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THE IMPACT OF DITCH BLOCKING ON PEATLAND HYDROLOGY AT THE GORDONBUSH ESTATE, BRORA, SCOTLAND, UK

Ben Smith [1*], Susan Waldron[1], Andrew C. G. Henderson[2], Hugh Flowers[3], David Gilvear[4].

[1] School of Geographical and Earth Sciences, East Quadrangle, Main Building, University of Glasgow, University Avenue, G12 8QQ, UK;*b.smith.1@research.gla.ac.uk, *Telephone: (+44) 0141 330 4395

[2] School of Geography, Politics and Sociology, Newcastle University, Newcastle-upon-Tyne, NE1 7RU, UK;

[3] School of Chemistry, Environmental Chemistry, Joseph Black Building, C Wing, University of Glasgow, University Avenue, G12 8QQ, UK;

[4] Biological & Environmental Sciences, School of Natural Sciences, University of Stirling, Stirling, FK9 4LA, UK.

SUMMARY

Historically ditches have been cut into peatland landscapes associated with agricultural drainage and peat-cutting activities. Ditches present on peatland landscapes lower the depth of water table in the surrounding area and can subsequently lead to peatland degradation, increased carbon losses and increased water colourisation. Therefore, to limit the impact of these previous activities, ditch blocking is being used as an environmental restoration strategy as part of a wider habitat management plan associated with Gordonbush wind farm development project, to increase the water table height and improve the surrounding peatland habitat.

KEYWORDS: Ditch blocking, aquatic carbon, water table depth, dip-well

INTRODUCTION

Many Scottish peatlands contain networks of open ditches associated with historical attempts to promote drainage for improving agricultural pasture and to dry peat subsequently excavated and used as a fuel source. It is increasingly acknowledged that open ditches enhance water colourisation, aquatic carbon export and actively lower carbon storage potential due to lowering average water table depths within peatland soils (e.g. Armstrong *et al.*, 2010). A water table located constantly at or near the surface of peatland areas creates anaerobic conditions which reduce decomposition and can limit the release of carbon through drainage channels (Clymo, 1984; Holden, 2005). The potential of peatlands to store carbon mean they are important for carbon sequestration and thus feedbacks to global climate change. Therefore, the restoration of peat by blocking old drainage ditches is vital to their ability to reduce overland flows and lower carbon export (Holden et al., 2006).

This study aims to assess the effectiveness of ditch blocking on water table depth and how in turn this influences the aquatic export of DOC. Monitoring began in June 2011 and results presented here represent pre-drain blocking, an activity is scheduled to take place after windfarm completion, likely June 2012.

MATERIALS AND METHODS

As part of a habitat management plan associated with peatland restoration on the Gordonbush windfarm, near Brora, Scotland, (58° 06’33 N, 03° 56’11 W), data has been collected prior to ditches being blocked. Water table depth was measured in a series of dip-wells installed along a transect of six ditches. Dip-wells were made from pieces of plastic tubing with holes drilled down their length to allow water to flow in and out of them. Dip-wells were positioned 0.5, 1, 2, 5, 10 and 20 metres perpendicular from both sides of the each ditch, similar to Wilson et al. (2011a). For comparison, a control site was identified, adjacent to the ditch transect, but within an area unaffected by drainage. This comprises six dip-wells placed 10 metres apart (Fig. 1). Slope and vegetation cover across control and drained areas were comparable, thus the study would not be confounded by variations in these parameters.

