Slowing-the-flows:
Post-forestry blanket bog restoration on the North York Moors

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1. Background

Deep peat soils cover 11% (27,000 km^2) of the UK, with the majority made up of blanket bogs (Cris et al., 2014). In the late 20th century, large areas of these upland moorlands, which remain naturally treeless, were drained for commercial forestry plantations. Afforestation of blanket bogs has been associated with a significant lowering of the water table, subsidence of the ground and increase in peak flow rates (Anderson et al., 2000). In addition, damaged peatlands are net sources of carbon to the atmosphere, with drained peatlands emitting worldwide over 2 billion tonnes of CO_2 annually (Joosten, 2010). Assessment and quantification of the impact of post-forestry bog restoration is currently limited by a lack of empirical models that link hydrological and climatic processes and a lack of data to derive such models. Here, the hydro-climatic processes are explored for an intact and adjacent deforested peatland at May Moss on the North York Moors.

2. May Moss: restoring the lost half of a bog

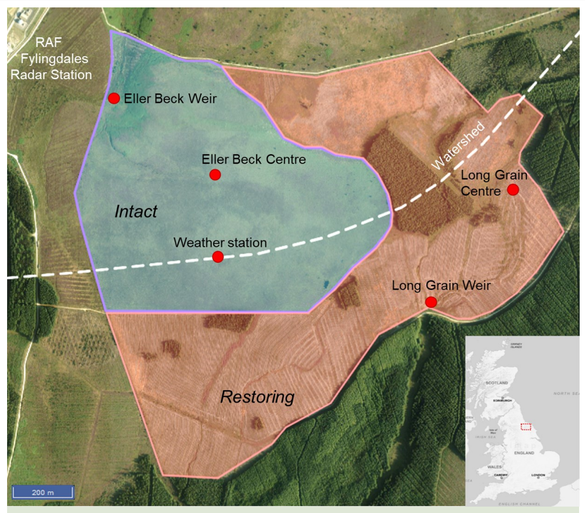

Fig. 1. May Moss, North York Moors. Dipwells are marked by red circles.

May Moss (SSSI), at 150 ha, is the largest area of intact ombrotrophic blanket mire in eastern England, with peat in excess of 5 metres in thickness (Atherden, 1976).

May Moss receives annual average rainfall of 909 mm and temperatures of 7.5°C (2011-2017), and drains waters towards the flood-prone Eskdale and Derwent catchments.

In 2006-8, a SITA-Trust funded 'Enriching Nature' grant to the Forestry Commission and University of Liverpool facilitated the removal of forestry from the SE of the mire.

Intact site: sphagnum-rich blanket bog, forming the main catchment area of Eller Beck.

Restoring site: commercially forested for lodgepole pine, *Pinus contorta*, until 2006, and drained by the Long Grain catchment.

Since 2010: May Moss weather station supplies hourly hydro-climate data.

Since 2017: Five additional dipwells provide hourly water table depths on intact and post-forestry bog sites.

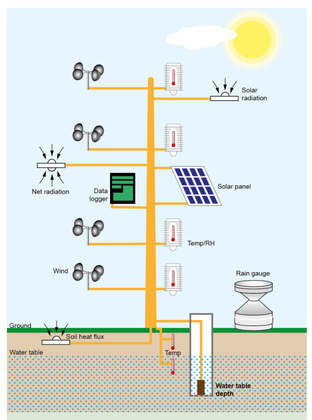

Fig. 2. The weather station.

3. The hydro-climate of May Moss: 2010 — 2018

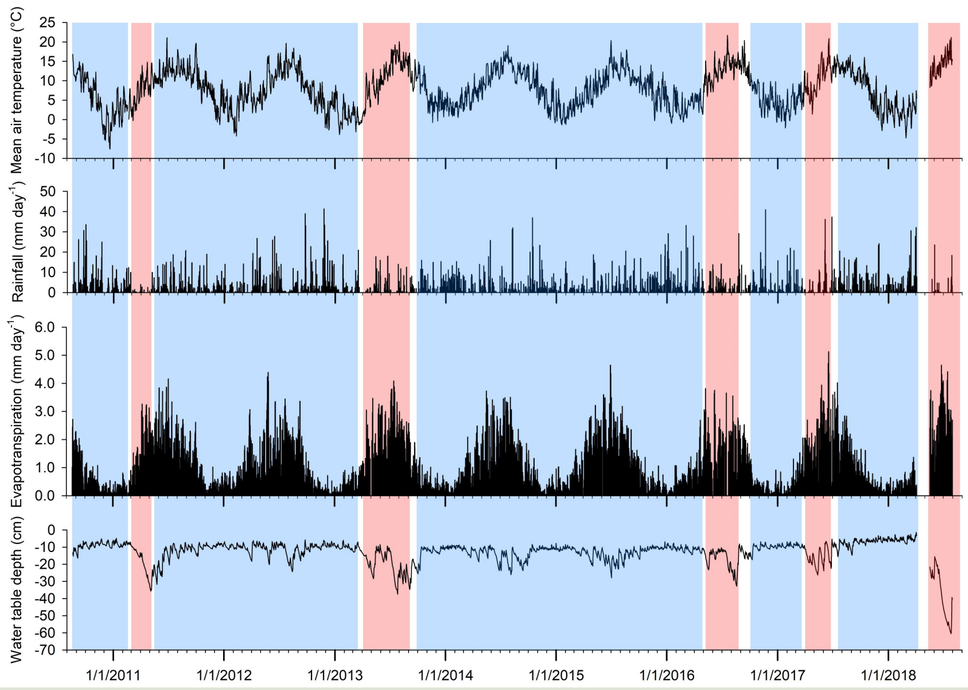

Fig. 3. Long-term hydro-climate record from the May Moss weather station. Evapotranspiration was quantified using the Penman-Monteith equation. Blue = wet/cool; red = dry conditions.

