



Researchers worry budget cuts could threaten the operation of Brazil's new Amazon Tall Tower Observatory, which makes atmospheric measurements.

## BRAZIL

# Fiscal crisis has Brazilian scientists scrambling

Government makes deep cuts in research budgets as economy stumbles

By **Herton Escobar**, in São Paulo, Brazil

**B**razilian neuroscientist Suzana Herculano-Houzel spent years studying the brains of mammals, including mice, whales, and humans, to understand the forces that shape their intricate folds. The effort paid off last month, when the Federal University of Rio de Janeiro professor co-authored a high-profile paper showing that the folding is governed by a relatively straightforward mathematical relationship (*Science*, 3 July, p. 74). But even as Herculano-Houzel's research soared, she was struggling to solve a much more pragmatic equation: how to pay her laboratory bills amid one of the worst science funding crises to strike Brazil in decades.

Battling a slumping economy and debt, Brazil's federal government has taken an ax to spending, and it isn't sparing science. President Dilma Rousseff's administration has cut by 25% the Ministry of Science's projected 2015 budget of

7.3 billion reais (\$2 billion), and sliced 9% from the 48.8 billion real (\$13.7 billion) budget of the Ministry of Education, which plays an important role in funding graduate students. Research agencies are delaying payments for grants that have already been awarded, and have canceled or postponed new calls for proposals. And Rousseff is re-

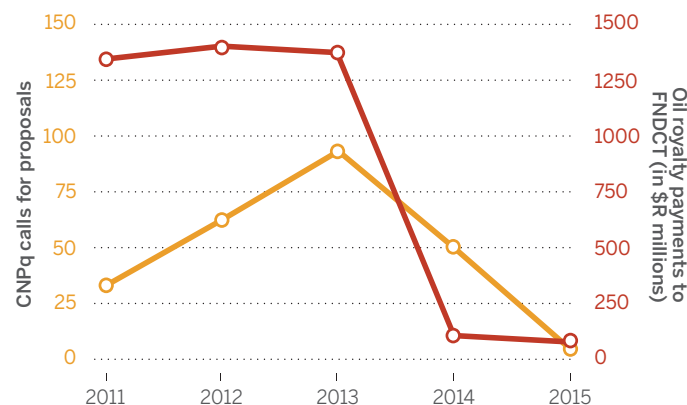
directing funds once earmarked largely for research to send Brazilian students abroad to study.

The funding climate is "the worst in 20 years," says Helena Nader, president of the Brazilian Society for the Advancement of Science (SBPC). Herculano-Houzel is even more pessimistic: "Brazilian science is bankrupt."

At the root of the problem are changes in how Brazil's government spends the royalties generated by the nation's lucrative offshore oil fields, which have been a major source of funding for science and technology development. As recently as 2013, oil royalties helped pump some 1.4 billion reais (roughly \$600 million at the time) into the country's National Fund for Scientific and Technological Development (FNDCT), which provides federal research agencies with the bulk of their funds. More recently, however, policy changes redirected much of the oil revenue from FNDCT into a new fund primarily focused on education and health.

## Falling fortunes

As Brazil's government has reduced the flow of oil revenue into a national fund that supports research (red), the country's main science funding agency has cut back on calls for proposals (orange).



The results have been disastrous for Brazil's science ministry and its main funding agency, the National Council for Scientific and Technological Development (CNPq), which receives from FNDCT a large share of the money it hands out as grants. This year, the council expected to receive 1.2 billion reais (\$350 million) from the fund; it has gotten just 27% of that amount. As a result, CNPq has not announced some of its usual granting programs, including the Universal Call open to all research fields, and canceled others. Officials have also delayed announcing awards in a major competition to establish new virtual research institutes; the winners were supposed to be announced this past March. And CNPq is withholding payments on some 5500 existing grants it awarded in 2014's Universal Call. "The money just wasn't there," says Glaucius Oliva, a researcher at the Physics Institute of São Carlos and a former president of CNPq.

