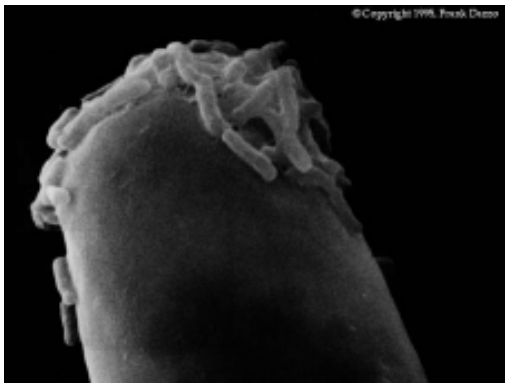
Winter Newsletter 2002 (Volume 3, Number 1)

ATBI QUARTERLY

Great Smoky Mountains National Park, The Natural History Assoc., Discover Life in America, and Friends of the Smokies



Rhizobium trifolii, a nitrogen-fixing and symbiotic bacterial species, attached to a white clover root hair (image scale is 12 micrometers across). The scanning electron microscope image is courtesy of Frank Dazzo, Michigan State University Center for Microbial Ecology (the original was published in the Journal of Bacteriology 137:1362-1373).

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Hemitrichia sp. (slime mold) drawing by Nancy Lowe

Microorganisms as the Cornerstone of the Smoky Mountain Ecosystem

Seán O'Connell

The role of the infinitely small in nature is infinitely large. These words have been used to underscore the critical part played in every environment by microorganisms (microbes). Fungi, algae, protists, bacteria, and archaea are all important organisms in Great Smoky Mountains National Park - even if many require a microscope to be seen. I study bacteria and archaea, single-celled organisms that are found in amazing habitats, in high numbers, and display incredible diversity.

Bacteria are given a bad name due to the few species that cause disease in humans, livestock, and crop species. However, greater than 99% of all bacterial species are harmless and many are beneficial to humans, plants, and animals. In fact, without bacteria most life would cease to exist. Microorganisms in the guts of animals help to digest food and supply their hosts with essential vitamins and nutrients. Many microbes associated with plants live in the root zone, supplying plants with nutrients such as nitrogen and phosphorus. Typical stream water has millions of free-living microorganisms per milliliter while soils may have billions of microbes per gram. In one gram of soil there may be more bacterial cells than humans on the planet and thousands of species living together! Any habitat imaginable, short of molten rock, is home to many microorganisms. From the ocean depths to the atmosphere, from the boiling water of hot springs to Antarctic ice, and from the deep rock subsurface to the soil zone, life is present and active. What microorganisms are doing in their environments is still an open question and one that I will address in a few habitats in the Smokies.

There are probably millions of bacterial and archaeal species on Earth, most of which have not yet been discovered. Microscopically, many of these species are indistinguishable. It is only by their metabolic differences that most microorganisms can be separated into coherent groupings. For example, a broad classification defines two large groups of microbes; those that obtain energy from photosynthesis versus those that obtain energy from chemicals in their environment. The role of microorganisms in the cycling of elements such as carbon, nitrogen, sulfur, and iron is perhaps the most environmentally relevant way to describe microbial diversity. On an ecosystem level, the biomass of these single-celled organisms is substantial, leading to massive exchange of nutrients between the microbes and other life forms as well as the soil, water, and atmosphere in their ecosystems.

The research that I am planning to carry out in the Park is twofold and includes the following objectives; 1) to document the species of bacteria and archaea that may be found in diverse habitats in the Park, including groundwater, surface water, and soil and 2) to define the communities in these environments based on species diversity and metabolic diversity. Dozens of new species will be described in these studies using DNA fingerprinting and metabolic analyses. Furthermore, with long-term studies, the changes in communities based on environmental changes such as atmospheric pollutant input, Anakeesta Formation leachate, and seasonal effects will be characterized. Changes in the community structure based on the dynamics of dominant species and their metabolic processes (e.g., nitrification, iron oxidation) will be assessed. It is expected that such long term studies will be useful in environmental monitoring of the Park while at the same time reveal the great diversity of microbial species within it.

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The President's Corner

The annual meeting is now a month past, yet the positive mood of the meeting and the enthusiasm of the Board meeting immediately after still lingers. Jeanie Hilten and Emily Jones certainly deserve much credit for organizing an annual meeting that was full of meaningful talks, fun and entertaining events, and lots and lots of opportunities for discussions on all aspects of inventory, education and collaborations (highlights are found elsewhere in this newsletter). At the Board meeting that followed on Saturday, we brought on a slate of new Board members, each with special skills important to our progress, and all possessing enthusiasm for Discover Life and the ATBI (see Board members list in left column). Having had some time to reflect on the two meetings, the word "maturity" keeps popping into mind to describe both. Clearly, we are moving across the boundary from an upstart enterprise to one that has staying power and long-term goals. However, with this transition from "upstart" to "adolescent" come many of the same challenges that we as parents have laid upon our children—accountability and responsibility. From the Board meeting we came away with a real sense of the need to be responsible to all those who have donated so much time, talent and resources to get us to this point. Before spring breaks, the Board committed to completing a strategic plan and accompanying business plan that will serve as a guide for business decisions and a tangible demonstration that we accept our responsibility of moving from youth to adolescent. At the December Board meeting we bade farewell with deepest thanks to several Board members. Each came to a new organization and contributed to our getting off the ground in many ways. However, the contributions of one outgoing Board member, Charles Maynard, stand out and deserve a special thanks here. Charles' advice and counsel was always wise and his support and encouragement carried us through many a crisis. Thanks, Charles!

