



FIFTEEN YEARS OF DISCOVERY







**G**reat Smoky Mountains National Park offers a globally significant wealth in the sheer number of life forms that call it home. This ecologic treasure trove is designated a World Wildlife Fund Global 200 Ecoregion and a UNESCO World Heritage Site and International Biosphere Reserve. Scientists estimate that The Smokies contain an estimated 60,000 to 80,000 forms of life, of which only 18,000 are known. Each day, scientists and trained volunteers focus their microscopes and magnifying glasses in the national park's forests and streams to discover the remaining 42,000 or so life forms.

This important project is coordinated by Discover Life in America (DLIA), a non-profit organization established on Earth Day 1998. To catalog these new discoveries –at a pace of more than one each week – DLIA documents the newly discovered life forms in a comprehensive scientific tool called the All Taxa Biodiversity Inventory (ATBI). It is through this powerful creation that DLIA shares its immensely valuable data with management and conservation organizations, and the international scientific community.

In a few short years the ATBI has far exceeded all expectations. At the time of this publication, DLIA-supported scientists have discovered an astonishing 926 species new to science, 7,636 species that were not previously known to exist within the Park. The species new to science include 36 moths, 42 spiders, 78 algae, 56 beetles, 26 crustaceans, 58 fungi, 20 bees and bee relatives, 16 tardigrades and 270 bacteria.

With solid and trustworthy organizational support from Discover Life in America, the ATBI in North Carolina and Tennessee's Great Smoky Mountains National Park has grown to become the largest sustained natural history inventory in the United States and one of the largest in the world. Dozens of universities and museums have participated in the ATBI. DLIA has trained more than 800 volunteers – scientists, students, teachers and citizens – in its "citizen science" project. More than 50,000 volunteer hours have been logged. In-kind support has averaged \$120,000 per year, and leveraged support \$400,000 per year.





*"[The All Taxa Bio Diversity Inventory] has enlisted experts on different kinds of organisms from all over ... Assisted by volunteers, and with only a shoestring budget, they have built it into a major enterprise of biological research, as well as teaching center for students at every level, from grammar school to Ph.D. and postdoctoral programs."*

*E.O. Wilson, Internationally acclaimed biologist and Pulitzer Prize-winning author*

## BUT WHY THE SMOKIES?

This beautiful mountain range is so extraordinarily rich in biodiversity because it has remained above sea level for millions of years, and has escaped glaciation. Global high points of diversity and endemic species to the region include plants, amphibians, fish, land snails and aquatic insects. The Park also contains the best old-growth watersheds in the eastern U.S. An amazing 20 percent of its forest has never been logged.

Researchers working through DLIA have provided data, amounting to approximately half of the GSMNP's almost 500,000 biodiversity database's records. This tremendous dataset is providing scientists a solid baseline to document the effects of pollution, invasions of deleterious foreign species, and climate change, on plants and animals, and their varied habitats, over time.

## PARK GEOGRAPHY

Great Smoky Mountains National Park lies along the crest of the Southern Appalachians, reaching its height at 6,640-foot Clingmans Dome, the third-highest peak in the eastern United States. The park is 58 miles long and averages 17 miles wide across its range.

The Smokies contain round-crested, steep-sided ridges dissected by deep V-shaped valleys, with many smaller ridges branching from the central ridgeline. These are carved into innumerable valleys in 45 watersheds with a total of 2,102 miles of clear fast-flowing streams. The water table is near the surface in nearly all parts of the park, which is often shrouded in smoke-like mists, giving rise to its name. Eighteen miles of the southwest margin is bounded by the 70-acre Lake Fontana reservoir, which lies behind the tallest dam in the eastern U.S.

Under the extensive forests lie Precambrian rocks formed 545 to 800 million years ago, many made of meta-sandstone, which is exposed on Clingmans Dome. These ancient rock layers were thrust up from deep in the crust roughly 300 million years ago by the slow collision of tectonic plates along Great Smoky Fault, rising over younger marine sediments formed on a shallow continental shelf. Millions of years of weathering result in today's rounded mountains. The park's many waterfalls occur where streams flow over more resistant layers of meta-sandstone.







## CULTURAL HISTORY

There is evidence that a hunter-gatherer people lived in the area 15,000 years ago. This was the territory of the relatively advanced Cherokee Nation until their forcible removal in the 1830s. Settlers took over the land and in the early 1900s logged much of the forests. Past subsistence farms and commercially logged areas have been allowed over time to revert to forest through natural succession.

The park's historical and cultural interpretation is based mainly on mills, churches, schoolhouses, barns and homesteads dating from the middle 19th century to 1920, which comprise the finest collection of log buildings in the country. The National Register of Historic Places includes three historic districts – Cades Cove, Noah Ogle and Roaring Forks – and 78 historic structures in the park, also home to the Oconaluftee Archaeological District.

