Assessing impacts of land use on carbon stock and properties of Irish ombrotrophic peat soils - preliminary results of a national peatland survey

Walz, K.[2], Wilson, D.[3], Renou-Wilson, F. [1], Byrne, K.A.[2]

Background

Peatlands constitute the largest soil carbon stock in Ireland with 75% of soil carbon stored in an area covering an estimated 1.5 million hectares or 20.6 % of the land area[1]. In spite of their crucial role as carbon stores and potential carbon sinks, biogeochemical processes of peatlands often are affected by past and present disturbances related to various land use activities, such as drainage, change or loss of vegetation cover and compaction. Afforestation, grazing and turf extraction for energy and horticultural use are major drivers of peatland degradation in Ireland, potentially leading to soil carbon mineralization, while contributing to increased carbon emissions[4,5,6]. Current research funded by the Irish Environmental Protection Agency (EPA) addresses these land use pressures with a major goal to investigate the impact of land use on carbon stocks in Irish peatlands and to model carbon stock changes and emissions from land use activity.*

Research questions & methodology

Research questions:

- To which extent do different land use categories impact carbon stock and other peatland properties across all peatland types in Ireland and between management types in peatland complexes?
- Can we model carbon loss along a land use and drainage gradient within a spatial continuum using multivariate relationships of peat properties?

National peatland survey:

Five Land Use Categories (LUC) each with a drainage gradient in a multi-stage design:

- Natural/near-intact peatland → undrained "control" Forestry → deeply drained to restored;
- Grassland → deeply drained to shallow drained;
- Domestic turf cutting → deeply drained to 'drained only and rewetted';
- peat mining → deeply drained to rewetted

-30 cm WT depth as limit between different

Peatland properties of >2000 peat samples and 50 sites:

- Bulk densities
- pH, EC, von Post Humification index
- Stoichiometry & elemental ratios
- Carbon density
- Nutrient composition
- Vegetation structure and PFT abundance
- Water table fluctuations over 2 year period
- Aeration depths using steel rods

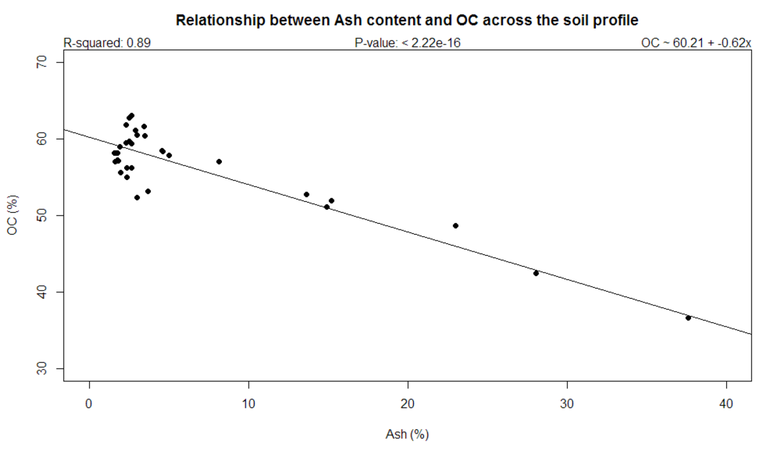
Impacts on a blanket bog – Bellacorick, Co. Mayo

forestry on blanket bog

'cut-away'-raised bog

'cutover'-blanket bog

Across the soil profile and all land uses (natural, cutover, cut-away, forestry, grassland), Bellacorick blanket bog



'rough grazing' grassland on blanket bog

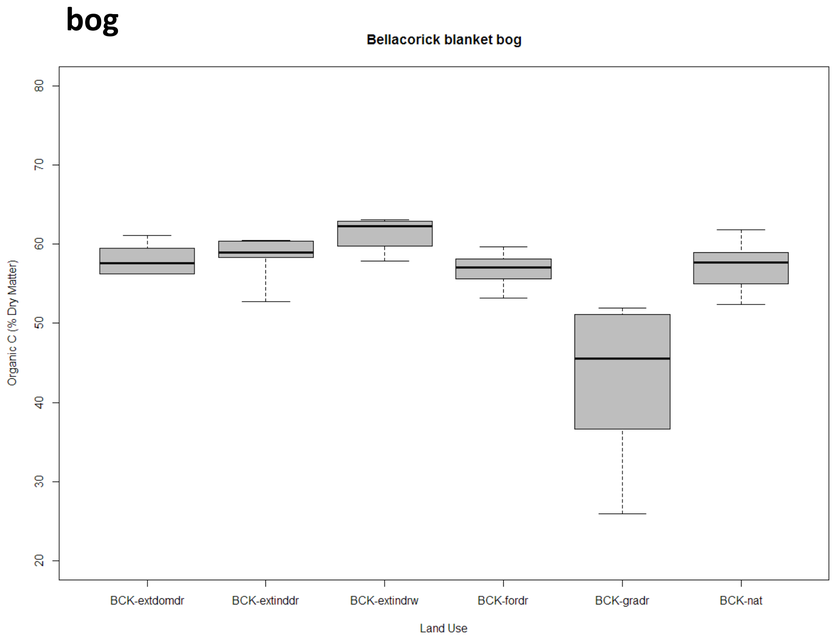
1. Ash content can be reliably taken for modeling Organic Carbon across the soil profile → How about other easily measurable covariates?

