

## **Marmots shift habits as temperatures climb**

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GOTHIC -- You could say marmot Z was a player. It didn't take him long to establish himself as top rodent in a yellow-bellied marmot colony perched on the cliffs above a roiling mountain stream. As a mere marmot teenager, he had at his behest a harem of six to 10 Rubenesque furry females encompassing three matrilineal lines. But life wasn't always a field of alpine daisies for our hero. Every morning he tenderly greeted his main woman and she smacked him broadside across the face. So spurned, he reasserted his marmot virility by chasing away one of his many daughters, who he was also likely sleeping with (paternity tests have yet to pan out).

Despite the looming threats of badger and fox, raptor and burly male marmot rival, Z lived and copulated to the gray and crusty old age of 11 before finally vanishing in a vicious April snowstorm.

Marmots like Z, corpulent critters that can be seen basking in meadows and rock outcroppings along Pitkin County's high trails, hardly bring to mind soap opera starlets with voluptuous curves and chiseled jaws. But above and below ground, according to marmot researcher Dr. Dan Blumstein, each rodent colony is its own serial of "As the Burrow Turns," packed with betrayal, intrigue and sex, all spiced with the immediate threat of being eaten alive.

Blumstein has long watched dramas like Z's unfold at the Rocky Mountain Biological Laboratory, located in the former silver mining town of Gothic, Colo., about 12 miles and a craggy spine of mountains away from Aspen as the trail winds. After years of careful observation, Blumstein and other scientists believe that life is getting even more complicated for the burrowing rodents -- not due to fad diets or an increase in torrid love trapezoids -- but because of global climate change.

That fact may have stark implications for other species.

HOT TIMES

In the spring of 2005, marmots near Gothic emerged early from their burrows after a winter of hibernation only to find deep snow, their usually hearty diet of succulent grasses and flowering forbs still dormant beneath a winter blanket.

"There was nothing to eat," said Blumstein, a behavioral ecologist and professor at the University of California Los Angeles who is carrying on a long-term study begun at the lab in 1962 by Dr. Kenneth Armitage. "We saw the marmots actually trying to eat trees. We saw yearlings starving to death and we saw their parents chasing them away" to lock in their own access to the scant food. Meanwhile predators were systematically picking off the stressed rodents, which are second in size only to beavers.

Though 2005 is an extreme example, University of Maryland ecologist and lab veteran Dr. David Inouye believes that particular spring saga may be a sign of things to come for mountain critters. Marmots at the lab are emerging about three and a half weeks earlier than they were 30 years ago -- a change that likely stems from a 7-degree-Fahrenheit increase in average low April temperatures since 1974, according to Inouye's analysis of long-term local records.

Those warmer temperatures may be fooling marmots into emerging before there's food to be had, Inouye explained. Even with a recent downturn in spring snowpack, marmots continue to pop up early enough to encounter significant snow still on the ground. That miscalculation could make them more vulnerable to starvation and predation if they are forced to spend precious fat reserves and range farther for forage in a snow-shrouded landscape.

Like the vast majority of scientists today, Inouye attributes the general warming trend to humans and their thirst for fossil fuels. Unless you're a marmot enthusiast, "there's nothing terribly special" about the rodents, per se, Inouye said -- save for the lab's long-term records on their emergence. "But they are likely indicators of things changing for a number of animal species up here. If people like pikas, deer and elk, pine martens and the other neat animals around, they should be concerned that what's spurring these changes might affect those other animals as well," he said.

Indeed, there is scientific and anecdotal evidence at the Rocky Mountain Biological Lab for critter shifts in our mountains.

Based on data collected on some 20 species since the mid-1970s by Billy Barr, the lab's good-humored, year-round resident business manager and amateur snow scientist, robins are migrating to the Gothic area an average of 8.5 days earlier than they did 30 years ago, likely responding to dramatically warmer temperatures at lower elevations, Inouye said. Flickers (large, flashy woodpeckers) are also showing up about a week earlier than they did 30 years ago. And ground squirrels and chipmunks are coming up three weeks earlier than they did in 1998, now that snowpack is declining, Inouye pointed out.