## ANCIENT BIODIVERSITY

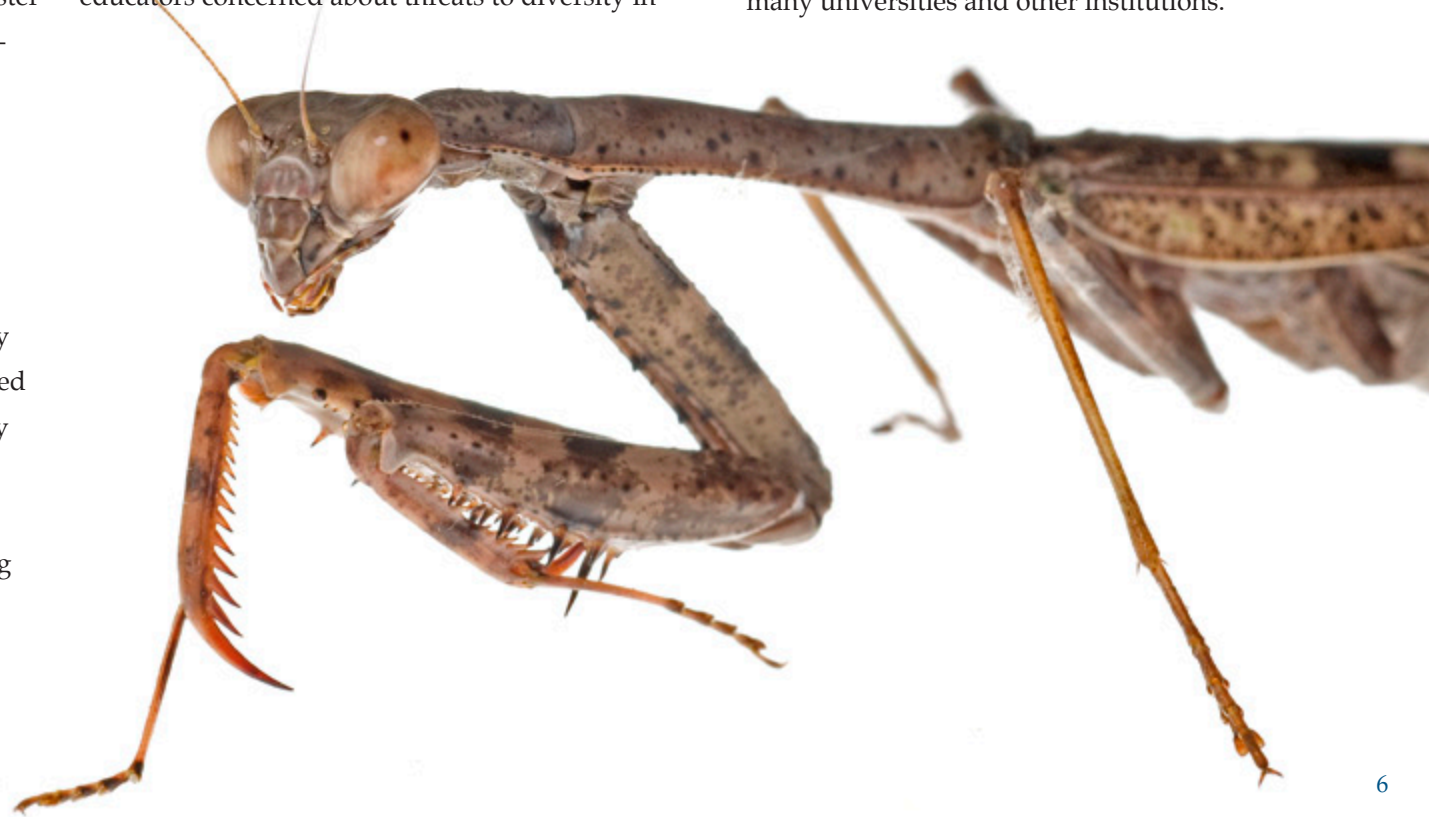
The region includes remnants of the Arcto-Tertiary Geoflora, a hypothesized floral assemblage believed to have covered the Northern Hemisphere as early as 250 million years ago. It is also considered a Pleistocene refuge, an unglaciated area in which species survived periods of climatic change during the last Ice Age.

## A COLLABORATIVE ORIGIN

To what degree is a major national park a refuge for a nation's biodiversity? How reliable are our predictions about the number and diversity of species within a given area? When comparing old-growth to second-growth forests, has the eastern U.S. already lost a significant percentage of its species? Are there reliable "indicator species" for natural communities that should be used as standards in monitoring programs?

