



# An Economist for Nature Calculates the Need for More Protection

By JOHN MOIR  
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COTO BRUS, Costa Rica — Dawn is breaking over this remote upland region, where neat rows of coffee plants cover many of the hillsides. The rising tropical sun saturates the landscape with color, revealing islandlike remnants of native forest scattered among the coffee plantations.



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Charles J. Katz, Jr.

A GLOBAL FOCUS Gretchen Daily, a Stanford biology professor, in Palo Alto, Calif.

But across this bucolic countryside, trouble is brewing. An invasive African insect known as the coffee berry borer is threatening the area's crops. Local farmers call the pest "la broca": the borer.

Despite the early hour, Gretchen Daily, a [Stanford University](#) biology professor, is already at work studying this complex ecosystem. Amid a cacophony of birdsong, Dr. Daily and her team are conducting experiments that demonstrate the vital connection between wildlife and native vegetation. Preliminary data from new studies suggest that consumption of insects like la broca by forest-dwelling birds and bats contribute significantly to coffee yields.

Since 1991, Dr. Daily, 46, has made frequent trips to this Costa Rican site to conduct one of the tropics' most comprehensive population-level studies to monitor long-term ecological change.

"We are working to very specifically quantify in biophysical and dollar terms the value of conserving the forest and its wildlife," she said.

In recent years, Dr. Daily has expanded her research to include a global focus. She is one of the pioneers in the growing worldwide effort to protect the environment by quantifying the value of "natural capital" — nature's goods and services that are fundamental for human life — and factoring these benefits into the calculations of businesses and governments. Dr. Daily's work has attracted international attention and has earned her some of the world's most coveted environmental awards.

Part of Dr. Daily's interest in natural capital emerged from her research in Costa Rica, where she became intrigued with an innovative government initiative known as Payment for Environmental Services. The program, initiated in the 1990s, pays landowners to maintain native forest rather than cut it and has contributed to a significant reduction in Costa Rica's deforestation rate.

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The Costa Rican program helped inspire Dr. Daily to co-found the Natural Capital Project in 2006. NatCap, as the program is known, is a venture led by Stanford University, the University of Minnesota and two of the world's largest conservation organizations, the Nature Conservancy and the World Wildlife Fund. It aims to transform traditional conservation methods by including the value of "ecosystem services" in business, community and government decisions. These benefits from nature — like flood protection, crop pollination and carbon storage — are not part of the traditional economic equation.

"Currently, there is no price for most of the ecosystem services we care about, like clean air and clean water," said Stephen Polasky, professor of ecological/environmental economics at the University of Minnesota. He says that because economic calculations often ignore nature, the results can lead to the destruction of the very ecosystems upon which the economy is based.

"Our economic system values land for two primary reasons," said Adam Davis, a partner in Ecosystem Investment Partners, a company that manages high-priority conservation properties. "One is building on the land, and the second is taking things from the land."

"Right now, the way a forest is worth money is by cutting it down," Mr. Davis said. "We measure that value in board-feet of lumber or tons of pulp sold to a paper mill." What has been missing, he says, is a countervailing economic force that measures the value of leaving a forest or other ecosystem intact.

Early on, Dr. Daily recognized that new tools were needed to quantify nature's value. "We began by developing a software program called InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) to map and value nature's goods and services that are essential for humans," she said.

The software, which is available as a free download, enables the comparison of various environmental scenarios. What is the real cost of draining a wetland or clearing a coastline of mangroves? InVEST models the trade-offs and helps decision makers better understand the implications of their choices.

"Our dream was not to try to capture the full value of nature's services, because that's so hard to do," Dr. Daily said. "Our goal is to begin making inroads in the decision-making process by including at least some of the value of nature in the economic equation."

The Natural Capital Project now works in Latin America, Africa, Asia, the Pacific and North America. In China, NatCap is working with the government on an ambitious program to protect natural capital. After deforestation caused extensive flooding in 1998, China committed \$100 billion to convert vast areas of cropland back into forest and grassland. The government is building on this success by helping to develop and test the InVEST software to put in place a new reserve network that is projected to span 25 percent of the country. The reserves will help with flood control, irrigation, drinking supply, hydropower production, biodiversity and climate stabilization.

At a NatCap site in Hawaii, Kamehameha Schools, the state's largest private landowner, used InVEST to evaluate future land use for a 26,000-acre site on the North Shore of Oahu. In the past, the landholding had been used for aquaculture, crops and habitation. After examining the alternatives modeled by InVEST, Kamehameha Schools selected a diversified mix of forestry and agriculture intended to improve water quality, sequester carbon and generate income.

About seven months ago, [Google.org](http://Google.org), the philanthropic arm of [Google.com](http://Google.com), unveiled a powerful new tool that enables global-scale monitoring and measurement of changes in the earth's environment. Called [Google Earth Engine](http://Google Earth Engine), it features a huge trove of satellite imagery of the earth's surface. NatCap is now moving the InVEST software onto the Google Earth Engine platform.



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“Right now, when we do a NatCap project or use InVEST, we send people to a country or state, and they spend weeks accumulating the data and putting it in the right format,” said Peter Kareiva, vice president and chief scientist for the Nature Conservancy. Google Earth Engine will greatly speed the analysis process, Dr. Kareiva said.

Luis Solórzano, program director of environmental science at the Gordon and Betty Moore Foundation, who worked on Google Earth Engine, says that the new tool can map trends and allow scientists to forecast such things as soil fertility, erosion and deforestation. “It’s the kind of tool policy makers need to make informed decisions,” Dr. Solórzano said.

Because the natural capital concept is anthropocentric, Dr. Daily sometimes is asked whether quantifying ecosystem services runs the risk of ignoring nature’s intrinsic worth or overlooking difficult-to-measure aspects of the natural world, like aesthetic or spiritual benefits.

Dr. Daily acknowledges that certain properties of nature defy quantification. “The beauty of the natural capital approach is it leaves the vast, immeasurable aspects of nature in their own realm while focusing in a very practical way on environmental benefits that we can and should incorporate into our current decisions.”

The precarious state of the world’s environment has concerned Dr. Daily since her teenage years, when her family lived in West Germany and she witnessed the destructive power of acid rain on the country’s forests. “I realized then that I wanted to be a scientist,” she said. This early fascination with nature led to her passion for the forests of Costa Rica, and that in turn set the course for her international leadership with natural capital.

Dr. Daily’s work took on a special urgency with the 2005 publication of the Millennium Ecosystem Assessment, which was developed under the auspices of the United Nations. This report found that recent and rapid human-caused changes have produced a “substantial and largely irreversible loss” in the diversity of life on earth and that two-thirds of the world’s ecosystem services were declining.

“The loss of earth’s biodiversity is permanent,” Dr. Daily said. “And it is happening on our watch. We need to convey with compelling evidence the value of nature and the cost of losing it. I find it stunning that until the next asteroid hits the planet, it is humanity that is collectively deciding the future course of all known life.”

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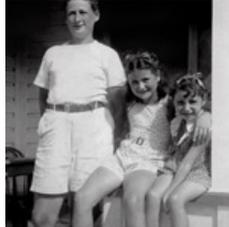


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