Calder's Updates

Nigel Calder takes the pulse of science, as the author of Magic Universe and Einstein's Universe. He checks predictions of the past half-century, to see how they worked out. And his hand is on the brow of frenzied climatology, as a co-author of The Chilling Stars: A Cosmic View of Climate Change.

Amazon rainforest

Predictions Revisited **and** ***Climate Change: News and Comments***

Will the Amazon rainforest survive?

A flurry of stories about the rainforests confirms that the proper concern about tropical deforestation has been thoroughly confused by improper attempts to invoke man-made global warming. Before turning to thunderstorms felling trees, let's start with the big picture of expectations, past and present, for the Amazon rainforest. For more than 30 years, large-scale assessments have been based on satellite imagery, despite the problem that much of the forest is covered with clouds at any one time. Brazil's own Instituto Nacional de Pesquisas Espaciais, INPE, has played a leading part.

In a forecast that proved wrong even more rapidly than *The Population Bomb* (see the previous post) an ecologist Philip Fearnside declared in 1982 that the Amazon forest was vanishing at an accelerating rate, with more than 40% to be gone by 1988. I told the tale in my 1991 book about remote sensing, *Spaceship Earth,* after visiting INPE in São Paulo.

During the 1980s Brazil found itself at war on two fronts. At home, the government tried to moderate the rate of clearances in the Amazonian forest, and police a frontier region as gun-happy as the old Wild West of the USA. Internationally, they had to deal with a rising chorus of criticism about the rate at which the forest was disappearing. In 1982, on the basis of INPE's figures, predictions by an American scientist P.M. Fearnside amounted to a forecast that 44 per cent of the Amazonian forest would be lost by 1988.

The Brazilians greeted such estimates with frank disbelief. There then followed a contest between calculation and remote sensing to try to establish the true facts. …

In 1989, the World Bank published estimates indicating that 12 per cent of Legal Amazonia was already deforested by 1988. This was based on calculations from the state of affairs in 1980. By this time the Brazilians were growing very angry. Although the figure was far less than the Fearnside estimate, the fact that it came from the World Bank secured it a place in international environmental

folklore. The Brazilians appealed again to the umpires in space: the unblinking instruments of the remote-sensing satellites.

At INPE, Roberto Pereira da Cunha decided to make a 'wall-to-wall' assessrnent of the deforestation in Legal Amazonia. As he remarked, 'No one wants to do the dirty work of gathering the data. It is a very trivial task for scientists.' Trivial, but not unlaborious. Pereira's team assembled 234 Landsat scenes and selected for close interpretation 101 images that showed evidence of deforestation. From colour composites of three wavelength bands the scientists outlined the deforested patches, and used a grid to measure their areas. Images for different years established rates of deforestation.

The most important conclusion was that there was no acceleration: deforestation was proceeding at a more or less steady rate. As for the total recent deforestation up till the end of 1988, INPE'S answer was 5 per cent of the area of Legal Amazonia. Meanwhile, Fearnside had changed his forecast. His new figures indicated 7 per cent deforestation of Legal Amazonia by 1989 – a far cry from his 44 per cent figure of just 7 years earlier, and almost in line with INPE's figure. In 1990 Jim Tucker and Chris Justice of NASA broadly confirmed the Brazilian result by a similar large-scale use of Landsat imagery, but with a different technique, using only a single infra-red channel.

So what do the umpires in space say now, two decades later?

INPE poster for DETER –
Deforestation Detection in Real Time

The latest official figures from INPE cover 1988-2009 (see the Butler references). They show that deforestation in Amazônia Legal amounted to 377,000 sq. km. from 1988 to the end of 2009, out of a recently forested area of about 3,700,000 sq. km. That puts the loss at 10 % over 22 years. When added to the earlier INPE data they suggest that from 1970 to 2009 about 15 % of the forest has been cleared. Not good, but not catastrophic either, except for some indigenous people of the forest.

A briefing paper just out from Chatham House reports that actions by governments and businesses over the past ten years have cut Illegal logging by between 54 and 75 % in the Brazilian Amazon. Compared with ranching and farming, logging legal or illegal is a very small direct contributor to deforestation.

Even so the overall deforestation rate, according to INPE, has fallen from a peak of 29,000 sq. km. per year In 1995 to 7000 in 2009. That low rate of 0.2 % per year must be more than compensated by natural forest regrowth in some of the cleared areas. If it can be maintained, the shrinkage of the Amazonian rainforest will have been halted.

Supporting an optimistic view is a factor that environmentalists prefer to ignore – the fertilizing effect of the increasing carbon dioxide in the air, which all plants love. In 2008 Oliver Philips of Leeds and his colleagues reported a remarkable increase in rates of growth in the Amazonian trees, and concluded, "The only change for which there is unambiguous evidence that the driver has widely changed *and* that such a change should accelerate forest growth is the increase in atmospheric CO_2."

