PROCEEDINGS

APPALACHIAN RIVERS

A COOPERATIVE INDUSTRY, GOVERNMENT, ACADEMIA, AND WATERSHED ORGANIZATIONS CONFERENCE AND WORKSHOP

PROCEEDINGS

APPALACHIAN RIVERS I

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Time: 8:00 A.M. - 5:00 P.M.

Date: April 23, 1998

Location: West Virginia High Technology Consortium (WVHTC), Fairmont, WV

A CONFERENCE AND WORKSHOP OF INVITED PARTICIPANTS TO ADDRESS DEVELOPMENT AND APPLICATIONS OF ADVANCED TECHNOLOGIES TO APPALACHIAN RIVERS

MOTEL RESERVATIONS AND ARRANGEMENTS

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OF ABSTRACTS

"WELCOME" BY CONFERENCE CHAIRMAN

Good Morning, I am Zane Shuck, Organizer of this conference.

I would like to welcome you to this first annual Appalachian Rivers Conference, Workshop and Exhibit, and thank you for your participation. I individually invited each of you because you are the experts in river matters. I also thank you for your efforts in monitoring our rivers, and to clean up our streams and rivers. I also think the general public needs to know more details about the good work you are doing.

At this time, I would like to introduce some people who helped make this conference happen. Introductions of Damita Pagan, and Michelle Cameron of NEW-BOLD Enterprises, Inc., and Nancy T. NewBold, President, NEW-BOLD Enterprises, Inc.

Shelly Montgomery, JoEllen Markley, Heather DuPont, Tammy Rebrook, and Dave Walker of WVHTCF. Thank you very much for your assistance with the arrangements and support throughout this project.

Barbara Weaver, Vice President of Administration, WVHTCF, (also a watershed organization officer), this conference could not have happened without your assistance and suport. And, thank you to Larry Milov, President of WVHTCF.

I would also like to recognize a few who helped in the planning of this conference.

Tom Keech, President, Process Dynamics
Dr. Joe Marshall, Biology Professor, WVU
Craig Means, Downstream Alliance and WVU NRCCE
Dr. Jerry Fletcher, WVU Resource Management
Dr. George Case, Biochemist, Biosensor paper, biotechnologies
Rich Little, Geologist, Coast Guard Auxiliary, Dunkard Creek Watershed Organization
Ramada Inn, Catering Service performs excellent on all occasions here.

I would like to especially thank the exhibitors. We have with us exhibiting their products and to discuss water chemical property measurements in rivers and harsh environments the world's two leading quality monitoring instrument manufacturer's representatives from:

Hydrolab: Phyllis Crutchfield and Jason Harrington
YSI: Steve Fondriest and Gayle Rominger
B. Preiser Scientific: Don Meyers
Polaroid: Darryl Rosenberg.

The format of this meeting is 10 minute briefings by each author in order to maximize the number of topics and communicate as much information as possible in a one day meeting.
These short briefings should be informative and interesting to all of the diverse groups of river stewards, academic and industry researchers, government representatives, manufacturers, and small business representatives without anyone getting bored.

OPENING REMARKS BY CONFERENCE ORGANIZER AND CHAIRMAN -- L. ZANE SHUCK

I would like to give you my interpretation of what this conference is about and why I think it is important to review the roles of advanced technology in the monitoring and clean up of rivers at this time(slide). In the past two to three years laptop computers, microprocessors, and software systems and computer based instrumentation systems have reached a level of capability that will permit us to realistically think differently about how we monitor river processes. We need to review and apply these new emerging technologies. There also continues to be improvements in stream and river cleanup processes, and we all need to be made aware of emerging problems.

Rivers and there ecosystems are very complex, dynamic, hydrodynamic, geobiochemical processes. There are many different disciplines associated with a large variety of issues that comprise the river ecosystem puzzle(slide). There are many government agencies and many different scientific and engineering fields associated with the monitoring and study of these different facets of rivers. This is one reason it is so very difficult to grasp an overall perspective of what the status is of each activity, and who is doing what and how.

The question addressed here today is "What can technology do for us?" (slide)
I have chosen to organize river and stream matters into four categories for the purpose of applying advanced technology. These four categories represent actions in which technology can be applied. These categories formed a basis for organizing this conference and selecting the topics and issues for presentation and discussion.

(slide) It is also logical and convenient to categorize the basic sciences associated with river ecosystems into four groups. These four basic science systems are: 1) the water or the media, 2) the microbes existing within the media, or water, 3) the macro aquatic plants and habitats, and 4) the macro aquatic animals living within the media (biota, fish), and the macro animals living in the benthic zone(benthos).

The degree to which we can develop and apply technology to achieve an action or result is dependent upon how good, or well developed and understood, the science is for each area of basic science. It appears that the basic science is very limited in some areas. We must acknowledge that each of these four basic science systems is interdependent upon each of the other three. Simply stated, this results in coupled phenomena, and the solution of more than first order simultaneous equations. Now, and only now, do we have the technology that will permit us to realistically untangle some of the mysteries and improve our basic science level of knowledge and databases for these basic science systems**. This is what technology can do for us.**

(slide) This slide shows how technology can work interactively in a feedback mode to: 1) improve our knowledge of the basic science systems, and 2) learn how they are related in a quantitative manner so they can be integrated into simulation models for further analysis and understanding.

Finally, as illustrated in this slide, our ultimate goal must be to generate realistic, highly capable models as tools, for river stewards to analyze and clean up streams and rivers, and for public administrators to use in carrying out their missions and formulating reasonable and meaningful public policy. These are the roles for technology as I see them in river affairs.

I look forward to your presentations and learning more about each of the basic science areas, and the technology developments that you bring here as the subjects of this conference.

APPALACHIAN RIVERS CONFERENCE, WORKSHOP AND EXHIBIT

A REVIEW OF

CURRENT ACTIVITIES AND CAPABILITIES

AND

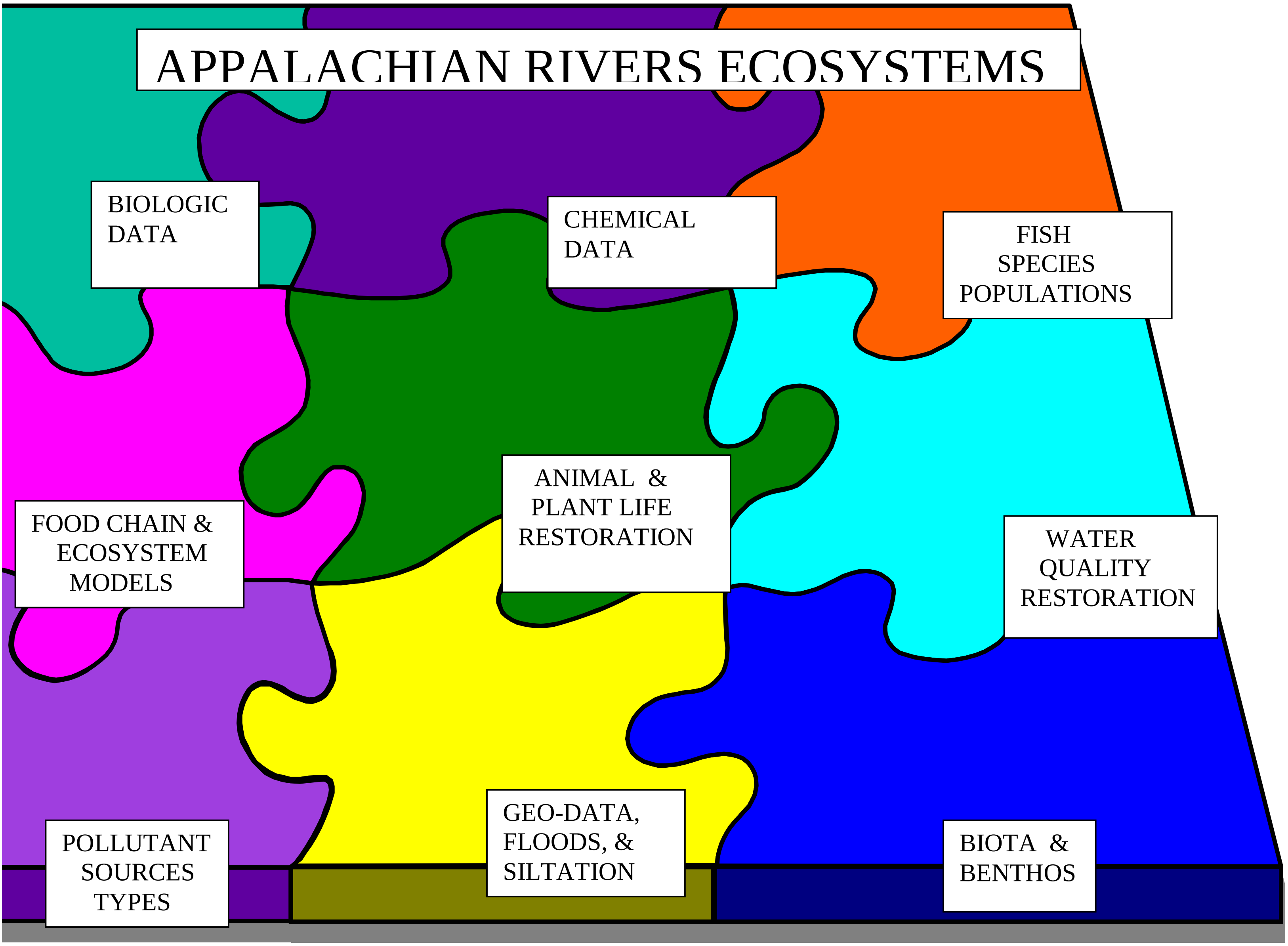
EXPRESSION OF NEEDS

ROLES FOR

ADVANCED TECHNOLOGIES

IN STREAM AND RIVER CLEANUP

AND ECOSYSTEM STUDIES


APPALACHIAN RIVERS ECOSYSTEMS
BIOLOGIC DATA
CHEMICAL DATA
FISH SPECIES POPULATIONS
ANIMAL & PLANT LIFE RESTORATION
FOOD CHAIN & ECOSYSTEM MODELS
WATER QUALITY RESTORATION
POLLUTANT SOURCES TYPES
GEO-DATA, FLOODS, & SILTATION
BIOTA & BENTHOS

RIVER AND STREAM TECHNOLOGY APPLICATIONS

WHAT CAN TECHNOLOGY DO FOR US ?

1. MONITOR & OBTAIN DATA from Basic Science Systems
- **a. WATER -- Chemical, Flows, Erosion**
- **b. MICROBES -- Plant, Animal**
- **c. MACRO -- Plants and Habitats**
- **d. AQUATIC ANIMALS -- Biota (fish) and Benthic**

2. DATA AND INFORMATION
- **a. GATHER -- multiple sources, chem,bio,geo, formats**
- **b. FORMAT --universal compatibility**
- **c. STORE -- universal access data bases**
- **d. INTEGRATE -- basic science sources**

3. COMPUTER MODELS
- **a. ASSIMILATE, ANALYZE, and SYNTHESIZE**
- **b. ASSIST interpretation and understanding**
- **c. SIMULATE for process design and control**

4. CHANGE, MODIFY, REMEDIATE, RESTORE -- to near self sustaining ecosystem (minimum human welfare status)
- **a. WATER QUALITY -- chemical and biological**
- **b. FLOODS -- small streams and large rivers**
- **c EROSION and SILTATION-- sources**
- **d. MICROBE -- populations**
- **e. MACRO AQUATIC PLANTS**
- **f. AQUATIC ANIMALS -- fish and benthos**

BIOSKETCH
OF
L. ZANE SHUCK

EXPERIENCE

40 years professional experience including college and university teaching, research and administration, planning, conducting and managing national energy research programs, consulting with industry, conduct interdisciplinary research in biomechanics and rheology, and proprietor and executive officer in consulting and R & D companies.

