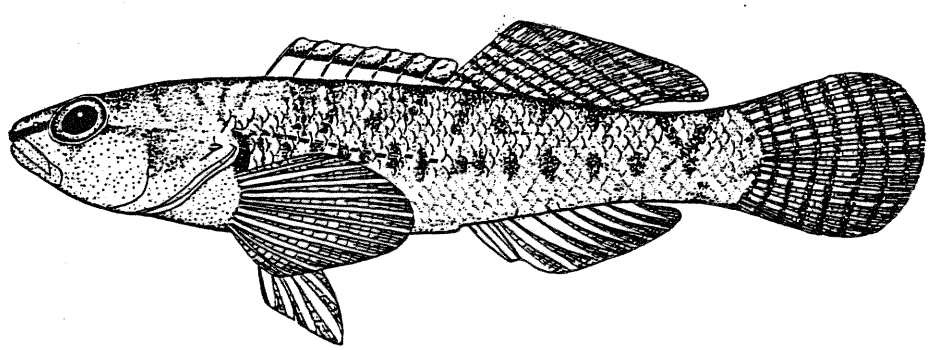
SOUTHEASTERN WATER POLLUTION BIOLOGISTS ASSOCIATION NEWSLETTER



SEPTEMBER 1990

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HIGHLIGHTS

Fall is rapidly approaching us here in the south. It seems a little darker each morning I make the fifty mile drive to work from Louisville. Tobacco harvesting has been under way since mid-August. Joe-Pye-weed, purple and yellow ironweed, white snakeroot, and goldenrod are in bloom along roadsides. Leaves are gradually turning color. In less than a month we will probably experience our first frost.

Highlights of this newsletter include: the agenda for the 1990 SWPBA meeting at Jekyll Island in October and two articles addressing biological monitoring. The first article entitled What can biological monitoring tell us about the environmental health of aquatic ecosystems was presented by Robert Hughes at the International Symposium on the Design of Water Quality Information Systems held at Colorado Sate University in June 1989. The second article was released by U.S. EPA in May 1990 and is entitled Ohio EPA's Use of Biological Survey Information. These articles should be of particular interest as we approach this year's SWPBA meeting. A listing of upcoming meetings has been included to keep members aware of events of possible interest.

(The line drawing on the cover depicts the stripetail darter Etheostoma kennicotti. The drawing was taken from The Fishes of Illinois by Philip W. Smith 1979.)

PLEASE CIRCULATE YOUR COPY OF THE NEWSLETTER

The Southeastern Water Pollution Biologists Association Newsletter is a publication for those interested in biological water pollution monitoring in Environmental Protection Agency IV.

SWPBA 1989-1990 President: Dave Chestnut, South Carolina Department of Health and Environmental Control, 2600 Bull Street, Columbia, SC 29201

SWPBA 1989-1990 Secretary: Lythia Metzmeier, Kentucky Division of Water, 18 Reilly Road, Frankfort, KY 40601

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ANNUAL MEETING OF THE SOUTHEASTERN WATER POLLUTION BIOLOGISTS ASSOCIATION (SWPBA)

THE BUCCANEER CLARION RESORT JEKYLL ISLAND, GEORGIA
OCTOBER 2-4, 1990

TENTATIVE AGENDA

Tuesday, October 2, 1990

8:00 - Noon	Registration ($15 to cover breaks and materials)	
8:30 - 8:45	Introduction	Mr. David Chestnut
8:45 - 9:15	Overview of State Program Highlights	One representative from each state
9:15 - 9:30	EPA Region IV Overview	Mr. Bruce Pruitt
9:30 - 9:45	Update of Interagency Cooperative Investigation of a PCB contaminated lake - Lake Hartwell, SC / GA	Mr. Don Dycus
9:50 - 10:05	Trend or Assessment? Edible Fish Tissue Data from a Textile Impacted Pond	Mr. Doug Darr
10:10 - 10:30	Break	

Biocriteria Development and Ecoregion Definition

10:30 - 10:45	Introduction - Goals of Ambient Monitoring; Why do we measure what we do, and is it really what we want?	Mr. David Chestnut
10:45 - 11:00	A New "Hilsenhoff-Type" Biotic Index for the Southeastern United States	Mr. Dave Lenat
11:05 - 11:30	Assessing Lotic Integrity using Geographic Information Systems and Biological Monitoring	Mr. Chris O'Bara
11:30 - 1:00	Lunch	
1:00 - 1:15	Potamoplankton, the River Continuum, Ecoregions, and other concepts: recycling old data into new information	Ms. Lythia Metzmeier
1:20 - 1:35	The Development of Criteria for Bioclassification Using Seven Years of Benthos Data, With Emphasis on Seasonal and Headwater Stream Complications	Ms. Trish MacPherson

1:40 - 4:00	Panel Discussion	
Panel Members:	Mr. Hoke Howard, moderator - EPA Region IV Ms. Vickie Bauer - Alabama Mr. Mike Beiser - Mississippi Ms. Trish MacPherson - North Carolina Mr. Mike Mills - Kentucky Ms. Vicki Tauxe - Florida	Each panel member should be prepared to discuss the experience and efforts of their state regarding these topics

Wednesday, October 3, 1990

8:30 - 8:45	Wetlands Advanced Identification of Western Kentucky Part I	Mr. Bill Ainslie
8:50 - 9:05	Wetlands Advanced Identification of Western Kentucky Part II	Mr. Bruce Pruitt
9:10 - 9:25	Toxic Blue-Green Algal Blooms Result in Advisories	Mr. Stanley Rogers
9:30 - 9:45	Is There Life in Oil Creek?, An Instream Survey of Browns Creek	Ms. Barbara Rector
9:50 - 10:10	Break	
10:10 - 10:25	Organic Chemical Assessment of Sediment, Two Finfish and Three Shellfish Species in Charleston Harbor, SC	Mr. Doug Darr
10:30 - 10:45	Seasonal Variation in the Fish Population of Big Sandy River / Kentucky Lake	Mr. Jeff Duke
10:50 - 11:05	Land Use Impacts in the Crescent Lake Basin, Florida Part I: Sediment and Macroinvertebrates	Mr. Russ Frydenborg
11:10 - 11:25	Land Use Impacts in the Crescent Lake Basin, Florida Part II: AGPT, Limiting Nutrients, and Phytoplankton	Ms. Kathy Lurding
11:30 - 1:00	Lunch	
1:00 - 1:15	Short-Term Toxicity Testing of Juvenile Freshwater Mussels as a Supplemental Measure to Insure Adequacy of National Toxics Control Policy	Mr. Aubrey McKinney
1:20 - 1:35	Microtox?	Ms. Joy Broach
1:40 - 1:55	An Overview of Whole Effluent Toxicity in North Carolina Compliance History	Ms. Dianne Williams Wilburn

Biological Laboratory Certification

2:00 - 2:15	Two Years Retrospective of the Biological Laboratory Certification Program in North Carolina	Mr. Matt Mathews

2:20 - 2:45	Break	
2:45 - 4:00	Panel Discussion	
Panel Members:	Mr. Skip Call, moderator - Kentucky Dr. Debra Sauer - South Carolina Mr. Ron Weldon - Region IV EPA Mr. Matt Mathews - North Carolina Mr. Norman Blakey - Alabama	Each panel member should be prepared to discuss their states experience and efforts regarding this topic

Thursday, October 4, 1990

8:30 - 8:45	Toxicity Testing in Alabama	Ms. Cathy Matthews
8:50 - 9:05	Effects of Two Electroplating Plants on the Macroinvertebrate Communities of Cane Creek, Lauderdale County, Tennessee	Ms. Debbie Arnwine
9:10 - 9:25	TBA	Mr. Ron Chandler
9:30 - 9:45	Lotus Spreadsheets	Mr. Dale Rector
9:50 - 10:05	WADE Project, Eutonton, Georgia: Constructed Wetlands for Assimilation of Dairy Effluents	Mr. Hoke Howard
10:10 - 10:25	Is Biomonitoring Working?	Mr. Al Westerman
10:30 - 11:00	TBA	
11:00 - Noon	Business Meeting	
ADJOURN		

WHAT CAN BIOLOGICAL MONITORING TELL US ABOUT THE ENVIRONMENTAL HEALTH OF AQUATIC ECOSYSTEMS?

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INTRODUCTION

Millions of dollars per year are spent on aquatic ecosystem monitoring directed toward these objectives:

- Assess status and trends
- Identify problems
- Refine standards, permits, and best management plans
- Evaluate the effectiveness of management programs
- Set management priorities

In the United States, however, we cannot yet meet even the first objective in any comprehensive manner. Consequently, management programs and priorities for aquatic ecosystems may or may not be fulfilling the Clean Water Act objective "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

During this meeting, many speakers expressed similar concerns about monitoring programs.

- What are the biological effects of highly dilute chemical concentrations? (Grigg, this volume)
- What is the current quality of the Nation's waters?
- Why do decision makers make such little use of monitoring information? (Moss, this volume)
- What are we getting for the $80 million we spend yearly on monitoring and pollution control?
- How does the quality of most waters compare with that of more natural environments?
- What are the likely ecological consequences of a management action, or continued inaction?
- If we meet permit and best management plan requirements, has ecological quality been achieved?
- Are we protecting the ability of ecosystems to recover from stress? (Messer, this volume)
- What are our major environmental problems and their probable causes? Are conditions improving, worsening, or relatively constant? (Magnien, this volume)

I contend that a major reason we have difficulty answering these questions is because we frequently monitor the wrong variables, or we monitor or analyze proper variables in wrong ways. The basic questions we must ask are, "How can we best assess the health of entire ecosystems and how can we extrapolate from a limited amount of site-specific monitoring?" Although measurement of standard chemical water quality variables seems to be the preferred approach, there are

several reasons to favor biological monitoring, though not to the exclusion of chemical/toxicological and physical monitoring. In addition, probabilistic sampling and eco-regional based standards offer a means to extrapolate site-specific monitoring data to large regions with known statistical confidence.

VALUES OF BIOLOGICAL MONITORING

Biological monitoring and analysis have advanced considerably in recent times. Historically, biological monitoring focused on indicator species, species presence/absence, or species lists unintelligible to nonexperts. Field sampling lacked rigorous, consistent proced- ures and occasionally involved expensive surveys of all biota over several seasons or years. Data analyses were simplistic and emphasized post facto "best professional judgement." In this paper, biological monitoring (biomonitoring) is defined as "the collection of quantitative or semiquantitative biological community data at regular intervals and with an established quality assurance (QA) protocol." Recently, the U.S. EPA (U.S. EPA 1987, Whittier 1988, Plafkin et al. 1989, U.S. EPA 1989) has shown increased interest in biological monitoring.

There are eight major reasons for adopting biological monitoring:

1. The biota are of direct concern to the public and to decision makers--many people care about particular game or rare species and about the richness of the biological community in general.

2. Biological monitoring allows assessment of a wide range of stressors--physical, chemical, biological, point, nonpoint, toxic, and nontoxic. It provides a firm basis for assessing nonchemical and nontoxic degradation, which is missing from chemical and toxicological monitoring.

3. Biomonitoring offers a mechanism for evaluating episodic events. The long-term effects of droughts, floods, spills, process changes,and illegal dumping are monitored continuously by organisms. Traditional chemical/toxicological monitoring is likely to miss such events.

4. The cumulative effects of multiple dischargers and stressors can be examined through monitoring of biological communities. Traditional chemical monitoring misses such synergistic effects.

5. The biota offer a means of estimating (1) bioaccumulation, through chemical analysis of tissues, and (2) indirect effects, through studying the influences of stressors on the food chain, competition, predation, migration, and life histories. These critical community characteristics simply cannot be assessed chemically or physically.

6. Biomonitoring frequently leads to diagnosis of the probable stressor(s) because of the different ways in which different stressors affect various components of the community. For example, comprehensive biological surveys have shown that in many parts of the country physical habitat (structural and hydrological) perturbations and diffuse pollution (particularly clean sediments) are much greater problems than such highly publicized stressors as point sources, acid rain, hazardous waste sites, and toxic chemicals.

7. Biological monitoring provides a direct measure of biological and ecological health or integrity; therefore, it provides a direct measure of whether the objective of the Clean Water Act is being met.

8. Biomonitoring is often more cost effective and less expensive than bioassays and chemical analyses (Table 1), thus it offers a useful screening or problem detection tool.

ADDRESSING ECOLOGICAL VARIABILITY

A basic problem that all environmental monitoring programs must address is ecological variability, both temporal and spatial.

Table 1. Cost Comparisons for Chemical, Toxicological, and Biological Assessments

Assessment	Number of Samples/Tests	Cost/site ($)
Water Quality	1-6	350-1,700
Bioassay	Grab acute/Composite chronic	3,200-12,600
Macroinvertebrates	1-3	175-700
Fish	1-3	235-900

(From Chris Yoder, pers. comm., Ohio EPA, Columbus, Ohio; Terry Maret, pers. comm., Nebraska Department of Environmental Control, Lincoln, Nebraska).

These are inherently interrelated and often difficult to distinguish. We can assess the magnitude of temporal variability by sampling frequently, but most monitoring programs lack the resources to do so. In ecological assessments, we attempt to minimize the influence of temporal variability in four ways:

1. Sample during periods of relative stability in flow and temperature, when assemblages are most stable and species least likely to migrate; at these times, anthropogenic stressors are less variable and typically most stressful.

2. Sample longer-lived species (e.g., macroinvertebrates and fish in streams and rivers), which are temporally the most stable components of the aquatic biota. Long-lived species are less influenced by daily temperature/flow/nutrient changes and they integrate longer term influences rather than the short-term fluctuations that can be considered as ecological noise (in a statistical sense).

3. Record the number or biomass of individuals of each species collected for a given unit of effort or area sampled. Such data are generally more informative of status and trends than presence/absence or rare/common/ abundant data and are much more easily and reliably collected than absolute abundances.

4. Analyze multiple structural and functional characteristics of assemblages as opposed to individual species or a single metric, such as a diversity index. This further reduces natural temporal variability resulting from species replacements that fill the same ecological niche.

Although not complete measures of ecosystem health, these assessments reflect the basic changes in the biota that occur over a single season or over years.

Like temporal variability, spatial variability can be accommodated. Toward this end, scientists at the U.S. EPA Environmental Research Laboratory in Corvallis, Oregon, have developed and evaluated a means for aquatic scientists and managers to stratify spatial variability. This method, called the ecoregion approach (Omernik 1987, Hughes and Larsen 1988), is a deductive technique based on the natural spatial (geographical) organization of ecosystems. In this approach, the patterns in ecosystem regions are evaluated through analysis of available maps, and ecoregion boundaries are delineated by synthesizing the maps (Figure 1). This is a qualitative technique requiring considerable geographic knowledge and expertise. The basis for this approach is the understanding that the character of a water body (e.g., its water quality, flow regime, habitat structure, energy base, and migration barriers) is in large part a function of the climate, topography, geology, soil, vegetation, and land use of its drainage basin.

Within each ecoregion, a series of minimally impacted reference sites (controls, benchmarks) is monitored (Hughes et al. 1986). Reference sites are selected to be as typical of the natural ecoregion conditions as possible; their selection is based on:

Minimal perceived impacts from stressors common to the ecoregion

Proximity to official and de facto biological refuges

Fewer migration barriers

Water body size and channel or basin type

Evaluation of historical conditions

Candidate sites are located on maps, then reconnoitered at ground level, and from aerial views, if possible. The biota and habitat are then quantitatively sampled and the data analyzed and ranked.

