1990 Md Anacostia River Basin Study

PART I: Habitat, Macrobenthic Invertebrate Communities, and Water Quality

PART II: Fisheries Rapid Bioassessments & The "Drop-In-The-Bucket-Brigades"

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ABSTRACT

Maryland tributaries of the Anacostia River System have been the focus of a third year of environmental study. As in previous studies, factors investigated include fish communities, benthic macroinvertebrate communities, microbiology, and selected physicochemical parameters. Fifteen study sites, distributed throughout Prince George's and Montgomery counties, were studied to help evaluate future and ongoing restoration efforts in the Anacostia Basin. In addition, students and teachers from intermediate and high schools located in both counties were incorporated into several small-scale restoration efforts aimed at assisting the migration of alewife herring and transplant stocking of resident fishes into Sligo Creek.

Fish communities were sampled using back-pack electrofishing in blocked-off sections of streams. Benthic macroinvertebrate communities were sampled with a surber sampler and dip nets. Fish collections and surber samples of benthic macroinvertebrates were analyzed by means of rapid bioassessment protocols (RBPs) which incorporated biological and habitat components. The biological component utilized metrics of community structure, community balance, and functional feeding group. The second component, habitat assessment, provided a qualitative prediction of the biological potential of an ecological situation. Integration of biological condition and habitat quality was used to make the overall site assessments for both fish and benthic macroinvertebrates.

Results of fish RBP indicate that stresses to fish communities in Lower Beaverdam Creek, Still Creek, and the mid-level and downstream stretches of the Northwest Branch can principally be attributed to habitat degradation. Mid-level Paint Branch and mainstem Northeast Branch fish communities show slight impairment in the absence of major water quality problems. Fish community impairment in the study area was judged to be primarily habitat-related. Several exceptions to this generalization are Sligo Creek and its principle tributary, Long Branch, and Little Paint Branch. Fish communities in these tributaries reflect problems most-closely associated with poor water quality.

Benthic macroinvertebrate RBP results indicate that stresses on benthic macroinvertebrate communities in Lower Beaverdam Creek, Little Paint Branch, and Paint Branch are mainly due to habitat degradation. Mainstem Northeast Branch and Northwest Branch (mid-level and downstream) exhibit benthic communities indicative of slight impairment in the absence of major water quality problems. As in fish RBPs, community impairment is largely habitat related. Sligo Creek and Long Branch showed impaired benthic communities with good habitat conditions. This situation suggests undetected problems (in our measurements) with water quality, particularly in Long branch. The headwater site on Sligo could simply be hypo-productive habitat.

Physicochemical parameters investigated included temperature, pH, dissolved oxygen, total dissolved solids and turbidity. Significant departures from state regulations were not detected consistently for any of these parameters. Violations of the pH standard were,

however, detected at a number of sites in July and August. Considering the widespread problems in the watershed with bank erosion and substrate embeddedness, increased turbidity levels are likely a problem during and immediately following storm events. However, this was not detected in our sampling.

Microbiological analyses (most probable numbers for total and fecal coliform densities; direct coliform counts, membrane filtration method) indicated that 84 percent of the samples taken exceeded state regulations for Class I waters. Based on fecal coliform contamination, the water quality of all tributaries investigated is below acceptable standards.

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INTRODUCTION

This study represents the second year of efforts to characterize the benthic macroinvertebrate communities and water quality of the Anacostia River watershed. Year one results (Stribling et al. 1990) were based on benthic samples, fecal coliform analyses and water physicochemical measurements taken from 26 sites.

The benthic macroinvertebrate community analysis was loosely modelled after rapid bioassessment protocols (RBPs) originally proposed by Plafkin et al. (1989). Modifications to the approach included the use of some metrics not specifically advocated in that original document and not taking into account variability in the biological potential of different stream types.

In order to more closely conform to the (RBP) approach documented by Plafkin et al. (1989), we have, for the year two analyses, used metrics provided by those authors and have also included habitat quality assessments. Although specific metrics differ, final results should be comparable to those of 1989; sampling techniques and effort are the same. As in Year One, this study includes analysis of the benthic macroinvertebrate communities, of fecal coliform contamination, and measurement of selected physicochemical characteristics.

Year Two of the Anacostia project focuses on 15 sites distributed throughout the watershed (Figure 1), many only upstream or downstream from sites sampled during 1989. The sampling of 41 sites within a two year time period provides baseline data against which future data might be compared.

STUDY SITES

The following descriptions are based on observations mostly independent of the habitat assessment process discussed later in this document. Please note that bank designation as either left or right is based on the observer looking downstream. Refer to Figure 1 for the location of each site in the watershed.

SITE 1

Location: Lower Beaverdam Creek just downstream of D.C. Highway 295 overpass and near Lower Anacostia Water Treatment Facility.

Description: Heavily disturbed site with cement sides and bottom under highway bridge; just upstream of bridge is automobile wrecking yard (south side); considerable amount of metal parts in stream channel both on and below end of cement; gravel substrate has built up in water flow on cement; below end of cement stream is normally deeper and very turbid with a mostly sandy bottom; paralleling stream on the north side are metrotracks and Highway 50; approximately 3 m in width.

SITE 2

Location: Mainstem Northeast Branch at Edmonston Park, M-NCPPC; northwest of Kenilworth Avenue (Hwy. 201) and Decatur Street intersection near level of Gallatin Street.

Description: Riparian vegetation minimal, consisting of 1-2 m of mixed willow and grasses growing through rip-rap; beyond this zone on left side are regularly-mowed soccer fields; vegetation on right side similar with less regular mowing; substrate mostly gravel on right side of stream grading into small boulders on the left; sporadic growth of filamentous algae; riffle areas large; depth varies to approximately 1 m maximum; width about 12 m.

SITE 3

Location: In Greenbelt Park just below confluence of Deep Creek and Still Creek; about 50 m northeast of Kenilworth Avenue (Hwy. 201) and Good Luck Road intersection.

Description: Riparian vegetative growths good, mostly deciduous trees providing nearly full canopy; some gaps allowing full sunlight to reach water surface; heavy leaf litter and woody debris input; some shrubbery, extensive growths of poison ivy; substrate variable from sand to large cobble; riffle areas common and of relatively large size; depth in riffles 8-10 cm; some pools up to 0.6 m; width up to approximately 4 m; no macrophytes and only minimal filamentous algae.

SITE 4

Location: Upper Beaverdam Creek on eastern side of BARC (Beltsville Agricultural Research Center) property; just downstream of first confluence west of Beaverdam Road and Baltimore-Washington Parkway (Interstate 295) crossover.

Description: Good riparian vegetative growth, mostly deciduous trees, some undergrowth; heavy input of leaf litter and woody debris; substrate sand, large gravel and small cobble, some areas of mud bottom; approximate 3 m^2 riffle headed by large pool up to about 1 m in depth, riffle 0.1 m in depth with substrate of gravel and small cobble; healthy growths of submerged macrophyte (tape grass, possibly Vallisneria) at beginning of riffle; stream about 1.5-2.0 m wide.

SITE 5

Location: Indian Creek off Old Baltimore Pike near Talbot Avenue; about 130 m upstream of Powder Mill Road (Hwy. 212).

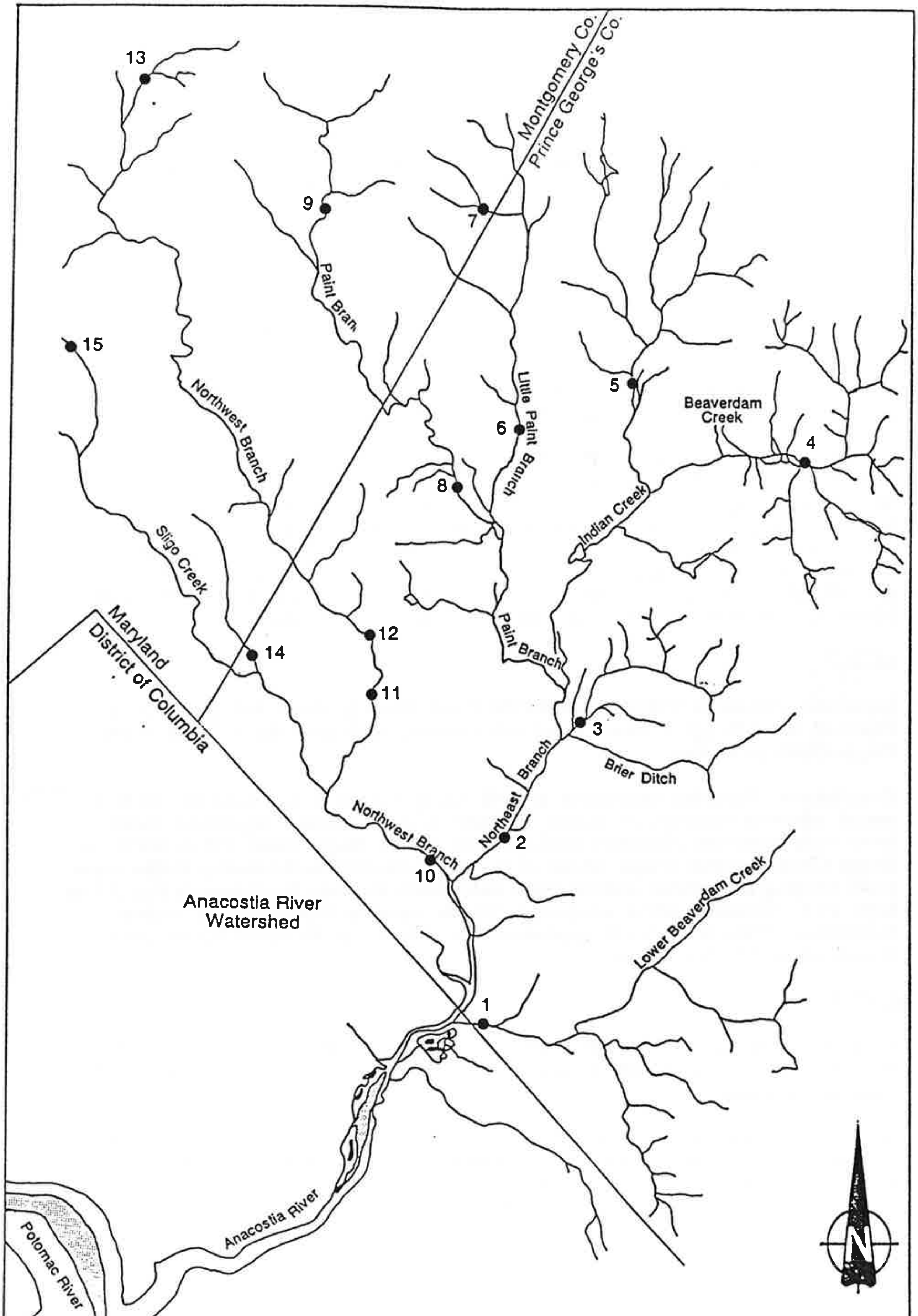

Figure #1: The Anacostia River Watershed, with sampling sites evaluated in 1990. Sites 7, 9, 13-15 are regarded as piedmont; the remainder, coastal plains

Description: Extremely heavy siltation occurring at confluence with unnamed Indian Creek tributary, grasses in siltation bank have germinated and are adding stability; riparian vegetation consists of mostly grasses; small riffle (less than 0.67 m^2) with pebble substrate and some emergent grasses; pools heavily silted; emergent grasses abundant; about 40 m downstream of concrete side-and-bottom channelization; rip-rap below channelization; riffle about 0.08 m deep and pools up to approximately 1 m in depth and 3 m in width.

SITE 6

Location: Little Paint Branch on BARC property between Baltimore Avenue (Hwy. 1) and Cherry Hill Road; about 300 m south of Sellman Road.

Description: Very little riparian vegetative growth; on west side, some small trees, shrub-type plants and grasses, on left side, actively eroding bank 3 to 4 m in height providing heavy input of cobble, gravel, and sand; large pool (approximately 1-1.5 m maximum depth) at head of riffle just downstream of cement weir; downstream of site, stream is bordered by larger trees, especially on left side; substrate on apparently more stable right side of channel covered by growths of green algae; substrate ranging from sand to large cobble; depth in riffles approximately 0.2 m; maximum width up to about 5 m.

SITE 7

Location: Northern tributary of Little Paint Branch; about 400 m north of Fairland Road/Briggs Chaney Road intersection; upstream about 90 m from Briggs Chaney crossing.

Description: Riparian vegetative growth fairly extensive but with recent (1-2 years) selective removal of timber on both sides of stream; vegetation mostly trees with relatively abundant undergrowth; refuse dump about 300 m north on Briggs Chaney above bridge, about 75 m east of stream; banks mostly stable, some roots hanging into water; downstream, outer bank in sharp bend near bridge 3-4 m high with extensive active erosion; substrate ranging from sand to cobble; numerous riffles with depth approximately 0.08 m, pools about 0.5 m deep; maximum width about 1.5 m.

SITE 8

Location: Paint Branch above confluence with Little Paint Branch; on BARC property approximately 800 m west of Cherry Hill Road and 200 m north of Buck Lodge Road.

Description: Riparian vegetation consisting almost solely of early colonizing species such as sycamore, black locust, blackberry, and abundant grasses; beyond this buffer zone on the immediate left side is a levee preventing flooding into the USDA agricultural experiment plots (mostly corn); on the right side is a relatively extensive rip-rap area with a 6-7 m buffer zone of the same type of vegetation and an old field situation beyond; sampling site is about 50 m downstream from a weir; substrate varies from large gravel to small boulder; large riffle areas up to about 0.3 m in depth, runs to 0.5 m, and some pools to about 1 m depth; large stream, at this point up to a width of about 12-13 m.

SITE 9

Location: Paint Branch about 40 m above East Randolph Road.

Description: Riparian buffer zone about 3-4 m on right side, fairly extensive on left; consists mostly of large trees interspersed with smaller trees, seedlings, and shrubs; groundcover mostly leaf litter; beyond narrow, right bank buffer zone is an approximately 2 acre mown field apparently for horseriding; substrate particles ranging from sand to small boulder; riffles very large and about 0.2 m in depth, runs to about 0.5 m deep, and some pools approximately 1.2 m deep; maximum width about 10-12 m.

SITE 10

Location: Northwest Branch about 1 km above confluence with Northeast Branch; 200 m above Rhode Island Avenue (Hwy. 1) at 40th Avenue.

Description: Riparian vegetative buffer zones approximately 3 m wide and consisting of early-colonizing species; outside of these strips are M-NCPPC mown grassy areas; substrate ranging from large gravel to cobble and some small boulder; large riffle area at 40th Avenue up to about 0.17 m deep, runs are about 0.6 m deep, and pools about 1 m in depth. The channel is approximately 20 m wide.

SITE 11

Location: Northwest Branch between East West Highway (Hwy. 410) and University Boulevard (Hwy. 193), off West Park Drive at Drexel Street.

Description: Riparian vegetation on either side at sampling site probably up to 50-60 m wide and consisting of large trees with vigorous undergrowths of shrubbery and seedlings; just upstream the right side riparian zone is thin, about 2-3 m of early-colonizing species, some large trees; beyond is large mown grassy area; outer banks in bends undergoing severe erosion; substrate ranging from sand to large cobble or small boulder; maximum depth in riffles 0.1 m, runs 0.15 m, and pools 1.2 m; maximum width approximately 10 m.

SITE 12

Location: Northwest Branch approximately 800 m north of University Boulevard (Hwy. 193); up West Park Drive to M-NCPPC parking lot, across mown field.

Description: Riparian vegetation on left side extensive, mixture of large trees with some undergrowth; ground cover consisting of leaf litter and patchy grasses; right side, some trees in sandy soil abruptly ending downstream with the mown field up to the actively eroding bank; extensive gravel bar formation; substrate with some sand, mostly gravel to cobble; maximum depths in riffles, 0.13 m, runs, 0.6 m, and pools, 1.2 m; maximum width approximately 4 m.

SITE 13

Location: Northwest Branch off Layhill Road at Layhill Park (M-NCPPC); east of soccer fields.

Description: Immediate riparian vegetation consisting of large trees providing abundant shading, some areas open and water surface receiving full sunlight at different times of day; width of buffer zone on left side extensive; on right, tree zone about 3 m wide changing into infrequently mowed, old-field-appearing situation; banks fairly stable, some erosion occurring on right side; substrate gravel to cobble, some small boulder; bar formation from mainly large gravel and small cobble; maximum depths of riffles, 0.15 m; of runs, 0.5 m; and pools, 1 m; maximum width approximately 6 m.

SITE 14

Location: Long Branch just above confluence with Sligo Creek; about 60 m northwest of Sligo Creek Parkway and New Hampshire Avenue (Hwy. 650) intersection; samples taken just below footbridge.

Description: Riparian vegetation patchy; residential area just above footbridge on right side, asphalt jogging/bike path on left side; buffer zone nearly non-existent; point of land at confluence with large trees, covered with trash and organic debris from episodic inundation; very little organic detritus in channel; banks mostly small to medium boulder; substrate pebble, cobble, and small boulder; maximum depth of riffle, 0.05 m; runs, 0.08 m; and pools, 0.5 m; maximum width approximately 1.5 m.

SITE 15

Location: Sligo Creek about 15 m above University Boulevard (Hwy. 193).

Description: Riparian vegetation good, dense canopy cover providing nearly complete shade, only filtered light reaching water surface; trees dominate with dense undergrowth of shrubs and vines; some banks becoming undercut on both right and left usually leaving roots hanging into water; some areas of banks covered with boulder, others actively eroding; substrate of some gravel, mostly cobble to an abundance of boulder; most rocks black; maximum depth of riffle 0.04 m; runs, 0.05 m; and pools, up to 0.6 m; maximum width approximately 1.5 m. Fifteen to 20 m upstream is stormwater management structure.

A. Macrobenthic Invertebrate Communities and Habitat Assessment

METHODS

Sampling. Benthic sampling was as in Stribling et al. (1990), that is, two 1 ft^2 samples at each site, on each sampling date, were taken. Sampling events were as follows: (1) April 11-May 1; (2) May 21-31; (3) July 18-20; (4) August 21-26; and (5) October 17-19. In addition, two qualitative samples were taken with a D-frame dip net. Surbers were used for sampling rocky substrate riffle or run areas; net samples were taken by stirring pool substrate and sweeping through the resulting cloudy water. As mentioned above, only the surber data has been used in metric calculation.

Samples were picked in the field, preserved in 70% ethanol, and returned to the laboratory for taxonomic analysis. Identifications were performed using primarily Merritt and Cummins (1984), Usinger (1956), Wiggins (1977), Edmunds et al. (1976), Schuster and Etnier (1978), Pennak (1978), Burch (1982), Brown (1982), Arnett (1968), Kissinger (1964), Johannsen (1934-35), and Stewart and Stark (1988).

Data Analysis. Six RBP metrics have been selected for use in this study: taxa richness, Hilsenhoff Biotic Index, percent contribution of dominant taxon, EPT index, ratio of shredder functional feeding group to total number of individuals, ratio of scraper functional feeding group to scrapers plus filter collectors, and ratio of number of individuals in EPT taxa to number of individuals in Chironomidae. Following are brief descriptions of these metrics.

1. Taxa Richness. Reflects health of the community through a measurement of the total number of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability.

2. Hilsenhoff Biotic Index (HBI). Tolerance values range from 0 to 10. The index was developed (Hilsenhoff 1982) to summarize the various tolerances of the benthic arthropod community with a single value. The formula for calculating the HBI is

$$HBI = \Sigma \frac{x_i t_i}{n}$$

where x_i = number of individuals within a taxon,

t_i = tolerance value of a taxon, and

n = total number of individuals in the sample.

Following Plafkin et al. (1989), the HBI was modified to assess the total benthic community and not just the arthropods.

3. EPT Index. This value generally increases with increasing water quality. This index is the total number of distinct taxa (in this study, counts at generic level) within the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). It summarizes the taxonomic richness of three groups of insects which are considered to be generally pollution intolerant.

4. Percent contribution of dominant taxon. The percent contribution of the dominant taxon to the total number of organisms uses abundance of the numerically dominant taxon relative to the rest of the population as an indication of community balance at the species level. A community dominated by relatively few species would indicate environmental stress.

5. Ratio of EPT to Chironomidae. The ratio of the number of individuals of Ephemeroptera, Plecoptera, and Trichoptera to the number of individuals of Chironomidae. Uses this ratio as a measure of community balance.

6. Ratio of Shredder Functional Feeding Group to Total Number of Individuals Collected. The abundance of the Shredder Functional Group relative to all other individuals allows evaluation of potential impairment as indicated by the detritus-based shredder community. Higher ratios would generally indicate better conditions.

7. Ratio of Scraper Functional Feeding Group to Scrapers Plus Filter Collectors. The relative abundance of scrapers and filtering collector metric reflects the riffle/run community foodbase. When compared to a reference site, shifts in the dominance of a particular feeding type indicate a community responding to an overabundance of a particular food source. Scrapers increase with increased diatom abundance and decrease as filamentous algae and aquatic mosses increase. However, filamentous algae and aquatic mosses provide good attachment sites for filtering collectors and the organic enrichment often responsible for overabundance of filamentous algae can also provide fine organic particles used by filterers.

These seven metrics form the basis of the data analysis approach used to assess the benthic community in the cobble substrate. More detail on the description of these particular metrics can be found in Plafkin et al. (1989) and Barbour et al. 1991 (in review).

Scoring criteria for the metrics are based on an equal trisection of the metric value range. Each section is assigned 2, 4, or 6 points. A summary of the metric scoring criteria is given in Tables 1-2. Once the criteria are established and scores assigned to each metric value, the scores are totalled for each site. These site totals are compared to the appropriate reference site for percentage comparability.

TABLE 1 COASTAL PLAINS SCORING CRITERIA FOR THE SEVEN METRICS USED IN THIS STUDY. FOR A DESCRIPTION OF THE METRICS AND THEIR DEVELOPMENT, SEE TEXT (pp. 7-8).

		SCORING CRITERIA		
Metric	Points	2	4	6
1) Taxa Richness		0-10	11-20	21-30
2) HBI		8.2-5.5	5.4-2.7	2.6-0
3) EPT Index		0-3.2	3.3-6.6	6.7-10
4) % Contr. Dom. Tax.		65-44	43-22	21-0
5) Shr/Tot		0-0.09	0.10-0.17	0.18-0.27
6) EPT/(EPT + Chir)		0-0.32	0.33-0.63	0.64-0.94
7) Scr/(Scr + Fil. Coll.)		0-0.25	0.26-0.50	0.51-0.75

TABLE 2 PIEDMONT SCORING CRITERIA FOR THE SEVEN METRICS USED IN THIS STUDY. FOR A DESCRIPTION OF THE METRICS AND THEIR DEVELOPMENT, SEE TEXT (pp. 7-8).

	SCORING CRITERIA		
Metric	Points 2	4	6
1) Taxa Richness	0-5	6-14	15-23
2) HBI	7.1-4.8	4.7-2.4	2.3-0
3) EPT Index	0-4	4-8	9-13
4) % Contr. Dom. Tax.	53-36	35-18	17-0
5) Shr/Tot	0-0.018	0.019-0.04	0.041-0.062
6) EPT/(EPT + Chir)	0-0.2	0.3-0.5	0.6-0.9
7) Scr/(Scr + Fil. Coll.)	0-0.11	0.12-0.25	0.26-0.4

Habitat Assessment. The condition of each site under study is rated as a function of its capacity to support a healthy biological community. The approach developed by Plafkin et al. (1989) with further modification (Barbour and Stribling 1991 [in press]) uses components derived from a number of authors, primarily Ball (1982) and Platts et al. (1983).

Twelve parameters are rated qualitatively in the field using the sheets given in Appendix A. The four primary parameters (nos. 1-4) are weighted more heavily (maximum 20 pts.) than the secondary (nos. 5-8, max. 15 pts.) or tertiary (nos. 9-12, max. 10 pts.). Primary parameters directly affect aquatic community vigor and characterize specific microhabitat features (Plafkin et al. 1989, Barbour and Stribling 1991 [in press]). Secondary parameters rate more gross characteristics such as channel morphology. Tertiary parameters focus on riparian vegetation and other features, and on bank structure.

Reference Site Selection. This watershed is recognized as being composed of two physiographic regions, generally divided along Route 29 and the Montgomery and Prince George's County line. East of this zone of transformation is considered coastal plains; west is considered piedmont (J. Cummins, personal communication). Reference sites were selected, one each in these two regions, to represent the "best attainable conditions" in the watershed. The coastal plains reference site, 4, is located on the eastern end of upper Beaverdam Creek on BARC property near the B-W Parkway overpass. It has consistently produced a high diversity of macroinvertebrates over seven months of sampling. Selection of this site has also been endorsed by a fisheries biologist (J. Cummins, personal communication).

Upper Northwest Branch, as evaluated in Stribling et al. (1990), exhibits consistently outstanding diversity and abundance of macroinvertebrates. Site 13 (downstream from the reference site of the 1989 study) was chosen to represent the best attainable conditions for the five piedmont sites of this study. Appropriateness of this site as reference is supported by 1989 results and recommendations of fisheries biologists.

RESULTS

Habitat Assessment (habitat quality) (Table 3). For sites occurring in the coastal plains region, scores range from the lowest for Site 1 (65 points, 42% comparable to the reference site) to Site 12 (140 points, 90% comparable). The five sites occurring in the piedmont region produced habitat scores ranging from 127 points (Site 7, 81% comparable to reference) to 157 points (Site 14, 99% comparable). The piedmont areas of the watershed, overall, scored higher reference site comparability due to lower levels of urbanization and thus imperviousness (MWCOG, 1990).

Macroinvertebrates. A taxonomic listing of benthic macroinvertebrates is presented in Appendix B along with numbers of individuals at each sampling date. Insects are also segregated into separate life stages. Table 4A gives a summary of the surber portion of this appendix; Table 4B summarizes the net samples. Numbers listed are combined totals from the five sampling events.

TABLE 3 HABITAT ASSESSMENT SCORES. ASTERISKS INDICATE THOSE SITES CONSIDERED TO BE IN THE PIEDMONT AREA OF THE WATERSHED, THE REMAINDER, IN THE COASTAL PLAINS. FOR HABITAT PARAMETERS, SEE APPENDIX A. SITES MARKED WITH "+" INDICATE THE REFERENCE SITES, 4 FOR THE COASTAL PLAINS SITES, 13 FOR THE PIEDMONT SITES.

Habitat Parameter	SITES														
	1	2	3	4+	5	6	7*	8	9*	10	11	12	13*+	14*	15*
1	11	10	19	20	11	19	16	19	19	10	14	19	19	20	19
2	6	11	7	16	8	11	10	14	12	9	10	15	16	16	19
3(b)	6	18	20	19	19	20	20	13	20	20	19	20	20	20	15
4	10	7	20	19	7	17	19	10	19	5	20	19	20	19	10
5	1	3	8	13	4	8	7	13	12	3	4	11	13	13	11
6	1	6	8	13	7	8	7	7	8	5	5	11	10	14	14
7	1	12	15	15	8	15	14	12	13	12	13	15	14	15	11
8	10	7	9	7	3	8	12	10	13	11	19	7	11	14	14
9	7	10	1	8	9	1	2	10	6	8	4	5	8	9	7
10(a)	3	10	9	9	5	6	9	10	10	10	9	7	9	8	9
11	8	10	8	8	8	9	8	9	8	9	9	8	8	8	8
12	1	1	8	9	1	5	4	3	7	6	6	3	7	1	8
Total Rating Points	65	105	132	156	90	127	128	130	147	108	132	140	155	157	145
Percent Comparison To Reference	42	67	85	100	58	81	83	83	95	69	85	90	100	99	94

(a) First parameter alternative.
(b) Second parameter alternative.

TABLE 4A SUMMARY OF MACROINVERTEBRATES COLLECTED BY SURBER AT EACH OF THE 15 SITES UNDER STUDY. NUMBERS REPRESENT TOTALS FROM A COMBINED TEN SURBER SAMPLES TAKEN DURING FIVE SAMPLING EVENTS, APRIL-OCTOBER 1990.

	SITES														
TAXON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Turbellaria				2											
Tricladida													1		
Nemertea					1			4		1					
Nematoda						4				1					
Oligochaeta	49	19	11	1	162	4	12	20	7	20	53	9	2	12	26
Glossophonidae					1										
Asellus			1	5			2								
Gammaridae					1										
Crangonyx				1	2									2	1
Astacidae						1						1	1		1
Hydracarina		2		2	6	10		6	4	3	4	2			
Collembola		1													
Baetis	2	2	4	1	17	14	2	7	24	7	5	2	2	5	44
Centroptilum				1				1							
Pseudocloeon				3					6				1		
Ephemerella									14				1		
Serratella															
Eurylophella				3					2						
Heptageniidae									3						
Stenonema				17	1				12	3	1		29		
Isonychia						1		11	15	1			25		
Stenacron										1					
Tricorythodes		5				2									
Calopteryx				3	1										
Boyeria vinosa				1									1		
Dromogomphus				1											
Cordulegaster				1				1							
Amphinemura				15									1		
Nigronia				2			1								
N. fasciatus			1				1								
N. serricornis			1	25				1	6				1		
Glossosoma									7						
Hydropsychidae			6	1		2	1	3	5			1			
Cheumatopsyche			18	29	3	5	8	2	11				22		1
Diplectrona							3								
Hydropsyche		2	46	85	22	39	7	129	25	15	2	9	3		
H. betteni			88	36	5	8	11	30	17	2	28	2	9	1	
H. morosa grp.								15	30		3	1	1		
Hydroptila		5						2							
Polycentropus				1											
Philopotamidae									2						
Chimarra									1						

Table 4A (Cont.)

TAXON	SITES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dolophilodes				1					18						
Helichus			1			1									1
Ancyronyx variegata									10	1					
Dubiraphia				1											
Macronychus glabratus					1										
Optioservus				3				35	34				10		
Stenelmis				13				2	1				3		1
Berosus		2						2							
Ectopria								1							
Psephenus herricki													1		
Chironomidae		60	12	19	81	19	40	13	25	92	12	9	11	24	24
Tanypodinae	1		4												
Empididae				1		1									
Hemerodromia								1		1			1		
Simuliidae			1	12					1		1			1	6
Prosimulium			1		2										1
Simulium			1	37	9										
Antocha			1					1	1		1	1			
Tipula			1	2	3	1	1				1	12	3		6
Telmatoscopus											1				
Ancylidae									1		2		1		
Lymnaeidae															1
Physella heterostropha		1		4	1		2								
Helisoma					1										
H. anceps					1										
Total Taxa	4	10	15	30	18	13	12	20	23	12	13	10	22	6	11
Total Number of Organisms	92	99	198	329	321	108	91	287	282	147	114	49	130	45	113

TABLE 4B SUMMARY OF BENTHIC MACROINVERTEBRATES COLLECTED FROM NET SAMPLES AT EACH OF THE 15 SITES UNDER STUDY. NUMBERS REPRESENT TOTALS FROM A COMBINED 10 NET SAMPLES TAKEN DURING FIVE SAMPLING EVENTS. APRIL-OCTOBER 1990.

	SITES														
TAXON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tricladida		1								1					6
Turbellaria		2													
Rhabdocoela													1		
Nemertea									1						
Oligochaeta	15	8	10	4	45	6	1	10	1	15	24	25	2	7	22
Hirudinea		1													
Rhynchobdellida								4							
Helobdella triserialis												1			
Cyclopoida							1								
Asellus			10	8						1			2		4
Crangonyx		2	1	4	5	4		3	2	4		2			2
Hyalella azteca		3		6											
Astacidae							2	1					4		
Hydracarina		9	1	5		3		9	4		2	2	1		1
Baetis	1		1		2	19		12	1	4		2	1	1	1
Centroptilum			1	1	4	4		3	5	1			14		
Caenis							1		6				7		
Eurylophella				43					15			2	13		
Heptageniidae									4						
Stenonema				2					7						
Stenacron									2						
Leptophlebiidae													1		
Paraleptophlebia				1											
Isonychia									3				1		
Tricorythodes						2		1							
Zygoptera			1												
Calopterygidae													2		
Calopteryx			9	10	4		10	1	8				3		
Hetaerina													3		
Lestes														1	
Coenagrionidae				1	6								1		
Argia		1		1	1		1	8	2				8		
Enallagma					2		4						1		
Ischnura					2										
Lestidae								1							
Archilestes											1				
Anisoptera													1		1
Boyeria				1	1										
Boyeria vinosa				2			2	6	3			1	4		
Cordulegaster				1											
Gomphidae				2									1		
Dromogomphus				3											
Stylogomphus									1						
Libellulidae											1		1		
Plathemis					1										

Table 4B (Cont.)

TAXON	SITES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Macromiidae													1		
Macromia								2				1	1		
Hemiptera		1								1					1
Nigronia serricornis				2				1	2						
Sialis			1	4									1		
Hydropsychidae						1		1		1					
Cheumatopsyche				1											
Diplectrona				1											
Hydropsyche		3	1	1		3			1		2	3			
H. betteni		1				3						1			
H. morosa grp.											1				
Ptilostomis			1												
Lepidostoma								1							
Oecetis				1											
Triaenodes				1											
Polycentropus				1											
Stenopelmus											1				
Helichus				3			2		7		1		1		
Dytiscidae					4									3	
Deronectes														1	
Derovatellus							1		1						
Elmidae				4									1		
Ancyronyx variegata			1	5				1			1				
Dubiraphia				10									2		
Macronychus				1									1		
Promoresia				18									10		
Stenelmis				1											
Dineutus				2											
Gyrinus													2		
Hydrophilidae		1						1					1		
Berosus		10									1				
Hydrochus				1				10							
Hydrobius							1								
Ceratopogonidae				1				1					1	2	
Chironomidae	6	44	23	22	48	15	10	25	12	23	20	17	26	20	17
Tanypodinae		1	3	1						2					
Culex															1
Hemerodromia			1												
Simuliidae				6		2									
Prosimulium										1					
Simulium				3											
Tipulidae							1								
Antocha			1												
Bittacomorpha													1		

Table 4B (Cont.)

TAXON	SITES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tipula								1	1		1	2			
Lymnaeidae		1				28	1								4
Physella heterostropha		5	1	1	18	4	1	4			1		6		27
Planorbidae				1	5										
Planorbella										1					
Total Number of Taxa	3	15	16	39	14	10	13	21	21	11	12	12	31	5	13

Metrics (Table 5). Total metric scores for coastal plains ranged from 14 points at 47% comparability to the reference site (Site 1) to 26 points (87% comparability; Sites 6 and 8). The reference site itself (Site 4) totalled 30 points.

Piedmont sites ranged from 42% comparability to reference (Site 14, 16 points) to 100% comparability (Site 9, 38 points). The piedmont reference site (13) scored 38 total metric points. Intermediate site ranks are Site 15 (24 points, 63%), 7 (20 points, 53%), and 14 (16 points, 42%).

Figure 2 illustrates the relationship between Metrics 1 and 4 at the 15 sites investigated. The graph shows a relationship between these two community characteristics which is generally negative.

Due to the difficulty in standardizing the area sampled with D-frame dip nets, these samples were not employed in metric calculation. However, taxonomic analysis has been completed and information may be drawn from the resulting list and abundance information (Table 4B).

Net samples produced more taxonomic diversity than the surbers because a variety of sub-habitats were often included such as pools, macrophyte beds, and root mats. The sites producing the highest number of distinct taxa in these net samples were, as expected, the reference sites on Beaverdam Creek (Site 4, 39 taxa) and upper Northwest Branch (Site 13, 31 taxa). The lowest number of taxa were found at sites on Long Branch (Site 14, 5 taxa) and on Lower Beaverdam Creek (Site 1, 3 taxa). Only six sites had "most abundant taxa" other than Oligochaeta and Chironomidae, Sites 4, 6, 7, 8, 9, and 13. Abnormal abundance levels of these two taxa often suggest stress conditions.

Integration: Habitat quality (habitat assessment) versus biological condition (metrics). Percent comparability of each site to the reference for habitat quality and biological condition are presented (Table 6). These values are plotted against each other to graphically illustrate their integration (Figure 3).

ASSESSMENTS

In this study we have developed integrated assessments of the aquatic ecological conditions at sites distributed throughout the watershed. The assessments presented in this section are based only on RBP which is itself an integration of physical habitat quality and biological condition (Plafkin et al. 1989, Barbour and Stribling 1991 [in press]). Interpretation of site plots (Figure 3; p. 23) depends on an understanding that there are essentially three parts to the curve. Sites which fall near the sigmoid curve indicate the predictable condition of the biological community in response to habitat quality. This relationship can be expected only in the absence of poor water quality. Sites which fall into the lower right-hand area indicate the depression of biological condition in habitat which has the capacity to support a healthy biological community. This is usually an indication of toxic conditions. Artificial (and usually temporary) elevation of biological condition due to organic enrichment would put sites in the upper left-hand area of this graph.

