Long Term Monitoring Network

April 2024

NEWSLETTER

Last summer's highlights

We completed in-house vegetation surveys at May Moss, Martin Down NNR, Lindisfarne NNR and The Stiperstones NNR, applying the usual vegetation survey method, with staff and external volunteers experiencing the wonderful habitats, and identifying and recording many vascular plant, moss and lichen species. The LTMN team are most grateful to all the surveyors, experts and reserve managers who made it happen.

At **May Moss:** we worked on the blanket bog and upland heathland, next door to RAF Fylingdales. We did both Living England and England Peat mapping too.

Photo: Belinda Lloyd

At **Lindisfarne NNR:** we ate supper in the village hall a couple of nights whilst waiting for the tide to uncover the causeway.

The Long Term Monitoring Network aims to track long-term environmental change, and understand the causes of change, across a range of habitats.

We record vegetation, butterflies, soils, air pollution and land management through regular surveys and on-site monitoring at 37 sites representing 10 target habitats across England. The project began in 2009. Three vegetation surveys and two soil surveys have been completed at most sites.

Data is available through Natural England's Access to Evidence catalogue.

Long-term data like this is key to tracking the impacts of climate change and air pollution on our ecosystems.

At **Martin Down NNR:** we loved the grassland but it was hard work! The best was 67 species in one 2m2 plot!

At **The Stiperstones NNR:** in the Shropshire Hills, surveyors had magnificent views, whilst working on the upland heathland.

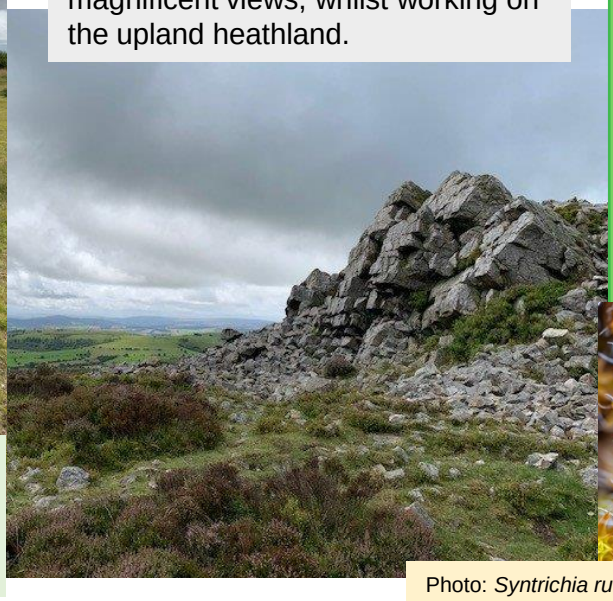

Photo: *Syntrichia ruraliformis,* Paul Ross

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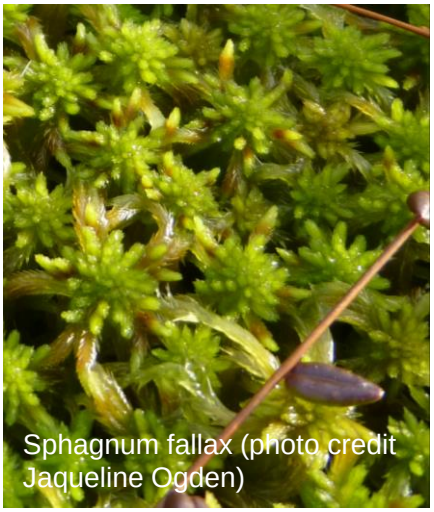
A change to the way that we publish LTMN vegetation data

All LTMN data is made available under the Open Government Licence; we use Natural England's Access to Evidence web catalogue to publish all the data that we collect ourselves, while air quality information (collected by partner organisations) is published on UKAir.

Until this year, the data collected during LTMN vegetation surveys has only been available as a separate spreadsheet for each survey (of which there are now approximately 130). To use the information across multiple surveys previously required multiple downloads of data, and time-consuming additional steps post download.



Sphagnum fallax (photo credit Jaqueline Ogden)

More problematic was a lack of taxonomic consistency. Surveys have tended to reflect the taxonomy when they were undertaken, but even since the surveys started in 2009 changing understanding of phylogenetic relationships has led to multiple changes in taxonomy. Examples include name changes (e.g. green-winged orchid, which was *Orchis morio* in 2009 when the project started but which is now *Anacamptis morio*) and species splits (e.g. *Sphagnum recurvum*, commonly recorded during earlier LTMN surveys, but which has been split into *S. angustifolium*, *S. fallax* and *S. flexuosum*). Any analysis of species data across multiple surveys using inconsistent naming conventions and taxonomies would lead to unreliable results.