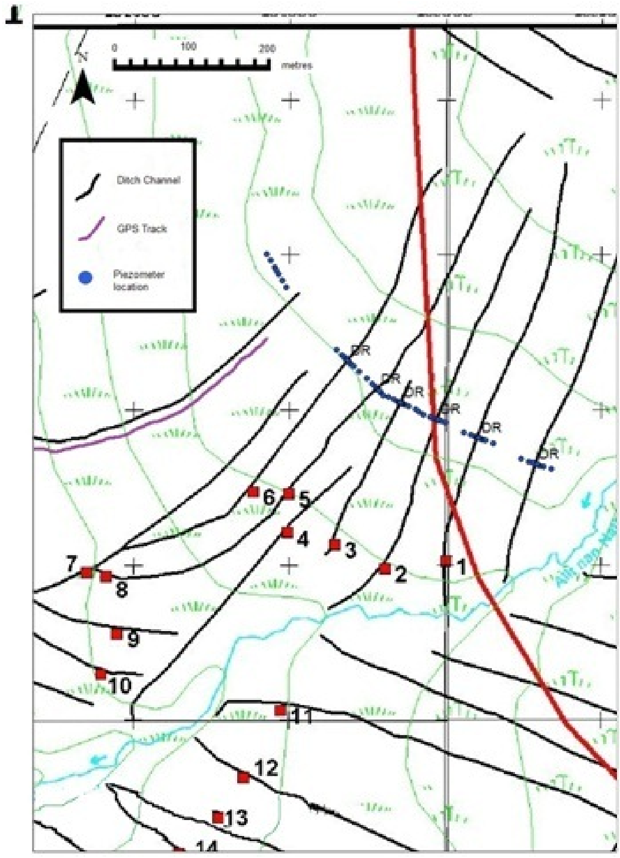

Fig. 1. Map of ditch blocking site, Gordonbush estate. Although there is a ditch marked close to the control array site, blue points further left, it is completely in-filled and our mapping of clear drainage is identified by the purple line. Therefore, we still feel that the control array dip-well positions are not affected by ditch drainage.

To measure water depth in dip-wells, air is blown into a hollow pipe, marked every centimetre, which is lowered inside the dip-well. When bubbling sounds are heard, caused by the air hitting the water, the depth of the hollow pipe is noted (A). The height of the dip-well above the peat surface is also noted (B) and water table depth below the surface is calculated by subtracting A from B.

To provide a continuous record of water table depth from which water table depth readings from manual dip-wells could be normalised, two pressure transducers, precise to 0.001 m, were installed along the transect, one in the centre of the ditch array and the other in the middle of the control array.

RESULTS

Data collected to date, when ditches have not yet been blocked, indicate water table draw down in the months of June, July and August 2011 in the ditch array (Fig. 2.).

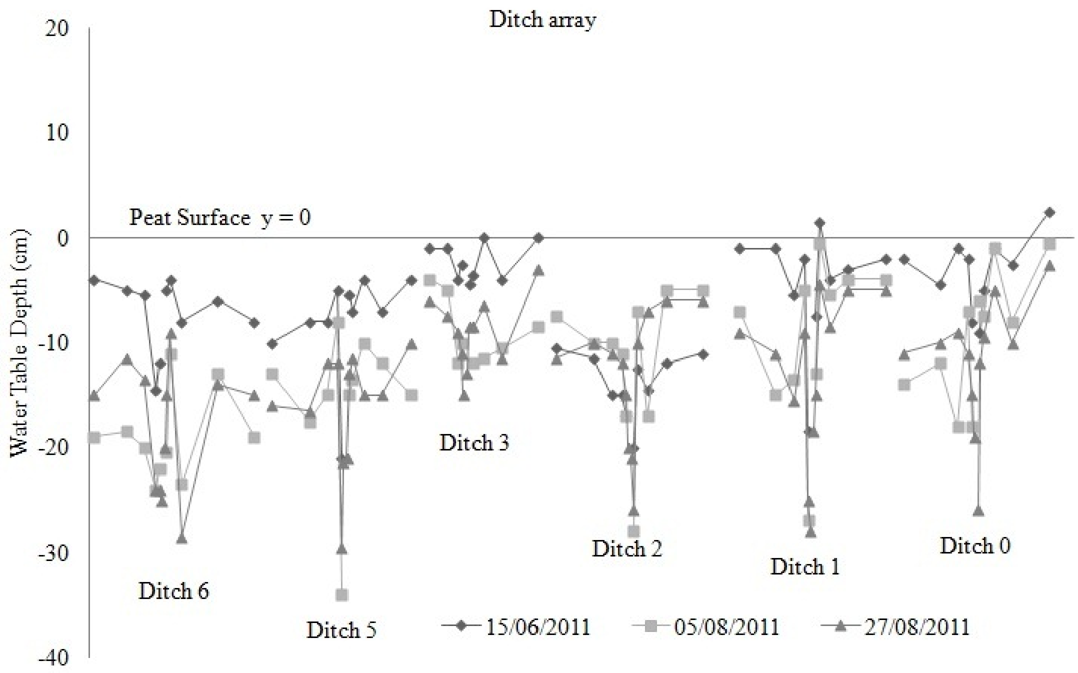

Fig. 2. Water table depths in ditch array from manual measurements taken during months of June and August 2011 of dip-wells placed 0.5, 1, 2, 5, 10 and 20 metres each side of each drain. The x-axis scale is set to scale for dip-well position across a single ditch but is not accurate between ditches.

