

Site Web

Search

Home News Business Sports Entertainment Living Outdoors Opinion Multimedia

Jobs Autos Real Estate Classifieds Shop

Breaking News & Updates Local Weather Traffic Education Politics Election 2008 Obituaries Special Reports Columns & Blogs

## A Change in the Air: Vital Signs

### Taking the pulse of climate change in the Colorado Rockies

*Jim Erickson, Rocky Mountain News*

Published December 13, 2005 at midnight

Text size  

- [0 Comments](#)
- [Email](#)
- [Print](#)

#### CHANGE IN THE AIR: FIFTH IN AN OCCASIONAL SERIES ABOUT HIGH-ALTITUDE RESEARCH IN COLORADO

*"It is not the strongest of the species that survive, nor the most intelligent, but the most responsive to change."* - **Charles Darwin, 1835.**

GOTHIC — The marmot was holding his own until the second coyote blindsided him.

The coarse-furred, groundhog-like rodent emerged from his hibernation burrow last April onto a thick crust of snow that blanketed this former mining town several miles north of Crested Butte.

A band of coyotes had been hanging around, and one of them pounced on the marmot. The feisty rodent rose to his hind legs and batted at the coyote with his clawed front paws, like a boxer, as he struggled to escape.

But a second coyote bounded in from behind and joined the fray. The two canines killed the marmot, then dragged him off.

To University of Maryland ecologist David Inouye, this grisly account serves as a cautionary tale about — believe it or not — the potential perils of global climate change.

Around the world, scientists are looking for biological red flags, signs that global warming is already affecting high-altitude plants and animals and could imperil fragile mountaintop ecosystems.

In the Colorado high country, that work includes studies of three seemingly unrelated phenomena: the shifting hibernation pattern of marmots, subtle changes at the forest tree line, and the chemical fingerprint of mountaintop air molecules trapped in glass flasks.

Results from all three research efforts, examined in this special section, suggest that life in the Colorado Rockies is already responding to climate change, though some scientists question the findings.

A matter of marmots

The yellow-bellied marmots of Gothic, home to the Rocky Mountain Biological Laboratory at 9,300 feet, are among the most thoroughly studied high-altitude creatures on the continent.

University of Kansas biologist Kenneth Armitage began monitoring the animals in 1962, and behavioral ecologist Dan Blumstein of the University of California at Los Angeles is continuing the work.

Detailed lab records show the Gothic marmots now emerge from hibernation about a month earlier than they did 30 years ago.

During that interval, the average April low temperature in nearby Crested Butte rose 5.9 degrees Fahrenheit, according to Inouye, a fellow Gothic researcher who analyzed National Weather Service records.

Inouye blames global warming for the rising temperatures and suggests the balmy April air is tricking the marmots into exiting their burrows before the snow has melted, leaving them potentially vulnerable to starvation and predation.

It's one of many examples of how a warming climate is disrupting the environmental cues that plants and animals around the world use to determine the timing of events such as hibernation, migration, breeding, flowering and pollination, Inouye said.

If the warming accelerates in coming decades, as climate models predict, nature will be forced to adapt quickly, he said. Plants and animals living at higher elevations — like those in the Colorado Rockies — will have fewer options and could be at greater peril than lower-dwelling species that can simply move to more agreeable locations.

"There are a lot of people who consider marmots as nothing more than moving targets for rifle practice," said Inouye, a wiry, soft-spoken academic who has spent his summers in Gothic since 1971.

"So if we were talking about just this one species, then many people might not be particularly concerned.

"But the bigger issue is that it's not just marmots," he said. "They are representative of a larger number of species out here that we're also at risk of losing.

"And when you get many, many observations of this kind all over the world, and everybody's seeing the same sorts of trends, then it makes sense in the context of global warming."

Biological indicators

The Earth has warmed about 1 degree Fahrenheit over the past century. Most scientists agree that human activities — mainly the burning of fossil fuels, which emits heat-trapping carbon dioxide gas — have contributed to the temperature rise.

Most climate scientists say receding mountain glaciers, declining global snow cover, thinning summer sea ice in the Arctic and rising sea levels are environmental indicators of a warming climate.