Green-winged orchid (photo credit Peter Wakely)

To overcome these issues and make available data that is ready for analysis, LTMN has published two datasets containing all vegetation species records* across all surveys combined. The first is a "split" dataset, which contains data at the taxonomic level at which it was collected. Using second example above, this data contains records for *Sphagnum recurvum*, *S. angustifolium* and *S. fallax* (*S. flexuosum* hasn't been recorded). This dataset also contains subspecies varieties where they were recorded. In other words, here the species records haven't been consistently handled and there are synonyms (e.g. the same species may be called *S. recurvum* in one record but *S. fallax* in another, or one surveyor may have separated out the yellow sedges into constituent species and subspecies while another may have called them all *Carex flava* agg.) but this data has lost none of its resolution. This dataset is unlikely to be suitable for analysis across multiple surveys without carefully considered changes. The second is a "lumped" dataset, where the species have been treated consistently. Subspecies and varieties have been removed, because this level of detail isn't always recorded. Where species have been split, records always reflect the species name prior to the split. If species aggregates have been recorded, constituent species revert to the aggregate throughout this dataset. Some of the detail has been lost from this data, but it can be used for analysis as it is across all surveys. The nomenclature of both the "lumped" and "split" datasets is aligned with the UK Species Inventory (UKSI)** and will continue to be over time with an annual check of the LTMN species lists against the UKSI database.

You will find the newly published complete vegetation datasets here, and another dataset covering basic plot details will be available imminently. We haven't yet compiled all plot details, or the tree data from woodland plots, and we won't remove the individual survey sheets until we do, but this will start happening over the coming months (although we will keep all versions of the data in the background for quality assurance purposes). The taxonomic consistency of the data is allowing us to analyse the data at the network level in ways that haven't been possible before, and work on that is ongoing.

***Because lichen data hasn't been consistently collected across all vegetation surveys, it has been removed from the vegetation data while we review our lichen data collection protocols (for further details see the lichen article in this newsletter).**

**** In theory, the UKSI is aligned with the Botanical Society for the British Isles (BSBI) and the British Bryological Society (BBS) taxonomies. In practice there is often a time lag between recommendation of taxonomic changes by the BSBI and BBS and adoption by the UKSI.**

LTMN repeat plots study

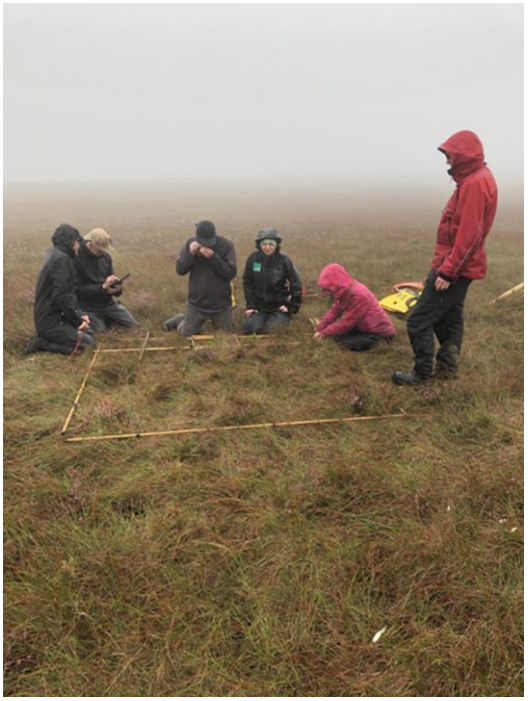
We repeated some plots this year, to start looking into surveyor teams' differences or error. For example, differences occur due to:

- Overlooked plant species
- Mis-identified plant species
- Differences in abundance estimations.

Questions:

- What is the general level of difference?
- Are certain habitats or plant groups worse e.g. species-rich habitats, mosses vs. vascular plants?
- Is there a difference between in-house and contracted surveys?

The results will be used in a power analysis that we're working on as we evaluate the monitoring design. It will help to inform the number of plots that we need to detect change, and as a result whether it might be sensible to increase the number of plots that we're surveying or whether we are surveying more than we need for analytical purposes.



