Long Term Monitoring Network

March 2023

NEWSLETTER

Last Summer's Vegetation Surveys

Our in-house vegetation surveys continue to attract many surveyors from around the country, both Natural England staff and external volunteers, providing opportunity for meeting-up and honing fieldwork and plant identification skills.

Last summer, we started at The Lizard NNR. Well, that was stunning scenery, good weather and a warm welcome from the NNR staff! The flora is arguably unsurpassed, with plant species of maritime-influenced clifftops and grasslands, and inland heaths, with some like the Cornish Heath not found anywhere else in the country and subspecies like Sea Carrot (*Daucus carota subsp. gummifer*) to keep us on our toes.

Then we went to Saltfleetby & Theddlethorpe Dunes NNR, crossing the flat Lincolnshire countryside to reach the wild and extensive coastal dunes and saltmarsh. Highlights included the expanses of purple Common Sea-lavendar and on the muddy areas, the unusual-looking spikes of Common Glasswort.

In July, it was Dersingham Bog NNR, with acid valley mire and heathland habitats, and precious plant species like bog mosses (*Sphagnum* species) and round-leaved and oblong-leaved sundews. There was an evening walk to see and hear nightjars, which nest on the ground across the reserve. Here, we trialled a new method of recording lichens,

Photo credit: Allan Drewitt

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.

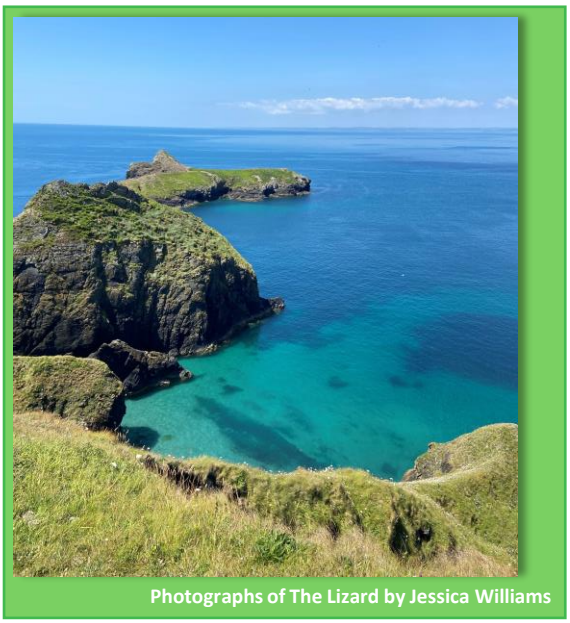
based on their morphology rather than identifying to species-level, aiming to start capturing useful data for this indicator group.

Then, we went to Ingleborough NNR in August. How lucky are we to go to these places? It was huge and hilly distances, with limestone and acid grasslands, heathland, limestone pavements and blanket bog. The varied habitats meant we recorded 240 plant species, including 66 mosses and liverworts.

For all these surveys, we are incredibly grateful to the reserve staff who hunt down the permanent markers in the ground, advise on health & safety, and are generally on hand before and during the survey; the roving experts who provide gold standard plant identification and coach the less experienced; and all the surveyors for their resilience and attention to detail, and for producing large and tidy datasets.

As usual, some vegetation surveys were also carried out by commissioned ecological consultancies - this time at Epping Forest, Kielderhead NNR, Malham Tarn NNR, Monks Wood NNR and Mottey Meadows NNR.

That makes 101 completed vegetation surveys across the 37 sites. We are looking towards 2024, when all sites will have had 3rd or even 4th surveys, and the data is becoming properly long-term and fit for analysis.



Photographs of The Lizard by Jessica Williams

Photo credit: Peter Wakely

Repeat plots targeted survey

This coming year, as part of our quality assurance, we will be investigating survey teams' results differences. This means that at the in-house and some of our contracted vegetation surveys we will survey twice using different but representative teams on eight to ten of the permanent plots.

There are three main sources of results differences or error: overlooking (failing to spot a plant species), misidentification and cover estimation. Looking in the scientific literature and comparing with other surveys, we feel that our project does a good job of protecting against such error e.g. 2-4 man teams, roving expert back-up and checks, the gridded 2m2 plot; but we do need to investigate the general level of surveyor teams' differences and publish the results, as part of quality assurance and in preparation for future publication. So, we'll be needing some extra surveyors for extra fieldwork this season!