BIOLOGICAL DATA ANALYSES

The assemblages chosen are usually a function of the water body, stressor of concern, and staff expertise; however, the U.S. EPA recommends that more than one assemblage be chosen to account for differing

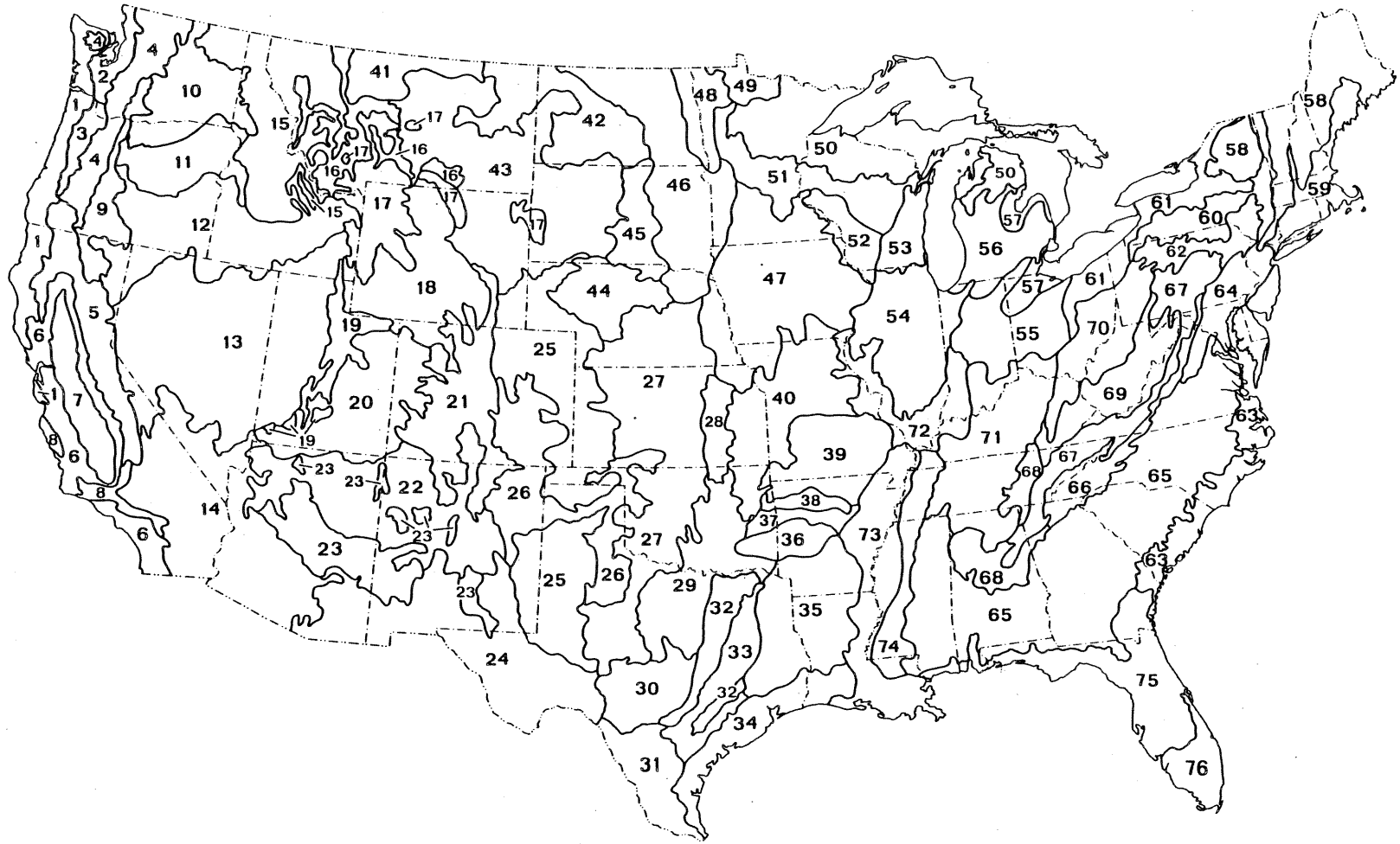

Figure 1. Ecoregions of the conterminous United States (from Omernik 1987). Numbers represent the 76 different ecoregions. Most major river basins cross ecoregions; therefore, reliable basin-wide extrapolations are hindered by drastically different types of landscapes.

sensitivities and provide additional verification (Whittier 1988, Plafkin et al. 1989). Monitoring of all possible assemblages is not recommended. Assemblages to be monitored should be selected carefully, by experienced biologists, to assure sufficient representation of the system but to avoid needless duplication and increased cost.

Histograms and detrended correspondence analyses are particularly effective for displaying ecoregional differences in species assemblages (Whittier et al. 1988; Figures 2 and 3). Indices of assemblage quality, which integrate several measures of biological health, are more useful for assessing and quantifying status, trends, and ecological integrity. One such index, the Index of Biotic Integrity (IBI) (Karr et al. 1986), is a quantification of a fish ecologist's judgment of the relative quality of a fish assemblage. The IBI is composed of 12 metrics (appropriately modified for different regions), each of which measures a different aspect of fish assemblage health (Table 2). Metric values approximating, deviating slightly from, or deviating greatly from expected ecoregional reference site values are scored 5, 3, or 1, respectively. The scores are added to give an IBI score of 60 (excellent) to 12 (very poor).

Quantitative indices such as the IBI and individual IBI metrics offer direct, objective, repeatable measures of aquatic ecosystem health (Karr et al. 1986, Lenat 1988, Ohio EPA 1988, Plafkin et al. 1989). For example, the Ohio EPA (1988) used the IBI and ecoregional reference sites to set quantitative biological criteria for stream and river ecosystems. One hundred regional reference sites were sampled three times a summer during a 2-year period and regional IBI values were determined. Regional criteria, based on the results from these sites, were set at the 25th percentile (Figure 4) and have been used to assess the impact of stressors on a particular river reach (e.g., Figure 5) or statewide (Figure 6). The IBI has also been used to assess site-specific trends over time in aquatic ecosystems (Figure 7).

SUMMARY

Biological monitoring offers a proven, cost-effective way to evaluate the health of aquatic ecosystems. For the sake of brevity, this paper focuses on examples using fish assemblages and the IBI, but fish and macroinvertebrate assemblages provide complementary information and it is best to monitor both for streams and rivers. Macroinvertebrates have been sampled for many years, but only recently have rigorous multimetric indices been suggested for them (Lenat 1988, Ohio EPA 1988, Plafkin et al. 1989), and the indices have not yet been tested as widely as the IBI. Quantitative biological data from relatively undisturbed reference sites typical of aquatic ecoregions provide us with benchmark information, hence these sites serve as "controls" in our "experiments" with anthropogenic perturbations. This information can be used to evaluate data for a particular site or, if a representative sample is drawn, for entire ecoregions. Finally, although this paper focuses on biological monitoring because of the current emphasis on chemical monitoring, it is not meant to suggest that physical habitat and chemical/toxicological monitoring are valueless. Rather, quantitative criteria developed from all three types of monitoring are necessary tools for improved water resource regulation and management (Figure 8).

ACKNOWLEDGEMENTS

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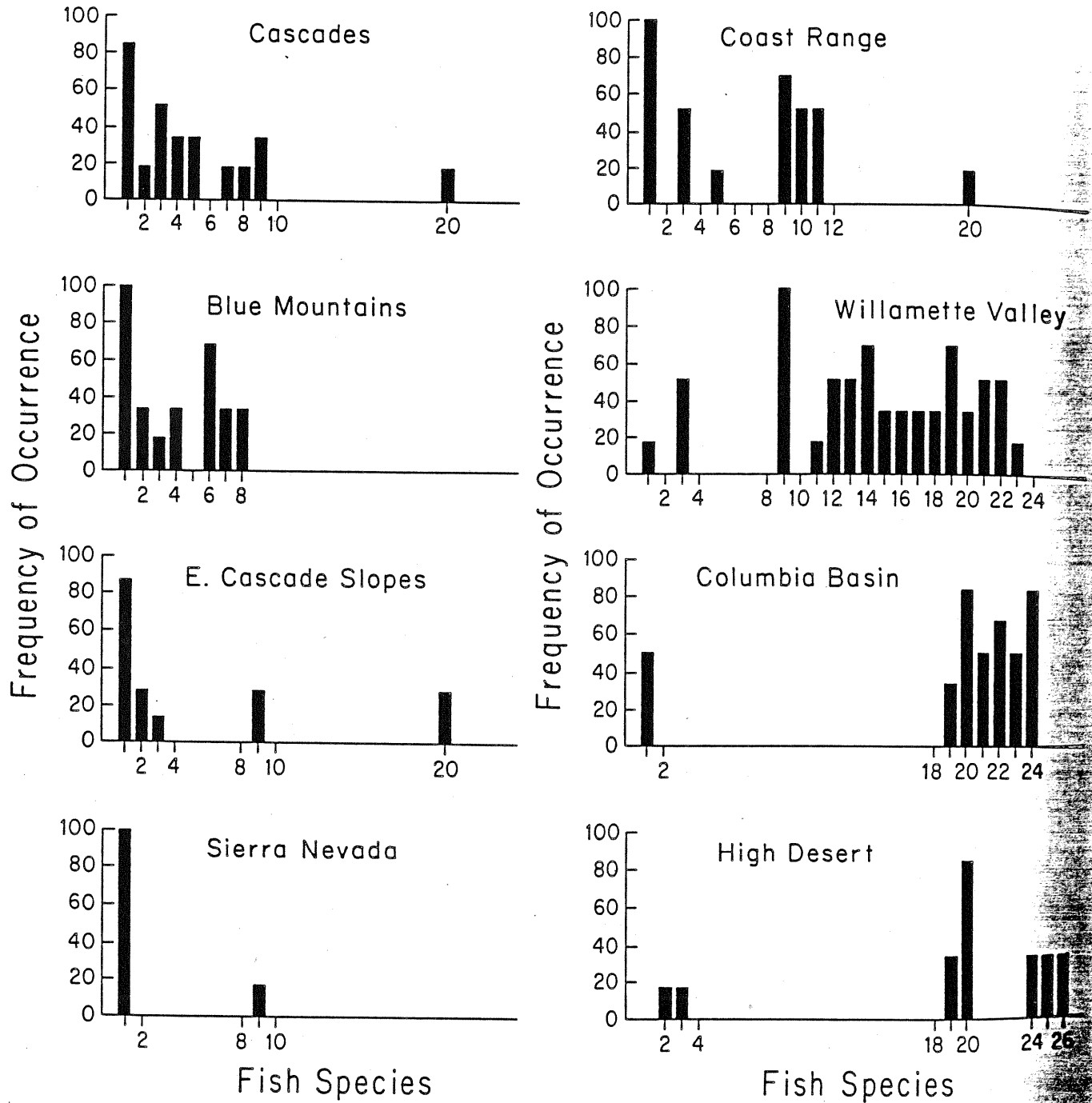

Figure 2. Histograms showing frequencies of occurrence of 26 fish species common to Oregon ecoregions (from Whittier et al. 1988). 1. Rainbow trout, 2. Brook trout, 3. Cutthroat trout, 4. Mottled sculpin, 5. Torrent sculpin, 6. Bull trout, 7. Piute sculpin, 8. Mountain whitefish, 9. Reticulate sculpin, 10. Pacific lamprey, 11. Coho salmon, 12. Pacific brook lamprey, 13. Warmouth, 14. Bluegill, 15. Largemouth bass, 16. Common carp, 17. Mosquitofish, 18. Threespine stickleback, 19. Redside shiner, 20. Speckled dace, 21. Largescale sucker, 22. Northern squawfish, 23. Chiselmouth, 24. Bridgelip sucker, 25. Tahoe sucker, 26. Redband trout.

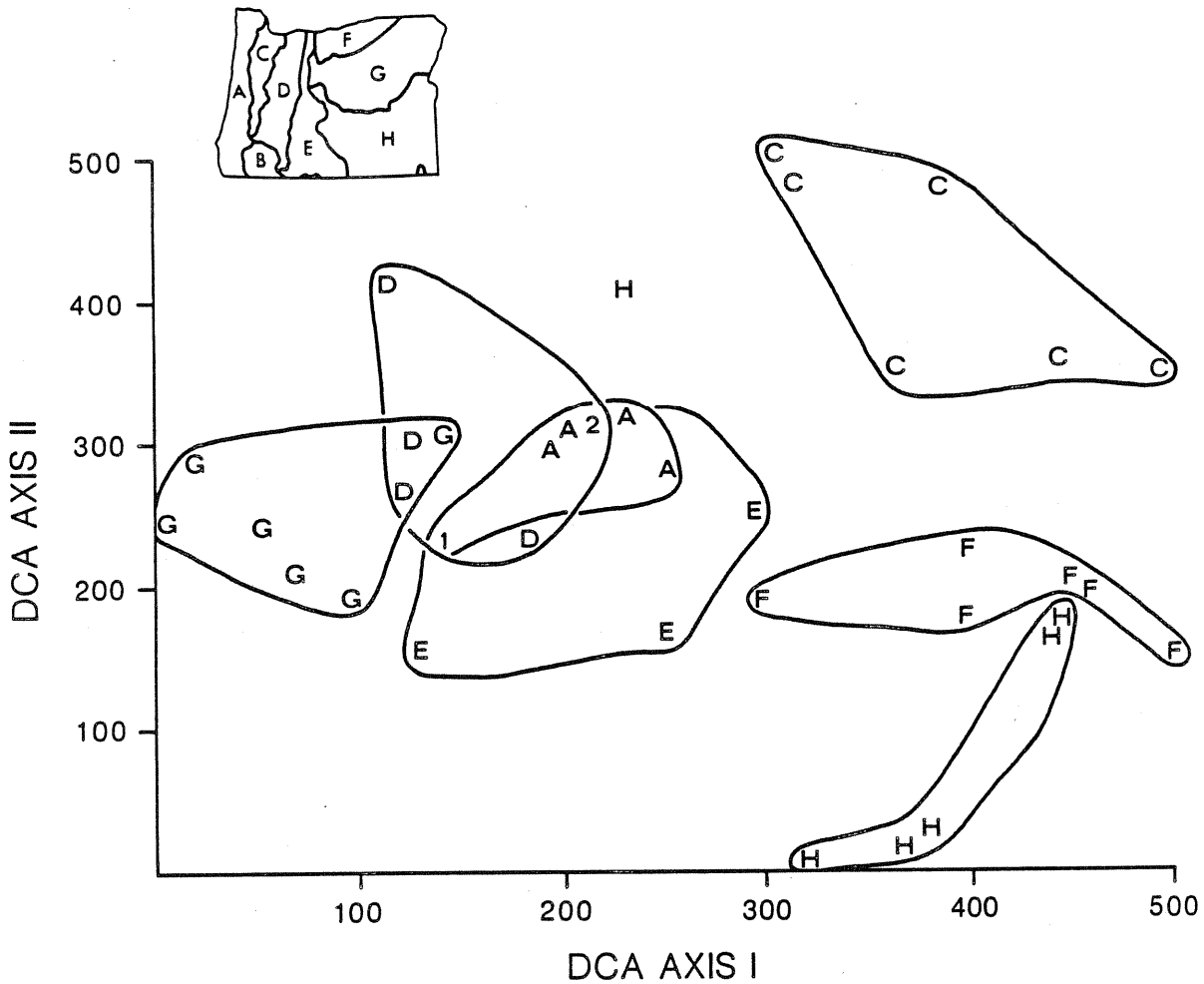

Figure 3. Regional patterns in Oregon fish assemblages (from Whittier et al. 1988). A = Coast Range, B = Sierra Nevada, C = Willamette Valley, D = Cascades, E = Eastern Cascades Slopes and Foothills, F = Columbia Basin, G = Blue Mountains, H = Snake River Basin/High Desert. 1 = sites with 100% rainbow trout, 2 = sites with only rainbow trout and reticulate sculpin.

Table 2. IBI Metrics and Examples of Scoring Criteria

Metric	Scoring Criteria (%)		
	5	3	1
Number of native fish species[a]	>67	33-67	<33
Number of darter/benthic species[a]	"	"	"
Number of sunfish/water column species[a]	"	"	"
Number of sucker/long-lived species[a]	"	"	"
Number of intolerant species[a]	"	"	"
Total number of individuals[a]	"	"	"
Top piscivorous individuals	>5	1-5	<1
Tolerant individuals	<10	10-25	>25
Omnivorous individuals	<20	20-45	>45
Insectivorous individuals	>45	20-45	<20
Exotic or hybrid individuals	<2	2-9	>9
Individuals with disease or anomalies	<1	1-5	>5

(From Karr et al. 1986, Ohio EPA 1988, Miller et al. 1988)

[a] Determined by maximum species richness (or total abundance) lines (Karr et al. 1986, Ohio EPA 1988) drawn from available data.