2. Rewetting has an impact onto elemental composition and ratio → How about elements H,S and O, and stoichiometry in general? Is it the same picture when we compare all sampled sites across the country?

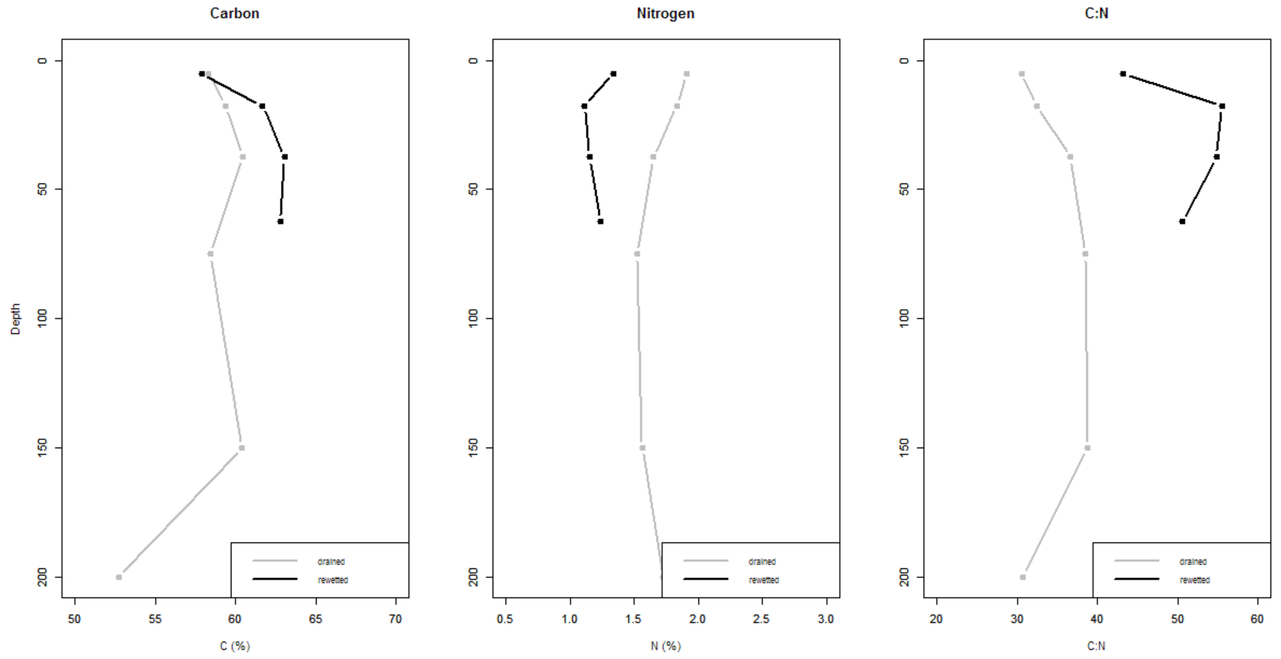
3. Impact onto C-stock most obvious in grassland → to be tested and calculated for national dataset;

4. Variation across peatland profile seems greatest in LUC grassland.

Organic Carbon contents (%DM of bulk sample) in different LUCs, across soil profile, Bellacorick blanket bog



Drained vs rewetted: Elements C, N and C:N (%DM of bulk sample) relationship distribution along the soil profile in land use category 'cutaway', Bellacorick blanket bog



*AUGER Project -- PeAtland properties infIUencing greenhouse Gas Emissions and Removals

The EPA-funded AUGER project (2016-2020) aims at identifying the major drivers of peatland degradation in Ireland while investigating the characteristics of peatlands under various land uses and assessing the impact of management options on the C stock and greenhouse gas (GHG) dynamics of these ecosystems. Data collected through a nationwide peatland survey is forming the basis for a comparative multivariate assessment of a range of edaphic, vegetation and hydrological properties. This large soil and management datasets will help developing Irish-specific models (using latest versions of ECOSSE) to compare the impact of land use, drainage and site management on carbon dynamics of the peatland resource in the Republic of Ireland.

References

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