Wheaton Branch Retrofit Project
1990-91 Biomonitoring Program

By

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INTRODUCTION

Watershed urbanization has considerable impact on the capacity of streams to maintain biotic, physical, and chemical integrity. Increases in impervious surface areas allow instantaneous conversion of rainfall to runoff by decreasing or eliminating the percolation aspect of soil structure. This rapid runoff increases the velocity and volume of stormflows in urbanized stream channels causing streambank soil and vegetative instability. This eventually leads to bank failure and channel-widening processes which in turn result in shallower base flows thus reducing habitat availability (Jones and Clark 1987).

In addition to the physical stress that urbanization places on stream channels, considerable impairment of water quality also occurs by runoff from asphalt roadways, parking lots, rooftops, and other impervious surfaces. In one major illustration of this fact, nonpoint source pollution in the form of urban runoff has been determined to cause pollutant levels in greater concentrations than from point sources in the Ohio River (Norman 1991). In his paper, Norman (1991) points out that the Environmental Protection Agency determined urban runoff flowing into the Ohio contained lead, zinc, copper, chromium, arsenic, cadmium, nickel, antimony, selenium, and some heavy organics. Other factors such as water temperature (Galli 1990) and suspended sediment yields (Crawford and Lenat 1989; Jones and Clark 1987) have been shown to increase with greater degrees of watershed imperviousness.

In comparing taxonomic richness of benthic macroinvertebrate assemblages from watersheds with variable land use in North Carolina, Crawford and Lenat (1989) found successively lower values in forested, agricultural, and urban settings. Similar effects of urbanization on benthic assemblages were found in northern Virginia. Jones and Clark (1987) documented shifts in taxonomic composition, increases in the numbers of tolerant species, and decreases in generic diversity and richness. From these examples it is clear that watershed urbanization has broad impacts on the water quality, physical structure, and biological potential of streams.

Wheaton Branch is a first-order tributary of the Sligo Creek watershed which has been subjected to severe urbanization pressures. A rapid increase in the percent coverage of the Wheaton Branch drainage by impervious surface has caused simultaneous increases in stormflow velocity and volume in this channel. Early 1991 witnessed severely eroding streambanks, riparian trees slumping into the water along with their substrate, plentiful input of human debris, and increasing substrate embeddedness.

The results of recent fishery surveys conducted in Sligo Creek portions of the Anacostia River Basin indicate that there is a critical need to restore both fisheries habitat and fish communities in Sligo Creek. As reported in the Interstate Commission on the Potomac River's (ICPRB) report entitled "1988 Survey and Inventory of the Fishes in the Anacostia River Basin, Maryland", fish populations in upper sections of Sligo Creek were especially poor, having very low species diversity and fish assemblages consisting only of a few highly pollution tolerant species.

However, recent improvements on upstream stormwater controls in Wheaton Branch should result in better regulated stream flows and a more stable environment in that tributary. If fish populations were to be re-established in Wheaton Branch, it is very possible that Wheaton Branch could serve as a refugium for fishes in Sligo Creek.

In anticipating the initiation of stormwater management and Wheaton Branch restoration activities, the Metropolitan Washington Council of Governments (MWCOG), through funding provided by the Maryland Department of the Environment's Small Creeks Restoration Program and local matching funds from the Montgomery County Department of Environmental Protection, authorized the Interstate Commission on the Potomac River Basin (ICPRB) to begin a biological monitoring program within this waterbody. The purpose of this program is to track changes (positive or negative) in the benthic macroinvertebrate and fish assemblages within Wheaton Branch before, during, and after these water resource management activities. The design was conceived to produce results compatible and potentially to be integrated with other recent bioassessment/biomonitoring efforts within the Anacostia River Watershed (Cummins 1989, Cummins 1990, Stribling et al. 1989, Stribling and Thaler 1990, EA Engineering, Science, and Technology 1990). This report represents the initial year of fish and benthic monitoring in Wheaton Branch.

In addition, ICPRB has recommended that local fish species be introduced into the Sligo Creek watershed in order to augment the recovery of fish populations. Therefore, as a future part of this project, selected native fish species will be captured from streams within the Anacostia watershed which currently have abundant and diverse fish communities, transported and then released into Wheaton Branch. These activities will be coordinated with Maryland's regional fisheries biologists and will include participation by local citizen groups.

PART I: BENTHIC MACROINVERTEBRATES

METHODS

Site Selection

Sites were selected to represent habitat upstream from retrofitting work (WB1), in the middle of the work area (WB2), on Sligo Creek upstream of the Wheaton Branch confluence (WB3), and on Sligo Creek downstream of the Wheaton Branch confluence (WB4). The distribution of these sites is illustrated in Figure 1.

Gear Selection

Because Wheaton Branch is a wadable stream with a cobble/gravel substrate and the desire of involved agencies to have this study be compatible with other Anacostia Basin programs, the surber sampler was chosen to be the primary sampling gear for riffle habitat. As a secondary method to provide variable information, a D-frame dipnet was also used for sampling pools and shorezone habitat. Each gear type has a standard no. 30 mesh net.

Surber Sampler

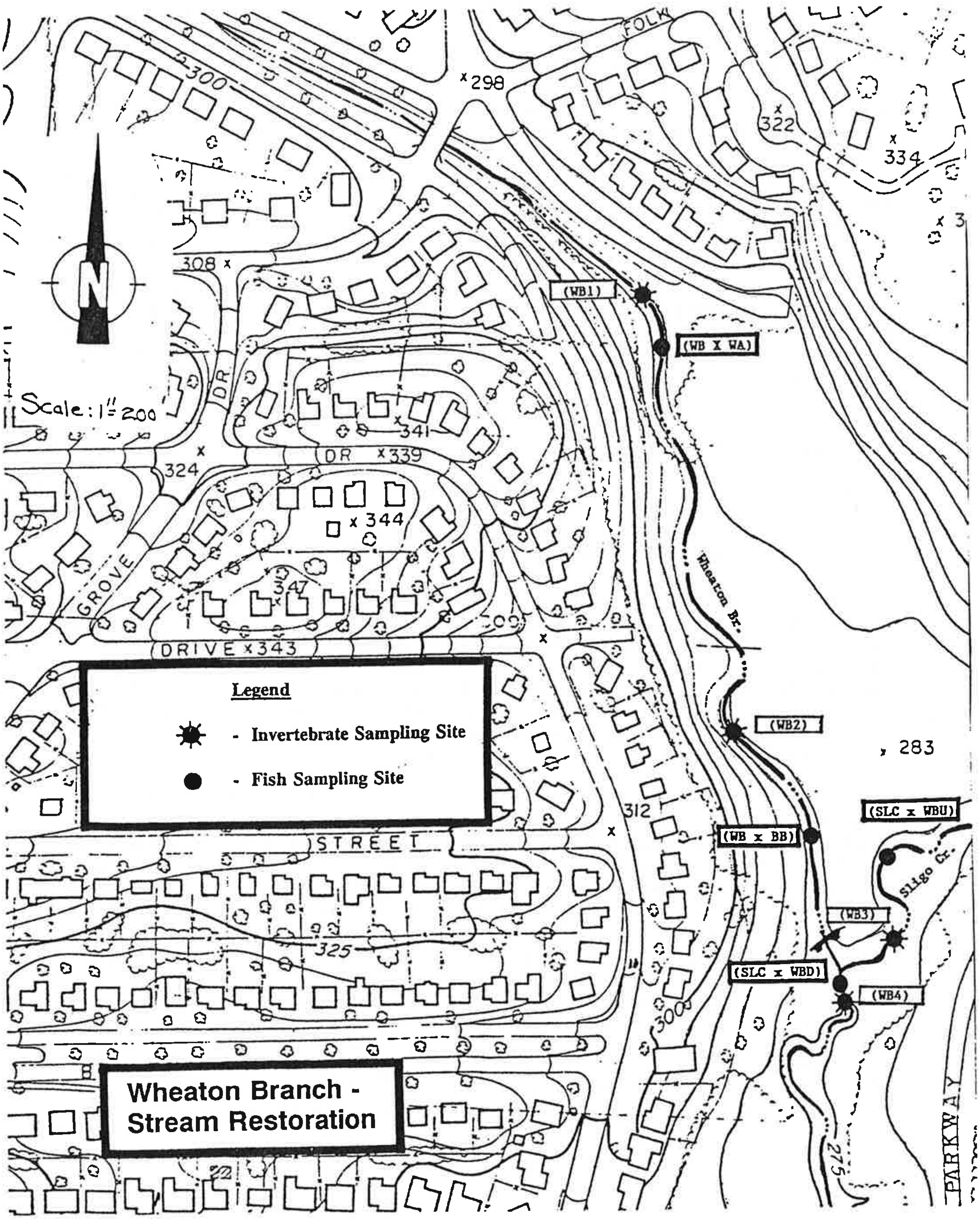
This sampling device is designed to sample one square foot of benthos, usually in riffle zones. Substrate is disturbed by use of a garden trowel to turn the surface particles (cobble, gravel) and approximately five cm of underlying soil. Large particles (such as small boulders and cobble) are washed by hand to loosen attached organisms. The entire sample is washed into a white porcelain sorting tray and picked in the field. Specimens are handled with fine field forceps and placed into 4-6 dram, prelabelled vials containing approximately 70 percent ethanol.

D-frame Net

The longhandled D-frame net is used as a more qualitative method to provide information on species composition not likely to be evident with surber samples alone. Its primary use is for sampling pools. In this habitat, the bottom substrate is disturbed by foot and the net is swept through the resulting cloudy water. It is also used for sampling roots handing into the water by raking through them. Following this, the sample is field processed as described above for the surbers.

Labels for surber samples are written, for example, for Site 1 as WB1S1, WB1S2, WB1S3 with the terminal numbers representing the first, second, and third surbers. Included on each label is the date of collection. Labels for the D-frame samples are written as WB1N. Labels are altered accordingly for sites WB2, WB3, and WB4.

Figure 1: Benthic and Fish Sampling Stations on Wheaton Branch and Sligo Creek.



Sampling Effort

At each site, three quantitative surbers and a single qualitative D-frame sampler were taken. Sampling occurred at the four sites on each of five sampling dates (3/26/90, 5/14/90, 7/28/90, 11/3/90, and 4/6/91) to represent stream conditions before, during, and after restoration activities; a total of 80 benthic samples were taken and make up the database for this analysis and the baseline for future studies of the Wheaton Branch benthic biota.

On the initial sampling date, two surbers and two qualitative D-frames were taken at each site. Low numbers of organisms were collected this visit. Considering this and the potential need for conducting additional statistical operations on these data, three surber samples were taken at all subsequent visits.

Taxonomy

Samples are returned to the laboratory for identification using compound dissecting microscopes. Specimens are identified to the lowest possible taxonomic level using primarily Merritt and Cummins (1984) supplemented with Burch (1982), Edmunds et al. (1972), Johannsen (1934-35), and Wiggins (1977). In most cases, Oligochaeta and Chironomidae are identified no further.

Data Analysis and Interpretation

Analysis for this project is based on tabulation and calculation of selected assemblage parameters. These parameters can be considered analogous to those presented by Plafkin et al. (1989) for rapid bioassessment protocols (RBPs). However, scoring criteria are not developed as is accomplished in the RBP method since the goal of this project is not a bioassessment decision but rather trend monitoring for benthic community responses to restoration activities.

The four parameters used include: number of individuals, number of taxa, EPT index, and percent composition of dominant taxon. Number of individuals is the total number of benthic organisms taken throughout the sampling period and may be totalled by sampling sites or by seasons. Number of taxa is the total number of distinguishable taxa within a sample or combination of samples. If some individuals are not identified to more specific taxonomic levels and others within that broader grouping are, likely determination is made whether the two or more groups are the same (genus or species). If those identified less-specifically are not the same, they are counted as a separate taxon; conversely, if they are likely the same, they are counted as individuals of the same taxon. A higher number of taxa is considered to indicate better biological condition.

The EPT index is the total number of distinguishable taxa within the relatively pollution-sensitive benthic taxa Ephemeroptera, Plecoptera, and Trichoptera. Higher numbers of these taxa are considered indicative of better conditions. In eastern North America very high abundance levels of certain EPT taxa (e.g., Baetis [Ephemeroptera: Baetidae] and Hydropsyche [Trichoptera: Hydropsychidae]) are often indicative of organic enrichment in aquatic situations. The fourth parameter, percent composition of dominant taxon, is designed to take this into account. It detects a situation where a single taxon is the most numerically dominant within a sample or sample composite. It is calculated for a sample as the number of individuals in taxon A divided by the total number of individuals of all taxa combined. Higher percentages for this parameter are considered symptomatic of decreased biotic quality.

Trophic categories are based on the functional feeding group concept (Cummins 1973, 1974) developed to indicate the general feeding strategy of stream organisms. Predators are those which feed on other animals; collector gatherers are species which actively forage for detrital particles; filter collectors, utilizing either modified morphological features or constructed nets, strain organic material from the flowing water for use as food; shredders feed primarily on leaf litter, usually following some conditioning by fungal and microbial decay activity; and scrapers, using specifically-adapted mouthparts, feed on fungal, bacterial, or algal mats growing on the surfaces of submerged objects such as leaves, woody materials, or rocks.

Comparisons for this study are of two types: temporal and spatial. Spatial comparisons may take two forms. First, assemblage parameters can be compared among sites within each sampling event (e.g., no. of individuals at WB1 in March compared to no. of individuals at WB2 in March, etc.). Second, site data may be composited from the five sampling events and the sites compared. The latter approach is being taken for this report in order to provide an integration of multiple season data.

Temporal comparisons involve description of the data within each site over the 12-month sampling period. For example, a certain assemblage value or parameter (such as 'number of individuals') is examined for each composite 3-surber sample; this value is then tracked for trends. Although it is difficult to detect trends with a single year of sampling, it may be possible to recognize seasonal optima for sampling efforts, to develop hypotheses related to population peak periods, and to build on this information for a long-term biomonitoring program.

RESULTS

The taxonomic list in Appendix A includes all specimens collected during this project. Analyses reveal a total of 40 taxa collected overall from all sites during the year. Taxa from surber samples and D-frame net samples are listed with tolerance values and trophic designations (Table 1; EA Engineering, Science, and Technology 1990). Tolerance values range from 4 to 9 on a scale of 10 with values toward the high end of the continuum indicating greater pollution tolerance. Trophic category or functional feeding group composition is as follows: predators 15, collector gatherers 11, filter collectors 5, shredders 3, and scrapers 2.

Taxa collected by surber are summarized in Table 2 with the composite number of individuals from each Station and total indicated. Table 3 shows parameter values for each Station calculated with overall data composite. Total number of individuals collected within Wheaton Branch (WB 1 and WB 2: 402 and 847, respectively) far outnumber those taken from the Sligo Creek sites (WB3 and WB4: 234 and 151, respectively). Wheaton Branch shows greater taxa richness than the Sligo Creek sites but there are only minor differences in the EPT counts. Midges (Diptera: Chironomidae, Tanypodinae, Conchapelopia, Acricotopus, and Diamesa) accounted for 32 percent of composited samples at WB1: the relatively pollution-tolerant caddisfly, Hydropsyche, was the most dominant taxon at the remaining three sites.

Calculation of the same parameters for each sampling date (Table 4) presents information for temporal comparisons. For Stations WB1, WB2, and WB3, highest numbers of individuals were collected during July and November (Figure 2). The largest change is in the November WB2 sample and is due to the dramatic increase in density of Hydropsyche. This parameter is relatively consistent for the May, July, and November samples from WB4. The number of taxa increased somewhat for all Stations during July (Figure 3), though it is probably not a significant increase.

The EPT index is variable in these data. As indicated by the taxonomic list, a total of five EPT taxa (Baetis, Hydropsyche, H. morosa species group, Cheumatopsyche [Trichoptera: Hydropsyche], and Hydroptila [Trichoptera: Hydroptilidae]) were collected overall; no Station had more than four of these taxa in any single sample (Figure 4). Of these five taxa, four are caddisflies, and three of these are considered relatively pollution-tolerant; the fifth, the mayfly, Baetis, is also considered relatively tolerant. The third EPT taxon, Plecoptera, or stoneflies, were never collected. Percent composition of dominant taxon (Figure 5) showed two different density peaks. At all Stations in the May sample, Chironomidae was the dominant taxon; in July, Hydropsyche had for the most part become dominant; by November, the density of the latter had increased for all Stations to 67, 92, 93, and 81 percent, respectively. These dominance levels dropped somewhat by the April samples.

TABLE 1

Tolerance values and trophic designations of benthic macroinvertebrate taxa collected in Wheaton Branch.

TOLERANCE VALUE		TROPHIC DESIGNATION
Tricladida (planarians)	6	predator
Hirudinea (leeches)	8	predator
Oligochaeta (earthworms)	9	collector gatherer
Gastropoda (snails)		
Physella heterostropha	7	collector gatherer
Ferrissia	7	scraper
Pseudosuccinea	6	collector gatherer
Planorbidae	6	scraper
Pelecypoda (clams, mussels)		
Pisidium	8	filter collector
Crustacea		
Amphipoda (amphipods)		
Gammarus	6	collector gatherer
Crangonyx	5	collector gatherer
Gammaridae	5	collector gatherer
Decapoda (crayfish)		
Astacidae	6	shredder
Isopoda (sowbugs)		
Asellus	8	collector gatherer
Acarina (water mites)		
Hydracarina	6	predator
Collembola (springtails)		
Entomobryidae*	-	-
Heteroptera (true bugs)		
Microvelia*	-	predator
Corixidae*	-	predator
Palmacorixa*	-	predator
Saldidae*	-	predator
Gerridae*	-	predator
Gerris*	-	predator
Trepobates*	-	predator

TABLE 1 (Cont.)

TOLERANCE VALUE		TROPHIC DESIGNATION
Odonata (damselflies)		
Argia	6	predator
Ishnura	9	predator
Calopteryx	6	predator
Ephemeroptera (mayflies)		
Baetis	5	collector gatherer
Coleoptera (beetles)		
Lampyridae*,@	-	predators
Trichoptera (caddisflies)		
Hydropsyche	4.5	filter collector
Hydropsyche morosa sp. group	4	filter collector
Cheumatopsyche	5.5	filter collector
Hydroptila	6	scraper
Lepidoptera (moths)		
Nepticula	5	shredder
Diptera (flies)		
Simulium	6	filter collector
Tipula	4	shredder
Allognosta	-	collector gatherer
Chironomidae	-	-
Tanypodinae	7	predator
Conchapelopia	6	predator
Acricotopus	5	collector gatherer
Diamesa	4	collector gatherer

* Non-benthic taxon, surface dweller or incidentally collected

@ Larvae of many species known to be inhabitants of riparian zones very near the edge of the water on wet but non-submerged soils; often predatory on riparian gastropods

TABLE 2

Summary of macroinvertebrates collected by surber at each of the two Wheaton Branch and two Sligo Creek stations under study. Each number represents the number of individuals pooled from 13 surbers taken over a one-year period.

	Station			
	Wheaton Branch		Sligo Creek	
TAXON	WB1	WB2	WB3	WB4
Hirudinea (leeches)	31	8	1	2
Oligochaeta (earthworms)	59	121	18	27
Gastropoda (snails)				
Gastropoda	1	0	0	0
Physella heterostropha	27	23	5	3
Pseudosuccinea	0	1	0	0
Crustacea				
Amphipoda (amphipods)				
Crangonyx	1	0	1	2
Gammaridae	0	1	1	0
Decapoda (crayfish)				
Astacidae	1	1	1	0
Isopoda (sowbugs)				
Asellus	0	3	0	0
Acarina				
Hydracarina (water mites)	0	3	0	0
Ephemeroptera (mayflies)				
Baetis	10	17	11	2
Trichoptera (caddisflies)				
Hydropsyche	96	554	163	49
Hydropsyche morosa sp. group	20	2	0	0
Cheumatopsyche	0	1	1	1
Hydroptila	1	2	0	0
Lepidoptera (moths)				
Nepticula	0	0	0	1
Diptera (flies; midges)				
Simuliidae	23	14	1	1
Tipula	2	5	0	0
Allognosta	1	0	0	0
Chironomidae	118	79	28	62
Tanypodinae	10	12	0	0

Table 2 (Cont.)

TAXON	Station: Wheaton Branch WB1	WB2	Sligo Creek WB3	WB4
Conchapelopia	1	0	0	0
Acricotopus	0	0	2	1
Diamesa	0	0	1	0
Total No. Individuals	402	847	234	151

TABLE 3

Tabulated assemblage parameters based on composited surber data representing the five sampling events. Each number is of a data composite from 14 individual surber samples. Under percent composition 'C' stands for Chironomidae and 'H' for Hydropsyche.

	Wheaton Branch		Sligo Creek	
	WB1	WB2	WB3	WB4
no. individuals	402	847	234	151
no. taxa	15	17	12	11
EPT*	4	4	3	2
percent composition dominant taxon (%)	32 (C)	65 (H)	70 (H)	32 (H)

*EPT = Total number of taxa of Ephemeroptera, Plecoptera, and Trichoptera

TABLE 4

Tabulated assemblage parameters based on surber samples at each of the four stations separated by date. Each number under 3/26 represents a data composite of 2 surbers; each for the remaining 4 events represents a 3 surber composite.

	1990-1991				
	3/26	5/14	7/28	11/03	4/06
A. Station: WB1					
no. individuals	44	41	136	105	76
no. taxa	2	5	10	6	6
EPT	0	0	4	1	1
percent composition dominant taxon	70 (C)*	54 (C)	23 (L)	67 (H)	32**

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	3/26	5/14	7/28	11/03	4/06
B. Station: WB2					
no. individuals	56	87	134	483	87
no. taxa	7	6	9	7	4
EPT	1	0	3	2	2
percent composition dominant taxon	45 (C)	51 (C)	59 (H)	92 (H)	64 (O)

****

	3/26	5/14	7/28	11/03	4/06
C. Station: WB3					
no. individuals	9	32	53	106	34
no. taxa	4	3	6	5	4
EPT	1	0	2	2	1
percent composition dominant taxon	56 (H)	66 (C)	64 (H)	93 (H)	74 (H)

****

	3/26	5/14	7/28	11/03	4/06
D. Station: WB4					
no. individuals	8	49	45	31	18
no. taxa	2	4	8	5	4
EPT	0	0	2	2	1
percent composition dominant taxon	63 (O)	80 (C)	42 (H)	81 (H)	39 (O)

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* C = Chironomidae (midges), L = Hirudinea (leeches), H = Hydropsyche (caddisflies), and O = Oligochaeta (earthworms)
** both oligochaetes and chironomids numbered 23 in this sample

Figure 2. Seasonal variation in number of individuals collected at benthic stations from March 1990 to April 1991.

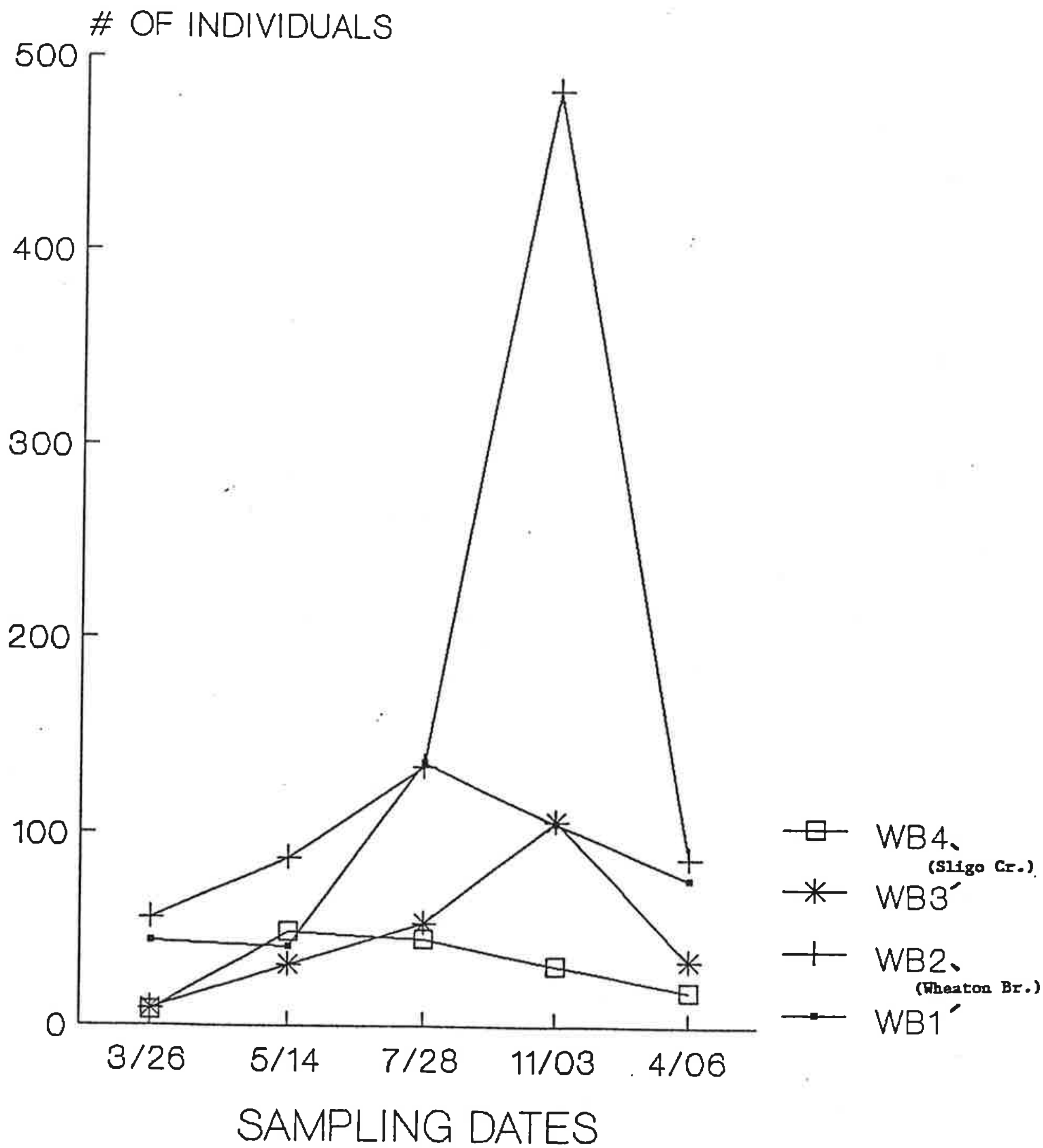


Figure 3. Seasonal variation in number of taxa collected at benthic stations from March 1990 to April 1991.

