Amazonia

Pathways to policy-makers

The complexity of change in tropical forests is challenging researchers. But, says **Alan Grainger**, so is communicating findings to governments and the public.

Citation indices may be controversial, but they provide some measure of how effectively scientific knowledge is transferred to fellow scientists. Assessing how our discoveries are used by everyone else – governments, industry, charities and the public – is more difficult.

The challenge is particularly acute for knowledge about global change, owing to its complexity and spatial diversity. Our experiences at the School of Geography at the University of Leeds in communicating findings about tropical forests testify to that. In this article I use these experiences to shed light on the various paths along which knowledge travels to policy-makers, and how scientists can increase their chances of achieving meaningful impacts.

Undisturbed forests

In 1998, while my colleague Oliver Phillips held a NERC Fellowship at the University of Leeds, he led an international team of researchers that published a groundbreaking paper in the American journal *Science*. Using detailed evidence collected in permanent forest plots, the team showed that undisturbed forests in Amazonia were continuing to take in, or sequester, carbon. Conventional wisdom, on the other hand, held that undisturbed forests were merely static stores of carbon.

Any challenge to accepted views is likely to spark off a vigorous debate, and this case was no exception. The paper has been cited over 200 times at the last count.

Oliver's response was to collect more data to consolidate his findings, and see whether this phenomenon was replicated elsewhere. Together with Tim Baker and Simon Lewis at Leeds, Yadvinder Malhi at Oxford, Percy Nuñez Vargas in Cusco, Peru, Niro Higuchi in Manaus, Brazil, and others, he established a tropics-wide network of permanent plots. The result was the Amazon Forest Inventory Network, more commonly known by its Spanish acronym RAINFOR.

RAINFOR was recently awarded a $4.5 million grant from the

US-based Gordon and Betty Moore Foundation to continue its research in Latin America, and a £3 million grant from NERC to better quantify the carbon balance of Amazonia. Simon Lewis has also received a NERC New Investigator's Award to check if undisturbed African and Asian forests are also sequestering carbon.

Further support for undisturbed tropical forests being net carbon sinks – they store carbon – came from measurements of the global distribution of carbon dioxide in the atmosphere, reported in *Science* in 2007. Another member of the Leeds RAINFOR team, Jon Lloyd, was a co-author.

The RAINFOR network is prolific in publishing the results of its research in scientific papers. These have taken two routes to policy-makers. First, by reaching governments indirectly through major reports from the UN Intergovernmental Panel for Climate Change (IPCC). The IPCC reports form the main evidence base for global climate policy.

The 1998 paper was mentioned in the IPCC's *Special Report on Land Use, Land Use Change and Forestry*, published in 2000, and in the physical science section of its Fourth Assessment Report, published in 2007.

Second, they have taken more direct paths. Assessing the effect of an individual scientific paper on national policies on climate change is tricky because policy documents often cite IPCC synthesis reports, not particular articles.

But, RAINFOR has clearly influenced the British government, because it circulated a report by Simon Lewis synthesising RAINFOR's findings to delegates at the 23rd session of the Conference of the Parties to the UN Framework Convention on Climate Change (FCCC), held in Montreal in 2005.

RAINFOR's findings are important for policy-makers because they strengthen the case for including conservation of undisturbed forests in strategies to combat climate change. They have been taken on board by carbon-offset schemes and other private-sector initiatives. Brazil has also just launched an £11 billion appeal to protect forests in Amazonia.

However, RAINFOR's work is still to become embedded in international policy. One reason is that developing countries are not yet required to implement the Kyoto Protocol. Another is that under the rules of the Protocol, even full partners can only gain carbon credits to offset their fossil fuel emissions by planting new forests, not sustainably managing or conserving existing natural forests. A further complication is that undisturbed forests are not regarded as sustainably managed.

So this and other pieces of knowledge about tropical forests are currently in a 'holding pattern' in IPCC's knowledge bank, waiting to be used when the scope of the Kyoto Protocol is extended.

This could happen soon if developing countries agree to implement the successor to the Kyoto Protocol when its mandate runs out in 2012. There are also signs that restrictions on including existing forests could be relaxed. At the last FCCC meeting in Bali in December 2007 proposals were tabled to launch a scheme to avoid deforestation. This is called REDD – short for Reducing greenhouse gas Emissions from Deforestation and forest Degradation.

Going, going, gone

How will climate change affect biodiversity in the Amazon? Oliver and I supervised NERC PhD student Lera Miles as she developed an innovative technique to model the potential impacts of global climate change on forests in Amazonia.

