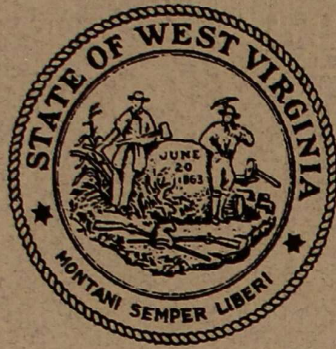


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1999**



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Annual Session



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**BIOLOGY**

MICHAEL LITTLE, Integrated Science and Technology, Marshall University, Huntington, WV 25755, ALAN TENNANT, U.S. Environmental Protection Agency, Research Triangle Park, NC, and VICTOR FET and DONALD TARTER, Biology Department, Marshall University, Huntington, WV 25755. The presence of unique forms of the common minnow, *Rhinichthys atratulus*, in West Virginia streams.

*Rhinichthys atratulus* is a cyprinid fish widely distributed in West Virginia streams. The species is morphologically divergent and has been divided into three subspecies defined mostly by male nuptial coloration. Over a period of twenty years, a group of investigators at Marshall University have recorded coloration of nuptial males from over 100 sites in the Cheat, Greenbrier, Gauley, Elk, Ohio, Tygart Valley, Youghiogheny, and Potomac River systems. Four distinct phenotypes of male nuptial coloration have been identified. Two phenotypes are consistent with nuptial coloration previously reported for the subspecies *R. a. atratulus* and *R. a. obtusus*. One phenotype is consistent with nuptial patterns previously described only for midwestern populations of *R. a. meleagris*, and one phenotype is described as unique to the state. Distribution of these phenotypes is consistent with two extensive stream capture events. The phenotype previously described only for midwestern populations of *R. a. meleagris* is widely distributed in Shavers Fork of the Cheat, the West Fork of the Greenbrier, and Gladly Fork of the Cheat River. The phenotype identified as *R. a. atratulus* and previously reported as mostly unique to Atlantic slope streams is extensively distributed

along both sides the Allegheny Front in streams of the Potomac, Youghiogheny, and Cheat Rivers. Nuptial males from the Elk River express nuptial coloration distinct from other populations of *R. a. obtusus*.

VICTOR FET, KECIA GERLACH, AND WESLEY GLADWELL, Biology Department, Marshall University, Huntington, WV 25755, and MICHAEL LITTLE, Integrated Science and Technology, Marshall University, Huntington, WV 25755. First mitochondrial DNA phylogenetic data from blacknose dace (*Rhinichthys atratulus*) (Cyprinidae, Osteichthyes) in West Virginia.

Specimens of blacknose dace have been collected from four localities (Shavers Fork, Randolph Co., North Branch of Snowy Creek, Preston Co., Horseshoe Run, Tucker Co., and Clover Run, Tucker Co.). Total DNA was extracted from frozen tissues and seven DNA sequences (each 449 base pairs long) of mitochondrial cytochrome oxidase I (CO I) gene were obtained via polymerase chain reaction (PCR) using universal conserved primers (Simon et al. 1994). Sequences were aligned and analyzed by PAUP 3.1.1. computer program (Swofford 1993). The population from Shavers Fork was distinctly isolated from three others at the genetic distance of 5.0 -5.2 % (while three remaining populations clustered together and differed at 0.7-0.9 %). This separation corresponds to the detected phenotype difference at least at subspecies level (*R. a. atratulus* vs. *R. a. meleagris*). Distance of *R. atratulus* from an outgroup species, *R. cataractae*, was 8.8 to 9.5 % and distance of both congeners from *Nocomis micropogon* (Cyprinidae) was 27.7 -29.8 %.

JENNIFER L. HICKERSON, Dept. of Biology, Shepherd College, Shepherdstown, WV 25443, CLIFFORD E. STARLIPER, USGS/BRD, National Fish Health Research Laboratory, Kearneysville, WV 25430 and BURTON C. LIDGERDING, Dept. of Biology, Shepherd College. Studies on the cohabitation of fresh water bivalves and salmonoid fishes: pathology to fish of mussel tissues and contagion of a known fish pathogen, *Aeromonas salmonicida*.

Currently, 71.7% of the known freshwater mussel species native to North America are categorized as endangered, threatened, or of special concern. In 1995, the US Fish and Wildlife Service and other partners initiated conservation efforts to protect native bivalves from zebra mussel infestation and other threats. Native animals are being relocated to refugia, e.g. salmonoid fish hatcheries that are void of these threats. These animals are being maintained and efforts at their propagation were established so they can be returned to their native environment at an appropriate future date. With cohabitation of the bivalves and hatchery-reared fish, questions arose regarding the potential for introduction and transmission of pathogens. The present study evaluated the possibility for (nonspecific) mussel tissue toxicity to fish and pathogen contagion between fresh water mussels and salmonids. Tissues were collected from 20 *Amblema plicata*, homogenized and evaluated invitro using the differential media Blood Agar, Gelatin, and Chondroitin Sulfate. Hemolytic activity was demonstrated in nineteen of the twenty animals and ten were selected for invivo (intraperitoneal and intramuscular) injections to *Salvelinus alpinus*. No adverse pathology was noted. Contagion between mussels and fish was studied using the bacterium *Aeromonas salmonicida*, the cause of furunculosis in salmonoids. *A. plicata* were exposed and

infected with the bacterium by either cohabitation with *A. salmonicida* infected fish or by challenge with a viable *A. salmonicida* culture. Infected mussels were then moved to a clean tank and uninfected fish added. Clean fish became infected only when *A. plicata* were exposed to high numbers of bacteria. Our results indicate minimal chance for contagion from *A. plicata* to salmonids.

AMY B. SPURGEON, Dept of Biology, Shepherd College, Shepherdstown, WV 25443, and The Freshwater Institute, Shepherdstown, WV, 25443; CLIFFORD E. STARLIPER, USGS/BRD Fish Health Lab, Kearneysville, WV 25430; and BURTON C. LIDGERDING, Dept of Biology, Shepherd College, Shepherdstown, WV 25443. Relative susceptibility of nauyuk and labrador arctic charr to experimental challenge with bacterial pathogens: a comparison to rainbow and brook trout.

Arctic charr are becoming commercially important in the United States, primarily in more Southern regions, because of their high conversion rate and high marketability. However, there is very minimal literature as to their susceptibility to the pathogens and diseases routinely encountered in other salmonid hosts. The present study was done to evaluate the virulence of selected bacterial pathogens, including *Aeromonas salmonicida*, to determine relative susceptibilities among four salmonid hosts: Rainbow trout (*Oncorhynchus mykiss*), Brook trout (*Salvelinus fontinalis*), and Nauyuk and Labrador Arctic charr (*Salvelinus alpinus*). All sample hosts were fingerlings, similar in size and averaging 8-10g each. Three challenge strains were isolated from naturally occurring epizootics in Brown (*Salmo trutta*) and Brook trout from the Eastern United States. Isolates of the bacterial pathogen were cultured in

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tryptic soy broth (TSB) and serial 10-fold dilutions were prepared. For each host, groups of 15 fish were challenged by a 0.1mL intraperitoneal injection (IP) of each dilution. Cultures for challenge were quantified with an average  $1.42 \times 10^8$  cfu/mL. In the group that received the lowest dilution, each fish was exposed to approximately  $1.42 \times 10^6$  cfu viable cells. Mortalities within each host were observed over a period of 14-21d. Re-isolation and confirmation of pathogen presence was determined by biochemical evaluation. Brook trout were recognized to be highly susceptible to the pathogen, Nauyuk was second in susceptibility, Labrador third, and Rainbow trout showed highest resistance. The same isolates were introduced to groups of host fish via waterborne, or bath challenges. Each challenge strain was grown in 1L quantities. Groups of 15 fish of each host were challenged with undiluted ( $10^0$ ) and diluted ( $10^{-1}$ ) viable culture. Fish were removed from their tanks, placed into challenge culture for 60s, and returned to tanks for observation. Mortalities were recorded, and re-isolation and confirmation was obtained by biochemical testing. These experiments are currently ongoing.

W. ALEX WADE, West Virginia University, Morgantown, WV 26506 and E. C. KELLER JR., Dept of Biology, West Virginia University, Morgantown, WV 26506. The analyses of cardiovascular trends in West Virginia.

Cardiovascular disease is the leading cause of death in the United States. It is of particular concern in West Virginia. This state has the fifth highest death rate due to cardiovascular disease in the country. The objectives of this study were to observe the trends of the five major components of cardiovascular disease in

each county, and overall, for West Virginia. The data were analyzed separately for each sex. The five major components of cardiovascular mortality examined were: heart disease, cerebral vascular disease, arteriosclerosis, other arterial diseases, and other cerebral vascular diseases. The observations for each county will determine if there are any regional trends in the state that deviate from the general trends throughout the state. A SAS<sup>®</sup> data set was used that contained all West Virginia resident death certificates for the period 1959 through 1994. (There were approximately 750,000 West Virginia resident death records.) The SAS<sup>®</sup> system was used through WVNET to complete the trends and regression analyses. For example, several of the components of cardiovascular disease showed overall statewide trends, for each sex, to be both increasing and decreasing. For example, arteriosclerosis mortality was observed, to have a monotonic linear decline in males over time of 6.1 deaths per year. It also showed a declining monotonic linear trend of approximately 5.7 deaths per year for females.

BRIAN J. SCHMIDT, West Virginia University, Morgantown, WV 26506 and E. C. KELLER, JR, Dept of Biology, West Virginia University, Morgantown, WV 26506-6057. Biological, Socio-economic, and Environmental Associations with Cardiovascular Disease in West Virginia

Cardiovascular disease is the primary cause of mortality in the United States, claiming more than 950,000 lives each year. So prevalent is the disease that it is responsible for more deaths than the next seven mortalities combined including cancer (American Heart Association). Cardiovascular mortality is much more prevalent in West Virginia, which nationally has the fifth highest mortality rate due to this

disease. The objective of this study was to determine those independent variables significantly associated with cardiovascular disease in West Virginia. Multiple regression analyses were utilized to analyze numerous independent variables across all 55 counties of West Virginia over an eleven-year period (1972 to 1982). The database contained nearly 300,000 death records and some 200 independent variables. These independent variables were grouped into three subcategories, viz., biological, socio-economic, and environmental. Biological variables included other mortality and genetic data, socio-economic variables included lifestyle and occupational variables, and environmental variables included geological, weather, and other physical attributes of West Virginia. For example, the variables that had the most significant associations with heart disease mortality, across the three subcategories, explained over 70% of the variation in heart disease mortality (in both sexes). The most significant association between heart disease mortality in the analyses was the proportion of the population over 65 years of age living alone. Regression models will also be presented on the other major components of cardiovascular disease (e.g., cerebrovascular disease, arterial disease, arteriosclerosis, hypertensive disease and nonspecific cardiovascular disease).

CATALINA V. TEBA, West Virginia University, Morgantown, WV 26506, E. C. KELLER JR., Dept of Biology, West Virginia University Morgantown, WV 26506, and DE QUAN West Virginia University, Morgantown, WV 26506. Comparative Studies of Human Mortalities between Northern and Southern West Virginia.

