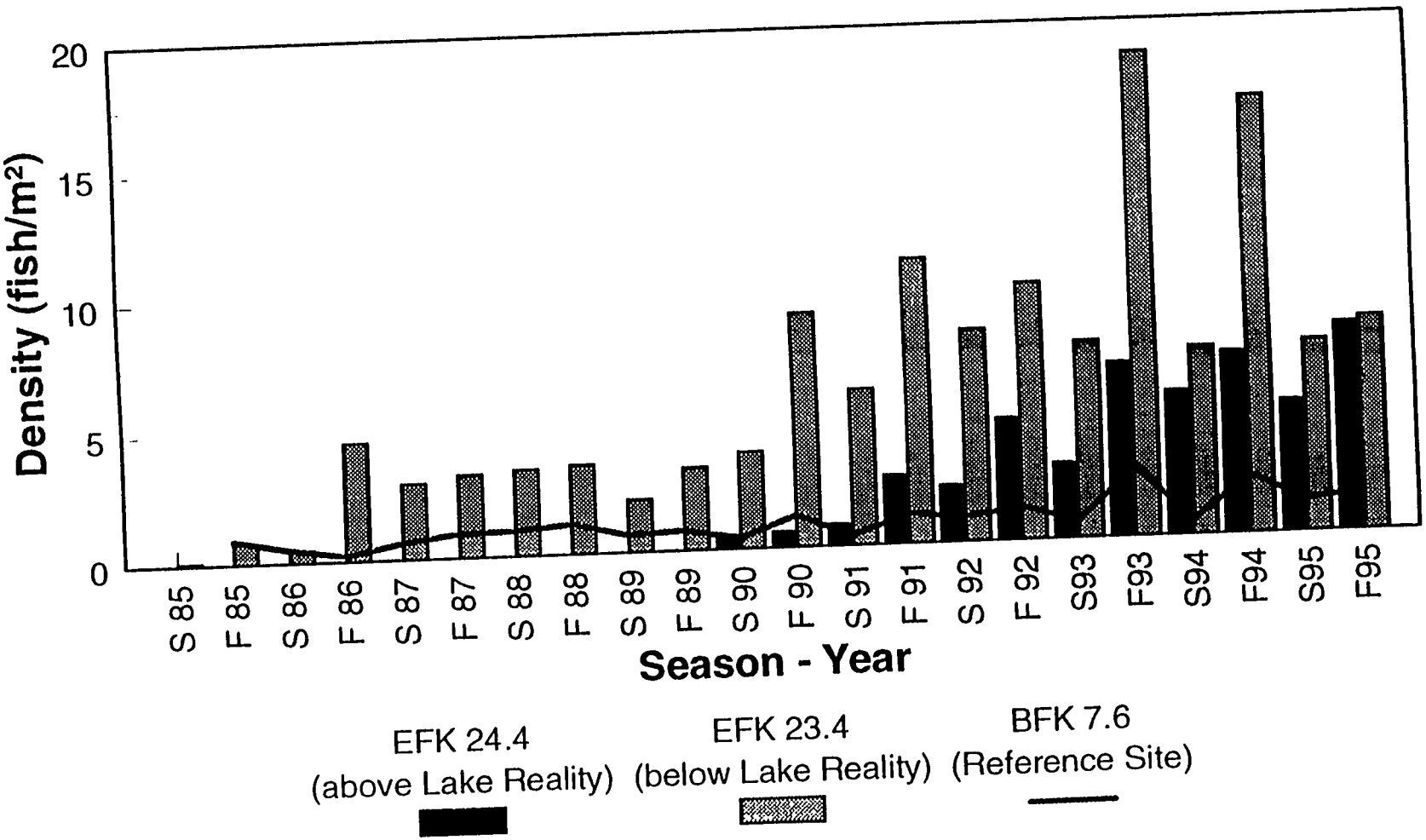
- Detect new releases

Benefits of ORR Biological Monitoring Programs

- Documented ecological recovery in 9 streams
- Identified causes of adverse ecological effects and guided selection of remedial actions
- Serve as performance indicators in assessing the effectiveness of remedial actions
- Use results to assess the ecological impact of fish kills
- Used results to support DOE in litigation
- Saved ER ~$2.5M because NPDES-mandated programs also meet data needs for ecological risk assessments
- Utilized biological monitoring approach at other DOE sites (PGDP, PORTS, Kansas City)


Poplar Creek
Poplar Creek
Brushy Fork
BFK
7.6
EFK
13.8
EFK
10.6
OAK RIDGE
East Fork
Poplar Creek
EFK
6.3
SEWAGE
TREATMENT
PLANT
EFK
18.2
Y-12 PLANT
EFK
23.4
EFK
24.4
NEW
HOPE
POND
DOE RESERVATION BOUNDARY

