



ATBI QUARTERLY

Great Smoky Mountains National Park, Great Smoky Mountains Association, Friends of the Smokies, and Discover Life in America

Grasshoppers in the Smokies

Matt Dakin



Matt Dakin

Arphia sulfurea, a banded wing grasshopper.



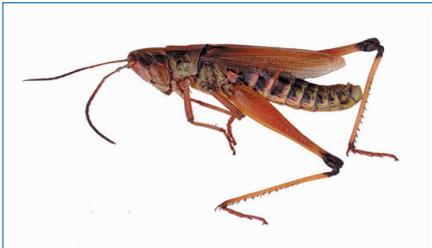
Matt Dakin

Melanoplus keeleri, a short horn grasshopper.



Matt Dakin

Booneacris variegata, a wingless grasshopper.



Matt Dakin

Chorthippus curtipennis, a slant face grasshopper.



Matt Dakin

Tettigidea lateralis, a grouse locust.

Grasshoppers are insects in the order Orthoptera. This order consists of two major suborders, Caelifera and Ensifera, both of which contain some species commonly referred to as grasshoppers; however, most of the species belong to the Caelifera, which are characterized by relatively short antennae and are most active during the daylight hours. Those species in the suborder Ensifera have long thin antennae and are primarily nocturnal.

Most grasshopper collecting in the Park has concentrated on the Caelifera and currently there are records of 45 species, 8 of which belong to the family Tetrigidae, which are commonly called either grouse locusts or pygmy grasshoppers. The other 37 are members of the family Acrididae, the short horn grasshoppers. The Ensifera will probably have at least as many species once we have made a serious effort to collect them. These two suborders require different collecting techniques and different timing of collecting effort.

Where do you find grasshoppers? "In the grass" is a logical answer but if you confined your collecting to grasslands you would find only about half of the 45 species. The species that have been least often collected prior to the ATBI are found in other habitats; for example, the entirely wingless *Booneacris* is found on rocks at the higher elevations in the Park, and many of the short wing species of the genus *Melanoplus* are found in the leaf litter in or near wooded areas. *Metaleptea* is found on semiaquatic plants. Many banded wings (subfamily Oedipodinae) are found on bare patches of dirt. Some species of *Dendrotettix* and *Melanoplus* live on trees, and the Tetrigidae are found in a variety of habitats but seem to require a fairly high amount of moisture.

The distribution of Park grasshoppers has proven to be very interesting biogeographically. For example, *Dichromorpha viridis* is a common grassland species in the

southern states and is common in the lower elevations of the Park; however, above 3,000 feet it appears to be replaced by *Chorthippus curtipennis*, a species common in the states north of the Park. Another "northern" species in the Park is *Chloealtis conspersa* taken at a high elevation at Purchase Knob. Also found in the Park are 11 species, all in the genus *Melanoplus*, that have reduced wings, are incapable of flight, and often have very restricted distributions. Five of these are members of the Viridipes Group which seems to have its center of distribution in the Park.

Adults of various species occur at different times of the year. Early season forms are replaced by related species or species with the same habitat requirements later in the year. For example, the banded wing *Arphia sulphurea* is very common in the spring and early summer in the Park, but is replaced in the late summer by *Arphia xanthoptera*. The Viridipes Group and *Melanoplus decoratus* adults occur as early as May and are replaced in the late summer by other short winged *Melanoplus* species. Some species such as *Schistocerca americana* can be found as adults year round. Most species survive the winter as eggs buried in the soil but some, such as the pygmy grasshoppers and *Chorthippus viridifasciata* (a banded wing), overwinter as nymphs.

Most grasshopper species are primary consumers, feeding on a wide variety of plants, and some, such as the African locust, can cause considerable damage when they swarm. In the Park, grasshoppers usually do not occur in numbers large enough to cause extensive damage, but are important parts of the food chain, serving as food for a wide variety of birds, amphibians, reptiles, mammals, and other insects.

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Chairman's Message:

Paul Hebert and the DNA Barcodes of Life

Paul Hebert of the University of Guelph visited Great Smoky Mountains National Park in May and dropped by the spring Board Meeting of Discover Life in America. Paul was there at the invitation of lepidopterist and Board Member David Wagner.

