



Flaws in studies about blue tit plumage motivated a push for more rigor in ecology.

ones. Together, these forces mean a literature overflowing with potentially dubious results, Parker says. It's a "house of cards."

But unlike psychology, in which researchers have tried to replicate famous studies and failed in about half the cases, ecology has no smoking gun. A 2019 *PeerJ* study found only 11 replication studies among nearly 40,000 ecology and evolution biology papers—and only four of these 11 studies managed to replicate the original finding. It's hard to replicate ecology studies, Parker says, because it often entails expensive and difficult data gathering in remote places or over long time frames. And ecosystems are so complex that any number of variables could affect the outcome of a repeat experiment—like the age of the organisms in the study, the temperatures at the time, or the presence or absence of pollutants. "No man can step into the same river twice because it's not the same man and it's not the same river," says Phillip Williamson, an ecologist at the University of East Anglia who has criticized a high-profile effort to replicate ocean acidification research.

Yet Williamson doesn't think ecology as a whole is at risk just because some experiments fail to replicate. "Biology isn't physics," he says. "I think that the consensus of science gets there eventually." Parker takes a harder line. "If we don't expect anything to replicate, why do we bother doing any of this?" he asks.

Even before they set up SORTEE, Parker and his corevolutionaries were pushing for change. They worked with journal editors to create checklists for details that papers should include—like whether researchers were blinded to the conditions of different subject groups. They've also set up a pre-

print server that Nakagawa hopes will help preserve results that never make it into journals. Julia Jones, a conservation scientist at Bangor University who is not involved with SORTEE, is advocating for preregistration, which forces a researcher to commit to a data collection plan and hypothesis before the study begins. Some journals offer registered reports—peer-reviewed preregistrations with a commitment to publish the results, however dull or dazzling. Preregistration isn't always possible, because the vagaries of fieldwork often force researchers to change plans. But she says it can help scientists avoid the "siren song" of looking for a clean story in messy data.

In April, Jones and her colleagues published the first registered report for the journal *Conservation Biology*. She analyzed extra data from a randomized controlled trial in Bolivia's highlands that had already found that paying farmers to keep their cattle out of rivers did not improve water quality. Jones found other interesting behavior changes—farmers kept their cattle on their farms rather than roaming the forests—but many results were statistically insignificant. In a normal review process, "we would have been forced to cherry-pick and tell a much simpler story," she says.

Others are working to address the sample size problems, by gathering massive amounts of data using consistent methods. They hope the data sets will make it easier to see which findings apply beyond a single ecosystem. The U.S. National Ecological Observatory Network (NEON), a continentwide program of more than 100 heavily instrumented field sites, became fully operational in 2019, and the first studies drawing on its data are now underway.

The Nutrient Network (NutNet), cofounded by University of Minnesota, Twin Cities, ecologist Elizabeth Borer, also pulls in large amounts of standardized data, to explore how changes in nutrients and herbivores affect grassland plant diversity. Rather than building infrastructure like NEON, NutNet gets research teams around the world to perform the same experiments—in return for access to a huge data set. Unifying experiments is hard, Borer says. For instance, the team discovered that the fertilizer brand Micromax had slightly different micronutrient mixes on different continents, forcing researchers to import or mix their own.

Borer, Wiersma, and Jones are all sympathetic to SORTEE's aims—and curious to see whether it takes off. Like the systems they study, ecologists can be fragmented, and developing sound research principles sometimes seems impossible, Wiersma says. "But I think maybe we could," she says. "We just need to try harder." ■

## VOICES OF THE PANDEMIC

# Mexico's controversial coronavirus czar

Hugo López-Gatell Ramírez's response has drawn criticism and praise

By **Rodrigo Pérez Ortega**

There's hardly a Mexican who doesn't know Hugo López-Gatell Ramírez by now. Mexico's undersecretary of prevention and health promotion has sat across from reporters at 7 p.m. sharp almost every single night since late February to update them, and the country, on the toll of the coronavirus pandemic. His firm demeanor, careful speech, and courteous personality have made his televised coronavirus press briefings even more popular than those of the country's president.

But as COVID-19 deaths in Mexico continue to soar—surpassed only by the United States, Brazil, and India—many have questioned López-Gatell Ramírez's leadership. Critics accuse him of undercounting the true numbers and mishandling the nation's response. In early August, the governors of nine Mexican states demanded his resignation. His defenders, though, say he's making sound decisions based on science and doing the best he can with the resources at his disposal.

López-Gatell Ramírez says the country's chronically underfunded public health system has complicated efforts to track the disease and coordinate the response. But he insists the government's approach—which includes forgoing widespread testing in favor of a more targeted approach—has been based on science. Many critics, he says, are politically motivated. He's been sleeping 3 to 4 hours a night since the pandemic started, he says, and he regrets the disruption to his family life. "The mission calls me and until I deliver results—I hope favorable—I cannot stop."

Fame might be new to López-Gatell Ramírez, but pandemics are not. Just 2 years after finishing his Ph.D. in epidemiology in 2006 at Johns Hopkins University, he became head of epidemiology at the Mexican health ministry. One year later, in 2009, the swine

flu pandemic struck Mexico, and López-Gatell Ramírez helped lead the response.