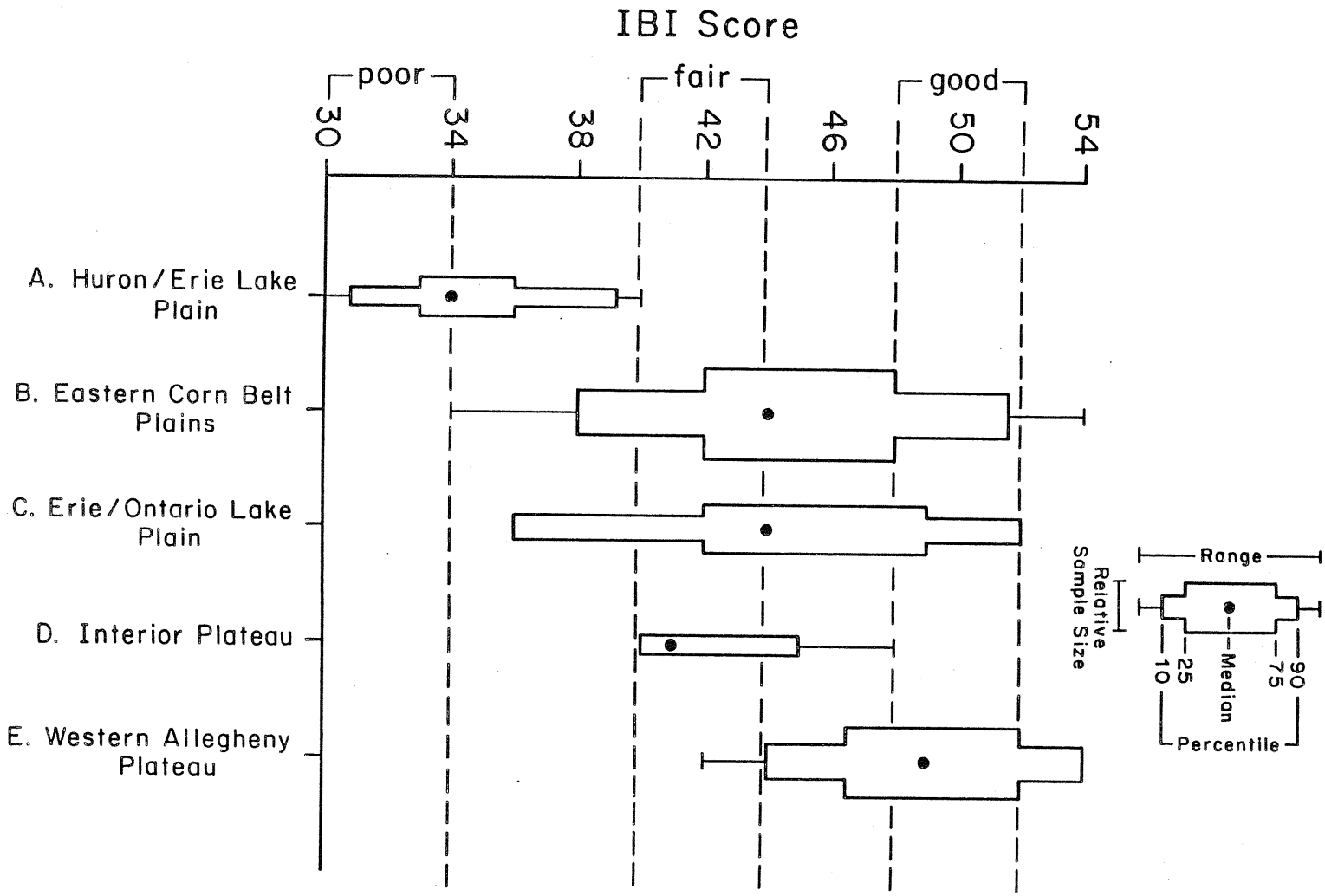

Figure 4. Index of Biotic Integrity (IBI) values for Ohio ecoregional reference sites (from Whittier et al. 1987). Protective expectations for one region may be underprotective or unreasonable for another.

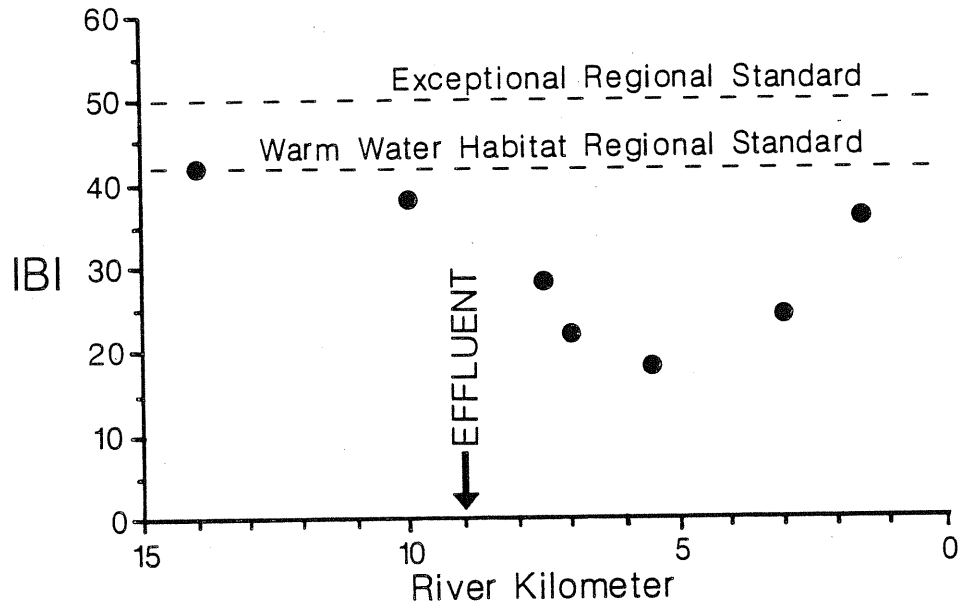

Figure 5. Recovery of Yellow Creek, in Ohio's Erie/Ontario Lake Plain ecoregion (from Ohio EPA 1988). No part of the creek, including the segment above the pollution source, is attaining the regional "exceptional" standard IBI value of 49, which is based on the 75th percentile in Figure 4 and allows for a 4-point IBI uncertainty. One-third of the creek is attaining the regional "warmwater habitat" standard of 42 (25th percentile).

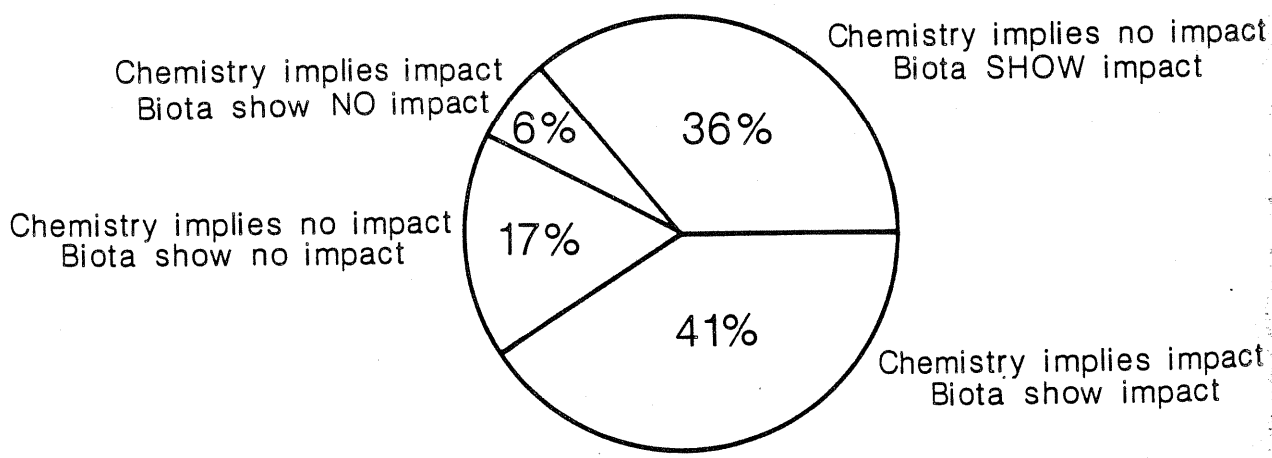

Figure 6. Discrepancies between chemical and biological assessments of impacts evaluated at 431 point source sites in Ohio (Gallant et al. 1989). Biotic impacts, where none are predicted from chemistry, apparently resulted from physical habitat perturbations. This figure suggests that biological evaluations may provide greater protection of Ohio surface waters than do chemical/toxicological assessments.

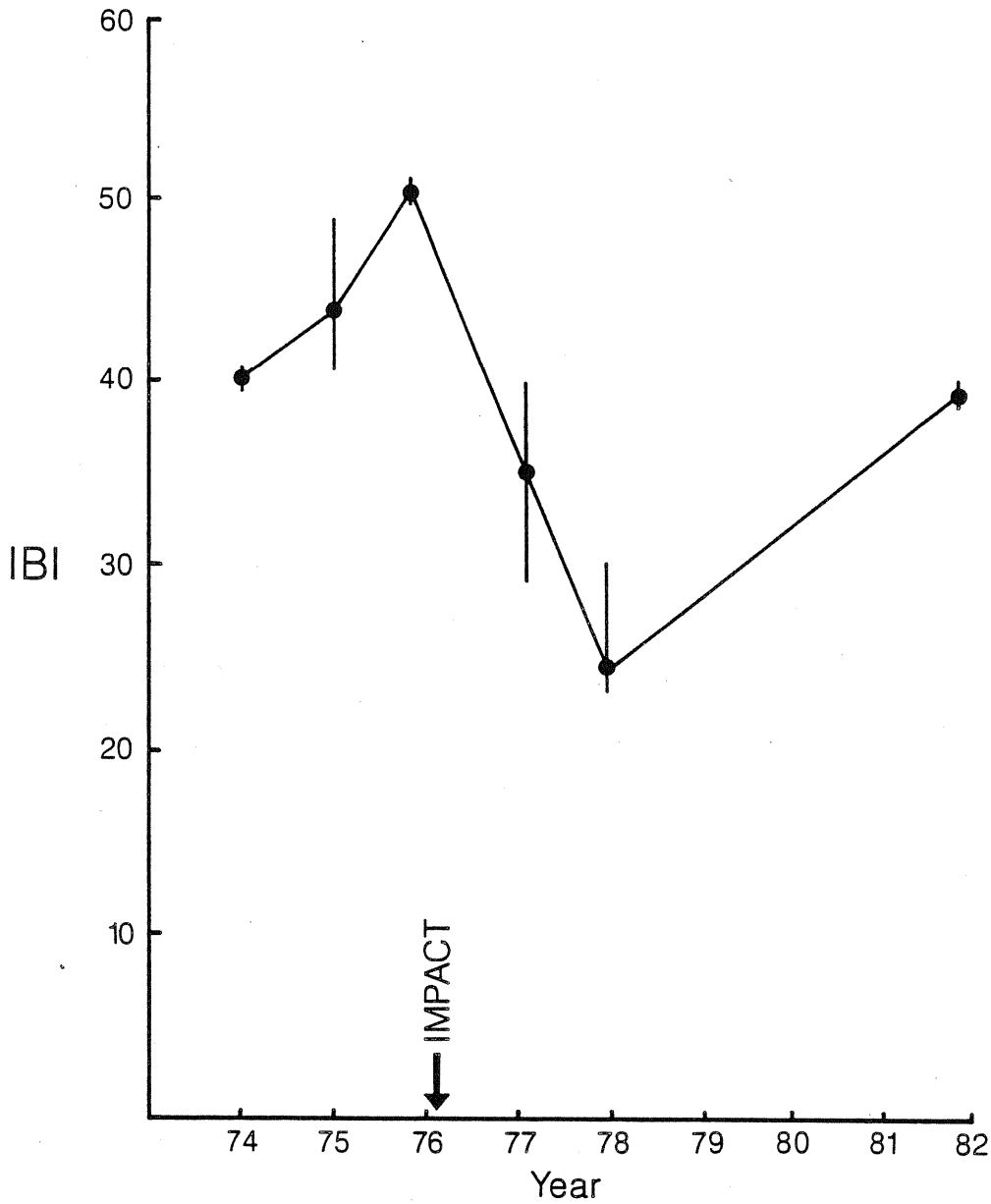

Figure 7. Temporal trend in Wertz Drain at Wertz Woods, Indiana, stressed by sediment (from Karr et al. 1986). Vertical lines represent ranges in seasonal samples. This multiyear sedimentation impact would not have been detected by water quality monitoring.

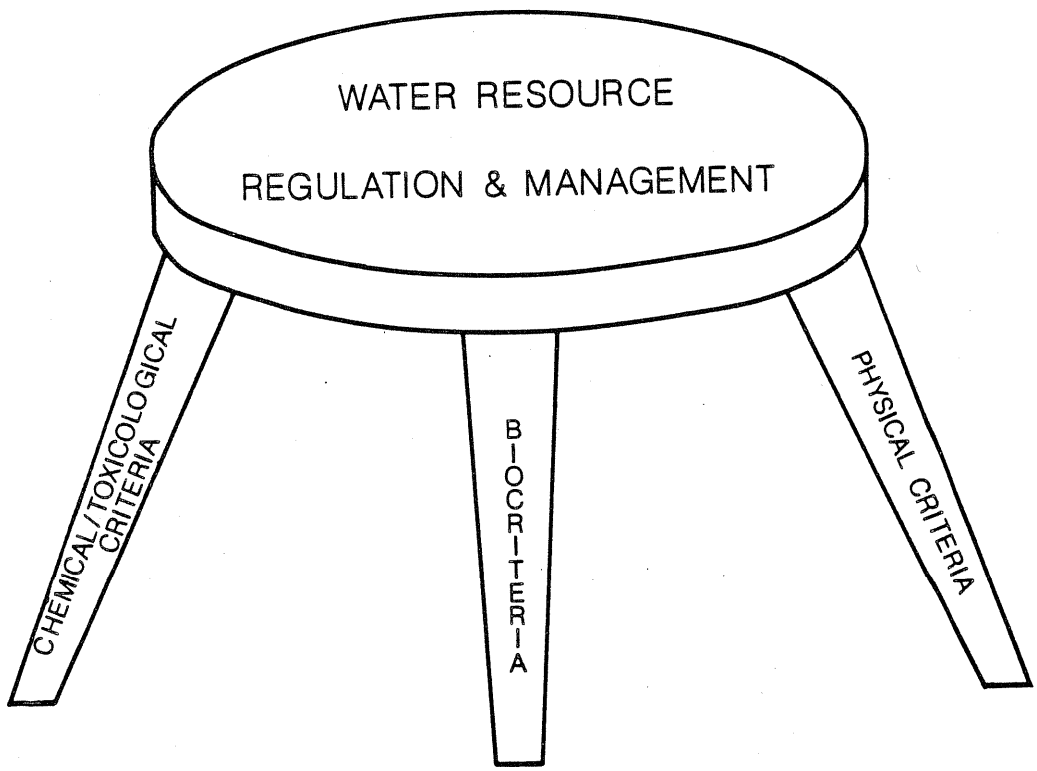

Figure 8. Just as a three-legged stool is more stable than a one- or two-legged stool, regulatory criteria and decisions based on biological, physical, and chemical/toxicological monitoring offer a more stable foundation for water resource management.

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EPA United States Environmental Protection Agency | Assessment and Watershed Protection Division, Office of Water, Washington, DC 20460 | May 1990

Water Quality Program Highlights

Ohio EPA's Use of Biological Survey Information

BACKGROUND

The Federal Clean Water Act has been amended numerous times since it was completely rewritten in 1972, but its principal goal remains unchanged: to restore and maintain the physical, chemical, and biological integrity of our surface waters. To achieve this environmental goal, we – EPA, the States, the regulated community, and the public – need information about the aquatic environment. We need information to help us develop meaningful yet workable water quality goals, wisely direct our limited resources to those waters that will benefit most from restoration or control efforts, and ensure that our efforts result in measurable environmental improvements.

