THE UNCERTAIN FUTURE OF THE AMAZON FOREST. DEATH OR RESILIENCY?

In the last decades the Amazon forest has undergone a deforestation of ~17% and, although its intensity has diminished in recent years, it continues. A World Bank report indicates that the Amazon forest survival threshold is of 20%, while for others deforestation ought to be between 40% and 60%. On the other hand, climate models predict the reduction of rain in the Amazon region as global warming progresses. The IPCC-2007 evaluation indicated that 40% of the Amazon forest is sensitive to draught. However, two contradictory outlooks for the future are considered in the scientific literature: on the one hand, draught and death; on the other, fertilization by CO_2 and resilience.

In 2005 a severe draught affected over 70 million hectares in Western Amazonia. This opened an opportunity for scientists to further studies on the possible effects of climate change. Through satellite tracking (microwave observations of rain and foliage) it was found that, despite the gradual recuperation of rain in the following years, the vegetation reduction persisted until the following great draught, in 2010 (*PNAS 110*: 565-570, 2013). This last event, which led to the drying of rivers, was even worse than the former draught. A study based on the amount of rain during the dry season in the two draughts predicts that, in the long term, the CO_2 emissions due to the death of trees during the 2010 draught would be 1.4 times that of 2005 (*Science* 331: 554, 2011). On the other hand, field studies performed in lots across the Amazon region found a reduction in growth and an increase in the death rate of trees after the 2005 draught (*Science 323*: 1344-1347, 2009). Also, an experiment of rain exclusion during seven years showed an increase to double in the tree mortality (*New Phytologist 187*: 579-591, 2010). It is evident that the recurrent draught is capable of severely affecting the Amazon forest.

In another research approach, the manner in which the increase in atmospheric CO_2 will affect the carbon storage in the Amazon forest was evaluated by studying climate models (*Nature 494*: 341-344, 2013; *Nature Geoscience 6*: 268-273, 2013). In principle, the studies found a positive effect of CO_2 fertilization on plant growth, which would suggest resilience to climate change. At high CO_2 levels stomata remain closed longer, reducing water loss due to evapotranspiration and making trees more resistant to heat and draught. However, the results of the models used involve a large degree of uncertainty since there are no studies about the way in which the vegetation of the Amazon forest will react to high CO_2 concentrations; the models are fed with information from forests in temperate regions. There are plans for *in situ* studies of the fertilization by CO_2 in the Amazon forest, but the expensive measurements will only start in 2015 (*Nature 496*: 405-406, 2013).

The possible future situations also have opposing climate connotations. A dying forest would emit tons of CO_2 into the atmosphere, accentuating the warming process (positive feedback). In contrast, forest revitalization due to a higher CO_2 consumption would oppose the effect of warming (negative feedback). Death or resilience? Researchers looking at satellites, other amidst the rainy forest, yet others in air conditioned rooms in front of computers, all render contradictory answers. Climate is very complicated, the Amazon forest large and diverse, and there are also multiple future incidences (deforestation, fragmentation, burning). Clearly, a lot of research in this respect is needed urgently. Tomorrow will be another day and we shall see.

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