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Abstracts  
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## ABSTRACTS 1997 ANNUAL MEETING

### BIOLOGY

CRAIG W. STIHLER, West Virginia Division of Natural Resources, Elkins, WV 26241, JACK L. WALLACE, WVDNR, Elkins, WV 26241, EDWIN D. MICHAEL, Division of Forestry, West Virginia University, Morgantown, WV 26506, and HARRY PAWELCZYK, U.S. Forest Service, Monongahela National Forest, Elkins, WV 26241. The range of the endangered northern flying squirrel, *Glaucomys sabrinus fuscus*, in West Virginia.

A subspecies of the northern flying squirrel, *Glaucomys sabrinus fuscus*, was added to the federal list of endangered species in 1985. At that time, this subspecies was known from 10 specimens collected in West Virginia (Randolph and Pocahontas counties) and 2 specimens from Highland County, VA. Surveys (nest box monitoring and live-trapping) conducted in West Virginia from 1985 through mid-1996 yielded 769 *G. s. fuscus* captures at 81 sites (many with multiple capture locations) in six counties (Greenbrier, Pendleton, Pocahontas, Randolph, Tucker, and Webster). Squirrels were captured at elevations ranging from 872m near Mountain Lick Creek, Pocahontas County to 1417m on Red Spruce Knob, Pocahontas County; however, the subspecies may reach its greatest elevation on Spruce Mountain, Pendleton County, where it has been captured at 1414m and suitable habitat occurs to near the top of Spruce Knob (1426m). This squirrel is associated with red spruce (*Picea rubens*) and northern hardwood forests (usually a mixture of the these two forest types). Hemlock (*Tsuga canadensis*) is often a habitat component, especially where red spruce is scarce. In West Virginia, this squirrel's range extends southwestward, following the Allegheny Mountains, from Canaan Heights and the western edge of the Dolly Sods Wilderness Area (both in Tucker County) in the north to Briery Knob (Pocahontas County) and Rabbit Run (Greenbrier County) in the south. Southern flying squirrels (*G.*

*volans*) were captured at 19 (23.5%) of the sites where *G. s. fuscus* was found.

CRAIG W. STIHLER, West Virginia Division of Natural Resources, Elkins, WV 26241. Bats of the Fernow Experimental Forest, Tucker County, West Virginia.

During the winter, five species of bats, including the federally endangered Indiana myotis (*Myotis sodalis*), have been documented hibernating in Big Springs Cave on the Fernow Experimental Forest, Tucker County, WV. The present study examined bat activity at the cave entrance and within 2.0km of the cave from April through November 1995. A total of 1054 bats of 9 species were captured; 859 were trapped at the cave entrance, and 195 were captured in mist nets set at six locations. Species captured, in decreasing order of abundance, were: *M. lucifugus* (N=363), *M. septentrionalis* (N=307), *Pipistrellus subflavus* (N=237), *M. sodalis* (N=69), *Lasiurus borealis* (N=51), *Eptesicus fuscus* (N=18), *L. cinereus* (N=4), *Lasionycteris noctivagans* (N=4), and *Corynorhinus townsendii virginianus* (N=1). Sex, weight, and forearm length data were collected. This study produced the first summer records of *M. sodalis* in West Virginia: 1 in June, 5 in July, and 10 in August. Because only males were captured in June and July, there was no indication that maternity colonies existed in the immediate vicinity. To identify recaptured individuals and to help determine movements between summer habitats and winter roosts, over half of the captured bats (N=585) were banded using either yellow plastic bands or numbered aluminum bands. On 23 February 1996, a bat survey in Big Springs Cave located 990 bats of four species; 110 were individuals that had been banded during the previous summer. Banded bats in the cave represented 11% of the *P. subflavus* banded during the study; 36% of the banded *M. lucifugus*, 86% of the banded *M. sodalis*, and 2% of the banded *M. septentrionalis*.

MICHAEL C. DEMCHIK, Environmental



Resources Research Institute, The Pennsylvania State University, University Park, PA 16801 and MICHAEL J. DEMCHIK, Jefferson High School, Rte 1, Box 83, Shenandoah Junction, WV 25442. The effect of soil horizon on *Quercus rubra* growth.

Soil horizon below the organic matter in western Pennsylvania have low levels of soil bases and high levels of toxic aluminum. A high school class in Jefferson County, West Virginia planted germinating *Quercus rubra* (red oak) acorns in 10 cm plastic pots in three blocks with six replicates of five soil horizon combinations: organic layer, A-horizon, B-horizon, layered organic/A/B horizons and layered A/B horizons. The oaks planted in the organic layer and the layered organic/A/B horizons tended to grow to a larger final size (leaf area and number of leaves) than the other treatments taken as a whole. No difference in height growth and no mortality was found. This suggests that while red oaks grow more quickly (at least during part of the season) in the organic soil layer, they can still avoid mortality in the mineral soil horizons (in this idealized laboratory experiment). These results are supported by field observations in high disturbance areas.

REBECCA J. BLEVINS and ERIC A. E. GARBER, Department of Chemistry, West Virginia State College, Institute, WV 25112-1000. Anaerobic bacterial tolerance and reduction of arsenate in soil near a coal-burning plant near Parkersburg, WV.

Arsenic in its most common stable, soluble inorganic form is arsenate. Arsenate is similar to phosphate in structure and therefore can substitute for it in biological pathways. The ADP-arsenate compound is unstable and readily hydrolyses uncoupling ATP synthesis in oxidative phosphorylation. Arsenate is released into the environment by the burning of fossil fuels, the smelting of metals, and the use of arsenic containing pesticides.

The wide use of arsenic containing pesticides in farming during the early part of the century has poisoned the groundwater and has made it a health concern today in Lingerwood, ND. Remediation is needed in order to restore clean water stores. Understanding the chemistry and bioenergetics of how arsenic-resistant bacteria survive in high levels of arsenic could potentially lead to cost effective remediation techniques. Some arsenic-resistant bacteria reduce arsenate to arsenite. It has been proposed that under anaerobic conditions arsenic compounds could substitute for terminal electron acceptor in oxidative phosphorylation. Anaerobic bacteria resistant to arsenate from twenty different sites near a coal-burning plant in Parkersburg, WV have been isolated. The tolerance level of the isolates towards varying concentrations of arsenate on agar plates and in liquid media will be measured. Gram stains will be done to indicate variability of surviving bacteria. Growth rates will be determined along with their ability to catalyze the reduction of arsenite. The colorimetric procedure of Lakso et al. (1979) will be used to confirm the production of arsenite.

TIMOTHY R. BROPHY and THOMAS K. PAULEY, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Notes on the life history of the southern two-lined salamander, *Eurycea cirrigera*, in West Virginia.

Studies were conducted during the spring of 1994 at a first-order stream in Wayne County, West Virginia to determine population density, range of horizontal movements, and reproductive characteristics of *Eurycea cirrigera*. Population density was 0.77 salamanders/m<sup>2</sup> and horizontal movements ranged from 1.1 m to 32.6 m. Adult males had an average snout-to-vent length (SVL) of 42.75 ± 2.59 mm and adult females had an average SVL of 42.29 ± 1.38 mm. Males had significantly wider heads and lacked well-developed cirri.

BETH A. PAULEY AND THOMAS K.



## ABSTRACTS 1997 ANNUAL MEETING

PAULEY, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Range and distribution of the Cheat Mountain salamander, *Plethodon nettingi*: an update.

The original range of the Cheat Mountain salamander was thought to only include the Cheat Mountain Range. Subsequent surveys have shown that it occurs from Backbone Mountain in the north to Back Allegheny Mountain in the South. The habitat was first described as a red spruce forest with a *Bazzania* floor above 3,500 ft. Recent studies have shown that there are 59 disjunct populations in Grant, Pendleton, Pocahantas, Randolph, and Tucker counties and the habitat varies from red spruce to mixed deciduous species and extends to elevations as low as 2,640 ft. Recent studies have also shown that forest fragmentation is detrimental to this Federally threatened species.

KAREN MORRIS, ANDREA ALLEN, KATHIE HESS & MARK CHATFIELD, Dept. of Biology, West Virginia State College, Institute, WV 25112. Studies on *Thiobacillus ferrooxidans*: an acidophilic, iron oxidizing bacterium associated with acid mine drainage.

*Thiobacillus ferrooxidans* is a small, rod-shaped bacterium that has been identified as a major producer of the sulfuric acid associated with acid mine drainage. The focus of this study is to understand the biology and genetics of *T. ferrooxidans* in an effort to establish possible methods to control acid mine drainage that are both economically and ecologically effective. Laboratory manipulation has been difficult because growth on solid media like agar or agarose is inhibited due to organic contaminants in the gelling agent. Also, due to the extreme acidic conditions needed by *T. ferrooxidans*, changes in microbiological protocols have been necessary because acidifying the gelling agents changes their physical properties and handling characteristics. A medium named Tf-1 was formulated by modifying the American Type Culture

Collection liquid medium #64 by the addition of a trace metals solution and Phytigel (gellum gum) as a gelling agent. The same medium was made with agar and agarose. The effects of concentration and composition of gelling agent on growth were compared and Phytigel was found to promote a faster growth rate. The distribution of *T. ferrooxidans* in native waters was determined by sampling numerous WV streams. This resulted in a collection of wild strains that are being characterized by traditional morphology and biochemical techniques. A nucleic acid based PCR tagging of *T. ferrooxidans* (FeII) oxidase protein is being developed to facilitate identification of these wild strains. Data will be presented on work in progress using the Tf-1 medium to screen the wild strains for plasmids and viruses.

GRANT PARKINS, VERNON FLETCHER AND MARK CHATFIELD, Depts. of Chemistry & Biology, West Virginia State College, Institute, WV 25112. Purification of thidiazuron from the agricultural product Dropp.

Thidiazuron (N-phenyl-N'-1,2,3-thiadiazol-5-ylurea) is a synthetic, cotton defoliant that has potent cytokinin activity. Cytokinins are a group of plant hormones that have numerous biological effects on plant growth and development. Thidiazuron (TDZ) has been incorporated into plant tissue culture and plant regeneration protocols that require significant quantities of purified TDZ. The current market value of TDZ make its use in these applications quite expensive. We have developed a purification of TDZ from the cotton defoliant Dropp (Agrevo USA, Inc. Wilmington, DE) which is 50% TDZ and much more reasonably priced. The method involves dissolution in dimethyl sulfoxide, followed by filtration to remove wettable clays and other contaminants that are insoluble. The addition of water causes precipitation of TDZ which is then collected by vacuum filtration. The impure tan powder is dissolved in hot ethanol, treated with charcoal, filtered and cooled to produce colorless crystals in good yield. Results of the physical



characterization by NMR, IR, UV spectra and biological characterization will be presented.

## **BOTANY**

DAN K. EVANS, Herbarium, Marshall University, Huntington, WV 25755. Hallucinogenic plants used in healing among indigenous people of southeastern Ecuador.

