THE COALITION TO PROTECT AMERICA'S NATIONAL PARKS
VOICES OF EXPERIENCE

GREAT SMOKY MOUNTAINS NATIONAL PARK

Where Science Helps Protect Our Nation's Most Biodiverse National Park

In the early morning, a soft mist clings to the ridgelines of the Great Smoky Mountains. Beneath that haze lies one of the most biologically rich landscapes in North America. It is a place where life thrives and much of it is still unknown. The Great Smoky Mountains are found in between Tennessee and North Carolina and are part of the larger Appalachian Mountain Range that stretches as far north as Canada and as far south as Alabama.

With more than 22,000 documented species, and tens of thousands of species are still waiting to be uncovered. The Great Smoky Mountains National Park is a biodiversity hotspot and demonstrates why biodiversity matters and sustained investment in science is essential to protect it.

Biodiversity and More to Discover

A spotted salamander. The National Park Service is dedicated to studying these species and preserving the critical habitats where they live. NPS photo.

The Smokies are often described as the most biodiverse national park in the United States. Biodiversity is the full variety of life on earth, spanning ecosystems, species, and genetic levels. It includes all living things, from microorganisms and invertebrates to plants and animals, intersecting within their habitats.

"To study biodiversity is to study the complete web of life that makes Earth the only known planet on which the human species can live," notes the National Park Service.

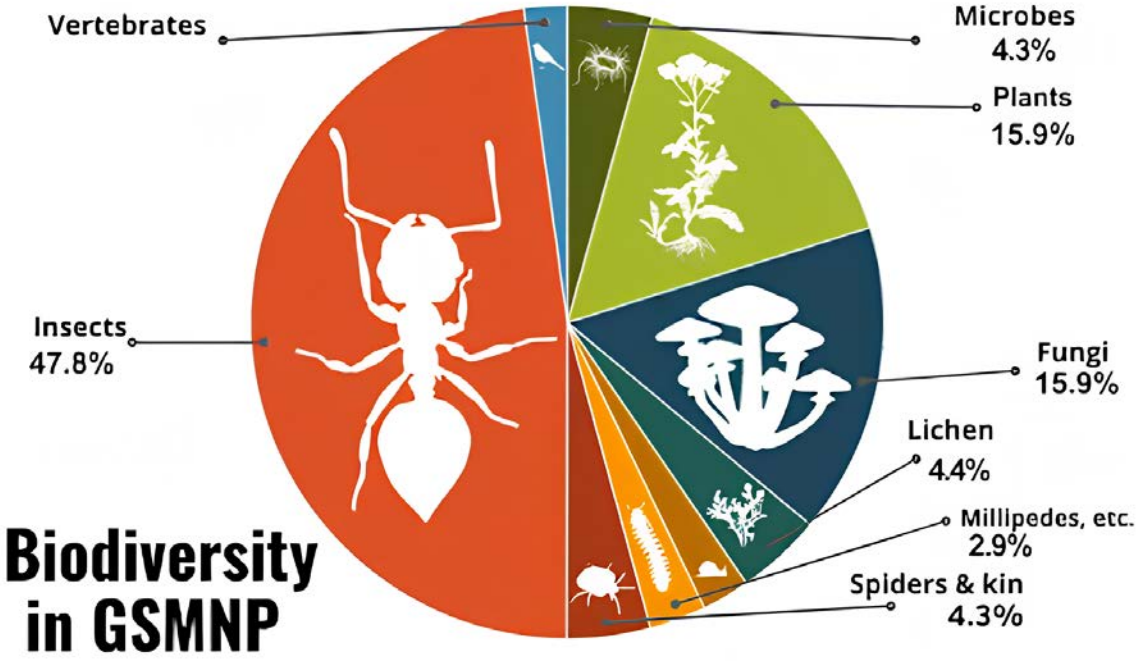
The Smokies' extraordinary biological diversity is driven by several factors. It is a temperate rainforest, receiving anywhere from 55-85 inches of rain each year and its high humidity levels gives way for all kinds of life to thrive. As Todd Witcher, Executive Director of Discover Life in America explains, "water drives biodiversity and the Smokies have it in abundance."

The essence of the mountain range also contributes. The complex topography creates diverse habitats across the different levels of elevation ranging from 850 to 6,643 feet. Since the mountain range remains unglaciated from the last Ice Age, species continue to evolve uninterrupted. The landscape is blanketed with lush vegetation, creating mist that rises from the forests and cloaks the mountains in fog, that gives the Smokies their name.

