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Tall and old or dense and young: Which kind of forest is better for the climate?

Paul Koberstein & Jessica Applegate 5 years ago

- *Scientists say reforestation and better forest management can provide 18 percent of climate change mitigation through 2030. But studies appear to be divided about whether it's better to prioritize the conservation of old forests or the replanting of young ones.*
- *A closer look, however, reconciles these two viewpoints. While young forests tend to absorb more carbon overall because trees can be crowded together when they're small, a tree's carbon absorption rate accelerates as it ages. This means that forests comprised of tall, old trees – like the temperate rainforests of North America's Pacific coast – are some of the planet's biggest carbon storehouses.*
- *But when forests are logged, their immense stores of carbon are quickly released. A study found the logging of forests in the U.S. state of Oregon emitted 33 million tons of CO2 – almost as much as the world's dirtiest coal plant.*

- *Researchers are calling on industry to help buffer climate change by doubling tree harvest rotations to 80 years, and urge government agencies managing forests to impose their own harvest restrictions.*

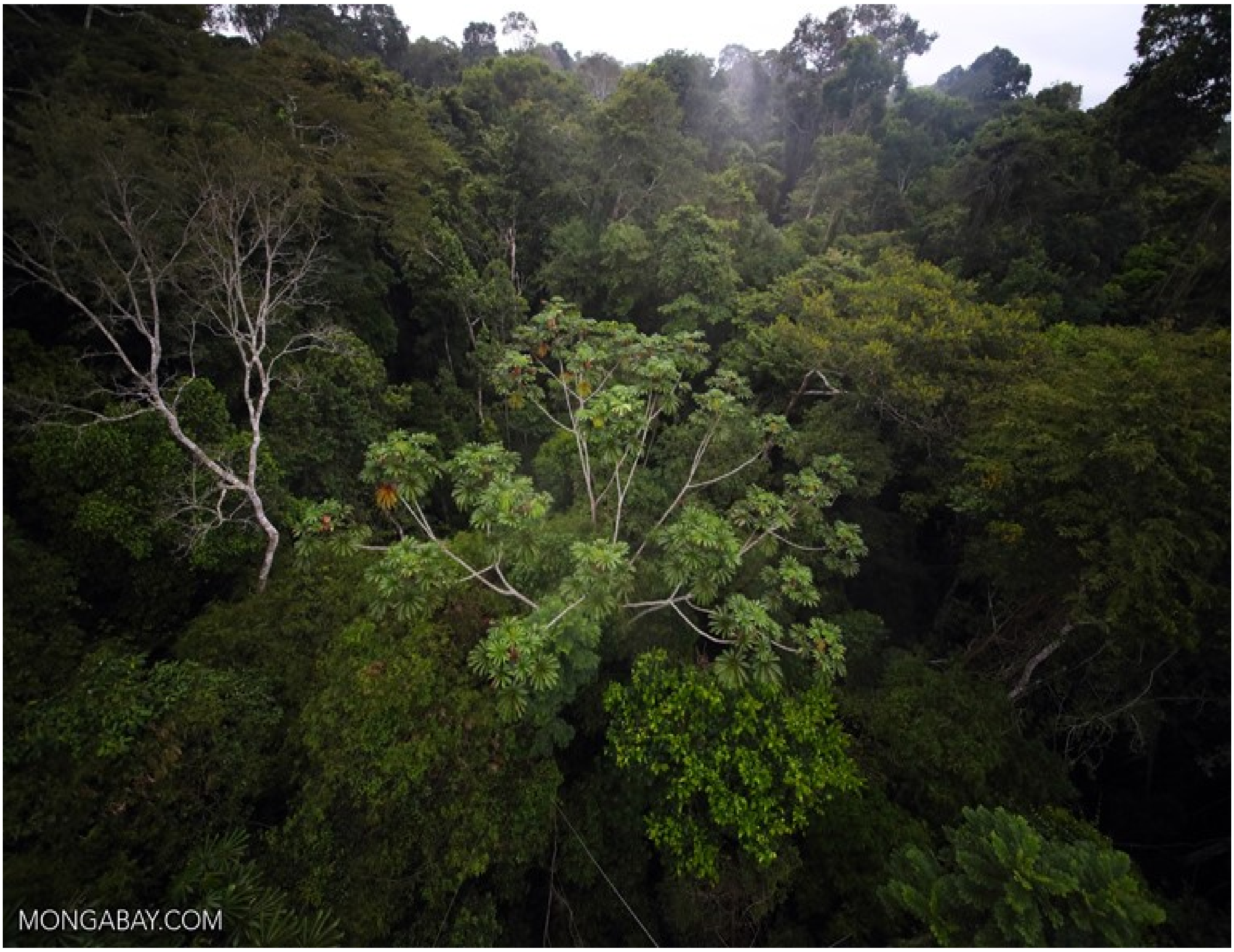
In 2007, Richard Branson, the British business magnate, offered a $25 million prize to anyone who can invent a device capable of removing significant volumes of carbon dioxide from the atmosphere.