Fish Density Trends in Upper East Fork Poplar Creek, 1985-1995



Fish Kills in 1995

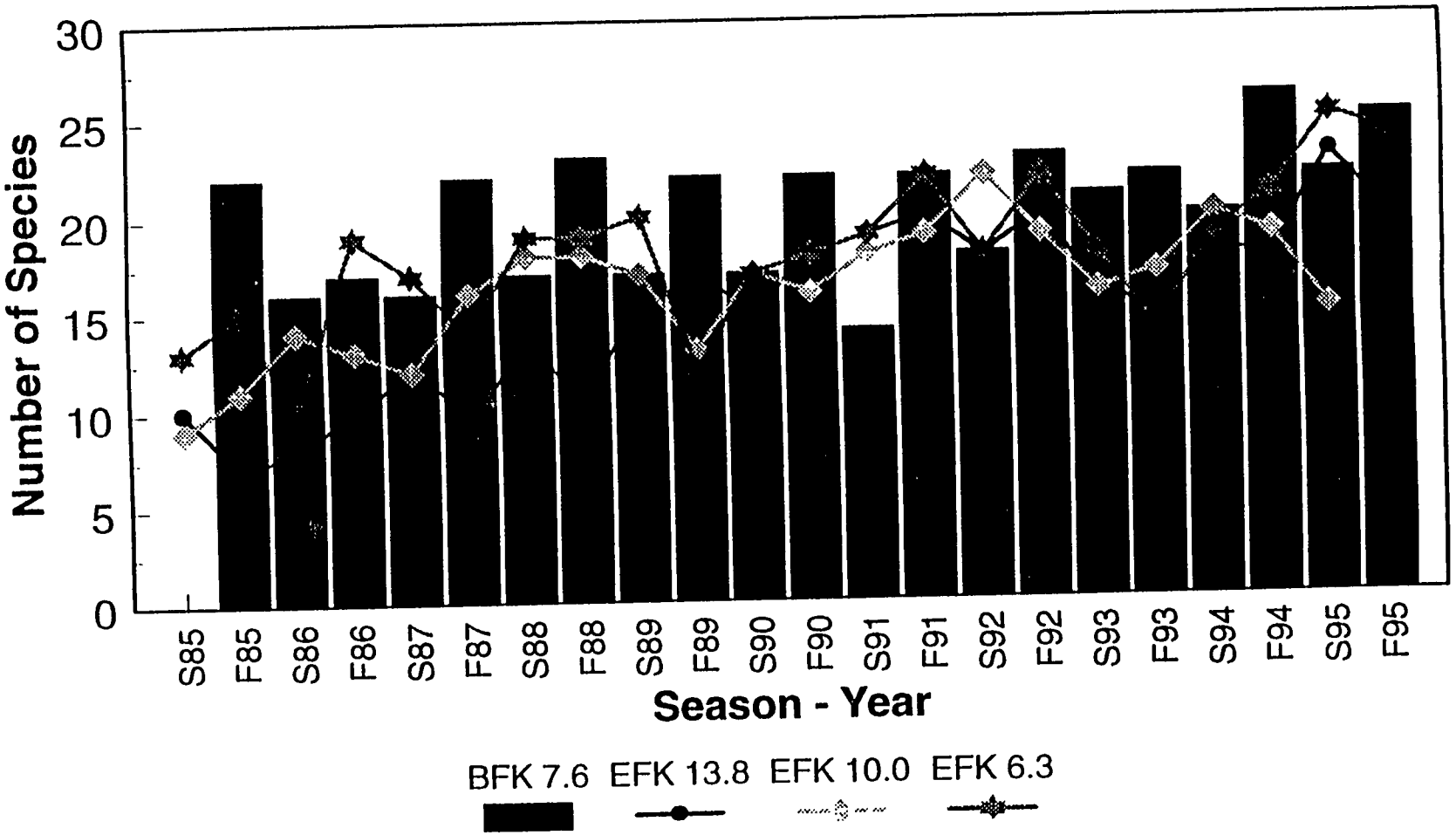
January 6, 1995

- 1,801 fish
- all species (95% stonerollers and striped shiners)
- all but one fish recovered above Lake Reality
- cause attributed to rapid snow/ice melt, resulting in runoff to upper EFPC and a significant decrease in temperature and increase in conductivity

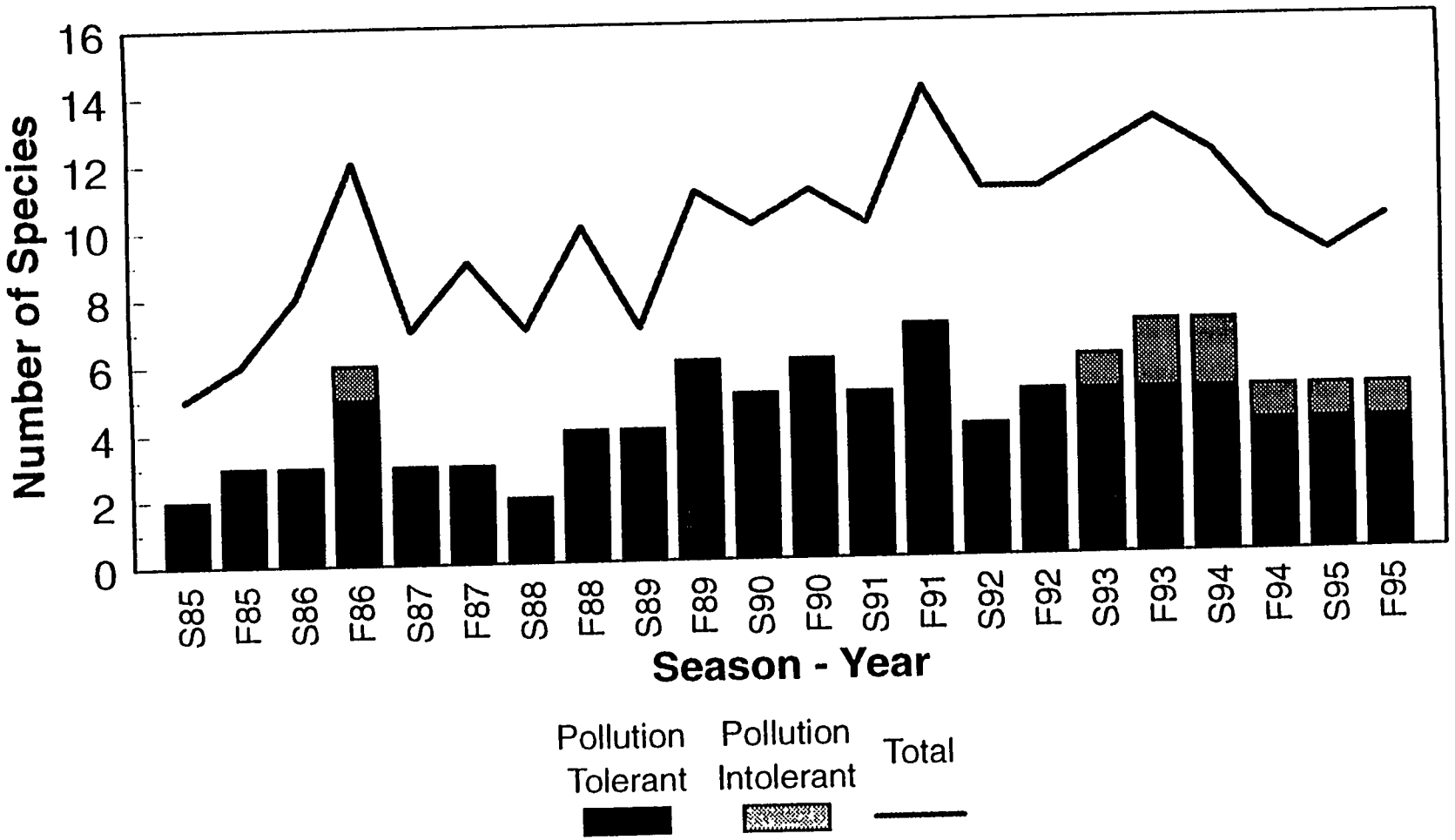
August 3, 1995

- 5565 fish
- all species (93% stonerollers and striped shiners)
- 98% of fish recovered between outfall 109 and the diversion channel
- cause attributed to release of a styrene resin via outfall 109 to upper EFPC during relining of storm sewers