Meanwhile, observers at the lab have recorded the first-ever starling to appear in Gothic, as well as a few Wyoming ground squirrels, which, according to Barr, are a more familiar sight farther south and 1,500 feet lower near Gunnison. There is anecdotal evidence that certain species of bees and flies are shifting their range to higher elevations -- a phenomenon that Inouye is collecting data on with Australian researcher Dr. Graham Pike this summer. And foxes have begun to stay at the lab through the increasingly mild winters, Barr said, "hammering" the local marmot pups and ground squirrels and completely obliterating the pocket gopher population in town.

As with marmots, the earlier appearance of migratory birds and other resident creatures can put them out of synch with favored food sources faster than they may be able to adapt -- something for which there is growing evidence around the world, Inouye said. And the first appearances of lower elevation species in the 80-year record of the 9,300-foot-high lab not only herald a changing climate, but the possibility of new competitors and predators to make life more difficult for mountain natives.

There is a growing body of scientific literature documenting climate change's effects on biological systems. Migrant birds are passing over the North Sea a few days earlier every decade. Tropical butterflies are breeding in Texas. Perhaps one of the best examples is the plight of the pika -- a short-eared, diminutive member of the rabbit family you may have seen living and capering in high-altitude talus fields. As temperatures warm and lower-altitude species move

uphill, there is increasing evidence from Yosemite and the mountains of the Great Basin that documented pika populations are disappearing or shifting uphill, either because they can't take the heat, or they are being displaced by invaders. All mountains peak, so there is only so far that an alpine creature like the pika can retreat before disappearing into thin air. Some scientists predict they will be extinct within the century.

"This is not just a local issue," Inouye said of the changes at the Gothic lab. "We just happen to have been collecting data on this side of the hill and have a better understanding of what's going on."

### A COMPLEX SYSTEM

But eventually all good soap operas come back to sex -- and so does the marmots' story.

Earlier marmot emergence has a lot to do with temperature and snow patterns, said UCLA's marmot expert Blumstein, but there's an overlapping early-marmot-gets-the-tail scenario at work. Hopeful studs may be popping up earlier and earlier to beat any rivals, win the girls (marmots organize into harems, after all), and better their chances of spawning hordes of offspring.

"Males in general emerge earlier because they've gotta get their spermatogenesis going. The more we look, the more we see this -- the males get up, they dig out their wives, and they give them flowers. It's so cute!"

And the earlier marmots have their young, the more time pups have to fatten up before winter, he said -- unless they're pinched by late spring snow. "They're playing a game of probabilities." Teasing apart that game and how sociality and environmental changes contribute is a future goal for Blumstein.

"Climate's an important factor, but it's not the only factor," he continued. Like marmots, all species have their idiosyncrasies, and it's these characters that make a clean picture of the effects of climate change difficult to come by.

Indeed, he pointed out, for whatever reason the Gothic-area marmots are cranking out more pups than ever before in the 45-

year history of the study -- one of the longest running in the country.

There is little doubt climate change is injecting more drama and hardship into marmots' already soap-operatic lives -- especially as things heat up, snowpack falters and familiar plant communities begin to change. But still, "I ask myself whether climate change is good or bad for these marmots," Blumstein said.

The species has a huge geographic and elevation range, living from 4,500 feet in elevation just west of Denver to the tops of most 14ers in the state, and across much of the West. Meanwhile, they're relatively long-lived and may be able to adapt their behavior based on circumstances, he explained. "If the season shifts a little, and the species has enough time to adapt to that within generations, I suspect they'll be fine. The take-home message is these guys can shift," Blumstein said.

But if climate change brings regular, severe summer droughts to the Rockies that fry marmots' diet of late-season flowers and grasses, adults and especially new pups may not be able fatten up enough to survive the winter, he explained. Forced to wander far from the safety of their burrows in search of wet, green vegetation, they will be easy pickings for hungry foxes and coyotes.

And if climate change leads to consistently heavy spring snow, or wildly fluctuating snow years, with freak late snowstorms one spring, and early melt the next -- marmots will likely have trouble adapting and get "hammered," potentially putting them in the same sinking boat as pikas.

With 45 years of data for the Gothic marmots' family groups, behavior, habitat choices, and environmental factors, Blumstein explained, "We have a pretty nifty system" to begin understanding how and if the rodents can adapt to their warming mountains, whether they are dealing with new predators or changes in snowpack.

But if the saga of the yellow-bellied marmot has a moral, he noted, it may be that changes are coming that spell trouble for other species, including other species of marmots, who may not be as adaptable.

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