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Keith Langdon Receives NPS Award

Larry Hartmann

At the ATBI Conference, Keith Langdon, Inventory and Monitoring Branch Chief, was presented with two important awards. First, the National Park Service's Associate Regional Director for Resources, Stewardship, and Science John Yancy came from the Regional Office in Atlanta to present Keith with the Regional Resource Manager of the Year award, largely for his work with the ATBI.

Park Superintendent Mike Tollefson and Assistant Superintendent Phil Francis jointly presented Keith with a GRSM award for successful management of the ATBI program, contributions to the New Learning Center and Science Center, work with other parks, and assistance to park management during special events. Keith deserves a very public and sincere thank you. His tireless efforts and remarkable talents have been key in putting the Smokies at the cutting edge of science-based park management. Great Job!!!

Rebecca Shifflet

Supt. Tollefson and Keith Langdon (with award)

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Call for Proposals: DLIA Grants Program, 2002

One hundred thousand dollars is allocated in the current funding cycle for research activities in support of Great Smoky Mountains National Park's ATBI. This is a call for proposals for grants to be awarded by Discover Life in America, Inc. (DLIA), for research to be conducted during the upcoming (2002) field season. Award amounts will not exceed $7,500.

Please submit a proposal of no more than 500 words outlining what would be done if you were provided that level of funding. Include research objectives, expected products (e.g., webpages, keys, checklists, etc.), and a budget that stipulates how the funds would be spent. In addition, append a short paragraph indicating any assured or anticipated funding (actual dollars or "in-kind" support) that would be leveraged by a DLIA grant award. The paragraph should contain, among other support, anticipated "in-kind" hours to be devoted to the project by all professionals, students, and technical assistants. DLIA policy does not permit use of these funds for the purchase of equipment or for the payment of indirect charges.

If your proposal is funded, a written and oral report of your results to date must be available for the December 2002 annual meeting of the ATBI, with a final report provided to the ATBI website via Jeanie Hilten **<jeanie @discoverlife.org>** by 1 May 2003. Besides the scientific findings, the final report must include a list of all funds that were leveraged by the DLIA support and a list of "in-kind" contributions included in the project, specifying the hours devoted by all professionals, students, and technical assistants. A copy of the final report (in Access database or Excel spreadsheet) must be forwarded by 1 May 2003 to Keith Langdon <Keith_Langdon@nps.gov> and the data provided by the same date to the ATBI database via Norman Johnson <johnson.2@osu.edu> in a format specified by him. (Note that assistance with database construction in Access is available free from the Park, if requested.)

Proposals are more likely to be successful if they are fully integrated with the ATBI Science Plan, which is available on the DLIA website <http://www.discoverlife.org/>. Proposals from previous awardees will be evaluated in part on their provision of products promised in earlier awards, and their timely provision of expected reports and data from those awards for the ATBI annual meeting, the ATBI website, and the ATBI database.To conduct research in the Park, a collecting permit is required. Refer to the online application for your scientific collecting permit at http://science.nature.nps.gov/research. Your proposal should be sent electronically as an e-mail text file and as an MS Word attachment to John Morse <jmorse@clemson.edu> by 28 February 2002. If awarded, the funds will be made available on or about 15 April 2002. Coordination and additional information may be obtained through Jeanie Hilten . We look forward to receiving your proposal and to working with you toward the completion of the ATBI!

To submit a 2001 Investigators Annual Report or to apply for a permit go to this web site < http://159.189.162.15 >.

Science Center Planning & Design

Keith Langdon

For 20 years, Great Smoky Mountains National Park has expressed its intention to build a new lab at Twin Creeks. With assistance from the Friends of the Great Smoky Mountains National Park, Senators Fred Thompson and Bill Frist, and many NPS personnel, this facility is about to become a reality. Planning for the~15,000 square foot Science Center is over 75% complete as of January 2002, and if the required reviews are completed on time, the construction bids will be let in early fall.

The building will include the critically needed curatorial space for the natural resource specimens, a very large flexible work room for use by visiting scientists and NPS staff, a wet lab, a Geographic Information System room, and a sizable education room. An invertebrate "rearing room" and offices for the Park's Inventory and Monitoring staff and partners are also planned. The planning and design team have developed a functional and flexible building floor plan to accommodate changing needs over time. A major theme of the design is to foster interactions between NPS staff, visiting scientists, agency partners, such as Discover Life in America and the US Geological Survey, and especially youths and citizens.

It is important for everyone to remember that at the first ATBI in 1997, the Park asked the assembled group of 100 people what were the most important things we could do to increase quality science partnerships over the long term. You told us: 1) a good work facility, 2) lodging nearby, and 3) a host friendly/less bureaucratic environment. You have had a major influence on the design. We also appreciate the valuable input of the folks at the 2001 ATBI Conference who made specific suggestions.

As part of the package that went to the Congress for funding, the Friends agreed to rehab buildings or build a new building that would provide nearby lodging for scientists engaged in work in the Park. Specific planning on the lodging has not yet begun.

