Where lightning strikes **twice**

Repeated lightning strikes – and the subsequent fires – make a group of islands in northern Sweden perfect for comparing old with new boreal forests. **Ruth Gregg** investigates.

The boreal forest is one of the few regions left in the world where you can experience true wilderness. It is a vast region – the largest of the terrestrial biomes – and forms a belt across the northern latitudes along and below the Arctic Circle. Forests stretch across the landscape, interrupted only by glacial lakes and mountain peaks.

Were you to visit a place twice you would be witness to ever-changing scenery. In the cold dark winters snow and ice cover the region reflecting the dancing northern lights above. In summer the forests are transformed, with the green coniferous trees making the most of the midnight sun.

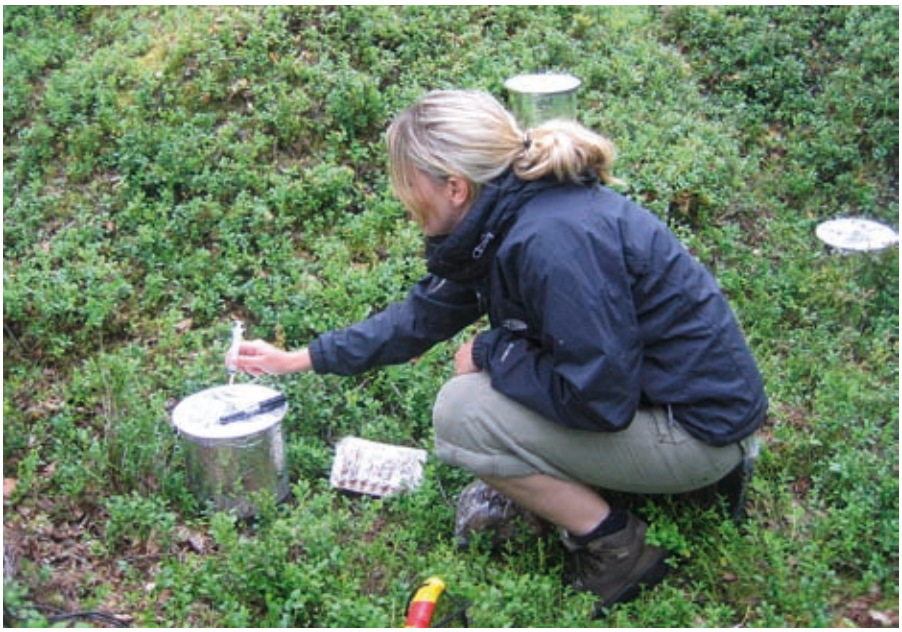
The long cold winters contribute to the boreal's status as a carbon store by slowing decomposition processes. The winters ensure the forests are the largest store of terrestrial carbon on Earth. Boreal soils alone hold more carbon than the tropical and temperate forests combined.

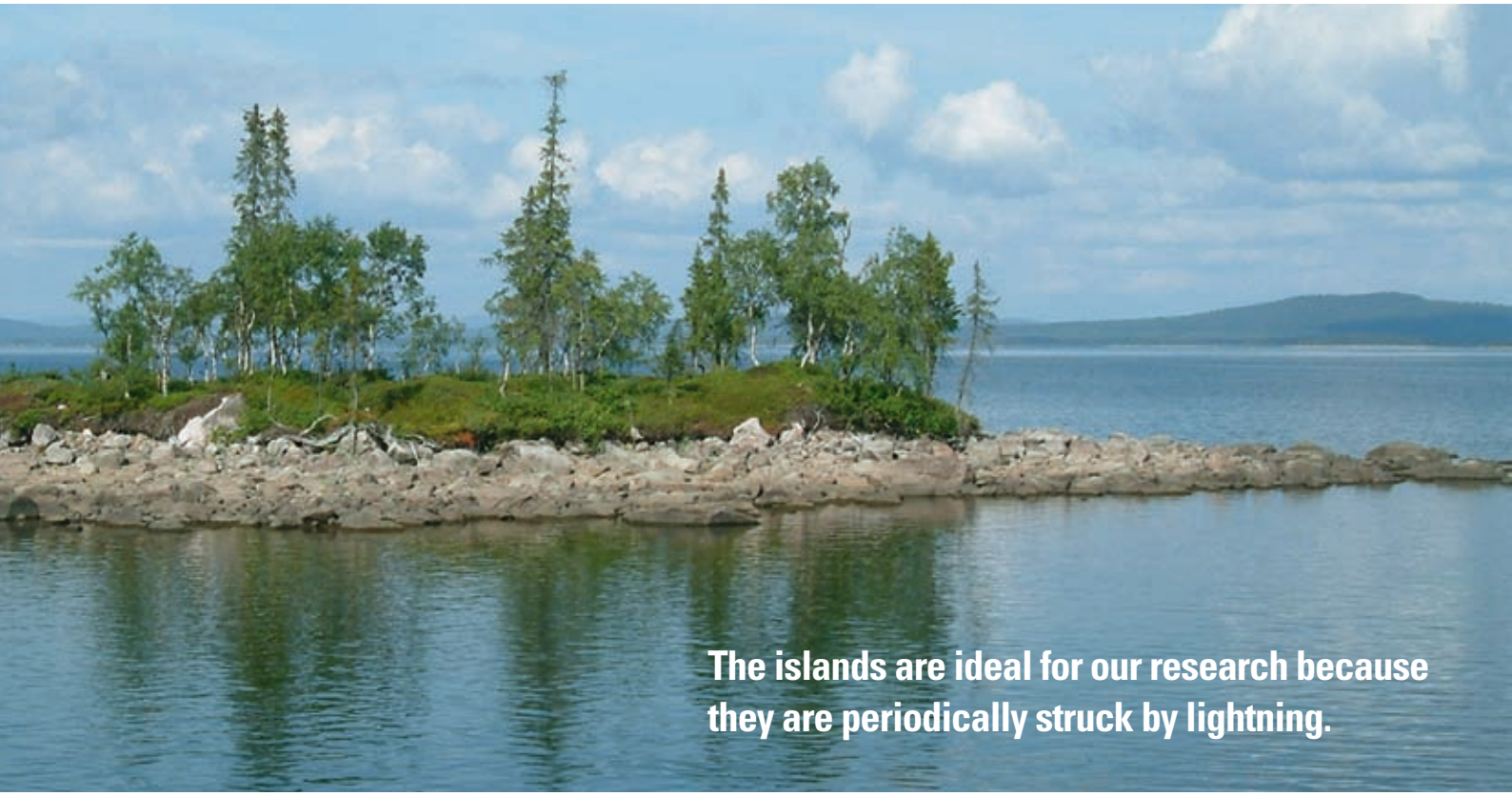
Climate change is at the forefront of many peoples' thoughts. The boreal region lies at latitudes where warming is predicted to be greatest. Scientists tend to focus upon the warming effects in the boreal, but climate change will have another important effect: a 40 per cent increase in lightning strikes. And in boreal forests, this means a lot more fires. Forest fires create a mosaic landscape with the changing vegetation patterns directly influencing the amount of carbon stored in soils and plants.