Some example results:

red = recorded by one team but not the other

Dark Peak 2023

	Repeat survey - NE survey teams - 22nd to 24th August	frequency	% cover		Main survey - contractor - 1st to 24th August	frequency	% cover
Plot 31	Calluna vulgaris	11	8	Plot 31	Algae	21	0.1
	Calypogeia muelleriana	12	0.5		Calluna vulgaris	9	3
	Campylopus flexuosus	12	2		Calypogeia muelleriana	21	1
	Campylopus introflexus	5	1		Campylopus flexuosus	21	3
	Cephalozia connivens	1	0.1		Campylopus introflexus	5	0.1
	Cephalozia	15	0.1		Campylopus pyriformis	1	0.1
	Cephaloziella	3	0.1		Cephalozia bicuspidata	19	0.1
	Cladonia	1	0.1		Cephaloziella	8	0.1
	Dicranella heteromalla	19	3		Diplophyllum albicans	11	0.1
	Diplophyllum albicans	8	0.5		Empetrum nigrum	2	0.1
	Empetrum nigrum	2	0.1		Eriophorum angustifolium	25	20
	Eriophorum angustifolium	25	16		Eriophorum vaginatum	25	80
	Eriophorum vaginatum	25	50		Lophozia ventricosa	11	0.1
	Lophozia ventricosa	8	0.1		Pohlia nutans	1	0.1
	Plagiothecium succulentum	2	0.1		Pseudotaxiphyllum elegans	4	0.1
	Polytrichum commune s.l.	1	0.1		Sphagnum subnitens	2	0.1
	Sphagnum recurvum s.l.	1	0.1		Vaccinium myrtillus	3	0.1
	Vaccinium myrtillus	4	0.5				

Andy McLay - NEFU bryologist - said:

The species lists show a remarkably strong correlation with good duplication among several of the trickier bryophyte groups like Campylopus. The Plagiothecium succulentum v Pseudotaxiphyllum elegans thing doesn't surprise me – both can occur commonly in that strongly acidic habitat and can look very similar in the field. The contractor's record of Cladopodiella fluitans will be an error for Gymnocolea inflata [plot 35] which is characteristic of degraded bog and wet heath. Typically there was a lot more variation in the estimates of species cover but this will always be the case. One example stood out a bit more though – Campylopus flexuosus in Plot 33 – we estimated 40% and the contractor 8% ?!!

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Measuring moisture and pH at LTMN vegetation plots.

Data collected from the vegetation surveys is used to create Ellenberg values. These values give us a proxy measure of environmental conditions such as moisture, pH, salinity and light availability, without needing to take direct measurements. This can give us useful information about how conditions may be changing over time, based on plant communities.

In 2023 we decided to trial taking direct measurements of soil moisture and soil pH alongside the vegetation surveys. The methodology is relatively straight forward, so as long as there was enough people to spare on the survey, this was an easy way of collecting additional data for the project.

Taking pH readings at the field lab! (Photo: Victoria Sloan)

Why take these measurements?

- Taking direct measurements of moisture and pH can be used for comparison of indirect measurements, e.g. Ellenburg Values, estimated from the vegetation surveys.
- Soil pH and water content is analysed thorough LTMN soil surveys which are undertaken every eight years but only across five larger plots. Testing at each vegetation plot provides additional data that can be used to carry out analysis at the plot level and identify any outlier plots.
- Measuring soil moisture can allow us to understand the effects of land management such as hydrological interventions.
- Soil pH affects soil nutrient availability and soil community compositions. It is altered by Nitrogen deposition and is important for understanding vegetation distribution.
- These measurements are useful at both site and network level – uses for LTMN include understanding site difference/similarities and explaining change over time

