Interior West forests on verge of becoming net carbon emitter
Land Letter (11/11/2010) April Reese, E&E reporter

Forests in the Interior West could soon flip from carbon sink to carbon source, forest experts say.

The region's forests once absorbed and stored more carbon from the atmosphere than they released. But huge conflagrations -- like the 138,000-acre Hayman Fire in Colorado in 2002 and the Yellowstone fires of 1988, which scorched 1.2 million acres -- combined with a series of severe bark beetle infestations and disease outbreaks, have left large swaths of dead, decomposing trees in almost every major Western forest.

Those dead trees are releasing massive amounts of carbon dioxide, turning the region into a net emitter of carbon rather than a CO2 sponge.

The reversal, which has already occurred in Colorado and is anticipated in several other states, is the result of misguided forest management practices and a changing climate, forest experts say.

Thinning and prescribed fire in Western forests are believed to aid in the forests' ability to absorb carbon. But excessive use of such techniques could tip forests to being net carbon emitters, experts say. Photo courtesy of the Fish and Wildlife Service.

Rising temperatures, resulting in shrinking snowpacks and drier conditions, have left the region's forests more susceptible to disturbances, such as wildfires, bark beetles and disease.

"In the Interior West, we've had a lot of these disturbances," said Dave Cleaves, the Forest Service's climate change adviser, who served as director of the agency's Rocky Mountain Research Station from 2005 to 2007.

But temperature alone is enough to cause mortality in some forests, scientists have found. According to a study published last year in the journal *Science,* the death rate for Western old-growth forests -- which are generally more resilient and more stable than younger forests -- has doubled in the past few decades as temperatures have risen. More trees are dying, while regeneration rates remain unchanged, the study found (*Land Letter*, Jan. 29, 2009).

Forest management has also contributed to the increase in carbon releases.

For about a century, forest managers thought the best way to deal with forest fires was to suppress them. Eventually, forest ecologists learned that fire plays an important role in the ecosystem in many forest types, clearing brush and small trees. But the fuel accumulation from years of fire suppression, combined with severe droughts in the early part of this decade, created conditions that allowed large, hotter-than-usual fires to sweep through the Interior West's forests.

"We've got several times more carbon per acre than those forests carried in the early days, when there was a natural fire disturbance interval there," Cleaves said. "And those systems are more susceptible to disturbances now. We've got a lot of acres in the Interior West that have reached that level."

Lost storage capacity

Fires themselves do not release that much carbon into the atmosphere, but the decomposition of the trees killed by fires does, said Michael Ryan, a research ecologist with the Forest Service's Rocky Mountain Research Station in Fort Collins, Colo.

As temperatures and mortality rates continue to climb, forests will have less carbon storage capacity, and their potential to offset carbon emissions from human sources, such as vehicles and power plants, is likely to decrease. Trees absorb carbon from the atmosphere during photosynthesis and store it in their trunks, branches and leaves.

But the shifting carbon dynamic in the West's forests is nothing new, Ryan said.

Experts say that regeneration, or the growth of young trees after a disturbance, is one of the best ways to maximize carbon sequestration by forests. Photo courtesy of the U.S. Geological Survey.

The reason Western forests have been a carbon sink for most of the past century is the growth of new trees after extensive logging and land-clearing for agriculture during westward expansion. During the decades after European settlement of the West, large amounts of carbon were released into the atmosphere, and the region was most likely a source at that time, he said.

"Current forests are recovering from past land use as agriculture, pasture or [timber] harvest, and because this period of recovery will eventually end, the resulting forest carbon sink will not continue indefinitely," concluded a synthesis of the current science on forests and carbon that appeared in the Spring 2010 edition of *Issues in Ecology*, a publication of the Ecological Society of America.

Ryan, who was the lead author on that summary, said the best way to restore a disturbed forest's carbon-absorbing capacity is to boost regeneration, so that new growth can help offset the carbon lost by decomposition.

For example, regeneration of severely burned areas in Yellowstone, which has occurred more rapidly than scientists expected after the 1988 fires, has allowed the forest as a whole to achieve an almost carbon-neutral state.

"Our study shows it should be approaching this neutrality," Ryan said, referring to a separate study published in the January 2010 issue of *Fire Science Briefs*. "I think it can recover carbon pretty quickly, which is a surprise."

Cleaves said forest managers could improve the carbon-absorbing capacity of other Interior West forests by planting more seedlings to accelerate regeneration, especially in intensively burned areas where the forest is likely to be replaced by meadows or sparse stands.

"What you worry about is, when you have more fires that burn hotter, do you have some irreversible losses, and how quickly do you place a new system on there so that we're back into producing carbon and producing watershed services and wildlife habitat as quickly as possible after the disturbance?" he said.

Thinning and burning

But Cleaves and other forest experts emphasize that national forests have to be managed for multiple uses, not just carbon sequestration and storage (*Land Letter*, Nov. 4).

Thinning and prescribed burns, which help clear out overly dense forests and reduce the risk of large, unnaturally hot fires, could help preserve forest carbon over the long-term, they point out. But removing carbon at too large a scale could tip forests toward becoming a carbon source.

"Some studies show that if you do prescribed burning and thinning and there's a fire, you'll retain more carbon than if you haven't done thinning," Ryan said. "But thinning puts a lot of carbon in the atmosphere. So if there is a carbon benefit from that, it's going to be very small."

Cleaves said the Forest Service is taking a cautious approach in working carbon considerations into forest management.

"We're trying to manage the risk of carbon loss," Cleaves said. "Our objective is to have a long-term sequestration of carbon. We also want other ecosystem services, like water, habitat and other things you're providing on the same landscape."

Reese writes from Santa Fe, N.M.