Many factors such as the environment, genetic makeup, diet, stress, and countless others

would affect one's mortality. This study examines the role geographical area plays in the distribution of mortalities. By examining death records of West Virginia residents (500,000 +) from 1959 until 1982, the causes of death in the northern areas were compared to those in the southern parts. The objective of this study was to determine the mortalities that are significantly different between northern and southern West Virginia. Differences in occupations, or cultural background, in the north compared to those of the south could be influencing the frequency of different mortalities. The research results for various causes of death, established that there were significant differences in rates of mortality between the northern and southern parts of the state. Residents in the north had a higher incidence of "old age" mortalities, such as: cerebral vascular disease, cancer of genitourinary organs, heart disease, malignant cancer of the digestive organs and peritoneum, major cardiovascular diseases, general cancers, and other disease of arteries, arterioles, and capillaries. In contrast, residents of the south had a significantly higher incidence of pneumoconiosis mortality due to silica and silicates. We further examined geographical differences for these mortalities by mapping the "hot spots" of the counties in West Virginia. For example, major cardiovascular mortalities are 6.42 per 1000 in the north versus 5.20 per 1000 in the south. Cerebrovascular disease was responsible for a mortality rate of 1.23 per 1000 in the north as compared to 1.00 in the south. Another major category of cancer mortality had a value of 1.87 per 1000 in the north versus 1.54 per 1000 in the south. For digestive and peritoneum mortality there were 0.54 per 1000 in the north compared to 0.40 per 1000 in the south. In contrast pneumoconiosis had 0.01 deaths per 1000 in the north as compared to 0.04 in the south, which was the only mortality to have a larger mean in the south.

JOANNA SAMSELL, West Virginia University, Morgantown, WV 26506 and E. C. KELLER JR., Dept. of Biology, West Virginia University, Morgantown, WV 26506. The study of human longevity in West Virginia within classes of human mortality.

It is general knowledge that there is a difference in life span between human males and females. The life span for males living in the United States is 73.0 yrs. The life span for females living in the United States is 79.0 yrs. (National Center for Health Statistics, 1996). The life span for males residing in the northern part of West Virginia is 65.3 yrs. and in the southern part, 63.2 yrs. The life span for females residing in the northern part of West Virginia is 70.0 yrs. and in the southern part, 67.9 yrs. (from the average of all resident deaths in WV from 1959-1994). The first objective was to determine any differences in human longevity within classes of mortality between males and females. The second objective was to examine longevity in residents of the Northern and Southern regions of West Virginia within classes of mortality. The database used in this project contains approximately 750,000 WV resident death records obtained from the WV Department of Health. The data records cover the years 1959-1994. The SAS<sup>®</sup> system at WVNET was used to compute the one-way analyses of variance and the corresponding averages. The results indicated that several of the mortalities showed differences in male and female longevity categories between the Northern and Southern areas of West Virginia. For example, the longevity of males who died of Heart Disease was 71.1 yrs. in the North, but 69.8 yrs in the Southern part of West Virginia. The female longevity for Heart Disease was 77.2 yrs. in the North and 76.2 yrs. in Southern West Virginia.

## BOTANY

DAVID DeRAIMO, AMY BRITT, JAGAN V. VALLURI, H. WAYNE ELMORE. Division of Biological Sciences, Marshall University, Huntington, WV 25755. Protein synthesis and stress ethylene production in sandalwood callus cultures exposed to heat shock.

Environmental stresses such as drought and heat shock have been shown to elicit the production of specific proteins in plants. Heat shock in higher plants induces synthesis of a unique group of proteins, the heat shock proteins (HSP). In plants, the major group of heat shock proteins has a molecular weight of 15 to 25 kilo daltons. A knowledge of the molecular responses such as gene expression during cellular adaptation would be helpful and might lead to the identification of the altered putative genes. Sandalwood callus was maintained on Murashige and Skoog medium supplemented with 1 mg/L 2,4-D and 1 mg/L benzyladenine. Rapidly growing sandal callus was exposed to elevated temperatures ranging from 32C to 45C. Protein synthesis and ethylene production induced by heat shock were assessed by SDS-polyacrylamide gel electrophoresis. After 48 h of exposure to stress, a 30% reduction in callus volume was observed. Silver staining and incorporation of radiolabel revealed a diverse array of low molecular weight proteins at 36, 40 and 45C after 6 to 8 hours of heat shock. Although most appeared to be synthesized only during heat shock, some were detectable at low levels in control tissue. At elevated temperatures ethylene production was greatly inhibited. However, recovery from heat shock is relatively rapid and is followed by stimulated ethylene production.



## ECOLOGY

RONALD FORTNEY, Dept. of Bioscience, Salem-Teikyo University, Salem, WV 26426, SAM NORRIS, Natural Heritage Program, WV Division of Natural Resources, Elkins, WV 26241, and TIM AIKEN, Dept. of Bioscience, Salem-Teikyo University, Salem, WV 26426. Old field succession in Canaan Valley, West Virginia.

Canaan Valley, a high elevation, canoe-shaped valley in the Allegheny Mountains of West Virginia, is an area of high interest because of its extensive wetland habitats and the number of rare species it supports. The Valley's vegetation was originally dominated by red spruce (*Picea rubens*), but clear-cut type logging and wildfires in the early 1900's resulted in significant changes to the plant life. Today Canaan's vegetation is typified by residual red spruce forest fragments on the surrounding mountain rims; northern hardwoods forests on well-drained slopes; old field type meadows on other upland areas; and bogs, swamps, and wet meadows in wetlands. There have been several ecological studies on the Valley's biota during the past 50 years, some directed only at the wetlands and others on the vegetation as a whole. None has focused primarily on the herbaceous-dominated old field vegetation that covers about 20 percent of the Valley. In 1995, the U. S. Department of the Interior, Fish and Wildlife Service (FWS), established the Canaan Valley National Wildlife Refuge. This study was conducted at the request of the FWS to quantitatively describe the old field vegetation in three separate tracts within the refuge. Eighteen 0.10 ha quadrats were established in the three tracts. They were located in habitats ranging from abandoned lowland moist to upland dry meadows. Using a cover class system developed after Daubenmire, the percent

ground cover was estimated for each species in 10 systematically established 1 x 1 m plots in each quadrat. An importance value was calculated for each species based on the sum of the relative frequency and relative cover divided by two. One hundred-eighteen vascular plant species were identified in the 18 quadrats. No one species was dominant in more than two quadrats. The lowland fields were admixtures of several species, with no one species predominating. Dry uplands ranged from varying mixtures of herbaceous species to fields where *Danthonia compressa*, *Dichanthelium clandestinum*, and *Solidago rugosa* occurred individually as the most prominent species. Up to one-third of the species present in any quadrat were nonnative. The results of this study were generally consistent with the findings of earlier vegetation studies in Canaan that included old field vegetation, except the proportion of nonnative species was higher in this study. The project was funded by the FWS.

MARTIN SCHNITTLER and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554, and CARLOS LADO, Real Jardin Botanico (CSIC), Plaza de Murillo 2, 28014 Madrid, Spain. Myxomycetes of the Maquipucuna Cloud Forest Reserve in Ecuador.

The Maquipucuna Cloud Forest Reserve is a 4,500 ha tract of forest located on the western slopes of the Andes in northwestern Ecuador, approximately 40 km northwest of Quito. Elevations within the reserve range from 1,200 to 2,750 m, and the predominant forest types are lower montane cloud forest and upper montane cloud forest. The climate is equatorial and wet, with very constant temperatures throughout the year. Annual rainfall varies with elevation and ranges from 2000 to 3000 mm. A collecting trip to the reserve during the

end of the dry season (late November and early December) in 1998 resulted in 502 fresh collections of myxomycetes along with a considerable body of data on the ecology and patterns of distributions of these organisms in tropical cloud forests. In addition, within three sampling plots that ranged in elevation from 1200 to 2700 m, 475 substrate samples of various types of aerial (dead but still attached plant parts) and forest floor litter as well as bark from living trees were taken. The present study is the first comprehensive survey of the myxomycetes associated with tropical cloud forests to include the moist chamber culture method. Cultures are still ongoing, but at least 90 species of myxomycetes are expected for the general study area. (Supported by grants from the National Science Foundation and the National Geographic Society.)

MARTIN SCHNITTLER and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Myxomycete biodiversity in four different forest types in Costa Rica.

The moist chamber culture technique was used to study the myxomycetes associated with four different forest types in northwestern Costa Rica. Although our study (with 497 total cultures) was one of the most comprehensive surveys of its type ever carried out, a statistical analysis showed that completeness in terms of the total number of species present was still not reached. The most obvious reason is the apparent rarity of many myxomycete species, a phenomenon well known for other groups of organisms from tropical ecosystems. The low average yield of the moist chambers (mean = 1.04 species/culture, 56% positive cultures) reflects this fact. Dramatic differences in myxomycete diversity were encountered among the forest types, which are arranged roughly

along an elevation gradient. The two seasonal dry forest types, semideciduous and evergreen lowland forest, accounted for 97% of the total species diversity. Corticolous myxomycetes have a clear abundance and biodiversity peak in the seasonal dry semideciduous forest, with trees of various bark types. In montane rainforest and cloud forest, where trees have uniformly smooth bark densely covered with epiphytes, abundance and diversity dropped to almost zero. Litter myxomycetes have their optimum in the seasonal dry evergreen forest. Aerial litter (mean = 1.78 species/culture) was distinctly richer in myxomycetes than forest floor litter (mean = 1.08 species/culture). (Supported by a grant from the National Science Foundation.)

DONNA L. MOORE, Dept. of Biological Sciences, University of Arkansas, Fayetteville, AR 72701; STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; and GARY A. LAURSEN and WAYNE WOODGATE, Dept. of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775. Protostelids from boreal forest and tundra ecosystems in Alaska.

Litter samples for isolation of protostelids were collected from four different study sites in Alaska. Six species of protostelids were recovered from these samples. No protostelids were isolated from samples of aerial litter (dead but still attached plant parts) collected in two boreal forest study sites (the Bonanza Creek Experimental Forest in central Alaska and north of Seward on the Kenai Peninsula in south-central Alaska), but four species (*Protostelium mycophaga*, *Schizoplasmodiopsis pseudoendospora*, *S. vulgare*, and *Tychosporium acutostipes*) were isolated from

samples of ground litter collected in these same two sites. Tundra study sites (north of Atigun Pass in the Brooks Range in northern Alaska and Serpentine Hot Springs on the Seward Peninsula in western Alaska) yielded all of the species recorded for forest study sites plus two additional species (*Nematostelium gracile* and *Protostelium arachisporum*). At Bonanza Creek, sets of sterile wheat straws were placed out in the two different litter microhabitats to obtain data on substrate colonization rates for protostelids. Straws from the aerial litter microhabitat yielded four species of protostelids, whereas straws from the ground litter microhabitat yielded six species. Two of the species (*Nematostelium ovatum* and *Soliformovum irregularis*) recovered from straws were not isolated from any of the samples of naturally occurring litter collected at this or the other Alaskan study sites, thus bringing the total number of protostelids recorded for the entire study to eight. In general, species richness of protostelids appears to be lower in high-latitude ecosystems than in the examples of temperate forests and grasslands thus far examined for the occurrence of these organisms. (Supported in part by the National Park Service.)

SEAN LOUDIN<sup>1</sup>, TIM HANCOCK<sup>1</sup>, TOM JONES<sup>1</sup>, AND WILLIAM PEARSON<sup>2</sup>. <sup>1</sup> Division of Natural Sciences, Alderson-Broaddus College, Philippi, WV 26416 and <sup>2</sup> Dept. Biology, University of Louisville, Louisville, KY. Temporal and spatial variation in reproduction of aquatic, troglobitic organisms from Mammoth Cave National Park.