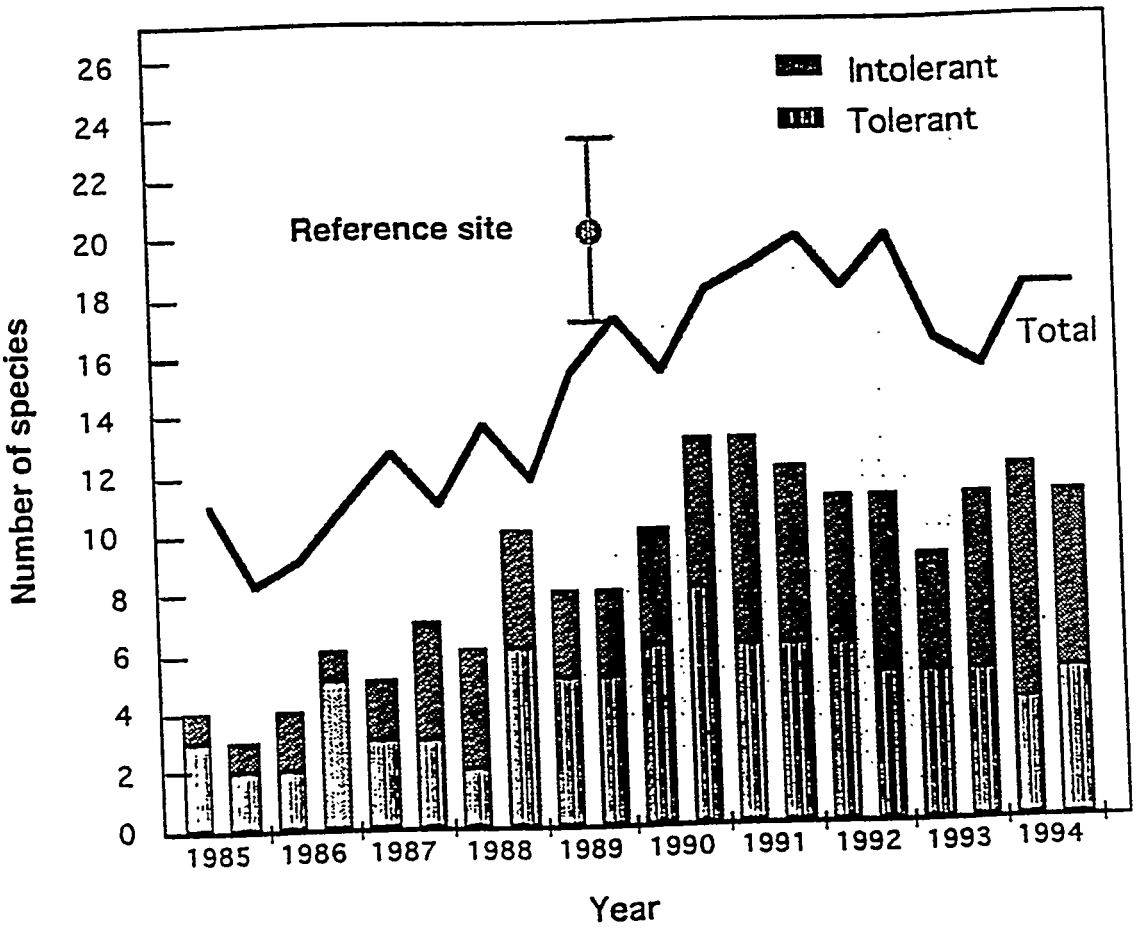
Trends in Fish Species Richness in Lower East Fork Poplar Creek, 1985-1995



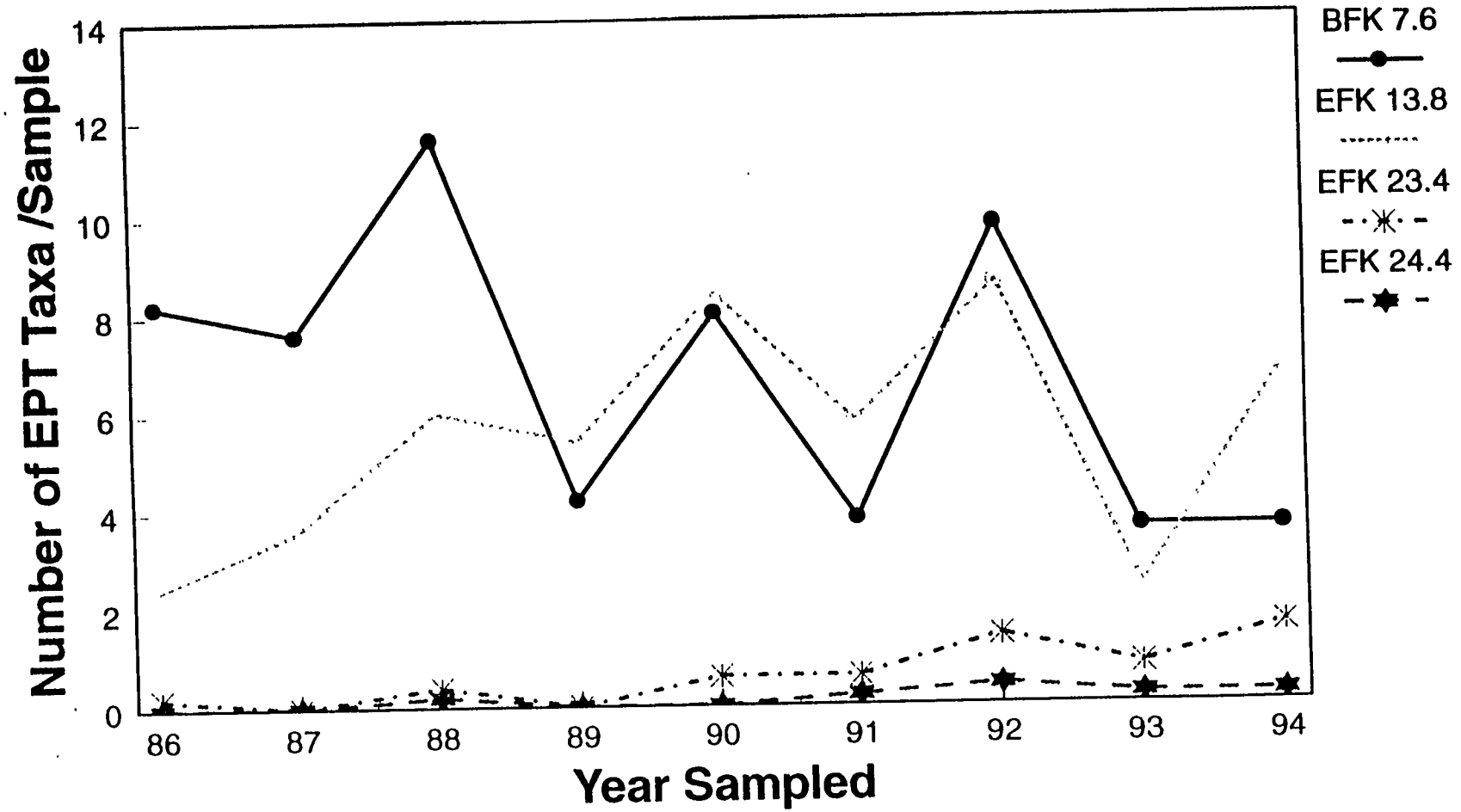
Trends in Fish Species Richness in Upper East Fork Poplar Creek at EFK 23.4, 1985-1995