Andy Kerr, a noted Oregon environmentalist, drew a picture of a tree and sent it in. After all, a tree performs the job of sucking carbon out of the air far better than any technology yet devised by humans. But Kerr didn't win, foiled by contest rules specifying the winner must be the inventor of such a device, and it's certain neither Kerr nor anyone else invented the tree. An artificial tree might win if it could perform the implausible feat of inhaling CO_2.

Kerr's idea, however, was rooted more in the climate benefits provided by an entire forest rather than just a single tree. These benefits can be enormous, according to "Natural Climate Solutions," a paper published in 2017 in the Proceedings of the National Academy of Sciences.

The paper asserts better management of forests, wetlands and farmland can provide 37 percent of the cost-effective climate mitigation needed through 2030. Forests alone can provide 18 percent of the mitigation, according to a statement published last year by the Climate and Land Alliance and signed by an international group of 40 scientists.

"The 'natural technology' of forests is currently the only proven means of removing and storing atmospheric CO_2 at a scale that can meaningfully contribute to achieving carbon balance," the 40 scientists said. "The world's forests contain more carbon than exploitable oil, gas, and coal deposits, hence avoiding forest carbon emissions is just as urgent as halting fossil fuel use."



The Amazon Rainforest is one of the world's most important carbon sinks.

Last year, the United Nations' Intergovernmental Panel on Climate Change (IPCC) warned we have only until 2030 to act if we hope to limit global warming to moderate levels.

Forests cool the atmosphere by inhaling CO_2 through the process of photosynthesis and storing or sequestering it in roots, trunks, branches, needles and leaves. Half a tree's weight is carbon. Although every backyard vegetable garden absorbs some amount of carbon, a rainforest takes in exponentially more. For this reason, rainforests and other large terrestrial ecosystems made up of dense vegetation are known as "carbon sinks."

Kerr lives at the edge of a temperate rainforest straddling the west coast of North America from the redwoods of Northern California into Alaska, the largest contiguous temperate rainforest in the world. Few ecosystems anywhere match its capacity to absorb and store carbon. Trees in the temperate rainforest, among the tallest in the world, live for 800 years or more.

The expansive Amazon tropical rainforest of South America is one of the world's largest carbon sinks. But on a per-acre basis, the Amazon is not nearly as efficient at absorbing carbon as the coastal temperate rainforest. The Douglas fir forests of Oregon and the hemlock and cedar forests of Alaska store about twice as much carbon per acre as the Amazon. The giant redwoods of Northern California, which store seven times as much, are regarded as the most carbon dense forests in the world.

The temperate rainforest is a "carbon storage powerhouse," says John Talberth of the Portland, Ore.-based advocacy group Center for a Sustainable Economy (CSE). "If allowed to mature, Pacific Northwest forests can capture and store more carbon than almost any terrestrial ecosystem on Earth."

Pound-for-pound, North America's temperate rainforests – like this one on the Olympic Peninsula of Washington – beat tropical rainforests when it comes to carbon storage.

The problem is most mature trees in the rainforest have been cut down and young ones are not allowed to mature. Outside conservation areas like national parks and wilderness, ancient groves are converted to industrial tree farms by the timber industry.

After cutting down every old growth tree it can get its hands on, the industry typically plants a young sapling in its place. The saplings grow for about 40 years on average until the next harvest. Then the cycle repeats again and again.

This business model might be good for timber industry profits, but what does it do to the climate?

Sara Duncan, a spokeswoman for the Oregon Forest Industry Council, a lobbying group, claims this business model is good for both profits and the climate. She says old growth trees store a lot of carbon, but like everything else, old growth trees eventually die. If they aren't harvested and converted into wood products, they will fall down in a windstorm, burn up in a wildfire or meet their fate some other way. Eventually they will release all their stored carbon content back to the atmosphere.

