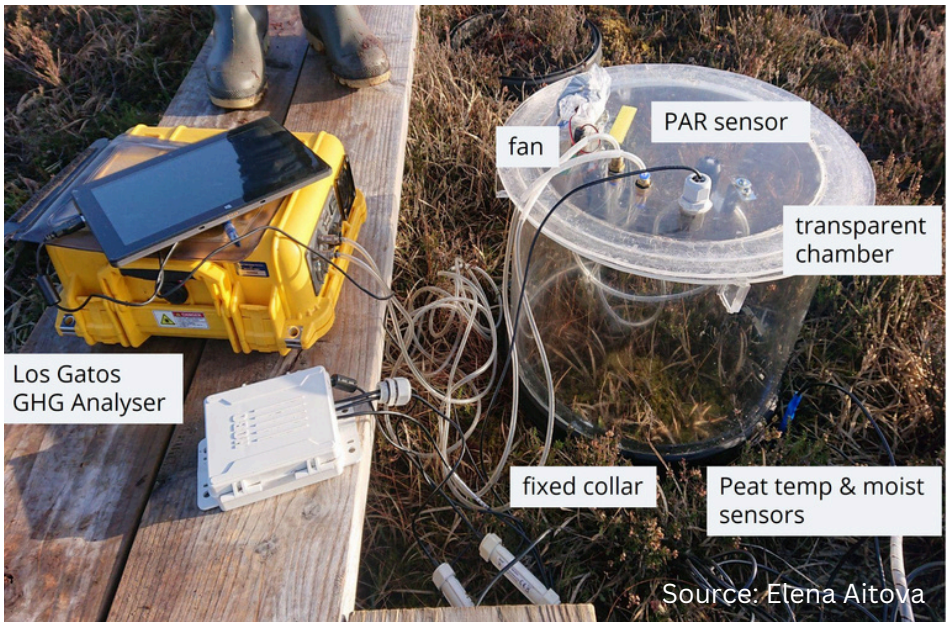
Static chamber measurements at Cloncrow Bog.

CLIMATE CHANGE AND GHG EMISSIONS

Introduction

Peatlands play a vital role in regulating the global climate by acting as long-term, small **carbon sinks**, which accumulate when the amount of carbon dioxide fixed by the peatland vegetation during photosynthesis is greater than that released during (a) respiration by the plants and the microbial communities, (b) methane emissions, and (c) leaching and surface runoff of dissolved organic carbon (DOC). On average, Irish peatlands contain more than ¾ of total soil organic carbon in Ireland with conservative estimates of **2.2 billion tonnes of carbon** locked up in the peat (733). However, this carbon is released when the peat is dry and so ensuring that the peat is wet is the first measure to reduce negative impacts on the climate (914).

Peatlands are likely to be **severely affected by climate change**, leading to a loss of the carbon stored; increased fire risk, and a reduced peatland area (144). Crucially, the rising temperatures will enhance peat decomposition and DOC release to inland waters. Degraded peatlands are also expected to be **more vulnerable** to climatic changes and the longer a rewetted peatland is established, the more resilient it will be to climate change (738).



Measuring carbon emissions on Irish peatlands

Long-term measurements are key to monitoring the carbon storage capability of peatlands and thus the impact of restoration, rewetting and rehabilitation on reducing greenhouse gas (GHG) emissions. Chambers and the eddy covariance method can be used to determine exchange rates of GHGs over natural ecosystems and agricultural fields, and to quantify emissions from other land and water areas (6).

Peatlands play a vital role in regulating the global climate by acting as long-term carbon sinks.

Peatlands are likely to be severely affected by climate change, including changes in decomposition rates, fire risk and a reduced peatland area.

The longer that a rewetted peatland is established, the more resilient it will be to climate change (738).

Rewetting can reduce carbon dioxide emissions in unvegetated peat areas by around 50% (916).

CLIMATE AND GHG EMISSIONS

Eddy covariance flux tower in blanket bog, Co. Sligo.

Rapid rewetting of drained peatland sites is important to (a) achieve strong carbon emissions reductions, (b) establish optimal conditions for carbon sequestration and (c) set the site on a climate cooling trajectory (6, 737, 918, 943).

Mitigation measures to reduce national emissions from peatlands could include:
1) Stronger enforcement approach to protect and enhance the carbon store in natural peatlands
2) Rewetting/restoration of degraded peatlands to reduce emissions and create suitable conditions for carbon sequestration
3) Use of alternative non-peat sources for energy production and horticulture use (919).

