



Peatlands

What is peat?

Peat is a type of soil that forms as a result of an accumulation of the remains of partially decayed organic material, mostly from plants.

What are peatlands?

Peatlands are waterlogged, carbon storing landscapes made up of peat and are estimated to cover over 90,000 ha, which is approximately 4.3% of Wales's total land area.

How does peat form?

Plants (notably flowering non-woody plants and mosses) play a vital role in the creation of peat. Where the water table is high and stable, dead plants do not fully decompose. The low levels of dissolved oxygen in the water means that there is a lack of decay organisms, allowing decomposed plant remains to accumulate faster than the rate of decomposition.

As decaying plants become compacted at a very slow rate, layers of peat form creating bogs and peatlands. As peat accumulates, it hampers the movement of dissolved oxygen in water thus creating an ongoing cycle which supports peat accumulation.

Peat soils accumulate at around 1mm every year so 1 metre of peat can take up to 1,000 years to form! As a result, many areas of Wales' peatlands have been accumulating these small increments for as much as 8,000 years or more; peat depths of over 10 meters have been recorded.

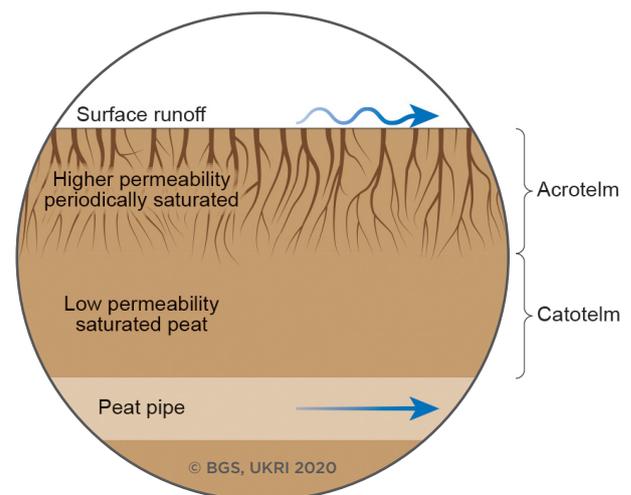
Peat formation preserves a wide range of other remains within the peat, including tiny pollen grains and even dust from volcanic eruptions. Studying these remains provides an important means to understand the evolution of the Welsh landscape and the effect of past variations in climate.

Peat in profile

The layer of peat closest to the ground's surface is called the acrotelm and is usually 10-60 centimetres deep. There is some movement of water through this partially decomposed layer with small amounts of dissolved oxygen available for decomposers such as fungi.

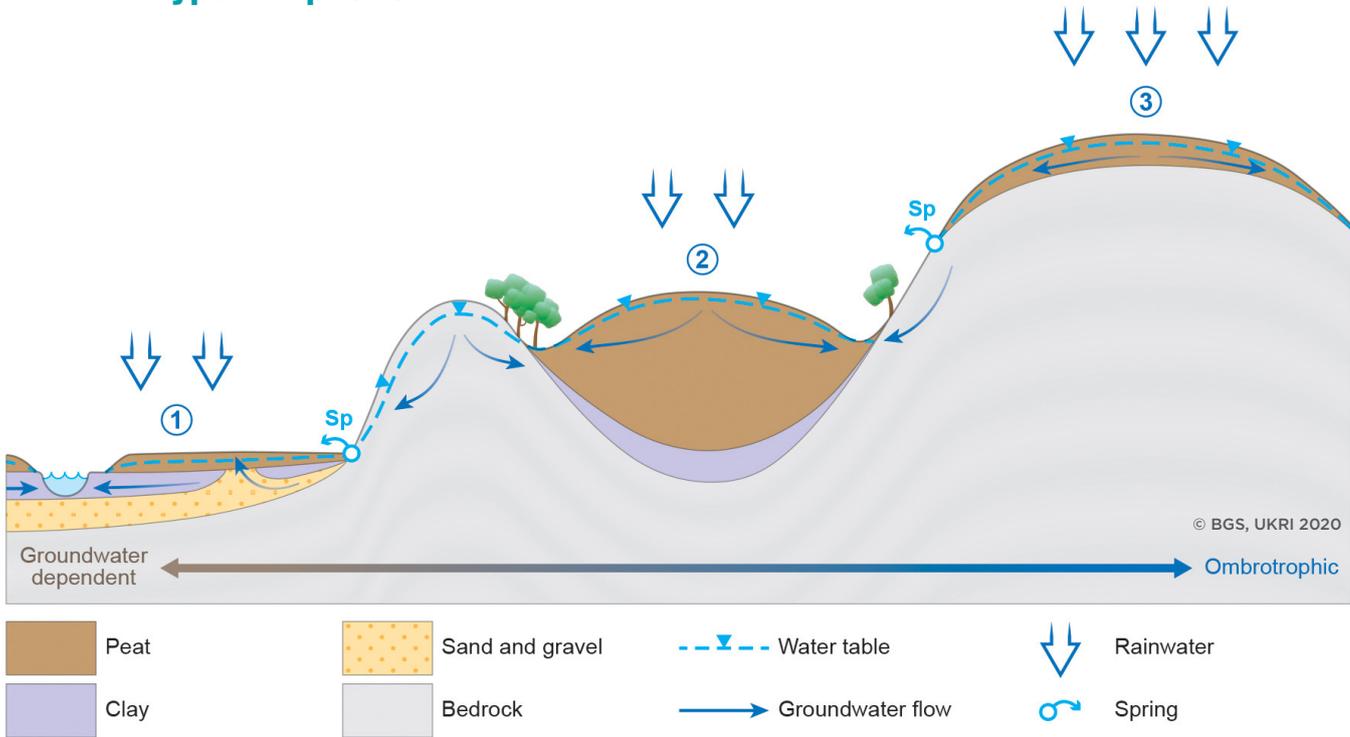
Under the acrotelm is the catotelm, where the peat is permanently waterlogged, preventing the movement of oxygen from above. Anaerobic bacteria (any organism that does not require oxygen for growth) breaks down the peat at a very slow rate.