The H1N1 virus, which caused panic around the world, likely originated on a pig farm in Mexico. Mexico City was shut down for 2 weeks, and the country scrambled to curb the virus' spread. López-Gatell Ramírez says the experience taught him many lessons, including the dangers of poor coordination among government institutions and "political opportunism" by officials trying to use the crisis to their advantage. This time, he says, President Andrés Manuel López Obrador has given his team decision-making power and protected them from political meddling.

Faced with the new pandemic, López-Gatell Ramírez placed his trust in the country's "sentinel" system, originally designed for flu outbreaks. In contrast to the massive testing and contact tracing efforts in many other countries, the system relies on a small, strategic, nationwide sample of tests, which are then used to predict the spread of a disease. As a result, even though Mexico's flagship diagnostics laboratory—the Institute of Epidemiological Diagnosis and Reference (InDRE)—developed the world's first polymerase chain reaction protocol to detect SARS-CoV-2, the country ranks among the world's lowest in per-capita testing. Mexico has performed about 17 tests per thousand people in total, whereas the United States has done more than 30 times that many.

Reliance on the sentinel model may have prevented López-Gatell Ramírez and his team from making accurate predictions. They forecast the pandemic would peak around 8 May, with 4500 daily cases, aided by a national voluntary lockdown in effect from late March until June. (The lockdown was voluntary because many Mexicans live in poverty and rely on daily work to survive.) Instead, daily cases kept climbing, to a peak of 9556 on 3 August. Since then, the number has fluctuated between 3000 and 12,000, and the pandemic is worsening. The official death count now exceeds 110,000, nearly twice the model's original worst case.

Researchers, politicians, and national and international media have suggested the true toll is even greater. As in almost every country, not every COVID-19 death is registered. But the rift between statistics and reality may be particularly wide in Mexico. In late November, officials released a report of excess deaths from all causes, suggesting

nearly 156,000 of them could be attributed to COVID-19 in people who were never tested. The rate of positive tests recently hit 47%, evidence of a rampaging epidemic.

Some observers think scarce funding was the real reason for the limited testing. Alejandro Macías, an infectious disease physician and Mexico's former H1N1 czar, doubts López-Gatell Ramírez truly believed the approach would be successful. "He got trapped in a system in which the InDRE was not given sufficient resources or all the money that was going to be needed for testing," Macías says.

"You can buy thousands of tests, but if you don't have the personnel [to perform

logists now concede that closing borders can help stem viral spread.

His stance on face masks is perhaps his most controversial: Despite growing pressure from the public, politicians, and scientists citing evidence that masks can reduce viral transmission, López-Gatell Ramírez still hasn't mandated their use nationwide. Masks would give a "false sense of security" and lead people to relax other measures such as hand washing and keeping a healthy distance, he said early in the pandemic. Even as evidence of the benefits of wearing masks became clear, he still has not fully come around, critics say. Some Mexican states, however, have imposed their own mask mandates.

Macías suspects López-Gatell Ramírez's statements on masks have been influenced by the views of his boss, López Obrador, who refuses to wear a face mask in public and constantly downplays the pandemic. "He had to defend the indefensible," Macías says.

Despite the adversities, the Mexican health system has scored some victories under López-Gatell Ramírez. Starting with a deficit of more than 310,000 health care workers, he says, the system hired more than 47,000 people in a matter of months and tripled the number of intensive care beds with ventilators.

"I think he's the right person to be in that position," says infectious disease physician Gustavo Reyes Terán, who leads the country's National Institutes of Health and its affiliated hospital network. The institutes and hospitals Terán coordinates avoided becoming overwhelmed, he says, thanks to López-Gatell Ramírez. "That, to me, has been one of the most important successes here," he says. (Media have reported, however, that many Mexicans died at home without setting foot in a hospital.)

López-Gatell Ramírez has also taken action against one cause of the virus' toll in Mexico: high rates of hypertension, obesity, and diabetes, which can make severe disease more likely. In response, López-Gatell Ramírez has renewed his long-standing campaign against junk food and sugary drinks, calling them "bottled poison."

"He is a person with good intentions to do things well, to be based on science," Alpuche Aranda says. "He's doing the best he can," Macías adds.

How history judges López-Gatell Ramírez, however, may ultimately depend on the pandemic's toll on his nation. ■

Rodrigo Pérez Ortega is a journalist in Mexico City.



## "The mission calls me and until I deliver results—I hope favorable—I cannot stop."

Hugo López-Gatell Ramírez, Mexico's undersecretary of prevention and health promotion

them], you can't do much," adds Celia Mercedes Alpuche Aranda, an infectious disease researcher at the National Institute of Public Health and former director of InDRE. López-Gatell Ramírez's strategy, she says, is adapted to the country's reality: too many people to test and not enough infrastructure.

Testing isn't the only area where López-Gatell Ramírez has drawn criticism. As Europe and the United States were dealing with their first waves of infections, he advised against closing Mexico's borders. Doing so would harm the economy, he said, but would not prevent the pandemic from arriving—a view shared by the World Health Organization and others at the time. Many epidemio-

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