



BY NATHAN LUMP PHOTOGRAPH BY JUSTIN JIN

1 RECENTLY I READ the 2018 book *The Wizard and the Prophet*, by Charles C. Mann. Through the lens of the lives of 20th-century scientists Norman Borlaug and William Vogt, it explores two contrasting visions of how humanity can meet the challenges we face as our population grows and our impact on the planet increases.

2 On the one hand is Vogt's embrace of limits: We should restrict ourselves to what Earth can handle. On the other is Borlaug's belief in innovation's promise: 5 We can invent solutions. Many, including me, don't see these two notions as binary but rather believe a combination is our way forward. Still, there's no consensus on the best approach.

3 This month *National Geographic* explores the ramifications of a milestone reached late last year, when the United Nations projected the world population had reached eight billion. Though the number of people on the planet has grown exponentially over the past century, that growth hasn't been uniform, and some nations now have

fewer people. So our stories consider the issue of population in two very different places: Nigeria, which is experiencing explosive growth, and China, which is coping with population decline.

In the coming decades those nations, and others with similar trends, will face disparate challenges. But the overall impact of rapid population growth—on matters from climate change and biodiversity loss to the availability of food and clean water—has implications for us all.

While reading our coverage, I thought a lot about Mann's book. Certainly we humans are ingenious at devising solutions—but will we rein ourselves in enough that those solutions can get ahead of the problems we create as we tax the planet's resources more and more? The answers won't be easy. But for our collective future to be a bright one, it's clear we must devote ourselves to finding them.

We hope you enjoy the issue.

Crowned with a headband of pink tulle and lace, a baby is photographed at a postnatal care center in Hangzhou, China. Though the nation's population is declining, the center's director says business is good because many mothers with infants seek assistance from professionals, to speed their return to work.

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cows need. (Previously, winters stayed so cold and dry they could paw through snow to eat greenery below it.) With sea ice melting earlier, polar bears spend more time on land. Grizzly bears already are venturing farther north. The two species have occasionally mated in the past, but hybrid “pizzly” bears, while still rare, are now expected to become more common.

THERE ARE RISKS FOR US TOO. Globally, markets for insect-pollinated crops, such as cacao, watermelon, cumin, and coriander, are worth up to \$577 billion annually. Changes to nature’s clock also may influence agriculture in dozens of hidden ways, not all of which can be addressed by shifting planting or harvest seasons. Farms may be exposed to more frosts or previously unseen crop-killing pathogens.

There is much we don’t yet know: Can timing changes alone drive significant extinctions? What is nature’s capacity for adaptation? And why is it so hard to see what’s coming next?

they do. The following day, Mary Caswell Stoddard, a Princeton University associate professor, led me through meadows above Colorado’s East River. A few years earlier, she’d found that broad-tailed hummingbirds see a far wider color array than humans, which probably influences which blossoms they visit. She showed me where she set up camera traps to see how climate change’s reorganization of flowering may alter hummingbirds’ “sensory perception”—and behavior.

Of course, one Inouye collaborator stands out: billy barr. A Colorado legend, barr (who does not capitalize his name) has been profiled on television, in newspapers, books, and films. He visited Gothic as a Rutgers University student and came back for good in 1973—and holed up in a mining shack without electricity or running water. In the summer there were scientists, including Inouye, but through spring and fall and the bitter, blustery winter, he lived in the Elk Mountains alone.

So barr measured things—temperature and snowfall and snow depth. He tracked moisture

WE’RE ALL PART OF A GIANT EXPERIMENT. THE POTENTIAL FOR NEGATIVE CONSEQUENCES IS MAGNIFIED. BUT THE WORLD MAY ALSO SURPRISE US.

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Teasing apart so many disparate changes takes an incredible amount of work. Documenting what influences the schedule of each organism in a single ecosystem requires countless studies of a wide variety of nearby life. Through the years, Inouye has joined up or shared insights with hundreds of scientists. During my week in the valley, I witnessed a delightful cross section of their research, which merely highlighted the difficulty of predicting the future.

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Below the granite of Gothic Mountain, Rebecca Irwin, a North Carolina State University ecologist, pointed out a parasitic cuckoo bee. When spring comes early, it seems, bumblebee queens grow weaker, and cuckoo bees have more luck stinging them to death and usurping their worker bees. “In these early snowmelt years, the queens are just more stressed,” Irwin told me. “They need more food. They have to forage more often.” But after 13 years working with bees in Gothic, she sees no clear long-term survival trend among the region’s 200 bee species.

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We’re also still learning why animals do what

content and noted in spring when snow melted. (He used a yardstick and a scale.) He heard each year’s first birdsong and recorded his first marmot spotting. He jotted it all in notebooks. “I was just there, and I just wrote down what I saw,” he told me. “I mean, I had all day long.”

Less modern-day Thoreau than restless data geek, barr enjoyed comparing year-to-year observations. And while barr and Inouye knew one another, it wasn’t until the late 1980s that the two chatted in depth about barr’s records. Inouye, intrigued, asked to take a look.

The notebooks astounded Inouye. They could show, in detail, reductions in snow seasons. It was barr who first noticed robins arriving early, barr who provided data that helped others link marmot emergence with early spring. As far back as 1991—just three years after NASA scientist James Hansen told Congress that greenhouse gases are warming the planet—Inouye and a colleague used barr’s notebooks to show how reduced snows could change flowering in the mountains, potentially harming bees and hummingbirds.