President, Technology Development Inc. (1980-present)
Founder and President, The WMAC Foundation (1997-present)
WVU, Professor Mechanical Engineering and Associate Director Engineering Experiment Station
Member Graduate Faculty, master and doctoral theses advisor
WVa Tech, Associate Professor and Chairman, Dept. of Mechanical Engineering
US Dept. of Energy, Supervisory Mechanical Engineer

EDUCATION

BSME - WVa. Institute of Technology, 1958
MSME -West Virginia University, 1965
PhD - West Virginia University, 1970
Graduate, post-doctoral, and summer programs at Iowa State University, Wayne State University and Massachusetts Institute of Technology

PUBLICATIONS AND PATENTS

62 publications, 13 patents(including first patent ever awarded through WVU), Producer 4 technical films for U.S. Dept of Energy

ANCILLARY INFORMATION

Registered Professional Engineer WV & OH, Certified by National Council of Engineering Examiners, National Science Foundation Science Faculty Fellow, Science Advisor WVa Governor John D. Rockefeller IV (78-81), Science and Technology Coordinator WV Legislature(79-80) ASTM Award (70), ASME Ralph James National Award (80), Editor Transactions Journals and Symposia Proceedings

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Gary S. Casuccio
RJ Lee Group, Inc

Evaluating Source/Receptor Relationships using the Automated Scanning Electron Microscope

Determining the source of river sediment can be of interest due to environmental concerns. This is especially true if the sediment contains toxic metals (e.g., lead, cadmium, arsenic, mercury) and there is a need to identify the principal responsible party (PRP). Receptor models based on computer controlled scanning electron microscopy (CCSEM) data offer great potential to provide increase insight in this area. Receptor models have been developed to estimate the contribution of a source(s) at a receptor location (e.g., river sediment). These models use physical and chemical characteristics of particles measured at the source and receptor to identify and quantify source contributions to receptor concentration. Receptor models have been historically used to apportion source impacts on ambient air quality. The techniques developed to evaluate ambient air quality are appropriate for river sediment.

The receptor model process requires knowledge on the nature of emissions from the source(s) that has a measurable impact at the receptor location. Information on source emissions is obtained through analysis of samples collected from the suspected source(s) of interest. By mathematically comparing the source concentration data to the concentrations observed on the receptor sample, an estimate can be made on the amount each source or source category contributes to the total mass.

Although traditional bulk analytical techniques (e.g., XRF, AA, ICP) offer better accuracy and sensitivity than microscopic methods, they provide no information on particle size, morphology or phase. Particle specific data is often necessary to determine the source of the particulate matter. An example of the power of scanning electron microscopy (SEM) data is provided in Figure 1. In Figure 1A, the elemental spectrum associated with a fly ash particle (by-product of coal combustion) is provided. Energy dispersive spectroscopy (EDS) analysis indicates that this particle is composed primarily of silicon with smaller amounts of aluminum and oxygen. A minor amount of carbon and potassium was also identified. The composition of this fly ash particle is similar to that found on a typical soil particle (see Figure 1B), yet they originate from different sources. Information of this nature (i.e., morphology and composition of individual particles) can be critical to the apportionment of particulate matter and can only be obtained through microscopic analysis. Thus, SEM analysis offers additional resolution and allows for further separation of source types that are indistinguishable by the traditional bulk analytical techniques.

While the SEM is a powerful analytical tool, receptor models require quantitative concentration data as input. To be able to quantify microscopic results, particles must be characterized in sufficient numbers to ensure representation of the entire population. With CCSEM, the size, shape and elemental composition of individual particles can be analyzed very quickly (i.e., seconds per particle) making quantitative characterization of
particles economically feasible. This permits large numbers of individual particles to be analyzed building a database representative of the entire sample. Furthermore, CCSEM enables each particle to be tested against the same analysis parameters which assures uniformity of the analysis. This technology has been used in numerous studies involving the apportionment of particulate matter.

Individual particles characterized during a CCSEM analysis can be grouped into particle type (species) classes based on their elemental composition and shape. The CCSEM particle type data can then be summarized into number distribution and mass distribution tables. The individual particle results can also be combined to provide for a representation of the overall sample chemical characteristics. Thus, CCSEM is able to provide information on a sample's bulk characteristics while retaining its microscopic properties.

The CCSEM particle type data can be used as input to receptor models. Most recently, the CCSEM particle data was used as input to the Chemical Mass Balance (CMB) receptor model. The CMB has been designed to determine the amount each source or source type contributes to the receptor sample. The CMB receptor model is based on the conservation of mass and uses an effective variance least squares analysis to fit the chemical compositions of the source samples with that of the receptor sample. Through evaluation of the source profiles (i.e., the fractional amount of particle types in the source emissions) and the receptor concentrations, along with their associated uncertainty estimates, an estimate can be made of the amount each source or source category contributes to the total mass. The CMB model requires that the potential source contributors have been identified; that a sufficient number of source and receptor samples have been collected with accepted sampling technology; and that the source and receptor samples have been analyzed using appropriate techniques to determine particle characteristics. The U.S. Environmental Protection Agency (EPA) has approved the CMB receptor model for use in air quality studies.

The solution provided by the CMB model consists of a source contribution estimate (SCE) and the standard error (STDERR) associated with it for a particular source. In addition to the primary output indicators (i.e., the SCE, STDERR and concentration of a species), the CMB is also equipped with several performance statistics and diagnostics (e.g., R-square, Chi-square) that indicate the goodness-of-fit of the specified input data. With the help of these diagnostics, the CMB7 model can be used in an interactive mode to determine a mix of sources and their contribution to the mass measured at the ambient monitor site.

An example of the CMB output is provided in Table 1. In this example, a ambient PM_{10} sample was apportioned against a road sample (SS4) collected in the vicinity of the ambient monitor. These samples were obtained as part of the Salt River Air Quality

Study in Phoenix, Az. The CMB results indicate that this source accounted for approximately 98 percent of the mass collected on the ambient sample. The high R-square (0.98) and low chi-square (0.12) values indicate a that the source concentrations are in close agreement to the ambient data. This can be seen in Table 1 by comparing the measured concentrations to the calculated concentrations based on the source profile for SS4.

In summary, evaluation of source/receptor relationships associated with river sediment can be performed using receptor modeling techniques originally developed for ambient air quality. Using CCSEM data as input to the receptor model will provide additional resolution on source and receptor constituents which can assist greatly in the apportionment process. It is anticipated that the CCSEM receptor model approach will be of unique value in apportioning river sediment containing toxic metals that are in multiple phases.

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G.S. Casuccio has over 15 years of experience in evaluating source/receptor relationships using receptor model techniques. He has performed over 100 receptor model studies for industry and governmental agencies. He is a consultant and advisor to the EPA in the use of CCSEM as a source apportionment tool.

Table 1. Example of CMB Output

SOURCE CONTRIBUTION ESTIMATES - SITE: Salt River DATE SAMPLED: 6/12/95
SAMPLE DURATION 24 HOURS SAMPLE TYPE: PM-10
R SQUARE .98 PERCENT MASS: 99.7
CHI SQUARE .12

	SOURCE	SCE(UG/M3)	STD ERR	TSTAT
4	SS4	.9971	.1283	7.7694

	PARTICLE TYPE-I		MEAS. CONC	CALC. CONC	RATIO C/M	RATIO R/U
1	MASS	T	1.00000+-.15000	.99713+-.12834	1.00+-.20	-.0
2	Si-ric	*	.11800+-.04800	.11268+-.04886	.95+-.57	-.1
3	Si/Al	*	.20100+-.03900	.17948+-.04188	.89+-.27	-.4
4	Si/Al/	*	.35800+-.04100	.36395+-.04188	1.02+-.17	.1
5	Si/Mg	*	.02700+-.02500	.03390+-.03689	1.26+-1.79	.2
6	Si/Ca	*	.07000+-.03200	.07080+-.03390	1.01+-.67	.0
7	Ca-ric	*	.04400+-.03200	.06780+-.03191	1.54+-1.33	.5
8	Ca/Si	*	.02800< .02900	.03490< .03390	1.25< 1.77	.2
9	CaSiAl	*	.08700+-.03100	.06681+-.03390	.77+-.48	-.4
10	Ca/Mg	*	.01000< .02700	.01895< .02692	1.89< 5.78	.2
11	Ca/S	*	.01800< .02000	.00100< .01496	.06< .83	-.7
12	Misc.	*	.03800+-.03100	.04687+-.03091	1.23+-1.29	.2

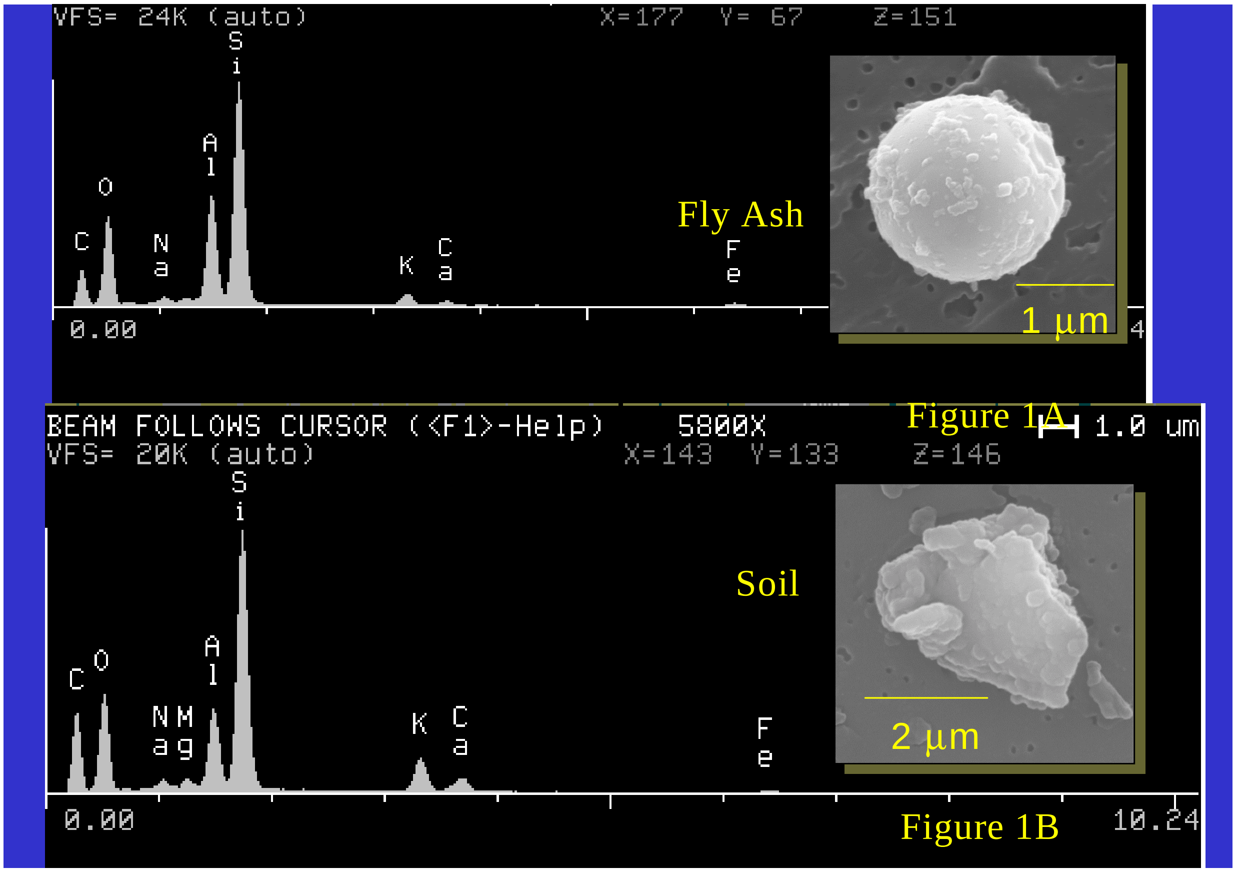

Figure 1. SEM image and elemental spectrum of fly ash and soil particles.

Sharon Whetzel,
Department of Agriculture, West Virginia,

The Use of Bioluminescense Analysis of River Water for Microbial Enumeration

Gus R. Douglass, (Commissioner), David Miller, (Deputy Commissioner), Janet Fisher (Assistant Commissioner), Department of Agriculture, West Virginia.

Dennis Crabtree, Taylor and Thomas Environmental Inc. Florida and West Virginia, and David Stafford, Hughes Whitlock Ltd, Wales.