EPA and State monitoring programs have historically relied on one type of information – measurements of individual pollutants in the water column. Only slowly have chemical analyses of the water column been supplemented by other monitoring methods. There seems to be a consensus today that to manage our remaining water quality problems cost-effectively, we must employ a variety of methods capable of assessing the impact of chemicals in tissue and sediment as well as in the water column, the condition of the physical habitat as well as water column chemistry, and the response of resident biota as well as laboratory test species.

HIGHLIGHTS OF OHIO EPA'S MONITORING PROGRAMS

The Ohio Environmental Protection Agency (Ohio EPA) uses a combination of chemical, toxicological, and ecological approaches to monitor the quality of its rivers and streams. This Highlight focuses on Ohio EPA's Biological and Water Quality Survey (BWQS) Program, and briefly discusses Ohio's long-term ambient water quality monitoring network (NAWQMN). Both programs make use of integrated chemical and biological monitoring. In the early 1980s, the highest priority in the BWQS was evaluating the need for publicly owned treatment works (POTW) to install advanced treatment; the current priority is to evaluate nonpoint sources and assess toxicity due to point sources. The main use of the NAWQMN data is to evaluate the effectiveness of selected pollution control projects.

Because the biological component of Ohio EPA's programs is likely to be of greatest interest, this Program Highlight focuses on the potential uses, advantages, and limitations of the biological survey information collected in these two programs.

Ohio EPA has found that incorporating biological survey methods into its water quality assessment program produces several benefits compared with relying exclusively on chemical-by-chemical or whole effluent toxicity monitoring. First, biological assessments can detect water quality problems that other methods might miss or underestimate. The resident biota act as continuous monitors of environmental quality, increasing the likelihood of detecting the effects of episodic events (e.g., spills, nonpoint sources) or other highly variable impacts that monthly or even weekly chemical sampling might miss. And sampling need not be conducted at critical low flow or under other worst case conditions. Second, biological surveys can detect problems such as habitat degradation that are not strictly water quality problems, but can prevent attainment of uses. Third, biological surveys directly assess biological integrity, providing information needed to identify high quality waters deserving special protection or confirm instream impacts predicted by fate and transport modeling (e.g., wasteload allocation) and toxicity testing (i.e., bioassays).

The power of biological assessments is their ability to assess aquatic ecosystem health (i.e., biological integrity). They can supplement, but not replace, chemical and toxicological methods that are necessary to predict risks (particularly to human health and wildlife) and to diagnose, model, and regulate problems once they are detected.

USES OF THE DATA

Three major uses of the chemical and biological data derived from the BWQS and NAWQMN Programs have included:

- improving water quality standards (including refinement of stream use classifications and development of biological criteria);
- identifying impaired waters and assessing attainment/nonattainment of beneficial uses;
- evaluating the effectiveness of pollution controls.

Use #1: Improving Water Quality Standards

A major use of BWQS data has been to improve Ohio's water quality standards by refining existing use classifications and developing numeric biological criteria to supplement existing chemical-specific and toxicity criteria. The development of biological criteria required descriptions of the type and condition of aquatic life thought attainable in streams and rivers throughout the State. Ohio recognized that biological criteria needed to account for intrastate differences in attainable quality due to regional variation in land surface form, land use, vegetation, soils, and climate, but realized that it was infeasible to develop site-specific criteria for each of the hundreds of waterbodies in the State. Their solution was to monitor streams least affected by human activity in each of several regions of the State ("least disturbed streams") and analyze the data to establish criteria specifying attainable conditions within each region.

Ohio EPA could not have developed biological criteria without first developing standardized biological assessment methods. Ohio has accomplished both – the development of assessment methods and criteria – through an iterative process of monitoring, the development of initial criteria, additional monitoring, and the subsequent development of more rigorous criteria. Ohio was fortunate to have a fairly extensive historical database dating back as far as 1979.

The process began in 1980, when Ohio EPA used the available database of about 150 sampling locations and the experience of its biologists to develop biological criteria for two aquatic life uses (exceptional warmwater habitat and warmwater habitat). These early criteria included both narrative and numeric requirements (e.g., a stream met the exceptional warmwater habitat use only if there were more than 30 taxa present and pollution-sensitive species were "abundant").

The process continued in 1983 and 1984, when Ohio EPA and USEPA's Environmental Research Laboratory in Corvallis, Oregon, carried out the Stream Regionalization Project. The project involved delineating the five distinct ecological regions ("ecoregions") illustrated in Figure 1, identifying "least-disturbed" watersheds in each ecoregion, and conducting extensive field work to characterize the health of fish and macroinvertebrate communities (and water quality) in the least-disturbed watersheds. Ohio chose fish and macroinvertebrates as its indicators of biological integrity because the

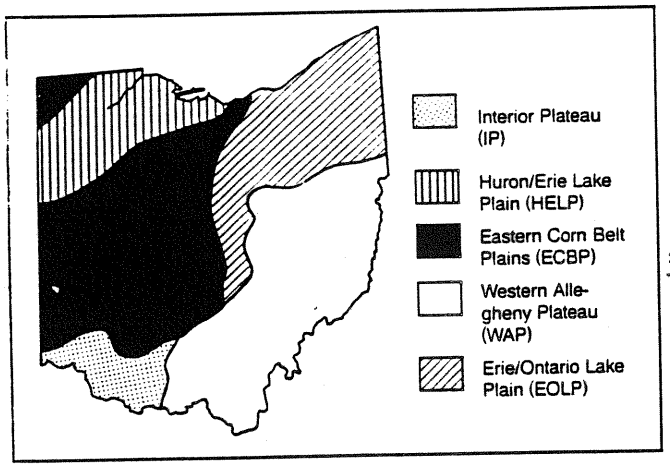
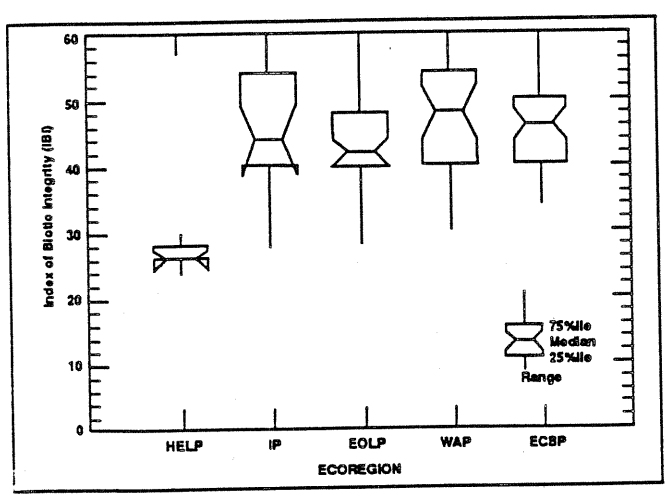


Figure 1. Ohio's Five Ecoregions.

distribution, environmental tolerance, and importance of these communities in lotic ecosystems were well known and because their health also reflects the health of lower trophic groups. More than 250 small stream sites and about 100 large river sites were sampled. These reference sites represent roughly the highest quality 5 percent of stream and river habitats in the State.

The field measurements were analyzed to determine various "metrics" of the health of the fish and macroinvertebrate communities such as species richness, trophic composition, diversity, the presence of pollution-tolerant individuals or species, abundance or biomass, and the presence of diseased or abnormal individuals. These metrics were in turn used to calculate values of three different biological indices: the Index of Biotic Integrity (IBI) for fish, the Modified Index of Well Being (Iwb) for fish, and the Invertebrate Community Index (ICI) for macroinvertebrates.

The next step in the analysis was to select values of each index thought attainable for each ecoregion. Figure 2 illustrates in a "box and whisker" plot the analysis conducted for one of the three indices: the IBI. The plot shows the distribution of IBI values calculated for least-disturbed streams in each of the five ecoregions. In the Huron/Erie Lake Plain ecoregion, for instance, IBI values for least-disturbed streams varied between 24 and 30. Ohio EPA established that a stream surpassing the 25th percentile value of the IBI scores of the reference streams in its ecoregion has attained the warmwater habitat use, in this case an IBI of 26. Ohio EPA established that a stream surpassing the 75th percentile value of the entire statewide reference site data set has attained the exceptional warmwater habitat use. These values serve as Ohio's numeric biological criteria. Generally, a waterbody is reported to fully attain its use only if all three index scores (IBI, Iwb, and ICI) surpass the ecoregional criteria. Ohio reports partial use attainment if only one or two index values are met and nonattainment if none of the indices meet applicable criteria or if one organism group indicates poor or very poor performance.



Note: See Figure 1 for definition of acronyms.

Figure 2. Notched Box-and-Whisker Plot of Reference Site Results for the IBI (headwater streams).

Ohio has now established reference values for each of its three biological indices for each of the five ecoregions in three of its five aquatic life use categories. In addition, because attainable fish community characteristics vary with stream size and sampling method, reference values have been established separately for headwater streams (streams with drainage areas less than 20 mi^2), nonheadwater streams sampled by wading (drainage areas between 20 and 500 mi^2), and streams and rivers sampled by boat (drainage areas between 200 and 6,000 mi^2).

The five aquatic life uses included in Ohio EPA's refined water quality standards are: warmwater habitat, exceptional warmwater habitat, modified warmwater habitat, coldwater habitat, and seasonal salmonid habitat. Warmwater habitat is designated where waters are believed capable of supporting balanced reproducing populations of warmwater fish and associated organisms; exceptional warmwater habitat is designated where more sensitive and diverse biological communities, or rare species, are possible; coldwater habitat is designated in waters capable of supporting coldwater fish and associated organisms or where salmonids are regularly stocked; and seasonal salmonid habitat applies between October and May in tributaries to Lake Erie used by migrating salmonids. The modified warmwater habitat use designation is intermediate between the existing warmwater habitat and limited resource water categories. Limited resource waters are those that have extremely limited physical habitats due to natural limitations or extreme alterations of anthropogenic origin. The modified use was adopted after integrated assessments identified a number of stream segments where irreversible impacts precluded the attainment of the warmwater habitat use, but documented that these segments were able to sustain a semblance of a warmwater biological community. A use attainability analysis and USEPA approval are required prior to designating a stream as a modified warmwater habitat. There are, in addition, designations for aesthetics, water supply, and recreational uses, but the aquatic life use designations generally have the more stringent chemical criteria.

Ohio devoted a substantial fraction of its monitoring resources for 10 consecutive years to improving its water quality standards. Ohio expects in future years to sample about 10% of the reference sites each year to detect any broad-scale changes in background conditions that might prompt a recalibration of the biological indices, revisions of the biological criteria, or both.

Ohio EPA's approach to developing biological criteria is but one of several approaches used by State water quality agencies to define and measure achievement of biological integrity. States may choose to conduct crash efforts and monitor reference sites statewide in a year or two, or follow Ohio's example and spread the sampling over a 5- to 10-year period. The level of effort required to develop criteria varies from State to State—more ecologically homogeneous and sparsely populated States might find tens of reference sites sufficient; more heterogeneous and densely populated States might need more than the 300 or so sites monitored in Ohio. See the *Proceedings of the First National Workshop on Biological Criteria* (December 1988) for a discussion of other approaches.

Use #2: Identifying Impaired Waters

Biological assessments offer a powerful tool for identifying waters degraded by sources and causes of impairment that other approaches are likely to miss. In the middle segment of the Little Cuyahoga River, for example, fish and macroinvertebrate sampling indicated severe, but unexpected, impacts indicative of toxicity. These findings were unexpected because point source dischargers in the segment claimed to discharge only noncontact cooling water and small quantities of sanitary wastes. Accordingly, their permit did not require monitoring for toxic pollutants.

A followup investigation revealed that most of the dischargers in the river basin were involved in plastic and rubber manufacturing and therefore handled organic chemical products on the premises. Ohio EPA plans further work to identify the source of toxicity reaching the

stream (e.g., spills, contaminated surface runoff, sewer system overflows, or unauthorized discharges).

In many other situations as well, Ohio EPA's increased reliance on biological methods has improved its ability to detect instream impacts (see Figure 3). The results of a survey of 431 stream segments found that instream chemical analyses for conventional pollutants, NH_3, and five heavy metals were in agreement with biosurvey results at 58% of the sites (at 17% of the sites both methods showed no impairment; at 41% of the sites both methods showed an impairment). At 6% of the sites, chemical data implied that there was an impairment while the instream biota showed no impairment. The most interesting finding, however, was that at 36% of the sites, instream chemical data implied no impairment while the instream biological communities showed impairment. The waters in this last category were degraded by "nonchemical" causes including sedimentation and/or habitat degradation (43%), subtle enrichment/dissolved oxygen impacts (31%), unknown toxicity (7%), and other causes (19%).

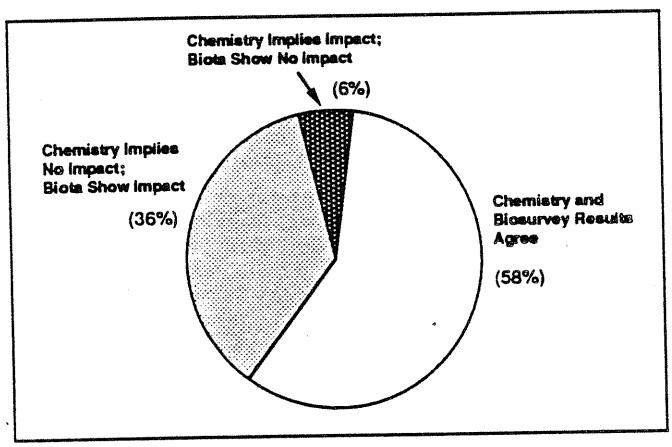


Figure 3. Biosurvey Results Usually Agree with Instream Chemistry or Reveal Unknown Problems.

An interesting consequence of Ohio EPA's improved ability to detect water quality problems is that the percentage of rivers and streams reported to fully support designated uses decreased between 1986 and 1988 from 61% to 32%. Ohio attributes this change to the adoption of revised biological criteria and more sensitive assessment methods, not to changes in water quality. Most of the waters newly designated in the 1988 §305(b) report as not supporting their uses experience "slight" to "minor" impairment, lending weight to Ohio's assertion that integrated assessments are capable of detecting increasingly subtle impacts.

Use #3: Effectiveness Evaluation

Ohio EPA also monitors a network of 36 NAWQMN sites to evaluate the effectiveness of selected projects. Each year, 10 of these sites are assessed for macroinvertebrate community health. When plotted versus time (which Ohio did for 11 rivers in its 1988 §305(b) report), the trends in ICI values from these sites present a meaningful indicator of environmental improvement. Where intensive survey data are also available to interpret observed trends (e.g., to correlate trends with program actions), these plots provide a measure of program success.

Figure 4 shows the results for two of the 36 sites, on the Mohican and Olentangy Rivers. At the Mohican site, four samples were collected between 1977 and 1987. Macroinvertebrate sampling shows an improving trend in biological condition since 1978. Warmwater habitat communities have been present in all years, with the most recent data suggesting that the site has the potential to achieve the exceptional warmwater habitat use. Ohio EPA attributes these improvements to industrial waste pretreatment requirements imposed in upstream cities and wastewater treatment improvements made by several industrial and municipal treatment plants.

At the Olentangy site, five samples were collected between 1977 and 1986. Biological condition at the site has steadily improved through this period. The most dramatic increase in ICI values occurred

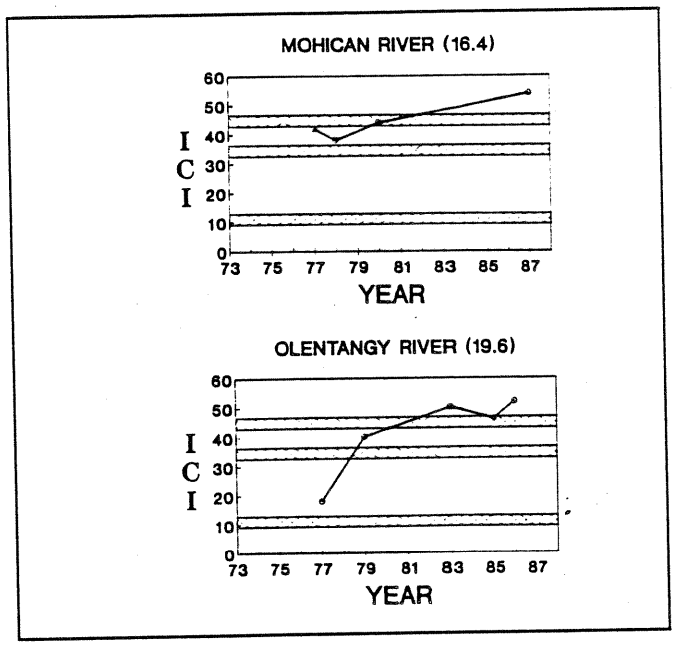


Figure 4. Long-term Trend of the Invertebrate Community Index (ICI) at Ohio EPA Annual Monitoring Stations.

between 1977 and 1979 when an ICI value reflecting nonattainment of the warmwater habitat aquatic life use improved to an ICI value reflecting full attainment. The ICI improved further in 1983 when the macroinvertebrate community was scored exceptional or near exceptional, but this improvement may have been an artifact of moving the sampling location upstream. Construction of a new advanced treatment plant and improvements at several existing plants are the most likely explanations of the overall improvement.