Her research predicts that climate change will lead to major spatial shifts in species distributions. This has huge policy significance. It means that climate change must be tackled urgently if the existing rate of degradation of biodiversity is not to accelerate. Planners must also retain natural forest corridors over large areas to allow species to adapt as climate changes. Otherwise many species could become extinct.

Lera published her findings in *Global Ecology and Biogeography* in 2004. She also contributed to a more comprehensive study published in *Nature* in the same year, coordinated by Chris Thomas, formerly of the School of Biology at Leeds.

Publishing in prestigious journals is a recipe for high scientific impact. The *Nature* paper, which estimated that at least 18 per cent of species could become 'committed to extinction' by 2050, has since been cited more than 500 times by fellow scientists. More detailed studies, like Lera's fine paper in *Global Ecology and Biogeography*, are often overshadowed by these megapapers. But the IPCC's Fourth Assessment Report in 2007 mentioned both studies in its impacts, adaptation and vulnerability section.

Top journals also bring massive media exposure, and policy-makers could not fail to notice the findings of the *Nature* paper given all the newspaper headlines it received.

Mark Edwards / Still Pictures

The golden lion tamarin of Brazil, an endangered species and among the rarest animals in the world. Biodiversity loss in the Amazon is accelerating.

Merijn van der Vliet/istockphoto.com

AMAZON IN NUMBERS

Amazonia's tropical forests are some of the most important ecosystems on Earth. They account for 45 per cent of the world's tropical forests and store around 40 per cent of the global carbon held in vegetation on land. Relatively small changes in the structure and function of these forests are likely to have far-reaching affects on biodiversity, the carbon cycle and the rate of climate change.

In a series of groundbreaking publications going back to 1998 a team of researchers from the University of Leeds has shown large-scale patterns and changes in the structure, metabolism, function and composition of one of the world's richest ecosystems.

A key finding is the discovery that trees in the Amazon are getting bigger across the basin. Most species of trees have begun growing faster. Existing trees are also dying faster and being replaced by young new trees. This may seem obvious because plants grow by fixing carbon dioxide from the air by photosynthesis. So higher carbon dioxide levels will act as a fertiliser promoting plant growth. But the discovery has surprised most tropical ecologists as they had assumed mature forests to be carbon-neutral, giving off as much carbon as they absorb.

These increases in biomass suggest the Amazon is a sink for atmospheric carbon dioxide, taking in 0.5 to 1 billion tonnes of carbon per year – equivalent to the fossil-fuel emissions of the major economies of Western Europe. Or put another way, Amazonia's biomass, at least for now, is absorbing 15 per cent of carbon dioxide emissions from human activities.

ZONES OF TENSION

Jon Lloyd from the University of Leeds leads the £1.6m NERC consortium Tropical Biomes in Transition (TROBIT). Jon and colleagues are interested in 'zones of tension' in Africa, Australia and South America. These are where rainforest and savannah, the other major vegetation system in the tropics, grow side by side.

Extending the reach of science

Scientific knowledge can easily get distorted on its way from the lab to government offices, via scientific reports or the media. The risk is even greater when knowledge is disseminated globally. So the personal touch is still important.

Policy-makers, for example, often respond strongly to research carried out by their own scientists. This is one advantage of multinational scientific networks like RAINFOR. I am also coordinating efforts to train researchers in South-east Asia and Latin America to adapt Lera's model to predict the impact of climate change on domestic distributions of biodiversity.

Scientists can also increase their influence by direct contacts with policy-makers. Addressing conferences attended by ministers is one way to do this. But greater impacts can be obtained through dialogue. According to David Guston's influential boundary organisation model, 'knowledge systems' that harness scientific discoveries are most effective when scientists and policy-makers work together to translate these into a form best understood by politicians.

Lera has had the opportunity to interact with policy-makers by representing the UN Environment Programme's World Conservation Monitoring Centre (WCMC) in Cambridge at meetings of the Conventions on Climate Change and Biodiversity, including the Bali Climate Conference last December. She joined WCMC on leaving Leeds in 2002, and became acting head of its Climate Change and Biodiversity Programme last year. Her joint assessment of the REDD scheme appeared in *Science* in June.

Forest decline?

Success in communicating research findings to anyone outside the scientific community is always limited by their preconceptions. Policy-makers often assume that scientists can provide them with certain knowledge. So communicating the uncertainty associated with global change needs great care.