TABLE 5 CALCULATED METRIC VALUES (AND SCORES). SCORES (IN PARENTHESES) DERIVED FROM APPLICATION OF CALCULATED VALUES TO THE CRITERIA GIVEN IN TABLES 1 AND 2. SCORE TOTALS AND PERCENT COMPARABILITY TO REFERENCE SITES ARE ALSO GIVEN.

METRIC	SITES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1) Taxa Richness	(2) 4	(2) 10	(4) 14	(6) 30	(4) 18	(4) 13	(4) 12	(4) 20	(6) 23	(4) 12	(4) 13	(2) 10	(6) 22	(4) 7	(4) 11
2) HBI	(2) 8.14	(2) 6.57	(2) 5.53	(4) 4.52	(2) 7.82	(4) 5.23	(2) 6.05	(4) 4.80	(4) 4.03	(2) 6.25	(2) 7.75	(2) 5.74	(4) 3.8	(2) 6.93	(2) 6.72
3) EPT Index	(2) 1	(4) 4	(4) 4	(6) 10	(4) 5	(4) 6	(4) 5	(6) 8	(6) 13	(4) 6	(4) 5	(4) 4	(6) 9	(2) 2	(2) 2
4) % Contribution of Dominant Taxon	(2) 53.3	(2) 60.6	(2) 44.4	(4) 25.8	(2) 50.5	(4) 36.1	(2) 43.9	(2) 44.9	(6) 12.1	(2) 62.6	(2) 46.5	(4) 24.5	(4) 22.3	(2) 52.2	(2) 38.9
5) Shredders/Total	(2) 0	(2) 0	(2) 0.01	(2) 0.07	(2) 0.01	(2) 0.02	(2) 0.03	(2) 0	(2) 0	(2) 0	(2) 0.01	(6) 0.27	(6) 0.05	(2) 0	(6) 0.06
6) EPT/(EPT + Chiron)	(2) 0.05	(2) 0.19	(6) 0.91	(6) 0.90	(4) 0.37	(6) 0.79	(4) 0.44	(6) 0.94	(6) 0.89	(2) 0.24	(6) 0.77	(4) 0.63	(6) 0.89	(2) 0.20	(6) 0.656
7) Scr/(Scr + Fil Coll)	(2) 0	(6) 0.75	(2) 0	(2) 0.15	(2) 0.09	(2) 0	(2) 0.06	(2) 0.15	(6) 0.33	(2) 0.22	(2) 0.08	(2) 0	(6) 0.41	(2) 0	(2) 0.11
Score Totals	14	20	22	30	20	26	20	26	38	18	22	24	38	16	24
% Comp Ref Site	47	67	73	100	67	87	53	87	100	60	73	80	100	42	63

In general, the order these evaluations are presented is beginning with mainstem and covering tributaries, east to west. This is also the order of the site-numbering system.

Lower Beaverdam Creek is a heavily stressed stream likely due to a combination of water quality and habitat problems. These findings agree with results from the 1989 survey (Stribling et al. 1990). Obvious habitat degradation would itself prevent development of a healthy benthic community in the absence of poor water quality.

Northeast Branch was found to have a benthic community indicative of slightly impaired biological conditions at the single mainstem site (Site 2). From these analyses there appears to be little water quality impairment; limitations to invertebrate community development apparently is largely habitat-related.

At the mainstem of the Greenbelt Park drainage system, Site 3 exhibited a slightly impaired benthic community with some presence of habitat degradation, mostly in the form of embeddedness resulting from bank erosion. There is also indication of some water quality problems.

Near the eastern end of Beaverdam Creek, Site 4 served as the coastal plains reference site. It is in very good condition. These results are in sharp contrast to those found in 1989 at the site downstream from BARC where the benthic community was found to be in poor condition.

Indian Creek (at Site 5) showed a slightly impaired benthic community in habitat conditions normally expected to be nonsupporting of resident biota. Such a situation suggests there may be some problem with organic enrichment in this area. There is an impairment of the benthic community in relation to the upstream Indian Creek site sampled in 1989 (Stribling et al. 1990). Between these two sites there is heavy commercial development and an approximate 1 km stretch of cemented channelization. These features have contributed to heavy siltation and nutrient input.

Little Paint Branch at its downstream site (Site 6) was found to have only a slightly disturbed habitat and a non-impaired benthic community. This integration provides no indication of water quality problems. One side of the channel at this site is bordered by an extremely actively eroding bank. Sedimentation and embeddedness probably limit benthic community development downstream as it does on that side of the stream at the site. The substrate on the right side of the stream is in very good condition; it is in this area where sampling occurred. Superficially, there appears to be an improvement in conditions of Little Paint Branch over the results of 1989. This may be due to specific locations of exact sampling areas rather than to actual problems with water quality.

Selected Metrics at Sites in the Anacostia River Watershed

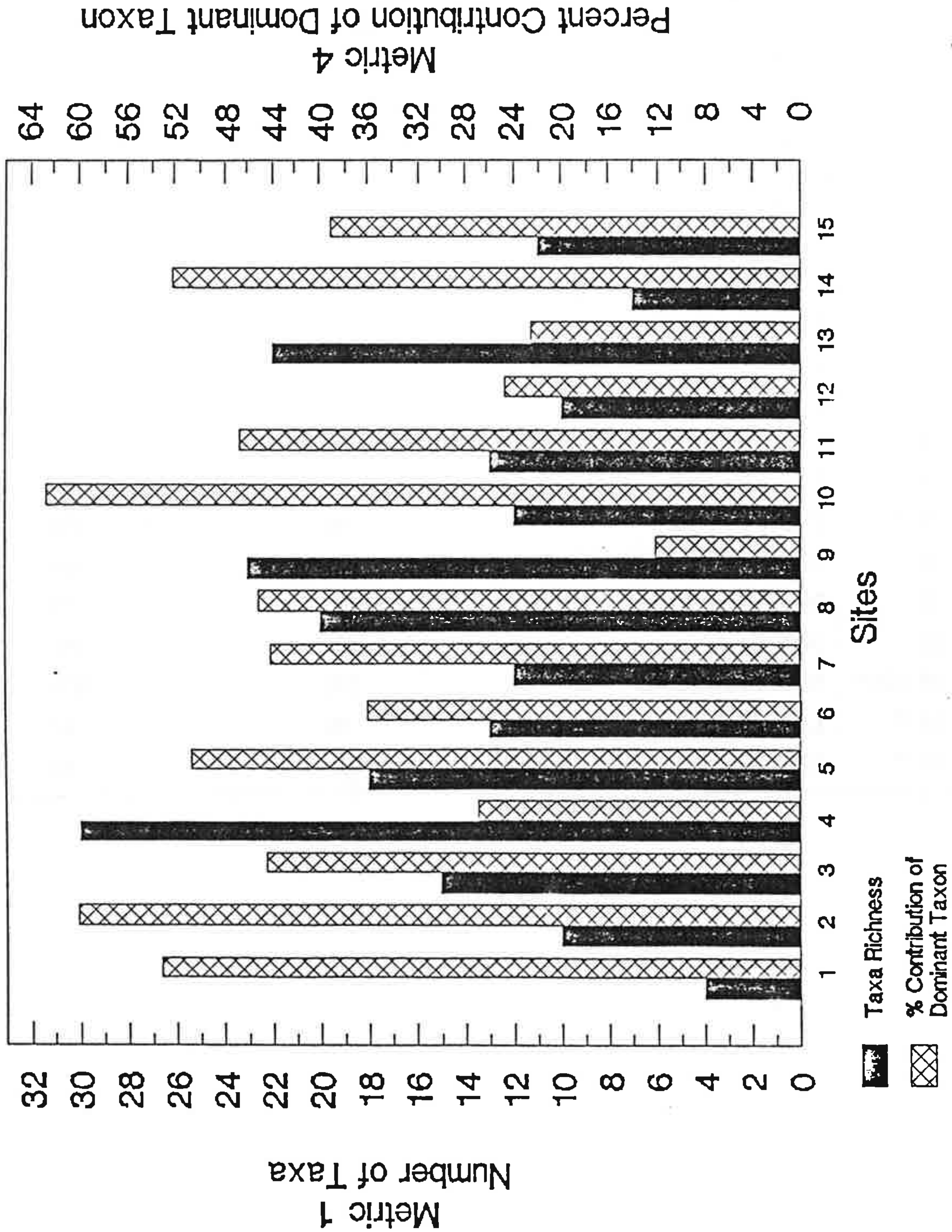

TABLE 6 ANACOSTIA RIVER WATERSHED STREAM SAMPLING SITES; PERCENT COMPARABILITY TO STUDY REFERENCE SITES, 4(R) FOR COASTAL PLAINS AND 13(R) FOR PIEDMONT. THESE VALUES ARE PLOTTED IN FIGURE 3. SITES MARKED WITH AN ASTERISK (*) ARE PIEDMONT.

Sites		Habitat Quality (% of reference)	Biological Condition (% of reference)
1	Lower Beaverdam Creek	42	47
2	NE Branch (mainstem)	67	67
3	Greenbelt NP Drainage	85	73
4 (R)	Beaverdam Creek	100	100
5	Indian Creek	58	67
6	Little Paint Branch	82	87
7 *	Little Paint Branch (trib.)	83	87
8	Paint Branch	83	87
9 *	Paint Branch	95	100
10	NW Branch (mainstem)	69	60
11	NW Branch	85	73
12	NW Branch	90	80
13 (R)*	NW Branch	100	100
14 *	Long Branch	99	42
15 *	Sligo Creek	94	63

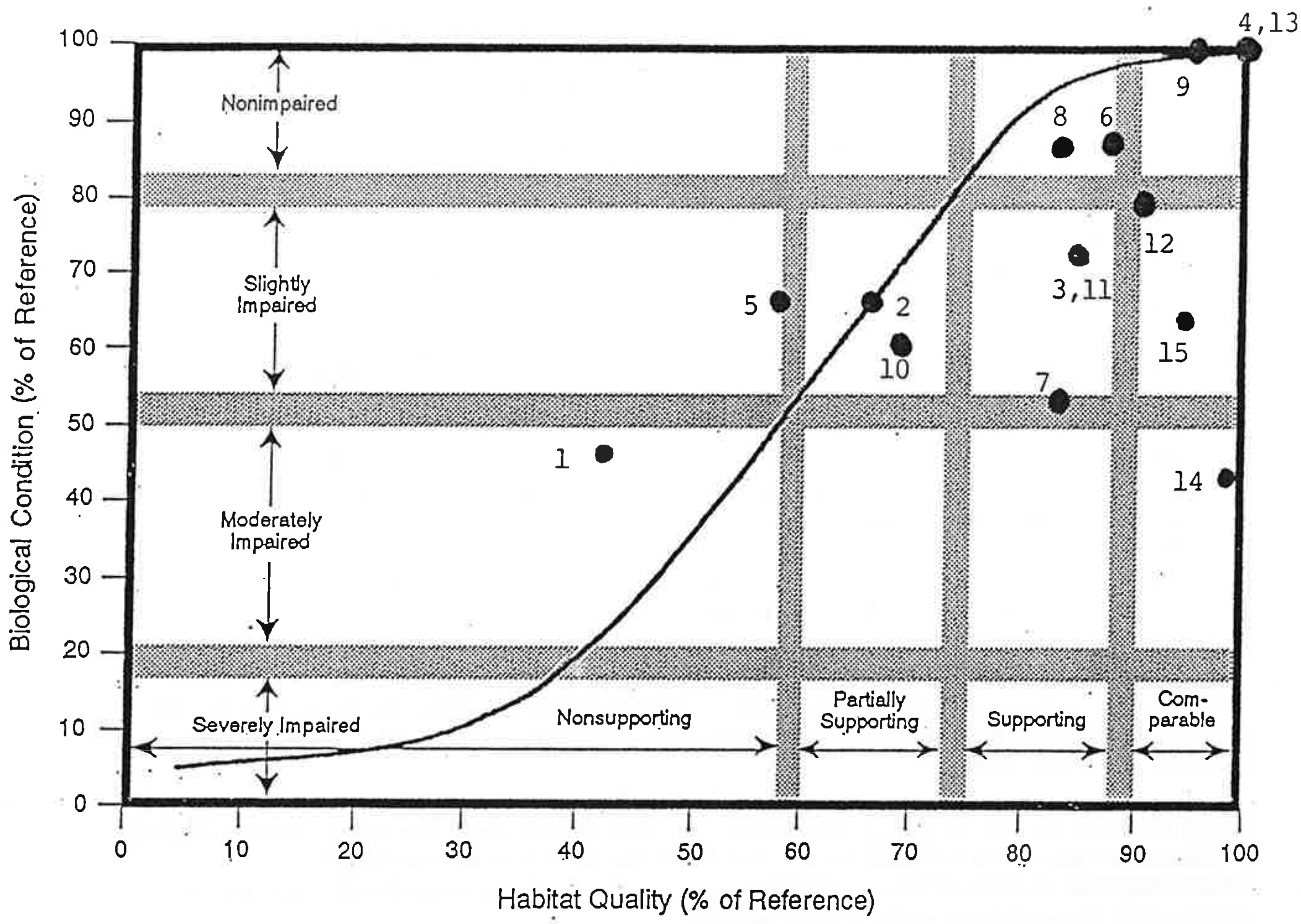

Figure 3. Relationship between habitat quality and biological condition (as percentage of the reference site) at each of the 15 sites studied. Values and stream names are given in Table 6. Reference sites: 4 (coastal plains) and 13 (piedmont).

Site 7, located on an unnamed tributary of Little Paint Branch upstream of Site 6, exhibits some indication of water quality degradation. This may be a result of the new residential development upstream at the sampling site.

Paint Branch, with Sites 8 (downstream) and 9 (upstream), showed non-impaired benthic macroinvertebrate communities. Habitat quality at the downstream site would be increased by more mature riparian growth. Apparently, however, there is little habitat limitation in this case. Site 9 could have easily served as a reference site. These results are in agreement with those found the previous study year (Stribling et al. 1990).

Mainstem Northwest Branch (Site 10), very similar to that of Northeast Branch (Site 2), showed an integrated relationship that would be expected from a lotic situation in the absence of major water quality problems. It exhibits habitat degradation and a slightly impaired benthic biota. The depressed invertebrate community is in somewhat better condition than found several hundred meters upstream in 1989. This is likely due to decreased siltation in this particular downstream stretch. Upstream, Sites 11 and 12 show slightly impaired benthic communities. At both sites there is major bank failure, sedimentation, and bar formation. In addition to this continuing habitat degradation, there appears to be some problems with water quality though not indicated in our analyses. The northernmost upstream site on Northwest Branch, Site 13, served as the piedmont reference site and is in good condition. Results from the intermediate Northwest Branch sites and the upstream site closely correspond with those from similarly located sites last year.

Long Branch at Site 14 has good, clean, silt-free substrate. The only major habitat problem seems to be related to the buffer zone which is non-existent. Macrobenthic invertebrate communities are substantially impaired, a situation likely due to problems with water quality.

Sligo Creek, near its headwaters at Site 15, showed benthic communities slightly impaired with habitat conditions comparable to the reference. This is indicative of water quality degradation. Results from the two years of survey do not seem to be contradictory.

B. Water Physical/Chemical Parameters

METHODS AND EQUIPMENT

The physical/chemical parameters measured in this study are based upon Standard methods (1985). The five parameters examined were water temperature, pH, dissolved oxygen, total dissolved solids, and turbidity. Four of the five parameters were collected in the field, with turbidity being measured in the lab from samples taken from the field. All data were collected with equipment following the manufacturers suggested calibrations and procedures.

Stream pH was measured in the field using a Hanna instruments microprocessing pH meter (model no. H18424). The meter was calibrated daily before going out into the field and immediately before a measurement was taken at each site.

Total dissolved solids measurements were taken from a Hach model 44600 conductivity/TDS meter. The meter was calibrated each morning before going into the field with a sodium chloride solution.

Turbidity, measured in nephelometric turbidity units (NTU), was evaluated in the lab using an HF scientific turbidimeter model DRT-100. The turbidimeter was calibrated immediately before each sample was run.

Dissolved oxygen was measured with a YSI Model 54 DO meter. The probe membrane and potassium chloride solution were replaced weekly or immediately in the field upon signs of bubbles.

Water temperature is based on the average of readings obtained from the pH meter and the dissolved solids meter. Further readings were taken with the DO meter.

RESULTS (Appendix C)

Results of the physical/chemical parameter collection are presented in Tables C1-C5. Dissolved oxygen measurements are given separately in Tables C6-C10.

DISCUSSION

Standards/Criteria

As outlined in the Maryland Water Pollution Control Regulations, Chapter 02, Section .02, subsection B.(3) "Water Quality Criteria": the criteria for Class I Waters: water contact recreation, aquatic life, and water supply; the normal ph may not be less than 6.5 or greater than 8.5, turbidity may not exceed 150 NTUs or a monthly average of 50 NTUs; dissolved oxygen concentrations may not be less than 5.0 mg/L at any time, and the maximum temperature not exceed 32°C.

pH

Observed pH measurements were generally in the recommended range (Figure 5). In both July and August this range was exceeded at a number of sites indicating a possible biotic stress on the watershed overall during these months. No site was particularly more abnormal than any other site in terms of pH.

Total Dissolved Solids

Total dissolved solids (TDS), though not generally considered a primary stress-producing factor to the stream, can be detrimental if the dissolved substances are toxic in nature to biota. However, water with high dissolved solids generally tastes bad and may cause illness upon consumption. No specific toxic substances were assayed in this study. General TDS ranged from 0.056 to 0.185 g/L (Figure 6), with a mean of 0.096 g/L for all sites over the five months sampled. Standard Methods (1985) recommends that 0.5 g/L are desirable for human consumption.

Turbidity

Turbidity, an important factor for primary producers such as algal communities, can be a critical parameter in assessing water quality. Turbidity was well below the recommended levels (Figure 7), ranging from as low as 0.34 up to 60.0 NTUs with a mean value of 4.96 NTU. Storm events (as observed in the previous year of study of this watershed), on the other hand, can create intense periods of high turbidity over the entire study area. This was not observed since no measurements of physical/chemical parameters were taken during a storm event for this study period.

Dissolved Oxygen

Dissolved oxygen (DO) is critical in its relationship to the suitability of aquatic habitat for life. In concurrence with a 1985 MWCOG report (cited in MWCOG [1989]), DO does not appear to be a problem in the watershed. In none of the 75 measurements (Tables C6-C10) did the reading violate the Maryland regulation minimum of 5.0 mg/L (Figure 8). The lowest recorded reading was 6.2 mg/L (June 28) in Lower Beaverdam Creek.

Water Temperature

Water temperatures did not exceed the regulation maximum 32°C at any of the sample sites during the months of study (Figure 4). This indicates that there does not seem to be any particular problem of thermopollution in these tributaries.

In terms of the physical/chemical parameters observed there does not seem to be a constant state of stressful conditions on the watershed as a whole. There are certain stress periods, that is, times of low pH, high turbidity and so on, that can affect the overall health of the streams. A monthly sampling schedule can fail to detect certain conditions that can be transitory on the short term but of vital influence on the aquatic system in the long term.

C. Microbiology

METHODS

The analysis of water quality using coliform density enumeration was continued in this, the second year of study of tributaries, of the Anacostia River. The 15 sites covered in this study were sampled on a monthly basis. Procedures used to determine the total coliform and fecal coliform levels of water samples taken from these tributaries conformed to those outlined in Standard Methods (1985). Analysis of samples using the multiple-tube fermentation method yielded a Most Probable Number (MPN) for both total and fecal coliform densities (using Escherichia coli as the indicator organism). Also, a direct count of coliforms was taken by the membrane filtration method.

RESULTS

Results are summarized in Tables 7-10 for the seven months of sampling and testing (April through October).

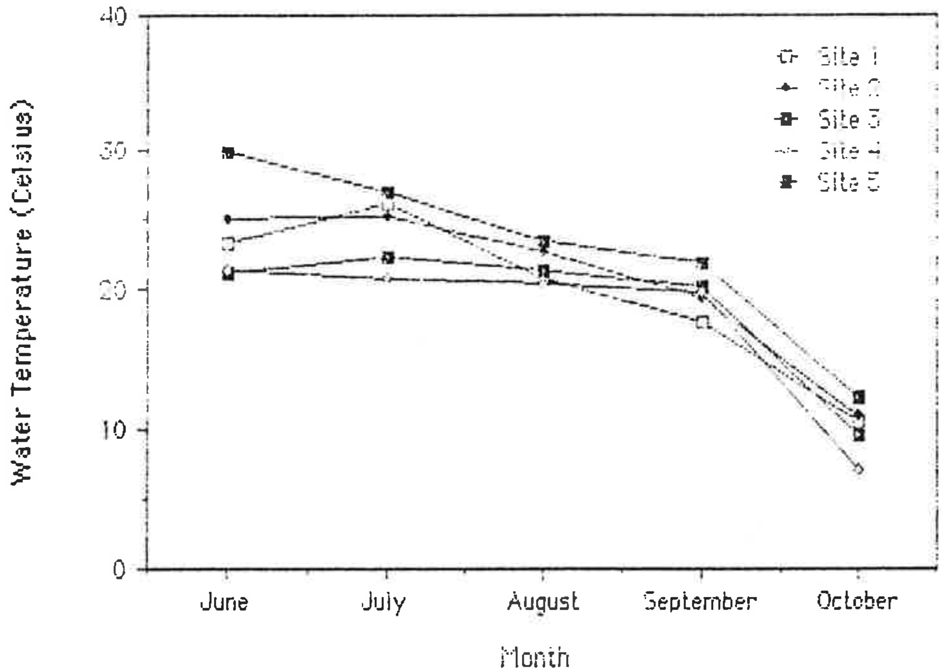

Figure 4a. Graph of water temperature for sites 1-5.

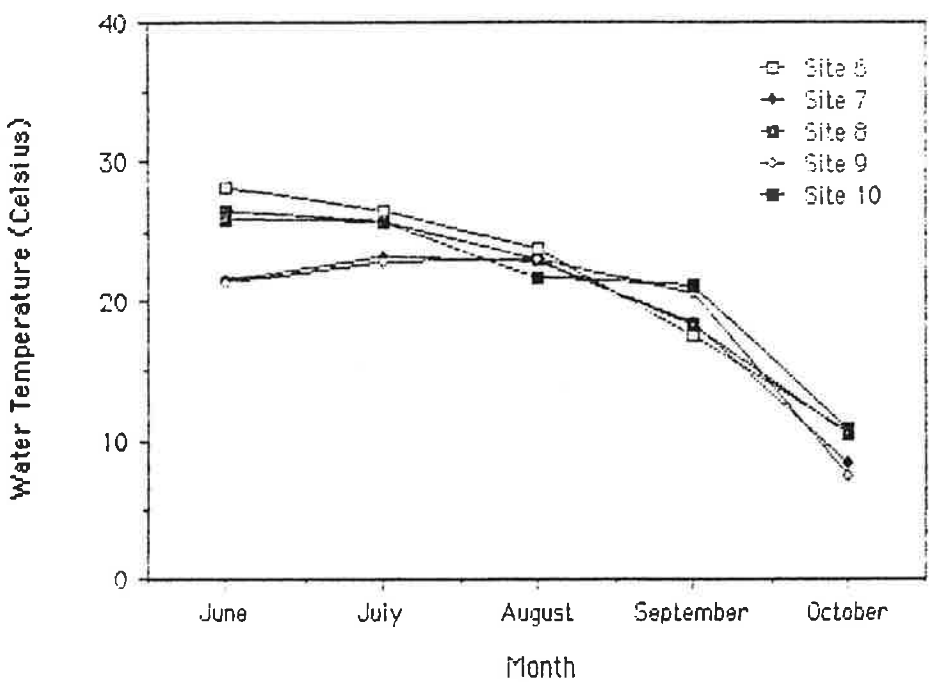

Figure 4b. Graph of water temperature for sites 6-10.

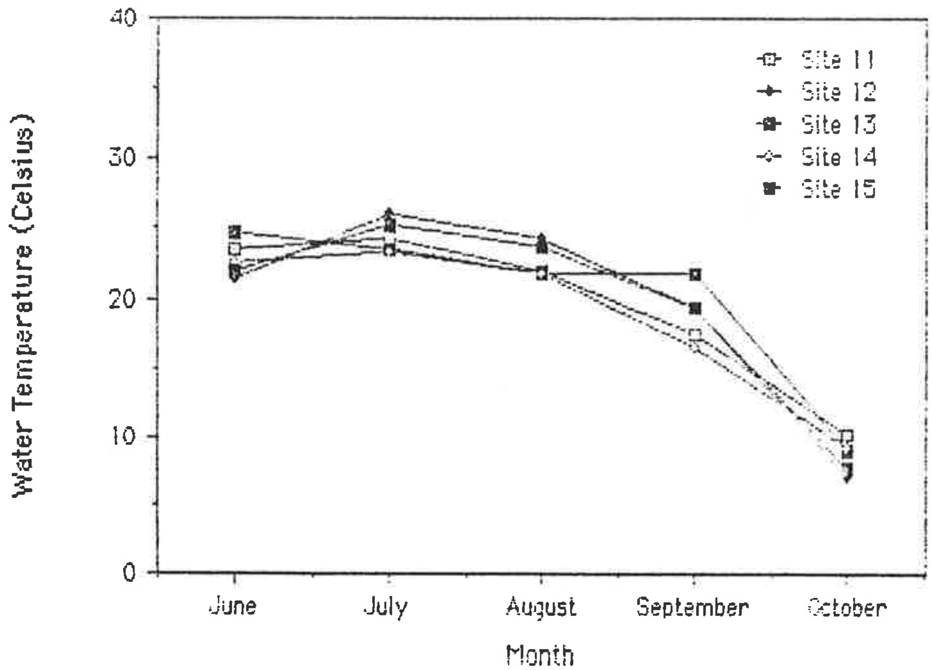

Figure 4c. Graph of water temperature for sites 11-15.

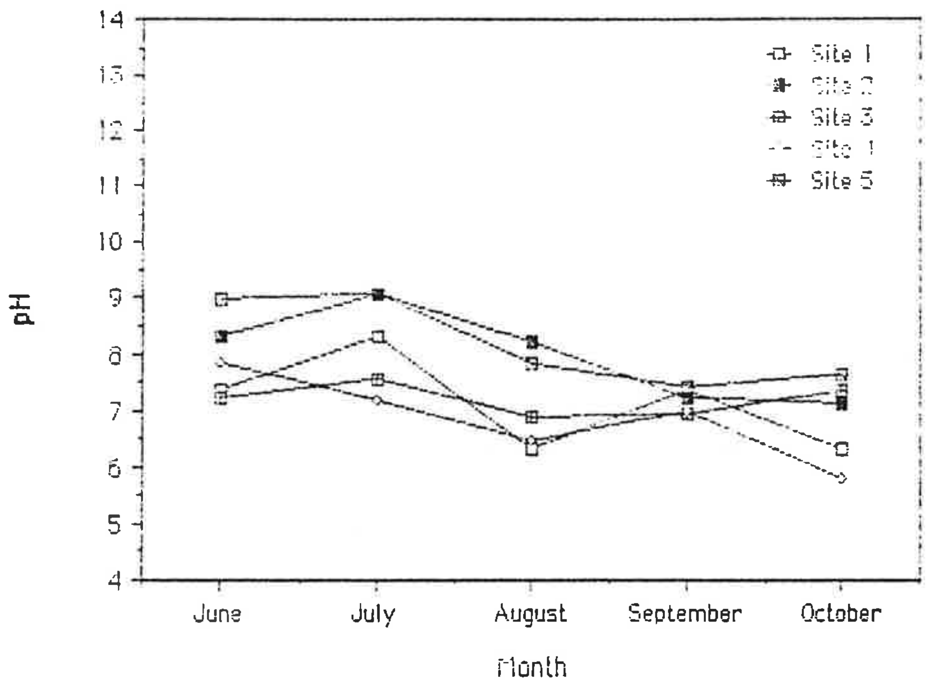

Figure 5a. Graph of pH for sites 1- 5 during the sample period.

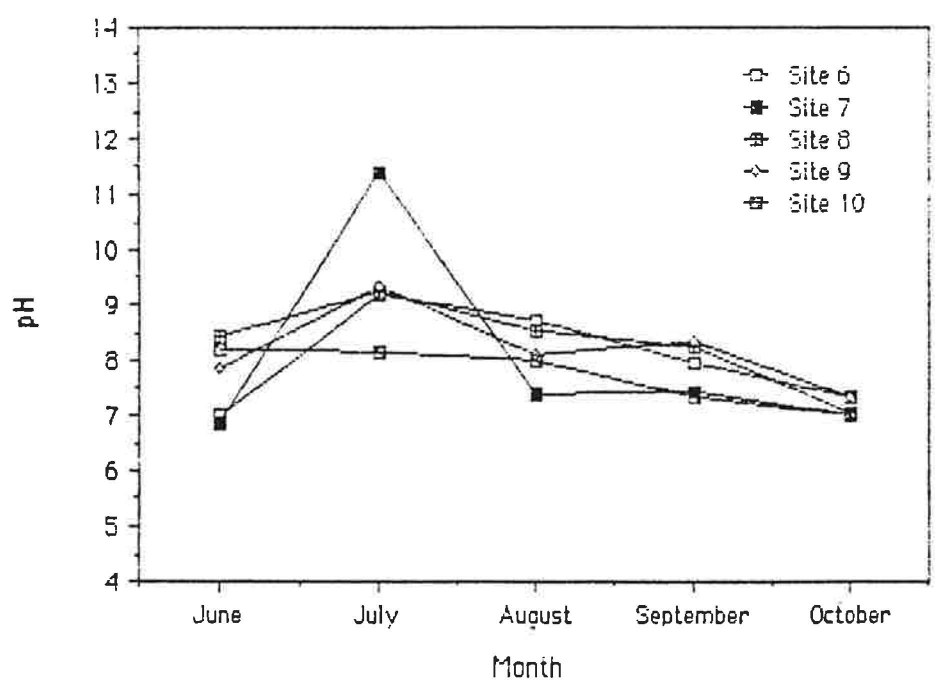

Figure 5b. Graph of pH for sites 6-10 during the sample period.

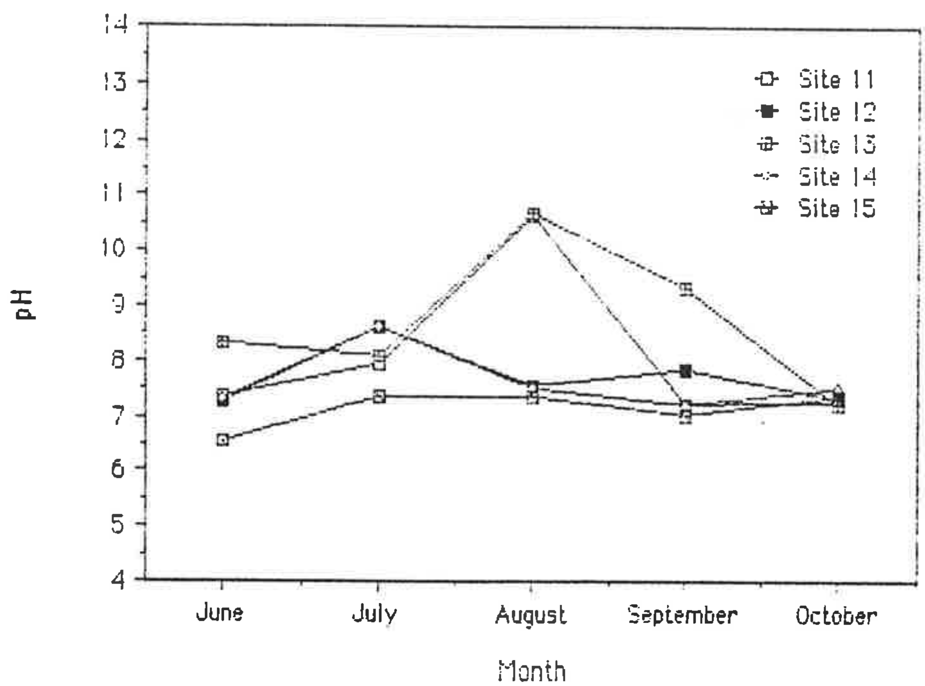

Figure 5c. Graph of pH for sites 11-15 during the sample period.

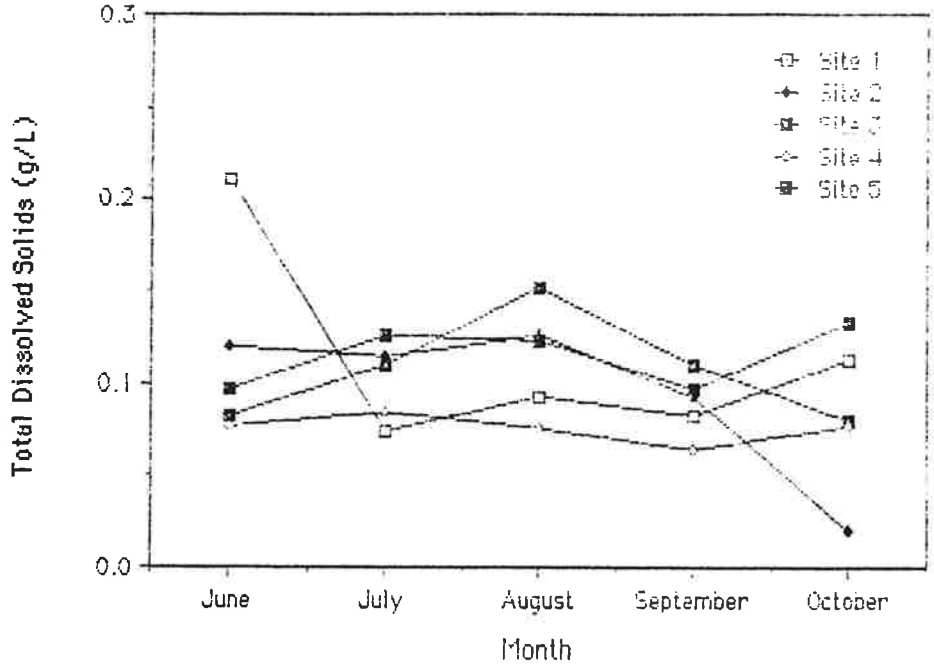

Figure 6a. Graph of total dissolved solids for sites 1-5.

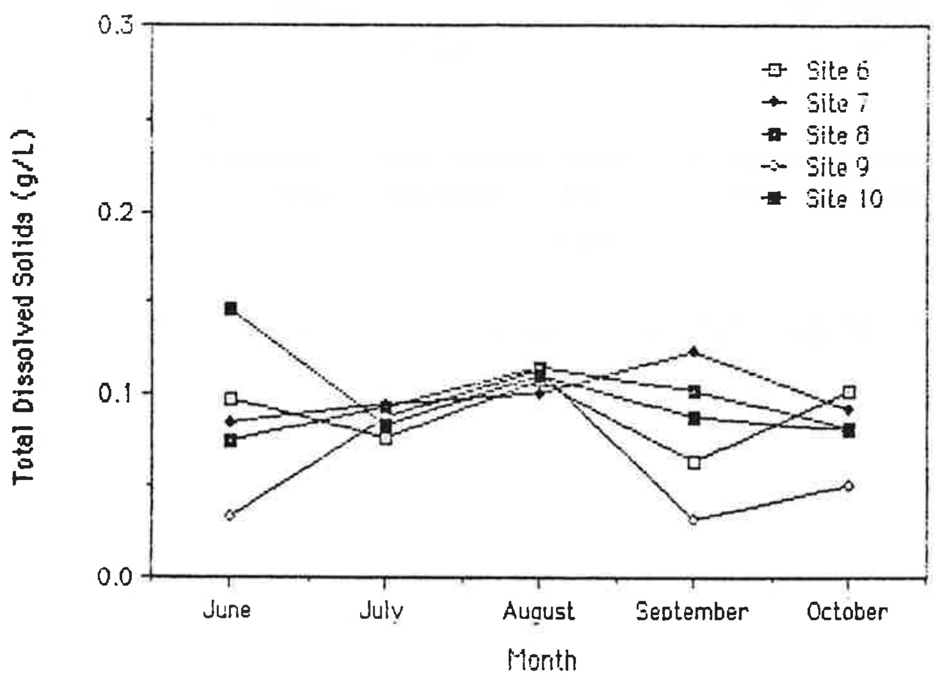

Figure 6b. Graph of total dissolved solids for sites 6-10.