Eleven subterranean, stream segments were bio-surveyed from 1993 to 1998. These stream segments vary in chemical, physical, and biological condition. Reproduction, as noted by the presence of juveniles, has been

temporally and spatially sporadic throughout the study period. No single site appears to act as a source subpopulation. Previous work suggests that reproduction is keyed to flooding and the resultant deposition of organic matter. Our data show this trend but there is not a significant correlation between these variables ( $R=0.68$ ,  $n=16$ ). Juvenile crayfish and cavefish are not found in close approximation to each other. This may suggest strong inter-specific predation. Cannibalism has been noted in both groups. Reproductive events were not correlated to simple prey density. The interaction of hydrology, interspecific predation, and prey density result in infrequent reproductive success. This reduced reproductive output may provide adaptive pressure on troglobitic organisms to develop extended life-spans.

TOM JONES<sup>1</sup>, AND WILLIAM PEARSON<sup>2</sup>. Division of Natural Sciences, Alderson-Broaddus College, Philippi, WV 26416 and <sup>2</sup> Dept. Biology, University of Louisville, Louisville, KY, 25226. Predator/prey interactions among aquatic, troglobitic organisms from Mammoth Cave National Park.

*Amblyopsis spelaea*, *Typhlichthys subterraneus*, and *Orconectes pellucidus* are the three most common troglobitic predators in the subterranean streams in Mammoth Cave National Park. Predator density was estimated using surveys of stream segments. To reduce impact, predator size was visually estimated, with a limited amount of truthing by capture and physical measurement. The most abundant prey items were troglobitic isopods and juvenile predators. Prey density was estimated using rock counts and 0.3 meter plots. Predator/prey ratios varied from 0 to 1. Prior site visits had suggested substrate composition influences predator density. Substrate complexity was estimated by using 0.3 meter

plots. Volume estimations were made assuming solid rectilinear shape for all objects within the plot. A simple ratio of volume to area was calculated for each stream segment studied. Both predator composition and density varied with the complexity ratios. In general, predator density increased with prey density. Prey densities exhibited a suppression point in relation to predator numbers. This suppression point varied with habitat complexity. Predator numbers varied widely with substrate complexity. This may be the result of higher prey abundances, flooding refugia for the predators, or the increased possibility of organic matter to be trapped by the substrate.

JOHN C. LANDOLT, Department of Biology, Shepherd College, Shepherdstown, WV 25443; STEVEN L. STEPHENSON and MARTIN SCHNITTLER, Department of Biology, Fairmont State College, Fairmont WV 26554; and CARLOS LADO, Real Jardin Botanico (CSIC), Plaza de Murillo 2,28014 Madrid, Spain. Cellular slime molds from cloud forests of the Maquipucuna Reserve, Ecuador.

Samples of soil and litter taken both from the ground and from the mat of material associated with the bases of epiphytes on the boles and branches of trees growing at three different elevations within the cloud forests of the Maquipucuna Reserve of Ecuador were processed to determine the occurrence and distribution of dictyostelid cellular slime molds. Eight different identified species together with several as yet unidentified forms were recovered. All identified species were either cosmopolitan forms or types with tropical affinities. Species richness and calculated estimates of density declined with increase in elevation. At all three elevations,

species richness of the assemblage of dictyostelids present in the ground level samples was equal to or greater than the assemblage associated with epiphytic samples, but at the lowest and highest elevations, calculated densities of dictyostelids were actually higher in the epiphytic samples than in the ground level samples. This study was supported in part by grants from the National Geographic Society and the National Science Foundation.

WM. JAMES ARNOLD, Biological Sciences, Marshall University, 153 Woodland Dr. Huntington, WV 25705. Spiders found in West Virginia.

A thorough survey of published accounts of spiders occurring in West Virginia found only 136 species among 72 genera and 25 families confirmed for the state. Expanding that list with species recorded from adjacent states and their immediate neighbors with habitats found also in WV (e.g., mountain summits), generates a target list of 789 species from 303 genera and 44 families. Field studies and searches of museum, university, and private collections for specimens have given vouchered status to 395 species in 185 genera and 41 families. Collections have been made by the author at 125 locations in 29 of the 55 counties in the state. Most of the species found had been predicted by the target list. Collections to date are insufficient to interpret spider distribution within West Virginia.

### ENGINEERING

ALAN D. SMITH, Department of Quantitative Sciences, Director of Engineering Programs, Robert Morris College, Pittsburgh, PA 15219-3098. Practicing Project Managers: Their Insights

on the Project Management Profession.

Project Management, as a discipline of study, deals in the explanation of conceptual and quantitative approaches used to manage nonrepetitive tasks within the organization's constraints of time, cost, and performance. Several institutions have adopted business coursework in the scope of Project Management within the business disciplines. Area professionals in the coursework in the relative importance of project management and work efforts as defined by the project Management Institute (PMI). After a follow-up letter, a total of 50 out of 210 (23.8%) responded to the questionnaire. A few of the highlights of the survey included the following: 68% of respondents thought more than half of their job involved project management; 56% felt more than half their subordinates do project management work; 64% would recommend graduate training to project management; and many respondents were interested in learning (90% or higher) topical areas such as scope management, time management, quality management, cost management, communication management, contract/procurement management, project monitoring, and project control.

### GEOGRAPHY

ROBERT F. MASLOWSKI,  
Environmental Resources Branch, U. S.  
Army Corps of Engineers, 502 Eighth  
Street, Huntington, WV 25701. Models in  
historic archeology: the MIA mission in  
southeast asia.

Archeologists from the U. S. Army Corps of Engineers periodically participate in MIA (Missing In Action) Missions in Vietnam, Laos and Cambodia. The missions consist of scientific excavations of aircraft crash sites and burial sites. These archeological sites are

affected by natural conditions such as site location, topography, soil conditions, and climate. In addition the distribution of artifacts are affected by local cultural practices, national policies and international politics and economics. Explanatory models are created to interpret the post-depositional history of these sites.

### GEOLOGY

RACHEL SEARS and EDWARD M.  
SNYDER, Dept. of Environmental  
Studies, Shepherd College, Shepherdstown,  
WV 25443. Taxonomic Comparison of  
Bryozoa from Kazan, Russia with  
Northeastern Nevada, USA Species.

A diverse and abundant assemblage of Bryozoa characterize the Guadalupian (Kazanian) Gerster Formation of northeastern Nevada and equivalent age rocks from the Kazan region of Russia along the Volga and Kama rivers. Comprehensive analysis of Bryozoa from both regions was undertaken employing techniques which distinguish zoarial from zooecial characters both quantitatively and descriptively, and through three-dimensional reconstruction of the zooecial chamber shape and size. Further, unusual preservation in which zooecial chambers were selectively preserved allowed extremely accurate reconstruction of chamber shape and dimension. Zooecial characters exhibit a lower intraspecies variation than zoarial characters, and are heavily relied upon in taxonomic analysis. A powerful analytical tool for taxonomic comparison of these species is the establishment of a virtual environment in which both the individual bryozoan zooid (autozooecia) and the colony (zoaria) from different specimens and species can be directly compared. Although in its developmental phase, when fully functional this will allow any researcher direct comparison with our materials in a true three-dimensional form.

## ABSTRACTS 1999 ANNUAL MEETING

The pronounced similarity between the Nevada and Russia Bryozoa indicates a possible continuity of seaways between these now distant regions during Permian time. Lack of similarity of Nevada materials with those of similar age from West Texas indicates no direct seaway connection between these now geographically close regions.

ROBERT F. MASLOWSKI, U.S. Army Corps of Engineers, Huntington, WV 25701 and DEWEY D. SANDERSON, Department of Geology, Marshall University, Huntington, WV 25755. A C14 archeological GIS of Kentucky, Ohio, and West Virginia.

Nearly 2000 C14 archeological dates originally compiled and published by Maslowki et al.(1966) in the West Virginia Archeologist have been put into a geographic information system(GIS) using the software ArcView. The original dBase IV formatted data lent itself well to integration into a GIS. State and county base maps provide the geo-referenced backdrop for display of the spatial information. Some of the problems encountered in establishing the GIS were incomplete and erroneous data and difficulty in obtaining corrections and additions from a wide range of original sources. The greatest number of archeological sites and C14 dates is represented by Ohio and the least by West Virginia. The major rivers and lakes appear to show the greatest concentration of dates, an observation that may reflect a bias in sites chosen to be dated. The least number of dates are associated with the Paleo-Indian period. The Archaic Period appears to be as well represented as the more recent Woodland and Late Prehistoric Periods. The C14 GIS is easily updated and revised in the ArcView system.

RAZI GASKARI, DONALD D. GRAY, and DARRELL R. DEAN JR., Department of Civil and Environmental Engineering, College of Engineering and Mineral Resources, West Virginia University, P.O.Box 6103, Morgantown, WV 26506. Automatic acquisition of input parameters for hydrologic modeling in West Virginia using Geographic Information System.

In highway engineering, the diversity of drainage problems is broad and includes the design of pavements, culverts, and other cross drainage structures for channels varying from small streams to large rivers. It is often necessary to evaluate the impact that future land use, proposed flood control and water supply projects, and other planned and projected changes will have on surface runoff. The rational method is not a desirable model, especially for midsize or large watersheds. In contrast to simple methods such as the rational method, a more complete model will provide a more accurate result. A drawback of using complex models is the wide range of data needed. New tools such as a Geographic Information System (GIS) make possible timesaving methods for inputting parameters into complete hydrologic models. The goal of this project was to create an automated system to calculate the amount of runoff by selecting a point on computer screen. In this study, the Geo-STORM software was used as a GIS/hydrologic model. Geo-STORM uses hydrologic modules such as TR-55 and TR-20 to simulate watershed and river basin hydrologic and hydraulic processes using information maintained within Arc/Info databases. Geo-STORM needs digital data such as Digital Elevation model (DEM), land cover, and soil types as input parameters. Once all the input parameters are provided in a GIS database, Geo-STORM is able to calculate the

runoff resulting from a given storm. A new feature added during this study is the ability to calculate the maximum runoff based on National Flood Frequency (NFF) method. All digital data required as input for the Geo-STORM software were developed for the State of West Virginia in the Arc/Info environment. The data is stored in raster format (Cell bases). The process for running the Geo-STORM software was very slow for the whole State of West Virginia. To overcome this, the data were categorized in different files based on hydrologic unit boundaries. The front end GUI (Graphical User Interface) was implemented using commercial software called Arc/View. The study was funded by West Virginia Division of Highways (WVDOH).

### GEOLOGY AND MINING

E. RAY GARTON, Curator, Museum of Geology & Natural History, WV Geological Survey, PO Box 879 Morgantown, WV 26507. The West Virginia Geological Survey Museum of Geology & Natural History, its establishment and mission.

Founded in 1863, West Virginia is not just 134 years old. Indeed West Virginia was millions of year in the making. The mineral wealth and natural beauty of West Virginia owe its origins to geology and geologic processes that literally began millions years ago. Geology does indeed underlie it all. Without geology and geologic processes there would be no rocks, rivers, minerals, or scenic beauty. Bringing examples of the state's geologic wealth before its citizens is the primary mission of the West Virginia Geological Survey Museum of Geology and Natural History. The museum is more than a collection of rocks, minerals and fossils. The museum offers an educational opportunity to everyone, young and old. The Museum of Geology and Natural History is a legacy to

future generations of West Virginians and its visitors. One of the primary purposes of the museum is to provide the state's citizens and its visitors with an opportunity to examine first hand and up close many of the geologic specimens and geologic processes responsible for the state's outstanding mineral wealth and scenic beauty. The museum visitor leaves with knowledge, an education, and an understanding of the geology that makes West Virginia unique. The visitors are inspired to visit the state's scenic treasures time and time again. The scope of the museum includes the collection, preparation, preservation, and exhibition of rock, mineral, and fossil specimens from all ages of West Virginia's geologic history. The museum is a perpetual repository for all types of geologic, rock, mineral, and fossil specimens including historic books, maps, manuscripts and artifacts. The museum encourages and seeks the donation and loan of important specimens found within and beyond the state's borders.