Photographs of Ingleborough by Sarah Grinsted

Too much innovation? Future-proofing for soils in LTMN

Environmental monitoring means you must keep measuring the same things in the same way. That may sound easy to do, but technology and innovation happen, and it makes sense to try to improve efficiency and sustainability. If we want to benefit from new approaches, we must make sure they match up with the older versions, so that data we already have remains useful. Our LTMN soils monitoring started in 2011, so this year we've been exploring whether we can use recent innovations in our protocols with two projects, one extremely high tech and one decidedly low-tech.

Soil dry bulk density is one of the most important measurements we can use to understand soil health. It's simply the dry weight per unit volume of soil, and we need to know it for scaling up measurements such as soil carbon content, as well as for understanding how porous the soil is, which relates to important functions such as the infiltration of rainwater and the production of greenhouse gas nitrous oxide. The current approach involves cutting pieces of plastic drainage pipe into the soil with a breadknife to take soil samples This works well on some soils but gives poor quality results if you hit a stone or root, or compress the soil. It also takes many hours to prepare the pipes and generates lots of plastic waste. To improve on this, Senior Specialist Dr. Matt Shepherd has designed an alternative soil corer, like a heavy-duty 'bulb planter' (see photo), which was built by a local blacksmith. This takes samples without the need for plastic tubes and instead of kneeling down and hammering, the user can stand up and use their bodyweight to drive the sampler in. To see if the 'bulb planter' gives reliable data from a range of soils, LTMN have commissioned a rigorous scientific test of it against both the current LTMN approach and a difficult but high-accuracy method of determining bulk density. If the results are favourable, the 'bulb planter' could become the LTMN standard from 2023, and if it's as simple to use as we hope, it could also be useful for on-farm soil sampling to assess soil health, or for other monitoring programmes.

Our second project is at the other end of the technological spectrum. The diverse communities of microbes that live in soils reflect the prevailing soil conditions but also respond rapidly to environmental changes. The current LTMN method characterises this community using the most robust method that was available in 2011 - terminal Restriction Fragment Length Polymorphism (tRFLP). This involves extracting some DNA markers (barcodes) from the soil and then using enzymes to snip the DNA into different fragment lengths. This technique is great for showing that communities differ, and how they change, but technology has advanced and the modern standard is to sequence the DNA using a technique called metabarcoding. Metabarcoding "reads" the sequence in the DNA strands and, if possible, matches them to known species and strains of microbes, creating a "species list" of soil microbes. Switching the LTMN to this approach would tell us the identity of the species in the soil community, and link this to the jobs we know they do, to help us get a deeper understanding of any changes we see. However, we still want to be able to use our tRFLP data and luckily, both techniques work on the same genes. We are currently carrying out metabarcoding on stored soil samples from 30 LTMN sites using both the reagents used with tRFLP and commonly used modern reagents. The results of this will help us to interpret old data, test the assumptions made about the techniques, and also let us know if we can safely switch to metabarcoding without losing the value of our existing data for detecting change.

Both these projects illustrate how monitoring needn't just be about the reapplication of the same techniques forever but can inspire new ideas, techniques and technologies. If you'd like to learn more and are up for a challenge, why not consider volunteering for the 2023 soil surveys. We'll be visiting Roudsea Moss, Ennerdale, May Moss (above photo) and the Dark Peak in autumn, and, who knows, perhaps wielding a bulb planter! To register your interest, email us at ltmn@naturalengland.org.uk