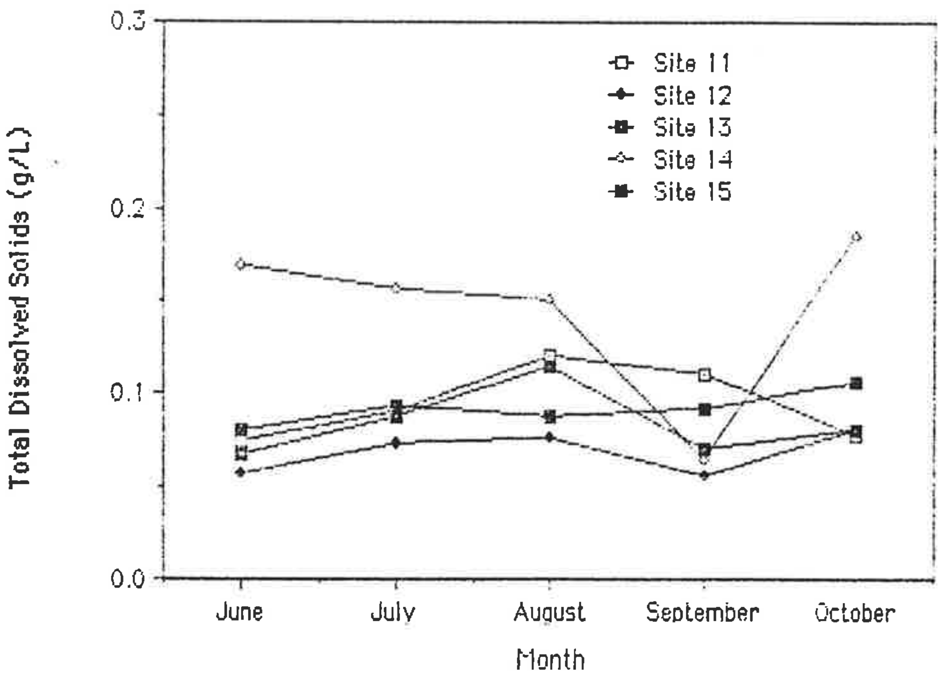

Figure 6c. Graph of total dissolved solids for sites 11-15.

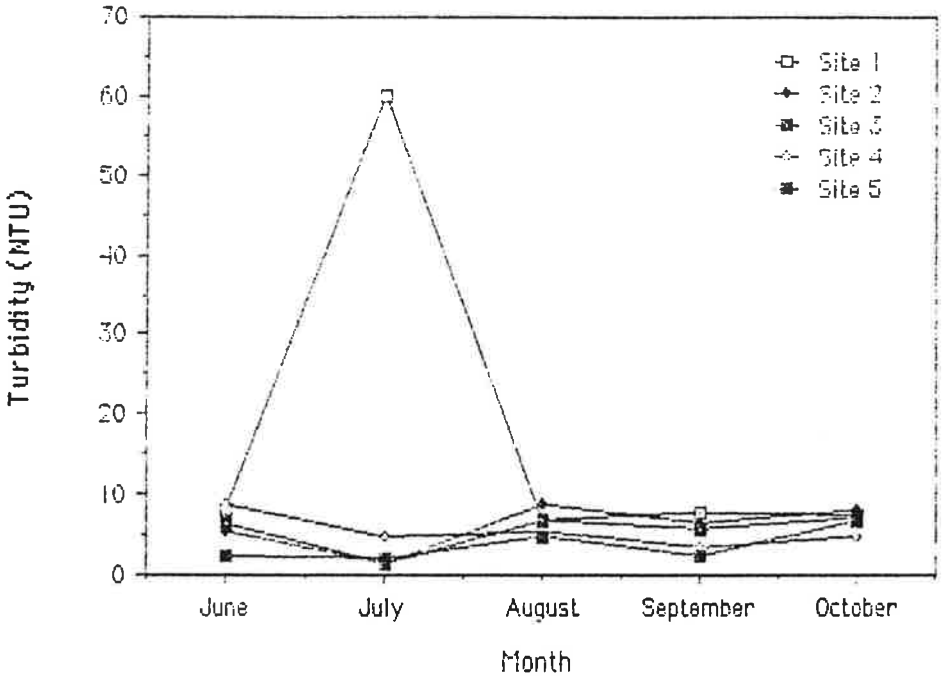

Figure 7a. Graph of turbidity for sites 1-5.

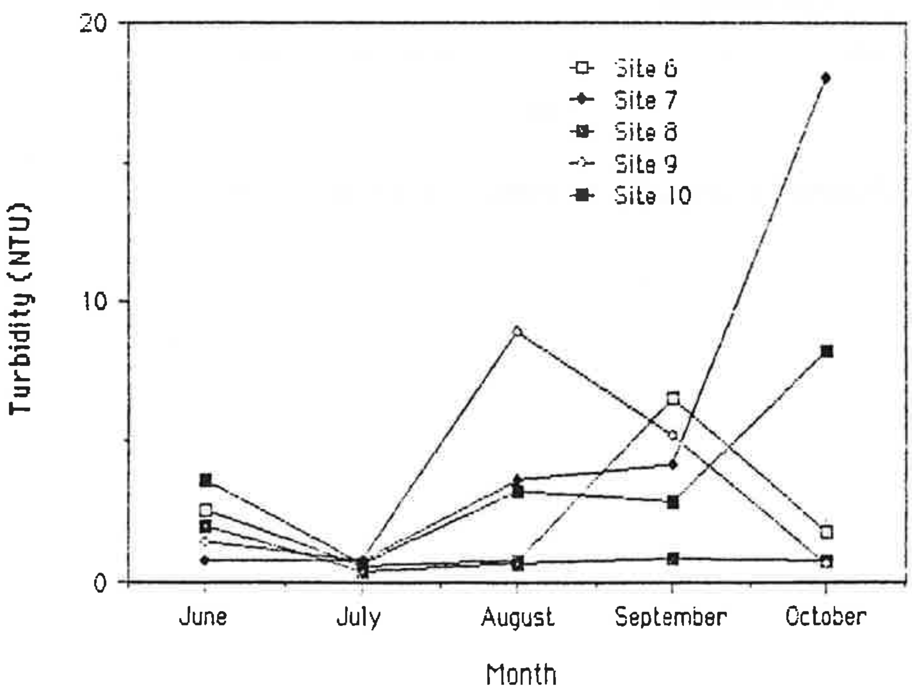

Figure 7b. Graph of turbidity for sites 6-10.

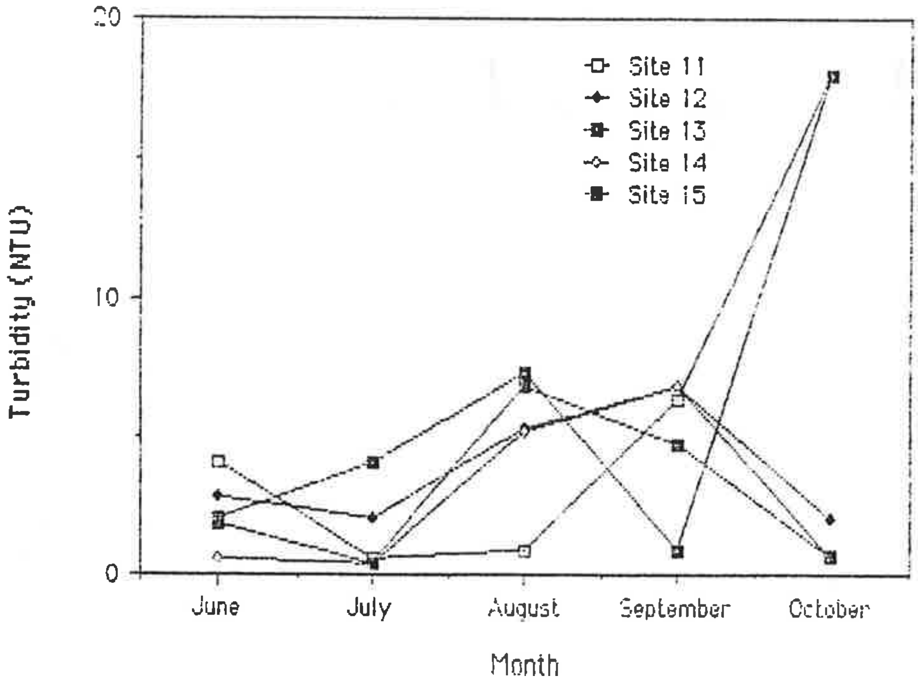

Figure 7c. Graph of turbidity for sites 11-15.

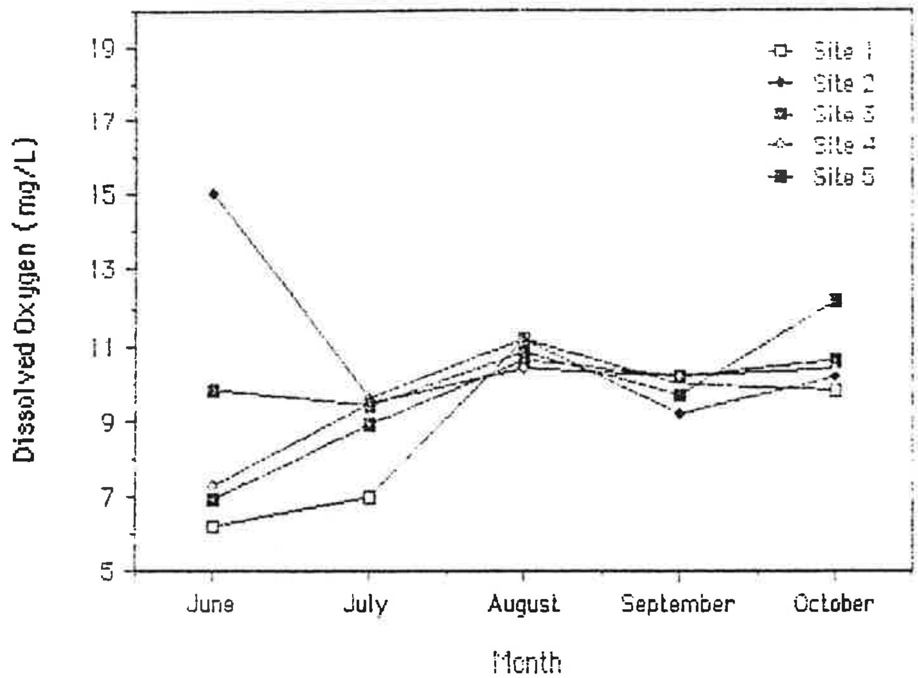

Figure 8a. Graph of dissolved oxygen for sites 1-5.

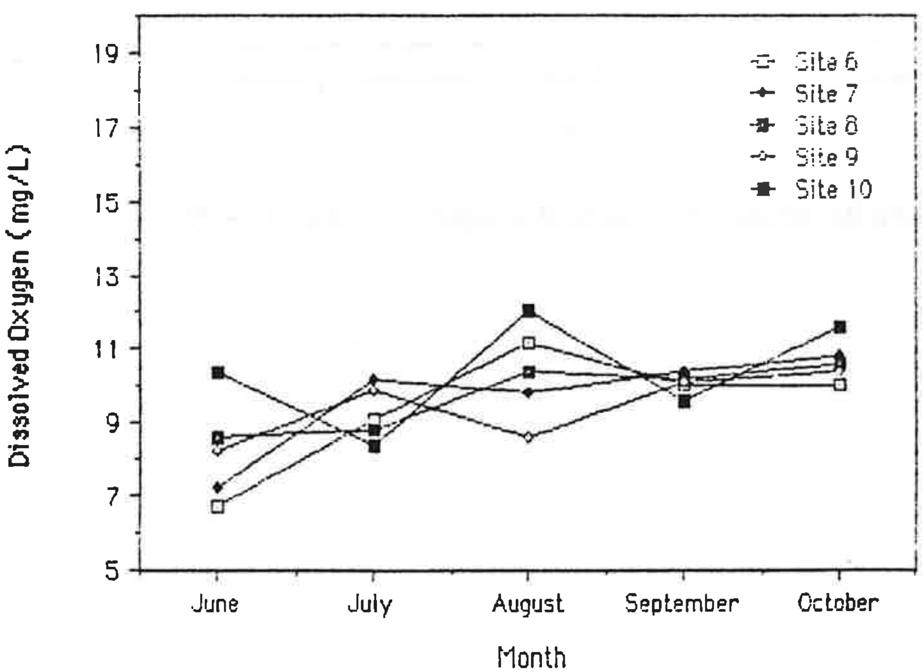

Figure 8b. Graph of dissolved oxygen for sites 6-10.

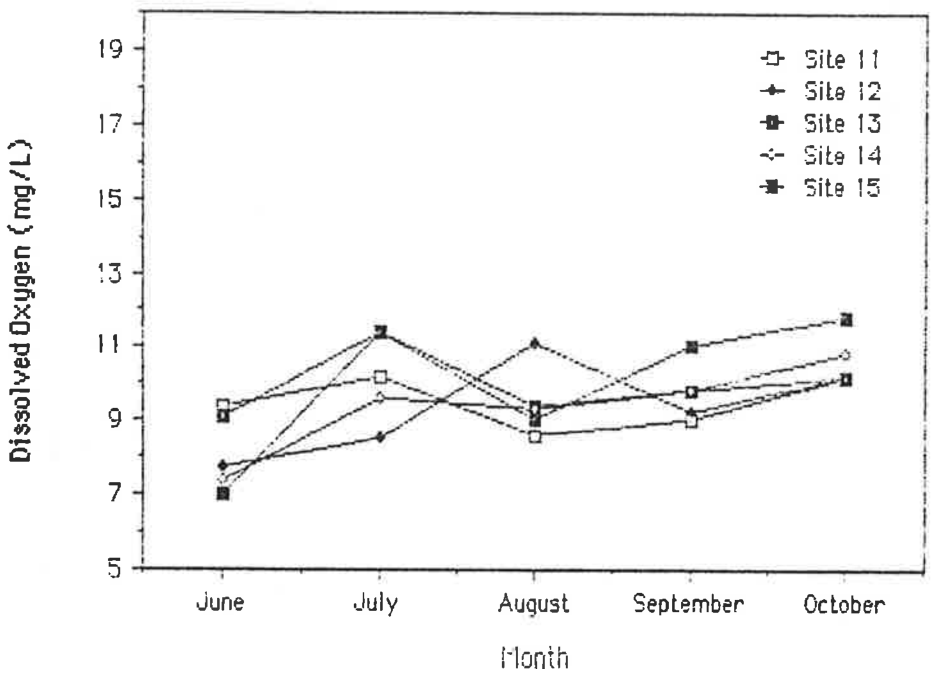

Figure 8c. Graph of dissolved oxygen for sites 11-15.

DISCUSSION

As outlined in the regulations, the fecal coliform density should not exceed a log mean of 200 per 100ml. Looking at the watershed as a whole over the seven month sample period, the range of fecal coliform densities observed was from <200 up to 13,000 per 100ml, with the highest densities occurring just after a storm event in May at Site 6 on Little Paint Branch. Of the incidents when the fecal coliform densities exceeded the recommended levels (84% of the samples), the average fecal coliform densities were approximately 2125 per 100ml, over ten times the standard allowed for Class I waters.

Looking at the tributaries on an individual basis there does not seem to be any significant difference in fecal coliform densities. Previous collection and analysis showed a trend of increased coliform densities being a function of storm event activity, that is, that levels rose greatly just after a rainfall and stabilized within a few days. Sampling included one sampling set just after a storm event (May), and this did show increased fecal coliform levels compared to the other months. Based on the fecal coliform levels observed, the water quality of all the tributaries is still below the acceptable standards for Class I waters as specified by state regulations.

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TABLE 7 TOTAL AND FECAL COLIFORM COUNTS FROM 15 SITES ON TRIBUTARIES OF THE ANACOSTIA RIVER TAKEN DURING APRIL AND MAY 1990.

	APRIL *				MAY *			
Site #	**	Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)	**	Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)
1		8 *	14	2	X	17	30	1.7
2		13	14	8	X	13	28	2.2
3		0.2	1	<0.2	X	17	15	3
4		0.2	1	0.2	X	1.1	3	0.2
5		8	13	<0.2	X	7	18	3
6		0.8	0	0.4	X	17	21	13
7		0.4	0	0.2	X	1.7	6	1.3
8		0.4	1	<0.29	X	0.7	1	<0.2
9		<0.2	1	<0.2	X	0.3	3	0.2
10		1.3	3	0.2	X	30	10	7
11		0.4	0	<0.2	X	160	68	8
12		3	2	4	X	90	52	5
13		4	1	<0.2	X	160	82	5
14		1.3	0	0.2	X	30	17	5
15		0.7	7	<0.2	X	11	11	0.2

* All numbers in thousands of individuals per 100ml.
** Indicates significant rainfall within 24 hrs before sampling.
*** Represents direct colony counts via membrane filtration methods.

TABLE 8 TOTAL AND FECAL COLIFORM COUNTS FROM 15 SITES ON TRIBUTARIES OF THE ANACOSTIA RIVER TAKEN DURING JUNE AND JULY 1990.

	JUNE *			JULY *		
Site #	** Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)	** Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)
1	160 *	107	0.8	2.3	5	0.4
2	7	7	1.3	11	10	1.1
3	0.8	6	0.2	3.4	10	0.4
4	1.7	9	0.4	17	3	0.7
5	50	16	1.3	13	19	3
6	5	3	2.3	1.7	3	0.2
7	1.7	1	0.8	7	6	<0.2
8	0.8	5	0.2	1.7	8	0.4
9	0.9	3	0.2	1.1	4	0.2
10	7	3	4	5	5	1.3
11	0.4	7	2	3	2	<0.2
12	0.7	4	0.4	17	7	0.4
13	1.7	7	0.4	0.8	0	0.2
14	3	9	0.4	13	9	1.2
15	8	7	0.8	1.3	4	0.2

* All numbers in thousands of individuals per 100ml.
** Indicates significant rainfall within 24 hrs before sampling.
*** Represents direct colony counts via membrane filtration methods.

TABLE 9 TOTAL AND FECAL COLIFORM COUNTS FROM 15 SITES ON TRIBUTARIES OF THE ANACOSTIA RIVER TAKEN DURING AUGUST AND SEPTEMBER 1990.

	AUGUST *				SEPTEMBER *			
Site #	**	Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)	**	Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)
1		17	10	3		5	10	3
2		30	2	8		3	6	2.3
3		1.3	2	0.2		3	4	2.3
4		2.3	3	0.4		2.3	2	0.4
5		11	13	3		0.8	0	0.4
6		1.3	0	<0.2		1.7	1	0.8
7		13	11	1.7		5	2	1.1
8		2.2	3	<0.2		0.2	0	0.2
9		17	8	8		0.4	0	0.4
10		30	12	7		17	8	5
11		1.7	4	0.4		5	3	1.1
12		1.4	10	<0.2		5	3	1.1
13		9	4	2.6		8	4	1.1
14		8	10	0.4		0.4	0	0.2
15		13	4	3		5	2	0.8

* All numbers in thousands of individuals per 100ml.
** Indicates significant rainfall within 24 hrs before sampling.
*** Represents direct colony counts via membrane filtration methods.

TABLE 10 TOTAL AND FECAL COLIFORM COUNTS FROM 15 SITES ON TRIBUTARIES OF THE ANACOSTIA RIVER TAKEN DURING OCTOBER 1990.

		OCTOBER *		
Site #	**	Total Coliforms (MPN)	Total *** Coliforms #/100ml (MF Test)	Fecal Coliforms (MPN)
1		13	7	5
2		14	4	4
3		13	5	5
4		1.3	1	<0.2
5		3	1	0.2
6		2.2	1	0.8
7		0.4	0	<0.2
8		0.6	0	0.2
9		0.4	0	<0.2
10		17	4	6
11		5	3	5
12		0.8	0	0.8
13		17	0	7
14		1.3	2	1.3
15		0.8	1	0.2

* All numbers in thousands of individuals per 100ml.
** Indicates significant rainfall within 24 hrs before sampling.
*** Represents direct colony counts via membrane filtration methods.

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APPENDIX A. HABITAT ASSESSMENT FIELD DATA SHEETS FOR RIFFLE/RUN PREVALENT SITUATIONS

HABITAT ASSESSMENT FIELD DATA SHEET
RIFFLE/RUN PREVALENCE

Habitat Parameter	Category: Optimal	Sub-Optimal	Marginal	Poor
1. Bottom substrate/ instream cover (a)	Greater than 50% mix of rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat. 11-15	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble, gravel, or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness (b)	Gravel, cobble, and boulder particles are between 0-25% surrounded by fine sediment. 16-20	Gravel, cobble, and boulder particles are between 25-50% surrounded by fine sediment. 11-15	Gravel, cobble, and boulder particles are between 50-75% surrounded by fine sediment. 6-10	Gravel, cobble, and boulder particles are over 75% surrounded by fine sediment. 0-5
3. <0.15 cms (5 cfs)→ Flow at rep. low	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
OR >0.15 cms (5 cfs)→ velocity/depth	Slow (<0.3 m/s), deep (>0.5 m): slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles or runs receive lower score). 6-10	Dominated by 1 velocity/ depth category (usually pools). 0-5
4. Canopy cover (shading) (c)(d)(g)	A mixture of conditions where some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light. 16-20	Covered by sparse canopy; entire water surface receiving filtered light. 11-15	Completely covered by dense canopy; water surface completely shaded OR nearly full sunlight reaching water surface. Shading limited to <3 hours per day. 6-10	Lack of canopy, full sunlight reaching water surface. 0-5
5. Channel alteration (a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; and/or extensive channelization. 0-3

RIFFLE/RUN PREVALENCE

Habitat Parameter	Category: Optimal	Sub-Optimal	Marginal	Poor
6. Bottom scouring and deposition (a)	Less than 5% of the bottom affected by scouring and/or deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and/or scour at obstructions, constrictions, and bends. Filling of pools prevalent. 4-7	More than 50% of the bottom changing frequently. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3
7. Pool/riffle, run/bend ratio (a) (distance between riffles divided by stream width)	Ratio: 5-7. Variety of habitat. Repeat pattern of sequence relatively frequent. 12-15	7-15. Infrequent repeat pattern. Variety of macrohabitat less than optimal. 8-11	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
8. Lower bank channel capacity (b)	Overbank (lower) flows rare. Lower bank W/D ratio <7. (Channel width divided by depth or height of lower bank.) 12-15	Overbank (lower) flows occasional. W/D ratio 8-15. 8-11	Overbank (lower) flows common. W/D ratio 15-25. 4-7	Peak flows not contained or contained through channelization. W/D ratio >25. 0-3
9. Upper bank stability (a)	Upper bank stable. No evidence of erosion or bank failure. Side slopes generally <30°. Little potential for future problems. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40° on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60° on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes >60° common. 0-2
10. Bank vegetative protection (d)	Over 90% of the streambank surfaces covered by vegetation. 9-10	70-89% of the streambank surfaces covered by vegetation. 6-8	50-79% of the streambank surfaces covered by vegetation. 3-5	Less than 50% of the streambank surfaces covered by vegetation. 0-2
OR Grazing or other disruptive pressure (b)	Vegetative disruption minimal or not evident. Almost all potential plant biomass at present stage of development remains. 9-10	Disruption evident but not affecting community vigor. Vegetative use is moderate, and at least one-half of the potential plant biomass remains. 6-8	Disruption obvious; some patches of bare soil or closely cropped vegetation present. Less than one-half of the potential plant biomass remains. 3-5	Disruption of streambank vegetation is very high. Vegetation has been removed to 2 inches or less in average stubble height. 0-2

RIFFLE/RUN PREVALENCE

Habitat Parameter	Category			
	Optimal	Sub-Optimal	Marginal	Poor
11. Streamside cover (b)	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
12. Riparian vegetative zone width (least buffered side) (e)(f)(g)	>18 meters. 9-10	Between 12 and 18 meters. 6-8	Between 6 and 12 meters. 3-5	<6 meters. 0-2
Column Totals	____	____	____	____

Score ____

(a) From Ball 1982.
(b) From Platts et al. 1983.
(c) From EPA 1983.
(d) From Hamilton and Bergersen 1984.
(e) From Lafferty 1987.
(f) From Schueler 1987.
(g) From Bartholow 1989.

APPENDIX B. MACROINVERTEBRATE TAXONOMIC LISTS. RESULTS FROM THE FIVE SAMPLING EVENTS, 1990. SURBER SAMPLES ARE INDICATED BY AN "S" IN THE STN./REP. CODE; SAMPLES BY D-FRAME NET ARE DESIGNATED SO BY AN "N" IN THAT CODE. ALL OF THE SURBER SAMPLES ARE LISTED FIRST AND FOLLOWED BY THE NET SAMPLES. EACH REPLICATE IS KEPT SEPARATE AS FOLLOWS: 5.S1 REPRESENTS SITE 5, FIRST SURBER; 5.S2, SECOND SURBER. IN THE CASE OF INSECTS, LIFE STAGES LARVAE [NYMPHS], PUPAE, AND ADULTS ARE SEGREGATED FOR ENUMERATION BUT COMBINED FOR A TAXON TOTAL. IN METRIC CALCULATIONS, REPLICATE RESULTS ARE POOLED FOR A SITE TOTAL. MORE INCLUSIVE TAXONOMIC CATEGORIES MAY BE FOUND IN MERRITT AND CUMMINS (1984) AND PENNAK (1978).

Appendix B. Macroinvertebrate taxonomic list.

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
1.S1	4/25	Oligochaeta				3
1.S2	4/25	Oligochaeta				17
2.S1	4/19	Oligochaeta				~3
2.S1	4/19	Hydropsyche	1			1
2.S1	4/19	Chironomidae	5			5
2.S1	4/19	Tanypodinae	1			1
2.S2	4/19	Oligochaeta				~2
2.S2	4/19	Chironomidae	1			1
3.S1	4/19	Oligochaeta				~3
3.S1	4/19	Chironomidae	3			3
3.S1	4/19	Tanypodinae	3			3
3.S2	4/19	Oligochaeta				~3
3.S2	4/19	Chironomidae	1			1
3.S2	4/19	Tanypodinae	1			1
4.S1	4/24	Tricladida				1
4.S1	4/24	Amphinemura	11			11
4.S1	4/24	Nigronia	2			2
4.S1	4/24	Stenelmis			1	1
4.S1	4/24	Cheumatopsyche	1			1
4.S1	4/24	Hydropsyche	40			40
4.S1	4/24	Dolophilodes	1			1
4.S1	4/24	Simuliidae	29			29
4.S2	4/24	Amphinemura	3			3
4.S2	4/24	Hydropsyche	1			1
4.S2	4/24	Simuliidae	8			8
5.S1	4/24	Oligochaeta				6
5.S1	4/24	Helisoma anceps				1
5.S1	4/24	Calopteryx	1			1
5.S1	4/24	Tipula	1			1
5.S1	4/24	Chironomidae	23			23
5.S2	4/24	Oligochaeta				~60
5.S2	4/24	Gammaridae				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
5.S2	4/24	Helisoma anceps				1
5.S2	4/24	Chironomidae	3			3
6.S1	4/25	Oligochaeta				3
6.S1	4/25	Empididae	1			1
6.S1	4/25	Chironomidae	3			3
6.S2	4/25	Hydracarina				2
7.S1	4/25	Oligochaeta				2
7.S1	4/25	Chironomidae	21			21
7.S1	4/25	Nigronia	1			1
7.S2	4/25	Oligochaeta				2
7.S2	4/25	Chironomidae	1			1
8.S1	4/25	Oligochaeta				1
8.S1	4/25	Nemertea				1
8.S1	4/25	Hydropsyche betteni	3			3
8.S1	4/25	Hydropsyche	1			1
8.S1	4/25	Hydropsychidae		1		1
8.S1	4/25	Stenelmis			1	1
9.S1	4/25	Hydracarina				2
9.S1	4/25	Eurylophella	2			2
9.S1	4/25	Chironomidae	8			8
9.S2	4/25	Hydracarina				2
9.S2	4/25	Ephemerella	2			2
9.S2	4/25	Chironomidae	3			3
10.S1	4/19	Oligochaeta				~7
10.S1	4/19	Ancyronyx variegata	1			1
10.S1	4/19	Chironomidae	3			3
10.S2	4/19	Oligochaeta				~4
10.S2	4/19	Chironomidae	7			7
11.S1	5/1	Oligochaeta				7
11.S1	5/1	Chironomidae	2	1		3
11.S2	5/1	Oligochaeta				16
11.S2	5/1	Hydracarina				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
11.S2	5/1	Baetis	1			1
11.S2	5/1	Hydropsyche betteni				1
11.S2	5/1	Chironomidae	4			4
12.S1	5/1	Oligochaeta				2
12.S1	5/1	Hydracarina				2
12.S1	5/1	Baetis	1			1
12.S1	5/1	Chironomidae	1			1
13.S1	4/11	Ephemerella	1			1
13.S2	4/11	Amphinemura	1			1
13.S1	4/11	Cheumatopsyche	1			1
13.S1	4/11	Stenelmis			1	1
13.S1	4/11	Chironomidae	2			2
13.S2	4/11	Chironomidae	5			5
14.S1	5/1	Oligochaeta				1
14.S1	5/1	Chironomidae	3			3
14.S2	5/1	Oligochaeta				9
14.S2	5/1	Chironomidae	8	1		9
14.S2	5/1	Simuliidae	1			1
15.S1	5/1	Oligochaeta				3
15.S1	5/1	Chironomidae	4	2		6
15.S2	5/1	Oligochaeta				14
15.S2	5/1	Chironomidae	2			2
15.S2	5/1	Tipula	1			1
1.S1	5/21	Oligochaeta				4
1.S1	5/21	Chironomidae	8			8
1.S2	5/21	Oligochaeta				8
1.S2	5/21	Chironomidae	9			9
2.S1	5/21	Oligochaeta				2
2.S1	5/21	Hydracarina				1
2.S1	5/21	Chironomidae	3	1		4
2.S2	5/21	Oligochaeta				8

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
2.S2	5/21	Chironomidae	4			4
3.S1	5/21	Oligochaeta				1
3.S1	5/21	Baetis	1			1
3.S1	5/21	Simuliidae	1			1
3.S1	5/21	Tipula	1			1
3.S1	5/21	Chironomidae	5	1		6
3.S2	5/21	Oligochaeta				2
3.S2	5/21	Chironomidae	1			1
4.S1	5/21	Asellus				1
4.S1	5/21	Crangonyx				1
4.S1	5/21	Simuliidae	2			2
4.S1	5/21	Chironomidae	8			8
4.S2	5/21	Oligochaeta				1
4.S2	5/21	Amphinemura	1			1
4.S2	5/21	Pseudocloeon	1			1
4.S2	5/21	Cheumatopsyche	1			1
4.S2	5/21	Hydropsyche betteni	2			2
4.S2	5/21	Nigronia serricornis	2			2
4.S2	5/21	Simuliidae	6			6
4.S2	5/21	Tipula	2			2
4.S2	5/21	Chironomidae	2			2
5.S1	5/21	Oligochaeta				12
5.S1	5/21	Hydropsyche betteni	1			1
5.S1	5/21	Chironomidae	5			5
5.S2	5/21	Oligochaeta				58
5.S2	5/21	Glossiphoniidae				1
5.S2	5/21	Physella heterostropha				1
5.S2	5/21	Baetis	4			4
5.S2	5/21	Hydropsyche betteni	1			1
5.S2	5/21	Simuliidae	2			2
5.S2	5/21	Chironomidae	20	1		21
6.S1	5/21	Hydracarina				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
6.S1	5/21	Baetis	1			1
6.S1	5/21	Chironomidae	3	1		4
6.S2	5/21	Nematoda				4
6.S2	5/21	Baetis	2			2
7.S1	5/23	Oligochaeta				2
7.S1	5/23	Baetis	1			1
7.S1	5/23	Chironomidae	9			9
7.S2	5/23	Oligochaeta				6
7.S2	5/23	Chironomidae	5			5
8.S1	5/30	Oligochaeta				15
8.S1	5/30	Hydracarina				4
8.S1	5/30	Baetis	1			1
8.S1	5/30	Antocha	1			1
8.S1	5/30	Hydropsyche betteni	1			1
8.S1	5/30	Chironomidae	5			5
8.S2	5/30	Oligochaeta				1
8.S2	5/30	Hydracarina				2
8.S2	5/30	Baetis	2			2
9.S1	5/23	Ephemerella	6			6
9.S1	5/23	Pseudocloeon	3			3
9.S1	5/23	Baetis	9			9
9.S1	5/23	Glossosoma	1			1
9.S1	5/23	Hydropsyche betteni	4			4
9.S1	5/23	Hydropsyche morosa group	2			2
9.S1	5/23	Hydropsychidae		1		1
9.S1	5/23	Nigronia serricornis	1			1
9.S1	5/23	Optioservus	2		5	7
9.S1	5/23	Chironomidae	6	1		7
9.S2	5/23	Oligochaeta				2
9.S2	5/23	Isonychia	1			1
9.S2	5/23	Ephemerella	6			6
9.S2	5/23	Pseudocloeon	3			3

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
9.S2	5/23	Baetis	12			12
9.S2	5/23	Dolophilodes	2			2
9.S2	5/23	Hydropsyche betteni	1			1
9.S2	5/23	Chironomidae	5		1	6
10.S1	5/30	Chironomidae	11	2		13
10.S2	5/30	Oligochaeta				1
10.S2	5/30	Chironomidae	9			9
11.S1	5/30	Oligochaeta				2
11.S1	5/30	Baetis	1			1
11.S1	5/30	Simuliidae	1			1
11.S1	5/30	Chironomidae	2			2
11.S2	5/30	Oligochaeta				3
11.S2	5/30	Hydropsyche betteni	2			2
11.S2	5/30	Chironomidae	4			4
12.S1	5/30	Oligochaeta				1
12.S1	5/30	Hydropsyche morosa group	1			1
12.S1	5/30	Antocha	1			1
12.S2	5/30	Hydropsyche betteni	1			1
12.S2	5/30	Chironomidae	2			2
13.S1	5/31	Stenonema	1			1
13.S1	5/31	Serratella	1			1
13.S1	5/31	Baetis	2			2
13.S1	5/31	Hydropsyche betteni	1			1
13.S1	5/31	Chironomidae	2			2
13.S2	5/31	Chironomidae	1			1
14.S1	5/30	Oligochaeta				1
14.S1	5/30	Baetis	2			2
14.S1	5/30	Chironomidae	2			2
14.S2	5/30	Baetis	3			3
14.S2	5/30	Chironomidae	6			6
15.S1	5/31	Baetis	19			19
15.S1	5/31	Simuliidae	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
15.S1	5/31	Tipula	1			1
15.S1	5/31	Chironomidae	4	1		5
15.S2	5/31	Oligochaeta				1
15.S2	5/31	Simuliidae	2			2
15.S2	5/31	Baetis	15			15
1.S1	7/18	Baetis	1			1
1.S1	7/18	Oligochaeta				2
1.S1	7/18	Chironomidae	5			5
2.S1	7/18	Oligochaeta				1
2.S1	7/18	Baetis	1			1
2.S1	7/18	Chironomidae	1			1
2.S2	7/18	Chironomidae	4			4
3.S1	7/18	Baetis	1			1
3.S1	7/18	Cheumatopsyche	1			1
3.S1	7/18	Hydropsyche betteni	16			16
3.S1	7/18	Hydropsyche	15			15
3.S2	7/18	Oligochaeta				2
3.S2	7/18	Baetis	1			1
3.S2	7/18	Hydropsyche	10			10
3.S2	7/18	Hydropsyche betteni	14			14
3.S2	7/18	Simuliidae	1			1
4.S1	7/18	Asellus				2
4.S1	7/18	Baetis	1			1
4.S1	7/18	Nigronia serricornis	10			10
4.S1	7/18	Stenelmis	3		1	4
4.S1	7/18	Optioservus	2			2
4.S1	7/18	Cheumatopsyche	6			6
4.S1	7/18	Hydropsyche betteni	6			6
4.S1	7/18	Hydropsyche	1			13
4.S1	7/18	Chironomidae	3			3
4.S1	7/18	Empididae		1		1
4.S2	7/18	Asellus				2