These and many related questions were brought to the table in Gatlinburg, Tennessee, in December of 1997 by 120 scientists, resource managers and educators concerned about threats to diversity in

Great Smoky Mountains National Park. They knew the Park's hallmark is its biological diversity, and its physical and geographic characteristics made it seem probable that a large portion of species had yet to be discovered, particularly among the invertebrates. Soon after, Discover Life in America was created as a non-profit organization to oversee and coordinate an exhaustive All Taxa Biodiversity Inventory of life forms in the park, bringing about a collaborative effort involving Great Smoky Mountains National Park, the Great Smoky Mountains Association, the Friends of Great Smoky Mountains National Park, the National Park Service, the U.S. Geological Survey, National Biological Information Infrastructure and many universities and other institutions.





## WHAT IS AN ALL TAXA BIODIVERSITY INVENTORY?

Some of the words in the phrase “All Taxa Biodiversity Inventory” may be unfamiliar to the non-scientist. All taxa refers to all living things. “Biodiversity,” though becoming a term more commonly used, is a relatively recent entry to the English language. The phrase “biological diversity” was first used in 1980 and the contraction “biodiversity” in 1985. While most people have an image of biodiversity as representing the biological variety across the living world, formal definitions include genetic diversity (on which each species depends) and ecosystem or habitat diversity (which provides the environmental setting and supports the lifestyles and interactions of those species).

The ATBI is more than just a list of species, explained Peter White in a statement for the Subcommittee on National Parks of the Senate Committee on Energy and Natural Resources.

“We seek to discover not only which species are present in each taxonomic group in the park, but also ...

1. Which of these species are rare enough to be of management concern
2. Where each species is found in terms of natural community affinities
3. The seasonal occurrences and changes in abundance of each species, and
4. What the ecological roles and interactions of the species are.”







“We found ourselves investigating everywhere; not only under rocks, but also climbing the tallest trees, examining grains of soil, and descending into the deepest caves. ATBI investigators examined the species that live in the feathers of birds and in the guts of other species ... I found myself, for the first time since my early undergraduate courses, dealing with all of biology (not just my specialty).”

Importantly, the ATBI includes people from all walks of life.

“The project was not solely a scientific effort,” White said. “But rather a deliberate weaving together of science, stewardship, and education... One area, however, that I didn’t anticipate at the beginning, was art! Photographers, artists, and even musicians, inspired by the excitement of exploration and the beauty and intricacy of the life forms we discovered, to fully circumscribe the species, the park itself soon joined our project. Artists collaborated with the science teams as essential members responsible for illustration and documentation...”

And finally, Great Smoky Mountains National Park provides a self-contained focus and sustainable boundaries for the concentrated efforts of the ATBI. “Whereas taxonomists often focus on a particular group of organisms regardless of location in order to fully circumscribe the species, the park itself provided the common denominator to make us all focus on goals, and also brought us together in ways that will support ecological understanding, monitoring, and conservation objectives.”



## FOSTERING COLLABORATION

Although small, the DLIA staff – including Executive Director Todd Witcher, Database Technician Chuck Cooper, and Administrative Assistant/Volunteer Coordinator Heather Hansen – organize a massive scientific effort each year. They also host an annual DLIA conference to highlight the discoveries in the Smokies and in protected areas globally, and to share the scientific protocols, best practices, and educational programs and products growing from DLIA.

## CITIZEN SCIENTISTS

The project also gives children the opportunity to be biodiversity explorers. By involving school children, DLIA is supporting public education and recruiting the next generations of scientists, experts and citizens informed about and interested in national parks and other conservation areas.

“For the ATBI to be successful, it is just as necessary to observe and cultivate these human interactions as it is to survey and document the other life forms of the Smokies,” wrote Jeanie Hilten, former DLIA Director, and her colleagues in a paper about DLIA’s education programs.







## VEGETATION

Approximately 80 percent of the the GSMNP is comprised of five major forest types: cove hardwood forest, hemlock forest, pine-oak forest, northern hardwood forest and spruce-fir forest. There are over 1,700 species of flowering plants, including 100 native trees, 100 native shrubs and an estimated 2,200 non-flowering taxa, including 450 bryophytes, some 50 ferns and fern relatives, mosses, liverworts, and a few hornworts.

Also, about 75 percent of all Southern Appalachian spruce-fir forest and the largest known block of virgin red spruce grows in the park. Heath balds, which occur on the driest high slopes in the east, are dominated by shrubs such as Catawba and small leaf rhododendrons, mountain laurel and mountain myrtle, blueberry and huckleberry, which form brilliant displays in mid-summer. Grassy balds, found mostly in the western end of the park, are dominated by grasses and, with bare ridges, cliffs and landslide scars, host some rare regionally endemic shade-intolerant plants.

## THE SMOKIES AS A SAFE HAVEN FOR PLANTS

The fields, forests and streams of Great Smoky Mountains National Park are home to an estimated 60,000-80,000 species of life. Here, 15 plants are listed for potential federal protection as threatened or endangered, and 120 species are rare enough to be of management concern. A similar number of bryophytes, lichens and fungi are also considered rare at regional, national, or global levels. The park has three federally listed threatened and endangered plant species: spreading avens, Virginia spirea, and rock gnome lichen, the latter being a lichen, which is a symbiotic organism comprised of both algal and fungal components. More than 300 species of native vascular plants and nearly 200 non-vascular plants are considered rare, generally found in small populations or having five or fewer occurrences within the park. Seventy-six species are listed as threatened or endangered in the states of Tennessee and North Carolina.