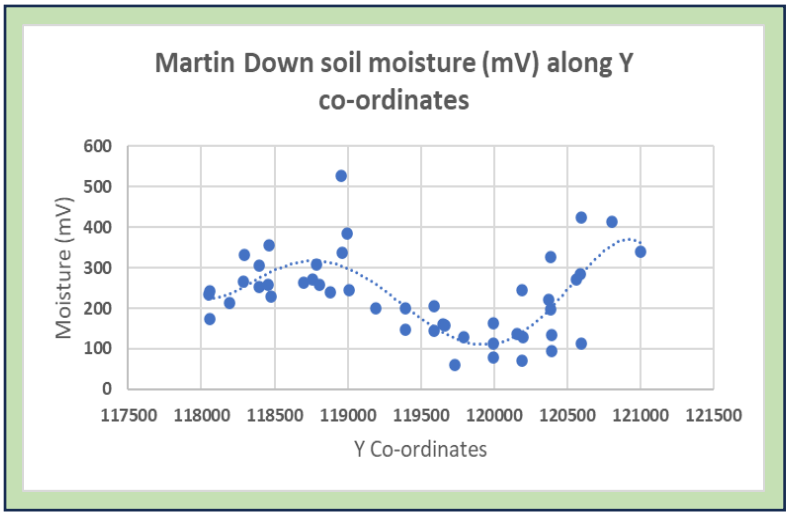
Methodology

Soil Moisture – measurements were taken directly using a soil moisture probe. Three readings were taken at each plot to give an average.

Soil pH **–** Soil samples were collected using a mini auger, which were taken away to be processed at the field lab (AKA the LTMN van). Both pH water in water and pH in calcium chloride were measured.

Martin Down initial results – soil moisture

It has been interesting to review the results to see if the data collected looks reliable and whether this is something that is worth replicating in future surveys.
One concern was that the soil moisture measurements appeared to vary a lot at the plot level when taking the three readings. However, once the readings were averaged and plotted against X and Y co-ordinates, clear polynomial lines could be drawn indicating that the moisture readings were meaningful.



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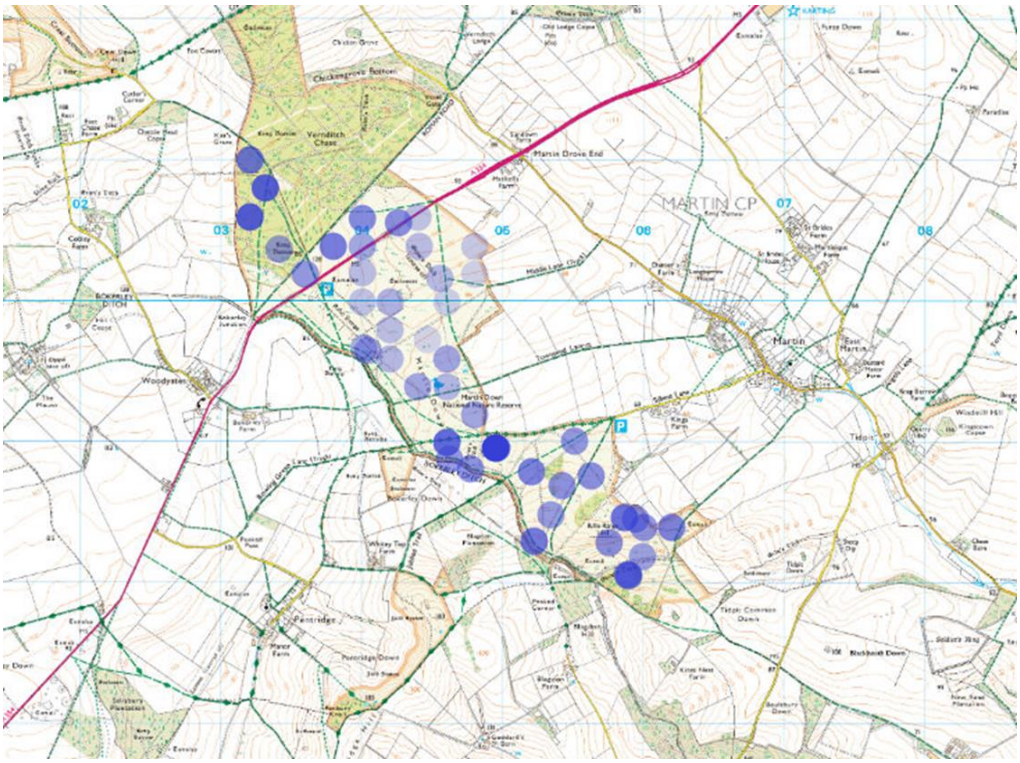
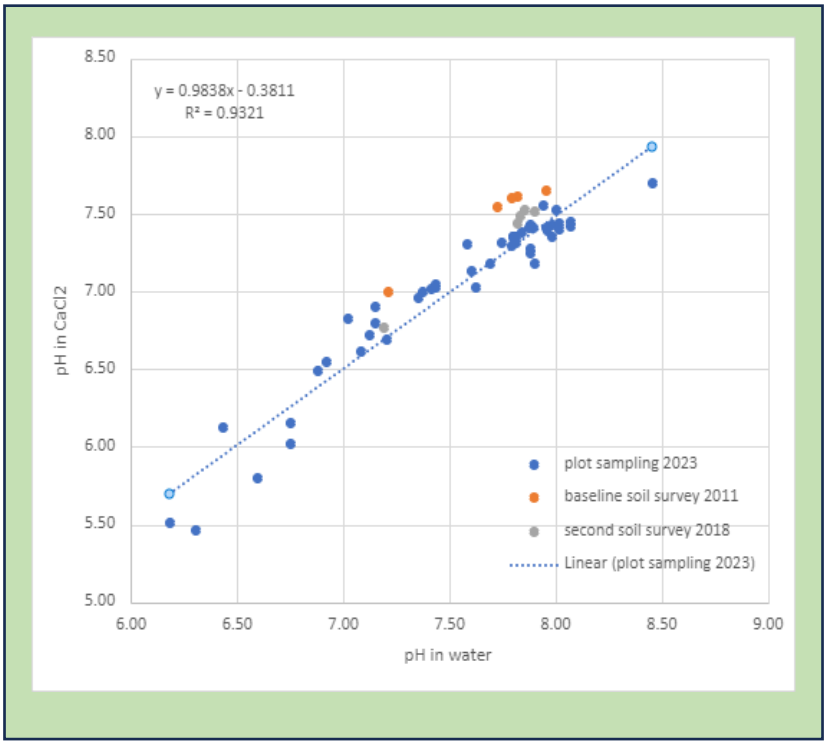