Climatic hand-wringing continues

From which we can segue to the concerns about climate change in Amazonia. Even now people go on saying that half the forest will be gone in a few decades, for climatic reasons. I was going to write about new work at the Max Planck Institute for Biogeochemistry about real-world observations of exchanges of carbon dioxide between ecosystems and the atmosphere. But David Whitehouse has beaten me to it, and he relates what you might want know about "particularly alarmist scenarios for the feedback between global warming and ecosystem respiration" at http://www.thegwpf.org/the-observatory/1240-new-carbon-cycle-data-casts-doubt-on-climate-models.html

Instead, here's another alleged feedback loop that's meant to make your flesh creep.

- **Trees sequester CO_2**
- **Windstorms fell trees**
- **Rotting releases CO_2**
- **More CO_2, more windstorms**
- **More windstorms, more CO_2**
- **We're all doomed**

The commendable research on which the current story is based has found that a 1000-km squall-line of thunderstorms, crossing Amazonia 16-18 January 2005, blew down about 320,000 trees around Manaus, which is half-way up the Amazon River. The storm may have felled 500 million trees across the whole Amazon Basin.

Robinson Negrón-Juárez and Jeffrey Chambers of Tulane University in New Orleans, together with colleagues from Brazil, Germany, Canada and NASA's Jet Propulsion Lab, used "before" and "after" satellite imagery of the rain forest to select 30 random plots around Manaus for field studies. In the following years, team members painstakingly distinguished the blowdowns from other dead trees.

They concluded that the Manaus area lost 0.2 % of its forest in the event and, assuming that the impact was similar across the basin, they arrived at the figure of half a billion trees. As some other areas looked more damaged in the satellite images, that may well be right. Squall-line storms of the same meteorological type occur about twice a year, but the team's own data indicate that the January 2005 event was exceptional. The report ends:

"If a warming climate increases storm intensity, forest mortality may also increase,

resulting in an unexpected carbon release to the atmosphere over many years, with the potential to further warm the climate system."

To be fair to the team, notice the "if". It reads to me like just the kind of man-made global warming sop that politically correct editors of scientific journals expect these days. (*Geophysical Research Letters* in this case.) In a press release from Tulane, Jeffrey Chambers is more circumspect.

"It's very important that when we collect data in the field we do forensics on tree mortality," says Chambers, who has been studying forest ecology and carbon cycling in Amazon since 1993. "Under a changing climate, some forecasts say that storms will increase in intensity. If we start seeing increases in tree mortality, we need to be able to say what's killing the trees."

To put all this in a global perspective, here's some more arithmetic. The authors say that the 320,000 trees lost around Manaus were equivalent to 85 gigagrams of carbon. The also tell us that it takes about 18 years for a tree to rot and return its carbon to the air. Let's say, just for the sake of argument, that events like that of January 2005 occur every 9 years. If so, in any one year, 2 times 500,000 blowdowns are giving back 1/18 of their carbon to the air:

(85/18)*1000000000/320000 Gg/yr = 14757 Gg/yr. Call it 15 teragrams per year. (Giga means a billion, tera 1000 billion, peta a million billion.)

This figure is to be compared with the annual uptake of carbon by the terrestrial biosphere (i.e. excluding the oceans). According to the latest measurement of gross primary productivity (published this month by Beer *et al.* – see the Whitehouse link above) it's 123 petagrams/yr, or 123,000 teragrams/yr. The annual release of carbon from the biosphere is similar to the uptake. So even if carbon from blowdowns in the Amazon were to double to 30 teragrams/yr (which, frankly, would be more likely in a cooling scenario than in a warming one) it would still be only one part in 4000 of the annual terrestrial turnover.

Benefits of disturbance

Prompting me to look into this story was the recollection of a storm on 15-16 October 1987 that destroyed 15 million trees in the very sparsely forested south-east of England where I live. By comparison, 500 million blowdowns across the far larger rainforest of Amazonia seems to me pretty modest. And in any case blowdowns have a wonderfully refreshing effect on the landscape, allowing previously overshadowed species to make a comeback. This is the intermediate disturbance theory that I explain the story about "Biodiversity", in *Magic Universe*.

In 1973, after monitoring for seven years the prosperity of wild flowers in many different habitats across the moors of northern England, Philip Grime at Sheffield came to a general conclusion. He reported that the diversity of species is at a maximum in places where the living is neither very easy nor very difficult, or where there is some interference, by grazing, mowing, burning or trampling, but not too much. The reason is that moderate hardship, and/or a moderate degree of management, curbs the dominant species.

Grime called his proposition a 'humped-back model', referring to the shape of the resulting graph of species diversity versus stress. A few years later, reflecting on the 'legendary' variety of species in rain forests and coral reefs, Joseph Connell of UC Santa Barbara offered a generalization similar to the latter part of Grime's: 'Highest diversity is maintained at intermediate scales of disturbance'. The idea came to be known in the USA as the 'intermediate disturbance hypothesis'.

Applied in the tropical rain forests, the implication was that moderate damage by windstorms, and perhaps by the temporary clearances of slash-and-burn farming or even limited logging, should tend to increase the number of species in an area. The idea that moderate human interference might be less harmful than it was often claimed to be, and could even help to maintain biodiversity, enraged environmentalists.