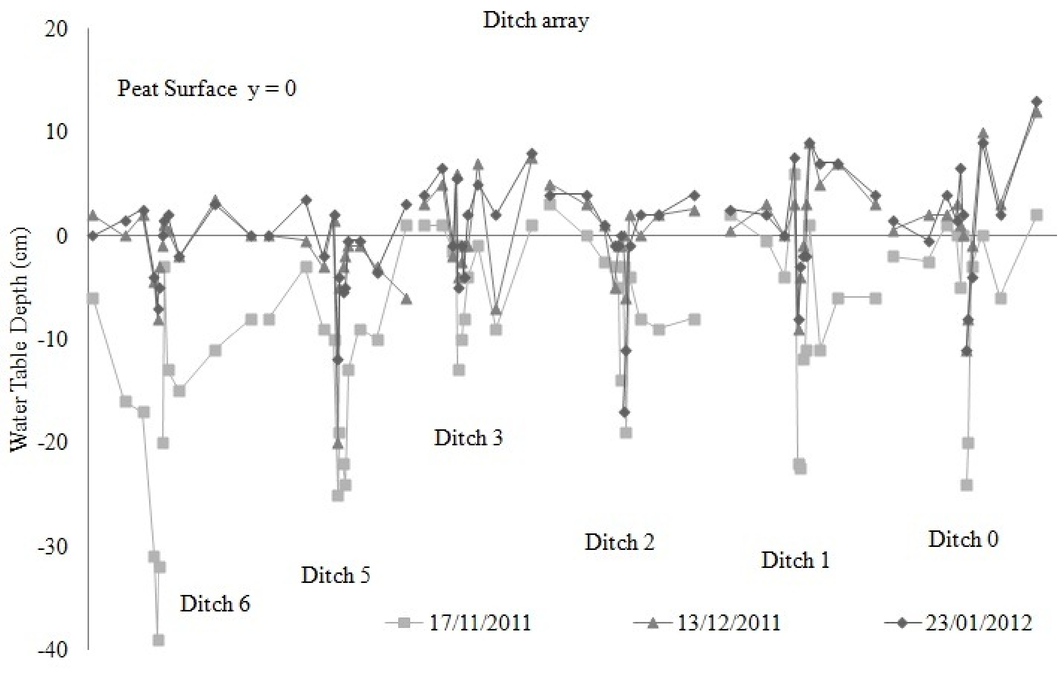

Fig. 3. Water table depths in ditch array from manual measurements taken during months of November and December 2011 and January 2012, of dip-wells placed 0.5, 1, 2, 5, 10 and 20 metres each side of each drain. The x-axis scale is set to scale for dip-well position across a single ditch but is not accurate between ditches.

Conversely, the depth of the water table becomes shallower, i.e. closer or above height of the peat surface in the months of November and December 2011, and January 2012 in the drain array (Fig. 3).

Water table depth responds to rainfall and catchment saturation: water table draw down during dry periods and rising water table during wet periods. Although absolute water depths are not as low in the control array, these same patterns observed in the ditch array can also be seen in the control array (Fig. 4).