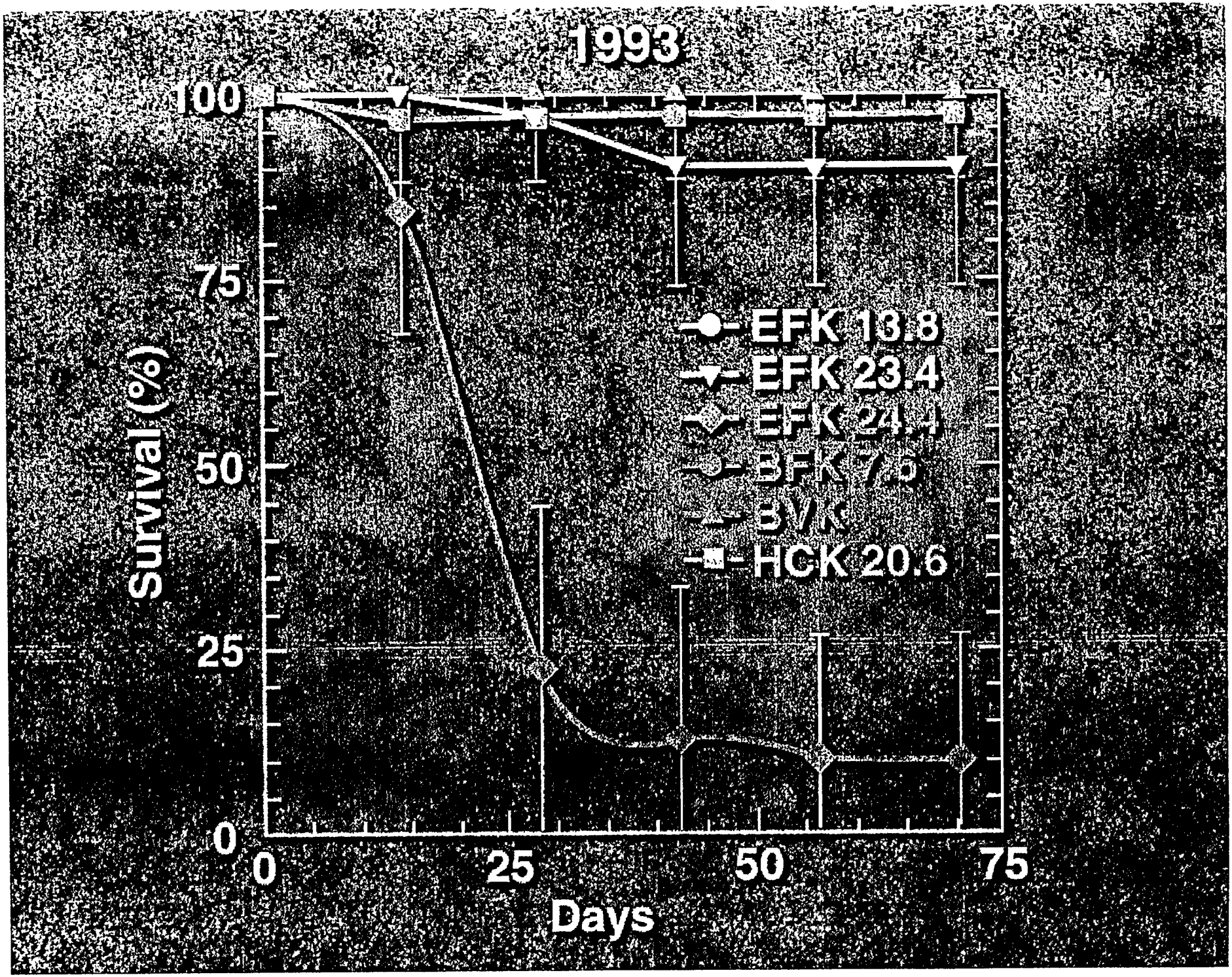


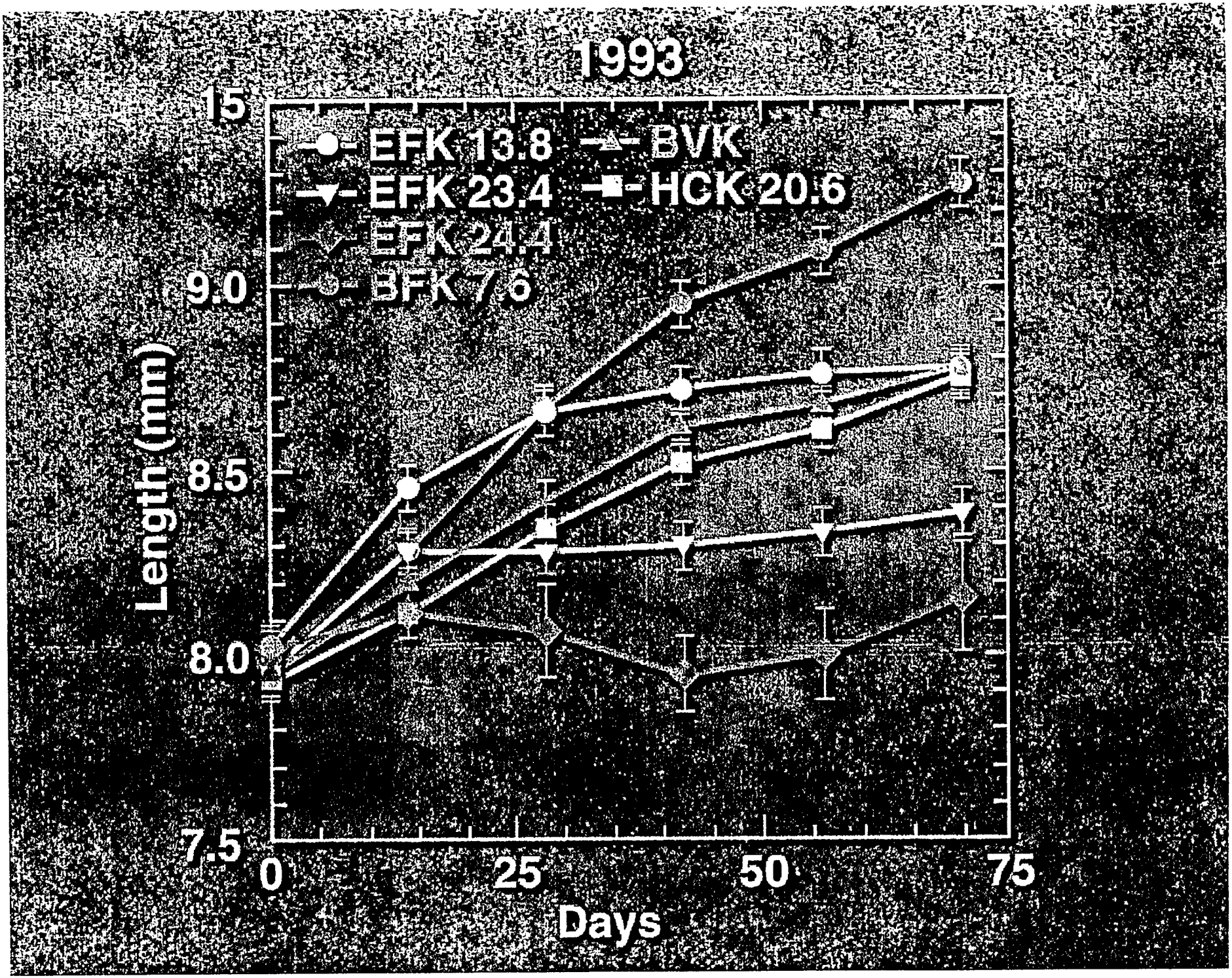
Recovery of the fish community in East Fork Poplar Creek, 10 km downstream from Y-12 Plant



