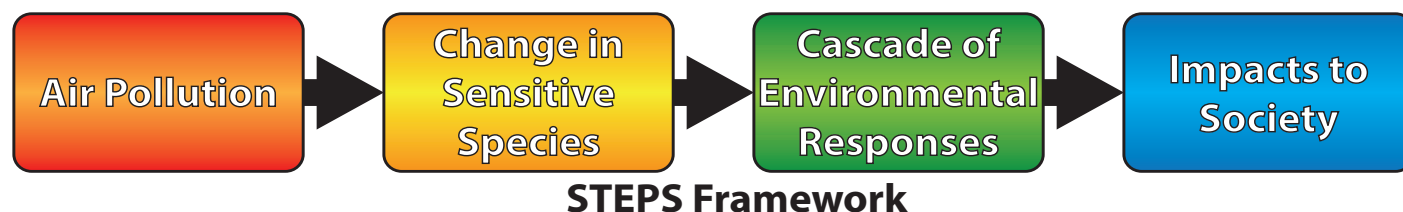




Air Quality & Ecosystem Services

New research shows over 1,000 ways that people are affected by air quality.

What is the value of a drop of water when you're thirsty, a gulp of air when you're breathless, a stunning view when you're desperate for inspiration? Ecosystem Services describe the ways in which humans benefit from ecosystems for free. Sometimes these services are described in economic value, but other values (such as number of human lives saved, amount of drinking water provided, spiritual or cultural values) are important also. A set of 5 studies published in the journal [Ecosphere](#) explore the many consequences to humans when air pollution exceeds threshold levels and changes natural resources in national parks and other protected areas.



These articles expand on [previous research examining human health impacts due to air pollution](#) to evaluate the broader impact to society when air pollution changes the world around us. The studies develop and use the STEPS Framework to link a **ST**ressor to an **E**cological **P**roduction function to a final ecosystem **S**ervice. Using excess nitrogen and sulfur from air pollution as a stressor, we identify how changes in soils, water, plants, and animals cascade through the environment eventually impacting resources used by 25 different user groups, creating over 1000 links to ecosystem services. Some of these services such as spiritual/cultural significance, aesthetics, and education opportunities cannot be replaced with manmade alternatives. Further, it is more expensive to repair or recreate the free services that nature provides than it is to preserve them in the first place.

Ecosystem Services

Understanding the ways in which ecosystems contribute to human well-being is important because this knowledge helps us make informed choices about how we choose to use resources, when we need to conserve resources, how to consider new ways of maximizing multiple simultaneous benefits, and to be explicit about the tradeoffs for human well-being when choosing actions affecting land, air, soil, water, plants, fish and wildlife.

People use, need, or appreciate the environment in multiple ways, whether or not they fully realize the connection

between ecosystem services and human benefits, or take them for granted. For example, one person may place the highest importance on clean water for drinking, healthy game fish populations for angling, and tourism for income; while another may be most interested in clean air to breathe to reduce their asthma, thriving wildlife populations for game hunting, and access to native plants for traditional medicinal purposes.

Impacts to National Park System Units

Curious minds are just beginning to untangle the mysteries of how human actions directly or indirectly alter the ability of the environment to provide humanity the ecosystem services we need to survive and thrive. Instead of looking at one ecosystem service at a time, the NPS is increasingly interested in looking at hundreds of ecosystem services at once. This better characterizes the many ways in which national parks benefit individual people, [communities, and businesses outside parks](#) while allowing managers to consider the full suite of impacts when making decisions.

Meanwhile, this landscape of over a thousand connections between humans and their air quality provides a new understanding of how ecosystems are quietly and efficiently working for us every day... whether we know it or not. The stories on the other side of this document highlight how air pollution is impacting some of your favorite parks. For more information go to: <https://go.nps.gov/ages>

Joshua Tree National Park – *A Rain of Fertilizer Leads to a Reign of Fire*

Nitrogen pollution blowing in from Los Angeles acts like fertilizer raining down out of the sky in Joshua Tree National Park. In your garden, fertilizer causes your lawn to grow lush and green and your tomatoes to grow big and red. In this desert ecosystem, nitrogen can cause invasive grasses such as Mediterranean split grass and red brome populations to increase exponentially in what were previously pristine wildflower displays. When invasive grasses grow dense, they not only outcompete native wildflowers, but also can now carry fire across some parts of the landscape which can perpetuate the cycle and make fires a common occurrence in these areas where they used to be rare. Not only does this impact park wildlife, visitors looking for flowers, local businesses dependent on tourists, but also homeowners outside of the park as fires can spread far across the landscape.



Joshua Tree NP, Photo by Lynn Sweet

Appalachian National Scenic Trail – *The Holidays are in the Air*



NPS Photo

As sulfur pollution from coal burning power plants deposits to the ground it changes the chemistry of the soil making it harder for some plants to grow. One tree that is severely impacted is the Balsam fir, which grows throughout the northeastern United States, including along the Appalachian Trail. You may be most familiar with balsam fir trees because they are commonly used as Christmas trees! Trees along the Appalachian Trail aren't harvested for Christmas, but their presence brings the scents of the holidays to visitors and welcome habitat for the snowshoe hare. That's right, the Easter bunny needs those Christmas trees to survive. As balsam fir trees die back, the thinning branches no longer provide this non-burrowing hare an area to live and protection from predators. This can lead to a decline in snowshoe hare populations and a disruption to the food chain. Thus, the impacts of air pollution cascade through the ecosystem, interacting with other stressors, causing visitors to the Appalachian Trail to see fewer healthy stands of balsam fir and fewer snowshoe hares. It is still an amazing place to spend a holiday but we need some clean air to bring back the true winter wonderland.

Great Smoky Mountains National Park – *Reeling in Acid Rain*

Acid rain has long been a problem in the eastern United States. The long standing tradition of families fishing enhances local values and economic opportunities within the region. While air quality has significantly improved over the last few decades, the long term impacts are still present in the streams of Great Smoky Mountains National Park. Acid rain changed the chemical composition of the soils and streams making it harder for bugs, small fish, and the birds and fish that feed on them to survive. This means that your prized brook trout is going to be a little bit harder to find and a little bit smaller if you can catch one. This disruption to the food chain by acidification impacts wildlife viewers, anglers, and teachers hoping to find a variety of critters under rocks when they bring their class to the park. If we don't reel in air pollution, you'd better prefer fishing to catching.



Photo by Ian and Chaity Rutter