INTRODUCTION

The enumeration of microorganisms in rover waters is becoming an important aspect of water quality, particularly in regard to effluent discharges from sewage treatment plants, farms and food processing industries. In the interests of public health, water samples taken from rivers should be tested regularly to confirm their freedom from such contaminations as total coliforms, *E. coli* and fecal streptococci. The baseline enumeration of such microbes is determined with conventional place counts using selective media. As the number of microbes present may be low in number per 100 ml of sample taken, membrane filtration techniques may be employed before use of selective media or other methods of augmenting the microbial signal tried including pre-incubation in peptone water. All such methods are usually historical in nature in that several days elapse before either a qualitative or quantitative measure of microbial contamination can be made.

RAPID METHODS

Rapid methods are available which allow for an immediate determination of microbial contaminations to be made and remedial measures taken in real time. Similarly point source pollution detection can be made where agricultural run off is correlated with total microbial counts. These counts in turn may be related to the presence of one or more pathogenic microbial discharges normally associated with human, agricultural sludges or effluents. Such quantifiable enumeration is discussed in this paper.

BIOLUMINESCENCE

The microbial enumeration of microbes using bioluminescence has been employed for several decades and within the last 10 years instruments and kits have been made available commercially, (Gehle, Presswood and Stafford, 1991). The application of the technology to measure small numbers of microbes with highly sensitive portable luminometers has also recently been made available (Stafford, Willis, and Bryant, 1995). The relationship between such highly sensitive techniques and conventional plate counts will enable its use in rapid enumeration of total viable counts as well as perhaps determining the presence of specific organisms such as total coliforms. This data acquisition possibility would enable real time analysis to be made for quality control evaluation in river water samples. Early warning of a point source discharge would enable monitoring of river water quality to be effective. The correlation with plate counts is an important aspect of the ongoing analysis and significant associations are expected to be determined during the correlation test procedures.

ADVANTAGES OF BIOLUMINESCENCE APPLICATIONS

One of the more problematic aspects of conventional plate count tests are the presence of non-culturable microbes, which will contribute to a falsely low count. These false negatives are not encountered with the bioluminescence technique since all microbes present are counted. All microbes contain ATP, which is detected with the luciferin/luciferase enzyme used in the analysis.

Sometimes the river samples will contain algae and/or protozoa as well as prokaryotic bacteria. The kit developed by Hughes Whitlock Ltd enables the sample to be treated to either remove the eukaryotic ATP or measure it separately. In this way the protozoal - algal species can be determined in real time together with the bacterial counts. If the eukaryotic count is more closely related to agricultural run-off because of the relationship with algal blooms, (especially during summer months), then a very quick confirmation can be made available with the application of such techniques.

The program, as determined, is intended to continue studying the correlations with chemical testing, conventional plate counts and the novel bioluminescence technique, to show the efficacy of this rapid method for providing useful data for determining the quality of river waters in the Potomac area of West Virginia.

IMPLICATIONS FOR EFFLUENT TREATMENT FACILITIES AND MICROBIAL ENUMERATION

The bioremediation of waste waters from food plant facilities or from sewage treatment and farm activities has been shown to be effective using aerobic, or anaerobic processes, as in the case of the Power Project at Moorefield West Virginia, (Stafford and Crabtree, 1996). The monitoring of rivers using bioluminescence technology may indicate the efficacy of the treatment process by determining the discharge quality at the river/effluent interface. The technology can also be applied to determine the chemical nature of a discharge to a water course in terms of its effect on sensitive bacteria. This application is expected to be applied in future programs.

Certainly it has been shown that treatment plants can be monitored using such technologies, (Johnson and Stafford, 1984), and the discharge quality may be monitored in facilities where biological treatment is an essential part of effluent management before discharge to a river.

The correlation of the Bioprobe technique with conventional microbial procedures will be presented and the implications for river analysis discussed.

George Constantz
River Network

Techno Wishes of a Field Ecologist

During 1989-92, Pine Cabin Run Ecological Laboratory assembled the ecological baseline of the Cacapon River in northeast West Virginia. The project involved 149 trips to 106 study sites along the River's entire 120-mile continuum. Based on previous studies and on current and expected landuses, we chose to study the following 8 parameters: mean daily discharge, water temperature, turbidity, pH, alkalinity, ammonia, phosphate, and fecal coliform bacteria. The baseline revealed that the River was relatively healthy, but in certain reaches at specific times it was degraded by nonpoint source pollution originating in the upper third of the watershed.

We learned from tax maps that the River's riparia are almost totally held by private landowners. This caused access problems: specifically, upriver landowners, where much of the contaminants originated, were least likely to grant permission to cross their land to reach the River. This is not an unusual problem in privately owned river corridors. Thus, in many areas river stewards need remotely sensed data to evaluate the ecological condition of privately owned stretches. How do we fix this problem?

Here are a few thoughts on what will not work. Continuous water samplers (e.g., Sigma) require frequent physical access to the site. Remotely accessed in situ detectors (e.g., Hydrolab wired to a phone line) require occasional access for installation and maintenance. Further, both are subject to vandalism.

Here is what I would like to have had, in increasing order of priority: (1) the ability to fly low over the River, lower a sampling device, collect water samples, and return the water samples to the lab for analysis; (2) the ability to fly high over the River, photograph or videotape the water, return to the lab, and interpret the images to estimate specific parameters. Both of these have the advantage of not requiring landowner permission, but neither allow real-time monitoring. (3) Even more useful would have been real-time data transmitted from a LANDSAT-type satellite to my personal computer.

What would I want to measure via a satellite? At a minimum, I would like to be able to monitor the River's water level in real-time. I could then convert water height to discharge volume. An expanded wish list would include the other water quality parameters. My ultimate techno wish would be to have all my remotely sensed data automatically acquired by the GIS residing in my personal computer.

Because nonpoint source pollution involves acute spikes in the concentrations of some pollutants, real-time monitoring of discharge is crucial. Water level should be

monitorable along the entire river continuum and in all tributaries, with an alarm set to sound at a preset water height. This would allow the monitors to mobilize at any time of day or night to document water quality during important discharge events.

I close with a personal wish. I would like this conference to lead to a commitment to a process for developing a strategic plan that would make high technology more accessible to grassroots river and watershed conservation groups. Such a plan would identify needs, assemble a list of available resources, develop a strategy to fill the gap between needs and resources, propose ideas for funding these resources, and suggest how to distribute the new tools. I'm ready to help.

River Network Watershed Program Manager
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biosketch: BA, Biology, Univ Missouri-St Louis, 1969
PhD, Zoology, Arizona State Univ, 1976
fish ecologist, Academy of Natural Sciences, Philadelphia, 1976-82
Biology Teacher, Hampshire High School, Romney WV, 1982-91
Director, Pine Cabin Run Ecological Laboratory, High View WV, 1985-93
Coordinator, Watershed Conservation & Management Program, WV Division of Natural Resources, Elkins WV, 1993-95
Environmental Resources Specialist, Watershed Assessment Program, WV Division of Environmental Protection, Charleston WV, 1995-98
Watershed Program Manager, River Network, Portland OR, 1998-present
15 research papers, 3 review chapters in edited symposia, 1 book (Hollows, Peepers, and Highlanders: an Appalachian Mountain Ecology, Mountain Press)

Lisa K. Ham
US Geological Survey

USGS Activities in the Ohio River Basin in West Virginia

The U.S. Geological Survey (USGS) has three major programs involved in collecting and analyzing data in the Ohio River Basin: the Hydrologic Surveillance program; the Kanawha-New River National Water Quality Assessment (NAWQA) program; and the Ohio River Studies program. Each of these three programs work in parallel to one another and rely on resources and data from each other to obtain optimal results.

The Hydrologic Surveillance program monitors river stage and flow from over 100 sites across the State of West Virginia. The data is retrieved using satellite and IFLOW transmissions and telecommunication. The satellite transmissions are available through the internet on the USGS real time web site http://www-wv.er.usgs.gov/rt.html. Flow records are used for flood warning, operating reservoirs and hydropower facilities, managing releases of wastewater, conducting environmental assessments, determining the magnitude and probability of future floods and droughts, and designing highways and bridges.

NAWQA is designed to describe the status and trends in regional water quality and to identify natural and human factors associated with observed water quality conditions. In the Kanawha-New River basin during 1996-98, the program monitored the quality of streams, using 12 indicator and integrator sites; the quality of ground water, using 90 wells for sub unit and land-use surveys; and the ecology of streams, using community surveys, fish tissue, bed sediment, and habitat indicators. Similar studies were performed in the Allegheny-Monongahela River NAWQA.

The Ohio River Studies program focused on monitoring, understanding, and modeling dissolved oxygen in barge-navigable rivers. During the summers of 1992-95, continuous dissolved oxygen monitors were maintained and scheduled longitudinal surveys completed in Belleville and Pike Island pools in support of operation and permitting for hydropower facilities. Oxygen transfer efficiencies were measured at 11 dams on the Ohio River in 1995 and 1996, using in situ methane gas as a surrogate tracer. Similar work is scheduled at 3 dams on the Kanawha River in the summer of 1998. Currently, the USGS is proposing to model the dissolved oxygen concentrations and river discharges from data collected in the Belleville and Winfield pools in order to develop dissolved oxygen budgets and to offer a better tool for managing the resource.

The USGS intends to continue applying science to improve our understanding of changing water-resource conditions in the Ohio River basin. Water-quality data for some sites will be added to the satellite transmission network. The Kanawha-New River NAWQA plans to sample 60 stream sites in coal mining areas for chemistry and ecology during summer 1998. The NAWQA will continue to collect monthly water-quality samples at 11 sites through September 1998, and maintain sampling at one or two sites through 2005. Interpretative reports will be generated by NAWQA personnel from 1998 to 2000. Future plans for the Ohio River Studies program are to investigate total maximum daily load issues, to restart the continuous monitor study, to begin a dioxin study, and to model the dissolved oxygen results.

U.S. Geological Survey
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I have worked for the USGS for 11 years on water-quality projects. My experience includes 3 years in ground water, 4 years on lakes, and 4 years on surface water. Currently, I am the surface-water lead for the Kanawha-New River National Water Quality Assessment (NAWQA) program.

Barbara Taylor
West Virginia Division of Water Resources
Office of Water Resources

West Virginia Water Quality Monitoring

In 1995, the Office of Water Resources (OWR) created the Watershed Assessment Program. This was the beginning of a larger state-wide initiative to move toward a watershed-based approach to better manage the environment.

In order to develop a consistent monitoring approach that would result in a greater quantity of timely data available for environmental decision-making, the state was divided into its 32 hydrologic regions. A five-year cycle was developed to assess waters in each of the hydrologic units resulting in an assessment of 20% of the states' waters annually. Data to be collected in the watersheds included chemical parameters, biological information, and habitat quantity and quality. Additionally, OWR maintains a network of about 35 ambient monitoring stations where data is collected on a quarterly or semi-annually basis.

Since initiation of the Watershed Assessment Program, data has been collected in the Upper Ohio River North, Cheat, Youghiogheny, South Branch Potomac, Shenandoah, Tygart, Lower Kanawha, Coal, Elk, and North Branch rivers.

Information assembled thus far for West Virginia's 1998 305(b) water quality status report indicates that the Cheat, Youghiogheny, South Branch, Shenandoah, Upper Kanawha, and Northern Ohio rivers or river segments, are negatively affected by a range of conditions that include fecal coliform, habitat alteration, flow alteration, elevated metals concentrations, pH violations, siltation, among other impacts. Not each watershed is affected by all of the above conditions.

Technology can significantly improve the data collection and analysis process. The OWR partners with many other state and federal agencies to leverage water resource management expertise and ability. However, specific areas where technology could assist OWR efforts includes improved models available for development of total maximum daily loads, greater use of geographic information systems in analyzing environmental conditions, access to public and private sector water quality data in an electronic format, and human and financial resources necessary to implement technology.

Gary Bryant
USEPA

Water Migration in Abandoned Coal Mines

Underground mines exist beneath hundreds of thousands of acres in the Appalachian coal fields. The Pittsburgh coal seam demonstrates the environmental threats that occur as mines close. The pools of water in flooding underground mines threaten stream water quality. Current technology does not enable anyone to accurately predict where mine pools will discharge and what will be the water quality and quantity that needs treated. A "flooded mine rover", similar to a small submarine, is proposed to explore coal mine passages to measure voids and monitor differences in water quality. Computer modeling of groundwater and streams is needed to design systems to meet the threat to the environment.