Indigenous Shuar and Achuar occupy a large part of southeastern Ecuador. Modern medicine is well established in the area and is supplemented by a variety of traditional plant medicines. Brujos practice traditional healing by invoking the spirit world while under the influence of hallucinogens from plant sources. Sources of psychoactive drugs from the Malpighiaceae are *Banisteriopsis caapi* (stems) and *Diplopterys cabrerana* (leaves). Additional sources of hallucinogens are harvested from members of the Solanaceae including *Brugmansia suaveolens* (stem bark), *Nicotiana tabacum* (green and cured leaves) and *Brunfelsia* sp. (leaves and stem bark). All taxa are commonly cultivated near traditional houses. During a healing session observed in 1996, stems of *Banisteriopsis* were combined with leaves of *Diplopterys* and water and boiled down to a brown, sticky residue. In addition, green tobacco leaves were crushed in water producing a viscous, green liquid. Further, green tobacco leaves were cured over an open fire and fashioned into cigars. At the beginning of the healing session the brujo drank the malpighiaceae mixture, aspirated the tobacco liquid from the palm of his hand and profusely inhaled smoke from the cigars. Under the influence of these materials he commenced the healing session involving an elderly woman suffering from partial blindness. Details of the healing session will be described.

JASON BARNETT, JAGAN V. VALLURI, AND H. WAYNE ELMORE, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Protein synthesis and ethylene biosynthesis in sandalwood callus

cultures exposed to drought and heat shock.

Plant cell cultures exposed to environmental stress conditions synthesize a unique group of stress proteins. These proteins seem to play a role in protecting the plant cell. 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. A group of rapidly growing sandal calli were exposed to elevated temperatures ranging from 32 to 45°C. Another group of calli were subjected to low water potentials ranging from -0.4 MPa to -2.5 MPa. Protein synthesis induced by heat shock and drought stress were assessed by SDS-polyacrylamide gel electrophoresis. After 48 h of exposure to stress, a 30% reduction in callus volume was observed in both groups of calli. *In vivo* labeling of stressed tissue with <sup>35</sup>S-methionine revealed a diverse array of low molecular weight proteins on SDS-PAGE gels at 36, 40 and 45°C 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. Measurements of ethylene precursors ACC and MACC levels in heat shocked tissues were used to determine changes in ethylene biosynthesis. ACC levels increased as the cells were exposed to higher temperatures of 36 and 42°C. It has been observed that MACC does accumulate when high rates of ACC synthesis was induced by elevated temperature.

PAUL J. HARMON, West Virginia Natural Heritage Program (WVHP), Division of Natural Resources, P. O. Box 67, Elkins, WV 26241. The West Virginia Flora and Fungi Herbaria Database System, the Flora West Virginia Project, and production of checklists and preliminary atlases of angiosperms, fungi, and bryophytes.



## ABSTRACTS 1997 ANNUAL MEETING

The purpose of the West Virginia Flora and Fungi Herbaria Database System (FFHDS) is to electronically organize floristic and fungal specimen label information, distribution data, species characterization data, and bibliographic data that could be used to support conservation work in West Virginia. The system uses an application program, developed within Foxpro relational database system, by Paul J. Harmon of the WVHP. The relational database system enables the production of curatorial products using data that are automatically available from other databases. For example, when one produces specimen labels, the system checks to see that the taxon entered is within the current checklist database, provides a pop-up of county names, quadrangle names, and past collectors' names. Botanists and mycologists associated with the Flora West Virginia Committee (FWVC), and/or WVHP have used or are currently using the FFHDS to produce *Checklist of the Vascular Flora of West Virginia*, *Checklist of the Wetland Vascular Plants of West Virginia* (Harmon, 1996), *Preliminary Checklist of Macrofungi Including Myxomycetes of West Virginia* (Steve Stephenson, FWVA, and Bill Roody, WVHP), *Preliminary Checklist of the Bryophytes of West Virginia* (Steve Stephenson, FWVA, Susan M. Studlar, WVA, and Thomas E. Weeks, MUHW, in progress), *Atlas of the Rare Plant Taxa of West Virginia* (Harmon, in progress), and *Preliminary Atlas of the Vascular Flora of West Virginia* (all FFHDS cooperators, in progress). John Kartesz and Amy Farstad (Biota of North America Program, UNC) scanned existing dot-map cards from WVA (created by Betty Bartholomew, formerly of WVA, now deceased, and Linda Rader, formerly of WVA, currently Asst. Curator of NEB), converting county dots into an electronic format that could be incorporated into the FFHDS. A draft preliminary atlas was produced. Specimen label data from WVA, MUHW, WVW, WVHP and other herbaria outside WV, are being entered into curatorial record databases, and used to automatically up-date the atlas database. Using FFHDS, herbarium specimen labels are more easily produced, and more accurate

distributional data are becoming available for systematic and conservation work. The FWVC, and WVHP, continue to up-date the distributional information in support of the revision of Strausbaugh & Core's classic manual, *Flora of West Virginia*. It is hoped that the first volume of the revision, the Class Liliopsida ("monocots"), will be published by the end of 1997.

NICHOLAS P. BELMONT, West Virginia Graduate College, South Charleston, WV 25305 and RONALD H. FORTNEY, Salem-Teikyo University. A comparison of the annual productivity values in three constructed wetlands and three similar naturally occurring wetlands in West Virginia.

During the past five years, the West Virginia Division of Highways (DOH) has constructed or is in the process of constructing nine wetlands to mitigate the loss of naturally occurring wetlands resulting from highway construction. Based on current plans, additional wetland construction will occur. This study, which is part of a larger multidisciplinary evaluation of the functional development of wetlands constructed by the DOH, focused on the annual primary productivity in DOH-constructed wetlands in north central West Virginia. Three constructed wetlands (two of which were four-years old and one was one year old) and three naturally occurring reference wetlands, all with similar permanent emergent vegetative cover and hydrologic regimes and within the same watershed, were studied during the 1996 growing season. In each wetland, two to six permanent 0.1 ha quadrats were established within an area of more or less uniform habitats. Ten 1 m<sup>2</sup> plots were established at regular intervals along the center line of each quadrat to quantitatively sample the vascular plant vegetation to yield species importance (IV = relative cover + relative frequency/2) for each species. Four of the ten 1 m<sup>2</sup> plots in each quadrat were randomly selected and a 1 m<sup>2</sup> subplot was placed 1 meter to the right of each plot. The



vascular vegetation in each subplot was placed 1 meter to the right of each plot. The vascular vegetation in each subplot was quantitatively sampled to yield species importance as in the 1 m<sup>2</sup> plots, and then the aboveground vegetation was harvested, placed in paper bags, oven dried at 65<sup>o</sup> C for an average of four days, and weighed. Harvesting was complete between early and mid-August. To correlate productivity with edaphic factors, several biogeochemical parameters were analyzed, including concentrations, pH, percent organic matter, and base exchange capacity. Soil samples were taken at 3-4 randomly selected locations approximately 1 m<sup>2</sup> plots in each quadrat. The values for average annual primary productivity determined for the three constructed wetlands were 524.75, 596.89, 573.30 g/m<sup>2</sup>/yr, with a range of 160.18 to 1,506.48 g/m<sup>2</sup>/yr in individual subplots. For the three reference sites, the values were 596.89, 828.76, and 816.25 g/m<sup>2</sup>/yr, with a range of 393.48 to 1,735.98 g/m<sup>2</sup>/yr in individual subplots. In general, the reference wetlands had the highest productivity values as well as the larger range of values. The quadrats with the highest productivity in both the constructed and reference sites were dominated by *Leersia oryzoides* or *Typha latifolia*. In all cases, the reference wetlands had the lower pH. Values and the higher percent of organic carbon. The constructed wetlands generally had the higher calcium concentrations, which is likely related to lime applications during construction. The results indicate that primary productivity in four-year old constructed wetlands were less than that of comparable natural wetlands, which is probably related to several edaphic factors, including relatively low percent of organic carbon.

#### CELLULAR MOLECULAR

ANGELA COOK, HEATHER MELLERT,  
JONETTE WEBB & MARK  
CHATFIELD, Dept. of Biology, West  
Virginia State College, Institute, WV  
25112. Construction of an antisense

ascorbate peroxidase gene cassette for  
assessment of function within the soybean  
root nodule system.

Nitrogen fixation in legume root nodules is where the defense against active forms of oxygen, like hydrogen peroxide is critical. Ascorbate peroxidase (AP) is one enzyme that scavenges hydrogen peroxide. We report here the construction of an antisense AP gene vector that will be used to reduce AP gene expression in soybean root nodules, hopefully allowing us to study the true need of this enzyme in nitrogen fixing root nodules. Mismatched primer PCR amplification of an AP gene (derived from pAP750) was used to introduce flanking restriction sites in the AP gene facilitating the placement of the antisense strand of AP adjacent to the regulatory regions that control gene expression. The chimeric gene produced contained the Cauliflower mosaic virus promoter (CaMV) and the nopaline synthetase termination region (NOS) flanking the antisense strand of the soybean AP coding sequence. This gene construction, when placed in the appropriate vector followed by insertion into soybean cells, should be expressed constitutively. One such suitable reporter vector to insert the antisense AP construction is pDusty. It was created by replacing the bacterial -glucuronidase (GUS) gene in pBI121 with a GUS intron gene developed by Vancanneyt et al., 1990. Mol. Gen. Genet. 220: 245-250. We plan to use an *Agrobacterium*-mediated transformation system to shuttle the reporter vector into soybean roots followed by inoculation with *Bradyrhizobium* to form transgenic root nodules. So using a GUS-intron containing reporter gene that cannot be excised properly by *Agrobacterium* or *Bradyrhizobium* will prevent GUS gene expression in the bacteria because the proper gene reading frame cannot be restored. Soybean transformation experiments with this AP antisense, pDusty binary reporter vector are in progress. This ongoing research is supported by National Science Foundation grant IBN-9206453.



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### CHEMISTRY

MICHELLE L. TAYLOR and MICHAEL J. PANIGOT, Department of Chemistry, West Virginia State College, Institute, WV 25112-1000. Effects of enhanced leaving group ability on the o-tolyl rearrangement observed in the alkylation of acetobromoglucose with benzylmagnesium chloride.

Attempts to directly prepare benzyl-C-glucoside by direct alkylation of acetobromoglucose with benzylmagnesium chloride provided a 3:1 ratio of the unexpected o-tolyl alkylation product to the desired alkylation product. While other synthetic routes to benzyl-C-glucoside have been found, it is of interest to determine what structural features inherent in acetobromoglucose lead to this rearrangement as it appears to be unique to acetate ester protected glucosyl bromides. The preparation of the mesylate and tosylate analogues corresponding to acetobromoglucose will be described. The products of their reaction of these glucosyl sulfonates with benzyl Grignard reagent after reacetylation will be analyzed and discussed with regard to their observed proton NMR spectra signals corresponding either to the benzyl or the ortho-tolyl alkylation products. In addition the attempted preparation of acetoiodoglucose by literature means will be discussed and alternative preparations of this compound will be proposed. Preliminary results indicate the desired benzyl C-glucoside is more readily formed using substrates with better leaving groups than bromide. A hypothesis for this observation based on acetate group participation will be presented.