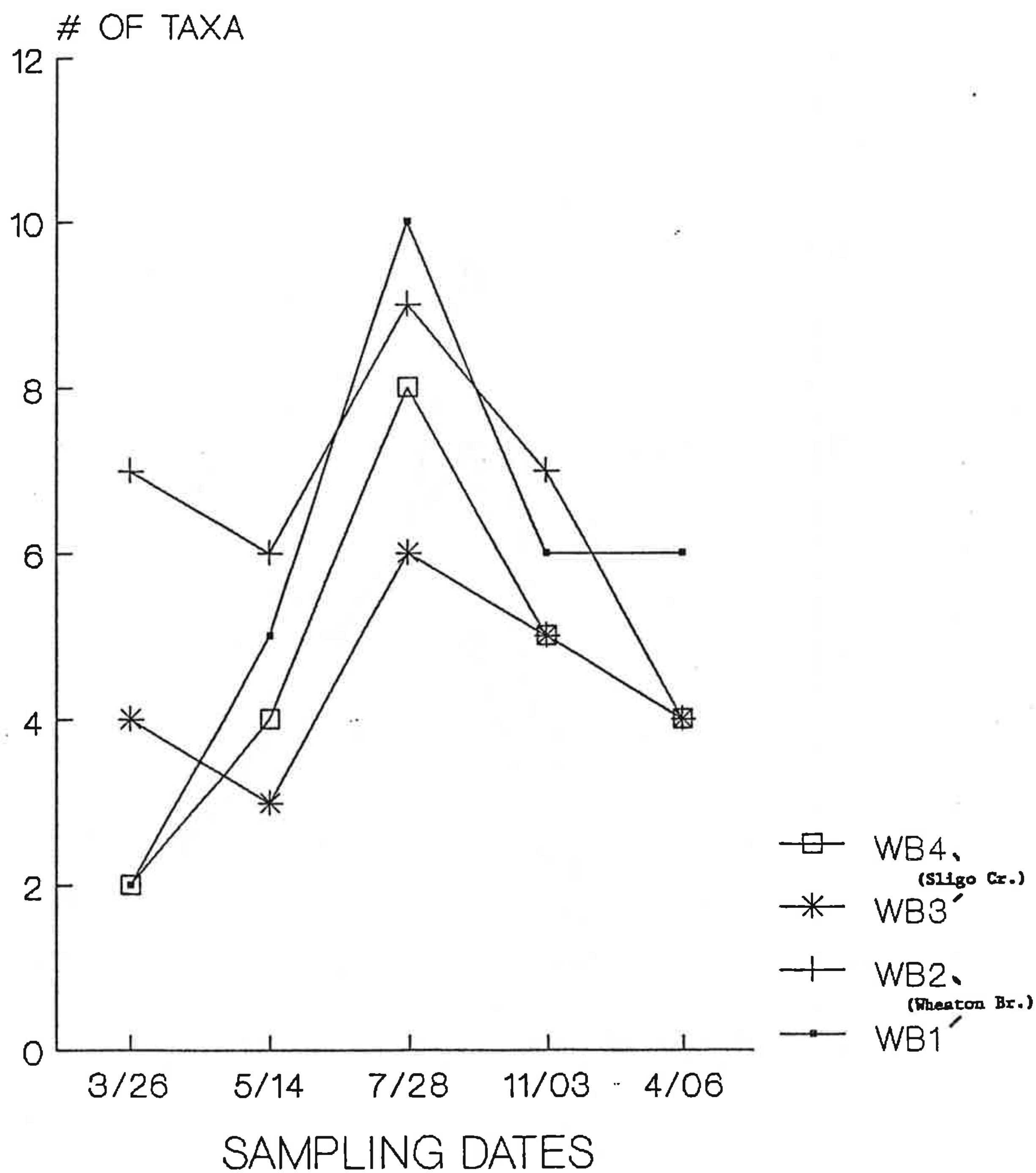


Figure 4. Seasonal variation in number of EPT taxa collected at benthic stations from March 1990 to April 1991.

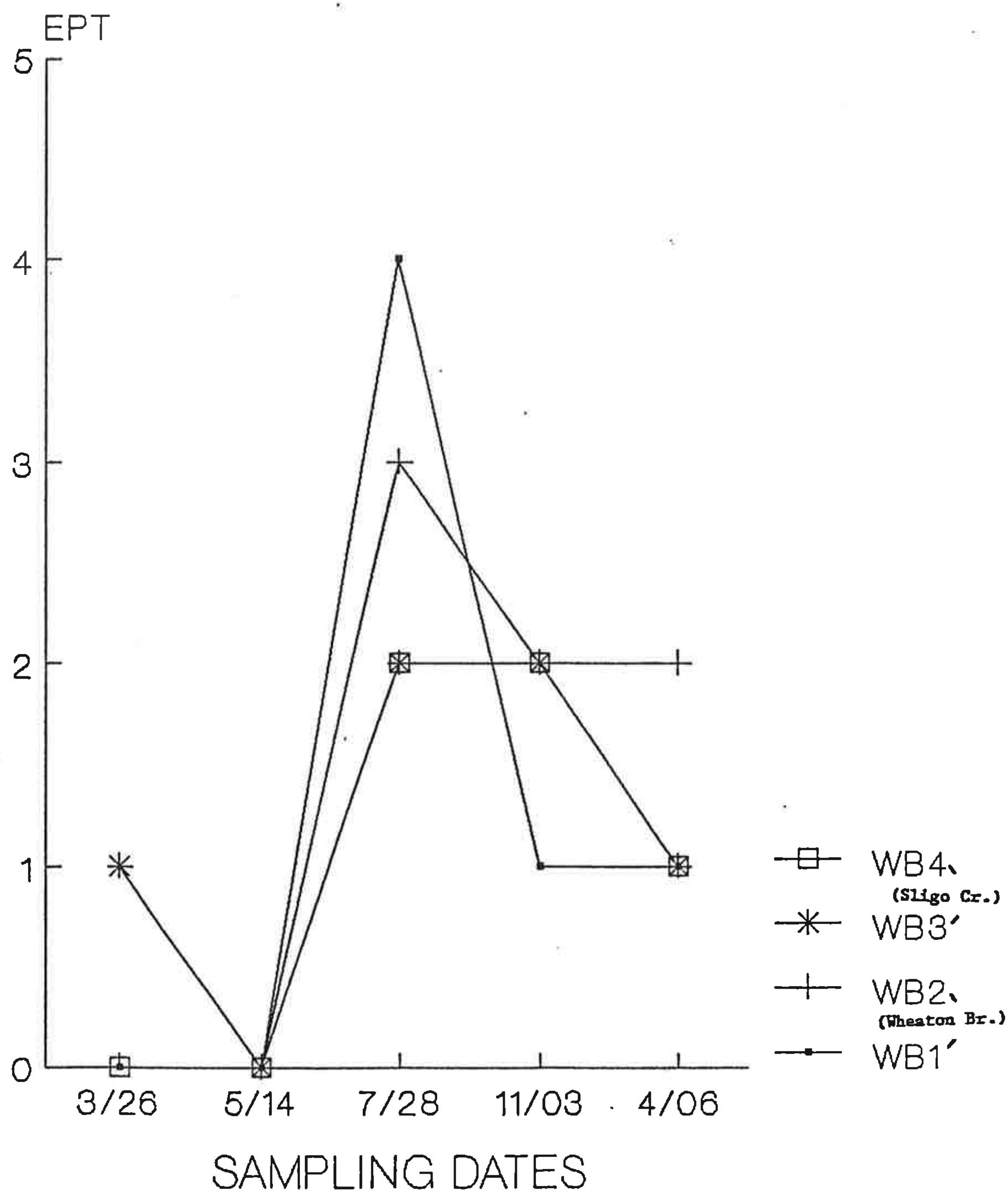
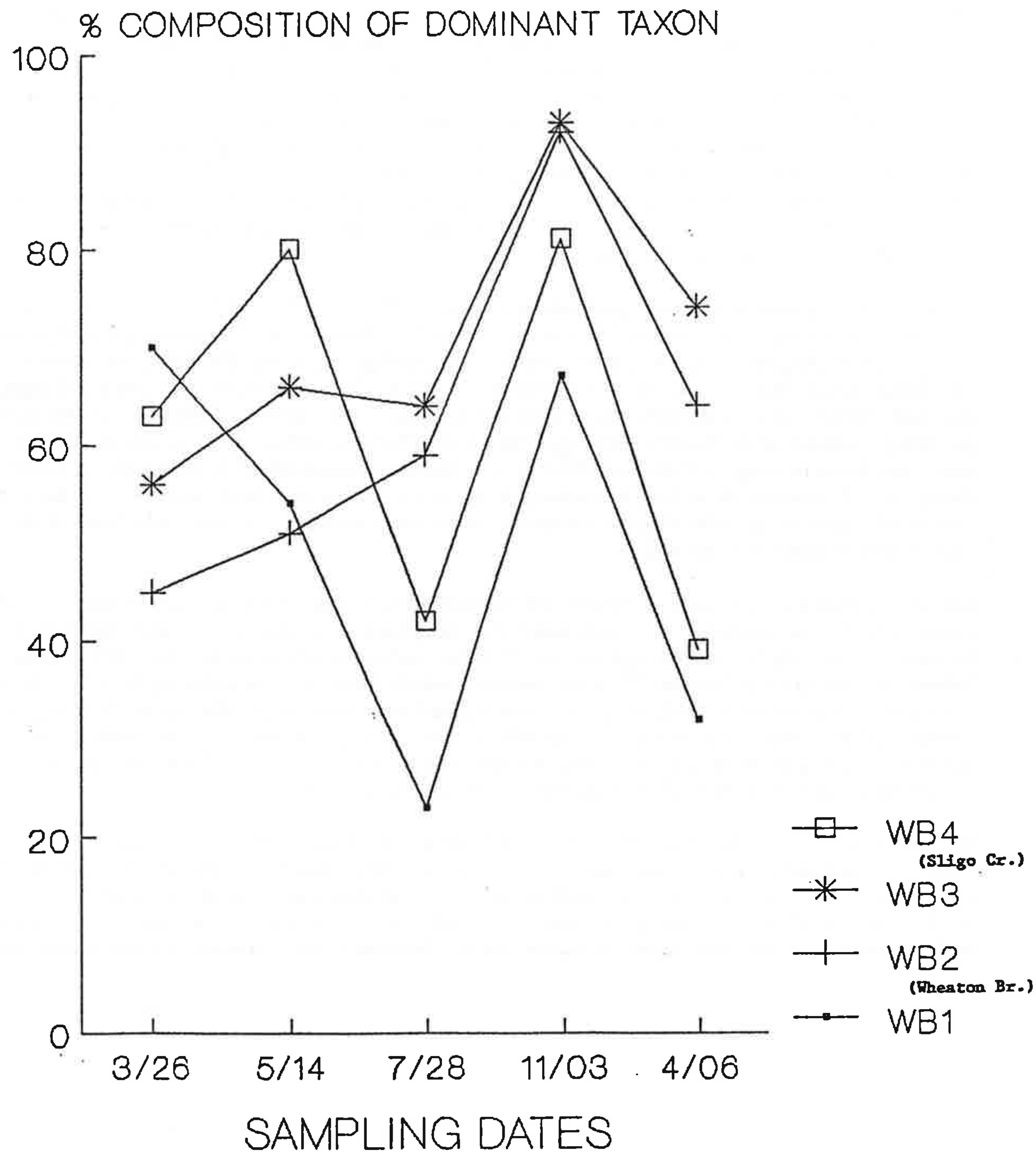


Figure 5. Seasonal variation in percent composition of dominant taxon from samples collected at benthic stations from March 1990 to April 1991.



DISCUSSION

Previous studies have indicated that although apparently adequate habitat for benthic community development exists in Sligo Creek, some other environmental variable may be causing biotic impairment (Stribling et al. 1989; Stribling and Thaler 1990). Results of this Wheaton Branch study appear to corroborate those data.

However, the intention of this project is for documentation of the biotic condition of the benthic macroinvertebrate community and to establish a baseline for future biomonitoring of Wheaton Branch. Even though the benthic samples appeared to indicate better conditions in Wheaton Branch than in Sligo Creek, in every sample composite from each sampling date (Table 4), the dominant taxon was one of three: either Annelida (usually, aquatic earthworms [Oligochaeta]; once, leeches [Hirudinea]), midges (Chironomidae), or caddisflies (Hydropsyche). These taxa contain species which are some of the most tolerant to environmental perturbation. Others are very responsive to organic enrichment; some of the dramatic population increases could potentially be due to a recently discovered sewer leak upstream of Woodman Avenue. This leak was not discovered until early May 1991 (J. Galli, pers. comm.). If this leak has been in existence throughout several years or even many months, many of these dominant taxa could have been heavily influenced.

High benthic population densities (particularly evident at WB2) easily provide a ready source of food for the predators which were obvious in the D-frame samples (such as firefly larvae [Lampyridae], broad shouldered water striders [Microvelia], water boatmen [Corixidae and Palmacorixa], shore bugs [Saldidae], and water striders [Gerris and Trepobates]). However, predators captured in the surber samples (the damselflies Argia and Ishnura) indicate that there could exist a dynamically stable food source in the benthic habitat. Differences in the interpretation of predatory species is related to differential agility between bottom and surface-dwelling species. Benthic species have much less ability to emigrate from the habitat in their immature stages (adults of these taxa are not normally taken during benthic surveys) when there is a reduction in resource availability. Surface-dwellers do have that ability to broaden foraging zones either through movement on the water surface or through flight (most of the surface taxa collected by D-frame were adults).

Seasonality should be a prominent variable in consideration of design for a biomonitoring program in this area. If sampling had to be restricted to a single season for budgetary or staffing reasons, data collected for this survey indicate Fall to likely be the most appropriate. Highest numbers of individuals and taxa were collected in Fall and Winter samples for most Stations. These seasons are when the immature stages of many benthic macroinvertebrates are attaining their maximum body size prior to pupation and adult emergence in the Spring. This suggests that future sampling efforts should have their greater intensity in these seasons. However, an optimal design should include at least one sampling event from each season. A single season, nor a single year, of data provides information which can characterize natural variability in any waterbody with any certainty.

Results reported here indicate that Wheaton Branch can support a healthy benthic community. With the restoration activities completed and the resulting baseflow maintenance and frequency reduction of channel-scouring stormflows, there should be an improvement in the condition of the benthic community. There is little evidence that the channel work around which this monitoring was designed directly affected the condition of the benthic community. Even in the current condition, food resources should not be a limiting factor if "natural" fish species are reintroduced.

PART 2: FISH

Fishery evaluations were performed with three primary goals; 1) to establish baseline, pre-restoration characterization of the fish community in Wheaton Branch, 2) to use this information as a basis for prescribing remediation measures and 3) to help track changes in fish assemblages following restoration activites. To this end, this study uses elements of the U.S. Environmental Protection Agencies (EPA's) newly developed Rapid Bioassessment Protocol (RBP) (Plafkin et al., 1989) and incorporates findings of recent bioassessment/biomonitoring efforts in other sections of the Anacostia Watershed (Cummins 1988, Cummins 1991).

Site Selection:

The four study sites were similar 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. Please refer to Figure 1, found in Part I, for an overview of the location of each site fish sampling site.

Materials and Methods:

Fish sampling followed the procedures discussed by Plafkin et al. (1989) and as described and modified by Cummins (1989 and 1991, respectively). Fish sampling occurred on two dates; 6/14/90 and 7/26/90. Sampling was conducted by first setting a block seine of 1/4" mesh across the downstream boundary of the sampling site, then fifty meters directly upstream a second block seine was set across the upstream boundary, thus impounding the fish in that section of the stream during sampling. Three backpack electrofishing passes were then made in the sampling area moving in an upstream direction. The duration of electrofishing time on an individual pass was approximately ten minutes. Stunned fish collected from each proceeding pass were individually identified, counted, measured, kept separated from the other collections and then released at the end of sampling. Fish population estimates were based upon three pass depletion models (Zippin, 1956).

Fisheries habitat assessments also followed the approach developed by Plafkin et al. (1989). The condition of each site under study was rated as a function of its capacity to support a healthy biological community. Appendix B contains the descriptions of the nine habitat parameters used for this survey.

Data Analysis:

Biological data analysis incorporated eight metrics to arrive at an Index of Biological Integrity (**IBI**) as modified from Plafkin et al. (1989) by Cummins, 1991. Individual IBI metric scores used criteria based on 1.) expectations of "optimal conditions", and 2.) comparability with an appropriate regional reference site which could be considered the "best obtainable conditions". "Optimal" metric values are scored as 5, while metric values 3, 1, and 0 respectively represent conditions approximating, deviating slightly below, or deviating greatly below the regional reference site values. Therefore, scoring is meant to establish a hierarchy with the best conditioned streams receiving the highest scores. Figure #6 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 #7.			
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[1].	≥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 #6: IBI metrics and scoring criteria.

The following descriptions of these IBI metrics are principally taken from Plafkin et al. (1989) as modified by Cummins, 1991;

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 should reflect watershed area at each site. Figure #7 (from Cummins, 1991) compares the number of species captured at fifteen Anacostia watershed sites sampled in 1990 (in squares) 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. The watershed areas above the Wheaton Branch and Sligo Creek sampling stations of this study are roughly 1.6 mi^2 and 1.9 mi^2, respectively. The Wheaton Branch and Sligo Creek sites sampled in this study are indicated by triangles.

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

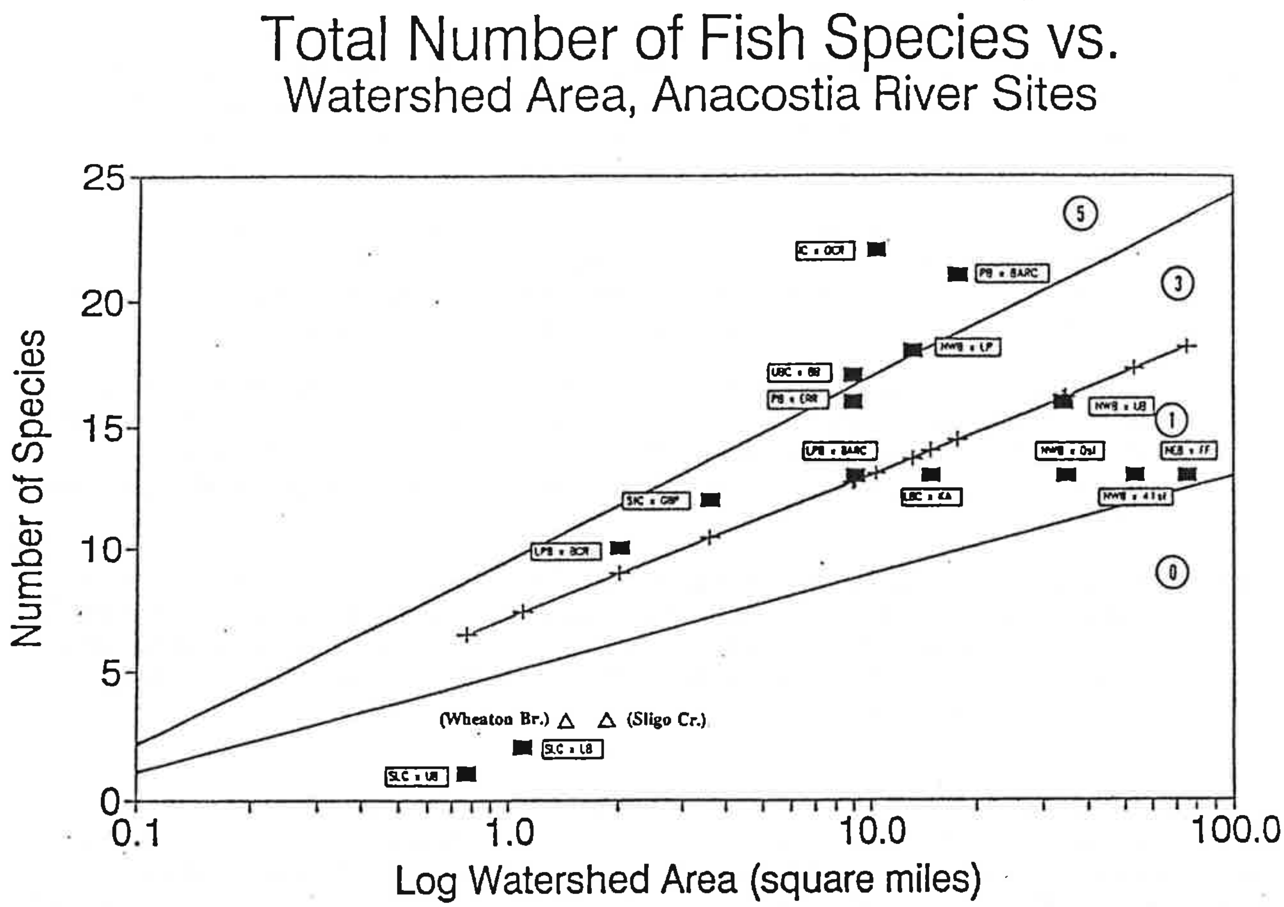


Figure #7: Total number of fish species versus watershed area for the Anacostia River (Cummins 1991).

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 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 C.

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 C.

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 an IBI reference site score. Therefore, the biological condition for each site was expressed as a percent of this reference-site condition. The reference site chosen for this study is the Northwest Branch, Anacostia River, near Montgomery County's Layhill Park[2].

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

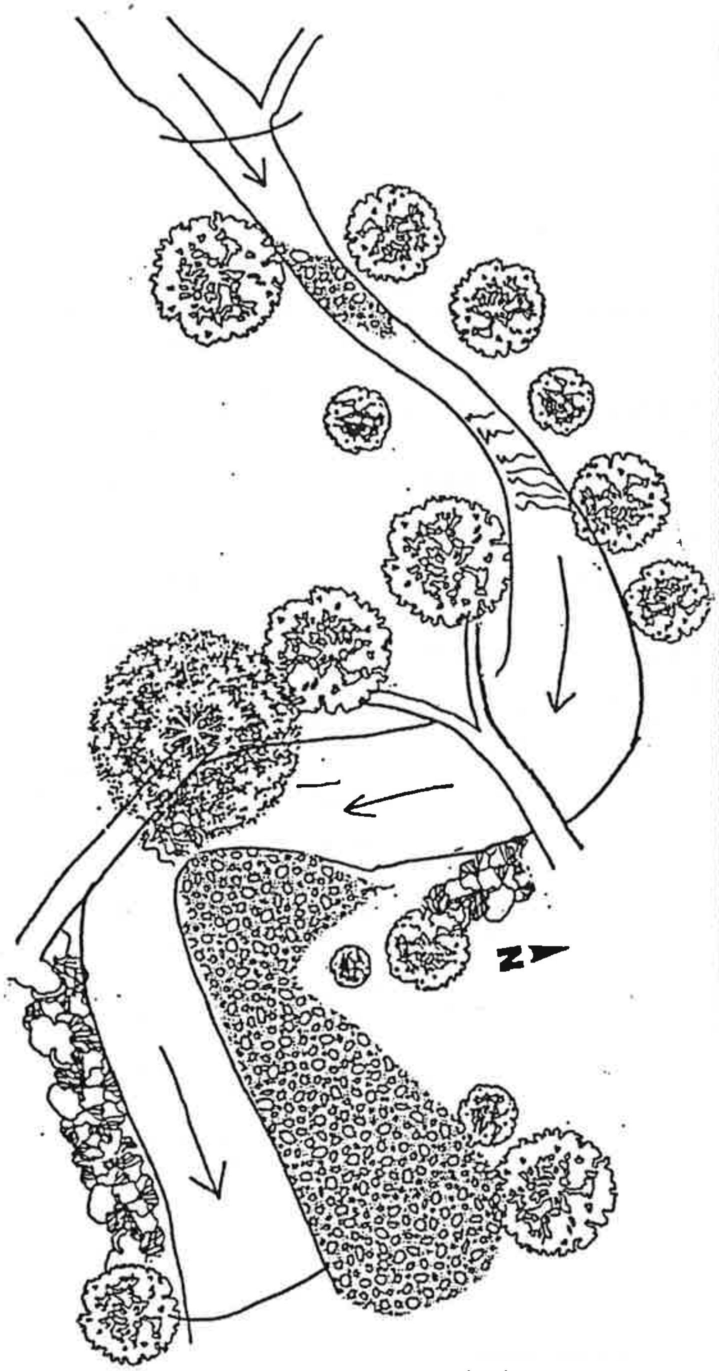
RESULTS

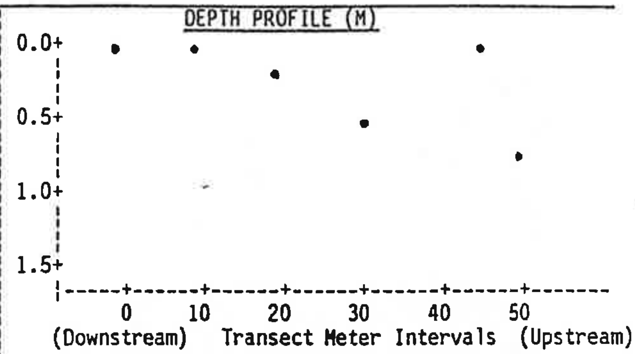
The following pages provide a synopsis of the data collected during the survey. Overhead views of each site, transcribed from field sketches made during sampling, are accompanied by habitat assessment scores, depth profiles, lists of species and numbers of individuals captured at each sampling date, estimates and notes on site characteristics. Only three species of fish, Blacknose Dace (Rhynichthys atratulus), northern creek chub (Semotilus atromaculatus), and goldfish (Carassius auratus) were captured. Habitat conditions were found to be poor in Wheaton Branch but Sligo Creek sites habitat conditions were scored slightly better than the reference site.