FREDERICK GRADY, 1201 South Scott Street, Apt. 123, Arlington, VA 22204 and E. RAY GARTON, Curator, Museum of Geology & Natural History, WV Geological Survey, PO Box 879 Morgantown, WV 26507 and MARSHALL G HOMES, PO Box 92 Snow Shoe, WV 26209. The Pleistocene peccary *Platygonus vetus* from Poorfarm Cave, Pocahontas County, West Virginia.

A virtually complete, articulated skeleton of the extinct peccary *Platygonus vetus* has been recovered from an obscure passage in Poorfarm Cave, Pocahontas County, West Virginia. *Platygonus vetus* dates from the early to middle Pleistocene at about 0.4 to 1.5 million years. Based on other associated fauna the Poorfarm specimen probably dates at the younger part of this time span. *Platygonus vetus* is much less frequently found than its younger and smaller

relative *Platygonus compressus*. The Poorfarm skeleton is only the second relatively complete skeleton of *Platygonus vetus* ever found in the United States. *Platygonus vetus* has also been found in Rennick Quarry Cave, Greenbrier County, Hamilton and Elias Davis Caves in Pendleton County, and possibly Bowden Cave in Randolph County.

## PSYCHOLOGY

J'AIME HALL and JOHN H. HULL, Dept of Psychology, Bethany College, Bethany, WV 26032. What does the early bird catch? Relationships among "Lark/Owl" behavior, extroversion, academic achievement, and sports participation.

Eighty-five college students (49 women, 36 men) completed a questionnaire designed to measure "Lark/Owl" tendency (active earlier versus later in the day), and a second questionnaire measuring extroversion. Students also recorded how many different sports seasons during which they had played in high school, and what their high school GPAs were. Pearson product-moment correlations showed a statistically significant relationship between Lark/Owl tendency and extroversion; "Owl" tendency was related to being more extroverted. Other statistically significant correlations included a positive one between extroversion and number of different sports seasons played in high school, and a negative one between number of sports seasons played in high school and high school GPA. Student gender did not significantly impact any of these correlations. The present study confirms previous reports of a relationship between Owl tendency and extroversion, but does not confirm a previous report of a relationship between Lark/Owl tendency and academic achievement. Future research should clarify

under what circumstances, if any, a Lark/Owl-academic achievement relationship exists.

JOHN H. HULL, Dept of Psychology, Bethany College, Bethany, WV 26032. Teaching probability concepts: Another look at "m&m" ® psychology.

To illustrate differences among subjective, empirical, and theoretical probabilities, 22 college students independently guessed at the proportions of brown, red, yellow, blue, green, and orange m&ms ® in candy bags (subjective probability), then computed the proportions of those colors in two small bags of candy (empirical probability). Finally, students were told the actual proportions, obtained from the Mars candy company (theoretical probability). When asked how many of the three types of probability each could have defined prior to the exercise, two students said two, two students said one, and 18 students said none. Three days later, with no intervening instructions about probability, students were asked to: Write definitions of the three types of probability; rate, on a scale from 1 - strongly disagree, to 5 - strongly agree, the following statements: "Friday's probability demonstration was enjoyable", "Friday's probability demonstration was useful". The mean number of correct definitions was 1.59; a correlated means *t*-test showed that was statistically significantly higher ( $p < .001$ ) than the mean number students reported they could have defined the day of the demonstration. Mean "enjoyability" and "usefulness" ratings were 4.36 and 4.55, respectively. Other uses of this form of m&m ® psychology should be developed in future applications. For example, one might illustrate the generally increased accuracy of estimates of population parameters one obtains from large vs small samples, or the relative accuracy of subjective vs empirical estimates of theoretical



probabilities.

## ZOOLOGY

VICTOR FET, Department of Biological Sciences, Marshall University, Huntington, WV 25755, MARK BARKER, Department of Biological Sciences, Marshall University, Huntington, WV 25755, and BENJAMIN GANTENBEIN, Division of Population Biology, Institute of Zoology, University of Berne, CH-3012, Berne, Switzerland. Species-level variation of the mitochondrial 16S rRNA gene sequence: use in molecular systematics and biogeography.

We report the first molecular systematic data on the mitochondrial 16S rRNA gene sequence variation at the species level among scorpions (Arachnida: Scorpiones), an ancient and vigorously speciating group of terrestrial arthropods. Several genera from various parts of the world, each including from three to five morphospecies of variable differences, were analysed, including *Hadrurus* (fam. Iuridae; SW USA, Mexico), *Euscorpius* (fam. Euscorpiidae; Southern/Central Europe), *Paruroctonus* (fam. Vaejovidae; SW USA, Mexico), *Mesobuthus* (fam. Buthidae; Southern Europe/Turkey/Central Asia), and *Centruroides* (fam. Buthidae; SW USA, Mexico). Total extracted DNA was amplified by PCR (polymerase chain reaction) using specific primers. Resulting 16S gene product (ca. 400 base pairs) was purified and sequenced for each species; sequences were compared with PAUP software. Phylogenetic trees and distance matrices revealed significant variation among congeners, usually under 10 % of genetic distance. DNA analysis allows to confirm status of morphospecies. Of five desert "giant hairy" *Hadrurus* species analysed, *H. pinteri* (Baja California), found on volcanic soils,

belongs to a well-separated clade (9.5 - 12.5 % distance from congeners) while *northern H. spadix* and *H. obscurus* (USA) are very close to each other (2.2 - 2.4 %); it is unclear if they are in fact separate species. Existence of the subspecies *H. arizonensis pallidus* (USA) so far was not confirmed since its DNA sequence was identical with that of the nominotypical subspecies; it might represent a phenotypic color variant. A more complex situation exists in the European genus *Euscorpius* where, in addition to three existing subgenera, a fourth one has to be introduced to preserve monophyly of all clades. DNA analysis reveals two deep clades (5.3 - 7.8 % distance) within an orophylic Alpine species *E. germanus* (Italy, Switzerland, Austria); this split follows local landscape isolation and could well predate Pleistocene glaciations. In this case, separation of two allopatric species is warranted following the phylogenetic species concept. This work was supported by the NSF Research Opportunity Award and NASA Research Initiation Grant (to V.F.).

KIRK BARNETT, MICHAEL LITTLE, AND DONALD TARTER. Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 Preliminary observations on the isozyme patterns and morphometrics of *Gambusia* sp. in the Green Bottom Wildlife Management Area, West Virginia.

Prior to 1988, two subspecies of the mosquitofish *Gambusia affinis* (*G. a. affinis* and *G. a. holbrooki*) were recognized in the warm southern waters along the Gulf and Atlantic coasts of the United States. Based upon electrophoretic and morphometric analysis in 1988, *G. holbrooki* and *G. affinis* were determined to be distinct taxa. Populations west of Mobile Bay, Alabama, were established to be *G. affinis* and those east of Mobile Bay to be *G. holbrooki*. Only two

populations of mosquitofish have been found in West Virginia: the Meadow River wetlands, Greenbrier County and the Green Bottom Wildlife Management Area, Cabell and Mason counties. Isometric focusing of glycerol-3-phosphate dehydrogenase isozyme patterns from heart, muscle, liver, and brain tissues, as well as ten morphometric characteristics were used to determine that the Green Bottom populations of mosquitofish were *G. affinis*.

JEFFREY GINGER and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755, and BRET PRESTON West Virginia Division of Natural Resources, Charleston, WV, and ERICH EMERY Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. The relationship between Ohio River bass tournament success rates, forage fish abundance, and environmental conditions.

Following low catch rates by Ohio River bass tournament anglers in 1981, 1990, and 1997, the West Virginia Division of Natural Resources (DNR) initiated a study to correlate annual variations in bass tournament success with annual river flows and forage abundance. The Ohio River Valley Water Sanitation Commission (ORSANCO), in conjunction with state and federal agencies, has collected Ohio River fish population data at lockchambers, and has measured various water quality parameters since 1957. This information coupled with Ohio River bass tournament data that the DNR has collected since 1975, and other fishery data sets, will provide an historic look into the variability of angler success. These data sets also will be used to characterize annual trends in the abundance of forage fish like gizzard shad and emerald shiners, and assess their relationship to the environmental data. Historic

angler success will then be compared to these data sets and statistically analyzed. It is suspected that cyclic patterns in forage fish abundance and weather events may affect angler success rates. The last part of the study is a characterization of the usefulness of lock chamber rotenone surveys in their ability to assess Ohio River fish populations.

BEN LOWMAN and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. Changes among Ohio River fish populations due to ecological and reproductive conditions created by high-lift dams.

Since 1957, biological data has been collected from the Ohio River by the Ohio River Valley Water Sanitation Commission (ORSANCO). Included in these data is an extensive monitoring of fish populations, which reflect many changes in the abundance of certain species. These population peaks may be associated with the construction of many high-lift dams along the entire reach of the Ohio River. Fish collections obtained through the use of rotenone, an ichthyocide, applied to navigational lock chambers and electrofishing verify that great differences in abundance exist between species found in waters raised by high-lift dams and those found in waters left shallow. Preliminary data analysis indicated that more than 25 species displayed a distinct increase in abundance or population peak during the period of dam construction. These increases may be associated with ecological and reproductive changes resulting from the vegetative habitat created by dam-expanded waters.

JASON MORGAN and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and JANET CLAYTON, West Virginia Division of Natural Resources, Elkins, WV 26241. Food habits of *Salmo trutta* and *Salvelinus fontinalis* (Pisces: Salmonidae) in relation to age, season, and mitigative liming effects in Dogway Fork, West Virginia.

Dogway Fork, a tributary of the Cranberry River in West Virginia, is acidic due to poorly buffered soils and acid precipitation. This study is part of a long-term investigation involving the effects of continuous limestone neutralization of the fishes and benthos of an acid stream. Prior to treatment (pH=4.5), no reproducing fish populations were collected in Dogway Fork. Following treatment (pH=6.0), nine species have been collected and six species have reproduced following the improvement in water quality. Densities of specific acid-sensitive benthic macroinvertebrates have increased following treatment. For the food habit study, trout were collected seasonally by electrofishing and stomach contents were removed by flushing using a bulb pipette. Benthic samples were collected in duplicates using a modified Surber Sampler. Comparisons were made between diets of brook and brown trout populations in the mitigated liming area.

TARA ROSE and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and ERICH EMERY Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. Distribution of the sucker family (Pisces: *Catostomidae*) in the Ohio River.

The sucker family (Pisces: *Catostomidae*) represents a major component of the fish fauna of the Ohio River. Because of their

considerable abundance, large biomass, and susceptibility to environmentally-induced anomalies, the 15 species of suckers found in the Ohio River will profoundly influence several of the metric components proposed for inclusion in the Ohio River Fish Index (ORFI) by the Ohio River Valley Water Sanitation Commission. To better understand the impact of the sucker family upon the index, electrofishing data collected from 1991 to 1998 were used to determine river wide distribution patterns for 14 sucker species. Most species were found in greatest numbers in the upper river; however, two species, the bigmouth buffalo (*Ictiobus cyprinellus*) and the river carpsucker (*Carpionodes carpio*), were captured more frequently in the lower river. Breeding habitat availability, stomach content, and microhabitat present throughout the river were also analyzed in order to identify the origins of these distribution patterns. Spatial distribution within navigational pools was determined for each species, and an examination of temporal distribution data obtained from rotenone lock chamber surveys and dating from 1957 showed a decrease in pollution tolerant sucker species, particularly the white sucker (*Catostomus commersonii*), with a concurrent increase in pollution intolerant species.