If you have suggestions or want to look over the plans for the Science Center, please contact Dianne Flaugh <Dianne_Flaugh@nps.gov>. Meanwhile, we are preparing for several reviews by government facilities development panels to ensure compliance with energy conservation, ecological sustainability and cost efficiency. The NPS is planning to require a 12 month deadline for construction, once the contracts are awarded. With luck we may have photos of the ground breaking in the fall issue!

Keith Langdon, Inventory and Monitoring Coordinator
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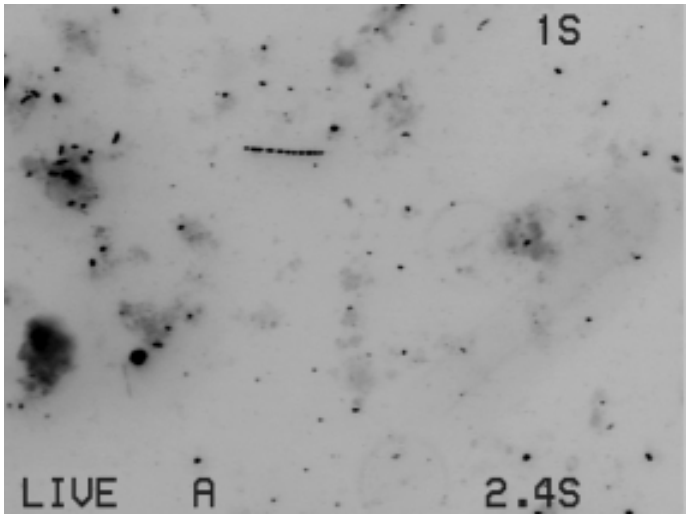
Steven W. Wilhelm

The rivers and streams in Great Smoky Mountains National Park like the Little River, often are thought of as teaming with life (e.g. , insects, trout, etc.).



Amanda Dean

Closer examination of streamwater (like the microscopic image shown here) shows that the dominant members of the system are microbes.

Why Care About Biodiversity of Microbial Communities in Great Smoky Mountains National Park?

Steven W. Wilhelm

Perhaps the most over-used and misunderstood word in the scientific vernacular is "biodiversity". Like many buzz words, it has different meanings to different people. In the eyes of microbial ecologists, biodiversity refers to the information stored in the genetic codes of organisms. The expression of this information manifests itself as the different characters (phenotypes) scientists employ for the delineation of different species. As such, more than 99% of the biodiversity in Great Smoky Mountains National Park (GRSM) is tied up in the unseen masses of microorganisms that inhabit the Park's lakes, streams and soils. In fact, it is safe to say that the microbial diversity in a cup of river water exceeds the diversity of all the Park's plants and animals combined. It has been estimated that most of the living carbon on the planet is microbial in nature. In general, we now know that bacteria persist in aquatic environments at numbers of 10^8 – 10^{10} per liter. Viruses are even more abundant in natural systems, and can range from 10^9– 10^{11} per liter. Although invisible to the naked eye, microorganisms (including bacteria, fungi, algae and viruses) dominate every known niche. While commonly considered as only agents of disease, they are in fact a natural part of any ecosystem.

> ...more than 99% of the biodiversity in Great Smoky Mountains National Park (GRSM) is tied up in the unseen masses of icroorganisms that inhabit the Park's lakes, streams and soils.

In the last two decades, an understanding of the importance of the ecology of systems has moved from discussions amongst academics to discussions in many households. Society has gained an appreciation for the cycle of growth, death and rebirth that passes carbon and nutrients through systems. Microorganisms play a critical role in these processes at all levels: photosynthetic organisms convert CO_2 into biomass and stored energy, viruses and grazing organisms kill photosynthetic organisms and convert the material to organic waste, and bacteria consume these components and return CO_2 back to the atmospheric pool.

As part of the ATBI, the Aquatic Microbial Ecology Research Laboratory *(*http://web.bio.utk.edu/wilhelm/*)* at the University of Tennessee has begun a program to examine the GRSM microbial communities. Working from a site on Little River, we have been monitoring viral and bacterial abundances for the past 15 months. As a contrast, we also sample a site in Fort Loudon Lake. Our studies demonstrate that bacteria and viruses in Little River show a spring-time increase in abundance similar to that seen in lakes. The long-term goals of this research are to characterize the diversity and activity of bacteria and viruses in this system.

Characterizing Bacteria in the GRSM Ecosystem

Understanding which bacteria are present and active members of the GRSM ecosystem is a daunting task. However, it is a necessary task as we can subsequently make basic predictions about their specific biochemistry and thus their role in the ecosystem. Modern day microbial ecologists rely on state-of-the-art molecular tools to dissect and characterize these systems. DNA can be extracted from soil or water samples and purified in the lab. Using a technique known as

the Polymerase Chain Reaction (PCR), many copies of microbial genes can be made to provide enough genetic material to study. While a variety of genes can be used for this process, most research involves the 16s rDNA gene. This gene encodes a nucleic acid fragment that forms a subunit of ribosomes, which carry out protein synthesis. As such, the DNA sequence of this gene changes very rarely and provides a platform for the study of the relatedness of distantly related organisms. As a large number of researchers have focused their studies on this gene, a large database allows us to take DNA sequences from unknown fragments and determine which bacteria they were amplified from. Analysis of a series (often hundreds) of these fragments slowly helps us assemble a picture of the microbial community structure.