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
4.S2	7/18	Hydracarina				2
4.S2	7/18	Psuedocloeon	1			1
4.S2	7/18	Dromogomphus	1			1
4.S2	7/18	Cheumatopsyche	1			1
4.S2	7/18	Hydropsyche	3			3
4.S2	7/18	Nigronia serricornis	1			1
4.S2	7/18	Stenelmis			1	1
4.S2	7/18	Simuliidae	2			2
5.S1	7/18	Oligochaeta				5
5.S1	7/18	Baetis	2			2
5.S1	7/18	Hydropsyche	1			1
5.S1	7/18	Chironomidae	2			2
5.S2	7/18	Oligochaeta				5
5.S2	7/18	Hydropsyche betteni	2			2
5.S2	7/18	Chironomidae	2			2
6.S1	7/18	Hydracarina				1
6.S1	7/18	Baetis	1			1
6.S2	7/18	Astacidae				1
6.S1	7/18	Hydropsyche betteni	2			2
6.S2	7/18	Hydracarina				2
6.S2	7/18	Baetis	1			1
6.S2	7/18	Hydropsyche betteni	3			3
6.S2	7/18	Chironomidae		1		1
7.S1	7/20	Baetis	1			1
7.S1	7/20	Hydropsyche betteni	2			2
7.S1	7/20	Hydropsyche	2			2
7.S1	7/20	Tipula	1			1
7.S1	7/20	Chironomidae	1			1
7.S2	7/20	Physella heterostropha				2
7.S2	7/20	Chironomidae	3			3
8.S1	7/19	Nemertea				3
8.S1	7/19	Oligochaeta				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
8.S1	7/19	Baetis	2			2
8.S1	7/19	Centroptilum	1			1
8.S1	7/19	Hydropsyche betteni	9			9
8.S1	7/19	Hydropsychidae		1		1
8.S1	7/19	Optioservus	8		3	11
8.S2	7/19	Oligochaeta				2
8.S2	7/19	Baetis	2			2
8.S2	7/19	Isonychia	1			1
8.S2	7/19	Nigronia serricornis	1			1
8.S2	7/19	Optioservus	7			7
8.S2	7/19	Ectopria	1			1
8.S2	7/19	Hydropsyche	2			2
8.S2	7/19	Hydropsyche betteni	17			17
8.S2	7/19	Hydropsychidae		1		1
8.S2	7/19	Hemerodromia	1			1
9.S1	7/20	Baetis	2			2
9.S1	7/20	Hydropsyche morosa group	1			1
9.S1	7/20	Cheumatopsyche	1			1
9.S1	7/20	Dolophilodes	10			10
9.S1	7/20	Philopotamidae		2		2
9.S1	7/20	Optioservus	6		9	15
9.S2	7/20	Isonychia	12			12
9.S2	7/20	Baetis	1			1
9.S2	7/20	Heptageniidae	3			3
9.S2	7/20	Nigronia serricornis	3			3
9.S2	7/20	Optioservus			4	4
9.S2	7/20	Cheumatopsyche	2			2
9.S2	7/20	Hydropsyche betteni	3			3
9.S2	7/20	Hydropsyche morosa group	24			24
9.S2	7/20	Hydropsyche	3			3
9.S2	7/20	Dolophilodes	4			4
9.S2	7/20	Glossosoma	6			6

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
9.S2	7/20	Simuliidae	1			1
10.S1	7/18	Oligochaeta				4
10.S1	7/18	Hydracarina				2
10.S1	7/18	Baetis	1			1
10.S1	7/18	Chironomidae	7			7
10.S2	7/18	Oligochaeta				1
10.S2	7/18	Hydracarina				1
10.S2	7/18	Chironomidae	4	2		6
11.S1	7/19	Oligochaeta				19
11.S1	7/19	Hydracarina				2
11.S1	7/19	Baetis	3			3
11.S1	7/19	Hydropsyche betteni	18			18
11.S1	7/19	Hydropsyche morosa group	1			1
11.S1	7/19	Chironomidae	1			1
11.S2	7/19	Ferrissia				1
11.S2	7/19	Hydracarina				1
11.S2	7/19	Hydropsyche betteni	4			4
12.S1	7/19	Oligochaeta				3
12.S1	7/19	Hydropsyche	3			3
12.S1	7/19	Chironomidae	3			3
12.S2	7/19	Oligochaeta				1
12.S2	7/19	Baetis	1			1
12.S2	7/19	Chironomidae	1			1
13.S1	7/20	Tricladida				1
13.S1	7/20	Ferrissia				1
13.S1	7/20	Isonychia	3			3
13.S1	7/20	Stenonema	7			7
13.S1	7/20	Boyeria vinosa	1			1
13.S1	7/20	Optioservus	1		1	2
13.S1	7/20	Hydropsyche betteni	2			2
13.S1	7/20	Hydropsyche	3			3
13.S1	7/20	Hemerodromia	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
13.S2	7/20	Stenonema	5			5
13.S2	7/20	Cheumatopsyche	1			1
13.S2	7/20	Hydropsyche morosa group	1			1
14.S1	7/19	Chironomidae		1		1
14.S2	7/19	Oligochaeta				1
14.S2	7/19	Hydropsyche betteni	1			1
15.S1	7/20	Oligochaeta				4
15.S1	7/20	Baetis	2			2
15.S1	7/20	Stenelmis			1	1
15.S1	7/20	Chironomidae	2			2
15.S2	7/20	Fossaria parva				1
15.S2	7/20	Baetis	2			2
15.S2	7/20	Chironomidae	2			2
1.S1	8/21	Oligochaeta				8
1.S1	8/21	Baetis	1			1
1.S1	8/21	Chironomidae	7			7
1.S2	8/21	Oligochaeta				1
1.S2	8/21	Chironomidae	4			4
2.S1	8/21	Oligochaeta				2
2.S1	8/21	Chironomidae	12			12
2.S2	8/21	Oligochaeta				1
2.S2	8/21	Chironomidae	4			4
3.S1	8/23	Asellus				1
3.S1	8/23	Hydropsychidae	4	1		5
3.S1	8/23	Cheumatopsyche	8			8
3.S1	8/23	Hydropsyche betteni	30			30
3.S2	8/23	Baetis	1			1
3.S2	8/23	Nigronia serricornis	1			1
3.S2	8/23	Nigronia fasciatus	1			1
3.S2	8/23	Helichus			1	1
3.S2	8/23	Cheumatopsyche	5			5
3.S2	8/23	Hydropsyche betteni	28			28

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
3.S2	8/23	Hydropsychidae	1			1
4.S1	8/26	Centroptilum	1			1
4.S1	8/26	Calopteryx	2			2
4.S1	8/26	Nigronia serricornis	2			2
4.S1	8/26	Chironomidae	2			2
4.S2	8/26	Physella heterostropha				1
4.S2	8/26	Stenonema	2			2
4.S2	8/26	Pseudocloeon	1			1
4.S2	8/26	Boyeria vinosa	1			1
4.S2	8/26	Nigronia serricornis	6			6
4.S2	8/26	Stenelmis	2		1	3
4.S2	8/26	Cheumatopsyche	1			1
4.S2	8/26	Hydropsychidae	1			1
4.S2	8/26	Hydropsyche betteni	28			28
4.S2	8/26	Chironomidae	4			4
4.S2	8/26	Simuliidae	4			4
5.S1	8/23	Crangonyx				1
5.S1	8/23	Baetis	1			1
5.S1	8/23	Chironomidae	7	2		9
5.S2	8/23	Oligochaeta				7
5.S2	8/23	Baetis	1			1
5.S2	8/23	Hydropsyche betteni	1			1
5.S2	8/23	Chironomidae	13			13
5.S2	8/23	Tipula	1			1
6.S1	8/23	Hydracarina				3
6.S1	8/23	Baetis	3			3
6.S1	8/23	Hydropsyche betteni	2			2
6.S1	8/23	Hydropsychidae		1		1
6.S1	8/23	Helichus			1	1
6.S1	8/23	Tipula	1			1
6.S1	8/23	Chironomidae	2			2
6.S2	8/23	Hydracarina				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
6.S2	8/23	Baetis	6			6
6.S2	8/23	Hydropsyche betteni	1			1
6.S2	8/23	Hydropsychidae	1			1
6.S2	8/23	Chironomidae	3	3		6
7.S1	8/24	Diplectrona	1			1
7.S1	8/24	Hydropsychidae	1			1
7.S2	8/24	Nigronia fasciatus	1			1
7.S2	8/24	Diplectrona	1			1
7.S2	8/24	Hydropsyche betteni	9			9
8.S1	8/23	Hydroptila	2			2
8.S1	8/23	Chironomidae	1			1
8.S2	8/23	Hydroptila	1	1		2
8.S2	8/23	Hydropsyche morosa group	1			1
8.S2	8/23	Optioservus	6			6
8.S2	8/23	Chironomidae	4	1		5
9.S1	8/24	Oligochaeta				2
9.S1	8/24	Isonychia	2			2
9.S1	8/24	Stenonema	1			1
9.S1	8/24	Nigronia serricornis	1			1
9.S1	8/24	Optioservus	3	1		4
9.S1	8/24	Cheumatopsyche	3			3
9.S1	8/24	Hydropsychidae	3			3
9.S1	8/24	Hydropsyche morosa group	1			1
9.S1	8/24	Hydropsyche betteni	9			9
9.S1	8/24	Chironomidae	1			1
9.S2	8/24	Oligochaeta				2
9.S2	8/24	Ferrissia				1
9.S2	8/24	Stenonema	1			1
9.S2	8/24	Hydropsychidae	1			1
9.S2	8/24	Optioservus	2		1	3
10.S1	8/21	Oligochaeta				1
10.S1	8/21	Chironomidae	13	1		14

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
10.S2	8/21	Nematoda				1
10.S2	8/21	Oligochaeta				2
10.S2	8/21	Baetis	2			2
10.S2	8/21	Hydropsyche betteni	2			2
10.S2	8/21	Chironomidae	17	1		18
11.S1	8/23	Hydropsyche morosa group	2			2
11.S1	8/23	Hydropsyche betteni	1			1
11.S1	8/23	Antocha	1			1
11.S2	8/23	Oligochaeta				4
11.S2	8/23	Ancylidae				1
11.S2	8/23	Hydropsyche betteni	2			2
11.S2	8/23	Chironomidae	2			2
12.S1	8/23	Oligochaeta				1
12.S1	8/23	Chironomidae	2			2
12.S2	8/23	Astacidae				1
12.S2	8/23	Hydropsyche betteni	1			1
12.S2	8/23	Hydropsychidae	1			1
13.S1	8/24	Stenonema	2			2
13.S2	8/24	Oligochaeta				2
13.S2	8/24	Stenonema	1			1
13.S2	8/24	Isonychia	5			5
13.S2	8/24	Nigronia serricornis	1			1
13.S2	8/24	Hydropsyche betteni	6			6
13.S2	8/24	Optioservus	2		1	3
13.S2	8/24	Stenelmis			1	1
13.S2	8/24	Chironomidae	1			1
14.S1	8/24	Crangonyx				1
14.S1	8/24	Chironomidae	2			2
14.S2	8/24	Chironomidae	1			1
15.S1	8/24	Baetis	5			5
15.S1	8/24	Chironomidae	2			2
15.S2	8/24	Oligochaeta				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
15.S2	8/24	Baetis	1			1
15.S2	8/24	Chironomidae	1			1
1.S1	10/17	Oligochaeta				4
1.S1	10/17	Chironomidae	4			4
1.S2	10/17	Oligochaeta				2
1.S2	10/17	Chironomidae	3			3
10.S1	10/17	Nemertea				1
10.S1	10/17	Baetis	3			3
10.S1	10/17	Isonychia	1			1
10.S1	10/17	Stenonema	2			2
10.S1	10/17	Stenacron	1			1
10.S1	10/17	Hydropsyche				
10.S1	10/17	Chironomidae	24	1		25
10.S2	10/17	Baetis	1			1
10.S2	10/17	Stenonema	1			1
10.S2	10/17	Hydropsyche	5			5
10.S2	10/17	Chironomidae	12			12
10.S2	10/17	Hemerodromia	1			1
2.S1	10/17	Physella heterostropha				1
2.S1	10/17	Hydracarina				1
2.S1	10/17	Collembola				1
2.S1	10/17	Baetis	1			1
2.S1	10/17	Tricorythodes	3			3
2.S1	10/17	Hydropsyche	1			1
2.S1	10/17	Berosus	2			2
2.S1	10/17	Chironomidae	2			2
2.S2	10/17	Tricorythodes	2			2
2.S2	10/17	Hydroptila	5			5
2.S2	10/17	Chironomidae	6			6
5.S1	10/17	Hydracarina				1
5.S1	10/17	Baetis	5			5
5.S1	10/17	Cheumatopsyche	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
5.S1	10/17	Hydropsyche	10			10
5.S1	10/17	Simuliidae	4			4
5.S1	10/17	Chironomidae	1			1
5.S2	10/17	Nemertea				1
5.S2	10/17	Oligochaeta				9
5.S2	10/17	Crangonyx				1
5.S2	10/17	Hydracarina				5
5.S2	10/17	Stenonema	1			1
5.S2	10/17	Baetis	6			6
5.S2	10/17	Cheumatopsyche	2			2
5.S2	10/17	Hydropsyche	11			11
5.S2	10/17	Macronychus glabratus			1	1
5.S2	10/17	Chironomidae	1	1		2
5.S2	10/17	Simuliidae	5			5
5.S2	10/17	Tipula	1			1
6.S1	10/17	Oligochaeta				1
6.S1	10/17	Isonychia	1			1
6.S1	10/17	Cheumatopsyche	1			1
6.S1	10/17	Hydropsyche	33			33
6.S1	10/17	Chironomidae	2			2
6.S2	10/17	Tricorythodes	2			2
6.S2	10/17	Hydropsyche	6			6
6.S2	10/17	Cheumatopsyche	4			4
6.S2	10/17	Chironomidae	1			1
8.S1	10/17	Isonychia	7			7
8.S1	10/17	Cordulegaster	1			1
8.S1	10/17	Hydropsyche	98			98
8.S1	10/17	Hydropsyche morosa group	9			9
8.S1	10/17	Optioservus	8			8
8.S1	10/17	Stenelmis			1	1
8.S1	10/17	Isonychia	3			3
8.S2	10/17	Cheumatopsyche	2			2

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
8.S2	10/17	Hydropsyche morosa group	5			5
8.S2	10/17	Hydropsyche	28			28
8.S2	10/17	Optioservus	2		1	3
8.S2	10/17	Chironomidae	1			1
3.S1	10/18	Cheumatopsyche	2			2
3.S1	10/18	Hydropsyche	18			18
3.S1	10/18	Chironomidae	1			1
3.S1	10/18	Antocha	1			1
3.S1	10/18	Simuliidae	1			1
3.S2	10/18	Cheumatopsyche	2			2
3.S2	10/18	Hydropsyche	3			3
4.S1	10/19	Tricladida				1
4.S1	10/19	Physella heterostropha				3
4.S1	10/19	Cordulegaster	1			1
4.S1	10/19	Calopteryx	1			1
4.S1	10/19	Stenonema	8			8
4.S1	10/19	Nigronia serricornis	1			1
4.S1	10/19	Eurylophella	2			2
4.S1	10/19	Hydropsyche	10			10
4.S1	10/19	Cheumatopsyche	10			10
4.S1	10/19	Polycentropus	1			1
4.S1	10/19	Dubiraphia			1	1
4.S1	10/19	Stenelmis	2			2
4.S2	10/19	Stenonema	7			7
4.S2	10/19	Eurylophella	1			1
4.S2	10/19	Hydropsyche	18			18
4.S2	10/19	Chemuatopsyche	9			9
4.S2	10/19	Nigronia serricornis	3			3
4.S2	10/19	Stenelmis	2			2
4.S2	10/19	Optioservus	1			1
11.S1	10/19	Oligochaeta				1
11.S1	10/19	Hydropsyche	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
11.S1	10/19	Tipula	1			1
11.S2	10/19	Oligochaeta				1
11.S2	10/19	Hydropsyche	1			1
11.S2	10/19	Stenonema	1			1
11.S2	10/19	Telmatoscopus	1			12
12.S1	10/19	Oligochaeta				1
12.S1	10/19	Hydropsyche	3			3
12.S1	10/19	Tipula	11			11
12.S2	10/19	Hydropsyche	3			3
12.S2	10/19	Tipula	1			1
14.S1	10/19	Crangonyx				1
15.S1	10/19	Oligochaeta				3
15.S1	10/19	Crangonyx				1
15.S1	10/19	Astacidae				1
15.S1	10/19	Cheumatopsyche	1			1
15.S1	10/19	Helichus			1	1
15.S1	10/19	Chironomidae	2			2
15.S1	10/19	Simuliidae	3			3
15.S1	10/19	Tipula	1			1
15.S2	10/19	Chironomidae	2			2
15.S2	10/19	Simuliidae	1			1
15.S2	10/19	Tipula	3			3
7.S1	10/19	Hydropsyche	4			4
7.S1	10/19	Cheumatopsyche	5			5
7.S1	10/19	Diplectrona	1			1
7.S2	10/19	Asellus				2
7.S2	10/19	Hydropsyche	1			1
7.S2	10/19	Cheumatopsyche	3			3
9.S1	10/19	Oligochaeta				1
9.S1	10/19	Stenonema	1			1
9.S1	10/19	Nigromia serricornis	1			1
9.S1	10/19	Optioservus	6			6

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
9.S1	10/19	Stenelmis			1	1
9.S1	10/19	Hydropsyche morosa group	1			1
9.S1	10/19	Hydropsyche	10			10
9.S1	10/19	Cheumatopsyche	5			5
9.S1	10/19	Dolophilodes	1			1
9.S1	10/19	Antocha	1			1
9.S2	10/19	Stenonema	9			9
9.S2	10/19	Dolophilodes	1			1
9.S2	10/19	Chimarra	1			1
9.S2	10/19	Hydropsyche morosa	1			1
9.S2	10/19	Hydropsyche	12		12	
9.S2	10/19	Optioservus	4		1	5
13.S1	10/19	Stenonema	8			8
13.S1	10/19	Isonychia	13			13
13.S1	10/19	Hydropsyche	3			3
13.S1	10/19	Cheumatopsyche	9			9
13.S2	10/19	Astacidae				1
13.S2	10/19	Stenonema	6			6
13.S2	10/19	Isonychia	4			4
13.S2	10/19	Hydropsyche	4			4
13.S2	10/19	Cheumatopsyche	11			11
13.S2	10/19	Psephenus herricki	1			1
13.S2	10/19	Optioservus	5			5
13.S2	10/19	Stenelmis	1			1
13.S2	10/19	Tipula	3			3

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
1.N1	4/25	Oligochaeta				1
1.N2	4/25	Oligochaeta				2
2.N1	4/19	Hirundinea				1
2.N1	4/19	Hydracarina				3
2.N1	4/19	Hydropsyche	1			1
2.N1	4/19	Chironomidae	13			13
2.N2	4/19	Tridadida				1
2.N2	4/19	Hydracarina				1
2.N2	4/19	Hydropshyche	2			2
2.N2	4/19	Chironomidae	4			4
2.N2	4/19	Tanypodinae	1			1
3.N1	4/19	Oligochaeta				1
3.N1	4/19	Chironomidae	2			2
3.N1	4/19	Tanypodinae	1			1
3.N2	4/19	Oligochaeta				2
3.N2	4/19	Chironomidae	4			4
3.N2	4/19	Tanypodinae	2			2
4.N1	4/24	Oligochaeta				1
4.N1	4/24	Calopteryx	1			1
4.N1	4/24	Cordulegaster	1			1
4.N1	4/24	Dubiraphia			6	6
4.N1	4/24	Simuliidae	1			1
4.N2	4/24	Dineutus			1	1
4.N2	4/24	Dubiraphia			1	1
4.N2	4/24	Tanypodinae	1			1
4.N2	4/24	Simuliidae	2			2
5.N1	4/24	Oligochaeta				11
5.N1	4/24	Chironomidae	1			1
5.N2	4/24	Oligochaeta				7
5.N2	4/24	Chironomidae	1			1
6.N1	4/25	Oligochaeta				3
6.N1	4/25	Chironomidae	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
6.N2	4/25	Chironomidae	4			4
7.N1	4/25	Oligochaeta				1
7.N1	4/25	Chironomidae	3			3
7.N2	4/25	Astacidae				1
7.N2	4/25	Chironomidae	1			1
8.N1	4/25	Hydracarina				2
8.N2	4/25	Oligochaeta				2
8.N2	4/25	Rhynchobdellida				4
8.N2	4/25	Chironomidae	1			1
9.N1	4/25	Eurylophella	4			4
9.N1	4/25	Stenacron	2			2
9.N1	4/25	Chironomidae	3			3
9.N2	4/25	Eurylophella	7			7
9.N2	4/25	Chironomidae	3			3
10.N1	4/19	Oligochaeta				~4
10.N1	4/19	Tanypodinae	1			1
10.N2	4/19	Oligochaeta				~5
10.N2	4/19	Chironomidae	5			5
10.N2	4/19	Tanypodinae	1			1
11.N1	5/1	Chironomidae	2	1		3
11.N2	5/1	Oligochaeta				9
12.N1	5/1	Oligochaeta				6
12.N1	5/1	Chironomidae	5			5
12.N2	5/1	Oligochaeta				9
12.N2	5/1	Helobdella triserialis				1
13.N1	4/11	Chironomidae	1			1
13.N2	4/11	Eurylophella	1			1
13.N2	4/11	Chironomidae	5			5
14.N1	5/1	Oligochaeta				2
14.N1	5/1	Lestes	1			1
14.N1	5/1	Chironomidae	4	1		5
14.N2	5/1	Chironomidae	2	2		4

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
15.N2	5/1	Fossaria parva				1
15.N2	5/1	Hemiptera				1
15.N2	5/1	Chironomidae	1			1
15.N1	5/1	Oligochaeta				2
15.N1	5/1	Asellus				1
15.N1	5/1	Chironomidae	3			3
1.N1	5/21	Oligochaeta				5
1.N2	5/21	Oligochaeta				7
1.N2	5/21	Chironomidae	2			2
2.N1	5/21	Oligochaeta				1
2.N1	5/21	Chironomidae	8	1		9
2.N2	5/21	Argia	1			1
2.N2	5/21	Chironomidae	7			7
3.N1	5/21	Zygoptera	1			1
3.N2	5/21	Oligochaeta				4
3.N2	5/21	Asellus				1
3.N2	5/21	Calopteryx	1			1
3.N2	5/21	Chironomidae	8			8
4.N2	5/21	Oligochaeta				2
4.N2	5/21	Asellus				2
4.N2	5/21	Crangonyx				1
4.N2	5/21	Calopteryx	1			1
4.N2	5/21	Sialis	1			1
4.N2	5/21	Dytiscidae			1	1
4.N2	5/21	Promoresia			1	1
4.N2	5/21	Chironomidae	2	3		5
4.N1	5/21	Helisoma anceps				1
4.N1	5/21	Asellus				3
4.N1	5/21	Crangonyx				1
4.N1	5/21	Calopteryx	1			1
4.N1	5/21	Eurylophella	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
4.N1	5/21	Dineutus	1			1
4.N1	5/21	Chironomidae	3			3
5.N1	5/21	Oligochaeta				2
5.N1	5/21	Chironomidae	11	1		12
5.N2	5/21	Oligochaeta				11
5.N2	5/21	Physella heterostropha				6
5.N2	5/21	Helisoma anceps				2
5.N2	5/21	Fossaria parva				25
5.N2	5/21	Crangonyx				2
5.N2	5/21	Enallagma	2			2
5.N2	5/21	Plathemis	1			1
5.N2	5/21	Chironomidae	5	1		6
6.N2	5/21	Oligochaeta				2
6.N2	5/21	Baetis	2			2
6.N2	5/21	Hydropsychidae	1			1
6.N2	5/21	Simuliidae	1			1
6.N2	5/21	Chironomidae	3			3
6.N1	5/21	Oligochaeta				1
6.N1	5/21	Chironomidae	2			2
7.N1	5/23	Chironomidae	1			1
8.N1	5/30	Oligochaeta	5			5
8.N1	5/30	Crangonyx				1
8.N1	5/30	Hydracarina				1
8.N1	5/30	Baetis	3			3
8.N1	5/30	Centroptilum	1			1
8.N1	5/30	Calopteryx	1			1
8.N1	5/30	Argia	1			1
8.N1	5/30	Hydropsychidae	1			1
8.N1	5/30	Ceratopogonidae	1			1
8.N1	5/30	Chironomidae	6	1		7
8.N2	5/30	Oligochaeta				3
8.N2	5/30	Crangonyx				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
8.N2	5/30	Baetis	9			9
8.N2	5/30	Centroptilum	1			1
8.N2	5/30	Argia	3			3
8.N2	5/30	Tipula	1			1
8.N2	5/30	Lepidostoma	1			1
8.N2	5/30	Hydrophilidae	1			1
8.N2	5/30	Chironomidae	11			11
9.N1	5/23	Eurylophella	3			3
9.N1	5/23	Baetis	1			1
9.N1	5/23	Stenonema	1			1
9.N1	5/23	Boyeria vinosa	1			1
9.N1	5/23	Nigronia serricornis	2			2
9.N1	5/23	Helichus			1	1
9.N1	5/23	Chironomidae	1			1
9.N2	5/23	Centroptilum	5			5
9.N2	5/23	Calopteryx	1			1
9.N2	5/23	Stylogomphus	1			1
9.N2	5/23	Chironomidae	2			2
10.N1	5/30	Oligochaeta				3
10.N1	5/30	Asellus				1
10.N1	5/30	Crangonyx				4
10.N1	5/30	Centroptilum	1			1
10.N1	5/30	Hydropsychidae	1			1
10.N2	5/30	Tricladida				1
10.N2	5/30	Oligochaeta				1
10.N2	5/30	Baetis	4			4
10.N2	5/30	Simuliidae	1			1
10.N2	5/30	Chironomidae	1			1
10.N1	5/30	Chironomidae	2			2
11.N1	5/30	Chironomidae	2			2
11.N2	5/30	Libellulidae	1			1
12.N1	5/30	Oligochaeta				7

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
12.N1	5/30	Ceratopogonidae	1			1
12.N2	5/30	Oligochaeta				1
12.N2	5/30	Crangonyx				2
12.N2	5/30	Eurylophella	2			2
12.N2	5/30	Baetis	2			2
12.N2	5/30	Hydropyschye morosa group	1			1
12.N2	5/30	Chironomidae	7			7
13.N1	5/31	Centroptilum	2			2
13.N1	5/31	Eurylophella	3			3
13.N1	5/31	Caenis	1			1
13.N1	5/31	Leptophlebiidae	1			1
13.N1	5/31	Argia	2			2
13.N1	5/31	Promoresia			1	1
13.N1	5/31	Chironomidae	3			3
13.N2	5/31	Baetis	1			1
13.N2	5/31	Oligochaeta				1
13.N2	5/31	Asellus				2
13.N2	5/31	Hydracarina				1
13.N2	5/31	Caenis	3			3
13.N2	5/31	Centroptilum	6			6
13.N2	5/31	Eurylophella	9			9
13.N2	5/31	Calopteryx	1			1
13.N2	5/31	Enallagma	1			1
13.N2	5/31	Libellulidae	1			1
13.N2	5/31	Promoresia			5	5
13.N2	5/31	Dubiraphia			1	1
13.N2	5/31	Dytiscidae			1	1
13.N2	5/31	Chironomidae	5			5
13.N2	5/31	Ceratopogonidae	2			2
13.N2	5/31	Bittacomorpha	1			1
14.N1	5/30	Oligochaeta				1
14.N1	5/30	Chironomidae	2			2

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
14.N2	5/30	Oligochaeta				1
14.N2	5/30	Baetis	1			1
14.N2	5/30	Chironomidae	1			1
15.N1	5/31	Oligochaeta				6
15.N1	5/31	Physella heterostropha				1
15.N1	5/31	Baetis	1			1
15.N2	5/31	Tricladida				1
15.N2	5/31	Oligochaeta				2
15.N2	5/31	Physella heterostropha				20
15.N2	5/31	Fossaria parva				1
15.N2	5/31	Asellus				1
15.N2	5/31	Crangonyx				1
15.N2	5/31	Helocombus			1	1
15.N2	5/31	Chironomidae	1	4		
1.N1	7/18	Baetis	1			1
1.N1	7/18	Chironomidae	2			2
1.N2	7/18	Chironomidae	1			1
2.N1	7/18	Oligochaeta				1
2.N1	7/18	Physella heterostropha				2
2.N1	7/18	Hydracarina				4
2.N1	7/18	Chironomidae		1		1
2.N2	7/18	Tricladida				1
2.N2	7/18	Physella heterostropha				2
2.N2	7/18	Hydracarina				1
2.N2	7/18	Hydropsyche betteni	1			1
2.N2	7/18	Chironomidae	10	1		11
3.N1	7/18	Physella heterostropha				1
3.N1	7/18	Baetis	1			1
3.N1	7/18	Antocha	1			1
3.N2	7/18	Centroptilum	1			1
3.N2	7/18	Chironomidae	1	2		3

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
4.N1	7/18	Oligochaeta				1
4.N1	7/18	Hydracarina				1
4.N1	7/18	Gomphidae	1			1
4.N1	7/18	Stenelmis			1	1
4.N1	7/18	Diplectrona	1			1
4.N1	7/18	Promoresia			1	1
4.N1	7/18	Chironomidae	3			3
4.N2	7/18	Physella heterostropha				1
4.N2	7/18	Hyalella azteca				3
4.N2	7/18	Asellus				2
4.N2	7/18	Hydracarina				4
4.N2	7/18	Centroptilum	1			1
4.N2	7/18	Gomphidae	1			1
4.N2	7/18	Coenagrionidae	1			1
4.N2	7/18	Triaenodes	1			1
4.N2	7/18	Boyeria	1			1
4.N2	7/18	Polycentropus	1			1
4.N2	7/18	Promoresia			16	16
4.N2	7/18	Chironomidae	2	1		3
5.N1	7/18	Oligochaeta				2
5.N2	7/18	Oligochaeta				6
5.N2	7/18	Physella heterostropha				7
5.N2	7/18	Coenagrionidae	2			2
5.N2	7/18	Centroptilum	2			2
5.N2	7/18	Chironomidae	8			8
6.N1	7/18	Baetis	1			1
6.N2	7/18	Baetis	1			1
6.N2	7/18	Hydropsyche betteni	3			3
6.N2	7/18	Hydropsyche	3			3
6.N2	7/18	Chironomidae	2	1		3
7.N1	7/20	Calopteryx	1			1
7.N1	7/20	Argia	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
7.N1	7/20	Boyeria vinosa	1			1
7.N2	7/20	Physella				1
7.N2	7/20	Boyeria vinosa	1			1
7.N2	7/20	Helichus			2	2
7.N2	7/20	Derovatellus			1	1
7.N2	7/20	Hydrobius			1	1
8.N1	7/19	Physella heterostropha				2
8.N1	7/19	Crangonyx				1
8.N1	7/19	Astacidae				1
8.N1	7/19	Tricorythodes	1			1
8.N1	7/19	Boyeria vinosa	1			1
8.N1	7/19	Argia	2			2
8.N1	7/19	Lestidae	1			1
8.N1	7/19	Hydrochus			10	10
8.N1	7/19	Chironomidae	1			1
8.N2	7/19	Hydracarina				6
8.N2	7/19	Argia	1			1
8.N2	7/19	Nigronia serricornis	1			1
8.N2	7/19	Chironomidae	1	2		3
9.N1	7/20	Crangonyx				2
9.N1	7/20	Eurylophella	1			1
9.N1	7/20	Boyeria vinosa	2			2
9.N1	7/20	Calopteryx	2			2
9.N1	7/20	Helichus			4	4
9.N1	7/20	Derovatellus			1	1
9.N1	7/20	Chironomidae		1		1
9.N2	7/20	Oligochaeta				1
9.N2	7/20	Isonychia	2			2
9.N2	7/20	Helichus			2	2
9.N2	7/20	Chironomidae	1			1
10.N1	7/18	Oligochaeta				1
10.N1	7/18	Chironomidae	5			5

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
11.N1	7/19	Physella heterostropha				1
11.N1	7/19	Ancyronyx variegatus			1	1
11.N1	7/19	Chironomidae	2			2
11.N2	7/19	Oligochaeta				1
11.N2	7/19	Hydracarina				1
11.N2	7/19	Archilestes	1			1
11.N2	7/19	Hydropsyche	1			1
11.N2	7/19	Helichus			1	1
11.N2	7/19	Chironomidae	4			4
12.N1	7/19	Oligochaeta				1
12.N2	7/19	Oligochaeta				1
12.N2	7/19	Macromia	1			1
12.N2	7/19	Boyeria vinosa	1			1
12.N2	7/19	Hydropsyche betteni	1			1
12.N2	7/19	Hydropsyche	1			1
12.N2	7/19	Chironomidae	1			1
13.N1	7/20	Physella heterostropha				2
13.N1	7/20	Astacidae				2
13.N1	7/20	Caenis	1			1
13.N1	7/20	Centroptilum	2			2
13.N1	7/20	Macronychus			1	1
13.N1	7/20	Promoresia			3	3
13.N1	7/20	Chironomidae	4	1		5
13.N2	7/20	Rhabdocoela				1
13.N2	7/20	Physella heterostropha				3
13.N2	7/20	Caenis	2			2
13.N2	7/20	Centroptilum	2			2
13.N2	7/20	Argia	6			6
13.N2	7/20	Coenagrionidae	1			1
13.N2	7/20	Boyeria vinosa	4			4
13.N2	7/20	Dubiraphia	1			1
13.N2	7/20	Dubiraphia			1	1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
14.N1	7/19	Deronectes	1			1
14.N1	7/19	Chironomidae	3			3
15.N1	7/20	Tricladida				3
15.N1	7/20	Oligochaeta				4
15.N1	7/20	Fossaria parva				1
15.N1	7/20	Asellus				1
15.N1	7/20	Chironomidae	2			2
15.N2	7/20	Tricladida				2
15.N2	7/20	Oligochaeta				2
15.N2	7/20	Physella heterostropha				3
15.N2	7/20	Fossaria parva				1
15.N2	7/20	Chironomidae	2			2
2.N1	8/21	Hyalella azteca				2
2.N1	8/21	Hemiptera				1
2.N1	8/21	Berosus			7	7
2.N1	8/21	Chironomidae	1			1
2.N2	8/21	Physella				1
2.N2	8/21	Lymnaeidae				1
2.N2	8/21	Hyalella azteca				1
2.N2	8/21	Berosus			3	3
2.N2	8/21	Hydrophilidae			1	1
2.N2	8/21	Chironomidae	1			1
3.N1	8/23	Chironomidae	1			1
3.N1	8/23	Hemerodromia	1			1
3.N2	8/23	Oligochaeta				3
3.N2	8/23	Crangonyx				1
3.N2	8/23	Asellus				8
3.N2	8/23	Sialis	1			1
3.N2	8/23	Calopteryx	8			8
3.N2	8/23	Hydropsyche	1			1
3.N2	8/23	Ptilostomis	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
3.N2	8/23	Ancyronyx variegata			1	1
3.N2	8/23	Chironomidae	3			3
4.N1	8/26	Hyalella azteca				3
4.N1	8/26	Boyeria vinosa	1			1
4.N1	8/26	Argia	1			1
4.N1	8/26	Calopteryx	4			4
4.N1	8/26	Sialis	3			3
4.N1	8/26	Ancyronyx variegata			2	2
4.N1	8/26	Hydrochus			1	1
4.N1	8/26	Uvarus			1	1
4.N1	8/26	Dubiraphia			3	3
4.N1	8/26	Chironomidae	3			3
4.N2	8/26	Ceratopogonidae	1			1
4.N2	8/26	Calopteryx	7			7
4.N2	8/26	Boyeria vinosa	1			1
4.N2	8/26	Dromogomphus	2			2
4.N2	8/26	Hydropsyche	1			1
4.N2	8/26	Ancyronyx variegata			3	3
4.N2	8/26	Macronychus			1	1
4.N2	8/26	Helichus			3	3
4.N2	8/26	Dubiraphia			4	4
4.N2	8/26	Simuliidae	6			6
4.N2	8/26	Chironomidae	1			1
5.N1	8/23	Centroptilum	1			1
5.N1	8/23	Argia	1			1
5.N1	8/23	Chironomidae	5	4		9
5.N2	8/23	Oligochaeta				1
5.N2	8/23	Physella heterostropha				1
5.N2	8/23	Fossaria parva				3
5.N2	8/23	Helisoma anceps				3
5.N2	8/23	Centroptilum	1			1
5.N2	8/23	Coenagrionidae	4			4

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
5.N2	8/23	Chironomidae	8			8
6.N1	8/23	Centroptilum	4			4
6.N1	8/23	Chironomidae	2	1		3
6.N2	8/23	Physella heterostrophia				4
6.N2	8/23	Fossaria parva				1
6.N2	8/23	Baetis	15			15
6.N2	8/23	Simuliidae	1			1
6.N2	8/23	Chironomidae		1		1
7.N1	8/24	Caenis	1			1
7.N2	8/24	Astacidae				1
7.N2	8/24	Calopteryx	1			1
8.N1	8/23	Physella heterostropha				1
8.N1	8/23	Boyeria vinosa	5			5
8.N2	8/23	Macromia	2			2
8.N1	8/23	Centoptilum	1			1
8.N1	8/23	Ancyronyx variegata			1	1
8.N1	8/23	Chironomidae	1			1
9.N1	8/24	Hydracarina				3
9.N1	8/24	Stenonema	6			6
9.N1	8/24	Caenis	4			4
9.N1	8/24	Isonychia	1			1
9.N1	8/24	Heptageniidae	3			3
9.N1	8/24	Chironomidae	1			1
9.N2	8/24	Nemertea				1
9.N2	8/24	Argia	2			2
9.N2	8/24	Calopteryx	4			4
9.N2	8/24	Caenis	2			2
9.N2	8/24	Heptageniidae	1			1
9.N2	8/24	Tipula	1			1
10.N1	8/21	Hemiptera				1
10.N1	8/21	Chironomidae	3			3
11.N1	8/23	Oligochaeta				1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
11.N1	8/23	Stenopelmus rufinasus			1	1
11.N1	8/23	Chironomidae	1	1		2
12.N1	8/23	Chironomidae	1			1
13.N1	8/24	Macromia	1			1
13.N1	8/24	Gomphidae	1			1
13.N1	8/24	Macromiidae	1			1
13.N1	8/24	Hetaerina	3			3
13.N1	8/24	Dytiscidae			2	2
13.N1	8/24	Elmidae			1	1
13.N1	8/24	Hydrophilidae			1	1
13.N2	8/24	Astacidae				1
13.N2	8/24	Calopterygidae	2			2
13.N2	8/24	Centroptilum	2			2
13.N2	8/24	Sialis	1			1
13.N2	8/24	Gyrinus			2	2
13.N2	8/24	Chironomidae		1		1
14.N1	8/24	Oligochaeta				1
14.N1	8/24	Chironomidae	2			2
14.N2	8/24	Oligochaeta				1
14.N2	8/24	Chironomidae	1			1
15.N1	8/24	Oligochaeta				3
15.N1	8/24	Physella heterostropha				3
15.N1	8/24	Culex	1			1
15.N1	8/24	Chironomidae	1			1
15.N2	8/24	Oligochaeta				1
15.N2	8/24	Crangonyx				1
15.N2	8/24	Hydracarina				1
15.N2	8/24	Chironomidae	2			2
1.N1	10/17	Chironomidae	1			1
10.N1	10/17	Planorbella				1
10.N1	10/17	Chironomidae	2			2
10.N2	10/17	Chironomidae	5			5

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
2.N1	10/17	Oligochaeta	3			3
2.N1	10/17	Crangonyx	2			2
2.N1	10/17	Chironomidae	4			4
2.N2	10/17	Trieladida				1
2.N2	10/17	Oligochaeta				3
2.N2	10/17	Chironomidae		2		2
5.N1	10/17	Oligochaeta				1
5.N1	10/17	Crangonyx				5
5.N1	10/17	Baetis	2			2
5.N1	10/17	Boyeria vinosa	1			1
5.N1	10/17	Calopteryx	4			4
5.N1	10/17	Ischnura	2			2
5.N1	10/17	Chironomidae	1			1
5.N1	10/17	Ceratopogonidae	1			1
5.N2	10/17	Oligochaeta				4
5.N2	10/17	Physella heterostropha				4
5.N2	10/17	Chironomidae	1			1
6.N1	10/17	Tricorythodes	2			2
6.N1	10/17	Hydracarina				1
6.N1	10/17	Crangonyx				1
6.N2	10/17	Hydracarina				2
8.N2	10/17	Physella heterostropha				1
8.N2	10/17	Argia				1
8.N2	10/17	Chironomidae	1			1
3.N1	10/18	Chironomidae	1			1
3.N2	10/18	Asellus				1
3.N2	10/18	Hydracarina				1
3.N2	10/18	Chironomidae	1			1
4.N1	10/19	Calopteryx	1			1
4.N1	10/19	Dromogomphus	1			1
4.N1	10/19	Stenonema	1			1
4.N1	10/19	Eurylophella	4			4

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
4.N2	10/19	Asellus				1
4.N2	10/19	Eurylophella	38			38
4.N2	10/19	Stenonema	1			1
4.N2	10/19	Paraleptophlebia	1			1
4.N2	10/19	Calopteryx	2			2
4.N2	10/19	Nigronia serricornis	2			2
4.N2	10/19	Dytiscidae	2			2
4.N2	10/19	Cheumatopsyche	1			1
4.N2	10/19	Oecetis	1			1
4.N2	10/19	Chironomidae	4			4
11.N1	10/19	Oligochaeta				3
11.N1	10/19	Berosus	1			1
11.N1	10/18	Tipula	1			1
11.N1	10/19	Chironomidae	3			3
11.N2	10/19	Oligochaeta				10
11.N2	10/19	Hydracarina				1
11.N2	10/19	Hydropsyche	1			1
11.N2	10/19	Chironomidae	4			4
12.N1	10/19	Hydracarina				1
12.N1	10/19	Hydropsyche	1			1
12.N1	10/19	Chironomidae	1			1
12.N1	10/19	Tipula	2			2
12.N2	10/19	Hydracarina				1
12.N2	10/19	Hydropsyche	1			1
12.N2	10/19	Chironomidae	2			2
14.N1	10/19	Chironomidae	2			2
14.N2	10/19	Oligochaeta				1
15.N1	10/19	Oligochaeta				2
15.N1	10/19	Chironomidae	1			1
15.N2	10/19	Asellus				1
7.N1	10/19	Cyclopoida				1
7.N1	10/19	Calopteryx	1			1

Appendix B. (Cont.)