## MAMMALS

A diverse fauna of 61 native mammals reflects the richness of the flora. Smaller mammals include opossum, Indiana bat, eastern cottontail, woodchuck, eastern chipmunk, red squirrel, gray squirrel and southern and Carolina northern flying squirrels, muskrat, beaver, long-tailed weasel, mink, striped and eastern spotted skunks, and a number of bats, mice, moles, and shrews.

Larger mammals include red fox, gray fox, coyote, black bear, raccoon, river otter, puma, bobcat, wild boar (an introduced pest) and white-tailed deer. Gray wolf, red wolf, fisher, and bison once roamed the Smokies but are now locally extinct. Elk, which were extirpated in the early 19th century, but have been successfully reintroduced.

## MAMMALS FOREVER LOST?

### **Eastern Spotted Skunk** (*Spilogale putorius*)

This small skunk was never known to be common in the park; only a handful of reports have been received in the last quarter century. It is not spotted but rather marbled in wavy black and white stripes, not in regular dorsal stripes like the larger striped skunk, which is not closely related. This species does a hand-stand to face a threat and arches its back over to point its anal spray glands toward the threat.

### **Appalachian Cottontail** (*Sylvilagus obscurus*)

This mid-to-high-elevation rabbit was recorded in the park several decades ago, but there are no recent records. This species is difficult to discern from the abundant eastern cottontail *S. floridanus* in the field. The Appalachian cottontail is generally smaller, has shorter ears, and has more black on its back and head than the eastern cottontail.

### **Mammals Rapidly Vanishing from the Smokies**

- Indiana Bat (*Myotis sodalis*)
- Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus*)
- Eastern Small-Footed Bat (*Myotis leibii*)
- Water Shrew (*Sorex palustris*)







## BIRDS

There are 340 bird species that inhabit the park, including the successfully reintroduced Peregrin falcons. Park visitors can see 60 residents species, like the ruffed grouse and wild turkey, year-round. During breeding season, visitors could encounter 120 breeding species, including warblers, flycatchers and other migratory songbirds. The Smokies and surrounding forested lands represent the largest track of unfragmented forests in the eastern U.S., which provides critical breeding habitats to many internationally threatened migratory bird species whose populations are declining annually.

## BIRDS FOREVER LOST?

### **Appalachian Bewick's Wren** (*Thryomanes bewickii altus*)

This species was last seen in the GSMNP in the 1950s in the Balsam Mountain area. It has disappeared from much of the eastern U.S. and the reason is unclear

### **Red-cockaded Woodpecker** (*Picoides borealis*)

For decades this federally endangered cavity nesting bird used to live in the open pine-oak forests in the west end of the park. It apparently abandoned these when the exclusion of fire led to growth of low brush, making the habitat unsuitable. It was last seen in the 1980s, and checks of suitable habitat then found no existing breeding birds.

### **Species of Concern**

- Henslow's Sparrow (*Ammodramus henslowii*)
- Cerulean Warbler (*Dendroica cerulean*)
- Red Crossbill (*Loxia curvirostra*)
- Black-capped Chickadee (*Poecile atricapillus*)
- Yellow-bellied Sapsucker (*Sphyrapicus varius*)
- Golden-winged Warbler (*Vermivora chrysoptera*)



## REPTILES & AMPHIBIANS

Some 84 species of herpetofauna exist in the park. Reptiles include eight turtles, nine lizards and 23 snakes. Heavy precipitation and numerous streams make these mountains ideal for a wide variety of amphibians, including three toad, 11 frog, and over 30 salamander species. The diversity of salamanders in the park is higher than anywhere else in the world and includes the tiny red-cheeked salamander that is only approximately 1.5 inches long and the giant eastern hellbender that can grow up to 20 to 29 inches in length.

### Species of Concern

- Eastern Hellbender (*Cryptobranchus alleganiensis*)
- Seepage Salamander (*Desmognathus aeneus*)
- Junaluska Salamander (*Eurycea junaluska*)





## THE SMOKIES: SALAMANDER CAPITAL OF THE WORLD

Known as the “Salamander Capital of the World,” the GSMNP has an abundance of salamanders. According to the National Park Service, “...the great majority of vertebrate animals, including human visitors, in the park on any given day are salamanders.” Types of salamander represented in the Smokies include newts, mudpuppies, mole salamanders, lungless salamanders, and the granddaddy of them all, the hellbender, which can grow up to two and a half feet long!