CHRISTINA S. WALLACE and MICHAEL J. PANIGOT, Department of Chemistry, West Virginia State College, Institute, WV 25112-1000. Effects of decreased leaving group ability on the o-tolyl rearrangement observed in the alkylation of acetobromoglucose with

benzylmagnesium chloride.

Attempts to directly prepare benzyl-C-glucoside by reaction of acetobromoglucose with benzylmagnesium chloride provided a 3:1 ratio of the unexpected o-tolyl alkylation product to the desired benzyl alkylation product. While other syntheses of benzyl-C-glucoside have been found, it is of interest to determine what features apparently present only in acetobromoglucose lead to this rearrangement. The preparation of acetochloroglucose and acetofluoroglucose by standard literature procedures will be discussed. The products of the reaction of these glucosyl halides with benzylmagnesium chloride after reacetylation will be analyzed and discussed with regard to their observed proton NMR spectra signals corresponding either to the benzyl or the ortho-tolyl alkylation products. Preliminary results indicate the rearrangement is comparable to or greater than that observed using acetobromoglucose as substrate. A proposed rationale for this observation will be presented.

CAMDEN E. MCLAUGHLIN, SHERINE O. OBARE and SUNDAR NAGA, Dept. of Chemistry, WVSC, Institute, WV 25112. Conceptualization of chemical thermodynamics through the Internet.

Concepts of chemical thermodynamics and quantum chemistry have traditionally been difficult to visualize and therefore difficult to understand. An understanding of such concepts is crucial to anyone in science, as it is well known that these principles of the microscopic world determine macroscopic behavior. In recent years, an invaluable tool has been developed that can revolutionize the learning of these principles: the Internet. We have been steadily developing a web page that will, upon completion, permit a user to operate in either a tutorial or a working environment which permits one a truly visual and fully interactive environment, in order to either gain more insight into a specific topic or carry out an



experiment in this "web" lab under specific conditions, without having to engage in any of the time-consuming and expensive "wet" lab activities. Currently, we are designing the tutorial version by developing our own software applications and by transforming previously researched theoretical data into a form presentable via Internet. These data represent such concepts as work (isothermal and adiabatic processes, path dependence of work, etc.), heat, energy, entropy, Boltzman Distributions, etc.

Support has been given by the WVSC Sciences Division, NASA, and various resources on the Internet itself.

## ECOLOGY

THOMAS E. WEAKS and REBECCA HALL RUTHERFORD, Department of Biological Sciences, Marshall University, Huntington, West Virginia 25755. A comparison of the periphyton communities of polluted and clean-water tributaries of the New River Gorge National River, West Virginia.

Periphyton community structure was studied in ten tributaries of the New River Gorge National River. The study area is heavily impacted by sports enthusiasts who utilize the river and its tributaries primarily for camping, fishing, hiking, and white-water rafting. Five of the ten tributaries studied receive moderate to high levels of organic pollutants from these activities. These are Arbuckle, Dunloup, Keeney, Marr and Wolf Creeks. The other five have a history of much higher water quality. These are Laurel, Glade, Dowdy, Lick and Meadow Creeks. The streams were sampled on a seasonal basis for one year. Chlorophyll, pH, dissolved oxygen, turbidity, conductivity, temperature and alkalinity were determined. Periphyton was identified and cell densities were established for each stream. Pennate and centric diatoms were found to be the dominant algal forms in all ten tributaries. Dominant species included *Melosira*

*varians*, *Cocconeis placentula*, *Gomphonema acuminatum* and *Tabellaria fenestrata*. Streams with the lowest species diversity were Laurel and Dowdy Creeks. Glade and Arbuckle Creeks had the highest species diversity. This suggests that factors other than levels of pollutants have influenced species diversity in these streams.

STEPHEN D. GREENE and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Simultaneous chemical and benthic diversity comparisons of acid mine drainage and unmitigated lotic systems.

Acid mine drainage research does not lend itself to simultaneous temporal comparisons of the type normally found in scientific studies. True treatment and control ecologies existing simultaneously are found in Logan Co., West Virginia. Two stream forks join to form a stream order two lotic system, draining watersheds with the same geological profiles, topographies, and riparian vegetation that create this site. The South Fork has been strip mined, then abandoned for approximately 20 years. The North Fork has yet to be mined. Aluminum hydroxide precipitates from solution due to the increased pH of acidified South Fork water upon mixing with runoff from the North Fork. This precipitate covers the stream bed almost to the receiving stream, about 3 miles away. This unusual occurrence appears to be caused by runoff seeping through exposed coal seams, becoming acidified, and draining into the watershed upon hitting an impervious clay horizon, the aluminum source. Aluminum stays in solution until confluence of the forks where the zone of precipitation is immediate and clearly demarcated. Initial benthic biodiversities indicate the unmitigated North Fork has by far the greatest biodiversity. The stream below the confluence has greatly reduced biodiversity, while the acidic South Fork has little biodiversity. Stream chemistries, with emphasis on metals, are being compiled to typify and compare these ecologies.



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ANDREA L. HENRY and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Ecological Observations of *Crangonyx pseudogracilis* Bousfield (Crustacea: Amphipoda) from the Green Bottom Wildlife Management Area, Cabell County, West Virginia.

Although the genus *Crangonyx* has been studied in the Appalachian area, most of this work has concentrated on subterranean species. A *Crangonyx pseudogracilis* population was sampled weekly from March 1995 through July 1996 to investigate the ecological life history of the amphipod. Amphipods were present in the study sites from November through July, at which time they migrated to deeper waters. *C. pseudogracilis* has a one year life cycle with breeding from November to May. Adult amphipods begin to die off in May and are gone by June. Males average 5.88 mm and females average 8.73 mm in length. There is no significant seasonal variation in sex ratio. Females produce several broods per year and ovigerous females were found from November 2 until May 8. They carried an average of 53.55 eggs and there was a low correlation between fecundity and length. The median tolerance limit ( $TL_m$ ) for low pH was 4.06, and a 96 hour laboratory test at this value produced a 65 percent survival rate. Plant detritus was the preferred food year round, comprising between 47 and 62 percent of the diet.

ROBERT W. HOOD and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755, and TED R. ANGRADI, Northeastern Forest Experiment Station, Parsons, WV 26287. Longitudinal, vertical, and seasonal variation of the interstitial macroinvertebrate fauna at the Fernow Experimental Forest, Parsons, West Virginia.

Multi-level basket samplers were placed in the substrate on first-through fourth-order streams on

the Elk Lick Run drainage at Fernow Experimental Forest, Parsons, West Virginia. Samplers were colonized by macro-invertebrates over three month intervals, collected and are in the process of being analyzed. Seasonal, longitudinal, and vertical variation in the macro-invertebrate community are being analyzed to better understand the structure and function of the interstitial macroinvertebrate and important influencing factors. Surber samples were also taken for comparison between surface and artificial basket samples. Temperature, dissolved oxygen, water chemistry, depth, and surface velocities were also measured to characterize conditions at each sampler during colonization, along with seasonal inter-gravel flow measurements. Preliminary data shows most macroinvertebrates decreasing in number with depth, and the family Chironomidae increasing in relative abundance with depth. Data also shows differences in community among stream sites.

ERICA S. MIDKIFF and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Comparative ecological studies on the diet and growth rates of larval and juvenile grass pickerel, *Esox americanus vermiculatus*, and central mudminnow, *Umbra limi*, and fall spawning of the grass pickerel in the Green Bottom Wildlife Management Area, West Virginia.

The grass pickerel, *Esox americanus vermiculatus*, is listed as Undetermined on the Vertebrate Species of Concern in West Virginia. The lentic, vegetated areas that are required for spawning for the grass pickerel and the central mudminnow, *Umbra limi*, are being reduced by residential, agricultural, and industrial developments. Green Bottom Swamp, a naturally occurring wetland of 58 ha, and a nearby mitigated wetland of 29 ha provides spawning habitat for the grass pickerel and the mudminnow. Fish (1994-96) were collected in beds of *Potamogeton crispus* and *Ceratophyllum demersum* from the old swamp. In



December 1994, 15 pickerel were collected from beds of *Polygonum* sp. in the mitigated wetland. Between April 1995 and July 1995, 65 pickerel (6.67-101.45 mm) and 155 mudminnows (3.89-30.68 mm) were collected from the old swamp. The growth of these fish have been compared along with the diet. Stomach contents of each fish were analyzed and assigned a point value ranging from 0 (empty gut) to 30 (full gut). The percent frequency of food items were determined for each stomach. In the larval pickerel and mudminnows, cladocerans and copepods were the most abundant. In the juvenile mudminnows, the items ranged from larval chironomids and ostracods to cladocerans, while the pickerel consumed naiadal stages of large aquatic insects (odonates and corixids) and small fish.

GAIL L. PERRINE and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Low pH tolerance of larval *Caenis amica* Hagen (Ephemeroptera: Caenidae) from a mitigated wetland in the Green Bottom Wildlife Management Area, West Virginia.

Several species in the genus *Caenis* are tolerant of pollution. The primary objective of this study was to determine the low pH tolerance of larval *Caenis amica*. The Green Bottom Wildlife Management Area is located along the Ohio River approximately 26 km northeast of Huntington, West Virginia. One-hundred larvae (2.50-4.45 mm,  $\bar{x}$ =3.53 mm) of *Caenis amica* were collected with a long-handled dredge from a nearby mitigated wetland. They were found in the silt near rooted vegetation. Under static bioassay conditions, larvae were experimentally tested to determine their tolerance to low pH. After a 24-hour acclimation period, they were exposed to five pH values (1.5, 3.0, 4.5, 6.0, 7.5/control) in a controlled environmental chamber at 10°C. The 96-hour  $TL_m$  (median tolerance limit) test was employed as a measure of acute toxicity to low pH. Linear regression analysis was

used to determine the pH value at which 50% of the larvae survived after 96 hours. The  $TL_m$  pH value was 5.2. Results will be compared with other laboratory pH tolerance studies of mayflies and other aquatic insects.

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; JOHN C. LANDOLT, Dept. of Biology, Shepherd College, Shepherdstown, WV 25443; and DONNA L. MOORE, Dept. Of Biological Sciences, University of Arkansas, Fayetteville, AK 72701. Protostelids, dictyostelids, and myxomycetes in the litter microhabitat of Luquillo Experimental Forest, Puerto Rico.

Protostelids, dictyostelids and myxomycetes are three groups of eukaryotic, phagotropic bacterivores usually present and often abundant in terrestrial ecosystems. Most of what is known about the assemblages of these organisms 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 primary objective of the present study was to obtain data on the distribution and ecology of all three groups of "slim molds" in the forest floor litter microhabitat of five different forest types (tabonuco forest, agriculturally disturbed forest, palo colorado forest, palm forest, and elfin forest) within the Luquillo Experimental Forest in Puerto Rico. A secondary objective was to obtain baseline data on the protostelids associated with aerial litter (dead but still attached plant parts) in the same five forest types. At least 13 species of protostelids, 13 species of dictyostelids, and 24 species of myxomycetes were recovered from samples of litter. Both species richness and abundance of dictyostelids and myxomycetes were higher in the agriculturally disturbed forest than in any of the other forest types sampled. The tabonuco forest yielded the most species of protostelids, but the



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next highest total was recorded from the agriculturally disturbed forest. Both of these forest types are located at the low end of the elevation gradient. All three groups of organisms displayed their lowest levels of species richness and abundance in the elfin forest, located at the high end of the elevation gradient. As such, the general pattern observed was that of decreasing diversity with increasing elevation. (Supported by a grant from the National Science Foundation.)