Within the catotelm is a peat pipe, an underground channel through the peat that water can flow through.





Different types of peatlands



Peatlands in Wales comprise of:

1. Lowland fens

Fens are a particular peatland type which receive water from the land as well as from rainfall. Less acidic than bogs, a fen is like the bottom of a kitchen sink with the plug left in. The sloping land that surrounds the fen is the sides of the sink. Springs, streams or groundwater feed into the fens, flushing water containing dissolved nutrients down to the bottom of the sink. The water level of a fen tends to be fairly constant throughout the year and because of this, fens support many native plants, grasses and sedges that depend on wet conditions. Examples of fens in Wales include Cors Erddreiniog (Anglesey) and Crymlyn Bog (Swansea) – despite the name, it is a fen!



Bogs

Peat bogs are ombrotrophic, which means they receive all their water from precipitation (rain, snow), rather than from streams or springs. Because they are only fed by precipitation, they are nutrient-poor and acidic habitats. Undisturbed peat bog vegetation is generally dominated by a few groups of plants e.g. sphagnum mosses and cotton grasses which have adapted to growing in nutrient-poor situations.



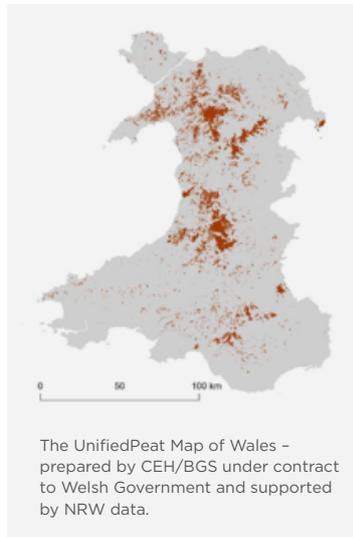
2. Lowland raised bogs

These bogs have formed in the lowlands on wet floodplains or in areas which were historically areas of standing water such as a lake or a hollow which has infilled e.g. Cors Caron (Tregaron) and Cors Fochno (Aberystwyth). Raised bogs form in areas where there is a cool climate throughout the year and get their name because of their domed shape.



3. Blanket bog

These bogs are areas where peat has accumulated across the entire landscape, typically forming in the uplands where drainage is poor and at the top of river catchments, where rainfall is frequent and heavy, and the water table is high. Blanket bogs form the largest areas of peat deposits in Wales. Examples include Mynydd Hiraethog (Denbighshire) the Migneint (Conwy/Gwynedd), the Elenydd plateaux near the Elan Valley lakes, and areas of the Brecon Beacons (Carmarthenshire/Powys/Monmouthshire).



The UnifiedPeat Map of Wales - prepared by CEH/BGS under contract to Welsh Government and supported by NRW data.



