Interreg
North-West Europe
Carbon Connects

EUROPEAN UNION

European Regional Development Fund

THEMATIC PRIORITY

LOW CARBON

MONITORING REPORT

VALANCE LODGE, UK
CARBON CONNECTS PILOT SITE

MONITORING PERIOD: MARCH 2020 - OCTOBER 2021

AUTHOR:
Kate Cartmell-Done, *North Pennines AONB*

NORTH PENNINES
Area of Outstanding Natural Beauty

United Nations Educational, Scientific and Cultural Organization
North Pennines UNESCO Global Geopark

EDITION: MARCH 2022

Table of content

Acknowledgments

This document is an output from the Interreg NWE Carbon Connects project, which has received European Regional Development Funding through the Interreg IVB NWE Programme.

1 Objectives

The main objectives of the monitoring regime on Valance Lodge are to assess the impact of reintroducing *Sphagnum* moss on vegetation cover, species diversity, water table depth and soil conditions. These results will be used to determine how successful the reintroduction of *Sphagnum* using this technique (transplanted clumps from donor sites) has been and inform future restoration decisions on comparable degraded peatlands in the North Pennines.

2 Sampling protocol

On Valance Lodge, four plots have been installed to ensure consistent monitoring. One plot is a control with no inoculation, and three are inoculated with *Sphagnum* clumps. Each 2 x 2m plot contains two dipwells and a 50 cm x 50 cm vegetation quadrat. The dipwells are positioned halfway (1 m) down each side and 50 cm into the centre, and the vegetation quadrat is positioned in the bottom right corner as demonstrated by figure 1, marked by canes. Dipwell 1 is marked with tape, dipwell 2 is not.

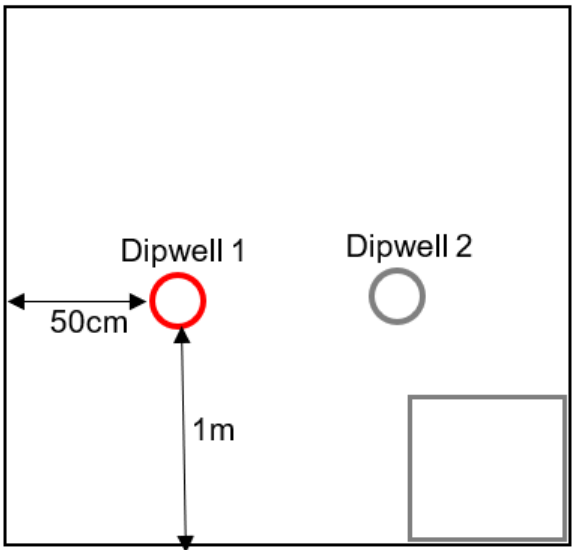

Figure 1. *Monitoring plot layout.*

Prior to restoration, the pilot site was surveyed using the Peatland Code methodology to calculate current emissions levels and predict cumulative emission reductions. Peat cores were also taken from each monitoring plot and sent to VHL for analyses.

Before inoculation and annually thereafter for the duration of the project, the following data is collected:

- Percentage cover of vegetation
- Vegetation quadrat photos
- Clump height and area
- Aerial photography

Before inoculation and three times a year thereafter (Jan/Feb, Jul/Aug, Oct/Nov) the following data is collected:

- Water table depth
- Soil pH

Table 1. *Annual monitoring protocol.*

Month	Activity
July/August	Vegetation quadrats and photos Clump height and area UAV aerials Dipwells pH
October/November	Dipwells pH
January/February	Dipwells pH

Table 2. *Monitoring completed to date.*

Date	Activity
March 2020	Monitoring plots installed
July 2020	Baseline vegetation quadrats Baseline UAV aerials Baseline water table depth Baseline pH Peatland Code assessment
November 2020	Peat cores
November 2020	Sphagnum inoculation Baseline sphagnum clump measurments
February 2021	Water table depth pH
July 2021	Vegetation quadrats UAV aerials Sphagnum clump measurements Water table depth pH
October 2021	Water table depth pH