STEVEN L. STEPHENSON, Dept. Of Biology, Fairmont State College, Fairmont, WV 26554; GARY A. LAURSEN, Dept. Of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775; and RODNEY D. SEPPELT, Australia Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia. Vegetation of subantarctic Macquarie Island.

Macquarie Island (54°30' S, 158°57' E) is an oceanic island 34 km long and 2.5 to 5.5 km wide located 1000 km southeast of Tasmania. The island, composed of oceanic crustal rocks lifted above sea level during the middle to late Pleistocene, lies close to but north of the Antarctic Convergence. The nearest land masses are the New Zealand shelf island groups of the Auckland Islands and Campbell Island, lying 640 and 700 km to the northeast, respectively. Macquarie Island is characterized by an equable oceanic climate that is cool, moist and windy with low temperatures (annual mean of 4.8°C, range 3.3°C), a mean annual precipitation of 895 mm, high humidity (89% average), and a mean wind speed of 9.3 m/sec. While wind, cloud cover, precipitation and relative humidity vary little throughout the year, there is a marked annual cycle in daylength from about 7 hours in mid-winter to 17 hours in mid-summer. Macquarie Island is the southernmost island in the world with a fairly complete cover of vegetation, but the vascular flora is impoverished and consists of only 46 species. The general aspect of the vegetation is tundra-like, and

the tallest plants are grass tussocks which sometimes reach a height of 1.5 m. Bryophytes, lichens, and low-growing vascular plants are the usual dominants in most situations, and there are no woody plants on the island. Five major types of plant communities are generally recognized: grassland (including both tall tussock grassland and short grassland), herbfield, mire, fernbrake, and feldmark. The most diverse of these plant communities are the mixed herbfield communities that occur on raised coastal terraces. (This research was funded in part by a grant from the National Science Foundation. We acknowledge logistical support provided by the Australian Antarctic Division. Permission to work on Macquarie Island was granted by the Tasmanian National Parks and Wildlife Service.)

ROBERT F. MASLOWSKI, Economic and Social Analysis Branch, U.S. Army Corps of Engineers, 502 Eighth Street, Huntington, WV 25701. The West Virginia Archeological Radiocarbon Database.

The first archeological radiocarbon database for West Virginia was published in the West Virginia Academy of Science Proceedings by Edward V. McMichael in 1965. This database was expanded to 73 dates by E. Thomas Hemmings in 1977. Today the database consists of 326 radiocarbon dates for 91 archeological sites or objects. The database is included in the Kentucky-Ohio-West Virginia database which is maintained in a computerized format by the Council for West Virginia Archaeology. The vast majority of radiocarbon dates are from sites along the major river systems. The counties along the Kanawha-New River produced 179 (60%) of the dates while the counties along the Ohio River produced 132 (40%) of the total dates. Mason County, located at the confluence of the Ohio and Kanawha Rivers produced 59 (18%) of the dates. The database provides an opportunity to develop more accurate cultural and temporal chronologies for West Virginia as well as to contribute to national and



international research efforts such as global climatic change.

MICHAEL J. DEMCHIK, Jefferson High School, Rt. 1 Box 83, Shenandoah Junction WV 25442. Project leap: local environmental assessment program

Project LEAP, Local Environmental Assessment Program, was a three year project funded in May, 1994, and completed in 1996. The project selected three streams, Elk Run, Town Run and Rocky Marsh, for environmental assessment using both chemical and biological assessments. The chemical assessment included pH, dissolved oxygen, dissolved carbon dioxide, nitrates, phosphates, silicates, total dissolved solids, and dissolved magnesium and calcium solids. The biotic index for each stream was determined using the Kimmel-Sharpe System (modified 1996). The Kimmel-Sharpe System sets numerical values for classifying streams. These include 0-4, grossly polluted; 5-7, mild pollution; 8-9, slightly polluted; 10 and above, clean stream. An *E.coli* test was run using the 24-48 hour test of a lipase medium with added indicator. The results indicated that Elk Run rated a 7 for all three assessments and was classified as mildly polluted. Elk Run showed a pH of 8 each of the three years. No nitrates nor phosphates were shown. Dissolved oxygen and carbon dioxide and silica were within accepted values. However, dissolved solids more than doubled the normal rating for high. The *E.coli* test was negative each year. Town Run is an unpolluted stream with a rating of 11 and 12 each of the years of the project. All readings were similar to those for Elk Run. Rocky Marsh had a biotic index of 7 for two years and a 5 on the last year reading indicating mild pollution. The major tests were consistent with those for the other streams. Town Run is a clean stream and has been the last three years. Both Rocky Marsh and Elk Run are mildly polluted. The streams have a pH of 8 consistently. The streams have an extremely high quantity of dissolved solids. Based on the

results, the watershed will be assessed based on acid rain collections and acid snow collections in February, 1997, with subsequent follow-up on each stream in March. The program was supported by a minigrant from the Eastern Panhandle Soil Conservation Service for the first three years. The acid snow project is supported by a minigrant from the West Virginia Education Fund.

JOHN C. LANDOLT, Department of Biology, Shepherd College, Shepherdstown, WV 25443 and STEPHEN L. STEPHENSON, Department of Biology, Fairmont State College, Fairmont, WV 26554. Dictyostelid cellular slime molds in canopy soils of tropical forests.

The occurrence and distribution of dictyostelid cellular slime molds (CSM) in the mantle of dead organic matter (literally a "canopy soil") typically found at the bases of larger vascular epiphytes present on the larger branches and trunks of trees in tropical forests were studied in the Luquillo Experimental Forest in northeastern Puerto Rico. Four species of CSM were recovered from this microhabitat. *Dictyostelium purpureum* was the single most abundant species present and represented almost (48%) of all clones isolated during the entire study. Total densities (clones/gram) averaged only 38 in the five study forest types examined, but densities >75 were recorded for two forest types. (Supported by a grant from the National Science Foundation.)

C. MICHAEL ANSLINGER, Cultural Resource Analysts, Inc., Hurricane, WV 25526. Buried site archeology in the Kanawha valley.

Since the mid-1960s West Virginia archeologists have been aware of the potential Kanawha River sediment units have to contain deeply buried archeological deposits. Two recent projects conducted by Cultural Resource Analysts' personnel at Lower Belle and St. Albans for the



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Huntington District Corps of Engineers generated geological and archeological data which are being used to reconstruct the depositional and occupational histories for these locations. Investigations at the St. Albans site (46KA27) identified intact archeological deposits extending up to 6 m (19.7 ft) below surface. Based on time sensitive artifacts and radiocarbon dates, a sequence of occupation spanning nearly 10,000 years has been documented. Geologic studies including grain-size, percent organic and stratigraphic analyses indicate that prehistoric remains are concentrated on a natural levee. The St. Albans site contains one of the best stratified sequences of early Holocene cultural deposits in eastern North America. The stratified nature of deposits provides a means by which archeologists can study early hunter-gatherer adaptive strategies and technological organization from a diachronic perspective.

Geoarcheological investigations conducted at Lower Belle resulted in the identification of Holocene and late Pleistocene/early Holocene landforms. Holocene landforms were located adjacent to the modern Kanawha and contain relatively deep sequences of buried cultural deposits. The presence of buried A horizons indicates that the building of the flood plain was punctuated rather than continuous. The late Pleistocene/early Holocene terrace remnant contained early Holocene deposits in the upper 1 m (3.3 ft) of alluvium. Soil-landform associations suggest landforms of similar age and origin might be present in the region. The identification of late Pleistocene/early Holocene landforms is important because early hunter-gatherer archeological deposits can be accessed in near surface contexts, thus enabling intra-site spatial data to be generated.

STUART WELSH, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, Morgantown, WV 26506. Spatial scales, quadrats, and substrate composition in streams.

Substrate composition is important to stream fishes

because of its association with spawning, foraging, and predator avoidance (cover). Fisheries managers and researchers use quadrats to describe substrate composition in streams; however, little is known about the influence of quadrat size on estimates of substrate composition. In a study of habitat use of darters in the Elk River, West Virginia, substrate composition was examined using a subdivided quadrat (25 5x5 cm cells). The quadrat was placed on the streambed at a point of interest, and the dominant substrate size (based on a modified Wentworth scale) was recorded for each cell. Three indices of substrate composition were calculated by (1) averaging the scores for all cells, (2) averaging the scores for the nine center cells, and (3) recording the score for the center cell within the quadrat. The objective was to examine the influence of three spatial scales on estimates of substrate composition. Differences in estimates of substrate composition were examined among the center cell (a 5x5 cm area), the nine center cells (a 15x15 cm area), and all 25 cells (a 25x25 cm area). In general, the estimate of substrate size increased with spatial scale. However, differences among estimates of substrate composition at the three spatial scales were less when examined for areas with homogeneous substrate. Higher statistical precision is obtained with larger quadrat sizes; however, in studies on habitat use, the spatial scale that is ecologically important presumably depends on the species of study.

JAMES RENTCH, School of Engineering and Science, West Virginia Graduate College, South Charleston, WV 25202, RONALD FORTNEY, Dept. Bioscience, Salem-Teikyo University, Salem, WV 26426, HAROLD ADAMS, Division of Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422, and STEVEN STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Vegetation study of the Bluestone River Gorge in Southern West Virginia.



During the summers of 1994-1996, the vegetation in the Bluestone National Scenic River was studied. A total of 30 sample sites were established as part of an ongoing project to: (1) quantitatively describe plant communities in the Bluestone River Gorge, (2) assess the role of physical environmental factors in determining plant distribution within the Gorge, (3) locate old growth communities and individual trees, and (4) establish a network of permanent plots to serve as baseline study sites. Seven transects, each consisting of 2-4 one-tenth (0.1) hectare quadrats, were established along elevation gradients that extended from rim (2200') to riverbank (1600') in the main gorge. The quadrats were permanently marked and their exact coordinates determined with the use of a portable GPS. Within each 0.1 ha quadrat, tree, small tree, sapling, shrub seedling, and herbaceous strata were sampled. In addition, composite soil samples were collected, increment cores extracted from several of the largest trees, and slope aspect and angle measured and recorded. From the field observations, importance value (IV) indices were determined for each species. Community composition and species distribution were correlated with site characteristics and edaphic conditions. Four forest community types were identified: (1) xeric, mixed Appalachian oak, (2) mesic, mixed Appalachian oak, (3) mixed mesophytic, and (4) xeric shale barren type. Of the 30 sites examined, half were xeric, mixed Appalachian oak communities. These communities, dominated by Chestnut oak (*Quercus prinus*) with scarlet oak (*Q. Coccinea*) white oak (*Q. Alba*), and black oak (*Quercus velutina*) as associate species, occurred on the highest ridges of the gorge, and on the drier, more exposed slopes. Slopes aspect for these communities ranged generally from south to west. Soils tended to be dry, acidic (pH 4.5-5.5), high in iron and aluminum, and relatively nutrient poor. Mesic, mixed Appalachian oak communities were found on midslope positions and at lower slope positions on north and northeast-facing slopes. Red oak and white oak were the usual canopy dominants. Mixed mesophytic communities occurred at midslope and lower slope

positions on more protected north-facing sites. Soils were more circumneutral, lower in iron and aluminum, and relatively nutrient-rich. Species richness, but not evenness, was highest in these sites. Tulip poplar (*Liriodendron tulipifera*) was the dominant canopy tree, with sugar maple, buckeye (*Aesculus octandra*), and basswood (*Tilia americana*) the usual condominiums. An unusual shale barren-like community was sampled on a dry southeast-facing site positioned on an upper-slope (elev. 2100'). The most important tree species present were white ash, red cedar (*Juniperus virginiana*), post oak (*Q. stellata*), and mockernut hickory (*Carya tomentosa*). Only at this site was hickory a dominant species.