Ron Preston
Canaan Valley Institute

Assessments of Appalachian Streams

The Mid-Atlantic portion of the Appalachian Region contains over 100,000 miles of streams that flow through a variety of ecological systems including forests, farmlands, wetlands and urban areas. These streams range in size from small headwater streams to large rivers such as the Ohio and Susquehanna. Stream quality and stream health is currently the focus of several regional, watershed and state assessments. Ongoing stream assessments include the US Environmental Protection Agency's Mid-Atlantic Highlands Assessment and the Mid-Atlantic Integrated Assessment; the US Geological Survey's National Water Quality Assessment Program in the Potomac, Susquehanna, Allegheny-Monongahela and the Kanawha-New River basins and the Maryland Department of Natural Resource's state wide stream survey. Agencies within the state governments of Pennsylvania, Virginia and West Virginia have begun updated or new state wide stream assessments.

Even though these assessment programs may have different objectives and monitoring designs, the agencies are interested in determining the " state of condition" of the streams in the Mid-Atlantic/Appalachian region. Further, these programs use similar protocols based on measuring ecological parameters to assess stream health. The suite of ecological characterization includes fish and benthic macroinvertebrate communities, habitat and water quality.

The preliminary analyses and interpretations of the results of the Mid-Atlantic Highlands Assessment provide the following observations for the region: the small, headwater streams have limited fish communities and less than half have sport fishes; approximately two-thirds of the streams are judged to meet expectations for balanced fish communities and approximately one-fifth do not meet expectations, the remainder are judged immediate; fish community analysis indicates (based on the fish index of biotic integrity) a dominance of poor conditions exist in the Allegheny-Monogahela watersheds and more frequent poor conditions in the Ohio drainage than the drainages of the Atlantic slope; the water quality indicates a greater frequency of streams reflecting the effects of acid deposition in the North Central Appalachian Ecoregion than other Mid-Atlantic ecoregions and an even greater proportion of the streams in that ecoregion are affected by acid mine drainage; almost one-quarter of the Highland streams have poor habitat conditions; over one-third of the streams contain nonnative fish; and almost half of the stream miles of the Mid-Atlantic region show evidence of watershed disturbance.

Two significant stressors (nonnative fish and habitat alteration) are nonchemical.

These assessments are applying the integration of several indicators to better characterize the condition of the streams of the region. Further integration between the programs are underway and as these analyses evolve, improved understanding of the stressors and their sources will provide a sound foundation for making management decisions relative to the future of the region's environment and economy.

Jason Harrington
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Hydrolab Corporation: Water Quality Monitoring Systems

Hydrolab is the leader in providing reliable instrumentation systems for in situ water quality data collection. For over 40 years, Hydrolab has designed and produced multiprobes to monitor parameters including temperature, dissolved oxygen, specific conductance, pH, turbidity, ammonium, redox, depth, and many others. All sensors are contained in a single, rugged, portable housing. Whether you are monitoring water quality in fresh water, salt water, ground water, or waste water, Hydrolab instruments provide reliability, accuracy, and ease of use. And whether you do simple spot checking or profiling; in situ or pumped sampling ground water monitoring; or wish to set up unattended, continuous monitoring stations, Hydrolab instruments will fit your needs. This presentation will look at the above applications, Hydrolab's technological firsts, and some of the emerging technologies.

Harry M. Edenborn
USDOE, FETC

Redox Gel Probe (RGP) Technology for the Evaluation of Heavy Metal Stability in Sediments

The redox gel probe (RGP) was developed to evaluate the stability of metals precipitated within the sediments of constructed wetlands used to remove metals from acid mine drainage. Over the past 5 years, it has been repeatedly field tested and has proven to be easy and inexpensive to use and readily adapted to site-specific environmental concerns. Solid redox-sensitive compounds, such as manganese dioxide (MnO_2), are incorporated into gels held in rigid plastic holders, leaving one longitudinal surface of the gel exposed. These probes are pushed vertically into sediments and are left *in situ*. After an incubation period of hours to weeks, the probes are removed from the sediment, and the depths where compound dissolution, transformation and/or redistribution have occurred are determined relative to the location of the sediment-water interface. Gel probes placed along surveyed transects and grids in wetland sediments have yielded maps of compound stability that reflect the beneficial and detrimental influence of various environmental variables on pollutant retention and diffusive metal flux from sediments. In one example, gel probes containing particulate manganese compounds (MnO_2, $MnCO_3$, and MnS) were placed along a surveyed grid in the sediment of a wetland built to remove Mn from coal mine drainage at a site in western Pennsylvania. The stability of these compounds within the wetland was shown to be highly variable both temporally and spatially, suggesting that long-term manganese retention in sediments was unlikely. The method has its most likely application to fine-grained metal-contaminated river sediments where the stability of metal species in sediments is in question. Recent experiments using live bacteria incorporated within the RGP gel matrix and the potential applications of this approach will be discussed.

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Steve Fondriest and Gayle Rominger
YSI

Water Quality Instrumentation and Future Directions

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Solar Radiation
Wind Speed
Wind Direction
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Humidity
Rainfall

Kyle J. Hartman
WVU Fish And Wildlife Service

Application of Hydroacoustics to Large Appalachian River Fisheries

Fisheries hydroacoustics is a technique that involves transmission of pulsed sound through the water to determine the sizes and abundance of fish or other targets (e.g. plankton) within the water column. The advantage of this technique for fisheries stock assessment is that it can provide near-real time analysis of the sizes, abundance, and spatial distributions of fish over large areas. The acoustic transducer is towed underwater alongside a research vessel at speeds of up to 6 knots. This allows mobile surveys to cover large sections of river in a relatively short time and also permits more thorough sampling of aquatic habitats than standard active capture techniques. The technique does still require some active capture to verify the identity and size of acoustic targets.

The acoustic system we use if a 120 kHz split-beam system manufactured by SIMRAD. We do not use their processing software. We have developed our own software that allows us to "unlock" more of the data available in the technology than is possible with the SIMRAD proprietary software. The system "pings" at 3 times per second providing information on the size and locations of fish within the acoustic "beam". We employ a "down-looking" technique for mobile surveys that permits us to detect fish within 10 cm of the river bottom.

During 1997 I had the opportunity to compare hydroacoustic data with that collected via lock rotenone surveys conducted by the WVDNR in the Ohio River. Comparison of the acoustic and rotenone data showed that abundance of fish < 250 mm TL and > 250 mm TL were very similar between the two techniques. Further, size distributions within each size group were also similar. Overall, hydroacoustics reported slightly higher abundance of fish than rotenone. However, this was expected as previous studies with long-term pick up of fish showed that short-term pick up of fish in rotenone surveys will underestimate true abundance by 30-50% depending upon the species and size of fish involved.

I believe this technique has excellent potential for use in the Ohio and other rivers in the Appalachian area. It can provide reliable estimates of fish density and abundance and will help to elucidate fish distributional patterns which can be important to shoreline development (e.g. power plant siting, etc.). The limitations of this approach are that the gear is not terribly effective in shallow areas such as embayments. Some of this limitation might be reduced through the application of "side-looking" fisheries sonar techniques. However, even if we use this equipment in the "down-looking" application for these rivers, the technique will provide and excellent tool in studying mainstem areas of rivers.

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I have been at WVU since 1996 as an Assistant Professor of Ecology in the Division of Forestry. I received my PhD from the University of Maryland, Chesapeake Biological Laboratory in 1993. Prior to that I received my M.S. (1989) and B.S. (1984) from The Ohio State University. My research has involved a variety of topics including: fisheries stock assessment, behavioral ecology, feeding and trophic relationships, and bioenergetics of fish. Within West Virginia I have began studying the sub-lethal effects of land-use practices on water quality and these impacts upon fish and invertebrate production in Appalachian streams. I have also initiated a study to examine the habitat use of juvenile through adult largemouth bass on the Ohio River and conducted studies comparing the sizes and numbers of fish from the Ohio River using lock rotenone and hydroacoustic techniques.

W. Neil Gillies
Pine Cabin Run Ecological Lab

Water Quality Studies in a Watershed Dominated by Integrated Poultry Agriculture

Poultry production in the Potomac Headwaters region of WV has more than doubled since the early 1990s. Concerns over the water quality impacts of integrated poultry production are widespread. This talk presents a case study of nutrient emissions in the Lost River, Hardy County, WV and focuses on lessons learned about water quality sampling for nutrients in an agricultural non-point source (NPS) dominated basin.

The Lost River basin (179 sq. mi. drainage area) contains 20% (185) of the Potomac Headwaters 870 poultry houses in only 2% of the region's drainage area. It contains a greater density of poultry houses (>1 house per square mile) than any other Potomac Headwaters area. Fields in the floodplain are often plowed down to the rivers edge, with no riparian forest and few buffer strips. Poultry litter is applied green or composted virtually year-round. Phosphorus (P) from long term litter application is known to be building up in the basin’s soils but studies by the USGS and Cacapon Institute between 1988 and 1995 did not detect elevated levels of P in the rivers of this region. Both of these groups looked for orthophosphate only, and neither study was specifically designed to detect nutrient pollution in a region dominated by non point sources.

In March of 1997, we started an intensive study of P (parameters: total phosphorus, orthophosphate and turbidity) in the Lost River; nitrate and fecal coliform bacteria were added as regular parameters in November 1997. Eight tributary and 4 mainstem sites were selected. Each site represents a different mix of land uses. Scheduled sampling initially occurred weekly, now bimonthly, with all samples collected within a 2-3 hour period. Intensive sampling is also included during and following storms. The study was designed to answer three questions: 1- are the nutrients accumulating in the basin's agricultural soils entering the river; 2- do streams with different land use characteristics contribute different nutrient concentrations; and 3- what are the peak nutrient loadings.

The spring of 1997 was very dry, and P concentrations were consistently low at all sites. A big storm in early June produced a very large but short lived flush of P and sediment out of the basin. Concentrations remained high the following day in only one tributary - Upper Cove Run. The first storm demonstrated that the basin can generate a large P load, that the basin flushes quickly in a big storm (in only 8 hours the main slug of pollutants was detected leaving the basin), and that the basin’s tributaries flush very quickly. Due to the rapid flushing of tributaries, the storm sampling regime was redesigned to be more narrowly focused during future events.

Upper Cove Run (UCR) was studied during a July storm to see why P and turbidity remained high in that tributary following the early June storm. UCR is a small tributary (9 sq. mi. drainage area) that contains a small town, the greatest density of poultry houses in the Lost River basin (3.2 / sq. mi.), light residential development and a flood control dam construction site well upstream. The sampling results demonstrated that the dam construction site was the main source of turbidity and phosphorus - peak concentrations of 28 mg/l total phosphorus and 37,000 NTU turbidity were detected immediately below the dam site. Later study demonstrated that the site, which had been covered with mature second growth forest prior to construction, had naturally high levels of P (up to 5000 lbs per acre) in some deep soils exposed by excavation. A smaller flush of phosphorus off the main poultry site along UCR was obscured by the construction site runoff.

A major storm on November 7, 1997 saturated the basin and signaled the end of near drought conditions prevailing throughout the summer. It coincided with the introduction of nitrate as a regular parameter and provided an opportunity to compare the behavior of NPS P to that of nitrate in this basin. As observed during previous storms, elevated P levels were short lived. At the most downstream mainstem site, peak total P load and concentration (350 lbs per hour and 0.87 mg/L, respectively) were detected on the day of the storm. P concentrations at this site fell to 0.1, then 0.05, and finally to 0.035 mg/L one, three and four days after the storm, respectively.

As with P, the peak nitrate load (1380 lbs/hr) and concentration (3.2 mg/L) at the most downstream mainstem site were detected on the day of the storm. However, rather than falling precipitously like P, the nitrate load fell gradually over the next several weeks. Nitrate concentrations fell to 1.9 then 1.8 mg/L in the three days following the storm, but then increased to 2.4 mg/L on the fourth day and then fell slowly over the next few weeks. The increase in nitrate concentration coincided with a falling river level and appears to be due to an influx of groundwater high in nitrate.

Nitrate concentrations at six of the studies' sample sites were followed closely for several weeks following the November 7 storm. Three of the sites had considerable upstream acreage in floodplain cropland that receives poultry litter applications, three sites had none. Nitrate concentrations were highest and increased with falling river level only at the cropland sites. The highest nitrate concentrations (6.8 mg/L) were observed at the most upstream mainstem site from four to six days following the storm. Riverside land use upstream of this site consists largely of agricultural floodplain land.

