

FORESTSOILC

Soil carbon stock changes and greenhouse gas fluxes in Irish forests

PROJECT TEAM

Prof. Gerard Kiely, University College Cork*
 Michael Wellock, University College Cork
 Christina LaPerle, University College Cork
 Nelius Foley, University College Cork
 Dr Kevin Black, FERS Ltd

* Email: g.kiely@ucc.ie

COMPLETION DATE: May 2011

BACKGROUND

Forests are a central component of the global (C) cycle and are estimated to store 77% of the C stored in vegetation and 39% of the C stored in soil. Therefore, the Kyoto Protocol includes mechanisms such as Article 3.3 for parties to use C sequestration in forests to meet emission reduction targets. Article 3.3 allows changes in C stocks due to afforestation, reforestation, and deforestation since 1990 to be used to offset emissions. Due to the rapid rate of afforestation in Ireland since 1990 Article 3.3 offers great potential for Ireland to offset emissions from other sources. In order to meet international reporting obligations Ireland must collect nationally specific data to increase the accuracy and reduce the uncertainty of the estimation of the GHG emissions offset by afforestation.

OBJECTIVES

- To use the paired plot approach to investigate the affect of afforestation on soil C stocks at 30 forest sites and to estimate forest soil carbon stocks.
- To determine the effect of afforestation and deforestation on CO₂ and CH₄ dynamics in peat soils and to develop CO₂ and CH emission factors for afforested and deforested blanket peat.
- To determine the effect of broadleaf afforestation of mineral soils on soil C stocks.
- To investigate the effect of afforestation on CO₂ and N₂O fluxes.

PROGRESS

National scale soil C stocks: The aim is to develop a quantitative assessment of the carbon (C) stocks in Irish forest soils. Following the development of sampling and laboratory protocols and some preliminary field work, 21

mineral soil sites (i.e. 21 pairs to include one forest site plus a nearby non forest site), 8 peaty mineral soil sites and 10 peat soil sites are to be sampled. The paired concept grew out of work in New Zealand.

The mineral soil sites have been divided into eight sampling groups based on soil type (brown earths, podzols, brown podzolics, and gleys) and forest type (coniferous, mixed, or broadleaf). The mineral soil forest sites are paired with a site representative of pre-afforestation site conditions.

The peat and peaty mineral (peaty gley and peaty podzol) sites are not be paired due to the level of variability in peat depth within a site.

Figure 1 shows the location of UCC sites sampled. It is important to note that UCD will be sampling the same number of sites in the northern half of the country. All UCC sites have been sampled to date. Figure 2 shows how average carbon density for three conifer gley sites changes with depth. As expected the carbon density decreases as the depth increases. Also, the total carbon density (including the litter layer) is greater in the forest compared with its paired pre-afforestation site. Figure 3 shows how the average bulk density for five low level (elevation < 150 m) blanket peat sites changes with depth. According to these data, the bulk density does not appear to increase as depth increases. This finding is contrary to some of the literature which predicts that the bulk density would increase down the profile.

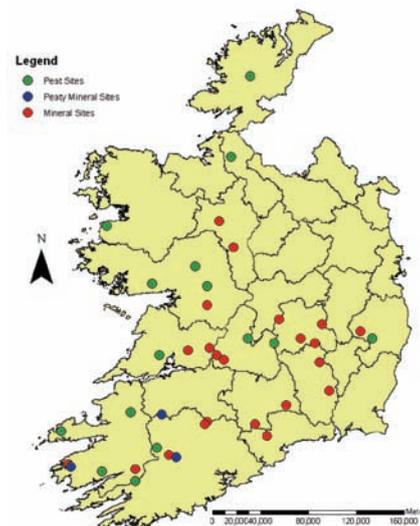


Figure 1: ForestSoilC project sampling sites.

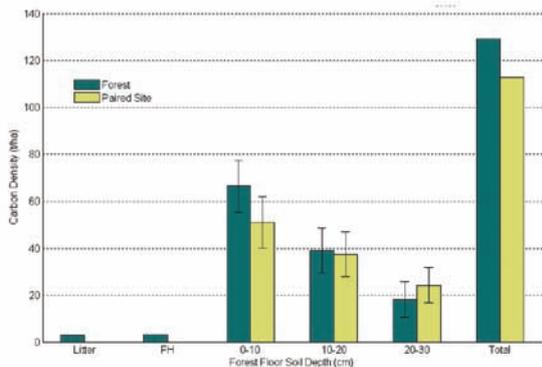


Figure 2: The average carbon density for conifer gley sites including NFI sites: 10847, 7495, and 6799.

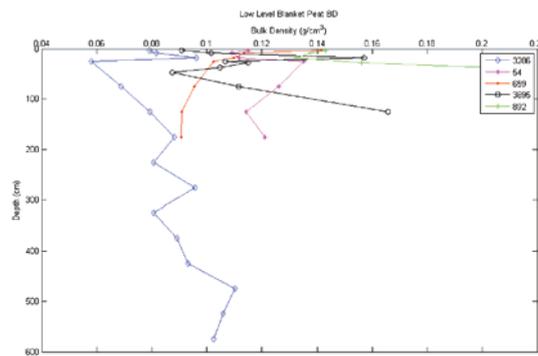


Figure 3: Average bulk density data for low level blanket peat sites including sites 3286, 54, 659, 3695, 892.

C dynamics in organic soils: Gas sampling for CO₂ and CH₄ began in July 2009. Litter collectors have been put out at all sites. Litter bags will be put out at sites and soil will be sampled for fine root turnover in January 2010.

C stocks and stock changes in mineral soils: Site selection is in progress.

CO₂ and N₂O fluxes in recently afforested grassland: The aim of this WP is to assess the impact of afforesting grassland on the fluxes of CO₂, N₂O and CH₄ from the soil. The site selected is a recently (2005) afforested ~ 10 ha grassland site at Dripsey, Co Cork. The eddy covariance flux tower was installed in the summer of 2008. The instrumentation on the 2 m scaffold tower (Figure 4) includes: radiation and PAR sensors; air temperature and humidity sensors; a LICOR 7500 sensor for 10 Hz CO₂ and H₂O concentrations; a 3D sonic anemometer; soil temperature and soil moisture.

Data collection began in September 2008. The data collected includes meteorological and flux data. For the measurement of N₂O and CH₄ fluxes from the Dripsey afforested site, 16 permanent collars have been placed at the soil surface in two transects. Soil moisture and temperature probes have been installed under each collar to allow for continuous measurements. The N₂O fluxes will be measured monthly during the winter and weekly during the growing season, measurements began December 2009.

ACTIVITIES PLANNED

- National scale soil C stocks: Complete the estimate of soil carbons stocks and stock changes in Irish forest soils.
- C dynamics in organic soils: Continue gas sampling for CH₄ and CO₂ fluxes and to collect litter decomposition and quantity data as well as root turnover data.
- C stock changes in mineral soils: Select sites and to complete site sampling.
- CO₂ and N₂O fluxes in recently afforested grassland: Continue N₂O data collection.

OUTPUTS

A national workshop with COFORD and UCD is planned for February 2010.



Figure 4: The eddy covariance flux tower.