#### PSYCHOLOGY & EDUCATION

ALAN D. SMITH, Dept of Quantitative and Natural Sciences, Robert Morris College, 600 Fifth Avenue, Pittsburgh, PA 15219-3099. Personality Testing and Job Classification.

It is estimated that there are over 6000 written employee tests and that over 8000 companies are currently administering them to prospective employees. One year alone, the use of employee testing in American industry increased by 30%. One must wonder if all this testing actually works. In general, personality tests try to determine if an individual's personality is similar to that of "past stars" in similar occupations. Is it possible to define which personality characteristics are most desirable, and which occupations demand which personality traits? Finally, do tests that define certain personality traits as desirable discriminate against minority groups? In order to investigate these questions a pilot study (n=59) was conducted at Robert Morris College, Pittsburgh. A personality test written by Bernard M. Bass was distributed to ninety-five employees. The instrument is based on McClelland's theory of motivational orientation and tests for three types of orientations: achievement, affiliation, and power. The employees were



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broken into three subgroups by job title: administrator, faculty, and staff to determine if a certain status of employee was more apt to be a certain motivational orientation. Seven variables were developed and collected through the questionnaire procedure. These variables included sex, age of respondent, birth order in the family, employee status (faculty, staff, administrator), achievement score, affiliation score, and power score. A total of nine nonparametric correlations among these variables were found to be statistically significant; however, further analysis using a Chi Square test yielded only five significant correlations.

B. DASSARMA, Department of Chemistry, West Virginia State College, Institute, WV 25112. Simple definitions and models in introductory chemistry to minimize misconception and chemophobia.

An elective introductory chemistry course should not be a watered down General Chemistry for science majors, or a dialog on selected environmental issues. Initial terms introduced to beginners should be in unequivocal common sense language, and topics covered should be such that an average student can apply to personal life. Models introduced should preferably be such as a student can construct with inexpensive materials available in everyday life. The author's philosophy on Common sense chemistry for non majors (Commentary, ACS Chemical Education Newsletter, Winter 1996, page 57-58) developed as a science component of General Education at West Virginia State College will be presented with special reference to redefining chemistry, chemicals, molecules, matter, energy, food, fiber and poison. Advantage of using balloons as models for atoms, ions, electronegativity, and atomic orbitals will be discussed.

JOHN H. HULL and AARON J. RIESMEYER, Dept of Psychology, Bethany College, Bethany, WV 26032. The effect of temperature and interstimulus

interval on habituation in earthworms (*lumbricus terrestris*).

Independent groups of earthworms were housed at either 7°C or 21°C. All worms were then exposed to three days of habituation training to a vibratory stimulus; half of the worms had an interstimulus interval (ISI) of 10 sec, the other half a 20-sec ISI. Prior to daily habituation sessions, all earthworms were warmed to 21°C. Between daily sessions, half of the worms returned to housing at 7°C, while the others remained housed at 21°C. A repeated-measures analysis of variance on number of stimulus presentations needed to produce habituation showed a significant effect of housing temperature; worms maintained at 21°C showed significant decreases in number of stimulus presentations needed to produce habituation across the three days, while those housed at 7°C did not. ISI did not produce any significant main or interactive effects. These results confirm and extend findings with other species that cooling an organism after a learning task may interfere with formation and/or retrieval of long-term memory.

## ZOOLOGY

JENNIFER A. ADERMAN and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Acid tolerance, under static bioassay conditions, of the freshwater prawn *Palaemonetes kadiakensis* Rathbun from the Green Bottom Mitigation Site, Cabell County, West Virginia.

Acidification can have major impacts on crustacean populations. Low pH can alter respiration, acid-base balance, and Na and Ca regulation. Using a standard D-shaped dredge, one hundred prawns (15.4-36.1 mm,  $\bar{x}$ =25.6 mm) were collected from the Green Bottom Mitigation Site near Huntington, West Virginia. The water temperature was 10°C. Prawns were returned to the laboratory and allowed to acclimate for 24 hours in a controlled environmental chamber (10°C). They were



experimentally tested to determine their tolerance to low pH. Ten prawns were placed in each of five duplicate bowls. They were exposed to the following pH values: 1.5, 3.0, 4.5, 6.0, 7.5 (control). After the 96-hour experiment, the  $TL_m$  (median tolerance limit) was calculated using linear regression analysis. The  $TL_m$  pH value was 5.03. Results will be compared with other laboratory and field studies on pH tolerance value crustaceans.

ERIC S. WILHELM, KEVIN D. BRITTINGHAM, ERICA S. MIDKIFF, and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Population dynamics of Chironomidae in Green Bottom Wildlife Management Area, Cabell County, West Virginia with notes on Chironomidae of West Virginia.

Chironomid larvae were collected from three separate impoundments within the Green Bottom Wildlife Management Area (GBWMA) from April 26-August 3, 1996. One impoundment was created and is maintained by beavers (*Castor canadensis*), while two additional impoundments were created via wetland's mitigation by the US Army Corps of Engineers. In spite of annual flooding by the Ohio River which temporarily joins the three wetlands, each impoundment has developed distinct vegetative and invertebrate communities. This study examines correlations between the chironomid populations of nine distinct vegetative communities occurring in the wetlands system. Eight taxa have been documented thus far, including: *Chironomus*, *Endochironomus*, *Glyptotendipes*, *Parachironomus*, *Polypedilum*, *Ablabesmyia*, *Larsia*, and *Tanypus*. Distributional records and habitat information on chironomid populations throughout West Virginia will be discussed.

DONALD C. TARTER, ERICA S. MIDKIFF, and ERIC S. WILHELM, Department of Biological Sciences, Huntington, WV 25755, and DIANE R. NELSON, Department of

Biological Sciences, East Tennessee State University, Johnson City, TN 37601. First records of tardigrades (Phylum: Tardigrada) from mosses in the New River Gorge, West Virginia.

Fifty-three miles of the New River and its gorge and 40 miles of its tributaries are preserved as the New River Gorge National River in southern West Virginia. The steep wall, meandering gorge is 700-1300 feet deep, averages one mile in width, and cuts through seven geological formations. Elevation in the New River Gorge ranges from 1300-3000 feet. Mosses were collected from several rocky ravines and talus slopes. The following species of tardigrades, including the state record *Diphascon pinque* Marcus, were identified from the mosses: *D. higginsii* Binda, *D. n. sp.*, *Itaquascon sp.*, *Macrobiotus hufelandi* Schultz, *M. occidentalis* Murray, *M. richtersi* Murray, *M. spectabilis* Thulin, *M. tonolii* Ramazotti, *Milnesium tardigradum* Doyere, *Minibiotus intermedius* (Plate), and *Pseudechiniscus suillus* (Ehrenberg). Twenty seven species of tardigrades have now been reported from West Virginia.

KEVIN D. BRITTINGHAM, and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755, and TED R. ANGRADI, Northeastern Forest Experiment Station, Parsons, WV 26287. A comparative study of the benthic populations in weir ponds draining watersheds of the Fernow Experimental Forest, Parsons, West Virginia.

A study on the comparison of the benthos in weir ponds draining watersheds of the Fernow Experimental Forest (FEF) was conducted in October and November of 1971 and 1994. The collection in 1971 was done by Steve Harris for his thesis work at West Virginia University. The objectives of this study were: (1) to relate differences in weir pond faunas to watershed treatments on the FEF, and (2) to compare current fauna to that described in 1973 by Steve Harris. The individuals collected were



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keyed to genus and densities calculated for a  $m^2$ . A Before-After/Control-Impact (BACI) sampling design was used, in which the impact and control sites were sampled contemporaneously and repeatedly in periods before and after the perturbation of interest. A comparison was conducted on taxa density and taxa richness. The data showed that the collection in 1971 had fewer numbers but greater taxa richness when compared to the collection in 1997. Overall there are significant differences in the weir pond populations when comparing 1971 to 1994 collection dates.

MATTHEW M. MCREYNOLDS, MICHAEL L. LITTLE, and DONALD C. TARTER, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Observations on reproduction, isozyme patterns, and meristics in mosquitofish (Pisces: Poeciliidae) from West Virginia.

Prior to 1988, two subspecies of the mosquitofish *Gambusia affinis* (*G. a. affinis* and *G. a. holbrooki*) were recognized along the Gulf and Atlantic Coasts of the United States. Based on electrophoretic analysis, subsequent investigators proposed the original taxonomic designation recognizing *G. holbrooki* and *G. affinis* as separate species. Populations in drainages west of Mobile Bay were considered *G. affinis*, and those east of this divide being *G. holbrooki*. The only population of mosquitofish in West Virginia is found in the Meadow River wetlands (1932 ha) located at the western end of Greenbrier County in the Allegheny mountain province. Using heart, skeletal muscle, and brain tissues, malate dehydrogenase isozyme patterns, along with some morphometric characteristics (e.g. dorsal and fin rays, etc.), were used to determine that the West Virginia population was *G. affinis*. The females from the Meadow River wetlands became mature at 32 mm in length. The population of mosquitofish in the wetlands began its reproductive period on May 24 and ended in late September, which is a period of 15 weeks. Also the

smallest male was 22 mm long and the smallest mature female was 32 mm long.

## GEOGRAPHY

PATRICIA WOOTEN, Alum Creek Elementary, South Charleston, WV 25309. Thailand adventures--discover the treasures of a kingdom.

This presentation gives an overview and provides highlights of a 1996 Fulbright-Hays Group Projects Abroad expedition to southern Thailand by ten WV teachers. Program components, field trips, and hands-on experiences are discussed with posters, graphics, and visuals. Get "up-close and personal" with an unforgettable in-depth study course enhanced by bamboo rafting, elephant riding, rubber plantations, snake farms, classical drama and dance, riding the tuk-tuk, visiting monuments and temples, and meeting mayors, governors, and diplomats. Share the emotional experience of visits to the Bridge on the River Kwai and to the country of Malaysia. Learn about the country and the many-faceted culture of this "Land of Smiles." Emphasis is placed on **DISCOVER** (exploring the geographic, linguistic, and cultural differences encountered by the group), **TREASURES** (sharing unique souvenir items that are reflective of the land and people of Thailand), and **KINGDOM** (discussing the King's Golden Jubilee Celebration, the ruling family, and its impact on everything Thai). Classroom applications include suggestions for science and social studies fair displays, learning centers, creative writing, cooperative learning, and ideas to "preserve, protect, and promulgate" cultural heritage.