ANN SCHOOLCRAFT and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and DAN CINCOTTA, West Virginia Division of Natural Resources, Elkins, WV 26241. Summer food habits of the candy darter, *Etheostoma osburni*, in the Cherry River, West Virginia.

*Etheostoma osburni* is endemic to the New River drainage of West Virginia and Virginia. In West Virginia, the candy darter has been given the status of "special concern" as a result of studies showing declines or complete

extirpation of several populations. Siltation has been found to be a major threat to the habitat of the candy darter in West Virginia. On 14 July 1998, benthic samples (triplicate) were collected from the riffle areas with a Surber sampler. At the same time, 20 candy darters were collected by a backpack electroshocker. The following insect orders and genera were identified from the benthic samples:

Ephemeroptera (113)(mainly *Acentrella*, *Baetis*, *Epeorus*), Diptera (43)(mainly *Simulium* and *chironomids*), Trichoptera (14) (mainly *Ceratopsyche* and *Rhyacophila*), Plecoptera (8), and Coleoptera (5). Based on preliminary results, the following orders and genera were recorded from the stomachs of candy darters: Ephemeroptera (*Acentrella*, *Epeorus*, *Baetis*), Diptera (*Simulium*, *Phloris*, *chironomids*), and Trichoptera (*Ceratopsyche*, *Rhyacophila*).

Forage ratios were used to compare the feeding habits of the candy darter with the availability of potential food sources in the Cherry River.

TERRY TOMASEK and DONALD TARTER. Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Preliminary results on the long-term impacts of multiple seam contour mining and valley fill on water quality and benthic macroinvertebrates in a West Virginia stream.

Seam surface coal mining removes entire mountain peaks or sides. Excess rock and dirt is layered into nearby valleys thereby creating a post-mining terrain that is flat or gently rolling. Since the headwaters of many streams are located in these valleys, water quality is a central focus of the current debate in regards to this type of mining. Using rapid bioassessment protocols, this study compared historical (1987) benthic macroinvertebrate and water quality data with current (1998) data on five stations in

an unnamed tributary in West Virginia. This tributary was impacted by overburden from multiple seam contour mining activities. After approximately four years, mining operations ceased and reclamation plans proceeded on the existing valley fill. Presently, water quality and erosion/sediment controls meet WVDEP standards. The following metrics improved after mining and reclamation activities: EPT (5 to 18), taxa richness (12 to 35), taxonomic orders (7 to 11), and species diversity (1.28 to 1.88). The average percent similarity between the historical sites (5) and current sites (5) was only 27.6. These preliminary results show that the benthic macroinvertebrates and water quality responded favorably after 11 years.

MATTHEW WOOTEN and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and ERICH EMERY Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. Selection of reference sites and testing of candidate metrics for a macroinvertebrate index on the Ohio River.

Macroinvertebrate indices have long been used as water quality indicators in small streams, but due to the constraints of working with large rivers, such as the Ohio River, an index has yet to be developed. Due to the diversity of large river systems, biological indices for small streams may not be applicable. The Ohio River begins in Pittsburgh, Pennsylvania at the confluence of the Monongahela and Allegheny Rivers and flows 981 miles in a southwesterly direction where it empties into the Mississippi River at Cairo, Illinois. Macroinvertebrate samples were taken using Hester-Dendy multiplate artificial substrates. A sampler was placed every five miles for the entire length of the river and collected after a six-week

colonization period. All samples were sorted and identified to the lowest taxonomic level possible. Reference locations were selected based on the distance below effluent discharges. Statistical analysis including correlation graphs and box and whisker plots were used to determine the most descriptive metrics and best location of reference sites. Preliminary results indicated that samplers located 1 mile or more below an outfall display only slight differences among the tested metrics.

### POSTERS

BECKY EURICE, BETH YOHO,  
MICHAEL NOLL, MICHAEL GURSON,  
ALICIA NORRIS, KRISTIN OTTO,  
WENDY RUNION, RACHEL SEARS,  
Dept. of Environmental Studies, Shepherd  
College, Shepherdstown, WV 25443.  
Analysis of stream health and urban  
impact: Town Run, Shepherdstown, WV.

The purpose of this study was to determine a baseline of data on the overall health of the Town Run, a small trout stream located in Shepherdstown, West Virginia. The section of stream studied begins at the edge of the town and extends to the stream's confluence with the Potomac River, an approximate distance of 500 meters. This section was chosen as it represents two areas of significantly different degrees of environmental impact. The first area is significantly impacted by human development, is strongly channelized and exhibits all characteristics of an urban waterway. The second lies downstream from the first and consists of a stream exhibiting little human impact, significant riparian buffer, many riffles, and an overlying tree canopy. Using a multi-function Trekker system (Ward) the group was able to monitor and track parameters such as air and water temperature, pH, conductivity, turbidity and dissolved oxygen.

Macroinvertebrate counts were taken using the Save Our Streams sampling methods, and vegetation analysis of the areas were also done. Over the course of the study, evidence was found to suggest negative impact on stream water quality in the town section with astoundingly rapid improvement in water quality in waters downstream and protected from the urban impact. The conclusion supports the need and effectiveness of riparian buffering in improvement of impacted waters.

SCOTT FINCHAM, ROB STULL, DEIDRE  
VEUGDENHIL, JUSTINPISTORE, RYAN  
BARKER, Department of Environmental  
Studies, Shepherd College, Shepherdstown,  
W.Va. 25443. Analysis of stream and wetland  
health, under industrial, residential, and  
agricultural impacts: Town Run,  
Shepherdstown, W. Va.

During the Fall of 1998 a hydrological study was performed on a section of the Town Run, a trout stream located in Shepherdstown W.V., Jefferson County. The purpose of this study was to determine the overall health of the Town Run, and to find evidence of any environmental impacts. The study was performed on a marshy 100 meter section of the Town Run which is located on the property of the Freshwater Institute, approximately one half of mile south of town. This area has unique environmental impacts, including agricultural, industrial, and residential. The team studied nitrates, phosphates, dissolved oxygen, pH, conductivity, turbidity, and air and water temperature. Research was done by a wide range of field equipment, including YSI 55 Dissolved Oxygen meters, the multi-functional Trekker system, and Nitrate and Phosphate test kits by LaMotte. Research was also conducted on macroinvertebrate counts using Save Our Streams (S.O.S.) sampling guidelines. Data also include analysis of terrestrial and aquatic flora and fauna adjacent to our stream site. Our

research provided information that showed human impact on the stream, and the need for a large, vegetative riparian zone. These data collections will help in further analysis of the Town Run. Industrial runoff from railroad tracks that cross the Town Run are currently under analysis. We observed improvement of water quality as a result of the large filtration and purification taking place at the marsh site. The results of our research allow recognition of environmental impacts on the Town Run and help foresee potential problems that may occur as population continues to grow in the region.

JACK A. THOMAS, DENNIS A. BURNS, RONALD FORTNEY, and BRUCE EDINGER, Department of Bioscience, Salem-Teikyo University, Salem, 26426. A comparison of forested plant communities occurring in selected river corridors in West Virginia.

There is a broad diversity of plant communities associated with river corridors in West Virginia. Generally, vascular species composition varies greatly depending on slope aspect, geographic position, and past land use practices. This poster presents a summary of the results of a study of forested communities adjacent to highway bridges or proposed bridge locations in the Middle Fork, Tygart, Meadow, Greenbrier, and Ohio River corridors. For each site, four 0.10 ha quadrats (20 m x 50 m) were located at 100 and 300m distances from existing or proposed highway bridge sites, with a set of two quadrats on opposite slopes. Within each quadrat, tree, small tree, sapling, shrub, and herbaceous layers were each sampled using a nested plot scheme. Importance values were calculated for each species sampled for tree, small tree, and herbaceous layers. Stem counts were recorded for shrubs and saplings. Vegetation cover type

maps were prepared for each site. The species composition and importance varied among sites, generally in accordance with slope characteristics aspect and position and with past land use. Oak species, e.g., *Quercus alba* and *Q. coccinea*, tended to be dominant on dry slopes and such mesophytic species as *Betula lenta* and *Liriodendron tulipifera* were dominant on moist slopes. The dominant shrub and herbaceous species varied widely among sites. This study was funded by the West Virginia Division of Highways.

LINDA H. GEISER, Siuslaw National Forest, 4077 Research Way, P.O. Box 1148, Corvallis, OR 97339; KAREN DILLMAN, USDA Forest Service, Tongass National Forest, P.O. Box 309, Petersburg, AK 99833; STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26522; RODNEY D. SEPPELT, Australian Antarctic Division, Kingston 7050, Tasmania, Australia; GARY A. LAURSEN, Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775; JOHN C. LANDOLT, Dept. of Biology, Shepherd College, Shepherdstown, WV 25442; RICHARD V. HARRIS, National Park Service, Western Arctic National Parklands, P.O. Box 220, Nome, AK 99762; ROLAND G. TREU, Institute for Systematic Botany, University of Munich, Germany; and HAROLD H. BURDSALL, JR., Center for Forest Mycology Research, USDA Forest Service, Forest Products Laboratory, Madison, WI 53705. Lichens of Beringia.

Lichens are a conspicuous, diverse, and colorful component of the Beringian flora. Approximately 965 species in 168 genera are known from the North American Arctic. About 25% (240) have been found on the Seward Peninsula. Lichens of the tundra (e.g.,

*Alectoria*, *Bryoria*, *Cetraria*, *Cladonia*, *Cladina*, *Hypogymnia*, *Lobaria*, *Masonhalea*, *Parmelia*, *Peltigera*, *Stereocaulon*, and *Umbilicaria*) form an integral component of the Arctic food web. Both reindeer and caribou depend on lichens. During northern Alaskan winters, an adult female caribou consumes between 3.7 and 6.9 kg (dry weight) of lichens each day. Muskoxen prefer sedges and willows but also forage lichens. In winter, both tend to graze ridge tops where lichens are the primary vegetation. Moose are browsers of trees and shrubs, especially in wet habitats, but at times they will eat substantial amounts of lichens. Smaller animals and birds depend on lichens for forage and nesting material, especially the reindeer lichen, *Cladina*. Traditional uses of lichens by the Inupuit and Yup'ic peoples of western Alaska include food, fiber, medicine, and fuel. *Stereocaulon paschale*, one of the most common snow lichens on the Seward Peninsula, frequently forms vast carpets. It has been used to stuff caribou skins for rafts. *Masonhalea richardsonii*, a common vagrant or tumbleweed lichen of western Alaska, can be used for tinder. When dry, it curls up and can be carried to a new location by wind. When wet, it lays flat exposing maximum surface area to sunlight. Although slow growing, lichens tolerate harsh environmental conditions and occupy many ecological niches. (Supported by the National Park Service.)

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; YURI K. NOVOZHILOV, V. L. Komarov Botanical Institute, 197376 St. Petersburg, Russia; and ADAM W. ROLLINS, Dept. Biology, Fairmont State College, Fairmont, WV 26554. Occurrence and distribution of myxomycetes in tropical forests of Puerto Rico.

