The case for stabilizing forest carbon to mitigate climate change

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There's no doubt that climate change is affecting ecosystems as well as the lifestyles of plants and animals around the globe. As temperatures rise, so do the complexity of the issues. Scientists, both in the United States and around the world, are actively pursuing mitigation solutions while providing governments with the understanding of natural hazards to help stem the effects of climate change.

At The University of New Mexico, Matthew Hurteau, associate professor in the Department of Biology, has conducted research to determine how disturbances influence tree mortality risk and how that information can be used in carbon management policies to mitigate climate change. Hurteau and several colleagues argue in an opinion piece, "Managing for disturbance stabilizes forest carbon," released today in *Proceedings of the National Academy of Sciences* (*PNAS*), a peer-reviewed multidisciplinary scientific journal, that policymakers would do well to use disturbance ecology in an effort to stabilize forest carbon.

Central to their piece, Hurteau and colleagues say that "forest systems sequester approximately 12 percent of anthropogenic carbon emissions, and that efforts to increase forest carbon uptake are central to climate mitigation policy.

Understanding the role of carbon is important. As plants photosynthesize, they're taking in carbon dioxide from the atmosphere and then, in the case of trees, turning that carbon into wood. Basically, you can look at a tree and that's carbon that could be in the atmosphere, but it's been taken up by that tree and locked up in wood.

Managing forests to store carbon has focused on increasing forested area, decreasing area lost to logging and clearing, and increasing forest carbon density. Warming, drought, and wildfires challenge the stability of carbon stored in forests.

"By contrast, natural cycles of low intensity fires in dry forests can, over the long term, promote forest carbon storage by protecting carbon in soil and in large, old trees. The conundrum is how to balance immediate, disturbance-driven carbon loss with long-term, stable carbon storage and account for these risks in policies for forest carbon management."

The understanding of disturbance ecology has come long way. Generally,

disturbance is a temporary change in environmental conditions that causes a definitive or pronounced change in an ecosystem. They act quickly, such as in the case of wildfire, and create significant effect in the physical structure and arrangement of living and nonliving elements.

"When you have a climate change mitigation project, like a forest carbon offset project, it has to meet several criteria," said Hurteau. "One of those criteria is that the carbon must be stored in the forest for some long period of time, which is called permanence. This is a tall order when it comes to a natural system, especially when it's disturbance prone."

Along those lines, one of the new areas policymakers should consider the researchers say, "is the explicit use of disturbance ecology to factor in tree mortality risk." Scientists understanding of wildfire and other impactful disturbances have grown to a level where it's time to incorporate these risks into policy mechanisms that enhance forest carbon storage. Governments and policymakers already use similar types of knowledge to make informed decisions for natural disasters including earthquakes, wildfires and floods.

"In the California compliance market for their cap and trade system, if you develop a forest carbon project, that carbon you quantify and sell as offsets has to be stored for a hundred years," Hurteau explained. "Things like wildfire, insect outbreaks, and drought pose what is called a 'reversal risk' in the carbon accounting world, where that carbon sequestration and storage gets undone by the disturbance.

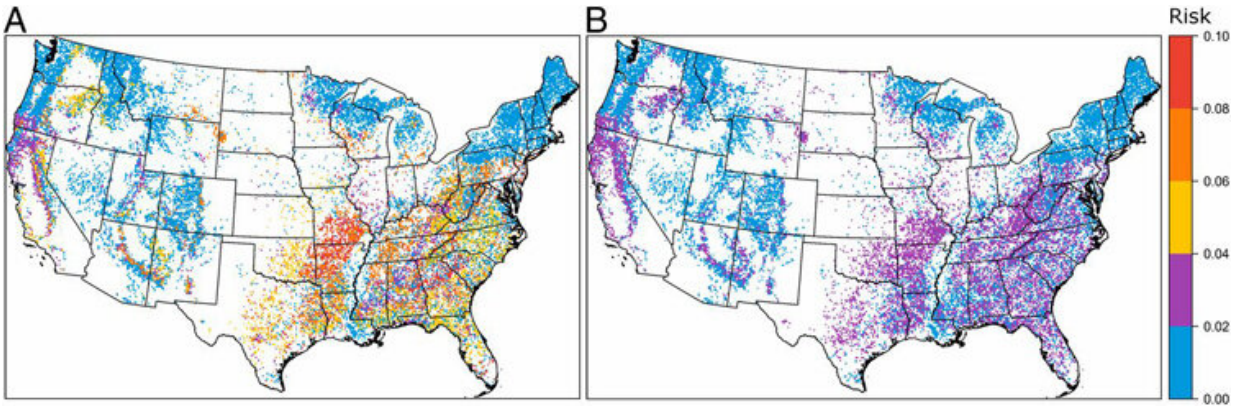
"This creates a situation where you've got offsets that had been sold to help reduce emissions that we put in the atmosphere that are causing the climate to change," said Hurteau. "When a disturbance happens, that carbon is no longer sequestered in the forest and so the idea is that we have the ability and the data to actually quantify what the chance of

these disturbances occurring is, and then what effect on any sort of management action could have on reducing that reversal risk."

As an example, the thinking behind these carbon offsets is that if a large power producer is burning coal and they need to meet an emissions reduction target and you own a forest, they can pay you to do some activity to store more carbon than you would have under business as usual conditions.

"If you've got a working forest and, and you usually harvest every so often, you develop carbon offsets by foregoing harvest and I buy them," said Hurteau. "And then you keep that carbon locked up in the forest."

In the opinion column, Hurteau and his colleagues encourage policymakers to use stability and risk accounting strategies based on the understanding of disturbance probability and severity. California's cap and trade program, which is one of the largest carbon markets, is currently being monitored by several U.S. states and other countries as a potential model to develop their own markets. The program allows California companies to buy forest carbon offsets that may be available anywhere in the U.S. Out-of-state offsets are valued by bid price and standing carbon stores.



The risk rating of different forested areas within the United States. (A) - Risk is calculated as VCx1mFRIVDx1mFRI, where mFRI is the pre–fire suppression fire return interval and VD is an index of how departed the current forest is from that maintained by regular fire. (B) The risk rating declines in frequent-fire forests when management intervention decreases VD to 0.2. Credit: University of New Mexico

An important piece of this idea is how researchers can help quantify and price risk, which is pretty common in other areas. Auto or homeowners insurance is a good example. The price of your policy all depends on how much exposure to loss you have.

Hurteau says scientists can actually quantify the risks to forest carbon offsets and then the benefit of management to reduce that risk can be priced by the market. Another key point in the dialogue is that the U.S. already has the legal framework in place to implement the initiative on federal lands in the U.S.

"One of the things that stands in the way of getting this done is that the U.S. Federal government has not recognized, the significant risks that we face from climate change and therefore is undervaluing the portfolio of options we have available to reduce that risk," said Hurteau. "The data and research on wildfire and forest management goes back to the '70s and '80s and we've known that the humans have been changing the climate for decades. We could have done something a lot sooner. As humans, we're real good at dealing with acute problems and not real good with the chronic."

More information: Matthew D. Hurteau et al. Opinion: Managing for disturbance stabilizes forest carbon, *Proceedings of the National*

Academy of Sciences (2019). DOI: 10.1073/pnas.1905146116