Boreal forests are also important stores of the greenhouse gas methane. This gas receives relatively little attention compared to carbon dioxide, despite it being 25 times as powerful. Methane has increased in our atmosphere by 150 per cent since the industrial revolution. Levels are still rising. Methane sinks – where methane is absorbed – are outweighed by wetlands and landfill sites that release methane into the atmosphere. The only land-based sink for methane is in aerated soils such as those found in forests. In these soils live methanotrophic bacteria which use the carbon atom in the methane molecule as a food source.

In the summers of 2006 and 2007 our research brought together these two often-overlooked subjects – lightning-strike fires and methane sinks – when we investigated the effect wildfire disturbance has upon methane movements into and out of

Ruth Gregg sampling gas from the island's soils.





The islands are ideal for our research because they are periodically struck by lightning.

boreal forest soils.

Being a soil ecologist I never dreamt boats would play a key part in my research. But our field site was an archipelago of 30 forested lake islands near the village of Arjeplog in northern Sweden. In summer Arjeplog is a quiet town where Swedes come to fish. In winter racing drivers descend, keen to test how their new super cars handle on the frozen lakes.

As the short summers of the sub-Arctic allow only a small window of opportunity we had to pack all our field research into just several months. Our trusty vessel became an invaluable member of the team, carrying our gas chambers and enabling us to transport 150 soil cores back to the mainland.

Climate change will have another important effect: a 40 per cent increase in lightning strikes.

The islands are ideal for our research because they are periodically struck by lightning. The strikes ignite wildfires causing long-term changes in the composition of plants communities and soil properties. What is so exciting is having access to these real-life laboratories. They allow us to study the long-term effect of fire disturbance in soil and plant communities, which would be impossible to recreate back at the Centre for Ecology & Hydrology in Lancaster.

To undertake research in such an unspoilt region is an ecologist's dream. Quite often 'office work' in the evenings was interrupted by a passing reindeer or red squirrel. It was certainly unusual passing time sampling soils by watching a sea eagle chase greedy gulls from its nest.

Each island was different to the next; some even had names given to them by researchers returning year on year. Banana Island really does look like a banana and Ant Island was home to a vicious colony of biting ants!

But what about the science? Carbon-dating techniques – analysing the ratio of the isotope carbon-14 – have revealed that the last major fires on the various islands ranged from 40 to 5500 years ago. Dating allowed us to look at the very long-term effect of fire on soil methane fluxes over 5500 years. Typically, most studies are only able to investigate forest disturbance of up to 100 years due to the rarity of these ancient forests. These 'old-growth forests' are known to be important soil carbon stores, accumulating carbon that would otherwise exist as carbon dioxide in our atmosphere.

We compared directly the methane balance on islands where forests have grown uninterrupted for thousands of years, with islands just recently ravaged by fire. We found that as forest communities age, their soils' ability to act as a methane sink increased significantly. This suggests the soils of old-growth forests are important methane sinks. Surprisingly, these forests are not considered in national carbon budgets, and they are being threatened by the demand for timber, minerals and water resources across their global range.

Internationally, governments are beginning to recognise the importance of these old-growth forests and steps are being introduced to protect them. Hopefully, by revealing their role as important methane sinks our research will contribute to their protection. After all, once these ancient forests are lost they, and their vast carbon stores, are gone for good. ❖

MORE INFORMATION

Ruth Gregg is completing a NERC-funded PhD at the Centre for Ecology & Hydrology and Lancaster University, email: RUGG@ceh.ac.uk

Access and information about the island chronosequence was provided by Professor David Wardle (SLU, Umeå). Research was supervised by Dr Niall McNamara, Dr Nick Ostle and Professor Richard Bardgett. Thanks to Simon Oakley and Will Mallott for help with field work.