Paul has proposed an amazing idea that is getting wide attention: the derivation of a species-specific "barcode" derived from the DNA that is in the cells of each living thing. Some sections of DNA are not variable enough among the members of a genus, family, or even higher taxonomic levels, to be used for identification. Conversely, some DNA is too variable in that individuals within a single species can be detected as unique entities (the idea behind DNA fingerprinting in forensics). Therefore, Paul started the search for DNA sequences that were in-between these two extremes which could be used as reliable indicators of the species-level of identification.

Paul and his collaborators have tested this idea on a variety of taxonomic groups. They have independently classified individuals based on DNA barcodes and then asked whether that separation of species is closely correlated with current taxonomy. The results were clear: the DNA-derived relationships agreed 95% of the time with classical taxonomy (based on morphology, physiology, and ecology) and there was even evidence that in the cases of disagreement, the DNA-derived classification was more precise! Not all insect groups have been subject to this analysis, but much work is underway.

Imagine what this technique could do for the ATBI. Imagine taking small tissue samples and associating caterpillars with the corresponding adult butterflies or moths, or identifying aphids to species when they are in one of their distinct developmental forms. Imagine identifying the viruses contained within plant leaves or the diet of insects from gut samples. Imagine being able to verify the presence of a rare animal from strands of hair, or to detect soil fungi that are ecologically important for nutrient and carbon cycling. Imagine being able to estimate the probability that a species is new to science and being able to focus intensive taxonomic work where it is most needed. In short, we would be able to much more quickly learn about the diversity of species and the likelihood of new species.

Taxonomic work is critically important, but it often is a slow step compared to field work, with sometimes a lag of months or even years before identification and naming can take place. Also, there are only a few specialists able to identify species for some groups, and DNA barcoding could help us stay organized as the work is done. Further, our study site, Great Smoky Mountains National Park, is so diverse that DNA barcoding here would rapidly build a reference database necessary for use in systematics elsewhere. We could show what a diverse "library" of biodiversity we have.

Paul Hebert himself has big dreams that within several decades the cost of the DNA analysis will decline, and tools will be available so that small tissue samples can be analyzed in the field. We are in a position to be the leaders in the way that this technology contributes to field surveys, monitoring, and the conservation of biological diversity.

For more information, visit the Barcode of Life web site at <http://www.barcodinglife.org/>.

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Park Science Center Update

Keith Langdon



Rendering provided by Lori Aeck and Sargent

The long-planned science center at Great Smoky Mountains National Park has had a difficult time coming to fruition. Earlier this year, when it was realized that delays had resulted in increased costs, and that these costs had now exceeded the funding available from the Congress, the monies were re-directed toward other projects in the Region. Superintendent Ditmanson and the Park staff continued to work on a solution, however, and with the assistance and support of the Great Smoky Mountains Association and the Friends of Great Smoky Mountains National Park, and some cost reduction in design, the overage has been covered. Director Fran Mainella was then able to restore the funding.

As of early July, the new design has been through a review and is awaiting final approval for advertisement of the construction contract. The Park anticipates awarding the contract for construction in the current fiscal year (before September 30, 2005). Assuming that administrative processes go relatively smoothly, ground-breaking could occur in a few months and the Park hopes to see the construction process completed as expeditiously as possible. Everyone in the science, natural resources, curatorial, and education communities who have been involved in this project over the years should be thankful that we have such strong support from the Association and the Friends, and for the sustained creative effort by the Superintendent and the Park's management team to find a solution.

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First Lichen Bio-Quest in Great Smoky Mountains National Park

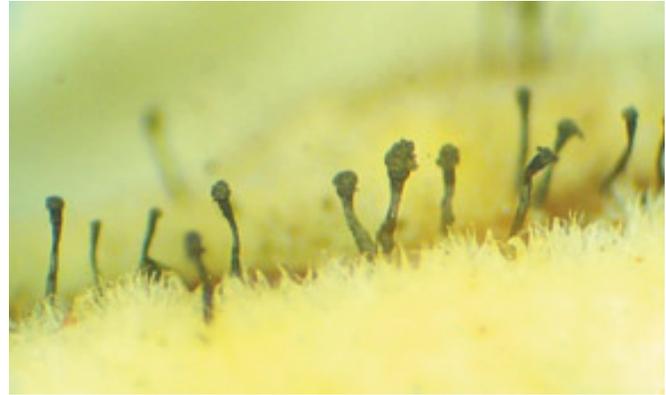
Harold W. Keller

The first Lichen Bio-Quest was held in Great Smoky Mountains National Park (GSMNP) at the Great Smoky Mountains Institute at Tremont (GSMIT) in June 2004. More than 30 participants registered, including high school and college students, university teachers, Park volunteers and staff, area residents, and amateur and professional lichenologists. The objective of the Lichen Bio-Quest was to compile an annotated checklist of lichens associated with high altitude and low altitude regions of GSMNP as part of the ATBI and to curate, identify, and characterize the lichen specimens for inclusion in the interim database and the Discover Life in America website hosted by the Southern Appalachian Information Node (SAIN), which is part of the National Biological Information Infrastructure (NBII). Educational objectives of the Lichen Bio-Quest were to help participants answer the following questions: What is a lichen? Where do lichens grow? How are lichens collected and preserved? What are the growth forms? What is lichen terminology? How does one identify lichens?