Summary

Elevated phosphorus concentrations in this basin are extremely episodic, and have been observed only during storms that produced overland runoff. Sources positively identified thus far include naturally occuring P in exposed soils from a construction site and agricultural P in runoff from a poultry house site during both light and heavy overland runoff events. No definitive evidence of P leaching from soils has been observed.

Elevated nitrate levels are closely tied to riverside cropland. Nitrate concentrations in the river reflect movement of this nutrient by both overland and in-ground pathways and high concentrations can persist for weeks following a saturating rainfall.

Problems that Might be Solved by New Technology

1. Access to the land and access to agricultural practices information is the single greatest impediment to understanding the potential for pollution from agriculture in the Lost River watershed and the Potomac Headwaters generally. For example, one important question raised by the nitrate data above is: "Do high nitrate levels reflect litter application keyed to crop needs, or dumping of excess material?" The answer to that question would help government agencies determine the correct response. Since access to farmland is likely to remain politically difficult for the foreseeable future, remote sensing of soil nutrient levels would provide a timely tool to help in the interpretation of water quality data.

2. Because of the extremely episodic nature of particulate NPS pollution (including P and fecal coliform bacteria) and the relatively stable concentrations of dissolved, fairly unreactive pollutants like nitrate, the cost of continuous monitoring in a watershed like the Lost River would probably not be worth the expense. However, bringing technology to bear in capturing storm events would be extremely helpful. At present, capturing peak pollutant loads is largely a matter of luck added to an intimate knowledge of and proximity to the basin. On-site, real-time water analysis for nutrients and bacteria during storms would take much of the guesswork out of the process.

3. We currently lack detailed, accurate land use data. This is needed for both the riparian corridor and basinwide.

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Stephen K. Kennedy
RJ Lee Group

Automated Scanning Electron Microscope for the Characterization of Particulate Materials

The scanning electron microscope (SEM) and its energy dispersive spectrometer (EDS) element analyzer collects information that can be used to describe the size, shape and composition of particulate materials. The SEM may be perceived as an instrument that can be used to collect highly detailed information on particulate materials, but, being a manual procedure, is not is not suitable for the analysis of the large number of particles required for characterization of particle populations with any statistical certainty. Modern SEMs, however, can be computer controlled, can obtain images in a digital format amenable to image processing, and are integrated with the EDS system, making computer controlled scanning electron microscopy (CCSEM) possible. In this way, hundreds to thousands of particles can be characterized in a reasonable amount of time, and result in statistically meaningful data. ZepRun, the CCSEM program operating on the RJ Lee Instruments PERSONAL SEM™ will be described.

The SEM can obtain a secondary electron image (SEI) or a backscattered electron image (BEI) as shown in Figure 1A and 1B. The SEI with light shading conveys a three dimensional aspect whereas the BEI conveys general compositional information. More backscattered electrons are produced by materials of high average atomic number and produce a brighter portion of the image than those materials of low average atomic number.

When particulate material is placed on a substrate of low atomic number (e.g., polycarbonate filter), it is brighter than that background and can be recognized as a particle. The CCSEM program finds the particle center then draws a series of 16 cords from the particle periphery through the particle center. From this series, various measures can be defined (including the average diameter, the maximum diameter, the diameter perpendicular to the maximum diameter, the aspect ratio, the perimeter length, and the area) and saved to a file. Once the particle has been sized, the elemental composition can be determined and saved in the file as the spectral peak area related to each element as shown in Figure 1C. Analysis continues for each particle in a microscope field, and additional fields are analyzed until some stopping criterion is met.

The data then consist of a table of physical and compositional information. As an option, an SEM microimage and the full EDS spectrum of each particle can be saved. Because the storing of images is rather space consuming, there is the option to establish rules to define particle types and make operational decisions based on the particle type. For example, some particle types may not be interesting and few images of low pixel resolution may be desired. Other particle types may be interesting and more images of higher resolution may be desired.

The automated analysis can take further advantage of operation in the backscattered electron imaging mode. The common rock forming minerals are relatively low in average atomic number. The CCSEM program can be set to ignore these particles and only analyze relatively high atomic number particles. This is referred to as a high-Z run where Z is the average atomic number. In this manner, the relatively rare particles, such as those consisting of heavy elements, can be detected in quantity. For example, the size and specific phase of lead-bearing particles have been described for soils in which the lead content is a few hundred parts per million. Lower levels can be detected given a longer time of analysis.

Once acquired, the CCSEM data are summarized and can be presented in a variety of formats. Commonly, the data are reported in a series of tables where, for each particle type, some aspect of quantity (number, area, volume, mass) is presented according to some aspect of particle size (average diameter, maximum diameter, aerodynamic diameter).

This type of analysis is particularly useful when particle by particle information is required. Wet or instrumental chemistry techniques are superior for the determination of average chemical composition, but cannot provide information on particle size, morphology, or specific phase present. These data are important in source identification and apportionment, remediation, and assessing the potential for adverse health effects. CCSEM analysis has been extensively applied to a wide variety of particulate (especially airborne and soils) and can applied to river sediment as well.

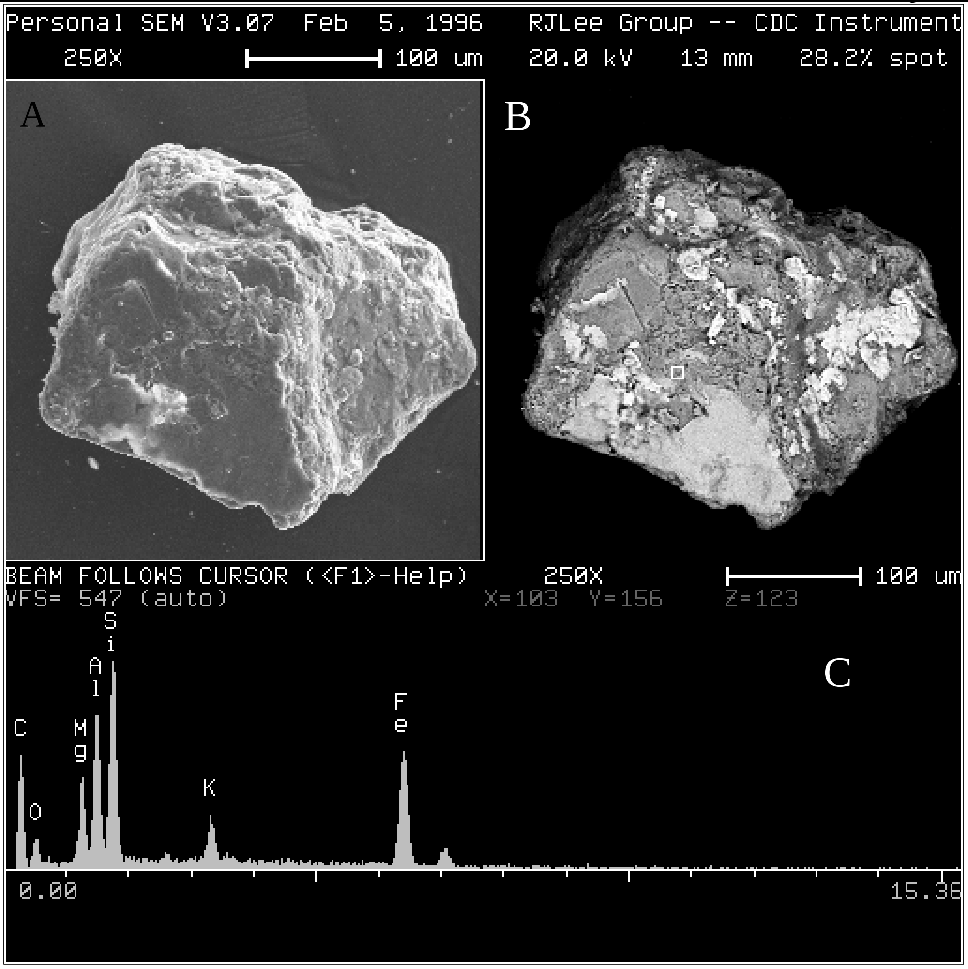

Figure 1 - Information obtained by the digital SEM. A) SEI of river sand grain showing morphology and surface texture. B) BEI of the same grain showing multiple phases. C) EDS spectrum of brighter region of B indicating a ferro-magnesium silicate composition.

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Polaroid

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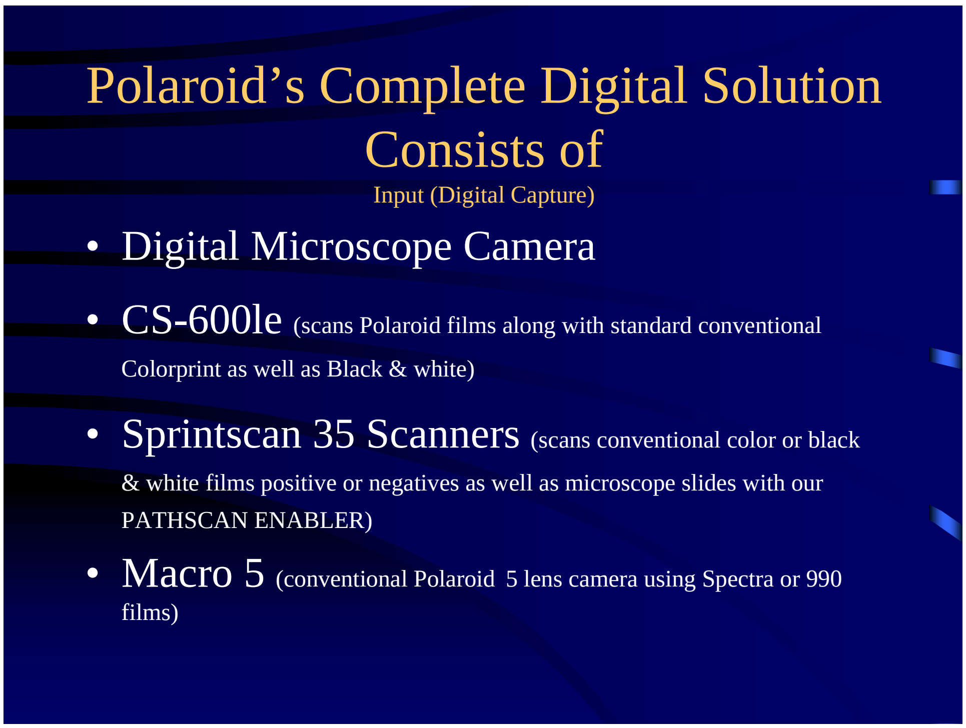

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  - Provides the Recipient the ability to edit without an image editing application on Desktop
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Polaroid's Complete Digital Solution Consists of
Output

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- Recipient can perform minor editing function on desktop with out an image editing program.


Polaroid's Complete Digital Solution Consists of
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Courtney Black
WVU NRCCE

The Environmental Technology Division (ETD) of the NRCCE at WVU is a recognized entity for multi-disciplinary environmental research. Located on the Evansdale Campus of West Virginia University in Morgantown, WV, the National Mine Land Reclamation Center of the ETD and NMLRC are funded through grants and contracts from private and federal agencies. Currently, projects funded by various mining companies, the Department of Energy, National Institute for Occupational Safety and Health (NIOSH), the U.S. Office of the Environmental Technology Division occupies a unique niche in the WVU structure. The Division functions as a program development agency, an administrative unit and a research unit. The Division concentrates on project progress and completion, which the NMLRC has extensive experience in project design, monitoring, and reporting. Additionally, NMLRC can effectively coordinate the resources of a research university to address the problems of the public and private sectors.

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Control of Acid Mine Drainage by Passive Treatment Systems

Acid mine drainage (AMD) pollutes about 5,000 miles of streams in the Appalachian region. Chemical treatment of AMD neutralizes acidity and removes metals, and the water must meet specific water quality criteria before it can be discharged to streams. There are various types of chemicals for neutralization but this technique of treating water is very expensive, and it must continue indefinitely. Ninety percent of AMD comes from abandoned coal mines (mostly underground mines) where no individual is responsible for treating the water with chemicals. Passive treatment systems, including the use of wetlands and anoxic limestone drains (ALD), offer an inexpensive alternative to treat many of these discharges without continual addition of chemicals and maintenance costs. Wetlands and ALDs have been installed on more than 100 sites and water quality improvements have been demonstrated through monitoring of flows and acid concentrations in the water.