Since plants and animals are exquisitely attuned to the environments that sustain them, certain biological changes might also provide early warnings of a warming world.

But attributing biological changes to global warming is a tricky and contentious endeavor.

Especially when claims are made about changes in the behavior of a single species, such as yellow-bellied marmots, at a single location, such as Gothic.

First, it's impossible to prove that the April warming in Crested Butte has anything to do with global climate change. The growth of the town in recent decades could be partly to blame and natural climate variability might also explain it.

Second, Inouye and his colleagues, who published their marmot findings in a peer-reviewed article in the *Proceedings of the National Academy of Sciences*, can't be sure the heavyset rodents' earlier emergence from hibernation is a response to warming April temperatures.

There could be some other explanation. Maybe the marmots are driven to find mates sooner. Maybe they're getting hungry earlier. Who knows?

"Changes in plants and animals at single locations . . . cannot be unambiguously linked to anthropogenic (human-caused) climate change," biologists Camille Parmesan and Hector Galbraith wrote in a November 2004 report, *Observed Impacts of Global Climate Change in the U.S.*

The best approach is to examine reported changes in many far-flung plant and animal species and look for trends that fit with global warming predictions, Parmesan and Galbraith wrote.

'Strong evidence' of link

For their report, sponsored by the Pew Center on Global Climate Change, Parmesan and Galbraith reviewed 40 studies that drew a possible tie between climate warming and ecological change in the United States. In more than half the cases, the researchers concluded there was "strong evidence of a direct link" between warming and the observed changes.

The two main types of trends involved phenology and range shift.

Phenology is the study of the timing of key biological events, such as the onset of spring growth, migration and breeding. Range shift refers to a geographical change in the distribution of plant and animal species.

In a warming world, many spring-time phenological events would likely occur earlier in the year. In the Northern Hemisphere, range shifts would be northward or to higher elevations.

According to Parmesan and Galbraith, the most convincing U.S. examples of biological changes that seem linked to a warming climate include reports that:

- **Tree swallows** at 3,400 nest sites across the United States now lay their eggs an average of nine days earlier than they did in 1959.
- **Mexican jays** in the Chiricahua Mountains of southeastern Arizona now breed 10 days earlier than they did in 1971.
- **The sacheem skipper butterfly** has expanded its range northward 420 miles, from California into Washington, in the past 35 years. It has moved into areas where winters were previously too cold for it to survive.
- **The rufous hummingbird's** winter range has shifted northward dramatically in recent decades. Thirty years ago it wintered mainly in Mexico, and there were never more than 30 winter sightings per year in the United States. In 1996, 1,643 U.S. winter sightings were reported.

On a global scale, two independent research teams concluded in January 2003 that they had found the "fingerprint" of global warming in hundreds of plant and animal species around the world whose behavior or distribution has changed in recent decades. The two reports were published in the journal *Nature*.

In one of the articles, a team led by Terry Root of Stanford University reviewed 143 studies of biological changes in nearly 1,500 plant and animal species around the world. About 80 percent of the species that displayed significant changes were shifting in the direction expected with warming temperatures.

Root's team concluded that "a significant impact of global warming is already discernible in animal and

plant populations."

Another group, led by Parmesan, reviewed long-term studies of more than 1,700 species. Eighty-seven percent of the significant phenological changes and 81 percent of the significant range changes matched climate-change predictions.

The researchers concluded they'd uncovered "a globally coherent fingerprint of climate change impacts across natural systems."

Skeptics unconvinced

But some scientists don't buy it.

Plants and animals have adapted to climate change for millions of years. Tree lines have crept up and back down mountainsides, and animals have migrated to more favorable territories in response to natural climate swings.

So it's not surprising to see nature responding to present-day temperature changes. In fact, it would be shocking if plants and animals weren't, said Tom Stohlgren, a U.S. Geological Survey ecologist based in Fort Collins.

What Inouye, Root, Parmesan and like-minded researchers cannot show is that these changes are linked to fossil fuel emissions and human-caused climate change, Stohlgren said.

"Species do change with climate. That shouldn't be a shocker," he said. "But linking it to global climate change resulting primarily from human activities is just a stretch."