BARBARA A. MILLER, Kingwood Elementary School, 207 South Price Street, Kingwood, WV 26537. Language and Area Studies.

The purpose of my presentation is to demonstrate how I made my lessons on Southeast Asia more interesting by teaching phrases in the Thai



language. My information was gathered from Berlitz conversational tapes and guide books on Thai language and customs. I was also a member of the Fulbright grant group, on a study trip of five weeks to Thailand in the summer of 1996. My middle school students enjoyed practicing the standard salutations and basic conversations and vocabulary. They should be able to remember more and relate better to Southeast Asia through this introduction to the Thai language.

MICHAEL CASTELLO, Department of Social Science, Concord College, Athens, WV 24712. A study of the affects of the Russian railways on the Russian Revolution.

The purpose of this presentation is to explore the affects the building of the Russian rail and telegraph system had on the revolutions of 1917. A review of the literature was conducted utilizing general works on the Revolution, and works specifically about the workers role in the revolution. A review of periodical literature on the Revolution was made, citing specific incidences of revolutionary activity. Maps were constructed to show the progression of the railroad and telegraph system to determine any correlation between the improvement of the infrastructure, and the movement of revolutionary ideology and action.

LINDA E. NEWCOME, Teacher at Kingwood Elementary, Kingwood, WV 26537. Investigation of various wetlands and their inhabitants

Wetlands have always fascinated me. I finally had the chance to study wetlands through RockCamp and field trips sponsored by the WV Geological Survey, and through the Project Wet workshops sponsored by Dr. Manzo and the Geographical Alliance at Concord College. In addition, the U.S. Soil Conservation Office in Morgantown has awarded grants which have helped me to offer this experience to my students. Wetland investigation is fascinating for all education levels. I introduce backyard, roadside, mud puddle, and U.S.

Government set-aside wetlands to students. Unit materials are usually inexpensive depending on the length of study and activities completed. We use slides, videos, and pictures to illustrate different types of wetlands including: marshes, bogs, swamps, saltwater estuaries, and marine wetlands. Hands-on activities in the classroom help us examine differences between saltwater wetlands and the others before going out into the field.

HUGH CAMPBELL, Department of Education, Concord College, Box 54 Athens, WV 24712. Teaching geography concepts and enhancing thinking skills through the use of the inductive model.

The purpose of this oral presentation is to help teachers and teacher educators to improve instructional techniques related to the development of critical thinking skills and content acquisition in geography. The original learning is stronger and the retention of content information is greater when students acquire information through means other than rote memorization of content. Approaches that emphasize student involvement increase the relevancy and meaning for students. As structural changes, such as block scheduling, take place in schools it is essential that teachers utilize varying forms of instructional techniques to optimize academic learning time. Use of the inductive model of instruction improves student motivation and concept acquisition while fostering critical thinking skills required in today's society.

BRIANNA MERCIER, Department of Geography, Concord College, Athens, WV 24712. A study of the diffusion of architecture into a region.

Architecture is a reflection of a community's cultural history. The style of architecture reveals social and economic change, and the style of architecture in a community collectively contributes to the personality of an area. I familiarized myself with basic designs from architectural



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literature. After taking slides of local housing I matched the architectural designs and concentrated on the historical geography of the most recurring designs. The purpose of this paper is to explore types of folk housing in Athens, West Virginia, a community in the heart of Appalachia. The diffusion of different architectural styles adds a European and Canadian influence to the community.

JAMES SEXTON, Social Studies, Van High School, Van, WV 25206. Factors Affecting College Attendance: A Thailand Example.

The purpose of this paper is to examine the factors influencing the rate of college attendance in Thailand. Data were collected through written documentation and classroom observation during a thirty-five day educational tour of Southern Thailand. Support for this field experience was provided by the US Department of Education's Group Fulbright Program, Concord College, The West Virginia Department of Education, The West Virginia Legislature and the West Virginia Geographic Alliance. Data indicate the major influences on college attendance are religion and cultural background.

### POSTERS

JOHN C. LANDOLT, Department of Biology, Shepherd College, Shepherdstown, WV 25443 and CRAIG W. STIHLER, West Virginia Division of Natural Resources, Elkins, WV 26241. Dictyostelid cellular slime molds from San Salvador Island, Bahamas.

Soil and litter samples from a number of locations, both from cave and above ground sites on the island of San Salvador, Bahamas were examined for the occurrence and distribution of dictyostelid cellular slime molds. These samples were collected during April 1995, January 1996, and January 1997. At least 10 different species of cellular slime molds were recovered:

*Dictyostelium aureo-stipes*, *D. firmibasis*, *D.*

*polycephalum*, *D. purpureum*, *D. sphaerocephalum*, *D. vinaceo-fuscum*, *Polysphondylium pallidum*, and *P. violaceum* together with two forms still to be identified: *Dictyostelium* sp. and *Polysphondylium* sp.. While most of these species are rather wide spread in world distribution, there are several particularly noteworthy collections. The *Polysphondylium* sp. is unique compared to all other species of the genus in that it produces spherical rather than oval spores. This suggests a possible new taxon. *Dictyostelium polycephalum* is occasionally isolated elsewhere, but is relatively common on San Salvador as it seems to be in certain other island groups.

CRYSTAL THOMAS, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Ecological studies on Fairmont streams.

The purpose of the experiment was to study area streams in order to determine their level of water pollution. Four stations were visited and a water sample was collected from each station. The air temperature, water temperature, pH, conductivity, and dissolved oxygen were measured and recorded. A small amount of bottom sediment was collected from each station. The biochemical oxygen demand (BOD) test was used to test the samples. The mixture of bottom sediments and water was studied under a compound microscope. The organisms present were identified and recorded. Pictures were taken of the most abundant and the most interesting organisms. The results were summarized by the following data table:

LISA J. GATENS, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Geographic variation of *Sorex cinereus* in West Virginia.

The morphological and geographical diversity of *Sorex cinereus* is evident in West Virginia. In an attempt to identify patterns of morphological



variation relative to age, sex, and geographic locality, and to clarify taxonomic status of the West Virginia soricids by defining diagnostic characters applicable to this area, a sample of 288 specimens representing three taxa were analyzed statistically. Standard external measurements were recorded, and a series of 12 cranial and dental characters were measured and recorded for each specimen. Morphological variation due to age was found in *S. c. cinereus*, but not in the smaller reference samples of *S. c. fontinalis* and *S. l. longirostris*. No sexual dimorphism was found in any of the taxa studied. Diagnostic characters found to separate *S. l. longirostris* from *S. c. cinereus* were rostral shape and relative sizes of the third unicuspid. Clear defining characters were not found for *S. c. fontinalis*, although this taxa resembles a smaller version of *S. c. cinereus* with shorter, broader rostra. These data and analyses did not reveal any presence of *S. c. fontinalis* additional to two documented specimens from Hampshire County. Although the presence of *S. l. longirostris* in West Virginia is likely, these analyses were inconclusive.

JENIFER HADLEY, JOEL ARCHIBALD, JEREMIAH WAYBRIGHT, and ALBERT MAGRO, Division of Science, Mathematics and Health Careers, Fairmont State College, 1201 Locust Avenue, Fairmont, WV 26554-2470. Screening of xenoestrogenic compounds.

Xenoestrogens are persistent environmental contaminants that are known to cause adverse reproductive effects in males and females. Among the compounds known to function as estrogenic agonists are pesticides, non-steroidal stilbenes, and phenyl analogs. The activity of these estrogen mimics results from direct binding to the steroid binding site of the nuclear estrogen receptor with  $IC_{50}$  values of 1-10  $\mu$ M. The wide chemical diversity of these compounds precludes an accurate prediction of estrogenic activity on the basis of chemical structure alone. An aim of this study was

to test the ability of estrogen mimics to compete with 17  $\beta$  estradiol for the steroid binding sites of anti-17  $\beta$  estradiol antibodies. Antibodies directed against various epitopes of the 17  $\beta$  -estradiol molecule were utilized. Compounds tested were shown to be ligands for the cellular estrogenic receptor and included estrogen analogs, stilbenes, alkyl and chlorinated phenols, polychlorinated biphenyls, polychlorinated hydroxybiphenyls, and various pesticides. It was determined that the non-steroidal estrogen mimics did not compete effectively for the binding site of the various anti-17  $\beta$  estradiol antibodies. It was concluded that the cellular estrogen receptor ligand interaction is less specific than the binding of antibodies directed against epitopes of the 17- $\beta$  estradiol molecule.

HAROLD S. ADAMS, Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, VA 24422; STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554; and STEWART A. WARE, Biology Dept., College of William and Mary, Williamsburg, VA 23185. The beech forest type in the mid-Atlantic region of eastern North America.

Quantitative data on topographic variables and composition and structure of the tree stratum (stems  $\geq 10$  cm DBH) were collected from a total of fifty forest stands with American beech (*Fagus grandifolia*) present as a significant (IV >17.5) component. Sampled stands were located in western Virginia (Giles County), West Virginia (Cranberry Glades and the Fernow Experimental Forest and adjacent portions of the Otter Creek Wilderness Area), southwestern Virginia (Mount Rogers and White Top Mountain), eastern Virginia, and the western portion of the Great Smoky Mountains (GSM). Forty-eight species of trees were tallied in the fifty stands. Basal area of trees ( $m^2/ha$ ) in the sampled stands ranged from 16.3 to 58.2, and density of trees (stems/ha) ranged from 198 to 1820. DECORANA ordination of the fifty stands resulted in an X-axis with GSM stands at



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one end and eastern Virginia stands on the opposite end. Southwestern Virginia stands clustered close to those from the GSM, whereas West Virginia stands and western Virginia stands were located close together near the center of the ordination. As such, the lines of compositional separation would seem to parallel those of the distributional limits of the three population types of beech, with gray beech in the GSM and southwestern Virginia, red beech in West Virginia and western Virginia, and white beech in eastern Virginia.

STEVEN L. STEPHENSON and JOANN B. SPOONER, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Myxomycetes associated with the aerial litter microhabitat in the Luquillo Experimental Forest, Puerto Rico.

