Human hands leave prominent ecological footprints

June 1 2012

Early human activity has left a greater footprint on today's ecosystem than previously thought, say researchers working at the University of Pittsburgh and in the multidisciplinary Long Term Ecological Research (LTER) Network, created by the National Science Foundation to investigate ecological processes over long temporal and broad spatial scales. Highlighted in the June issue of *BioScience*, the Pitt/LTER collaboration shows how historic human actions caused changes in nature that continue to reverberate throughout present-day ecosystems.

In the article, researchers take a retrospective look at the impact of human activity on LTER Network sites spanning states from Georgia to New Hampshire and propose methods for measuring the effects of such activity. The study of legacy effects is important because it provides insights into how today's actions can affect tomorrow's ecological systems, says Daniel Bain, coprincipal investigator at the Baltimore Ecosystem Study LTER Network site and an assistant professor in the Department of Geology and Planetary Science in Pitt's Kenneth P. Dietrich School of Arts and Sciences. Bain notes that decision makers at all levels, including those creating policy, need historical information about ecosystems to make more effective environmental policies. In a democracy, says Bain, a diverse group of stakeholders—such as outdoor enthusiasts like Trout Unlimited, fiscal watchdog groups such as Common Cause, and individual landowners—needs this kind of data to effectively engage in the management of common resources.

"Increasingly, we propose to manage our ecosystems with sophisticated and complicated strategies," Bain says. "For example, we are attempting to manage agricultural runoff by changing how streams and floodplains are arranged. However, while designing these strategies, we tend to address the most recent impacts rather than the entire history of impacts. This can lead to wasted effort and misuse of relatively limited resources."

Legacy effects from human activities are all around us, says Bain, but few people ever give them a thought. For example, urban systems accumulate a lot of human-made materials, some of which have large ecological footprints and will ultimately leave a legacy. Bain cites the example of lead, which has been banned from gasoline and paint in the United States for several decades but can remain in soils for much longer periods of time. "We should be careful about growing food close to roads or near old houses," he cautions.

In agriculture, areas that were plowed hundreds of years ago react differently to contemporary acid deposition from air pollutants when compared with adjacent unplowed areas. Similarly, our extensive use of cement may add substantial amounts of calcium to urban soils, although the ecological impact of this practice is not yet fully understood, Bain adds.

Indeed, many landscapes that provide baseline ecological data for evaluating environmental change were structured in part by previous human interactions, such as settlements and agricultural practices. To make sense of the observed ecological patterns on such landscapes, Bain says, we must know something of the history of the processes acting to shape those patterns. A recent example of the need for historical data associated with the impact of humans is the debate over global warming and its associated climate change—the legacy of increased emissions of carbon dioxide and other greenhouse gases over millennia, but hugely accelerated since the industrial revolution and, especially, over the past several decades.

Bain points out that without a systematic collection of data recorded by the LTER Network, the broader geographical patterns of legacy effects would be much more difficult to detect. For example, scientists have discovered that recently glaciated areas have much less dirt accumulation than unglaciated areas. When Europeans first arrived in the eastern United States and dramatically changed local agricultural practices, eroded soil ultimately found its way into waterways. However, the glaciated areas produced less dirt, leaving less of an erosional signal in contrast to unglaciated areas, which lost more dirt and left such erosional legacies as buried valley bottoms and filled harbors. "In terms of policy, the management of glaciated and unglaciated areas requires different approaches," Bain says.

Nevertheless, Bain says, "although LTER sites have decades of data to draw from, we do not necessarily capture these changes, even with our best multidecade studies. It's hard to know what we might have been able to understand now had the LTER Network been established six or nine decades ago instead of three."

Another major benefit of the LTER approach, according to Bain, is the network of scientists that can jointly design a study, analyze the data, and produce such synthetic work efficiently. This type of historical analysis would take a small scientific team much longer to produce and perhaps be restricted to a smaller geographical and time scale than this regional synthesis of historical human legacies at long-term research sites in the eastern United States, Bain emphasizes.

Provided by University of Pittsburgh Schools of the Health Sciences