

In that project², researchers swapped all 321 instances of one 3-letter genetic word, or codon, with another that conveys the same message. They then eliminated the gene that allowed the cell to read the original codon. This didn't much affect the redesigned microbe, but it did neutralize viral invaders because, like all natural life, they rely on that codon for proper protein assembly.

Extending this recoding technique to the human genome won't be easy. Repurposing

just one codon across all 20,000 human genes will require hundreds of thousands of DNA changes. It might be easier to synthesize large swathes of the genome rather than edit letters one by one.

Church's team used synthesis in follow-up work³ to recode seven codons in the *E. coli* genome. That effort needed close to 150,000 genetic changes, and it revealed unexpected design constraints and difficulties in stitching together DNA fragments. These have

stymied efforts to make the reconstructed bacterium viable.

That should be a sobering reminder as the ultra-safe human-cell-line project gets off the ground, says Nili Ostrov, a postdoc in Church's lab who is leading the research. "In humans," she says, "there are going to be a lot of design rules that we just don't know." ■

1. Boeke, J. D. *et al. Science* **353**, 126–127 (2016).
2. Lajoie, M. J. *et al. Science* **342**, 357–360 (2013).
3. Ostrov, N. *et al. Science* **353**, 819–822 (2016).

ENVIRONMENT

Brazil's lawmakers push to weaken environmental rules

Legislation includes proposals to open up the Amazon rainforest to agriculture.



Trees taken in illegal logging operations in the Brazilian Amazon lie in piles at a sawmill.

BY JEFF TOLLEFSON

A conservative coalition that dominates Brazil's Congress is girding itself for a final push to roll back environmental regulations before campaigns for the country's October presidential election ramp up.

The legislation under consideration includes proposals to open up the Amazon rainforest to sugarcane farming — which was banned in 2009 over concerns about deforestation. Another proposal would weaken licensing requirements for infrastructure such as dams, roads and agricultural projects. But the rural-agricultural coalition behind the proposals is running up against public opposition that has thwarted previous efforts to loosen environmental rules.

Further complicating this fight is an ongoing corruption scandal that has landed former president Luiz Inácio Lula da Silva in jail. He was a leading candidate in this year's election before his conviction.

"There's this very delicate balance," says Mercedes Bustamante, an ecologist at the University of Brasilia. The conservatives have support from Brazilian president Michel Temer as well as the votes they need to move legislation through Congress, she says. Lawmakers could push forward, Bustamante adds, but they're wary about sparking a public backlash before the election.

Previous efforts to scale back protected areas and indigenous rights in the Amazon rainforest floundered as activist groups and celebrities mobilized public opposition.

The conservatives have had only one major success on the environmental-regulation front so far. In 2012, they revised the Brazilian law governing forests, making changes such as eliminating penalties for any illegal deforestation that took place in the Amazon before July 2008. Environmental groups challenged the constitutionality of the revised law, but in February Brazil's Supreme Court upheld those changes.

"It was the worst thing that could have happened," says Carlos Nobre, a climate scientist in São José dos Campos and former secretary for research and development at Brazil's Ministry of Science, Technology and Innovation. But he thinks the conservative coalition's broader environmental agenda has stalled and is unlikely to advance in the coming months.

Brazil was once seen as a global leader on environmental issues, in large part because of its success in curbing deforestation. Between 2004 and 2012, the annual amount of rainforest that was cleared for agriculture fell by nearly 84% to 4,571 square kilometres. Those numbers subsequently crept back up, peaking at 7,893 square kilometres cleared in 2016. However, deforestation dropped by 16% to 6,624 square kilometres in 2017, partly because of lower demand for beef and the restoration of law-enforcement funding, which had been cut during a prolonged financial crisis.

The environment will certainly be on the election agenda, says Bustamante, because Lula's first environment minister, Marina Silva, is one of the candidates.

Regardless of the outcome, the political dynamic in Brazil's Congress is unlikely to change, says Paulo Barreto, a senior researcher with the activist group the Amazon Institute of People and the Environment in Belém. The conservative coalition is strong, and Barreto thinks that it will stay in power. ■