### **The Hellbender Salamander** (*Cryptobranchus alleganiensis*)

Hellbenders have a few characteristics that make them distinguishable from other native salamanders – these include a gigantic, dorsoventrally flattened body with thick folds traveling down its sides, a single open gill slit on each side, and hind feet that have five toes each. Hellbenders also employ an unusual means of respiration, which involves cutaneous gas exchange through capillaries found in their dorsoventral folds.

The hellbender salamander is considered a habitat specialist in that it has adapted to fill a specific niche within a very specific environment. Its success is dependent on a constancy of dissolved oxygen, temperature and flow found in swift water areas, which in turn limits it to a narrow spectrum of stream/river choices. As a result of this specialism, hellbenders are generally found in areas with large, irregularly shaped and intermittent rocks and swiftly moving water, while they tend to avoid wider, slow moving waters with muddy banks and/or slab rock bottoms.

This specialism has likely contributed to the documented dramatic decline in hellbender populations, as collectors could easily identify their specific habitats. Many different anthropogenic sources have helped to create this decline, including the siltation and sedimentation, blocking of dispersal/migration routes, and destruction of riverine habitats created by dams and other development. Other causes of decline include pollution, disease and overharvesting for commercial and scientific purposes. Many of these detrimental effects have done irreversible damage to hellbender populations, so it is important to conserve the remaining intact populations by protecting their habitats.





**Jordan's Salamander** (*Plethodon jordini*)

This species only occurs in wooded habitats at high elevations in Great Smoky Mountains National Park. This highly terrestrial species is often found under rocks, logs, or debris on the forest floor. These salamanders are most easily detected at night, especially under wet conditions, as individuals wander the forest floor in search of food. Across its small range, this species is often extremely abundant.

**Green Salamander** (*Aneides aeneus*)

This species is found locally, west of the park on the Cumberland/Allegheny Plateau along crevices of sandstone cliffs. There also are a few small, disjunct and declining populations southeast of the park in the Blue Ridge area of North Carolina. The only park record is from 1929 near Rainbow Falls Trail. Notes taken by the collector clearly state it was found under a log somewhere on the Rainbow Falls Trail. Although known mostly from sandstone crevices, a recent hypothesis is that this could be an arboreal species perhaps declining with forest clearing in the early 20th century.

## FISH

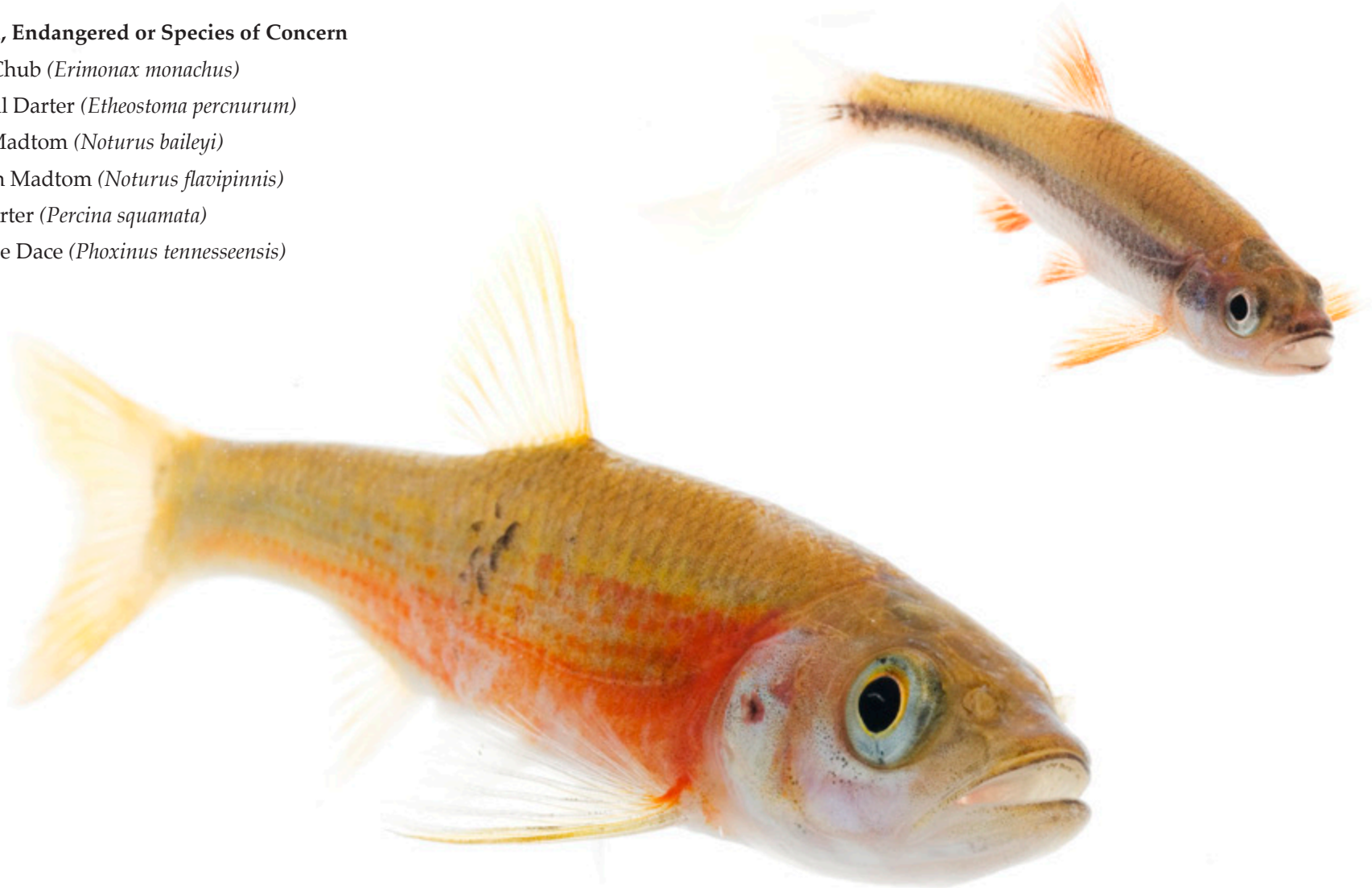
Over 50 species of native fish live in the streams, including eastern brook trout, which may be a separate and threatened subspecies. Other threatened fish are smoky and yellowfin madtoms, and spotfin chub, which are being reintroduced into the park.