Herculano-Houzel is among the scientists waiting for payments. She holds a CNPq grant for 50,000 reais, but has gotten just 6500. That's better, however, than the zero payout she's received on another grant, awarded by a state funding agency. To keep her lab operating, she's loaning her own money to her project. "I owe myself some 15,000 reais already," she says.

Paulo Artaxo, a University of São Paulo physicist, worries the cuts will hamper one of Brazil's newest research efforts. Just last week, officials celebrated the opening of the 325-meter-high Amazon Tall Tower Observatory, which will collect atmospheric data deep in the Amazon (*Science*, 6 March, p. 1051). But the funding crisis is threatening "our ability to secure funds for its operation and long-term measurements," Artaxo says.

Scientists blame some of the cuts in FNDCT grants on the Rousseff administration's determination to protect one of its flagship programs, Science Without Borders, which is sending 100,000 students (mostly undergraduates) to study abroad. Last year, the program received 1 billion reais from the fund, and it may get the same sum this year. Science Without Borders "is important" but shouldn't come "at the expense of the entire scientific community," Nader says.

The Brazilian Academy of Sciences and SBPC are pleading with Rousseff to find new sources of funding—but so far to no avail. In the meantime, the science ministry officials have negotiated a \$2.5 billion loan from the Inter-American Development Bank to help researchers through the crisis, but Brazilian officials and lawmakers have yet to approve the deal. ■

## REPRODUCIBILITY

# Many psychology papers fail replication test

An effort to repeat 100 studies yields sobering results, but many researchers are positive about the process

By John Bohannon

The largest effort yet to replicate psychology studies has yielded both good and bad news. On the down side, of the 100 prominent papers analyzed, only 39% could be replicated unambiguously, as a group of 270 researchers describes on page 943. On the up side, despite the sobering results, the effort seems to have drawn little of the animosity that greeted a similar replication effort last year (*Science*, 23 May 2014, p. 788). This time around, many of the original authors are praising the replications as a useful addition to their own research.

"This is how science works," says Joshua Correll, a psychologist at the University of Colorado, Boulder, and one of the authors whose results could not be replicated. "How else will we converge on the truth? Really, the surprising thing is that this kind of systematic attempt at replication is not more common."

That's encouraging news to Brian Nosek, a psychologist at the University of Virginia in Charlottesville who led the effort. "I don't know if replication is 'entirely ordinary' yet, but it is certainly more ordinary than it was [a few] years ago," he says. In that time, major psychology journals have started publishing replications alongside original research. "The change is pretty remarkable."

The mass replication effort began in 2011 with the goal of putting psychological science on more rigorous

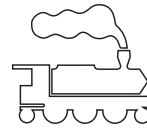
experimental footing. The strategy was to replicate a sample of published studies using an approach that Nosek has popularized through the Center for Open Science, a nonprofit he founded in 2013: publish your experimental design first, receive open peer review on it, and only then carry out the experiment and share the results, no matter the outcome. That should reduce the number of papers that report statistically significant results that are actually false positives.

In the Open Science Collaboration, 270 psychologists from around the world signed up to replicate studies; they did not receive any funding. The group selected the studies to be replicated based on the feasibility of the experiment, choosing from those published in 2008 in three journals: *Psychological Science*, the *Journal of Personality and Social Psychology (JPSP)*, and the *Journal of Experimental Psychology: Learning, Memory, and Cognition*. Not only were all 100 replications preregistered, but the authors of the original studies were invited to collaborate in the design of the replication.

The results lend support to the idea that scientists and journal editors are biased—consciously or not—in what they publish. For example, even in studies that could be replicated, the size of the effect—a measure of how much of a difference there was between the experiment groups—was on average only half as big as the original studies. The bias could be due to scientists throwing out negative

## Real effect?

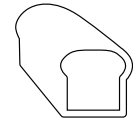
A 2008 study found that people were slower to correctly name an object when shown the names of similar objects. A replication of this study failed to find that effect.



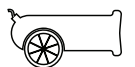
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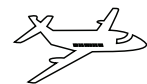
Ankle



Cracker



Pistol



Ferry



Clam