Other:
Heinemeyer, Andreas (2023) Protecting our peatlands - short summary of the 10-year Peatland- ES-UK report. University of York.

Protecting our peatlands

Managing heather moorland to restore, nurture and promote active peatland in the UK's uplands.

Short summary of the
PEATLAND-ES-UK ten-year report

January 2023

UNIVERSITY of York

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Protecting our peatlands

Managing heather moorland to restore, nurture and promote active peatland in the UK´s uplands: Peatland-ES-UK

Short summary of the Peatland-ES-UK ten year report

A landmark project studying moorland management has released its ten-year results. Peatland-ES-UK is a University of York project designed to address many of the key questions that drive the debate around moorland management – especially prescribed heather burning, which is often associated with management for red grouse. What impact does moorland vegetation management have on peatland? Can active bogs be maintained under the different management approaches, so they function as healthy ecosystems that support biodiversity, store carbon and lay down peat? Peatland-ES-UK addressed these and other questions using a robust scientific design to give reliable answers. The results so far are findings from the first half of a long-term study. It is vital that the work continues for at least the length of a complete management cycle of about 20 years.

The project studied unmanaged heather, compared to areas where heather was managed with either mowing or prescribed burning. We have found so far that all three management approaches can support active, healthy peatlands in the right conditions. Burning and mowing both release considerable amounts of carbon during or in the first years after management but this is counteracted by increased absorption later on. Management also seems to increase biodiversity and maintain higher water tables in the longer term compared to unmanaged heather. Where a site is wet enough to use prescribed burning (mean annual water table 12 cm below the surface or less), this seems to be the most suitable option to allow carbon storage, peat growth, reduce heather dominance, and increase biodiversity. Where a site is drier (12 cm or more), mowing is likely more appropriate and may help keep the site wetter in the first years. Wildfire risk is a serious hazard and either management approach reduces fuel load, burning probably more than mowing. Unmanaged heather dominated peatlands are likely very high risk.

So far, Peatland-ES-UK finds that different management approaches have different benefits, depending on the site and circumstances. Choosing the right management approach from all available options for any given site will allow managers to select the benefits they need in their area. Prescribed heather burning, mowing or leaving areas unmanaged should all be available to practitioners so they can choose the most suitable technique for their site.

Background

The project was designed to investigate the impact of heather management on blanket bog peatlands on carbon, water and biodiversity. The issue of moorland management is complex for several reasons including:

- There is no consensus in the science on many issues that may be affected by moorland vegetation management approaches, including carbon storage or loss, water services such as quality, flow, flooding, as well as biodiversity impacts on the vegetation and other wildlife found in these iconic landscapes.
- The debate is emotive and very divided. The different sides hold very different views and the arguments around them have become more heated as well as positions becoming entrenched. Contradictions within the scientific literature do not help the situation as they have not to date been able to provide clear answers to these questions.
- There are many reasons for this lack of clarity amongst the scientific evidence – one of those is the difficulty in conducting studies which:
    - Study the area before the experiment begins, thus giving a reliable baseline
    - Account for pre-existing differences between study sites and plots
    - Separate the effects of other factors such as drainage from the effect of the management under investigation
    - Include a variety of site conditions to be applicable to different situations
    - Continue for long enough to capture the genuine effects across a whole management cycle, as these change dramatically over time

Therefore, although many smaller studies have been carried out, some of these can give conflicting or unreliable results because of limitations in their design. Peatland-ES-UK was designed, in conjunction with Defra and Natural England, to avoid these common pitfalls and provide robust, reliable results that can be applied elsewhere. Notably, the study was overseen by an Advisory Group that had representatives from all the major interested parties, supporters, and funding sources. These included Natural England, Defra, various upland groups, several water companies, and the Natural Environment Research Council.

The project studied three moorland peat bogs in northern England to compare areas which were managed either by burning or mowing the heather, or where the heather was left unmanaged. We examined three main aspects to see how they were affected by the management approaches: water, carbon and biodiversity. Specifically, we studied water flow over and through the peat, water flow in the streams draining the areas, water quality and water table depth. We assessed vegetation in the different areas for heather, mosses and sedges, as well as monitoring cranefly emergence and abundance, and predicting the likely effect on bird populations. We studied carbon uptake and release from the sites in terms of soil carbon and decomposition, peat growth, overall ecosystem CO_2, carbon export via water routes, and methane release. These were used to look at the overall carbon balance of the ecosystem and overall greenhouse gas emission or uptake.