Researchers at WVU have intensively monitored several passive AMD treatment systems in West Virginia. They treat flows ranging from 1 to 250 gpm and acidity concentrations from 170 to 2,400 mg/L. Five wetland systems reduce acidity by 3 to 76%, and iron concentrations by 62 to 80%. Iron and acid reductions were consistently greater in wetlands with limestone incorporated into the substrate. Eleven ALDs reduce acidity by 11 to 100%. Based on our successes and failures in building and monitoring ALDs, the following conclusions have been reached: 1) organic matter should not be placed in drains owing to microorganism growth on the limestone, 2) the amount of limestone in the passive system shows little correlation to effectiveness and acidity reductions, 3) larger limestone particle size (1 to 6 inch) helped maintain water flow through the drain especially when some aluminum, iron, and grit accumulated in the drain, 4) oxygen intrusion into the drain reduced effectiveness, and 5) pipes installed in drains must be large in diameter with large perforations and to reduce the chance for plugging.

Greens Run, a tributary of the Cheat River, is heavily polluted by AMD. Several point sources of acid water were located in the watershed. With the help of WVU researchers, Anker Energy designed and installed passive treatment systems to treat the acid drainage. An ALD was constructed in the fall of 1995 and water quality from the limestone drain has improved from a pH of 3.1 to 6.0, acidity concentrations have been reduced from 840 to 0 mg/L. More passive treatment systems are being planned for other tributaries of the Cheat River. Treating the water at their sources in Pringle, Heather, Lick, Morgan, and Greens Run, as well as Muddy Creek before the water reaches the Cheat River is a cost-effective way of cleaning up the river for recreational, aesthetic and human uses.

An underground mine discharge empties 500 to 3,000 gpm of AMD into the North Fork of the Blackwater River near Thomas, WV. The water has a pH of 3.1 and acidity concentrations around 500 mg/L. Treating the AMD with chemicals would be a long-term and expensive option (about $100,000 per year for this water). The West Virginia Division of Environmental Protection asked WVU researchers for help in designing a passive AMD treatment system, which does not require continual addition of chemicals and maintenance costs. If AMD contains little dissolved oxygen and primarily ferrous iron, it can pass through limestone without armoring the rock surface. Wetlands underlain with limestone function in a manner similar to an ALD and extend ALD use to partially-aerated AMD by scavenging dissolved oxygen and promoting microbial reduction of ferric to ferrous iron. Due to the oxidation status of the Thomas water and the specific metal concentrations, a wetland or an ALD by themselves would not treat the water adequately. Therefore, the passive system designed for this site was an innovative combination of a wetland and an ALD. The innovative system was designed in two cells. The first cell had 5 ft of organic matter over 1 ft of limestone, while the second cell had 2 ft of organic matter over 6 ft of limestone. In total, the system is 2,600 ft long containing 19,000 tons of limestone and 6,600 cubic yards of organic material. The system was constructed on the site in the fall of 1993. Acid mine drainage was introduced into the system in July 1994.

The Thomas wetland/ALD successfully improved effluent water quality over a 12-month period. However, it is likely that this system is not functioning in an optimum manner. Poor substrate permeability in Cells I and II has led to significant overland flow, resulting in minimal treatment in the wetland portion and insufficient contact with the underlying limestone. It is likely that declining performance in this system is primarily attributable to hydrologic factors and not to clogging and coating of the limestone. This observation is consistent with continuously alkaline water from bottom samplers throughout the drain, continuing precipitation of iron in the system, and lack of ferrous iron in the effluent water.

Abandoned coal mines cover about 200,000 acres in West Virginia. The Abandoned Mine Land Program (administered by the West Virginia Division of Environmental Protection) has been reclaiming these areas for 18 years with an average of $20 million spent annually, and only about 4 percent of the potential abandoned lands have been reclaimed. Remining allows an operator to remove remaining coal reserves that were left on the site and reclaim the entire abandoned mine site to current reclamation standards. Remining operations provide income through coal production, create jobs in the coal industry, and afford environmental enhancement through reclamation of previously-affected areas.

Remining is the surface mining of previously-mined and abandoned surface and underground mines to obtain remaining coal reserves. Remining operations create jobs in the coal industry, produce coal from previously-disturbed areas, and improve aesthetics by backfilling and revegetating areas according to current reclamation standards. Remining operations also reduce safety and environmental hazards by sealing existing portals and removing abandoned facilities, enhance land use quality, and decrease pre-existing pollutional discharges. Ten sites in the Appalachian Coal Region were selected to 1) compare the costs associated with remining and reclaiming a site to current standards versus costs associated with reclaiming the site by abandoned mine land (AML) programs, and 2) evaluate water quality before and after remining. All of the remining operations in our study resulted in environmental benefits. Dangerous highwalls were eliminated, spoil piles were regraded, coal refuse left on the surface was buried, and sites were revegetated to provide productive post-remining land uses. In all but two cases, coal mined and sold from the remining operation produced a net profit for the mining company. While AML reclamation removes hazards and improves aesthetics on AML sites, remining these 10 sites saved the AML reclamation fund an estimated $4 million. Water quality after remining improved in all cases. Impediments to remining AML sites should be removed so that mining companies will actively select previously-disturbed and abandoned sites for remining and reclamation.

Acid mine drainage (AMD) from an Upper Freeport abandoned deep mine near Masontown was eliminated by remining the deep mine workings and adding alkaline overburden material during backfilling and reclamation. About 6,500 tons/ac of alkaline shale were hauled to the remined Upper Freeport site from a nearby Bakerstown surface mine, and the shale was placed on the pit floor and compacted around toxic material placed “high and dry” in the backfill. No AMD has come from the site during the past five years since reclamation. The cost of hauling the alkaline material to the site was about $4,000/ac. Chemical treatment costs of AMD previously coming from the site before remining ranged from $800 to $1,500 per year. The receiving stream is Mountain Run, a tributary of Bull Run of the Cheat River, and its quality has improved due to remining.

Randy Robinson
WVU Education

The West Virginia K-12 RuralNet Project Watershed Education Workshop

Forty K-12 teachers from the Cheat River watershed and throughout West Virginia met this past summer in Preston County for a workshop on how to teach watershed related concepts in K-12 classrooms. Alpine Lake Resort near Terra Alta was the site for the three day workshop which ran July 27-30, 1997 and featured 20 speakers, three field trips, Internet training sessions and a whitewater trip on the Cheat River Narrows.

The workshop was sponsored and planned by the West Virginia K-12 Ruralnet Project at West Virginia University. The Ruralnet project is funded by the National Science Foundation and based in West Virginia University's College of Human Resources and Education. The primary work of the Ruralnet Project is to train and assist West Virginia science and mathematics teachers to use the Internet in a variety of ways that will enhance classroom instruction. Project partners are Bell-Atlantic Corporation and Marshall University.

Terra Alta Middle School's computer lab hosted the Internet sessions which introduced teachers to the Ruralnet Project web pages and on-line resources. Ruralnet teacher-leaders Kirk Lantz and Sally Kelly were instrumental in recruiting teachers and coordinating lab sessions. Sarah Easterbrook of the Ruralnet Project organized the web-based registration and made sure on-site sessions ran smoothly.

The goals of the West Virginia watershed education workshop were:

> To enhance science teaching by observing and discussing, with working researchers, the design and operation of current projects or field studies in environmental restoration, environmental protection and natural resource management.
>
> To explore methods of incorporating watershed studies into existing K-12 curriculum with an emphasis on integrating and relating science concepts to other subjects and "hands on" activities for students.
>
> To provide resources and contacts for teachers in various local, state, and national organizations and how to access these resources, data, and information via the Internet.
>
> To use the Cheat River watershed as a model for watershed studies that could be replicated in other watersheds, schools and communities throughout West Virginia.
>
> To introduce teachers to on-line resources provided by the Ruralnet Project such as the West Virginia watershed switchboard, database, and lesson frameworks which are all accessible via the World Wide Web.

Featured speakers and topics included:

State Initiatives:
West Virginia Watershed Assessment Program
George Constantz - WV Division of Environmental Protection

Watershed and Community Initiatives:
Friends of the Cheat
Dave Bassage, Executive Director

NGO Initiatives:
West Virginia Rivers Coalition
Roger Harrison, Executive Director

Regional Initiatives:
Canaan Valley Institute/WV Watershed Network
Kiena Smith, Executive Director, CVI

Mid-Atlantic Highlands Coordinating Council
Ron Preston, Executive Director

MAHA Student Project: Biological Database Mapping
John Young, Fish and Wildlife Biologist (GIS Specialist)

Overview of AMD and Hydropower impacts on fish populations of the Cheat and Tygart:
Frank Jernejcic - WV Division of Natural Resources

Fish Survey Methods:
Dan Cincotta - WV Division of Natural Resources

Mapping Your Watershed:
Craig Mains - Downstream Alliance

Science and Natural History of the Cheat River Watershed:
Ben Stout - Wheeling Jesuit College

Hydrodynamics of Squirt Boating:
James Snyder - Friends of the Cheat
Curriculum Integration Strategies:
Bill Moore - Hampshire High School

Stream Table Demonstration:
Dan Cincotta - WV Division of Natural Resources

Watershed Curriculum Resources: GREEN, SOS, Give Water a Hand, and others: Joyce Meredith - WVU Extension Specialist – Science, Randy Robinson - Ruralnet Project.

Establishing a Statewide Network of Educators:
Kiena Smith - Canaan Valley Institute
Bill Moore - Hampshire High School

Three concurrent full day field sessions were a highlight of the workshop. Teachers had to choose just one of the three trips to join but many later commented that they would like to have been able to participate in all three!

Watershed Restoration:
The lower Cheat River watershed has had severe ecological impact from acid mine drainage (AMD). Paul Ziemkiewicz and Courtney Black from the National Mine Land Reclamation Center at WVU lead a tour of current restoration work. Chemical (active) and biological (passive) methods of AMD control were demonstrated at several sites. This group also attended the River of Promise ground-breaking ceremony for the EPA funded Sovern Run restoration project.

Canaan Valley National Wildlife Refuge and Blackwater River/Wetlands: Biologist Ben Stout lead a tour and discussed his Canaan Valley wetland studies. Chemical, biological & physical stream assessment techniques were demonstrated. The group visited the Douglas Reclamation site on the Blackwater River (AMD neutralization and fisheries restoration). Rounding out the day was a visit to the Canaan Valley Institute. Paul Kinder demonstrated how a Geographic Information System (GIS) can be used to map and correlate biological data with other spatial data sets such as soil type or elevation.

National Project WET (Water Education for Teachers) and WV-SOS (Save Our Streams):

Hands on workshops for K-12 teachers who want to learn proven methods for helping students understand watershed related concepts and stream monitoring techniques.

Rose Long of the WVDEP and WV Coordinator for Project WET facilitated a workshop in which teachers tried out a number of activities and lessons from the Project WET Activity Guide. After completing this workshop teachers received the Activity Guide which gives complete instructions for over 100 lessons/activities designed for K-12 students.

Alvan Gayle of the WVDEP Citizens Monitoring Program demonstrated biological methods for stream monitoring using the Save Our Streams (SOS) program which is widely used in schools throughout the country. This technique is relatively inexpensive and provides an enjoyable way for students to learn about data collection, aquatic ecosystems and bio-diversity. Craig Mains of Downstream Alliance demonstrated chemical and physical monitoring techniques and the use of various test kits and equipment that students might use. Craig recently completed a 3 yr. study and water quality mapping of tributaries in Preston Co. Participants studied Snowy Creek near Alpine Lake and learned how a local school integrates stream studies into their science curriculum. Craig later provided a fall follow-up session at the Fellowsville School in Preston County.

Science and mathematics education is changing across West Virginia and the nation. This change to a more coordinated, thematic, hands-on approach requires innovative strategies for augmenting the curriculum. A number of educators are using the Internet as a powerful tool for developing or enhancing these innovative strategies.

To provide participating teachers with a model of how Internet resources might be utilized in the classroom, the Ruralnet project has developed on-line resources for school / community based stream and watershed investigations. The activities associated with these investigations provide an excellent link between the new West Virginia State Science Curriculum framework and Internet-based resources. Through their observations and data collection, students can become active producers of information about their watershed.