3 Costs

Table 3. *Approximate costs of monitoring to date.*

Item	Units	**Cost**	**Total**
Field Officer days	7	300.00	2100.00
UAV (inc. annual insurance & pilot training costs)	1	4527.00	4527.00
UAV image processing software	1	393.00	393.00
UAV image analysis	1	650.00	650.00
pH meter & solutions	1	100.00	100.00
Monitoring quadrat	1	15.00	15.00
Postage and packaging for peat cores to VHL	1	69.00	69.00
Total:			£7,854.00

4 Results

4.1 Water table depth

As expected, the average water table depth was significantly lower during the summer monitoring season than February and October in both the control and inoculated plots. It was almost double the depth in July 2021 than July 2020. There has been no discernible pattern in water table depth between the control and inoculated plots since inoculation took place, with the water table depth being higher in the control plot in February 2021, but significantly lower in October 2021. See Figure 2.

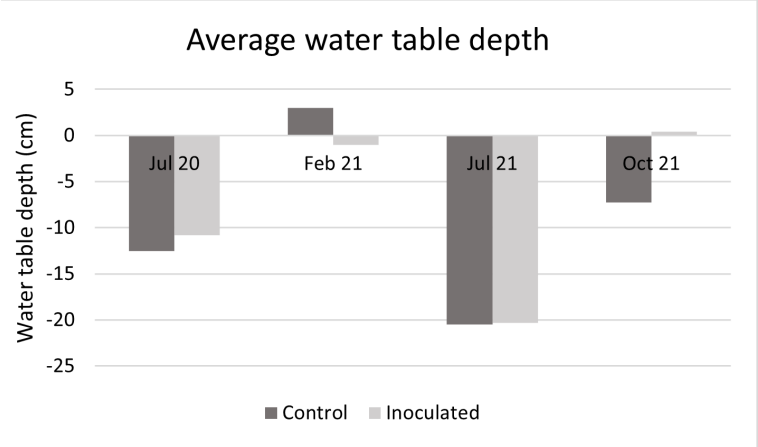

Figure 2. *Graph showing the change in average water table depth so far across the control and inoculated plots.*

4.2 Soil pH

There has been no discernible trend in soil pH since inoculation (see Figure 3). The average soil pH of the inoculated plots has fluctuated but decreased overall since inoculation. The average soil pH of the control plot has fluctuated over the same period but increased overall. The control plot had a significantly lower soil pH than the treatment plots prior to inoculation, following inoculation the control plot soil pH is still lower than the treatment plots but only marginally.

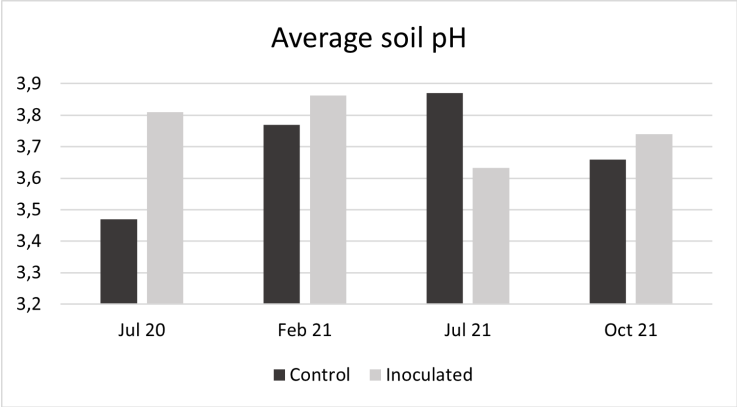

Figure 3. *Graph showing the change in average soil pH so far across the control and inoculated plots.*

4.3 Vegetation cover

In the vegetation quadrat within the control monitoring plot, there was no change in the percentage cover of *Sphagnum* moss between July 2020-July 2021. Within the same period across the treatment monitoring plots, there was an average percentage increase of *Sphagnum* moss cover of 10% (see Figure 5).

In the vegetation quadrat within the control monitoring plot, there was a percentage decrease of 5% in bare peat area between July 2020-July 2021. Within the same period across the treatment monitoring plots, there was an average percentage decrease of 17% in bare peat area (see Figure 5).