### Threatened, Endangered or Species of Concern

- Spotfin Chub (*Erimonax monachus*)
- Duskytail Darter (*Etheostoma percnurum*)
- Smoky Madtom (*Noturus baileyi*)
- Yellowfin Madtom (*Noturus flavipinnis*)
- Olive Darter (*Percina squamata*)
- Tennessee Dace (*Phoxinus tennesseensis*)

### Flame Chub (*Hemitremia flammea*)

The flame chub is an inhabitant of springs and spring runs, usually in areas of lush aquatic vegetation. It is known in the park only in spring pools along Abrams Creek near Cades Cove.





## INVERTEBRATES

The park also hosts a diversity of invertebrates, a class that is not well known, and is thought to be a regional or continental center of diversity for several groups, especially land snails, spiders, insects and other arthropods. The majority of the unknown species often belong to taxa that are little understood and understudied, but these organisms provide the foundation for the ecosystem functions that support the iconic higher plants and animals that we all treasure in the Smokies.

More than 1800 moths and butterflies have been recorded as well as more than 240 species of caddisflies and stoneflies. Most groups reveal a complex assortment of forms that often include species endemic to the park and/or new to science.

## INVERTEBRATES FOREVER LOST?

### **Rusty-Patched Bumble Bee** (*Bombus affinis*)

Common across the eastern U.S. until the late 1990s, we have records at several locations from low to high elevations up until 2003. It is now thought to be near

extinction as a species, probably due to an exotic microsporidium introduced with bumble bees from Europe used in greenhouse tomato production. We are hopeful of finding a remnant population of this species in the park, but it may have disappeared from its entire range.

### **Nine-Spotted Lady Beetle** (*Coccinella novemnotata*)

Once one of the most common lady beetles in the northeastern U.S., it began to decline sharply in the 1980s, and now rarely found in the eastern U.S. It is hypothesized that it is being displaced by the invasive multicolored Asian lady beetle (*Harmonia axyridis*).

### **Appalachian Elktoe Mussel** (*Alasmodonta raveneliana*)

This very rare mussel is federally endangered. We have no records of any mussel species whatsoever from the park on the North Carolina side, where Fontana reservoir was created in the mid-1940s. However, in 2010 a fish parasitologist found mussel glochidia on a fish in Deep Creek, so scientists are hopeful that some mussel species may be returning.









# GREAT STORIES OF DISCOVERY

**We are discovering more than one new species each week in the Smokies. Here are some of the more unusual and fascinating discoveries that demonstrate the vast diversity of life contained in Great Smoky Mountains National Park.**

## **Ligdia Moth (*Ligdia wagneri*)**

This beautiful moth is in a group that had always been hypothesized to live in North America, but until the ATBI began, it had not been discovered here.



## **Giant Earthworm (*Clitellata spp.*)**

A work crew clearing trails found the 18-inch earthworm along the Appalachian Trail after a rainy weekend. After analysis by DLIA scientists, this giant was classified as a new species.

