Why bogs may be key to fighting climate change

November 28 2019, by Caleb Davies, From Horizon Magazine

Peatlands occupy roughly 2% or 3% of the land's surface but we don't know how deep they go. Credit: Marisa04/ Pixabay

There are, arguably, only two interesting facts about bogs. The first is that some people have a jolly good time swimming through them, notably at the World Bog Snorkelling Championships held each year in central Wales, UK. The second is that they could help save the world.

Bogs, more properly known as peatlands, are areas that accumulate dead plant material under a layer of standing water. Those conditions ensure that the dead plant material rots away only very slowly. This means peatlands are an excellent store of carbon dioxide. If we can protect them—possibly even extend and enhance them—it could be an effective way of tackling climate change.

Yet we know little about bogs. The details of their biochemistry and how it might change in response to climbing temperatures are fuzzy. And we don't have an accurate idea of how much peat is out there. Those two problems, however, may soon be cracked.

One thing we do understand is the reason peat locks away carbon so tightly. In 2001, biogeochemist Professor Chris Freeman at Bangor University, UK, discovered that it's down to what he called the enzymatic latch.

Plant material is broken down by enzymes in microorganisms, but in peatlands there are an assortment of compounds called phenols that stop the various enzymes working. You can think of them like a key left in the wrong side of a door, blocking the lock from being used. "It's a spectacular failure of decomposition," said Prof. Freeman.

Delicate latch

Under normal circumstances, those phenols would all be degraded themselves by an enzyme called phenolic oxidase, but in peatlands that doesn't happen, principally because the enzyme needs a supply of oxygen to work. Rather worryingly, Prof. Freeman discovered that if this single enzyme were to kick back into action peatlands would begin to release their carbon. It's a delicate latch holding back the door to climate disaster.

More recently, Prof. Freeman began to wonder what might happen to this latch in different peatlands around the world as the climate warms and droughts become more common. Prof. Freeman and Dr. Juanita Mora-Gomez, now at the Institute of Earth Sciences in Orléans, France, began a project called microPEAT, looking at peatlands in Wales, the Arctic and Colombia. They took samples, brought them back to Bangor, and subjected them to drought-like conditions. Then they looked to see what happened.

They expected that, with little water to shut out oxygen, the microbes in the peat would shift their metabolism up a gear and began belching carbon. That is what happened with the samples from Wales and the Arctic, but with the samples from Colombia, drought actually suppressed the enzymes even further.

That was a big surprise and it isn't yet clear why it happened. Prof. Freeman points out that there are factors other than oxygen that affect the enzymes, such as acidity, and this could explain the findings.

But the implication is clear: some peat spots might be more resilient to climate change than we thought.

Prof. Freeman is careful to say that this doesn't mean we can let our guard down when it comes to reducing carbon emissions. Yet the results raise questions, he says, about whether we could enhance the carbon sequestering abilities of peat, perhaps by somehow intervening to change their biochemistry so that even less carbon can escape. "That's a very important possibility," he said. "We have to keep it in our pocket as a plan B for the planet."

One thing that will determine peat's effects on our future climate is precisely how much of it is out there—and that is a fact that Dr. Sonia Silvestri at the University of Bologna in Italy says we need to get a better

handle on.

Surveys

Dr. Silvestri began her scientific career in a sphere perhaps even less glamorous than peat. She was using geophysical surveys from helicopters to spot illegal rubbish dumps for the Italian authorities. Then one day a colleague asked her whether such surveys could be used to map peat instead.

She quickly realised both the importance of mapping peat and that her methods were perfectly positioned to help. We know that peatlands occupy roughly 2% or 3% of the land's surface, but because we don't know how deep the peat goes, we're not sure how much carbon they lock away. Our best estimates put the figure at 500-600 gigatonnes of carbon, though some reckon it could be much higher.

In 2017, Dr. Silvestri began the CRESCENDO project to map peatlands in 3-D for the first time. She uses data provided by a firm called Skytem, which flies a helicopter about 40 metres above the peat with a circular coil hanging below it. This creates a magnetic field that interacts with the ground in different ways depending on the conductivity of the substructures and the helicopter measures these with a receiver.

In June, she published the results from the survey of two bogs in Norway , the first published proof of concept showing that aerial geophysics can be used to map peat in 3-D. "Now we can tell this methodology works and works very well," said Dr. Silvestri.

Global peat map

She next wants to explore how we could go from local maps like this to a global peat map. That will require a smarter approach than just covering

more ground. "The instrument itself—not to mention the fuel and renting the helicopter—are really expensive," said Dr. Silvestri.

Her plan is to compare satellite imagery with the peat maps and try to find easily topographical features of the landscape that correlate with areas of peat distribution. If she can find several such features that correlate strongly with the peat, she could then use those as proxy measure for peat and develop a global map.

That is a long-term goal, however. It's more likely that Dr. Silvestri will focus first on maps for individual countries where peat destruction is problematic, such as Indonesia. "It's hard to explain to local people (farmers) that they shouldn't slash and burn peatlands," said Dr. Silvestri. So what we need are international agreements and mechanisms to prevent this practice—and the essential precursor to that is knowing where the important peat reservoirs are, she says. "We definitely need to protect these areas."

Provided by Horizon: The EU Research & Innovation Magazine