Vegetation assessment

Results

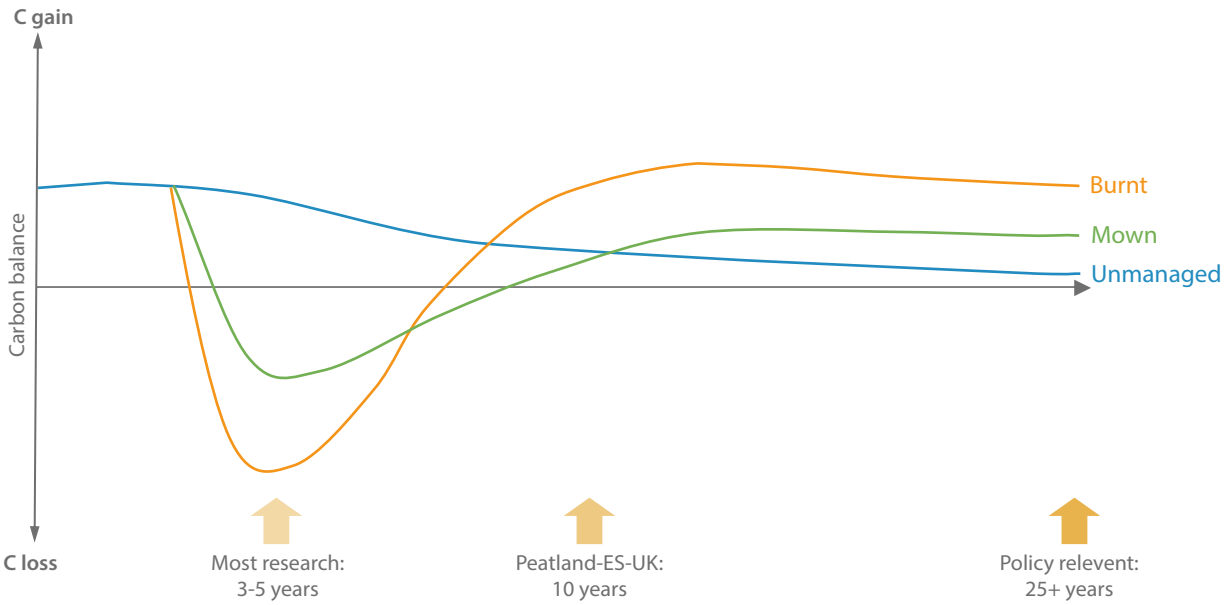
All three of the management approaches could maintain active, functioning peatland that stored carbon and laid down peat. This was the case at all sites over the ten-year period, when the conditions were favourable (meaning that it was wet enough). During periods of drought or specific unusual events such as heather beetle attack, the sites or areas that were affected released carbon.

Greenhouse gases

Carbon was released from both burnt and mown plots in the first years after management.

- Combustion during prescribed burning led to high release initially, but the sites recovered more quickly afterwards. Our results suggest these areas would become a carbon sink within 5-7 years.
- Mown sites did not have such high immediate carbon release, but brash left on the surface gradually decomposed and released carbon over a longer period, totalling a greater amount than burnt plots. Our calculations suggest that mown sites would become a carbon sink about 7-9 years after management.
- Unmanaged plots took up and stored carbon throughout the project, but the amount per year that is stored has been dropping over time.

Carbon storage on burnt plots was boosted by charcoal formation as only about 75% of biomass is lost due to combustion. Charcoal and other charred remnants from prescribed burning are resistant to decomposition and can store this carbon long term in the peat. Charcoal also reduces methane release and peat decomposition, both of which can contribute to greenhouse gas emissions from peatland. Other research on peat formation suggests that mown plots might store only around 5% of their cut biomass as peat carbon, after the brash has decomposed.



Carbon Balance Scenarios

This graph sums up the carbon story for the three management scenarios, excluding heather beetle damage, which affected carbon uptake at some sites and managements. It shows the "progressive average" carbon balance for each year. This means that the total carbon released and emitted in the area up to that point in the project was averaged over the number of years that had elapsed by then. It includes carbon losses during combustion or brash decomposition, as well as carbon that is stored as charcoal. The graph indicates an approximate amount of carbon lost or gained per year for each treatment at that point in the project.

Predictions are made to around 25 years, and as the project progresses we aim to replace these estimates with measurements. To understand the full picture over a whole management cycle, and therefore be able to have usable information to develop effective moorland management policies, we need at least ten more years of data.

Uncut plots have stored the most carbon on average across the three study sites so far, overall having not released any during the monitoring period. Mown plots released more carbon overall than burnt, when all emissions from combustion and decomposition as well as carbon stored in charcoal are included.