[2] This reference site has been previously used as a reference site for small piedmont streams in the Anacostia watershed (Cummins 1991). Appendix D provides a list of the fish collected in the Northwest Branch during 1990.

SITE:#1 Wheaton Branch and Woodman Avenue (WB x WA)

Site Location: downstream of Woodman Avenue, immediately below where stream enters current park area.





TEMPS: Spring 17 c Summer 25 c

GRADE: ________ SINUOSITY: ________

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	Fair	6	10-30% rubble or gravel, Habitat less than desirable
Embedded-ness	Poor	2	Gravel, cobble, and boulder >75% surrounded fine sediment
Velocity/ Depth	Fair	7	2 of 4 habitat categories pres. missing riffles/runs = low score
Channel Alteration	Poor	2	Heavy deps. of fine mat., increased bar devel. pools w/silt
Scouring/ Deposition	Fair	4	30-50% affected, deps. and scour at bends, some filling of pools
Pool/Riffle Run/Bend	good	9	Adequate depth in pools, riffles Bends provide habitat
Bank Stability	Poor	2	Unstable, many eroded areas, side slopes >60% & raw areas common
Bank Veg. Stability	Fair	5	25-49% of the strm. bank covered by veg., gravel, or lger. mat.
Streamside Cover	Good	8	Dominant vegetation is of tree form
	Total Score	43	

(6/14/90)

Species captured	# of individuals	pop. est.	std error
Blacknose Dace	92	109.4	9.8
Northern Creek Chub	24	32.7	9.9

(9 Northern Creek Chub had fin erosions)

(7/26/90)

Species captured	# of individuals	pop. est.	std. error
Blacknose Dace	90	97.9	5.4
Northern Creek Chub	34	41.9	5.3

stream surface area- 207.75 square meters (.021 h)

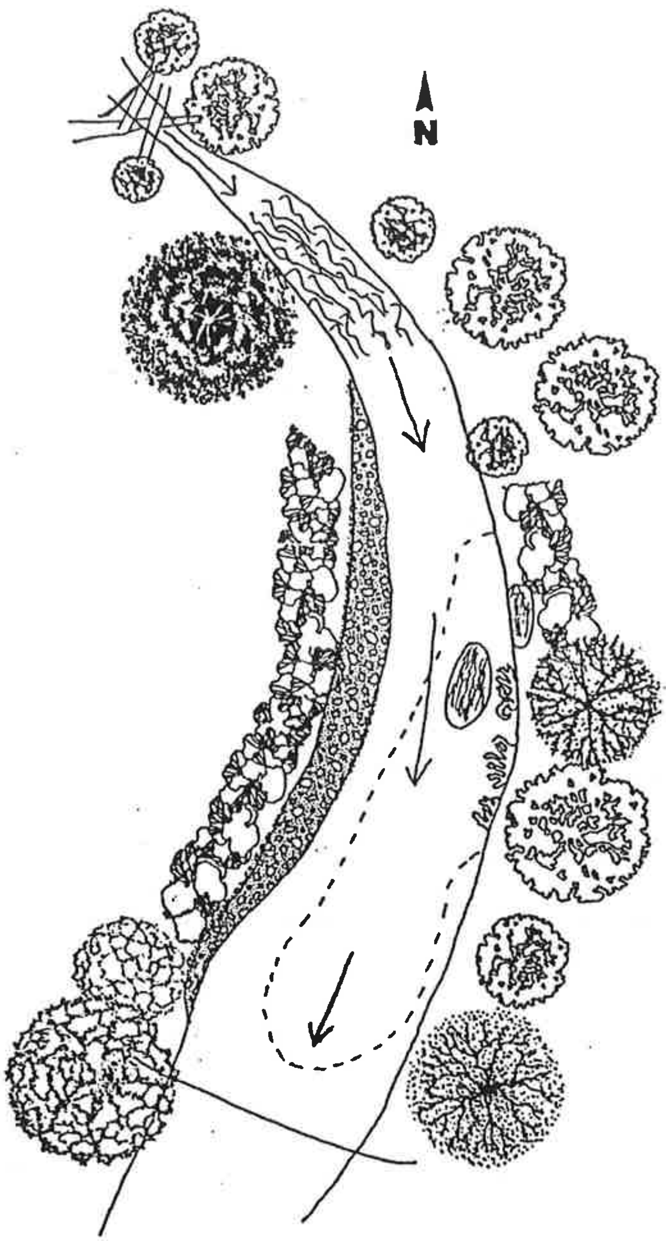
= 4936 Blacknose Dace per hectare

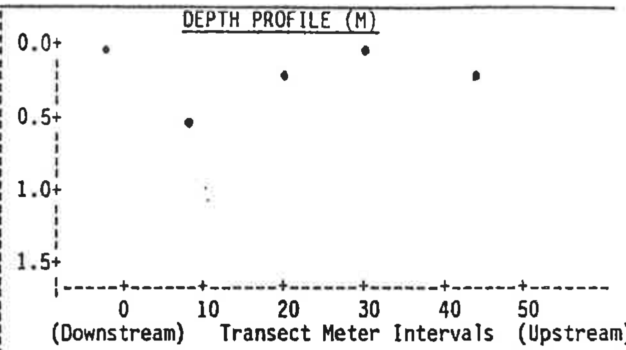
= 1381 Northern Creek Chub per hectare

Riffle:pool ratio- 1:5.7

SITE:#2 Wheaton Branch and Belvedere Boulevard (WB X BB)

Site location: downstream of Belvedere Boulevard. The downstream edge of the transect was approximately 25 meters upstream from the park footbridge.





TEMPS: Spring 18 c Summer 22 c

GRADE: ________ SINUOSITY: ________

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	Fair	9	10-30% rubble or gravel habitat less than desirable
Embedded-ness	Poor	2	Gravel, cobble, and boulder >75% surrounded by fine sediment
Velocity/ Depth	Fair	8	2 of 4 hab. categories present missing riffles/runs = low score
Channel Alteration	Fair	4	Mod dep. of new gravel, pools w/ silt, embankments on both sides
Scouring/ Deposition	Fair	7	30-50% affected, deps. & scour at bends, some filling of pools
Pool/Riffle Run/Bend	Fair	6	Occasional riffle or bend, Bott-om contours provide some habitat
Bank Stability	Poor	1	Unstable, many eroded areas side slopes >60% & raw areas common
Bank Veg. Stability	Fair	4	25-49% of the streambank covered by veg., gravel, or lger. mat.
Streamside Cover	Good	8	Dominant vegetation is of tree form

Total Score 49

Species captured	# of individuals	(6/14/90) pop. est./std error	
Blacknose Dace	59	65.8	5.0
Northern Creek Chub	34	34.9	1.3
Goldfish	2	N/A	N/A

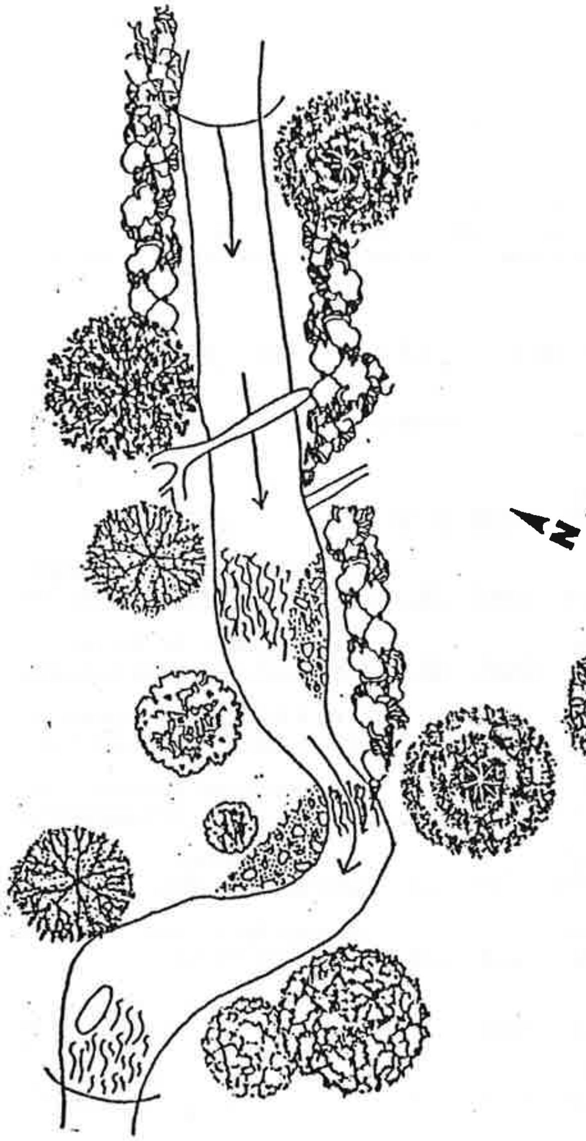
(5 Northern Creek Chub had fin erosions, 2 had skin lesions, and 1 had skin lesions and fin erosions)

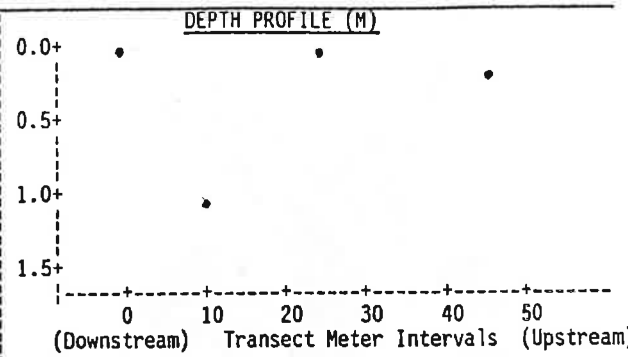
Species captured	# of individuals	(7/26/90) pop. est./std. error	
Blacknose Dace	152	166.2	6.7
Northern Creek Chub	22	35.1	17.4

stream surface area- 277.0 square meters (.028 h)
= 4143 Blacknose Dace per hectare
= 1250 Northern Creek Chub per hectare

Riffle:pool ratio- 1:9.6

SITE:#3 Sligo Creek and Wheaton Branch (upstream) (SLC x WBU)
Site location: Sligo Creek, 90 meters upstream from the confluence of Wheaton Branch.





TEMPS: Spring 15 c Summer 23 c

GRADE: ________ SINUOSITY: ________

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	excel	16	>50% rubble, gravel, submerged logs, undercut banks or other hab
Embeddedness	excel	18	Gravel, cobble & boulder are between 0-25% covered by fine sed.
Velocity/ Depth	Fair	10	2 of 4 hab. categories present missing riffles/runs = low score
Channel Alteration	Good	11	Some new increase in bar form. coarse gravel, some channelizat.
Scouring/ Deposition	Good	10	5-30% affected, scour at constrictions, some dep. in pools
Pool/Riffle Run/Bend	Good	8	Adequate depth in pools & riffle Bends provide habitat
Bank Stability	Good	7	Mod. stable, small areas of erosion, 1 side slope up to 40%
Bank Veg. Stability	Good	7	50-79% of the streambank covered by veg., gravel or lger. mat.
Streamside Cover	Good	6	Dominant vegetation is of tree form

Total Score 93

(6/14/90)

Species captured	# of individuals	pop. est./std error	
Blacknose Dace	130	146.7	7.9
Northern Creek Chub	44	73.7	15

(2 Northern Creek Chub were covered with Saprolenia sp. ("Ick") and 1 had tumors)

(7/26/90)

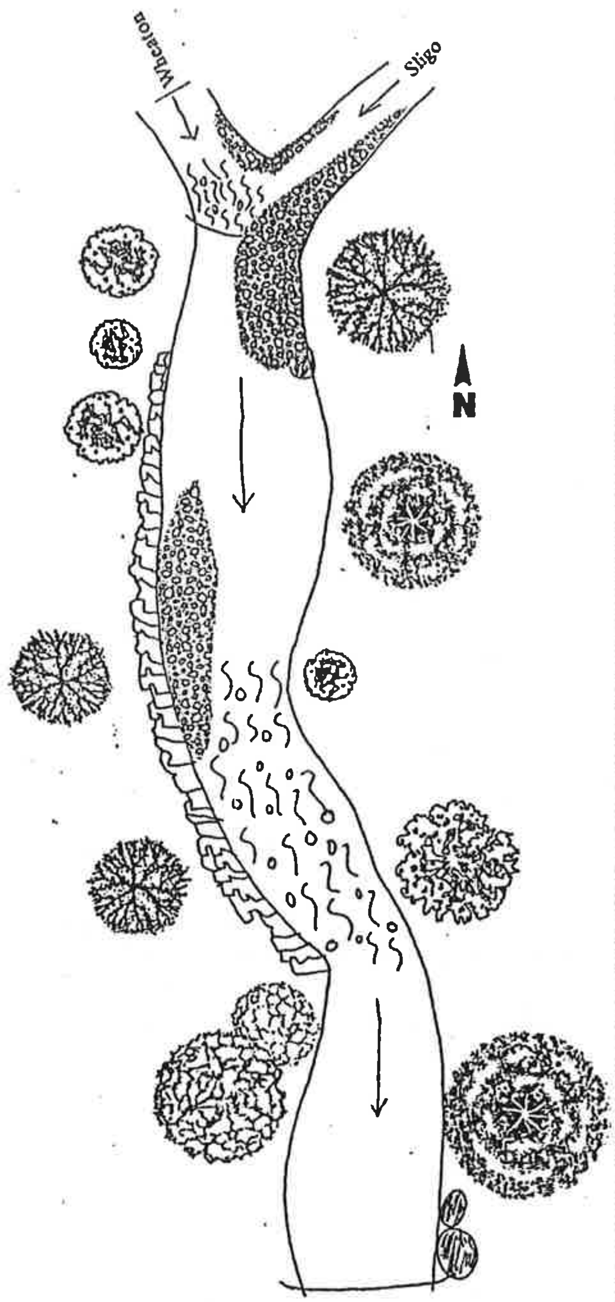
Species captured	# of individuals	pop. est./std. error	
Blacknose Dace	55	78.7	18.4
Northern Creek Chub	24		

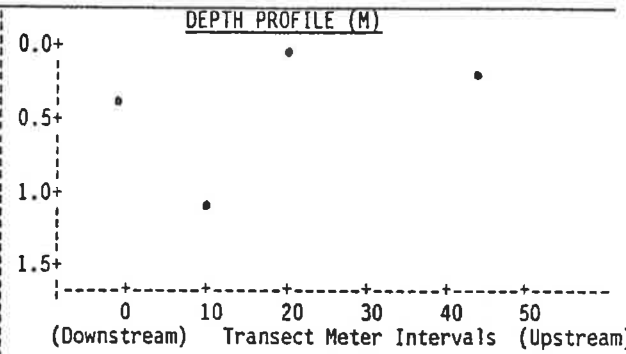
stream surface area- 181.05 square meters (.018 h)
= 6261 Blacknose per hectare
= 4093 Northern Creek Chub per hectare

Riffle:pool ratio- 1:4.1

SITE: #4 Sligo Creek and Wheaton Branch (downstream) (SLC x WBD)

Site location: Sligo Creek, immediately downstream from it's confluence with Wheaton Branch.





TEMPS: Spring 14.5 c Summer 21 c

GRADE: ________ SINUOSITY: ________

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	Excel	16	>50% rubble, gravel, submerged logs, undercut banks & other hab
Embedded-ness	Excel	18	Gravel, cobble, boulder are between 0-25% coveref by fine sed.
Velocity/ Depth	Fair	10	2 of 4 hab categories present missing riffles/runs = low score
Channel Alteration	Good	10	Some new increase in bar form. coarse gravel & some channeliz.
Scouring/ Deposition	Excel	12	>5% of the bottom affected by scouring and deposition
Pool/Riffle Run/Bend	Good	10	Adequate depth in pools & riffle Bends provide habitat
Bank Stability	Good	7	Mod. stable, small areas of erosion, 1 side slope up to 40%
Bank Veg. Stability	Good	8	50-79% of the streambank covered by veg., gravel, or lger. mat.
Streamside Cover	Good	6	Dominant vegetation is of tree form
	Total Score	97	

(6/14/90)

Species captured	# of individuals	pop. est./std error	
Blacknose Dace	306	344.0	12.1
Northern Creek Chub	36	41.5	5.0

(4 Northern Creek Chub had fin erosions and 2 had skin lesions)

(7/26/90)

Species captured	# of individuals	pop. est./std. error	
Blacknose Dace	118	130.7	6.7
Northern Creek Chub	12	12.6	1.1

stream surface area 203.75 square meters (.024 h)

= 9890 Blacknose Dace per hectare

= 1127 Northern Creek Chub per hectare

Total IBI and Habitat Assessment scores, along with the percent of reference for each site, are shown below in Table 5.

Table 5.

IBI and Habitat Assessment Scores for Wheaton Branch Project

Site	IBI SCORES	IBI % of Reference	Habitat Scores	Habitat % of Reference
1. Wheaton Br. at Woodman Ave	0	.00	43	.49
2. Wheaton Br. at Belvedere Blvd.	0	.00	49	.56
3. Sligo Cr. above Wheaton Br.	0	.00	93	1.06
4. Sligo Cr. below Wheaton Br.	0	.00	97	1.10
13. NW Branch at Layhill Park (R)	27	1.00	88	1.00

(R) = Reference Site

Fish species compositions in the study area were also compared to fish species compositions at other small-stream sites in the piedmont/coastal-floodplain transition area of the Anacostia basin. Table 6, found on the following page, compares proportions of individuals represented by each fish species collected at Wheaton Branch and these four sites. Table 6 is arranged such that the least disturbed sites are on the right with increasing degradation as one reads the table from right to left. The general trend in this comparison follows basic ecological tenants; i.e., that the least disturbed sites have greater numbers of species and the numbers of individuals representing these species are more evenly distributed. Also, in disturbed sites, pollution tolerant species[3] occupy a larger proportion of the community, both in terms of numbers of species and numbers of individuals. For example, the Northwest Branch site had 21 species with one pollution intolerant species, the rosyside dace (Clinostomus funduloides), representing 30% of the individuals captured. Conversely, Wheaton Branch had only three species, all highly pollution tolerant, with one species, the blacknose dace, having 77% of all individuals captured. Another indication of environmental stress was that 11% (20 of 182) of the northern creek chubs collected had either fin erosions, skin lesions, external fungal infections or combinations of these external symptoms. These symptoms are associated with environmental degradations such as chronic, sublethal exposure to contaminants, low dissolved oxygen, or high levels of suspended solids (Wedemeyer, G. A. et al., 1990).

[3]Assignments of pollution tolerances can be found in Appendix C.

TABLE 6: % IND./SITE IN SMALL ANACOSTIA PIEDMONT STREAMS

(Wheaton Branch Fish Transplant Stockings)

Site / Species	1990 Wheaton Branch	1990 Little Paint Branch x BARC (Site #6)	1988 Little Paint Br. x Briggs Chaney Road (Site #12)	1990 Little Paint Br. x Briggs Chaney (Site #7)	1988 Northwest Branch x Norwood Rd. (Site #23)	Stocking Potential
	>---------->----------More-or-Less Progressively Cleaner	--------------->	--------------------------------->			
1. Blacknose Dace	.77	.40	.37	.34	.11	*N/A
2. N. Creek Chub	.23	<.01	.01	.19	.03	N/A
3. Goldfish	<.01					N/A
4. Swallowtail Shiner		.17	.12		.04	3
5. Cutlips Minnow		.11	.07	.04	.02	3
6. Satinfin Shiner		.10	.10		.01	3
7. Longnose Dace		.07	.02		.01	1
8. White Sucker			.04	.08	.02	1
9. American Eel		.03	<.01	.01	<.01	**N.N.
10. Tessellated Darter		<.01	<.01		.04	1
11. Bluntnose Minnow					.05	1
12. Silverjaw Minnow					.09	1
13. Common Shiner			.03		.17	2
14. Rosyside Dace		<.01	.10	.30	.30	2
15. Golden Shiner		<.01				
16. Spottailed Shiner			.08		.07	
17. Eastern Silvery Minnow			<.01			
18. River Club				<.01		
19. Yellow Bullhead		<.01				
20. Brown Bullhead			<.01		<.01	
21. Bluegill Sunfish		<.01	.01	<.01	<.01	
22. Redbreast Sunfish		.10	<.01		<.01	
23. Eastern Mudminnows				<.01		
24. Margined Madtom			<.01		<.01	
25. N. Hog Sucker					.02	
26. Fallfish			.01	.02	<.01	
27. Fantailed Darter					<.01	
28. American Brook Lamprey			<.01			
TOTAL SPECIES	3	13	19	10	21	(14)

* N/A = Not Applicable (already present)

** N.N.= Not Necessary: The American eel is not limited by small stream blockages.

1 = 1st recommended stocking (Spring 1992)

2 = 2nd recommended stocking (Spring 1993: Scenario 1)

3 = 3rd recommended stocking (Spring 1994: Scenario 1, 1993: Scenario 2)

CONCLUSIONS AND RECOMMENDATIONS

The "0" values for IBI scores at all four sites and the community population comparisons found in Table 5 reflect the depauperate condition of fish communities in the study area. Chronic problems with water quality and loss of habitat have eliminated all but the hardiest of fish species in Wheaton Branch. In addition, downstream barriers to fish migration in Sligo Creek prevent natural re-establishment of fish populations back into it's headwater streams such as Wheaton Branch (Cummins 1991).

That is the bad news, but there is good news. Improvements in the physical-habitat/structural-complexity of Wheaton Branch were completed in April of 1991. Water quality benefits and improved stability in flow regime are expected due to a recently completed stormwater retrofit facility upstream from the study area. In addition, the availability of food, as described in the benthic macroinvertibrate analysis of this report, does not appear to be a limiting factor for fish in Wheaton Branch. Based upon these factors, Wheaton Branch should support a greater diversity of fish species. Unfortunately, downstream blockages to fish migration prevent the natural re-establishment of a more diverse fish community in Wheaton Branch. Therefore, we recommend experimental transplant stocking of selected fish species into Wheaton Branch.

To our knowledge, no one has attempted this type of urban stream fish reintroduction. Therefore, our approach will be experimental. Several meetings, or "brainstorming sessions", were held during the course of this study in order to develop a restocking strategy. Participants included Charlie Gougeon (Maryland Department of Natural Resources), Dan Harper (Montgomery County Department of Environmental Protection), Keith Van Ness (Maryland National Capitol Parks and Planning Commission), Jim Cummins (Interstate Commission on the Potomac River Basin), John Galli (Metropolitan Washington Council of Governments), and Sam Stribling (Environmental Associates). From these meetings several recommendations where developed to improve the success of such transplant stocking.

First, we recommend stocking only a select collection of fish species which are indigenous to small-streams and native to the area. Using our collective experience in the region and Table 6 as a reference, we selected the following ten species[4] as target introductions;

- Swallowtail Shiner (Notropis procne)
- Satinfin Shiner (Notropis analostanus)
- White Sucker (Catostomus commersoni)
- Bluntnose Minnow (Pimephales notatus)
- Common Shiner (Notropis cornutus)
- Cutlips Minnow (Exoglossum maxillinqua)
- Longnose Dace (Rhinichthys cataractae)
- Tessellated Darter (Etheostoma olmstedi)
- Silverjaw Minnow (Ericymba buccata)
- Rosyside Dace (Clinostomus funduloides)

Such species could all be collected and culled from other Anacostia streams, including the Northwest Branch, and then re-introduced into the Wheaton Branch study area. We do not recommend stocking of any sunfish species into the study area because of expected problems with sunfish predation on the establishing minnow populations and, from our experience, sunfish tend to be introduced all too rapidly by local anglers.

Second, stocking should be phased in order to permit less prolific species to establish themselves prior to the introduction of the prolific species, thereby reducing inter-species competition pressures. If the prolific species were introduced concurrently with the other species, they might prevent the successful recolonization of the less prolific species into Wheaton Branch. The targeted fish species and the three phases of stocking are represented in the far right column of Table 6.

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[4]See Attachment I: "Index and Field Identification Guide to the Fishes in the District of Columbia" for pictures and descriptions of these fishes.

The first phase of stocking should consist of moderately pollution-tolerant/moderately-prolific species such as the bluntnose and silverjaw minnows, white suckers, longnose dace and the tessellated darter (indicated by a #1, Table 6). If this stocking proved successful by the establishment of viable populations of these first-phase stocked species, two additional stocking scenarios could also be attempted as follows;

A.) In the first scenario, where the water quality of Wheaton Branch shows a marked improvement over pre-restoration conditions[4], a second-phase stocking of more pollution-intolerant/less-prolific species such as the common and rosyside shiners (indicated by a #2, Table 6) should be tried. If this stocking also proved successful, a third stocking consisting of cutlips minnows, swallowtail shiners and satinfin shiners should be performed. These are the moderately pollution-tolerant/prolific species (indicated by a #3, Table 6) which should be the last species stocked. If they were stocked in earlier events they would probably out-compete the developing populations of the non-prolific species.

B.) An alternative stocking scenario is recommended in the event that the first stocking is successful but the water quality of Wheaton Branch does not show an improvement from pre-restoration conditions. In this case, the pollution-intolerant species would not be stocked during the second phase of stocking. Instead, the moderately pollution-tolerant/prolific species would be stocked following the first-round stocking effort.

The preferred stocking time is early spring, when most species are in preparation for spawning. If these fish could subsequently spawn in Wheaton Branch it could increase the chances of establishing viable fish populations during the first year. Monitoring of each phase of stocking should occur both during the proceeding fall and prior to any subsequent stocking the following spring.

As previously stated, there is very limited information regarding restocking of non-game (forage-base) species into urban impacted streams. Therefore, we relied upon our best professional judgement coupled with the availability of the two general habitat types found in Wheaton Branch; pools and riffles, to develop stocking rates. We recommend stocking approximately 10-20 individuals of each species into each pool or riffle, depending on species habitat preference and size and depth of individual pools or riffles. We also strongly recommend that local volunteers be incorporated into the stocking program. Local involvement will help develop and build a sense of neighborhood stewardship, an element which is vital to insuring respect and concern for the integrity of the resource.