I encountered this problem when I challenged another long-held assumption – that tropical forest area is in long-term decline – in a paper published in the *Proceedings of the National Academy of Sciences* in January. This concluded that the evidence for forest decline provided by frequent estimates of deforestation rates is not, paradoxically, matched by convincing evidence for a net downward trend in forest area.

The paper did not deny that deforestation is still continuing on a large

scale, but showed that there are doubts about the reliability of UN forest statistics, on which reports of deforestation are often based. It also contained a new time series, which included recent satellite data, that showed no evidence for a net decline in forest area in the humid tropics since 1970. My analysis was supported by a more comprehensive study in the *Journal of Official Statistics*. This showed that inconsistencies in UN area statistics are matched by other inconsistencies in every stage of their production.

UN forest statistics have been widely used in modelling land-use change, calculating the global carbon budget, and predicting future trends in biodiversity. So the paper has major implications for global -

Any challenge to accepted views is likely to spark off a vigorous debate.

change scientists, and has already been cited four times in the academic literature.

One explanation for my discovery is that any net decline in tropical moist forest area is masked by the large errors involved in making global estimates. But another is that tropical forest change is more complex than previously imagined, and that deforestation is being offset by natural reforestation in abandoned clearances on a larger scale than shown by earlier estimates.

To test my hypothesis about natural reforestation I am following the example of RAINFOR by forming a global network of scientists to collate measurements of this phenomenon throughout the tropics. The first synthesis of findings could be out later this year.

This may affect international policy on climate change. For if developing countries agree to implement 'Kyoto II' they could ask to receive credits for carbon being sequestered in regrowing forests, as well as that added in undisturbed forests.

Drawing attention to the uncertainty of our knowledge about the trend in tropical forest area was risky, since policy-makers could use this as an excuse not to take action on tropical forests. To guard against this I stressed the importance of errors in forest estimates, and at the end of the paper called for a new global monitoring scheme to reduce these.

Balancing the assessment of scientific uncertainty with a positive policy message paid dividends. It has got people all over the world talking about the need for a World Forest Observatory.

To ensure that my message got across clearly I spent a lot of time before publication working on a press release with our excellent Leeds University press office.

The potential to influence policy-makers and the public was boosted by an interview on BBC radio. The BBC then listed my findings on its website. This, and the press release, led to worldwide coverage, in newspapers as far afield as Australia, Brazil and the Philippines.

From policy to practice

It is one thing to influence policy. It is quite another for policies to lead to practical outcomes on the ground.

So if carbon credits are to be given for forest regrowth and protecting forests under the REDD scheme, this will need meticulous checking. This means that tropical forests must be monitored with greater accuracy than current national and international mechanisms permit. So the idea for a World Forest Observatory could be quite timely.

From science to policy

Devising a social impact index comparable to a citations index is not impossible, but it is made difficult by the many pathways research findings take to reach governments, and by the frequent gulf between government policies and outcomes on the ground.

Our experiences at Leeds show that scientists can communicate their findings effectively by exploiting as many of these routes as possible. Keeping the scientific message clear is even more important in complex global-change studies, and having a distinct policy message also helps.

While scientific papers and media reports have a huge impact, the personal touch is still important. That is why international networks of scientists like RAINFOR are not only useful for collecting data – every scientist is a potential communicator to their own government. NERC recently recognised this by extending its Knowledge Exchange Programme to include international partners.

One thing that scientists have little influence over, however, is the long time-lag between the publication of research findings and their translation into policy documents and practical outcomes. Governments should remember this when evaluating the impacts of their science spending! ❖

In 2008-09, NERC is developing a series of similar case studies. If your work fits into this format and has had significant policy and economic impacts contact editors@nerc.ac.uk

FURTHER READING

Changes in the carbon balance of tropical forests: evidence from long-term plots. *Science* 1998. 282: 439-442.

Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences* 2003. 100: 8086-8091

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The role of end users in an international statistical process: the case of tropical forest statistics. *Journal of Official Statistics* 23 (4): 553-592.

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Reducing greenhouse gas emissions from deforestation and forest degradation: global land-use implications. *Science* 2008. 320: 1454-1455.

MORE INFORMATION

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In March 2008, NERC launched the £3m Amazonia consortium led by Emanuel Gloor from the University of Leeds.

Oliver Phillips and Jon Lloyd lead the global Amazon Forest Inventory Network (or RAINFOR network). RAINFOR, which is funded by a range of international partners, coordinates research on tropical forest ecology across four continents.

Simon Lewis leads a NERC New Investigator's Award to extend evaluations of change in undisturbed tropical forests into Africa and Asia.

See also: Measuring the carbon jungle page ten.