

Edited by Jennifer Sills

Brazil's drought: Beware deforestation

BRAZIL, WHICH HAS the world's largest renewable water supplies, has recently experienced water shortages, and therefore energy crunches, caused by its worst drought since 1930 (1). The water crisis has spread across large areas of the country's breadbasket region—southeast Brazil—affecting crop production, industrial activities, and millions of people. After a lengthy delay, the São Paulo government has developed emergency measures to reduce the severity of the water crisis (“Drought triggers alarms in Brazil's biggest metropolis,” In Depth, H. Escobar, 20 February, p. 812). Although pressing actions are needed to avoid water collapse in Brazil, an understanding of the importance of preserving large tracts of tropical forest, such as the Amazon rainforest, is essential to promote more effective climate change policies and lower the risk of future droughts.

Long-term research in the Amazon (2) suggests that the basin produces some 9.3 trillion liters of water vapor per year through the process of evapotranspiration from plants and the soil. A large portion of this water vapor—about 3.4 trillion liters per year—appears to be transported to South America's south (2). This means that, in a nondisturbed ecosystem, the forest and atmosphere are basically recycling the same water, as well as exporting a massive amount of water vapor to distant basins. To remove any of these elements impairs the whole natural system—a process that may not be easily repaired (3).

The unprecedented drought affecting Brazil may be a consequence of the depletion of water vapor from the Amazon basin that normally brings rain to Brazil's center and southeast regions. Indeed, precipitation levels in the last several months in the Amazon were just half that in 2014 to 2015 over the same period, according to Escobar's News story. Changes in rainfall patterns in the Amazon rainforest have been attributed to the ongoing human-induced activities such as forest conversion and habitat degradation (4). Brazilian Amazon deforestation rates over the past decade remain lower than historic patterns, but with rates rising sharply in recent years (5), the southeast and other

Brazilian regions could well be receiving less rainfall.

Given growing concerns about global climate change, restoring lost forests and limiting deforestation and forest degradation are important strategies for solving climate change, and it should be a priority in the environmental agenda of developing nations such as Brazil. Otherwise, extreme hydrological events—such as the drought in São Paulo and the two severe droughts within the Amazon basin over the past decade (6)—could occur more frequently.

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Brazil's drought: Protect biodiversity

THE BRAZILIAN WATER crisis linked to climate change has led the government to take drastic measures (“Drought triggers alarms in Brazil's biggest metropolis,” In Depth, H. Escobar, 20 February, p. 812),

ONLINE BUZZ: SCIENCE EDUCATION

Evolution in teaching

In his In Depth News story “Why many U.S. biology teachers are ‘wishy-washy’” (6 March, p. 1054), J. Mervis describes a recent study showing that students training to become teachers do not understand or embrace the concept of evolution well enough to teach it. Readers shared their own experiences on the subject in the online comments section. Excerpts from their comments are below. Read the full comments, and add your own, at <http://comments.sciencemag.org/content/10.1126/science.347.6226.1054>.

A selection of your thoughts:

I am surprised that there is still this talk about the theory of evolution in Western countries. In India, when I first learned about the theory of evolution in 1966, I was absolutely fascinated, as this fits in very well with the Indian philosophy of the evolution of the spirit....
Vadakkupattu Ramanathan

...Decisions concerning curriculum and policy are often made by those who have little education in science, which is precisely the reason we must be sure we are adequately teaching the nature of science to all citizens.... Evolution is science, and educators must understand that what we teach must be what the evidence shows again and again, not what we simply want to be true. There is no refutation of religion in evolution, just as there is no denial of God in physics, or chemistry, or anatomy. Understanding the true nature of science can make this fact undeniably clear.... [We] absolutely need more educators at the primary and secondary level with strong content knowledge. This will not be done by attempting to educate those who want to be in the classroom, but by making the classroom appealing for those who excel in science....
Amy Connor

...[B]iology teachers that are highly effective at developing in students an understanding of evolutionary biology [and] scientific investigation [depend on] real-life experiences with good mentors in the field. It should be a required part of any training for teaching....
R. Steven Gumbay

...Evolutionary theory poorly taught ingrains misconceptions in students that can be difficult to counter later on, so I sympathize with teachers who hesitate to present the subject inexpertly. I didn't get a good foundation in evolutionary theory until graduate school and even after 20 years of teaching, I am acutely aware of how much more I have to learn about teaching it well.
Mallory Pratt

such as water diversion projects to transpose water between isolated river basins, without regard for biogeography or aquatic biodiversity. In São Paulo city, the largest metropolis of South America, authorities recently approved a project that will transfer water from the Paraíba do Sul catchment to the Cantareira system (1), watersheds that have distinct aquatic biota (2). This water diversion will lead to the substantial exchange of organisms between separate ecoregions (2), resulting in a massive introduction of distinct biodiversity, bioinvasions, and biotic homogenization (3). In turn, we expect that biodiversity and ecosystem services, including the sustainable provision of the water quality, will suffer.

Projects like this are not isolated actions; in semiarid zones (1), plans are under way to transpose the São Francisco River Basin to different naturally seasonal basins in northeastern Brazil (i.e., the Caatinga Biome). Authorities have clearly neglected or are unaware of the risks associated with biological invasions (4) and biotic homogenization (5, 6). They blame climate change for the current water crisis, but acknowledge neither the role humans have played in surpassing



A severe drought has pushed river levels in Brazil's Amazon region to record lows.

operational limits of the planet nor the negative consequences of biodiversity loss on humanity (7).

Rather than implementing water diversion programs, local, state, and federal authorities must work together to raise public awareness to prevent water waste, conserve aquatic sources and aquatic diversity, and restore essential ecosystem services in urban centers and agricultural areas, according to The CBD 2020 Targets (8). Only by meeting these goals can we ensure a safe and constant water supply in a transparent and sustainable manner.

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