Two lichenologists served as experts for identification and as foray captains. H. Thorsten Lumbsch presented a lecture that covered lichen symbiosis, morphology (growth forms and terminology), reproduction, physiology, ecological importance, systematics, and taxonomic characters. Steven B. Selva gave a lecture on the use of calicioid (stubble) lichens as environmental indicators of old-growth forests, and on the morphological characters used to distinguish this group of lichens. Participants viewed lichen specimens using microscope videos to illustrate lichen morphology, terminology, and taxonomic characters.

Lower elevation collection sites (Lumber Ridge Trail and Spruce Flats Falls Trail, 405-550 meters) were located in the Tremont area on the Tennessee side, and higher elevation sites (Spruce-Fir Nature Trail, lower Beech Gap Trail, and Balsam Mountain Road, 1,094 to 1,728 meters) were all on the North Carolina side of the Park. These forays resulted in the collection of 136 lichen taxa, representing 7 orders, 5 suborders, 29 families, 57 genera, and 88 species. Four stubble lichen species and four crustose lichens were new records for the Park, but are rather common and widely distributed species. Many areas of the Park have not been investigated and are still poorly known. Certain groups of lichens, such as crustose, siliceous, lignicolous, and stubble lichens, have been overlooked or neglected, and our results clearly indicate that continuing intensive studies of lichens are necessary to thoroughly evaluate the species diversity of this group. Many new lichen records and new species await discovery in GSMNP.

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Steve Selva

Phaeocalicium polyporaenum, a stubble lichen growing on a polypore bracket fungus, *Trichaptum pergamenum*, which is growing on a standing dead *Liquidamber styraciflua* (sweetgum). The lichen represents a new record for the Park.



Harold W. Keller

Harry Hitchcock, Clinton High School teacher, Clinton, Tennessee, along the Spruce-Fir Nature Trail. This tree trunk is covered with all three growth forms of lichens: crustose, foliose, and fruticose.



Harold W. Keller

Jessica Hoffman, a DLIA intern, who assisted with the Lichen Bio-Quest.

Solitary Bees in Great Smoky Mountains National Park

Adrieen Mayor



Marilyn Lovelace

Andrena miserabilis female entering nest.

The U.S. Department of Agriculture's Agricultural Research Service Bee Biology and Systematics Laboratory in Logan, Utah, recorded 144 species of bees in Great Smoky Mountains National Park in 2002. The Utah bee lab anticipates a Park bee fauna of over 250 species. The inventory was only one of five bee inventories conducted east of the Mississippi River and it resulted in 16 new state records. One of the bees found, *Andrena* sp. 2, may be a new species to science. Since this inventory, an additional 20 species have been discovered in the Park, bringing the total to 164.

Bee lifestyles vary considerably. Honey bees, bumble bees, and some others, are social and live in colonies; however, most bees are solitary, with each female constructing a nest on her own. Very little is known about solitary bees and finding the nests can be a challenge, but many are active very early in the spring even before the major wildflower displays of April. Finding solitary bee nest sites is typically a matter of luck and a great thrill to those of us who look for them. In 2005, nest sites were discovered for two common species, *Andrena* (*Ptilandrena*) *erigeniae* and *Andrena* *distans*.

The first species, *A. erigeniae*, was discovered nesting in early March along the Greenbrier Ridge Trail at an elevation of 4,000 feet. The name of this bee species suggests a relationship with the

Finding solitary bee nest sites is typically a matter of luck and a great thrill to those of us who look for them.

plant genus *Erigenia* (harbinger of spring); however, it actually gathers pollen only from spring beauty (*Claytonia virginica*), a behavior which is termed "oligolectic" (to gather pollen from only one or a few related plant species). In a 1986 publication, *A. erigeniae* was only recorded from Raleigh, North Carolina. Since the start of the ATBI, it has been collected on the North Carolina side of the Park from Balsam Mountain Campground, The Purchase, and Andrews Bald, and on the Tennessee side from Goshen Prong, Albright Grove, Snakeden Ridge, Cades Cove, Indian Gap, Twin Creeks, and Park Headquarters, presumably mirroring the distribution of spring beauty in the Park. The Tennessee findings are new state records.