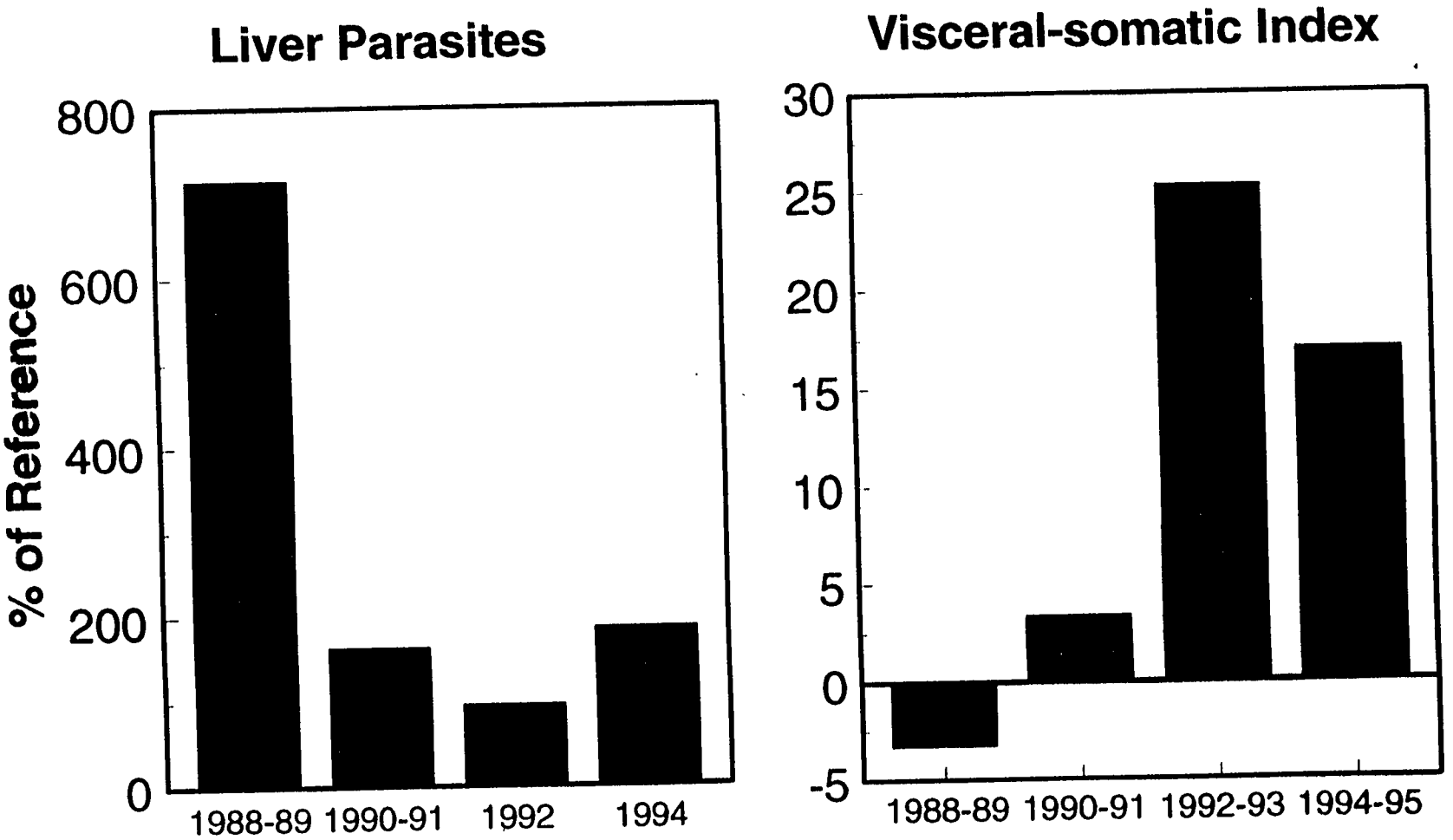
EPT Richness

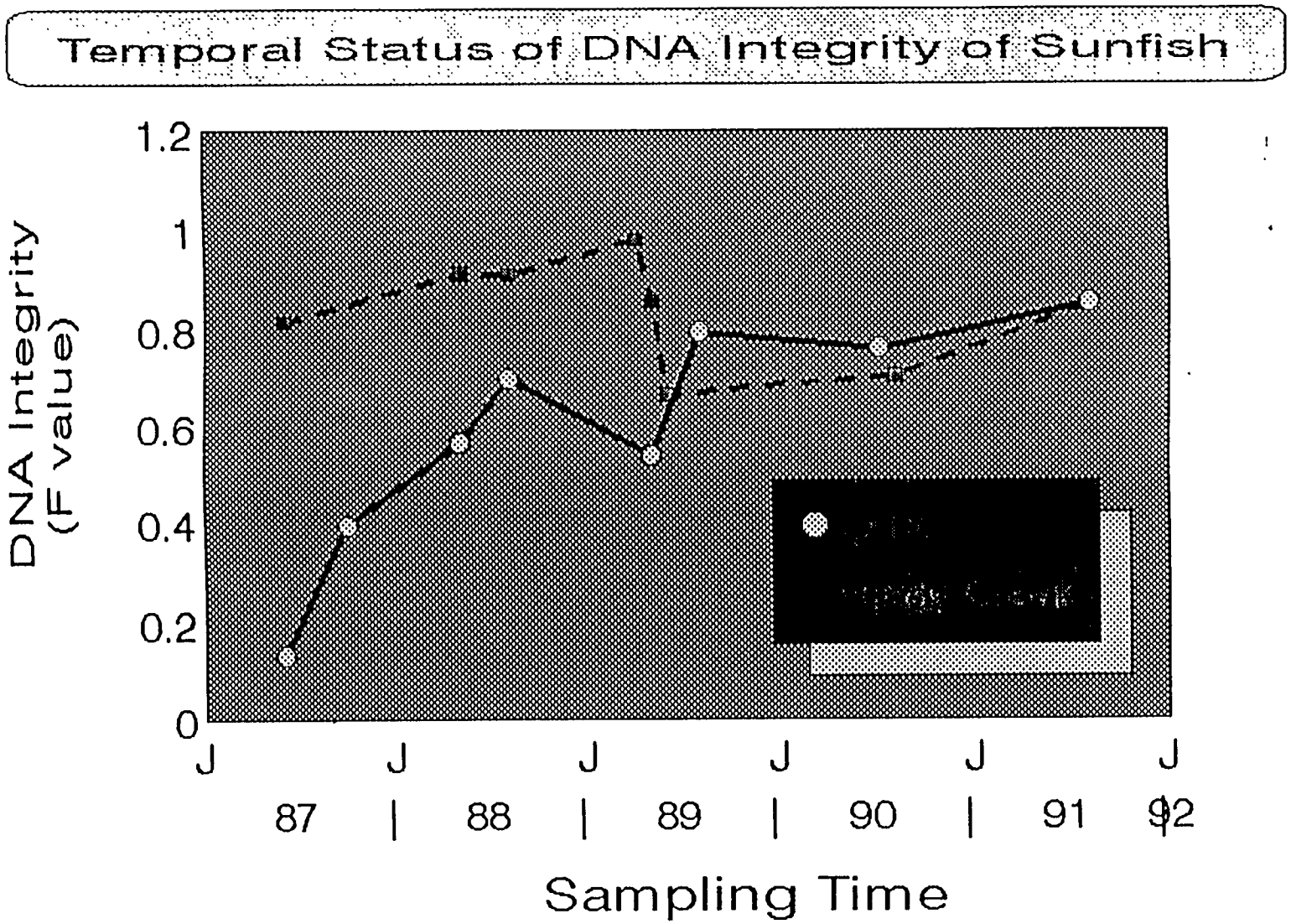



1993
100
75
50
25
0
Survival (%)
0
25
50
75
Days
EFK 13.8
EFK 23.4
EFK 24.4
BFK 7.9
BVK
HCK 20.6


1993
EFK 13.8
EFK 23.4
EFK 24.4
BFK 7.6
BVK
HCK 20.6
Length (mm)
15
9.0
8.5
8.0
7.5
0
25
50
75
Days

Redbreast sunfish collected from EFKs 19 and 23 (pooled) compared with Hinds Creek and Brushy Fork (reference sites - pooled)