Peat is neat

Peatland, in pristine or good condition, provides a range of critical ecosystem functions and is a vital component of the Welsh landscape:

- Sphagnum mosses are the building blocks of many peatlands and look like a mossy carpet spreading out over the surface. In their sodden form, sphagnum mosses can hold 20 times their weight in water. If areas of peatland are left undisturbed these mosses retain huge volumes of water in situ, slowing the flow and helping to prevent the risk of flooding downstream.
- As rainwater infiltrates through the air spaces within the uppermost deposits of peat, the water is naturally filtered. Debris, leaves, insects, chemicals and minerals are retained in the soil as water drains through. If peatlands are in good condition and undisturbed (not dug up and drained), the water that runs off them is usually cleaner, thanks to the sphagnum mosses which filter the water. The more peat that is left in position and undisturbed, the less work water companies must do to clean and purify water before they supply it to our homes because, the peat does a lot of the hard work for them.
- Occupying 12% of the UK's land area, peatlands capture natural greenhouse gases, particularly carbon dioxide (CO₂) and methane (CH₄) from the atmosphere.
- All green plants absorb carbon dioxide from the atmosphere through photosynthesis and use the absorbed carbon to help build their plant structure. When a plant dies, the carbon that was contained in the plant structure is released back into the atmosphere as CO₂ - unless the plant material is somehow preserved. Luckily for humans, peatlands act as climate regulators, locking away carbon.



- As the plants that grow on peatlands don't fully decompose due to the wet conditions, the carbon that was fixed into the plant tissue isn't released back into the atmosphere. Peatlands in good condition lock away more carbon than forests and woodlands and have the potential to sequester (soak up) carbon in perpetuity acting as a global carbon store of significant importance to the planet.
- Peatlands contribute to biodiversity by supporting a large proportion of the plant and animal species which are adapted to waterlogged, acidic and nutrient-poor conditions e.g. sundews, bog rosemary and sphagnum mosses. Peatlands also provide important nesting and feeding grounds for many birds such as golden plover, lapwings and curlews, as well as important habitats for rare insects including the large heath butterfly.
- People visit peatlands to relax, explore and unwind, enjoying the tranquillity of the vast, wild, desolate and open expanses that other landscapes cannot replicate. From hiking to wildlife watching, peatlands attract visitors that will often spend money on accommodation and food helping to support the local economy.



What does a healthy peatland look like?



- A healthy peatland is a wet environment. In practical terms, the ground is wet enough to require you to put your wellies on or risk getting damp feet.
- In technical terms, the peatland has not been disturbed.
- The water table is stable and high with a large amount of varied species of sphagnum mosses and other specialist plant species carpeting the peatland floor which can tolerate the wet growing conditions.
- Non-desirable vegetation associated with drier conditions cannot survive the waterlogged, acidic conditions.

What does a damaged peatland look like?

- Dry, cracked and exposed areas of compacted peat.
- Non-desirable vegetation dominates e.g. dense clumps of heather, purple moor-grass, trees and rhododendron.
- Evidence of drainage and peat cutting on the landscape.





Unfortunately, peatlands are facing many problems

Pristine peatlands are under threat for a range of reasons, the following table attempts to outline these problems, the issues they cause and what's being done to address them.

Problem	Consequence	What's being done to address the situation
<p>Drainage</p> <p>Large areas of peatland have been drained over the last 300 years to make way for agriculture and forestry. Although rich in biodiversity these waterlogged landscapes do not lend themselves well to intensive farming and forestry which require drier conditions to maximise production. An estimated 18,092 ha of woodlands and forests are thought to have been established on peat soil in Wales.</p> <p>In good condition, due to their high-water content, acidic pH and low nutrient content, the potential for the colonisation of peatlands by invasive species is low. However, drained and damaged peatlands with lowered water table levels make conditions difficult for sphagnum mosses to grow.</p>  <p>Evidence of drainage on the landscape at Cors Caron</p>	<p>Draining peat causes the water table to drop causing the compressed organic matter within peat to dry out and decay. Over time the organic matter becomes exposed and can get washed away into watercourses, increasing turbidity levels (creating murky water) and affecting water quality.</p> <p>The drier conditions on drained areas give non-peat forming plant species such as purple moor grass and rhododendron the opportunity to colonise. Tree seeds transported by the wind, in water or animals can also take root. These plants form a dense layer of vegetation which consume large volumes of water, compete with and shade out peatland specialised plants that need good condition peatland to grow.</p> <p>With less sphagnum mosses covering the peatland surface, the capacity to 'slow the flow' and absorb rainwater is reduced. No longer trickling through and across the peatland surface, water will flow quickly and directly through drainage ditches and erosion gullies, into downstream rivers, and streams exacerbating the damage caused by costly flood events.</p> <p>The capacity of drained peatlands to filter and improve water quality is reduced, increasing the cost to water companies of cleaning the water supply.</p>  <p>Rhododendron</p> <p>Loss of habitat may lead to the extinction of iconic peatland rare bird, plant and insect species.</p>	<p>Reprofiling – Creating low level banks of peat on raised peat bogs to plug holes and cracks appearing on some parts of the bog that have become drier.</p> <p>Blocking drainage ditches to improve water levels, reducing and/or slowing water from running off peatland and allowing the habitat to get re-saturated, providing ideal conditions for important plants like sphagnum to regrow.</p> <p>Restoring and reconnecting springs, streams and seepages that supply fenland with the water they rely on. On fens, where water levels can't be raised, lowering land levels to ensure that the water table is closer to the surface and better for the wetland habitat.</p> <p>Removing invasive species such as rhododendron and trees helps to keep peatlands wet and boggy. Cutting down and removing trees that have grown on areas of deep peat and the mowing and rolling of grasses such as purple moor grass with a large wetland harvester machine, creates open areas for important bog plants to grow and thrive.</p>  <p>Mowing in progress at Cors Fochno. ©Farming Photography Ltd</p>