Most of what is known about the assemblages of myxomycetes (plasmodial slime molds)

associated with particular types of terrestrial ecosystems has been derived from studies carried out in temperate regions of the world. The species associated with tropical forest ecosystems have received very little study. The objective of the present study is to obtain data on the occurrence and distribution of myxomycetes in tropical forest ecosystems of the Luquillo Experimental Forest in northeastern Puerto Rico. Primary emphasis is being directed towards five different forest types (tabonuco forest, secondary tabonuco forest, palo colorado forest, palm forest, and elfin forest) that are stratified roughly by elevation. Preliminary analysis of the data represented by more than 1,200 field and moist chamber collections of myxomycetes indicates that levels of species richness and abundance tend to be highest in tabonuco forest and secondary tabonuco forest, both of which are located at the low end of the elevation gradient. By contrast, species richness and abundance tend to be lowest in elfin forest, located at the high end of the elevation gradient. As such, the general pattern observed is that of decreasing diversity with increasing elevation. (Supported by a grant from the National Science Foundation.)

KRYSTAL A. KOLOZY, STEVEN L. STEPHENSON, and MARTIN SCHNITTLER, Dept. of Biology, Fairmont State College, Fairmont, WV 26554 and ANGEL M. NIEVES-RIVERA, Departamento de Ciencias Marinas, Universidad de Puerto Rico, P. O. Box 9013, Mayaguez, Puerto Rico 00680. Myxomycetes appearing on various types of organic material collected in southern and southwestern Puerto Rico.

Although the fruiting bodies of myxomycetes (plasmodial slime molds) are most often collected from coarse woody debris and decaying leaf litter in nature, these organisms

are known to be associated with a variety of other microhabitats, including the bark surface of living trees, soil, the dung of herbivorous animals, and aerial litter (dead but still attached portions of plants). In the present study, samples of various types of organic material were collected at several localities in southern and southwestern Puerto Rico and used to prepare a series of moist chamber cultures. Among the samples of organic material cultured were decaying plant parts of several species of cacti (*Harrisia portoricensis*, *Melocactus intortus*, *Opuntia* spp. and *Pilosocereus* cf. *royeni*), iguana (*Cyclura stejnegeri* and *C. nubila nubila*), dung, dead twigs from red mangrove (*Rhizophora mangle*), tree bark, and various other types of plant debris. Among the myxomycetes recorded to date from this set of samples are *Arcyria cinerea*, *Arcyria* cf. *afroalpina*, *Badhamia gracilis*, *Cribraria violacea*, *Physarum decipiens*, *Perichaena chrysosperma*, *P. depressa*, and *P. vermicularis*. (Supported in part by a grant from the National Science Foundation.)

MARIBETH OVERKING and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; JOHN C. LANDOLT, Dept. of Biology, Shepherd College, Shepherdstown, WV 25443; BESS MORRISON and GARY A. LAURSEN, Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775.

Myxomycetes and dictyostelids associated with the soil/litter microhabitat of a forest in central Alaska.

Myxomycetes (plasmodial slime molds) and dictyostelids (cellular slime molds) are two groups of mycetozoans associated with the soil/litter microhabitat of forest ecosystems.

Most of what is known about the occurrence and distribution of these organisms has been derived from studies carried out in temperate regions of the world. During the 1998 field season, samples for isolation of myxomycetes and dictyostelids were collected from a paper birch-quaking aspen-white spruce forest located in the Bonanza Creek/Caribou-Poker Creeks LTER site (65° 09' N, 147° 29' W) in central Alaska. Ten soil/humus samples yielded a total of four species of dictyostelids and an average density of 780 clones/gram. *Dictyostelium minutum* and *D. mucoroides* were the most important species present and together represented >90% of all clones. Thirty of 36 moist chamber cultures (83%) prepared with samples of leaf litter yielded myxomycetes. *Perichaena minor* (14 collections) was clearly the dominant species present, and *Physarum bivalve* was the only other species represented by  $\geq 4$  collections. Among the other species recorded were *Arcyria cinerea*, *Cribraria violacea*, and *Didymium squamulosum*. The most unexpected result of the present study was the appearance of *Diderma miniatum* in three of the moist chambers cultures. This species was not previously known from high-latitude regions of the northern hemisphere.

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; HAROLD S. ADAMS, Div. of Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422; DAVID M. LAWRENCE, 9272-G Hanover Crossing Drive, Mechanicsville, VA 23116; JAMES S. RENTCH, Div. of Forestry, West Virginia University, Morgantown, WV 26505; ROBERT B. COXE, Biota of North America Program, UNC-CH, Chapel Hill, NC 27599; MARTIN SCHNITTLER, Dept. of Biology, Fairmont State College, Fairmont, WV



26554; MOLLY J. PRESTON, Div. of Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422; and HEATHER M. ROBERTSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Forests along the Blue Ridge Parkway south of Roanoke in southwestern Virginia.

Quantitative data on the composition and structure of the tree (stems  $\geq 10$  cm DBH) and small tree (stems  $< 10$  but  $\geq 2.5$  cm DBH) strata were collected from forest communities at ten localities along the Blue Ridge Parkway between Roanoke and Rocky Knob in southwestern Virginia. Few studies have considered the forests of this portion of the southern Blue Ridge. Forest types sampled ranged from a Virginia pine (*Pinus virginiana*) community on a xeric, low elevation site to mixed oak (with *Quercus rubra* and *Q. prinus* the most important species of oak present), tulip poplar (*Liriodendron tulipifera*), and white pine (*Pinus strobus*) communities on more mesic upland sites. Of particular interest was a Carolina hemlock (*Tsuga caroliniana*) community located on a steep, north-facing slope. Red maple (*Acer rubrum*) was consistently present as a canopy associate in most of the communities sampled, with black gum (*Nyssa sylvatica*), sourwood (*Oxydendrum arboreum*), black locust (*Robinia pseudoacacia*), black birch (*Betula lenta*), scarlet oak (*Quercus coccinea*), and pignut hickory (*Carya glabra*) also important in some situations. Mean values of density and basal area for the tree stratum were 494 stems/ha and 39.3 m<sup>2</sup>/ha, respectively.

CYNTHIA D. BRYANT and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Myxomycetes associated with aerial litter of common corn (*Zea mays*).

Myxomycetes (plasmodial slime molds) are often common inhabitants of the aerial litter (dead but still attached plant parts) microhabitat in subtropical and tropical forests. The aerial litter microhabitat is poorly represented in temperate forests, but the dead leaves of corn (*Zea mays*) plants that remain standing in fields and gardens during the fall would seem to provide one non-forest example of this type of microhabitat in temperate regions of the world. In the present study, samples of the dead leaves of corn were collected from five different study sites in Harrison, Marion, Hardy, and Grant counties in northern West Virginia during November of 1998, brought back to the laboratory, and used to prepare a series of 50 moist chamber cultures for isolation of myxomycetes. Values of pH recorded for these cultures ranged from 2.3 to 7.1 (mean = 6.1), which is an exceptionally wide range for a particular type of microhabitat. Myxomycetes recovered to date include *Didymium iridis*, *Perichaena chrysosperma*, and *Physarum pusillum*. Interesting, all of these are species commonly associated with the aerial litter microhabitat in subtropical and tropical forests.

C. BALDWIN, K. TERNEUS, D. DILELLA, AND E. VOLKER, Shepherd College, Shepherdstown, WV 25443. Methods development for ergosterol determination in environmental samples.

Ergosterol is an important fungal biomarker. We are optimizing the procedure for the extraction and quantification of this compound by HPLC from environmental sources such as leaf litter and soil. Important variables include types and sequence of extraction solvents, concentration of base used for liberating ergosterol from esterified forms, refluxing period, HPLC analysis conditions, and methods of integration of peak areas. We are also investigating internal and external standards. We have developed an analytical procedure

based on experimentation with the variables listed above. Partial support for the HPLC instrument was received from WV EPSCoR.

JOHN C. LANDOLT, Department of Biology, Shepherd College, Shepherdstown, WV 25443; S.L. STEPHENSON, Department of Biology, Fairmont State College, Fairmont, WV 26554; D.L. MOORE, Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701; G.A. LAURSEN, Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775; R.D. SEPPELT, Australian Antarctic Division, Kingston 7050, Tasmania, Australia; R.G. TREU, Institute for Systematic Botany, University of Munich, Germany; H.H. BURDSALL, JR., Center for Forest Mycology Research, USDA Forest Service, Forest Products Laboratory, Madison, WI 53705; L.H. GEISER, Siuslaw National Forest, 4077 Research Way, P.O. Box 1148, Corvallis, Oregon 97339; K. DILLMAN, USDA Forest Service, Tongass National Forest, P.O. Box 309, Petersburg, AK 99833; R.V. HARRIS, National Park Service, Western Arctic National Parklands, P.O. Box 220, Nome, AK 99762.. Beringian slime molds.

Slime molds are relatively common but understudied organisms found in association with decaying organic material in terrestrial ecosystems. Three different groups of slime molds (Myxomycetes, Dictyostelids, and Protostelids) are recognized. Myxomycetes (plasmodial slime molds) produce macroscopic fruiting bodies and thus can be observed directly in the field. Myxomycetes may also be cultured from substrate material in the laboratory. All life stages, including the fruiting bodies, of dictyostelids (cellular slime molds)

and protostelids are microscopic. Species richness is low for all three groups in high-latitude ecosystems compared with what has been reported for temperate and tropical ecosystems of the world. At least a few species tend to be present at any given locality, and some of these are often quite abundant. Prominent examples are *Mucilago crustacea* for the myxomycetes and *Dictyostelium mucoroides* for the dictyostelids. The former has a distribution apparently centered at high latitudes, while the latter is a cosmopolitan species. Myxomycetes recorded from the Seward Peninsula of western Alaska since 1994 total 49 species, representing 25 genera. Twenty-four of these species are known only from field collections, whereas 20 species have been obtained only from moist chamber laboratory cultures. Five species of myxomycetes have been recorded as both field and moist chamber collections. Only three confirmed species of dictyostelids (*D. mucoroides*, *D. sphaerocephalum*, and *Polysphondylium pallidum*), together with one or two additional different, but as yet unidentified forms have been isolated from soil and litter samples collected in western Alaska, but the total number of species known from all of Alaska is only eight. Protostelids were first reported from Alaska in 1997, and four species have been recovered from samples collected on the Seward Peninsula during the 1998 field season.

ROBIN DOLIN, BENJAMIN LOWMAN, JASON MORGAN, ANN SCHOOLCRAFT, and DONALD TARTER. Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Low pH tolerance of the central mudminnow, *Umbra limi*, from the Green Bottom Wildlife Management Area, West Virginia.

Low pH can have serious impacts on fish populations. It can change respiration, acid-base balance, and sodium and calcium regulation. The Green Bottom Wildlife Management Area, Cabell County, West Virginia, is a wetland complex adjacent to the Ohio River. Mudminnows are found in undisturbed clear-water areas of low gradient where the bottoms are of organic debris, muck, peat, and aquatic vegetation. Using a D-shaped dredge, 60 mudminnows were collected in the old swamp and returned to the laboratory for acclimation. Ten mudminnows were added to each of the following pH values: 2.0, 2.8, 3.4, 4.0, 6.0, 8.0 (control). Photoperiod was set at 12L:12D and water temperature was held at 25C. After the 96-hour experiment, the median tolerance limit (TLM) was calculated using the straight line graphical interpolation method. The 96 hour TLM pH value was 3.4, showing that the central mudminnow is extremely tolerant to acid stress. Results will be compared to other laboratory studies involving low pH tolerance values in fishes.