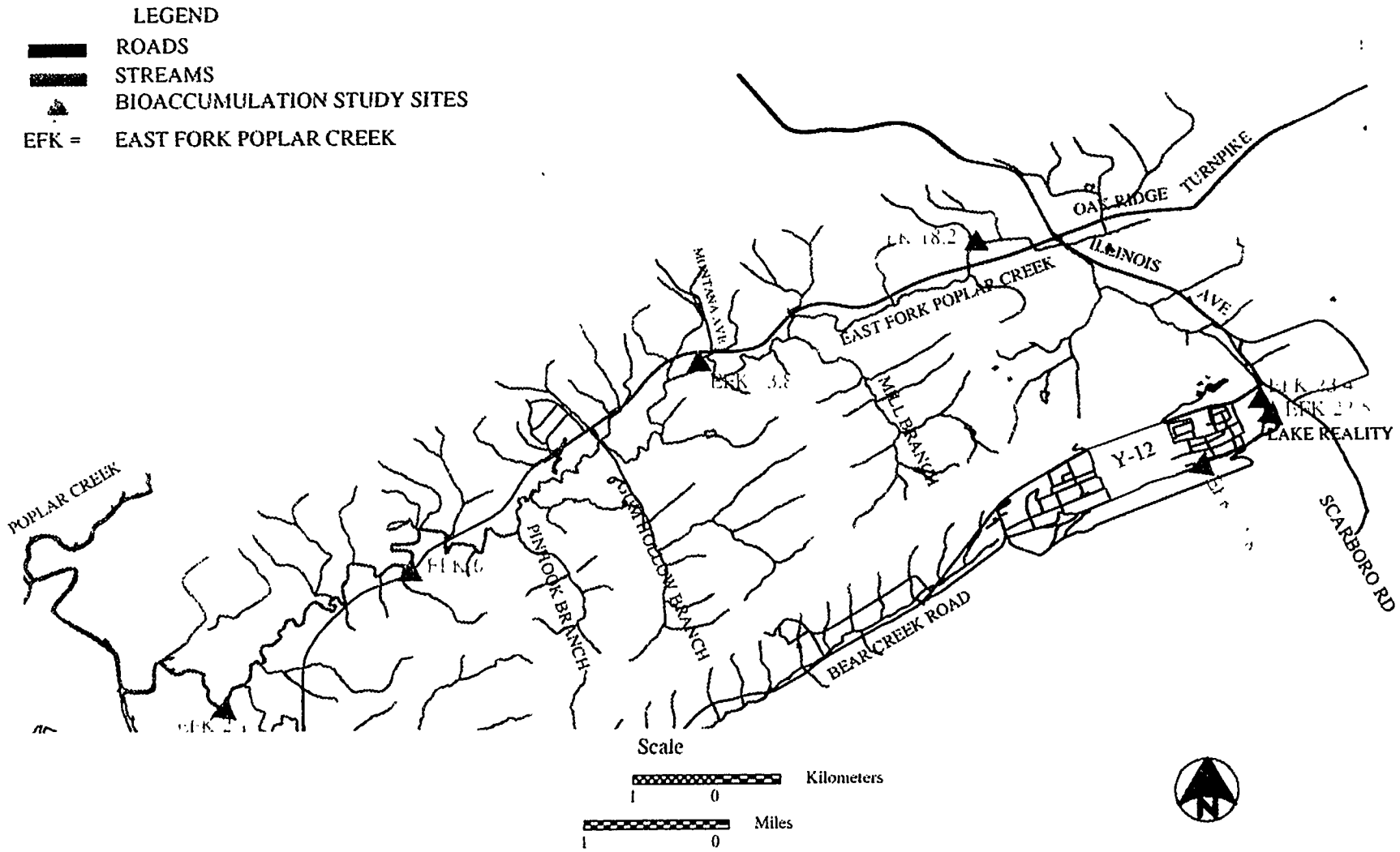


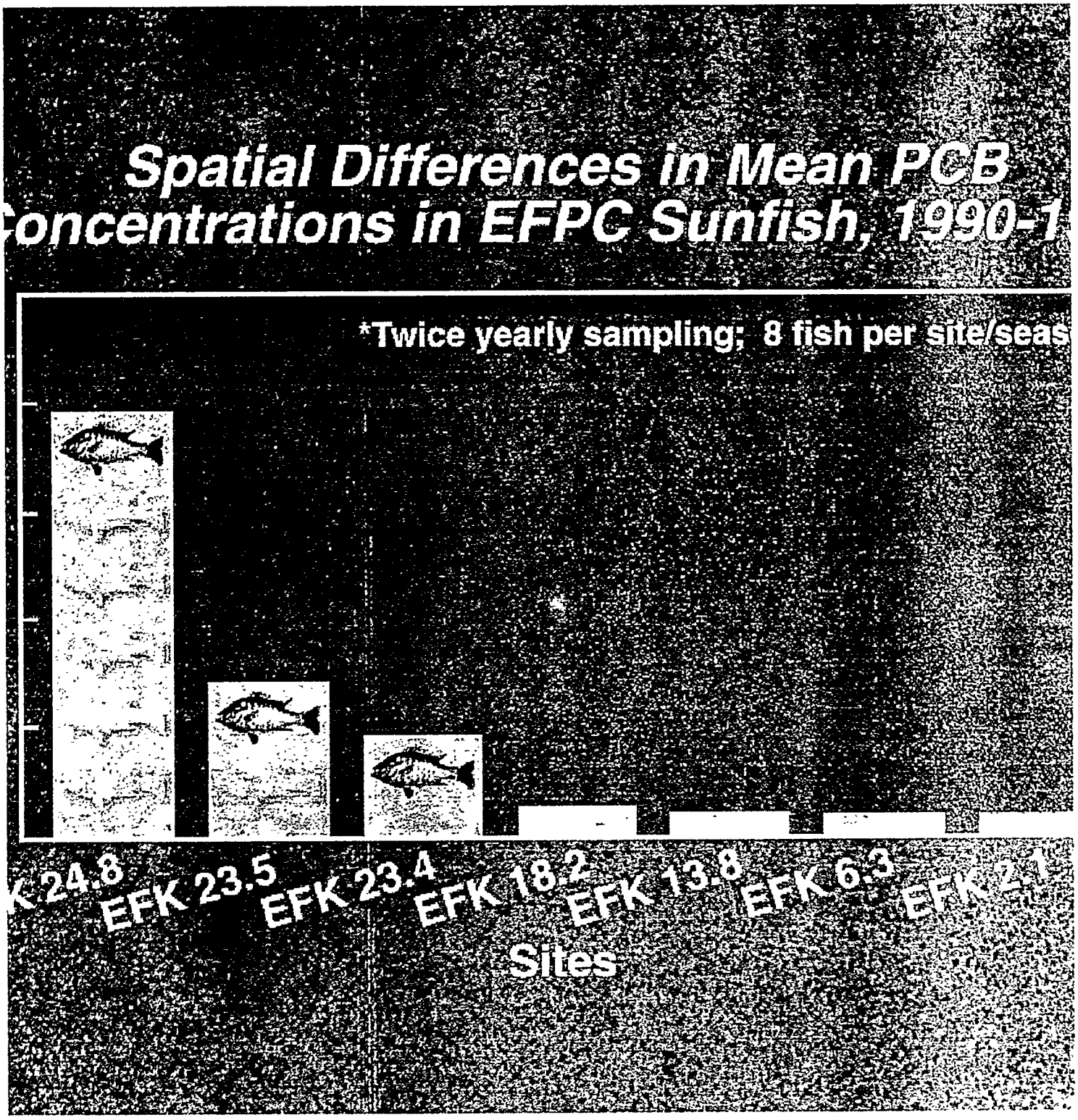

Temporal Status of DNA Integrity of Sunfish
DNA Integrity
(F value)
1.2
1
0.8
0.6
0.4
0.2
0
J
J
J
J
J
J
87
88
