Peatlands of the western Amazon

Recent investigations in western Amazonia have revealed vast peatlands, up to 8m thick in places. Because they are so remote, we know little about them compared to peatlands in the northern hemisphere. Tom Kelly and Freddie Draper explain how their work will help us understand these ecosystems and revel how big they really are.

Mauritiella palm pollen.

From floating mats of grasses and sedges, to diverse flooded forest and palm-dominated swamp, the pollen tells a tale of ecosystem changes.

Taking measurements at Buena Vista.


Esme Shattock

Seen from space the Amazon River winds like a silk ribbon from the Andes to the Atlantic. Here, it delivers a fifth of the freshwater that enters the world's oceans. Along its length beneath feathery palm fronds, in old channels carved out by the river, lie some of the most substantial peatlands in the tropics. Some of these are many kilometres long, the size of small towns, and like small towns they have their own colourful inhabitants.

Macaws nest in dead palm trunks, hummingbirds feed from the white trumpet flowers of peatland trees, and tapirs and monkeys feast on the red armoured fruit of *Mauritia flexuosa*, often the dominant species of palm. People also prize this fruit, as it contains high levels of essential beta-carotene; in the city it is even made into ice cream.

Like all peatlands across the world, those in Amazonia store carbon. Plants take carbon dioxide from the air and use the carbon to build their leaves, roots and branches. When they die, this carbon is stored in the peatland's layers of organic material. These build up over time, since water-logging means that there is little oxygen and so decay is very slow. By removing carbon dioxide from the atmosphere and storing it for long periods, peatlands have the potential to help slow man-made climate change. But if they are damaged, for example by drought or deliberate drainage, they can also release that stored carbon back into the atmosphere.

Over the last few years, our group at Leeds has been trying to learn more about Amazonian peatlands. Collaborating with colleagues from the Instituto de Investigaciones de la Amazonía Peruana at Iquitos in Peru, we have set out to answer some basic questions: how do Amazonian peatlands work, what controls peat accumulation, and how are they changing?

The Amazonian climate already seems to be shifting, with less rain falling during the dry season and more in the wet season, creating greater climatic variation and some extreme floods and droughts over the last few years. To try to understand how peatlands might respond to these changes, we can use their current hydrology and ecology as well as their past behaviour as a guide.

In 2011 and 2012 we set out to undertake the first detailed hydrological study of an Amazonian peatland at a site named Quistococha, meaning Christ's lake, close to the city of Iquitos. We measured how quickly the water flows through the peat and then, back in Leeds, used numerical models to help understand whether this might be important for its behaviour. If a peatland drains quickly when the moisture source is switched off it means that the carbon stored there is more vulnerable to release during dry conditions, as oxygen can reach the peat in the upper layers and cause fast aerobic decay.

Where does the water go?

Our results were surprising: water flows very quickly through the peat by comparison with many northern peatlands, but the models show that even this rapid flow is not enough to shed a lot of the water entering the peatland each year from the heavy rain that falls in the western Amazon. A large proportion of the water must leave the peatland by travelling up and out through the tree leaves, a process known as evapotranspiration.

So it's clear that vegetation must be important to how Amazonian peatlands function today, as it helps to determine the degree of water-logging as well as the nature of the organic matter contributed to the accumulating peat. To understand how peatland behaviour might change over time, we need to know how the vegetation has changed in the past, and why.

To discover a peatland's history, it is possible to look at the plant remains in samples going down through the peat; the deeper you go, the further back in time. The pollen and spores produced by plants are virtually indestructible except when exposed to the air, so pollen in lake sediments and swamp peats can be preserved for thousands of years.

The first pollen record for Quistococha extends 2300 years into the past and shows that the peatland vegetation has completely changed several times during this period. From floating mats of grasses and sedges, to diverse flooded forest and palm-dominated swamp, the pollen tells a tale of pronounced ecosystem changes caused by shifts in the course of the river and its flooding regime. Their history is inseparable from that of the dynamic rivers that characterise this landscape. It also appears that although these peatlands may not be as diverse as a non-flooded rainforest at any one point in time, over the course of thousands of years they host a wide array of different species and habitats.

Our research group plans to continue building on our knowledge of Amazonian peatland ecosystems by combining vegetation census and pollen work with hydrological and geochemical analyses to develop a more detailed understanding of these landscapes' function and sensitivity. This will help us predict how they are likely to respond to future environmental changes.

We will also be drawing on images of the Amazon from space, which are scientifically valuable as well as beautiful. Satellite data will let us extrapolate from our observations of patterns and processes at individual sites to the whole Amazon basin and understand the role that the region's unique peatlands play in the global carbon cycle.

i Tom Kelly and Freddie Draper are PhD students in the School of Geography at the University of Leeds. The project 'Long-term Forest Dynamics of Peruvian Amazonia' is led by K. Roucoux, I. Lawson and T. Baker. See www.geog.leeds.ac.uk/projects/ltfd for further information. The work was carried out in collaboration with colleagues in Peru.