Scientists show how species diversity can pay dividends
6 April 2017, by Glenys Young

Grasslands with higher biodiversity (left) store more carbon than grasslands with simpler communities (right). Carbon storage in ecosystems has economic value because of the social cost of carbon emissions and associated climate change. Credit: Victor Leshyk

For decades, conservationists have focused on the possible costs of extinction: the effects on a lost species’ predators, prey and environment, or the effects on people who can no longer use the species for food or clothing. In many cases, these costs are seen as ambiguous.

Now, a collaboration of scientists has developed one of the first models to assign a dollar value to the loss or gain of species in an ecosystem. The new work, published in Science Advances, offers an economic argument for preserving biodiversity.

"Biodiversity evokes exotic birds, tropical forests, the beauty of nature. Money isn't usually what comes to mind," said Natasja van Gestel, co-author on the study and a research assistant professor at the Texas Tech University Climate Science Center. "But biodiversity has monetary value, and in this study, we figured out how much value for one critical ecosystem service: carbon storage."

"We tackled this by blending models of ecology and economics to make explicit, quantitative estimates about the value of species richness for carbon storage," said Bruce Hungate, lead author of the study and director of the Center for Ecosystem Science and Society at Northern Arizona University.

To build the model, researchers first had to identify some measurable service of biodiversity that society has priced. While biodiversity provides many valuable services, concern about climate change has led economists to put a dollar value on the abatement of climate-warming carbon emissions, ranging between roughly $40 and $400 per metric ton. And now there’s a $175 billion global carbon market that pays for activities to remove carbon from the atmosphere.

Natasja van Gestel. Credit: Texas Tech University
Biodiversity could enter the game through a 4-billion-year-old form of carbon storage that plants provide: photosynthesis. Plants absorb carbon dioxide for energy and growth, storing the carbon in their leaves, stems and roots, and later transferring it to the soil through decay. The key is to link biodiversity and carbon storage in a quantitative way. So researchers asked: Will changing the number of plant species in an ecosystem affect the amount of carbon that ecosystem stores over time?

The National Socio-Environmental Synthesis Center (SESYNC) convened the team of scientists, which included economists and ecologists. They analyzed data from two long-term experiments in the Minnesota grasslands that measured how plant and soil carbon changed with the number of plant species in a plot. Modeling results over 50 years, they estimated the "marginal" increase in carbon storage, or how much additional carbon is stored for every species added to the mix.

Each additional species in a grassland plot increased the plot's overall carbon storage, on average. One reason for this gain may be that new species can fill new niches, yielding more overall growth.

With more species came diminishing returns in cumulative carbon storage. A change from five to six species stored almost 10 times more carbon than a change from 15 to 16 species, showing that the biggest benefit came from adding species to the least diverse plots.

At small scales, such as 1 hectare, going from one to two plant species over a 50-year time period would store an additional 9.1 metric tons of carbon, potentially saving $804.55 per hectare based on a mid-range estimate ($137 per metric ton) of the social cost of carbon. At larger scales, cost savings could hypothetically be significant. For example, adding just one species to the 12.3 million hectares of cultivated lands restored to grasslands by the U.S. Department of Agriculture’s Conservation Reserve Program could save more than $700 million. The biggest cost savings come from restoring the most degraded, species-poor lands.

"This is one of the first studies to estimate the economic value of biodiversity," said Brad Cardinale, professor at the University of Michigan and leader of the working group that brought the economists and ecologists together at SESYNC. "It provides what is almost certainly an underestimate of value, but I still expect the study to become a classic as others repeat and improve these estimates for other ecosystems."

It's an underestimate because biodiversity confers...
economic value in many ways beyond storing carbon.

"Biodiversity means products like wood, food and fuel, and services like recreation, water purification and flood protection, all of which could be quantified using our approach," van Gestel said. "Money is a language that speaks, and showing the economic value of biodiversity underscores the importance of conservation and the policies that support it. While the value of biodiversity is more complex than just one economic measure, this new research takes a bold step toward understanding its value."


Provided by Texas Tech University

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