Rain-forest campaigners were reassured when [Stephen] Hubbell and his colleagues declared in 1999 that the idea of beneficial light gaps was false. On Barro Colorado Island in Panama there are indeed species that rely on light gaps to survive, but their seeds are not widely scattered. For want of sufficient new recruits, incumbent species tend to do better than the opportunistic light-lovers, in filling a light gap. There is no significant difference in the total count of species, whether this particular forest has many light gaps or few.

The rain forest of Paracou in French Guiana told a very different story, and Jean-François Molino and Daniel Sabatier of the Institut de Recherche pour le Développement in Montpellier doubted if Hubbell's results from Panama were generally valid. In 1986-88 loggers cleared parts of the Paracou forest, in some places intensively and in others more sparingly. Plenty of untouched forest remained, for comparison.

Ten years after the disturbances, the lightly logged places had about 25 per cent more biodiversity in tree species than the undisturbed places. The main reason was a big increase in light-loving species growing in the forest. The census of 17,000 trees in seven logged and three untouched areas, counted all that were more than 2 centimetres thick at breast height. Altogether 546 species of trees appeared in the count, compared with 303 in the Panama forest.

To explain their very different result, the French scientists suggested that Hubbell's forest in Panama had been greatly disturbed by severe droughts. Those left it already well provided with light-loving species, so that further small disturbances could have no great effect. Another difference was that the Paracou situation was evaluated after a longer time had elapsed, following the disturbance.

'The intermediate disturbance hypothesis remains a valid explanation for high species diversity in tropical forest trees,' Molino and Sabatier concluded. They were nevertheless careful to point out that the result applied only to small, lightly logged patches in an area that was otherwise undisturbed for hundreds of years. 'Our study gives no evidence in favour of commercial logging on a large scale,' Molino said.

Remembering really serious climate change in the Amazon

In the same story in *Magic Universe* I refer to species loss, and the theory of island biogeography. I've used colour to highlight a key point.

It is as well to remember that fewer than 2 million species have been identified and named. Island biogeography nevertheless became a basis for calculating the loss of species, as a result of destruction of habitats. A rule of thumb is that if a habitat loses 1 per cent of its area, then 0.25 per cent of its species will become extinct. So if you guess that the tropical forests harbour 10 million species, and are disappearing at a rate of 1 per cent per year, you arrive at a loss of 70 species a day.

To ask which species they are is a waste of breath. The whole exercise is conjectural, with virtually no observational evidence. To say so is not to doubt the likelihood that species are disappearing, but only to stress how tentative is the scientific grasp of the problem. Intellectual progress is impeded by conservationist zeal, such that prophets of a mega-extinction always get a hearing, while people with better news may not.

In 1988, Aldo Lugo of Puerto Rico's Institute of Tropical Forestry was rash enough to tell a conference in Washington DC that the consequences of almost complete deforestation of his island early in the 20th Century were not nearly as dreadful as the theorists were predicting for other places. Secondary forest was flourishing, after a lamentable but not disastrous loss of species. 'I almost got eaten alive,' Lugo said, 'with [an eminent conservationist] yelling at me in the cafeteria of the Smithsonian.'

Rarely mentioned in public information on this subject is that 90 per cent of the Amazonian forest disappears every 100,000 years or so for natural reasons, in an ice age. According to island biogeography's reckoning of losses, millions of species should be wiped out each time, making every ice age a mass extinction comparable with the event that killed off the dinosaurs. Yet the tropical forests have remained roughly in a steady state over dozens of ice ages. So the losses must either be overestimated, or else be made good by dozens of new species evolving each year, compared with a supposed natural turnover, new for old, of only about one species per year.

I give the last word to Brazil's prominent paleo-ecologist Aziz Ab'Saber of São Paulo. He helped to develop the ice-age refuge hypothesis to explain the enormous biodiversity of the Amazonian jungle by its reduction to small enclaves, with old species disappearing but many new species evolving. He has been a fierce critic of man-made deforestation, but he is totally sceptical about the alleged effects of global warming. He points out that 6000 years ago the planet went through a climatic optimum (warmer than now) that caused more rains and the "re-tropicalization" of Brazil. "The warm currents of the Atlantic will continue, and they were not taken into consideration by the IPCC," Ab'Saber has said.

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   Thanks for this. A point related to your last post is that UN estimates predict that the Brazilian population will go into decline around 2040, earlier than most countries.

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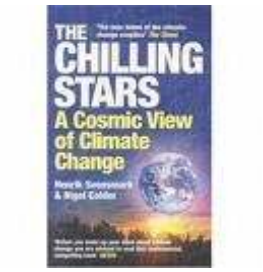

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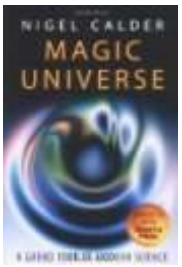

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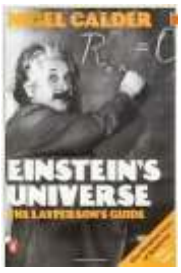

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