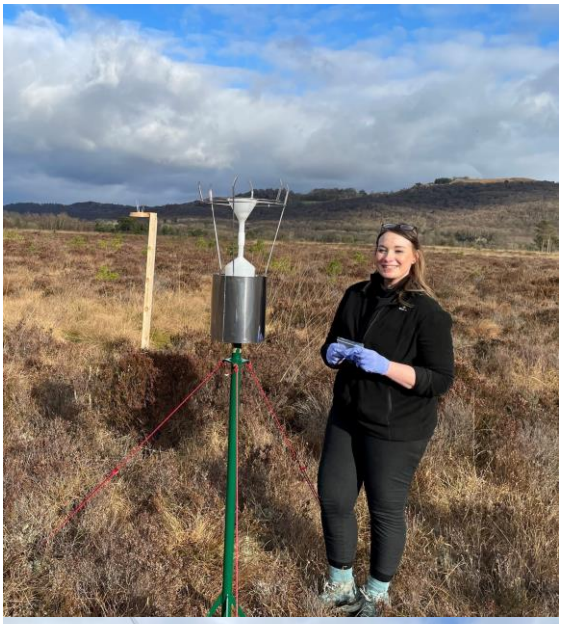
Monitoring Air Quality in the Long Term Monitoring Network

Monitoring levels of air pollutants is essential to understand their prevalence and distribution – both at the point(s) being monitored and via data informing modelling of concentrations and deposition – and also, in conjunction with other data, to understand the effects they have on the environment and/or human health. Certain pollutants can have particular detrimental effects on semi-natural habitats, the main area of concern in recent years being excess nitrogen (N), primarily as nitrogen oxides (NOx) and ammonia (NH3) / ammonium (NH4), dry and wet deposited onto sensitive habitats. To understand whether N deposition is affecting a site requires a measure of the N inputs at that site over time. Ideally air quality data collected on-site would be used, especially for ammonia as concentrations can vary considerably and may not be represented accurately by modelled data. Cost and logistics – sample collection, analysis, etc – can however limit on-site monitoring.

There has been some air quality monitoring within LTMN from the early days of the project, and as of 2022 monitoring of (in most cases) both dry and wet deposited N was being undertaken at just under half of our sites. Since 2016 LTMN's air quality monitoring has all been part of the Defra-led umbrella **UK Eutrophying and Acidifying Pollutants (UKEAP) Network**, with sites part of the **National Ammonia Monitoring Network** (**NAMN** – dry deposition ammonia monitoring) and/or **Precip-Net** (wet deposition rainfall chemistry monitoring). The data provided by LTMN to UKEAP contributes to modelled concentration and deposition data – which in turn feeds into resources such as **APIS** www.apis.ac.uk (used by colleagues in NE for protected sites work). Information about the networks and air quality data for LTMN sites (and others) is available through UK AIR: https://uk-air.defra.gov.uk/networks/

LTMN is also part of **UK APIENs** (the Air Pollution Impacts on Ecosystems Networks), formed by integrating established networks to deliver statutory monitoring and reporting requirements from the National Emissions Ceiling Regulations. LTMN is a major data contributor of important variables for UK APIENs having permanent vegetation and soils plots in key semi-natural habitats.

In 2022 approval was given to fund a large increase in our air quality monitoring, bringing LTMN closer to the initial plan to monitor wet and dry N deposition at every site. This gives us an opportunity to assess the accuracy of the modelled data for LTMN sites, and, if not feasible to continue with this level of monitoring in the long-term, prioritise site monitoring on that basis.



It is well established that excess N can cause changes to habitats and vegetation. These can vary by type and sensitivity, though overall some of the main effects are considered to be: loss of species richness, increase of graminoids / other N-tolerant species, increased biomass, and loss of sensitive lichens and bryophytes.

Outside of controlled experimental conditions, attributing air quality as a driver of changes in vegetation and soils is not straightforward. Correlations between datasets may indicate relationships, but could be misleading if not interpreted with care. There are complex and multi-stage interactions between pollutants, wind patterns, temperature, moisture, soil types and vegetation types that will affect deposition, uptake and N cycling in habitats, and the availability of N (and also phosphorus P) in soils for plants to use. Interpretation of air quality as a driver of change could be further complicated by the effects of both land management and groundwater nutrients, if insufficiently understood. These and other considerations will need to inform future analysis.

We'd like to express our gratitude to all the site managers and partners who are essential in operating our Air Quality protocol, including those who have helped set up the new sites!

Photos: Mike Ward. Setting up new monitoring at Roudsea (ammonia and rainfall) and North Walney (ammonia).

What can LTMN data tell us about England's biodiversity?