Stohlgren said nature will face far more urgent threats than climate change in the coming decades: habitat loss, pollution, emerging diseases, invasive species and overharvesting, to name a few.

"I don't want to denigrate their work. They're doing fabulous research. But I'm not sure we have our priorities right," he said.

"There just aren't many things on the endangered species list because of climate change. Zero, in fact."

Root acknowledged that pinning the biological trends to human activities has been a challenge. But scientists are making headway.

In a May 24 article in the *Proceedings of the National Academy of Sciences*, Root and her colleagues describe a computer-modeling study that enabled them to link some regional phenological changes directly to human-caused warming.

And yes, plants and animals have adjusted to past climate changes.

But two major differences distinguish the current situation, Root said in an interview.

First is the rate of change. One degree Fahrenheit of warming over the past century may not sound like much, but it's likely the quickest global temperature change of the past 1,000 years, according to the Intergovernmental Panel on Climate Change.

Computerized climate models suggest the planet will warm another 2.5 to 10.4 degrees by 2100. The extent of the warming depends largely on future rates of fossil-fuel emissions, according to the IPCC, the world's most authoritative source on climate research.

"The projected rate of warming is much larger than the observed changes during the 20th century and is very likely to be without precedent during at least the last 10,000 years," the IPCC concluded in 2001.

So plants and animals may have to adjust fast. But urbanization, agriculture and other land-use changes have created barriers that didn't exist during earlier climate swings, Root said.

"It's not that species can't move. They can. But now they have to cross our freeways and our farms and our Kmart parking lots," she said. "The habitat isn't continuous the way it used to be."

And the plants and animals trapped on mountaintops are especially vulnerable because they have no escape route.

"I honestly believe that we are standing at the edge of a very, very large mass extinction, and top-of-mountain species are going to be the first ones to go," said Root, a senior fellow at Stanford University's Center for Environmental Science and Policy.

To which Stohlgren replies: "Many species have adapted to climate change — warm and cold periods — throughout the Earth's history. . . . I guess I'm just not as much of an alarmist as some."

Birds, bees, butterflies

Back at the Rocky Mountain Biological Laboratory in Gothic, marmots aren't the only creatures showing noteworthy changes, Inouye said.

American robins, which spend the winter at lower elevations, now return to Gothic about two weeks earlier than they did in 1981, he said.

Anecdotal evidence suggests that a species of bumblebee has migrated to higher elevations in recent years; that the timing of the Milbert's tortoiseshell butterfly's emergence has changed; and that chipmunks and ground squirrels may be emerging from hibernation earlier.

At Gothic, the early bird doesn't always get the worm.

Both the robins and the insomniac marmots now face longer periods of foraging over snow-covered

ground, when food is scarce, Inouye said.

"As the environment is changing, cues like temperature and snowmelt that once made sense for timing biological events like hibernation, migration and flowering are becoming unreliable," he said.

"The historical synchrony of these events is breaking down."

While Inouye's interpretations are open to challenge, the climate data he's using in the ongoing marmot study seem rock-solid, said research climatologist Nolan Doesken of the Colorado Climate Center.

At the request of the *Rocky Mountain News*, Doesken reviewed National Weather Service temperature records from Crested Butte between 1970 and 2004.

He confirmed that April overnight low temperatures have increased by 5.9 degrees over that span.

Similar increases were seen at two nearby weather stations — at Taylor Park Reservoir and in Gunnison — he said.

"The warming trend for April minimum temperatures was quite dramatic at all three stations since 1970," he said. "And he (Inouye) is seeing a pretty nice-looking correlation between locally observed temperatures and local behavior of wildlife.

"The only stretch in any of this discussion is whether this is due to anthropogenic global warming," Doesken said. "And I can give you a very solid 'I don't know.' "

Doesken said natural climate variability, along with the growth of Crested Butte and Gunnison, could partly explain the warming observed at those sites. And the weather stations in both towns have been moved several times, which affects the reliability of long-term records, he said.

"I respect him (Inouye), and he can say boldly that what he's seeing is due to global warming," Doesken said. "I can't quite say that, but I'm paying close attention to it."