Ecology of Viruses in Natural Systems

Today, we no longer think of viruses as pathogens that just cause disease in animals and plants, but also as integral parts of natural ecosystems. In systems such as the rivers in the Park, viruses regenerate nutrients for phytoplankton and bacteria as they lyse the organisms they infect. Our preliminary work suggests they play an important role in recycling organic carbon to bacteria. Other insight suggests they also play an important role in controlling the diversity of bacteria in a system. Unfortunately, the current research only scratches the surface of the pivotal role viruses play in these systems.

Future Directions

Currently, work in both the Aquatic Microbial Ecology Research Laboratory and in the University of Tennessee Center for Environmental Biotechnology (http://www.ceb.utk.edu/) is moving to provide insight on microbial diversity and activity in GRSM. New technologies, stable funding and increased public interest are driving researchers to resolve issues concerning this unseen biodiversity. Not only does this provide scientists with a better understanding of the system, but it also provides UT educators with a platform to train students in microbial ecology, environmental engineering and biotechnology that will augment the activities in the Park and ultimately the quality of life in East Tennessee.

Acknowledgments

Research described in this article is the work of University of Tennessee researchers (Amanda Dean, Gerda Harms, Melanie Eldridge) and has been sponsored by funds from the National Science Foundation (DEB-0003069) and Discover Life in America.

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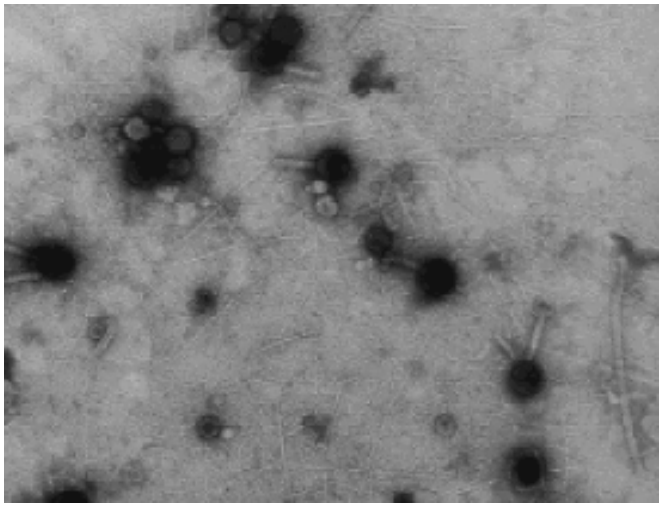


Transmission Electron Micrograph of a natural virus community from the Gulf of Mexico.
Courtesy of Curtis A. Suttle and Amy M. Chan, The University of British Columbia

Today, we no longer think of viruses as pathogens that just cause disease in animals and plants, but also as integral parts of natural ecosystems.

Steven W. Wilhelm

Research assistant Amanda Dean collecting carboys of water. The water is taken to The Aquatic Microbial Ecology Research Lab at The University of Tennessee where the abundance, activity and diversity of viruses, bacteria and algae is examined.

Worms! Segments, Hairs, Maybe Gills — Oh My!

(Aquatic Oligochaeta in the Great Smoky Mountains National Park)

Mark J. Wetzel and Peggy Morgan

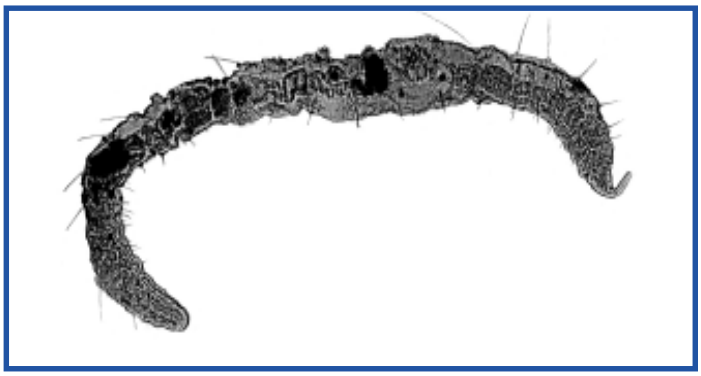
The Oligochaeta, one of several groups of true-segmented worms in the Phylum Annelida, are commonly found in terrestrial, as well as marine, brackish, estuarine, and freshwater ecosystems on every continent. Other groups of segmented worms in this phylum include the Polychaeta, or bristle worms — primarily marine, with several freshwater and estuarine species; the Hirudinea, or leeches — primarily freshwater, with several marine and terrestrial species; the Branchiobdellida, or crayfish worms — almost exclusively associated with freshwater crayfishes; the Aeolosomatida, or suction-feeding worms (now considered to be polychaetes) — freshwater; and the Acanthobdellida, or bristle leeches — with only one or two species associated with marine fishes in Arctic waters.

> To date, thirteen species representing 8 genera and 3 families of aquatic oligochaetes have been documented from the Park, all representing new Park records...

As is true for all groups of organisms, some oligochaetes are restricted to unique as well as disjunct habitats such as caves, springs, other groundwater habitats, and even thermal vents in the oceans. Many are endemic to a single or limited number of sites. While most oligochaetes are free-living, several species have commensal relationships with other animals, and many species are commonly associated with aquatic and terrestrial plants.

Worldwide, oligochaetes range in length from less than two-hundredths of an inch to almost 10 feet! However, you will not find a 10 foot worm unless you go to Gippsland in Australia. The largest terrestrial worm you may encounter in the Great Smoky Mountains National Park may reach a length of 10 inches; the longest aquatic species may reach a length of 1.5 inches. Like all annelids, oligochaetes are bilaterally symmetrical, with an elongate, cylindrical body shape divided both externally and internally by a regular, linear series of segments.