DESIGN CONSIDERATIONS RELEVANT TO ALL USES OF MONITORING DATA

Ohio EPA conducts 12 to 15 intensive surveys per year during the June to October sampling season. Intensive surveys can be as short as 1 week, but usually last several months. They include chemical analyses of samples collected at between 3 and 80 sites at frequencies ranging from three times during the survey to once each week. They typically include fish sampling at each site between one and three times during the survey. Macroinvertebrate sampling is typically conducted at between 6 and 80 sites, with artificial samplers remaining instream for 6 weeks at each site sampled.

Where monitoring data are needed to calibrate and validate water quality models, more intensive sampling is done for selected physical/chemical parameters.

Ohio's biocriteria describe attainable conditions. In addition, one or more reference sites located upstream of all known sources of pollution are typically sampled to sort out the effects of multiple dischargers, but not as an arbiter of attainable condition. In a typical point source evaluation, one site is located upstream from the outfall, another site is located within the mixing zone, and additional sites are located at intervals downstream to determine the extent and severity of impact.

Fish Sampling Methods

The Ohio EPA has developed and documented standardized procedures for fish sampling. Pulsed DC electrofishing is used to obtain a representative sample of the fish community, either by wading into the stream or using a boat, depending on the size of the waterbody. In a survey, field personnel conduct repetitive sampling based on distance (rather than time) to avoid bias that would result where fish differ in spatial distribution due to differences in available habitat. Field personnel also weigh fish, identify each fish to the species level, and record external abnormalities. A three-person crew is required. Analysis of data collected at test sites indicates that spatial and temporal variability are low if standardized procedures are followed.

Macroinvertebrate Sampling Methods

Ohio relies primarily on a modified Hester-Dendy multiplate artificial substrate sampler for quantitative sampling of macroinvertebrates in streams and rivers. The Ohio EPA uses a composite set of five samplers, supplemented with a qualitative sample from the natural substrate that provides a more complete inventory of all taxa present. The Ohio EPA prefers artificial substrate samplers because they work in locations that cannot be sampled effectively by other means, require lower operator skill requirements, are nondestructive to the environment, and reduce the influence of the natural substrate. Results collected over the past 15 years confirm that sampling variability is low if there is strict adherence to standardized procedures.

Chemical Analyses

Ambient water samples (usually grab samples) are collected during integrated surveys. These samples are analyzed for dissolved oxygen, nutrients, solids, oil and grease, total organic carbon (TOC), methylene blue activated substances (MBAS), fluoride, organics, metals, pesticides, cyanides and phenols, as appropriate. Effluent and sediment samples are collected as necessary.

Quality Assurance

Quality assurance is of paramount importance to the Ohio BWQS Program. In September 1989, the Ohio EPA published an updated version of *Biological Criteria for the Protection of Aquatic Life*. This document, published in three volumes, details all aspects of sample collection and analysis of biological samples including:

- minimum staff training in sample collection and species identification needed to ensure adequate data quality;
- methods for selecting and evaluating sampling sites;
- sampling procedures including the design and use of sampling equipment, species identification, field counting and weighing procedures, sample preservation, and "chain-of-custody" procedures;
- habitat evaluation procedures;
- laboratory procedures for handling and identifying preserved specimens;
- data management and storage procedures;
- data analysis methods (including statistical tests and calculation of metrics).

Ohio EPA uses the USEPA's STORET database to manage its chemical data and its own Fish Information System (FINS) and Macroinvertebrate Data Gathering and Evaluation System (MIDGES) for its biological community data. Personal computers are used extensively to analyze data and prepare reports.

PROGRAM RESOURCE REQUIREMENTS

Out of an estimated 52 workyears available for Ohio EPA's monitoring activities in FY88 (field sampling, field and laboratory analyses, data analyses, and reporting), 9.5 workyears (18.4%) went toward BWQS (surveys), 0.2 workyears (0.3%) went toward the biological portion of Ohio EPA's NAWQMN, and 0.8 workyears (1.6%) went toward the chemical portion of the NAWQMN. The remaining monitoring program resources went toward wasteload allocation modeling/permitting, toxic contaminant monitoring, compliance/enforcement monitoring, water quality criteria, §401 certifications, and other needs.

Collection of biological data has the reputation of being resource-intensive and too costly for routine application in State monitoring programs. In 1989, Ohio EPA compared the cost of different approaches assumed to provide the same analytical and evaluative "power." Ohio EPA believes that, on a per-site basis, sampling fish and macroinvertebrate communities can be equal to or lower in cost than chemical sampling or toxicity testing. More comprehensive chemical monitoring, such as priority pollutant scans and sediment analyses, further increases costs for chemical data.

THE FUTURE

Improving the ability of its monitoring program to produce the type of monitoring information needed to support water quality program decisions has, in turn, increased the demand for Ohio EPA's biological monitoring resources. Managers of Ohio EPA's permits, nonpoint source, hazardous waste, and other environmental programs now compete for limited monitoring resources. In its most recent 5-year monitoring strategy (Ohio EPA 1985), Ohio estimated that at current staffing levels it would take 13 years to satisfy its outstanding monitoring needs.

Material for this report was furnished primarily by Chris Yoder, Ohio EPA. Figures 1 and 3 were prepared using data from Ohio EPA's 1988 §305(b) report. Figures 2 and 4 were taken from Biological Criteria for Protection of Aquatic Life, *February 28, 1988, Ohio EPA, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio. For more information, contact Chris Yoder.*

This report is produced by EPA to highlight EPA and State monitoring activities. Contributions of information for similar reports are invited. Please contact: Monitoring Branch, EPA, AWPD, WH-553, 401 M Street S.W., Washington, DC 20460 (202) 382-7056.

ALABAMA

Another summer has come and gone in Alabama. The nip of fall is already in the air and fish shocking is just around the corner. Yours truly would like to retract the line in last quarter's newsletter "hoping Alabama has received its share of the rain" and replace it with "hoping Alabama will receive a little larger share of that rain stuff". Yards are drying up and small fires along roadsides are not uncommon. It would have been nice to have spread the flood-causing rains of spring over the entire year. (It has been nice not having to reschedule field trips though.)

On with the events of summer... An Ecoregion Workshop was held in Montgomery May 1-3, 1990. Attendees included the ADEM and the Mississippi Bureau of Pollution Control along with USEPA; Atlanta, and Athens, GA and Corvallis, OR. The purpose of the Workshop was to plan initial activities relative to further refinement of ecoregions and the establishment of potential reference stations. Hopefully, the long range goal of this activity would be the development of biocriteria for wadeable rivers and streams in the states of Alabama and Mississippi. A joint biological assessment trip was taken to two streams in different ecoregions, with each state using its own methods and individually completing habitat assessments. A comparison of the results will hopefully be completed in time to present at SWPBA in October.

So far this year we have completed three intensive survey waste load allocations; Sugar Creek at Alexander City, Drum and Turkey Creeks at Albertville and Town Creek at Town Creek. The latter being located in northwestern Alabama near beautiful Joe Wheeler State Park, which made for very comfortable accommodations. Coming home to a cottage on the lake every night sure made the work seem like a vacation.

Our water quality demonstration studies for this season are nearing completion. Brien Diggs and Vickie Bauer have finished all of the biological assessments and now have the insurmountable task of sorting and identifying all of the little 'critters'. On a VERY positive note we have a new compound microscope on order. Vickie looks forward to retiring the antique we have been using and she's sure that the Chironomids will almost identify themselves using the new scope.

Congratulations go out to Brien and his wife on the birth of their daughter, Rae.

Fred Leslie and crew have completed the reservoir monitoring for the 1990 season. This program will eventually include monitoring of all publicly accessible lakes and increase monitoring on lakes that have from past data collection, been indicated to be use threatened or impaired. Lakes that exhibit an advanced trophic state would be monitored on a regular basis so that data would be available to assist in regulatory actions. It is proposed that all reservoirs would be monitored a minimum of one year out of every three with some being monitored more frequently. Fifteen reservoirs were monitored during the growing period of 1990. The water quality data collected will be compiled and entered in STORET. Trophic state index values for each reservoir will be calculated from corrected chlorophyll a concentrations.

After a long spring of sorting out Ceriodaphnia culturing problems, brought on mainly by the shortage of Perrier Water, the Toxics Unit is up and runnning again on all cylinders. The Toxics Unit staff (Marion Bertolotti, Norman Blakey, Cathy Matthews, and Gerrie Sanders) completed several chronic toxicity tests this summer. Included in these toxicity tests were 7 samples from dischargers to the Tennessee River taken in response to citizen complaints to ADEM of alleged mussel die-offs in the area. Results of preliminary testing should encourage the Industrial Branch of the Water Division at ADEM to further evaluate their toxicity testing requirements written into certain permits. In addition, the staff learned a valuable lesson: never run 7 chronic samples concurrently with such a small staff! We are still waiting to see when, or even if, we will be moving to more spacious facilities. This would be especially appreciated by the the Toxics Unit. Marion and Cathy attended the Toxicity Identification Evaluation workshop held in Athens, Georgia during the week of August 27th. This training will enable us to be of assistance to the permit writers when overseeing a TIE.

Congratulations to Gerrie Sanders--She is now a Sophomore at Auburn University in Montgomery!!

The ADEM held a public hearing in August on proposed changes to regulations regarding water quality criteria and water use classification. The proposed changes to the state water pollution control regulations are a result of a petition filed with the Alabama Environmental Management Commission by the Cahaba River Society requesting the establishment of a water use classification for outstanding natural resource waters (ONRW). Changes associated with this would include clarification of the state's antidegradation policy to require "no degradation" of water quality in waters designated as ONRW and the inclusion of language taken, in part, from the federal guidance for the ONRW designation as follows: "high quality waters of national and state parks, wildlife refuges, waters supporting rare, threatened or endangered species and waters of exceptional recreational or ecological significance. Waterbodies that are important, unique or sensitive ecologically, but whose quality as measured by traditional parameters (such as dissolved oxygen, pH, etc) may not be particularly high or whose character cannot be adequately described by these parameters also may specifically qualify as outstanding natural resource waters." Any changes to existing water quality use classification\criteria would be made by the Commission following review of public comments and other pertinent material.

A special thanks to all those who reviewed our draft macroinvertebrate SOP. The Final draft should be completed this month. Looking forward to seeing everyone at Jekyll Island!!!

KENTUCKY

It's September and that meets Ohio River fish collection time. As usual our biologists are busy this month assisting ORSANCO (the Ohio River Sanitation Control Commision) collect fish for community structure and fish tissue analysis. September 12 and 13 samples were collected at Greenup Locks and Dam and Markland Locks and Dam. At Markland several paddlefish were taken, along with many large carp and good eatin' size catfish. Also included were the usual garbage can fulls of drum and shad. Next week our intrepid fish folk will sample at Cannelton and Uniontown.

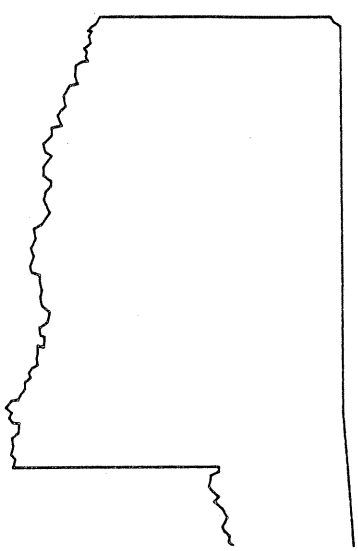
Lythia Metzmeier and Ron Houp have been busy this summer with ambient monitoring collections. Skip Call, and a chorus of others, have conducted intensive surveys in the Eagle Creek, Little Sandy River, and South Elkhorn Creek basins. Cliff Schneider has been busy collecting lake samples.

Meetings attended include: a Water Quality Network Design Workshop in Fort Collins, Colorado attended by Giles Miller, the American Fisheries Society annual meeting in Pittsburgh attended by Mike Mills and Bob Logan, and a Wetlands Delineation Training workshop in Chicago attended by Jeff Grubbs.

As noted in the last newsletter, our water quality regulations were up for review by the legislature. The Agriculture and Natural Resources Committee did not accept the regulations. Therefore, the regulations while taking effect, must be brought up as statutes at the next meeting of the legislature in two years. If not passed, Kentucky will effectivily be without water quality regulations.

This summer we added a new employee to the Ecological Support Section. Karen Smathers comes to us from Eastern Kentucky University where she received her B.S. and M.S. degrees. Her thesis title was Community analysis of a freshwater bivalve community in the Licking River at Moores Ferry, Kentucky. The reach of the Licking River studied by Karen harbors a particularily diverse freshwater mussel community and has been considered as an Outstanding Resource Water candidate. Karen has been assisting Allen Robison with fish collections and identifications and has also assisted Skip with intensive survey work. She will be assuming a reference reach biologist position around the first of the year.

P.S. Our toxicology team is at Barren River State Park conducting their final intensive study of the year. So far, the new toxs mobile has performed well in service. Work is progressing on the culture facility.



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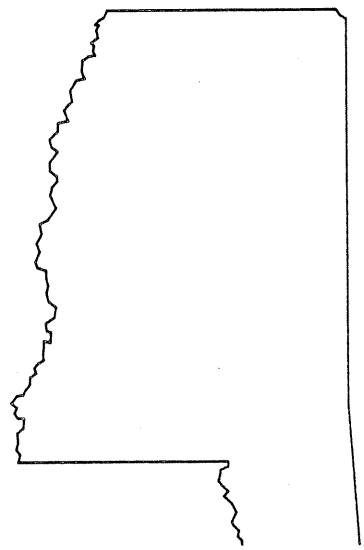

ADDITIONAL FISH TISSUE ADVISORIES ON MISSISSIPPI WATERWAYS

In the last newsletter, we provided a list of streams upon which fish tissue and consumption advisories existed. Since that time, the advisory on the Leaf River has been extended downstream several miles, and on the Escatawpa River from the Interstate 10 bridge to the mouth near the coast.

Warning issued against eating fish from 2 rivers

■ Stretches of the Escatawpa and Leaf rivers are being posted.

By Marky Aden
Clarion-Ledger Staff Writer

Pollution from cancer-causing dioxins may make fish from portions of two south Mississippi rivers too dangerous to eat, state officials said Thursday.

The state Office of Pollution Control issued the warning for a 10-mile stretch of the Escatawpa River and a 10-mile stretch of the Leaf River. Signs are to be posted on both rivers within 10 days.

"It's prudent for us to take as conservative approach as possible," said Jimmy Palmer, director of the Office of Pollution Control.

Although recent tests of fish show levels of dioxins are down from 1989, the office acted because of concern that even the lower levels could be harmful.

"You're dealing with a chemical that supposedly might have a cancer-causing potential, and it does have a toxic potential," said Phillip Bass, laboratory director for the Office of Pollution Control.

The warning is the first from the state about fish in the Escatawpa. State officials in November warned against fish from a shorter stretch of the Leaf because of dioxins.

The Thursday warning remains in effect indefinitely, but does not bar recreation on the rivers.

The affected stretches of the rivers are:

Fish

■ The Escatawpa between the I-10 bridge and the Pascagoula River.

■ The Leaf from Tallahalla Creek to the Mississippi 15 bridge at Beaumont. That includes the boundaries of the November 1989 warning, from Mississippi 29 to Mississippi 15.