The industry's solution to the climate crisis is to log the trees, truck them to the mill, and store the carbon in 2-by-4s, plywood boards and toilet paper. Eventually, however, the carbon in these products will still return to the atmosphere one day.

But is there a more climate-friendly way to manage our forests? Can we get more climate mitigation from a forest if we don't cut it down every 40 years? The science suggests we can.

In 2014, a study published in Nature by a team an international team of researchers led Nathan Stephenson, a forest ecologist with the United States Geographical Survey, found that a typical tree's growth continues to accelerate throughout its lifetime, which in the coastal temperate rainforest can be 800 years of more.

Stephenson and his team compiled growth measurements of 673,046 trees belonging to 403 tree species from tropical, subtropical and temperate regions across six continents. They found that the growth rate for most species "increased continuously" as they aged.

"This finding contradicts the usual assumption that tree growth eventually declines as trees get older and bigger," Stephenson says. "It also means that big, old trees are better at absorbing carbon from the atmosphere than has been commonly assumed."

But the science, as usual, is muddy. As Mongabay reported in February, a study published in the Proceedings of the National Academy of Sciences in 2019 by Thomas Pugh of the Birmingham Institute of Forest Research in the UK found young forests sequester more carbon per year than old-growth forests.

"These findings upend conventional wisdom that old-growth tropical rainforests are the planet's biggest carbon sinks," Pugh's study said. It defined old-growth forests as any stand over 140 years of age.

It

This giant cedar sucked in a lot of carbon during its 1,000-year life. Photo by Morgan Erickson-Davis.

would appear the two studies contradict each other. But both scientists say they are consistent.

“The difference is that Stephenson et al. looked at biomass of individual trees, whereas our study looks at biomass of whole stands of trees,” Pugh said in an email. “Whilst a single tree might continue to pile on more and more biomass, there will be less of such trees in a stand, simply because of their size and as tree stands age, gaps tend to appear due to tree mortality.”

“So, our conclusion is actually that young forests are responsible for more of the terrestrial carbon sink than old growth forests,” Pugh said.

"Both things are true," Stephenson said in an email. "Individual tree mass growth rate increases with tree size, but old forests usually absorb carbon more slowly than young forests."

However, the relative growth rates of young and old trees do not tell the entire story.

"Older forests store a lot more carbon than young forests and much of it is returned to the atmosphere quickly when harvested and planted with young trees," says Beverly Law, a professor of global change biology at Oregon State University.

By the time it becomes a desk, table or 2-by-4, a log will lose about 70 percent of its carbon, according to Dominick DellaSala, director of the GEOS Institute, an environmental think tank based in Oregon.

About 45 percent of the carbon is left on the forest floor, said DellaSala, a member of the Oregon Global Warming Commission Task Force on Forest Carbon. "This includes decomposition of root wads, branches, and tops remaining on site and a little soil carbon. Logging takes nearly half the carbon and puts it into the atmosphere within years."

Trees that fall naturally release their carbon gradually over decades as they decompose.

Another 25 percent is lost during manufacturing, he said. And as the finished wood products decay over time, he said, they emit even more.

And that doesn't include carbon emitted by chainsaws, logging trucks and lathes. In 2018, Law led a team of researchers who quantified these and all other carbon emissions as logs move from forest to sawmill. Their paper, published in the Proceedings of the National Academy of Sciences, said logging operations in Oregon contribute an average of 33 million tons of CO2 to the air. This equates to almost as much as the world's dirtiest coal plant, Taichung Coal Plant in Taiwan, which emits about 36 million tons per year.

Moreover, the climate impacts of logging are even greater if you factor in a harvested log's lost future growth opportunities, Law says. Although her paper makes no attempt to quantify a logged tree's foregone climate mitigation potential, she acknowledges it could be significant.

Law called on the industry to help buffer climate change by doubling harvest rotations to 80 years and urged government agencies managing forests to impose their own harvest restrictions. These and other actions could increase the amount of carbon absorbed by Oregon forests by 56 percent by the year 2100, as well as improve water quality and biodiversity, her paper said. She is conducting a similar analysis for forests in California and Washington.

Even after the wood is converted into a wood product, the carbon will likely return to the atmosphere sooner than people might think, Law said.

"Old growth trees in the coastal temperate rainforest can sequester carbon for hundreds of years," she said, "which is much longer than is expected for buildings that are generally assumed to outlive their usefulness or be replaced within several decades."

Paul Koberstein and Jessica Applegate are editors of Cascadia Times, an environmental journal based in Portland, Oregon.

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