S.J. Taylor, INHS



Digitally enhanced photomicrograph of *Pristina leidyi* Smith, 1896 (Oligochaeta, Naididae), one of several aquatic oligochaetes collected from Parson Branch Road Spring and other sites in Great Smoky Mountains National Park.

The number of segments is relatively fixed in some annelid groups, but indeterminate in others. The highly developed digestive, circulatory, nervous, and excretory systems within the body cavity (coelom) reflect external segmentation, and generally are repeated serially; this is called metameric segmentation, distinguishing annelids from all other worm-like groups.

Externally, annelid form is diverse, even within each group; many polychaetes may have distinct body regions, with limb-like parapodia, chaetae (hairs), tentacles, and antennae, while others may appear similar to an earthworm, with few if any external appendages. Most oligochaete species have chaetae arranged in bundles on nearly every segment, and several aquatic oligochaete species have gills, eyes, and/or a proboscis. Oligochaetes are hermaphroditic (both sexes are present in each individual); reproduction is commonly sexual, but many species reproduce asexually by budding or fragmentation.

Oligochaete worms are important components of their respective habitats — streams, lakes, ponds, springs, the ocean, or soil. The feeding habits of many species are important in the decomposition of organic matter and recycling of nutrients in terrestrial and aquatic environments. Aquatic oligochaetes, like several other groups of plants and animals, have long been recognized as indicators of water quality. In fact, Aristotle (384-322 B.C.) has often been cited as the first person to associate a writhing carpet of red worms with raw sewage. Aristotle most likely observed large colonies comprised of several oligochaete species in the family Tubificidae, or sludgeworms.

Although a few aquatic oligochaetes can be identified under a dissecting microscope, most species must be mounted on microscope slides and observed at high magnification under a compound microscope before accurate identifications can be determined.

While aquatic oligochaetes commonly are an important and often dominant component of the benthic community, specimens rarely are identified beyond class or family level because of perceived difficulty in taxonomic resolution. To bring the study of Oligochaeta into perspective, we currently recognize 38 families, 803 genera, 60 subgenera, and over 8,200 nominal species of terrestrial and aquatic species of oligochaetes, worldwide. Over 200 species of freshwater oligochaetes representing 13 families and 74 genera are known to occur in North America; of these, at least 10 families, 58 genera, and

Location of 63 sites within the Park, where surveys for aquatic Oligochaeta were conducted in 1999, 2000, and 2001.

M.J. Wetzel, INHS.

Parson Branch Road Spring, located south of Cades Cove, from which *Pristina leidyi* (Oligochaeta, Naididae) and other aquatic oligochaetes were collected in 2001. A YSI Model 556 multimeter was used to measure field water quality parameters.

120 nominal species are known or thought likely to occur in the southeastern U.S., including earthworm species occasionally collected from aquatic and muddy habitats.

Over the last 40 years, many publications have focused on the distribution, ecology, classification, taxonomy, and systematics of aquatic oligochaetes at the North American, regional, and state/provincial levels. No published papers have summarized the distribution of aquatic oligochaetes in the Great Smoky Mountains National Park (the Park), although several papers have provided collection records for a few taxa.

Small grants awarded by Discover Life In America, Inc. (DLIA) have supported our collection of aquatic annelids and other macroinvertebrates from 63 sites within the Park as part of the ATBI project; these include 49 stream sites, 12 springs or seeps, a pond, and Gum Swamp. Field collections were conducted in September 1999, September 2000, and April and September/October 2001. Funding from DLIA is also supporting surveys in the Park for other groups of annelids. Samuel W. James (Maharishi School of Management) is studying terrestrial Oligochaeta, and William M. Moser (U.S. National Museum-Smithsonian Institution) and Donald J. Klemm (U.S. Environmental Protection Agency), are studying leeches. Sam James published an article on terrestrial oligochaetes in the autumn 2000 ATBI Quarterly. An article focusing on the leeches of the Park, written by Moser and Klemm, was published in the autumn 2001 ATBI Quarterly.

In September 1999, a preliminary checklist of aquatic and terrestrial annelids known to occur in the states adjacent to the Park was established on the World Wide Web: < **http://www.inhs.uiuc.edu:80/~mjwetzel/AqAnnel.GSMNP.html** > This site also provides a summary of field surveys for aquatic Oligochaeta conducted in 1999, 2000, and 2001 — locality information for collections, field and laboratory methodologies, status of samples and specimens that have been collected from the Park, and pertinent literature.

To date, thirteen species representing 8 genera and 3 families of aquatic oligochaetes have been documented from the Park, all representing new Park records; the collection of *Rhyacodrilus subterraneus* (Tubificidae) represents a new state record for North Carolina. Representatives of two other families of aquatic oligochaetes, and three other annelid groups, the Aeolosomatida, Branchiobdellida, and Hirudinea, also have been collected during this study. The density and diversity of oligochaetes in samples collected to date is surprising low, considering the diversity of physical habitat present at each site. Additionally, many specimens collected to date have been immature, preventing species-level determinations.

Future surveys for aquatic oligochaetes will be conducted in streams and springs draining to the north, several caves within the Park that contain standing or flowing water, small seeps and springs that occur at high altitudes within the Park, and several minor drainages flowing south, particularly those that flow into the impoundments of the Little Tennessee River system.