## **Southern Tawny Crescent Butterfly (*Phyciodes batesii macronensis*)**

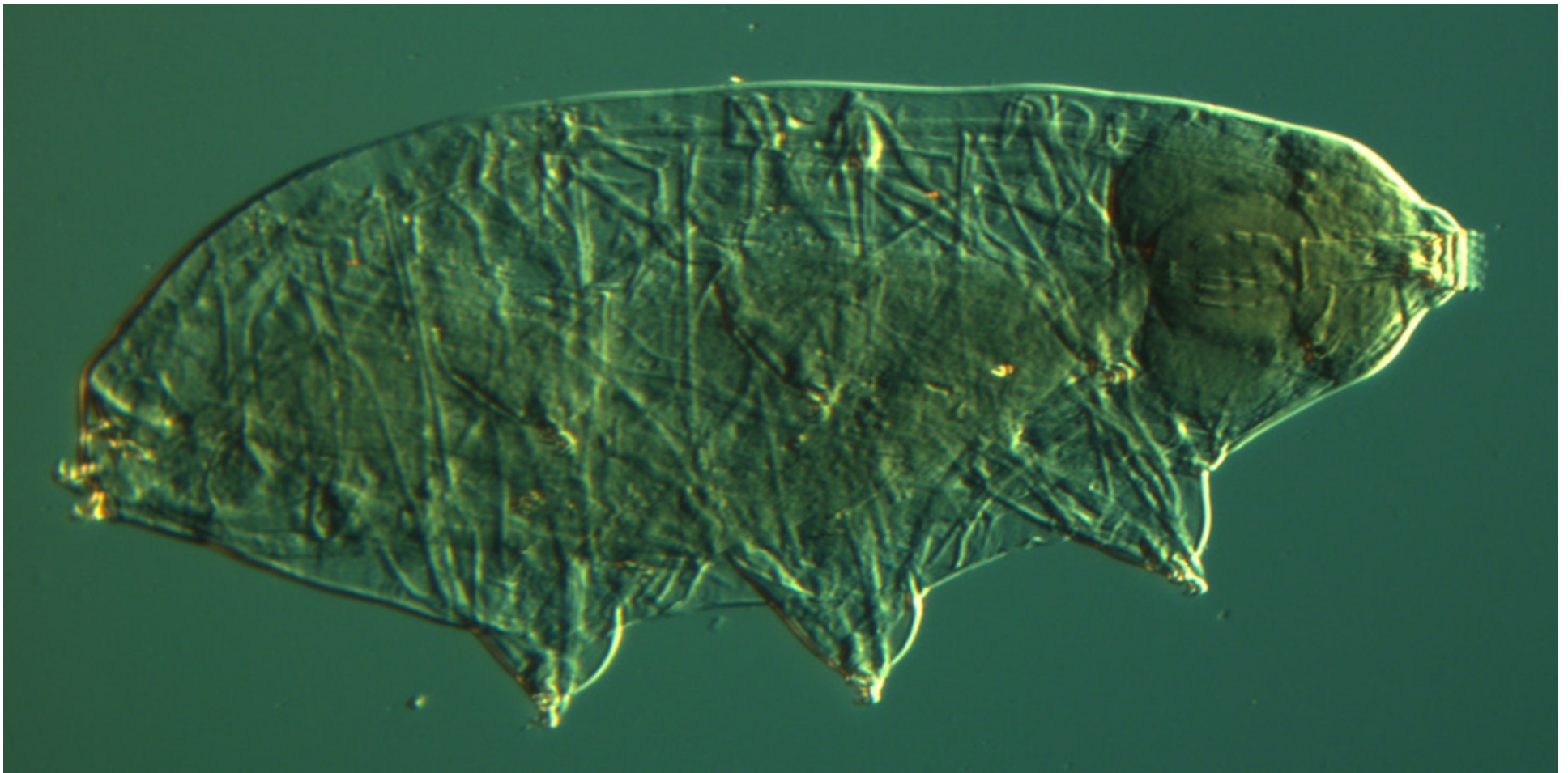
This small butterfly species was feared extinct, but has been found at several locations in the region recently. It is a Federal Species of Concern. It can be confused with the abundant pearly crescent (*P. tharos*), but does not fly at exactly the same time, and the underside of its wings are yellow with no dark mottled areas on the hind wings.

## **Kolodski's Caddisfly (*Neophylax kolodskii*)**

The species is only known to be found in three locations in the GSMNP. This genus of caddisfly emerges in the fall, and its eggs are laid out of water. The larvae make their nests out of pebbles held together by silk for protection, camouflage and possibly respiration. This species was named for Park Ranger Joe Kolodski, who was shot and killed while on duty.

## **Great Smoky Mountain Sedge (*Carex fumosimontana*)**

This new species is completely restricted to the highest peaks within the park, and is one of the most common species atop the state's highest peak, Clingmans Dome.



**Waterbears (*Phylum: Tardigrada*)**

These bizarre-looking creatures look more like space aliens than waterbears. The park has quickly accelerated from one known species of waterbears to more than 90! To accomplish such a feat, DLIA paired a university taxonomic authority with a small, enthusiastic liberal arts undergraduate program at Warren Wilson College. The park is now the best-studied location in the world for this phylum of life.

**Hazel Creek Lobster (*Cambarus spp.*)**

It is thought there are around 10 species of crayfish throughout the park. Three of these are new to science and have yet to be officially named.