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[4]Key water quality conditions necessary for the selected pollution intolerant fishes; the rosyside dace and common shiner, include maintaining summer water temperatures below 25° C, and decreased sediment and organic loadings.

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APPENDIX A. Taxonomic list. Asterisk indicates non-benthic taxon.

Stn/rep	Date	Taxon	Total
WB1S1	3/26/90	Oligochaeta	3
WB1S1	3/26/90	Chironomidae (14L)	14
WB1S2	3/26/90	Oligochaeta	10
WB1S2	3/26/90	Chironomidae (17L)	17
WB1N1	3/26/90	Chironomidae (2L)	2
WB1N1	3/26/90	Conchapelopia (1P)	1
WB1N2	3/26/90	Oligochaeta	1
WB1N2	3/26/90	Chironomidae (3L)	3
WB2S1	3/26/90	Oligochaeta	10
WB2S1	3/26/90	Physella heterostropha	1
WB2S1	3/26/90	Pseudosuccinea	1
WB2S1	3/26/90	Hydropsyche (10L)	10
WB2S1	3/26/90	Chironomidae (6L)	6
WB2S1	3/26/90	Acricotopus (1P)	1
WB2S2	3/26/90	Oligochaeta	4
WB2S2	3/26/90	Entomobryidae*	2
WB2S2	3/26/90	Hydropsyche (1L)	1
WB2S2	3/26/90	Chironomidae (7L)	7
WB2S2	3/26/90	Conchapelopia (1P)	1
WB2N1	3/26/90	Crangonyx	1
WB2N1	3/26/90	Hydracarina	3
WB2N1	3/26/90	Chironomidae (4)	4
WB2N1	3/26/90	Conchapelopia (1P)	1
WB2N2	3/26/90	Chironomidae (2L)	2
WB2N2	3/26/90	Conchapelopia (1L)	1
WB3S1	3/26/90	Physella heterostropha	1
WB3S1	3/26/90	Crangonyx	1
WB3S1	3/26/90	Hydropsyche (4L)	4
WB3S2	3/26/90	Oligochaeta	2
WB3S2	3/26/90	Entomobryidae*	1
WB3S2	3/26/90	Hydropsyche (1L)	1
WB3N1	3/26/90	Oligochaeta	1
WB3N1	3/26/90	Physella heterostropha	1
WB3N1	3/26/90	Hydropsyche (1L)	1
WB3N2	3/26/90	Oligochaeta	1
WB4S1	3/26/90	Oligochaeta	2
WB4S1	3/26/90	Physella heterostropha	1
WB4S1	3/26/90	Chironomidae (1L)	1
WB4S2	3/26/90	Oligochaeta	2
WB4S2	3/26/90	Entomobryidae*	1
WB4S2	3/26/90	Chironomidae (2L)	2
WB4N1	3/26/90	Oligochaeta	2
WB4N1	3/26/90	Microvelia* (1N)	1
WB4N2	3/26/90	-	0
WB1S1	5/14/90	Oligochaeta	1
WB1S1	5/14/90	Physella heterostropha	5
WB1S1	5/14/90	Chironomidae (10L)	10
WB1S1	5/14/90	Simulium (1L)	1
WB1S2	5/14/90	Oligochaeta	2
WB1S2	5/14/90	Physella heterostropha	3
WB1S2	5/14/90	Chironomidae (4L)	4
WB1S2	5/14/90	Simulium (2)	2
WB1S2	5/14/90	Astacidae	1
WB1S3	5/14/90	Oligochaeta	3
WB1S3	5/14/90	Physella heterostropha	1
WB1S3	5/14/90	Chironomidae (8L)	8
WB1N1	5/14/90	Oligochaeta	2
WB1N1	5/14/90	Physella heterostropha	2

Stn/rep	Date	Taxon	Total
WB1N1	5/14/90	Chironomidae (3L)	3
WB2S1	5/14/90	Oligochaeta	4
WB2S1	5/14/90	Physella heterostropha	3
WB2S1	5/14/90	Chironomidae (8L)	8
WB2S1	5/14/90	Simulium (1L)	1
WB2S2	5/14/90	Oligochaeta	3
WB2S2	5/14/90	Physella heterostropha	9
WB2S2	5/14/90	Chironomidae (18L)	18
WB2S2	5/14/90	Guttipelopia (1P)	1
WB2S2	5/14/90	Simulium (3L)	3
WB2S2	5/14/90	Tipula (1L)	1
WB2S3	5/14/90	Oligochaeta	10
WB2S3	5/14/90	Physella heterostropha	5
WB2S3	5/14/90	Asellus	2
WB2S3	5/14/90	Astacidae	1
WB2S3	5/14/90	Chironomidae (15L, 2P)	17
WB2S3	5/14/90	Simulium (3L)	3
WB2N1	5/14/90	Oligochaeta	5
WB2N1	5/14/90	Physella heterostropha	1
WB2N1	5/14/90	Corixidae (1N)	1
WB2N1	5/14/90	Chironomidae (2L)	2
WB2N1	5/14/90	Guttipelopia (1P)	1
WB4S1	5/14/90	Oligochaeta	4
WB4S1	5/14/90	Physella heterostropha	1
WB4S1	5/14/90	Baetis (11N)	11
WB4S1	5/14/90	Chironomidae (6L)	6
WB4S2	5/14/90	Physella heterostropha	1
WB4S2	5/14/90	Chironomidae (5L)	5
WB4S2	5/14/90	Simulium (1L)	1
WB4S3	5/14/90	Oligochaeta	3
WB4S3	5/14/90	Baetis (2N)	2
WB4S3	5/14/90	Chironomidae (5L)	5
WB4N1	5/14/90	Baetis (4N)	4
WB4N1	5/14/90	Saldidae* (1N)	1
WB4N1	5/14/90	Chironomidae (4L)	4
WB3S1	5/14/90	Oligochaeta	3
WB3S1	5/14/90	Baetis (3N)	3
WB3S1	5/14/90	Chironomidae (10L)	10
WB3S2	5/14/90	Chironomidae (3L)	3
WB3S3	5/14/90	Oligochaeta	7
WB3S3	5/14/90	Physella heterostropha	1
WB3S3	5/14/90	Baetis (10N)	10
WB3S3	5/14/90	Gerridae* (1N)	1
WB3S3	5/14/90	Chironomidae (6L)	6
WB3N1	5/14/90	Oligochaeta	1
WB3N1	5/14/90	Physella heterostropha	16
WB3N1	5/14/90	Planorbidae (Gyraulus?)	1
WB3N1	5/14/90	Pisidium	1
WB3N1	5/14/90	Gammarus	1
WB3N1	5/14/90	Baetis (1N)	1
WB3N1	5/14/90	Chironomidae (1L,1P)	2
WB1S1	7/28/90	Oligochaeta	3
WB1S1	7/28/90	Trepobates* (1N)	1
WB1S1	7/28/90	Hydropsyche morosa sp. group (20L)	20
WB1S1	7/28/90	Hydroptila (1L)	1
WB1S1	7/28/90	Chironomidae (10L, 2P)	12
WB1S1	7/28/90	Simuliidae (17L)	17
WB1S3	7/28/90	Oligochaeta	6
WB1S3	7/28/90	Hirudinea	31
WB1S3	7/28/90	Physella heterostropha	9

WB1S3	7/28/90	Baetis (4N)	4
WB1S3	7/28/90	Hydropsyche (9L)	9
WB1S3	7/28/90	Chironomidae (4L, 2P)	3
WB1S3	7/28/90	Simuliidae (2L)	2
WB1S3	7/28/90	Tipula (1L)	1
WB1N	7/28/90	Hirudinea	1
WB1N	7/28/90	Ferrissia	1
WB1N	7/28/90	Physella heterostropha (26 empty)	53
WB1N	7/28/90	Oligochaeta	1
WB1N	7/28/90	Palmacorixa (1A)	1
WB1N	7/28/90	Hydroptila (1L)	1
WB1N	7/28/90	Chironomidae (3L)	3
WB1N	7/28/90	Simuliidae (1L)	1
WB2S1	7/28/90	Oligochaeta	3
WB2S1	7/28/90	Baetis (15N)	15
WB2S1	7/28/90	Hydropsyche (2L)	2
WB2S1	7/28/90	Chironomidae (5L)	5
WB2S1	7/28/90	Tipula (1L)	1
WB2S2	7/28/90	Oligochaeta	1
WB2S2	7/28/90	Hirudinea	7
WB2S2	7/28/90	Baetis (2N)	2
WB2S2	7/28/90	Hydroptila (1L)	1
WB2S2	7/28/90	Hydropsyche (43L, 2P)	45
WB2S2	7/28/90	Chironomidae (3L)	3
WB2S2	7/28/90	Simuliidae (3L)	3
WB2S3	7/28/90	Oligochaeta	6
WB2S3	7/28/90	Hirudinea	1
WB2S3	7/28/90	Physella (all empty shells)	5
WB2S3	7/28/90	Hydropsyche (32L)	32
WB2S3	7/28/90	Hydroptila (1L)	1
WB2S3	7/28/90	Chironomidae (3L)	3
WB2S3	7/28/90	Tipula (1L)	1
WB2N	7/28/90	Oligochaeta	3
WB2N	7/28/90	Chironomidae (8L)	8
WB3S1	7/28/90	Oligochaeta	1
WB3S1	7/28/90	Baetis (3N)	3
WB3S1	7/28/90	Hydropsyche (19L)	19
WB3S2	7/28/90	Oligochaeta	3
WB3S2	7/28/90	Hirudinea	1
WB3S2	7/28/90	Veliidae (1N)	1
WB3S2	7/28/90	Baetis (6N)	6
WB3S2	7/28/90	Hydropsyche (11L)	11
WB3S2	7/28/90	Chironomidae (1L)	1
WB3S2	7/28/90	Simuliidae (1L)	1
WB3S3	7/28/90	Oligochaeta	2
WB3S3	7/28/90	Baetis (2N)	2
WB3S3	7/28/90	Hydropsyche (4L)	4
WB3N	7/28/90	Chironomidae (2L)	2
WB4S1	7/28/90	Oligochaeta	4
WB4S1	7/28/90	Hirudinea	2
WB4S1	7/28/90	Crangonyx	1
WB4S1	7/28/90	Hydropsyche (14L, 2P)	16
WB4S1	7/28/90	Chironomidae (1L)	1
WB4S1	7/28/90	Nepticula (1L)	1
WB4S2	7/28/90	Oligochaeta	2
WB4S2	7/28/90	Physella heterostropha	1
WB4S2	7/28/90	Baetis (1N)	1
WB4S2	7/28/90	Hydropsyche (3L)	3
WB4S2	7/28/90	Chironomidae (2L)	2
WB4S3	7/28/90	Oligochaeta	1
WB4S3	7/28/90	Baetis (1N)	1
WB4S3	7/28/90	Chironomidae (6L, 3P)	9

Stn/rep	Date	Taxon	Total
WB4N	7/28/90	Tricladida	1
WB4N	7/28/90	Hirudinea	1
WB4N	7/28/90	Baetis (1N)	1
WB4N	7/28/90	Argia (1N)	1
WB4N	7/28/90	Hydropsyche (2L)	2
WB1S1	11/03/90	Oligochaeta	1
WB1S1	11/03/90	Hydropsyche (40L)	40
WB1S1	11/03/90	Chironomidae (9L)	9
WB1S1	11/03/90	Simuliidae (1L)	1
WB1S2	11/03/90	Oligochaeta	6
WB1S2	11/03/90	Hydropsyche (20L)	20
WB1S2	11/03/90	Chironomidae (15L)	15
WB1S2	11/03/90	Tipula (1L)	1
WB1S3	11/03/90	Oligochaeta	1
WB1S3	11/03/90	Hydropsyche (10L)	10
WB1N	11/03/90	Oligochaeta	1
WB1N	11/03/90	Ischnura ? (4N)	4
WB1N	11/03/90	Hydropsyche (6L)	6
WB1N	11/03/90	Chironomidae (13L)	13
WB1N	11/03/90	Tipula (1L)	1
WB2S1	11/03/90	Oligochaeta	12
WB2S1	11/03/90	Hydropsyche (36L)	36
WB2S1	11/03/90	Simuliidae (2L)	2
WB2S1	11/03/90	Chironomidae (1L)	1
WB2S2	11/03/90	Gastropoda	1
WB2S2	11/03/90	Hydropsyche morosa sp. group (2L)	2
WB2S2	11/03/90	Hydropsyche (312L)	312
WB2S2	11/03/90	Chironomidae (1L)	1
WB2S2	11/03/90	Simuliidae (1L)	1
WB2S2	11/03/90	Tipula (1L)	1
WB2S3	11/03/90	Oligochaeta	3
WB2S3	11/03/90	Asellus	3
WB2S3	11/03/90	Hydropsyche (98L)	98
WB2S3	11/03/90	Simuliidae (1L)	1
WB2S3	11/03/90	Tipula (1L)	1
WB2N	11/03/90	Oligochaeta	2
WB2N	11/03/90	Chironomidae (6L)	6
WB2N	11/03/90	Oligochaeta	4
WB3S1	11/03/90	Physella heterostropha	3
WB3S1	11/03/90	Cheumatopsyche (1L)	1
WB3S1	11/03/90	Hydropsyche (82L)	82
WB3S2	11/03/90	Oligochaeta	2
WB3S2	11/03/90	Hydropsyche (15L)	15
WB3S2	11/03/90	Chironomidae (2L)	2
WB3S3	11/03/90	Crangonyx	1
WB3S3	11/03/90	Hydropsyche (2L)	2
WB3N	11/03/90	Oligochaeta	3
WB4S1	11/03/90	Gerris (1A)	1
WB4S1	11/03/90	Hydropsyche (2L)	2
WB4S2	11/03/90	Cheumatopsyche (1L)	1
WB4S2	11/03/90	Hydropsyche (3L)	3
WB4S2	11/03/90	Chironomidae (2L)	2
WB4S3	11/03/90	Oligochaeta	1
WB4S3	11/03/90	Crangonyx	1
WB4S3	11/03/90	Hydropsyche (20L)	20
WB4S3	11/03/90	Chironomidae (1L)	1
WB4N	11/03/90	Oligochaeta	1
WB4N	11/03/90	Crangonyx	1

Stn/rep	Date	Taxon	Total
WB4N	11/03/90	Calopteryx (1N)	1
WB4N	11/03/90	Lampyridae* (1N)	1
WB4N	11/03/90	Chironomidae (2L)	2
WB1S1	04/06/91	Oligochaeta	4
WB1S1	04/06/91	Crangonyx	1
WB1S1	04/06/91	Hydropsyche (13L)	13
WB1S1	04/06/91	Chironomidae (7L)	7
WB1S1	04/06/91	Tanypodinae (8L)	8
WB1S1	04/06/91	Conchapelopia (1P)	1
WB1S1	04/06/91	Allognosta (1L)	1
WB1S2	04/06/91	Oligochaeta	17
WB1S2	04/06/91	Hydropsyche (2L)	2
WB1S2	04/06/91	Chironomidae (5L)	5
WB1S2	04/06/91	Tanypodinae (2L)	2
WB1S3	04/06/91	Oligochaeta	2
WB1S3	04/06/91	Hydropsyche (2L)	2
WB1S3	04/06/91	Chironomidae (11L)	11
WB1N	04/06/91	Oligochaeta	2
WB1N	04/06/91	Chironomidae (1L)	1
WB1N	04/06/91	Tanypodinae (5L)	5
WB2S1	04/06/91	Oligochaeta	25
WB2S1	04/06/91	Hydropsyche (4L,1P)	5
WB2S1	04/06/91	Cheumatopsyche (1L)	1
WB2S1	04/06/91	Matus* (3A)	3
WB2S2	04/06/91	Oligochaeta	20
WB2S2	04/06/91	Hydropsyche (12L)	12
WB2S2	04/06/91	Tanypodinae (4L)	4
WB2S3	04/06/91	Oligochaeta	11
WB2S3	04/06/91	Hydropsyche (1L)	1
WB2S3	04/06/91	Tanypodinae (8L)	8
WB2N	04/06/91	Tanypodinae (2L)	2
WB3S2	04/06/91	Oligochaeta	1
WB3S2	04/06/91	Astacidae	1
WB3S2	04/06/91	Hydropsyche (15L, 2P)	17
WB3S2	04/06/91	Chironomidae (1L, 1P)	2
WB3S2	04/06/91	Acricotopus (1P)	1
WB3S1	04/06/91	Hydropsyche (4L)	4
WB3S1	04/06/91	Acricotopus (1P)	1
WB3S1	04/06/91	Chironomidae (1L)	1
WB3S3	04/06/91	Diamesa (1P)	1
WB3S3	04/06/91	Hydropsyche (4L)	4
WB3S3	04/06/91	Chironomidae (1L)	1
WB3N	04/06/91	----	0
WB4S1	04/06/91	Oligochaeta	1
WB4S1	04/06/91	Hydropsyche (2L)	2
WB4S1	04/06/91	Chironomidae (1L)	1
WB4S2	04/06/91	Oligochaeta	2
WB4S2	04/06/91	Hydropsyche (2L)	2
WB4S2	04/06/91	Chironomidae (2L)	2
WB4S2	04/06/91	Acricotopus (1P)	1
WB4S3	04/06/91	Oligochaeta	4
WB4S3	04/06/91	Hydropsyche (1L)	1
WB4S3	04/06/91	Chironomidae (2L)	2
WB4N	04/06/91	Hydropsyche (1L)	1
WB4N	04/06/91	Chironomidae (1L)	1

Appendix B

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 for use with all Rapid Bioassessment Protocols.

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

Fish Species	Trophic level	Tolerance	Origin	Source[5]
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

[5] 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

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)

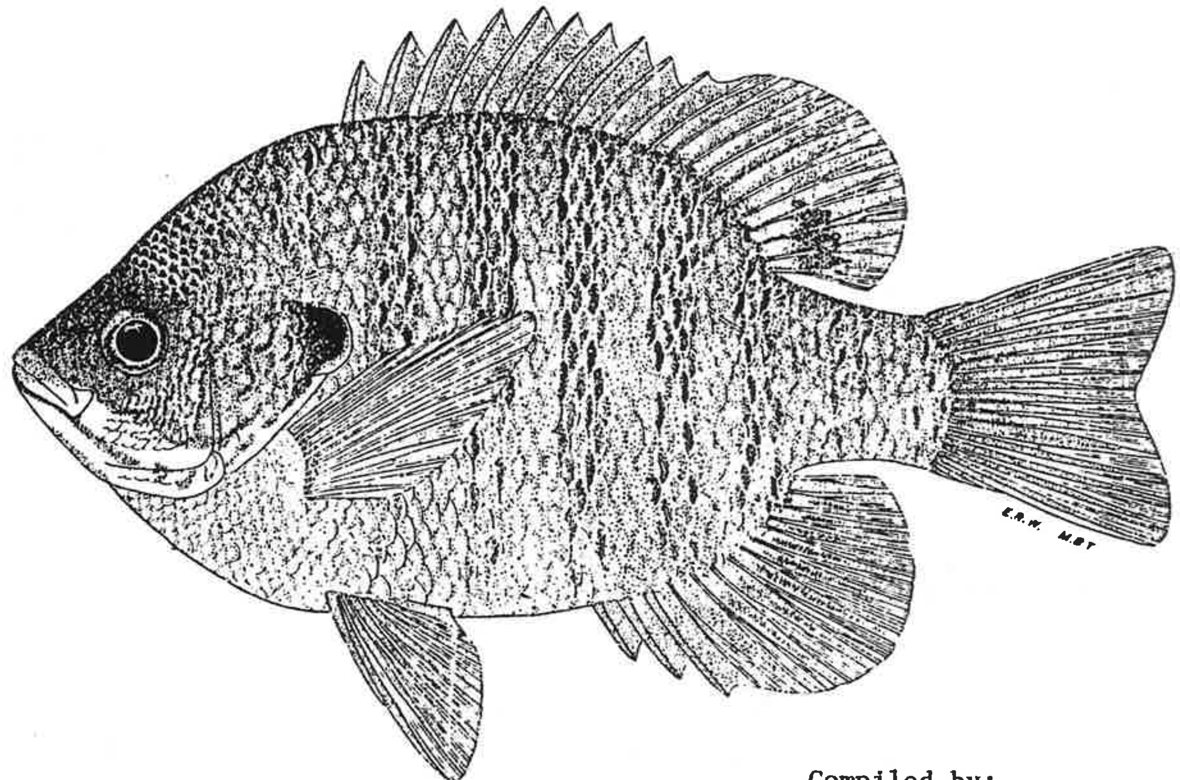
Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Bluegill Sunfish	44	56	50	0	0
Redbreast Sunfish	194	249	20	0	0

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

Index and Field Identification Guide to the Fishes of the District of Columbia



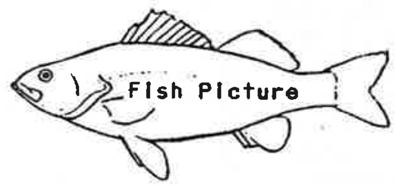
Compiled by:
James D. Cummins
Govt. of the District of Columbia
Dept. of Consumer & Regulatory Affairs
Environmental Control Division
Fisheries
October, 1987

FISHES OF THE DISTRICT OF COLUMBIA

Introduction and Use Guide for Fish Field Identification

This pamphlet is designed to serve as a field guide for fish researchers in the Washington, D.C. area. It has not been designed as a key, but is meant to serve as a summary text which consolidates information on local fish species from a variety of sources. The identification and life study notes are meant to be used as an abbreviated supplement and index of local fisheries information. Therefore, the descriptions are brief and some degree of prior knowledge of these fish by the reader is required. The following diagram illustrates the layout of the fish identification guide:

General description of group

Order	Family / Common Name of Group	Field Identification and Life Study Notes	
Common Name Scientific Name Translation of scientific name	Initials of Source of Pictures (see List below) — Average Adult Length, Maximum Length  Color and/or Special Notes — Abundance	ID: = Field IDentification highlights, Underlined and/or CAPITALIZED text indicates particularly significant characteristics which distinguish this species from similar species; H: = General preferred Habitat, life habits, etc; Sp: = Spawning notes, preferred temperatures, age at maturity, etc.;	Source Code (see List below)

List of References by Source Code:

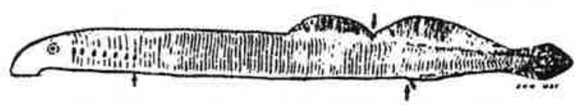
AFGF = The Audubon Society Field Guide to North American Fishes, Whales & Dolphins
FCB = Fishes of the Chesapeake Bay
FFC = Freshwater Fishes of Canada
FFNH = Freshwater Fishes of New Hampshire
FGM = Fishes of the Gulf of Maine
FOH = The Fishes of Ohio
FFV = The Freshwater Fishes of Virginia
HOD = Handbook of Darters
KFFM = Key to the Freshwater Fishes of Maryland
ANAF = Atlas of North American Freshwater Fishes
CFM = The Common Fishes of Maryland
FF = How to Know the Freshwater Fishes
FFCO = Freshwater Fishes of Connecticut
FGLR = Fishes of the Great Lakes Region
FOK = The Fishes of Kentucky
FOSE = Fishes of South Eastern U.S.
FWNA = Fishes of the Western North Atlantic
MFGF = McClane's Field Guide to Freshwater Fishes of North America

Due to its cost and availability, The Audubon Society Field Guide to North American Fishes, Whales & Dolphins (AFGF) will usually be the first reference cited in the source code. This field quality book contains references to most of the fishes in the District of Columbia. The number in parenthesis under the AFGF listing is the page which contains the picture of the species (an "x" in the parenthesis signifies that there is no picture). The second reference will be the Atlas of North American Freshwater Fishes (AFGF). This reference usually contains many up-to-date scientific nomenclatures, systematics, and species biology references. The other references listed for each species are publications used in preparation of field identification and life study notes. Please note that the source of each picture is indicated by it's reference code in the upper left-hand corner.

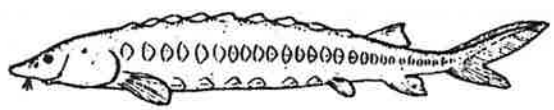
An attempt was made to arrange the fishes by systematic order. However, to simplify and/or clarify field identification, pages often were arranged to include fishes which are hard to tell apart because of thier similarities in appearances. Therefore, although fishes listed on the same page are often closely related, at times they are not systemically arranged.