Andrena distans is less common in the Smokies and is a relative of *A. erigeniae*. It was previously recorded from several localities in North Carolina (including Cherokee) but not from Tennessee. This species is oligolectic on *Geranium maculatum*. It has not yet shown up in the ATBI plot samples; however, the Utah bee survey group recorded the first Park record from Cataloochee Valley in North Carolina. Last spring it turned up in traps at Twin Creeks, which documents a new record for Tennessee. Based on locality data in the herbarium for *G. maculatum*, we might expect to find *A. distans* at Smokemont, Gregory Bald, Cataloochee Divide, Mt. Sterling, Twentymile Ranger Station, Porters Flats, and Bull Head Trail.

Additionally, a very large colony of *Andrena miserabilis* was discovered in April 2005 in the meadow at the Cataloochee Group Camp on the North Carolina side of the Park. This colony is extremely large with thousands of individual nest sites present. Female bees loaded with pollen were observed returning to nest sites; however, there were very few wildflowers in bloom, and surely not enough to sustain thousands of foraging bees. Females were observed dropping down into the meadow, suggesting that they had perhaps been foraging in trees, or another possibility is that they were foraging for long distances to find pollen. Obviously, much is yet to be learned regarding the distributions and unique habits of solitary bees in the Park.

Adrieen Mayor, Museum Curator
Great Smoky Mountains National Park

Carnivores: From Smallest to Largest

Don Linzey

Of all the taxonomic groups being studied during the ATBI, mammals are probably the best known group. In 1995, all known mammal data was compiled in two publications - Mammals of Great Smoky Mountains National Park and Mammals of the Great Smoky Mountains National Park 1995 Update, both by D. W. Linzey. Therefore, our team did not anticipate adding many new species records to the known Park fauna. Since 1995, we have been extensively sampling mammal populations throughout the Park and have significantly refined the distributions of many species. One member of our team, Dr. Michael (Mick) Harvey, has been responsible for discovering our only new record to date - the evening bat (*Nycticeius humeralis*).

Two species of carnivore, the smallest and one of the largest in the United States, have been the specific objects of my attention for the past several years. The least weasel (*Mustela nivalis*) is the smallest carnivore on earth. Adults are only 7-8 inches in length and weigh about 2 ounces, hardly larger than the mice and meadow voles on which they feed. They are primarily a northern species, with the Smokies marking the southern terminus of their range. Extensive live-trapping has proven unsuccessful at documenting the least weasel in the Park. Posters were distributed in 2002 asking residents around the Park to be alert to what their cats may bring in, as least weasels have previously been reported near the Park boundary in this manner. This situation would alert us to the location of a possible population, thus giving us a starting point for looking inside the Park.

At the other end of the size range is the Park's largest carnivore, the panther (*Puma concolor*), also known as cougar, mountain lion, and puma. Many sightings have been reported but in most cases cannot be verified. A few involve photographs, most of which are either indiscernible or show some animal other than a panther. Until recently, the last verified evidence of a panther in the Park was in 1920.

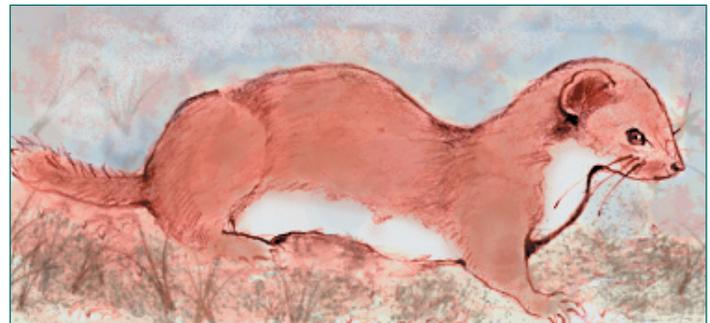
In 2001, rubbing pads were used as a technique for obtaining hairs for DNA analysis. Sixty-five pads were in operation; however, panther hair was never collected. Also, remote heat-sensing, infra-red cameras have been used and have captured images of various animals, but still no panther. In 2001, a Park visitor observed a panther looking out of a small cave and captured it on video. I later examined the cave but was unable to locate any evidence. In 2004, another visitor took a full broadside photograph of a panther in Cades Cove. At present, these are the only two known distinct photographs from the Park.