This autumn, 15 Long Term Monitoring Network field seasons will have been undertaken. By the end of 2024 we will have completed three vegetation surveys and two soil surveys at every site; data is fast accumulating. Diverse ecosystems are resilient and resistant to change, and random change, surveyor error, and unusual weather events are likely to increase the time before long-term trends can be detected. The frequency of surveys (every four years for vegetation and every 8 years for soils) means that it will take longer to detect change than if we were surveying more frequently. It was anticipated towards the start of the project that it would be 20 years before any significant, directional change in the biotic factors of ecosystems might be identified through LTMN's data, and we're nearly at that point.

Figure 1. Percentage change in cover between baseline and third surveys of the geographic ranges of the plants that comprise calcareous grassland plant communities. Geographic range information taken from Plantatt, expanding on Prescott and Hill (1999)

We're starting to interrogate the data, to get a better understanding of the temporal and spatial variation and therefore what the project is likely to be capable of. We're looking at how best to analyse the data to address questions about ecosystem change. At the same time, we are evaluating the monitoring design to address any weaknesses and make sure that we're collecting the right data in the most efficient and effective way. We're also looking at the evidence needs of Natural England and the wider conservation community with the intention to better define LTMN's objectives and the questions that the project should address.

The conditions that result in an ecosystem's structure and function are complex and can change in many different ways and for many different reasons. It is often tempting to attribute unjustified importance to correlative relationships between ecological change and potential causes of change, and part of the work that LTMN is doing to look at the capability of the data involves understanding to what extent the causes of change might be explored. At this early stage in the project any apparent ecosystem changes should be treated with caution because they may not indicate real trends, but indications are that a directional change in vegetation communities is starting to become apparent. Investigation of the species that comprise the calcareous grassland communities of sites that are predominantly calcareous grassland indicates a trend for decreasing cover of plants with more northern geographic ranges, alongside an increase in the cover of plants with more southern ranges, between the baseline and most recent surveys (a period of 8 or 9 years) (Fig. 1).

It's an exciting time as we start to uncover what the data is telling us about biodiversity change now and what it could achieve in the future. There's much more underway, so we'll have more to share next year. Watch this space!

Prescott, C. D. & Hill, M. O. (1997). The geographical relationships of British and Irish vascular plants. Botanical Journal of the Linnean Society. 124: 1-120

SPOTLIGHT ON A SITE – LINDISFARNE

On Northumbria's stunning coastline, just before England meets Scotland, lies one of the most peaceful and holy sites in Britain. Sprawling across 3500 hectares, Lindisfarne National Nature Reserve includes 'Holy Island' that can only be reached at certain times of the day due to it residing just off the coast, connecting to the mainland via a tidal causeway. Renowned for its historical importance as well as its natural beauty, Lindisfarne continues to attract historical enthusiasts, bird fanatics and lovers of natural photography to its shores.

This beautiful setting, where land meets the sea, is comprised of three predominant habitat types: a shifting landscape of sand dunes, salt marshes, and mudflats, heavily influenced by their tidal environment. Much of Holy Island is also used for arable farming providing crops like barley, wheat, and oats which allow for the growth of arable plants including poppies, cornflowers, and chamomile. The farming community has played an important role in shaping the cultural heritage of Lindisfarne by preserving many traditional agricultural practices such as livestock grazing and crop rotation. This agricultural heritage is celebrated each year with the Lindisfarne Festival of Agriculture.

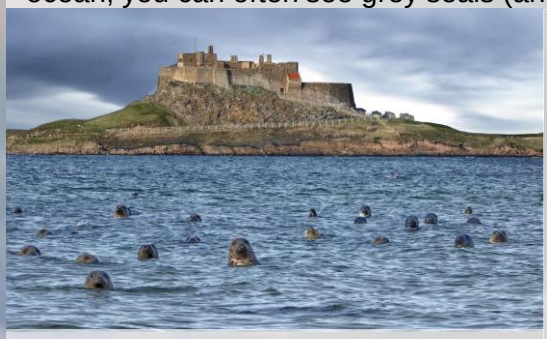
As well as the common plant species, the unique conditions of Lindisfarne have led to it becoming home to a diverse range of vegetation species, from salt-tolerant coastal vegetation to woodland and meadow plants. The 3 mile long island also includes 11 different species of orchid in it's impressive collection. Among these is the Lindisfarne helleborine, which can only be found on Holy Island. Despite the island's harsh coastal environment, which is characterized by strong winds, salt spray, and occasional flooding, Holy Island also boasts over 60 different lichen species.