In the vegetation quadrat within the control monitoring plot, there was a percentage increase in total vegetation cover of 6% between July 2020-July 2021. Within the same period across the treatment monitoring plots, there was an average percentage increase of total vegetation cover of 39% (see Figure 5).

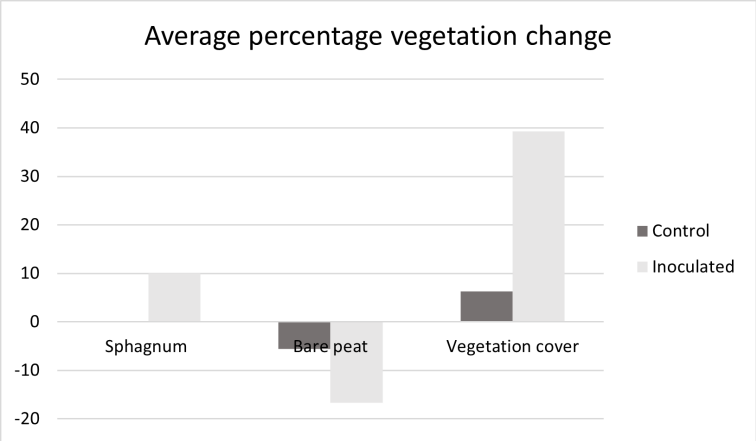

Figure 5. *Graph showing the average change in percentage cover of **Sphagnum** moss, bare peat and total vegetation cover.*

4.4 Sphagnum clump diameter

The average diameter of the *Sphagnum* clumps planted in the inoculation plots has increased across all 13 clumps (see Figure 4), with an average increase of 1.5cm (see Figure 4). However, on average out of the 13 clumps, 1 clump (8%) had died, 8 (62%) appeared bleached or stressed and only 4 (30%) appeared healthy.

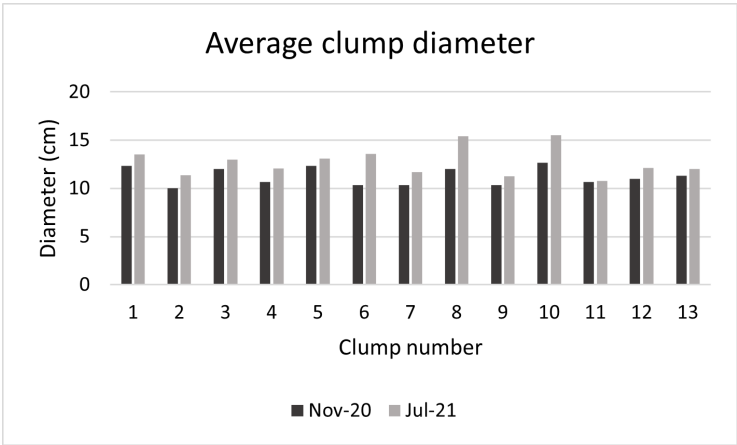

Figure 4. *Graph showing the average clump size across the inoculated plots.*

4.5 Carbon emissions

Based on the Peatland Code methodology, prior to restoration the Valance Lodge pilot site was calculated to have annual CO_2 emissions of 31.33 tonnes per year. Based on the Peatland Code condition categories, of the 4.5ha, 0.84ha were assessed as 'Actively eroding', 0.99ha were assessed as 'Drained' and 2.68ha were assesses as 'Modified'.

Based on Peatland Code calculations, within 5 years of restoration Valance Lodge will have a net emissions reduction of -75 tonnes of CO_2 equivalent per year (a net increase in emissions). However, after 10 years this will have increased to a net emissions reduction of 7 tonnes CO_2 equivalent per year, and after 15 years to a net emissions reduction of 89 tonnes CO_2 equivalent per year. The emissions reductions will continue to increase with time (see Annex 1).

5 Discussion

Other than the expected dip in water table levels during the summer sampling season, there is no discernible change in water table depth as a result of *Sphagnum* inoculation. In the most recent sampling period in October 2021, the water table depth of the control plot was significantly lower than the treatment plots, but further monitoring is required over a longer period to determine if this is an actual trend.

There is no discernible difference in soil pH as a result of *Sphagnum* inoculation. The large fluctuations in pH of both the control and treatment plots may be due to the accuracy of the pH meter used. Further monitoring is required to determine if any trends become apparent.