Myxomycetes (plasmodial slime molds) are eukaryotic, phagotrophic bacterivores usually present and often abundant in terrestrial ecosystems. Most of what is known about the assemblages of myxomycetes associated with particular types of ecosystems has been derived from studies carried out in temperate regions of the world. The species associated with tropical forests have received relatively little study. In the present study, the moist chamber culture technique was used to study the myxomycetes associated with the aerial litter (dead but still attached plant parts) microhabitat of five different forest types (tabonuco forest, agriculturally disturbed forest, palo colorado forest, palm forest, and elfin forest) within the Luquillo Experimental Forest in northeastern Puerto Rico. Based on results obtained thus far, myxomycetes appear to be relatively common in the aerial litter microhabitat of tropical forests. At least 24 species in 13 genera have been recorded from the five forest types, and the percentage of cultures yielding myxomycetes has ranged from a low of 69% (for samples from the colorado forest) to a high of 98% (for samples from the tabonuco forest). Among the most consistently abundant species are *Arcyria cinerea*,

*Cribraria microcarpa*, *Diderma effusum*, *Lamproderma scintillans*, and *Physarum melleum*. (Supported in part by a grant from the National Science Foundation.)

ANGELA D. EDMUNDS and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. Myxomycetes associated with the litter microhabitat in forests of the New River Gorge.

Myxomycetes (plasmodial slime molds) are eukaryotic, phagotrophic bacterivores usually present and often abundant in terrestrial ecosystems. Despite their abundance and widespread occurrence, relatively few ecological studies of these organisms have ever been carried out. Most studies have focused on those species characteristically associated with decaying wood or bark, although myxomycetes are known to occur in a number of other types of microhabitats. The primary objective of the present study was to investigate the quantitative ecology and distributional relationships of the myxomycetes associated with the litter microhabitat in forests of the New River Gorge in southern West Virginia. During the 1996 field season, samples of forest floor leaf litter were collected from a series of study sites within the gorge, transported to the laboratory, and used to prepare moist chamber cultures. Fifty-six cultures were prepared with samples collected from sites on the rim of the gorge and 40 cultures were prepared with samples collected from sites along the river at the bottom of the gorge. At least 15 species representing nine genera have been recovered from these cultures. This total includes one species not previously known to occur in West Virginia. Interestingly, the majority of the species appearing often enough to give some indication of distribution trends seem to display a clear reference for a particular type or litter, for example, *Diderma effusum*, *D. hemisphaericum*, *Didymium ochroideum*, and *Perichaena chrysosperma* were consistently present in cultures prepared with samples of litter collected from forests on the rim



of the gorge but uncommon or even absent in cultures prepared with samples of litter collected from forests at the bottom of the gorge. In contrast, *Arcyria cinerea* was much more common in cultures prepared with samples of litter from forests on the rim.

DENISE BINION, USDA Forest Service, Morgantown, WV 26555, MICHELLE JENKINS, South Carolina Botanical Garden, Clemson, SC 29631, NATHAN D. MISSEL, Dept. of Botany, Clemson University, Clemson SC 29631, and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont WV 26554. Corticolous myxomycetes of the Luquillo Experimental Forest, Puerto Rico.

Myxomycetes (plasmodial slime molds) are eukaryotic, phagotrophic bacterivores usually present and often abundant in terrestrial ecosystems. A number of different microhabitats for myxomycetes exist in forest ecosystems. One of these is the bark surface of living trees. More than 100 species of myxomycetes have been reported from the bark microhabitat as field and/or moist chamber collections. Virtually all of these records are based on studies carried out in temperate regions of the world; studies of the bark-inhabiting (or corticolous) myxomycetes of tropical trees are generally lacking. During the 1996 field season, samples of the dead outer bark were collected from 35 different species of trees within the Luquillo Experimental Forest at the El Verde Field Station in northeastern Puerto Rico. These samples were brought back to the laboratory and used to prepare a series of moist chamber cultures. Results obtained thus far seem to indicate that species richness of myxomycetes in the bark microhabitat in tropical forests is much lower than is the case for temperate forests. Only a few species were recorded often enough to be considered common. Prominent examples were *Arcyria cinerea*, *Cribraria microcarpa*, *C. violacea*, and *Perichaena chrysosperma*. In general, values recorded for bark

pH (which ranged from 3.4 to 7.2 for all samples) were not very different from those reported for bark samples from trees in temperate forests. (Supported in part by a grant from the National Science Foundation.)

AARON P. SMITH, STEVEN K. ROOF, and STEVEN L. STEPHENSON, Department of Biology, Fairmont State College, Fairmont, WV 26554. Isolation and amplification of plasmodial slime mold ribosomal RNA genes from two species in the genus *Arcyria*.

Phylogenetic analyses of myxomycetes (plasmodial slime molds) at the molecular level are few. The goal of the present project is to apply some of the molecular techniques utilized in studies of other organisms to myxomycetes. The total DNA of the myxomycete *Arcyria cinerea* was isolated using the microwave miniprep method first described by Steven Lee. Following the isolation, specific ribosomal RNA genes were amplified using two known ribosomal RNA primers (NS5 and NS6) and the polymerase chain reaction (PCR). From the PCR products, these ribosomal RNA genes will be sequenced. The same procedure will be followed for DNA isolated from an apparently undescribed species of myxomycete in the genus *Arcyria*. After the sequencing of the ribosomal RNA genes from both species has been carried out, the sequences will be compared to determine what differences (if any) exist. Our ultimate objective is to assess the applicability of using this type of data for species identification and species circumscription in the myxomycetes.

SABINA MUEND and SUZANNE M.D. ROGERS, Department of Bioscience, Salem-Teikyo University, Salem, WV 26426-0500, 304-782-5585.

Vacuum infiltration as a method for *Agrobacterium* transformation of *Typha* contaminated water is a major environmental problem. Many contaminated sites are wetlands.



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*Typha* is a plant used in constructed wetlands to remediate contaminated water from acid mine drainage, livestock wastewater, municipal sewage and industrial wastewater. Research into improved environmental clean-up technology has led to the isolation of genes coding for specific remediation activities. This, coupled with gene transfer techniques, offers the possibility of creating genetically altered plants with enhanced decontamination activity. Model plant systems are required to investigate the potential for transgenic wetland plants expressing genes for direct or indirect bioremediation. To create a transgenic plant model using *Typha*, an effective genetic transformation protocol is needed. The technique of vacuum infiltration of *Agrobacterium* into plant tissue, for genetic transformation, has been successfully applied to *Arabidopsis*. This technique offers the advantage of being able to simultaneously treat large numbers of target explants. The objective of this study was to develop a vacuum infiltration protocol for introducing *Agrobacterium*, carrying marker genes, into *Typha* seedlings. Seeds were surface sterilized and germinated. *Agrobacterium*, carrying the gene for GUS activity (NPTII), were grown up overnight in liquid medium, and then collected by centrifugation. Young seedlings were placed in side arm flasks containing MS medium and *Agrobacterium*. When placed under a vacuum of greater than 5 in. Hg air bubbles rapidly appeared on the leaves. The vacuum was then abruptly released. The infiltrated seedlings were cultured in MS medium for 1 week. Then the seedlings were ground, using liquid nitrogen, and assayed for GUS activity, using the technique of Jefferson. No GUS activity was found in the infiltrated tissue. In conclusion the vacuum protocol may need to be altered, possibly by using a stronger vacuum. Alternatively, *Typha* has not previously been genetically transformed by *Agrobacterium*. It is not known how virulent the infiltrated bacterium strain is toward this monocot, nor if the plasmid employed is expressed in *Typha*. This study was supported by Salem-Teikyo University, Salem, WV.

SARMA S. KHANDAVILLI and SUZANNE M.D. ROGERS, Department of Bioscience, Salem-Teikyo University, Salem, WV 26426-0500, 304-782-5585. Callus regeneration and micropropagation of *Juncus*.

Constructed wetlands, using plants like *Typha* and *Juncus*, have been used to remediate acid mine drainage, livestock wastewater, municipal sewage and industrial wastewater. Collection from naturally occurring wetlands and traditional plant propagation methods have been used to produce the required wetland plants. However, thousands of plants are needed for a single wetland. The traditional techniques of plant propagation do not always yield adequate numbers of plants to fill the market demand. Effective tissue culture propagation systems are not yet available for the wetland monocot *Juncus*. The objectives of this study were to develop a regeneration and plantlet establishment protocol for *Juncus*. Callus was induced from aseptically germinated seedlings on auxin supplemented medium. After 3 to 4 weeks the calli were transferred to medium supplemented with cytokinin to induce shoots. Visible shoots appeared after about 4 weeks. Upon subculture the shoots rapidly grew to a size of 2 to 3 cm. Roots were induced and the rooted plants were established in soil. In conclusion a successful tissue culture propagation system was defined. This study was supported by Salem-Teikyo University, Salem, WV.

MARY ETTA HIGHT, DEPT. OF BIOLOGICAL SCIENCES, MARSHALL UNIVERSITY, HUNTINGTON, WV 25755.

Collections of biological specimens and their role in conservation of biodiversity.

Mankind's survival is tolerated on earth by the same set of environmental complexities which either sustains or tolerates all other earthbound life. Along with the recognition of human threats to the survival of many species comes doubt about the continuing viability of Earth's ecosystems and from this the conclusion that conservation of



species diversity is of paramount importance. Collections of biological specimens in academic and public museums and herbaria are essential resources for addressing human environmental problems as well as for research in biodiversity conservation. The science of species conservation, like most other biological disciplines, is grounded in the knowledge of the basic components of the subject, the individual species and their temporal, phylogenetic, and spatial relationships. That we know anything objective about any given species, or biological diversity in an area, is because there have been specimens preserved in museums. Distribution of species in time and space is known scientifically from specimens collected at various times and places and preserved in a museum. What we learn about any specimen is linked through museum collections to type specimens, from which the species was described, and thence to all other organisms by the science of systematics. One must be able to compare an organism taken from nature with museum specimens to know its identity and whether it is known or new, different or how different from the known. To detect changes in communities one must know what was there before. Museum collections of organisms provide the gateway to connect a specimen's identity with its community associations and other data taken with it to what is known in the literature. Large sums of public money are spent to investigate important issues in biological science. The usefulness of the studies depends on the soundness of their scientific foundation. Collections of biological specimens documenting biodiversity in West Virginia are important to ongoing and future research related to conservation and economic concerns.

WATARU TAMURA and KIRK V.  
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Reconstitution of partially assembled light-harvesting complexes.