89
90
91
92
Sampling Time

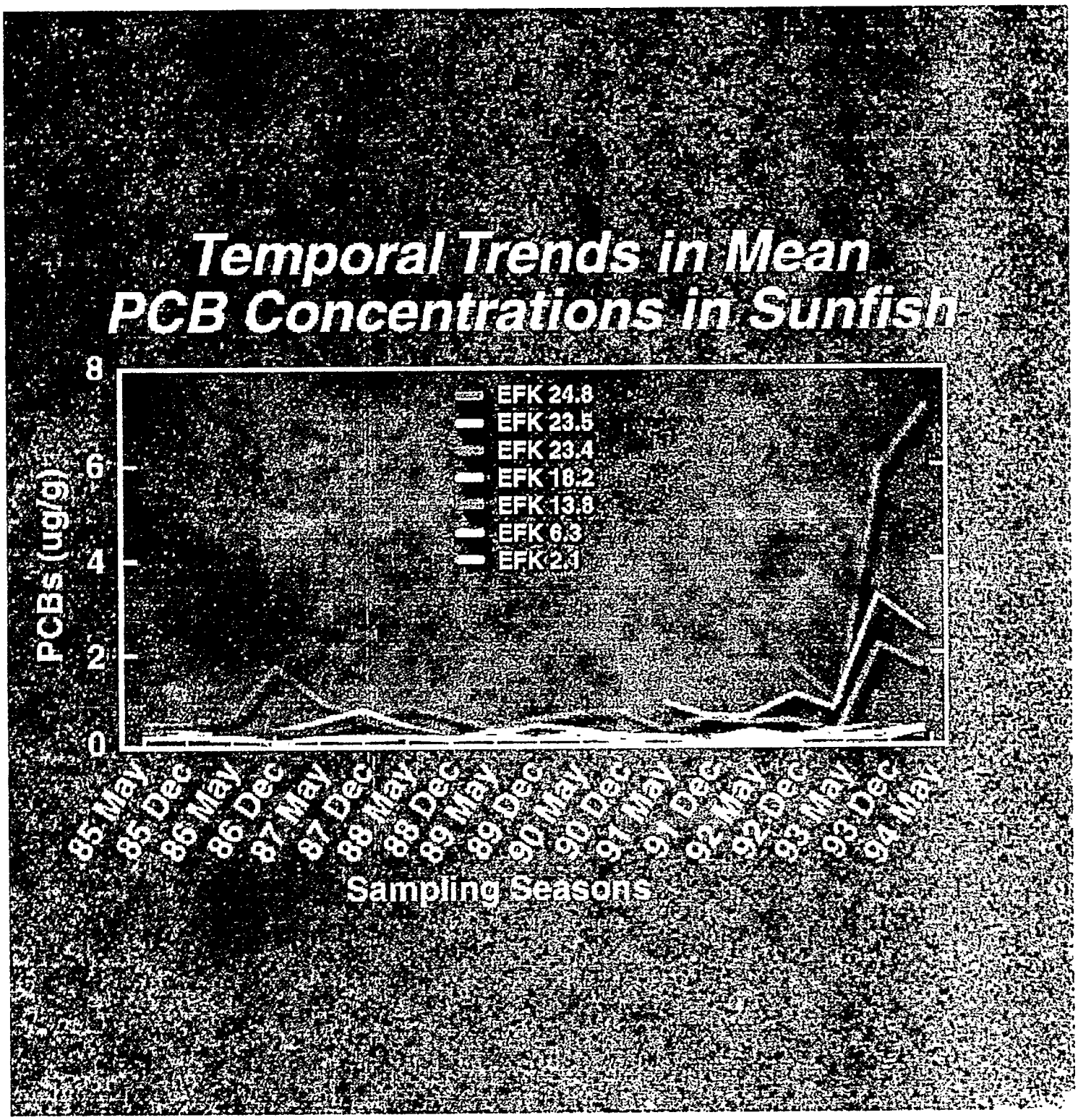
Annual discharge volumes and contributions of toxicity to EFPC by various types of wastewaters from the Oak Ridge Y-12 Plant