Problem

Digging peat

Historically, peatlands were dug up and the peat used to heat homes and provide fuel for the stove.

Peat is a fossil fuel being mainly composed of carbon and can be burnt in a similar way to coal. Bogs were traditionally harvested for peat in the spring, with a farmer or labourer manually cutting thick strips of peat with a hoe. The peat was cut into bricks, stacked next to where it was cut and left to dry over the summer. In the autumn, the bricks would be taken off the bog using ponies, barrows or sleds to be burnt on the fire place to heat the home or to be used on the range to cook food. Following the advent of central heating the practice of cutting peat for fuel has stopped.

Peat is being dug up and drained to produce garden compost. Applying peat compost to the garden to produce an organic rich soil has long been used by gardeners to encourage plant growth. Peat compost is made up of partially decomposed plant material that hasn't fully decayed and as a compost, holds water well, which is good for growing plants.



Cutting peat into bricks

Dinner time during peat cutting at Cors Caron
 © Ceredigion Museum



DINNER IN TRECARON BOGS

Consequence

The after effects caused by the historic digging up, disturbance and removal have contributed to the disturbance and drying out of peatlands and despite the end of this practice, the damage continues to cause many problems today.

As the water table in a peatland is lowered because of disturbance, the carbon sink turns into a carbon source. Carbon that was previously sequestered is released into the atmosphere, contributing to an increase in greenhouse gas emissions.

What's being done to address the situation

Land purchase - In Wales and elsewhere in the UK, digging to extract peat has been reduced by conservation bodies buying peatland areas, turning them into nature reserves such as Cors Caron and ensuring they are conserved, protected and open for people to visit and enjoy.

Peat-free alternatives are being developed using materials such as bark, wood fibre, bracken and wool.

For peat's sake - An increased public awareness of the importance of peatland habitats has given rise to campaigns asking the UK Government to pass legislation to ban the extraction of peat. Consequently, the general public are becoming increasingly aware of the options to go peat free in their growing. This includes taking action on an individual basis, seeking out and purchasing peat free, bagged compost or learning how to make their own compost.



Peat alternatives - wool compost



Problem	Consequence	What's being done to address the situation
<p>Over and under grazing peat</p> <p>Some peatlands suffer from unsustainable levels of grazing and trampling from livestock, or inappropriate grazing regimes. Over grazing from sheep can have adverse effects on the peatland ecosystem. Blanket bogs can provide enough vegetation to sustain low stocking rates of animals.</p> <p>Some peatlands are under grazed. Some bogs and fens need active grazing and trampling by animals such as cattle and ponies to maintain the peatland habitats in good condition.</p>	<p>If stocking rates are too high the effects of over grazing and trampling can lead to small areas of bare peat being exposed. These can become eroded and the decline of the blanket bog is exacerbated.</p> <p>With modern agricultural practices steering away from traditional rough grazing to more intensive farming methods, under-grazed peatlands can suffer from the dominance of purple moor grass (<i>Molinia</i>) which smothers the habitat.</p>	<p>By grazing a peatland with the right number and type of livestock, shrubs, grasses and heather will be trampled and lightly grazed, allowing sphagnum moss to thrive underneath.</p>  <p>Horses grazing at Crymlyn Bog, Swansea</p>
<p>Traditional crafts associated with fens have declined</p> <p>Traditionally the vegetation on fens was harvested to provide animal bedding, foodstuffs and roofing thatch. Some of these wetland habitats, like meadows, depend on managed cutting or grazing to maintain their condition and hold back the natural succession to scrub and eventually woodland.</p>	<p>Mass production methods and the use of synthetic materials has resulted in the decline of these traditional fenland crafts, contributing to the neglect of these habitats.</p>  <p>Rush weaving a traditional fenland craft</p>	<p>An increasing interest in sustainability and greater appreciation of handmade objects has resulted in a resurgence of these traditional crafts, supporting the need for the sustainable management of this habitat in some areas.</p>