Martin Down soil moisture results mapped over a contoured map give a clearer picture of the results. Plot soil moisture is represented on a gradient with dark blue indicating higher moisture. Plots situated in the scrubbier habitat on the west of the site had highest moisture readings. Those on the south-east facing slopes being were the driest, with the plots on the north facing slopes further east being slightly wetter.

Martin Down initial results – soil pH

Soil pH (in water and calcium chloride solution) analysed in the LTMN van lab against plots surveyed in soil surveys in 2011 and 2018 and analysed by the James Hutton Institute.



Next steps

The 2023 vegetation data isn't quite ready to use for analysis yet – once it is we will be able to compare the results against Ellenberg values to see if they align, which will be very interesting to see!

It would also be interesting to relate the soil data to sward height; ground cover and existing hydrological data.

We have only trialed this on three sites so far, but we hope to continue to gather soil moisture and pH measurements in future surveys to build on the data set.

Unfortunately, we did not have time to collect data at Lindisfarne due to it being a very species rich site. This is a possible constraint to consider when planning this work on other species rich sites.

Finally, we would like to give a big thank you to everyone who helped with the soil data collection either by walking across the entire site to collect soil and take moisture readings, or by carrying out the pH analysis from the back of the van!

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LTMN lichen monitoring – an update

What are lichens?

Lichens are mini-ecosystems consisting of at least two organisms - a fungus that provides the structure, and a photobiont (either alga or cyanobacterium) that provides the energy. Species are named after the fungus. The body of the lichen containing both fungal and algal cells is called a thallus. Lichens are sensitive and valuable indicators of environmental change due to their unique biology and ecology, but are difficult for non-experts to identify so often go unrecorded.

Lichen Recording in the Long Term Monitoring Network

Surveys for lichens will usually need to be undertaken by expert lichenologists, as correct identification requires experience and a range of techniques. This can mean that lichens are insufficiently recorded where expertise is not available or resourced. There are some lichen monitoring schemes designed for use by non-experts, though these mostly focus on a few indicator species found on trees to assess impacts of air pollution. Since the inception of LTMN in 2009 the recording of terricolous (ground dwelling) lichens within our vegetation quadrats had been unavoidably hit-and-miss, largely due to the lack of available experts able to record accurately to species level.

Over the past three years the LTMN team have worked with lichen experts to produce and trial new, simplified approaches to recording lichens based largely on morphological categories, the main aim being to ensure consistent ongoing monitoring of lichens in LTMN surveys. This should strengthen LTMN's ability to deliver its purpose of monitoring change and understanding the drivers of change. We are now reviewing our approach to lichen recording, in terms of:

- How well does the lichen guidance work in the field with non-expert surveyors?
- Do morphological categories (including certain genera) tell us anything environmentally meaningful? Can they be a proxy for species?