INDEX OF FISHES

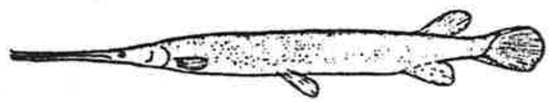
Jawless Fish:

O. Petromyzontiformes	F. Petromyzontidae Lampreys	Field Identification and Life Study Notes	
Least Brook Lamprey Lampetra aepyptera a= tall wings (D. fin)	FOH 10-15 cm. TL 18 cm. TL  dark tan no recent reports	ID: LACKS teeth; dorsal fin deeply notched; H: NON-parasitic, in clear creeks; over sand & gravel; SP: Mid-late March;	AFGF 327 (37) ANAF 21 FOH 160 FFV 45 FF 45
American Brook Lamprey Lampetra appendix L= to suck a stone a= that which hangs on	FF 10-22 cm. TL 30 cm. TL  dark tan no recent reports	ID: SINGLE row of posterior teeth; dorsal fin is deeply notched; H: NON-parasitic; over sand, debris, gravel; SP: In creeks and rivers;	AFGF 327 (x) ANAF 23 FFNH 12 FOH 164 FFV 45 FF 30
Sea Lamprey Petromyzon marinus P= stone sucker m= of the sea	FF 13-86 cm. TL 120 cm. TL  blotchy-brown no recent reports	ID: NUMEROUS 2 pronged circumeral teeth; tan above; blotched; In larvae, unpigmented area behind nostril is smaller than nostril; H: PARASITIC; anadromous; SP: Excavates nest; dies after spawning;	AFGF 328 (38) ANAF 35 FOH 157 FFNH 11 FFV 45 FF 27 FFC 69

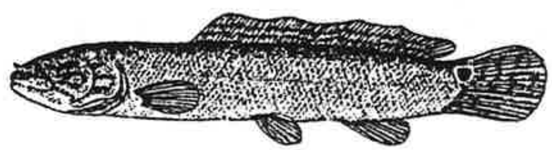
Fishes with bony plates on sides:

O. Acipenseriformes	F. Acipenseridae Sturgeons		
Shortnose Sturgeon Acipenser brevirostrum A= higly esteemed fish b= short-nosed	FF 40-90 cm. FL  no recent reports dark brown endangered	ID: Short snout; wide mouth; ABSENCE of postdorsal shields; pre-anal shields in SINGLE row; attains adult characteristics at about 2'; H: Tidal rivers; bottom feeder; slow grower, lives 40-60 yrs.; SP: Spring, at peak flows; eggs are dark brown; matures at 4-16 yrs (m=20", f=24");	ANAF 38 FWNA 37 FFV 48 FF 35 FFC 88
Atlantic Sturgeon Acipenser oxyrhynchus o= sharp snout	FF 130 cm. FL 210 cm. FL  no recent reports blue-black very rare	ID: Long snout; small mouth; PRESENCE of postdorsal shields; pre-anal shields in DOUBLE row; attains adult characteristics at about 4'; H: Anadromous, ascends tidal rivers; lives to 60 yrs.; SP: Spring, 56-64°F (13-18°C); deep water (11 m); eggs demersal, adhesive;	AFGF 365 (x) ANAF 41 FWNA 46 FCB 73 FFV 48 FF 34 FFC 92

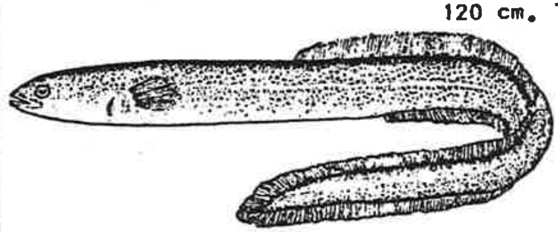
Fish with elongate jaw, needlelike teeth, ganoid scales:

O. Semionotiformes	F. Lepisosteidae — Gars	Field Identification & Life Study Notes	
Longnose Gar Lepisosteus osseus L= scales of bone o= bony	FF — 150 cm. TL 200 cm. TL  dark greenish-brown — common	ID: Body rounded; snout very long; teeth large; scales rhomboid, not overlapping; caudal fin short, rounded, heterocercal; H: Clear, low gradient waters; near vegetation; young in surface floating vegetation; grows very rapidly, to 4 mm/day; lives to 22 yrs.; SP: Spring: roe is green, poisonous;	AFGF 369 (25) ANAF 49 FOH 186 FF 37 FFC 105

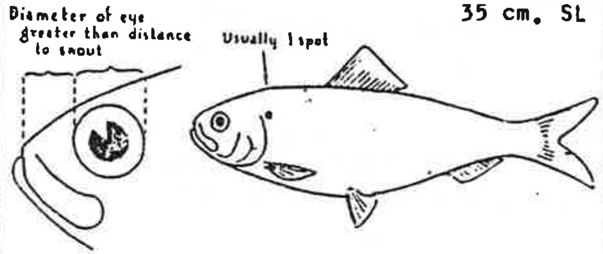
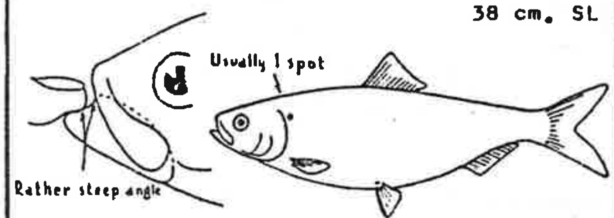
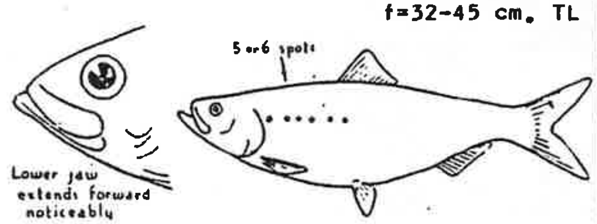
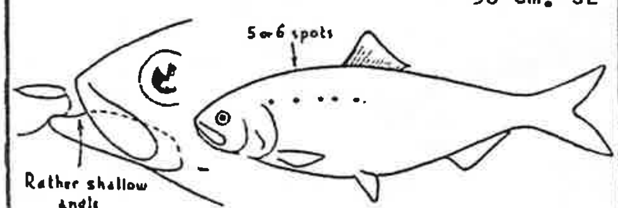
Stocky fish with gular plate:

O. Amiiformes	F. Amiidae — Bowfins		
Bowfin Amia calva A= a kind of fish c= bald	FF — 45-60 cm. TL 87 cm. TL  brown — no reports	ID: Long, moderately robust; head massive; nostrils tubular; large gular plate; dorsal fin long; abbreviated, rounded, heterocercal tail: H: Clear waters; in rooted vegetation; very hardy; SP: Spring; male guards eggs and young; male excavates shallow nest in vegetation;	AFGF 371 (44) ANAF 53 FOH 189 FOSE 34 FF 36 FFC 112

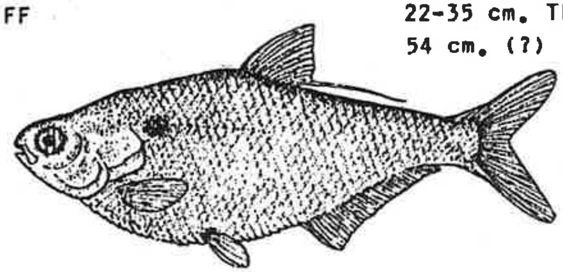
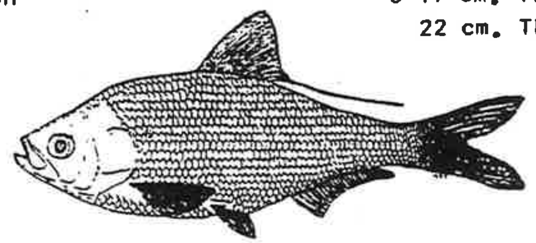
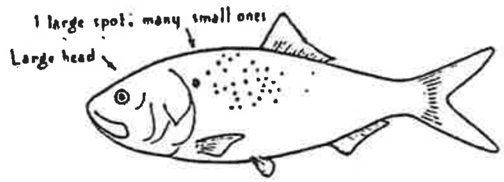
Long, snakelike fish without pelvic fins

O. Anguilliformes	F. Anguillidae — Eels		
American Eel Anguilla rostrata A= "European" eel r= beak or snout	FF — 6-30 cm. TL 120 cm. TL  olivaceous — common	ID: Snakelike; no pelvic fins; scales exceedingly small, deeply embedded; dorsal+caudal+anal fins continuous; H: Tolerant of turbid waters; active at night; prefers deep water with mud bottoms; inactive in mud in winter; lives to 25 yrs; SP: At maturity (5-10 yrs) migrates to sea; elvers migrate inland in spring;	AFGF 376 (39) ANAF 59 FOH 192 FFNH 13 FOSE 36 FF 39

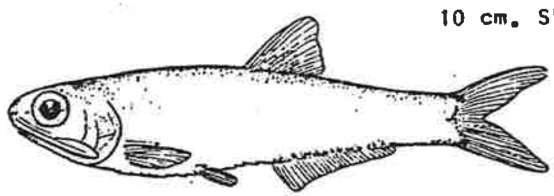
Fish with cycloid scales, scutes, and no lateral line:

O. Clupeiformes	F. Clupeidae Shad & Herring	Field Identification and Life Study Notes	
Alewife Alosa pseudoharengus A= "European" shad p= "false" herring	CFM 25-30 cm. SL 35 cm. SL  back = grey-green common	ID: Diameter of eye GREATER than distance from eye to snout tip; usually 1 spot after opercle; steep angle of upper margin of lower jaw; peritoneum SILVER; BROAD cheek bone; H: Anadromous; eats plankton; important forage of striped bass; SP: 48-54°F (9-12°C); on bottom; earlier and in slower, shallower waters than blueback; may return to home stream;	AFGF 381 (140) ANAF 65 FFNH 16 CFM 5 FOH 198 FCB 89 FOSE 95 FFV 49 FF 41
Blueback Herring Alosa aestivalis a= "of the summer"	CFM 20-30 cm. SL 38 cm. SL  back = blue-grey common	ID: Diameter of eye LESS than distance from eye to snout tip; usually 1 spot after opercle; steep angle of upper margin of lower jaw; peritoneum BLACK; BROAD cheek bone; H: Anadromous; planktonivore; lives to 8 yrs.; SP: 57-80°F (14-27°C); open, swift waters to 18 ft.; young move seaward at 1 month (3-6 cm.);	AFGF 381 (x) ANAF 61 CFM 5 FCB 85 FFNH 17 FOSE 90 FFV 49
Hickory Shad Alosa mediocris m= common, ordinary	CFM m=29-41 cm. TL f=32-45 cm. TL  back = grey-green occasional	ID: Long, PROJECTED lower jaw; sharply curved belly; adults have a ROW of black spots behind opercle; faint lines on sides; BROAD cheek bone; H: Anadromous; least common east coast species; eats small fish, plankton; SP: 50-52°F (10°C); Open water shoals; prefers small tributaries to rivers; may not be spawning in our area;	AFGF 381 (x) ANAF 64 MFGF 4 FCB 83 FOSE 92 FFV 49
American Shad Alosa sapidissima s= most delicious	FF 25-35 cm. SL 58 cm. SL  silvery occasional	ID: Lower jaw ENTIRELY ENCLOSED within upper; low angle of upper margin of lower jaw; dorsal and ventral profiles EVENLY rounded; DESIDUOUS scales; ROW of spots; NARROW, DEEP cheek bone; H: Anadromous; planktonivore; highly specific to 55-65°F (13-19°C); lives to 9 yrs; SP: 62-67°F (17-19°C); matures at 4-5 yrs; shallow water flats in mainstem;	AFGF 381 (123) ANAF 67 FFNH 18 CFM 7 FCB 93 FOSE 96 FFV 49 FF 41

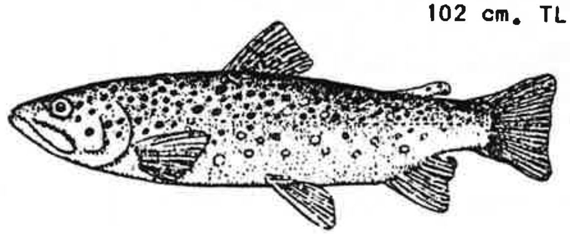
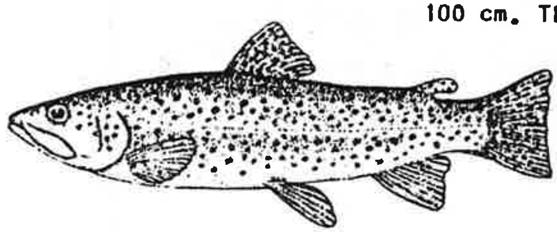
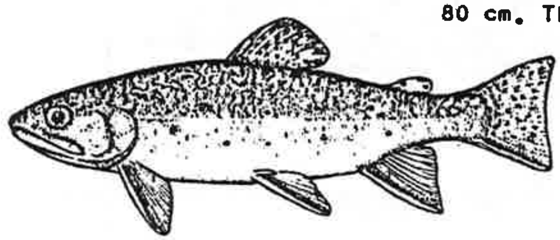
Fishes with cycloid scales, scutes, and no lateral line:

O. Clupeiformes, Cont.	F. Clupeidae, Cont. Shad & Herring	Field Identification and Life Study Notes	
Gizzard Shad Dorosoma cepedianum D= lance bodied c= after Lacepede	FF 22-35 cm. TL 54 cm. (?)  silvery-green very abundant	ID: Elongate last dorsal ray; partial adipose eyelids; mouth small, sub-terminal; upper jaw PROJECTING beyond lower; NOTCH in posterior half of upper jaw; post-operular spot at AT LEAST AS LARGE OR LARGER than eye; origin of dorsal insertion AFTER pelvic fin; H: Variable; planktonic & bottom feeder; SP: Mid-March to August; shallows;	AFGF 383 (122) ANAF 69 FOH 201 FOSE 38 FFV 49 FF 40
Threadfin Shad Dorosoma pretenense	FOH 8-17 cm. TL 22 cm. TL  no recent record	ID: Elongate last dorsal ray; partial adipose eyelids; mouth small, sub-terminal; upper jaw NOT PROJECTING beyond lower; NO NOTCH in upper jaw; post-operular spot SMALLER than eye; origin of dorsal insertion OVER pelvic fins; H: Variable, planktonic & bottom feeder; SP: 70°F (21°C); over vegetation;	AFGF 384 (x) ANAF 70 FOH 205 FFV 49 FF 40
Atlantic Menhaden Brevoortia tyrannus B= short precious stone t= king	CFM 46 cm.  common bluish-brown above, sides silvery	ID: Oval, deep, compressed; head very large; humeral spot often followed by rows of smaller spots; eyes large; DEEP, LONG cheek bones; Peritoneum BLACK; H: Variable; planktonic schooler; at or near surface, in deeper water; 1 yr = 13 cm., 2 yr = 21.5 cm.; SP: Fall & spring(?); bay & ocean(?); matures at 3-4 yrs (> 21.5 cm.(8"))	AFGF 382 (576) ANAF (x) FCB 102

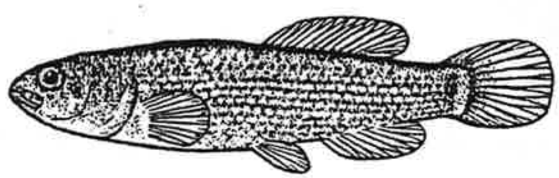
Small, delicate fish with large mouth & eye

O. Clupeiformes, Cont.	F. Engraulidae Anchovies		
Bay Anchovy Anchoa mitchilli A= strangled	FF 3-8 cm. SL 10 cm. SL  common bright silver band on sides	ID: Elongate, VERY compressed; lower jaw VERY long, slender, posterior end reaches lower edge of opercle; translucent body musculature; no scutes; caudal fin deeply forked; no keel on belly; H: Anadromous; planktonic; schooler; SP: Pelagic; winter & spring;	AFGF 385 (x) ANAF 73 FCB 108 FGM 119 FF 42

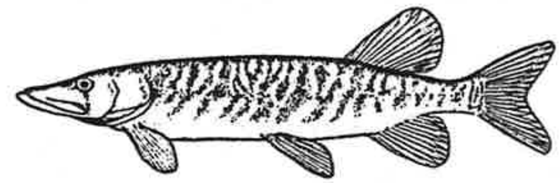
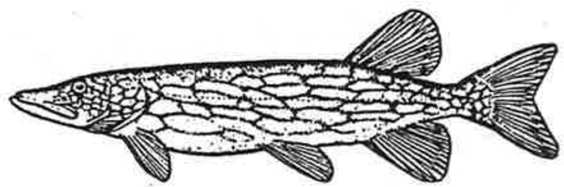
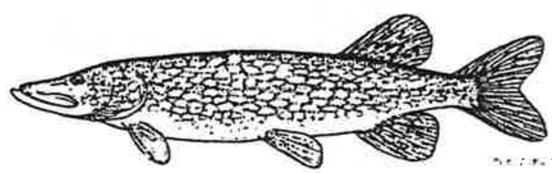
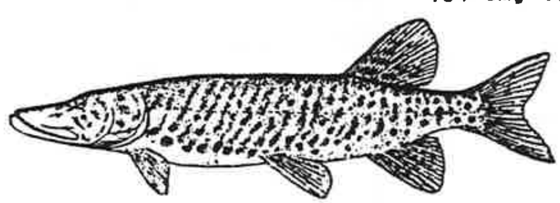
Fishes with adipose fins, pelvic axillary scale, small scales:

O. Salmoniformes	F Salmonidae Trout	Field Identification and Life Study Notes	
Brown Trout Salmo trutta S= leaper t= trout (L)	FF 20-82 cm. TL 102 cm. TL  yellowish-brown rare	ID: Elongate, fusiform; numerous orange-BLACK-RED spots surrounded with blue halo; tail slightly FORKED; H: Introduced from Europe; tolerant to higher temps (to 85°F (30°C)); prefers 54-64°F (12-18°C); pH range: 4.5-9.8, prefers < 8.2; SP: Fall; female builds redd, guarded by both parents;	AFGF 396 (62) ANAF 109 FOH 218 FFNH 29 MFGF 11 FOSE 6 FFV 50 FF 47
Rainbow Trout Salmo gairdneri g= after Dr. M. Gairdner	FF 25-75 cm. TL 100 cm. TL  bluish-silver rare	ID: White tips on pelvic & anal fins; tail forked; mouth white; distinctive red bands on sides; black-edged adipose fin; H: Introduced from west coast; lives to 11 yrs; tolerant to 85°F (30°C); prefers 65-68°F (18-20°C); pH range: 5.8-9.5 SP: Jan-August; requires alkaline waters; matures: m=1 yr., f=6 yrs.;	AFGF 394 (61) ANAF 106 FOH 221 FFNH 31 MFGF 19 FOSE 4 FFV 50 FF 48
Brook Trout Salmo fontinalis f= living in springs	FF 20-40 cm. SL 80 cm. TL  olive-green rare	ID: YELLOW-PINK spots with blue halos; tail SQUARE; dark green wavy lines on back; lower fins & tail are light-orange to red with white boarder; H: Cool clear creeks; prefers < 68°F (20°C); survives to 77°F (25°C); pH range: 4.0-9.8 SP: Fall; 40-50°F (4-10°C); redd over gravel; prefers cold, spring-fed water;	AFGF 396 (65) ANAF 114 FOH 224 FFNH 33 MFGF 24 FOSE 8 FFV 50 FF 49

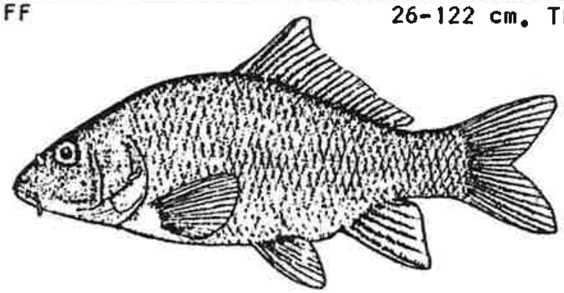
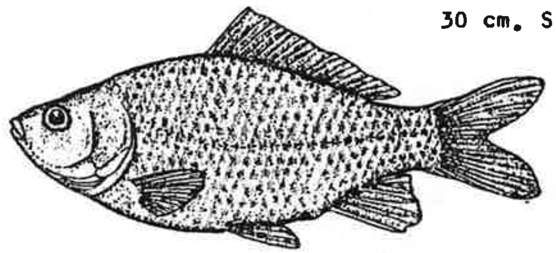
Small, extremely hardy fish with short snout, cycloid scales:

O. Salmoniformes, Cont.	F. Umbridae Mudminnows		
Eastern Mudminnow Umbra pygmaea U= shade (habitat) fish p= dwarfish race	FF 8 cm. SL max.  Reflecting Pools(?)	ID: Resembles killifish; mouth terminal and large (extends to middle of eye); mottled or barred with black, forming 10-14 light, longitudinal stripes; H: Tolerant of extremes of temp, pH, DO; may become dormant in mud; in vegetation; SP:	AFGF 402 (x) ANAF 130 FF 59

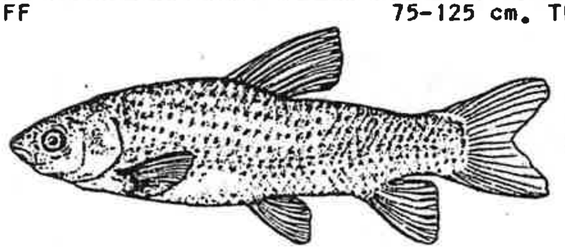
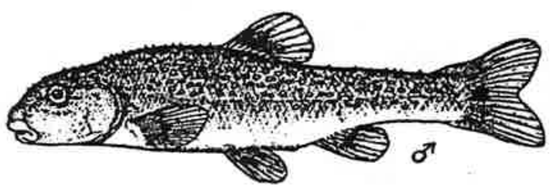
Elongate fish with large, flattened head & large, sharp teeth:

O. Salmoniformes, Cont.	F. Esocidae Pikes & Pickerels	Field Identification and Life Study Notes	
Redfin or Grass Pickerel Esox americanus E= pike a= from america	FF 25-30 cm. TL 38 cm. TL  greenish-brown rare	ID: No scales on top of head; SHORT snout; opercles FULLY scaled; 4 sensory pores on each jaw; 20-36 dark vertical streaks on sides; H: Acidic waters with submerged vegetation; see chain pickerel; SP: 50°F (10°C); demersal; no nest;	FOH 245 ANAF 131 FOSE 40 FFV 52 FF 58
Chain Pickerel Esox niger n= black	FF 38-45 cm. TL 78 cm. TL  greenish-brown rare	ID: See grass pickerel, except with chain-like reticulations on sides; LONG snout; H: Native to Atlantic coastal plain; quiet, shallow water with mud bottom, abundant vegetation; prefers 80-90°F (26-32°C); SP: Early spring; shallows; string of eggs layed over vegetation; no parental care;	AFGF 404 (36) ANAF 137 FOH 248 FFNH 43 FOSE 42 FFV 52 FF 58
Northern Pike Esox lucius l= pike (L)	FF 50-70 cm. TL 133 cm. TL  greenish-brown rare	ID: Opercles SCALELESS on lower halves; checks FULLY scaled; 5 sensory pores on each jaw; SPOTTED fins; H: Solitary; cooler waters than pickerel; lives to 24 yrs; SP: 40-52°F (4-11°C); demersal; no nest; adhesive eggs; matures at 1-3 yrs;	AFGF 402 (35) ANAF 133 FFNH 46 FOH 250 FFV 52 FF 57
Muskellunge Esox masquinongy m= large pike	FF 68-122 cm. TL 164 cm. TL  greenish-brown rare	ID: Opercles SCALELESS on lower halves; checks SCALELESS on lower halves; 6-9 sensory pores on each jaw; H: Slow meandering streams and rivers; solitary; lives to 25 yrs; SP: 48-60°F (9-14°C); demersal; no nest; adhesive eggs; matures at 3-5 yrs;	AFGF 403 (34) ANAF 135 FOH 253 FFV 52 FF 57

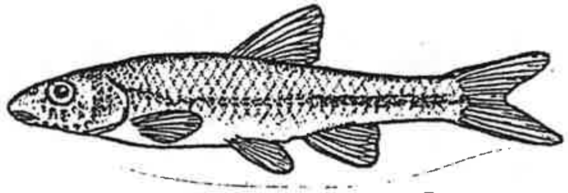
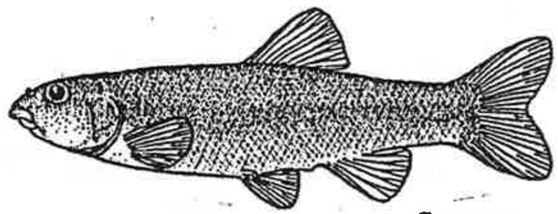
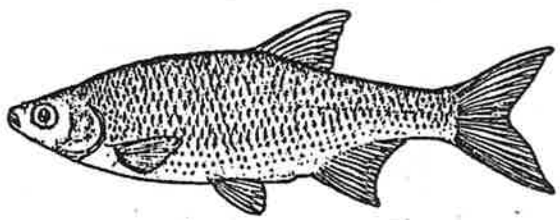
Fish with single, rayed dorsal fin & jaws without teeth:

O. Cypriniformes	F. Cyprinidae Carps & Minnows	Field Identification & Life Study Notes	
Common Carp Cyprinus carpio C= from cypris c= carp (L)	FF 26-122 cm. TL  golden very abundant	ID: ONE serrated, spinous-ray on anal and dorsal fins; 2 FLESHY BARBELS on each side of upper jaw; dark SPOT on scale bases; H: Low gradient, warm, organically rich water; SP: Spring to late summer; shallows; requires vegetation to lay adhesive eggs; scattered randomly;	AFGF 412 (118) ANAF 152 FFNH 53 FOH 259 FOSE 44 FFV 55 FF 63
Goldfish Carassius auratus C= European crucian carp a= gilded	FF 12-22 cm. SL 30 cm. SL  golden common	ID: Dorsal+anal fin have 1 serrated spinous ray; NO fleshy barbels on jaws; NO dark spot at scale bases; H: Same as carp but more specialized (less tolerant); SP: Same as carp; spring & early summer	AFGF 410 (120) ANAF 147 FFNH 55 FOH 262 FFV 55 FF 63

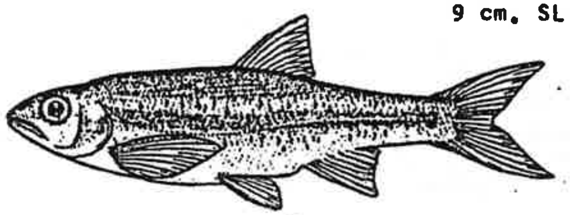
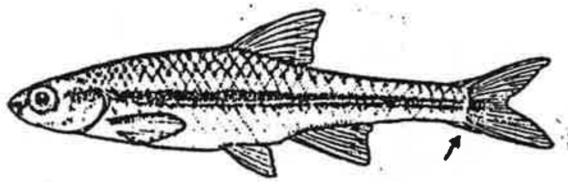
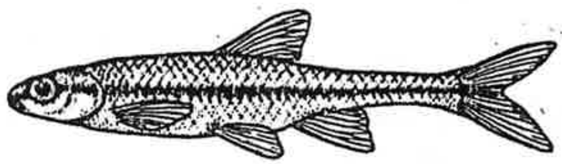
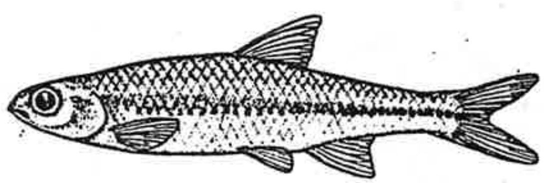
Fish which lack fin spines, lack teeth on jaws:

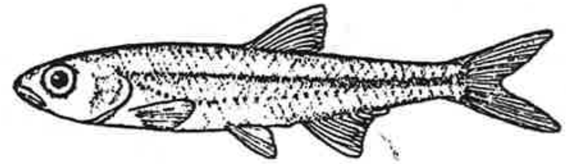
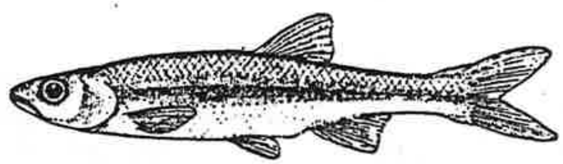
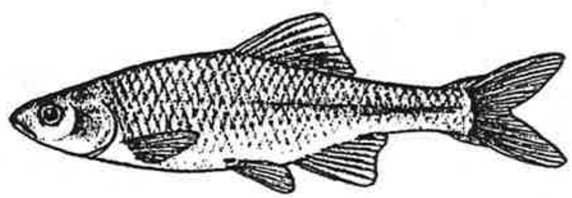
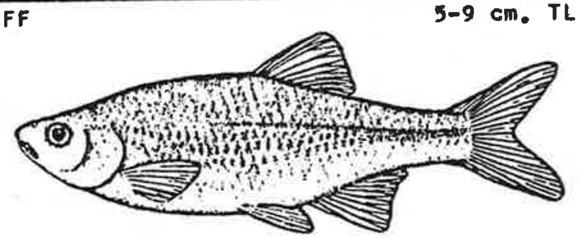
Grass Carp Ctenopharyngodon idella C= comb throated	FF 75-125 cm. TL  golden recently (1989) reported in D.C.	ID: Snout short; head blunt, broad; eyes located low in head; upper scales give crosshatched appearance; anal fin origin well back; H: Exotic (Asia); may eat more than its body weight daily; tolerant of very low D.O. (.5 ppm.) SP:	AFGF 412 (117) ANAF 151 FFV 55 FF 84
Stoneroller Campostoma anomalum C= flexible mouth a= uneven	FF 7-23 cm. SL  light brown uncommon	ID: Mouth sub-terminal; upper lip fleshy; lower lip with cartilagenous ridge; NO barbels; H: Small-medium size streams; tolerant of turbidity; SP:	AFGF 409 (115) ANAF 143 FOH 397 FFV 55 FF 63

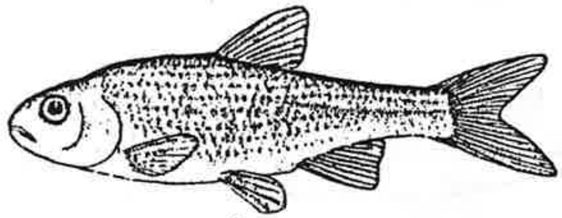
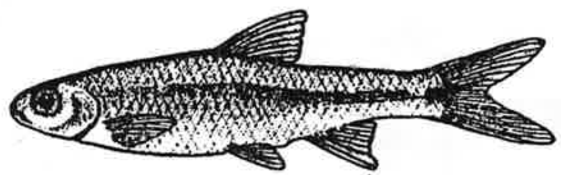
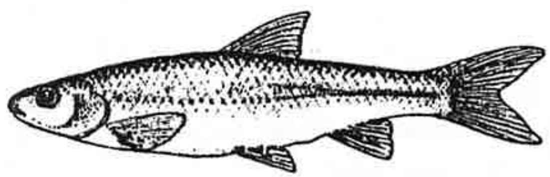
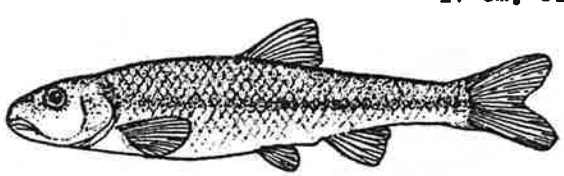
Fish which lack fin spines, lack teeth on jaws:

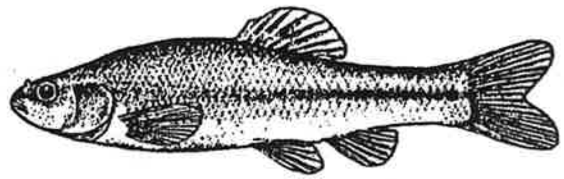
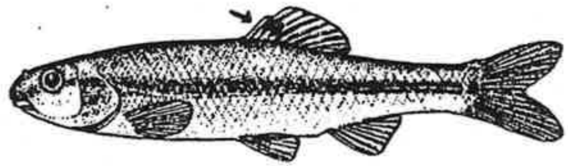
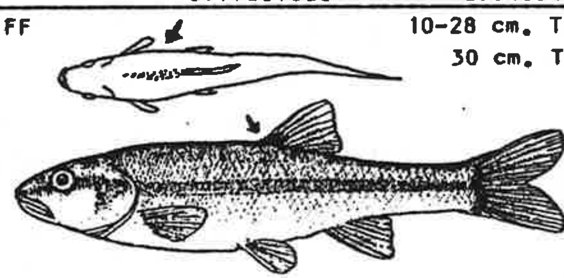
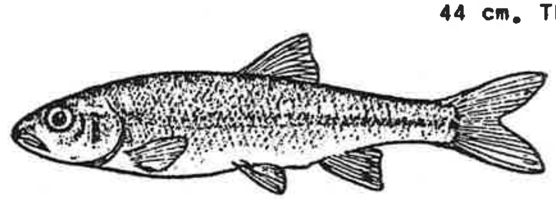
O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carp & Minnows	Field Identification & Life Study Notes	
Silverjaw Minnow Ericymba buccata E= many hollow vessels b= of the mouth	FF 3-4 cm. SL 6 cm. SL  olivaceous, Common Rock Creek	ID: Large, CAVERNOUS CHANNELS on ventral and lower sides of head; dorsal fin origin slighty in advance of pelvic fins; fins plain; H: Small creeks to rivers: moderate current; sand or gravel; bottom schooler; SP: R	AFGF 414 (172) ANAF 156 FOK 191 FOH 382 FFV 56 FF 84
Cutlips Minnow Exoglossum maxillinqua E= outside tonque m= jaw; tonque	FF 9-12 cm. SL  silvery Common Rock Creek	ID: Lower jaw profile has 3 LOBES; outer lobes fleshy; head broad; snout blunt; mouth subterminal; scales crowded anteriorly; H: Clear, gravel-boulder streams, under rocks; lives to 2 yrs; SP: 62-72 F (17-22 C); nest builder;	AFGF 414 (X) ANAF 158 MFGF 61 FFV 58 FF 67
Golden Shiner Notemigonus crysoleucas N= keel-shaped back c= gold-white	FF 5-23 cm. SL  silvery-gold common	ID: Slab-sided body; relatively small head; midline of belly naked of scales, keel-like; complete lateral line is sharply decurved anteriorly; anal fin is strongly falcate; H: Clean, quiet, vegetated waters with access to shallows; close relative to E. cyprins; SP: Spring to late summer; similar to carp;	AFGF 431 (131) ANAF 219 FFNH 57 FOH 265 CFM 13 FOSE 46 FFV 57 FF 76

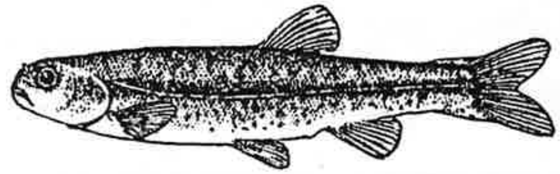
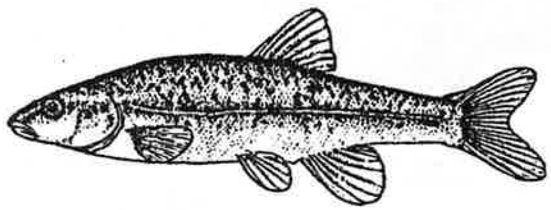
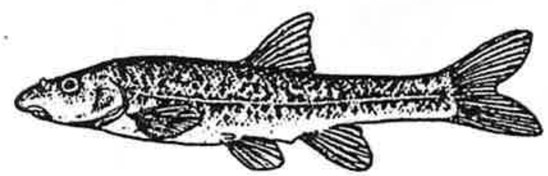
Minnows with lateral bands or stripes:

O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carps & Minnows	Field Identification & Life Study Notes	
Rosyside Dace Clinostomus funduloides C= sloped mouth f= bottom	FF 5-8 cm. SL 9 cm. SL  bluish-green above occasional	ID: Large mouth; mid-lateral stripe more pronounced at posterior; adults with light rosy color on sides; lower jaw extends past upper jaw; scattered spots or mottling on sides; H: Clear to turbid, small to midsize streams; SP:	AFGF 411 (192) ANAF 149 FOK 126 FOH 312 MFGF 74 FFV 57 FF 81
Ironcolor Shiner Notropis chalybaeus N= back-keeled c= iron colored	FF 5-6 cm. TL  dark above occasional	ID: Lustrerous black lateral band from snout, through eye, to caudal base; large eyes; LOWER LIP WELL PIGMENTED; intense black pigment about anus, anal fin base, and caudal peduncle; DETACHED black spot at base of caudal fin; lateral line INCOMPLETE; H: Clear, open waters in slow, lowland waters; often in some vegetation; SP: April-Sept.; free spawner; male turns bright red underneath;	AFGF 442 (x) ANAF 250 MFGF 68 KFFM 32 FFV 64 FF 108
Bridle Shiner Notropis bifrenatus b= two-bridled	FF 2-5 cm. TL  straw colored occasional	ID: Black lateral band from snout, THROUGH eye, to tail; large eyes; dorsal fin originates ON OR BEFORE pelvic fins; lateral line very INCOMPLETE; H: usually over mud, silt or detritus in slack water areas: SP: 58-80°F (14-27°C); shallow; in vegetation;	FFNH 60 ANAF 238 FFC 61 KFFM 32 FFV 62 FF 93
Swallowtail Shiner Notropis procne	FF 3-6 cm. SL  silver, common in Rock Creek	ID: Lateral band DOTTED, thin and black, NOT definitely continued forward through the eye and around muzzle; lateral line COMPLETE; Breast are scaleless; H: Warm, turbid streams & rivers; sand to rock; SP:	KFFM 32 ANAF 298 FFV 62

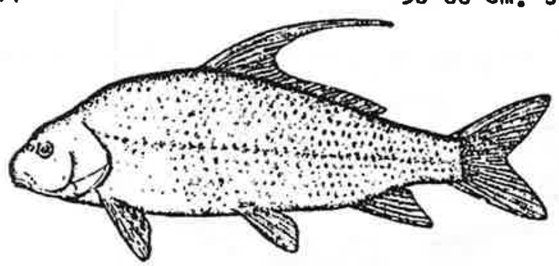
O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carps & Minnows	Field Identification & Life Study Notes	
Comely Shiner Notropis amoenus N= back-keeled a= pleasant, charming	FF 5-8 cm. SL 9 cm. SL  olive green occasional	ID: Body long and compressed; head relatively large (1/4 of TL); mouth oblique; lateral line decurved, ending in faint spot; dorsal fin insertion WELL BEHIND insertion of pelvic fins; usually 11 anal rays; gular pigment in "V" shape, well defined; H: Variable; larger streams; midwater schooler; SP: Early spring to late summer, esp. July;	MFGF 59 ANAF 225 KFFM 30 FFV 67 FF 98
Rosyface Shiner Notropis rubellus r= slightly reddish	FF 5 cm. SL max.  olivacious with bluish cast, occasional	ID: Long, slender, compressed; snout pointed; dorsal fin transparent, WITHOUT spots; WIDE lateral line with dark edged pores; anal rays more than 9; dorsal fin insertion WELL BEHIND insertion of pelvic fins; gular pigment rectangular, often vague; H: Clear, fast water with clean gravel or rubble bottom; intolerant to turbidity; SP: Over sandy gravel;	AFGF 441 (188) ANAF 302 FOK 169 FOH 327 FFV 67 FF 97
Spotfin Shiner Notropis spilopterus s= spotted fin	FF 5-11 cm. TL  bluish-silver common	ID: Snout pointed; posterior dorsal fins dusky; Body slender; fin bases WHITE; anal rays 8; lateral band on posterior part of body is NARROW and largely BELOW midline; membrane after 3rd principal dorsal ray without pigment in young and half-grown; H: Moderate-large weedless waters; variable bottoms; tolerant of silt & pollution; SP: Deposits eggs underneath objects; males compete for mates	AFGF 441 (149) ANAF 312 FGLR 74 FFV 63 FF 91
Satinfin Shiner Notropis analostanus a= after analostanus Is. (Roosevelt Is.)	FF 5-9 cm. TL  bluish-silver common Type specimen is from Rock Creek	ID: Same as spotfin shiner except as below; body deep; fin bases PLAIN; anal rays 9; lateral band on posterior part of body is WIDER and nearly MEDIAN; membrane after 3rd principal dorsal ray w/out pigment in young; H: Moderate to large, weedless streams & tidal rivers over sand or gravel; clear to turbid; SP: 64-80°F (18-27°C); shallow water; near rocks/attached to branches or stumps;	AFGF 432 (151) ANAF 226 FGLR 74 FFV 63 FF 92

O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carps & Minnows	Field Identification & Life Study Notes	
Common Shiner Notropis cornutus N= back-keeled c= horned	FF 6-10 cm. SL  silvery-bronze occasional	ID: Deep, compressed; HEAD LARGE, blunt; anteriorly crowded scales on sides; pronounced grey-blue mid-dorsal stripe; unspotted dorsal fin far forward, origin slightly before pelvic fins; H: Clear, cool, shaded, weedless water; small to medium streams; gravel to rubble; SP: >60°F; in running water over gravel; male developes large tubercles (horns);	AFGF 436 (155) ANAF 258 FFNH 59 FOH 340 FFCA 448 FF 90
Spottailed Shiner Notropis hudsonius h= from Hudson river	FF 7-11 cm. TL  silvery very abundant	ID: Often has caudal spot; peritoneum silvery; small notch in anal fin; ventral edge of caudal fin generally milky-white; dorsal fin far forward; no lateral band when live; scales on lateral line have small, dark CRESENT SHAPED BARS; NO barbel on jaw; H: Variable; rivers; lives to 4 yrs.; SP: Runs in streams in spring; shallow sandy shoals w/ running water;	AFGF 438 (146) ANAF 275 FFNH 61 CFM 13 FOH 346 FFV 63 FFCA 459 FF 109
Eastern Silvery Minnow Hybognathus regius H= protuberant jaw r= king	FF 5-12 cm. TL  silvery very abundant	ID: Lacks caudal spot; peritoneum black; lateral line UNPIGMENTED; edges of scales not heavily pigmented; extremely long, coiled intestine; edge of anal fin straight; H: Medium to large streams, rivers; SP: 55-68°F; matures: m=2 yr., f=1 yr.; non-adhesive eggs on silt substrate;	AFGF 419 (147) ANAF 179 FFNH 68 FOH 385 FFV 57 FFCA 417 FF 86
River Chub Nocomis micropogon N= fish (Am. Indian) m= small barbel	FF 9-18 cm. SL 27 cm. SL  dark-olive above occasional	ID: Cylindrical & stout; head broad; snout overhangs large, slightly oblique mouth; scales are large; males can be rose colored; H: Clear, warm, gravel-boulder creeks & rivers; eats insect larvae; lives to 5 yrs; SP: Intermittently over pebble nest; guarded by male; matures at 3 yrs; males with 30-65 tubercles on head;	AFGF 430 (113) ANAF 215 FOH 272 FFV 60 FF 71

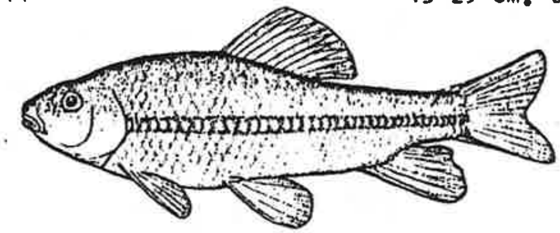
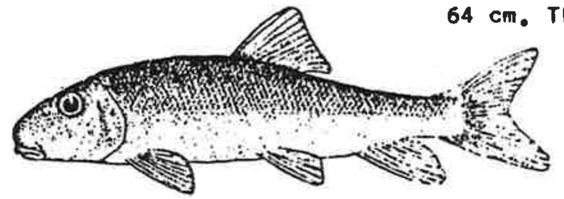
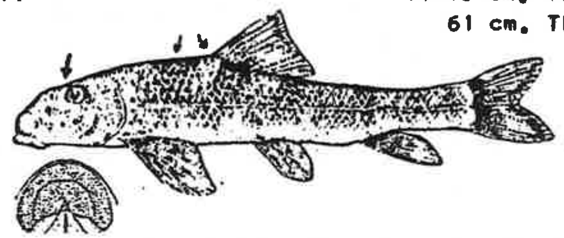
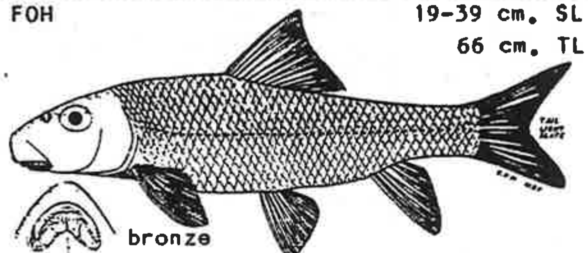
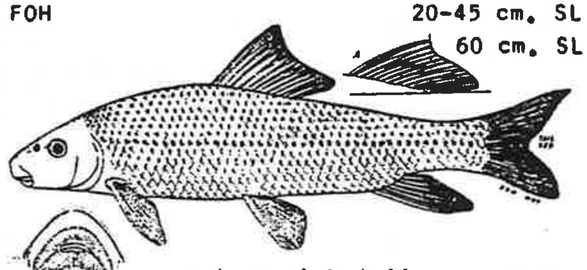
O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carps & Minnows	Field Identification & Life Study Notes	
Fathead Minnow Pimephales promelas P= fathead p= black before	FF 4-10 cm. TL  dark-olivacious no recent reports	ID: NO caudal spot; lateral line INCOMPLETE; scales on back small; crowded anteriorly; head blunt; mouth nearly terminal, oblique; SPOT on anterior rays of dorsal fin rays; 1st dorsal fin ray short, splint-like; H: Variable; tolerant of high temp., low DO, turb., pH extremes; schooler; SP: Similar to bluntnose minnow; underside of floating objects; female has ovipositor, can spawn in 1st year;	AFGF 450 (154) ANAF 341 FOH 391 FFNH 68 FFV 68 FF 82
Bluntnose Minnow Pimephales notatus n= marked, spotted	FF 4-9 cm. TL 11 cm. TL  olivacious abundant	ID: Black CAUDAL SPOT; lateral line COMPLETE; scales cross-hatched, crowded on back, behind head; small SUB-TERMINAL mouth; dusky blotch on 2-3 anterior dorsal rays; 1st dorsal fin ray short, splint-like; H: Variable; tolerant of pollutants; bottom feeder; mid-water schooler; SP: Spring, >68°F; shallow water, night; protracted spawning; males very dark, guard nest; eggs deposited underneath objects;	AFGF 449 (178) ANAF 340 FOH 394 FFV 69 FFCA 478 FF 83
Northern Creek Chub Semotilus atromaculatus S= spotted dorsal fin a= blackspotted	FF 10-28 cm. TL 30 cm. TL  bluish-olive common	ID: Prominant dusky blotch at anterior base of dorsal fin; large, blunt head; LARGE mouth; PREDORSAL STRIPE; caudal spot; SMALL scales; dorsal fin origin AFTER pelvic insertion; margin of operculum dusky; H: Small, clean, high graded streams; deeper in winter or droughts; omnivore; SP: Late spring to early summer, >55°F (13°C); small, gravelly streams; pebble-heap nest;	AFGF 456 (139) ANAF 361 FOH 297 CFM 13 FFNH 67 FFV 69 FFCA 507 FF 68
Fallfish Semotilus corporalis c= pertaining to body	FF 9-24 cm. TL 44 cm. TL  dark bluish-green uncommon	ID: NO SPOT at anterior base of dorsal fin; heavy bodied; dorsal fin origin OVER pelvic insertion; LARGE scales, with crescent-shaped black bars at scale bases; H: Cool (<83°F (28°C)), clean, rapid streams; gravel to rubble bottoms; SP: Spring, >54°F (12°C); large mound of gravel (to 3' high)	AFGF 456 (x) ANAF 362 FFNH 65 CFM 13 FFV 69 FFCA 511 FF 68

O. Cypriniformes, Cont.	F. Cyprinidae, Cont. Carps & Minnows	Field Identification & Life Study Notes	
Pearl Dace Semotilus margarita S= spotted dorsal fin m= pearl	FF 6-12 cm. TL 16 cm. TL  reddish occasional	ID: No spot at anterior base of dorsal fin; sides speckled by specialized dark scales; dorsal fin origin after pelvic insertion; mouth small; H: Cool, clear streams, bogs & ponds; closely associated with trout; SP: Spring; over sand and gravel; no nest but male guards territory;	FGLR 70 ANAF 364 FFCO 70 KFFM 27 FFV 69 FFCA 515 FF 69
Blacknose Dace Rhinichthys atratulus R= snout fish a= small thing dressed in black	FF 4-6 cm. SL  blackish occasional	ID: Slight overhanging snout; minute scales; dorsal BLACK BLOTCHES ALONG ENTIRE BODY; mouth small, subterminal; lateral band may be rosy in males; H: Small, cool streams w/ gravel-rock bottoms; closely associated w/ trout; eats aquatic insects; lives to 4 yrs; SP: Late spring to early summer, >70°F (21°C); builds nest; cannabalistic to eggs;	AFGF 453 (158) ANAF 352 FOH 291 FFNH 63 FFV 69 FF 65
Longnose Dace Rhinichthys cataractae c= plunging, of the cataract, (original type specimen from Niagara Falls)	FF 7.5 cm. (?)  blackish occasional	ID: Snout projects WELL BEYOND the almost horizontal, small mouth; small eye; head flattened; sides mottled; males may be reddish on sides during spring; H: Swift streams w/ gravel; pools in rivers; clear to turbid; benthic feeder; SP: 60°F (16°C); adhesive eggs; in riffles over gravelly bottoms;	AFGF 454 (159) ANAF 353 FOH 294 FFNH 64 FFV 69 FF 66

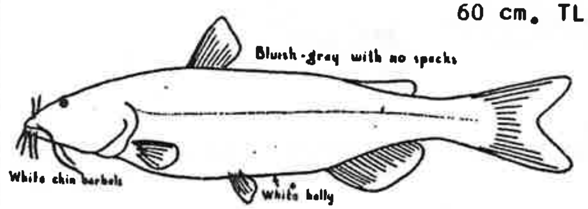
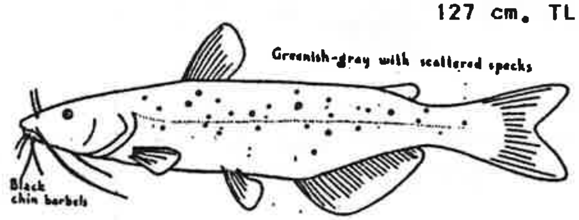
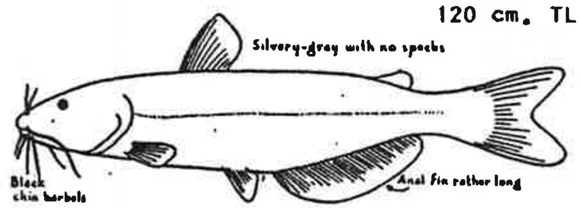
Fishes with no spines, thick ventral lips, short anal fin well back:

O. Cypriniformes, Cont.	F. Catostomidae Suckers		
Quillback Carpsucker Carpoides cyprinus c= carp	FF 38-66 cm. SL  sides silvery abundant	ID: Deep, compressed, highly arched back; head small; mouth small; numerous dorsal rays (>24); quite long anterior rays of dorsal fins; fins plain, pointed; H: Variable; mid to deep water; sandy silt bottoms; SP: Spring; no nest, no care; over sand or mud;	AFGF 458 (102) ANAF 368 FOH 416 FF 112

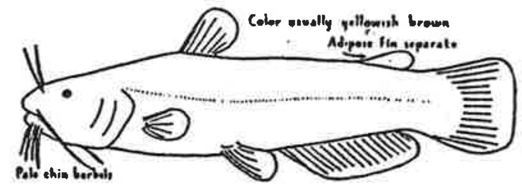
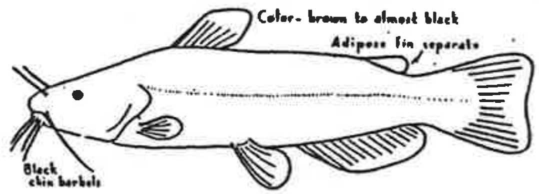
Fishes with no spines, thick ventral lips, short anal fin well back:

O. Cypriniformes, Cont.	F. Catostomidae, Cont. Suckers	Field Identification & Life Study Notes	
Creek Chubsucker Erimyzon oblongus E= suck particle o= oblong	FF 13-29 cm. SL  olivaceous occasional	ID: NO LATERAL LINE; PLICATE lower lips; SLIGHT "V" angle of post. edge lower lips; LARGE scales; large blotches on young; no black spots at scale bases; fins ROUNDED; resembles carp as adult; H: Variable; intolerant to silt; SP: Spring to summer; streams; stones are pulled by males to build nest;	AFGF 460 (104) ANAF 397 CFM 11 FFNH 73 FFV 78 FF 113
White Sucker Catostomus commersoni C= inferior mouth c= after P. Commerson	FF 30-50 cm. TL 64 cm. TL  olivaceous-silver common	ID: Lateral line COMPLETE; PAPILLATED lips; DEEP "V" angled posterior edge lower lips; SMALL scales; anterior scales smallest and crowded; H: Widely variable; lives to 12 yrs; tolerances: silt, turb., pollutants, low DO; SP: 42-74°F (6-23°C); no nest; migrates to gravel streams;	AFGF 459 (106) ANAF 375 FOH 458 FFNH 70 CFM 11 FFV 78 FF 119
Northern Hog Sucker Hypentelium nigricans H= 5 lobes below (lips?) n= grayish black	FF 14-46 cm. TL 61 cm. TL  grayish-black occasional	ID: Lateral line COMPLETE; thick PAPILLATE lips; HEAD WIDE; strongly depressed between eyes; snout long, blunt; 3-4 DARK SADDLES ACROSS BACK; pectoral fins carried horizontally; H: Riffles & pools of streams; gravel-rubble; intolerant to turb., pollution; SP: Spring, >60°F (16°C); in shallow riffles; no nest; demersal, non-adhesive eggs;	AFGF 461 (109) ANAF 402 FOH 455 FFV 79 FFCA 554 FF 114
Golden Redhorse Moxostoma erythrurum M= sucking mouth e= red tailed	FOH 19-39 cm. SL 66 cm. TL  bronze Recently introduced to Potomac	ID: Lateral line COMPLETE; lips coarse; BROAD "V" angle of post. edge of lower lips; POST. PORTION OF SCALES OBVIOUSLY DARKER; LARGE scales; NO distinct dark scale bases; d. fin black on sharp tip & margins; H: Variable, often over silt and sand; lives to 8 yrs.; SP: Spring; 62-72°F (17-22°C); runs & riffles; constructs communal nest; over gravel	AFGF 464 (108) ANAF 421 FF 116 FFV 82 FOH 434
Shorthead Redhorse Moxostoma macrolepidotum m= large scales	FOH 20-45 cm. SL 60 cm. SL  red or pink tail common	ID: short head; lateral line COMPLETE; post. edge of lower lip ALMOST STRAIGHT; subplicate lower lip; tip of 1st d. fin ray FALLS SHORT of origin of last d. ray; LARGE scales; DARK SPOTS AT SCALE BASES; H: Large, shallow streams & rivers; intolerant to pollution; lives to 9 yrs; SP: 51-72°F (11-22°C); gravelly runs; see golden redhorse;	FF 115 ANAF 427 CFM 11 FFV 81 FOH 438

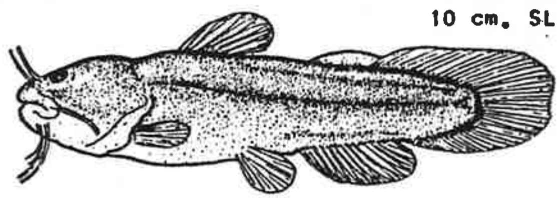
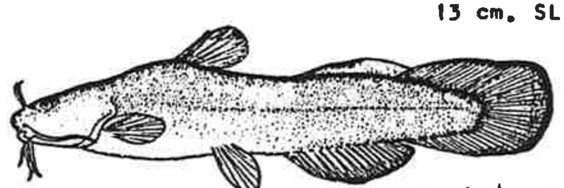
Catfish with adipose fin seperate from forked caudal fin:

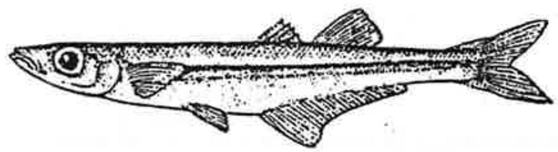
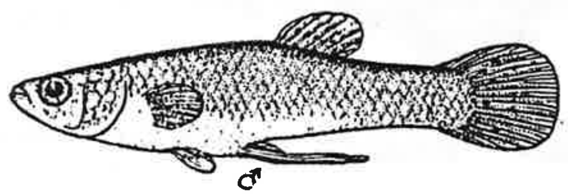
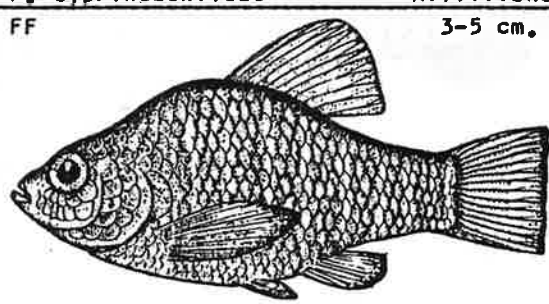
O. Siluriformes	F. Ictaluridae Catfish	Field Identification & Life Study Notes	
White Catfish Ictalurus catus I= fish-cat c= cat	CFM 60 cm. TL  silver gray common	ID: Chin barbels WHITE; tail moderately forked; fins WITHOUT dusky tips; SHORTER anal fin base than channel catfish, anal fin-rays < 24; H: Characteristic of rivers; SP:	FOH 478 ANAF 438 FF 112 FOSE 50 CFM 17
Channel Catfish Ictalurus punctatus p= "point" or spot (L)	CFM 127 cm. TL  greenish-grey very abundant	ID: Chin barbels BLACK; young often spotted; tail deeply forked; fins WITH dusky borders; LONGER anal fin base than white catfish, anal fin-rays 24-30; H: Medium to large rivers w/ swift currents; deep, clear water, over sand & gravel; lives to 40 yrs.; SP: May-July; 70°F (21°C); builds nest under banks, logs, or in open;	AFGF 470 (56) ANAF 446 FOH 475 FF 122 FOSE 58 CFM 17
Blue Catfish Ictalurus furcatus	CFM 120 cm. TL  bluish-gray 1 recent report	ID: Chin barbels BLACK; no spots on body; fins WITHOUT dusky tips; tail deeply forked; shallow groove from nostrils to dorsal fin; LONGER anal fin base than channel catfish, anal fin-rays 30-36; H: Rivers, in good, deep current(swift chutes); over bedrock, gravel, or sand; SP:	AFGF 468 (54) ANAF 438 FOH 478 FOSE 52 FF 122 CFM 17

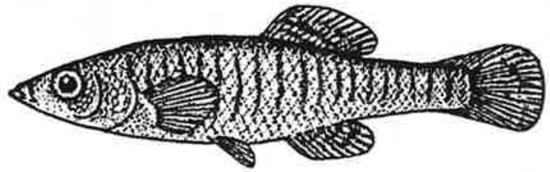
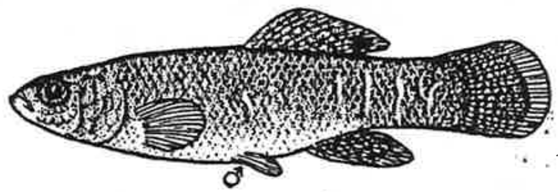
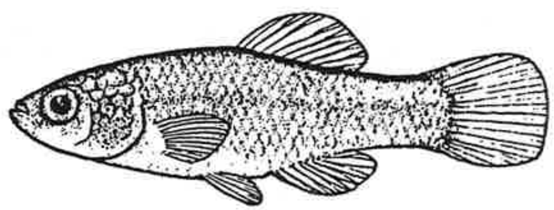
Catfish with adipose fin seperate from unforked caudal fin:

O. Siluriformes	F. Ictaluridae, Cont. Bullheads	Field Identification & Life Study Notes	
Yellow Bullhead Ictalurus natalis I= fish-cat n= large buttocks	CFM 38 cm. TL  yellowish brown common	ID: Chin barbels WHITE or yellowish; SMALL serrations on posterior edge of pectoral spine; unforked & round tail; H: Smaller, weedy, and slow moving water; scavenger; lives to 6 or 7 yrs; SP: >65°F (18°C); burrow nest (2 ft.); over sand; near shelter; matures at 2-3 yrs.; parental care of eggs & young;	AFGF 469 (57) ANAF 442 FOH 481 FF 123 FFNH 78 FOSE 54 FFV 87 CFM 19
Brown Bullhead Ictalurus nebulosus n= clouded	CFM 7-38 cm. TL 53 cm. TL  brown to black abundant	ID: Chin barbels GREY BLACK or black-spotted, at least at bases; LARGE serrations on posterior edge of pectoral spine; unforked and squarish (falcate) tail; H: Moderately deep water with ample vegetation; less turbid waters than the yellow bullhead; SP: Similar to yellow bullhead, but at temps >70°F (21°C), spring to September; parents sometimes ventilate eggs in mouth;	AFGF 470 (56) ANAF 443 FOH 484 FF 124 FFNH 76 FOSE 56 FFV 87 CFM 19

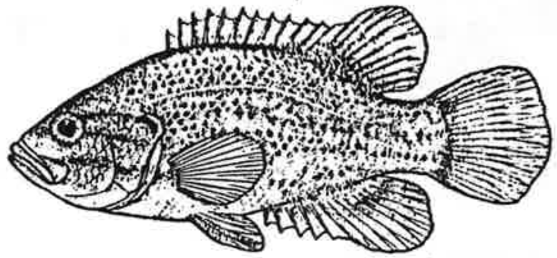
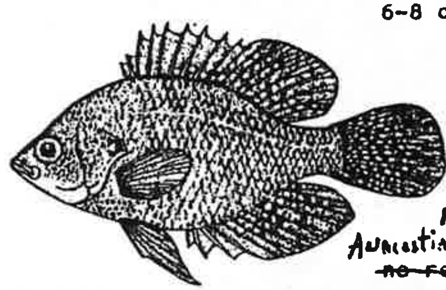
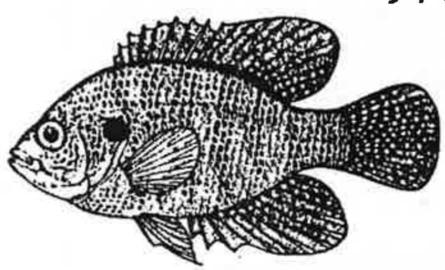
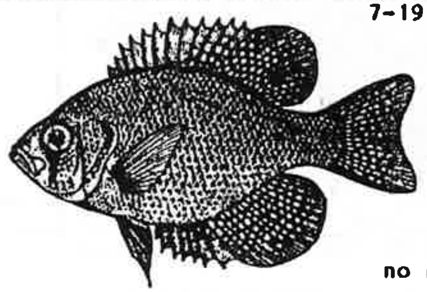
Catfish with adipose fin joined to caudal fin:

O. Siluriformes	F. Ictaluridae, Cont. Madtoms	Field Identification & Life Study Notes	
Tadpole Madtom Noturus gyrinus N= tall over back g= tadpole	FF 2-6 cm. SL 10 cm. SL  grey-yellowish brown no recent reports	ID: Tadpole shaped; mouth terminal; groove but NO SERRATIONS on pectoral spine; H: Quiet, slow moving water, especially over soft, muddy bottoms w/ extensive vegetation; secretive; SP: Summer;	AFGF 472 (51) ANAF 459 FOH 509 FFNH 80 FFV 88 FF 128
Margined Madtom Noturus insignis I= without marks	FF 5-9 cm. SL 13 cm. SL  Rare in upper Anacostia tribs, MD. dusky 1 recent report, PEPCO (1985)	ID: Slender; upper jaw overhangs lower jaw; SERRATED pectoral spine; head depressed; median fin w/ dusky margins; adipose is long and keel-like; H: Streams; gravel-rubble riffles; intolerant to silt & turb.; hides under rocks; lives 3-5 yrs.; SP:	AFGF 472 (x) ANAF 461 FFV 88 FF 130

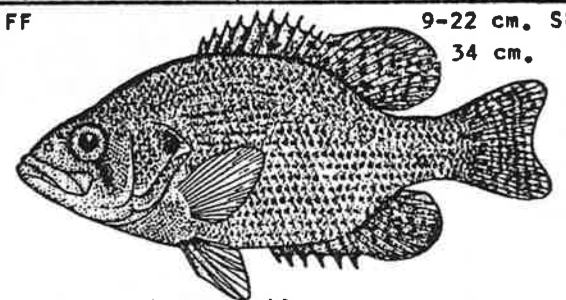
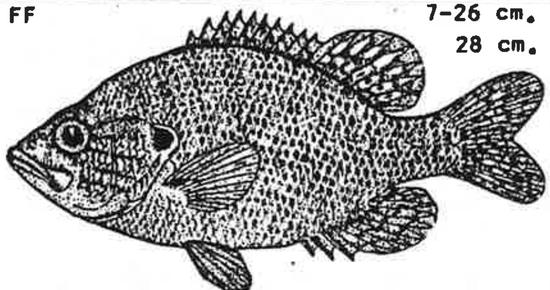
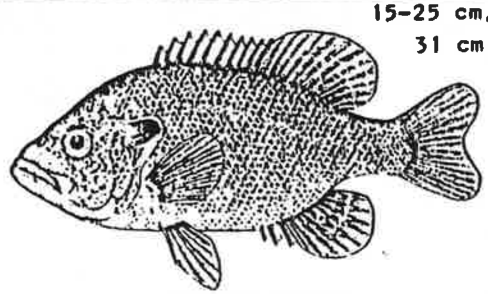
O. Antheriniformes	F. Belonidae — Needlefishes	Field Identification & Life Study Notes	
Atlantic Needlefish Strongylura marina S= cylindrical tail m= of the sea	FF 30-50 cm. SL 64 cm. SL  bluish-green occasional	ID: VERY elongate & cylindrical; jaws very elongate, armed w/ sharp teeth; small, cycloid scales; no spines on fins; H: Coastal marine waters & into freshwater coastal streams; SP: Fresh to brackish, shallow water; on submerged algal mats;	AFGF 504 (435) ANAF 489 FCB 149 FF 135
O. Antheriniformes	F. Antherinidae — Silversides		
Tidewater or Inland Silversides Menidia beryllina b= sea green jewel	FF 5-10 cm. SL 12 cm. SL  silvery type specimen is from D.C. common	ID: Elongate & compressed; lateral band silvery; mouth terminal, oblique; snout short; peritoneum SILVERY; scales w/ black spots and smooth edges; H: Quiet waters; usually at surface; over sand and gravel; SP: April-Sept.; shallows; eggs adhere by threads on dead leaves, tree roots;	AFGF 521 (568) ANAF 558 FCB 94 FF 148
O. Antheriniformes	F. Poeciliidae — Live-bearers		
Mosquitofish Gambusia affinis a= related	FF 2-6 cm. TL  light olive common in reflecting pools	ID: Robust & compressed; mouth superior, small; scales have small dusky spots near edges; anal fin of male forms gonopodium; H: Near surface of vegetated, still waters; eats mosquitos; SP: Warm months; vegetative shallows; live-bearer;	AFGF 516 (208) ANAF 538 FF 146
O. Antheriniformes	F. Cyprinodontidae — Killifishes		
Sheepshead Minnow Cyprinodon variegatus v= variously marked	FF 3-5 cm. SL  olivaceous no recent reports	ID: Moderately compressed; snout blunt; mouth terminal, small; has humeral scale; caudal fin edge & base with dark bar; H: Coastal marshes, enters fresh water; shallow, still waters, sandy bottoms; tolerant: extreme temp. & salinity changes; SP: Spring & early summer; mud bottom; adherent w/ threads on fibrous substrates;	AFGF 507 (197) ANAF 504 FCB 135 FF 137

O. Antheriniformes	F. Cyprinodontidae, Cont. Killifishes	Field Identification & Life Study Notes	
Banded Killifish Fundulus diaphanus F= bottom (L) d= transparent	FF 5-8 cm. TL  olivaceous very abundant	ID: Elongate, stout; head flat; mouth upturned; no spines or lateral line; tail rounded; dorsal fin origin far beyond pectoral fins; narrow vertical bars on sides; H: Quiet waters w/ sand or gravel bottoms; around patches of vegetation; versatile feeder throughout water column; SP: Vegetative shallows; eggs in clusters; attached with filaments;	AFGF 514 (x) ANAF 513 FOH 521 FFNH 85 FFV 90 FF 141
Mummichog Fundulus heteroclitus h= unusual	FF 7-10 cm. TL 13 cm. TL  dull green abundant	ID: See banded killifish, except: much plumper with blunter snout; sometimes w/ black spot on REAR of d. fin; females very dull olive color; H: Near vegetation; prefers salt marshes; SP: Vegetative shallows; no nest;	AFGF 509 (x) ANAF 517 FFNH 84 MFGF 86 FFV 90 FF 141
Spotfin Killifish Fundulus luciae	ANAF 2-4 cm. SL no reports	ID: Small; dorsal fin insertion over or alittle behind the origin of the anal fin; black spot at ANTERIOR of dorsal fin; H: Typically saltmarshes, enters freshwater; SP:	ANAF 520
Rainwater Killifish Lucania parva L= troubled by light p= small	FF 2-6 cm. SL  pale greyish-green no recent reports	ID: Males w/ black spot at FRONT of dorsal fin; dusky margins of scales give pronounced cross-hatched appearance; dull markings; H: Invariably near vegetation; wide salinity tolerance; SP: Vegetative or clear shallows;	AFGF 515 (207) ANAF 535 FF 139

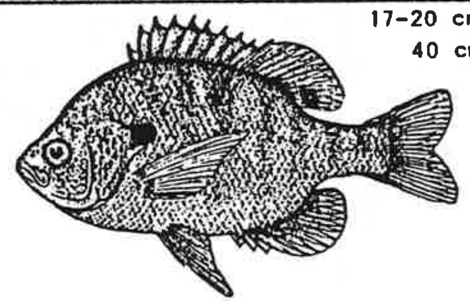
Sunfishes = Fish with dorsal fins joined, separated only by notch, anal fin with 3 or more spines.

O. Perciformes	F. Centrarchidae Sunfishes	Field Identification & Life History Notes	
Mud Sunfish Acantharchus pomotis A= superior spine	FF 11-17 cm. SL  dark green no reports	ID: Oblong, robust; snout short; mouth wide; maxilla extends past middle of eye; large, DARK BLOTCH on upper opercle; sides w/ 3-5 irregular greenish-yellow stripes; caudal fin rounded; H: Streams & sluggish waters; around abundant vegetation; over mud; nocturnal & secretive; SP:	AFGF 549 (x) ANAF 577 MFGF 126 FFV 99 FF 161
Bluespotted Sunfish Enneacanthus gloriosus E= nine spined g= glorious	FF 6-8 cm. SL  1988 Anacostia, MD ~~no reports~~ bright blue spots in irregular rows	ID: Short, compressed; snout short; mouth terminal, slightly oblique; PEARLY-EDGED DARK SPOT on upper edge of SHORT opercle; 16-18 scale rows on caudal peduncle; H: Shallow, heavily vegetated, sluggish waters; acidic; often found where dissolved oxygen is too low for companion species; SP: 5-12" circular nest; among plants; adhesive eggs	AFGF 552 (80) ANAF 586 MFGF 122 FFV 100 FF 162
Banded Sunfish Enneacanthus obesus o= corpulent	FF 5-7 cm. SL  no reports	ID: See bluespotted sunfish; has blue spots + 4-8 dark bars; black opercular spot BORDERED WITH PURPLE; 19-20 scale rows on caudal peduncle; H: Sluggish, acidic, heavily vegetated waters; SP:	AFGF 552 (x) ANAF 589 MFGF 118 FFV 100 FF 162
Flier Centrarchus macropterus C= arched in the center m= large fin	FF 7-19 cm. TL  no reports greenish-yellow	ID: Oval, strongly compressed; snout short; mouth SMALL, extending to pupil of eye; dark, WEDGED-SHAPED SPOT THROUGH EYE; 8-12 horizontal rows of dark spots on body; H: Clear, quiet streams, swamps, ditches; in heavy vegetation; winter schooler; SP: March-May; 70°F (15°C); colonial nester; male guards nest & fry;	AFGF 551 (83) ANAF 583 FOSE 62 FFV 99 FF 160

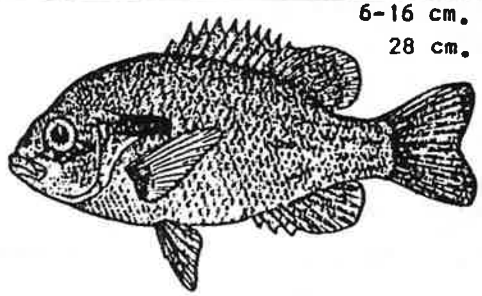
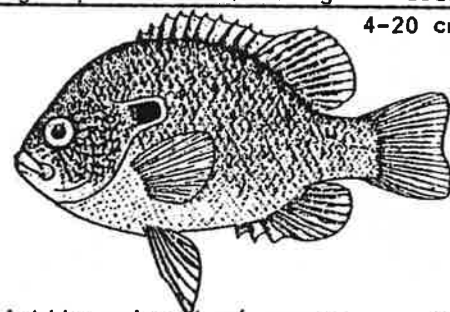
Sunfish with LARGE mouths, conspicuous red eyes, no red on opercular flap:

O. Perciformes, Cont.	F. Centrarchidae, Cont. Sunfishes	Field Identification & Life History Notes	
Rock Bass Ambloplites rupestris A= blunt armature r= living among rocks	FF 9-22 cm. SL 34 cm.  brassy-olivaceous rare	ID: BRIGHT RED EYE; bass-like mouth; light purple opercular spot w/ WHITE border; 6 anal spines; HORIZONTAL STRIPES made up of small, black spots on each scale; H: Medium sized rivers with rocky bottoms; weedy, silt free substrates; fair currents; SP: 60-70°F (15-21°C); average of 5000 eggs; shallow nests; diverse bottoms;	AFGF 549 (82) ANAF 581 FOH 556 CFM 29 FFNH 106 FFV 100 FF 163
Warmouth Lepomis gulosus L= scaled gill covers g= gluttonous	FF 7-26 cm. TL 28 cm. TL  dark brassy-olive green occasional	ID: Eye not as bright as rock bass, radiating 4-5 lavender horizontal stripes on head; 3 anal spines; teeth present on tongue; dark opercular spot WITHOUT border; mottled vertical bars on sides; H: Quiet water with muddy bottoms; along C & O canal; SP: Late spring to summer; >70°F (21°C); average of 15,000 eggs; multiple nester over sand/gravel w/ silt;	AFGF 555 (86) ANAF 595 FOH 573 CFM 29 FOSE 69 FFV 101 FF 162
Green Sunfish Lepomis cyanellus c= slightly bluish	FF 15-25 cm. TL 31 cm.  brassy-green rare	ID: May lack red eye; side of head with EMERALD MOLDINGS; tiny green specks on body; 3 anal spines; dark opercular spot with WHITE border; usually dusky spot at bases of last 3 rays of dorsal and anal fins; H: Clear to turbid, slow moving waters; tolerant of many habitats; SP: May-August; average of 6,000 eggs; in colonies in shallow water; mature 2 yrs;	AFGF 553 (75) ANAF 591 FOH 577 CFM 29 MFGF 124 FOSE 65 FFV 101 FF 164

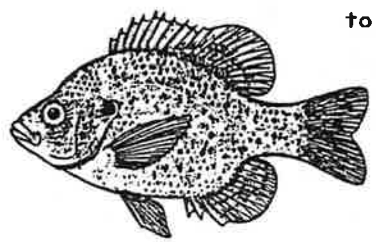
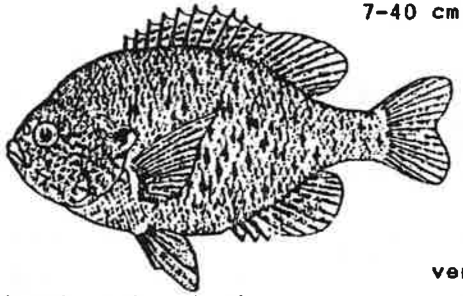
Sunfish with SMALL mouth, POINTED pectoral fins, & a dark opercular spot which LACKS red:

Bluegill Sunfish Lepomis macrochirus m= large hand	FF 17-20 cm. TL 40 cm. TL  bluish-olive green abundant	ID: Long & pointed pectoral fin; "ears" broad, uniformily black, soft, with NO red; DUSKY BLOTCH ON POSTERIOR DORSAL FIN; 6-8 irregular vertical bars on sides; H: Shallow, warm, slow moving water; quiet, around vegetation; omnivores; SP: >67°F (19°C) to August; see green sunfish; average of 12,000 eggs;	AFGF 555 (85) ANAF 597 FOH 580 CFM 27 FFNH 103 MFGF 120 FOSE 71 FFV 101 FF 165

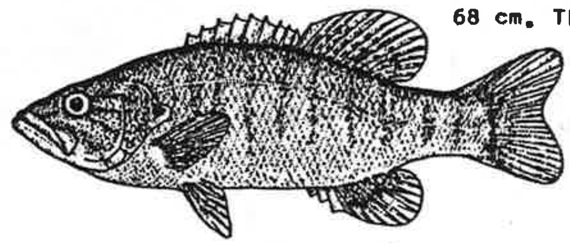
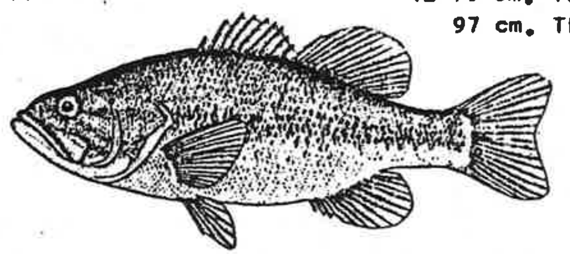
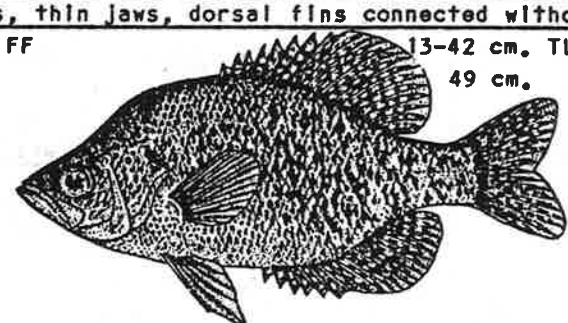
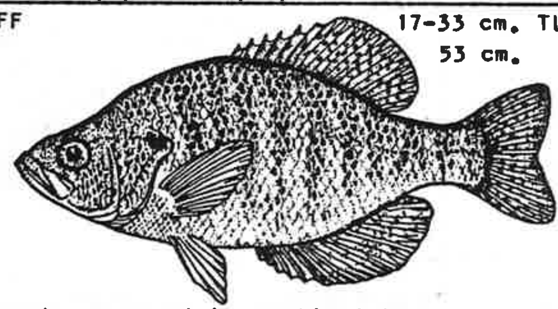
Sunfishes with MEDIUM-SIZED mouths, ROUNDED pectoral fins, LONG, dark opercular flap which MAY HAVE red:

O. Perciformes, Cont.	F. Centrarchidae, Cont. Sunfishes	Field Identification & Life History Notes	
Redbreast Sunfish Lepomis auritus L= scaled gill covers a= eared	FF 6-16 cm. TL 28 cm.  brightly colored w/ orange abundant	ID: LONG, uniformly black, NON-bordered "ear" is NO WIDER than eye, with NO RED, pectoral fin short, rounded; brightly colored; H: Streams, prefers rivers; over sand, gravel, rocks; in association w/ smallmouth bass; SP: See bluegill; >60 F (15 C); only sunfish with auditory courtship;	AFGF 553 (75) ANAF 590 FFNH 102 MFGF 129 FFV 101 FF 165
Longear Sunfish Lepomis megalotis	FF 4-20 cm. SL  brightly colored w/ orange common	ID: Long, black-centered "ear" is WIDER THAN eye, pointed upward, may have posterior red spot(s) on tip; BORDERED WITH WHITE, sometimes red; very flexible; pectoral fin short, rounded; emerald-blue bars radiating from eyes; H: Clear, weedy streams, upland rivers; moderate current; over sand, gravel, rocks; SP: June-August; matures at 3 yrs, (3"); average of 6,000 eggs;	AFGF 556 (74) ANAF 600 FOH 592 MFGF 125 FOSE 72 FFV 101 FF 165

Sunfishes with SMALL mouths, POINTED pectoral fins, and RED TIPS on their opercular flaps:

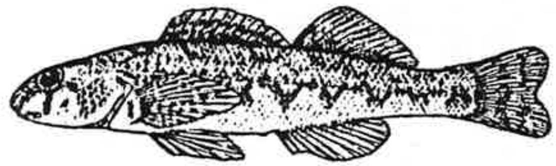
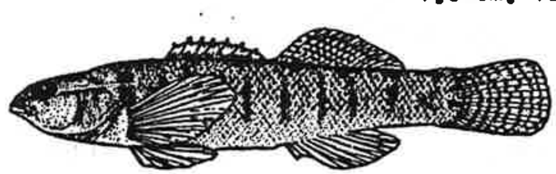
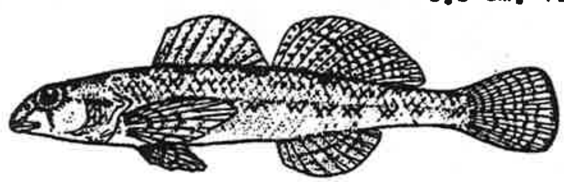
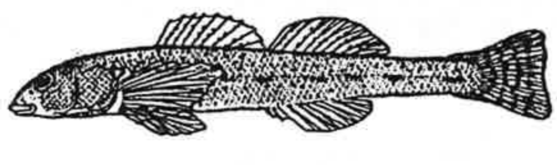
Redear Sunfish Lepomis microlophus m= small crested	FF 13-25 cm. TL to 4.5 lbs.  greenish-yellow w/ orange rare	ID: Moderately small mouth; SOFT, black "ear", bordered with white, with a WIDE, posterior red spot; NO spots on dorsal or anal fin; NO BLUEISH BANDS on the side of head; H: Large, warm, clear, quiet waters with vegetation & cover; favorite food is mollusks (snails); SP: See bluegill, but less prolific;	AFGF 557 (78) ANAF 601 FOH 595 MFGF 129 FOSE 75 FFV 102 FF 167
Pumpkinseed Sunfish Lepomis gibbosus g= like a full moon (rounded body)	FF 7-40 cm. TL  brightly colored w/ orange very abundant	ID: Small mouth; STIFF, black "ear", bordered with white, with a posterior red spot; SPOTS on dorsal & anal fin; WAVY BLUE BANDS on the side of face; H: Cooler, shallow, sheltered water with dense vegetation, soft bottoms; favorite food is fish; SP: See bluegill; matures at 2 yrs.; average of 2,000 eggs;	AFGF 554 (73) ANAF 593 FOH 599 CFM 27 FFNH 100 MFGF 125 FOSE 67 FFV 102 FF 166

Sunfishes with very large mouths:

O. Perciformes, Cont.	F. Centrachidae, Cont. Sunfishes	Field Identification & Life Study Notes	
Smallmouth Bass Micropterus dolomieui M= small, or short, fin d= after M. Dolomieu	FF 20-56 cm. TL 68 cm. TL  greenish-yellow bronze common	ID: Elongate, compressed; dorsal spines almost of EQUAL length; upper jaw DOES NOT extend past eye; YOY tricolor tail = ORANGE-black-white; H: Clear, cool, fast-moving rocky waters with gravel or rubble bottoms; temps. <80 F (27 C); SP: <60 F (16 C); 2-12 ft. deep, over gravel; to 7,000 eggs/lb; (>73 F (23 C) kills eggs)	AFGF 557 (90) ANAF 605 FOH 560 CFM 25 FFNH 95 MFGF 141 FFV 102 FF 159
Largemouth Bass Micropterus salmoides s= trout like	FF 12-70 cm. TL 97 cm. TL  dark olive-green abundant	ID: Moderately deep, robust; dorsal spines of much DIFFERENT length; upperjaw DOES extend past eye; YOY tricolor tail = CLEAR-dark-light; H: Slightly turbid, warm, quiet water with vegetation; lives to 16 yrs.; SP: Prefers 64.F (18 C), to 80 F (27 C); up to 7,000 eggs/lb. of body weight;	AFGF 559 (92) ANAF 608 FOH 569 CFM 25 FFNH 98 MFGF 136 FOSE 80
Sunfishes with large mouths, thin jaws, dorsal fins connected without notch:			
Black Crapple Pomoxis nigromaculatus P= sharp opercle n= darkspotted	FF 13-42 cm. TL 49 cm.  body profusely speckled common	ID: Deep, strongly compressed; head long, concave near eyes; LONGER dorsal fin-base than white crapple; 7-8 dorsal spines; 6 anal spines; H: Clean, deep, cool waters; sandy to muddy bottoms w/ vegetation; lives 8-10 yrs.; SP: 58 F (14 C); see bluegill, except 3-8 ft. deep; 40,000 eggs/lb. body weight;	AFGF 560 (81) ANAF 613 FOH 553 CFM 31 FFNH 107 FOSE 84 FFV 103 FF 160
White Crapple Pomoxis annularis a= ringed	FF 17-33 cm. TL 53 cm.  spots arranged in vertical bars common	ID: Deep, compressed; head long, concave near eyes; SHORTER dorsal fin base than black crapple; 6 dorsal spines + 6 anal spines; H: Slow-moving parts of rivers; more tolerant of turbidity & siltation; lives to 8-10 yrs.; SP: See black crapple;	AFGF 560 (x) ANAF 611 FOH 549 CFM 31 MFGF 134 FOSE 85 FFV 103 FF 161

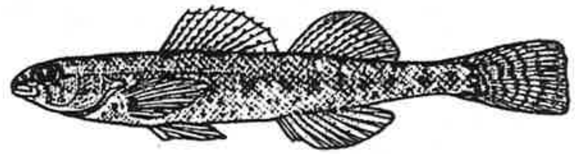
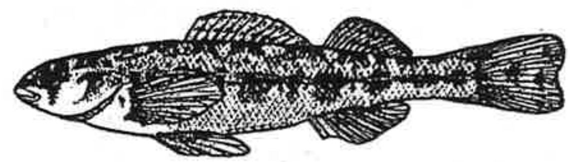
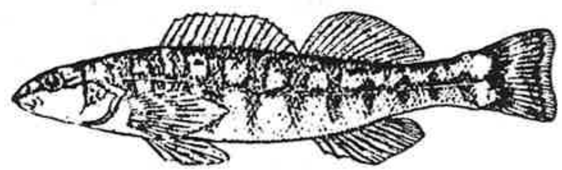
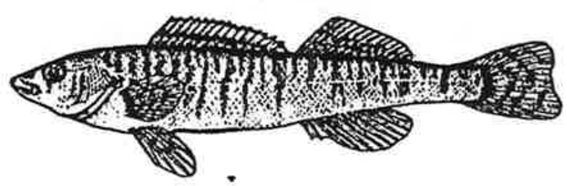
Perches = Fish with dorsal fins separate, 1 or 2 spines in anal fin

Small perch which dart along bottom:

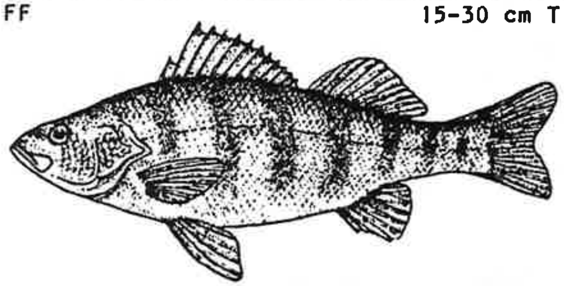
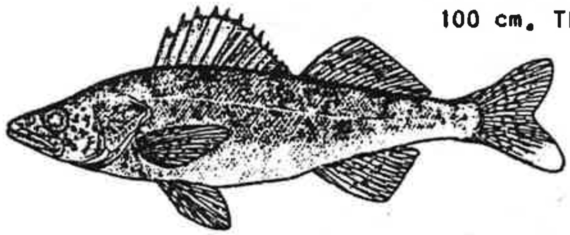
O. Perciformes, Cont.	F. Percidae Perches	Field Identification & Life Study Notes	
Greensided Darter Etheostoma blennioides E= various mouths b= fishlike	FF 6-8 cm. SL 14 cm. SL  greenish-orange no recent reports	ID: Elongate, robust; head blunt; SHORT 2nd groove between upper jaw & snout; 6-7 dark saddles & orange spots; "U" markings on sides; tail emarginate; middle of upper lip has nipple-like bump; H: Variable, prefers rivers of moderate current & low turbidity; among rubble & small boulders; lives 3-4 yrs.; SP: >55°F (13°C); among strands of vegetation; males guard eggs;	AFGF 564 (243) ANAF 628 FOH 656 HOD 68 plate 13 FFV 109 FF 176
Fantailed Darter Etheostoma flabellare f= fan	FF 3-7 cm. TL 7.6 cm. TL  olive-green no recent reports	ID: Deep, compressed; pointed head, round tail; PROTRUDING lower jaw; sides light w/ narrow, dark stripes; males 1ST 6-9 DORSAL SPINES W/ FLESHY LOBES; INCOMPLETE lateral line; H: Small to medium sized, shallow streams; sand to gravel bottoms; vegetation; rather tolerant to siltation, pollution; SP: Variable: bottom nest, underneath objects or on vegetation, depending on conditions;	AFGF 567 (238) ANAF 647 FOH 691 HOD 147 plate 33 FFV 107 FF 189
Tessellated Darter Etheostoma olmstedi o= after C. H. Olmstead	FF 4-6 cm. TL 8.8 cm. TL  straw-olive common	ID: Elongate, cylindrical; DEEP GROOVE seperates mouth and snout; "W,X or Y" markings on sides; 6 dark, saddle-shaped blotches along back; STRAIGHT, COMPLETE lateral line; H: Variable; shallow, mud to rubble bottoms; avoids strong riffles; hardy; lives 3-4 yrs; SP: Shallow water (to 60 cm.), over sand-gravel; in single layer underneath objects; male guards nest; 45-55°F (12-18°C)	AFGF 570 (247) ANAF 677 FFNH 113 HOD 85 plate 19 FFV 108 FF 177
Glassy Darter Etheostoma vitreum v= glassy	FF 4-6 cm. SL  many villi surround anus in spring pellucid-tan very rare	ID: Very slender; head pointed; NO BAR ACROSS EYE; translucent abdomen; fins plain; pectoral fins VERY large; 6-9 dark mid-lateral dashes; STRAIGHT, COMPLETE lateral line; H: Creeks & small rivers; over sand or gravel; only Etheostoma darter to spend most of its time buried in sand; SP: March-April; over rocks or logs; its communal spawning is unique;	AFGF 576 (250) ANAF 708 HOD 92 plate 20 FFV 106 FF 174

(see Kennedy 1965, Ches. Biol. Lab. (mimeo) on reproductive habits in D.C. area)

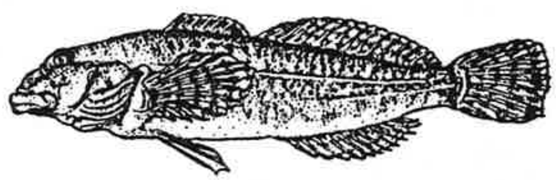
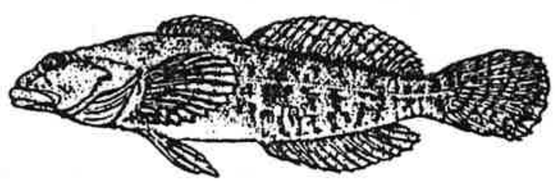
Small perch which dart along bottom:

O. Perciformes, Cont.	F. Percidae, Cont. Perches	Field Identification & Life Study Notes	
Swamp Darter Etheostoma fusiforme f= spindle shaped	FF 3-5 cm. SL  green no recent reports	ID: Elongate, slender, laterally compressed; snout short; strong opercular spine; NO GROOVE separating mouth & snout; 3-4 DISTINCT DARK SPOTS AT BASE OF TAIL; UPWARD-ARCHED, INCOMPLETE lateral line; H: Shallow, slow-moving to stagnant waters; over mud & detritus; heavy vegetation; tolerant of temps. to 90°F (32°C); SP: In spring, amongst vegetation;	AFGF 568 (248) ANAF 650 FFNH 114 HOD 155 plate 36 FFV 106 FF 185
Shield Darter Percina peltata P= diminutive of Perca p= shield	FF 5-8 cm. (?)  greenish-tan above, no recent reports	ID: Elongate, stout; snout moderately blunt; 2-9 large, modified scales on male belly; dark bar on midline of chin; large, dark blotches & small, lighter, squarish ones form midlateral band; lateral line complete; H: Riffles; over gravel & rubble; adults avoid mud, silt, slow-moving water; SP: Mid-April-May; 45°F(10°C); large specialized scales on belly of male stimulate female;	AFGF 582 (237) ANAF 736 HOD 39 plate 3 FFV 113 FF 173
Stripeback Darter Percina notogramma	FF 4-7 cm. SL  no recent reports tan above In Anacostia tribs.(?)	ID: See shield darter; LACKS dark bar on midline of chin; blotches are more oval; distinct pale yellow dorso-lateral stripe above 6-8 black blotches; H: Riffles & pools of streams; SP: See shield darter; 40-52°F (8-16°C); In riffles; agonistic behavior(Loos);	AFGF 582 (x) ANAF 731 HOD 38 plate 3 FFV 113 FF 174
Log Perch Percina caprodes c= pig (snout)	FF 10-15 cm SL  olive to yellow extirpated	ID: Elongate, almost cylindrical; 15-22 DARK SADDLES ABOVE; head cone shaped; snout pointed, extends beyond mouth; caudal spot usually present; lateral line complete: H: Clean, varied composition runs to 39 meters; avoids silted areas, pollution; captures insects by flipping stones with snout; SP: Spring; shallow sandy shores; eggs buried in sand;	AFGF 578 (239) ANAF 719 HOD 50 plate 7 FFV 112 FF 170

Large perches with stiff, serrated opercles:

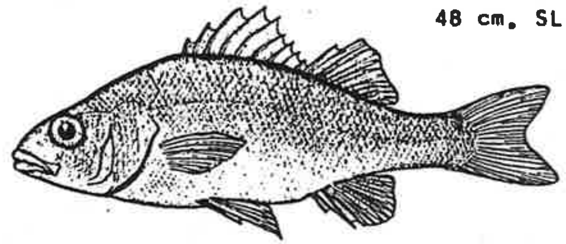
O. Perciformes, Cont.	F. Percidae, Cont. Perches	Field Identification & Life Study Notes	
Yellow Perch Perca flavescens P= perch f= yellowish	FF 15-30 cm TL  brassy-green to golden-yellow abundant	ID: Oblong, moderately compressed; mouth large; NO canine teeth; free-edges of preopercle strongly serrated; 5-9 dusky bars across back almost to belly; prefers temps of 70-77 F (21-24 C); H: Variable; deep water schooler which prefers clear, open water w/ moderate vegetation; moves to feed in shallows at dusk; SP: Mid 40's°F (4°C); tribs.; no parental care; average of 40,000 eggs in ribbons to 8 ft.;	AFGF 578 (89) ANAF 713 FOH 614 FFNH 110 FOSE 102 FFV 105 FF 169
Walleye Stizostedion vitreum S= pungent throat v= glassy (eye)	FF 30-78 cm. TL 100 cm. TL  dusky-brass, greenish-yellow common	ID: Elongate, slightly compressed; milky eyes; mouth large; CANINE TEETH on jaws; free edges of preopercle strongly serrated; black basal blotch on last 3 dorsal spines; lower lobe of caudal fin whitish; H: Moderately deep water (to 15 m); nocturnal; firm bottoms; avoids vegetation, turbidity; SP: 37-63°F (3-17°C); over shallow gravel; requires extended chill (10 C) for spawning; eggs scattered, 40,000/lb. of body weight;	AFGF 585 (98) ANAF 747 FOH 607 FFNH 112 FFV 113 FF 168

small fishes with large heads, tapering bodies, serrate opercles:

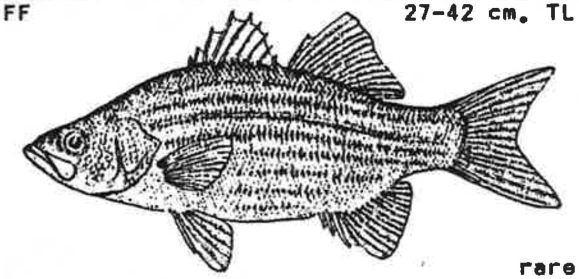
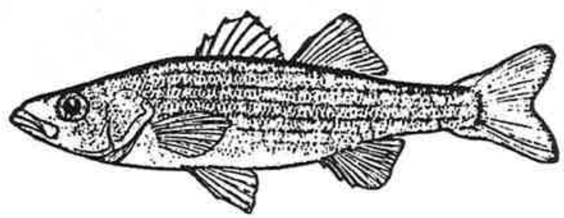
O. Perciformes, Cont.	F. Cottidae Sculpins	Field Identification & Life Study Notes	
Mottled Sculpin Cottus bairdi C= miller's thumb	FF 4-12 cm. SL  brown to grayish olive no recent reports	ID: Robust, THICK anteriorly; no scales; large, flat, broad head w/ preopercle spine; broadly rounded snout; NO chin mottling; 3 saddles on back under dorsal fins; caudle peduncle DEEP; tail rounded; H: Clear, cold to warm streams; over rocky or sandy-gravel bottoms; benthic feeder; essentially a headwater fish; SP: Spring, 50°F (10°C); adhesive eggs on roof of nest, under rocks;	AFGF 727 (246) ANAF 805 FF 156
Potomac Sculpin Cottus girardi	to 12.5 cm. TL  pale-brownish no recent reports	ID: Robust, DEPRESSED anteriorly; large, flat, broad head; CHIN MOTTLED; 3 DARK saddles on back under dorsal fins; caudle peduncle SLENDER; (see Banded, Slimy (AFGF 728) Sculpin) H: Upper Potomac river; common in elodea; tolerant of turb. & high temp.; SP:	AFGF 728 (x) ANAF 812 FFV 94 FF 155

Temperate Basses = Fishes with 1 or 2 opercular spines, 2 dorsal fins that are deeply divided or seperate, forked caudal tail:

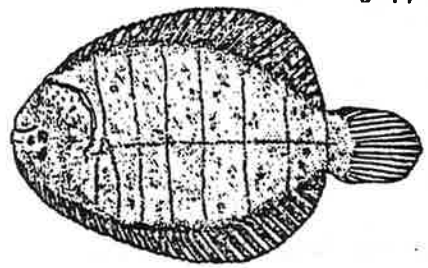
Fish with well developed pseudobranchiae, dorsal fins not divided:

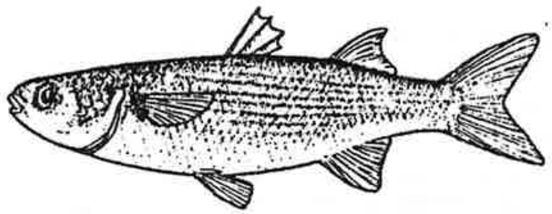
O. Perciformes, Cont.	F. Percichthyidae Temperate Basses	Field Identification & Life Study Notes	
White Perch Morone americanus M= (is unexplained) a= from america	FOH 10-17 cm. SL 48 cm. SL  silvery very abundant	ID: Oblong, moderately compressed; head SMALL; jaws EQUAL; 2 opercular spines; dorsal fins barely connected; 2nd anal spine length roughly EQUAL to 3rd; NO stripes on sides; H: Semi-anadromous; brackish bays & freshwater rivers; SP: Upper 50 's F (13 C); in coves over gravel, stones, logs, or open water;	AFGF 553 (97) ANAF 573 FF 158 FFNH 90 FCB 244 FOSE 98 FFV 97 FOH 546

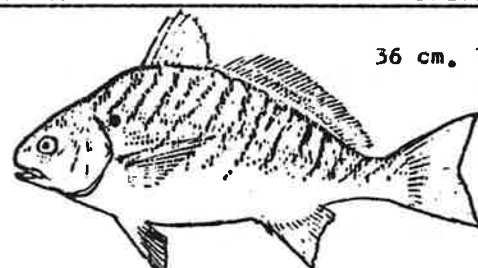
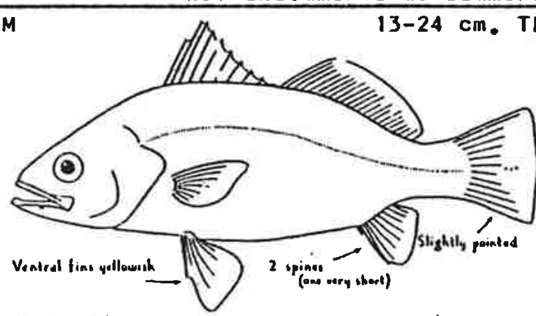
Fishes with well developed pseudobranchiae, dorsal fins divided:

White Bass Morone chrysops c= appears golden (eye)	FF 27-42 cm. TL  rare bluish-silver escapes from VA lakes?	ID: Robust, moderately compressed; head SMALL; lower jaw slightly PROJECTING; EYE YELLOW; single, sharp opercular spine; SINGLE patch of teeth on back of tonque; 2nd anal spine 2/3 (or more) length of 3rd; 6-12 dusky stripes, often interrupted; H: Prefers clear, slow moving waters with firm bottoms; SP: Spring; migrates up streams; no nest; no parental care;	AFGF 534 (95) ANAF 574 FOH 542 FOK 250 FFV 97 FF 157
Rockfish or Striped Bass Morone saxatilis s= living among rocks	FF 45-200 cm. TL  black olivaceous, silvery common	ID: Elongate, moderately compressed; head LARGE; lower jaw slightly PROJECTING; 2 flat opercular spines; 2 parrallel patches of teeth on tonque; 2nd anal spine 1/2 the length of 3rd; upper sides w/ 6-9 uninterrupted stripes; H: Anadromous; variable; SP: Spring; 57-70 F (14-21 C) no nests, no parental care;	AFGF 535 (94) ANAF 576 FOH 539 FCB 247 FOSE 100 FFV 97 FF 157

Note: Hybrids of striped bass x white bass are also found in the District of Columbia, possibly excapes from stocking in Occoquon Lake, Virginia. Hybrids have deep bodies; stripes distinct, usually broken, several extending to tail; 2 parrallel patches of teeth on tonque; 2nd anal spine 2/3 (or more) the length of 3rd spine. Presumably these fish cannot spawn.

O. Perciformes, Cont.	F. Soleidae — Soles	Field Identification & Life Study Notes	
Hogchoker Trinectes maculatus m= spotted	FF 8-14 cm. TL  brown occasional	ID: Deep, round, dorso-ventrally flat body; eyes on right side; upper jaw longer than lower jaw; dusky w/ 7-8 narrow black bars across body; NO pectoral fins; H: Bottom feeder, eats annelids; downriver spring migration + upriver fall migration; SP: Spring, 68-77°F (20-25°C); sal. 9 ppt; 54,000 eggs; young move upstream;	AFGF 750 (70) ANAF 831 FCB 175 FOSE 105 FF 196

O. Perciformes, Cont.	F. Mugulidae — Mullets	Field Identification & Life Study Notes	
Striped Mullet Mugil cephalus M= the mullet c= head	FF 23-35 cm. SL  rare grey Mouth of Oxon Creek, 1985	ID: Elongate, cylindrical; NO lateral line; 6-7 darkish stripes on sides; head flat between eyes; mouth small, wide, terminal; lower jaw has fleshy knob at tip; H: Sifts micro-organisms from mud; SP: Migrates to marine waters to spawn;	AFGF 660 (484) ANAF 779 FCB 193 FOSE 196 FF 193

O. Perciformes, Cont.	F. Sciaenidae — Drums	Field Identification & Life Study Notes	
Spot Leiostomus xanthurus L= smoothed mouthed x= yellowish	FOSE 36 cm. TL  grayish-silver, yellow above not uncommon some summers	ID: Body deep, compressed; back strongly elevated; yellowish-black SHOULDER SPOT; NO barbels on chin; CONCAVE caudal fin; H: Bottom feeder; tolerates wide range of temps (35-95°F); moves to shallows in summer; lives to 5 yrs.; SP: Marine spawner; during late fall & winter; 59-79°F, matures at 2 yrs.;	FCB 271 ANAF 759 FOSE 156
Silver Perch Bairdiella chrysoura c= gold tailed	CFM 13-24 cm. TL  bluish-silver no recent record	ID: Moderately elongate, compressed; back elevated; mouth terminal, oblique; preopercle with SERRATED margin; fins mostly yellowish; body uniform in color, NO spots; H: Bay dweller, enters freshwater; eats small crustaceans, annelids, fish; midwater & bottom schooler; lives to 6 yrs.; SP: Late spring to summer; in the bay;	FCB 279 ANAF 757 FOSE 151

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