Wastewater Source	1986 - 1988 Annual Flow (L/year)	1986 - 1988 Toxic Units[a]	1988 - 1992 Annual Flow (L/year)	1988 - 1992 Toxic Units[a]
Cooling Tower Blowdown	556×10^6	0.12	354×10^6	0.051
Non-treated Wastewaters	113×10^6	3.82	0	0
Treated Wastewaters	138×10^6	0.23	447×10^6	0.187
Total	807×10^6	4.17	801×10^6	0.238

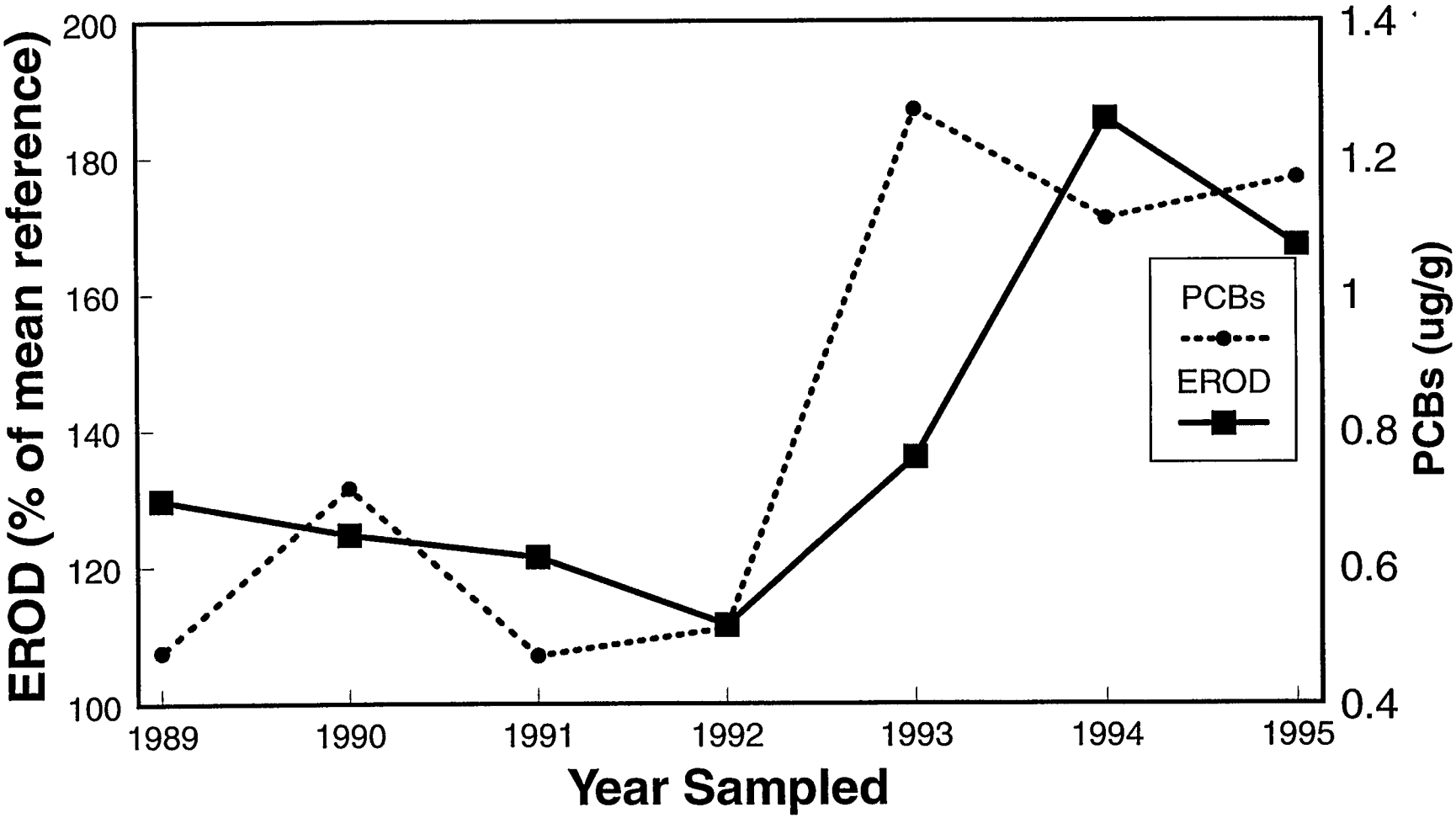
[a] Toxic Units = IWC/NOEC


LEGEND
ROADS
STREAMS
BIOACCUMULATION STUDY SITES
EFK = EAST FORK POPLAR CREEK
OAK RIDGE TURNPIKE
ILLINOIS AVE.
EAST FORK POPLAR CREEK
MONTANA AVE.
MILL BRANCH
Y-12
LAKE REALITY
SCARBORO RD
POPLAR CREEK
PINHOOK BRANCH
BEAR CREEK ROAD
Scale
Kilometers
1 0
Miles
1 0
N


Spatial Differences in Mean PCB
Concentrations in EFPC Sunfish, 1990-1
*Twice yearly sampling; 8 fish per site/seas
EFK 24.8
EFK 23.5
EFK 23.4
EFK 18.2
EFK 13.8
EFK 6.3
EFK 2.1
Sites


Temporal Trends in Mean PCB Concentrations in Sunfish
PCBs (ug/g)
0
2
4
6
8
EFK 24.8
EFK 23.5
EFK 23.4
EFK 18.2
EFK 13.8
EFK 6.3
EFK 2.1
85 May
85 Dec
86 May
86 Dec
87 May
87 Dec
88 May
88 Dec
89 May
89 Dec
90 May
90 Dec
91 May
91 Dec
92 May
92 Dec
93 May
93 Dec
94 Mar
Sampling Seasons

Sunfish Detoxification Enzymes (EROD) and PCB bioaccumulation



Summary: Ecological Recovery

- Although rates vary widely, ecological recovery can take years at some ORR sites
  - Effluent-dominated streams (e.g., East Fork Poplar Creek) have multiple stressors and longer recovery periods than noneffluent streams (e.g., McCoy Branch)
- Effects of contaminants can extend many kilometers downstream
  - Recovery occurs earlier at downstream sites (assuming no additional sources of impact downstream)
- Simple, quantitative, community-level parameters in combination with sensitive indicators of organism health provide the most accurate assessment of ecological health and recovery