**Toothy Coil Land Snail (*Helicodiscus spp.*)**

This snail is named for the rectangular teeth on the opening of its shell, a feature that allows it to avoid predation from beetles. This snail is only known to exist in one location outside of the park.

**Thermophilic bacteria (*Kingdom: Eubacteria*)**

In 2003, a BioBlitz for bacterial diversity was held in 12 unique vegetation plots in the park. Thermophiles were detected from 16 of 21 samples taken. The actual species of these bacteria has yet to be determined. This unique group of bacteria only live at temperatures ranging from 113 to 176°F!



### Slime molds (*Kingdom: Fungi*)

ATBI studies have yielded at least 284 different species, which is the highest total known for any comparable region outside of the tropics. Ten of the 284 species recorded from the park turned out to be new to science, which is a remarkable total for a group of organisms represented by only few hundred species worldwide.



### Bluegreen algae (*Phylum: Cyanobacteria*)

This algae is found nowhere else in the world. This newly discovered green alga is characterized by distinctly swollen axial cells, which are longer than they are wide. The study of algal communities in Great Smoky Mountains National Park has yielded many new park records and several species new to science. To date more than 1,000 algal taxa records have been documented from the park, with 108 of those representing cyanobacterial (a phylum of bacteria that obtain their energy through photosynthesis) records.



### Giant springtail (*Pogonognathellus magnibrunneus*)

Measuring seven millimeters, this may be the largest springtail in the U.S. It is abundant in the Smokies but also occurs in the northeast. Even so, it was not discovered in the park until 2011, demonstrating that there is tremendous work to be done by DLIA.

### Eastern leatherwood (*Dirca palustris*)

This strange shrub has incredibly flexible twigs that were used by some Native Americans for rope and other cordage. Leatherwood has a widespread distribution in eastern North America, but is rare south of Virginia. Its discovery represents a new family of plants in the park.

### Velvet-leaf blueberry (*Vaccinium myrtilloides*)

This was DLIA's 5,000th discovered species for the Smokies! It is a low-lying shrub with bright green leaves and a paler colored underside. This blueberry is also known as the common blueberry and is native to most of the American Northeast and Northwest, as well as Canada. Its berries provide an important food source to birds, deer, and black bears that live inside the park.

### Defoe Beetle (*Pseudotriphyllus defoei*)

Found among forest litter and rotting logs, this specimen is a fungivore (fungus-eating organism) known from two specimens representing a newly recorded genus for the Western Hemisphere.







## CONCLUSIONS: THE EDGE OF THE UNKNOWN

### Future Threats to Biodiversity

Globally and locally we are losing species at a pace faster than any other period of time on Earth. Over the next century, we will face new and old challenges that could threaten the existence of species that define America. Some of the biggest threats to biodiversity are the following:

- **Changing Climate:** Increasing levels of CO<sub>2</sub> to our atmosphere is causing increasing temperatures and alterations to precipitation patterns. Species must adapt, move, or go extinct to changing climates.
- **Increasing Human Population:** As the human population grows so will the demand for natural resources. This demand will directly and indirectly place pressure on protected areas through increased water, air, noise and light pollution.
- **Expanding Development:** New development of cities, roads, and energy-production facilities will fragment the landscape and reduce viable habitats.
- **Continuing Non-native Species Introductions:** Humans move nonnative species both accidentally and intentionally to new regions. Some of these non-natives grow in population size, eventually impacting native animals and plants and the ecosystems where they live.
- **Poaching:** Persistent wildlife trafficking and poaching will bring some species to the brink of extinction.

### How DLiA Helps

To preserve biodiversity we first must know what species exist and where they are found. DLiA is accomplishing this basic need through by cataloging and counting the species that make America species. We are enlisting new generations of individuals who support science in the national parks. We provide hands-on field experiences for researchers, citizen-scientists, and the general public that, in turn, generates powerful advocates for our national parks and the diversity they protect.

It is through these discoveries that we can reach a greater understanding of the patterns of biodiversity and what species need to persist. Understanding the relationship of species within their environments provides us with knowledge that is paramount to maintaining ecosystem stability in a changing world. Discover Life in America needs your help to complete this project—we need you to research, study, preserve and support biodiversity for generations to come.



**ALL PHOTOS** by Clay Bolt | [www.claybolt.com](http://www.claybolt.com) and (white background species) Clay Bolt for [www.meetyourneighbours.net](http://www.meetyourneighbours.net) with the following exceptions: E.O. Wilson, pg 4, by Kevin Fitzpatrick | [www.allspeciesphotography.com](http://www.allspeciesphotography.com). Waterbear, pg 20, by Dr. Paul Bartels. Bluegreen Algae, pg 21, by Dr. Rex Lowe.

**ALL ILLUSTRATIONS** by Leigh Ann Carter.



[WWW.DLIA.ORG](http://WWW.DLIA.ORG)