Dioxins encompass 75 chemical compounds that were found to cause cancer in animals and are suspected of causing birth defects and miscarriages.

Among other sources, dioxins are produced by the chlorine bleaching process that makes paper white. Discharge from paper mills flows into both rivers.

Georgia-Pacific Leaf River Pulp Operations in New Augusta is responsible for most of the dioxins in the Leaf, and the International Paper Co. mill at Moss Point is discharging into the Escatawpa, said Jerry Cain, chief of the state agency's industrial wastewater branch.

Dioxins come "from a number of different sources but bleach-kraft paper mills have been identified as a significant source," Cain said.

"Both these mills have undertaken major changes in the way they bleach the paper, and there have been significant reductions in the amount of dioxin in their effluent," Cain said.

July tests by Georgia-Pacific showed the dioxin in Leaf River fish down from 24 parts per trillion in 1989 to 7.9.

The Office of Pollution Control's tests in recent weeks show dioxin levels of less than 1 part per trillion to a little more than 4 parts per trillion in fish from the two rivers.

The U.S. Food and Drug Administration advises people to reduce consumption of fish with more than 25 parts per trillion and stop when dioxin levels reach 50 parts per trillion. It also restricts commercial fishing and interstate commerce in fish with more than 50 parts per trillion.

Neither the state nor the Environmental Protection Agency has standards regarding safe dioxin levels in fish.

Meanwhile, the state Department of Wildlife, Fisheries and Parks is taking steps to close commercial fishing on the affected stretch of the Escatawpa.

Warren Richardson, general manager of Georgia-Pacific, said he believes the Environmental Protection Agency will demand states toughen regulation of dioxins. "I think the state is trying to react ahead of time," Richardson said.

Georgia-Pacific will conduct new testing next week, Richardson said.

Officials with International Paper could not be reached.

Escatawpa River Advisory On Fish Eating Criticized

MOSS POINT, Miss. (AP) — A Moss Point paper mill has criticized the state for advising people not to eat fish and seafood caught in the lower Escatawpa River.

Officials from both the International Paper Co.'s Moss Point Mill and the Georgia-Pacific Leaf River Pulp Operations plant in New Augusta said Friday the advisory is unnecessary because they have reduced dioxin emissions.

"We feel it has caused undue alarm in the community," said Karen Harris, public relations manager for International Paper Co.

On Thursday, the state Office of Pollution Control issued the Escatawpa advisory and expanded one for Leaf River. Although recent tests indicated dioxin levels in those sections of the rivers are decreasing, they are still higher than levels found in other waterways.

Public concern over dioxins, called by some "the most toxic substance known to man," began in the late 1970s when dioxin contamination prompted the abandonment of the Love Canal area of Niagara Falls, N.Y., and later Times Beach, Mo. It also is a contaminant in the herbicide Agent Orange.

For the past two years, ongoing state studies have found elevated dioxin levels in fish taken from portions of the Escatawpa and Leaf rivers. Dioxins may cause liver damage and cancer in people if ingested in large enough quantities.

Although trace amounts of dioxins form in the waste of several industrial and municipal processes along the rivers, the main sources have been International Paper and the Georgia-Pacific Leaf River Pulp Operations plant in New Augusta.

Dioxins form when chlorine from a wood pulp bleaching process mixes with other chemicals in the mills' waste water.

Since the fish testing program began, both mills have voluntarily made expensive process changes that have reduced dioxin emissions by 90 to 95 percent, pollution control officials said.

In recent waste water testing, no dioxin has been detected at either mill, said company officials.

"Frankly, we think we've pretty much solved this problem," said Warren Richardson, general manager for the Georgia-Pacific mill, formerly called Leaf River Forest Products. "It's kind of disturbing why they would do this."

On Thursday, the state extended the Leaf River advisory about three miles upstream from the mill and broadened it to include all fish. The previous advisory, issued in November 1989, was only for bottom-feeding fish.

Advisories were issued for the lower Escatawpa River between the Interstate 10 bridge and the Pascagoula River and the Leaf River from Tallahalla Creek to the Mississippi 15 bridge at Beaumont.

ITS FISH KILL TIME AGAIN

Remember last year when we were griping about all of those fish kills? This year is not as bad, but with no rain in some parts of the state for nearly 2 months, its indeed a wonder that we haven't been bombarded with reports of dying fish. Most of the kills reported to use thus far this time around have been caused by low D.O. Bureau biologists have investigated several kills on private lakes, including Greenbrook Lake near Memphis, Swan Lake in the Delta, Crossgates Lake in Jackson, and one on the Pearl River near the Louisiana-Mississippi border.

LEAF RIVER DIOXIN STUDY CONTINUES

During the week of August 20th, Bureau fisheries biologist Billy "Skeeter Peeter" Justus and lab director Phil Bass spent the week of the Leaf River working with paper mill officials in collecting fish from a fifty mile stretch of the Leaf and Pascagoula Rivers for analyses for TCDD and TCDF. Thanks to efforts by the mill to clean up their effluent, dioxin levels in the fishes have begun to decrease markedly. Results of this latest effort are not available, but another collection is scheduled for late October.

MISSISSIPPI'S CLEAN LAKES PROGRAM

From July 23-25, Stanley Rodgers and Mike Beiser collected physical and chemical data and water samples for algal growth potential tests from three oxbow lakes in the Mississippi Delta region as part of the "Clean Lakes" program. The lakes sampled were Wolf Lake, Moon Lake and Lake Washington, and all have shown improvements in water quality since the onset of the clean lakes effort. Data on the algal growth potential tests are pending. By some quirk of fate, a few weeks after our visit Lake Washington was the site of a toxic algal bloom (See below) and had to be closed to human activity by our agency. I promise we did not pee in the lake while we were there!

TOXIC ALGAL BLOOM ON LAKE WASHINGTON

As mentioned above Lake Washington was the site of a toxic blue green algal bloom August 13-16th. The implicated algae was Microcystis aeroginosa, and had reportedly killed a couple of puppies that had drank the water. The lake has been closed by the Bureau of Pollution Control until further notice, and the University of Mississippi Department of Pharmacology's Dr. Bill Benson has performed bioassays with mice on the Lake water. The Bureau is continuing to monitor this situation. I'll not say any more about this as Stanley will give you all the information available at the upcoming SWPBA Meeting.

Rare Algae Poisons Lake Temporarily

GREENVILLE — A recent "bloom" of rare, toxic blue-green algae in Lake Washington is evidence that the lake needs restoration, a state water quality expert said.

Robert Seyfarth, chief of the water quality branch of the Mississippi Office of Pollution Control, took samples of the algae, which emits a strong odor and resembles bright-green blobs of paint.

Seyfarth said Tuesday that even though scientists noticed large amounts of normal green algae on the lake last year when water samples were being collected for the study, they didn't detect any samples of the rare blue-green variety.

"The blue-green was probably out there all along, but it takes a certain set of circumstances for it to dominate over the green algae," Seyfarth said. "This is the time of the year that it will occur — if it is to occur."

THE GREAT TILAPIA KILL

On August 27, 1990 Stanley Rodgers accompanied Mississippi Department of Wildlife, Fisheries, and Parks personnel to the Gulf Coast to help in destroying a fish culturing experiment gone bad. An individual had been granted permission by Wildlife, Fisheries and Parks to culture Tilapia commercially, provided that the fish did not reproduce or escape from the rearing ponds via the effluent----they did! He was ordered to kill them, and with the aid of State Fisheries Biologists the ponds and effluent settling pond was rotenoned. No effort has been made to kill those escapees that have entered the receiving stream.

TOXICOLOGY UPDATE

Lab toxicologist Doug Upton has been busy completing his scheduled bioassays, and rearing fatheads for use in toxicity testing. We plan to use fatheads to compliment our already existing Ceriodaphnia tests. Plans are underway to take the Labs mobile toxicity trailer on site at the Leaf River Forest Products Plant at New Augusta, MS for a series of fathead and Ceriodaphnia tests September 10-17. This will be our first attempt at a fathead bioassay.

Results of a couple of recent bioassays done at the lab have resulted in one industry having to submit to a T.R.E., and a second discharger has been required to submit a plan for a T.R.E.

AMBIENT BIOLOGICAL MONITORING

As is the case all over the nation, 'tis the season to wade about in streams, and despite our lack of precipitation we're out doing our best. We've sampled 40 sites for macroinvertebrates, and nearly that many for fish tissue analysis. We're about half-way through with this years ambient sampling. Our study plan calls for 95 sites to be sampled for macroinvertebrates in 1990. This year we were able to spend a week in north Mississippi for macroinvertebrate monitoring, and sampled 20 sites that we had not previously monitored. In addition we sampled a small stream in central Mississippi which will receive effluent from a chicken processing operation beginning in October of this year.

We returned to the Gulf Coast region to again sample the potential reference sites we located last year. Any of the 40 sites examined in 1989 having no point source, a taxa richness greater than 40 and an HBI in the good range were resampled again in 1990. Fourteen of the 40 sites fit this criteria and were resampled during the week of August 12th. One of the sites we resampled had been subjected to some clear-cutting since our 1989 visit, and an increased amount of fine sediment was noted there. Another site located in the National Forest had been "improved"

just upstream from our site, and rendered useless as a reference site.

About 1/3 of last years samples have been identified. Because most of our historical sites were previously sampled in September and October, these two months will be especially busy.

UPDATE ON THE PERRY CREEK STUDY

Last year bureau biologists responded to three fish kills within a months time on Perry Creek. Fish kills were linked to spills of brine water from adjacent Tinsley Oil field operations. Mike Beiser and Billy Justus returned about a month later to do a series of 4 bioassessments along the stream and tributaries. All of the sites examined showed an impact, however the best water quality was noted far downstream in an area of less oil pumping activity. On August 31, 1990 Mike and Stanley Rodgers returned to the stream to sample the benthos again. Salinity in much of Perry Creek was measured at 5 ppt, and reached 9.5 ppt in a small tributary which ran nearby a separating apparatus. Field examination of the benthic fauna does not appear to differ greatly from last years samples. Data from this study has been accepted for presentation at the formal conference on aquatic insects at the Entomological Society of America National Conference in December, 1990.

THE MISSISSIPPI-ALABAMA REFERENCE SITE WORKSHOP

As most everyone in attendance at the Asheville Rapid Bioassessment Workshop in May of this year is aware, Mississippi and Alabama Biologists and supporting agencies, EPA-Atlanta, EPA-Athens, EPA-Corvalis, Florida, and EA Engineering representatives attended a Reference Site Workshop in Montgomery, AL the following week. In attendance from Mississippi were: Mike Beiser, Stanley Rodgers, and Charles Cockrell as well as Mr. Paul Davis of Mississippi Automated Resource Imaging Systems (M.A.R.I.S.). There we met with our Alabama counterparts, members of the Alabama Geological Survey, Bob Hughs and Jim Omernick, Hoke Howard, Jim Harrison, Mike Barbour, and several others. Discussions were lively as to how to best combine resources from the two states to determine ecoregional reference sites to be shared between them. In the upcoming year (1991) biologists from each participating state have committed to sampling several sites selected by Jim and Bob based upon maps and physical-chemical data sent to them be each state. The long-term goal being to have a set of shared reference streams pinpointed and studied within the next two years.

The highlight of the meeting was two joint sampling efforts by Alabama and Mississippi Biologists in two different ecoregions. Methods of sampling were reviewed by observers, and the data collected will be used for comparative purposes of the two state's sampling methods. The macroinvertebrates collected from these forays are currently being identified and will hopefully be

presented at this years SWPBA meeting. Representatives from both states hope to be members of the panel discussion at the meeting.

MEETINGS ATTENDED

In addition to the Asheville Rapid Bioassessment Meeting and the Reference Site Workshop, Several members of the Lab biology staff were able to attend meetings. Mike Beiser, Billy Justus, and Stanley Rodgers all attended the NABS meeting in Blacksburg, VA and each presented a paper during the water quality session there. Phil Bass and Billy Justus attended the American Fisheries Society Meeting in Pittsburg, August 20-24.

NORTH CAROLINA

BENTHOS

Recent Surveys

ORW

Black and South Rivers. The designation of the Black and South Rivers has turned out to be a highly complex and controversial process. The current report (now in about the tenth draft) recommends most of the Black River and half of the South River as ORW, but most tributaries have been excluded. The Division now faces the problem of formulating a management strategy for the entire catchment.

South Fork and North Fork of the New Rivers. This has turned out to be another highly complex study, where we must deal with the effects of seasonality, stream size and erratic changes in water quality due to scour, dilution, development, etc., etc.

Cedar Creek. Four sites were sampled on Cedar Creek (Davie County, June 1990) in response to an ORW nomination by the county's Public Works Department. This area was not found to be suitable for ORW classification, mostly due to nonpoint source impacts.

High Quality Waters

Rockfish Creek. Four sites were sampled on Rockfish Creek in June 1990 in response ot an HQW nomination by the field office. Only the lower portion of the stream was found to quality.

Dischargers

Swift Creek quarries. Swift Creek is of special interest as the last refuge of an endangered mussel species. We conducted a "before" study in the vicinity of two new quarries (4 sites) to document water quality conditions prior to discharge.

Holly Farms. We examined the effects of the Holly Farms discharge on the biota of Hunting Creek, Iredell County (3 sites, June 1990). Some minor impact was noted, particularly on the most intolerant species.

Aquatic Toxicology studies. To further document the predicted impact of chronic toxicity (as measured by *Ceriodaphnia* tests) on stream biota, we will be conducting upstream/downstream surveys of up to 20 dischargers in September 1990. Two dischargers in Gastonia have already been sampled in August 1990, verifying the predicted impact.

Low Flow Studies. The Division is considering the advisability of permitting dischargers to very small streams, i.e., into stream with low dilution and/or assimilative capacity. Eight dischargers (in compliance with their permits) will be studied to see if some impact is almost unavoidable.

Trout Farms. We continue to study the effects of trout farm discharges on clean mountain streams. The joint project with the Agricultural Extension Service is continuing on two streams, to determine both the amount of seasonal variation and the effect of BMP's.

We also have responded to complaints of algal blooms in Lake Santeetlah. In the latter study we found that there was only minor impact on stream biota, but the added nutrient loading may be causing the extensive blooms in Lake Santeetlah. Studies of the lake are being conducted by the Intensive Survey folks.

Woodlake Mobile Home Park. Aquick suvey of Polecat Creek, near the Woodlake Mobile Home Park, indicated severe stress.

Nonpoint studies

Fort Bragg. Eighteen sites were sampled in the Fort Bragg Military Reservation in April/May 1990 to determine the effects of various land disturbance activities on stream biota. Severe erosion problems were documented in several areas, and this information will be used in an enforcement action. In these naturally acidic streams, we found that disturbance tended to raise the pH while lowering taxa richness and abundance. The first big study by our new Environmental Biologist II, Ferne Winborne.

USGS study. USGS has been monitoring the effects of BMP's applied to tobacco lands in Guilford County. We compared conditions at two sites in June 1985 (before) to those in June 1990 (after). No improvement was noted in the condition of the stream biota.

Bridge Construction. We looked at the possible impacts of bridge construction on the fauna of the South Toe River, an Outstanding Resource Water. No impact was found, and the construction appeared to be using good ersoion control measures. The first study by our transplanted Florida biologist, Neil Medlin.

Other

Stream size studies. To evaluate the effects of stream size on out taxa richness estimates, we sampled sites of 2-20 meters (usualy 4 sites) in nine unimpacted watersheds. Most of these studies were in mountain and piedmont ecoregions. Trish MacPherson also is revising our "small stream" criteria, a particularly difficult type of stream to classify. Stay tune for results.

Biotic Index development. Dave Lenat is attempting to use our computer data base to derive tolerance values for a Hilsenhoff-type biotic index. Results should be available by the time of the SWPBA meeting.

Seasonality. Seasonality collections continue at selected sites throughout the state.

BMAN. We have completed the usual summer collections at ambient sites, and are starting the identifications. Samples are piled everywhere.

A VIEW FROM THE OTHER SIDE

"Governments have a talent for making it hard to love them consistently. Besides talking and writing gobbledygook, they are forever getting their right and left hands mixed up."

