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Tropical peatlands

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Forest canopy – trees growing in tropical peatland

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*The word 'peat' may conjure up images of bleak, boggy hillsides across Northern Europe, Russia and the USA. But did you know that peatlands are also found in the tropics? These currently act as a significant store of carbon, yet these valuable ecosystems are under threat. As **Caroline Wood** explains, their disappearance could have severe consequences for the global climate.*

Approximately 400 million hectares (3%) of the world's land surface is covered by peatlands. Although most of this is found in temperate zones, 10-12% is located in the tropics (see map). Similar to their northern counterparts, tropical peatlands are nutrient poor, or ombotrophic, systems with low drainage rates and high levels of precipitation. In northern peatlands, the vegetation is mainly moss (particularly Sphagnum moss). Tropical peatlands typically have an overlying forest, giving rise to unique biodiversity.

The global distribution of peatlands. Tropical peatlands are found in Southeast and Eastern Asia, Central America, the Caribbean, South America and South Africa.

How do peatlands form?

Both northern and tropical peatlands are found where there is high rainfall and drainage is poor. This leads to anaerobic (oxygen-free) conditions and acidification of the soil. This restricts the activity of aerobic microorganisms that break down organic matter. Consequently, the rate of plant production is greater than the rate of breakdown, causing partly-degraded material to accumulate over time.

Tropical peat forms more rapidly than northern peat due to the high productivity of the forest above it and can reach accumulation rates of up to 13 mm a year. Most tropical peatlands are between 3500 and 6000 years old, but some date back to the Late Pleistocene (13 000 – 11 500 years before present). This steady deposition produces dense mats, up to 20 m thick.

Meanwhile, peatland vegetation removes carbon dioxide (CO_2) from the atmosphere, but because these plants are not fully broken down, most of the carbon becomes stored in the peat. As a result, tropical peatlands represent a very concentrated store of CO_2. Compared with temperate forests, which store 150-250 tonnes of carbon per hectare, tropical peatland contain up to 10 000 tonnes per hectare. It is not surprising then, that tropical peatlands are estimated to contain 3% of the world's soil carbon stores, despite only covering 0.25% of the Earth's surface. Peatlands emit other greenhouse gases, including nitrogen dioxide (N_2O) and methane (CH_4), but only at a low rate and is more than compensated for the CO_2 that is stored. Tropical peatlands therefore play a valuable role in maintaining a stable global climate.

Tropical peatland also performs many other valuable functions. Many plants are endemic to

peatland and these systems also support rare animal life, including the orangutan, blackwater fish, false gharial and the Sumatran rhino.

They provide a source of timber, medicine, bark, resin. In addition, tropical peatlands filter and store water, combat erosion and reduce the effects of flooding. So, although tropical peatland may only have a small geographical distribution, its importance cannot be over-estimated.

Wildlife of peatlands

Tropical peat swamps support an amazing diversity of plant and animal life.

Sumatran orang-utan

blackwater fish

Sumatran rhino

false gharial

Peatland under threat

Climate scientists are highly interested in peatlands. As we have seen, they act as a huge store of carbon but also, under certain conditions, they can act as carbon sources instead of carbon sinks. Many areas of tropical peatland are threatened with land-use conversion into agricultural plantations (especially for oilpalm). Cultivated crops require drainage systems, but when these are introduced into peatland, the water table is lowered and oxygen enters the soil. This enables greater decomposition, releasing the carbon dioxide stored in the soil. Furthermore, conversion into plantations or pasture increases nitrogen dioxide emissions. Together, these cause peatlands to turn into sources of greenhouse gases, rather than sinks. Drained tropical peatland is currently thought to release 2000 million tonnes of carbon dioxide annually, equal to 8% of global emissions from fossil fuels.

Land-use conversion frequently involves deforestation (often illegally), which stops the input of organic matter into the peatland system. This also exposes the peat, leading to erosion and surface subsidence, making areas more vulnerable to severe flooding. If surface subsidence continues, up to 70% of peat lands bearing plantations may become unusable within 100 years. Perhaps the most unsuccessful example was the Mega-Rice Project started in 1996; this aimed to convert 1 million hectares of 'unproductive' peatland in Borneo into rice paddyfields. Draining the water from these peatlands, however, allowed oxidation of minerals contained within the soil, producing sulphuric acid. This caused widespread river pollution and the project was eventually abandoned in 1999.

Perhaps more worryingly, as peat dries, it becomes highly flammable and poses an acute fire risk. As well as releasing methane and carbon monoxide, peat fires produce noxious vapours that reduce air quality and can affect human health.

Fires burn in the Tripa peatlands of Sumatra.

The devastating peat fires of 1997-98 (known as the 'Sumatra Haze') released between 3000 and 9000 million tonnes of CO_2, equivalent to 13-40% of the annual European CO_2 emissions from fossil fuels. This could set in motion a vicious cycle, where rising global temperatures cause peatlands to dry out, introducing more oxygen and making them more vulnerable to fire.

Protecting peatland

A key challenge for climate scientists is to model the impact of peatland destruction on global and regional temperatures. This is complicated by the fact that uptake and release of greenhouse gases varies considerably across peatlands, depending on their structure, hydrology and ecology.

The effect of peatland conversion on gaseous emissions is being investigated by researchers based at the University of Leicester, led by Professor Susan Page. She confirms that her research shows "the carbon debt associated with recent wildfires and the conversion of peatlands to agriculture, particularly for plantations, is enormous", and so "the scale of greenhouse gas emissions needs to be taken into account in any assessment of the impact of land use change."

Members of the Sumatran Orangutan Conservation Project examine peat after a devastating fire.

Meanwhile, hydrological restoration projects are underway to investigate if damaged peatlands can recover. Raising the water table by removing drainage systems reintroduces anoxic (oxygen free) conditions and can decrease CO_2 emissions by up to 20%. Certain areas of northern peatland have even been restored to carbon sinks using this strategy. It has been found, however, that rewetted peatlands often show greater rates of methane (another greenhouse gas) release.

The best strategy therefore, is to prevent peatlands from being converted in the first place, but this could affect the economic development of local communities. One proposed strategy has been financial payments for reduced emissions from avoided deforestation and forest degradation (REDD). This would give peatlands an economic value, making them more valuable in their intact form rather than as oil palm plantations. It is hoped that greater awareness of the crucial role tropical peatlands play in supporting a stable climate and biodiversity will compel local communities to cherish them and governments to protect them.

Palm oil

The oilpalm tree is mainly grown as a source of palm oil, which comes from its fruit. This is used in many food products, including chocolate and margarine. Increasingly, however, palm oil is being grown for biodiesel; this demand has been heightened by European legislation ruling that, by 2020, 10% of fuel must come from biofuel sources. It is ironic therefore that biofuel, designed to offset carbon emissions, may actually increase these due to peatland devastation.

Planting out oil palm plants in Guinea-Bissau, Africa

The fruits of the oil palm are crushed to extract oil for food products.

Get involved!

If you want to learn more about tropical peatlands, or even contribute towards their preservation, then OuTrop (Orangutan Tropical Peatland Project) is the organisation for you. Based in Borneo, this charity operates a long-term biodiversity research programme, besides working with local communities to implement conservation measures. OuTrop also offers volunteer placements where students can immerse themselves in the tropical forest, assisting with ecological surveys and replanting schemes. See www.outrop.com for more details.

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