At present our existing lichen data is removed from the main dataset (due to its inconsistency) until we complete this review and settle on the best approach.

Appendix 2: Cladonia categories

What can you see Q1?	What can you see Q2?	Record growth form as…	Species recorded at Lindisfarne
Upright podetia without squamules *(Squamules = basal mats of small <1cm leafy structures)*	Many branched/bushy podetia	**Mat-forming** *Or if certain no squamules* **Reindeer mosses**	C. portentosa C. ciliata
	Tubes that are inflated	**C. uncialis**	None recorded
	Shrubby lichens superficially like Reindeer mosses but brown and shiny	**Cetraria sp.**	Cetraria aculeata
Upright podetia with at least some squamules *(Squamules = basal mats of small <1cm leafy structures)*	Many branched/bushy podetia	**Mat-forming** *Or if certain squamules present* **Reindeer mosses**	C. rangiformis C. furcata
	Usually well -developed typically goblet shaped cups, mostly brown or sometimes red at tips if visible	**Pixie Cups** *(if unsure of colour)* **Pixie cups (red)** **Pixie cups (brown)**	Red - C. diversa, C. polydactyla, C. digitata Brown - C. chlorophaea agg, C. fimbriata, C. pyxidate, C. humilis, C pocillum
	Simply branched upright podetia, with no or very small cups. Brown or red at tips	**Heathtails** *(brown or unsure)* **Devil's matchsticks** *(red)*	Heathtails – C. coniocraea, C. furcata, C. squamosa, C subulata, C. crispata Devil's matchsticks – C. macilenta
Squamules, no podetia present	Prominent mats of basal small leafy squamules, usually often sterile Cladonia species or with very small podetia	**Squamule mats**	Range of species inc C. foliacea, C. subcervicornis

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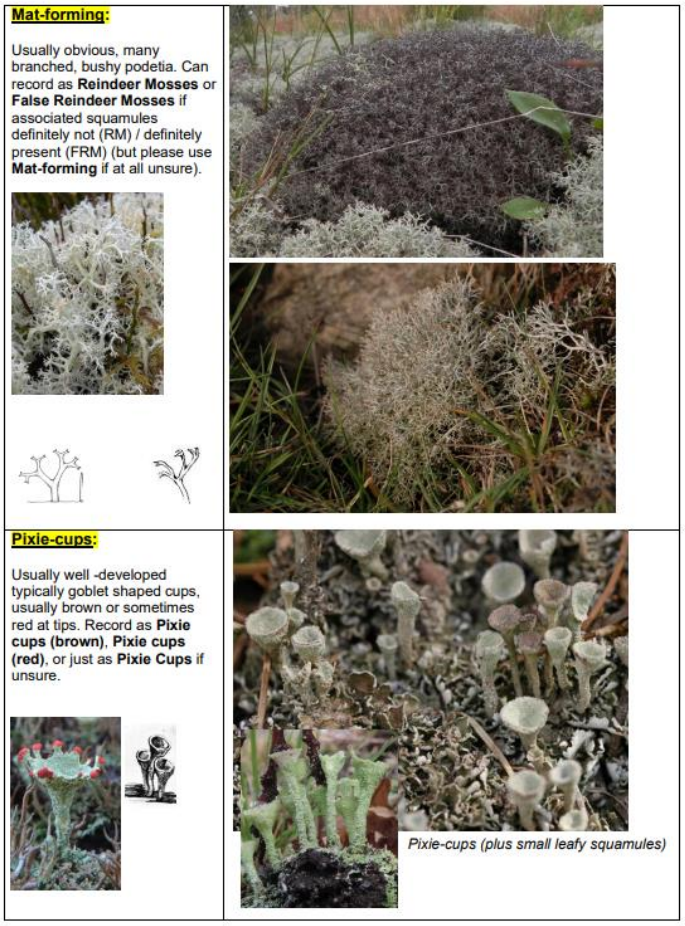
How well does the guidance work in the field with non-expert surveyors?