Panthers currently in the Park may represent individuals from the Park's original population, or they may be part of the southern Florida population that have moved northward. At present, however, the most plausible explanation seems to be that any



J. Scott Altenbach

Nycticeius humeralis, the evening bat (Source: Bats of the United States by Michael J. Harvey and J. Scott Altenbach:1999).



Drawing by Ruihame Livaditis

Mustela nivalis, the least weasel, is the smallest carnivore on earth.

animals currently in the Park are the result of captive panthers either escaping or deliberately being released. Evidence of a reproducing population is necessary to establish that panthers are truly members of the Park's fauna, and the best hope of securing this evidence rests in obtaining a photograph of a young animal.

Our efforts are continuing in order to definitively add the least weasel and the panther to the current Park fauna. In 2005, we will continue using some of the methods discussed above, and, in the case of the panther, at least one new technique will be implemented. Please contact me if you have information concerning either of these species; it could be very helpful.

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ATBIs at Other Reserves: Some Updates

Jeanie Hilten

Do you know of a park, forest, wildlife area, or other reserve that is interested in or is already conducting a biodiversity inventory? Discover Life in America encourages you to let us know about these other projects. We hope to host another meeting at our December 2005 conference on an "Alliance of ATBIs." Through communication and cooperation, we can face challenges, such as declining numbers of taxonomists and of funding issues, in order to make the best use of available resources and share ideas, methods, and knowledge. Below are recent highlights from a small sample of parks/reserves in various stages of development towards conducting ATBIs.

Ben Becker, Marine Ecologist at **Point Reyes National Seashore**, reports that warmer than average waters off of California this year have resulted in the finding several new species in Tomales Bay, and potentially slowed the spread of a noxious invasive. Grunion (*Leuresthes tenuis*), a species of fish known for wiggling up onto the beach at high tide to lay its eggs in the sand, was first documented in Tomales Bay in June 2005. This is the first record for grunion north of San Francisco Bay. Additionally, a spiny lobster (*Panulirus interruptus*), another species usually found further south, was caught in the bay this past spring. Another notable event concerns the invasive *Didemnum* sp., a tunicate which has been overrunning rocky substrates around Tomales Bay. The tunicate experienced a massive die-off this spring, probably due to lowered salinities from heavy rains, or the above average spring water temperatures. We hope that additional removal efforts this fall will further reduce this species' range in the bay. Finally, a species of anemone (*Nematostella vectensis*: see photo below) commonly found on the east coast, but recently appearing on the west coast, was confirmed in Tomales Bay. It is thought that this non-native species (which is

a model for genetic studies) will be somewhat benign, but its ecological impacts are currently unclear.

Tennessee State Parks have begun inventory work in some of the states' 54 parks.

Protocols for all state parks have been established for plants, mammals, and herpetofauna, and bird protocols will be forthcoming (thanks to the state ornithologist). Also, vegetation plots have been established at several parks and plant inventories will begin this spring/summer, or are already in progress in a couple of parks. Various other taxonomic groups being studied in some parks include aquatic macroinvertebrates, small mammals (including bats), mosquitoes, butterflies, salamanders, and snakes.

Additionally, the database is nearing completion, with the help of Great Smoky Mountains National Park staff, and a grant has been awarded to map boundaries and develop other GPS layers. Please contact LinnAnn Welch, Tennessee State Biologist, for more information at 615-532-0241 or LinnAnn.Welch@state.tn.us.

A growing collaboration of scientists, citizens and educators will soon host the largest ATBI in the Northeast in the **Adirondack Park** in New York. Because of the size (6 million acres) and mix of public and private lands, organizers believe that citizen participation is an absolutely critical element to the future success of the Adirondack ATBI. The Adirondack Park is 12 times the size of the Smokies, and is comprised of ecosystems ranging from alpine zones on 5,344-foot Mount Marcy to the Lake Champlain region at nearly sea level. Through the ATBI, which is modeled after the Smokies effort, citizens will be able to take an active role in obtaining better scientific knowledge of biological diversity in the park. The Adirondack Research Consortium will play a supporting role in the effort as cooperators draft a project plan, develop organizational structure, develop communication and outreach plans, obtain financial support, and begin field work. GSMNP's Becky Nichols visited the Adirondacks this spring to give a presentation about the Smokies' ATBI. Craig Milewski, Fisheries Biologist at Paul Smith's College in New York, is one of the coordinators of this effort; milewsc@papulsmiths.edu or 518-327-3525.