Incidental oligochaete specimens collected by other biologists will be identified as time permits. Voucher specimens of each species will be forwarded to the central ATBI repository at Twin Creeks; other specimens will be deposited in the INHS Annelida Collection in Champaign. Non-annelid macroinvertebrates are being sent to the Twin Creeks facility for distribution to and identification by other taxonomists. Data relating to the collection and identification of aquatic oligochaetes from the Park will be included in the INHS Annelida Collection Database, and conveyed to Norm Johnson and Luciana Musetti for assimilation into the ATBI Database. The success of this investigation for aquatic oligochaetes in the Park is the result of the cooperative efforts of many individuals. In particular, we recognize the continued support and suggestions from Keith Langdon and Becky Nichols (NPS-GRSM), Jeanie Hilten (DLIA) and Chuck Parker (USGS), John Morse (Clemson University / ATBI Science Committee), and Frank Harris (Chairman, Discover Life In America Board of Directors).

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Mary Sega

St. Mary's school students left to right: Brett Blair, Egan Moore, Jennifer Lea, Sara Lammert, Daniel Stephenson, Sarah Budai and Brian Peek. Paul Super is at the back.

Mary Sega

Brett Hardt and Jennifer Lea checking out GPS coordinates with parent volunteer Steve Lammert

Building Bridges Among Teachers, Students, and Scientists

Michelle Prysby

Each week during the summer of 2001, Marsha Sega and eight co-researchers traveled to the Smokies to conduct ATBI trailside surveys. At 200-meter intervals along West Prong, Bote Mountain, and Chestnut Top trails, these researchers inventoried ferns, collected beetles and snail shells, and characterized the habitat by recording canopy cover and dominant species. By the end of the summer, the group had surveyed over 4 miles of trails. While this project would be a significant accomplishment for any scientist, it was particularly noteworthy for these researchers. Marsha Sega is a science teacher at St. Mary's School in Oak Ridge, and her co-researchers were all middle school students who gave up part of their summer vacation to assist with ATBI efforts.

The scientific value of their work is obvious. The St. Mary's "citizen scientists" were reliable and capable field assistants collecting valuable data. The educational value of their work, however, extends far beyond the data collection activities. The students are now doing independent research projects based on their work. They used their observations from the summer to design new research questions, returned to the Park to collect more data, and drew their own conclusions. They will present their findings at a school science fair in February. Not only did the students contribute to the data collection step of a large research project, they experienced all the other steps of scientific research by completing smaller projects and used their ATBI experiences to fulfill curriculum requirements at school.

The activities of Marsha Sega and her students are a fine example of how teachers can integrate real scientific research into their classrooms. Finding ways to help more teachers incorporate research in Great Smoky Mountains National Park into their curricula is part of my job as Science Education Specialist at Great Smoky Mountains Institute at Tremont. Too often there are communication gaps among researchers doing science, teachers teaching science, and students learning science. All three groups can gain from greater interaction. By partnering with students and teachers, scientists can do more long-term, broad-scale studies that require many assistants (such as the ATBI). In return, scientists can help students move beyond the dry facts in science textbooks and experience the excitement of the scientific process in action.

Involving students in research can be intimidating. When we do real science, we don't know the "answers" ahead of time. The potential is high for results to turn out differently than we expected or for our methods to not work as well as we had planned. Making real research fit into the limitations of a 50-minute class period, an overstretched budget, and a focus on test scores can be especially challenging. However, there are teachers out there (e.g., Marsha Sega, Jon Souders from Glen Este High School) making it work. At Tremont, we want to empower more teachers to try what these pioneers have done.

We invite all educators interested in the potential of citizen science to attend our Integrating Science workshop for teachers April 5-7, 2002. We will discuss a variety of citizen science opportunities, including the ATBI, and how to make them work in the classroom. Teachers new to citizen science will have opportunities to talk with teachers who have successfully integrated real research into their curricula. We will refresh our understanding of the scientific process by participating in some of the exciting field research happening at Tremont. It is sure to be a fun and learning-filled weekend, and we encourage both informal and formal educators to join us.

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The Role of the Student Conservation Association in the Great Smoky Mountains

Carroll Schell

Great Smoky Mountains National Park is the biggest user of Resource Assistants (RAs) from the Student Conservation Association (SCA). Not only were we number one in the National Park Service in 2001 but we were also number one of all federal government installations that utilize RAs! The Student Conservation Association is a non-profit organization with a goal to link conservation minded individuals, especially high school and college students, with organizations that need assistance in protecting and managing natural and cultural resources. As a result of their work, they place over 2,000 students each year in conservation positions throughout the United States!

With this Park in mind specifically, what does this all mean for us? First, RAs and high school crews are volunteers. We only pay a stipend to SCA to cover uniforms, travel, food, and administrative overhead for each RA or high school crew. Second, for the Park in 2001 (not counting the high school crews who addressed trail maintenance needs), this means that our RAs volunteered some 16,300 hours of labor to protect Park resources, educate the visiting public and assist in activities associated with the ATBI. Third, and most important of all, our expenditures of approximately $60,000 to SCA converted into over $250,000 in volunteer services.