BRIAN CLAUTO, SARAH REAVES,  
MELISSA FRANK, PETE KINYON,  
CHANDA MASON, MARGARITA  
PROVENZANO, Dept. of Environmental  
Studies, Shepherd College, Shepherdstown,  
WV 25443. Headwaters analysis of a karst  
stream: Town Run, Shepherdstown, WV

The purpose of this study was to obtain a baseline from which the general health of the Town Run, a small trout stream in Shepherdstown, WV could be conducted. The section studied consisted of two springs that formed the headwaters at Morgans Grove Park, Approximately two miles south of town. This section consists of a flat, shallow stream channel with confluence of the springs in the center of the park. Data were obtained from five sampling sites that were distributed over a 100 meter section of the stream. Using the

Trekker System (Ward) the group monitored pH levels, temperature, conductivity, dissolved oxygen, and turbidity over a 30 day period with samples taken twice a day. A Save Our Streams analysis yielded information on the general health of the stream prior to the 30 day testing period. Under this protocol, the stream was rated fair to poor by SOS guidelines, Over the 30 days, the information obtained suggested that the stream is impacted by the activities in the park as well as the agricultural runoff from nearby farms. The in stream pH level increased as it flowed farther from its source at the spring house. Decreased pressure associated with spring emergence from subsurface caused carbon dioxide outgassing of the water and corresponding decrease in pH. Further, change in pH and dissolved oxygen was noted when comparing the immediate stream input with that from a measured distance downstream. Additional data is being gathered to further substantiate this observation.

DORA GONZALES and MARCIA A.  
HARRISON, Dept. of Biological Sciences,  
Marshall University, Huntington, WV  
25755. Growth and gravity responses in  
ethylene mutants of *Arabidopsis*.

Gravitropism, the physiological and cytological events associated with a change in orientation to gravity (gravistimulation), is regulated by light and plant hormones. The gaseous plant hormone, ethylene, inhibits cellular growth and alters orientation to gravity in plant stems and roots. In this investigation, growth and gravitropic curvature were investigated in mutant strains of *Arabidopsis* (common wall cress) which exhibit altered ethylene response or biosynthesis. Growth, crookedness (angle from vertical), and gravitropic curvature (angle after gravistimulation) were measured from 3-day-old seedlings. Cellular measurements of the elongation zones of vertical and gravistimulated roots and hypocotyls were

analyzed microscopically. Mitochondrial distribution in growing cells was determined by confocal microscopy. Roots of the *eto1-1* (ethylene overproducer) mutant exhibited significantly less growth, decreased crookedness, and less gravitropic curvature. However, *eto1-1* hypocotyl measurements were similar to wild type. These results indicate that the *eto1-1* strain exhibited ethylene-induced growth inhibition a small degree for this allele. The *ctr1-1* (constitutive triple response; short, swollen stems with horizontal orientation in dark-grown plants) mutant seedlings exhibited growth inhibition in both roots and hypocotyls. Gravitropic curvature was reduced in roots but not in *ctr1-1* hypocotyls. The *hls1-1* (hookless; a low ethylene producer with altered differential growth along the stem) mutant exhibited somewhat reduced gravitropic curvature proportional to reduced growth in both roots and hypocotyls. The altered differential growth along the stem exhibited by this mutant does not appear to affect the plant's ability to curve in response to gravity. Cellular changes during gravitropic curvature in light- and dark-grown seedlings will be discussed in terms of ethylene's effect on the pattern of cellular growth and gravitropic curvature.

BRUCE EDINGER, Department of Bioscience, Salem-Teikyo University, Salem, WV 26426. Comparison of bird diversities and densities of mitigated and natural wetlands in West Virginia.

Many new wetlands are created to offset the impact to natural wetlands that occurs during highway and other construction. It is important to assess the functional similarity of these mitigated wetlands to natural counterparts and thus evaluate the effectiveness of mitigated wetland construction methods. One important function of wetlands is to serve as habitat for

wetland dependent species. The purpose of this study was to compare avian diversity and densities of three recent mitigation wetlands with three natural or reference wetlands of similar size, with emphasis on birds which require wetlands. Transects established in six wetlands were visited in a standard fashion four times each during the breeding season and once each during fall, winter, and early spring. Bird detections were noted onto spot maps and diversity and densities calculated. Overall species diversity averaged somewhat higher for mitigated sites (48) than natural sites (42), although non-wetland birds associated with non-wetland habitat in the mitigated sites caused this result. Mitigated wetlands averaged 10.3 wetland species (range 7-14), while natural wetlands averaged 8.3 wetland species (range 7-10). Mitigated wetlands attracted red-winged blackbirds, wood ducks, green herons, mallards, yellow warblers, and common yellowthroats, species also found in the natural wetlands. Species lacking from mitigated wetlands, but found in natural wetlands, were alder flycatchers, willow flycatchers and black ducks. The lack of a shrub layer in the mitigated wetlands is probably responsible for the lack of flycatchers, and the absence of a remote location may be responsible for lack of black ducks. The Buckhannon Triangle site, a mitigated wetland, had the highest avian wetland function. It had the highest diversity of wetland birds of all six sites. Its densities of breeding wetland birds was second only to one natural wetland. These qualities of avian diversity and density are probably due to a history of the site as a natural wetland prior to disturbance, close proximity of the Buckhannon River, gallery forest between the wetland and the river, balance of areas as wetland, open water, and mud flat, and maturation time since construction. Natural or reference wetlands differed considerably in percent of shrub cover,

open water, and mode of formation, which strongly influenced bird communities present. Mitigation wetlands may be modeled after one of the several types of natural wetlands. Financial support was provided by the West Virginia Department of Transportation, Division of Highways.

DENNIS A. BURNS, BRUCE EDINGER and RONALD FORTNEY, Department of Bioscience, Salem-Teikyo University, Salem, WV 26426. Avian communities along highways associated with bridges: Comparison of bird diversity and densities of near, intermediate and distant plots.

Highway construction modifies forest communities by creating corridors of grassland, shrub, and edge habitat. Where highways cross rivers, bridge construction creates additional impacts. Few studies have compared avian diversity and populations along highways associated with bridges with control habitats some distance from the bridge. In this study, during April and June, we censused birds along 100 m transects parallel to the road established 1) down the median of the highway, 2) 100 m to the side of the highway, and 3) 300 m away from the highway. Four bridge sites, and seven sets of transects (each with 3 transects) were studied. Bird detections during six visits to each transect were written on spot maps. Comparisons of avian diversity and population densities were tabulated for 1 hectare plots associated with transects 1, 2, and 3, and larger plots associated with transects 1 and 3. Bird species diversity of highway plots averaged 7.9, while plots 100m from the highway averaged 12.1 species. Plots 300 m away averaged 10.3 species. However, 2 sets of transects showed increase in bird diversity with greater distance from the road. Another set of transects showed the opposite trend. One explanation for average diversity being highest in intermediate distance plots was that these included

grassland, shrubby edge, and woods border. The average densities of all bird species varied little as a function of distance from the highway (5.2 birds/ha along the road, 4.6/ha 100m away, and 4.9/ha 300m away). Two sets of transects showed a strong deviation from this trend. Individual bird populations were either generally more abundant near bridges, less abundant near bridges or showed little difference, as revealed by a comparison of plots within 100 m of the road and plots 200 to 400 m from the road. American robins, indigo buntings, eastern phoebes, song sparrows, and yellow warblers occurred in higher densities within 100m of roads, apparently reflecting preference for open, shrubby or edge habitat. Species with similar densities in both far and near plots were scarlet tanager, northern cardinal, red-eyed vireo, Carolina wren, and cedar waxwing, reflecting either use of multiple habitats or habitat generalization. Species found at higher densities away from the road were tufted titmouse, ovenbird, northern parula, and black-and-white warbler. These species may be edge-shy or rely on deep woodland. The relationship of bird diversity and densities to vegetation variables of herbaceous cover, shrub counts, and tree density will also be discussed. This study was supported by West Virginia Department of Transportation, Division of Highways.

JACOB OTT and BRUCE EDINGER, Department of Bioscience, Salem-Teikyo University, Salem, WV 26426. Comparison of the benthic macroinvertebrate communities of six Hardy County stream sites.

Samples of communities of benthic macroinvertebrates (BMs) are widely used to assess stream quality. Temporary degradation of water quality that might be missed by samples of physical or chemical parameters can be indicated by changes in the BM community,

since BMs have long life spans and residence and are affected by cumulative impacts. The purpose of this study is to determine the baseline water quality conditions of six stream locations in Hardy County, and to evaluate whether these streams are of suitable quality to serve as monitors of possible degradation associated with future road construction. Fall and spring samples were collected from riffle areas using a 500 micron mesh kick net and preserved. One hundred individual subsamples were identified to genus (except for chironomids) using EPA rapid bioassessment protocol. These data were used to calculate several indexes of invertebrate community integrity. The diversity of Ephemeroptera, Plecoptera, and Trichoptera genera (generally pollution intolerant orders) averaged 9.3, and ranged from six to 14. The proportion of each sample that was in either Ephemeroptera, Plecoptera, or Trichoptera averaged 0.75 and ranged from 0.33 and 0.99. The Hilsenhoff Biotic Index (HBI) creates a weighted average, the number of individuals in each genus is multiplied by the genus' tolerance for disturbance, and an overall average tolerance value is calculated. The HBI for these sites averaged 3.03 (scale from 0-10), and ranged from 2.39 to 3.81. These values correspond to assessment of either non-impacted or slightly impacted, depending upon the index. Close monitoring of one or two sites may be needed to ensure they do not slip into a more heavily impacted category. The relationship of these benthic macroinvertebrate indices to season, stream flow, pH, conductivity, calcium and chlorides will also be discussed. This study was supported by West Virginia Department of Transportation, Division of Highways.

CYNTHIA D. BRYANT and MARK R. FLOOD, Biology Dept., Fairmont State College, Fairmont, WV 26554.

Determining the response of frog embryonic cells to benzo[a]pyrene exposure.

Animals' are constantly struggling to rid their bodies of foreign compounds and internally produced molecules. Benzo[a]pyrene (BaP) is a byproduct of organic compound combustion, such as occurs daily in our use of fossil fuels. Therefore, it is a model toxicant because it is an ubiquitous compound animals come into contact with daily. BaP binds to and causes breakage of chromosomes. This causes abnormal cell growth, and can lead to the formation of cancerous tumors. Among the many ways animals detoxify molecules like BaP is a group of enzymes called the UGTs (uridine diphosphate glucuronosyltransferases). UGT expression could be critical to the survival of embryos that develop outside of the mother. A better understanding of whether UGTs are expressed in response to exposure of foreign materials is important to establish the best way to protect embryos during many critical development periods. The objectives of this project were to determine 1) if UGT DNA is present in frog cells; and 2) if UGT mRNA is produced by frog embryonic cells in response to BaP exposure. In order to test objective one, genomic DNA was extracted from both frog embryonic cells and adolescent liver samples. Then 20 ug of this DNA was transferred to a charged nylon membrane and hybridized with a UGT-specific probe. To test the second objective, RNA was extracted from frog embryonic cells (ATCC # CCL128) exposed to  $10^{-4}$  Molar BaP for five days. Then 20-30 ug of total RNA was transferred to a charged piece of nylon membrane and hybridized with a UGT-specific probe. Hybridization results indicate that UGT-specific DNA is present in frog cells. In addition, frog embryonic cells produce UGT-specific mRNA in response to BaP

exposure. Therefore, frog cells contain UGT genes that can be specifically expressed in response to harmful environmental pollutants. Whether the level of expression is high enough to provide sufficient protection to the cells remains to be determined. This research was partially funded by the NASA WV Space Grant Consortium.