Students learn that science is not isolated from other social, political and economic issues. They also learn that partnerships are necessary to get things done. Watershed studies encourage partnerships between schools, communities, businesses, watershed associations, local and state governments and non-governmental organizations. Increasingly, these entities are coming on-line and communicating.

Ruralnet teachers are not only provided a model for integration that can be extended to other subject areas, but also have the opportunity to involve their students in authentic and meaningful science through involvement with stream monitoring activities and local watershed assessments.

On-line resources to support this work were developed by Steve Storck, Sarah Easterbrook and Randy Robinson of the Ruralnet Project and include the WV watershed database, url database, collaborative projects and acompilation of web sites related to environmental science and watershed studies. Links to these resources can be found at the WV Watershed Switchboard:

http://www2.ruralnet.wvu.edu/Rnet/portfolio/

One example from the Cheat watershed database was contributed by Rowlesburg School teachers Devra Deems and Henrietta Bolyard who assisted their kindergarten and 8th grade students in conducting a biological study of Fill Hollow and Saltlick Creeks this past fall . Their results can be viewed by going to the url listed above and then selecting links to WV watershed database, Cheat watershed and Rowlesburg School.

The workshop wrapped up with a sunny afternoon trip down the Cheat River Narrows with Appalachian Wildwaters outfitting rafts and inflatable kayaks. Extra water from a summer storm in the headwaters gave plenty of action and a fun finishing touch.

Teacher evaluations of the watershed education workshop were very good. A number of teachers and speakers alike commented that this was one of the most productive workshops they had ever attended and would like to see these workshops continued.

If your agency or association is interested in co-sponsoring or hosting a summer '98 watershed workshop for teachers please contact Randy Robinson at the address below.

The Ruralnet Project will again offer Internet training workshops for K-12 teachers during the summer of '98. These workshops are provided free of charge through funding from the National Science Foundation.

Teachers who would like to participate can request more information at:
The West Virginia K-12 Ruralnet Project
West Virginia University
609 Allen Hall
PO Box 6122
Morgantown, WV 26506-6122

Randy Robinson
rrr@wvu.edu
Phone 304-293-5913 x-1817

Visit the Ruralnet homepage at:
http://www.wvu.edu/~ruralnet

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Biosketch

Randy R.Robinson

Randy Robinson is a doctoral student in the College of Agriculture, Forestry and Consumer Sciences at West Virginia University. He works as a research assistant with the Ruralnet Project at WVU which provides Internet training for WV K-12 science teachers. His research interests include Internet based electronic field trips and other web based resources for environmental science education.

His work with the Ruralnet project includes:

Facilitating Internet training workshops for teachers.

Development and implementation of on-line graduate courses.

Mentoring and evaluation of on-line course work.

Planning and implementation of watershed studies as a framework for integrating science across the K-12 curriculum.
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Randy holds a bachelors degree in environmental education and teaching certifications in environmental education, geography and science. After serving with the US Navy at communications stations in the Philippine Islands and Morocco, he completed the masters degree in secondary education at WVU.

Working in West Virginia's whitewater industry since 1976, Randy worked as a river guide, trip leader and staff trainer. In 1986 he began a video production business that specializes in outdoor recreation and environmental science education topics. Randy's goal with the Ruralnet Project is to help develop Internet based watershed studies and stream monitoring programs for West Virginia schools.

Watershed studies integrate environmental science topics with the K-12 curriculum and encourage partnerships between schools and their surrounding communities. Randy R. Robinson
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Frank Gmeindl
National Technology Transfer Center

National Technology Center

The National Technology Transfer Center's (NTTC) mission is to transfer National Aeronautics and Space Administration (NASA) and other federal technologies to the private sector. This presentation describes the evolution of the NTTC and its recent creation of a Commercialization Center. The Commercialization Center offers the following advanced product development services: Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), engineering drawings, models, technical search, product/process redesign, and rapid prototyping. It also offers business services including: business planning, market analysis, sales & distribution planning, capitalization assistance, production planning, partnerships and virtual corporations. The Commercialization Center targets the following industries: indigenous local industries, environmental, materials, information technology and computational modeling, sensors, and biotechnology.

"Feasibility of Measuring Total Dissolved Gas Pressure, Dissolved Oxygen and Carbon Dioxide Based on Head-Space Partial Pressures"

By

Barnaby J. Watten [1]
and
Michael F. Schwartz [2]

Dissolved gas constraints are often corrected through application of air-water or oxygen-water gas transfer equipment. Given that influent dissolved gas levels can vary hourly or seasonally depending on the water source, operating costs are reduced through use of equipment designed to match gas transfer rates with gas transfer needs.

Feedback control loops satisfying this requirement have been described but rely on accurate and robust dissolved gas sensors. Unfortunately, biological fouling of the wetted, gas-permeable membrane used by polarographic and galvanic dissolved oxygen (DO) probes inhibits gas transfer and hence probe performance. This problem was circumvented by designing a DO monitoring system that eliminates the need for submerging analytical components. Dissolved oxygen is calculated using Henry's Law, water temperature, and the partial pressure of oxygen that develops within the head space of a vertical gas-liquid contacting chamber. Water enters the chamber as a spray, then exits into a receiving basin through a cone diffuser designed to minimize bubble carryover. Head-space gas composition, measured with a galvanic oxygen sensor, changes as an equilibrium is established between gas-phase partial pressures and dissolved gas tensions.

Calculated DO concentrations were compared with those obtained by Winkler analysis (n=67) over a range of DO (0.0 - 18.0 mg/1), water temperature (11.5 - 27.5 degree C), and dissolved nitrogen conditions (73.4 - 107.0% saturation). Differences between the two analytical methods averaged just 0.25 mg/1 (range -0.51 to 0.86 mg/1). The precision of DO estimates established in a second test series was good; coefficients of variation (100 SD/x) averaged 0.88% at 10.2 degree C (n=6) and 1.21% at 25 degree C (n=6). The time required to reach 90% and 100% of equilibrium DO concentrations averaged 8.6 min (range 7-10 min) and 17.4 min (range 15-23 min), respectively. This response was sufficient to adequately follow changes in DO of up to 26.3 mg/1 hr. The instrument developed has also been modified to allow for the continous monitoring of dissolved carbon dioxide. Here gas phase partial pressures were determined with either an infrared detector or by measuring voltage developed by a pH electrode immersed in an isolated sodium carbonate solution sparged with head space gas.

Tests conducted over a wide range of operating conditions (N=96) established statistically significant correlations between head space and titrametrically determined dissolved carbon dioxide concentrations.

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2. Title: Group Leader, Fishery Research Biologist

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6. Email Address: Barnaby_Watten@usgs.gov

7. Biosketch: Barnaby holds a BS degree in Aquatic Biology, a Masters degree in Agricultural Engineering and Ph.D. in Fisheries and Allied Aquaculture. His research has in the last 20 years supported intensive fish production and pollution abatement in industry as well as State and Federal programs, primarily in the area of gas transfer. He is past President of the Bioengineering Section of the American Fisheries Society, is currently a Board Member of the Aquacultural Engineering Society and is a member of The Standard Methods Committee of the American Public Health Association. He has also served as an Editorial Board Member for the Journals Aquacultural Engineering and the Progressive Fish Culturist.

[2] Michael F. Schwartz
Freshwater Institute
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GEORGE CASE

APPLICABILITY OF A FIELD BIOSENSOR FOR CARCINOGENIC TOXICITY EVALUATION OF SEDIMENTS AND OTHER WATERSHED MEDIA

GEORGE CASE

APPLICABILITY OF THIN MEMBRANE SENSOR MEDIA FOR SAMPLING AND DETECTION OF MERCURIALS AND HYDROPHOBIC POLLUTANTS

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APPALACHIAN RIVERS CONFERENCE, WORKSHOP, AND EXHIBIT PARTICIPANT LIST (Page 1)

April 23, 1998

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APPALACHIAN RIVERS CONFERENCE AND WORKSHOP
THURSDAY, APRIL 23, 1998

ALAN B MOLLOHAN INNOVATION CENTER--MAIN CONFERENCE ROOM
WEST VIRGINIA HIGH TECHNOLOGY CONSORTIUM
1000 TECHNOLOGY DRIVE
FAIRMONT, WEST VIRGINIA 26554

INSTRUCTIONS TO SPEAKERS

A. Submit a one to three page abstract of your presentation to be published in the proceedings either by **Email** or on 3-1/2" floppy to Michelle Cameron (304-366-0774) at: nbe@access.mountain.net, or 7001 Mountain Park Drive, Suite C, Fairmont, WV 26554 by **April 17, 1998**. You may use either MSWORD or WORDPERFECT. Please plan on a TWELVE minute presentation briefing and a three minute discussion period.

B. In your presentation, **as one engaged in river monitoring or cleanup**, please emphasize some of the following:

1. In your stream/river activities, what problems do you incur that new technology might help?
2. What data would you like to have that you presently do not have?
3. Would river data received: a) quicker after collection, or b) in a better format, help your efforts?
4. Would a) higher sampling rates or frequency of sampling , or b) more sample locations, help?
5. Would on-site, real- time data reduction, analysis and display benefit your projects? How?
6. Would on-site computer models using real time data benefit your projects? How?
7. What variables not measured would make the greatest impact if measured and available?
8. What technology would you like to see further developed to help in your mission?
9. What emerging stream/river problems do you foresee?
10. What are the greatest chemical or biological monitoring, analysis, and cleanup technology needs?

C. In your presentation, **as one providing or developing river applicable technology**, please emphasize:

1. Ultimate potential uses of your technology
2. Intermediate steps or improvements needed to make your technology more useful to river applications
3. Any partnering or joint efforts you would welcome to demonstrate or develop your technology

D. Please use the following general format for submitting your abstract and other information.

"PRESENTATION TITLE"
by
"Your Name"

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxx------------------------3/4" margins all sides, 12 pt font preferred

(ONE TO THREE PAGE ABSTRACT)

----

1. Affiliation **2. Title** **3. Mailing address**
4 Office telephone **5. Fax telephone** **6. Email address**
7. Biosketch

APPALACHIAN RIVERS CONFERENCE AND WORKSHOP
THURSDAY, APRIL 23, 1998

ALAN B MOLLOHAN INNOVATION CENTER--MAIN CONFERENCE ROOM
WEST VIRGINIA HIGH TECHNOLOGY CONSORTIUM
1000 TECHNOLOGY DRIVE
FAIRMONT, WEST VIRGINIA 26554

INSTRUCTIONS TO EXHIBITORS

B. You are invited to submit an abstract and/or literature describing your exhibits to be included in the proceedings of the conference. The material should show clearly when copied with a conventional copying machine, and all pages submitted should not exceed 3 pages. At your option, I would suggest a one page written description with all pertinent information such as specifications, contacts, distributors, telephone numbers, email addresses, etc. For this one page, please follow the procedure below. You may submit two other pages of hard copy literature describing the products as long as it copies well.

C. Submit a one page abstract describing your exhibits to be published in the proceedings either by **Email** or on 3-1/2" floppy to Michelle Cameron (304-366-0774) at: nbe@access.mountain.net, or 7001 Mountain Park Drive, Suite C, Fairmont, WV 26554 by **April 17, 1998**. You may use either MSWORD or WORDPERFECT. **You may also submit a good original typed version** of your one page exhibits abstract , if you prefer, **along with the two other pages of product literature to Michelle**.

C. The exhibit area will be in the same large room as the morning speakers conference and the afternoon work group sessions, the catered buffet luncheon, and the evening social hour from 5:00 p.m. to 7:30 p.m. You will be provided access to this conference room from 2:00 p.m. (Wednesday afternoon, the day before the conference) until 6:00 p.m. Registration for the conference begins at 7:30 a.m. the next morning, and the conference program begins promptly at 8:00 a.m., so there will be only about one - half hour setup time available Thursday morning. One six foot long by three foot wide table will be available for you to use. You may bring your own curtain backdrop or table spread and front table drop cover if you prefer to do so. The available space for your exhibit is about eight feet wide maximum. Someone will be available during the 2 to 6 p.m. period on Wednesday the 22nd, to show you the exhibit area.

D. The people doing the exhibiting are invited to participate in the conference questioning after each speaker, and in the work group sessions in the afternoon.