Each year, new species in the Smokies are discovered. Scientists estimate as many as 60,000 species may exist within the park, yet only about 22,000 have been documented. More than 1,100 of those species are identified as new to science. New discoveries serve as a reminder that even in a place as well-loved as the Smokies, with over 12 million park visitors a year, there is still so much to discover.

Making the Unknown Known

"It's mind-blowing that we're still discovering species in the Smokies," former Superintendent Cassius Cash reflects. "Just a few years ago, another salamander was identified that exists in the Smokies and nowhere else on Earth." This new species of salamander brought the total number of salamander species to 31, allowing the park to claim the title of "salamander capital of the world."



Pie Chart of the Biodiversity of Great Smoky Mountains National Park. Photo courtesy of Discover Life in America.

Tens of thousands of species are waiting to be discovered in the Smokies. They remain a mystery because it is not large or charismatic wildlife that remains undocumented but rather the small, foundational organisms that are vital to ecosystem function. They are the insects, fungi, and microbes that play critical roles in pollination, nutrient cycling, soil health, and are the bedrock of food webs. These are, as biologist E.O. Wilson famously described, "the little things that run the world."

New species of bees, flies, moths, and other arthropods have been discovered by scientists even after decades of study. In partnership with the National Park Service, the non-profit Discover Life in America works year-round on the All Taxa Biodiversity Inventory (ATBI), a project that catalogues all the new species.

The ATBI project is "the baseline for future changes," says Todd Witcher. "We are starting to see some of these changes in real time. For example, small species that are very dependent on temperatures, if it's too hot or too cold, they can't survive."

"We cannot protect what we do not yet understand, and you can't manage what you don't know is out there," says former superintendent Cash.

Understanding what exists today is essential to knowing what may be lost tomorrow.

A Park Built for Science

Established in 1934, Great Smoky Mountains National Park is a place of discovery and science. Biodiversity inventories date back to the earliest years of the park and it was among the first to be included in long-term ecological monitoring efforts.

Dragonfly inventory conducted in Great Smoky Mountains National Park.

Today, the All Taxa Biodiversity Inventory (ATBI) is one of the most ambitious scientific efforts undertaken in a national park. It works to answer four fundamental questions: What species exist here? Where are they found? What roles do they play? Are they rare, stable, or declining?

This ATBI is only possible through partnerships and collaboration. As Executive Director Witcher explains, "we have a close relationship with park staff and especially the NPS Inventorying and Monitoring team. We work closely alongside them to plan and carry out research in the park, and to collaborate with scientists on what needs to be done."

Witcher adds, "we couldn't accomplish this work without national park staff in the Smokies. This is a deeply intertwined partnership that strengthens and expands the science happening in the park."

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The National Park Service manages 84 million acres of land including over half a million acres within Great Smoky Mountains National Park. The responsibility is vast and understanding what exists within these landscapes is essential to managing them well.

New Threats and Invasive Species

At its core, biodiversity science defines the essential natural heritage we must preserve. We will be unable to detect future changes if we don't understand the biodiversity that exists today, especially in the face of a rapidly changing environment and climate.

Invasive plants and insects are often introduced unintentionally to a park, as there are many points of entry and park boundaries can be shared with communities and developed areas. Scientific monitoring of the Smokies is more important than ever, given the park's high visitation of 12 million visitors annually, rapid regional development, and an increasing demand for water sourced from the park's six main watersheds.

According to a February 2026 study, 67% of parks are highly exposed to one or more potentially transformative climate change impacts including fire, drought, sea-level rise, and forest pests and diseases.

Given the factors outlined above, Great Smoky Mountains National Park is especially vulnerable to forest pests and diseases.

The study also identified a devastating example in the hemlock wooly adelgid, an invasive insect that has already killed a large number of eastern hemlock trees. It is estimated that up to 75% of hemlocks may be lost due to this invasive species. Entire forests and their watersheds can be affected.

However, there is hope through science. It's possible that up to 25% of hemlocks may be saved due to scientists knowing and understanding the threat. The wooly adelgid was first detected it in the park in 2002. Thanks to this early monitoring, the NPS developed a nationally recognized program to protect hundreds of thousands of hemlocks throughout the park.