Bill Gilbert, Our Nature, 1986

"It may occur to some of those among you to ask why should the insect collector be regarded by others with amusement and why should he usually be represented pictorially by a decrepid old gentleman in a slouch hat and dark glassess and a green net chasing a butterfly. I cannot say why, but it is a fact that, not so very long ago in a case in the Edinburgh courts in which a will was in dispute, the fact that the testator collected insects was admitted as evidence of weakness of intellect."

F. Balfour-Browne, Concerning the habits of Insects, 1925

Taxonomy

"There is so much in a name. To find out what a thing is called is a great help. It is the beginning of knowledge; it is the first step. When we see a new person who interests us, we wish to know his or her name. A bird, a flower, a place, - the first thing we wish to know about it is its name. Its name helps us to classify it; it gives us a handle to grasp it by, it sheds a ray of light where all before was darkness. As soon as we know the name of a thing, we seem to have established some sort of relation with it."

John Burroughs, Riverby, 1894

New or Unusual NC Records

1. *Hydropsyche carolina*: S Fork New River, Ashe co., 3/90; W Fork Pigeon River, Haywood Co., 5/90. First DEM records.
2. *Neoephemera compressa*: Naked Crerk, Richmond Co., 5/90. New NC state record. Prior records only from FL and GA.
3. *Wormaldia* sp.: A large population of this caddis fly (species unknown) was discovered in Deep Creek, Person Co, 5/90. It was not present in other nearby streams.
4. *Macdunnoa brunnea*: Swift Creek, Nash Co., 5/90; Hunting Creek, Davie Co., 5/90. First DEM records. For a picture of the nymph, see Flowers, "Review of the genus Macdunnoa...", Great Lakes Entomologist 15: 25-30. This mayfly is described in the Mayflies of Florida as having records in FL, SC and NC, but we had not previously collected it (or successfully identified it).
5. *Barbaetis benfieldi*: Jacob Fork, Burke Co., 6/90. We hadn't seen this species since 1983.
6. *Parapsyche apicalis*: UT West Fork Pigeon River, Haywood Co., 5/90. First DEM records. Alll previous Parapsyche had keyed to *P. cardis*.

"...Most of us do not rejoice when we contemplate the overwhelming diversity of nature; we are stunned by complexity and confusion. We cannot be satisfied until we have established some kind of order; we must make sense of the bewildering variety by classifying it."

Steven Jay Gould, Bound by the Great Chain, 1985

The Last Poker Game

The old Green River flowed homeward to the sea.

Toward the sea, pardon. Suffering evaporation in the Lake Foul National Settling Pond, then the Lake Merde National Recreation Slum, then diverted into canals, conduits, channels and ditches to die by slow degree among the surplus-cotton plantations of Arizona, the sorghum fields of the Imperial Valley, the beanfields and alfalfa farms of Mexicali, the cistern, swamp coolers, car washes, fire hydrants, Laundromats, golf courses, swimming pools, sensory deprivation tanks, kitchen sinks, toilet bowls, septic tanks , leach fields, sewage lagoons and sewage treatment plants or Grater L.A....this ancient and noble river never achieved union anymore with its parent body, the Sea of Cortez and the Pacific Ocean, but expired in poisoned trickles and polluted dribbles on the baked cracked desiccated mud of the barren delta, far above its natural outlet. Centipedes crawled, flies buzzed, cows stumbled, vultures cruised, spiders crept, weeds grew where once a time and not so long ago a living river flowed and sparkled, fish danced, herons stalked and falcons gyred and stooped,with a green fragrant forest, on either bank, sheltering the secret lives of deer and ocelot, jaguar and javelina, gray wolf and black bear, red fox and puma, armadillo and snapping turtle, anhinga, elegant trogon, ivory-billed woodpecker, kingfisher, bald eagle, marsh hawk, sea gull, pelican, f--king albatross, magnificent f--king frigate bird....

Gone. A river no more.

Edward Abby
-Hayduke Lives, 1988

ADDITIONAL NOTES

MORE BIOCRITERIA INFORMATION

Dave Penrose will no longer work for North Carolina (that is for the next three months anyway). Dave's been asked to assist EPA in Washington with several projects that are related to biocriteria development. One of his major responsibilities will be to network with other state, federal and academic agencies to activiely pursue biological criteria related research in the areas of habitat evaluation, determination of unimpaired referenced waters and protocols for determining water quality impairments. Dave will also serve as the reference person to edit the Technical Guidance Document for Streams. Now's our chance in Region IVto let EPA know how we feel about biocriteria development. Dave's told me that he will see to it that opinions from Region IV biologists will get top priority (just kidding Suzanne). Dave can be reached at the following address:

U.S. Environmental Protection Agency
Office of Water, Criteria and Standards
WH-585, 401 "M" Street S.W.
Washington D.C. 20460
(phone 202-475-7315)

NABS 1990 - Santa Fe, New Mexico

Dave Penrose and Skip Call will be putting together a contributed paper session for the next NABS meeting in Santa Fe. The session will topic "applications of community bioassessment approaches (rapid bioassessment)" and possibly any relavant biocriteria work being done. If you have any ideas and/or topics for presentations, please look up either or Dave or Skip at the meeting in Jekyll Island. Potential contributors need to respond in writing by November 1.

PHYTOPLANKTON

It's been a busy summer for the phytoplankton group. The wet spring and dry summer resulted in more algal blooms than we have seen in recent years. Everyone has been diligently knocking out algal samples and finagling field trips to escape the microscope, except for Dianne Reid. She has a bad case of the Stuck Behind the Desk Blues and is getting phone-a-phobia.

Four reports have been released by the Phytoplankton Subgroup this year. They are:

- 1989 Algal Bloom Reports-- This report provides a summary of the algal bloom data received from around the state for 1989. The algal bloom program has been in effect since 1984 with the results assisting with water quality assessments and indicating waterbodies or watersheds requiring further water quality data.
- New River, Onslow County: Nutrient Control Measures & Water Quality Characteristics for 1986-1989-- The New River is a highly eutrophic, brackish water system. In 1987 controls of phosphorus from point sources were initiated using a regulation which allows the Director of the Division of Environmental Management (DEM) to implement nutrient controls in the presence of chlorophyll-a concentrations greater than 40 ug/l (state standard) or where microscopic or macroscopic vegetation is impairing best usage of the waterbody. This report reviews data collected since that time and recommends the present nutrient control strategy be formalized utilizing the supplemental classification - Nutrient Sensitive Waters (NSW). NSW status, in addition to providing point source nutrient controls, would target agricultural cost shares monies to Onslow County for nonpoint nutrient controls.
- Interim Review (June-November 1988) of Baseline Water Quality Data from the Pamlico and Neuse River Estuaries-- As part of DEM's commitment to the Albemarle/Pamlico Estuarine Study ambient sampling in the Pamlico and Neuse Rivers has been expanded to include more stations. This study reviews water quality data collected in 1988 and compares the two systems.
- Albemarle - Pamlico Estuarine Study Synoptic Survey Data Review July 25, 1989-- On July 25, 1989, 128 stations were sampled within a 5 hour time frame. A total of 33 water quality parameters were sampled at each station from the surface, photic zone, bottom and throughout the water column. The study was designed to provide an indication of the spatial heterogeneity of selected parameters and to coincide with a satellite fly-over, allowing the data to be utilized for ground-truthing and calibrating models using NOAA AVHRR and Landsat TM satellite images. This report, prepared jointly by the Biological Assessment Group and the Intensive Survey Group, reviews the data collected and provides a summary of the results.

At a workshop held in Asheville, it was suggested that EPA sponsor some phytoplankton/periphyton workshops. If the potential Middle East War doesn't cut budgets too badly, those workshops should become a reality. At the SWPBA meeting in October of this year, EPA personnel will be soliciting suggestions and requests regarding the types of workshops we would like to have. Please have your representatives at SWPBA prepared to provide this information.

Aquatic Toxicology Unit

Toxicity Evaluation Group

The Toxicity Evaluation Group has performed the following toxicity tests this fiscal year: 84 acute screening, 57 chronic (effluent), 39 ambient site, 59 contract lab-related, 99 quality assurance related tests, and 9 special studies. The summer has seen us branch out into new testing regimes and capabilities. We have experimented with sea urchin (*Arbacia punctulata*) fertilization tests in association with a marina sediment toxicity project (Intensive Survey Group). Additional marine organism testing work was done with mysids (*Mysidopsis bahia*) to evaluate eight stations along the Cape Fear River near Wilmington. In August, the TEG participated in an EPA Region 4 study involving chronic testing of WWTPs by contract laboratories. Results form this series are pending.

The remainder of 1990 promises to keep the Group extremely busy as we juggle the SWPBA meeting, the State Fair (where we will again exhibit our mobile laboratory), SETAC, and the long awaited move into our new laboratory complex with our regular schedule of events.

Data Assessment and Certification Group

Since the last newsletter the Data Assessment and Certification Group has attempted to to take a proactive role in the quality assurance of submitted toxicity data. Facilities and certified laboratories were mailed a "checklist" of acceptable testing parameters. Issues addressed by this checklist include sample handling, control organism survival and reproduction, statistical checks, and dilution water quality. Additionally, the group has requested the submission of all reference toxicant test data from the certified laboratories for the period January 1, 1990 through June 30, 1990. The submission and subsequent evaluation of this data will become a biannual event. Also, DAC Group personnel have inspected two laboratories each in Virginia and South Carolina.

In the data assessment area, the number of dischargers required to perform selfmonitoring toxicity tests grows steadily. Statewide, 371 NPDES permits now have toxicity testing selfmonitoring requirements. Additionally, 68 self-monitoring requirements have been required by administrative letter. Since January 1, DAC Group personnel have also processed 30 applications for the use of biocidal compounds in cooling tower systems which have discharges to surface waters.

The Data Assessment and Certification Group welcomes Daniel J.S. Rowe to its staff. Daniel has obtained an M.S. in biology from Appalachian State University and has had experience in teaching and the water treatment field. Daniel has taken a lead role in quality assurance and evaluation of the steadily growing volume of selfmonitoring toxicity data.

"If we create the political, chemical, physical, and moral environment that other forms of life cannot survive--by what insane arrogance do we think*we* could survive? The animals uise the same air, the same water, the same space. Animals use protein, carbohydrates--and if the animals around us are dropping dead we had better take a look--a careful look."

Roger Tory Peterson, 1974

Tennessee Department of Health and Environment
Laboratory Services
Aquatic Biology Section

In recent months the Aquatic Biology Section has completed several interesting projects at the request of the Division of Water Pollution Control. We have completed the FY 89-90 bioassay schedule entailing determination of wastewater toxicity of NPDES (National Pollution Discharge Elimination System) dischargers across the state. Also finished is the FY 89-90 Ambient Monitoring Benthological Report, as well as a benthos study on the Cane Creek watershed in Ripley Tennessee. The Ambient report is about water quality statewide while the Cane Creek study documents the effects of two electroplating companies and one sewage treatment plant on a particular stream in Ripley. The carcinogenic chemical dioxin is suspected as a fish flesh contaminant in the Memphis area. As a result we have collected catfish, river carpsucker, carp, buffalo, and striped bass for analysis from the Mississippi River, upstream and downstream of Memphis. Results will determine if the fish are safe for human consumption. Another project initiated, is a fish study designed to determine the effects of low dissolved oxygen in the Big Sandy River area of Kentucky Lake. Although ecological in nature, these projects protect the health of Tennesseans by protecting water and water related resources.

Leira Scott, Debbie Arnwine, and I (Dale Rector) collected fish on the Mississipi River at 27 feet above mean level. Amidst the floating trees, tires, and other asundry objects, up paddled a man in heavily loaded canoe with a plastic goose decoy tied on the bow as an ornament. He tied up to a tree at the Shelby Meeman Forest ramp from where we were surveying the river and asked us what we were up to. I told him "about 5ft 9 but we were also collecting fish for analysis of toxic chemicals" and asked him what he was up to. "Paddlin' the Mississipi River from Indiana to Louisiana wher' I'm gonna buy a horse and ride it to Arizona." He said. I was about to suggest an easier way to get to Arizona but decided to let him go on talking instead. On the river alone for days at a time the ole boy was lonesome for conversation, mostly his. He said. "I got my lags sunburnt after I got swamped by a barge the other day. I held my canoe up against the bank till I could bail it out but it kept fillin' up with water again. Finally after about 4 hours I drug it up on the bank. I stayed ther' about two days dryin' everthang out. I'm gonna head down to Memphis in the mornin' to get me a job for a few days so I can buy me a new tent. The one I got now leaks. I left my wife 15 years ago and ain't been back since." He rambled. I suspected she had run him off, but I didn't say anything. "Ye know." He said. "I hope you guys find out what's in these fish but I have to eat'em anyway." The man had a point.

As aquatic biologists we are responsible for measuring the quality of Tennessee's waters and fisheries. Some of the greatest contributors to water quality degradation in Tennessee are private industry, business, and public owned wastewater treatment plants. These facilities are required by law to file for and get a National Pollution Discharge Elimination System (NPDES) permit in order to discharge wastewater into Tennessee streams and rivers. At present about 1400+ permits have been issued in Tennessee. A permit defines the limits of metals, organics, and nutrients which can be legally discharged. As thousands of new chemicals are being manufactured and discharged into the environment, defining permit limits using only chemical data has become more complicated, more costly, and less dependable.

One primary goal of NPDES permitting is to assure that toxic chemicals do not enter receiving streams in toxic concentrations. Biological toxicity testing by the permittees themselves with periodic verification by the state is currently the most effective way to document waste toxicity. Many waste dischargers familiar with chemical testing are finding that EPA style toxicity testing using fathead minnows and Ceriodaphnia is a new game.

The Aquatic Biology Section put on two toxicity workshops in 1989 and two workshops in 1990 in order for NPDES permittees to get some hands-on experience with fathead minnows and Ceriodaphnia dubia. EPA acute and chronic methods were covered in both lectures and lab practicals with instruction from state and EPA experts. Many of the participants had no previous experience while a few had already used the methods on a daily basis. Since pupils brought in their own wastewater, we had a contest to see who's was the most toxic. The result of the contest is best left to your conjecture.

Industries, cities, and private consultants alike gave good to excellent evaluations of our workshop. Most importantly an even better relationship was developed between regulators and regulatees. Three or four industries decided to share information on ways of reducing toxicity. Everyone seemed genuinely interested in keeping Tennessee's waters clean, a worthy goal.

Ecological Support Branch Activities, May 1990

Marine/Wetlands and Water Quality Section

1. Hoke Howard, Bruce Pruitt and Mark Koenig travelled to Madisonville, KY to conduct wetlands ADID on Drake's Creek.

2. Delbert Hicks and Philip Murphy travelled to Charleston/Georgetown, SC to meet with enforcement counsel regarding a 404 Wetland Enforcement Action on Sasser Project.

3. Don Lawhorn attended a meeting of the EPA Safety Officers in Savannah, GA for presentation on diving.

4. Dave Smith and Candace Halbrook conducted SOD studies on the Coosa River and Neely Henry Reservoir in Alabama.

5. Tom Cavinder, Hoke Howard, Mark Koenig and Jake Weaver conducted stream studies on three streams in Alabama for possible upgrading their classification.

6. Tom Cavinder presented a statement at a public hearing in Panama City, FL on the Bay County wastewater discharge.

7. Bruce Pruitt, Phil Murphy and Mel Parsons conducted wetland mapping at the Pensacola Naval Airfield.

8. Delbert Hicks and Don Lawhorn travelled to Savannah, GA to provide the RA a tour of the Savannah River reach studied last summer.

9. Mark Koenig and Dave Smith travelled to Columbus, MS to conduct SODs on the Tombigbee.

10. Don Lawhorn and Mel Parsons attended the Dive Masters Training course in Gulf Breeze, FL.

11. Hoke Howard, Bruce Pruitt, Tom Cavinder and Don Schultz assisted SCS in gathering plants for use in the constructed wetlands project.

12. Phil Murphy, Russ Todd, and Candace Halbrook conducted an ocean mapping survey aboard the Peter W. Anderson at the Pensacola ODMDS site.