As for the idea that the marmots are emerging earlier because they sense the warmer April air, that's all it is: an idea.

The Gothic-area marmots have been studied continuously since 1962 — nearly as long as Jane Goodall has followed the Gombe chimps in Tanzania.

But even now, researchers can't say for sure exactly what makes them end their winterlong snooze, said UCLA's Blumstein.

A self-styled "marmoteer," Blumstein has been live-trapping, tagging, probing and prodding many of the 200 or so Gothic-area marmots since 2001. He has studied marmots from British Columbia to Pakistan for 17 years.

Blumstein is a behavioral ecologist whose main interests are marmot evolution, behavior and communication.

But he also wonders how climate enters the mix.

"I'm not entirely convinced, but I'm not dismissive of it, either," Blumstein said of Inouye's global-warming assertion.

As he spoke, he sprinkled a molasses-and-oats mix into marmot traps scattered around the clustered wooden cabins that constitute the Rocky Mountain Biological Laboratory campus.

The best bet is that springtime emergence involves an interplay between climate and sexual competition for mates, he said. The emergence date can affect a marmot's chances of finding a mate and successfully breeding, as well as its ability to find food, re-establish territory and avoid predators such as coyotes, foxes, badgers and bears.

A bad spring for marmots

Last spring, after the first above-normal winter snowfall in several years, Gothic-area marmots emerged on April 17 to a snow-covered landscape. Food was scarce and the marmots' vast network of escape burrows remained plugged with snow.

As a result, some of them starved and others were picked off by predators, Blumstein said.

"We saw all sorts of carnage this year," he said. "Animals got up early because it was warm, but there was tons of spring snow. And we saw animals competing for food, but there was no food, so they were competing to chew on the branches of trees.

"They were either starving or being killed by predators," he said.

"And that's the cost of coming up early," he said. "So if in fact it is getting warmer, that's how there can be a demographic consequence to this. The population can decline because animals get nailed."

But again, Blumstein said he's not sure global climate change contributed to the 2005 Gothic marmot massacre.

Despite the doubters, Inouye remains adamant that global warming is already at work in Gothic.

"That's how I interpret it," he said. "We have enough of a history here to be pretty confident that there are significant changes taking place," he said.

As further evidence, he points to his plant-monitoring plots.

Inouye has chronicled the blooming of Gothic-area wildflowers every spring since 1973. It is one of the

longest unbroken studies of high-altitude plants in the United States.

The Crested Butte area is home to more than 100 species of flowering plants and was designated the Wildflower Capital of Colorado by the state Legislature. About 60 percent of those plants are represented in Inouye's 30 meadow plots.

Every other day throughout the growing season, Inouye and his assistants record the number of flowers of each species in every plot.

Over most of the past three decades, the number of species in the plots remained remarkably stable, Inouye said.

Until five years ago.

Since then, the once-common tall bluebell has vanished from all 30 plots. A species of early-season mustard is nearly gone, and another mustard seems to be declining.

"Those plants were in my plots for 25 years and now, in the last five years, they've just disappeared," he said.

"So yeah, I think we're beginning to see some changes, not just in phenology but also in abundance and distribution."

But again, forces other than global warming could be to blame.

Colorado and much of the West were in the grip of a multiyear drought for the first part of this decade. The drought may have caused the changes seen in Inouye's plots, and the drought may have been unrelated to global warming.

In addition, a long-term fluctuation in Pacific Ocean sea-surface temperatures, called the Pacific Decadal Oscillation, could be responsible for recent milder, drier conditions in parts of the West.

A shift in the oscillation might also explain the Gothic plant declines.

Even so, when you look at the scores of changes being observed in plants and animals worldwide, it seems clear that global forces are at work, Root said.

"We will never have outright proof that plants and animals are responding to human-caused climate change. We will only, always, have circumstantial evidence," Root said.

"I liken it to evidence in a trial. You have to wait until you have enough circumstantial evidence for it to support your case," she said.

"And I think we're there. We can say beyond a reasonable doubt that plants and animals are being affected by humans warming the planet."

*ericksonj@RockyMountainNews.com or 303-892-5129*

## Share

What is this?

## Featured