Problem	Consequence	What's being done to address the situation
<p>Peatlands suffer from the effects of pollution</p> <p>Sources of pollution such as inorganic fertilisers, organic manure, slurry or sewage can travel long distances during periods of high rainfall and can reach peatland areas. More widespread is the effect of atmospheric nitrogen deposition (nitrogen which is present in the air and rain because of emissions of oxidised nitrogen from fossil fuels). Almost all parts of Wales are now subject to deposition rates high enough to be a cause of concern for peatland habitats.</p>	<p>When chemicals such as nitrogen, contained in agricultural fertiliser or rainfall make their way to a peatland they can encourage the growth of certain widespread species such as purple moor grass, which have the ability to exploit the extra nutrients. This can lead to the suppression of crucial peatland sphagnum mosses which have evolved to cope with a limited supply of nitrogen leading to a decline in the overall biodiversity of the peatland.</p>	<p>Environment Officers have a critical frontline role in protecting the environment across Wales. They help to create a cleaner, safer and healthier environment for people and wildlife, dealing with a wide range of environmental issues from permitted and illegal waste sites to rivers, waterways and farms ensuring all activity happens without harm to people, wildlife or the environment. Where an incident of pollution is identified they investigate, identify and implement the most appropriate intervention option to ensure a return to compliance as quickly as possible, taking appropriate action to collect evidence for enforcement purposes when necessary.</p> <p>Encouraging the use of greener transport among other measures, will help to reduce the release of nitrogen compounds into the atmosphere.</p>

Problem	Consequence	What's being done to address the situation
<p>Peatlands are susceptible to fire</p> <p>Wet bogs and fens don't burn easily, however drained sites with lower water tables and areas of over-grazed, dry and exposed peat provide the perfect opportunity for grasses and heather to thrive.</p> <p>Heather is a delicate and fine fuel covering a large surface area and dries out quickly requiring little exposure to heat for it to be ignited. A discarded cigarette or match has the potential to cause huge devastation.</p> <p>Burning heather can transfer enough temperature into the soil to cause the underlying peat to ignite.</p>	<p>Peat burns slowly at a low temperature, smouldering as opposed to burning with an open flame. Once alight, peat can burn downwards into the thick layers of peat over large areas, sustaining underground fires that can continue to burn for several weeks, making them difficult to put out.</p> <p>Smouldering peat emits smoke which consists of partially decomposed vegetation and is thicker than smoke released by other types of vegetation. Amounts of carbon, nitrogen and sulphur along with fine particles of organic matter are present in peat smoke and all are damaging to human health.</p> <p>As well as the obvious loss of globally important habitat, tackling these fires is a drain on the emergency services and costly to the tax payer.</p> <p>Burning peat has the potential to release thousands of years' worth of stored carbon back into the atmosphere.</p>	<p>Work to restore and re-wet peatlands helps to reduce the risk of fire at peatland sites.</p> <p>Through campaigns and interpretation, the general public's awareness of the vulnerability of peatlands to fire is being raised.</p> <p>Land managers work closely with the emergency services and surrounding land owners to put methods into action to minimise the risk of fire and ensure plans are in place to tackle fires quickly and efficiently should they occur.</p> <p>Using fire as a technique to clear land is being reduced and discouraged.</p>



Looking to the future

Despite the fact they offer a range of important ecosystem services, peatlands have long been overlooked and undervalued. All the factors that contribute to their degradation need to be addressed to restore peatlands to fully functioning and resilient habitats that have a rich biodiversity, store carbon, help reduce flood risk, filter water and reduce greenhouse gas emissions.

Scientific evidence suggests that a healthy peatland will be more resilient to the effects of climate change whilst damaged peatlands are more vulnerable. The effects of climate change e.g. lower rainfall, more frequent extreme weather events and increased temperatures, are likely to compound the deterioration of peatlands, contributing to them drying out, making them more susceptible to erosion, coastal inundation and the risk of wildfires. Taking thousands of years to form and recover, if the effects of climate change are to be mitigated, the long-term protection and conservation of these landscapes will be key for future generations.

A range of the management techniques listed above are being adopted as opposed to using one method in isolation. Nobody can fix the problems facing peatlands on their own and joint active management on a local, national and international level is taking place.

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