The changes in vegetation cover as a result of *Sphagnum* inoculation are the most significant results of the pilot monitoring so far. As expected, the percentage cover of *Sphagnum* has increased on the treatment plots but remains at 0 on the control plot. This shows that during the period monitored so far, no *Sphagnum* moss has recolonised the area naturally.

The percentage cover of bare peat has decreased 12% more on the treatment plots than the control plot. This shows that the introduction of *Sphagnum* clumps had an immediate effect on the amount of bare peat. It also indicates that bare peat cover is reducing naturally on the site, but at a lower rate than where *Sphagnum* has been reintroduced.

The percentage total vegetation cover has increased 33% more on the treatment plots than the control plot. This shows that the introduction of *Sphagnum* clumps had an immediate effect on total vegetation cover and encouraged other species to expand their range. The increase in total vegetation cover on the control plot shows that vegetation cover is increasing naturally on the site, but at a much lower rate than where *Sphagnum* has been reintroduced.

There was a clear increase in *Sphagnum* clump diameter across the treatment plots, showing that they had grown in the 8 months between inoculation and monitoring. However, a total of 70% of the clumps appeared dead or stressed which is concerning, showing that conditions are not optimal for *Sphagnum* clump growth and growth has likely been limited.

The limited growth of the clumps can be attributed to the extremes in weather seen since inoculation took place, with a prolonged period of inundation, snow and ice during the winter, followed by a long drought during the summer when the clumps dried out completely. The planting method used is also a likely factor as it was difficult to keep the clumps whole and ensure they were planted the correct way up. They were also not planted very deeply into the peat which may have limited their access to moisture during the summer months.
Continued monitoring will indicate whether the clumps survive or not and what impact this has on the progress made so far with bare peat reduction and vegetation cover increase.

6 Conclusion

Further monitoring is required to assess the success of *Sphagnum* clump transplanting as a restoration method and its impact on soil and groundwater conditions. Monitoring will continue for the duration of the Carbon Connects project and is expected to extend beyond it for at least three years. The proximity of the pilot sites to other restoration sites means that monitoring can be coincided with activities on other sites without much difficulty.

So far, the monitoring indicates that transplanting *Sphagnum* clumps from donor sites onto degraded blanket bog has a positive impact on bare peat and vegetation cover in the short-term. However, the suitability of site conditions needs to be considered on potential future restoration areas, and the planting technique needs developing to ensure the long-term survival of the clumps.

As a result of the findings on Valance Lodge, for future restoration areas we will consider splitting the harvested clumps into smaller plug sized strands which can be planted deeper into the peat using a rod or dibber. We will also consider sites with a lower water table to reduce the amount of time the clumps spend inundated during the winter.

Annex

Annex 1. *Peatland Code cumulative emissions reduction over project duration (tCO2e).*

Cumulative Emissions Reduction over project duration (tCo2e)					
Period (Year)	**Gross Emissions Reduction (tCO2e)**	**Emissions Reduction less 10% model precision (tCO2e)**	**Net Emissions Reduction adjusted for Leakage (tCO2e)**	**Cumulative Risk Buffer Contribution (tCO2e)**	**Cumulative Claimable Emissions Reduction (tCO2e)**
0-5	91	82	-75	-11	**-64**
5-10	182	164	7	1	**6**
10-15	273	246	89	13	**76**
15-20	364	327	171	26	**145**
20-25	455	409	253	38	**215**
25-30	546	491	335	50	**284**
30-35	637	573	416	62	**354**
35-40	728	655	498	75	**424**
40-45	819	737	580	87	**493**
45-50	910	819	662	99	**563**
50-55	1001	901	744	112	**632**
55-60	1092	982	826	124	**702**
60-65	1182	1064	908	136	**771**
65-70	1273	1146	989	148	**841**
70-75	1364	1228	1071	161	**911**
75-80	1455	1310	1153	173	**980**
80-85	1546	1392	1235	185	**1050**
85-90	1637	1474	1317	198	**1119**
90-95	1728	1555	1399	210	**1189**
95-100	1819	1637	1481	222	**1259**