Stn./Rep.	Date	Taxon	L(N)	P	A	Total
7.N1	10/19	Enallagma	2			2
7.N1	10/19	Chironomidae	1			1
7.N2	10/19	Enallagma	2			2
7.N2	10/19	Chironomidae	1			1
7.N2	10/19	Tipulidae	1			1
9.N1	10/19	Calopteryx	1			1
9.N2	10/19	Hydracarina				1
9.N2	10/19	Hydropsyche	1			1
13.N1	10/19	Oligochaeta				1
13.N1	10/19	Astacidae				1
13.N1	10/19	Calopteryx	2			2
13.N1	10/19	Isonychia	1			1
13.N1	10/19	Physella heterostropha				1
13.N1	10/19	Helichus			1	1
13.N1	10/19	Chironomidae	4			4
13.N2	10/19	Chironomidae	2			2

APPENDIX C. PHYSICOCHEMICAL MEASUREMENTS, DATA TABLES BY SAMPLING EVENT. TABLES 1-5: WATER TEMPERATURE, pH, TOTAL DISSOLVED SOLIDS, AND TURBIDITY; TABLES 6-10: AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN.

APPENDIX C

TABLE 1 ANACOSTIA RIVER WATERSHED. WATER PHYSICAL/ CHEMICAL PARAMETERS. JUNE 1990. (TDS=TOTAL DISSOLVED SOLIDS; NTU=NEPHELOMETRIC TURBIDITY UNITS) WATER TEMPERATURES GIVEN ARE AN AVERAGE OF TWO READINGS, ONE EACH FROM THE TURBIDIMETER AND THE PH METER.

Site	Water Temp. (°C)	pH	TDS (g/L)	Turbidity (NTU)
1	23.2	7.37	0.211	8.2
2	25.0	8.29	0.119	5.2
3	21.1	7.23	0.082	6.2
4	21.3	7.85	0.077	8.8
5	29.9	8.97	0.097	2.2
6	28.1	7.02	0.097	2.6
7	21.6	6.85	0.084	0.78
8	26.0	8.41	0.074	2.0
9	21.4	7.85	0.033	1.4
10	26.4	8.17	0.147	3.6
11	23.6	7.35	0.075	4.0
12	21.5	7.25	0.058	2.8
13	24.7	8.35	0.067	2.0
14	22.5	7.32	0.169	0.54
15	22.0	6.53	0.080	1.8

APPENDIX C

TABLE 2 ANACOSTIA RIVER WATERSHED. WATER PHYSICAL/ CHEMICAL PARAMETERS. JULY 1990. (TDS=TOTAL DISSOLVED SOLIDS; NTU=NEPHELOMETRIC TURBIDITY UNITS) WATER TEMPERATURES GIVEN ARE AN AVERAGE OF TWO READINGS, ONE EACH FROM THE TURBIDIMETER AND THE PH METER.

Site	Water Temp. (°C)	pH	TDS (g/L)	Turbidity (NTU)
1	26.2	8.33	0.074	60
2	25.1	9.09	0.114	1.5
3	22.3	7.54	0.109	1.2
4	20.8	7.16	0.084	4.8
5	26.9	9.05	0.125	2.0
6	26.5	9.21	0.076	0.54
7	23.2	11.37	0.095	0.76
8	25.7	9.26	0.093	0.34
9	22.8	9.32	0.088	0.74
10	25.7	8.16	0.083	0.64
11	24.4	7.96	0.091	0.56
12	26.1	8.61	0.073	2.0
13	23.5	8.08	0.087	4.0
14	23.4	8.60	0.156	0.36
15	25.3	7.37	0.093	0.34

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TABLE 3 ANACOSTIA RIVER WATERSHED. WATER PHYSICAL/ CHEMICAL PARAMETERS. AUGUST 1990. (TDS=TOTAL DISSOLVED SOLIDS; NTU=NEPHELOMETRIC TURBIDITY UNITS.) WATER TEMPERATURES GIVEN ARE AN AVERAGE OF TWO READINGS, ONE EACH FROM THE TURBIDIMETER AND THE PH METER.

Site	Water Temp. (°C)	pH	TDS (g/L)	Turbidity (NTU)
1	20.7	6.33	0.093	6.7
2	22.7	8.20	0.125	8.8
3	21.3	6.90	0.152	6.8
4	20.3	6.48	0.075	5.3
5	23.5	7.83	0.123	4.8
6	23.9	8.70	0.108	0.78
7	22.8	7.38	0.101	3.6
8	23.0	8.54	0.115	0.63
9	23.1	8.11	0.113	8.9
10	21.7	8.02	0.110	3.2
11	22.0	10.64	0.120	0.88
12	24.4	7.55	0.076	5.3
13	21.9	10.70	0.115	7.3
14	21.9	7.53	0.150	5.2
15	23.8	7.35	0.087	6.8

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TABLE 4 ANACOSTIA RIVER WATERSHED. WATER PHYSICAL/CHEMICAL PARAMETERS. SEPTEMBER 1990. (TDS=TOTAL DISSOLVED SOLIDS; NTU=NEPHELOMETRIC TURBIDITY UNITS.) WATER TEMPERATURES GIVEN ARE AN AVERAGE OF TWO READINGS. ONE EACH FROM THE TURBIDIMETER AND THE PH METER.

Site	Water Temp. (°C)	pH	TDS (g/L)	Turbidity (NTU)
1	17.6	7.38	0.082	7.8
2	19.5	7.22	0.093	6.2
3	20.1	6.95	0.109	5.6
4	19.8	6.98	0.063	3.3
5	21.9	7.42	0.097	2.5
6	17.6	7.93	0.063	6.5
7	18.4	7.45	0.123	4.2
8	18.2	8.22	0.102	0.82
9	20.5	8.32	0.032	5.2
10	21.2	7.35	0.088	2.8
11	17.4	7.22	0.111	6.3
12	19.3	7.83	0.056	6.8
13	21.9	9.36	0.071	0.83
14	16.4	7.20	0.065	6.8
15	19.4	7.02	0.092	4.7

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TABLE 5 ANACOSTIA RIVER WATERSHED. WATER PHYSICAL/CHEMICAL PARAMETERS. OCTOBER 1990. (TDS=TOTAL DISSOLVED SOLIDS; NTU=NEPHELOMETRIC TURBIDITY UNITS.) WATER TEMPERATURES GIVEN ARE AN AVERAGE OF TWO READINGS. ONE EACH FROM THE TURBIDIMETER AND THE PH METER.

Site	Water Temp. (°C)	pH	TDS (g/L)	Turbidity (NTU)
1	10.6	6.33	0.113	7.5
2	10.9	7.11	0.020	8.0
3	9.7	7.36	0.080	7.0
4	7.1	5.82	0.077	4.6
5	12.4	7.67	0.133	6.8
6	10.7	7.33	0.101	1.8
7	8.4	6.98	0.092	18.0
8	10.4	7.07	0.082	0.8
9	7.5	7.32	0.050	0.7
10	10.9	7.02	0.081	8.2
11	10.2	7.25	0.078	18.0
12	7.1	7.31	0.080	2.0
13	9.0	7.22	0.080	18.0
14	9.1	7.50	0.185	0.64
15	7.6	7.36	0.106	0.66

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TABLE 6 ANACOSTIA RIVER WATERSHED SAMPLING STATIONS. AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN MEASUREMENTS FROM 28 JUNE 1990. ALL MEASUREMENTS TAKEN WITH A YSI MODEL 54 DO METER.

Site	Date	Air Temp. (°C)	H_2O Temp. (°C)	DO (mg/L)
1	6/28	30	25	6.2
2	6/28	30	24.5	15.0
3	6/28	35	21	6.9
4	6/28	30	20	7.3
5	6/28	31	27	9.8
6	6/28	35	27.5	6.7
7	6/28	28	21.5	7.2
8	6/28	31.5	26	8.6
9	6/28	27	21.5	8.2
10	6/28	30	25	10.4
11	6/28	28	27	9.4
12	6/28	27	22	7.7
13	6/28	33	28	9.1
14	6/28	27	23	7.4
15	6/28	27	22.5	7.0

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TABLE 7 ANACOSTIA RIVER WATERSHED SAMPLING STATIONS. AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN MEASUREMENTS FROM JULY 1990. ALL MEASUREMENTS TAKEN WITH A YSI MODEL 54 DO METER.

Site	Date	Air Temp. (°C)	H_2O Temp. (°C)	DO (mg/L)
1	7/18	25	22.5	7.0
2	7/18	26	22.5	9.6
3	7/18	27	22	8.9
4	7/18	29	21	9.5
5	7/18	28	29	9.4
6	7/18	37	29	9.1
7	7/20	25	21	10.2
8	7/19	32	22	8.8
9	7/20	27	21	9.9
10	7/18	31	24	8.4
11	7/19	29	24	10.2
12	7/19	42	24	8.5
13	7/20	29	22	11.4
14	7/19	32	24	9.6
15	7/20	24	21	11.4

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TABLE 8 ANACOSTIA RIVER WATERSHED SAMPLING STATIONS. AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN MEASUREMENTS FROM AUGUST 1990. ALL MEASUREMENTS TAKEN WITH A YSI MODEL 54 DO METER.

Site	Date	Air Temp. (°C)	H_2O Temp. (°C)	DO (mg/L)
1	8/21	18	19	11.2
2	8/21	19.5	19	11.2
3	8/23	19	20	10.6
4	8/23	19	19	10.4
5	8/23	20	19	10.8
6	8/23	22	20	11.2
7	8/24	21	19	9.8
8	8/23	21	19	10.4
9	8/24	20	18	8.6
10	8/21	19	19	12.0
11	8/23	21	19	8.6
12	8/23	22	20	11.1
13	8/24	20	18	9.4
14	8/24	20	19	9.3
15	8/24	20	19	9.0

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TABLE 9 ANACOSTIA RIVER WATERSHED SAMPLING STATIONS. AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN MEASUREMENTS FROM 19 SEPTEMBER 1990. ALL MEASUREMENTS TAKEN WITH A YSI MODEL 54 DO METER.

Site	Date	Air Temp. (°C)	H_2O Temp. (°C)	DO (mg/L)
1	9/19	15	15	10.0
2	9/19	16	16	9.2
3	9/19	16	15	10.2
4	9/19	16.5	13	10.2
5	9/19	17	16	9.7
6	9/19	18	16	10.0
7	9/19	17	16	10.4
8	9/19	16.5	15	10.2
9	9/19	17	14	10.1
10	9/19	16.5	16	9.6
11	9/19	17	15	9.0
12	9/19	17	15	9.2
13	9/19	17	14	9.8
14	9/19	18	15	9.8
15	9/19	18	15	11.0

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TABLE 10 ANACOSTIA RIVER WATERSHED SAMPLING STATIONS. AIR TEMPERATURE, WATER TEMPERATURE, AND DISSOLVED OXYGEN MEASUREMENTS FROM OCTOBER 1990. ALL MEASUREMENTS TAKEN WITH A YSI MODEL 54 DO METER.

Site	Date	Air Temp. (°C)	H_2O Temp. (°C)	DO (mg/L)
1	10/17	13	15	9.8
2	10/17	19	15	10.2
3	10/18	19	17	10.6
4	10/19	9	13	10.4
5	10/17	21	17	12.2
6	10/17	26	18	10.0
7	10/19	15	14	10.8
8	10/17	22	18	10.6
9	10/19	13	13	10.4
10	10/17	16	15	11.6
11	10/19	11	14	10.2
12	10/19	12	14	10.2
13	10/19	13	13	10.2
14	10/19	13	13	10.8
15	10/19	13	13	11.8

1990
Md Anacostia River Basin Study

PART II: Fish Community Rapid Bioassessments & The "Drop-In-The-Bucket-Brigades"

By

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Interstate Commission on the Potomac River Basin
Living Resources Section

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PART II

INTRODUCTION

This study represents the third year of fisheries investigations in the Anacostia River, Maryland. The first year of study (Cummins, 1989) focused on temporal comparisons with previous studies of fish communities at 26 sites in the watershed and evaluated migratory fish blockages. The second year (Cummins, 1990) was used to assess gamefish populations and to re-assess migratory fish blockages. During this third year, 1990, surveys of resident fishes were designed to characterize site-specific aquatic conditions using recently developed rapid bioassessment protocols (RBPs). RBPs are used to quantify and integrate habitat quality and fisheries conditions. They permit the researcher to expand beyond species list and incorporate numeric values to community attributes such as presence/absence of sensitive species or prevalence of trophic guilds that reflect upon environmental quality.

Many of the fifteen sites selected for this study are located downstream from ongoing or planned restoration\"retrofit" projects in the watershed. Such selections were obtained from the Anacostia Watershed Urban Retrofit Directory (Galli et al., 1989) and are identified in Appendix D. It is intended that the results of these RBPs also will be used in future evaluations of these projects. After several years, these sites should be resampled and reevaluated to assess the effectiveness of these practices on the aquatic life in the streams.

As in Part I, fisheries community analysis was modelled after modified RBPs proposed by Plafkin _et_ _al_. (1989). Modifications included metrics not specifically advocated in the original document and changes in the scoring criteria of the metrics.

STUDY SITES

The 15 study sites are the same for both fish and macrobenthic invertebrate community analysis, except for minor variations in exact upstream or downstream locations. The locations of fish sampling sites are more accurately described in the proceeding results section. Figure 1, reproduced from Part I on the following page, provides an overview of the location of each site in the watershed.

METHODS

Sampling: Resident fish sampling followed the procedures discussed by Plafkin _et_ _al_. and as is described in Cummins (1990). The upstream and downstream boundaries of one or two fifty-meter sections of stream were blocked with a 1/4" mesh net. Three-pass electrofishing depletion samples were then performed with all fish species being collected. In the field, fish collected from each proceeding pass were individually identified, counted, notes were made on any visible abnormalities including skin lesions, fin erosion, and tumors. Gamefish species were weighed and maximum total length measurements taken. Fish were kept separate from the other collections and then released. Gamefish population estimates were based upon three pass depletion models (Zippin, 1956). Habitat conditions also were evaluated at each site during sampling.

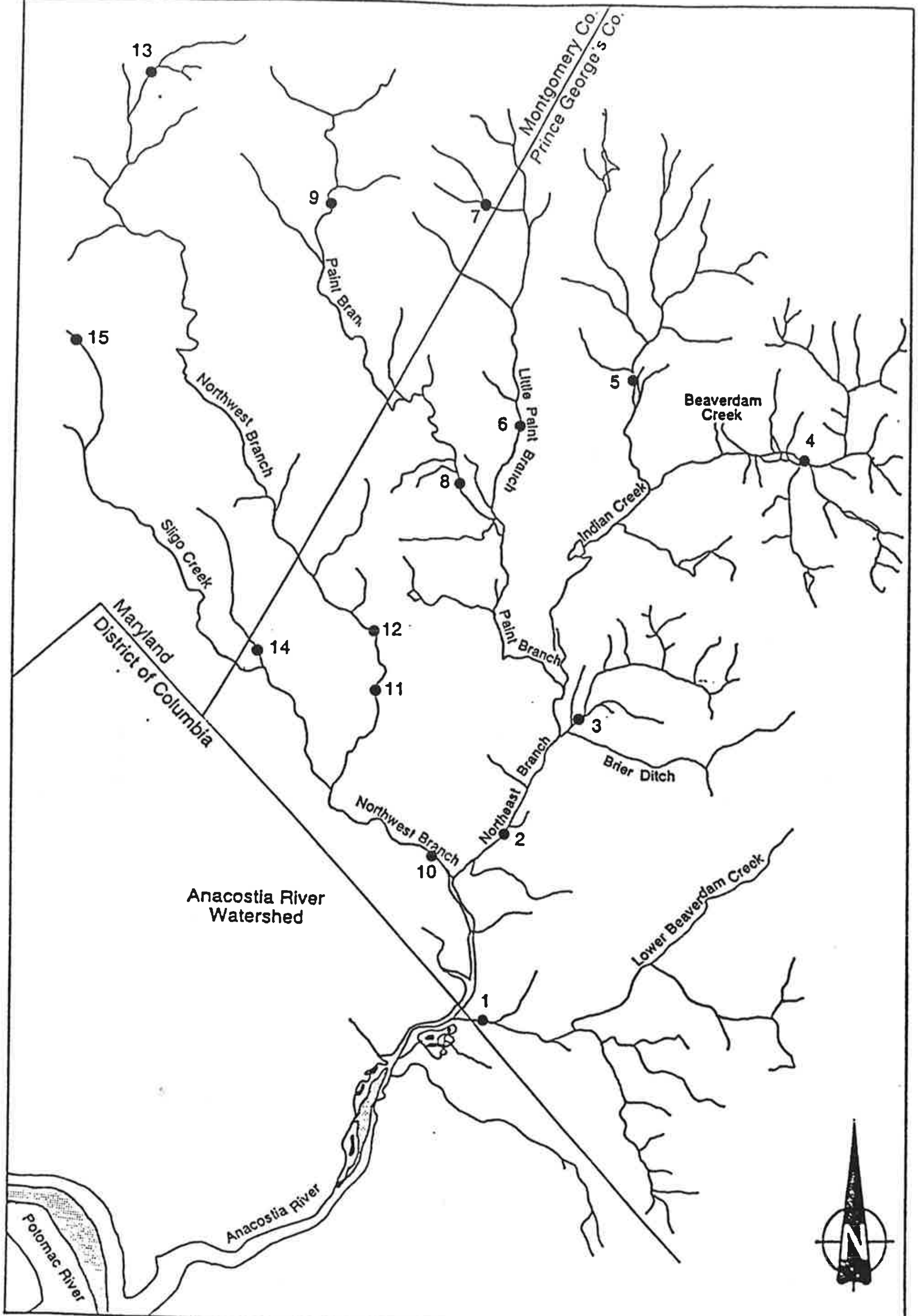

Figure #1: The Anacostia River Watershed, with sampling sites evaluated in 1990. Sites 7, 9, 13-15 are regarded as piedmont; the remainder, coastal plains

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Habitat Assessment: As described in Part I, the condition of each site under study was rated as a function of its capacity to support a healthy biological community. Fisheries habitat assessments also followed the approach developed by Plafkin et al. (1989) as previously outlined in Part I. Nine of the twelve parameters in Part I were used. Fisheries habitat assessments unintentionally did not include parameters 4, 8 and 12. These parameters were being developed this summer (Pers. comm., Sam Stribling) and were not available at the time of sampling. Please refer to Appendix A for a description of parameters.

Reference Site Selection: As in Part I, the watershed was divided into two physiographic regions, coastal plains and piedmont, for selection of reference sites. In the Anacostia watershed, piedmont streams drain into the coastal plain region. Consequently the coastal plain region contains the largest order streams. Therefore, comparisons of the fisheries information from the coastal plain region was further subdivided into two additional parts depending on drainage area; one for small coastal plain streams (≤10 mi^2) and one for large coastal plain streams (>10 mi^2)[1].

Reference sites for each of these three areas were then selected to represent the "best **obtainable** conditions" in the watershed, i.e., they were judged to be the best current conditions for these areas. Site #4 (Upper Beaverdam Creek at Becks Branch) was selected as representing the best obtainable conditions for small coastal plain streams in the study area (3 total sites). Site #9 (Paint Branch at the Beltsville Agricultural Research Center properties) was selected as the study area reference site for larger coastal plain streams (7 total sites). Site #13 (Northwest Branch at Layhill Park) was selected to represent the best obtainable stream in the piedmont area of study (5 total sites).

Data Analysis: Data was separated into two categories; biological and habitat. Biological data analysis incorporated eight metrics to arrive at an Index of Biological Integrity (IBI) that was modified from Plafkin et al. (1989). Individual IBI metric scores used criteria based on 1.) expectations of "**optimal conditions**", and 2.) comparability with appropriate regional reference sites ("best obtainable conditions"). "Optimal" metric values are scored as 5, while metric values approximating, deviating slightly from, or deviating greatly from regional reference site values are scored as 3, 1, or 0, respectively.

The "optimal value" is an additional scoring category, a modification of the IBI scoring described by Plafkin et al. (1990). Through this modification there is an increase from three scoring categories to four. The "optimal value" was applied because it was felt that it would augment the "best attainable" philosophy of the IBI metrics. Although the "best attainable" philosophy does provide justifiable comparisons of current conditions within a given ecological system, an arguable shortfall of that philosophy is that it

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[1] The two largest stream sites in the coastal plain, Northeast Branch near 41st Street (Site #10) and the Northwest Branch near Fletcher's Field (Site #2), have drainage areas of approximately 53 mi^2 and 75 mi^2, respectively. By contrast, the largest site in the piedmont region, Layhill Park on the Northwest Branch (Site #13), has an approximate drainage area of only 13.2 mi^2.

tends to limit the perception of "obtainable" conditions within a system. The "optimal value" should provide a dynamic mechanism for evaluating and improving existing conditions of "best attainable" reference sites. This can be especially important in areas without a reference site that has not been significantly impacted by anthropogenic activities, as is the case for the Anacostia streams and many of the streams in the Washington metropolitan area.

Figure #2 shows the IBI metrics and corresponding scoring values used.

IBI METRIC SCORES				
Metric	Scoring Criteria 5	3	1	0
1. Total number of fish species/watershed area.	Dependent on watershed area, See Figure #3.			
2. Number of darter & sculpin species.	3	2	1	0
3. Number of sunfish species.	≥5	3-4	1-2	0
4. Average size of principal gamefish[2].	≥10% Pref.	≥30% Qual.	≥50% Stock	≤50% Stock
5. Number of intolerant species.	≥3	2	1	0
6. Proportion of common carp, white suckers, northern creek chub, and blacknose dace.	0-25%	26-50%	51-75%	>75%
7. Proportion of omnivorous/generalist individuals	1-30%	31-60%	61-80%	>90%
8. Proportion of disease/anomalies.	≤1%	2-5%	6-10%	>10%

Figure #2: IBI metrics and scoring criteria.

The following descriptions of these IBI metrics are principally taken from Plafkin et al. (1989), with the exception of metric #4.:

Metric 1. **Total number of fish species:** This number generally decreases with increased degradation. Because the number of potential species can be strongly affected by stream size, scoring reflected watershed area at each site. Figure #3 compares the number of species captured at the fifteen sites sampled with their corresponding watershed area. A regression line of these points was calculated (Y=7.189 + 5.862(log X) and drawn (the center line with cross hatches). Flanking lines were then drawn by eye that roughly bisected the data points above and below the regression line. The assigned metric values are indicated by circles.

[2] The size groupings are taken from Gabelhouse (1984).

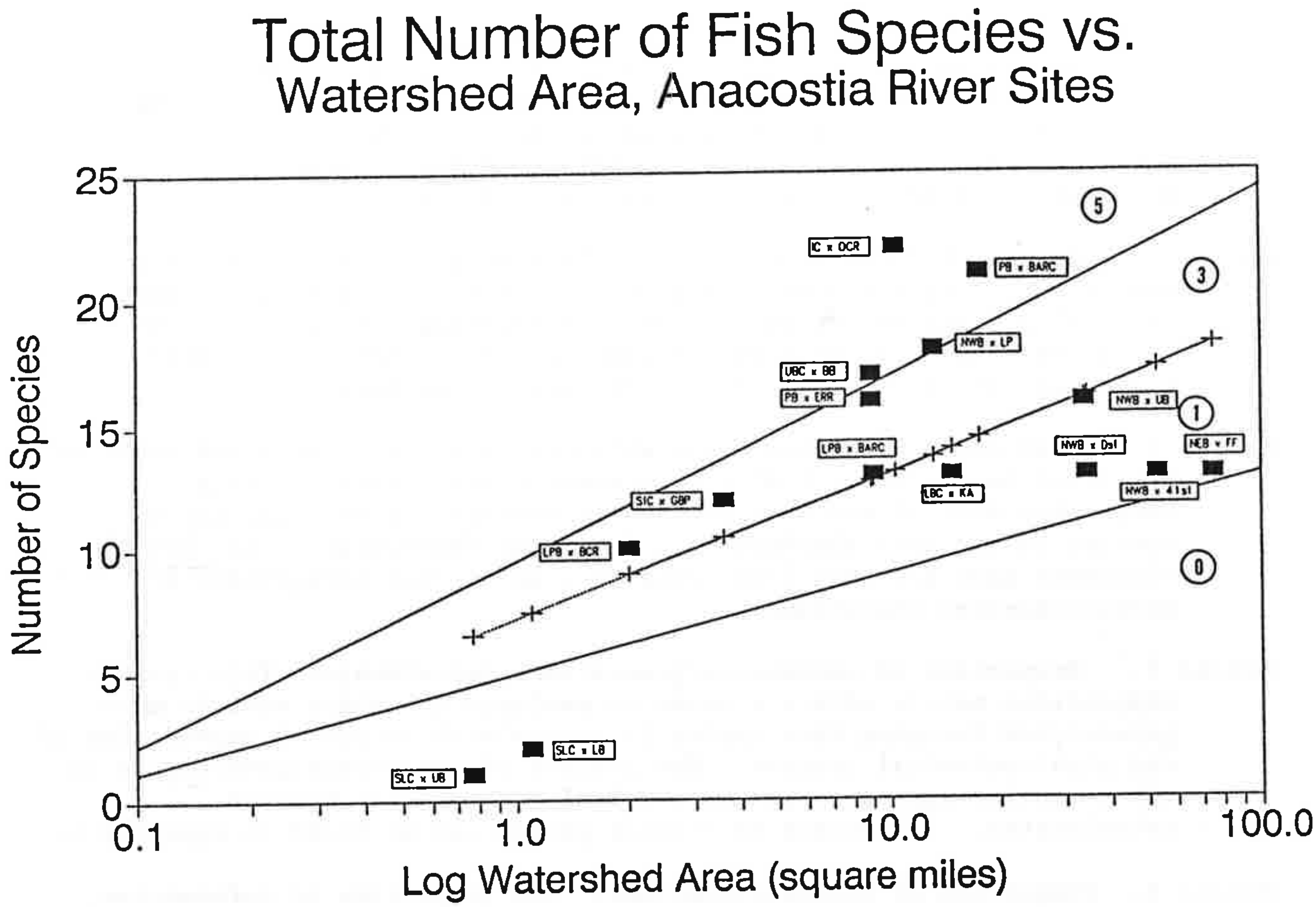


Figure #3: Total number of fish species versus watershed area for the 1990 Anacostia River Sites.

Metric 2. **Number of darter, sculpin or madtom species:** These species are sensitive to degradation resulting from siltation and benthic oxygen depletion because they feed and reproduce in benthic habitats (Kuehne and Barbour 1983: Ohio EPA 1987). The metric scores may be conservative, since six darter species, two sculpin species and two madtom species have historically been documented in the area or are reported to include this area within their natural range (Cummins, 1987).

Metric 3. **Number of sunfish species:** Numbers of these pool species decrease with increased degradation in pools and instream cover (Gammon et al.. 1981; Angermeier 1983; Platts et al.. 1983). Most of these fishes feed on drifting and surface invertebrates, are active swimmers and important sport species.

Metric 4. **Average size of principal gamefish:** Streams with poor habitat for adult gamefish tend to be unproductive and support populations of small-sized gamefish. This metric reflects biological condition as a function of gamefish sizes. Gamefish size groupings for gamefishes found in the Anacostia are from Gabelhouse (1984). Metrics based on gamefish sizes are used in the midwest (Plafkin et al., 1989) and have been used in the west for salmonids (Hughes and Gammon, 1987). Research by Bayless and Smith (1964) revealed the numbers of legal-sized fish were reduced by nearly 90% following the channelization of lotic waters in North Carolina. By contrast, Burgess (1985) found that average sizes of gamefish increased following stream restoration.

Metric 5. **Number of intolerant species:** This metric distinguishes high and moderate quality sites using species that are intolerant of various chemical and physical perturbations. Intolerant species are typically the first species to disappear following a disturbance. Assigned tolerances of specific fishes can be found in Appendix E.

Metric 6. **Proportion of common carp, white suckers, northern creek chub, and blacknose dace:** These fish are tolerant species which usually compromise most of the fish biomass in streams. Generally, these species become more abundant with increased degradation. All but the blacknose dace are long-lived provide a multi-year integration of physicochemical conditions.

Metric 7. **Proportion of omnivorous/generalists individuals:** This trophic composition metric offers a means to evaluate the shift towards more generalized foraging that typically occurs with increased degradation of the physicochemical habitat. The percent of omnivorous/generalists in the community increases as the physical and chemical habitat deteriorates. Assignment of trophic guilds can be found in Appendix E.

Metric 8. **Proportion of disease/anomalies:** The proportion of deformities, eroded fins, lesions, or tumors (DELT's) depicts the health and condition of individual fish. These conditions occur infrequently or are absent from minimally impacted reference sites, but occur frequently below point sources and in areas where toxic chemicals are concentrated. They are excellent measures of the subacute effects of chemical pollution and the aesthetic value of game and nongame fish.

Each site was evaluated by calculating values for each metric and then comparing these values with the respective scoring criteria. Individual metric scores are then added to calculate the total IBI score. The total IBI score for each site is then divided by the IBI score of the appropriate reference site. Thus, the biological condition for each site was expressed as a percent of the reference-site conditions.

Habitat analysis evaluated habitat assessment scores in the same manner. Each site's total habitat score was divided by an appropriate reference site score. Habitat quality was expressed as a percent of reference site conditions.

The ratios of biological condition were plotted against the ratios of habitat quality and inferences were made based upon the resulting relationships.

RESULTS

The following pages provide a synopsis of the data collected during the survey. Overhead views of each site, transcribed from field sketches made during sampling, are accompanied by habitat assessment scores, depth profiles, lists of species and numbers of individuals captured at each sampling date, gamefish populations estimates and notes on site characteristics. Refer to Appendix F for each site's individual IBI metric scores.

Total IBI and Habitat Assessment scores, along with the percent of reference for each site, are available below in Table 1.

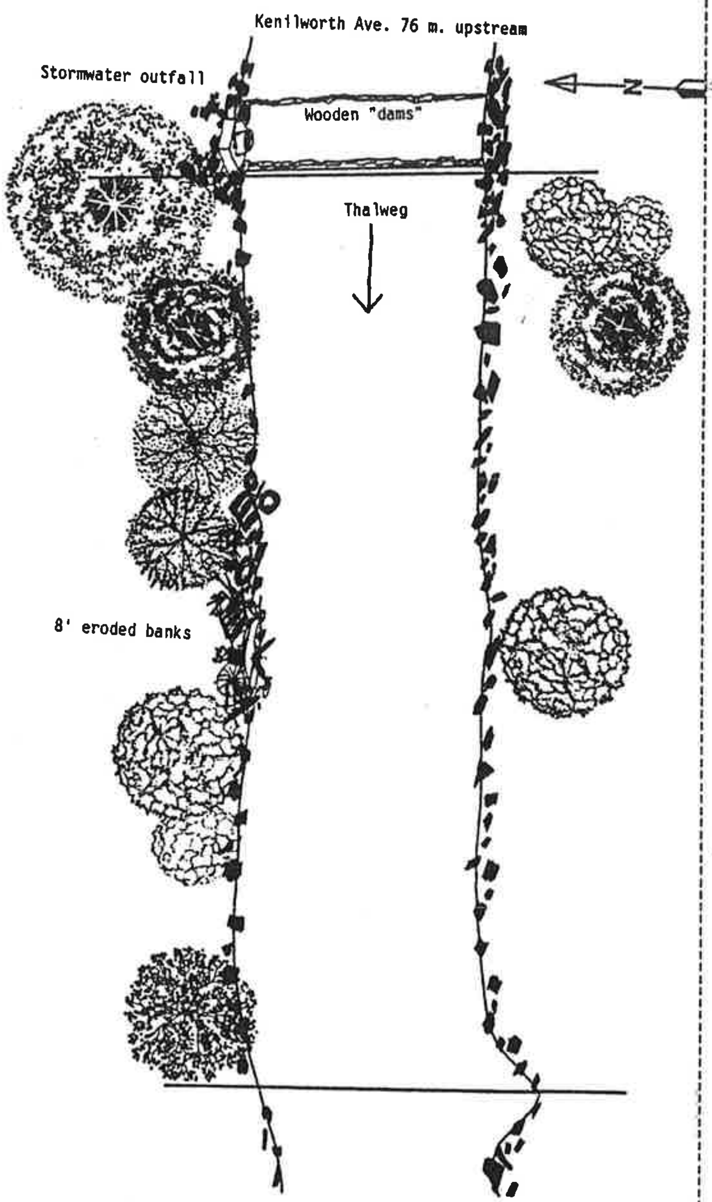
Table 1.

