Introduction to Soil Sampling for Grassland Restoration

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1. Introduction

When it comes to grassland habitat management and restoration, sampling and analysing the soil can provide vitally useful information, not only for understanding what type of grassland you have or what the most viable type of grassland is to restore, but also guiding and monitoring the success of management practises. In this Introduction to Soil Sampling for Grassland Restoration guide, we explain what some of the most useful soil markers to start monitoring are for grassland conservation management, how to interpret the results, how to take the soil samples yourself, and where to get the samples analysed.

2. Markers of soil health to monitor

This instruction manual provides an introduction on what markers of soil health to monitor for grassland restoration: for increasing botanical biodiversity in the sward and achieving a more natural community of species for the natural grassland habitat. However, there are many soil properties that can be useful to monitor, depending on the objectives for the land. For example, you may want to monitor additional nutrient levels for optimal livestock nutrition.

pH

The pH of the soil is useful to understand what type of grassland community and habitat can be achieved through successful grassland restoration. Based on pH, lowland species-rich grasslands typically occur in three broad habitat types: acid grassland, neutral grassland and calcareous grassland (Figure 1).

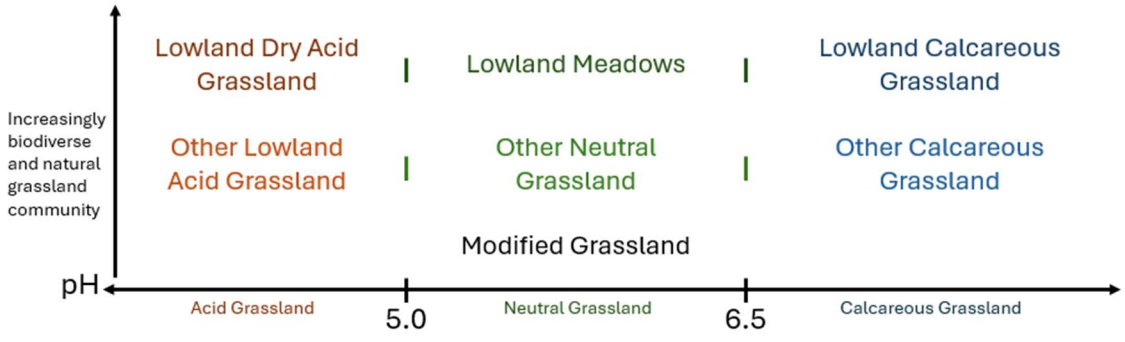

Figure 1: Main grassland communities of Sussex, grouped by soil pH, and increasing biodiversity and naturalness.

Having lost more than 97% of our unimproved species rich grassland, each of the three lowland species rich grassland communities are vanishingly rare in the UK: Lowland Dry Acid Grassland, Lowland Meadow and Lowland Calcareous Grassland. Each of these grassland habitat types

have their own unique community of grasses and broadleaf herbs. Where it is possible to sustain or restore these habitats, doing so would have a very real and meaningful impact on UK conservation, and knowing the pH of your soil environment is the first step in knowing which, if any, of these grassland habitats are viable for your land.

Phosphorous (P)

Soil fertility has perhaps the biggest impact on potential biodiversity for a grassland. If the soil fertility is high, then species richness and biodiversity will be limited. Phosphorous (P) is considered to be the most important nutrient influencing sward diversity, and is therefore the standard marker for monitoring soil fertility in conservation.

Phosphorous is a major plant fertiliser, having a major influence over grass growth. It is very insoluble, so it does not readily leach out of the soil in water like other nutrients, until about Index 5 (Table 1). This makes P very stable in the soil and the impact of artificially applying P can be felt for many years, even decades, even without further application. Most fields in used for conventional agriculture, which have received P applications in the past, have a moderately high P level of Index 2 or more (Table 1).

There are several methods of analysing soil phosphorous, a common one is Olsen's P expressed in mg/l (from dry soil), but all can then be converted into a standardised index system (Table 1).

Table 1: Index conversion table for Olsen's P in mg/l.

Phosphorous Index	Olsen's mg/l
0	0 – 9
1	10 – 15
2	16 – 25
3	26 – 45
4	46 – 70
5	71 – 100
6	101 – 140
7	141 – 200
8	201 – 280
9	>280

Where the objective is to sustain or restore a species rich grassland (e.g. Lowland Meadow), the level of P needs to be kept relatively low, with an optimal Index of 0 or 1. While low soil fertility is a prerequisite to achieving species rich grasslands, correct grassland management is also imperative. Where P Index is >1, remedial long-term hay meadow management can also be used to reduce soil fertility, whilst restoring biodiversity. Where soil P Index is >3, remedial long-term hay meadow management can still be effective at reducing soil fertility and increasing biodiversity, however, to achieve species rich grasslands in this manner may take decades, though this will vary widely depending on the specific context. Where soil P is relatively high, other remediation techniques can be considered, or it may be more viable and beneficial to

conservation to consider other habitat types to create, such as tussocky grassland, wetland (ponds and scrapes), scrubland or woodland.

Carbon

Soil carbon is a major indicator of soil health and the level of biological activity in the soil. The greater the soil organic matter is, the more flood resilient and drought resilient the soil is. Furthermore, with an increasing need to reduce carbon emissions and sequester more atmospheric carbon, monitoring the soil carbon of the grassland can demonstrate the carbon storing and sequestering function of the grassland.

Percentage soil organic matter (SOM), soil organic carbon (SOC) soil inorganic carbon (SIC) and soil total carbon can be calculated alongside nutrient analysis. Quantifying the bulk density of the soil can then be used to convert carbon percentages into carbon mass in a particular volume of soil.