MELISSA L. BAKER and MARK R. FLOOD, Biology Dept., Fairmont State College, Fairmont WV 26554. Partial cDNA sequence determination of UDP-glucuronosyltransferases from an ethanol-induced liver.

Phase II enzymes, including the UDP-glucuronosyltransferase (UGT) enzymes, can be induced by various drug treatments. Previously, an ethanol-induced rabbit UGT enzyme has been identified and characterized (Hutabarat and Yost, Arch. Biochem. Biophys. 273:16, 1989). We report here the isolation and cloning of cDNA clones for an UGT expressed during the ethanol-induced state. The ethanol-induced state was accomplished by the treatment of a male New Zealand White rabbit with 10% ethanol:90% water solution for 14 days prior to tissue collection. Total RNA was isolated from liver samples via standard guanidium thiocyanate extraction procedures. mRNA was isolated from a Poly (A) Quik™ (Stratagene) oligo dT column. Northern blot hybridizations with a 51 bp oligonucleotide, corresponding to a UGT conserved region, indicated that there were higher levels of UGT mRNA expression with ethanol-induced animals than control animals. A rabbit liver cDNA library was constructed from the ethanol-induced liver mRNA using a ZAP-cDNA synthesis kit (Stratagene). The library was screened using a UGT-specific oligonucleotide. After tertiary screening, positive clones were packaged into a bluescript vector and placed into XL1-Blue cells using an

*in vivo* excision protocol. XL1-Blue cells containing the vector and insert were then subjected to a plasmid DNA preparation. Double-stranded plasmid cDNAs have been partially sequenced. The sequencing data and comparison to other known UGT clones will be presented. Future work will center around determining the function of the expressed proteins from full-length cDNA clones and also to obtain a full-length cDNA clone of an ethanol-induced UGT. The UGT clones we are isolating may correspond to a constitutively expressed UGT that is induced by consumption of ethanol. The UGT enzymes are responsible for metabolism of various therapeutic drugs in humans, and changes in metabolism could be a concern to individuals who consume ethanol while on some drug treatment regimes.

DONNA SIMS, GARRY GLASPELL, CHANDA RANJIT, JIM WEEKLEY and ERICA HARVEY, Dept. of Chemistry, and MARK FLOOD, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. High performance liquid chromatography analysis of benzo[a]pyrene and possible metabolites in frog embryonic cells.

Frog embryo cells exposed to the environmental pollutant benzo[a]pyrene (BaP) previously have been shown to experience inhibited growth. In the present work, extracts from the cultured cells are subjected to analysis by high performance liquid chromatography (HPLC) to verify the presence of incorporated BaP and to search for possible metabolites of the toxin that could indicate the presence of a detoxification method in the embryo cells. Detoxification enzymes called uridine diphosphate glucuronosyltransferases (UGTs) are known to produce oxygenated derivatives of BaP in mammalian cells and have been found in adult frogs, but the role of UGTs in detoxification of embryos has not been defined.

Using adaptations of a literature method for BaP metabolite analysis of fish liver endoplasmic reticulum, the BaP-exposed frog embryo cells are extracted with ethyl acetate and the extracts dried over MgSO<sub>4</sub>. Upon redissolution in methanol, the extracts are injected onto a 4.6 x 250mm YMC (S5 micron particle size) column at 33 °C. A linear gradient of 65% of aqueous methanol changing to pure methanol is used to separate BaP and its metabolites. Initial experiments verify that BaP is incorporated within the cell and do not indicate the presence of large amounts of metabolites. Very small peaks visible in the chromatograms of the cell extracts will be further investigated using fraction collection and gas chromatographic-mass spectrometric analysis to determine their composition. Detection limits for BaP and suspected metabolites will also be determined. This work is supported by a NASA WV Space Grant.

BETH THOMPSON, GARRY P. GLASPELL, MATTHEW SCANLON and ERICA HARVEY, Dept. of Chemistry, Fairmont State College, Fairmont, WV 26554. Using NMR titrations to determine association constants for a series of neutral anion receptors with various tetrabutylammonium salts.

Using NMR titration techniques, association constants for the complexation reactions of a series of neutral anion receptors were determined. The data were obtained by observing peak shifts in the proton and c-13 spectra for solutions in which the anion to receptor ratios were varied. Iterative calculations were performed using a Mathcad template. These values were used to determine which receptors were able to cage anions most effectively.

CHRISTOPHER HORSTKEMP, GLEN OLIVERA, KATA RISHHEL, APRIL SHIMP, RENEE YOST. Dept. of Physical Sciences, Shepherd College, Shepherdstown, WV 25443. Modified techniques for taxonomic analysis of Fenestrate Bryozoa.

In this project a taxonomic analysis of Fenestrate Bryozoa, colonial marine invertebrates of Paleozoic age, was undertaken. Whole colonies were photographed and documented as to colony age, location, and preservation. Once photographed and input into the digital imaging system, the samples were embedded in epoxy and through a process of grinding, polishing, etching, and making an impression of this etched surface in acetate peel interior colony analysis was undertaken. Peels representing a three-dimensional view of colony interiors were then employed to reconstruct autozoecial chamber shape and dimension. Quantitative and descriptive distinction between zoarial and zooecial characters (Snyder 1991) was employed in specimen analysis and subsequently in taxonomic placement. Methodology of reconstruction involved the use of a scope mounted digital camera, allowing direct input of images, with need for time consuming photographic analysis greatly reduced. The availability of data storage allows incorporation of volumes of data not practical with traditional methods; thus allowing direct visual and quantitative comparison of the fossils herein analyzed by other bryozoan workers. Measurements were taken using the freeware program NIH Image. Presentation will focus on the benefits of this technique as well as reconstruction of the colony.

ROSA LEE MILLER, BRANDY DORSEY, KIRK CAMMARATA, AND



RONALD FORTNEY. Bioscience Dept, Salem-Teikyo University, Salem, WV, 26426. Baseline water chemistry analysis for assessment of Corridor H highway construction impacts.

Water chemistry monitoring in ten West Virginia streams and a bog is providing baseline data for assessment of impacts on stream ecosystems from a major highway construction project (Appalachian Corridor H). A preconstruction ecological baseline will establish the basis for pre- and post-construction comparisons. Our sampling regime was developed with two impact models: one for perpendicular highway crossings and a second for parallel construction of the roadway in the headwaters (Cumulative Model). The sampling regime and assay protocols are described in *Proceedings of the West Virginia Academy of Science*, 70:1 (1998). Results are presented from monthly sampling over a period of approximately 1 year for 5 streams (Waites Run, Baker Run/Long Lick, upper Lost River in Hardy County, and Pheasants Run and Big Run/Big Run Bog in Tucker County). At Big Run Bog, all flowing tributaries and the bog outflow were monitored. For the eastern streams, pH generally varied between 7 and 8.7. Conductivity and alkalinity were 30-240  $\mu$ S and 20-120 mg/L, respectively. Observed calcium levels were 10-85 mg/L. Values at the high end of these ranges were established by samples from Lost River. Anion levels were generally less than 15 mg/L and 12 mg/L, respectively, for chloride and sulfate. However, Long Lick consistently exhibited higher chloride levels (5-45 mg/L). Total dissolved iron ranged between 0.05-0.2 mg/L. Water chemistry for these streams showed seasonal fluctuations which correlated with stream flows. A progression of the water chemistry was observed for samples from 6 locations along the Baker Run/Long Lick watershed where the Cumulative Impact Model

applies.

Pheasants Run exhibited characteristics similar to the eastern streams (pH 7-8.5, <10 mg/L chloride and sulfate, 35-110  $\mu$ S for conductivity, 15-55 mg/L alkalinity, and <0.08 mg/L iron). Big Run Bog and its tributaries were characterized by pH 4-5, conductivities of 20-60  $\mu$ S, iron < 0.2 mg/L, and chloride below 2 mg/L. Interestingly, the water exiting Big Run Bog consistently showed elevated levels of iron as high as 2 mg/L, but without a corresponding increase in the conductivity. This result suggests an unidentified source of iron entering the bog. Big Run, which is not a tributary to the bog, exhibited characteristics similar to the bog except for elevated chloride (5-12 mg/L) and conductivity (50-70  $\mu$ S). A source for the chloride was traced to the headwaters of Big Run where levels exceeded 40 mg/L. Results indicate that the chosen streams are, in their preconstruction state, healthy and suitable for assessing the impacts of highway construction.

TERRI HOLT and JAGAN VALLURI.  
Division of Biological Sciences, Marshall University, Huntington, WV 25755.  
Characterization of molecular responses in gravistimulated pea stems.

The objective of this project is to investigate the changes in gene expression after gravistimulation (change in orientation to gravity) in etiolated pea seedlings. Gravistimulation alters the pattern of cellular growth along the stem resulting in a characteristic upward gravitropic curvature. These changes in cell growth are necessarily linked to enzymatic activities in the cell wall which facilitate loosening of the matrix and increase elasticity in growing cells. Analysis of the soluble cell wall and cytoplasmic proteins during gravitropic curvature was investigated using SDS-PAGE gels. For protein labeling, 4 seedling shoots were diced into 2 mm pieces

and incubated at approximately 23<sup>0</sup> C for 1.5 h in 50  $\mu$ l of water containing 150  $\mu$ ci of <sup>35</sup>S-methionine (1100 Ci/mmol; ICN). After labeling, tissue was washed with cold 1mM methionine. Tissue was then homogenized in ice-cold 50 mM Tris-HCl buffer (pH 8.65), containing 20 mM KCl and 10 mM MgCl<sub>2</sub>. The slurry was centrifuged at 13,000 g for 15 min and the supernatant was collected for protein analysis. Incorporation of label into protein was determined by scintillation counting after precipitation in 10% TCA. *In Vivo* synthesized proteins were separated on one-dimensional gels as described by Laemmli. Preliminary analysis of cell wall proteins separated by SDS-PAGE and silver stained revealed 23 extracellular proteins ranging from 10-150 kD in size.

SARA MAENE, M.S., Dept. of Physical Sciences, Shepherd College, Shepherdstown, WV 25443; JASON BEST, Ph.D., Dept. of Physical Sciences, Shepherd College, Shepherdstown, WV 25443. Three-dimensional modeling of galactic distributions using virtual environments.

The Space Sciences Group at Shepherd College is initiating the use of virtual environment technologies at the College by bringing to life the distribution of galaxies within nearby galaxy clusters, as well as the larger-scale distributions of galaxies within the Universe. A demonstration of this work is presented. This work is performed in conjunction with efforts to explore the fractal nature of the distribution of galaxies throughout the universe. Three-dimensional visualizations and simulations of data are invaluable tools in modern scientific ventures. Seeing representations of objects in three dimensions allows visual evaluation, and subsequently provides a deeper understanding

of the physical situations underlying observational and mathematical results. This technology has applications in many areas of science, such as environmental sciences (e.g. models of the Chesapeake Bay), chemistry (e.g. molecular models), biology (e.g. anatomical structure visualizations), and engineering (structural analysis). All simulations are constructed using Virtual Reality Modeling Language (VRML) on a Silicon Graphics O2 workstation. Support for this work has been generously provided by grants from the National Science Foundation, the National Aeronautics and Space Administration, the West Virginia Governor's Office of Technology, and the West Virginia Experimental Program to Stimulate Competitive Research.

