MINNESOTA PUBLIC RADIO

Forest experiments track causes and effects of global warming

by Bob Kelleher, Minnesota Public Radio
August 8, 2006

Researchers are trying to determine how north country woods and wetlands will respond to a changing climate. In Wisconsin, researchers are finding that gases like carbon-dioxide and ozone will determine what survives in a future forest. But they don't know whether the forest can change as quickly as the climate does.

In Minnesota, a researcher says wetlands like bogs could be the key to how fast the worldwide climate changes. He says Minnesota is in the bullseye for rapidly changing temperatures and rainfall.

Duluth, Minn. — I'm standing inside a circle of trees not far from Rhinelander, Wisconsin. The paper birch, aspen, and sugar maples are maybe 15 feet high. They are surrounded by a ring of large white pipes spraying the trees with gases.

Among the 12 rings of trees, some get carbon dioxide, or ozone, or a combination. These are the gases believed responsible for changing the climate -- they hold in the earth's warmth, forcing surface temperatures higher.

Dave Karnosky of Michigan Technological University heads the Aspen Face project and is trying to predict how these gases will affect the northern forest.

"Aspen and aspen mixed with birch and maple make up a huge portion of our northern forests," Karnosky says. "And there was a lot of interest by industry as to what's going to happen in the future, as these greenhouse gases continue to build up in the atmosphere."

Even 10 years ago, when this project started, it was clear that carbon dioxide and ozone levels were on the increase. Both come largely from human activities such as industries and motor vehicles.

Ozone is destructive for people and for plants. Carbon dioxide, on the other hand, is what we exhale, and what green plants need to grow. Karnosky says he knew aspen were quite responsive to both CO2 and ozone.

"We weren't sure much about the interaction, but we were sure interested in what would happen with that, because those two pollutants are both increasing at about the same rate in the atmosphere," Karnosky says.

So here we are. We're sitting right now right in the bullseye of the greatest

The Aspen Face experiment has shown that most trees grow well when exposed to carbon dioxide, and most do poorly in ozone. With the gases combined, bad effects tend to offset the good ones.

Karnosky has found that the diversity among trees could be their strength. For example, if some trees die off from ozone, others may do OK, and fill the forest back in. Sugar maples, which seem more tolerant of ozone, could replace some aspen and birch. The forest will change,

but it would survive.

amount of warming that will happen on the face of the earth.

- Researcher John Pastor

But there could be problems if the forest changes too quickly.

Neil Nelson, a plant physiologist with the U.S. Forest Service, says the region's paper and pulp industries rely heavily on aspen trees. He's uncertain how quickly the forest -- and forest industry -- can respond, if aspen begins to die off, and how long it might take for other trees to grow in.

"One of my colleagues has said the key issue may be whether things change too fast for our society and economy to adjust to," Nelson says. "And I think that's an open question. There seems to be great plasticity, and we aren't quite there in terms of predicting from a forest management standpoint what these results mean."

Aspen Face has already provided regulators preliminary data on ozone. It could become the basis for future pollution law. But the Aspen Face project doesn't consider a likely consequence of greenhouse gases -- rising temperatures.

That's something John Pastor has studied in bogs near Duluth. Pastor has found that in a warmer future, bogs will either help slow climate change, or accelerate it.

"The one problem in science that has the most ramifications throughout all of science -- it's global warming," Pastor says.

Pastor says all cards are off the table if temperatures keep rising.

If John Pastor invites you for a walk, bring your waders. We're in a swamp north of Duluth -- actually, with standing water, it's called a fen. It borders a bog, where a mat of plants floats on top of water. What fens and bogs have in common is water, and peat -- the not quite decomposed stuff left over when plants die.

Pastor says peat lands are one of the world's significant bank accounts for carbon. They keep carbon out of the atmosphere.

"Peat lands cover only 3 percent of the earth's surface, but they contain 30 percent of all the carbon that's in all the soil in the world, locked in that partially decomposed organic matter, that peat," Pastor says.

Minnesota has vast peat lands that have been storing carbon for 10,000 years. But Minnesota's peat lands pale in size compared to those around Hudson Bay and in the Russian republics, all regions that are facing higher temperatures, according to Pastor.

"All of the global climate models, one thing they all agree on, is that the greatest amount of warming will occur in areas from Minnesota northward, and then inland, mid-continent areas," says Pastor. "So here we are. We're sitting right now, right in the bullseye of the greatest amount of warming that will happen on the face of the earth."

Will higher temperatures help trap more carbon in bogs, or force more carbon into the atmosphere?

In this bog, Pastor's been trying to figure out how warmer weather will affect bogs and fens, and in turn, what role the wetlands will play in global change. One thing he's found is that the results depend largely on rainfall.

In some combinations, say with additional heat and additional rainfall, bogs could thrive, trapping more carbon. That would be good.

In other conditions, with more heat but less rainfall, bogs and fens could die and decompose, releasing even more carbon into the atmosphere. That would be bad.

"Now we have kind of a double whammy," Pastor says. "Not only are we putting carbon dioxide from fossil fuel into the atmosphere. The warming from that could cause the carbon from the peat land also to go into the atmosphere and accelerate the warming."

Pastor is working with new mathematical theory to try to determine at what point global warming has gone too far.

"What seems to be happening is the temperatures of the earth have crossed some kind of a threshold. Before they crossed that threshold, the old earth that we grew up with was stable," Pastor says. "Now it's becoming very unstable, and ice sheets are collapsing, birds and plants are migrating. Everything's happening very, very quickly. And we're going to enter into a new kind of earth that has a different kind of stability -- a different stable endpoint."

Pastor says there's no more complicated problem in all of science than global warming, and no more important problem. Global warming, he says, changes everything, from the forests to the wetlands.