Site	IBI SCORES	IBI % of Reference	Habitat Scores	Habitat % of Reference
1. LBC x KA	13	.45	23	.26
2. NEB x FF	22	.76	63	.70
3. STC x GBP°	16	.55	43	.57
4. UBC x BB°(R)	30	1.00	76	1.00
5. IC x OCR	27	.93	60	.67
6. LPB x BARC°	15	.50	73	.96
7. LPB x BCR*	12	.44	58	.66
8. PB x BARC(R)	29	1.00	90	1.00
9. PB x ERR*	19	.70	58	.66
10. NWB x 41st	22	.76	44	.49
11. NWB x Dst	16	.55	40	.44
12. NWB x UB	19	.66	53	.59
13. NWB x LP*(R)	27	1.00	88	1.00
14. SLC x LB*	5	.19	103	1.00
15. SLC X UB*	5	.19	79	.90

* = Piedmont Streams
° = Small Coastal Plain Streams
blank = Large Coastal Plain Streams
(R) = Reference Site

As was previously stated, only nine habitat parameters were evaluated in the fish surveys as compared to the twelve used in benthic macroinvertebrate sampling. Therefore, total scoring of sites in fisheries habitat assessments were reduced from scores of the benthic macroinvertebrate habitat assessments. While there was general compliance of habitat assessments between the two surveys, there was some variation attributed to differences in scoring and differences in selected reference sites. In both cases, evaluations of habitat assessments used ratios to compare individual sites to reference conditions. The use of ratio should minimize impacts of additional scores.

SITE #1: Lower Beaverdam Creek and Kenilworth Avenue



DEPTH PROFILE (M)

0.0+

.33 — Not applicable because this site is tidally affected

.66+

1.0+

0 (Downstream) 10 20 30 40 50 (Upstream)

Transect Meter Intervals

TEMPS: Spring 25c Summer N/A

GRADE: 9.8'/mile (1.9m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	poor	3	less than 10% gravel, rubble or other stable hab. lack of hab.is obvious
Embedded-ness	poor	1	gravel,cobble,and boulder particles over 75 sorrounded by sediment
Velocity/ Depth	N/A	N/A	N/A
Channel Alteration	poor	1	heavy deposits of fine material, increased bar development,silt in pools
Scouring/ Deposition	poor	2	more than 50% of the bottom changing nearly year long, much deposition
Pool/Riffle Run/Bend	fair	5	occasional riffle or bend, bottom contour provides some habitat
Bank Stability	poor	1	unstable, many eroded areas. side slopes >60% common "raw" areas frequent
Bank Veg. Stability	fair	3	25-49% of the streambank surfaces covered by veg., gravel or lg material
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 23

1990 Anacostia River Fisheries Survey
Site #1-Lower Beaverdam Creek x Kenilworth Avenue

Species captured	(7/5)	(8/16)	/ pop. est./	std. error
1. American Eel	1	1		
2. Eastern Mudminnow	0	1		
3. Goldfish	1	0		
4. Golden Shiner	13	0		
5. Spottail Shiner	1	7		
6. White Sucker	1	0		
7. Brown Bullhead	16	1	16.9 /N.A.	1.5/N.A.
8. Banded Killifish	10	0		
9. Mummichog Killifish	13	10		
10. Bluegill Sunfish	2	0		
11. Redbreast Sunfish	2	3		
12. Pumpkinseed Sunfish	32	8		
13. Striped Bass	0	1		
# of Species	11	8		
# of Individuals	92	32		
Species Diversity(H')	1.83	1.70	Average = 1.77	

Approximate drainage area above site = 14.9 square miles
Stream suface area = 412 square meters (.041 hectare)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Brown Bullhead	339	411	81	44	0
Bluegill Sunfish	40	49	50	0	0
Redbreast Sunfish	60	73	33	0	0
Pumpkinseed Sunfish	640	781	100	0	0
Striped Bass	20	24	0	0	0

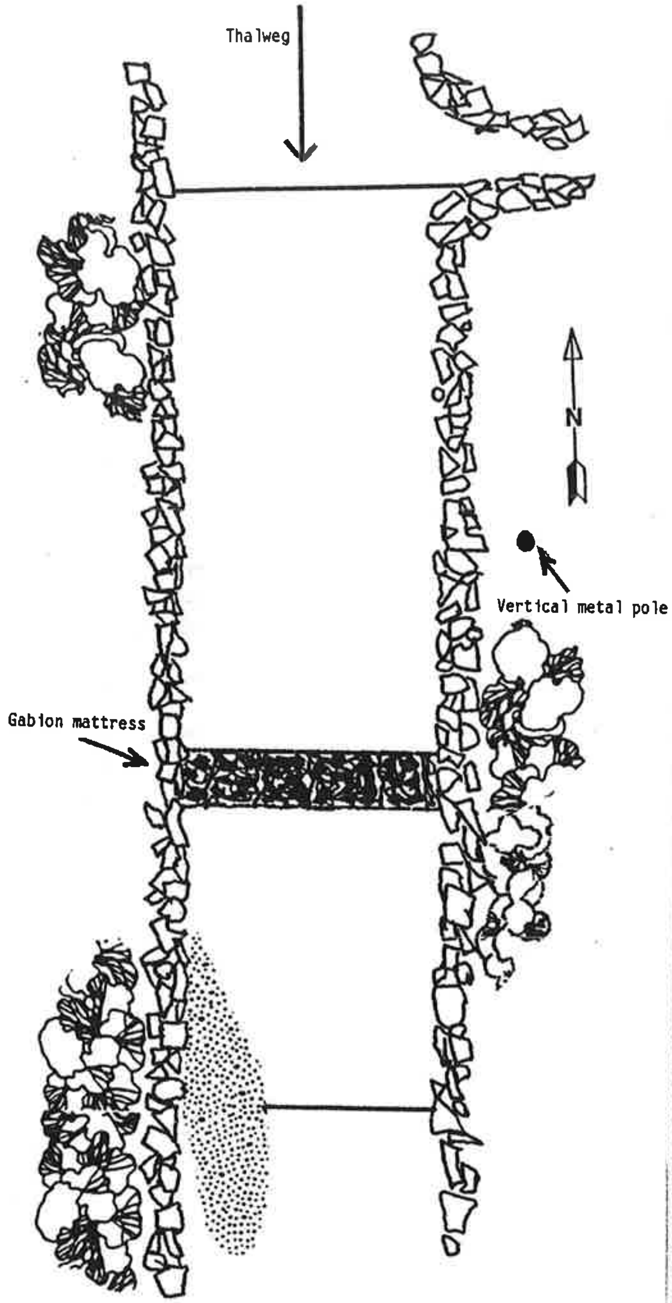
Riffle/pool ratio = N/A-because site is tidally affected.

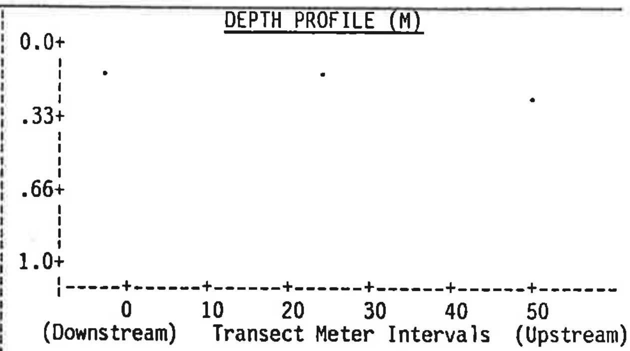
1st sampling- Brown Bullhead anomolies: 3 with erosions, 2 with eroded barbels, 1 with lesions, 1 blind and with erosions, 1 with eroded barbels and eroded fins, 1 with eroded barbels and tumors, one with eroded barbels and lesions, 1 with no tail// Pumpkinseed anomolies: 6 with erosions// Bluegill anomalies: 1 with erosions// Golden Shiner anomalies: 1 with lesions.

2nd sampling- Brown Bullhead anomalies: 1 with erosions, burnt barbels, and lip and tongue tumors, and young of the year with lesions// Pumpkinseed anomalies: 2 with erosions (only one pass completed).

Site is located 76 meters downstream from where Kenilworth Avenue Bridge crosses Lower Beaverdam Creek, top of transect was an old dam constructed of wooden post located in front of a capped culvert pipe on the north side.

SITE #2: N.E. Branch and Fletchers Field





TEMPS: Spring 18c Summer 24c

GRADE: 11'/mile (1.7m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	fair	8	10-30% rubble, gravel or other stable habitat habitat less than desiarable
Embeddedness	fair	6	gravel, cobble and boulder particles are >75% surrounded by fine sediment
Velocity/ Depth	fair	8	only 2 of 4 habitat categories present (missing riffles/runs = lower score)
Channel Alteration	fair	7	moderate dep. of new gravel coarse sand on bars, pools partially filled w/ silt
Scouring/ Deposition	good	8	5-30% affected scour at constrictions and where grades steepen, some dep. in pools
Pool/Riffle Run/Bend	fair	7	occasional riffle or bend. bottom contours provide some habitat
Bank Stability	good	8	moderately stable, infrequent small areas of erosion, side slopes up to 40% on one bank
Bank Veg. Stability	good	6	50-79% of the streambank surfaces covered by veg., gravel, or larger material
Streamside Cover	fair	5	dominant vegetation is grass or forbes

Total Score 63

1990 Anacostia River Fisheries Survey
Site #2- Northeast Branch x Fletchers Field

Species captured	(6/4)	(8/13)	/pop. est./std. error	
1. American Eel	0	13		
2. Common Carp	1	0		
3. Swallowtail Shiner	0	4		
4. Satinfin Shiner	0	5		
5. Spottail Shiner	0	7		
6. Silvery Minnow	0	7		
7. White Sucker	0	3		
8. Yellow Bullhead	1	0		
9. Banded Killifish	0	10		
10. Bluegill Sunfish	16	2	18.3/N.A.	3.1/N.A.
11. Redbreast Sunfish	36	22	57.4/27.3	22.3/6.1
12. Pumpkinseed Sunfish	3	2		
13. Tessellated Darter	0	1		
# of Species	5	10		
# of Individuals	57	76		
Species Diversity (H')	.94	2.08	Average = 1.51	

Approximate drainage area above site = 75.0 square miles
Stream surface area = 887.8 square meters (0.089 hectares)

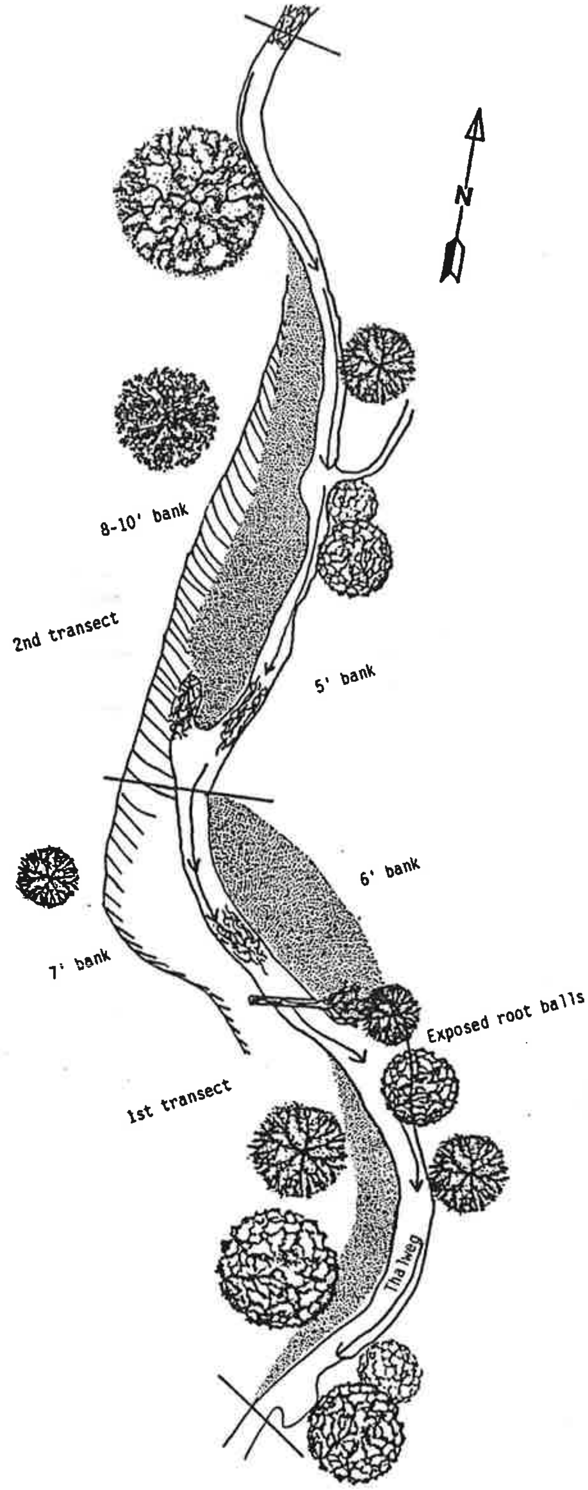
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Common Carp	10	6	0	0	0
Yellow Bullhead	10	6	60	0	0
Redbreast Sunfish	847	476	66	0	0
Bluegill Sunfish	366	206	60	0	0
Pumpkinseed Sunfish	50	28	42	0	0

Riffle/pool ratio = all run

Anomalies: none

Upstream transect net was immediately downstream from unnamed tributary, approximately 900 meters (2952.7 ft.) downstream from Riverdale Road Bridge

SITE #3: Still Creek and Greenbelt Park



DEPTH PROFILE (M)

```
0.0+
   |        .          .            .   .            .
   |                                             .
.33+
   |
   |
.66+
   |
   |
1.0+
   |-----+-------+------+------+------+------+-------
         0       20     40     60     80     100
   (Downstream)   Transect Meter Intervals   (Upstream)
```

TEMPS: Spring 16c Summer 20.5c

GRADE: 33.3'/mile (6.5m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	13	30-50% rubble,gravel or other stable habitat, adequate habitat
Embedded-ness	poor	1	gravel,cobble,and boulder particles are >75% surrounded by sediment
Velocity/ Depth	fair	7	only 2 of 4 habitat categories present (missing riffle/run = lower score)
Channel Alteration	poor	1	heavy deposits of fine material, increased bar development,
Scouring/ Deposition	fair	4	30-50% affected,deposits and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	good	9	adequate depth in pools and riffles bends provide habitat
Bank Stability	poor	0	unstable, many eroded areas,side slopes >60% common,"raw" areas common
Bank Veg. Stability	poor	1	<25% of the streambank surfaces covered by veg. ,gravel,lg. material
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 43

1990 Anacostia River Fisheries Survey
Site #3- Still Creek x Greenbelt Park

Species captured	(6/18)	(8/1)	pop. est	std. error
1. American Eel	14	12		
2. Cutlips Minnow	16	18		
3. Swallowtail Shiner	34	9		
4. Satinfin Shiner	7	13		
5. Common Shiner	6	4		
6. Spottail Shiner	18	16		
7. Blacknose Dace	33	38		
8. Longnose Dace	3	2		
9. Northern Creek Chub	1	3		
10 White Sucker	1	3		
11. Redbreast Sunfish	13	13	N.A./14.8	N.A./1.8
12. Tessellated Darter	7	8		
# of Species	12	12		
# of Individuals	153	139		
Species Diversity(H')	2.13	2.19	Average = 2.16	

Approximate drainage area above site = 3.6 square miles
Stream surface area = 387.6 square meters (.039 hectares)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Redbreast Sunfish	296	382	77	15	0

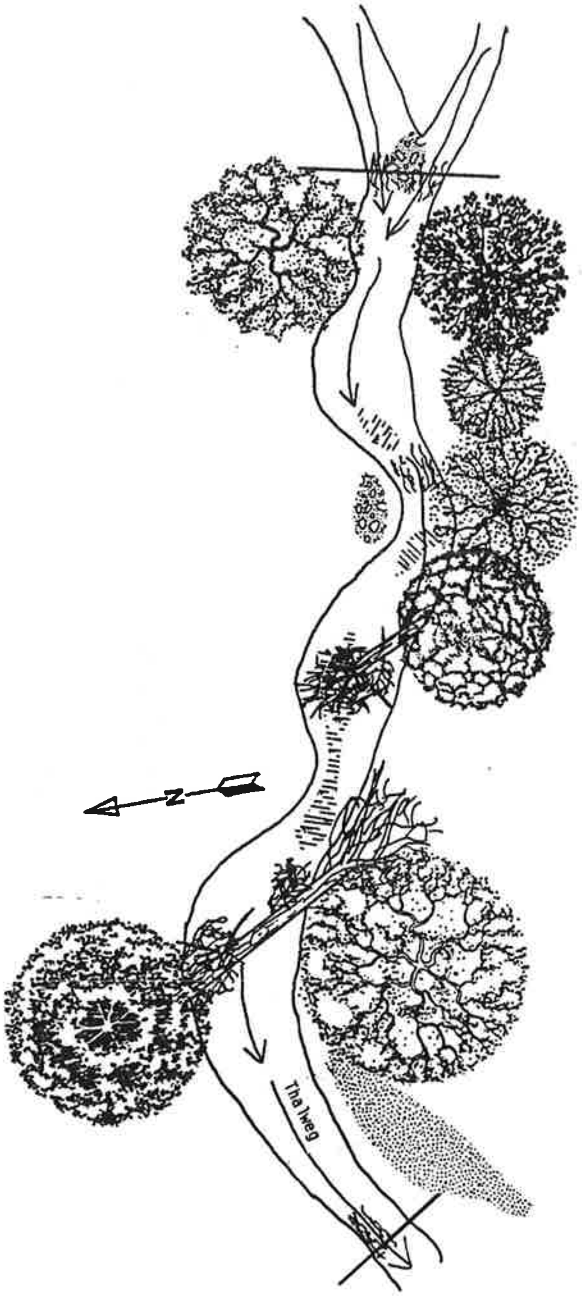
Riffle:pool ratio = 1:3.5

1st sampling- Anomalies: none

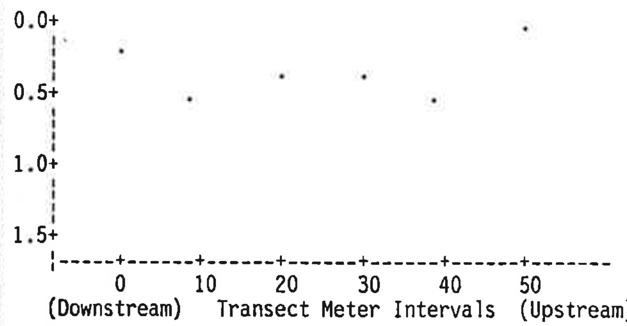
2nd sampling- American Eel anomalies: 1 with erosions

(Transect consisted of two 50 meter sections)
Fifty meters upstream from confluence of Still Creek and Deep Creek was the top of the transect and 50 meters downstream from the confluence was the bottom of the transect

SITE #4: Upper Beaverdam Creek and Beck Branch



DEPTH PROFILE (M)



TEMPS: Spring 17c Summer 20c

GRADE: 8.3'/mile (1.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	14	30-50% rubble,gravel or other stable habitat, adequate habitat
Embedded-ness	poor	2	gravel,cobble, and boulder particles are >75% surrounded by sediment
Velocity/ Depth	good	13	only 3 of 4 habitat categories present(missing riffle/runs lower score
Channel Alteration	good	9	some new increase in bar formation mostly from coarse gravel,some chan.
Scouring/ Deposition	good	9	5-30% affected, scour at obstructions and where grades steepen,some depo.
Pool/Riffle Run/Bend	excel	12	variety of habitat, deep riffles and pools
Bank Stability	fair	3	moderately unstable,moderate frequency of erosional areas, some slopes >60%
Bank Veg. Stability	good	7	50-79% of the streambank surfaces covered by veg., gravel,lg. materials
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 76

1990 Anacostia River Fisheries Survey
Site #4-Upper Beaverdam Creek x Beck Branch

Species captured	(6/21)	(8/8)	/ pop. est.	/ std.error
1. A. Brook Lamprey	3	6		
2. American Eel	5	6		
3. Eastern Mudminnow	17	9		
4. Chain Pickerel	1	4		
5. Cutlips Minnow	1	0		
6. River Chub	2	0		
7. Golden Shiner	0	1		
8. Northern Creek Chub	1	0		
9. Fallfish	5	4		
10. Creek Chubsucker	5	2		
11. Bluespotted Sunfish	4	0		
12. Green Sunfish	1	0		
13. Bluegill Sunfish	16	5	27.7/N.A.	19.5/N.A.
14. Pumpkinseed Sunfish	3	2		
15. Largemouth Bass	2	2		
16. Black Crappie	1	0		
17. Tessellated Darter	7	3		
# of Species	15	10		
# of Individuals	74	45		
Species Diversity(H')	2.34	2.24	Average = 2.29	

Approximate drainage area above site = 8.9 square miles
Stream surface area = 260.8 square meters(.026 hectare)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Chain Pickerel	50	96	20	0	0
Green Sunfish	20	38	100	0	0
Bluegill Sunfish	554	1060	16	3	0
Pumpkinseed Sunfish	60	115	84	0	0
Largemouth Bass	40	77	0	0	0
Black Crappie	20	39	100	0	0

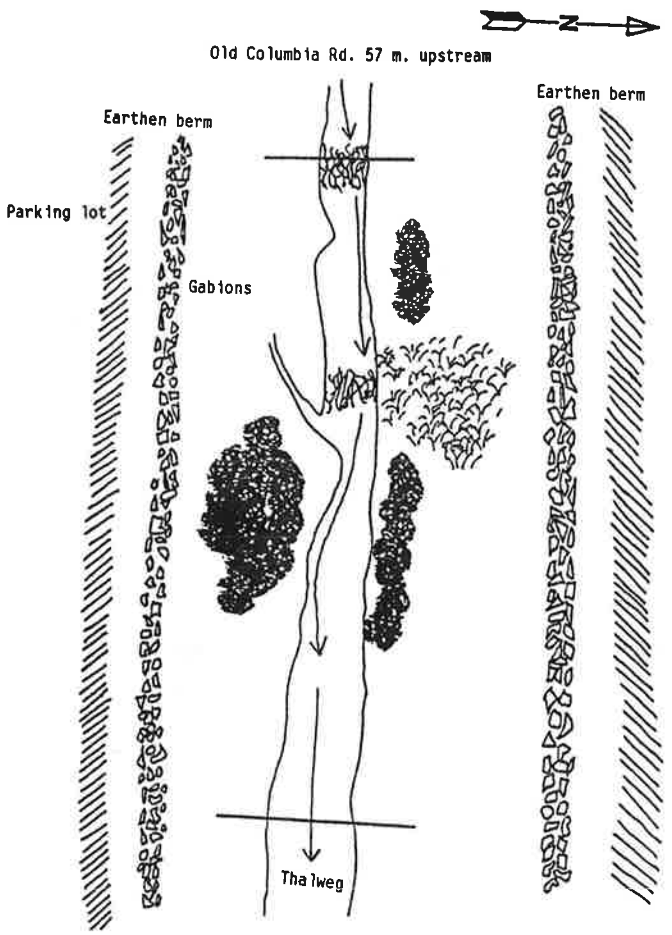
Riffle/pool ratio = 1:10.1

1st sampling- Pumpkinseed anomalies: 1 with erosions

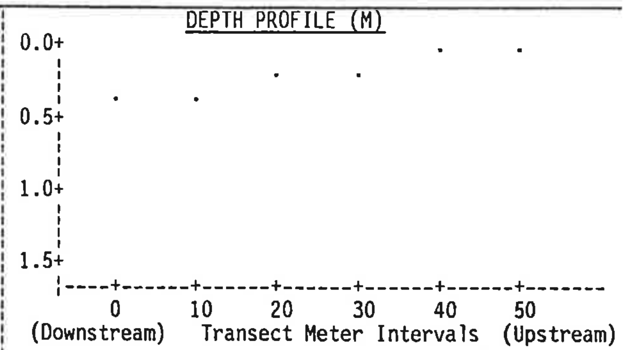
2nd sampling- Anomalies: none

Upstream transect net was directly downstream of the confluence of the Upper Beaverdam Creek mainstem and Beck Branch

SITE #5: Indian Creek and Old Columbia Road



cross section



TEMPS: Spring 24c Summer 22c

GRADE: 19.2'/mile (3.7m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	14	30-50% rubble,gravel or other stable habitat, adequate habitat
Embedded-ness	poor	3	gravel,cobble, and boulder particles >75% surrounded by fine sediment
Velocity/ Depth	fair	7	only 2 of 4 habitat categories present (missing riffles & runs = low score)
Channel Alteration	poor	1	heavy deposits of fine material,increased bar development,silt in pools
Scouring/ Deposition	fair	5	30-50% affected,deposition and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	good	8	adequate depth in pools and riffles bends provide some habitat
Bank Stability	excel	9	stable, no evidence of erosion or bank failure, side slopes mostly <30%
Bank Veg. Stability	excel	9	over 80% of the streambank surfaces covered by veg., boulders or cobble
Streamside Cover	fair	4	dominant vegetation; grass or forbes

Total Score 60

1990 Anacostia River Fisheries Survey
Site #5 - Indian Creek x Old Columbia Road

Species captured	(7/3)	(8/8)	/ pop. est. /	std. error
1. A. Brook Lamprey	4	2		
2. American Eel	4	1		
3. Eastern Mudminnow	52	19		
4. Chain Pickerel	1	2		
5. Cutlips Minnow	3	1		
6. Golden Shiner	30	3		
7. Swallowtail Shiner	37	19		
8. Satinfin Shiner	13	0		
9. Common Shiner	10	1		
10. Spottail Shiner	15	5		
11. Blacknose Dace	3	10		
12. Northern Creek Chub	1	2		
13. Creek Chubsucker	54	20		
14. White Sucker	11	7		
15. Brown Bullhead	0	2		
16. Green Sunfish	2	2		
17. Bluegill Sunfish	7	6	7.3/N.A.	.9/N.A.
18. Redbreast Sunfish	44	15	56.9/15.7	10.6/1.2
19. Pumpkinseed Sunfish	38	57	43.1/63.6	4.5/4.9
20. Largemouth Bass	3	0		
21. Black Crappie	1	0		
22. Tessellated Darter	3	1		
# of Species	21	19		
# of Individuals	336	175		
Species Diversity (H')	2.47	2.26	Average = 2.37	

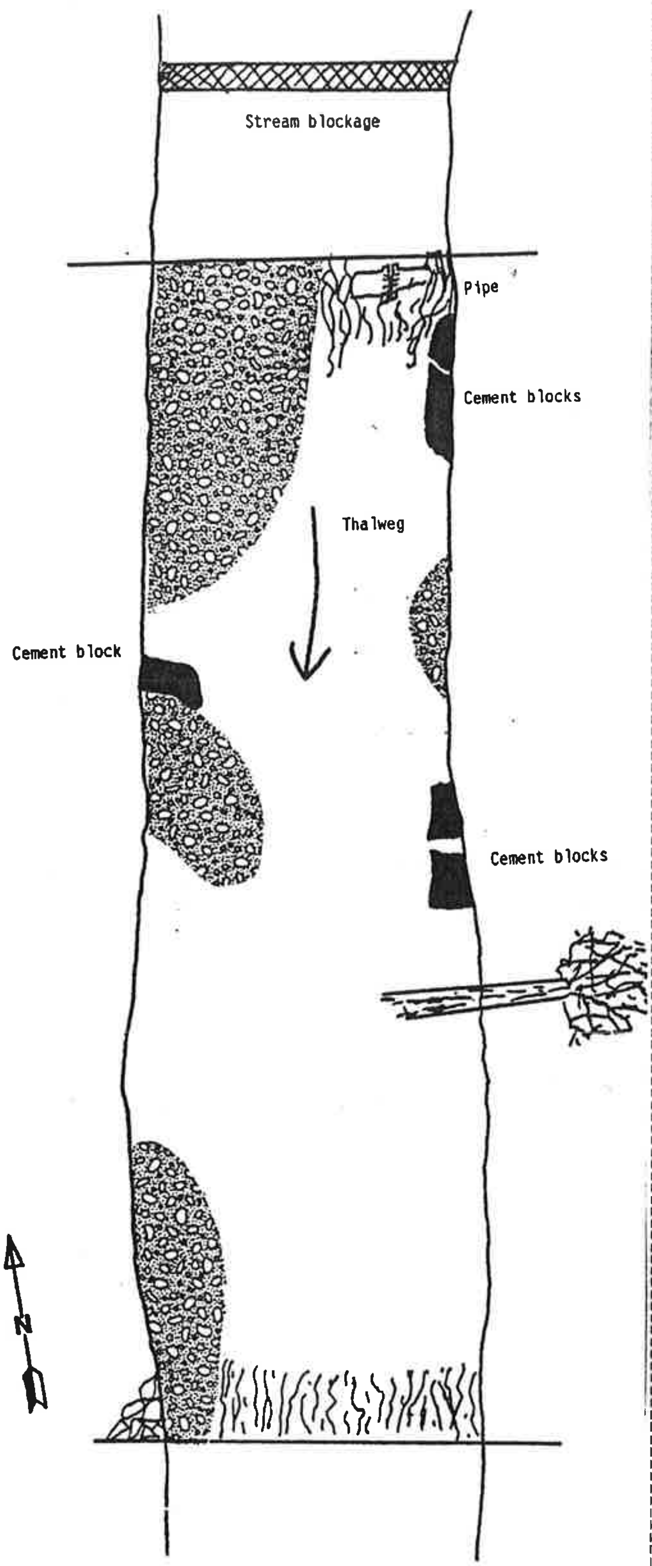
Approximate drainage area above site = 10.4 square miles
Stream surface area = 179.8 square meters (.018 hectares)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Chain Pickerel	30	83	0	0	0
Green Sunfish	40	111	25	0	0
Bluegill Sunfish	409	554	28	0	0
Redbreast Sunfish	2016	1138	73	0	0
Pumpkinseed Sunfish	2963	861	50	0	0
Largemouth Bass	30	83	0	0	0
Black Crappie	10	28	0	0	0

Riffle/pool ratio = 1:5.1
Anoamalies: none

The upstream transect net was located 57 meters (187.0 ft.) downstream from the center culvert of the bridge on Old Columbia Road where it crosses Indian Creek

SITE #6: Little Paint Branch and Beltsville Agricultural Research Center



DEPTH PROFILE(M)

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 (Downstream)  Transect Meter Intervals  (Upstream)
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TEMPS: Spring 23c Summer 28.5c

GRADE: 26'/mile (5.1m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	12	30-50 rubble,gravel or other stable habitat, adequate habitat
Embedded-ness	good	13	gravel,cobble,and boulder particles are 20-50% surrounded by sediment
Velocity/ Depth	good	12	only 3 Of 4 habitat categories present missing riffles/runs gets lower score
Channel Alteration	fair	6	moderate dep. of new gravel, coarse sand on old and new bars,pools w/silt
Scouring/ Deposition	fair	7	30-50% affected,deps. and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	fair	5	ocassional riffle or bend bottom contour provides some habitat
Bank Stability	good	7	moderately unstable, moderate frequency of erosion, side slopes up to 40%
Bank Veg. Stability	good	7	50-79% of the streambank surfaces covered by veg., gravel,lg. material
Streamside Cover	fair	4	dominant vegetation grass or forbes
	Total Score	73	

1990 Anacostia River Fisheries Survey

Site #6-
Little Paint Branch x Beltsville Agricultural Center(BARC)

Species captured	(6/26)	(8/3)	/ pop. est.	/ std. error
1. American Eel	5	2		
2. Cutlips Minnow	20	10		
3. Golden Shiner	1	0		
4. Rosyside Dace	2	0		
5. Swallowtail Shiner	26	19		
6. Satinfin Shiner	11	15		
7. Blacknose Dace	34	73		
8. Longnose Dace	11	7		
9. Northern Creek Chub	1	1		
10. Yellow Bullhead	1	0		
11. Bluegill Sunfish	3	0		
12. Redbreast Sunfish	17	10	17.8/10.9	1.3/1.7
13. Tessellated Darter	2	1		
# of Species	13	9		
# of Individuals	134	138		
Species Diversity (H')	2.07	1.52	Average = 1.80	

Approximate drainage area above site = 9.1 square miles
Stream surface area = 274.2 square meters (.028 hectares)

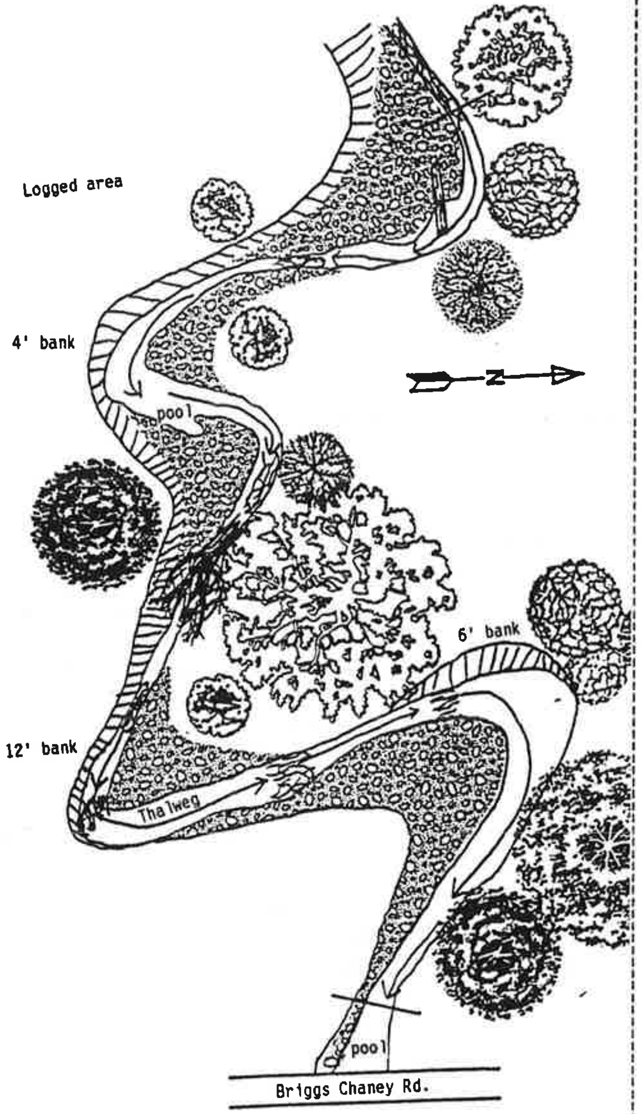
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Yellow Bullhead	20	36	0	0	0
Bluegill Sunfish	60	107	0	0	0
Redbreast Sunfish	218	512	50	0	0

Riffle/pool ratio = 1:3.4

Anomalies: none

Beltsville Agricultural Research Center, downstream of Sellman Road. Top of transect net was loacated approximately 91.4 meters (300 ft.) dowmstream from where service road crosses Little Paint Branch.