We have trialled the morphological categories approach approach at a number of recent LTMN vegetation surveys including Dersingham Bog, Ingleborough, Lindisfarne and Stiperstones, with guidance sheets tailored to the sites. At Ingleborough we also trialled guidance for recording lichens on rocks, though these are more difficult to simplify into a few categories and it proved quite challenging for surveyors.

The guidance has worked reasonably well in the field and has now been through several iterations. However, reviewing the surveyor records for the 2023 surveys against what roving experts recorded highlighted a number of discrepancies. It is unclear what the causes of this might have been – perhaps confusion over categories, the effort made to look for things, the way samples were taken, etc – though we are keen to establish whether the guidance is overall fit for purpose and relatively foolproof. With this in mind we are running some focussed field testing of the guidance at Ainsdale NNR in April 2024, and which we will hopefully repeat later in the year.



Do morphological categories tell us anything environmentally meaningful?

Recording morphological categories gives us more information about the lichens present than just recording e.g. 'lichen' or '*Cladonia* sp.' (or of course not recording at all), but can they be a useful proxy for species? Firstly does diversity of categories reflect the diversity of lichen species at a site? This is something we have started to investigate by comparing species lists and the categories they would correspond to (though this isn't entirely straightforward as some lichens can be morphologically variable). Secondly do categories tell us anything about the environmental conditions and/or management influences at a site that help determine the vegetation present? Species generally have established associations with or tolerances of particular environmental conditions – pH, moisture, light, habitats, etc – whereas it could be assumed that artificial categories would not.

A potential area for exploration here is considering trait-based approaches to lichen ecology and distribution. Lichen traits include different morphological characteristics as well as other traits such as photobiont type. Certain traits may give different lichens an advantage in differing environmental conditions or niches, and may help explain lichen distribution at different scales - see Ellis *et al* 2021 et al for a review, where it is suggested that traits may be a way for non-experts to record environmentally relevant lichen information. However, identifying what may be some of the more useful traits (photobionts, certain reproductive strategies - see Phinney, Ellis & Asplund 2021) would require a knowledge of species or the skill to discern particular features, and the influence of different traits on lichen distribution may operate on scales not easily detected at a plot, site or network level, so this approach needs more investigation to assess its usefulness.

Ellis, C. J., Asplund, J., Benesperi, R., Branquinho, C., Di Nuzzo, L., Hurtado, P., Martínez, I., Matos, P., Nascimbene, J., Pinho, P., Prieto, M., Rocha, B., Rodríguez-Arribas, C., Thüs, H., & Giordani, P. (2021). Functional traits in lichen ecology: A review of challenge and op-portunity. Microorganisms, 9(4), 766.

Phinney, N. H., Ellis, C. J., & Asplund, J. (2022). Trait-based response of lichens to large-scale patterns of climate and forest availability in Norway. Journal of Biogeography, 49, 286–298.Trait-based response of lichens to large-scale patterns of climate and forest availability in Norway. Journal of Biogeography, 49, 286–298.

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Quick updates

Land management recording
It has always been intended that LTMN would collect information about how the sites are managed so that management changes are accounted for as we look to understand the causes of biodiversity change. This has proven to be difficult, but we have now produced a spatial tool for recording land management across all LTMN sites. It uses the ArcGIS Field Maps app, and collects categorical and quantitative data based on existing NNR site management categories. We will soon be asking NNR site managers to help us by testing it and providing feedback, and we are working with the national NNR operations team to include it in Natural England's new Nature Recovery Management System.

PhD research
LTMN's first PhD student will start this autumn. The studentship is titled "Evaluating changes in Holocene and Anthropocene biodiversity and healthiness of English Peatlands", and will be supervised by Nicholas Branch and Steve Robinson from Reading University alongside Barbara Silva from Natural England's geology team. The student will be using 2-3 LTMN peatland sites to link past and current climate change and biodiversity change, and will undertake a work placement with LTMN as part of the studentship.

The LTMN Team – Who's Who?

Kate Fagan, Senior Advisor and Project Manager
Matthew Shepherd, Senior Soil Specialist – responsible for the soils protocol
Dan Pedley, Lead Advisor – responsible for the air quality protocol and weather protocols
Sarah Grinsted, Lead Advisor – responsible for the vegetation and butterflies protocols
Victoria Sloan – maternity leave until August
Keeley Spate - Lead Advisor – responsible for the land management protocol, soils sampling
Wendy Holland, Team Leader for LTMN staff as well as others

Roudsea Wood & Mosses NNR

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