E. There is no charge for this exhibit or the abstract in the proceedings. This is a courtesy to you for coming to exhibit at this conference. We thank you, and look forward to your participation. If you have further questions, please feel free to call Michelle at 304-366-0774, or, L. Z. Shuck, conference chairman, at 304-292-7590.

APPALACHIAN RIVERS CONFERENCE, WORKSHOP AND EXHIBIT
WORK GROUP 1
RIVER CHEMICAL MONITORING TECHNOLOGY

As a river steward looking for pollution sources and keeping a vigilant watch over streams and rivers what technologies or new tools could help the most to make your job more efficient and effective? Respond as an experienced government agency scientist, or a local chemist watershed organization volunteer, or a university researcher, who would like to help improve the local stream quality.

1. What chemical and physical properties need to be monitored every few minutes for 24 hours year around to give comprehensive baseline data for normal diurnal/nocturnal and seasonal variations in Appalachian region rivers? Assume data are to be used for comprehensive computer simulation, watershed and river ecology research, and long term history matching/comparison studies.

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14.	19.
5.	10.	15.	20.

2. As terrorism spreads throughout the world should we consider a special alert monitoring program to protect drinking water supplies which come from rivers in most Appalachian cities? Yes___ No___
Why?, Why not?

3. The variables typically monitored today at fixed river stations on an hourly (more or less) basis include: DO, temp, pH, total conductivity, ammonium/ammonia, nitrates, turbidity, TDS, and chloride. As a river steward making stationary or traverse water chemical property measurements, list the additional variables most important that need to be quickly measured onsite rather than taking samples back to the laboratory for analysis.

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14.	19.
5.	10.	15.	20.

4. Should a combination of river continuous, real-time monitoring instruments and an onsite computer flow simulation program be used at key river locations to detect spills or pollution sources around the clock in order to send an alarm and back calculate to locate the point of entry of the source? Yes___ No___
Considering the costs/benefits, should we locate such a system:
a) one mile or so above each city water supply intake? Yes___ No ___
Why?, Why not?
b) a mile or so below each city or high risk industrial area? Yes ___ No ___
Why?, Why not?
c) on major creeks and streams passing through populated or industrialized communities just before they enter into larger rivers? Yes ____ No____
Why?,Why not?

5.What new portable chemical measuring instruments or measuring techniques/capabilities would you like to have and see developed for stream and river monitoring ?

1.	4.
2.	5.
3.	6.

OTHER CHEMICAL PROPERTY ISSUES YOU THINK NEED TO BE DISCUSSED

APPALACHIAN RIVERS CONFERENCE, WORKSHOP AND EXHIBIT

WORK GROUP 2

RIVER BIOLOGICAL MONITORING TECHNOLOGY

MICROBIAL(PLANT OR ANIMAL)

As a river steward looking for pollution sources or ecosystem problems and keeping a vigilant watch over streams and rivers, what technologies or new tools could help the most to make your job more efficient and effective? Respond as an experienced government agency scientist, or a local scientist watershed organization volunteer, or a university researcher, who would like to help improve the local stream/river quality OR detect abnormal or unhealthy ecosystem characteristics.

1. What MICROBIAL properties need to be monitored HOURLY, or DAILY up to MONTHLY year around to give comprehensive baseline data for normal diurnal/nocturnal and seasonal variations in the Appalachian region ? Assume data are to be used for comprehensive computer simulation, river ecology research, and long term history matching/comparison studies.

1.	**6.**	**11.**	**16.**
2.	**7.**	**12.**	**17.**
3.	**8.**	**13.**	**18.**
4.	**9.**	**14.**	**19.**
5.	**10.**	**15.**	**20.**

2. As terrorism spreads throughout the world should we consider a special microbe alert monitoring program to protect drinking water supplies which come from rivers in most Appalachian cities? Yes___ No___ , Why?, Why not?

3. As a river steward making stationary or traverse water biological-microbial property measurements in rivers and small tributaries, list the parameters/variables most important that need to be quickly measured onsite rather than taking samples back to the laboratory for culture and microscopic analysis.

1.	**6.**	**11.**	**16.**
2.	**7.**	**12.**	**17.**
3.	**8.**	**13.**	**18.**
4.	**9.**	**14.**	**19.**
5.	**10.**	**15.**	**20.**

4. Assume quick response real time microbial (plant or animal) monitoring instruments were commercially available. Should a combination of stream/river continuous, real-time monitoring instruments and an onsite computer flow simulation program be used at key river locations to detect new microbial sources around the clock in order to send an alarm and back calculate to locate the point of entry of the source? Yes___ No___

Considering the costs/benefits, should we locate such a system:

a) one mile or so above each city water supply intake? Yes___ No ___

Why?, Why not?

b) a mile or so below each city? Yes ___ No ___

Why?, Why not?

c) on major creeks and streams passing through populated or industrialized communities just before they enter into larger rivers? Yes ____ No____

Why?, Why not?

5.What new portable biological-microbial measuring instruments or measuring techniques/capabilities would you like to have and see developed?

1.	**3.**
2.	**4.**

APPALACHIAN RIVERS CONFERENCE, WORKSHOP AND EXHIBIT

WORK GROUP 3

RIVER BIOLOGICAL MONITORING TECHNOLOGY

AQUATIC MACRO PLANT OR ANIMAL

As a river steward looking for environmental problem sources or ecosystem problems and keeping a vigilant watch over streams and rivers, what technologies or new tools could help the most to make your job more efficient and effective? Respond as an experienced government agency scientist, or a local scientist watershed organization volunteer, or a university researcher, who would like to help improve the local stream/river quality OR detect abnormal or unhealthy ecosystem characteristics.

1. What are the most important macro plant and animal data that really <u>need</u> to be obtained, and how frequently, in order to establish well defined improvement/deterioration trends in the overall health of rivers and their ecosystems? What are the prime indicators?

1.	**6.**	**11.**	**16.**
2.	**7.**	**12.**	**17.**
3.	**8.**	**13.**	**18.**
4.	**9.**	**14.**	**19.**
5.	**10.**	**15.**	**20.**

2. There seems to be a need to capture biological data and represent it in a digital format so that it can be processed in a computer and compared with chemical and other data for a wide variety of reasons in the study of ecosystems. Considering all aquatic animal and plant species, diversity and population size, what parameters would you give the highest priority for measuring and digital comparison with water chemical or other properties for overall river ecosystem health evaluation or ecosystem studies?

1.	**6.**	**11.**	**16.**
2.	**7.**	**12.**	**17.**
3.	**8.**	**13.**	**18.**
4.	**9.**	**14.**	**19.**
5.	**10.**	**15.**	**20.**

3. As a river steward doing surveys of rivers and watersheds, what features, and of what individual plants, would you want to digitally record in or along the river by use of a digital camera in order to use some type of digital processing, such as pattern recognition, filtering, size, shape, spectral reflectance, or other computer based analysis techniques?

1.	**6.**
2.	**7.**
3.	**8.**
4.	**9.**
5.	**10.**

4. What new <u>portable</u> computer based instruments or measuring techniques/capabilities would you like to have and see developed for capturing macro plant and animal life features for ecosystem studies and evaluation?

1.	**6.**
2.	**7.**
3.	**8.**
4.	**9.**
5.	**10.**

OTHER RELATED TOPICS YOU WOULD LIKE TO PURSUE OR HAVE INVESTIGATED & GENERAL COMMENTS:

APPALACHIAN RIVERS CONFERENCE, WORKSHOP AND EXHIBIT

WORK GROUP 4

THE BASS MYSTERY

ASSUME THE FOLLOWING

The changing industrial base in West Virginia has led to TOURISM as the number two industry in the State exceeding 4 billion dollars per year. Fishing is a significant part of the tourism business. This trend will likely continue or increase in the future. Bass fishing is the historical favorite in most Appalachian streams and rivers. Large bass populations could greatly increase the number of bass tournaments in the State and other fishing activities that would have a large economic impact.

In addition to the financial incentives, a more fundamentally important ecological issue lurks in the rivers. The mystery is why are the bass populations below historical levels, and below the levels "healthy" rivers support.

TASKS

You are charged with five tasks to unravel this mystery by scientific investigation and correct it:

1. **Offer a list of possible reasons for low bass population density with supporting arguments.**
2. **List the likely food diet options through a 12-month cycle assuming a serious siltation condition.**
3. **Trace the likely food chain assuming a serious stream condition of siltation and all else OK.**
4. **List the most important things you think can be done to increase bass populations in WV rivers and the technologies needed to help achieve the results.**
5. **Outline a scientific protocol or list of experiments for obtaining the supporting data to prove the contribution each of the possible reasons makes in a given stream through a 12-month cycle.**

QUESTION: If these tasks or questions cannot be comprehensively answered with existing information and scientific data, is such a research project to answer them warranted? Yes___ No___

TASK 1---List possible reasons for low bass populations, and explain why.
i) List both the stream problems, such as siltation, pH, TDL, and the problems they create for bass.
ii) List such considerations as spawning problems, over fishing, diet deficiencies, pollutants.
iii) Consider the impact of each problem on each of the possible food chain ingredients.
iv) Bass are near the top of the food chain. Do other predatory fish eat bass ? Explain.

1. Siltation	**1.**	**2.**	**3.**
2.			
3.			
4.			
5.			

WORK GROUP 4

THE BASS MYSTERY

(Cont'd)

TASK 2---Likely food diet through a 12-month cycle

The likely food diet (top 5 foods) assuming a serious siltation stream problem

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1												
2												
3												
4												
5												

TASK 3 ---List the likely food chain links leading up to the top of the chain, the bass, assuming that a serious siltation stream condition exists and all other conditions are normal.

TASK 4 ---List the most important things you think can be done to increase bass populations in WV streams and rivers, and the technologies needed to help achieve the results. Include anything from regulatory to biotechnologies that you think could be useful.

Things to be done:

1.	**9.**
2.	**10.**
3.	**11.**
4.	**12.**
5.	**13.**
6.	**14.**
7.	**15.**
8.	**16.**

Technologies needed

1.	**7.**
2.	**8.**
3.	**9.**
4.	**10.**
5.	**11.**
6.	**12.**

TASK 5 ---Outline a scientific protocol or list of experiments for obtaining the supporting data to prove the contribution each of the possible reasons makes in a given stream through a 12-month cycle. Disregard the costs of making the measurements to provide the data. List the chemical and biological parameters that need to be measured.

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WORK GROUP 5
DATA AND INFORMATION

1. Does a list exist of all of the agencies, organizations, and businesses that collect water chemical property data in WV on WV creeks, streams and rivers? Yes ____ No_____
If answered "yes", what place and address? ____
Does this list include names of independent and municipal water companies? Yes ___ No___
Does this list include collection by private companies or organizations? Yes ____ No____

2. Is there a central database or repository where all chemical data are stored in addition to STORET? Yes ___ No ____
Does this database include chemical data collected by all drinking water companies? Yes ___ No___
Does this database include chemical data collected by private companies who volunteer it?

3. What groups are using this state-wide collection of data to do global WV analyses or modeling?
What types of models are being used?

4. Does a list exist of all of the agencies and organizations that collect biological data in WV on WV creeks, streams and rivers? Yes ____ No_____
If answered "yes", what place and address? ____
Does this list include names of drinking water companies? Yes ___ No___
Does this list include collection by private companies or organizations? Yes ____ No____

5. Is there a central database or repository where all WV biological data are stored? Yes ___ No___
Does this database include biological data collected by all drinking water companies? Yes ___ No___
Does this database include biological data collected by county health departments? Yes ___ No___

6. What groups are using this state-wide collection of data to do global WV analyses or modeling?

7. Are there GIS maps showing the locations of all known chemical and biological data collection sites and the respective types of data collected in WV? Yes ___ No ___
Comments:

8. Educating and sensitizing the public to pollution problems may be one of the best ways to reduce pollution. What new technology tools can be most useful in this effort?

9. How helpful would it be to all of the state and federal agencies and other river stewards if more data, information, and advanced technology tools were provided to them at the local level?
What tools from monitoring instruments to computer simulation programs would be most beneficial?

10. In Minnesota, school children discovered that 50% or so of the frogs in a three-state area had serious deformities. Watershed organizations are increasing, but often play relatively low-tech roles of helping clean up rivers and the environment. Can we amplify the efforts of our river stewards by enlisting high tech neighborhood assistance from watershed organizations? What high technology tools and efforts would be most helpful?