SITE #7: Little Paint Branch and Briggs Chaney Road



DEPTH PROFILE (M)

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         0      10     20     30     40     50
  (Downstream)  Transect Meter Intervals  (Upstream)
```

TEMPS: Spring 17c Summer 21.5c

GRADE: 29.4'/mile (5.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	fair	8	10-30% rubble,gravel or other stable hab., habitat less than desirable
Embedded-ness	fair	7	gravel,cobble,and boulder particles 50-75% surrounded by fine sediment
Velocity/ Depth	good	12	only 3 of 4 habitat categories present missing riffle/runs gets lower score
Channel Alteration	fair	5	moderate dep. of new gravel, coarse sand on old and new bars,some pools w/silt
Scouring/ Deposition	fair	5	30-50% affected deps. and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	good	8	adequate depth in pools and riffles bends provide habitat
Bank Stability	poor	1	unstable,many eroded areas, side slopes >60% common, "raw" areas frequent
Bank Veg. Stability	fair	5	25-49% of the streambank surfaces covered by veg., gravel or lg material
Streamside Cover	good	7	dominant vegetation is of tree form
Total Score		58	

1990 Anacostia Fisheries Survey
Site #7- Little Paint Branch x Briggs Chaney Road

Species captured	(7/2)	(8/1)	/ pop.est	/ std. error
1. American Eel	2	1		
2. Eastern Mudminnow	2	1		
3. Cutlips Minnow	9	1		
4. River Chub	0	1		
5. Rosyside Dace	68	7		
6. Blacknose Dace	63	21		
7. Northern Creek Chub	22	25		
8. Fallfish	3	2		
9. White Sucker	9	10		
10. Bluegill Sunfish	1	0		
# of Species	9	9		
# of Individuals	179	69		
Species Diversity (H')	1.49	1.59	Average = 1.54	

Approximate drainage area above site = 2.0 square miles
Stream surface area = 185.8 square meters (.019 hectares)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Bluegill Sunfish	20	53	0	0	0

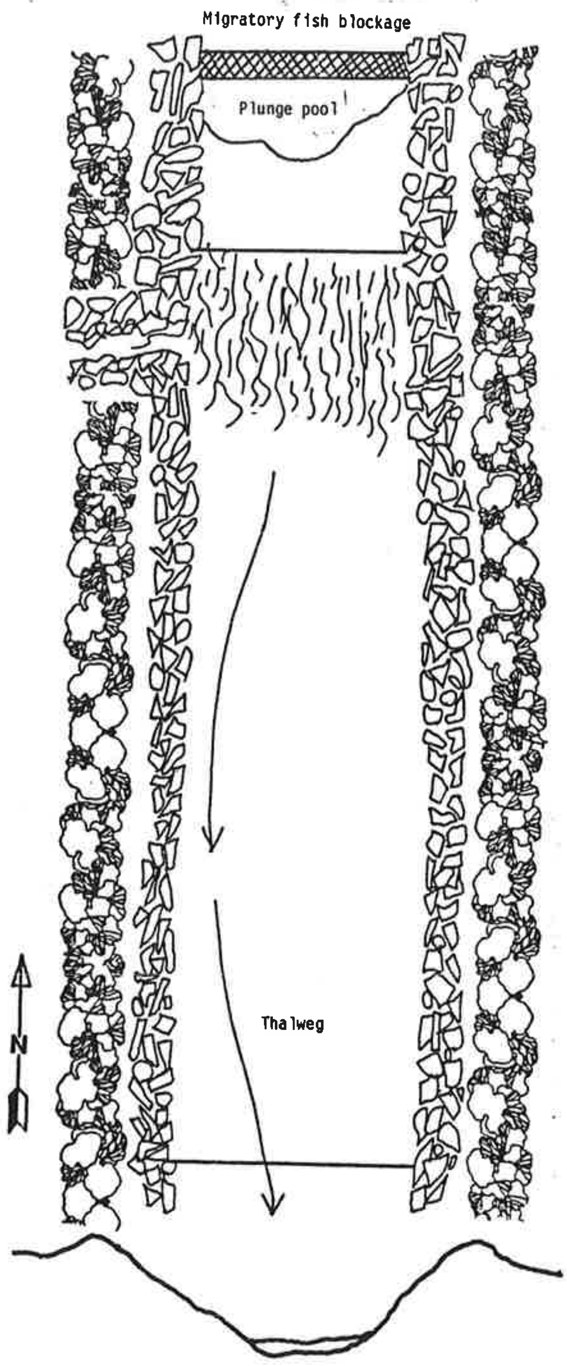
Riffle/pool ratio = 1:3

Anomalies: none

Downstream transect net was approximately 20 meters (65.6 ft.) upstream from one lane bridge on Briggs Chaney Road

SITE #8: Paint Branch and Beltsville Agricultural Research Center

The beltway is approximately 500 meters upstream.



Cross section

DEPTH PROFILE (M)

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         0      10      20      30      40      50
(Downstream)  Transect Meter Intervals  (Upstream)
```

TEMPS: Spring 15c Summer 21c

GRADE: 21.3'/mile (4.1m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	14	30-50% rubble,gravel or other stable habitat, adequate habitat
Embedded-ness	excel	16	gravel,cobble,and boulder particles are 0-25% surrounded by sediment
Velocity/ Depth	poor	2	dominated by one velocity /depth category (usually pool)
Channel Alteration	good	11	some new increase in bar formation mostly from coarse gravel,some chan.
Scouring/ Deposition	good	11	5-30% affected,scour at constrictions and where grade steepens,some deposit
Pool/Riffle Run/Bend	fair	4	occasional riffle or bend bottom contours provide some habitat
Bank Stability	good	8	moderately stable,infrequent areas of erosions,side slopes up to 40%
Bank Veg. Stability	excel	9	over 80% of the streambank surfaces covered by veg., boulders or cobble
Streamside Cover	excel	10	dominant vegetation is shrub

Total Score 90

1990 Anacostia River Fisheries Survey
Site #8- Paint Branch x BARC

Species captured	(6/13)	(8/3)	/pop. est. /	std. error
1. American Eel	1	0		
2. Goldfish	1	1		
3. Cutlips Minnow	36	27		
4. Golden Shiner	1	0		
5. Swallowtail Shiner	13	5		
6. Satinfin Shiner	3	5		
7. Common Shiner	3	6		
8. Spottail Shiner	6	3		
9. Blacknose Dace	7	18		
10. Longnose Dace	3	5		
11. Northern Creek Chub	0	2		
12. Fallfish	3	4		
13. White Sucker	3	10		
14. Brown Bullhead	0	1		
15. Green Sunfish	0	1		
16. Bluegill Sunfish	31	44	33.7/64.2	2.8/17.8
17. Redbreast Sunfish	96	99	126.0/113.1	16.9/7.8
18. Pumpkinseed Sunfish	0	10		
19. Largemouth Bass	0	2		
20. Black Crappie	1	0		
21. Tessellated Darter	13	4		
# of Species	16	18		
# of Individuals	221	247		
Species Diversity(H')	1.86	2.03	Average = 1.95	

Approximate drainage area above site = 17.7 square miles
Stream surface area = 325.5 square meters (.033 hectares)

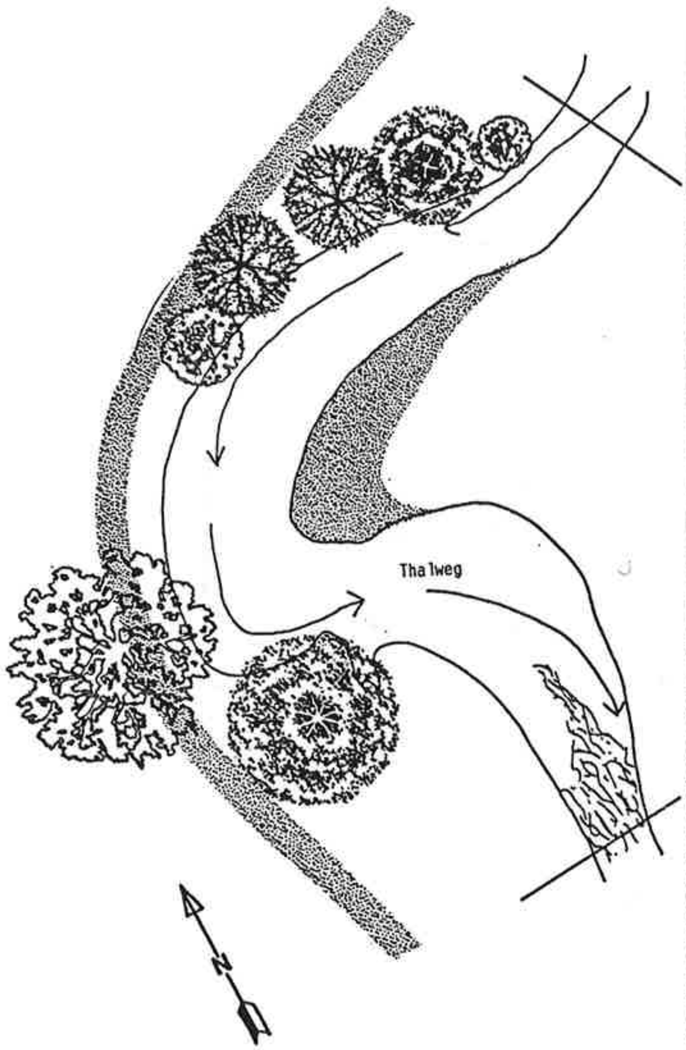
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Brown Bullhead	20	30	100	0	0
Green Sunfish	20	30	100	0	0
Bluegill Sunfish	980	1485	33	0	0
Redbreast Sunfish	2391	3625	58	1	0
Pumpkinseed Sunfish	100	152	90	0	0
Largemouth Bass	20	30	0	50	0
Black Crappie	10	15	0	0	0

Riffle/pool ratio = 2:3

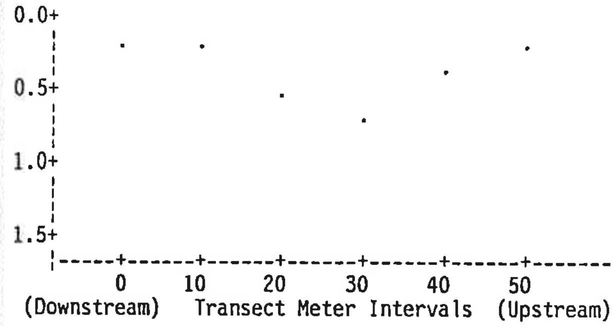
1st sampling- Redbreast Sunfish anomalies: 1 with a tumor
2nd sampling- Largemouth Bass anomalies: 1 with cataract in one eye

Beltsville Agricultural Research Center, off Cherry Hill Road, follow dirt road to stream, the upstream transect net was loacated approximately 10 meters (32.8 ft.) downstream from drop blockage

SITE #9: Paint Branch and East Randolph Road



DEPTH PROFILE (M)



TEMPS: Spring 22c   Summer 19c

GRADE: 29.4'/mile (5.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	fair	7	10-30% rubble,gravel or other stable habitat, habitat less than desirable
Embedded- ness	fair	7	gravel,cobble,and boulder particles 50-75% surrounded by fine sediment
Velocity/ Depth	fair	8	only 2 of 4 habitat categories present missing riffles/runs = low score
Channel Alteration	excel	12	little or no enlargement of islands or point bars and/or no channelazation
Scouring/ Deposition	fair	7	30-50% affected deps and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	good	8	adequate depth in pools and riffles bends provide habitat
Bank Stability	fair	5	moderately unstable, mod- erate frequency of erosional areas, side slopes <60%
Bank Veg. Stability	fair	4	25-49% of the streambank surfaces covered by veg., gravel, lg. material
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 58

1990 Anacostia River Fisheries Survey
Site #9- Paint Branch x East Randolph Road

Species captured	(7/10)	(8/9)	/ pop. est. /	std. error
1. American Eel	7	5		
2. Brown Trout	1	0		
3. Cutlips Minnow	7	5		
4. Rosyside Dace	5	0		
5. Swallowtail Shiner	1	1		
6. Common Shiner	10	0		
7. Blacknose Dace	16	0		
8. Longnose Dace	18	3		
9. Northern Creek Chub	3	0		
10. Fallfish	0	1		
11. White Sucker	16	12		
12. Margined Madtom	2	0		
13. Bluegill Sunfish	2	1		
14. Redbreast Sunfish	3	0		
15. Largemouth Bass	1	2		
16. Tessellated Darter	3	1		
# of Species	15	9		
# of Individuals	95	31		
Species Diversity	2.33	1.80	Average = 2.07	

Approximate drainage area above site = 8.9 square miles
Stream surface area = 440.0 square miles (.044 hectare)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Brown Trout	20	23	One trout, 348 mm		
Bluegill Sunfish	30	34	0	0	0
Redbreast Sunfish	30	34	50	0	0
Largemouth Bass	30	34	0	0	0

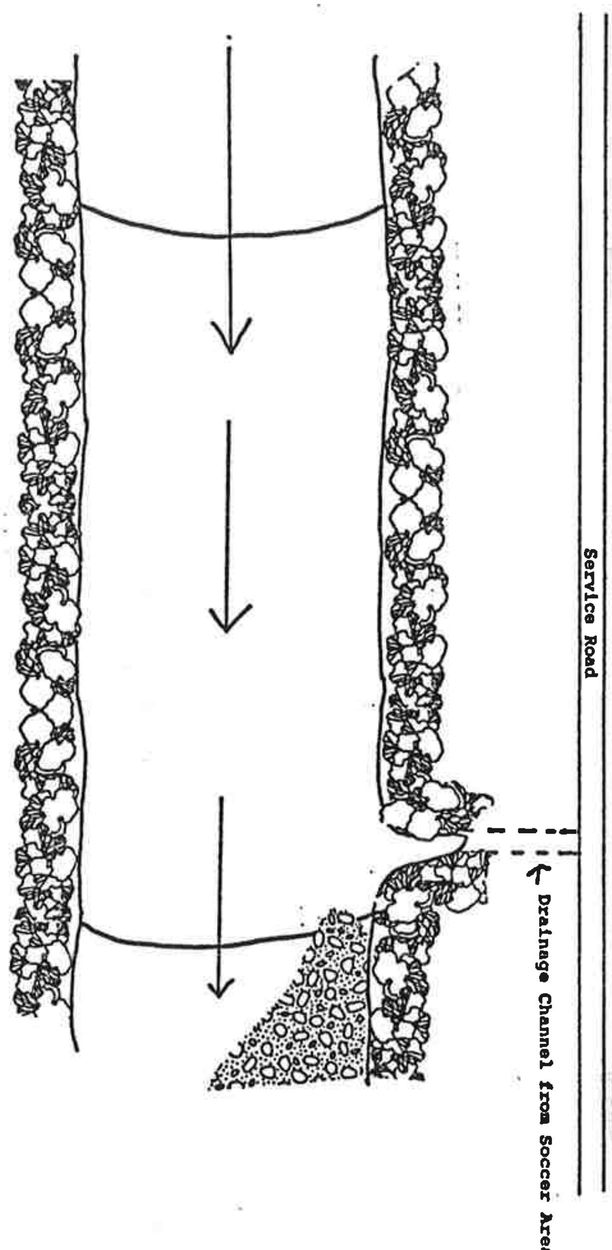
Riffle:pool ratio = 1:4.2

1st sampling- Brown Trout anomalies: right pelvic fin clipped// Redbreast anomalies: 2 with leeches on fins// Bluegill anomalies; 1 with leeches on fins

2nd sampling- Anomalies: none

Upstream transect net was approximately 480 meters (1574.8 ft.) downstream from where Paint Branch crosses East Randolph

SITE #10: N.W. Branch and 41st Street



DEPTH PROFILE (M)

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         0     10      20      30     40    50
(Downstream)  Transect Meter Intervals  (Upstream)
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TEMPS: Spring 18c   Summer 10:00-24c
12:00-26c

GRADE: 13.9'/mile (2.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	fair	8	10-30% rubble,gravel or other stable habitat. habitat less than desirable
Embedded-ness	poor	5	gravel,cobble,and boulder particles are >75% surrounded by fine sediment
Velocity/ Depth	poor	2	dominated by one velocity /depth (usually pool)
Channel Alteration	poor	0	heavy deposits of fine material increased bar devlopment,silt in pools
Scouring/ Deposition	fair	5	30-50% affected deposits and scour at obstructions, some filling of pools
Pool/Riffle Run/Bend	poor	1	essentially a straight stream, all flat water or shallow,poor habitat
Bank Stability	excel	9	stable,no evidence of erosion or bank failure, side slopes generally <30%
Bank Veg. Stability	excel	9	over 80% of the streambank surfaces covered by veg., boulders or cobble
Streamside Cover	fair	5	dominant vegetation; grass or forbes

Total Score 44

1990 Anacostia River Fisheries Survey
Site #10- Northwest Branch x 41st street

Species captured	(6/8)	(7/30)	/pop. est.	/ std.error
1. American Eel	7	13		
2. Satinfin Shiner	6	0		
3. Spottail Shiner	6	0		
4. White Sucker	0	3		
5. Brown Bullhead	1	0		
6. Mummichog Killifish	1	1		
7. Bluegill Sunfish	0	6		
8. Redbreast Sunfish	273	144	312/174.7	13.0/13.8
9. Longear Sunfish	1	0		
10. Pumpkinseed Sunfish	0	10		
11. Striped Bass	0	1		
12. Largemouth Bass	0	4		
13. Tessellated Darter	5	3		
# of Species	8	9		
# of Individuals	300	185		
Species Diversity	0.46	0.92	Average = 0.69	

Approximate drainage area above site = 53.4 square miles
Stream surface area = 929.0 square meters(.093 hectares)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Brown Bullhead	10	5	0	0	0
Bluegill Sunfish	120	65	83	0	0
Redbreast Sunfish	4867	2617	78	5	0
Longear Sunfish	20	11	100	0	0
Pumpkinseed Sunfish	200	108	70	0	0
Striped Bass	20	11	0	0	0
Largemouth Bass	40	22	0	0	0

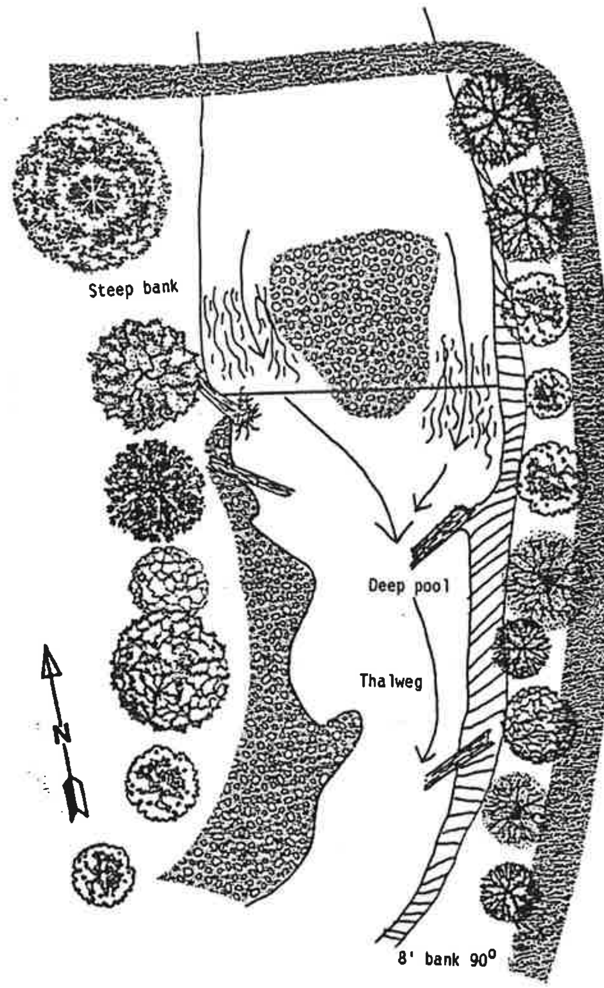
Riffle/pool ratio = all run

1st sampling- Redbreast anomalies: 3 with erosions

2nd sampling- Redbreast anomalies: 1 with erosions// Bluegill anomalies: 1 with erosions

Downstream transect net was located .3 miles upstream from the bridge where Route One crosses Northwest Branch

SITE #11: N.W. Branch and Drexel Street



DEPTH PROFILE (M)

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         0     10     20     30     40     50
(Downstream)   Transect Meter Intervals  (Upstream)
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TEMPS: Spring 18c   Summer 20c

GRADE: 9.1'/mile (5.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	poor	4	less than 10% rubble gravel or otherstable hab-itat lack of habitat obvious
Embedded-ness	poor	3	gravel,cobble,and boulder particles are >75% surrounded by fine sediment
Velocity/ Depth	fair	8	only 2 of 4 habitat categories present missing riffles/runs; lower score
Channel Alteration	poor	3	heavy deps.of fine material , icreased bar development pools filled with silt
Scouring/ Deposition	poor	2	more than 50% of the bottom changing nearly year long, pools almost absent
Pool/Riffle Run/Bend	good	8	adequate depth in pools and riffles bends provide habitat
Bankside Stability	poor	2	unstable,many eroded areas slopes >60% common, "raw" areas frequent
Bank Veg. Stability	fair	3	25-49% of the streambank surfaces covered by veg., gravel,lg. material
Streamside Cover	good	7	dominant vegetation is of tree form
	Total Score	40	

1990 Anacostia River Fisheries Survey
Site #11- Northwest Branch x Drexel Street

Species captured	(6/26)	(8/2)	/ pop.est.	/ std.error
1. American Eel	9	7		
2. Cutlips Minnow	10	3		
3. Swallowtail Shiner	10	2		
4. Satinfin Shiner	30	20		
5. Common Shiner	2	1		
6. Spottail Shiner	3	1		
7. Blacknose Dace	17	12		
8. Longnose Dace	1	8		
9. Fallfish	1	0		
10. White Sucker	3	6		
11. Yellow Bullhead	1	4		
12. Redbreast Sunfish	16	12	16.1/15.3	.3/5.2
13. Tessellated Darter	1	4		
# of Species	13	12		
# of Individuals	104	80		
Species Diversity(H')	2.06	2.18	average = 2.12	

Approximate drainage area above site = 34 square miles
Stream surface area = 629.8 square meters (.063 hectare)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Yellow Bullhead	50	40	20	20	0
Redbreast Sunfish	322	249	62	11	0

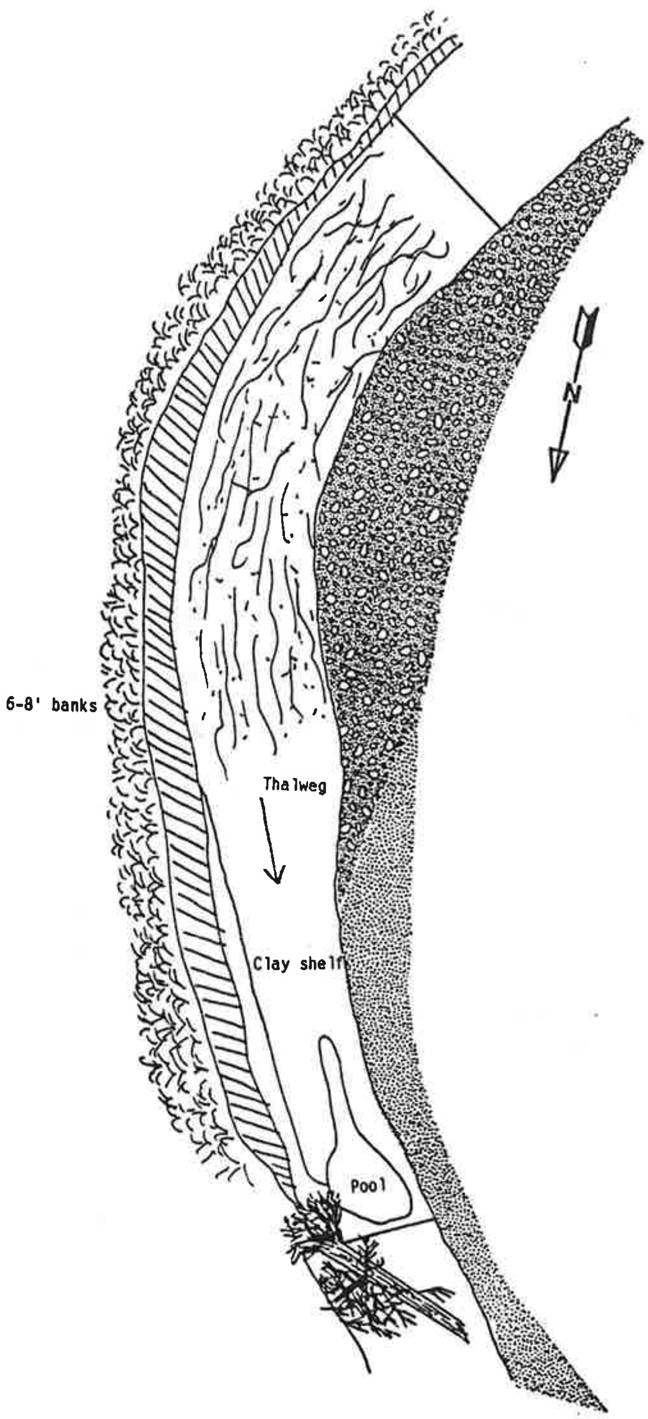
Riffle/pool ratio = 1:1.6

1st sampling- Yellow Bullhead anomalies: 1 with lesions

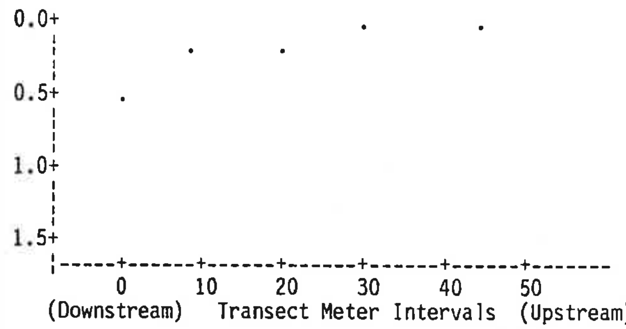
2nd sampling- American Eel anomalies: 1 with lower jaw malformed

Stream is adjacent to Drexel Road in park, upstream transect net was 29 meters (95.1 ft.) downstream from foot bridge

SITE #12: N.W. Branch x University Boulevard (upstream)



DEPTH PROFILE (M)



TEMPS: Spring N/A Summer 24 C

GRADE: 9.1'/mile (5.6m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	good	14	30-50% rubble gravel or other stable habitat, adequate habitat
Embedded-ness	poor	3	gravel, cobble, and boulder particles are >75% surrounded by fine sediment
Velocity/ Depth	fair	7	only 2 of 4 habitat categories present (missing riffles/runs lower score)
Channel Alteration	good	9	some new increase in bar formation mostly coarse gravel some channelazation
Scouring Deposition	fair	7	30-50% affected deposits and scour at obstructions and bends, filling of pools
Pool/Riffle Run/Bend	good	9	adequate depth in pools & riffles bends provide habitat
Bank Stability	poor	1	unstable, many eroded areas side slopes >60% common "raw" areas frequent
Bank Veg. Stability	poor	1	<25% of the streambank surfaces covered by veg. gravel or larger mat.
Streamside Cover	poor	2	>50% of the streambank has no veg. and dominant mat. is soil, rock, bridge mat.

Total Score 53

1990 Anacostia River Fisheries Survey
Site #12-Northwest Branch x University Boulevard

Species captured	(7/6)	(8/2)	/ pop. est. / std. error
1. American Eel	9	5	
2. Cutlips Minnow	12	10	
3. Rosyside Dace	1	0	
4. Swallowtail Shiner	1	71	
5. Satinfin Shiner	0	69	
6. Bluntnose Minnow	6	1	
7. Common Shiner	0	25	
8. Blacknose Dace	0	25	
9. Longnose Dace	5	16	
10. Northern Creek Chub	1	0	
11. Northern Hog Sucker	2	2	
12. White Sucker	2	0	
13. Yellow Bullhead	0	1	
14. Redbrest Sunfish	29	2	
15. Pumpkinseed Sunfish	1	0	
16. Tesellated Darter	17	2	
# of Species	12	12	
# of Individuals	93	229	
Species Diversity(H')	2.02	1.79	Average = 1.91

Approximate drainage area above stream = 34 square miles
Stream surface area = 228.3 square miles (.023 hectare)

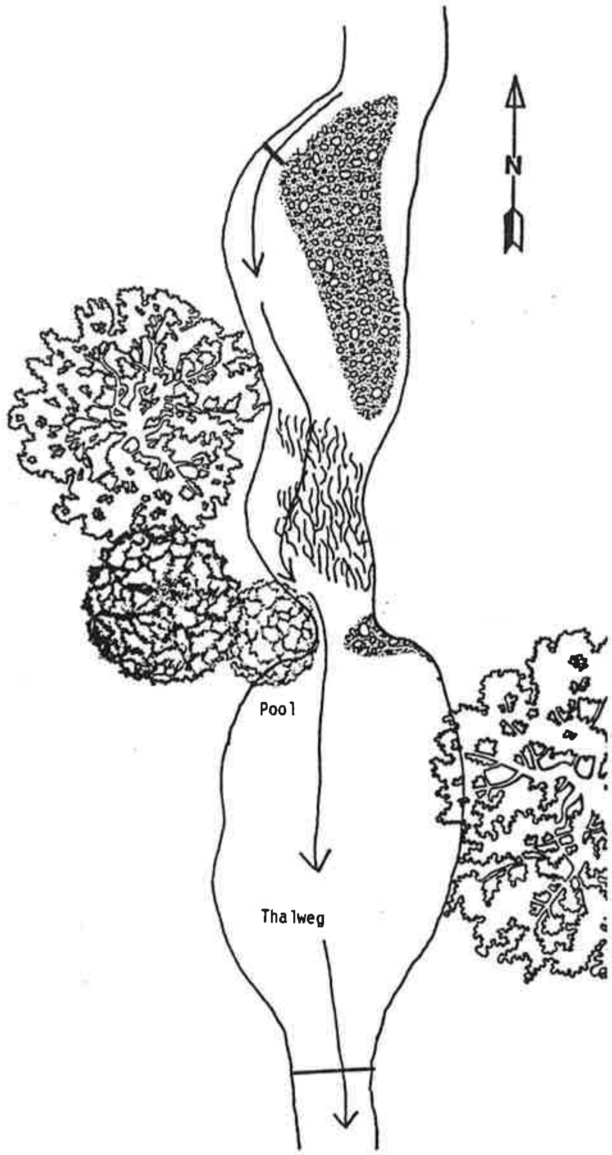
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Yellow Bullhead	10	43	0	0	0
Redbreast Sunfish	310	673	100	0	0
Pumpkinseed Sunfish	10	22	0	0	0

Riffle/pool ratio = 1:2.3

Anomalies: none

Approximtely 600 meters (1968.5 ft.) upstream from University Boulevard was the location of the downstream transect net

SITE #13: N.W. Branch x Layhill Park

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                  DEPTH PROFILE (M)
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   |                                          .
   |            .
0.5+
   |
   |
1.0+
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   |
1.5+
   |-----+-----+------+------+------+-----+-------
         0    10     20     30     40    50
(Downstream)  Transect Meter Intervals  (Upstream)
```

TEMPS: Spring 14 C   Summer 22 C

GRADE: 43.5'/mile (8.4m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	excel	18	>50% rubble,gravel, submerged logs undercut banks or other stable hab.
Embedded-ness	good	14	gravel,cobble, and boulder particles >24% & <50% surrounded by fine sediment
Velocity/ Depth	excel	19	all habitat categories present
Channel Alteration	good	11	some new increase in bar formation mostly coarse gravel,some channelazation
Scouring/ Deposition	good	9	5-30% affected scour at constrictions & were grades steepen, some dep. in pools
Pool/Riffle Run/Bend	excel	13	variety of habitat deep riffles and pools
Bank Stability	fair	4	moderately unstable,moderate frequency and size of erosional areas slopes-60%
Bank Veg. Stability	good	7	50-79% of the streambank surfaces covered by veg., gravel or larger materiel
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 88

1990 Anacostia River Fisheries Survey
Site #13- Northwest Branch x Layhill Park

Species captured	(6/15)	(7/31)	pop. est.	std. error
1. Silverjaw Minnow	0	1		
2. Cutlips Minnow	2	2		
3. Rosyside Dace	19	5		
4. Swallowtail Shiner	69	24		
5. Satinfin Shiner	6	10		
6. Common Shiner	135	17		
7. Spottail Shiner	12	6		
8. Bluntnose Minnow	129	24		
9. Blacknose Dace	90	40		
10. Longnose Dace	13	8		
11. Northern Creek Chub	1	0		
12. White Sucker	4	6		
13. Northern Hog Sucker	10	4		
14. Margined Madtom	0	1		
15. Bluegill Sunfish	2	0	2.2/N.A.	.8/N.A.
16. Redbreast Sunfish	9	10	9.2/10.2	.6/.53
17. Fantail Darter	4	5		
18. Tessellated Darter	0	2		
# of Species	15	16		
# of Individuals	505	165		
Species Diversity	1.92	2.34	Average = 2.13	

Approximate drainage area above site = 13.2 square miles
Stream surface area = 384.5 square meters (.039 hectares)

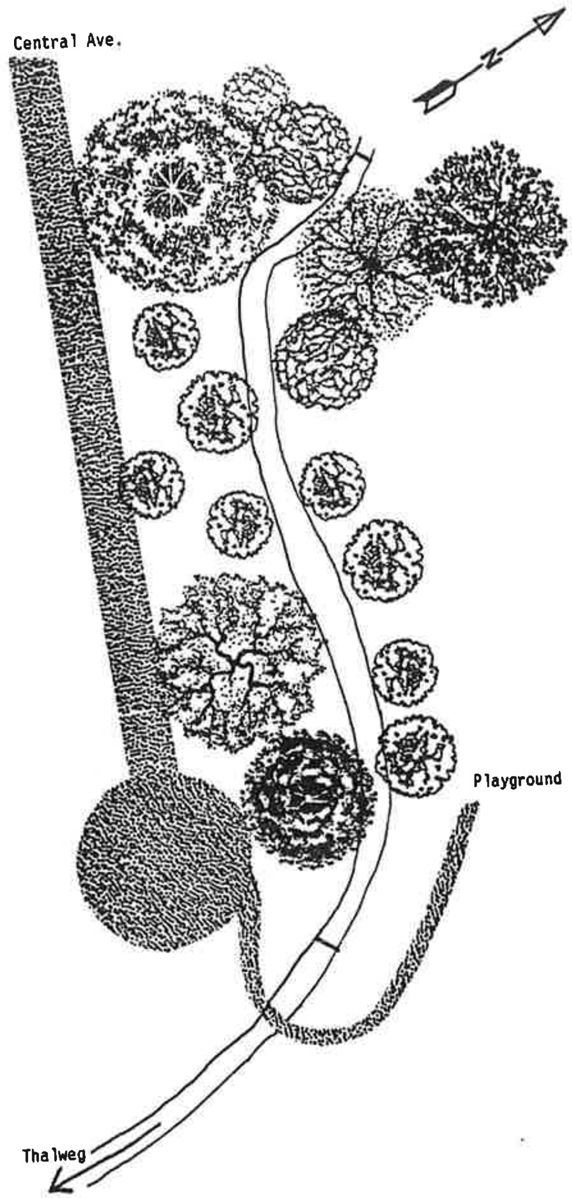
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Bluegill Sunfish	44	56	50	0	0
Redbreast Sunfish	194	249	20	0	0

Riffle/pool ratio = 1:1.8

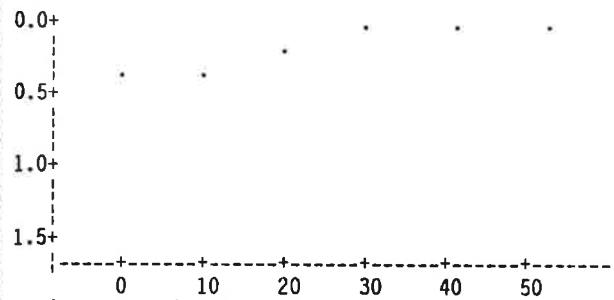
Anomalies: none

Upstream net was approximately 900 meters (2952.7 ft.) downstream from the confluence of Northwest Branch and Buckhorn Branch

SITE #14: Sligo Creek x Long Branch



DEPTH PROFILE (M)



TEMPS: Spring 17 C Summer 23 C

GRADE: 21.3'/mile (4.1m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	excel	19	>50% gravel,rubble, submerged logs undercut banks, or other stable hab.
Embedded-ness	good	11	gravel,cobble,and boulder particles >25% & <50% surrounded by sediment
Velocity/ Depth	good	15	only 3 of 4 habitat categories present (missing riffles/runs lower score)
Channel Alteration	excel	12	little or no enlargement of islands or point bars and/or no channelization
Scouring/ Deposition	good	10	5-30% affected scour at constrictions & where grades steepen some dep. in pools
Pool/Riffle Run/Bend	good	11	adequate depth in pools & riffles bends provide habitat
Bank Stability	good	8	moderately stable, in-frequent,small areas of erosion, side slopes up to 60%
Bank Veg. Stability	excel	9	over 80% of the streambank surfaces covered by veg. or boulders & cobble
Streamside Cover	good	8	dominant vegetation is of tree form

Total Score 103

1990 Anacostia River Fisheries Survey
Site #14- Sligo Creek x Long Branch

Species captured	(6/20)	(7/30)	/ pop.est.	/ std.error
1. Blacknose Dace	223	206	297.8/228.2	25.7/8.8
2. Northern Creek Chub	0	4		
# of Species	1	2		
# of Individuals	223	210		
Species Diversity (H')	0	.1	Average =.05	

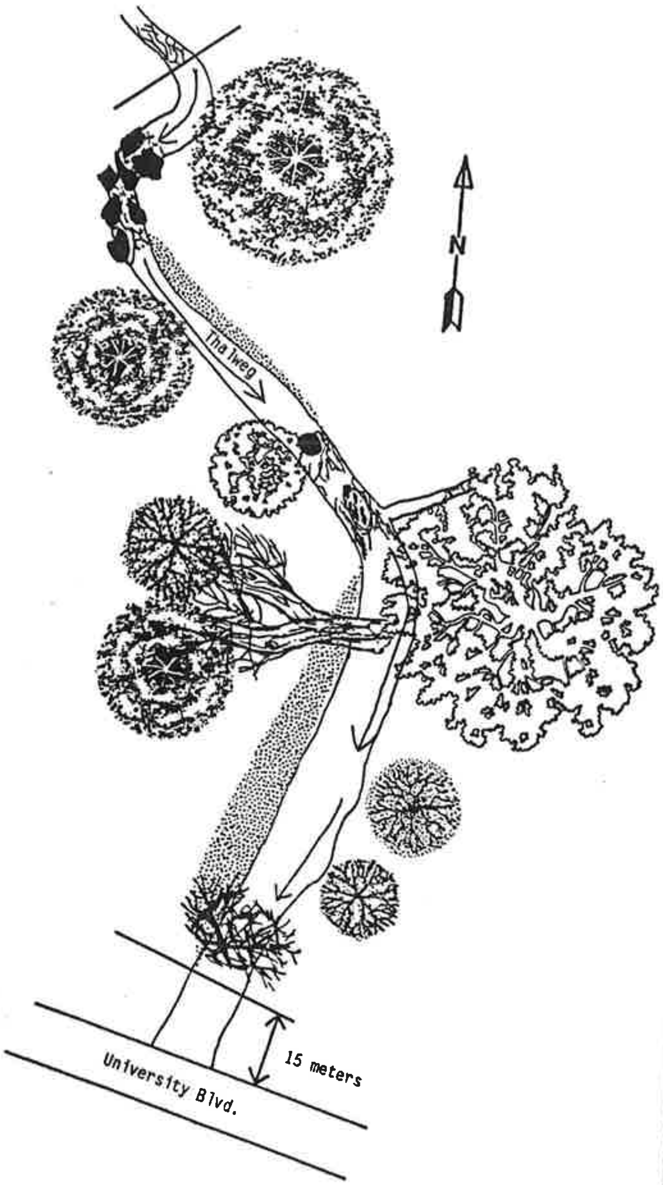
Approximate drainage area above site = 1.1 square miles
Stream surface area 134.3 square meters (.013 hectares)

Riffle/pool ratio = 1:2

Anomalies: none

Site is located off Central Avenue in park, downstream net was approximately 11 meters (36.10 ft.) upstream from footbridge

SITE #15: Sligo Creek x University Boulevard



DEPTH PROFILE (M)

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0.0+     .       .       .      .      .      .
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0.5+
   |
   |
1.0+
   |
   |
1.5+
   |-----+------+------+------+------+------+-------
         0     10     20     30     40     50
 (Downstream)   Transect Meter Intervals   (Upstream)
```