Park foresters and researchers continually treat Eastern Hemlock trees in their fight against the Hemlock Woolly Adelgid. NPS Photo.

Understanding the baseline of species and the potential for threats is essential for informed resource management decisions, outlining conservation priorities, effective visitor use planning, and protecting infrastructure within our national parks.

Air Quality Transformation & Protection

Air quality does not start and end at the park's boundaries. Air pollution and haze is produced by the burning of fossil fuels, industrial emissions, and vehicle exhaust, and can cause the visibility in the Smokies to drop dramatically. According to NPS briefing statement on air quality in the smokies, "the park experiences some of the highest measured amounts of air pollution of any national park in the U.S."

On average, visibility is 25 miles, and on a clear day it can reach almost 100 miles. On some days, visibility drops to just a few miles due to pollution. Pollution is damaging forests, acidifying streams, and affecting the ecosystem and human health from local research data.

Compelled to act, the park became a leader in air quality science. In the 1980s, scientists established an air quality monitoring program across the park, with high elevation stations to valley sites.

Researchers began to track pollutants, measuring acid deposition, and studying impacts on plants, water, and wildlife.

As Phil Francis recalls, "we went public to fight for air quality." This issue was not just environmental but deeply connected to human health. Research has shown how pollution has affected lungs, especially for children and older adults.

Air quality and visibility changes in Great Smoky Mountains National Park. NPS Photo.

The NPS worked alongside a broad group of partners, including the Environmental Protection Agency, state governments, the Tennessee Valley Authority, and regional air quality programs. The research and findings of this group resulted in major policy changes, amendments to the Clean Air Act, and regional efforts to reduce sulfur dioxide and nitrogen oxide emissions.

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It is important for people to come together to protect our parks. Francis shared. "We are the guardians of these places. If people don't step up, who will?"

Although actions have resulted in some tremendous improvements, the work is not finished. Sustained scientific monitoring will help make future solutions possible to maintain better quality air for the environment and communities.

What's at Stake: Making the Case for Science and Biodiversity

Biodiversity includes the systems that sustain human life. They are essential to food production, clean water, medicine, climate change stability, and more. As former superintendent Cash emphasizes, the Smokies function as a "living medicine cabinet," holding species that may one day contribute to breakthroughs we cannot yet imagine.

The Smokies also carry deep cultural significance in ties to the Cherokee Nation. Their traditional ecological knowledge reflects a long-standing understanding of the interconnectedness of life.

"We are part of biodiversity, not separate from it." Emphasizes Cash.

> **The National Park Service has lost approximately 25% of its permanent staff since January 2025. These losses include deep cuts to resource management staff and science programs. This loss limits the ability of parks to carry out essential work to document new species, ensure continuity of long-term datasets, provide**

the analysis to understand how management decisions impact ecosystems long term, and the perpetuity of institutional knowledge.

"You shouldn't stop this work now. We've built decades of knowledge," Francis warns. "Without continued investment, we risk losing both species and the ability to understand their decline."

A Reason for Hope

The Smokies stand as a brilliant testament to the possibilities unlocked by investing in science. There are a number of success stories that demonstrate real change, such as improved air quality, improved protection of watersheds, and an expanded understanding of biodiversity. The NPS and its partnerships have strengthened the public's understanding of why biodiversity and science in our parks matter. Thousands of everyday people participate as volunteers in citizen science programs and in doing so, grow strong partnerships between the NPS and local and regional communities.

Students from Jackson State and Tuskegee University spending a week in an immersive experience in the park learning about park resources, careers and resource stewardship. NPS Photo.

"There are so many people excited about science and our national parks," Executive Director Todd Witcher says.

The combination of science, community, and commitment offers a powerful path forward.

"People who work in the NPS are really committed to the mission of the park service. Francis emphasized, "our friends, neighbors, and communities are committed to leaving the world in a better place."

Parks are Proof

The Great Smoky Mountains National Park proves that when we invest in understanding nature, we improve our ability to protect it. Biodiversity is vast and there is so much left to discover. Science is essential to the conservation in our national parks. Partnerships and public engagement make that protection possible.

NPS Photo

"Biodiversity isn't abstract," Cash notes. "It's a living system that supports us. Our water, our health, our future."

When visitors begin to understand that connection, their relationship to national parks shifts from appreciation to stewardship. Protecting and investing in biodiversity is not just about saving species, it is about sustaining the systems and the parks that sustain us.