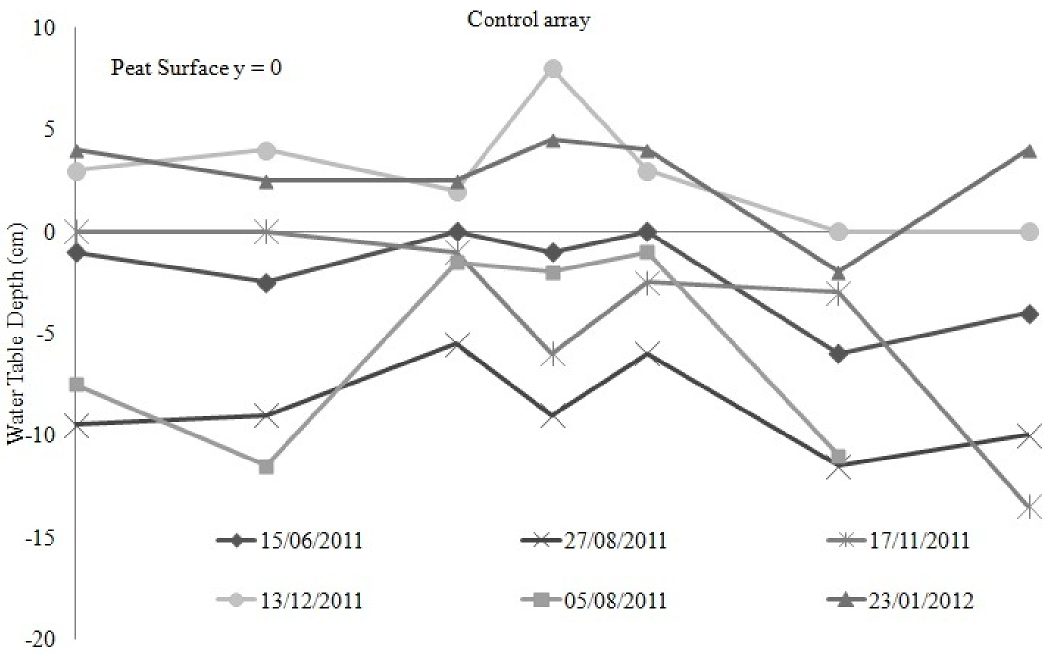

Fig. 4. Water table depths in control array from manual measurements taken during months of June 2011 through to January 2012, of dip-wells placed 0.5, 1, 2, 5, 10 and 20 metres each side of each drain. Dip-wells within control array are set 10 metres apart.

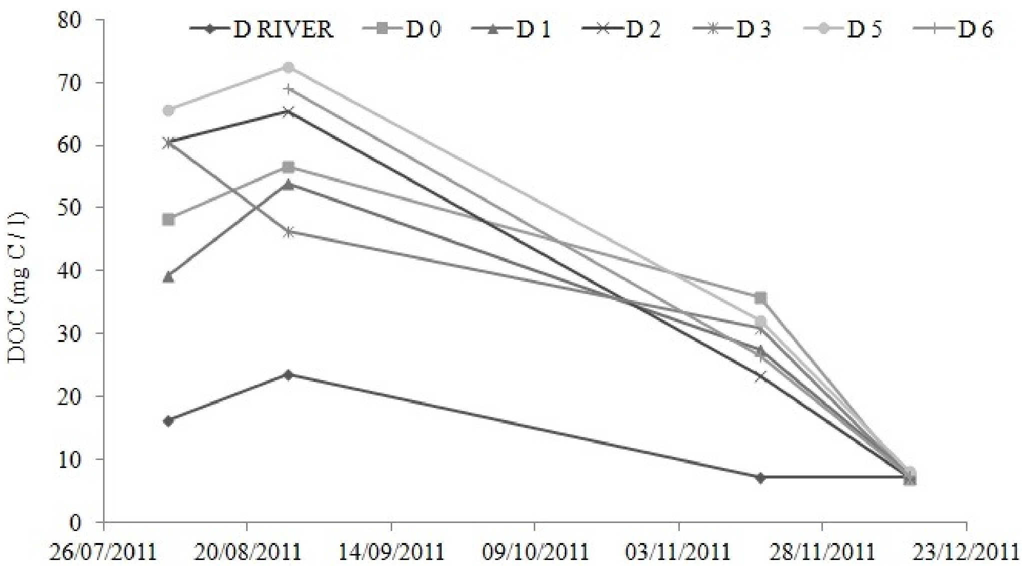

Fig. 5. DOC for samples collected from all ditches on various dates. The graph also shows DOC of samples collected from the river all ditches drain into on the same dates. In the legend, D1 = Ditch 1, D2 = Ditch 2 etc (see also Fig. 1).

Dissolved organic carbon concentrations (DOC) from the ditches were six times, or more, higher in August than they were in December. Also, DOC concentrations in the ditches are consistently higher than the river all six ditches drain into (Fig. 5).

DISCUSSION

The data collected show the predictable seasonal response of water table depth decreasing during warmer, dry summer months and increasing during colder wetter winter months. DOC results again highlights the well researched characteristic of peatland landscapes wherein DOC production in summer and late autumn months is higher, and therefore export increases through drainage channels at these time periods compared to winter months.

After ditches blocking activities start in June 2012, it is predicted that average water table depths should increase compared to similar times data was collected when the drain remained unblocked. We would also expect a decrease in DOC within the ditches compared to data collected previously within 6-9 months after draining blocking activities are completed (Wallage *et al.*, 2006; Wilson *et al.*, 2011b)

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