Methane is an important greenhouse gas that peatlands often release, and methane emissions were especially high from our sites in the warmer and wetter periods during 2015 to 2017. Uncut plots released by far the most methane, mown plots were intermediate and burnt areas released the least.

At this ten-year point, all three management options are predicted to be taking up and storing carbon each year, if we discount heather beetle impacts, which affected some sites and managements. After initially releasing, burnt sites now take up and store the most carbon per year. Mown and uncut sites both absorb about half the carbon per year of burnt plots. Our predictions suggest that uncut plots will gradually absorb less and less over the next decade, whereas mown and burnt plots will likely keep absorbing at similar levels for a considerable time.

Wildfire

A connected concern in the carbon story is the risk of wildfire. Unmanaged areas maintain a high, dry, fuel load and the water table in these areas is dropping so the peat is drying out and the risk of wildfire is increasing. Wildfire carries the threat of huge carbon release by burning into the peat. Both mowing and burning reduce the above ground fuel load, although when brash is left, it can act as tinder to help ignite and fuel wildfire. Wildfire risk is a serious yet so far relatively unstudied factor in moorland management in the UK.

Water

The factor which had the greatest effect on water quality, flow, and flooding did not seem to be the different management approaches but instead was probably pre-existing characteristics of the different sites. Slight differences were observed between the managements, but they were minor, very variable, and likely reflected these site differences, such as previous drainage, which had been encouraged by government incentives in past decades.

Water tables were found to be important for carbon storage, with a threshold at around 12 cm below ground level. When the mean annual water table is shallower than 12 cm (closer to the surface, meaning that the site is wetter), sites are more able to absorb and store carbon overall, but when the water table is deeper than 12 cm underground, the area is more likely to release carbon into the atmosphere instead of locking it away. This is probably because when oxygen in the air can get to the peat, it decomposes, breaks down and can release its stored carbon into the air.

Management effects

In areas where heather was not managed but was left to grow, water tables gradually dropped throughout the project, and the peat dried out. Average yearly water tables began at about 11 cm below ground level and dropped to about 13 cm during the last three years. Mown plots became wetter in the first few years after mowing, rising during summer by about 2 cm compared to burnt plots. However, compared to initial levels, the burnt plots subsequently showed the most rise in water levels in recent years, but with more variability between seasons than mown plots.

Biodiversity

Mowing and burning both reduced the dominance of heather as expected. Cover of Sphagnum mosses, which hold a lot of water and promote peat-forming conditions, increased equally over time. The most Sphagnum moss was always found on the wettest sites, regardless of how the heather was managed. The overall number of plant species increased after either management, slightly more in burnt areas, but fell in unmanaged areas. Both approaches improved the nutritional value of heather, yet more so on burnt areas. This was also important for efficient plant growth as the vegetation needs those nutrients for carbon uptake by photosynthesis.

In terms of vegetation height and structure, we saw two effects that could impact moorland birds. Both burning and mowing reduce vegetation height compared to uncut heather, which is important for some ground nesting birds. Tall heather severely limits ground nesting sites for those birds which prefer a more open situation such as Golden Plover. Burning reduces vegetation height more and for longer than mowing. Cutting heather with machinery also removed the tops of grassy tussocks and moss hummocks on the moorland. This means that the ground profile is smoother, with lower clumps of e.g. cotton grasses. Some moorland breeding birds use these higher areas as dry nesting sites away from the wetness of the peat surface, so this levelling out of the peat surface profile that results from cutting to a uniform height may impact some bird species.

The effect that management had on water tables also affected peat moisture, and therefore cranefly emergence in the spring. Craneflies are an important food source for several moorland waders, so can give useful information about biodiversity. Cranefly have an ideal soil moisture range, and in dryer areas the higher water tables the first few years after mowing led to more craneflies, but it seemed in wetter years and areas that there were fewer craneflies on mown plots. It may be that higher moisture levels on mown plots on already wet sites means that cranefly larvae cannot survive in peat that is too wet. For more information on all aspects of the project, please read the fuller summary or the complete report.

For more information, please read the fuller summary, available at: **https://pure.york.ac.uk/portal/en/persons/andreas-heinemeyer/publications/**

Complete ten-year report is available at: **https://doi.org/10.15124/yao-2wtg-kb53**

Project website: **https://peatland-es-uk.york.ac.uk/home**

Please cite this summary as: Heinemeyer A. (2023) Protecting our peatlands - short summary of the 10-year Peatland-ES-UK report.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