Our involvement with the Student Conservation Association began in 1967 with 15 boys reporting to the Park in two separate groups. The first group was based in the old schoolhouse in Catalochee and the second group was based in the old Greenbrier barn. They did trail clearing and improvement work and boundary clearing and marking. Now, in addition to the above work, RAs are involved in wildlife, vegetation, air quality, and fisheries management; archeology, fire management, Inventory and Monitoring, Resource Education, and the ATBI.

On average, one thousand young people may be here on average for 12 weeks during any given part of the year. For the past 34 years young people have contributed volunteer labor with the express purpose "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (NPS Organic Act). Can you think of a more noble cause?

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TAXON	SPECIES NEW TO SCIENCE	SPECIES NEW TO PARK
Microsporidia	1	4
Slime molds	14	110
Fungi	1	6
Algae	42	210
Plants	0	2
Protozoans	0	10
Nematomorpha (horse hair worms)	0	3
Nematodes (roundworms)	1	2
Mollusks (snails, slugs, mussels)	3	4
Tardigrades (waterbears)	0	19
Annelids (segmented worms)	4	14
Crustaceans (copepods, crayfish, etc)	25	6
Millipedes	1	1
Pauropods	2	31
Arachnids (spiders, mites, ticks)	39	479
Collembola (springtails)	35	97
Diplura	0	1
Odonata (dragonflies, amselfies)	0	19
Blattodea (cockroaches)	0	1
Plecoptera (stoneflies)	0	3
Homoptera (hoppers)	0	1
Neuroptera (lacewings, antlions, etc.)	0	8
Coleoptera (beetles)	2	0
Mecoptera (scorpionflies)	2	1
Siphonaptera (fleas)	1	0
Diptera (flies)	33	73
Trichoptera (caddisflies)	6	34
Lepidoptera (moths, butterflies, skippers)	1 (new tribe for NA)	467
Hymenoptera (bees, wasps, ants)	3	0
Amphibians	0	2
Mammals	0	1
TOTALS	216	1609

Becky Nichols, Park Entomologist
Becky_Nichols@nps.gov


Kemp Davis

5th Annual ATBI Conference Celebrates Discovery of Life

Jeanie Hilten

From the gathering of photographers on Wednesday afternoon to the two full days of scientific and education sessions, exhibits, and discussions, this year's Conference was a showcase of interaction. As researchers presented their findings, participants learned more and more about the incredible array of biological diversity in Great Smoky Mountains National Park. Just as valuable as the exciting discoveries of life new to science were the dynamic connections growing among the humans.

Over 150 people participated in the meeting as presenters, exhibitors, educators, students, volunteers, citizens—a virtual super-organism, or as Peter White alluded, maybe something similar to a slime mold! One of the finest aspects of the conference was the multi-disciplinary interest displayed. Those who devote themselves to work on the ATBI have a wide span of curiosity—as easily amazed by stoneflies in the streams as tardigrades in the moss.


Kemp Davis

Exhibitor Robert Martin of Martin Microscope

Photographers Rebecca Shiflett, Don McGowan, and Kevin Fitz Patrick captured the scientific method in progress with an inspiring slide/music show. Artist Nancy Lowe showed the beauty of moths and myxomycetes. Young people from several schools and from programs such as Upward Bound demonstrated their abilities in the field and the lab. Over 50 presenters from universities and museums across the midwest and southeast enthusiastically shared the results of fine work. Discover Life in America volunteers reported on their unique adventures. Emily Jones cheered us all on and liberated quite a few of us from our wallets at Chris Headrick's Biodiversity auction.

Our special guest speakers revealed in different ways the greatness of the task to which we all aspire. Charles Maynard's eloquence and the poetry of Robert Frost led us to question whether "our premises are right". Michael Donoghue's intriguing research assembled a veritable Noah's Arc of the strange and unusual. Hearing their messages about exploration and discovery, we are imbued with a sense of wonder—and a mission to be good stewards of the entire enthralling earth.

Whatever work we can each undertake to learn more about this planet and all its denizens, let's plunge in! In the coming year, we will gain energy and momentum—like children running down a hill, exuberant with the joy of living. Just as there is a role for everything in an ecosystem, there is a part for every person to play as we come to know and to treasure our natural heritage.

Jeanie Hilten
DLIA Administrative Officer
jeanie@discoverlife.org


Kemp Davis

Guest Speaker Michael Donoghue


Rebecca Shiflett

Presenter Mark Wetzel

Events Calendar

Jeanie Hilten

In the coming year, Discover Life in America is coordinating more ATBI volunteer training and several exciting special events—"Bio-Quests". If you are interested in becoming a volunteer and would like to participate in one of the orientation sessions, please note that two programs are offerd in 2002. Enroll soon because space is limited. There also will be specialized training and other educational programs in conjunction with the Bio-Quests. Scientists and educators who would like to participate are encouraged to get in touch with me.

For more information about upcoming events, contact Jeanie Hilte (DLIA), <jeanie@dis-coverlife.org> or Tom Rogers (DLIA Board and Science/Taxonomy volunteer team leader, <trogers@rollinscorp.com>or Pat Cox (University of Tennessee) for the Fern Forays <pcox@utk.edu>.

MARCH

Saturday, March 23 - Sunday, March 24: Volunteer Training Orientation I. Sugarlands Training Room. Optional field/lab activities on Sunday. Call Jeanie Hilten at 865-430-4752 to register.

Saturday evening, March 23: "Millipede March" Bio-Quest. Meet Sugarlands Training Room.