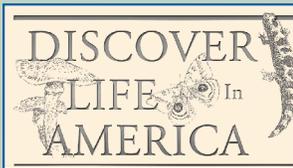
Acadia National Park has been conducting various taxonomic collecting events to obtain inventory data. David Manski, Chief of Resource Management, notes that there will be a Coleoptera Blitz in July, 2005, which follows their highly successful Ant Blitz of 2003 and a Lepidoptera Blitz in 2004. The Maine Entomological Society, National Park Service, and Maine Forest Service will be joining forces to conduct this Coleoptera Blitz, which will run from July 16 to July 17, 2005. Additional work sessions will be held on Monday, July 18. The National Park Service has a limited amount of free housing available between July 15-18 for participants at the Schoodic Education and Research Center. For more information please contact Lynn Havsall 207-565-3424, lhavsall@hotmail.com or Dick Dearborn 207-293-2288, modear@prexar.com.

Daniel Sarr, Inventory and Monitoring Coordinator for the National Park Service's Klamath Network, is very interested in planning an ATBI at the small but ecologically unique **Oregon Caves National Monument**. He welcomes ideas for ways to kick things off, such as a planning conference or a Bio-Quest, and suggestions for development of methods and protocols. Contact him at daniel.sarr@orst.edu.

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Adam Reitzel



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DLIA Calendar of Events - 2005

Jeanie Hilten

Mark these events on your calendar and stay tuned for more details and other programs. See the website at www.discoverlifeinamerica.org or www.dlia.org. For more information, to learn about DLIA's volunteer "project teams" and to sign up for activities, contact Jeanie Hilten, 865-430-4752 or jeanie@dlia.org.

Wednesday, July 20: DLIA Education Committee Meeting. Pi Beta Phi Elementary School, Gatlinburg, TN. Contact Judy Dulin, judydulin@sevier.org or Wanda DeWaard, earthkin@icx.net.

Monday, July 25—Thursday, July 28: Science Teacher Enrichment - GLOBE and Smokies Science. Join GLOBE trainers and National Park Service staff as they delve a bit deeper into GLOBE air, water, and soil monitoring by focusing on long-term monitoring projects in the Smokies. Teachers will use techniques that can be replicated in the schoolyard with students who then can compare their data to National Park data via a website hosted by Hands on the Land. For more information call Susan Sachs at 828-926-6251. This workshop will be held in Cherokee, NC.

Saturday, August 6: Fern Foray. Clingman's Dome Road area. Contact Patricia Cox, 865-632-3609 or pbcoc@tva.gov.

Saturday, August 27: Discover Life in America Board Retreat. Contact DLIA staff.

Saturday, September 3: Fern Foray. Balsam Mountain area. Contact Patricia Cox, 865-632-3609 or pbcoc@tva.gov.

Monday, September 5—Friday, September 9: Fungi Bio-Quest: "Pyreno Pursuit". Pyrenomycetes represent one of the largest groups of fungi, but are also among the most poorly known most likely due to their small size (usually < 1 mm diameter). These organisms occur throughout all geographical areas on plant material and dung where they play an essential role in nutrient cycling and decomposition of organic matter. The Pyreno Pursuit is the first attempt to bring together experts to inventory the diversity of pyrenomycetes in the GSMNP. Contact Andy Miller, amiller@inhs.uiuc.edu or volunteers can contact Jeanie Hilten.

Friday, September 16—Sunday, September 18: Tennessee Environmental Education Annual Conference. The meeting will be held at Carson Springs, Newport, TN and the focus is "Place Based Education." For details contact Judy Dulin, judydulin@sevier.org.

Friday, October 28—Sunday, October 30: Fall Naturalist Weekend. Great Smoky Mountains Institute at Tremont. Topics include Fungi of the Smokies, Black Bears, Geology of the Smokies, and Fall Potpourri. For more details, go to www.gsmiit.org or call 865-448-6709.

Tuesday, December 6—Friday December 9: DLIA/ATBI Annual Conference. Glenstone Lodge, Gatlinburg, TN. There may be pre-conference workshops on either Monday or Tuesday of that week. The DLIA Board will meet Saturday, December 10. Contact DLIA staff for details.

A selection of summer activities photos by Ron McConathy