3. How to sample the soil

How to take a core sample

A soil auger and a metre rule are perhaps the best equipment one might need for taking soil samples, allowing you to efficiently collect samples at different depths in the same core. Once the auger has been used to extract some soil, the meter rule than then be put down the core to verify what depth of soil has been augured out. Taking 5 samples at 0-10cm, 10-20cm, 20-30cm, 30-40cm and 40-50cm would give comprehensive information for top 50cm profile of the soil.

If a soil auger is not available, or there are insufficient resources to sample at multiple depths, then sampling the top 10cm is the most important, as this is where the highest concentration of nutrients will be. The first 10cm can be done with a rule, with either an auger, a pot corer or a trowel.

Do not include vegetation or turf in the sample, only soil. Do not sample exactly where an animal has dunged. Do not include rocks either, though taking note of the approximate stone and rock percentage would be useful when calculating bulk density.

Transect

Individual fields should be sampled separately. A field may also be sampled in separate compartments if the soil, topography, hydrology, plant community, or land management practises are significantly different from each other. Any one of these factors may cause the results of the compartments to be different.

Soil sampling should be carried out in a ‘W’ shaped transect across a field, sampling from 10 or more cores (Figure 2). The soil taken at each depth taken is to be put into a bucket and the samples from the 10 cores mixed together. This ensures a single average soil sample, to be analysed at the lab, for each depth from across the compartment.

Features of the field that cause a local area not to representative of the overall field management are not to be sampled and excluded from the survey. These local areas are likely to have nutrient levels differing from the overall field and cause the results to be erroneously biased towards these features, ergo not representative of the overall field.

Features whose local area is to be excluded from the soil sample consist of:

- Field headland
- Gateways
- Water troughs
- Areas of supplementary feeding
- Underneath trees where livestock congregate more than the rest of the field
- Field tracks

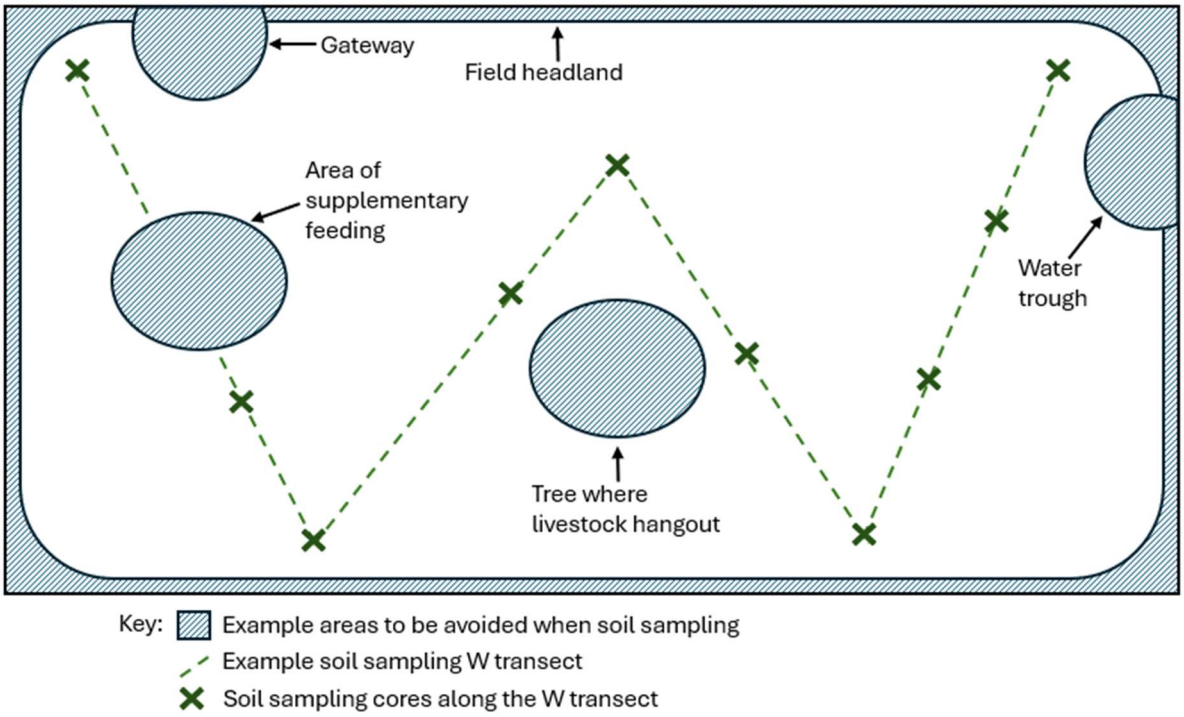

Figure 2: Example soil sampling W transect across a field compartment.

4. How to analyse the soil

There are many soil sampling companies would have the laboratory resources and expertise specifically to analyse soil samples. For example, NRM (part of Cawood) https://cawood.co.uk/nrm/soil-analysis-nrm/ is a soil analysis company offering a wide range of different tests. NRM's test A218 tests for available phosphorous, potassium and magnesium, as well as pH and soil organic matter.

5. References

Natural England Technical Information Note TIN035 – Soil sampling for habitat recreation and restoration. Natural England. First edition. Published: 21/02/2008. Date Accessed 13/01/2025.

Natural England Technical Information Note TIN036 – Soils and agri-environment schemes: interpretation of soil analysis. Natural England. First edition. Published: 21/02/2008. Date Accessed 13/01/2025.

Natural England Technical Information Note TIN037 – Soil texture. Natural England. First edition. Published: 21/02/2008. Date Accessed 13/01/2025