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Quantifying fluvial carbon losses from lowland peatland ecosystems across a drainage-impact spectrum

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The export of Dissolved Organic Carbon (DOC) and evasion of carbon dioxide (CO_2) from inland waters is increasingly being recognized as a key part of the terrestrial carbon (C) cycle, with recent global estimates suggesting that the magnitude of the aquatic CO_2 conduit is equivalent to global Net Ecosystem Productivity (2.0 Gt C yr-1; Tranvik et al., 2009). However, a major weakness in the carbon balance estimation of terrestrial ecosystems, such as peatlands, is the poor quantification of DOC and CO_2 evasion fluxes associated with drainage waters. This has implications for conservation, land-use management and climate change mitigation. Whilst intact peatland systems typically sequester carbon, drainage reverts peatlands to being C sources due, primarily, to the degradation of organic peat soil. This study examines the export of C in fluvial pathways from relatively intact catchments to those that are heavily drained, and also from peatland sites undergoing restoration works. This research is being carried out parallel other linked studies that are quantifying the carbon gaseous emissions from directly from the different bogs in order to determine the comparative net carbon budgets.

This study will focus on three raised bog sites in the midlands of Ireland: one in near natural condition (Clara bog), one significantly drained and degraded due to peat extraction (Garryduff) and one undergoing rehabilitation following many years of peat extraction (Cavemount). Flumes and sondes, with fluorescent dissolved organic matter (fDOM), temperature/conductivity and turbidity sensors, have been installed on the sites. The fDOM measurements will be correlated to grab samples taken every two weeks to give half hour proxy measurements for DOC.

Preliminary results suggest that DOC flux from the heavily drained and mined peatland site is some 295 times higher than that from the catchment with minimal interference. In addition to this, drainage waters are super-saturated in CO_2 and rapidly evades back to the atmosphere resulting in an additional C loss. Thus, C losses in the drainage systems of peatland catchment areas are significantly under-reported and a significant source of C in countries with significant peat land cover such as Ireland. This research is thereby addressing the magnitude of C losses in fluvial pathways, the associated effects on ecosystem biodiversity and the effectiveness of restoration activities on mitigating against net C loss in degraded systems.