Toxics Evaluation Section

1. Ron Weldon and Kay LaMotte conducted chronic toxic tests with fathead minnows and daphnids on surface water samples from Rocky and Hollinger Creeks, Mobile, AL as part of the water quality assessment.

2. Ron Weldon and Kay LaMotte conducted acute toxicity tests with fathead minnows and daphnids on surface water samples from Drakes Creek and Pleasant Run, Hopkins County, KY as part of the Wetland Evaluation Technique Field Verification.

3. Technical assistance on toxicity testing and culturing of test organisms was provided to consultants and state personnel.

4. Toxicity testing and culturing methods were demonstrated to two UGA environmental health classes.

5. Finalized comments on contractor's fish tissue bioaccumulation study for Stauffer (AK20) Chemical, AL.

6. Work is continuing on report of environmental studies at Aberdeen Pesticides, NC.

7. Work continuing on report of wetland impact study at Bay Drums, FL.

8. Alan Auwarter provided comments on Dredged Material Biological Testing Requirements to Chris Hoberg on generic recommendations the Jacksonville District COE can provide to applicants on bioassay and sampling for bioassay.

9. Alan Auwarter reviewed contractor-prepared Remedial Investigation report for Olin Corporation, AL and provided technical assistance to Remedial Project Manager (RPM) through ETAG.

10. Alan Auwarter reviewed RI/FS Work Plan for Ft. Hartford Mine, KY and provided technical assistance to RPM through ETAG.

11. Jerry Stober traveled to Montgomery with Atlanta Permits staff to meet with ADEM and USFWS regarding endangered species and cool gas development.

12. Jerry Stober participated in Living Waters Symposium sponsored by BASS.

13. Jerry Stober prepared update of regional activities for Mid-America Fish Contaminated Group.

14. Jerry Stober presented preliminary study plans and estimated costs for Toxics inventory in the Chattahoochee River - West Point Reservoir to Water Division.

June 1990

Toxics Evaluation Section

1 Alan Auwarter met with a representative of Pasons, Brinckerhoff, Quade & Douglas, Inc. concerning construction of a dry dock facility in Charleston Harbor. A consensus opinion on sampling specifics for bioassay of dredged material from the site was arrived at by the Charleston District COE (Steve Morrison), EPA ERL-Gulf Breeze (Rod Parrish) and Region IV (Chris Hoberg). The file was turned over to Phil Murphy for consideration of other issues relating to the site.

Bay Drum Wetland Impact Study Plan -

2 Alan Auwarter met with ECB project coordinator (Fred Sloan) to discuss project changes for incorporation into the Project Operations Plan and WISP.

3 The section has begun to assemble the needed sampling materials.

4 ESD and external peer review comments were incorporated into the draft WISP by Alan Auwarter.

5 Alan Auwarter assisted the ESAT contractors in their preparations for project bioassay work.

Aberdeen Pesticides Site -

6 Alan Auwarter and Dann White began a review of fish bioaccumulation data from the site lakes. Alan Auwarter reviewed the Fairway Six Disposal Site Record of Decision.

Hazardous Waste Storage/Handling/Disposal -

7 Alan Auwarter and Dann White participated in an extended conversation with the ERL-Corvallis to learn of their hazardous waste procedures. Alan Auwarter also met with Bobby Carroll to begin planning for BRA's hazardous waste storage and disposal.

8 Alan Auwarter met with EPA and UGA representatives on plans for an incineration system to be built as part of a new containment research facility at the veterinary medical school.

9 Alan Auwarter arranged a meeting in Atlanta primarily of individuals who use or have need of water and fish tissue criteria and standards for Superfund applications. Jerry Stober and Linda Anderson-Carnahan also participated in the meeting. The purpose of the meeting was to foster a better understanding of he EPA fish tissue concentrations (criteria) and to force consideration of their application in Division work and their relationships to existing and often-cited FDA action levels.

10 Kay LaMotte and Ron Weldon conducted acute screening toxicity tests with Menidia beryllina (silverside minnows) on 30 samples from the Munisport superfund site area in Miami, Florida.

11. Kay LaMotte conducted a fathead minnow embryo-larval test on cadmium chloride, a reference toxicant.

12. Technical assistance, Ceriodaphnia and culture water were provided to GaEPD to aid in replenishing their cultures.

13. Lewis Cain, a consultant in Chattanooga, Tennessee was provided Ceriodaphnia and food to start a culture in his lab.

14. Jenny Mapes of Rogers and Callcott Engineers in Greenville, SC was provided technical assistance and culture water to aid in establishing a culture in her lab.

15. Paul Osemene of Priester and Associates and Lewis Frederick of Environmental Services both in Columbia, SC, visited with Ron Weldon and Kay LaMotte to receive assistance on toxicity testing and culturing procedures.

16. Richard Griner of ESAT started working with staff to be trained in the culturing of toxicity test organisms.

17. Jerry Stober reviewed Champion's response to the draft permit for the Canton Mill on Pigeon River. He also met with company representatives in Atlanta June 13.

18. Jerry Stober helped Ron Raschke sample on the FLAP project.

19. Jerry Stober attended a meeting of the Eco-toxicity Subcommittee at Headquarters and began working with the Eco risk subgroup for populations.

20. Jerry Stober planned the Fish Health Short Course and submitted the purchase request for the contractor. He also reviewed the Cohutta hatchery facilities where the course will be held.

21. Jerry Stober traveled to the Pigeon River June 27-28 and observed TVA-TWRA-ORNL sampling of fish for health effects and biomarker samples.

22. Jerry Stober compiled information on the Pigeon River dioxin study to develop an addendum to the report.

23. Jerry Stober continued working with Headquarters on the National Bioaccumulation Study.

24. Jerry Stober carried out the planning for sampling of General Smelting and Refining, Inc. in College Grove, TN.

25. Bill Peltier participated in a workshop sponsored by the U. of Wisconsin-Madison on Effluent Toxicity, Bioaccumulation and Toxicity Reduction Evaluations. Approximately 75 people representing industry, POTW's, State regulatory agencies, consulting firms, etc., attended the workshop.

26. Bill Peltier has completed directories on consulting firms that provide toxicity testing and aquatic organisms for testing. A summary of tests' cost was compiled for distribution. Directory and test costs were mailed out to OWEP, EPA Regional offices, and State regulatory agencies.

27. Mr. Peltier has put together a questionnaire on resource allocation for individual toxicity tests used in the NPDES permit program. The questionnaire was sent to all Regional ESD biologist. Results of the questionnaire will be compiled and sent to the OWEP Enforcement Division for use in determining resource allocation (FTE's) for Regional ESD toxicity testing programs.

28. Bill Peltier has been working with Rod Frederick, EPA, Headquarters, and Nelson Thomas, ERL-Duluth, to obtain support for reactivating the Complex Effluent Toxicity Information System previously used by State and Regional personnel.

29. Bill Peltier has been working with Ms. Florence Kessler, Computer Science Corp (Contractor, EMSL-Cincinnati) on the statistical evaluation of Region IV's NaCL round robin study.

30. Dann White has been working on preparing SOP's for the terrestrial tests for hazardous waste. The Corvallis SOP was used in completing the procedures that the published hazardous waste manual (EPA 600/3-88/029) does not cover.

31. On June 29, EPA held its first ETAG meeting. Jerry Stober and Dann White attended. The Bay Drum site and the Carolina Transformer site were discussed. The next meeting is set for July 25, 1989.

32. Linda Anderson-Carnahan presented a training session on toxicant identification evaluation techniques at the monthly staff meeting.

33. Linda Anderson-Carnahan and staff from the Florida DER conducted an on-site toxicity characterization evaluation at the St. Andrew's Bay WWTP in Panama City, FL. David Graves of SC DHEC also participated.

34. Linda Anderson-Carnahan, Delbert Hicks, and Hoke Howard met with the Region IV Water Quality Standards staff regarding the integration of whole effluent toxicity, biosurvey and chemical specific data in standards and water quality-based permitting.

35. Linda Anderson-Carnahan reviewed and commented on the draft proposed amendments to the Tennessee Water Quality Standards for the WMD, the Gulf Breeze ERL Marine Fisheries Health and Diagnostic Center statement for GB-ERL, and the Toxic Substance and Pesticide Subcommittee meeting report for the Gulf of Mexico program.

Marine/Wetlands and Water Quality Section

1. Branch staff continue to conduct work on the FLAP project.

2. Ron Raschke attended a South East Regional Workshop on Lake Reservoir Management held in Chattanooga, TN.

3. Ron Raschke conducted an analysis of Georgia's West Point Reservoir/Chattahoochee WLA report and submitted the results to Water Division.

4. Several algal assay tests were conducted including marine toxicity tests on samples from Munisport Dump Site in Florida.

5. Several staff members attended a safety training course in Atlanta.

6. Hoke Howard and Russ Todd met with program staff and representatives from CSX regarding a restoration plan for lake contaminated with acid from overturned rail road car.

7. Staff continue to conduct sampling on the Savannah River for D.O. and salinity.

8. Candace Halbrook began sediment sizing work on samples from Charlotte Harbor ODMDS.

9. Russ Todd and Ron Rashcke attended the ETAG meeting to discuss the Bay Drum and Carolina Transformer workplan.

10. Phil Murphy, Don Lawhorn and Mel Parsons traveled to Perdido Bay, Florida with personnel form UGA, Center for Applied Isotope Studies to test sampling methods and conduct sediment chemistry mapping of upper Perdido Bay.

11. Bruce Pruitt completed the SAPP Battery wetland delineation/qualification report.

12. Bruce Pruitt met with program staff to discuss upcoming activities, objectives and priorities on advance identification of Broward and Dade county wetlands.

13. Mark Koenig, Bruce Pruitt, Tom Cavinder and Delbert Hicks completed the field work for the toxological assessment of Munisport landfill.

MARINE/WETLANDS AND WATER QUALITY SECTION

1. Donald Lawhorn conducted a Sediment Oxygen Demand study on Ashley River to assist the State of South Carolina in a modeling project.

2. Candace Halbrook transported Canaveral's macroinvertebrate samples to Barry Vittor and Associates in Mobile, Alabama for benthic identification.

3. Candace Halbrook began sediment sizing analysis on Cape Canaveral ODMDS sediments.

4. Candace Halbrook drafted an SOP for sediment sizing techniques for inclusion in the Branch SOP manual.

5. Mel Parsons and Ron Raschke continued work on FLAP for mapping of lakes.

6. Mel Parsons, Don Lawhorn, Dave Smith and Phil Murphy participated in the Charleston ODMDS Reef Study/Ashley River SOD. They were involved in photographing and videoing live bottom characterization of impacted reef and reference reef site.

7. Ron Raschke attended and made presentation at the 1st meeting of the newly organized Georgia Lakes Management Society in Dahlonega, Georgia.

8. Bruce Pruitt assisted Region IV Headquarters personnel and State of Kentucky personnel on Western Kentucky Wetland Advanced Identification.

9. Staff attended Riparian/Water Quality Function Workshop.

10. Hoke Howard conducted reconnaissance of proposed impoundment site at Tracy City, Tennessee with Laura Mazanti of the Wetlands Section in Atlanta.

11. Staff continued work on the Water Quality sampling - WADE Project in Eatonton, Georgia.

12. Work continued on WADE project and Drake Creek Wetlands Study.

13. Russ Todd conducted preliminary planning and work plan for Florida Steel Biological Study to be conducted in August.

14. Staff attended the ETAG meeting held in Atlanta to review Ciba-Geigy RI workplan and Tri City, Kentucky Landfill.

TOXICS EVALUATION SECTION

1. Jerry Stober developed 2nd Draft Chattahoochee River - West Point Reservoir Contaminants Study Plan for Region IV internal review.

2. Jerry Stober participated in the region-wide non-point source evaluation for the comparative risk strategic planning study.

3. Jerry Stober continued organizing details for AFS Contaminants in Fish Symposium.

4. Jerry Stober reviewed and commented on Federal-State Forum on Fish Consumption Advisories and 1989 Census Report for Headquarters OWRS.

5. Alan Auwarter worked on the Aberdeen Pesticides study and continued work on the ESD environmental studies report. The projected delivery for internal review is August 31, 1990.

6. Alan Auwarter worked on the Bay Drums, Peak Oil and Reeves Southeastern, Florida Areawide Wetland Impact Study report which is nearing completion. The projected delivery for internal review is August 13, 1990.

7. Alan Auwarter and Jerry Stober participated in Ecological Technical Advisory Groups reviews of Florida Steel and the Tri-City site in Kentucky, as well as participating in a discussion which involved the possibility of a regional study to encompass all or part of the Tombigbee/Mobile River system, as an ETAG member.

8. Ron Weldon and Kay LaMotte provided technical assistance to Mary Gair of EPA Headquarters on toxicity testing methods.

9. Ron Weldon conducted Performance Audit Inspections on Grove Scientific in Orlando, Florida and Envirolab in Ormond

Beach, Florida. These laboratories conduct compliance toxicity tests for NPDES permittees.

10. Phyllis Meyer researched the 2nd Draft of the Chattahoochee River Study Plan and compiled graphs and tables.

11. Phyllis Meyer worked on Bay Drums, Peak Oil and Reeves Southeastern, Florida Area-wide Wetland Impact Study Report.

12. Phyllis Meyer worked in the Algal Assay Lab and is currently working with the Wetland Agricultural Dairy Effluent Study (WADE).

Meetings

October 2-4, 1990 - 1990 Annual Meeting of the Southeastern Water pollution Biologists Association. Buccaneer Clarion Resort, Jekyll Island, Georgia. For info: Dave Chestnut, South Carolina Department of Health and Environmental Control, 2600 Bull Street, Columbia, SC 29201.

October 16-19, 1990 - International Symposium on Ecological Indicators. Clarion Castle Hotel, Miami Beach, Florida. For info: Janet McDonald, Kilkelly Environmental Associates, P.O. Box 31265, Raleigh, NC 27622. 919/781-3150.

October 21-24, 1990 - Southeastern Fish and Wildlife Conference. Marriott Hotel, Richmond, Virginia. For info: Charlie Sledd, Virginia Department of Game and Inland Fisheries, 4010 West Broad Street, Richmond, VA 23230. 804/367-6481.

October 22-24, 1990 - Florida Acidic Deposition Conference. Tampa Hilton at Metrocenter, Florida Department of Environmental Regulations. For info: Curtis E. Watkins 904/488-0782.

November 6-9, 1990 - 10th International Symposium of the North American Lake Management Society. Sheraton Tara, Springfield, Massachusetts. For info: Judith A. Sutterfield, P.O. Box 217, Merrrifield, VA 22116. 202/466-8550.

November 11-15, 1990 - 11th Annual Meeting of the Society of Environmental Toxicology and Chemistry. Hyatt Regency Crystal City, Arlington, Virginia. For info: Randell Wentsel, U.S. Army, Attn: SMCCR-RST-E, Aberdeen Proving Ground, MD 21010. 301/671-2039.

November 26-28, 1990 - Geographic Information System Research Applications Symposium. Tennessee Technological University, Cookeville, Tennessee. For info: Yvette Robinet Clark, Center for Management, Utilization, and Protection of Water Resources, Tennessee Technological University, Box 5033, Cookeville, TN 38505.

November 29-December 1, 1990 - Biological Monitoring of Freshwater Ecosystems. Purdue University, West Lafayette, Indiana. For info: Stanford L. Loeb, Department of Systematics and Ecology, University of Kansas, Lawrence, KS 66045-2106.

December 10-12, 1990 - 2nd National Water Quality Standards Conference, U.S. EPA, Stouffer Concourse Hotel, Crystal City, Virginia. For info: Marjorie Pitts 202/475-7304.

May 21-24, 1991 - 39th Annual Meeting of the North American Benthological Society. College of Santa Fe, Santa Fe, New Mexico. Abstracts should be sent by 11 January 1991 to: Cliff Dahm, Department of Biology, University of New Mexico, Albuquerque, NM 87131.

August 12-14, 1991 - 11th International Symposium on Chironomidae. University of Amsterdam. For info: Congress Management, Conference Office, University of Amsterdam, Spui 21, 1012 WX Amsterdam.

November 11-16, 1991 - 11th Annual International Symposium of the North American Lake Management Society. Sheraton Denver Tech Center, Denver, Colorado. For info: NALMS office (202)466-8550.