APRIL

Friday, April 5 - Sunday, April 7: "Integrating Science" Workshop for Teachers. Great Smoky Mountains Institute at Tremont (GSMIT) invites all educators interested in the potential of citizen science to attend this workshop for teachers. For more information about the GSMIT Teacher Workshop, call 865-448-6709 or visit <http://www.gsmit.org>.

MAY

Saturday, May 18 - Sunday May 19: Volunteer Orientation II. Purchase Knob, NC. Optional field/lab activities on Sunday.

JUNE

Saturday, June 8: "Fern Foray I". Meeting place to be announced. (The Fern Forays, coordinated by Dr. Patricia Cox at the University of Tennesse, involve trail hikes with sampling points to identify ferns. Pat provides at least one "real botanist" with each group of volunteers, so don't hesitate to join the fun.)

Sunday, June 9 - Thursday, June 13: A variety of activities centered around the June 10-11 "Lepidoptera Quest". Scientists please contact Dr. Dave Wagner, <wagner@unconnvm.uconn.edu> , Dr. Brian Scholtens, <scholtensb@cofc.edu>, or Tom Rogers, <trogers@rollinscorp.com>, to participate in the collecting and sorting. There will be volunteer training on June 9 and programs for students and teachers on June 12-13.

Saturday, June 22: "Fern Foray II". Meeting place to be announced.

Thursday, June 27 - Sunday June 30: "Protista Pursuit" Bio-Quest. Sugarlands Training Room. (This venture will survey not only protozoans and algae, but also other life forms collected along the way, such as tardigrades.) Contact Tom Rogers <TRogers@rollinscorp.com>.

JULY

Saturday, July 13: "Fern Foray III". Meeting place to be announced.

Saturday, July 20 - Sunday, July 21: "Snail Search" Bio-Quest. Sugarlands Training Room.

Saturday, July 27: "Fern Foray IV". Meeting place to be announced.

Late July-early August: "Bat Blitz" Bio-Quest. Volunteers and the public will not be involved directly in this work, but will be invited to bat awareness education programs. Get in touch with Jackie Belwood <ohiobats@aol.com>.

Jeanie Hilten, DLIA
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865-4304752

Fall Picnic at Purchase Knob: Inspiring Views and Fellowship

In early November, ATBI scientists, volunteers, Park Service and Discover Life staff gathered at the lovely Purchase Knob to enjoy an afternoon "Potluck Picnic" together. As clouds and mist played tag with the sunshine over the mountains, folks visited, munched, hiked, and reflected on the past research season. Thanks to everyone for delicious food and fine camaraderie. Let's make this an annual event!

Kemp Davis

Potluck picnic indoors at Purchase Knob

NPS

View from the porch

Note to ATBI Authors

We are especially interested in news items about a broad range of organism groups and research activities. Authors should avoid technical jargon unless explained or defined in the text. Send your text as an MS Word file. Send black and white illustrations as 300 dpi TIF files or large format JPG files attached to your e-mail message. Remember to limit your text to 600 words.

Ruthanne Mitchell,
coordinating editor
cwmitchell@ntown.com

A Note from the DLIA Development Coordinator

Emily Jones

What a great conference in November! It really laid the groundwork to begin an exciting new year. I enjoyed meeting folks and putting names and faces together. I want to thank all those who donated items to the First Annual Biodiversity Auction. We raised over $4,000 to support the mini grant program and had some beautiful (and exotic) items donated from area businesses and artists, and the individuals and organizations that are part of the ATBI. For those of you who could not join us, I hope you will do so next year. There was a great selection to bid on from chocolate covered grass hoppers to bonsai trees, incredible photography, beautiful paintings, prints, and Nancy Lowe's original drawing of *Ligdia* sp., a new species of Geometrid moth found at Clingman's Dome.

Great ideas for raising money (and awareness) came from the conference, the Board meeting, the break out session, and informal discussions in the hallways and over meals. Never let it be said that scientists don't think outside the box. Ideas included everything from developing a line of plush toys based on new species (stuffed tardigrades and slime molds) to having a new species of the month web site to introduce people to these great discoveries. These are great ideas and I cannot wait till the day we sell Sammy the Huggable Slime Mold and Beatrice the Beautiful Bacteria on the DLIA website.

One of the challenges of our work on the ATBI is to capture and translate this infectious excitement about discovery to the general public. Thanks to ATBI photographers, Kemp Davis, Kevin Fitz Patrick, Rebecca Schiflett, Don McGowan and Joe Conn, we now have a compelling multimedia presentation which illustrates the wonder of discovery that is the ATBI. The program currently is being converted to a power point and video formats

Kodak Corp. donated 200 rolls of 36 exposure film to DLIA.

An exciting development from the Board meeting immediately following the conference is the creation of an ad hoc Marketing and Development Committee to focus on strategic work with national, private, and corporate funders. There are many great opportunities that lie ahead for us and we need to be in the best possible position to partner with funders who can support this work. Mary Johnson graciously agreed to chair this committee. Members are George Briggs, Frank Harris, John Pickering, Tom Rogers, Kevin Fitzpatrick, and Michael Donoghue . If you would like to help with these efforts or share ideas and contacts please let me know. I've already heard from Ernie Bernard and others who are willing to help in these efforts.

It s eems in conducting the ATBI, there are a lot of really great people dividing up the ATBI work and adding it to their already full schedules. Thanks for all each of you are doing and I look forward to seeing you in the Park this year!

Emily Jones, DLIA
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