- The average annual water table depth near the watershed is 13.1 cm.
- Since monitoring began in Aug' 2010, both min. (0 cm) and max. (60.4 cm) water table depths were recorded in 2018, with an interval of 115 days.
- High winter water tables appear to be driven by higher rainfall and minimal evapotranspiration losses. Summer water table draw-down, governed by evapotranspiration, varies between years largely reflecting the frequency and magnitude of summer rainfall events.

4. Impact of re-wetting on the water table

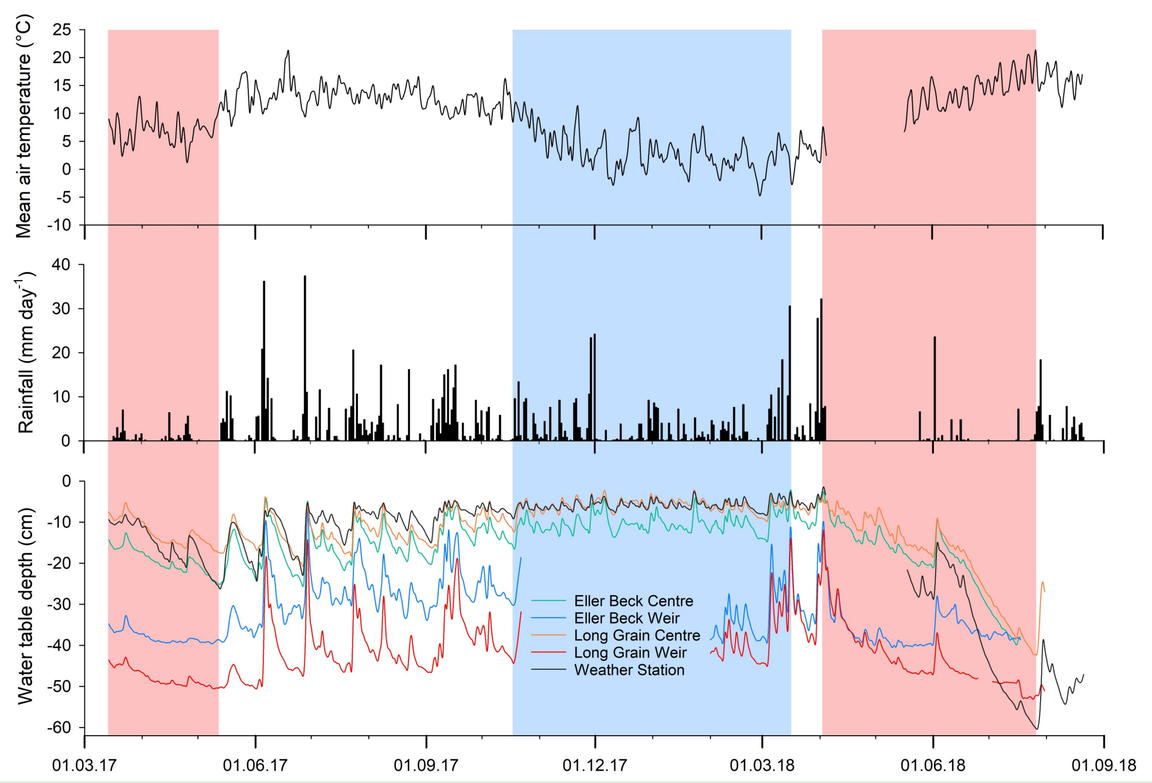

Fig. 4. Water table records from intact (Weather Station, Eller Beck Centre and Eller Beck Weir) and restoring (Long Grain Centre and Long Grain Weir) sites. Blue = wet/cool; red = dry conditions.

- During summer 2017, water table response to high rainfall events was greatest at the two weir sites, near the perimeter, and least at intact and restoring sites near the centre of the bog.
- Winter (Dec, Jan, Feb 2017/18) base-flow was high and synchronous among central sites (Eller Beck Central, Long Grain Central and Weather Station).
- During the 2018 summer drought, May Moss received less than 8 mm of rainfall between 19.06.2018 and 23.07.2018. Over this 35 day period, maximum water table draw-down, among all sites, was measured at the Weather Station, at 26.2 cm, situated at the watershed and dependent solely on rainfall for water input.

5. Conclusion

Understanding and improving the effectiveness of post-forestry moorland restoration requires the quantification of impacts of restoration on bog hydrology. Nearly a decade after begin of restoration, water table records on intact (Eller Beck) and restoring (Long Grain) sites are relatively synchronous and highly responsive to variations in air temperature and rainfall.

The monitoring at May Moss will enable us to compare a post-forestry bog with the adjacent intact site to test hypotheses about 'slow-the-flow' in the context of managed peat moorlands.

References

Anderson, A.R., Ray, D. and Pyatt, D.G., 2000. Physical and hydrological impacts of blanket bog afforestation at Bad a' Cheo, Caithness: the first 5 years. Forestry, 75(5), pp. 467-478.

Atherden, M.A.,1976. Late Quarternary vegetational history of the North York Moors. III. Fen Bogs. *Journal of biogeography*, 3(2), p. 115-124.

Cris, R. Buckmaster, S. Bain, C. Reed, M. (Eds), 2014. Global Peatland Restoration demonstrating SUCCESS. IUCN UK National Committee Peatland Programme, Edinburgh.

Joosten, H., 2010. The Global Peatland CO2 Picture: Peatland status and drainage related emissions in all countries of the world. Ede: Wetlands International.

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