The Lindisfarne helleborine

For the ornithologists among you, if the rare light-bellied brent geese is on your 'must see' list, this National Nature Reserve is the ideal place to spot them. The mudflats attract and host huge flocks of winter waterfowl including the light-bellied brent geese. After breeding in the archipelago of Svalbard, the geese arrive in Holy Island in September and the reserve becomes the largest wintering site in Britain, containing roughly half the world's population.

The Mudflats of Lindisfarne coming alive with flocks of light-bellied brent geese

Looking beyond Holy Island's shores and into the ocean, you can often see grey seals (and if you're lucky, you may spot a harbour seal) playing among the waves and basking on the beaches. They are most prevalent between the end of February and the end of October as they swim off to the Farne Islands when the weather gets cold.



Seal colony just off Holy Island

Holy Island is most famous for its association with the early Christian monk Saint Aidan and his disciple Saint Cuthbert, who established a monastery there in the 6th century. The site played a crucial role in the spread of Christianity in the Northeast and as result, is a popular pilgrimage site today. St Cuthbert was known for his love of the local fauna, especially the birds and is arguably the world's first nature conservationist. In the 9th and 10th centuries, Lindisfarne was repeatedly raided by Vikings. The monks eventually abandoned the island and relocated to Durham, taking with them the remains of Saint Cuthbert and the Lindisfarne Gospels.

Lindisfarne is an NNR managed by Natural England. There are several evidence projects running at the site currently. Funded by the EU, LIFE WADER is a five year long project that aims to 'improve the condition of river, intertidal and marine habitats'. As well as Lindisfarne, the project aims to Improve the water quality all along the Northumbrian coast. Natural England also includes Lindisfarne as one of 37 study sites for the Long Term Monitoring Network (LTMN).

Holy Island is a place of unique ecology, history, and natural beauty. It continues to attract people from all over the country with its effortless tranquillity and mystique. But before you rush into booking yourself onto the next train to Northumbria to see this amazing place for yourself, if you can hold on just a few months, LTMN are heading there this summer and are seeking volunteers. Good botanical knowledge is preferred but not necessary. We hope to see you there very soon, just make sure to check the tide times so you don't get stuck!

Student Placement: My Experience

My name is Jessica Williams and I've been this year's placement student for LTMN. I'm a student at Manchester Metropolitan University heading into my final year of an undergraduate Zoology degree in September. I started in June taking part in The Lizard survey and went on to partake in all four vegetation surveys in summer, plus a soil survey In October. I have thoroughly enjoyed my time here working with an amazing team and will continue to do so until July.

This experience has been extremely beneficial to my education. I have gained experience working in the field and organising surveys, improved my (very limited) botany skills and learnt invaluable professional skills that I'll take with me in the future. I've met such a variety of and interesting and intelligent people working and volunteering for Natural England which helped me comprehend the true scale of the organisation and all the different work areas they cover. I've had an incredibly eye-opening time working alongside the LTMN team members and can't thank them enough for this opportunity.

Get involved this summer

The 2023 Vegetation Surveys are just around the corner!

May Moss, North Yorkshire, 19th – 23th June

Martin Down NNR, Hampshire, 3rd – 7th July

Lindisfarne NNR, Northumberland, 17th – 21st July

The Stiperstones NNR, Shropshire, 31st July – 4th August

The extremely rare burnt tip orchids, photographed at Martin Down

The Stiperstones

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 protocol
Sarah Grinsted, Lead Advisor – responsible for the vegetation protocol and butterflies protocol
Victoria Sloan, Lead Advisor – responsible for the land management protocol
Wendy Holland, Team Leader for LTMN staff as well as others
Jessica Williams, Placement Student

Interested in volunteering? For more information contact us at ltmn@naturalengland.org.uk