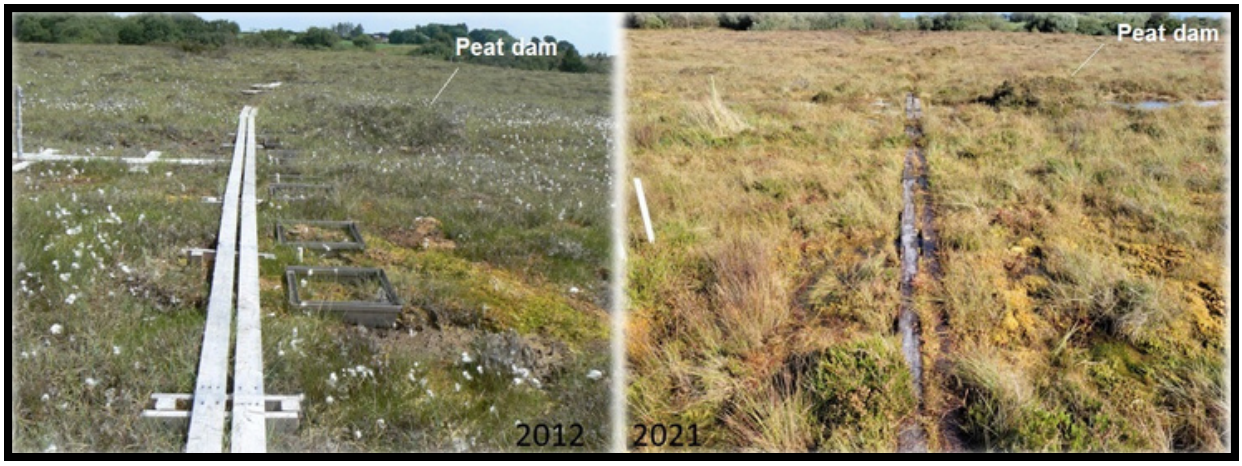
Key Research Findings

- Near-intact blanket bogs are **net sinks for carbon** where carbon dioxide sequestration rates (in most years) are greater than losses from methane emissions and water-borne components (448, 452, 462, 794, 797).
- In vegetation communities with a permanently high water level, the amount and species composition of vegetation are a good indicator of carbon flux rate (474).
- **Water table level** has a very strong influence on carbon dioxide dynamics in peatlands (462, 557, 794, 797).
- Temporal variation in soil carbon dioxide emissions is also driven by **soil temperature** (426).
- Prolonged **drought** may alter the competitive balance between species, favouring hummock species over hollow species (747).
- Increased rainfall may drive increased natural **methane emissions** which lead to increased global methane levels amplifying climate change (220).
- The complex **spatial heterogeneity of peatlands** strongly impacts methane fluxes, and emphasises the need to integrate dominant plant species into methane budget models with wider upscaling approaches (407).
- Studies quantifying **nitrous oxide** emissions from peatlands are scarce, particularly in natural ecosystems (943).
- The novel use of **remote sensing** products and **machine learning algorithms** will continue to provide valuable data to improve upscaling approaches by understanding the impacts of key environmental drivers and vegetation dynamics on methane emissions to further inform effective rehabilitation measures (407).
- **Drained peatland sites are net sources of carbon dioxide**, with emissions greatest in nutrient-rich industrial cutaways followed by domestic cutover sites, nutrient-poor industrial cutaways and grassland. **Methane emissions are low at drained sites** (737).
- **Afforestation** of blanket peat, with necessary installation of drains, is **unsuited as a strategy** to fix atmospheric carbon (425).
- Greenhouse gas emissions from peatlands drained for agriculture could be greatly reduced without necessarily halting their productive use. For every 10 cm of reduction in water table depth, there could be a **reduction in the net warming impact** of carbon dioxide and methane emissions by the equivalent of at least **3 t carbon dioxide per hectare per year** (266).

CLIMATE AND GHG EMISSIONS

Key Research Findings (continued)

- Methane emissions from ditches can be large in many cases, countering the view that emissions cease following wetland drainage. Available data suggest that DOC losses increase by around 60% following drainage, and that this increase may be reversed in the longer-term through re-wetting (267).
- **Rewetting is an effective, climate-proof mitigation strategy** provided that extreme events, such as summer drought, are not recurrent (738).
- There are **fundamental differences between the GHG dynamics of drained and rewetted organic soils** - rewetting of drained organic soils leads to net annual removals of carbon dioxide in the majority of organic soil classes; an increase in annual methane emissions; a decrease in nitrous oxide and DOC losses; and a lowering of net GHG emissions (914).
- **Rewetting can reduce carbon dioxide emissions in unvegetated peat areas** by approximately 50% (916).
- Peatland lake creation is likely to result in the **re-creation of a methane hot spot** at the landscape level. However, the transition from cutaway to wetland ecosystem may lead to a **reduction in the global warming potential** of the peatland (912).