TEMPS: Spring 18 C   Summer 21 C

GRADE: 15.6'/mile (3.1m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	excel	17	>50% rubble,gravel, submerged logs undercut banks or other stble habitat.
Embedded-ness	poor	5	gravel,cobble, and boulder are >75% surrounded by fine sediment
Velocity/ Depth	good	15	only 3 of 4 of the hab. categories pre-sent (missing riffles/runs lower score
Channel Alteration	fair	7	moderate dep. of new gravel on old & new bars some pools partly filled w/silt
Scouring/ Deposition	fair	4	30-50% affected,deposits & scour at obstructions & bends,some pools filling
Pool/Riffle Run/Bend	good	9	adequate depth in pools & riffles bends provide habitat
Bank Stability	good	7	moderately stable, infrequent ,small areas of erosion side slope up to 40%
Bank Veg. Stability	good	8	50-79% of the streambank surfaces covered vegetation, gravel,or larger material
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 79

1990 Anacostia River Fisheries Survey
Site #15-Sligo Creek x University Boulevard

Species Captured	(6/19)	(7/31)	/ pop. est	/ std. error
1. Blacknose Dace	3	3		
# of Species	1	1		
# of Individuals	3	3		
Species Diversity(H')	0	0	Average = 0	

Approximate drainage area above site = .8 square miles
Stream surface area = 117.5 square meters (.012 hectares)

Riffle/pool ratio = 1:2.8

Anomalies: none

Downstream transect net was located approximately 15 meters (49.2 ft.) upstream from where University Boulevard crosses Sligo Creek

Figure #4 below shows the relationship of biological condition (IBI scores as a percent of reference conditions) and habitat quality (Habitat Assessment scores as a percent of reference) for all 15 sites:

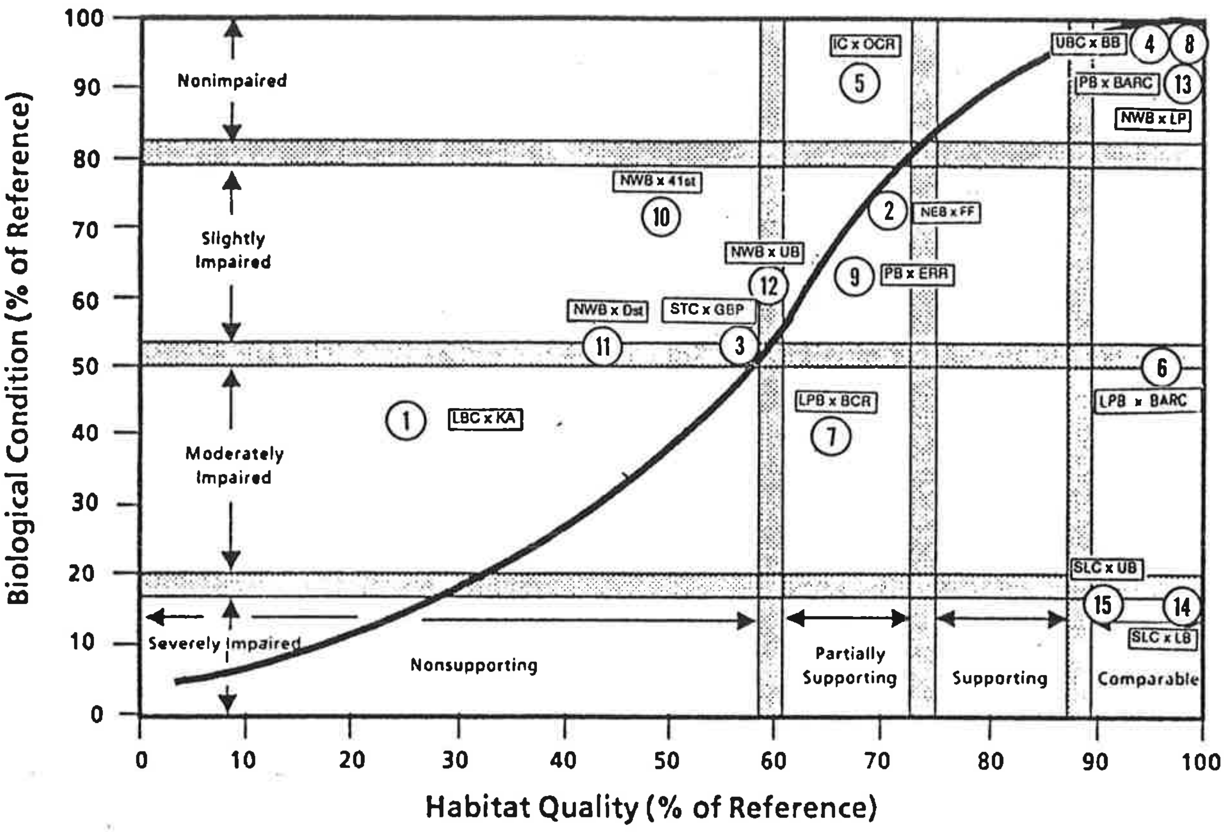

Figure #4: The relationship between habitat and biological condition. (Cirles represent site-specific locations)

DISCUSSION

Figure #4 may be better understood if you roughly divide the figure into quarters. Conceptually, sites located in the upper right are in the best condition, those in the lower left are in the worst condition. Sites located in the upper left tend to have problems with organic enrichment, sites located in the lower right are often associated with toxicant problems.

In Figure #4, many of the sites are grouped just above the center, i.e., in the partially supporting regions in terms of habitat and in the slightly impaired regions in terms of biological condition. Generally, results of the fisheries surveys indicate that habitat degradation appears to play a more significant role in depressing fish communities in the Maryland portions of the Anacostia watershed than water quality problems.

Poor water quality, however, is a problem that should not be understated. Site #1 (Lower Beaverdam Creek below Kenilworth Avenue) is a notable example, its location in the lower left of Figure #4 provides evidence of its severe problems in terms of both poor habitat and poor water quality. Lower Beaverdam Creek's problems are best illustrated by reviewing Appendix G, which provides an inventory of trash and debris we noted during one our sampling efforts.

Sites #5 (Indian Creek at Old Columbia road), #10 (Northwest Branch near 41st Street) and #11 (Northwest Branch near Drexel Street) are in regions of the figure that indicate nutrient enrichment is a problem, coupled with degraded habitat. Sites #6 (Little Paint Branch at the Beltsville Agricultural Research Center (BARC)), #14 (Sligo Creek at Long Branch) and #15 (Sligo Creek above University Boulevard) are located in the bottom right of Figure #4, an area that indicates organic pollution or toxicant problems at sites with relatively good habitat. Sites #14 and #15 also had better ratings in the benthic macroinvertebrate evaluations than with fisheries evaluations. This supports an idea raised in our 1989 survey report (Cummins, 1990), i.e. that one reason that the fish communities in the upper portions of Sligo Creek are depauperate is that they are prevented from recolonizing the area due to fish blockages.

CONCLUSIONS AND RECOMMENDATIONS

This study is meant to serve as an initial stab at a rapid bioassessment for the Maryland portions of the Anacostia basin. Refinements to the IBI and habitat criteria can be made as additional regional data bases are accumulated and processed. These refinements should enhance bioassessments.

The RBPs used in this study have helped to differentiate habitat and biological problems in the Anacostia watershed. Perhaps most importantly, though, these RBPs provide a system for evaluating restoration progress in the Anacostia watershed. Therefore, we recommend periodic re-evaluations of the Anacostia tributaries using these rapid bioassessment protocols[3]. If the restoration efforts on the Anacostia River are successful we should be able to observe a "migration" of the site locations in the habitat/biological condition relationship (Figure #4) toward the upper right hand corner, i.e., towards the "best quality" portion of the figure. Hopefully, the current commitments to restore the Anacostia watershed will not wane and we will witness this "migration" towards a healthier river along with the migration of river herring to their historical spawning grounds.

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[3] Due to their rapid recolonization potential, benthic macroinvertebrates can be sampled at 2-3 year intervals. Fish, however, are slower to show a response to restoration and should be resampled every five years.

The "Drop-in-a-Bucket" Brigades

In addition to the environmental surveys, ICPRB also involved several schools located within the Anacostia Basin with our fisheries restoration activities. Originally, the concept for student involvement was under an informal "contest" format through which students submitted stream restoration designs. The winning designs were then to be funded and implemented. During January and February, informational presentations and announcements[3] describing the projects were provided to members of Prince George's and Montgomery counties' public school science department's administrators, teachers and students. Students were asked to be as original as possible with their restoration plans and told that ICPRB would provide close guidance with all concepts, designs, and implementations. Selected submissions were to be funded through the Maryland Department of Natural Resources and ICPRB. However, after submitting such requests, the students responses to the project did not come as predicted. We found that although there was much interest in participating in restoration projects, both students and teachers expressed problems with allocating the time required to perform in-depth restoration projects due to work and/or other commitments[4].

By tailoring our activities to these needs, we arranged for several schools to participate in shorter-term restoration projects. This last spring, students and teachers helped to increase the range of migrating river herring in the Anacostia River[5]. Between April 11th-24th, selected students from Paint Branch, Blair and Parkdale High Schools and Eastern Intermediate School helped to trap and transport 241 alewife herring over a metal-weir blockage to fish migration located upstream from Riverdale Road on the North East Branch. This "trap and transport" operation was performed to help imprint larval herring to upstream waters in hopes that they will have the instinctual drive to negotiate fish passageways that should be installed by the time they return from the sea to spawn in three to four years. In addition to their work with migratory fishes, students were given hands-on instructions on the aquatic ecology of the river and human effects on this ecology, they used shore haulseines, and they learned about a variety of non-migratory fishes found in the Anacostia.

Then, as a fall follow-up, Paint Branch High School and Eastern Intermediate School participated in a forage fish transfer project as part of an effort to restock native fish species in upper portions of Sligo Creek. Letters describing these activities are provided in the Appendix H(2).

These activities provided a direct and fairly simple way to get "hands-on" involvement of students in the Anacostia restoration effort. Hopefully, the students were also imprinted, in this case with a desire to improve the condition of the Anacostia tributaries. These activities were quite well received by both students and teachers. All expressed interest in remaining active with Anacostia stream restoration in the future.

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[3] A copy of a posted announcement is available in Appendix H(1).

[4] Many of the students had prior commitments to summer jobs or other activities away from the area.

[5] See attached copy of Washington Post article in Appendix H(3).

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HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category: Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS.

. Habitat Assessment Field Data Sheet

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	____	____	____	____

Score ________

APPENDIX D: LOCATION OF 1990 STREAM MONITORING SITES

PRINCE GEORGES COUNTY

Site # Stream	Project Description[1]	Location
1. Lower Beaverdam Creek		Downstream from Kenilworth Avenue
2. N.E. Branch	Fletcher's Field	Upstream from Emerson Street
3. Still Creek (NPS)	Golden Triangle	Across from Old Calvert Road
4. Upper Beaverdam Creek		Downstream from Beck Branch
5. Indian Creek	Phase II & III	Talbot Avenue
6. Little Paint Branch	BARC	Downstream from unnamed bridge, near Waste Water Treatment Plant
8. Paint Branch	BARC	Upstream from Buck Lodge Road
10. N.W. Branch		Across from 41st Street
11. N.W. Branch		Between Univ. Blvd. & Rt. 410 (Drexel St.)
12. N.W. Branch		Between Riggs Rd. & University Blvd.

MONTGOMERY COUNTY

Site # Stream	Project Description	Location
7. Little Paint Branch	Tanglewood	Upstream from Briggs Chaney Rd.
9. Paint Branch		Downstream from E. Randolph Rd.
13. N.W. Branch	N.W. Br. Regional Park	Across from soccer fields
14. Long Branch (SC)	COG Phase 2	At Central Avenue
15. Sligo Creek	COG Phase 2	Above University Blvd.

[1] Locations are from the Anacostia Watershed Retrofit Directory, COG (1989).

APPENDIX E: TOLERANCES, TROPHIC GUILDS, AND ORIGINS OF SELECTED ANACOSTIA RIVER FISH SPECIES

Fish Species	Trophic level	Tolerance	Origin	Source[1]
1. A. Brook Lamprey	filterer	intolerant	native	EPA
2. American Eel	piscivore	intermediate	native	EPA
3. Blueback Herring	invertivore	intermediate	native	JC
4. Alewife	invertivore	intermediate	**native**	EPA
5. Gizzard Shad	omnivore	intermediate	native	EPA
6. Brown Trout	insectivore	intermediate	exotic	EPA
7. Rainbow Trout	insectivore	intolerant	**intro**	EPA
8. Eastern Mudminnow	insectivore	tolerant	native	JC
9. Chain Pickerel	piscivore	intermediate	native	EPA
10. Common Carp	omnivore	tolerant	exotic	EPA
11. Goldfish	omnivore	tolerant	exotic	EPA
12. Silverjaw Minnow	insectivore	intermediate	native	EPA
13. Cutlips Minnow	omnivore	intermediate	native	JC
14. River Chub	piscivore	intermediate	native	JC
15. Golden Shiner	omnivore	tolerant	native	EPA
16. Rosyside Dace	insectivore	intolerant	native	JC
17. Swallowtail Shiner	omnivore	tolerant	native	JC
18. Rosyface Shiner	insectivore	intolerant	native	EPA
19. Spotfin Shiner	insectivore	intermediate	native	EPA
20. Satinfin Shiner	insectivore	tolerant	native	JC
21. Common Shiner	insectivore	intermediate	native	EPA\JC
22. Spottail Shiner	insectivore	intermediate	native	EPA
23. E. Silvery Minnow	herbivore	intolerant	**intro**	EPA
24. Bluntnose Minnow	omnivore	tolerant	native	EPA
25. Blacknose Dace	generalist	tolerant	native	EPA
26. Longnose Dace	insectivore	intermediate	native	EPA
27. Northern Creek Chub	generalist	tolerant	native	EPA
28. FallFish	generalist	intermediate	native	JC
29. Creek Chubsucker	insectivore	intermediate	native	EPA
30. White Sucker	omnivore	tolerant	native	EPA
31. Northern Hog Sucker	insectivore	intolerant	native	EPA
32. Channel Catfish	generalist	intermediate	**intro**	EPA
33. Yellow Bullhead	insectivore	tolerant	native	EPA\JC
34. Brown Bullhead	insectivore	tolerant	intro	EPA
35. Margined Madtom	insectivore	intermediat	native	JC
36. Inland Silversides	insectivore	intermediate	native	JC
37. Sheepshead Minnow	insectivore	tolerant	**native**	JC
38. Mosquitofish	insectivore	intermediate	**native**	EPA
39. Banded Killifish	insectivore	tolerant	native	JC
40. Mummichog Killifish	omnivore	tolerant	**intro**	JC
41. Bluespotted Sunfish	invertivore	tolerant	**native**	JC
42. Green Sunfish	invertivore	tolerant	**intro**	EPA
43. Bluegill Sunfish	insectivore	tolerant	**intro**	EPA
44. Redbreast Sunfish	invertivore	tolerant	native	JC
45. Pumpkinseed Sunfish	invertivore	tolerant	native	JC
46. Longear Sunfish	insectivore	intolerant	native	EPA
47. Black Crappie	invertivore	intermediate	**intro**	EPA
48. White Crappie	invertivore	intermediate	**native**	EPA\JC
51. Smallmouth Bass	piscivore	intermediate	**intro**	EPA
52. Largemouth Bass	piscivore	tolerant	**intro**	EPA
53. Yellow Perch	insectivore	intermediate	exotic	EPA
54. Fantail Darter	insectivore	intermediate	**intro**	EPA
55. Tessellated Darter	insectivore	tolerant	native	JC
56. Walleye	piscivore	intermediate	**intro**	EPA
57. Mottled Sculpin	insectivore	intermediate	native	EPA
58. White Perch	piscivore	intermediate	**native**	EPA
59. Striped Bass	piscivore	intermediate	**native**	EPA

1 EPA - From EPA's "Rapid Bioassessment Protocols For Use In Streams And Rivers: Benthic Macroinvertebrates And Fish", Appendix D, Table D-1
EPA\JC - From EPA as above except where **bolded.**
JC - Assigned by author
Thomp - From "Thompson's Guide to Freshwater Fishes"

APPENDIX F: INDIVIDUAL SITE IBI METRICS VALUES AND SCORES[1]

1. Total Number of Fish Species/Watershed Area:							
1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
13 ¦ **1**	13 ¦ **1**	12 ¦ **3**	17 ¦ **5**	22 ¦ **5**	13 ¦ **3**	10 ¦ **3**	21 ¦ **5**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
16 ¦ **3**	13 ¦ **1**	13 ¦ **1**	16 ¦ **1**	18 ¦ **5**	2 ¦ **0**	1 ¦ **0**	

2. Number of Darter and Sculpin Species:							
1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
0 ¦ **0**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	0 ¦ **0**	1 ¦ **1**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	2 ¦ **3**	0 ¦ **0**	0 ¦ **0**	

3. Number of Sunfish Species:							
1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
3 ¦ **3**	3 ¦ **3**	1 ¦ **1**	5 ¦ **5**	5 ¦ **5**	2 ¦ **3**	1 ¦ **1**	5 ¦ **5**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
2 ¦ **3**	4 ¦ **5**	1 ¦ **1**	2 ¦ **3**	2 ¦ **3**	0 ¦ **0**	0 ¦ **0**	

4. Average Size of Principal Gamefish Species:							
1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
53% ¦ **1**	46% ¦ **0**	37% ¦ **0**	53% ¦ **3**	25% ¦ **0**	0% ¦ **0**	0% ¦ **0**	62% ¦ **3**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
17% ¦ **0**	26% ¦ **0**	41% ¦ **0**	29% ¦ **0**	35% ¦ **0**	N.A.	N.A.	

5. Number of Intolerant Species:							
1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
0 ¦ **0**	1 ¦ **2**	0 ¦ **0**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	1 ¦ **1**	0 ¦ **0**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
1 ¦ **1**	1 ¦ **1**	0 ¦ **0**	1 ¦ **1**	2 ¦ **3**	0 ¦ **0**	0 ¦ **0**	

[1] under each site, the numbers on the left are calculated numbers, percentages, etc., the numbers in bold on the right are the IBI scores

APPENDIX F: INDIVIDUAL SITE IBI METRICS VALUES AND SCORES[2]

6. Proportion of A) Common Carp, B) White Suckers, C) Northern Creek Chub, D) Blacknose Dace, E) Total %

1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
A)0%	1%	0%	0%	0%	0%	0%	0%
B)4%	2%	1%	0%	4%	0%	10%	3%
C)0%	0%	1%	1%	1%	1%	24%	0%
D)0%	0%	24%	0%	2%	40%	33%	5%
E)4% ¦ **5**	3% ¦ **5**	26% ¦ **3**	1% ¦ **5**	7% ¦ **5**	67% ¦ **1**	67% ¦ **1**	8% ¦ **5**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
A)0%	0%	0%	0%	0%	0%	0%	
B)28%	1%	5%	1%	2%	0%	0%	
C)2%	0%	0%	1%	0%	1%	0%	
D)8%	0%	16%	10%	21%	99%	100%	
E)38% ¦ **3**	1% ¦ **5**	21% ¦ **5**	12% ¦ **5**	23% ¦ **5**	100% ¦ **0**	100% ¦ **0**	

7. Proportion of Omnivorous/Generalist Individuals:

1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
31% ¦ **3**	6% ¦ **5**	53% ¦ **3**	10% ¦ **5**	25% ¦ **5**	68% ¦ **1**	67% ¦ **1**	28% ¦ **5**
9. PBxERR	10.NWBx41st	11.NWBxDst	12.NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
49% ¦ **3**	1% ¦ **5**	35% ¦ **3**	40% ¦ **3**	58% ¦ **3**	100% ¦ **0**	100% ¦ **0**	

8. Proportion of Disease/Anomalies:

1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
16% ¦ **0**	0% ¦ **5**	0% ¦ **5**	1% ¦ **5**	0% ¦ **5**	0% ¦ **5**	0% ¦ **5**	0% ¦ **5**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
2% ¦ **5**	1% ¦ **5**	1% ¦ **5**	0% ¦ **5**	0% ¦ **5**	0% ¦ **5**	0% ¦ **5**	

9 . Total Score:

1. LBCxKA	2. NEBxFF	3. StCxGBP	4. UBCxBB	5. ICxOCR	6. LPBxBARC	7. LPBxBCR	8. PBxBARC
13	**22**	**16**	**30**	**27**	**15**	**12**	**29**
9. PBxERR	10.NWBx41st	11.NWBxDst	12. NWBxUB	13. NWBxLP	14. SlCxLB	15. SlCxUB	
19	**22**	**16**	**19**	**27**	**5**	**5**	

[2] under each site, the numbers on the left are calculated numbers, percentages, etc., the numbers in bold on the right are the IBI scores

APPENDIX G: Garbage description and count of trash in one 50 meter (164 feet) section of Lower Beaverdam Creek below Kenilworth Avenue (7/5/90)

Miscellaneous garbage and debris:

1 large trash dumpster
7 55 gallon steel barrels
1 standard refrigerator
1 small refrigerator
2 air conditioning units
1 compressed air container
1 hot water heater
1 metal cart with wheels
2 shopping carts
1 6"x 6" roll of fencing wire
18 cable/wire bundles
1 piece of wire mesh
6 metal grates
2 road guard rails
3 railroad ties
1 lawn mower
1 wash tub
2 office chairs
1 aluminum downspout
1 storm drain pipe
2 electric fans
3 plastic/nylon garden hoses
1 artificial christmas tree
4 wooden pallets
2 foam sheets
1 piece of plastic packing foam
1 plastic bucket
7 rugs
3 mattresses
1 stereo and cassette system
1 telephone
1 blinking hazard light
1 large stuffed panda bear
2 plastic childrens tricycles
2 metal trays
15 plastic trays
16 plastic bags
58 beverage cans
43 beverage bottles
79 styrofoam cups

Automobile parts:

1 hood
4 fenders
2 doors
27 gasoline tanks
1 gas tank filling pipe
7 pieces of sheet metal auto parts
1 truck battery
1 automobile dashboard
3 automobile seats
1 drink holder
1 carburetor
1 exhaust pipe
1 hydraulic bottle jack
8 hubcaps
5 rims
3 truck tires
58 automobile tires

ANNOUNCEMENT

WANTED: Students interested in helping the environment.

WANTED: Students who want to work with fish and learn about fish.

WANTED: Schools which want to "develop and apply knowledge and skills at the community level for cooperative action to protect and sustain the environment"[1].

The Interstate Commission on the Potomac River Basin (ICPRB) is looking for students or student organizations willing to help restore fisheries habitat in streams and tributaries of the Anacostia River in Prince Georges and Montgomery Counties, Maryland. Grants of up to $5,000 will be awarded by ICPRB through a program funded by the Maryland Department of Natural Resources. Projects such as stocking of native and migratory fishes, stream bank stabilization and instream habitat improvements will be preformed during this spring, SUMMER and fall. Experience is not necessary. Staff biologist will help with design and implementation of the projects. What we want are enthusiastic students and teachers who have the desire to improve the environment, particularly the stream environments in their neighborhoods and their community. Cleaning these streams is one of the best ways to clean the Chesapeake Bay.

A tributary to the Anacostia may be as close as your back yard or just behind your school. Paint Branch, Little Paint Branch, Sligo Creek, the Northwest Branch, Beaverdam Creek, and Indian Creek can all use your help. Learn about fish, learn about stream life and get involved with improving your environment. Call or write us now! Migratory fish projects will start in April. Don't miss this opportunity!

Contact: Jim Cummins
Associate Director-Living Resources
Interstate Commission on the Potomac River
6110 Executive Blvd., Suite 300
Rockville, Maryland 20852
(301)-984-1908

1 Excerpted from goal "E" of the Maryland State Dept. of Education's Environmental Education Bylaw.

APPENDIX H(2): THE "DROP-IN-THE-BUCKET-BRIGADES"
EXAMPLE OF FOLLOW-UP LETTER TO PARTICIPANTS

December 4, 1990

Eastern Intermediate School
C/O Kathleen Bender and Susan LaMoe
300 University Blvd. East
Silver Spring, MD 20901

Dear Students and Teachers:

I thought you would all be interested to learn the tally of our recent fish transplant stocking project. So far, thanks to your efforts, we have stocked the following fishes in Sligo Creek;

Common Name	Species Name	# of individuals
1. Silverjaw Minnow	Ericymba buccata	123
2. Cutlips Minnow	Exoglossum maxillingua	9
3. Swallowtail Shiner	Notropis procne	2071
4. Satinfin Shiner	Notropis spilopterus	1064
5. Common Shiner	Notropis cornutus	65
6. Spottailed Shiner	Notropis hudsonius	82
7. Bluntnose Minnow	Pimephales notatus	40
8. Rosyside Dace	Clinostomus funduloides	10
9. Longnose Dace	Rhinichythys cataractae	9
10. White Sucker	Catostomus commersoni	11
11. Northern Hog Sucker	Hypentelium nigricans	13
12. Bluegill Sunfish	Lepomis macrochirus	2
13. Redbreast Sunfish	Lepomis auritus	2
14. Pumpkinseed Sunfish	Lepomis gibbosus	2
15. Largemouth Bass	Micropterus salmoides	3 (young of the year)
16. Tessellated Darter	Etheostoma olmstedi	57
17. Banded Killifish	Fundulus diaphanus	39
	TOTAL =	3660

This was quite an event for Sligo Creek, as these fish have not been found in the upstream stretches of the creek since before 1948. The Interstate Commission on the Potomac River Basin wishes to express its gratitude for your help on this project. Please accept this book "The Audubon Society Field Guide to North American Fishes, Whales & Dolphins" for your library as a token of our appreciation. Information on most of the fishes we collected can be found in this book. I hope you enjoy it. We look forward to your continued support in the future. Thank you.

Sincerely,

James D. Cummins
Associate Director-Living Resources

APPENDIX H(3): WASHINGTON POST ARTICLE

C12 Sunday, April 22, 1990 — The Washington Post

RECREATION

ANGUS PHILLIPS

Earth Day on the Anacostia River: a Drop in the Bucket Brigade

"Think Globally," say the bumper stickers, "Act Locally."

Well, you couldn't get much more local than this. The kids from Thomas Hausmann's ecology class walked down from Parkdale High School to help the herring, which swam in from the salt sea to spawn in their back yard—the ravaged Northeast Branch of the Anacostia River.

That's right, wildlife in the funky Anacostia, and far more than you might expect. As the students squeezed into chest-high waders, young Roy Smithers was down at water's edge doing a little recreational fishing. First cast, chain pickerel; second cast, largemouth bass—right there in the heart of Prince George's County.

By day's end the high school kids also had trapped 117 river herring and carried them around a man-made dam that denied the fish access to miles of spawning habitat upstream. Suckers, bluegills, bass, gizzard shad and minnows that turned up in the net were tossed back.

"If there's that many fish in this dirty water now," said Parkdale senior John Fitzhugh, gesturing at the clear-cut banks and the tortured, muddy flow, "think what it must have been like when it was clean."

Think, indeed . . .

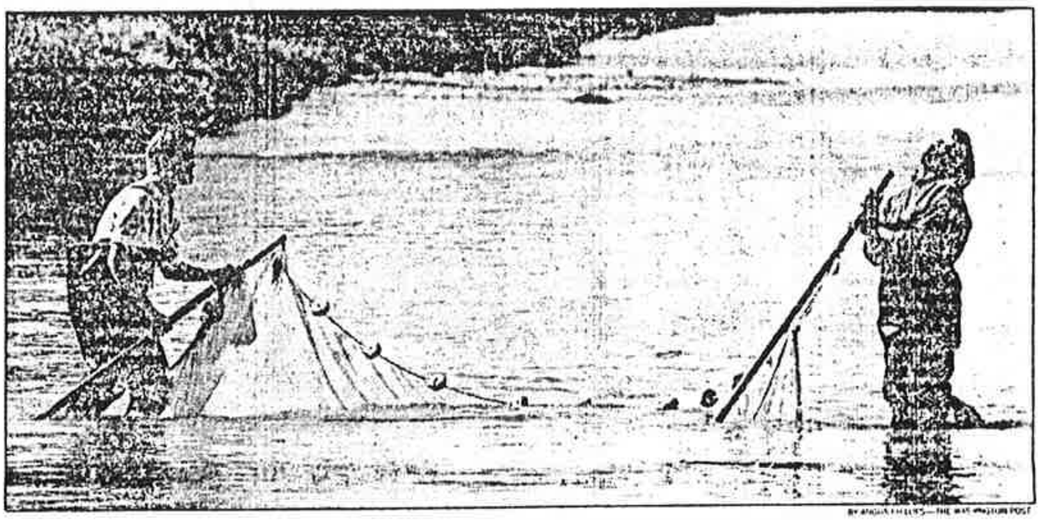
That's what the kids were there to do, after all, on the eve of the 20th anniversary of Earth Day—to think about what their environment was, what it had been and what it could be.

When Capt. John Smith landed on the Chesapeake's shores 383 years ago, he found 5,000 Indians living in paradise. "Heaven and Earth," he wrote, "never agreed better to frame a place for man's habitation . . . All is overgrown with trees and weeds, being a plain wilderness as God first made it.

"In all the small rivers in all the year there is good plenty of small fish . . ."

Good plenty of ill-conceived dams have gone up since, of course, and good plenty of water has flowed over them. Trees and weeds came down; highways and shopping malls went up.

Now came 15 optimistic high school seniors and a couple of wildlife biologists to help the fish on their reproductive way. "If there are any fish in here yet," said biologist Jim Cummins, raising a glance to providence in a prayerful way.



Parkdale High students Scott Buchanan, left, and Rhonda White have a laugh as they try to net herring in Anacostia feeder stream.

Cummins, a D.C. employee working on Anacostia restoration for the Interstate Commission on the Potomac River Basin, handed one end of a seine net to his assistant, Khoshkoo Behrooz, and set out with the other across the shallow branch. When his circle was complete, they gathered the ends and pulled, revealing at last a shimmering pile of silver herring on a mission as old as life itself.

"Male," Cummins called out, squeezing a drop of white milt from one and tossing the fish into a bucket for transportation. "Female," came next. The kids hopped to, forming a bucket brigade to haul the catch above the dam and send the fish on their way.

Overhead, an osprey scanned for his brunch; three mallards sped upstream on a hurried mission; a great blue heron stalked minnows in the shallows. The sky was azure blue.

So, if there is much to worry about on this important environmental anniversary, there are things to celebrate too.

The kids from Parkdale weren't even alive for the first Earth Day 20 years ago, yet the river they worked on last week was considerably healthier than when they were born.

Surveys in 1972 turned up about half as many fish species in the Anacostia as a 1988 survey (25 vs. 48). Much of the credit for the improving diversity goes to federal Clean Water Act provisions, which upgraded sewage treatment plants and got folks off failing septic systems and into municipal wastewater treatment, said Cummins. Where once it stank, the Northeast Branch, like other Anacostia tributaries, stinks no more.

But the branch has absorbed environmental insults, as well. After Hurricane Agnes put much of Riverdale and Bladensburg under water in 1972, the Army Corps of Engineers and Washington Suburban Sanitary Commission drew up flood plans.

They called for straightening the meandering branch, cutting away trees in the valley that impeded flow and reinforcing the banks with heavy stone to create a sluiceway for future floods to exit fast.

The little dam at Riverdale Park was part of the plan, but no one considered its effect on herring, which can't jump. It created a dead end, blocking off miles of spring spawning habitat above, which is what the Parkdale kids came to bypass.

Long range, said Cummins, Anacostia restoration calls for removal of this and other spawning barriers. Meantime, he wanted to imprint some 1990 herring fry on the stream's upper stretches, so when they came back to spawn in three or four years, they'd go past the site of the dam, which by then should be fixed to allow passage.

Sound complicated? Such is life when you mess with nature.

When flood control was the burning issue after Agnes, authorities brought in hydrodynamicists to fix the branch, Cummins said. "All they knew about was carrying capacity and volume."

So they turned the creek into a treeless eyesore that bakes under summer sun. "The water in here got to 95 degrees last year," Cummins said.

But there's a plan for that too. The restoration strategy calls for replanting some trees and bushes and improving underwater habitat with wing dams and rocky structures for fish to hide in.

Small steps all, just like last week's bucket brigade, but steps in the right direction.

Twenty years ago, the Potomac River, which the Anacostia feeds, was an algae-laden eyesore that defied recreational use. Today, thanks to a $1 billion cleanup, it's packed with fishermen, windsurfers, boaters, birds, grasses, bass.

Now the Maryland Department of Natural Resources, the D.C. Fisheries Department and the Interstate Commission on the Potomac River Basin are taking aim on the Anacostia.

If the Potomac proved things *can* get better, there's hope now for its foulest tributary. If you doubt it, ask the kids.

"A lot of people think there's no hope," said Parkdale senior Rhonda White, hauling herring. "But if you just do it, there's that much more that's done.

"I was trying to get a recycling project going where I work at Safeway," she said. "The other people all said, 'Are we going to get paid?'

"I said, 'Paid? You're living, aren't you? You're breathing, you're eating. That's your pay. Your life!' "

Points of sparkling light from the new generation. Carry on, Rhonda. Carry on.