Photosynthetic light-harvesting complexes associ-

ated with Photosystem II (LHCII) in higher plants are trimers of subunits which comprise a single polypeptide, at least 12 chlorophylls *a* and *b* (1:1) and at least 3 xanthophylls. Each polypeptide forms three transmembrane alpha-helical spans following import of the nuclear-encoded apoproteins into the chloroplast. The folding process itself can be reconstituted *in vitro* and is known to require xanthophylls (Plumley & Schmidt, PNAS 84:146, 1987). Reconstitution of apoproteins overexpressed in *E. coli* has shown that only a single gene product from the LHCP multigene family is required to fold ligate all of the pigments and that certain polypeptide regions are not involved in ligation (Cammarata & Schmidt, Biochem. 31:2779, 1992). However, much remains to be learned about the sequence of events in the folding process. Mutants of *chlamydomonas* deficient in chlorophyll *b* and neoxanthin accumulate partially assembled and incorrectly fold LHCII complexes in the thylakoids suggesting that pigment synthesis/assembly are interdependent (Plumley & Schmidt, Plant Cell 7:689 1995). In the work presented here, it is shown that pea LHC apoproteins overexpressed in *E. coli* can be partially reconstituted with only chlorophyll *a* or *b*, provided that xanthophylls are also included. The aforementioned reconstituted with only chlorophyll *a* or *b*, provided that xanthophylls are also included. The aforementioned reconstitution procedure is modified as follows: 1) freeze/thaw cycles are replaced by addition of KCl to 150 mM to precipitate excess SDS; and 2) octyl glucoside is added to 1% final concentration. In the absence of chlorophyll *a*, the partially assembled complex is stable enough to be isolated by partially-denaturing SDS-PAGE or sucrose-density gradient centrifugation. Preliminary results suggest that the partially-assembled complex may be capable of oligomerization as indicated by mobility on SDS-PAGE. Complexes reconstituted in the absence of chlorophyll *b* are isolable by solution electrophoresis. In both cases, circular dichroism spectra indicated that the reconstituted pigments are specifically-oriented. Moreover, the complex CD



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signature of "native" LHCII can be better understood by verification of the origin of specific signals.

YETUNDE ARANMOLATE & TIM

RUHNKE, Dept. of Biology, West Virginia State College, Institute, WV 25112.

Taxonomic resolution of *Orymatobothrium paulum* from the Tiger shark, *Galeocерdo cuvieri*.

Linton (1897) described *Orymatobothrium paulum* for worms from the Tiger Shark (*Galeocерdo cuvieri*). Studies of newly collected worms from Western Atlantic and Gulf of Mexico Tiger Sharks prompted an examination of this tapeworm species' taxonomic status, and its distribution within the host shark species. Specimens were examined with light and electron microscopy, and relevant taxonomic literature concerning the species was reviewed. Morphological characteristics of *O. paulum*, *O. musteli*, and species of the genus *Paraorymatobothrium* were analyzed using phylogenetic methods. This systematic analysis suggests that *O. paulum* is actually a covert member of

*Paraorymatobothrium*. Evidence that suggests this hypothesis include phylogenetically derived bothridial microtriche morphologies, and character conditions of the mature segment.

*Paraorymatobothrium paulum* can be distinguished from other species of the genus by its possession of a muscular bundle along the posterior border of each the four bothridia. The muscle bundle functions to hold the bothridium in a "C" shaped orientation, and may aid in attachment to the host gut. An analysis of the co-evolutionary pattern between sharks and worms indicates that *Orymatobothrium* and basal species of *Paraorymatobothrium* are found in Houndshark species (Triakidae). The species that includes *P. paulum* are found in larger carcharhinid sharks, and one species is found in the Thresher shark. These results indicate a general history of co-evolution between host and parasite lineages. In

addition, *Paraorymatobothrium paulum* has been found in only large Tiger sharks. An undescribed species of *Paraorymatobothrium* has been found in smaller host individuals.

CHRISTY LAWRENCE, SETH

RICHARDSON & TIM RUHNKE, Dept. of Biology, West Virginia State College, Institute, WV 25112. Systematic study of the tetraphyllidean tapeworm genus *Rhinebothrium*

Linton (1890) first described the genus *Rhinebothrium* for tapeworms from the Roughtail stingray, *Dasyatis centroura*. Approximately 48 species have been placed in the genus at one time or another. Recent collections of worms from dasyatid stingrays of the Gulf of California prompted an examination of the systematic status of *Rhinebothrium*. The goals of this study were to morphologically characterize new tapeworm species collected from the Gulf of California, and to evaluate whether phylogenetic evidence exists to support the monophyly of *Rhinebothrium*. Worms collected from *Dasyatis longus* and *D. brevis*, were studied with light and electron microscopy. A comprehensive literature survey was conducted for information on species in the genus. Three new tapeworm species were discovered as a result of this systematic study. One species is parasitic in *Dasyatis brevis* and two species reside in *D. longus*. All three species belong to the "hinged bothridia" sub-group of *Rhinebothrium* and have potential sister-group relationships to three known species. No evidence exists to support an explicit hypothesis of monophyly of *Rhinebothrium*. The pattern of bothridial location is similar among the species, but this feature is shared among tetraphyllideans of other genera from stingrays. Morphological evidence exists to support the "hinged bothridia" clade within the genus. Species in this clade are parasitic in urobatid and dasyatid stingrays. An evaluation of the cladistic analysis by Brooks and Deardorff will be presented. This research was supported by NSF Grant DEB 9300796 and a Summer Student



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Stipend award from the West Virginia State College Foundation

JOEY TURNER & TIM RUHNKE, Dept. of Biology, West Virginia State College, Institute, WV 25112. Systematic study of two tetraphyllidean tapeworm species from *Rhinoptera steindachneri*.

A collection of worms from *Rhinoptera steindachneri* revealed two tetraphyllidean tapeworm species unknown to science. The goal of this study was to place these worms within the current taxonomy of the Order Tetraphyllidea. Specimens were prepared and studied with light and electron microscopy. Relevant literature concerning similar species was collected and analyzed. Phylogenetic methods were employed to recover a hypothesis of relationship of these species to similar tetraphyllideans. The two unknown species have characteristics that are common to the species *Duplicibothrium minutum* and *Glyphobothrium zwernerii*, and are members of a phylogenetic group of tapeworms common in stingrays. There are several morphological characteristics shared between the new species, *Duplicibothrium* and *Glyphobothrium*. The scolex bothridia are fused dorso-ventrally, there are multiple longitudinal septa present on the scolex bothridia, the ovarian lobes are digitiform, and the testes extend into the ovarian field. The phylogenetic study indicated that in addition to the above two taxa, the new worms from *Rhinoptera steindachneri* belong to a lineage including the genera *Caulobothrium*, *Serendip*, the "lost" genus *Tiarabothrium*, and the dioecious species in *Dioecotaenia*. This tapeworm lineage appears to have a cosmopolitan distribution in Cownose and Bat rays. These results indicate a general history of co-evolution between host and parasite lineages. This research was supported by NSF Grant DEB 9300796.

THOMAS ALLMAN, Dept. of Biology, West Virginia State College, Charleston, WV 25112,

ERIC GARBER, Dept. of Chemistry, West Virginia State College, Charleston, WV 25112. Bacterial resistance to arsenic of soil near a coal burning plant in Belmont, West Virginia.

The purpose of this project is to isolate and characterize naturally occurring bacteria that metabolize arsenate to arsenite. The long term study on the prevalence of arsenate of arsenate resistant bacteria will provide information on the bioavailability on arsenate in areas suspected of heavy metal and toxic material contamination. The burning of coal emits an ash that contains arsenate. Soil samples were obtained from a meadow on the northeast side of a coal burning power plant in Belmont, West Virginia. Approximately 250 grams of soil was obtained from twenty different specific locations in the meadow. The soil samples were refrigerated to maintain the organisms. Once in the laboratory, soil samples were placed in nutrient broth, Luria-Bertaini (LB), containing 2 mmol of sodium arsenate medium. After 48 hours of stirring in a water bath at 30 degrees celsius, the solution was transferred to arsenate containing LB agar plates. Colonies of bacteria were observed approximately 96 hours after incubation. Isolates were tested and compared for resistance and growth rate under varying concentrations of arsenate. It was found that the isolates rate in growth was inhibited with increasing arsenate concentrations. Identification of the bacteria is in progress as well as titration of their arsenate resistance. The organisms will be examined to see if resistance is due to arsenate uptake or arsenate reduction.

JESSICA D. TALLEY and JOHN H. HULL, Dept of Psychology, Bethany College, Bethany, WV 26032. Children's worries and parents' perceptions of those worries.

This study examined the nature and intensity of children's worries and the extent to which parents are aware of those worries. Participants were



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children from three class ranges - third and fourth graders, seventh and eighth graders, and eleventh and twelfth graders - and their parents. Participants filled out questionnaires designed to measure children's self-reported levels of worries, and parents' estimates of their individual child's worries, in three broad areas: Physical Harm (e.g., being a crime victim, AIDS), Daily Life Matters (e.g., not being liked, divorce), and Global Issues (e.g., world hunger, destruction of the rainforests). Analyses of variance showed that children overall reported significantly more worry about Physical Harm issues than about Daily Life or Global Issues. Boys reported significantly less worry than girls about Global issues, while Global and Physical Harm worries decreased significantly from the youngest to the oldest group. Further, parents significantly underestimated the degree of worry their children reported about Global and Physical Harm issues. These findings confirm and extend reports of previous researchers who worked only with elementary-school children and their parents.

RACHEL SEARS, Dept. of Physical Science, Shepherd College, Shepherdstown, WV 25443 and TAMARA HARDING, Dept. of Physical Science, Shepherd College, Shepherdstown, WV 25443. Taxonomy and paleobiogeography of fenestellid bryozoa of the silurian age brownsport formation, tennessee.

The Upper Silurian Brownsport Formation in western tennessee is well known for its numerous, well preserved fossils. Lithologically it consists of thin-bedded, argillaceous limestones and calcareous shales, all of which are fossiliferous. Although studies of parts of the fauna have been undertaken, the abundant fenestrates present remain unexamined. A detailed taxonomic examination of two previously undescribed species of fenestrate bryozoan is herein undertaken employing a comprehensive three-dimensional taxonomic approach, after Snyder (1991). In this approach zoarial (colonial) and zooecial (individual) characteristics are distinguished both quantitatively and

descriptively, and through three-dimensional reconstruction of the zooecial chamber shape and size, species are delimited. Species of *Fenestella* and *Acanthocladia* are recognized in this presentation. The similarity of these species with those described in materials from France and Great Britain suggest a continuity of seaways between these now distant locations and Tennessee during the Silurian. Future detailed analysis of these European fossil materials employing this taxonomic approach will allow a more accurate species comparison.

CYNTHIA J. SPIKER, ADAM P. SMITH, and ERICA L. HARVEY, Department of Chemistry, Fairmont State College, Fairmont, WV 26554. Synthesis and computation of di-2-pyridyl ketone p-sulfobenzoylhydrazone.

The relative concentrations of  $\text{Fe}^{+3}$  and  $\text{Fe}^{+2}$  ions in cloud water affect the rate of acid rain formation. A recently-discovered ligand, di-2-pyridyl ketone benzoylhydrazone (DKB), has shown promise in simultaneously determining  $\text{Fe}^{+3}$  and  $\text{Fe}^{+2}$  concentrations. A major difficulty in the method is the rapid reduction of  $[\text{FeIII}(\text{DKB})_2]^+$  to  $[\text{FeII}(\text{DKB})_2]$ , which is partially caused by the use of ethanol as a solvent. Since ethanol must be used to dissolve the ligands, such undesirable reactions can occur. To take care of this problem, the goal of our research is to synthesize the water soluble ligand, di-2-pyridyl ketone psulfobenzoylhydrazone (DPKSB), which has the backbone DKB structure. Previous attempts to synthesize the ligand have been unsuccessful. After altering specific methods in the procedure, we have obtained the ligand. Various properties of (DPKSB), including heat of formation, have been calculated using Spartan software on a silicon graphics UNIX workstation.