Bog growth in Moyarwood bog, Co. Galway within 10 years of rewetting.

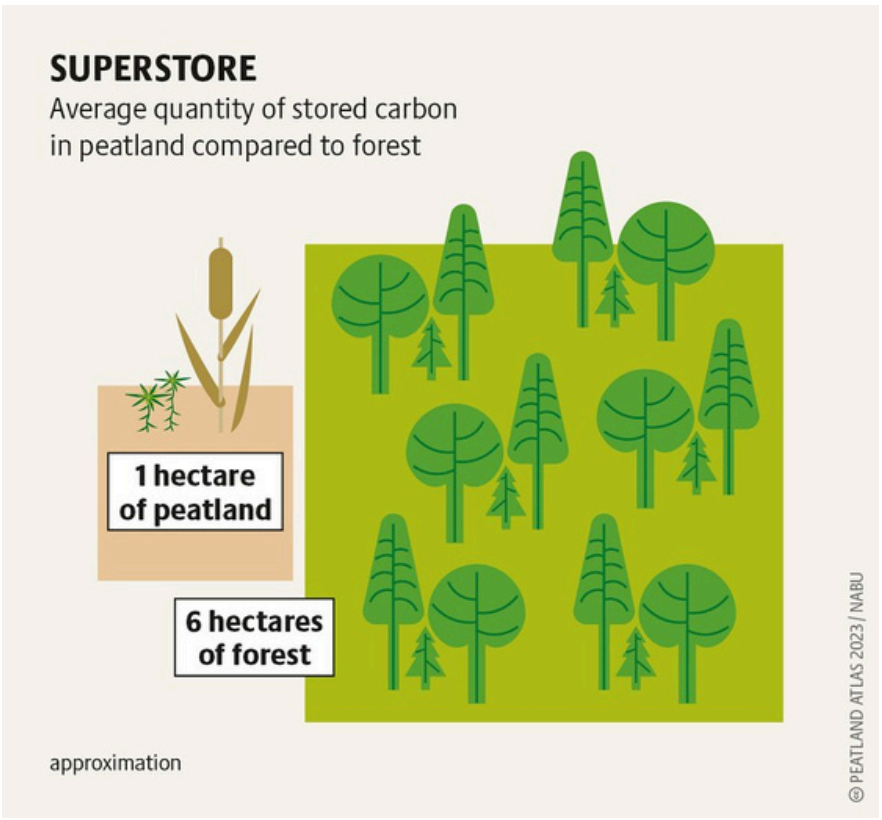
- **Afforestation on peat soils may reduce the net carbon sink**, although the extent to which it does so is highly dependent on assumptions regarding the rate of peat carbon loss (91).
- **Nutrient-poor organic soils** (under either peat extraction or grassland) have been identified as **priority sites** that can provide the greatest benefits not only in terms of reducing GHG emissions relative to their drained state but also with the potential to sequester carbon in the long term (737).
- **Nutrient-rich organic soils** should also be targeted for rewetting as a strategy to mitigate carbon emissions (734).
- Critical to develop strategies to reduce GHG emissions tailored to local grassland types (734).
- **Grassland on organic soils** is likely a **net carbon source** with emissions strongly linked to the drainage status of the site (730, 734).
- Land management that lowers the water table in peat soils could significantly increase carbon dioxide emissions and **should be avoided** (2).
- **Peatlands are vulnerable to interannual variations in climatic inputs** and that future predictions of climatic change may make restoration of the carbon sink function in cutaway peatlands in the temperate maritime climatic zone a considerable challenge in the years ahead (920).

CLIMATE CHANGE & GHG EMISSIONS

How can we effectively address the global climate crisis and GHG emissions through the sustainable management of Irish peatlands?

- Natural/near-natural peatlands should be adequately protected to ensure that their carbon function values (carbon store, carbon sequestration) are preserved.
- Where feasible, drained peatlands should be rewetted.
- Afforestation and re-afforestation of peat soils is not a suitable climate change strategy and should be phased out.

Conifer plantation removal, EU LIFE Raised Bog Restoration project at Girley Bog, Co. Meath.



Eimermacher/stockmarpluswalter, CC BY 4.0. Peatland Atlas 2023, Heinrich-Böll-Stiftung & others.

Database

This factsheet is part of a series produced by Peat Hub Ireland (PHI). The reference numbers in brackets refer to individual publications in the PHI database which link to the original source of evidence. Use the QR codes to access the database or view research projects associated with the themes. All factsheets in the series are available on the PHI website.

Research Projects